Proposed New Major: Bachelor of Science in Construction Management
Proposal to Establish a New Major in Construction Management

Introduction
The following is a proposal to develop a Bachelor of Science in Construction Management (B.S.C.M) as a new major within the Leonard C. Nelson College of Engineering & Sciences. This proposal provides an overview of the construction industry and post-secondary construction education, justification, program content and curriculum, the required catalog information.

Overview
Construction Management is an exciting field and rewarding career choice. Professional construction managers earn excellent salaries and derive great satisfaction working in any one of the many sectors of the construction industry. Construction is the second largest industry in the United States with over $1 trillion in total volume, accounting for approximately 8% of the nation’s GDP. It is the industry responsible for constructing the buildings and infrastructure that are so vital to the quality of life.

Construction is a technically driven, complex business that requires knowledgeable, highly-skilled managers to lead operations. There is and will be a continuing demand for professional construction managers. Construction management practitioners work in various construction organizations such as CM firms, general contractors, specialty contractors, design-builders, consulting engineers, architects, and real estate developers. Construction Management practitioners are also employed in various capacities representing project owners, suppliers, regulators, lenders, and other stakeholders involved with construction. Positions include project managers, coordinators, estimators, schedulers, safety specialists, business development managers, and many others. Some rise to senior level executive positions, while others own and operate their own firms.

Future construction industry leaders need to have broad technical knowledge as well as strong business acumen. These critical competencies can be developed through formal post-secondary construction education at the university level, but such curriculum is presently not available in the WVU system, nor in the State of West Virginia. This proposed new major in Construction Management is intended to fill this critical gap.

WVU Institute of Technology Construction Management graduates will:

- possess depth and breadth in the construction body of knowledge
- immediately add value to an organization
- be equipped to perform equally well in the field or office
- display growth potential that is not limited to front line or technician status, but are destined to become future industry leaders
- be safety-focused, environmentally and socially responsible, and ethical in professional practice.

The new major in Construction Management is proposed to educate tomorrow’s leaders of the construction industry who are technically competent, safety-focused, quality-centered, socially
and environmentally responsible with strong ethical values. The objectives include educating men and women who will contribute to society by advancing the construction industry while enjoying happy, successful careers. These objectives are congruent with the University’s mission.

**Relationship to the University’s Mission**

The proposed Construction Management major is a multi-disciplinary, STEM-based program that aligns with and supports the stated vision “To be a nationally-recognized and preeminent regional undergraduate STEM (Science, Technology, Engineering and Mathematics) teaching institution with well-balanced curricula across diverse academic disciplines.”

As an 1862 Land-Grant, the West Virginia University system is dedicated to teaching practical science to expand the associated educational and career opportunities for its citizens. Furthermore, the built environment is essential to human existence and impacts all residents on many levels. There is however, a gap in West Virginia between post-secondary education opportunities and those who construct and maintain the built environment. According to the West Virginia Economic Outlook 2016, construction employment is expected to lead all other industry sectors in growth for the period between 2015-2020. Currently, there is no a 4-year Construction Management (CM) program available in West Virginia, despite the fact that demand is increasing and firms are focusing on hiring construction managers with a bachelor’s degree in construction management.

The proposed Construction Management major perfectly aligns with the mission of West Virginia University Institute of Technology to provide high-quality education and promote new opportunities to the citizens of West Virginia. The proposed program will allow the Leonard C. Nelson College of Engineering & Sciences to deliver a new high quality, practice-based, major at the undergraduate level to students who currently do not have the opportunity to pursue post-secondary education in Construction Management. This major will provide undergraduate students with the opportunity to learn and advance knowledge, technical skills and competencies pertaining to construction management through a high-quality set of courses and studio experiences in order to pursue entry-level opportunities across various construction industry divisions and sectors.

**Employment Opportunities**

According to the Bureau of Labor Statistic’s Occupational Outlook Handbook, Employment of construction managers is projected to grow 5 percent from 2014 to 2024, about as fast as the average for all occupations. Construction managers will be needed as overall construction activity increases over the coming decade. Those with a bachelor’s degree in construction science, construction management, or civil engineering, coupled with construction experience, will have the best job prospects.

