INSTITUTION OF ENGINEERS, BANGLADESH

International Symposium on
QUALITY ASSURANCE IN ENGINEERING EDUCATION THROUGH ACCREDITATION

13-14 MARCH 2019

VENUE **Radisson Blu Dhaka Water Garden**
Dhaka, Bangladesh

BOARD OF ACCREDITATION FOR
ENGINEERING AND TECHNICAL EDUCATION

www.baetebangladesh.org/symposium

IEB and BAETE

The Institution of Engineers, Bangladesh (IEB) was founded as the Institute of Engineers, Pakistan, which was registered on May 7, 1948, by the Registrar of Joint Stock Companies, East Bengal. It was recognized as the representative body of qualified engineers when its constitution was ratified by the government of what was then Pakistan in September 1952. After Bangladesh emerged as an independent country in 1971, the society's name was changed from the Institute of Engineers, Pakistan, to the Institution of Engineers, Bangladesh. The new organization was registered by the Registrar of Joint Stock Companies, Government of the People's Republic of Bangladesh, in July 1972.

To become a member of IEB and provide professional services in Bangladesh, an individual must hold an engineering degree recognized by IEB. Additionally, IEB oversees the growth and quality of engineering education in Bangladesh. To this end, the IEB constitution encompasses the accreditation of programs within the country that award engineering degrees.

The Board of Accreditation for Engineering and Technical Education (BAETE) was established by IEB in accordance with provision enshrined in IEB constitution. BAETE, thereafter referred to as "the Board", is empowered to function as an independent and autonomous body to establish the policy, procedure, criteria, and related systems to conduct engineering program accreditation.

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BACKGROUND

Assuring quality in engineering education is crucial for efficiency and sustainability in national development. The Board of Accreditation for Engineering and Technical Education (BAETE) of the Institution of Engineers, Bangladesh has been striving to achieve this through accreditation of engineering undergraduate degrees. It has already received Provisional Membership of the Washington Accord, the global body of national engineering accreditation bodies. Signatories of the Washington Accord of International Engineering Alliance establish and enforce internationally benchmarked standards for engineering education to offer expected competence for engineering practice. The BAETE is trying to get Full Signatory status of the Washington Accord by 2021.

To achieve the present government's goal to elevate Bangladesh's status to a developed nation by 2041, it needs adequate numbers of competent engineers with the knowledge, skills and attitude to build, operate and maintain our infrastructure. To this end, the BAETE is organizing the International Symposium mentioned above. It will be held at Hotel Radisson Blu, Dhaka, on March 13 and 14.

OBJECTIVES AND ORGANIZATION

The symposium also aims to introduce our engineering education system to the other signatory countries of the Washington Accord and to learn from other countries for further quality enhancement. We are expecting well-known engineering educators from Australia, China, Japan, Singapore, Hong Kong, Malaysia, Pakistan, Nepal and Turkey, who have been involved with quality enhancement through accreditation, to join this important event.

THE **BOARD**

Chairman	**National Professor Dr. Engr. Jamilur Reza Choudhury** Vice-Chancellor, University of Asia Pacific
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Member	**Prof. Dr. Engr. Anisul Haque** Professor and Dean, Faculty of Engineering East West University
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Member	**Prof. Dr. Engr. A. F. M. Saiful Amin** Professor, Dept. of Civil Engineering Bangladesh University of Engineering and Technology

SECTORAL **COMMITTEES**

PROGRAM: MECHANICAL ENGINEERING

Chairman	**Prof. Dr. Engr. Md. Fazli Ilahi** Former Professor, Dept. of Mechanical Engineering Bangladesh University of Engineering and Technology Former Vice Chancellor, Islamic University of Technology
Member	**Prof. Dr. Engr. Maglub Al Nur** Department of Mechanical Engineering Bangladesh University of Engineering and Technology Dhaka 1000, Bangladesh
Member	**Engr. Hasmotuzzaman** Chief Executive Officer, Utility Professionals

PROGRAM: CHEMICAL ENGINEERING

Chairman	**Prof. Dr. Engr. A.K.M.A. Quader** Former Professor, Department of Chemical Engineering Bangladesh University of Engineering and Technology
Member	**Engr. Rahman Murshed** President, BUET Chemical Engineering Alumni Association
Member	**Engr. Jawaherul Ghani** Managing Director, MEL Group

PROGRAM: COMPUTER SCIENCE AND ENGINEERING

Chairman	**Prof. Dr. Md. Sohel Rahman** Department of Computer Science and Engineering, Bangladesh University of Engineering and Technology
Member	**Prof. Dr. Mahmuda Naznin** Department of Computer Science and Engineering, Bangladesh University of Engineering and Technology
Member	**Engr. A. R. Azimul Haque** Director of the Board Information Services Network Ltd.

PROGRAM: CIVIL ENGINEERING

Chairman	**Prof. Dr. Engr. Ainun Nishat** Professor Emeritus Centre for Climate Change and Environmental Research BRAC University,
Member	**Prof. Dr. Md. Tarek Uddin,** PEng Department of Civil and Environmental Engineering Islamic University of Technology
Member	**Engr. Nashid Islam** Director, ABC Limited

PROGRAM: ELECTRICAL & ELECTRONIC ENGINEERING

Chairman	**Prof. Dr. Engr. Muhammad Fayyaz Khan** Pro-Vice Chancellor, Green University of Bangladesh
Member	**Prof. Dr. Engr. Abdur Rahim Molla** Department of Electrical and Electronic Engineering & Dean, Faculty of Engineering Ahsanullah University of Science and Technology
Member	**Engr. N.S.M. Yunus** Former Additional Chief Engineer, Public Works Department

TASKFORCE FOR OBA MANUAL

Chairman	**Prof. Dr. Engr. Sarwar Jahan Md. Yasin** Department of Civil Engineering Bangladesh University of Engineering and Technology
Member	**Prof. Dr. Engr. Anisul Haque** Member, Board of Accreditation for Engineering and Technical Education, and Professor and Dean, Faculty of Engineering East West University
Member	**Prof. Dr. Engr. A.F.M. Saiful Amin** Member Secretary, Board of Accreditation for Engineering and Technical Education, and Professor, Department of Civil Engineering Bangladesh University of Engineering and Technology
Member	**Prof. Dr. Engr. Sirajul Islam** Department of Civil and Environmental Engineering, North South University
Member	**Prof. Dr. Engr. Salekul Islam** Head, Department of Computer Science and Engineering United International University
Member	**Prof. Dr. Engr. Arshad M. Chowdhury** Dean, School of Engineering and Physical Sciences North South University

COORDINATION COMMITTEE FOR IMPLEMENTING OBA MANUAL

Convener	**Prof. Dr. Engr. A.F.M. Saiful Amin** Member Secretary, Board of Accreditation for Engineering and Technical Education, and Professor, Department of Civil Engineering, Bangladesh University of Engineering and Technology
Member	**Prof. Dr. Engr. Anisul Haque** Member, Board of Accreditation for Engineering and Technical Education, and Professor and Dean, Faculty of Engineering East West University
Member	**Prof. Dr. Engr. Md. Ziaur Rahman Khan** Department of Electrical and Electronic Engineering, Bangladesh University of Engineering and Technology
Member	**Prof. Dr. Engr. Hasan Sarwar** Department of Computer Science and Engineering United International University
Member	**Prof. Dr. Engr. Md. Sohel Rahman** Department of Computer Science and Engineering, Bangladesh University of Engineering and Technology
Member	**Prof. Dr. Engr. A.K.M. Muzahidul Islam** Department of Computer Science and Engineering United International University
Member	**Dr. Engr. Md. Ashraful Alam** Assistant Professor, Dept. of Civil Engineering, University of Asia Pacific
Member	**Prof. Dr. Engr. A.K.M. Nurul Amin** Department of Mechanical Engineering Ahsanullah University and Science and Technology
Secretary	**Dr. Md. Nazmul Ahasan** Registrar, Board of Accreditation for Engineering and Technical Education

NATIONAL STEERING COMMITTEE FOR THE SYMPOSIUM

CONVENER

National Professor Dr. Engr. Jamilur Reza Choudhury
Chairman, BAETE and Vice Chancellor
University of Asia Pacific

MEMBER SECRETARY

Prof. Dr. Engr. A.F.M. Saiful Amin
Member Secretary, BAETE and
Professor, Department of Civil Engineering
BUET

MEMBERS

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Chief Coordinator, Padma Multipurpose Bridge Project and
Padma Multipurpose Rail Link Project

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Dean, Faculty of Mechanical Engineering

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Head, Department of Computer Science and Engineering
United International University

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Director, Institutional Quality Assurance Cell, BUET and
Professor, Department of Naval Architecture and Marine Engineering, BUET

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Dean, School of Engineering and Physical Sciences
North South University

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Dean, Faculty of Civil Engineering
Chattogram University of Engineering and Technology

Dr. Engr. Nehreen Majed
Associate Professor, Department of Civil Engineering
University of Asia Pacific

PUBLIC UNIVERSITIES OFFERING ENGINEERING PROGRAMS

1. Bangabandhu Sheikh Mujibur Rahman Digital University
2. Bangabandhu Sheikh Mujibur Rahman Maritime University
3. Bangabandhu Sheikh Mujibur Rahman Science & Technology University
4. Bangamata Sheikh Fojilatunnesa Mujib Science and Technology University
5. Bangladesh Agricultural University
6. Bangladesh Open University
7. Bangladesh University of Engineering & Technology
8. Bangladesh University of Professionals
9. Bangladesh University of Textiles
10. Barisal University
11. Begum Rokeya University
12. Chittagong University of Engineering & Technology
13. Chittagong Veterinary and Animal Sciences University
14. Comilla University
15. Dhaka University of Engineering & Technology
16. Hajee Mohammad Danesh Science & Technology University
17. Islamic University
18. Jagannath University
19. Jahangirnagar University
20. Jatiya Kabi Kazi Nazrul Islam University
21. Jessore University of Science & Technology
22. Khulna Agricultural University
23. Khulna University
24. Khulna University of Engineering and Technology
25. Mawlana Bhashani Science & Technology University
26. Noakhali Science & Technology University
27. Pabna University of Science and Technology
28. Patuakhali Science And Technology University
29. Rajshahi University of Engineering & Technology
30. Rangamati Science and Technology University
31. Shahjalal University of Science & Technology
32. Sheikh Hasina University
33. University of Chittagong
34. University of Dhaka
35. University of Rajshahi

PRIVATE UNIVERSITIES OFFERING ENGINEERING PROGRAMS

1. Ahsanullah University of Science and Technology
2. American International University-Bangladesh
3. Anwer Khan Modern University
4. Army University of Engineering and Technology (BAUET), Qadirabad
5. Asian University of Bangladesh
6. Atish Dipankar University of Science & Technology
7. Bangladesh Army International University of Science & Technology(BAIUST) ,Comilla
8. Bangladesh Army University of Science and Technology(BAUST), Saidpur
9. Bangladesh University
10. Bangladesh University of Business & Technology
11. Bangladesh University of Health Sciences
12. BGC Trust University Bangladesh
13. BGMEA University of Fashion & Technology(BUFT)
14. BRAC University
15. Britannia University
16. Canadian University of Bangladesh
17. CCN University of Science & Technology
18. Central University of Science and Technology
19. Central Women's University
20. Chittagong Independent University
21. City University
22. Cox's Bazar International University
23. Daffodil International University
24. Dhaka International University
25. East Delta University

List of Private University continued .....

