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ABET-accredited civil engineering programmes following track system: Part I - survey and framework development

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ABSTRACT: Civil engineering graduates face several challenges due to global and economic pressures, and rapid advances in technology. At the same time, many engineering education leaders and professional organisations are calling for engineering education reform to prepare civil engineering graduates to meet future challenges better. This article presents the development of a civil engineering curriculum based on the so-called *track system*. As an initial step in the curriculum development, 222 ABET-accredited programmes in the United States were surveyed. Further, in-depth survey and analysis of the 37 programmes were conducted. The research effort was devoted to identifying an approach to reform the civil engineering curriculum to cope with the foreseen challenges. Finally, the study proposes a framework for curriculum development based on the track approach within the ABET criteria.

Keywords: Undergraduate engineering degree, ABET-accredited, civil engineering curriculum, curriculum development

INTRODUCTION

Calls for engineering education reform have been raised by many organisations and engineering education leaders. At the same time, many engineering education leaders and professional organisations are calling for engineering education reform to prepare civil engineering graduates to meet future challenges better. About fifteen years ago, discussions and research efforts were focused on preparation and expectations of new engineering graduates by 2020, in view of globalisation, impact of the world economy and advancement in technological challenges. The concerns centred on the impression that graduates were not ready to function in the global market due to deficiencies in communication, management and leadership skills [1-7].

Year 2020 is approaching and yet another concern, lack of *in-depth* understanding of the technical concepts, has started to surface. This could be attributed to the reduction in the total credit hours that many undergraduate civil engineering programmes have been facing lately [8]. Considering the factors affecting engineering education, it can be viewed as a multi-objective optimisation problem. Basically, these programmes have to satisfy the criteria set by the accreditation agency, try to reduce the number of credits in the programme and aim to satisfy the market's needs. Accreditation Board for Engineering and Technology (ABET) criteria regarding basic mathematics, science and general education were established to ensure continuous improvement of the engineering programmes [9].

At the same time, some universities claim that only basic/fundamental knowledge needs to be provided to students and on-the-job training is essential to acquire more knowledge, based on the nature of their specialisation after graduation. However, many professional firms have raised a concern that graduates do not have the required analysis/design background for practice [8][10]. The civil engineering profession covers many sub-areas (such as structures, construction management, geotechnical, transportation, environmental, water resources and construction materials), which is one of the main reasons for the difficulty in reducing the number of credits in the curriculum. One of the proposed solutions to this problem is a track system curriculum [11][12].

In the track system, the graduate is expected to acquire only the basic/introductory level of knowledge in most civil engineering areas; in addition, the rest of the curriculum will concentre on one of the civil engineering sub-areas (track), which will help the student to specialise and gain detailed/in-depth knowledge in the area of interest. By doing so, the total number of credits can be maintained at an acceptable level, the accreditation requirements can be satisfied, and the professional firms/companies will be able to hire a graduate who has a more solid background in a specific area of civil engineering based on their main interest area.

This article provides guidelines for development of the civil engineering curriculum following a track system based on surveying ABET accredited programmes in the United States. It summarises the existing track-based curriculum and proposes guidelines for preparing civil engineering graduates for market needs.

The proposed curriculum takes into account the following constraints and requirements: pre-engineering fundamentals, science and mathematics, general education, English language proficiency, core engineering subjects, specialised tracks and ABET criteria. It considers the minimum required set of core courses within a track to provide the student with depth within a specific concentration. In addition, the proposed framework is designed to support further development of the Master of Science and Doctoral programmes.

BACKGROUND

Undergraduate curriculum development has recently become a dynamic issue in the various engineering fields due to the continuous updates in accreditation requirements, advancements in engineering practice, increased environmental awareness and progress in research. Development and improvement of the undergraduate civil engineering curriculum can be divided into three main stages. Stage one focused on developing a strong technical background within the students, the second stage was driven by the rapid advances in science, technology and importance of general education, and the third and current stage addresses the global and economic challenges.

Curriculum Development and Improvement - USA Experience

The earliest track approach was recognised about 30 years ago when the boundaries between civil and environmental engineering were clearly distinguished. Many programmes were restructured to reflect this change, requiring additional courses and modifying others to meet the track change. For example, in the early 1990s, the civil engineering faculty at Stanford University changed their curriculum to broaden students' perspectives on engineering and steer them toward one of two tracks, referred to as the *wet side* and the *dry side* [13]. The wet track was designed for students interested in water resources and environmental engineering. The dry track was meant to satisfy students' interested in structures and construction.