The West Virginia Economic Outlook 2016 published by the Bureau of Business & Economic Research, West Virginia University College of Business and Economics states that construction employment is expected to grow at a rate of 1.8 percent per year, leading all other industry sectors for the period between 2015-2020 (Fig.1).
Globally, the volume of construction output is expected to grow by 85% to $15.5 trillion worldwide by 2030, with three countries, China, US and India, leading the way and accounting for 57% of all international growth\(^1\).

**Industry Demand**

The clientele to be served is a very broad and diverse construction industry that includes owners, users, and constructors of the built environment. This includes public and private interests, and ultimately society at-large. Construction is an inherently complex business replete with various levels and types of risk. It is one that will always be vital to society and one that is not easily outsourced. Constructors build things that make people's lives better. The proposed Construction Management major is intended to build people that will make the industry better. Construction projects continue to evolve in terms of complexity and face continually increasing internal and external demands. The new major will enable West Virginia University Institute of Technology to raise generations of constructors who will bring sophistication and heightened professionalism with a greater focus on safety and ethical practice to an industry and State in dire need of such improvements.

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Industry Overview
The construction industry is classically categorized by one of four major divisions:

- **Building – commercial and institutional**
  - includes healthcare, education, office, retail, recreational, religious, government
- **Residential – single and multifamily**
  - includes single-family homes, multi-unit townhouses, apartments, condominiums
- **Heavy/Infrastructure – transportation, utilities**
  - bridges, tunnels, highways, airports, dams, water and waste water treatment facilities, railroad and transit systems, port and marine construction, pipelines, power and communication networks
- **Industrial – manufacturing, processing**
  - petroleum refineries/petrochemical plants, power plants, manufacturing facilities

The Construction Industry is further subdivided into sectors or segments by:

- Public vs. private ownership/funding
- Union labor vs. merit (open) shop
- Organization and method of project delivery, e.g.: traditional, design-build, etc.
- Type of work: new vs. renovation/rehabilitation/retrofit/restoration/
- Contract type

There are several industry organizations whose membership seeks well educated graduates from 4-year construction management programs. These include:

- Associated General Contractors of America (AGC)
- Contractors Association of West Virginia (CAWV)
- Associated Builders and Contractors (ABC)
- ABC West Virginia Chapter
- Construction Management Association of America (CMAA)
- American Subcontractors Association (ASA)
- Design-Build Institute of America (DBIA)

Government agencies who typically employ construction managers include:

- West Virginia Department of Transportation (WVDOT)
- General Services Administration (GSA)
- United States Army Corps of Engineers (USACOE)
Industry Engagement
The Leonard C. Nelson College of Engineering & Sciences will assemble an industry advisory board designated as the WVU Tech Construction Management Advisory Council (CMAC). The CMAC shall be a diverse cross section of the construction industry and will include members from the various industry divisions and sectors. The CMAC will be a partnership between industry and faculty to form a network of support for the Construction Management Program and our students. The CMAC is essential in:

1. establishing and maintaining the critical connections between the University and regional and national Industry
2. providing input, feedback, and validation of curricular content and program excellence
3. supporting marketing and recruiting efforts for the Program
4. student support through dedicated scholarships and endowments
5. employment and placement network for students, internships and permanent placement
6. information and technology exchange
7. external funding sources for research
8. funding for Program enhancements and resources
9. accreditation (an active industry advisory board is required to achieve and maintain accreditation)

Post-Secondary Construction Management Education
As stated on their website, the Associated Schools of Construction (ASC) is the professional association of construction educators and industry practitioners working together for the development and advancement of construction education. It promotes the sharing of ideas and knowledge and inspires, guides and promotes excellence in curricula, teaching, research and service. The ASC is made up of 8 regions; 7 regions from the United States and Canada and one European region.

There are 143 4-year Construction Management programs of member universities and 9 2-year member schools\(^2\). Graduates from these institutions fill entry-level positions as project engineers, estimators, safety managers, superintendents, BIM managers, pre-con, document control and communication positions, schedulers, etc.

There are currently no accredited, non-accredited, or candidate status post-secondary construction management programs in West Virginia. The closest institution to Beckley offering a Bachelor degree in Construction Management is Virginia Tech.