26. East West University
27. Eastern University
28. European University of Bangladesh
29. Fareast International University
30. Feni University
31. First Capital University of Bangladesh
32. German University Bangladesh
33. Global University Bangladesh
34. Gono Bishwabidyalay
35. Green University of Bangladesh
36. IBAIS University
37. Independent University, Bangladesh
38. International Islamic University Chittagong
39. International Standard University (Academic programs have not yet started)
40. International University of Business Agriculture & Technology
41. Khwaja Yunus Ali University
42. Leading University
43. Manarat International University
44. Metropolitan University
45. N.P.I University of Bangladesh
46. North Bengal International University
47. North East University Bangladesh
48. North South University
49. North Western University
50. Northern University Bangladesh
51. Northern University of Business & Technology, Khulna
52. Notre Dame University Bangladesh
53. Port City International University
54. Premier University
55. Presidency University
56. Prime University
57. Primeasia University
58. Pundra University of Science & Technology
59. Queens University
60. Rabindra Maitree University, Kushtia
61. Rajshahi Science & Technology University (RSTU), Natore
62. Ranada Prasad Shaha University
63. Royal University of Dhaka
64. Shanto-Mariam University of Creative Technology
65. Sonargaon University
66. Southeast University
67. Southern University Bangladesh
68. Stamford University Bangladesh
69. State University of Bangladesh
70. Sylhet International University
71. The International University of Scholars
72. The Millennium University
73. The People's University of Bangladesh
74. The University of Asia Pacific
75. Times University, Bangladesh
76. United International University
77. University of Creative Technology, Chittagong
78. University of Development Alternative
79. University of Global Village
80. University of Information Technology & Sciences
81. University of Liberal Arts Bangladesh
82. University of Science & Technology Chittagong
83. University of South Asia
84. Uttara University
85. Varendra University
86. Victoria University of Bangladesh
87. World University of Bangladesh
88. Z.H Sikder University of Science & Technology
89. Z.N.R.F. University of Management Sciences

INTERNATIONAL UNIVERSITY

1. Islamic University of Technology, Gazipur

CAPACITY BUILDING INTERACTIONS OF BAETE IN NATIONAL AND INTERNATIONAL ARENA

International Engineering Alliance Meeting 2016 at Kuala Lumpur, Malaysia

International Engineering Alliance Meeting 2017 at Anchorage, USA International Engineering Alliance Meeting 2017 at Anchorage, USA

International Engineering Alliance Meeting 2018 at London, UK

BAETE RECEIVED MENTORS FROM BOARD OF ENGINEERS, MALAYSIA AND INSTITUTION OF ENGINEERS, SINGAPORE

2016

2017

2018

2019

NATIONAL LEVEL WORKSHOPS, EXPERIENCE SHARING SESSIONS AND INTENSIVE TRAINING OF PROGRAM EVALUATORS

2016

2019

2019


Bangladesh University of Engineering and Technology
Seminar
on
Top Universities Go for Washington Accord
Outcome-based Accreditation
Chief Guest : Professor Dr. Saiful Islam
Special Guest : Professor Dr. Jamilur Reza Choudhury
Speaker : Professor Kai Sang LOCK

INTENSIVE GROOMING SESSIONS FOR OBE EDUCATORS BY BOARD OF ENGINEERS, MALAYSIA MENTORS IN A RETREAT VISIT OUTSIDE DHAKA

2016




BAETE WAS OBSERVER TO THE ACCREDITATION PROCEDURES IN MALAYSIA AND SINGAPORE

2017




2017

BAETE CONDUCTED CUSTOMIZED ON-SITE TRAININGS FOR PROGRAMS ALL OVER BANGLADESH THROUGHOUT 2018

2018

2018


ON SITE TRAINING ON OUTCOME BASED EDUCATION
AE DEPARTMENT, MIST
28 JULY 2018


On-Site Training on
Outcome Based Education (OBE)
11 Aug 2018
Military Institute of Science and Technology


CENTRE OF EXCELLENCE
ON SITE TRAINING ON OUTCOME BASED EDUCATION (OBE)
DEPARTMENT OF MECHANICAL ENGINEERING, MIST
31 AUGUST 2018


ON SITE TRAINING ON OUTCOME BASED EDUCATION
AE DEPARTMENT, MIST

PROGRAM **AT A GLANCE**

13 MARCH 2019, WEDNESDAY

10:00—11:00	Opening Ceremony
11:00—11:30	Tea Break
11:30—13.15	Keynote Paper Session-I
13:15—14:30	Lunch
14:30—15:15	Special Plenary Session
15:15—17:00	Invited Paper Session-I
17:00—17:30	Tea Break
19:00—21:00	Conference Dinner & Cultural Program

14 MARCH 2019, THURSDAY

09:30—11:15	Invited Paper Session-II
11:00—11:30	Tea Break
11:30—12:40	Keynote Paper Session-II
12:45—14:00	Concluding Ceremony
14:00—14:30	Lunch

15 MARCH 2019, FRIDAY

Field Trip to the Padma Bridge Site
(International delegates only)

08:30	Departure from hotel
19:00	Arrival at hotel

DETAILS OF **THE SESSIONS**

Day-1: 13 March 2019, Wednesday

KEYNOTE PAPER SESSION-I

11:30-13:15

Chair: Prof. Dato' Ir. Dr. Wan Hamidon Wan Badaruzzaman

Professor and Chairman, Smart and Sustainable Township Research Centre, Universiti Kebangsaan Malaysia and Mentor, Board of Accreditation for Engineering and Technical Education

Accreditation: A Strategy for Quality Assurance and Innovation in Engineering Education
Elizabeth Taylor

Establishing Internationally Benchmarked Accreditation System for Engineering Education in Bangladesh
Jamilur Reza Choudhury and ***AFM Saiful Amin***

WP and EA
Siti Hawa Hamzah and ***Liew Chia Pao***

INVITED PAPER SESSION-I

15:15-17:00

Chair: Er. Prof. Dr. Kai Sang Lock

Professor (Engineering), Singapore Institute of Technology, Singapore and Mentor, Board of Accreditation for Engineering and Technical Education

Journey of Engineering Education in Bangladesh Towards Outcomes-Based Accreditation
Anisul Haque

China Engineering Education and Accreditation
Shuqian Xia

The Washington, Sydney & Dublin Accords: Educational and Professional Pathways for the Engineering Team in Malaysia
Hassan Basri

Quality Assurance in Engineering Education in Nepal: Role of Nepal Engineering Council
Arna Raj Silwal

Day-2: 14 March 2019, Thursday

INVITED PAPER SESSION-II

09:30-11:15

Chair: Em Prof. Elizabeth Taylor

Deputy Chair, Washington Accord, International Engineering Alliance

Assessment of Outcomes Achievement: Status of Quantification and Automation in Bangladesh
Hasan Sarwar

Outcomes-Based Engıneerıng Program Accreditation For Quality of Educatıon: MÜDEK Experience
Yavuz Ercil

Accreditation by Japan Accreditation Board for Engineering Education and Experiences of Saitama University
Yasunao Matsumoto

KEYNOTE PAPER SESSION-II

11:30-12:40

Chair: Engr. Md. Abdus Sobhan

Board Member, Board of Accreditation for Engineering and Technical Education

An Overview of Outcome-Based Education (OBE)
Wan Hamidon Wan Badaruzzaman

Back to the Basic
Peter Y Wong

Accreditation for Quality Assurance of Engineering Education - Singapore's Experience after 16 years of Washington Accord
Kai Sang Lock

KEYNOTE PAPERS

KEYNOTE PAPER

ACCREDITATION: A STRATEGY FOR QUALITY ASSURANCE AND INNOVATION IN ENGINEERING EDUCATION

Elizabeth Taylor
Deputy Chair, Washington Accord, International Engineering Alliance

ABSTRACT

Facilitating mobility for international engineering practice has resulted in the development of international-level accords focused on the accreditation of engineering programs. These accords sit within the International Engineering Alliance and cover all members of the engineering team. Because the basis of the accords is mutual recognition of substantial equivalence, engagement with the accreditation systems of each accord signatory, and their constituent institutional engineering programs, is imperative. All signatories share a commitment to finding common ground for stakeholders to share engineering standards and practice through dialogue and exchange of views and to work together collaboratively. This presentation will detail the quality assurance system of the accords and analyze the way in which the engagement provides significant opportunities to identify best practices and so continually improve international engineering accreditation standards, education, and practice.

Elizabeth spent 10 years in design and construction management. She then joined UTS as the Women in Engineering coordinator before moving into academe. During that time, she completed a law degree. In 2009, she resigned as pro vice-chancellor and executive dean, Faculty of Sciences, Engineering and Health, CQ University. Presently, she consults with various organizations on education and asset management. She has always engaged in diverse pro-bono work. Within Engineers Australia, this has included Accreditation Board chair, Sydney Division president, chair of the National Women in Engineering Committee and of Engineers Media, and membership on two Code of Ethics reviews. She chaired the Board of Professional Engineers of Queensland for 8 years. Currently, she is chair of the Cambodian Children's Trust Australia, RedR Australia, and RedR International. She is deputy chair, Washington Accord, International Engineering Alliance. In 2004, she was appointed an officer of the Order of Australia. In 2018, she was UNSW Engineering Alumni of the Year, and her work was recognized with an Honorary Doctorate in Engineering. Elizabeth is an Honorary Fellow of Engineers Australia and Fellow of the Australian Institute of Company Directors and in 2015 was elected to Fellow, Academy of Technological Sciences and Engineering.

KEYNOTE PAPER

ESTABLISHING AN INTERNATIONALLY BENCHMARKED ACCREDITATION SYSTEM FOR ENGINEERING EDUCATION IN BANGLADESH

Jamilur Reza Choudhury
National Professor
Chairman, Board of Accreditation for Engineering and Technical Education
Institution of Engineers, Bangladesh
Vice Chancellor, University of Asia Pacific

and

A.F.M. Saiful Amin
Professor, Department of Civil Engineering, Bangladesh University of Engineering and Technology, Dhaka 1000, Bangladesh
Member Secretary, Board of Accreditation for Engineering and Technical Education
Institution of Engineers, Bangladesh

ABSTRACT

Engineering education at the tertiary level started in Bangladesh in 1947, when the Ahsanullah Engineering College in Dhaka started admitting students to 4-year degree programs in five engineering disciplines. It was affiliated to Dhaka University. In 1962, the college was upgraded to an independent university and named East Pakistan University of Engineering and Technology. With independence of Bangladesh in 1971, it was renamed as Bangladesh University of Engineering and Technology. During the last two decades, the education system has expanded very rapidly and currently 29 public, 79 private, and one international university are operating in Bangladesh, offering 260 undergraduate engineering programs. The engineers graduating from some of these institutions have made their marks around the world in the last seven decades in every branch of engineering.

In order to achieve the present government's goal to elevate Bangladesh's status to a developed nation by 2041, adequate numbers of competent engineers with the knowledge, skills, and attitude to plan, design, build, operate, and maintain our infrastructure is needed. Moreover, there exists a considerable opportunity to convert the country's additional human resources into world-class engineers for the world market to greatly scale up the national earnings from the international market.

Graduates from some of the universities of Bangladesh have no difficulty in getting admitted to top universities in the world for pursuing Masters and PhD degrees, and on completion, join the profession in those countries. However, many countries are now making it a requirement that the degree must be accredited by a national body which is a signatory of Washington Accord. To this end, the Institution of Engineers, Bangladesh, the lone nationally approved and internationally recognized professional body for engineers in the country, has established the Board of Accreditation for Engineering and Technical Education (BAETE), bestowing it full autonomy and support to establish and enforce an internationally benchmarked accreditation system for The BAETE became a provisional signatory of the Washington Accord (WA) in 2011. At present, the BAETE is working closely with WA and its appointed mentors to enhance the quality of the accreditation system with the implementation of the outcome-based new accreditation manual, creating a more systematic, transparent, and fair system; to ensure the adoption of WA graduate attributes as standard outcomes; to elevate the quality and competency of the program evaluators; and finally, to enhance the BAETE's reputation, image, and ability to attract more public and private higher institutions of learning to apply for accreditation under the BAETE. It is expected that by attaining these definite targets, the Institution of Engineers,

Bangladesh will achieve the full signatory status of the WA in the very near future. This will enable our graduate engineers to enter into national and international engineering projects at home and abroad, not only with better knowledge, skills, and attitudes but also with quantified assessment track records generated from an efficient outcome-based education system.

Prof. Dr. Engr. Jamilur Reza Choudhury is one of the leading engineers and academics in the country. He started his career in 1963 as a lecturer in the Department of Civil Engineering at Bangladesh University of Engineering and Technology and was appointed a professor in 1976. He was head of the department (1978-79, 1981-83), dean of the Faculty of Civil Engineering at BUET (1983-85), and director of the Computer Centre at BUET (1982-92), the largest computing facility in the country. He received his PhD from the University of Southampton, UK, in 1968 and was awarded the Doctor of Engineering (Honoris Causa) degree by the University of Manchester, UK, in 2010. He has been involved with the planning, design, and construction of some of the largest infrastructure projects in Bangladesh (ports, airports, buildings, and bridges). He was the president of Institution of Engineers, Bangladesh (1992-93). He was elected a Fellow of the Institution of Civil Engineers, UK, in 1995. He was an advisor (minister) in the Caretaker Government of Bangladesh in 1996 and was in charge of the Ministry of Energy and Mineral Resources and Ministry of Water Resources. He has headed a large number of committees and task forces formed by the government to formulate ICT policies and plans (1997, 2001, 2007). He was the first vice-chancellor of BRAC University (2001-10), and since 2012, he has been the vice-chancellor of the University of Asia Pacific. In 2018, he was appointed a national professor by the government. He has been chair of the Board of Accreditation for Engineering and Technical Education, Institution of Engineers, Bangladesh, since its inception in 2003.