Curriculum improvement reflecting the needs of the marketplace is demonstrated by the new curriculum of the Department Civil Engineering at Cooper Union University [14]. The curriculum change was prompted by the need to have students conceptualise, design and construct projects involving infrastructure and large constructed facilities. It made greater use of case studies in the courses, introduced a convergent technology course in the sophomore year and developed a comprehensive senior design capstone course that focused on real planning and design for a local project. In addition, it created a new course in smart structures and transportation systems, developed areas of concentration and increased the opportunities for undergraduate students to be involved with academic staff in collaborative research. Other examples of curriculum restructuring were prompted by a change in the composition of the faculty, input from the parents and students, industry participation and the college's concerns [2][5][15].

Another approach for curriculum improvement is based on acquiring subjects from different areas to teach students about design and problem-solving without increasing the number of credit hours. This approach is called *Integrated Curriculum* [16]. Freshman engineering and senior capstone design courses are two examples of integrated courses. This approach offers a useful mean to add material to the four-year programme without increasing the number of credit hours and presents flexible courses to meet goals of professional groups.

In an effort to analyse civil engineering curricula in the US, Russell and Stouffer surveyed about 90 accredited undergraduate civil engineering programmes in the US [17]. The study focused on data related to the mathematics and science requirements, general education courses and engineering subjects. It was found that while the total number of technical credits in US curricula has decreased over the past century, the number of technical credits offered through electives has steadily increased. Furthermore, civil engineering curricula in the US were found to lack concentration in the liberal arts, professional skills and systems thinking.

Curriculum Development and Improvement - International Experience

One of the primary goals of the curriculum improvement is the desire to produce students with appropriate skills and motivation to face the challenges of the 21st Century. Table 1 provides a sample of curriculum development studies in several countries around the world. The summary provides highlights, approaches of continuous improvements and curricular reforms to meet the current and future challenges.

21st Century Challenges for Civil Engineering Education

Many global, economic and cultural issues influenced by rapid advances in technology are the challenges for 21st Century graduates. To help identify the preparation required, the expectations of graduates should be clearly defined. Recent studies emphasised employers' expectations of recent engineering graduates to be successful in the current marketplace [1][6][7][22-26].

These expectations can be divided into two categories: hard skills and soft skills. Hard skills include a strong analytical background, practical proficiency, skills in planning, combining and adopting; and soft skills comprise creativity, discovery and design, communication, responsibility, knowledge of business and management principles, leadership, professionalism, ethical standards and lifelong learning. However, the number of credit hours available in most 4-year programmes does not support all the previous expectations. Therefore, programmes should be creative in providing the necessary preparation within the limited credit hours.

Table 1: Curriculum development - *International Experience* [6][12][18-21].

Region/Country	Development/Improvement of the civil engineering curriculum
Middles East	Several engineering curricula are influenced by British, French or US educational systems. However, some civil engineering programmes have clear track system with up to 160 credit hours, which are used to focus on technical stuff with less emphasis on general education. Recently, many programmes started curriculum improvement to have their graduates ready for the marketplace.
India	Focus on technical and improvement in finance, management, organisation and marketing.
Singapore	Improvement to address the globalisation challenges by introducing management related subjects since majority of the engineering curricula focus on the technical background.
Hong Kong	Improvement at the Master level to offer professional engineering management related topics.
Japan	Efforts at the undergraduate and graduate levels to improve the curricula to prepare the graduates for the global market place better. Differences between the civil engineering system in Japan and other countries are based on the differences in values and traditions.
France	Major reform is expected to meet the 21st Century challenges; in addition to the efforts to integrate the French system with the European Union's educational system.
Europe	A call to provide a new strategic approach to address the challenges imposed by the world-wide trends and anticipated societal requirements.
Australia	A major revision of the civil engineering curriculum driven by rationalisation of course offerings, changes in expectations from industry, integration with combined degrees, moves toward a common freshman engineering year, changes in student expectations and abilities, and greater integration of teamwork and generic skills within the courses. The broad changes were consistent with the objectives set out by the American Society of Civil Engineers (ASCE) in their Body Of Knowledge (BOK) for the 21st Century, and with statements by the European Civil Engineering Education and Training (EUCEET).

ABET Criteria

ABET criteria are designed to be generic and flexible; therefore, they can accommodate the inherent diversity in the different engineering fields offered at different universities. This is achieved through specifying engineering areas rather than prescribing specific courses for each curriculum component that is consistent with the programme objectives and student outcomes.

According to ABET, the professional component needs to incorporate at least one year of combined mathematics and basic sciences, one and a half years of engineering sciences and design, as well as a general education component complementing the technical curriculum content. One year is the lesser of 32 semester hours (or equivalent) or one-fourth of the total credits required for graduation [9].

