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Civil Engineering Education in Afghanistan

Abstract

Engineering education in Afghanistan was being delivered by two centers before the war, the Faculty of Engineering in Kabul University and Kabul Polytechnic Institute.

The Faculty of Engineering was established as part of the Faculty of Science in 1956. At the end of 1959, the first group of graduates received their Bachelor of Science in Engineering degree from the Faculty of Engineering. Through a contract with the United States Agency for International Development (USAID) and the then Royal Government of Afghanistan, the University of Wyoming assumed the responsibility for guiding the new faculty. The University of Wyoming supplied the staff members and equipment and established a four-year “general” engineering program.

In recent years, a number of universities have been established that deliver engineering education, mainly in the field of civil engineering. Five of these universities have the semblance of an engineering program, and the rest are engineering in name only.

Two systems of engineering education are followed in Afghanistan: the Russian model and the American model. Kabul University, Herat University, and Kandahar University follow the American model while Kabul Polytechnic, Balkh University, and Nangarhar University follow the Russian model.

In the Russian model, students are trained to specialize in different fields of civil engineering. In the American model, students get a broad background in different fields of civil engineering and specialize by going through a master’s program or through on- the-job training.

At this time, there is no equivalency or coordination between the two systems. If a student wants to transfer from one university to another, he/she may be facing an impossible task. This paper is focused on explaining the similarities and differences of the two systems and attempts to explore ways of harmonizing the two so that the two systems are better coordinated.

Introduction

Formal engineering education in Afghanistan began with the establishment of the Faculty of Engineering in Kabul, as part of the Faculty of Science, in 1956 with the first graduates in 1959. Through a contract with the United States Agency for International Development and the Royal Government of Afghanistan, the University of Wyoming guided the new faculty. The University of Wyoming supplied the staff members and equipment and established a four-year “general” engineering program.

In 1958, a joint faculty of Engineering and Agriculture became separate from the Faculty of Science. In 1963, the Faculty of Engineering was separated from the Faculty of Agriculture, and

at approximately the same time a new team, the United States Engineering Team (USET), took over responsibility for assisting and guiding the university. USET was charged with operational responsibility in Kabul by a consortium known as the Kabul Afghan-American Program. It was composed of the Education Development Center, Newton, MA, along with eleven American institutions: Carnegie-Mellon University, Georgia Institute of Technology, Illinois Institute of Technology, Lehigh University, North Carolina State University at Raleigh, Purdue University, Rice University, Stevens Institute of Technology, University of Cincinnati, University of Notre Dame, and Washington University (St. Louis).

Of great significance also was the move into new and permanent quarters at the end of 1963. This building was one of several newly constructed buildings on the new Kabul University campus that were planned and built through the joint efforts of the Royal Government of Afghanistan and the United States Government. In 1970, a five-year curriculum was adopted, consisting of nine semesters of academic work and a six-month practical training period.

The University of Nebraska team, through USAID, came to Kabul University in 1974 until the communists took over the country in 1978. One of the institutions they wanted to destroy was the Faculty of Engineering. They finally succeeded and in 1984 the Faculty of Engineering in Kabul was closed. By that time, a large number of professors of the Faculty of Engineering had migrated to foreign countries.

A small group of these professors, through funds provided by USAID, established the Construction Related Training for Afghanistan (CRTA) in Peshawar, Pakistan in 1987. The program included a four-year bachelor's -level Construction Engineering Program and a two-year Construction Institute Program, which trained construction supervisors and assistant engineers.

The USAID aid was terminated in the early 1990s and again a group of professor with the help of CHA and Ismael Khan, the then Governor of Herat, managed to rescue the program and move it to Herat, Afghanistan in 1995. The program is currently recognized by the Ministry of Higher Education and the degrees are conferred by Herat University. The Faculty is administered by CHA through funds provided by NOVIB¹

Meanwhile, since the fall of the communist regime in Afghanistan, the Faculty of Engineering at Kabul University has reopened. With a vibrant new faculty as well as experienced faculty, it is trying to claim its once-famous tradition of excellence in engineering education. Currently it offers programs in Civil Engineering, Mechanical Engineering, Electrical Engineering, and Architectural Engineering. Herat University is following a similar curriculum. With an equally active and very young and enthusiastic faculty, Herat University is trying to invigorate its engineering education. Kandahar University is lagging behind in this process because of security problems in the area.