The Construction Management Program will seek accreditation through ABET under the Applied Science Accreditation Commission (ASAC) to remain consistent with engineering and

\(^2\) Includes International members beyond the United States
engineering technology programs within the Leonard C. Nelson College of Engineering and Sciences.

Program Content
The proposed Construction Management curriculum will provide an interdisciplinary education including courses in mathematics, physics, economics, and communications. Core construction management courses will cover construction methods and materials, soils and structural systems, surveying, estimating, scheduling, field and office operations, construction law, construction safety and production, and building systems. However, the curriculum is designed around project-based learning through the integrated lab approach in teaching core construction competencies (planning, scheduling, estimating, means & methods, etc.) rather than only individual silo courses. The project-based learning experiences will span the industry divisions of commercial and institutional building, residential, heavy civil, and industrial construction. This approach is intended to produce well-rounded construction professionals. The integrated approach fosters team-building, collaboration, and leadership. Practice-based deliverables serve to sharpen students’ written and oral communication skills, promote critical thinking, and heighten creativity. The curriculum will also include technical coursework in BIM (Building information Modeling) and CIM (Civil Information Modeling) and related construction information technologies.

Expected Learning Outcomes
Applicants must meet the curriculum requirements required for general undergraduate admission to West Virginia University Institute of Technology. In addition to the general requirements for admission, applicants must also achieve an ACT math score of at least 19 or a SAT math score of 460 taken prior to March 2016 or a 500 SAT score taken March 2016 and after. Students that do not meet the admission standards can be considered for conditional admission. The admissions standards which currently apply to Leonard C. Nelson College of Engineering & Sciences are appropriate for incoming freshmen to the Construction Management Program. These admission standards are appropriate in terms of enrolling students who will be capable of exhibiting the listed program objectives upon graduation.

ABET ASAC Program Objectives include producing graduates who exhibit:

(a) an ability to apply knowledge of mathematics, science, and applied sciences
(b) an ability to design and conduct experiments, as well as to analyze and interpret data
(c) an ability to formulate or design a system, process, or program to meet desired needs
(d) an ability to function on multidisciplinary teams
(e) an ability to identify and solve applied science problems
(f) an understanding of professional and ethical responsibility
(g) an ability to communicate effectively
(h) the broad education necessary to understand the impact of solutions in a global and societal context
(i) a recognition of the need for and an ability to engage in life-long learning
(j) a knowledge of contemporary issues

(k) an ability to use the techniques, skills, and modern scientific and technical tools necessary for professional practice.

Graduates of the Construction Management program will have the knowledge, as well as the technical, administrative and communication skills, necessary to succeed in the construction industry. Students will demonstrate the knowledge and skills to deliver construction projects with respect to scope, schedule, budget, quality, safety, and the environment. More specifically:

1. construction project management from pre-design through commissioning;
2. project life-cycle and sustainability;
3. health and safety, accident prevention, and regulatory compliance;
4. law, contract documents administration, and dispute prevention and resolution;
5. materials, labor and methods of construction;
6. finance and accounting principles;
7. planning and scheduling;
8. cost management including plan reading, quantity take offs and estimating;
9. project delivery methods;
10. leadership and managing people;
11. business and communication skills required for professional practice

Program Quality Assurance
The ongoing efficacy and continuous improvement of the proposed Construction Management Program will be measured and driven by a comprehensive Quality Improvement Plan (QIP). The QIP consists of program-specific Strategic Plan, Assessment Plan, and Implementation Plan, which are interdependent upon one another. The QIP shall be outcomes-based, constructed around a set of outcomes that represent behaviors, skills, and knowledge that construction management practitioners need to possess in order to thrive in their profession. The outcomes-based approach focuses on 1) learning, not teaching, 2) students, not faculty, and 3) outcomes, not inputs or capacity. The Strategic Plan establishes and guides the Assessment Plan. The Assessment Plan drives Implementation. The Assessment Plan components include tools and mechanisms for routinely collecting and analyzing direct and indirect evidence of learning. Student Learning Objectives (SLOs) will utilize the measureable Bloom’s Taxonomy verbs of remembering, understanding, applying, analyzing, evaluating, and creating in line with the required core competencies identified by construction industry leaders. The curriculum shall be mapped to connect course deliverables to outcomes.