For civil engineering, the ABET criteria indicate that the programme should provide its graduates with the ability to apply mathematics through differential equations, calculus-based physics, chemistry, with an additional area of science. The programme should also prepare the graduates to demonstrate knowledge in four technical areas of civil engineering: conduct experiments and extract and interpret results; design systems, components or processes. In addition, since 2007, new criteria to introduce students to the basic concepts in management, business, public policy, leadership, as well as the importance of professional licensure have been required. The ABET criteria also emphasise that the design courses should be taught by academic staff qualified in the subject matter. Qualification can be demonstrated by faculty background education, professional licensure or design experience [9].

American Society of Civil Engineers (ASCE) Role

To improve the civil engineering profession, ASCE has recognised many challenges that face the professional practice of civil engineering. Specifically, it has focused on the inadequate formal academic preparation due to the reduction of the credit hours requirements, particularly in the technical areas, for the four-year Bachelor's degree programmes. In 2004, the ASCE Body of Knowledge Committee of the Committee on Academic Prerequisites for Professional Practice stated:

At the same time, reductions in credit hours required for graduation are making the current four-year bachelor's degree inadequate formal academic preparation for the practice of civil engineering at a professional level in the 21st century [8].

Since then, several committees provided a range of recommendations to help shape the future of the profession. One of several recommendations supports the concept of the Master's degree or equivalent as a prerequisite for licensure and the practice of civil engineering at the professional level. This recommendation recognises the need for graduates to have detailed/in-depth knowledge in an area of specialisation before practicing at the professional level [27-29].

RESEARCH OBJECTIVE AND METHODOLOGY

Objectives

The main objective of this research effort is to investigate the possibilities of developing guidelines for civil engineering curricula based on a so-called *track approach*. The authors recognise that the programme educational objectives at any institution should reflect the needs of the programme's constituencies and one curriculum will not meet the needs for all programmes. However, having a framework or guidelines will ensure improving the curriculum development and warrant that the engineering graduates nationwide will have similar preparation to meet the future challenges.

Methodology

The approach followed in this research was based on a survey of ABET accredited programmes in the US that operate on the semester system and a clear track system at the undergraduate level [30][31]. The track system is a specialty area, which provides undergraduate students with in-depth knowledge in one of the civil engineering areas. Courses in a track are designed to provide the analysis/design background that is needed for practice. It should be noted that programmes offering accelerated Bachelor/Master degrees and specialty certificates fifth year systems were not included in the study. The following approach was used during the data collection:

1. the total number of hours in the degree, number of hours of mathematics, science, general education, English, senior capstone design, engineering core and specialty track were recorded;
2. the core courses from each programme were listed;
3. the courses offered in each track to provide the breadth from other tracks were listed and others suggested;
4. courses with similar content with different titles were consolidated;
5. data were processed for findings and discussions.

FINDINGS AND ANALYSIS

The research team collected curricula from 222 programmes, which are listed on the ABET Web site (ABET 2009). Information on each programme was obtained and evaluated following the research criteria discussed before. The first evaluation showed that approximately 25% of the ABET accredited programmes are based on a track system. Out of these programmes, 37 of them met the survey criteria and the authors had access to all details of the curricula, hence, they were considered in the study.

A detailed investigation was conducted to collect data about these programmes' curricula, and the data were compared against the ABET criteria for combined mathematics and science (32 semester hours or one-fourth of the total hours) and core civil engineering hours (48 hours or one-fourth of the total programme hours) [9].

Overall Distribution of Curricula Credit Hours

Analysis of the results was carried out by comparing the various components of the curricula. Details of the investigation are summarised in Table 2, which shows the credit hours in the various components of the curricula. The data in Table 2 were compared against the ABET criteria for combined mathematics and science, and core civil engineering hours. It was found that all programmes met both requirements with different approaches. In Table 2, it is noteworthy that the number of hours for the English language in some curricula was listed as zero because these hours were used to satisfy the general education requirement.

For data analysis consistency, it was decided that if the hours were listed clearly by the programme as a part of the general education requirement, then, they should not be double counted to satisfy the English language requirement. Also, the same concept was used for the senior capstone design; some curricula devoted a specific course within the track for the senior design experience. In these cases, the senior design hours were not counted as a separate course, rather they were counted as a part of the track hours.

Total Number of Credit Hours

Further analysis was conducted on the main categories in the curricula: total credit hours, core civil engineering and track credits. It was also found that about 84% of the programmes have the total number of credits between 125 to 132 hours, while the other 16% are distributed outside the previous range, as shown in Figure 1. This indicates that track system curricula with 125-132 total credit hours are more common.