Parallel to the growth of the Faculty of Engineering in Kabul, with the assistance from the Soviet Union, Kabul Polytechnic Institute was established in 1967 with its first graduates in 1972. Recently the name has changed to Kabul Polytechnic University. Among other colleges and departments, the curriculum in the college of construction is presented here.

Through the years, two models of engineering education gradually developed in Afghanistan: a so-called Kabul University (KU) model and a Kabul Polytechnic University (KPU) model. The KU model mainly follows an American system of engineering education while the KPU model follows the Russian system. Major universities following the KU model are the Faculty of Engineering at Kabul University, Herat University, and Kandahar University. Universities following the KPU model are the College of Structure at Kabul Polytechnic University, and the Faculty of Engineering at Balkh University and Nengarhar University.

By far, civil engineering–related fields are the most sought after majors in Afghanistan today. However, despite the interest in the field, the infrastructure to support engineering education has deteriorated to the extent that it needs a major overhaul. The curriculum in both the KU and KPU model is in serious need of modernization and upgrading.

Both models include several courses in Islamic studies, history, and language, mainly English. The basic science components are almost the same; however, the rigor and emphasis in math is slightly greater in the KU than in the KPU model. On the other hand practical field training is emphasized more in the KPU than in the KU model. Each one of these models is presented in the following sections.

Kabul University Model

The current civil engineering curriculum at Kabul University was established in the 1970s as a five-year program, as shown in Table 1. The KU model is a typical American-style engineering education consisting of basic sciences, such as, two courses in chemistry, three courses in physics; a mechanics series including statics, dynamics, and strength of materials, fluid mechanics, and thermodynamics; a math series, including pre-calculus, calculus I and II, calculus of several variables, and differential equations.

Major areas of civil engineering are covered through required as well as elective courses, including structures, water resources, transportation, and geotechnical engineering. Structural engineering is covered by two courses in structural analysis and two courses in concrete. Water resources engineering is covered by hydrology, hydraulics, and canalization. Transportation is covered through courses in highway engineering and transportation. Geotechnical engineering is covered by courses in geology, soil mechanics, and foundation engineering.

Students who graduate from the program will become civil engineering generalists and have a wide latitude in being hired in a civil engineering fields, that are crucial at this stage of infrastructure rebuilding in Afghanistan. They are expected to become specialists once they start working in any subfields of civil engineering. In this model, one whole semester in the fourth year is devoted to practical training. In previous years textbooks were American textbooks and English was the medium of instruction. Currently, no textbooks are available and the medium of instruction is mainly Dari with some English, primarily for technical words.

Table 1: Civil Engineering Curriculum at Kabul University (KU Model)

First Year			
First Semester		Second Semester	
Math I – Algebra, Trig., & Analytical Geometry	6	Math II – Calculus I	6
English I	4	English II	4
Drawing I (Graphic I)	2	Graphic II	2
Intro to Engineering I	2	Intro to Engineering II	2
Modern History	2	Physics I	4
Islamic Studies	4	Islamic Studies	4
Total Hrs/wk	20	Total Hrs/wk	22
Second Year			
First Semester		Second Semester	
Math III – Calculus II	6	Math IV– Calculus III	6
English III	4	English IV	4
Physics I	4	Physics II	4
Chemistry I	4	Chemistry II	4
Surveying I	2	Statics	4
Islamic Studies	4	Islamic Studies	4
Total Hrs/wk	24	Total Hrs/wk	26
Third Year			
First Semester		Second Semester	
Math V – Differential Equation	4	Hydrology	4
English V	4	Surveying II	2
Strength of Materials	4	Structures I	4
Dynamics	4	Thermodynamics I	4
Circuit Analysis (EEI)	6	Fluid Mechanics	4
		Computer	4
Islamic Studies	4	Islamic Studies	4
Total Hrs/wk	26	Total Hrs/wk	26

