

## **A Study of Civil Engineering Education at Singapore Nanyang Technology University and at the University of Florida**

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### Abstract

Civil Engineering education plays a vital role in the development of infrastructure in Florida and Singapore. The University of Florida and Nanyang Technology University offer civil engineering courses to undergraduate and graduate students. This paper discusses and compares Civil Engineering curriculum in both Universities. The Civil Engineering courses at the University of Florida are divided into two phases of general education and upper division/civil engineering core education. At Nanyang Technology University, the Civil Engineering offers courses of a prescribed core of essential subjects and both institutions offer excellent program of study. The Civil Engineering program at Nanyang Technology University offers courses closely related to industry and government needs. Similarly, at the University of Florida, Civil Engineering program also offers excellent education program in line with government and industries needs. At both institutions, efforts should be focused on revising curriculum that is more responsible to existing and future rapid technological changes.

### 1. Introduction

Singapore is widely recognized for its high level of academic achievements. Civil Engineering (*CE*) plays a vital role in the development of Singapore's infrastructure. Nanyang Technology University (*NTU*) offers *CE* program for undergraduate and graduate students. The University has implemented a hybrid American-British degree structure that incorporates the credit system with a prescribed core of essential subjects. This system facilitates a broad-based education where students are encouraged to take general electives outside their main discipline. At the University of Florida (*UF*), the Department of Civil and Coastal Engineering provides a comprehensive *CE* program that includes all aspects of *CE* curriculum. The Department divides the undergraduate education into the two phases of general education and upper division/ *CE* core education. The *CE* program at *NTU* is well balanced with a requirement of six months industrial training before graduation. At the *UF*, *CE* students are required to take Engineering Intern Test (*EIT*) before graduation.

## **2. Course requirements in the Department of Civil and Environmental Engineering at NTU and in the Department of Civil and Coastal Engineering at the UF**

The *CE* curriculum at the *UF* toward a Bachelor of Science degree provides a depth of knowledge and enable a graduate is able to pursue a career in design, construction and planning. The program incorporates Information Technology (*IT*) to facilitate students' creativity and independent thinking. Lectures, tutorials, laboratory sessions, design projects, practical training, industrial visits and seminars are employed to equip the students with principles and practical aspects of *CE*.

In both institutions, students typically complete the degree course requirement in four years. At the *UF*, a bachelor degree study is divided into two phases: general education and upper divisions. In the first two years, students take: Writing for Engineer, Humanities, Social & Behavior Science ,General Chemistry, General Chemistry Laboratory, Analytical Geometry & Calculus, Physics with Calculus and Physics Laboratory (see Table 1).

In the first two years(see Table 2), students at *NTU* undertake basic course in Science and Technology and core subjects in *CE* such as Structural Mechanics, Theory and Design, Soil Mechanics and Hydraulic (*I*).

Third year students at *NTU* are exposed to a balanced mix of core and practical subjects. They include Structures, Reinforced Concrete Design, laboratory exercises, and various subjects in Transportation, Geotechnical and Environmental engineering (see Table 4). For six months of the year, students spend their time on project called Industrial Attachment (*IA*). This assignment can be with a private company or public organization. Students can learn *CE* professional practice under the guidance of experienced civil engineers and managers. While at the *UF*, students can be admitted to the Department of *CE* only if they have completed the previous two years study. They will take Engineering Core courses and *CE* course in the last two years ( see Table 3). The courses in third year include Strength of material, Mechanics of Engineering Structure, Project Development and Visualization, Civil Engineering Cost Analysis, Thermodynamics, Dynamics, Civil Engineering Materials, Soil Mechanics, Stress analysis and Computer Method in Civil Engineering (*2*).

At *NTU*, in the final year, students take courses that focus on training in professional *CE* practice, analysis, design, construction, and managerial and entrepreneurial studies. Each student is also required to undertake a year-long research project in the different disciplines of *CE* such as Materials, Electrical Engineering, Thermodynamics, Construction, Hydraulics, Geo-technical, Structural, Transportation and Surveying (see Table 4). At the *UF*, students in their last two years take further courses related to *CE*. These courses include Hydrodynamics, Experiment & Instrumentation in *CE*, Analysis & Design in Concrete, Geotechnical Engineering, Analysis & Design in Steel, Construction Method and Management, Professional Issues in Engineering, Engineering Hydrology, Transportation Engineering and Route Geomatics (see Table 3). In addition to the required courses, students at the *UF* can choose elective courses in the field of Construction, Geomatics, Geotechnical, Material, Structure, Transportation, Hydrology and Water Resources, Public Works. In their last year at *UF*, students can also take such elective course called Capstones that deal with the actual problems in the different fields in *CE*. These

Capstones are Construction Engineering Design for Construction undergraduate, Subdivision Design for Geomatics undergraduate, Pavement Design for Geotechnical undergraduate and Infrastructure Materials undergraduate, Comprehensive Design of a Complete Building System for Structure undergraduate, Transportation Facility Design for Transportation undergraduate (3).