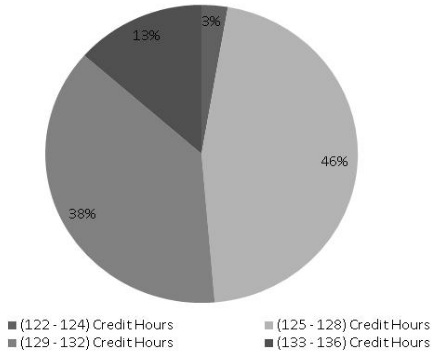


Figure 1: Programme distribution according to total number of credits.

Table 2: Summary of the curricula data collected from the considered programmes.

Number of Credits	Average	Minimum	Maximum	σ*	COV**
Mathematics	19	15	24	3	0.14
Sciences	16	10	23	3	0.16
Computer	3	0	6	2	0.70
English Language	6	0	10	3	0.52
General Education	19	12	26	4	0.21
Free Electives	3	0	15	4	1.24
Senior Design	3	0	6	1	0.37
Core Civil Engineering	45	25	62	9	0.19
Track Credits	17	6	31	6	0.37
Curriculum Total	129	122	136	3	0.02

*Standard Deviation
**Coefficient of Variation

Core Engineering Credits

The expected range of the core engineering credits for the programmes under consideration to meet the ABET criteria is 30 to 34 hours. While all programmes satisfied this criterion through the required courses, only two programmes used technical or free electives to meet ABET's total number of core engineering credit.

In addition, frequency (number of programmes offering the same subject) of core engineering subjects was recorded and summarised in Figure 2. Twenty-seven subjects were offered in more than 10% of the programmes; however, traditional subjects, such as statics, mechanics of materials, constructions materials and introduction to tracks are commonly offered by a majority of the programmes.

It is also worth noting that about 10% of the programmes started devoting core credit hours to cover subjects, such as professional practice, engineering ethics and project management. These topics respond to some of the challenges discussed before. Furthermore, the addition of these subjects showed the flexibility that the programmes have due to the track system, which allows them the opportunity to address the challenges within the limited credit hours of the curriculum.
Tracks and Credits Hours

The total number of credits in each track was also investigated. About 76% of all programmes have 9 to 18 credits in each track. The other 24% are distributed among the following categories; 0 to 6 (3%), between 21 and 27 (8%), and between 29 and 33 (14%), as shown in Figure 3. This indicates that 9-18 credit hours are most commonly used for track hours in a civil engineering curriculum.

The higher range of track hours (29 to 33) was used by the programmes to satisfy the core engineering hours; in addition, it gave more flexibility in forming the direction of a specific track at early stage in the curriculum.