The SLOs for individual courses will be mapped to the learning outcomes promulgated by the ABET ASAC. Achievement of these ABET Learning Outcomes will enable Construction Management graduates to realize the stated Program Objectives. The ABET Leaning Outcomes are mapped to core courses for direct assessment measures based upon culminating deliverables.
The QIP shall include dynamic feedback loops intended to assure quality and ensure continuous improvement. Components of the QIP include direct assessment of learning, indirect assessment through surveys of students, graduating seniors and alumni, as well as survey feedback from employers. The QIP also includes regular evaluation and feedback from the CMAC.

**Impact of Construction Management on Other Programs**
The proposed Construction Management Program will contribute to the Leonard C. Nelson College of Engineering & Sciences by making elective courses available to interested students majoring in various engineering and engineering technology fields. There is an expectation that, over time, the Construction Management program will contribute towards the overall enrollment at the University and the College; therefore, the main impact on other programs is the potential increase in the enrollment of students in supporting courses. Moreover, Construction Management graduates are expected to have a profound, positive influence on the industry not merely within West Virginia, but national and globally. The influence of our graduates is certain to enhance the reach and stature of WVU Tech and the Leonard C. Nelson College of Engineering & Sciences, and contribute towards achieving the University’s mission to develop active and contributing members of society.

**Administrative Organization**
The Construction Management program will reside in the WVU Tech Leonard C. Nelson College of Engineering & Sciences. The administrative body will include the Program Director, College Dean, and Campus Provost. Academic and curriculum issues will be addressed using the appropriate WVU policies and channels. Once formed, the WVU Tech Construction Management Advisory Council will advise the Program Director regarding academic and curriculum recommendations. There will be no changes in the institutional organization, other than to name a Program Director from among the Construction Management Faculty.

**Planned Enrollment Growth**
Enrollment is projected to reach 100 full-time students after five years (Fig.2). This is a conservative estimate based upon the number of students in similar programs at peer universities. Figure 3 shows the anticipated number of degrees awarded.
Need for Additional Resources
The Construction Management Program will require one additional full-time, tenure track or a term appointment professor (TAP) position be hired each year for the Years 1 through 4, for a total of 4 (Fig. 4). The first new hire will be at the rank of associate/full professor and will concurrently serve as the Program Director. The rank distribution should initially be one full professor, one associate professor, and two assistant professors. All Construction Management faculty will have significant industry experience with a record of achievement as well as the requisite academic credentials.
Aspirational construction management and/or science programs located in the Southeastern United States, ASC Region 2, include:

- M. E. Rinker, Sr., School of Construction Management at the University of Florida
- McWhorter School of Building Science, Auburn University
- Myers-Lawson School of Construction, Virginia Tech

These programs provide dedicated lab space to enhance the student learning experience. This includes multi-station computer labs with state-of-the-art construction and modeling software including packages for computer-aided design, cost control, estimating, and scheduling. They also provide material and physical construction lab space.

The Charles R. Perry Construction Yard at the Rinker School, University of Florida is a 2,800-square foot demonstration area for crafts with an outdoor teaching amphitheater. Construction management students at the Rinker School receive hands on experience through in-class labs in the Charles R. Perry Construction Yard. The “Yard” includes a two-ton gantry crane and houses a 100-seat amphitheater and real-world tools and testing machines. The Yard also boasts the first green roof on the University of Florida campus. The green roof reduces the building’s heating and cooling costs and reduces storm water run-off.

In addition to a fabrication shop, students in the Auburn University McWhorter School of Building Science have access to a three-acre Field Lab, which offers a unique opportunity to incorporate hands-on experiential learning to complement and enhance students’ classroom lectures. The field lab is designed to provide a learning environment where lessons can be reinforced by doing instead

<table>
<thead>
<tr>
<th>FACULTY &amp; STAFF</th>
<th>FTE</th>
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<tbody>
<tr>
<td>1. Full Time Faculty</td>
<td>4*</td>
</tr>
<tr>
<td>2. Part Time Faculty</td>
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<td>3. Lab Technician:</td>
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<td>4. Administrative Assistant:</td>
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* One new F-T CM faculty member will be hired through Year 0 - Year 3.