### **3. Teaching methods in both Departments at NTU and at the UF**

In the development of courses, the Departments of *CE* in both *NTU* and the *UF* use traditional methods; they also make the best use of IT in enhancing engineering education. *NTU* has one of the largest campus networks and office automation systems (*CNOAS*) in the Southeast Asia. The *CNOAS* infrastructure has been extended to all students' dormitories, staffs' residential quarters, the libraries and various study rooms. Students and staff benefit greatly from such facilities; students can access the Inter-Net to chat and gain knowledge from any place in the campus. The bandwidth has been upgraded to enable the transmission of multi-media services. These services include live video broadcasts, and Virtual Library. Online learning is becoming an established fact of campus life and a very effective way to enhance students' learning. Video-conferencing also allows staff and students to interact with foreign universities for collaborative courses. Video lectures have proved to be a useful alternative for some lecturers.

At the *UF*, civil engineering department has its own computer laboratories equipped with electronic projectors. Professors mostly utilize computers, audio-video facilities in delivering their lectures. The utilization of new technology is highly effective in enhancing students' learning.

### **4. Conclusion**

The *CE* education system in *NTU* is well balanced. It combines the traditional lecture, industrial involvement on practical training through *IA*, and the use of *IT* technology in education. The six months industry attachment is a unique program that prepares students for their future job career opportunities.

The *UF* offers a very comprehensive and flexible *CE* education program. It mandates that all students must take the required *CE* courses in all fields of civil engineering, which include Construction, Geomatics, Geotechnical, Materials, Structures, Transportation and Water Resources. In addition, it also provides all the necessary elective courses for the students who are interested in specific areas of *CE*. The program effectively combines the required core courses and elective courses. Through this program, students are well prepared for their future professional career; they should be capable of working in design, planning and construction management. By taking a wide range of elective courses, students are able to select a specific discipline for graduate study within *CE* curriculum. As the result of this requirement, It ensures that students have all the necessary knowledge in both breadth and depth of *CE* after graduation.

## 5. Recommendation

The *CE* programs in both institutions are responsive to their public and industrial needs. The program at *NTU* should incorporate more comprehensive pre-professional education such as social science and technical writing for undergraduates in their first year. At the *UF*, a semester of practical training program with industry or government should enhance students' practical skills.

## 6. Reference

- 1). <http://www.ntu.edu.sg/cee/school/school.htm>, NTU School of Civil and Environmental Engineering, [access on December 30<sup>th</sup>, 2000]
- 2) <http://www.ce.ufl.edu/courses/undergraduate/syllabi.htm>, Civil Engineering Undergraduate Course Syllabi, University of Florida, [accessed on January 13<sup>th</sup>, 2002]
- 3). <http://www.ce.ufl.edu/undergraduate/program.htm> Civil and Coastal Engineering Department, Civil Engineering Undergraduate Curriculum, [accessed on January 12<sup>nd</sup>, 2002]

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- Table 1 Curriculum I of Civil Engineering Department at the University of Florida.  
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Table 4 Curriculum II of Civil Engineering department at Nanyang Technology University.

Table 1 Curriculum I of Civil Engineering Department at the University of Florida.