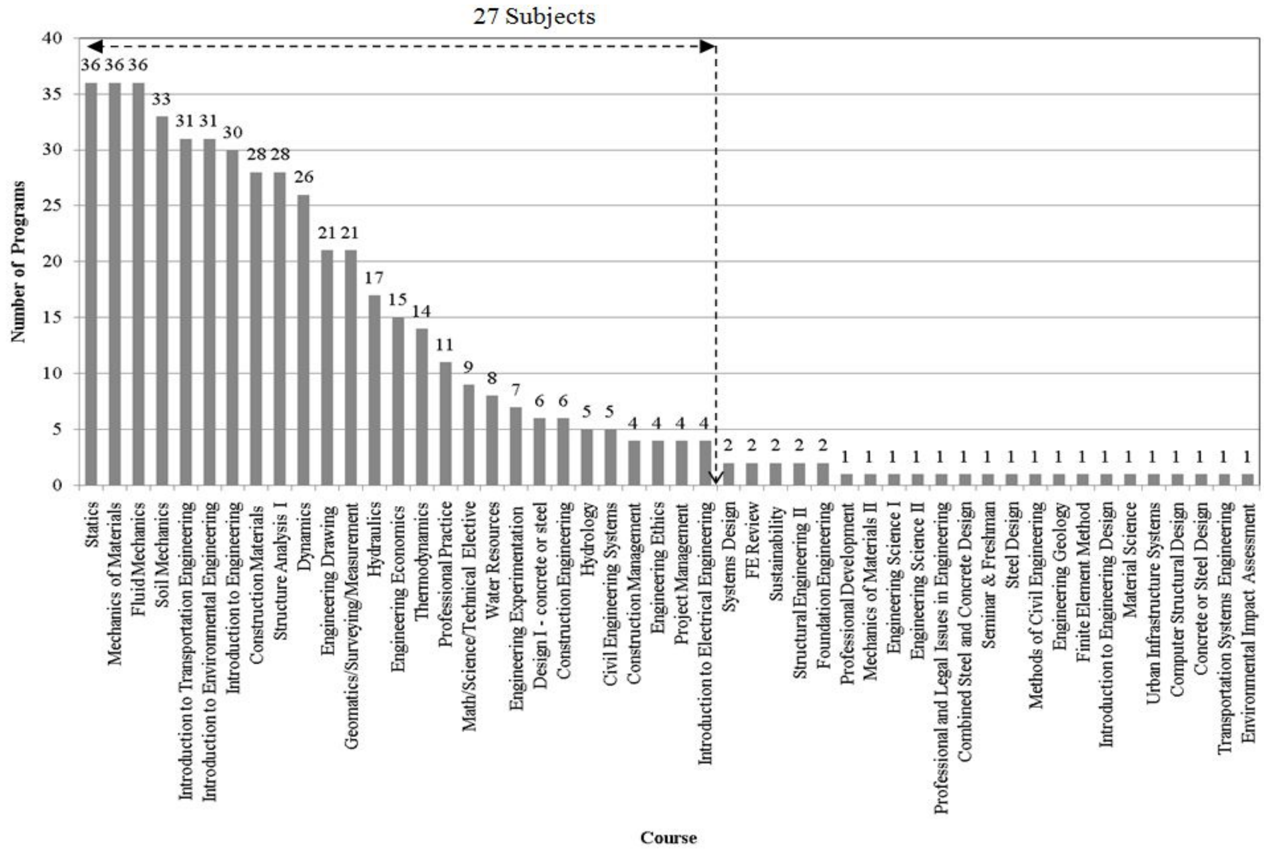


Figure 2: Core engineering subjects and offering frequency.

At this stage, the research efforts were devoted to answering the following questions: *what are the commonly adopted:* 1) *Tracks by the civil engineering programmes?* 2) *Subjects for each track?* 3) *Subjects needed to provide the breadth and knowledge from other tracks?* The following discussion is an attempt to answer the aforementioned questions.

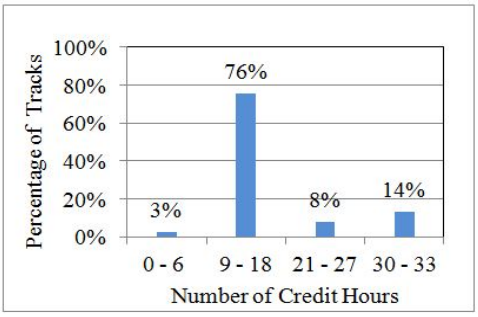


Figure 3. Programmes distribution according to the number of credits in each track.

Figure 4 provides the tracks offered and their frequency; the % reflects the number of programmes offered in similar tracks as listed by the programmes considered in the study. Few of these tracks could be consolidated under other traditional tracks. However, it was decided at this stage to keep the tracks as listed by the programmes. Traditional tracks, such as Structural Engineering/Mechanics, Transportation Engineering and Planning, Geotechnical Engineering, Water Resources Engineering, Environmental Engineering, Construction Engineering and Management are commonly offered by more than 40% of the programmes. However, particular tracks were offered by a few of the considered programmes due to faculty interest or to meet programme educational objectives. In addition, several programmes offered general civil or civil systems as an option for students with no interest in a specific focus area of study.

Moreover, it was found that some programmes addressed the sustainability issue (one of the 21st Century challenges) within the subjects offered by the tracks and did not devote a special track of study for it.

The frequency of track subjects was also investigated. The data collected were classified into two categories. The first category deals with main subjects required to provide in-depth knowledge about the track; while the second category provides the breadth needed by expanding to other tracks. Table 3 provides a summary of the high frequency subjects offered by the common tracks found in this study. In addition, another track, Civil Systems or General Civil, was included as an alternative focus of study. The subjects included in Table 3 provide flexibility for the programmes to select the course offering based on faculty interest and help planning for graduate studies.