Dr. A.F.M. Saiful Amin is a professor of civil engineering whose fundamental contributions have resulted in major improvements in the design and performance of bridges, strengthening the noncompliant structures. Dr. Amin focuses especially on improving codes and standards and the construction quality of civil engineering infrastructure. His dedicated R&D teams have overseen the repair and retrofitting of structures, helping increase and preserve the structural soundness of many important buildings and remarkable bridges in Bangladesh. Specializing in the fields of structural engineering—particularly structural mechanics—and applied mechanics, Dr. Amin's expertise also includes thermodynamics, thermophysics, cement chemistry, and, more recently, engineering education. Prof. Amin is a respected Fellow with the Institution of Civil Engineers, United Kingdom (on presidential invitation) and Institution of Engineers in Bangladesh. He also held visiting professorships in 2004 at the University of Kassel (Germany) and in 2007 at the University of Federal Armed Forces, Munich (Germany) on invitation from the German Academic Exchange Service and Alexander von Humboldt Foundation, Germany. After graduating from BUET in 1996 as a civil engineer and completing his MSc studies there in 1998, Dr. Amin completed his PhD at Saitama University in 2001. He also received the Malik Akram Hossain Gold Medal 1996, University Merit Scholarships, F.R. Khan Scholarship, and many other honors. In 2017, Japan Society of Civil Engineers honored him in Tokyo with the prestigious JSCE International Outstanding Collaboration Award; he was the first person from Bangladesh to receive it. The Institution of Civil Engineers, UK flew him to London as the lone ambassador from South Asia to participate in the bicentenary celebration of the Institution of Civil Engineers, UK in 2018. Prof. Amin took current responsibility for the Board of Accreditation for Engineering and Technical Education, Institution of Engineers, Bangladesh in 2016.

KEYNOTE PAPER

WP AND EA

Siti Hawa Hamzah
Associate Director (Civil Engineering), Accreditation Department
Board of Engineers Malaysia (BEM), Malaysia

and

Liew Chia Pao
Associate Director (Electronic Engineering), Engineering Accreditation Department
Board of Engineers Malaysia (BEM), Malaysia

ABSTRACT

This session discusses the design and assessment of learning outcomes with complex engineering problems (WP) and complex engineering activities (EA). The distinctive roles of engineers, technologists and technicians are defined by the range of problem-solving and engineering activities. The aims are to discuss the characteristics of WP and EA according to the Washington Accord (WA) and how WP and EA can be implemented in engineering curriculum. Their characteristics in conjunction with the IEA's 12 Graduate Attributes (GAs) must be aligned with the learning outcomes and learning and teaching methods, as well as assessed and analyzed. Identification, adaptation, planning, and execution toward the attainment of the 12 GAs must be evident as true attainment. Continuous quality improvements are implemented toward improving the learning process and students' achievement of the learning outcomes. Examples of actual implementation of WP and EA that take into account the Knowledge Profile (WK) of the WA will be shared with participants.

Ir. Dr. Siti Hawa Hamzah's academic qualifications: BSCE & Cert. of Education from University of Miami, USA; MSCE from University of Kentucky, USA; and PhD from UKM Malaysia. Professionally, a licensed professional engineer with a practicing certificate, Fellow of The Institution of Engineers (IEM) Malaysia, Hon MAFEO ASEAN engineer, life member of Majlis Rekabentuk Malaysia, and life member of Persatuan Siswazah Wanita Malaysia. Currently, an associate director (Civil Engineering) with the Accreditation Department, Board of Engineers Malaysia (BEM) since 2016, assumed a former role as the associate director (Structural Engineering) from 2014 and a Washington Accord mentor to the Board of Accreditation for Engineering and Technical Education (BAETE) Bangladesh since 2016. She has more than 33 years of teaching and academic experience, majoring in structural engineering; supervised and examined more than 110 postgraduate students and more than 450 undergraduate students; completed 21 research projects; coauthored and published 11 books in structures; published more than 165 technical papers in journals and proceedings; and published videos (YouTube) on engineering accreditation. She has been involved with Dewan Bahasa & Pustaka in publications of more than five textbooks and reference books for technical schools, publication of Malaysian Standard with SIRIM Berhad & CIDB, Editorial Advisory Board to national and international journals and proceedings, reviewed books, journal publications, technical articles, and research proposals. She has also conducted consultancy work. She has acquired comprehensive expertise and talent in undergraduate and postgraduate curriculum development and reviews, moderate examinations, mentoring young lecturers and accreditation (EAC & ETAC) panels, and advising and organizing academic activities such

as conferences and workshops. She has been the academic administrator for more than 15 years. She has been appointed as an external examiner, assessor, and OBE adviser and trainer. She is an expert and resource on engineering accreditation matters. She has been involved in at least 120 engineering education accreditation evaluations. Synonymously, at IEM, she has served in all Standing Committees, served as a council member and executive council member, served the BEM in the T&E Committee, conducted professional interviews, provided trainings, and given lectures related to the profession. Additionally, she has been active in community services. She was given the IEM Lady Engineer Award in 2007 and appointed as an honorary member to AFEO in 2008. She has received more than 20 research accolades at both international and national invention, innovation, and design competitions. Lastly, she is a triple award recipient for UiTM excellent services and in 2017 retired from the Faculty of Civil Engineering, Universiti Teknologi MARA Shah Alam Malaysia, as a professor.

Ir. Liew Chia Pao is a principal lecturer in the Faculty of Engineering and Technology, Tunku Abdul Rahman University College (TAR UC), Malaysia. Professionally, he is a licensed professional engineer with a practicing certificate from the Board of Engineers Malaysia and a corporate member of the Institution of Engineers Malaysia. Currently, he is an associate director (Electronic Engineering) of the Engineering Accreditation Department, Board of Engineers Malaysia (BEM). He has over 9 years of teaching and academic experience, managing engineering programs; has accreditation evaluator experience in more than 60 programs; and has published accreditation videos on YouTube and some technical papers. He has over 11 years of experience as an R&D engineer and project manager in powerline communication. He is editor of the 2017 Engineering Accreditation Council Accreditation Manual. He was appointed by the Ministry of Education, Malaysia as an evaluator to assess the engineering program in Spain in 2016. He has delivered a number of workshops and talks on accreditation, outcome-based education, and complex engineering problem-solving for the Engineering Accreditation Council Malaysia, many Malaysian universities, and, most recently, Conference of the ASEAN Federation of Engineering Organizations (CAFEO) in Singapore in November 2018. He has worked as an R&D engineer and project manager in powerline communication with OCM-Web and as a consultant in the industrial and electronics sector with Frost & Sullivan. His research areas are complex engineering problem-solving and engineering program outcome assessment. He is the external examiner of the Bachelor of Electrical and Electronic Engineering degree program at Xiamen University Malaysia Campus and KDU University College, Malaysia. He obtained his diploma from TAR UC (1996) and a Master of Science from University of Hertfordshire, UK (1998), and he passed the Engineering Council UK examinations.

KEYNOTE PAPER

AN OVERVIEW OF OUTCOME-BASED EDUCATION (OBE)

Wan Hamidon Wan Badaruzzaman
Professor and Chairman
Smart & Sustainable Township Research Centre, Universiti Kebangsaan Malaysia

ABSTRACT

There is a need to migrate from the traditional prescriptive-based and teacher-centered to an outcome-based education (OBE) approach in countries seeking to become full signatories of the Washington Accord (WA), and elsewhere. For mutual recognition to be accorded to graduates from a WA signatory by the other signatories (which is the main advantage of becoming a WA full signatory), graduates from accredited program in the country are expected to have achieved the twelve (12) WA Graduate Attributes (GAs) or exemplars of the graduates' profiles upon graduation. An accrediting body that aspires to be admitted as a full signatory of the WA must demonstrate that it has established an outcome-based accreditation (OBA) system, where the WA GAs shall become the main component of accreditation criteria for accreditation of any engineering program. The WA GAs encompass abilities in the knowledge, skills, and affective domains. The level of achievement of the attributes by the students must be demonstrated through valid or authentic assessment tools, and hence, OBE can be adopted to provide the correct approach. In 2009, Malaysia was admitted to the WA as a full signatory nation. Malaysia was admitted as a provisional member of the WA in 2003. This presentation shares the Malaysian experience, specifically with regard to OBE and OBA in the process to be admitted as a full signatory of the WA in 2009. It is hoped that Bangladesh can expedite the migration process and quickly elevate the accreditation system and the quality of engineering graduates to a higher level.

Prof. Wan Badaruzzaman is the chairman of the Smart & Sustainable Township Research Centre, Universiti Kebangsaan Malaysia. He has vast professional and academic experience. He is currently a Washington Accord mentor for the BAETE (2017–present). Prof. Wan has been the director of the Engineering Accreditation Department (2014–2016), EAC Council member (2006), EAC associate director (Accreditation) (2006–2013), and BEM Accreditation Consultative Panel (2017–2018). He chaired the team that drafted the new EAC Outcome-Based Accreditation Manual 2006. Currently, he is an international/ academic advisor and external examiner to several Malaysian universities. He sits on the Curriculum Board for Malaysian Polytechnics Courses and Training Programmes (2017–present) and is a Universiti Teknologi Petronas Accreditation Council member (2017–present). He was the founder and chief executive officer of UKM Perunding Kejuruteraan & Arkitek Sdn. Bhd. (2006–2011); deputy director of the Advanced Engineering Centre, UKM (1999–2000); and head of the Civil Engineering Department, UKM (2002–2005). Prof. Wan has been appointed as an external examiner for engineering programs at Sohar University, Oman (2013), and committee member, Civil Engineering Periodic Programme Review, Sohar University, Oman (2017). He has won many academic and research awards and has conducted many training workshops on accreditation and OBE for many universities in and outside Malaysia.

KEYNOTE PAPER

BACK TO THE BASICS

Peter Y Wong
Chairman, Accreditation Board
The Hong Kong Institution of Engineers, Hong Kong, China

ABSTRACT

Ir. Wong believes engineering is truly an international language, the practice of which, across the international horizon, is based on the same formulae and theories, albeit many of them were developed decades ago. To meet the modern and ever-changing needs, the challenge is to ensure timely evolvement in engineering practice. Tertiary education is obviously the root of this growing point. The task at hand is not only about coaching competent practitioners but also cultivating a corps of ethical and responsible professionals that would put the well-being of the community up front. Undergraduate education is the prime foundation for our younger generation. Where else could we find a better opportunity to instill this cogitation in our successors? The Washington Accord has now come of age, with dedicated participants from all corners of the world. Where else could we find a better venue to preach our commitment to our learned neighbors? It must be remembered, though, that the fortune we enjoy today is the fruit of the collective dedication and devotion of all the signatories of the Washington Accord over the years, endowed with the foresight and insight of the six founding members. With this reflection, it should be noted that we all bear the duty to help shape the engineering profession and practice into the proper perspective.

Ir. Peter Y Wong is an Honorary Fellow at the Hong Kong Institution of Engineers, HKSAR; Fellow, the Chartered Institution of Building Services Engineers, UK; Fellow, the Institution of Engineering and Technology, UK; registered professional engineer (building services, electrical engineering), HKSAR; chartered engineer, Engineering Council, UK; and chairman, Accreditation Board, the Hong Kong Institution of Engineers (2015-present). He has also been the president of the Hong Kong Institution of Engineers, Hong Kong, China (2008-2009); president, the Chartered Institution of Engineers, UK (2017-2018); and chairman, Engineers Registration Board, Hong Kong, China (2010-2013). Upon graduation, Ir. Wong returned from the USA to Hong Kong in 1971 and worked for the consultant firm M/s Scott Wilson Kirkpatrick & Partners for the HK Cross Harbour Tunnel project. Ir. Wong also worked for a Hong Kong-Taiwan JV cable manufacturer and a contractor firm before joining M/s Yook Tong Electric Company Ltd in 1976 as director, a position he still holds to date. Ir. Wong is a registered professional engineer in the building services and electrical engineering disciplines in Hong Kong. He is also a chartered engineer registered with the Engineering Council UK. On the professional side, Ir. Wong has been active with various professional engineering institutions, both in Hong Kong and the UK. He also served on the Engineers Registration Board, a statutory body, for 12 years before being appointed as the board chairman in October 2010. In the industrial and educational sectors, Ir. Wong is always conscious of the need for proper training across the whole spectrum of the engineering profession, from craftsmanship to professional engineering. For many years, he served on various industrial training boards and advisory committees under the Vocational Training Council and Education Bureau of the HKSAR government, as well as on engineering advisory committees of various tertiary institutions in Hong Kong. Ir. Wong was also a past president of HK & Kowloon Electric Trade Association. He is currently the chairman of the Accreditation Board, taking the lead representation at IEAM meetings on behalf of the HKIE.