Table 1: Civil Engineering Curriculum at Kabul University, continued

Fourth Year			
First Semester		Second Semester	
Hydraulics	4	Practical Training	
Geology	4		
Concrete I	4		
Technical Elective I	4		
Non-technical Elective	4		
Structures II	4		
Islamic Studies	4		
Total Hrs/wk	28		
Fifth Year			
First Semester		Second Semester	
Soil Mechanics	4	Foundation Engineering	4
Highway Construction	4	Design Project	2
Concrete II	4	Canalization	4
Transportation	4	Technical Elective III	4
Technical Elective II	4	Construction Engr Mgt.	4
Non-technical Elective	4	Non-technical Elective	4
Total Hrs/wk	24	Total Hrs/wk	22
Total Credit Hours: 218			

Kabul Polytechnic University Model

The second engineering education system in Afghanistan is known as the Kabul Polytechnic University model, which is more practice oriented. In addition to in-class lectures, many courses involve field work. In their last year of education, students are involved in a design project that they present to the public. In this program, called the Civil and Industrial Structural Department, students are exposed to engineering as well architectural design. A typical program is depicted in Table 2. Kabul Polytechnic, Balkh, and Nengarhar Universities follow this model.

In this model, basic science is covered through two chemistry and two physics courses. Math through differential equations is covered by advanced math courses, and mechanics through thermodynamics is covered by statics, dynamics, and strengths of materials, fluid mechanics, and thermodynamics. The courses are primarily structure oriented and contain some architectural design component. Students have one semester of practical training, and the program takes about five years to finish. Water Resources in this model is covered by a completely separate department and is not presented in this paper.

Table 2: Civil and Industrial Structure Curriculum at Kabul Polytechnic University

First Year			
First Semester		Second Semester	
Islamic Studies I	2	Islamic Studies II	2
Modern History I	1	Modern History I	1
Foreign Language	2	Foreign Language II	2
Physical Ed.	1	Physical Ed. II	1
Math I	4	Math II	3
General Chemistry	3	General Chemistry II	3
Geometry	2	Geometry II	2
Tech. Drawing	2	Tech. Drawing II	2
Intro to Engineering	1	Computer Basics	2
Total Hrs/wk	18	Total Hrs/wk	18
Second Year			
First Semester		Second Semester	
Foreign Language	2	Technical English	1
Math III	4	Advanced Math IV	3
Physics I	4	Physics II	4
Engr. Geology	3	Mechanics	2
Comp. Programming	2	Computer	2
Engr. Surveying	3	Engr. Surveying	2
		Const. Materials	3
		Hydraulics	2
Total Hrs/wk	18	Total Hrs/wk	19
Third Year			
First Semester		Second Semester	
Mechanics	3	Structural Mech.	3
Strength of Materials	2	Strength of Material II	2
Structural Economics	2	Architecture	3
Engr. Hydraulics	3	Metals and Plastics St.	3
Building Architecture	3	Cost Estimate	2
Const. Machinery	2	Stone Str.	2
Electrotechnic	2	Heat Technology	1
Engr. Environment	1	CAD	2
Total Hrs/wk	18	Total Hrs/wk	18

Table 2: Civil and Industrial Structure Curriculum at Kabul Polytechnic University

Fourth Year			
First Semester		Second Semester	
Technology and Mgmt of Constr. Prod I	4	Technology and Mgmt of Constr. Prod II	4
Reinforced Conc I	4	Reinforced Conc II	4
Metal Structures I	4	Metal Structures II	4
-		Testing and Eval. of Structures	2
-		Earthquake Resistance Structures	2
-		Foundation Engr.	2
-		Computers	2
-			
Total Hrs/wk	18 estimated	Total Hrs/wk	20
Fifth Year			
First Semester		Second Semester	
Diploma Project	9		
Practical of Prod.	3		
Practical Before Diploma	4		
Technical Elective	2		
Technical Elective	2		
Total Hrs/wk	18		
Total Credit Hours: 165 (estimated)			

Near the end of their course of study, students have to present a design project called “the defense of the diploma.” This entails a student working on a project all semester, completing the “practical” (for one month). Professors are assigned to students as guides, and students collect data from the real world and academia to defend their assigned topic. Four professors decide if a student is ready to defend his or her diploma. If students fail their defense, they get a chance the next year to defend. In earlier years, architecture students at the college of engineering used this model but civil engineering students did not.