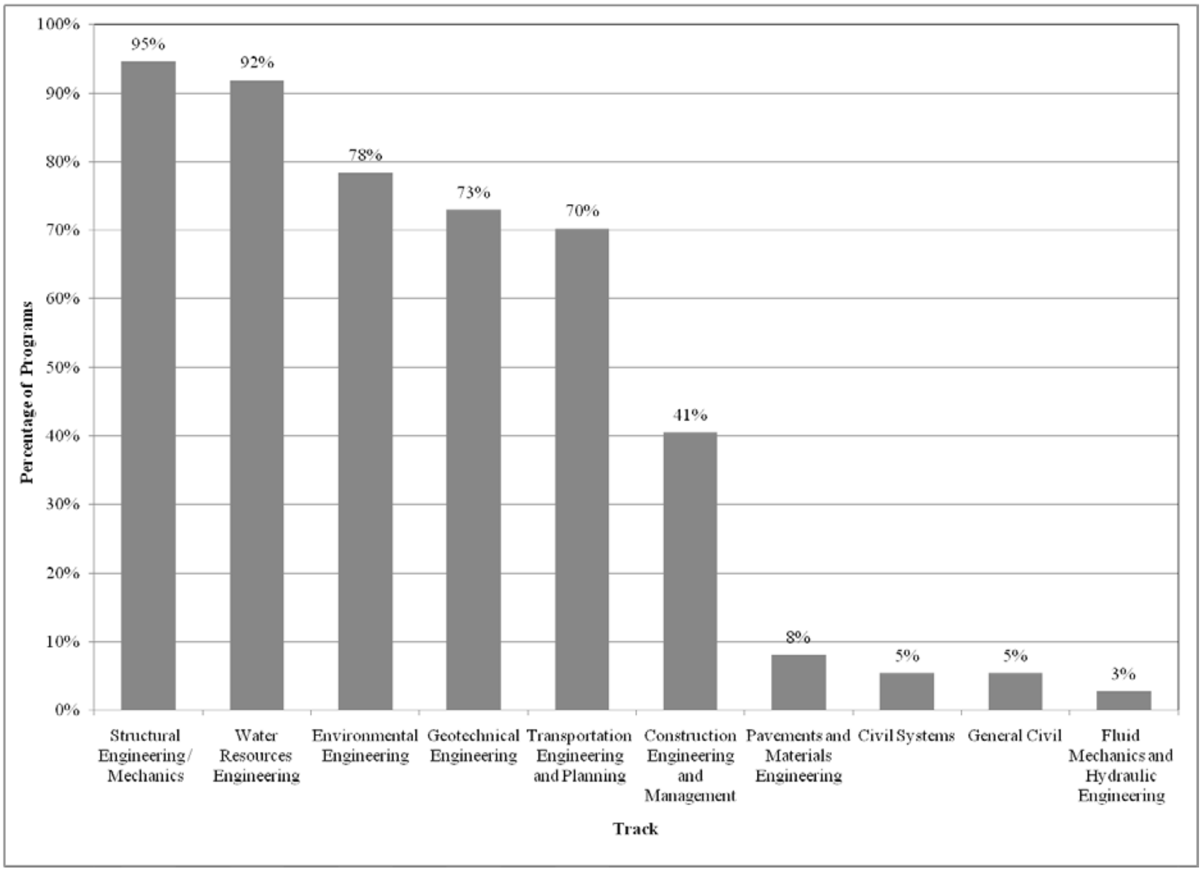


Figure 4: Tracks offered by different programmes.

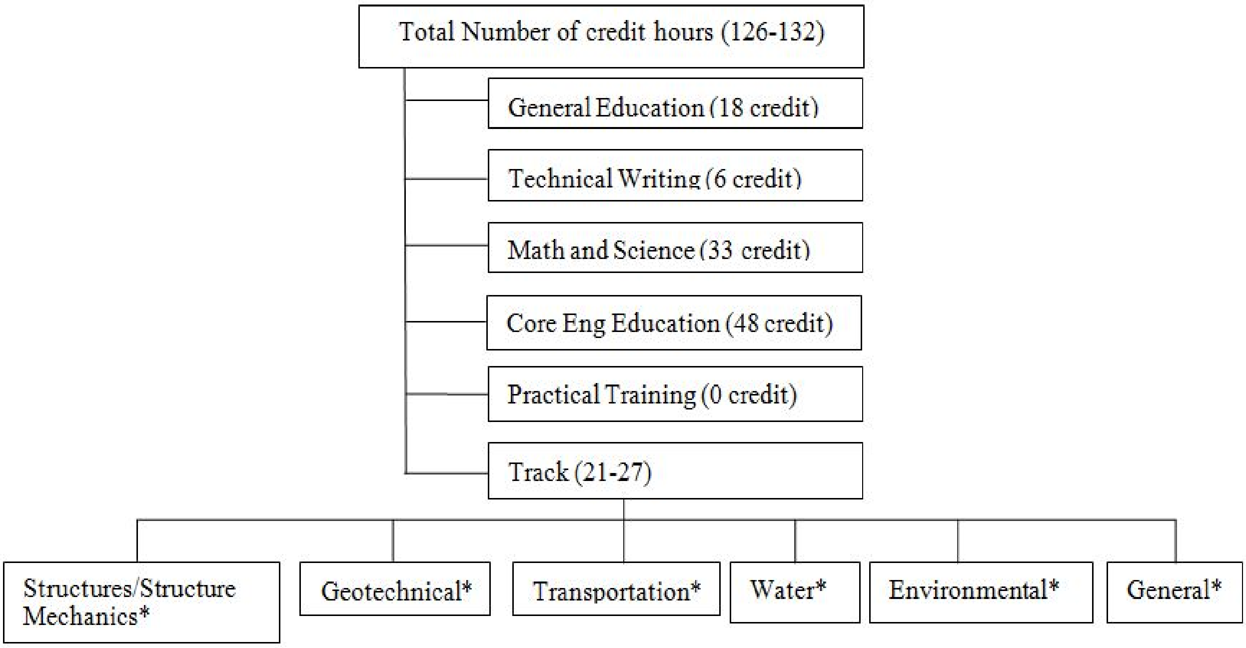
Table 3: Summary of high frequency subjects offered by tracks.