KEYNOTE PAPER

ACCREDITATION FOR QUALITY ASSURANCE OF ENGINEERING EDUCATION: SINGAPORE'S EXPERIENCE AFTER 16 YEARS OF THE WASHINGTON ACCORD

Kai Sang Lock
Professor (Engineering), Singapore Institute of Technology, Singapore

ABSTRACT

This paper examines the role of accreditation in quality assurance of engineering education, drawing from Singapore's experience after 16 years in the Washington Accord. The presentation will cover an overview of engineering education in Singapore, accreditation activities before the Washington Accord, reflection on 16 years of association with the Washington Accord, impact of the outcome-based accreditation framework in quality assurance of engineering education, overcoming challenges, and an overview of the international scene.

Dr. Lock is a professor (engineering) at the Singapore Institute of Technology (SIT), the fifth new government-funded university in Singapore. He is a past president of the Institution of Engineers Singapore (IES). He served as chairman of the Engineering Accreditation Board, IES, from 2002 to 2009, leading IES to become a signatory of the Washington Accord in 2006. He still actively contributes as a program evaluator and team chair for accreditation evaluation of engineering programs. He is presently a mentor to the BAETE and BPERB, after having successfully mentored the engineering accreditation board in India and Pakistan to gain full-signatory status in the Washington Accord. He served as a Washington Accord review team member and team chair for review visits to South Africa, South Korea, the USA, China, and the UK. He has served as a board member of the Professional Engineers Board, Singapore for over 12 years and was chairman of its examination committee responsible for the implementation of the examination system for qualifying professional engineers in Singapore. He is a Fellow of the Academy of Engineering Singapore, an Honorary Fellow of the Institution of Engineers, Singapore, and an Honorary Fellow of the ASEAN Federation of Engineering Organizations. He received both his BSc (1975) and PhD (1979) degrees in electrical engineering from the University of Strathclyde, UK. He was a faculty member in the Department of Electrical Engineering, National University of Singapore for 17 years before he left to set up his consulting practice in 1997. He returned to academia as a professor in 2016, after 20 years in the industry.

INVITED PAPERS

INVITED PAPER

JOURNEY OF ENGINEERING EDUCATION IN BANGLADESH TOWARD OUTCOME-BASED ACCREDITATION

Anisul Haque
Professor, Department of Electrical and Electronic Engineering
East West University, Dhaka, Bangladesh

ABSTRACT

Accreditation of engineering programs in Bangladesh has come a long way since its beginning in 2000, when the Board of Accreditation for Engineering and Technical Education (BAETE) was first established by the Institute of Engineers (IEB). Not too many higher learning universities paid attention to BAETE accreditation initially. However, once the IEB began to require that with the exception of the few oldest and most reputed public universities, only graduates from accredited programs were eligible to become IEB members, accreditation became important to many private universities offering degrees in engineering, as well as to a number of newer public universities. The BAETE becoming a provisional member of the Washington Accord in 2011 also contributed to the increased value of accreditation. Outcome-based education (OBE) had already become the standard globally for tertiary education in engineering. However, no engineering program in Bangladesh was practicing OBE at that time. Despite that fact, the BAETE decided that it needed to adopt outcome-based accreditation (OBA) as well. The BAETE organized many training workshops on OBE for the academic leaders of the higher learning institutes. Around the same time, the Government of Bangladesh, through the University Grants Commission (UGC), launched a Higher Education Quality Enhancement Project (HEQEP) to address the globalization challenges in higher education. Seventy-six institutes of the country, both public and private, were brought under this project. Workshops and trainings on modern educational paradigms and techniques, including OBE, were conducted at the 76 academic institutes. The academic departments of these institutes also conducted self-assessments. Many revised curricula and teaching-learning practices based on outcomes. The HEQEP project had a synergic effect on the efforts of the BAETE to introduce OBA. When the BAETE finally launched the first version of the OBA manual in 2017, most institutions were aware of OBE, and a few were ready to adopt OBE. The importance of accreditation was also increasing among the stakeholders, particularly among the prospective students of private universities. Within a year of introduction of the OBA manual, the BAETE received 26 applications from 14 academic institutions for accreditation under the new manual. In this presentation, we will share the experiences of the higher learning institutes and the BAETE during this journey toward OBE and OBA.

Dr. Anisul Haque has been working as a professor in the Department of Electrical and Electronic Engineering, East West University since 2006. Before East West University, he taught in the Electrical and Electronic Engineering Department, BUET for 18 years. He has served as a visiting faculty member at Tokyo Institute of Technology, Japan; University of Connecticut, USA; and Clarkson University, USA. He is a member of the Board of Accreditation for Engineering and Technical Education (BAETE), Institute of Engineers, Bangladesh (IEB). Prof. Haque is also a member of the BAETE task force for the formulation and revision of the BAETE accreditation manual for outcome-based accreditation (OBA). He has performed as the chair of many accreditation evaluation teams and has conducted a number of on-site workshops on outcome-based education and accreditation for institutions of higher learning aspiring to get accredited by the BAETE. Prof. Haque's research interests include the physics, modeling, simulation, and characterization of nanoelectronic devices and photovoltaic devices and systems. He was the recipient of the Bangladesh University Grants Commission Award in 2006 and the gold medal from the Bangladesh Academy of Science in 2010. Prof. Haque is an editor of IEEE Transactions on Electron Devices and an associate editor of IEEE Access. He has also been serving as an IEEE Distinguished Lecturer.

INVITED PAPER

CHINA ENGINEERING EDUCATION AND ACCREDITATION

Shuqian Xia
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ABSTRACT

Over the past 40 years, China's engineering education has prepared more than 20 million talents for industrial and economic development. Nowadays, with industry and technology developing rapidly, engineering education must meet demands accordingly. A large amount of reforms are being undertaken, including the Excellent Engineer Training Program and practice of "Emergent Engineering." Quality plays a key role in these reforms. Therefore, how to improve quality through quality assessment is a great challenge for engineering education. We believe engineering education accreditation provides the answer. China has been working on building an accreditation system in engineering education since 2006. Over the past decade of development, a well-developed accreditation system has been established. In 2016, China became a full member of the Washington Accord. Accreditation is of great significance to engineering education, for example, for ensuring the quality and facilitating the reform of engineering education and enhancing exchanges and mutual recognition in engineering education between China and international counterparts. Engineering education accreditation activities are undertaken by the China Engineering Education Accreditation Association (CEEAA), which is under the umbrella of the China Association of Science and technology (CAST). There are 33 national members within the CEEAA. All of them are influential National Societies, Associations or Institutes, which cover 20 of the engineering and technology fields nationwide. The accreditation timeline, procedure, visiting schedule, and criteria will be introduced. One of the most essential accreditation criterion, graduate outcomes, will be particularly discussed. Some good practices for insuring our engineering education accreditation, including the training of volunteers and the strict three-level consistency check system, will also be included.

Shuqian Xia is a professor at the School of Chemical Engineering and Technology, Tianjin University, China. She is also the associate dean of the school and in charge of the undergraduate education. She received her PhD degree (2003) in chemical engineering from Tianjin University, China. She has been a visiting scholar at Manchester University, UK. She is the chairman of the Tianjin Research Association of Chemical Process and Equipment Technology and director of the Chemical Industry and Engineering Society of China (CIESC). She has been an experienced expert in the China Engineering Education Accreditation Association (CEEAA) for several years. She is a member of the Editorial Board of Education for Chemical Engineers (a publication of the Institution of Chemical Engineers). She has published four books, including Chemical Engineering Thermodynamics. She has received four National Teaching Achievement Awards from the Chinese government. Her present scientific interests are focused on chemical engineering thermodynamics and biomass energy utilization technology. She has completed a number of national scientific research projects and published over 60 peer-reviewed papers in the Journal of Thermodynamics, Chemical Engineering Science, etc.

INVITED PAPER

THE WASHINGTON, SYDNEY & DUBLIN ACCORDS: EDUCATIONAL AND PROFESSIONAL PATHWAYS FOR THE ENGINEERING TEAM IN MALAYSIA

Hassan Basri
Board Member, Board of Engineers Malaysia

ABSTRACT

In 2009, Malaysia, via the Board of Engineers Malaysia (BEM), was admitted as a signatory to the Washington Accord, the mutual recognition agreement for engineering education programs under the governance of the International Engineering Alliance (IEA). Nine years on, in June 2018, the BEM was accepted as a full signatory for the other two IEA agreements for education, i.e., the Sydney Accord for engineering technology education and the Dublin Accord for engineering technician education. These achievements by the BEM represent significant milestones in international benchmarking for quality engineering education in Malaysia, where henceforth, Malaysia has been an active signatory in all three education accords of the IEA. The IEA is the umbrella body that champions cross-border collaboration and mobility within the engineering profession by promoting clarity in the relevant standards and competencies. Full-signatory status to these three accords can only be granted after rigorous audit by international peer reviewers during a provisional signatory status, which normally requires massive and intensive efforts by the relevant stakeholders in the jurisdiction's engineering education community. Hence, graduates of BEM-accredited program are now recognized by other signatory nations of the accords and can look forward to having in their possession a very marketable qualification for them to commence their professional career. Such graduates will be of international standing and hence will help to attract foreign companies to set up their businesses in Malaysia, consistent with the aspiration to develop competent human capital that is necessary to propel the nation toward a high-income economy. Signatory status for the Washington, Sydney, and Dublin Accords ensures the high standards necessary for graduates to enter the profession for the entire engineering team, which importantly includes engineering technologists and technicians. These two categories of engineering professionals have traditionally been overlooked in the past, despite their significant role within the engineering profession. Pursuant to this, the BEM has developed education standards based on the adopted IEA Graduate Attributes and is currently developing IEA-based professional competency frameworks. This will provide clarity for potential students intending to become engineers, engineering technologists, and technicians to chart their educational and professional pathways within the engineering profession, where the outcomes and competencies are globally recognized.

Prof. Hassan Basri is a professor of environmental engineering at the National University of Malaysia (UKM) and is currently a board member on the Board of Engineers Malaysia (BEM). He has been a long-serving council member of the Engineering Accreditation Council (EAC-BEM) since 2003, including as a past chair. He played a key role in transforming engineering education in Malaysia in preparing for Malaysia's entry into the Washington Accord, the international agreement for mutual recognition for the accreditation of engineering degree programs. Prof. Basri has also been involved in the Engineering Technology Accreditation Council (ETAC) since 2013. He was appointed as its pro tem chairman in 2012, a past deputy chair, and was an active participant in Malaysia's effort to secure full-signatory status of the Sydney and Dublin Accords in June 2018. Prof. Hassan obtained his B.E. in civil engineering with honors from Tasmania University in 1982, MSc (engineering) with distinction from Leeds University in 1988, and PhD in 1994, also at Leeds. He practiced as a civil engineer with MMC Engineering Services Sdn Bhd (1983-1987), and subsequently on a part-time basis with several engineering companies. At UKM, Prof Hassan served as head of the Civil Engineering Department, dean of Engineering, director for Research, director for Corporate Planning, and deputy vice-chancellor. He is also a past chair of the Malaysian Council of Engineering Deans.

INVITED PAPER

QUALITY ASSURANCE IN ENGINEERING EDUCATION IN NEPAL: ROLE OF NEPAL ENGINEERING COUNCIL

Arna Raj Silwal
Nepal Engineering Council, Nepal

ABSTRACT

Formal enrollment in engineering education in Nepal began in 1943 with civil sub-overseer (currently called technical SEE/10th grader), Diploma in Civil Engineering in 1953 (equivalent to 12th grader), and then Bachelor of Civil Engineering in 1978. The first master's degree in the engineering discipline was formed in 1996. PhD programs were launched in 2003, which focused on various engineering subjects. Now, 49 colleges affiliated with six different universities are offering engineering degrees in 17 subjects, enrolling 9,415 students each year. Before Kathmandu University was established in 1995, Tribhuvan University was the only institution responsible for regulating the quality of engineering education. The professional body Nepal Engineering Council (NEC), an autonomous organization formed by the government, was founded in 1999 with the objective of proper and effectual mobilization of the engineering profession. It was also responsible for determining engineering qualification standards, the approval and monitoring of engineering colleges, and the registration of engineering graduates in Nepal. The University Grant Commission (UGC) was established in 1994 to regulate quality, alongside other issues of multiple universities. The need for the formation of the Quality Assurance and Accreditation Division (QAAD) was realized in 2007. The NEC has been independently monitoring the quality of engineering education provided by different colleges in Nepal. The UGC also prepared guidelines in 2013 for the purpose of quality assurance and accreditation. None of the engineering campuses have received accreditation. Since the publishing of the QAA guidelines, the UGC, in coordination with the NEC, has been carrying out accreditation procedures for engineering colleges. Quality monitoring procedures being implemented by the NEC highlight physical infrastructure, faculty/administrative staff, and teaching methodologies adopted. The prevailing act of the NEC qualifies only those graduates who have received a four-year degree from engineering campuses. This prevents engineers from gaining their qualifications through other modes of learning, such as vocational qualification systems, lateral entry systems or distance learning models. The NEC has planned to address other equivalent qualifications through an amendment of the act.