Challenges in Curriculum Improvement

Based on the above observations, it appears that the two systems are heavy in credit hours, long in duration, and outdated. There is no harmony between the two systems and credit allocations for each course is arbitrary. The Ministry of Higher Education has mandated the range of credits for a degree to be 135 to 145. In order for these two systems to conform to the credit requirements, they have to seriously rearrange the courses. Course credits should not be arbitrarily assigned but rather should be a measure of transfer of intellectual content for each course.

One reason for the seeming arbitrary assignments of credits is the different notions of credit brought in by foreign advisors. US academics are familiar with one credit equals 15 teaching hours. However, European advisors say that one credit equals 45 hours, including contact and non-contact hours. Hence, the confusion.

Another challenge in restructuring the curriculum is the balance between keeping abreast with US based (or Russian based) curriculum and staying relevant to local structural conditions that range from mud huts to multi-story buildings.

A continuing challenge is what to include in the curriculum with regards to construction standards and other standards, since there is no Afghan standard but multiple standards—Korean, Chinese, Turkish, German, American, etc. This is where associations, such as the Society for Afghan Engineers and Architects can facilitate the drafting of codes and standards. While industry has been helpful in defining standards in the US, they have not been helpful in setting standards in Afghanistan as they are more attuned to donor requirements.

Finally, purists in civil engineering are reluctant to consider why more management-oriented courses, as in construction management, maybe necessary to integrate in the curriculum to equip graduates to successfully compete for civil engineering projects. Moreover, the integration of information-based tools, such as, AutoCad, engineering graphics, digital drawings, and global information systems (GIS) in civil engineering² has not been fully considered as non-existent traditional laboratories remain the focus of attention.

To address some of these issues, a series of workshops and meetings were held in 2006 with those who follow the Kabul University model with an attempt to modify the old curriculum. Table 3 depicts the proposed new curriculum for the Kabul University model, which has been received well by those following it^{3,4}. The proposed program for this model lowers the number of required credits. The duration is reduced to four years instead of five and the medium of instruction is proposed to be in English because of a shortage of texts in the local languages.

Cross Model Equivalency

To facilitate transfer of courses and credits between the two models, it is proposed to create an equivalency system through standardized course descriptions in which minimum coverage is mandated by the Ministry of Higher Education. Each engineering program in order to be recognized as such will have to cover the mandated minimum. As a result, the current confusion as to the equivalency of course will be removed.

In conclusion, while much progress has been made with improving the curriculum, major challenges remain along with development of young faculty who have only bachelor's education and who will have to implement the reforms.

Table 3: New Proposed Civil Engineering Curriculum at Kabul University (KU Model)

First Year			
First Semester		Second Semester	
English I	4	English II	4
Calculus I	4	Calculus II	4
Technical Drawing	3	Computer Prog.	3
Intro to Computers	3	Physics I	4
Islamic Studies	1	Islamic Studies	1
Hist. of Afghanistan	1	AutoCAD	2
Total Hrs/wk	16	Total Hrs/wk	18
Second Year			
First Semester		Second Semester	
English III	3	Chemistry II	4
Calculus III	4	Diff. Equations	4
Physics II	4	Dynamics	3
Chemistry I	4	Circuit Analysis	3
Statics	3	Strength of Materials	4
Total Hrs/wk	18	Total Hrs/wk	18
Third Year			
First Semester		Second Semester	
Engineering Geology	3	Soil Mechanics	4
Structural Analysis	4	Concrete I	4
Hydrology	3	Hydraulics	4
Thermo-Fluid	4	Steel Design	3
Surveying I	3	Surveying II	3
Total Hrs/wk	17	Total Hrs/wk	18
Fourth Year			
First Semester		Second Semester	
Concrete II	4	Waste Water Engr.	3
Technical Elective	3	Non Tech Elective	3
Water Supply	3	Foundation Engr.	3
Construction Methods and Materials	3	Technical Elective	4
Transportation Engr.	3	CE Design Project	4
Technical Elective	3		
Total Hrs/wk	19	Total Hrs/wk	17
Total Credit Hours: 141			

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