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# **Civil Engineering Education in Herat, Afghanistan A Collaborative Effort Between Herat University and University of Hartford**

**Mohammad Saleh Keshawarz and Azizurahman Azimi**

*University of Hartford, West Hartford, CT 06117, USA*

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## **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 was established and later, 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 Faculty. 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 and remained there until the government was changed in 1978. One of the institutions the the new government wanted to eliminate 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.

### **Civil Engineering Education at Herat University**

The civil engineering program was officially incorporated as part of Heart University in 2002. Since the transfer of the engineering program to Herat in 1995, a total of 441 civil engineers have graduated. Table 1 shows enrollment data for the Faculty of Engineering in Herat since 1995.

**Table 1: Enrollment Data, Faculty of Engineering, Herat University**

<b>Year</b>	<b>Number Enrolled</b>	<b>Number Graduated</b>
1995	50	-
1996	35	-
1997	45	-
1998	59	22
1999	66	25
2000	73	23
2001	92	23
2002-2005	not available	260
2006	not available	48
2007	not available	40
<b>Total</b>	—	<b>441</b>

Through the services and dedication of a vibrant and dynamic young faculty members and a supportive administration, the Faculty of Engineering at Heart University has had tremendous growth in recent years.

The faculty moved into a brand new building in 2008. Through a series of collaborative efforts with foreign universities, the Faculty has managed to modernize its curriculum, equip its laboratories, and provide faculty development opportunities for its instructors.

Eleven instructors from Faculty of Engineering are pursuing their masters' degree at Hartford. Seven in Civil Engineering, three in Mechanical Engineering/Mechatronics, and another two in Civil Engineering/Architecture. These scholarships are funded through a grant from the World Bank to the Ministry of Higher Education under the Strengthening Higher Education Program (SHEP), and a USAID grant to through the eQuality Program.

Curriculum reform has been another major undertaking by the Faculty of Engineering. The current civil engineering curriculum at Herat University was established based on the Kabul University (KU) curriculum. However, that curriculum had to be modified and the number of credits required had to be reduced. To address some of these issues, a series of workshops and meetings were held in 2006 with those who follow the Kabul University model of engineering education with an attempt to modify the old curriculum.

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. The Herat University engineering curriculum (See Program Sheet, appendix) is a slightly modified version of this curriculum. It includes 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, water supply, and waste water engineering. Transportation is covered through courses in surveying, highway engineering, and transportation. Geotechnical engineering is covered by courses in geology, soil mechanics, and foundation engineering.

Students who graduate from this program will become entry level civil engineering generalists and will have wide latitude in being hired in different civil engineering fields, which are crucial at this stage of infrastructure rebuilding and development in Afghanistan. They are expected to become specialists once they start working in any subfields of civil engineering. Because of the lack of engineering textbooks in Dari, English textbooks are being used and the medium of instruction is almost in English.

## **Variations of Civil Engineering Curriculum in Afghanistan**

By far, civil engineering-related fields are the most sought after majors in Afghanistan today. Through the years, two models of engineering education have emerged in Afghanistan, a Kabul University (KU) Model and Kabul Poly Technique

University (KPU) Model. Faculty of Engineering in Kabul, Faculty of Engineering in Herat, and Faculty of Engineering in Kandahar, follow the KU Model, while Kabul Poly Technique, Balkh University, and Nangarhar University follow the KPU Model.

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.

The KPU model 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 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.

## **Challenges in Curriculum Improvement**

Based on the above observations, it appears that 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 advisor. 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. 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 engineering<sup>2</sup> has not been fully considered as non-existent traditional laboratories remain the focus of attention.

## **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.

### ***Acknowledgement***

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## **Appendix**

## Program Sheet

### DEPARTMENT OF CIVIL ENGINEERING (Herat University)

The curriculum of this department is designed to provide basic training to engineering students in various fields of civil engineering. A degree of Bachelor of Science in Civil Engineering is awarded upon completion of the four year program as outlined below. Civil Engineering includes such fields as Transportation, Soils and Foundation, Structural, Sanitary and Water Resources. It is the aim of the department to prepare its graduates for technical and administrative positions in the design, construction, operation and management of engineering projects.

#### FRESHMAN YEAR

##### FIRST SEMESTER

IS 101	Islamic Studies	1
M 144	Calculus I	4
ES 120	Technical Drawing I	3
ES 141	Intro to Engineering	4
ENG 110	English I	4
HIS 110	History of Afghanistan	1
Total:		17

##### SECOND SEMESTER

IS 102	Islamic Studies	1
M 145	Calculus II	4
ES 115	Computer Programming	3
PHY 112	Physics I	4
ENG 111	English II	3
ES 122	Technical Drawing II	3
Total:		18

#### SAPHOMORE YEAR

##### THIRD SEMESTER

IS 201	Islamic Studies	1
CH 110	Chemistry I	4
M 240	Calculus III (Calculus of several Variables)	4
PHY 113	Physics II	4
ENG 112	English III	3
ES 110	Engineering Mech. I (Statics)	3
Total:		19

##### FOURTH SEMESTER

IS 202	Islamic Studies	1
CH 111	Chemistry II	4
M 242	Differential Equations	3
ES 211	Engineering Mech. II Dynamics	3
EE 210	Circuit Analysis	4
ES 212	Strength of Materials	4
Total:		19

#### JUNIOR YEAR

##### FIFTH SEMESTER

IS 301	Islamic Studies	1
ES 315	Engineering Geology	3
CE 310	Structural Analysis	4
CE 315	Hydrology	3
ES 320	Thermo-Fluids	4
CE 350	Surveying I	3
Total:		18

##### SIXTH SEMESTER

IS 302	Islamic Studies	1
CE 330	Soil Mechanics	4
CE 310	Concrete I	4
CE 320	Hydraulics	4
CE 312	Steel Design	3
CE 355	Surveying II	3
Total:		19

**SENIOR YEAR**

**SEVENTH SEMESTER**

IS 401	Islamic Studies	1
CE 410	Concrete II	4
	Technical Electives	3
CE 420	Water Supply	3
	Technical Elective	3
CE 452	Transportation Engineering	3
	Total:	17

**EIGHTH SEMESTER**

IS402	Islamic Studies	1
CE 422	Wastewater Eng	3
	Non Technical Elective	3
CE 430	Foundation Engineering	3
	Technical Elective	4
CE 460	CE Design Project	4
	Total:	18

**Total Number of Credits: 145**

**List of Technical Electives:**

Design of Hydraulic Structures (Dam Design)(Construction Management: Planning, Estimation, QA and QC)Irrigation

**List Of Non-Technical Electives:**

Renewable Energy

The following courses will have laboratory:

1. Tech Drawing I and II
2. Physics I and II
3. Chemistry I and II
4. Circuit Analysis
5. Strength of Materials
6. Surveying I and II
7. Soil Mechanics
8. Concrete I
9. Hydraulics

Note: Course numbers are proposed numbers and they are not formally adopted by Herat University yet.