Arna Raj Silwal received his MSc in structural engineering from TU, Nepal, in 2002, his bachelor's degree in civil engineering from the Institution of Engineers (India) in 1999, and a diploma in civil engineering from TU, Nepal, in 1994. He has attended training and seminars, including but not limited to the Afro-Asian Hydro Power Conference in Bhutan (1 week), Training of Trainers for Vocational Skills from Interserve/United Industrial Services (2 weeks), and Technical Auditor Training from TITI (3 weeks). He presented a paper at the National Convention on Science Information and Technology by National Youth Council, Nepal, and at TVET in Nepal: Issues and Challenges, organized by CTEVT, as well as facilitated an ISO Audit for 9001:2015 for two companies. From 2003 to date, he has been the chairperson, Inclusive Consultants (P) Ltd, Kalimati, Kathmandu (Inclusive Consultants has gained expertise in providing consulting service in planning, designing of roads and bridges, construction supervision, etc.). He gained experience working with many government and nongovernmental agencies in Nepal. From 2013 to date, he has been the chairperson, Padmashree International College, Tinkune, Kathmandu (Padmashree provides bachelor-level education in food technology, information technology, etc.). From 2000 to date, he has been the managing director, Training Center Nepal, Sitapaila, Kathmandu (one of biggest private-sector companies in training and consulting sector in Nepal. Currently, it employs more than 500 technical persons, including 150 engineers). From 1999 to 2000, he was a structural engineer, National Society for Earthquake Technology (NSET): Nepal (NSET is a pioneer nongovernmental organization working in the area of reducing earthquake risks). He is a member of the Nepal Engineering Council, Nepal Engineers Association, Institution of Engineers, India, and Structural Engineers Association Nepal. He is now the vice chairperson of the Nepal Engineering Council.

INVITED PAPER

ASSESSMENT OF OUTCOMES ACHIEVEMENT: STATUS OF QUANTIFICATION AND AUTOMATION IN BANGLADESH

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United International University, Dhaka, Bangladesh

ABSTRACT

Bangladesh is starting her journey to implement outcome-based education (OBE). Universities are working hard to introduce OBE curricula and assessment mechanisms. However, it is understood that teaching delivery and assessment are going through a paradigm shift. Initially, it seems that the workload of teachers has increased due to the extra effort they need to put into calculating marks to determine OBE parameter achievements. In this scenario, development of a generic Web-based tool having easy integration facilities with existing software packages deserves to be accepted by the academic community. This write-up presents such a system that is being designed and developed for the academic community of higher education in Bangladesh. Our initial perception is that if we could prepare an automation that will reduce teachers' workload for OBE mark calculation, teachers will be more empowered to provide their best effort in developing and designing curricula and assessment mechanisms. In a way, this will help the country to better absorb the main theme of OBE curricula and end the journey of implementation quite early. The present system deals with data entry for program outcomes, course outcomes and linkage with course curricula and assessment mechanisms. The system is now ready to prepare reports on CO achievement, PO achievement, CQI reports, and more.

Hasan Sarwar received his BSc in CSE from Bangladesh University of Engineering and Technology in 1995. Later, in 2006, he received his PhD in applied physics, electronics, and communication engineering. Currently, he is working as a professor of CSE at United International University. His research interests include optical character recognition, health monitoring systems, software engineering, and education management. Prof. Hasan recently started a software company that designs, develops, and deploys a total ERP solution for university automation. He is also a member of the Board of Accreditation for Engineering and Technical Education (BAETE), Bangladesh.

INVITED PAPER

OUTCOME-BASED ENGINEERING PROGRAM ACCREDITATION FOR QUALITY OF EDUCATION: MÜDEK EXPERIENCE

Yavuz Ercil
Secretary General, MÜDEK, Turkey

ABSTRACT

Outcome-based evaluation for accreditation of engineering programs has become a key instrument that enhances and improves the quality of engineering education. The program outcomes, which are statements defining the knowledge, skills, and attitudes that students must have acquired by the time they graduate, compose the driving force of outcome-based accreditation. MÜDEK (Association for Evaluation and Accreditation of Engineering Programs) is an independent nongovernmental organization that carries out evaluation and accreditation of engineering programs. In Turkey, accreditation of engineering programs is not compulsory, and engineering programs apply for and are awarded accreditation with the main incentive of improving the quality. MÜDEK has been authorized to award the EUR-ACE (bachelor) label since 2008 and has been a full signatory of the Washington Accord since 2011. The program outcomes of MÜDEK hence comply with both EUR-ACE Framework Standards and Washington Accord Graduate Attributes. The assessment process used by MÜDEK is designed to be a tool for providing feedback to the educational programs on the areas in which they need to improve. This presentation will outline the accreditation criteria used by MÜDEK and summarize the main areas where the programs have shortcomings in complying with the MÜDEK criteria on program outcomes. Various actions taken by MÜDEK toward assisting the educational programs in remedying such shortcomings will be indicated. The impact of these actions on the degree programs will also be discussed.

Dr. Yavuz Ercil received his BS, MSc, and PhD degrees from Bogazici University (Turkey), University of Manchester Institute of Science and Technology (UK), and Brown University (USA) in 1974, 1976, and 1981, respectively. He completed his military service as a naval officer at the R&D laboratories of the Naval Shipyard Taşkızak, Istanbul, in 1983. Then he moved to the USA to start working as a test systems design specialist at Mosaic Systems Inc., Michigan. Upon returning to his home country, Turkey, in 1988, he worked as the head of the IC Design Department of Teletaş, a telecommunications company in Istanbul. In 1992, he joined the R&D Center of Arçelik AŞ, a leading manufacturer of durable consumer goods in Turkey, where he worked in several positions, including as an electronic technologies manager of the center, and published several articles on electronic control systems, as well as being a co-inventor of some granted patents, until his retirement in 2010. He started working for MÜDEK (Association for Evaluation and Accreditation of Engineering Programs) of Turkey in 2005 as an assessor of electrical and electronic engineering programs, and he contributed to evaluation of several engineering programs. In 2010, he joined MÜDEK as the secretary general of the association and as one of the managers of its Economic Enterprise.

INVITED PAPER

ACCREDITATION BY JAPAN ACCREDITATION BOARD FOR ENGINEERING EDUCATION AND EXPERIENCES OF SAITAMA UNIVERSITY

Yasunao Matsumoto
Professor, Structural Dynamics and Head, Department of Civil and Environmental Engineering
Saitama University, Japan.

ABSTRACT

Japan Accreditation Board for Engineering Education (JABEE) is a nongovernmental organization established in 1999 and started accreditations of education provided by a department or a course within the faculty of engineering, agriculture or science at universities or institutes of technology in 2001. JABEE was admitted as a provisional signatory of the Washington Accord in 2001 and has held full-signatory status since 2005. Since its start of accreditation, JABEE has applied outcome-based assessment. Instead of structural assessment, the contents of education are assessed as outcomes. JABEE does not question the approach of the program as long as the outcomes are assured. The program shall set up and demonstrate with benchmarks of the outcomes, which the program expects. The outcomes of the program are evaluated based on the expectations of society. There are four assessment criteria: (1) learning outcomes, (2) educational methods, (3) achievement of learning outcomes, and (4) educational improvement. These four criteria are streamlined with a Plan-Do-Check-Act (PDCA) loop. The accumulative number of accredited engineering programs at the bachelor and master levels was 506 as of 2017. The undergraduate education program offered by the Department of Civil and Environmental Engineering at Saitama University has been accredited by JABEE since 2003. The original motivation of the department to be accredited was to take advantage of the fact that graduates of the accredited program could be exempted from the first of the two-step examinations for professional engineers in Japan. The maintenance of accreditation turned out to work well to maintain and improve the quality of education.

Yasunao Matsumoto is professor of Structural Dynamics and, currently, the head of the Department of Civil and Environmental Engineering at Saitama University, Japan. He is also the head of the International Graduate Program on Civil and Environmental Engineering. He obtained his first and master's degrees in civil engineering from the University of Tokyo, Japan, in 1993 and 1995, respectively. He then worked on human responses to vibration at the Institute of Sound and Vibration Research, the University of Southampton, England, where he obtained a PhD in 1999. He has been working as an academic staff member at the Department of Civil and Environmental Engineering at Saitama University for over 20 years. He has had abundant experience in teaching various courses, including main specialized subjects such as structural mechanics and fundamental engineering subjects such as differential equations. Also, he has guided research projects for more than 80 students, including more than 30 international students. His research interests include evaluation and mitigation of vibration problems in civil engineering structures, vibration-based structural health monitoring, environmental vibration, and noise problems caused by civil infrastructures and human responses to vibration and noise. He has been involved in various expert committees organized by academic societies, public agencies, and road administrators.

ARTICLE

ENGINEERING EDUCATION: BANGLADESH PERSPECTIVE

Jamilur Reza Choudhury
National Professor
Vice-Chancellor, University of Asia Pacific

ENGINEERING EDUCATION: BANGLADESH PERSPECTIVE

1. Evolution of Technical and Engineering Education in Bangladesh.

The foundation of technical education in Bangladesh was laid in the year 1876 when British colonial rulers established a survey school in Dhaka. They did so for the main purpose of producing trained manpower in land surveys, which was necessary in determining land revenue and in planning and laying out of publicly funded civil works projects. Twenty-five years later, at the commencement of the 20th century, the survey school was upgraded to an engineering school to produce Overseers to supervise the government's development projects of the government and a 3-year; Licentiate in Civil Engineering Diploma course was introduced. Thanks to the financial assistance of the Nawab of Dhaka, Khwaja Salimullah, the school was named Ahsanullah Engineering School after his father, Nawab Khwaja Ahsanullah. Later in 1911, when the partition of Bengal was annulled, the school moved to a new building, constructed for the East Bengal and Assam Government Printing Press near Palashi. Within a short time this institution became well-known for its high-quality technical education and started attracting students from different regions of Northeast India and Nepal. In 1947, the government decided to upgrade this school to a college that would offer four-year academic programs leading to B. Sc. Engineering degrees. The first batch of students enrolled in May 1947, three months before the British left after partitioning India into two independent countries viz. India and Pakistan. Dhaka became the capital of East Pakistan province. The University of Dhaka, which had been established in 1921, affiliated this college and made it the Faculty of Engineering and appointed its Principal as the ex-officio Dean of the Faculty of Engineering. It should be noted that prior to partition, most of the students interested in engineering education studied at Bengal Engineering College, which was established in Calcutta (now Kolkata) in 1854, leading to BE degrees from the University of Calcutta.

Students admitted in the first batch to the Engineering College in Dhaka had to attend various theoretical, practical, design sessional and workshop classes on the basis of a common syllabus. Later in their third and fourth years, they could specialize in one of three disciplines (viz. civil engineering, electrical engineering or mechanical engineering) for their undergraduate degree. Two more disciplines (chemical engineering and metallurgical engineering) were added after 2 to 3 years. However, in August 1950, communal riots in Calcutta resulted in almost all Muslims students studying in Bengal Engineering College to move to Dhaka. Among them, fourth-year students had completed all of their classes and needed only to pass their final examinations. In response to their applications, the government agreed to make special arrangements for final examinations at the Engineering College on basis of the syllabus of the University of Calcutta and the University of Dhaka agreed to award degrees to successful examinees. On publication of their results at the end of 1950 they became the first engineers with an undergraduate degree from Bangladesh. The name Fazlur Rahman Khan is notable in this regard; he had the distinction of occupying 1st class 1st position among the students of this special batch in the Department of Civil Engineering. After teaching for two years as a Lecturer in the Engineering College, he went to University of Illinois at Urbana Champaign for higher studies with a Fulbright scholarship. In three years, he got two Masters degrees (in Structural Engineering and Applied Mechanics) and a Ph.D. degree in Structural Engineering. He returned to Dhaka in 1957 but in 1960 decided to go back to Chicago to resume his career as a Structural designer in the well-known firm Skidmore Owings and Merrill (SOM). He demonstrated his professional acumen and went on to become one of the best known structural engineers of the twentieth century. Engineering Newsrecord, the well-known magazine, gave him the sobriquet, "Einstein of Engineering". During the liberation war of Bangladesh in 1971, Dr. F. R. Khan mobilized support of the Bangladeshis residing in the United States and played an important role in gaining the support of influential American politicians and policymakers. In recognition of his contribution, the government honored him posthumanly by giving him Independence Award (the highest civilian award), and issued a commemorative postage stamp bearing his portrait.