Term	Course Title	Credit	Year
1	Analytical Geometry & Calculus 1	4	1
	General Chemistry 1	3	
	General Chemistry Lab	1	
	Humanities	3	
	Social & Behavioral Science	3	
2	Analytical Geometry & Calculus 2	4	1
	General Chemistry II	3	
	Physics with Calculus 1	3	
	Physics Lab	1	
	Speaking & Writing for Eng. Or Technical Writing	3	
3	Analytical Geometry & Calculus 3	4	2
	Physics with Calculus 2	3	
	Physics Lab	1	
	Humanities	3	
	Social & Behavioral Science	3	
4	Differential Equations	3	2
	Statics	3	
	Humanities or Social Science	3	
	Biological Science Elective	3	
	Geomatics	3	

Table 2 Curriculum I of Civil Engineering at Nanyang Technology University of Singapore

Course Code	Course Title	Credit	Year
G121	Electric Circuits	3	1
G123	Statics	3	
G125	Mathematics I	2	
G128	Computing	3	
G127	Thermodynamics & Fluid Mechanics	3	
G129	Materials Science	3	
G131	Laboratory & Workshop 1	1	
G135	English Proficiency	0	
G122	Electronics	3	
G124	Dynamics	3	
G126	Mathematics II	2	
G130	Graphics	3	
G133	Principle of Economics	4	
G134	Communication Skills I	2	
G132	Laboratory & Workshop 2	1	
CV211	Strength of Materials	3.5	
CV212	Structures I	3	
CV231	Soil Mechanics I	3.5	
CV261	Hydraulics	3.5	
CV270	Essential Mathematics	0	
CV271	Engineering Mathematics	3	
CV273	Engineering Surveying	3.5	
CV120	Communication Skills II	3	
CV213	Structures II	3	
CV232	Soil Mechanics II	3.5	
CV262	Hydrology	3.5	
CV272	Numerical Methods	3	
CV274	Civil Engineering Materials	3	

Table 3 Curriculum II of Civil Engineering Department at the University of Florida

Term	Course Title	Credit	Year
5	Strength of material	3	3
	Mechanics of Engr Structure	4	
	Project development visualization	3	
	Civil Engr Cost Analysis	2	
	Thermodynamics	3	
6	Dynamics	2	3
	Civil Engr Materials	4	
	Soil Mechanics	4	
	Stress Analysis	2	
	Computer Program for CE	4	
7 (summer)	Hydrodynamics	4	3
	Experiment & Instrumentation in CE	3	
	Analysis & Design in Concrete	3	
	Geotechnical Engineering	3	
8	Hydraulics	3	4
	Analysis & Design in Steel	3	
	Construction Method & Management	3	
	Professional Issues in Engineering	3	
	Route Geometric	2	
	Route Lab	1	
9	Hydrology	3	4
	Water Resources	3	
	Physical Design Trans Facilities	3	
	Design Elective	3	
	Technical or Design Elective	3	

Table 4 Curriculum II of Civil Engineering department at Nanyang Technology University.

Course Code	Course Code and Title	Credit	Year
CV311	Structures III	3	3
CV312	Steel Design	3.5	
CV313	Reinforced Concrete Design	3.5	
CV331	Foundation Engineering	3.5	
CV341	Transportation Engineering	4	
CV351	Environmental Engineering	3.5	
CV391	Industrial Attachment	5	
CV140	Engineers & Society	2	4
CV144	Principles of Law	2	
CV407	Civil Engineering Practice	3	
CV491	Final Year Project	8	
CV141	Human Resources Management & Entrepreneur	3	
	Prescribed electives	15	
	General electives	4-6	



## **7. Biographical Information**

Liu Feng

Liu Feng is a graduate student in the Civil and Coastal Engineering Department, University of Florida. He did his undergraduate study at the NTU, Singapore before joining UF.

Dr. Fazil T. Najafi

Dr. Fazil T. Najafi is Professor in the Department of Civil and Coastal Engineering (CCE) at the University of Florida in Gainesville. He is also the Graduate Coordinator of the Public Works Engineering and Management Division. Dr. Najafi earned his BS (Architectural Engineering), MS, and PhD degrees (Civil Engineering) from Virginia Polytechnic Institute and State University (VPI&SU). He also has a BSCE from the American College of Engineering, Kabul, Afghanistan. Dr. Najafi came to the United States with a Fulbright scholarship in July 1966 and started his formal education at VPI&SU. His teaching responsibilities include graduate and undergraduate courses in the Civil and Coastal Engineering Department. His research focuses on diverse areas such as the development of User Cost Data for Florida's Bridge Management Systems, Radon Reduction in the construction of new houses, the Oil Spill Response System in Florida, methods to reduce Urban Congestion, Transportation Planning and Cost Optimization, including Maglev systems, High Speed Rail, Tort Liability related to utility, Public Works Planning and Management, Construction Engineering and Management, Legal Aspects of Engineering and Engineering Cost Analysis. Current research includes the evaluation of Flowable Fill in Florida.