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<th>LABORATORIES</th>
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<tr>
<td>1. Material/Construction Methods Lab: Minimum Good State-of-the-Art</td>
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<tr>
<td>Start-up Cost:</td>
<td>$300,000.00</td>
<td>$600,000.00</td>
<td>over $1 Million</td>
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<tr>
<td>2. Designated CM Computer Lab: 30 computer stations + Accessories + Software</td>
<td></td>
<td>$200,000.00</td>
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</table>
Auburn’s dedicated construction education spaces include Thesis Room, Peripheral Lab, and Building Information Modeling Lab (BIM) Lab.

The Thesis Room has forty-five individual work stations, of which thirty-five are configured with dual twenty-two inch monitors with a late model Dell i7 machines. The other ten workstations are used as laptop stations where students can “check out” a laptop from the IT office for use. The Peripheral lab contains twelve Core 2 duo machines with one twenty-two-inch monitor for each computer. The BIM Lab has twenty-four late model HP Elite i7 machines with dual twenty-two inch monitors. The computers are set up into four PODS of six, and each POD faces a sixty-five-inch-wide screen TV, which is used in place of a projector in the class and enables students to see what is being projected up close. In the front of the classroom is a fifth large screen TV with a touch screen overlay so the instructor can stand at the TV and touch the screen to display different things. All three rooms are equipped color printers and plotters.

The Myers-Lawson School at Virginia Tech Virginia Tech provides students with substantial studio and collaboration space. In addition, construction students at Virginia Tech have access to three distinct lab spaces including, the BEST Lab, BuildLAB, and Virtual Facilities Lab. The Building Enclosure and Systems Technologies, or BEST Lab enables students to engage with faculty and industry partners to investigate and analyze building systems performance. This includes mechanical, electrical, and lighting systems and a specific focus on building enclosure systems and their interrelated thermal, hygrothermal, and acoustic performance.

The BuildLAB provides students with access to physical assets such as tools, materials, and equipment; as well as the not-so-physical in the form of an experimental environment whose purpose is to foster and support innovation of all kinds. Virtual Facilities Lab provides the opportunity for research in the applied use of Building Information Modeling across the facility lifecycle.

It is expected that the WVU Tech Construction Management Program will provide designated computer lab space with the appropriate hardware and software and support peripherals. The Program should also house dedicated physical lab space to provide hand-on learning opportunities related to materials, means and methods, fabrication, process improvement, and most importantly, safety.

Budget and Net Income Projections
Budget and Net Income projections are shown below (Fig.5). It is anticipated that the tuition and fee revenue will exceed the direct expenses in the second year of the program.
### BUDGET

<table>
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<tr>
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<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
<th>Year 6</th>
<th>Year 7</th>
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<tr>
<td><strong>A: Faculty Salaries (Base)</strong></td>
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<tr>
<td>Program Director (Associate/Full Prof)</td>
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<td>$91,800</td>
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<td>$95,509</td>
<td>$97,419</td>
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<td>$72,828</td>
<td>$74,285</td>
<td>$75,770</td>
<td>$77,286</td>
<td>$78,836</td>
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<tr>
<td>Assistant Professor</td>
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<td>$75,770</td>
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<td>$328,921</td>
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<td>$69,306</td>
<td>$90,292</td>
<td>$92,098</td>
<td>$93,940</td>
<td>$95,819</td>
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<td><strong>B: Start-Up Computer/Software Costs</strong></td>
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<td><strong>C: Operating Budget:</strong></td>
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<td>$20,000</td>
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<td>$21,855</td>
<td>$22,510</td>
<td>$23,185</td>
<td>$23,881</td>
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<td><strong>TOTAL:</strong></td>
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<td>$298,371</td>
<td>$348,045</td>
<td>$444,618</td>
<td>$453,529</td>
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### NET INCOME

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<th>Year 5</th>
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<tr>
<td>Adjuncts</td>
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<td>10,000</td>
<td>10,000</td>
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<tr>
<td>Start-Up/Computer Software</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
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<tr>
<td><strong>Total Expenses</strong></td>
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<tr>
<td><strong>NET INCOME</strong></td>
<td>(42,644)</td>
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<td>310,077</td>
<td>498,148</td>
<td>601,483</td>
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Figure 5: Budget and Net Income Projections for Years 1-7
Catalog Description
Bachelor of Science in Construction Management

Construction Management is an exciting field and rewarding career choice. Professional construction managers earn excellent salaries and derive great satisfaction working in any one of the many sectors of the construction industry. Construction is the second largest industry in the United States with over $1 trillion in total volume, accounting for approximately 8% of the nation’s GDP. It is the industry responsible for constructing the buildings and infrastructure that are so vital to the quality of life.