The Ahsanullah Engineering College attracted many meritorious students right from its establishment. It was fortunate in receiving financial assistance from the American government in the beginning of the 1950s and had a number of faculty members from Texas A&M College (now Texas A&M University) working as Visiting Professors. They assisted in introducing the syllabi of different departments and introduced the semester and credit system, similar to that followed in the US Universities. Ahsanullah Engineering College thus became one of the first academic institutions in South Asia to introduce the semester system in the mid-1950s. Moreover, based on their suggestion, text books that were used in the American universities were introduced here as well. As part of this project, US-manufactured laboratory and workshop equipment including latest testing machines were installed in almost every

department. Furthermore, talented graduates who had completed undergraduate degrees and had secured top positions in the merit list were appointed as lecturers and sent to Texas A&M College to continue their postgraduate studies with scholarships. These students returned to the country after one or two years with Masters degrees and played significant roles in developing the academic programs of different departments. In the span of just a few years after its establishment, Ahsanullah Engineering College had made its mark as an institution for high-quality education in this region and began attracting students from various countries, including Nepal, Sri Lanka, Malaysia, and a few countries from the Middle East and West Africa.

2. Establishment of an Engineering University.

In December 1959, the National Education Commission recommended the establishment of an engineering university in each wing, viz. East and West Pakistan. Based on the recommendation, the government decided to upgrade Ahsanullah Engineering College into a full-fledged university. The East Pakistan University of Engineering and Technology began functioning on June 1, 1962 with the well-known educationist, former Principal of Engineering College, Dr. M. A. Rashid as its first Vice-Chancellor. In December, 1971, when Bangladesh emerged as an independent country, the University was renamed as Bangladesh University of Engineering and Technology (BUET).

The rapidly increasing number of development projects in the country, particularly for development of physical infrastructure, led to increasing demand for graduate engineers, which could not be met by one institution. Hence, the government decided to establish engineering colleges in various regions of the country. Upon analysis of the demand in North Bengal, an engineering college was established in Rajshahi in 1964 and it was affiliated with Rajshahi University.

The Chittagong Engineering College was established near Rangunia, Chittagong, in 1968, whereas the Khulna Engineering College was constructed in 1974. Like other public institutions, the administrative control and responsibility (e.g. appointments and promotion of faculty, development of infrastructure) of all these institutions were vested with the Directorate of Technical Education. However, academic control (e.g. syllabus, examinations award of degrees) was exercised by the universities; this dual control created several barriers. To resolve the problem, the government decided to upgrade these engineering colleges to autonomous institutions for higher studies modelled after the highly successful model of the Indian Institutes of Technology (IIT). The four existing engineering colleges were converted to BITs, viz. BIT, Rajshahi; BIT, Chittagong; BIT, Khulna; and BIT, Dhaka. Separate, but identical, Acts of Parliament were enacted for each of these BITs. A high-powered Council BITs with the Minister of Education as its Chair, was formed to coordinate the activities of the four BITs.

Unfortunately, after a few years of operation of BITs, it appeared that the major objective of granting autonomy was not being fulfilled, with most major decisions requiring approval from relevant ministries of the government. After a thorough review, the Boards of Governors of the four BITs recommended to the government to convert the BITs into Universities, similar to other public universities. The Government approved the recommendation, and in 2003, four new Acts of Parliament were enacted leading to creation of four technical universities, viz. RUET, CUET, KUET and DUET.

3. Private Universities.

As the member of students seeking admission to universities started increasing, and the government was failing to respond either by creating new public universities or increasing the intake capacities of existing universities, the government decided to allow the establishment of private universities for the first time in 1992. An umbrella Act was enacted in the National Parliament (Private University Act, 1992). Many entrepreneurs showed their interest in establishing universities during that time. The academic programs of the universities that received the government's permission in the initial phase were limited to bachelor's degrees in business administration (BBA) and computer science/engineering. The National Parliament made some amendments to the Act in 1998 and passed a new Act in 2010, explicitly including a clause which made them "not for profit" institutions. The number of approved private universities proliferated rapidly during the last few years to present total of 103.

4. Present Situation.

A total of 29 out of 42 public universities are currently involved in offering degrees in various branches engineering. In addition, undergraduate/postgraduate degrees in engineering are currently being offered at one international university and 79 out of 103 private universities. In recent years, engineering degrees have been introduced in many new disciplines, such as aeronautical engineering, leather engineering, and mechatronics engineering.

5. Quality of Education.

The number of students in tertiary education (i.e. at university level) has grown rapidly over the last few years, and the total number of students in different subjects in public and private universities and colleges has gone up to around 3 million. Currently there are undergraduate degree programmes in 23 major engineering fields. Availability of qualified faculty members in these fields, keeping pace with the increasing number of students pursuing engineering degrees, has become a major challenge. Moreover, building adequate infrastructure, including laboratory equipment, which is a prerequisite for good quality engineering education, requires large investments. Unfortunately, degrees are being offered in many universities regardless of the deficiencies in these sectors. There is a danger that students from some of these institutions would be employed by different organisations upon completion of their undergraduate studies. With this view in mind, Institution of Engineers, Bangladesh (IEB), the only professional institution for all Bangladeshi graduate engineers, established an accreditation board (Board of Accreditation for Engineering and Technical Education, or BAETE) in 2003. The prime responsibility of the Board is to ensure the minimum standards necessary for an engineering program to be accredited, which is essential for getting membership of IEB. BAETE has been accrediting engineering degree programs of public and private universities based on a specific established policy and criteria. Around 50 programs offered by various universities (both public and private) have already been accredited and 46 more are currently in the process for accreditation.

In 1989, the Washington Accord was signed in the capital of the United States to harmonize the requirements of an engineering degree program which must be met for full mutual recognition and accreditation. Countries that have full signatory status of the Accord will have their accredited programs recognized in other signatory countries. The BAETE earned provisional membership in 2013 and is taking the necessary steps to achieving full signatory status around the year 2021.

6. Postgraduate Studies.

Postgraduate studies in engineering commenced in 1963 at EPUET (at present BUET) with the admission of students into the MSc engineering degree programs of some departments. The programmes were designed in the light of US universities, i.e. students were given a choice of selecting subjects from within their areas of specialization and some courses from outside their major field of study. Total credit requirement is usually 36 credits for are M.Sc. degree, a six 3-credit courses and a thesis of 18 credits, whereas for M.Engg. degrees (mainly for practising professionals) ten 3-credit courses plus a 6-credit project. For full-time students, it requires a minimum of one year to earn a Master's degree.

Initially, the number of students interested in pursuing Masters degrees was very small. In view of the availability of assistantships and scholarships in foreign universities, students were more interested in going abroad for post-graduate studies. Thousands of Bangladeshi students have gone to some of the best universities in the world and completed their Masters and Ph.D. studies there. However, the situation has changed in recent years. Increasing number of students are getting admitted to Masters programmes in various disciplines of engineering in Bangladeshi universities.

BUET started offering PhD programs around the end of the 1970s, and the first PhD degree was awarded in the year 1982. Soon after this, many other public universities, besides BUET, began offering PhD programs as well; however, the number is small. One of the reasons is that if a student completes his/her post-graduate studies abroad, it is easier to find employment outside the country after obtaining the degree.

7. Conclusion.

Engineering education in Bangladesh is witnessing a rapid growth, particularly at the undergraduate level. After the first female student graduated in 1968 from the Department of Civil Engineering, BUET, many female students are also becoming attracted to engineering education. Engineering graduates from Bangladeshi universities have proven that their level of competence is upto international standards and have earned reputation while working in the country and abroad. The success of BUET graduates in the academia is reflected in some of them being elected to prestigious learned societies like Royal Academy of Engineering, UK, Royal Society of Canada and the National Academy of Engineering, USA.

The BAETE, established by IEB has accredited many programs following internationally recognized criteria and expects to receive full signatory status of the Washington Accord in the near future. This will lead to more universities being motivated to strive to continuously improve the quality of education with the aim of achieving global professional recognition. This will enable them to produce competent engineers who can be entrusted with solving complex engineering problems.

The academic activities at the postgraduate level have not made much progress although qualified faculty members and the necessary infrastructure are available in many institutions to offer Master's and PhD degrees. From a national perspective, it is extremely important to strengthen these activities, so that various technological problems being faced by the country are solved by researchers in Universities and R&D institutions.

ARTICLE

REFURBISHING THE ENGINES OF ENGINEERING EDUCATION IN BANGLADESH: A VISIONARY APPROACH

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REFURBISHING THE ENGINES OF ENGINEERING EDUCATION IN BANGLADESH: A VISIONARY APPROACH

Bangladesh is looking forward to standing as a developed nation in the next few decades. Infrastructure will be a key feature in this targeted prosperity - planned, designed, constructed, operated, maintained and rehabilitated by engineers. These professionals need to be better equipped in the profession than with the knowledge acquired by our engineering education system, introduced at least seven decades ago. When the world's knowledge base and societal needs are continually evolving, the current vision of our nation and the entire world needs to be reflected in the engineering education system. Have we enabled our engineers to solve emerging problems of our society and bestow their innovations in each domain of higher education learning objectives? Imparting better quality and ability in the engineering education system that will measure outcomes against professional and societal needs can only bring efficiency and sustainability to the national development process. We want to see future engineers think big and think far with the knowledge that has evolved in the last few centuries, from steam engines to electrical power to digital spaces and machine intelligence. Empowering the individual with such capacities can bring innovation to the economy.

Our future engineers must be agile in responding to the revolutionary needs of society. Modern engineering education does not need to merely address the demands of industrial revolution, but needs to fit the necessities of the digital age or Internet of Things. They need to integrate multidisciplinary knowledge: an engineer who can roll with the fast pace of ever-changing situations where cities are growing, needs are increasing, the population is rising, and competing demands between food and necessities are steaming up. Society wants to see them as the vanguards of change. They need to have the capability to link stakeholders of different infrastructures and work with partners in the public and private sectors. Infrastructures in Asia have to serve a population that is more diverse, scattered, but unique in terms of wealth and culture. ASEAN countries have a fast-growing middle class segregated by sea with a scattered land mass—much different than our South Asia where social and rich cultural diversities exist. The role of the future engineers is to link up regional stakeholders in order to integrate and connect to future world scenarios.

Emerging engineering leaders from academia and industry will devise global engineering programs that tie theory to application in the industry. Future engineers will have deeper internships to learn and appreciate the work environment and its complexities. Students need opportunities to learn from cross-disciplinary areas and have cross-border experiences. The curricula need continual updating to address the product, processes and systems so that solutions can be achieved after a fruitful integration. For example, the design of an aquarium will need expertise in materials, structure, fluid mechanics, aquatic chemistry, environmental laws, submerged soils and food for various fish. A large fun of knowledge needs to be connected for sustainability and innovation.

Through a proper assessment procedure followed by the purveyors of outcome-based education, business owners can have confidence in their potential future employees. They will then be able to bridge engineering, business and liberal arts for a new technical landscape by embracing innovation. Our engineers should have skills and attitudes for lifelong learning, and our industries will need to have transformation maps to scale the ladder of progress. They will embrace technology and innovation by addressing real-life problems, connecting employers and employees by knowing with whom to collaborate. Our engineers will be the vanguard of change with seamless connectivity. They will optimize individual networks to transport ideas and means to develop interfaces for interconnectivity for resilient and lasting development. They will know the ways to mitigate and adapt to situations in Bangladesh where low-lying civilizations are more vulnerable. Vulnerability can be decreased with greater collaborative input. Bangladesh, a small but densely populated country, well known for big rivers and rains, is struggling to assure water for human consumption, agriculture and industry. Engineers in Singapore and Japan are now overcoming similar challenges of water and land by looking forward at their vast shorelines. Our future engineers will make design decisions for long-term implementation that will help them to reduce emissions and tap into renewable resources, increasing the landmass and economic merits of the Bay of Bengal. They will harness emerging green resources and be drivers of innovations for lasting development in the forthcoming Fourth Industrial Revolution with new growth and opportunities. They will develop engineering solutions in digital space with well–trained, creative engineers having attitudes of lifelong learning. They should be able to appreciate why an airport terminal is different from a cargo complex in terms of social demands in the competitive world.

Any investment in infrastructure is not free from disputes. The engineers need to have the capacity to manage disputes up front by reducing friction before entering courtrooms or arbitration. They will adopt comprehensive dispute management mechanisms to minimize time and cost overruns. Lawyers with engineering knowledge in architecture and planning, specification and quantity surveying will be needed. A project with access to a set of experts will reduce disputes at earlier stages, working under an infrastructure dispute management protocol.