Structural Engineering/Mechanics	Geotechnical Engineering	Transportation Engineering and Planning	Construction Engineering and Management
Main subjects/Track			
Steel Design	Foundation Design	Highway Geometric Design	Engineering Project Management
Concrete Design	Applied Geotechnical Engineering Analysis	Traffic Engineering	Construction Equipment and Methods
Advanced Structural Analysis	Design and Construction of Earth Structures	Pavement Analysis and Design	Cost Engineering
Advanced Mechanics of Materials	Engineering Geology	Urban Planning	Project Planning, Scheduling and Control
Finite Element Method		Airport Design	Construction Engineering
Concrete Design II			Construction Estimating
Advanced Steel Design			Contracts, Liability and Ethics
Introduction to Structural Dynamics			Civil Engineering Systems Design
Pre-stressed Concrete Design			Construction Safety and Health
Timber Design			
Masonry Engineering			
Subjects to provide breadth from other tracks			
Foundation Engineering	Contaminant Hydrogeology	Design of Earth Structures	Civil Engineering Systems Design
Tunnelling	Environmental Geotechnical	Dynamics	Foundation Design
Route Location and Design	Environmental Systems Design	Hydrology	Steel
Hydrology	Hot Mix Asphalt Design and Construction	Construction Methods and Management	

	Natural Disaster Mitigation	Hot Mix Asphalt Design and Construction	
	Finite Element Method in Civil Engineering	Infrastructure Condition Assessment	
	Pavement Design	Advanced Concrete Pavement Analysis and Design	
Water Resources Engineering	Environmental Engineering	Civil Systems	General Civil
Main subjects/Track			
Hydrology	Microbiology	Transportation Systems Engineering	Introduction to Civil and Environmental Engineering
Hydraulics of Open Channels	Hazardous Waste Management	Engineering Risk Analysis	Civil Engineering Measurements
Applied Hydrologic Analysis and Design	Chemical Principles of Environmental Engineering	Civil Systems: Control and Information Management	Introduction to Land Development Design
Ground Water Hydrology	Air Pollution	Control and Optimisation of Distributed Parameters Systems	Computer Applications in Civil Engineering
Water Resources Engineering and Planning	Air Pollution Control	Sensors and Signal Interpretation	CAD Applications in Civil Engineering
Advanced Hydrology	Environmental Engineering Design	Structural and System Reliability	Sustainable Land Development
Groundwater and Seepage	Biological Wastewater Treatment	Civil Systems and the Environment	Land Development Design
Hydraulic Design	Environmental Health Engineering	Human and Organisational Factors: Quality and Reliability of Engineered Systems	Advanced Land Development Design
Water and Wastewater Treatment Design	Indoor Air Quality	Analysis of Indeterminate Structures	Professional and Legal Issues in Engineering
Groundwater Modelling	Environmental Engineering Unit Process Design	Reinforced Concrete Design	Undergraduate Independent Study
Waste Containment Systems	Environmental Engineering Biological Process Design	Soil and Site Improvement	Sustainable Land Development
Introductory Ocean Engineering	Environmental Water Resources	Pavement Design	Municipal Engineering
Solid and Hazardous Waste Management		Civil Engineering Materials	Hydrology
Storm Water Management		Pre-stressed Concrete Design	Municipal Hydraulics
Contamination Transport		Foundation Design	Highway Engineering
		Civil and Environmental Systems Analysis	Traffic Engineering
			Pavement Design
			Pavement Maintenance and Rehabilitation
			Geotechnical Engineering
Subjects to provide breadth from other tracks			
Environmental Engineering Unit Process Design	Hydrology		
Fundamentals of Public Health Engineering	Design of Hydraulic Engineering Systems		
Foundation Design	Water and Wastewater Treatment		
Street and Highway Design	Solid Waste Engineering and Management		
Applications with Landfill Design Geosynthetics	Introduction to Water Quality		
Geotech Engineering			

PROPOSED FRAMEWORK

A framework for curriculum development is proposed based on the results and analysis discussed earlier. Figure 5 summarises the layout of the proposed curriculum hours' distribution.