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Curriculum (Total of 121 credit hours)

General Education Foundations
Commencing Fall 2016, students enrolled at WVU Institute of Technology are required to fulfill General Education Foundations (GEF) curriculum requirements. Construction Management majors will complete 34 credits in the following courses to satisfy the GEF curriculum requirements:

GEF 1 English (6 credits)  
- ENGL 101 Composition & Rhetoric (3/6)
- ENGL 102 Composition & Rhetoric (6/6)

GEF 2 Science & Technology (4 credits)  
- PHYS 101 Introductory Physics I (4/4)

GEF 3 Mathematics & Quantitative Skills (3 Credits)  
- MATH 126 College Algebra (3/3)

GEF 4 Society & Connections (3 credits)  
- ECON 225 Elementary Business & Economics Statistics (3/3)

GEF 5 Human Inquiry & the Past (3 credits)  
- PHIL 170 Introduction to Critical Reasoning (3/3)

GEF 6 The Arts & Creativity (3 credits)
The Arts & Creativity Elective (3/3)
GEF 7 Global Studies & Diversity (3 credits)
  • Global Studies & Diversity Elective (3/3)
GEF 8 Focus (9 credits)
  • MATH 128 Plane Trigonometry (3/9)
  • ECON 201 Principles of Microeconomics (6/9)
  • PHYS 102 Introductory Physics II (4)(9/9)

Construction Management Core Courses (64 credits)
  • CMGT 101 Introduction to Construction Management (3)
  • CMGT 110 Computer Applications for Construction (4)
  • CMGT 120 Analytical Techniques for Construction (3)
  • CMGT 150 Construction Graphics (3)
  • CMGT 210 Statics & Strength of Materials (3)
  • CMGT 220 Construction Methods & Materials I (3)
  • CMGT 225 Construction Methods & Materials II (3)
  • CMGT 230 Construction Survey & Layout (3)
  • CMGT 240 Soils & Foundations (3)
  • CMGT 320 Mechanical Building Systems (3)
  • CMGT 330 Electrical Building Systems (3)
  • CMGT 340 Construction Planning & Scheduling (3)
  • CMGT 350 Construction Estimating (3)
  • CMGT 360 Construction Law & Contract Administration (3)
  • CMGT 370 Construction Safety & Production Systems (3)
  • CMGT 380 Residential Construction Practice (3)
  • CMGT 410 Construction Finance & Cost Control (3)
  • CMGT 420 Management of Construction Operations (3)
  • CMGT 430 Commercial Construction Practice (Studio) (3)
  • CMGT 440 Heavy Construction Practice (Studio) (3)
  • CMGT 460 Management of the Construction Firm (3)

Construction Management Electives (9 credits)
  • CMGT 450 Industrial Practice Studio (3)
  • CMGT 465 BIM in Construction Management (3)
  • CMGT 466 Marketing Construction Services (3)
  • CMGT 467 Facilities Management (3)
  • CMGT 468 Temporary Structures (3)
### Course Descriptions

**CMGT 101 Introduction to Construction Management (3-0)3**
Introduction to construction management including industry divisions and sectors, stakeholders, organization structures, project delivery methods, and contracting. Overview of the roles of management and the trades, resources, safety, environmental issues, ethics, and codes, standards, and regulations.
CMGT 110 Computer Applications for Construction (3-3)4
Utilization of spreadsheets, charts and tables for problem-solving and creating reports and presentations required for construction management. Overview of information technology in construction including software and hardware.