Safety is a mandatory requirement. Lack of health and safety culture in educational institutions may mean that graduates will not be conscious about health and safety measures. They may become engineers who are not sensitive to health and safety risks in their future work environments.

To achieve all these striking outcomes, the necessity of embracing outcome-based education is evident. Engineering education in many countries in Asia and the Pacific has embraced a qualified accreditation process much earlier than South Asia, ensuring quality through outcome-based engineering education. This focuses on the forest, not just the trees, planting the trees to have a forest for future renewable resources. Their engineers are better equipped in solving complex engineering problems that involve wide-ranging or conflicting technical, engineering and other issues, or have no obvious solution and require abstract thinking and originality in analysis. Our engineers must be able to formulate suitable models, think outside the problems encompassed by standards and codes of practice for professional engineering, and work with diverse groups of stakeholders with widely varying needs. They must solve problems that have significant consequences in a range of contexts, include many component parts or sub-problems or require research-based knowledge, informed by the forefront of the professional discipline and allowing a fundamentals-based, first-principles analytical approach. They will be able to analyze complex problems to achieve practical solutions.

Finally, we need to recruit more talented young people to join the procession of innovative engineers who will shine in the domains of knowledge, skills and attitudes. Considerable opportunities are also there to convert the country's additional human resources into world-class engineers for the world market to greatly scale up the national earnings from the international market.

ARTICLE

REVAMPING ENGINEERING EDUCATION IN BANGLADESH

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REVAMPING ENGINEERING EDUCATION IN BANGLADESH

Historically, engineers have been of great importance to any society, and their importance is only likely to increase over time. On the other hand, the world is experiencing the creation of various innovative jobs; machines do many traditional jobs and the talk of future and futuristic jobs now becomes an important subject. Practically robots have taken over thousands of routine tasks and will eventually eliminate many low-skill jobs in developed and many developing countries. At the same time, technology creates opportunities, paving the way for new and altered jobs, increasing productivity, and improving the delivery of public services. When we consider the scope of the challenge of preparing the workforce of the future, it is important to understand that many children currently in primary school will work jobs as adults that do not even exist today. That is why we must emphasize the primacy of human capital in meeting a challenge that, by its very definition, resists simple and prescriptive solutions. Many jobs today and many more in the near future will require specific skills: a combination of technological know-how, problem- solving, and critical thinking as well as soft skills, such as perseverance, collaboration, and empathy. The days of staying in one job or with one company for decades are waning. In the gig economy, workers will likely have many gigs over the course of their careers, which means they will have to be lifelong learners. The need of the hour is to revamp the engineering education system in Bangladesh to create skills that are actually of use to graduates in modern jobs.

The traditional education (TE) system cannot help learners effectively implement their learned knowledge in real-world environments. Moreover, the TE model does not inspire learners to devise their own approaches to solving problems. Instead, the TE model gives students very little say in what they learn. The only way to gain knowledge is to follow a set curriculum in a set order. Curriculum design focuses on the transmission of discrete pieces of information and does not set any outcome goals. Teachers mainly focus on effective delivery of course topics and do not help students develop competencies and achieve mastery. They do not monitor each student's academic progress. Therefore, TE model is designed for mass consumption rather than individual needs, learning styles, and outcome goals. This trait suppresses the creative side of learners' personalities, so they never get to know their strengths. Therefore, a new system that will produce skills, competencies, and innovation is needed. In addition to imparting knowledge, academic institutions need to focus on developing students' communication skills, entrepreneurship, innovation, and creative systematic thinking. Unfortunately, engineering education in Bangladesh has changed little even though many new engineering fields have been created since Bangladesh emerged as an independent country in 1971. As universities in Bangladesh employ TE system they have failed to produce highly skilled graduates with innovative qualities, so the business community hires foreign experts instead of employing local graduates. Now, over eighty-five thousand foreign people work in different capacities in Bangladesh and remit over $2 billion. Graduates with high-level skills and innovative qualities will not only be successful at their jobs but will also prove themselves as successful entrepreneurs and create innovative technology-based businesses. Our universities must, therefore, adopt a radically different approach to undergraduate engineering education. Approximately three million educated workers enter the job market each year. Providing employment opportunities to such a huge population is a difficult task for the government and the local private sector. It is, therefore, imperative for institutions to mentor youths for entrepreneurship and encourages them to develop high-level skills and competencies to become employable in national and international job markets. Innovative youths will create jobs for themselves.

Undergraduate engineering education needs renovation aimed at (i) an educational approach that is underpinned by design synthesis and innovation, (ii) educational delivery that integrates effective and appropriate modern pedagogical approaches supported by a flexible curriculum and (iii) an educational structure that reflects the challenges facing engineering in the 21st century. Today's pedagogy is teacher-centered, not student-centered as it should be. Our students are aware of what will be required of them in the future and the skill sets they will need. Therefore, we should come alongside them in their education to give them those skill sets. The curriculum should emphasize the importance of student choice, multidisciplinary learning, and its societal impact so that students are exposed to a breadth of experiences outside the classroom, outside the traditional engineering disciplines, and around the world. The globally accepted guideline for curriculum design is that an engineering program's curriculum should target predetermined program educational objectives (PEOs). Each program has program outcomes (POs) and individual course learning outcomes (CLOs). PEOs must align with the institution's vision statement and end with

the assessment of each student before and after graduation. PEOs are broad statements that describe graduates' careers and professional accomplishments. Although PEOs focus on performance well after graduation, it is possible within an undergraduate program to identify the skills, attitudes, and understanding that underpin these long-range objectives. On the other hand, POs must be achieved during the academic program. The design of each course, the selection of instructional methods, and student assessment are based on these statements. Moving from a statement of objectives and outcomes to deciding on and implementing a program and relating individual courses to the curriculum requires careful planning. If, for example, speaking skills are identified as a basic competency that every student must possess by graduation, public speaking must be initially taught and then reinforced, and no student should be able to graduate without receiving appropriate instruction and practice in this skill. Courses must be analyzed to identify where this skill is introduced and reinforced, and the curriculum must be structured so that every student has the opportunity to acquire speaking skills. In the case of developing speaking competency, required courses will most likely be those with smaller enrollment or lecture courses with associated discussion sessions. Developing and using interpersonal skills, problem-solving, critical thinking, and basic statistics are widely listed core objectives and can be integral parts of most courses. At every institution, the final determinant of academic program quality is the performance of its graduates. Their success depends on how well the curriculum is delivered through its courses and other learning experiences provided to students. Every student must have the opportunity to reach and demonstrate every stated basic competency. Carefully articulated learning outcomes must be the basis on which instructional methods are chosen and the criteria by which competency is measured. The effectiveness of an institution or program and of individual faculty members is then determined by the ability of students to meet these objectives and outcomes. At the same time, not all students will reach these goals because their attitudes, willingness to work, and abilities also play an important role in determining success. An institution's responsibility is to do all it can to facilitate learning and to give each student a fair opportunity to succeed.

Universities such as the Singapore University of Technology and Design (SUTD), the Pontifical Catholic University of Chile (PUC), Charles Stuart University (Australia), University College London (UK), Delft University of Technology (Netherlands), and Olin College of Engineering (USA) have been identified as emerging leaders worldwide (MIT report, March 2018). These universities align their academic programs with the goals of national governments and higher education, delivering student-centered learning to large student cohorts and setting up faculty appointment and promotion systems that better reward high-quality teaching. They are successful in integrating student-centered learning with a curriculum oriented to the pressing challenges of the 21st century—societal, environmental, and technological. Their governments make major investments in engineering education as an incubator for the technology-based entrepreneurial talent that will drive national economic growth. With an emphasis on interdisciplinary, hands-on learning and strong connectivity with the industry, emerging universities also offer 'a new future-oriented educational approach' designed to nurture technology-driven entrepreneurs and inspire future generations to pursue careers in science and engineering. Each emerging university has nurtured an environment where creativity can flourish. The quality of its students bears testimony to the success of its approach.

The type of education that I have described is rather expensive and demands significant faculty participation. University authorities in Bangladesh ought to make substantial investments in developing and running this system. Before implementing this education system, teachers must be properly trained by experts in this field. Otherwise, universities cannot succeed. Universities must also value teaching excellence, such as the quality and pervasiveness of faculty training in education or the extent to which it is recognized in faculty career progression.

ARTICLE

BANGLADESH ARMY CORPS OF ENGINEERS DEVELOPING ICONIC MEGA PROJECTS IN BANGLADESH

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BANGLADESH ARMY CORPS OF ENGINEERS DEVELOPING ICONIC MEGA PROJECTS IN BANGLADESH

INTRODUCTION

In recent years, the project management endeavors of the Bangladesh Army, particularly the Corps of Engineers, have flourished, reaching new heights of sophistication to meet the challenges of the contemporary economic environment. The epitome of inspiration, the Corps basks in its motto "always and everywhere." It has mastered the art and science of handling complex and time-constrained assignments using an interdisciplinary approach, moving beyond the combat sphere to contribute to nation building through civil works and development initiatives. Experience in constructing roads in hilly terrain has pushed the learning curve to continue with an upward trajectory towards attempting approach roads at Padma Multipurpose Bridge, Begum Rokeya Bypass Road, Marine Drive and similar projects. These projects not only suggest the highest level of quality, but many of them reached completion well ahead of the budgeted timeframe. The Corps now enjoys the support and confidence of various government echelons for fast-track critical and challenging projects that require innovative project management skills and superior techniques.

A project in the economic sense directly or indirectly contributes to the economy of Bangladesh. However, introspection regarding project performance indicates that the situation often is far from satisfactory. Most major critical projects in the public sector, particularly in crucial sectors like infrastructure, are plagued by tremendous time and cost overruns. The Corps of Engineers has triumphed over those constraints through proper utilization and cross-linking of all government-owned components and machinery to achieve the desired outcome. Thorough analysis encompassing available alternative technologies, selection of the most appropriate technology in terms of optimum combination of project components bolstered by devotion and relentless hard work are the virtues of the Corps' successful projects. The timely implementation of mega projects like Hatirjheel and Mirpur Flyover testify to the eminence of the aforementioned competency. Let us look at few successful initiatives by the Corps of Engineers.

INTEGRATED DEVELOPMENT OF THE HATIRJHEEL AREA, INCLUDING THE BEGUNBARI KHAL PROJECT

Over the years, the Hatirjheel area was encroached upon by illegal occupants, and the wetlands were filled up, reducing storm water retention capacity. The calamitous consequences for adjoining areas included inundation, waste and pollution. To resolve this appalling state, the government initiated the project "Integrated Development of the Hatirjheel area including Begunbari Khal" and assigned the Bangladesh Army Corps of Engineers to spearhead

the initiative. The major objective was to ensure the protection of 311 acres of land for storm water retention to fight inundation and reduction of accompanying environmental hazards.

While planning for this challenging project, it was realized that the Hatirjheel project could alleviate local traffic congestion and connect an important East–West link between two major arterial roads by constructing a peripheral road and walkaway systems. In addition, a unique waterfront park and a green space for urban residents was appealing to consider.

However, there were major hurdles to overcome, such as maintaining the water quality of the low-lying areas behind the Sonargaon Hotel and the Hatirjheel area at an acceptable level. Due to the presence of uncontrolled, untreated domestic sewage and industrial wastewater disposal within and around the area, restoration of water quality to the desired level emerged as a major challenge. In addition to the main diversion sewers, the project also planned local sewers to divert domestic sewage discharged into project lowlands. Three deep tube wells (DTWs) and DTW pump stations were necessary. The project also planned to lay water supply lines (mains) along the peripheral roads. A special sewage diversion structure (SSDS) at each of the 11 major storm sewer outfall locations was planned as well.

The relentless work continued, and Hatirjheel's dreams became a reality. Hatirjheel now acts as a storm water retention basin for the surrounding area and prevents waterlogging during the rainy season. The project also successfully diverted both liquid and solid waste, which were detrimental to the environment, and it reduced traffic congestion citywide and prevented illegal encroachment. The right initiative from the government, accompanied by good teamwork and generous support from all quarters have made the project successful. With the successful implementation of the project, Hatirjheel offers a rare, refreshing environment to the residents of Dhaka and has now become the largest surface water body in the city. Once a symbol of environmental degradation, Hatirjheel now symbolizes a remarkable success in environmental restoration.

REHABILITATION OF THE MEGHNA AND MEGHNA-GUMTI BRIDGE SUPERSTRUCTURES

The two bridges over the Meghna and Meghna-Gumti Rivers on the Dhaka–Chittagong highway (N1) are part of the essential road link between Dhaka and Chittagong. A two-lane undivided highway (presently being upgraded to four-lane divided highway) forms the only direct road link between the two cities. The Meghna Bridge and the Meghna-Gumti Bridge are two-lane bridges some 12 km apart on this important road. They serve more than 20,000 vehicles a day, many of which are overloaded. The bridges have deteriorated significantly over the years due to a virtually non-existent maintenance program, posing a threat to safety and serviceability. Both bridges' mid-span hinge bearings had worn out, and the deck expansion joints made of reinforced rubber had all but disappeared. In addition, at the Meghna Bridge, river bed scour occurred, exposing the pile caps and piles and increasing free length of the cantilever piers.