*Refer to Table 3 for course selection

Figure 5: Proposed distribution of credit hours for civil engineering curriculum based on track approach.

The total curriculum hours range between 126 and 132 credit hours, depending on the institution and programme objectives. Out of the total credit hours, 33 are devoted to mathematics and science including the fourth area of science recommended by ABET. General education requirements and technical writing occupy 24 credit hours. The 48 credit hours for the core engineering courses are needed to satisfy ABET definition of core engineering credit: *These studies provide a bridge between mathematics and basic sciences on one hand and engineering practice on the other.*

The total hours for the track system, including the senior design hours, are in the range of 21 to 27 hours. This range will provide an opportunity for four to six subjects to be devoted for the main track, two subjects from other tracks to provide the breadth needed, and three credit hours to the capstone design project. In addition, the proposed framework includes practical training with zero credit as a part of the degree requirement. Required duration of the practical training may vary from one programme to another.

One question arises in response to the previous proposal: *Does the proposed framework adequately prepare our students for current/future challenges that they may face as engineers and/or technological decision makers?* In other words, does the proposed framework provide strong technical background, professional and ethical responsibility, knowledge of contemporary issues, leadership, management skills, life-long learning, other cultures, modern technology and globalisation?

- Looking closely at the 48 hours available for the core engineering education, it was recognised that up to six credit hours could be used to introduce some of the previous topics without affecting the technical requirements, as shown in the suggested list in Table 4.
- Continuous improvement of the curriculum is needed to avoid reaching a steady state situation and to meet future challenges. This could be achieved by several means:
  - *Integration of research within the undergraduate curriculum* will ensure continuous development of the undergraduate education. In addition, this integration will provide an opportunity for the undergraduate students to explore and gain skills needed for future jobs or higher education at the graduate level. Also, it will emphasise the importance of life-long learning.
  - *Respond to the rapid advances in technology* by introducing modern computational software and modern laboratory testing equipment.
- Introducing the sustainability concept to the undergraduate level could be achieved through most of the engineering topics at different levels starting from the freshmen year.

Table 4: Suggested core engineering courses.

Subject	Credit Hours
Statics	3
Fluid Mechanics	3
Mechanics of Materials	3
Surveying	3
Engineering Drawing	3
Dynamics	3
Engineering Experimentation	3
Introduction to Transportation Engineering	3
Introduction to Water and Environmental Engineering	3
Introduction to Construction Engineering and Management	3
Construction Materials	3
Structure Analysis I	3
Engineering Economics	3
Design Concrete or Steel	3
Professional Practice, Development and Engineering Ethics	3
Project Management	3
Total	48

Suggested addition to core engineering courses

CONCLUDING REMARKS

Preparing engineering graduates to face the challenges of the 21st Century, requires a unique approach to ensure that the graduates have the technical background and necessary skills. Consequently, the limited number of credit hours promotes the development of civil engineering curricula based on a track approach to provide the needed depth. Of 222 ABET-accredited programmes in the United States that were surveyed, 37 programmes met the research criteria (semester and clear track system). The 37 programmes with a track system were surveyed and data were collected and analysed. The findings of the research showed that about 25% of the ABET accredited programmes, which follow the semester system are offering track systems, while a few other programmes provide solutions by offering an accelerated Bachelor/Master degree and specialty certificate fifth year system.

Several parameters, such as the number of students, number of faculty, specialty of the faculty, and availability of resources usually influence the decision to adopt a track system. It was found that Structures/Structural Mechanics, Geotechnical, Transportation, Water and Environmental tracks were offered by more than 40% of the programmes included in the study. In addition, several subjects in each track were found to be offered by the majority of the programmes. Other scattered subjects were offered based on faculty interest or programme objectives.

Finally, a proposed framework was developed to provide a layout of curriculum based on track approach with flexibility of subject selection to meet the programme educational objectives and student outcomes. In addition, this layout addresses several areas to prepare the graduates better for the current and future challenges of the profession. It is important to note that adopting the track system curricula will require listing of the specialty in the awarded degree. This will help identifying the technical strength of the graduates.

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