CMGT 120 Analytical Techniques for Construction (3-0)3
Qualitative and quantitative methods for problem solving and decision making for construction professionals. Quantitative techniques include time value of money concepts, benefit-cost analysis, break-even analysis, discounted payback, and the application of decision trees applied to problems typically encountered in construction management. Qualitative analysis tools include ranking, root cause analysis techniques such as the 5 Whys and A3 problem solving.

CMGT 150 Construction Graphics (2-3)3
Basics of reading and interpreting construction drawings. Includes graphics and symbols for site work, foundations, framing, interior and exterior finishes, and electrical and mechanical systems. Manual sketching and use of CAD to prepare details of building and site details, and introduction to 3D modeling and BIM.

CMGT 210 Statics & Strength of Materials (3-0)3
( PHYS 101)
Introduction to statics and mechanics of materials for constructors. Topics include forces, static equilibrium, the concepts of stress and strain, elastic deformation, and mechanical properties of materials. Graphical techniques include free body diagrams along with moment and shear diagrams.

CMGT 220 Construction Methods & Materials I (2-3)3
Introduction to building materials including wood and timber, earth products, concrete, and masonry. Topics include lumber and engineered wood products, fasteners, aggregates, concrete production, cast-in-place and precast concrete, concrete block, brick, and stone masonry. Mechanical and non-mechanical properties, production, and installation of these materials are discussed with consideration of safety, sustainability, and quality.

CMGT 225 Construction Methods & Materials II (2-3)3
(CMGT 220)
Content covers steel and nonferrous metals, glass, polymers and roofing and waterproofing materials. Topics include steel framing, cladding, curtain wall construction, roofing systems, and architectural finishes. Mechanical and non-mechanical properties, production, and installation of these materials are discussed with consideration of safety, sustainability, and quality.

CMGT 230 Construction Survey & Layout (2-3)3
(MATH 128)
Basics of land surveying and layout for building and infrastructure construction. Topics include distance and angular measurement, leveling, total station, lasers, GPS field procedures, and robotics. The traverse, layout techniques, and construction control are addressed including an
introduction to horizontal and vertical curves. The course opens with a brief review of basic trigonometry and coordinate geometry.

**CMGT 240 Soils & Foundations for Constructors** (2-3)3  
(CMG 210)  
Overview for construction practitioners that begins with basic soil classifications and behavior, through soil mechanics, and ultimately foundations. Topics include soil exploration, compaction and consolidation, stabilization, water flow, subsurface stresses and shear strength of soil, and shallow and deep foundations. Lateral earth pressure and retaining structures will also be discussed.

**CMGT 250 Structural Systems** (3-0)3  
(CMG 210)  
Overview of structural systems for constructors. Topics include determining load paths in structural systems and the analysis and design of wood, steel, and concrete components. These includes beams, columns, and trusses.

**CMGT 320 Mechanical Building Systems** (3-0)3  
(PHYS 101)  
Fundamentals of mechanical systems design and installation for buildings. Topics include heating, ventilating, and air conditioning (HVAC); drain, waste, vent (DWV) systems; water supply, fire protection, and stormwater management. The course opens with a brief review of heat transfer and fluid flow. Life-cycle costs, energy efficiency, and sustainability are reoccurring themes throughout the course.

**CMGT 330 Electrical Building Systems** (3-0)3  
(PHYS 102)  
Fundamentals of electrical and lighting system design and installation for buildings. Topics include generation, transmission, and distribution of electricity; building power requirements, electrical circuits and wiring, conduit, appliances and devices, direct and indirect lighting, and controls. The course begins with a brief review of the basics of electricity and light and concludes with a discussion of commissioning of building systems.

**CMGT 340 Construction Planning & Scheduling** (2-3)3  
(CMG 101, CMGT 150, CMGT 225)  
Content covers construction planning, scheduling, network systems, and communications required for project execution and control. It includes designing construction activities, logic diagramming, computing durations, and identifying resource requirements. Scheduling techniques presented are Critical Path Method (CPM), Location-Based Management System (LBMS), and Last Planner System (LPS). Brief introduction of commercially available scheduling software.
CMGT 350 Construction Estimating (2-3)3
(CMGT 101, CMGT 150, CMGT 225)
Intended to develop knowledge and skill in the estimating process from takeoff through preparation of the final bid. Introduction to conceptual estimating, developing unit prices; markups for overhead, contingency, and profit; and ethical practice. Includes a brief introduction to commercially available estimating software.