It was no surprise that the bridges were visibly distressed. The deck deflected and vibrated significantly as heavy vehicles passed over the joints, the piers swayed, and riding over the expansion joints became bumpy and dangerous. The Roads and Highways Department (RHD) took immediate measures, including prohibiting the passage of vessels between piers affected by river bed scour and makeshift arrangements for temporarily stabilizing the superstructures. Steel plates and rubber sheets were also installed over the deteriorated expansion joints, and steel plates and rubber packing were inserted in gaps in the hinge bearings created by worn out pot bearings.

The government plans to construct two new bridges adjacent to the existing ones to serve the new four-lane highway. Continued performance of the old bridges is essential until the new bridges are commissioned. Thereafter, a retrofitting of the existing bridges may be undertaken to strengthen them and to give them a new lease on life. Rehabilitation works included river bed correction and pier protection using sand bags and sand filled geobags for the Meghna Bridge, replacement of expansion joints with a more permanent type of joint for both Meghna and Meghna Gumti bridges, and replacement of pot bearings in hinges inside the box girder deck and rehabilitation of the hinge bearings for both bridges.

Additionally, it was planned for the bridges to have a facelift that included repair of worn courses and road markings, replacement of light fittings and electrical lines, repair of railings, and painting. The plan for the rehabilitation work, including the design of new expansion joints and material and methods for hinge bearings, was formulated by the Corps of Engineers.

The job was successfully completed, and the bridges were reopened to traffic in March 2013.

FLYOVER AND OVERPASS PROJECT

It was conceived that a road linking Mirpur and Airport Road through Dhaka Cantonment would facilitate a shorter commute between the greater Mirpur area and Airport Road, Gulshan, Banani, and Tongi. A road from Mirpur to Airport Road had the potential to reduce travel distance from 11 km to only 3 km. At the Banani rail crossing, more than 72 trains pass, and the gate remains closed for about 5 minutes. During that time, heavy vehicle congestion occurs, causing traffic jams and lost work hours. Therefore, the government decided to construct an overpass at this critical rail crossing and assigned the task to the special work organization (SWO) of the Bangladesh Army.

There were three main components of Flyover and Overpass Project:

- **Flyover at Mirpur-Airport Road:** Consisting of four ramps and one trumpet interchange, this four-lane flyover with four-lane ramps (two lanes in some places) had a length of 1790 m and width of 15.52m.
- **Overpass at Banani Rail Crossing:** Consisting of four lanes with two ramps, this overpass had a total length of 804 m and width of 15.52 m.
- **Link Bridge:** A part of this project connects the overpass with the flyover at Zia Colony MP CP to facilitate traffic to the Mirpur area from Banani. Its length is 562m, and its width is 6.7 m.

The flyover at Mirpur-Airport Road and the overpass at the Banani rail crossing have tremendous

influence on the surrounding areas. The construction of a link road and flyover at Mirpur resulted in the regeneration of the area, developing Mirpur into a vibrant new commercial city.

ROLE OF THE BANGLADESH ARMY IN THE CONSTRUCTION OF PADMA MULTIPURPOSE BRIDGE

The Padma Multipurpose Bridge Project (PMBP) is Bangladesh's dream infrastructure project. In the inaugural ceremony of Hatirjheel project, the Corps of Engineers proposed the idea of supervision by its engineers and experts. The idea received further momentum when the Honorable PM initiated the formulation of a team incorporating the Bangladesh Army Corps of Engineers, BUET, BBA and other experts. This was the first time the Bangladesh Army assumed the role of construction supervision consultant.

The Bangladesh Army has successfully completed its supervision consultancy of three packages of the PMBP in the format of FIDIC rules. The progress of the work and the quality of consultancy has already been praised due to the devoted role of the CSC-1. In addition, the Bangladesh Army's composite brigade is providing continuous security to personnel and materials, including local and foreign experts.

The mega structure is being constructed in 5 packages. Among those 5 packages, the contractor of first 3 packages is AML-HCM (JV), and consultants include the CSC, Bangladesh Army, in association with BRTC ofBUET. The main bridge contractor is China Railway Major Bridge Engineering Group Co., Ltd., and the river training works contractor is Sinohydro Corporation Ltd., China.

Technical Challenges and Mitigation

During the execution phase, many problems surfaced, all of which have been addressed prudently and conquered efficaciously.

Bitumen Quality Control: Bitumen is a complex hydrocarbon compound which demands optimum viscosity. The consultant initiated viscosity tests for the bitumen and, accordingly, penetration grade bitumen was sent to the USA, Singapore and BUET. The viscosity test results from all laboratories met the specification and was approved for incorporation into asphalt concrete works.

Breaking of Pile Head Reinforcement: During the pile head breaking process, some 32-mm diameter rebar was broken at Shikderkandi Bridge (Approach Road 1). This was due to a problem with the ductility of the rebar. To overcome the problem, rebar retrofitting was planned and carried out following a jacketing method to attach new rebar to the broken rebar. An additional layer of reinforcement was provided by drilling inside the pile with advanced bonding material.

Embankment Settlement: Settlement was a serious problem and delayed the completion of embankment construction. However, various methods, such as sand compaction pile and preloading, were successful in treating the soft soil. SPT values before and after the treatment showed that the bearing capacity of the soil improved significantly.

Corrosion of Expansion Joints: Within 3 months of installation, corrosion was seen in some parts of the expansion joint. The matter was further investigated by the BUET team, which determined that the expansion joint material did not comply with ASTM A242 specifications as claimed by the manufacturer. However, it was suggested that the expansion joint could still be used with continuous monitoring and maintenance.

The completion of PMBP will be a testament to Bangladesh's ability to handle mega projects. The Bangladesh Army involved itself from the beginning

and completed 3 PMBP packages within the budgeted timeframe. Completion of the approach roads and associated facilities has emphasized that Padma Bridge is no longer just a distant dream. Technical challenges faced during project execution were handled professionally by the CSC team. Specifications, drawings, BOQ, terms of reference, contract documents, and other items were analyzed properly at every step. In addition, POE also provided timely decisions when needed. Through concerted effort, the Bangladesh Army carried out its responsibilities with the utmost sincerity and dedication.

PADMA BRIDGE RAIL LINK PROJECT (PBRLP) - A MAJOR MILESTONE

The Padma Multipurpose Bridge features four lanes for road traffic on its top deck, and the bottom deck supports a broad-gauge single railway track for connecting direct rail service from Dhaka to Jessore, Khulna, Benapole and Mongla. With a view to connect Dhaka with the southwest part of the country quickly, construction of a rail link between Dhaka and Jessore received priority. Bangladesh Railway (BR) engaged the construction supervision consultant of the Bangladesh Army for the PBRLP, and the Chinese government funded the project under the G to G loan assistance program.

The scope of the project included construction of new broad-gauge 172-km main line and a 43.02 km-loop and siding line (total track is 215.02 km, including loops and sidings), along with 21.86 km of viaducts, 1.98 km of ramps, 66 major bridges, 224 minor bridges/culverts/underpasses, 1 pedestrian underpass, 1 road bridge at Maowa approach, 30 level crossing gates and 14 new station buildings. Six existing station buildings were remodeled. The scope also included installation of a computer based interlocked signaling system with color light signals and digital telecommunication systems at 20 stations, acquisition of 1481 acres of land, implementation of RP and EMP and supply of 100 BG passenger coaches.

The CSC's main functions included the supervision of the efficient and economic construction of the rail link for all four sections of the PBRLP, consistent with internationally accepted standards and practices. The CSC of the Bangladesh Army Corps of Engineers, in association with experts from BRTC of BUET and domestic and foreign experts, is to carry out the tasks covering the pre-construction, construction and post-construction stages of the project contracts.

JOLSHIRI ABASHON: A VISION TO COMMITMENT

Jolshiri Abashon, an ambitious housing project aimed at proving housing for military officers, was undertaken using a balanced approach that incorporated comprehensive and careful planning that preserved the settlements of indigenous residents. The overall goal for Jolshiri Abashon was to create an intelligent and sustainable model city with superior planning, urban design and environmental management. Jolshiri would be a smart city that offers unrivaled comfort and security for its residents. Within a short time, huge areas of low-lying barren land were filled up with sand simultaneous with pre-survey, lake-cutting, leveling and plot marking. Fifteen kilometer of artificial lake was made to maintain an improved catchment storage for surface runoff and maintain a smooth natural flow up to the river. It was the largest water modeling in the history of any development works in Bangladesh, and the Corps of Engineers was at the forefront with the highest professionalism and innovation to address all challenges. Some major considerations included detailed surveying, hydrological assessment and detailed profiling and drainage systems. Jolshiri is a dream project of the Bangladesh Army, and it is well on its way to achieving excellence in sustainability, efficiency and livability.

CONCLUSION

The Bangladesh armed forces have come a long way since the Liberation War in 1971. The armed forces have emerged as a well-developed asset capable of not only performing the primary role of defending the country's frontier from external aggression and internal subversion, but also increasingly and successfully assisting with the task of nation-building. The Bangladesh Army Corps of Engineers has rightfully earned the confidence of the government and people as beacon of mega projects regardless of size or magnitude. In peace and in war, at present and into the future, the Corps of Engineers remains relevant to the nation's goals and objectives.

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A Blue Economy can be built to serve two prime purposes: Japan and Norway being the best examples, with their reliance on offshore fishing for their dietary requirements, as well as offshore oil and gas extraction for energy production.

A more cogent and relevant case for Bangladesh, is the second option, which is building vast coastal manufacturing hubs to employ its huge underemployed and unemployed manpower. Such hubs will have huge port facilities for the import of raw materials and export of finished products. A coastal manufacturing hub will have its own supporting townships, power generation and other utilities, as well as social and business amenities.

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For Bangladesh market, CCCC has always paid high attention to it and the relationship can be dated back to early 1990s, when China Road and Bridge Corporation (the main component of current CCCC) is awarded as the contractor for the Six China Bangladesh Friendship Bridge. Lateron, CCCC has successfully executed projects like Repair of Cracks with Epoxy and Providing CRFP, Damping Proofing, Mastic Asphalt Wearing Course on the Bridge Deck of Bangabandhu Bridge, the Repair of Cracks inside the Box Girder of Bangabandhu Bridge, Operation and Maintenance of Bangabandhu Bridge in Five Years. And CCCC now is constructing the First Tunnel of Bangladesh in Chattogram with 30% of work completed till end of 2018.

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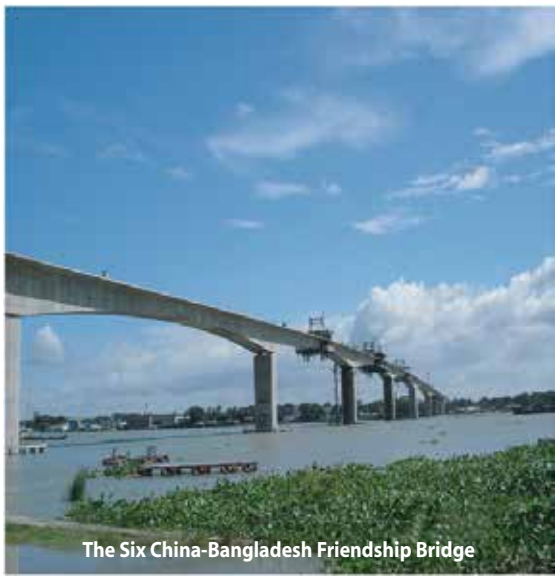
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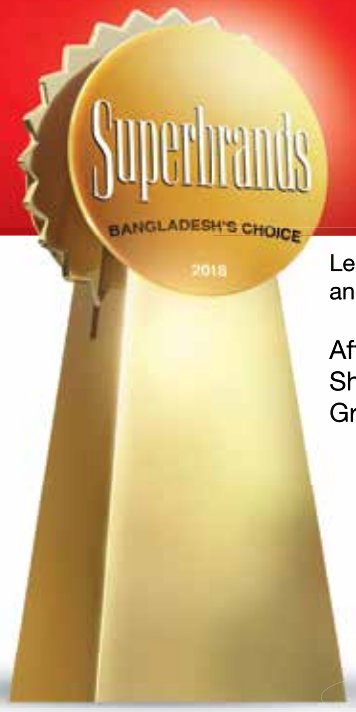

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