CMGT 360 Construction Law & Contract Administration (3-0)3
(Junior or senior status)
Construction law topics covering contracts, torts, and statutory law. Topics include contract documents and specifications, liability, claims, and liens. Ethical practice and risk management are underlying and reoccurring themes.

CMGT 370 Construction Safety & Production Systems (3-0)3
(CMGT 150 and CMGT 225)
Concurrent design of safety and production systems. Topics include design of safe, effective, and reliable construction processes; integration of prefabricated and precast elements, safe ingress, egress, and access to the workface, and stable workflow. Reoccurring themes include continuous improvement, respect for people, elimination of waste, reducing variability and increasing plan reliability.

CMGT 380 Residential Construction Practice (Studio) (2-4)3
(CMGT 225)
Studio course applying construction management knowledge and tools to developing and constructing single and multifamily projects. Project life cycle includes conceptualization and feasibility, preconstruction service, construction, and closeout. Introduction and application of the Value Management framework. The course culminates with a report and presentation.

CMGT 410 Construction Finance & Cost Control (3-0)3
(CMGT 120 and CMGT 350)
Overview of financial and accounting practices applied to construction projects and company management. Topics include financing construction projects, cash flow, budgeting, capturing and analyzing cost data, and time value of money in decision making. Ethical practice is an underlying and reoccurring theme.

CMGT 420 Management of Construction Operations (3-0)3
(Senior status)
Addresses the execution and control of construction operations in the field and office. Topics include procurement, production control, site logistics, communication and stakeholder management, change management, tracking progress, and project closeout. Safety, quality, reliability, and ethical practice are reoccurring themes.
CMGT 430 Commercial Construction Practice (Studio) (2-4)3  
(CMGT 350, CMGT 360, CMGT 370, CMGT 380)  
Studio course applying construction management knowledge and tools to developing and constructing commercial or institutional building projects. Project life cycle includes conceptualization and feasibility, preconstruction service, construction, and closeout. Application of the Value Management framework. The course culminates with a report and presentation.

CMGT 440 Heavy Construction Practice (Studio) (2-4)3  
(CMGT 350, CMGT 360, CMGT 370, CMGT 380)  
Studio course applying construction management knowledge and tools for constructing heavy infrastructure projects. Project life cycle includes preconstruction, construction, and closeout. The course introduces bridges, pavements, utilities, and heavy equipment applications. The course culminates with a report and presentation.

CMGT 450 Industrial Construction Practice (Studio) (2-4)3 (Electives)  
(CMGT 350, CMGT 360, CMGT 370, CMGT 380)  
Studio course applying construction management knowledge and tools for constructing industrial projects. Such projects include power plants, manufacturing facilities, and petrochemical plants. Project life cycle includes preconstruction, construction, and startup. The course introduces heavy vessel and equipment installation, process piping, and controls for electromechanical systems. The course culminates with a report and presentation.

CMGT 460 Management of the Construction Firm (3-0)3  
(CMGT 360)  
Application of management principles to construction firm operations. Topics include strategic planning and management techniques for long-term planning and management of the firm. Ethical practice and risk management are underlying and reoccurring themes.

CMGT 465 BIM in Construction Management (2-3)3 (Elective)  
(Senior status)  
Application of building information modeling software to model building and infrastructure systems and construction processes. Computerized BIM applications include integration of prevailing commercially available software.

CMGT 466 Marketing Construction Services (3-0)3 (Elective)  
(CMGT 350)  
Application of marketing principles to the construction industry. Topics include market research, developing marketing strategy, and business development techniques.
CMGT 467 Facilities Management (3-0)3 (Elective)
(CMGT 320 and CMGT 330)
Integration of business administration principles with building systems operations. Topics include facilities planning, budgeting, real estate transactions, construction, emergency preparedness, security, operations, and maintenance.

CMGT 468 Temporary Structures (3-0)3 (Electives)
(CMGT 240 and CMGT 250)
Analysis, design and installation of temporary structures required to facilitate construction flow. These include scaffolding, concrete formwork, falsework, and support of excavation.