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# The Engineering Graduate Training Scheme of the Hong Kong Institution of Engineers—Fulfilling the Purpose of Training Civil Engineering Graduates to Become Professional Civil Engineers*

W. H. FOK
*WH Fok Professional Services, Unit A 20/F, Nine Queen's Road Central, Central, Hong Kong. Email: whf@whfok.com*

*For more than two decades, the Hong Kong Institution of Engineers has been administering its Engineering Graduate Training Scheme 'A' (Civil) for the purpose of transforming graduates of accredited civil engineering degree programmes to become professional civil engineers through supervised or controlled training. A study on whether the training scheme is fulfilling this purpose was performed. This included the identification of the range of qualities that a professional civil engineer should possess and the evaluation of whether the training scheme can ensure trainees acquire all these qualities to an acceptable level.*

**Keywords:** training scheme; training objectives; knowledge; experiences; competencies; qualities; continuing professional development (CPD); engineering supervisor; professional assessment; qualification; standard

## INTRODUCTION

THE ONLY RECOGNIZED formal training scheme of its kind in Hong Kong provides controlled and supervised training to graduates with accredited civil engineering degrees. Through this Engineering Graduate Training Scheme 'A' (Civil) of the Hong Kong Institution of Engineers (referred to as the Training Scheme), graduates can acquire the required competencies of a professional civil engineer quicker than those who are not so trained. Upon successful completion of the course and a further year of professional experience, the trainee is eligible for professional assessment, leading to corporate membership of HKIE which is recognized as of equivalent professional status as Chartered Civil Engineer in UK.

The Training Scheme has three major elements. It includes practical experience in design office and on site, meeting of training objectives through practical experience and participating in continuing professional development (CPD) activities.

The Training Scheme is comparable to some established similar schemes in terms of academic prerequisite for commencement, anticipated duration of relevant experience, competencies or training objectives to be achieved, commitment to CPD activities and the tight control of the process through traceable training records. They include the Company Approved Training Scheme of the Institution of Civil Engineers, the Individually Managed IPD of the Institution of Structural Engineers, the Graduate Training Programme/IPD of the Institution of Engineers Ireland, the Professional Development Programme (PDP) of Engineers Australia (formerly known as the Institution of Engineers, Australia) and the Competency Development Programme of the Institution of Professional Engineers of New Zealand [1].

Although the Training Scheme has been generally reviewed about once every three years, there was no comprehensive study on whether it is fit for training civil engineering graduates to become professional civil engineers. There was no significant change in its process and contents since its inception in 1984.

However, several rounds of extensive reviews on the national policies of training engineers in UK have taken place in the last three decades. The Institution of Civil Engineers has been revising the training objectives of its engineering graduate training scheme, from which the Hong Kong Training Scheme was originated, to suit the policies whenever a new set was published. It would be useful to see the sequence of events in relation to the developments of engineering training/qualification policies in UK, as summarized in Table 1, and its effects on the training of civil engineering graduates.

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Table 1. UK civil engineering training/qualification—sequence of events

| Year | Event |
|---|---|
| 1818 | The Institution of Civil Engineers (ICE) was formed. |
| 1828 | The ICE received its Royal Charter. |
| 1962 | 13 Chartered engineering institutions established the Engineering Institutions Joint Council to represent all professional engineers. |
| 1965 | The Engineering Institutions Joint Council changed its name to Council of Engineering Institutions (CEI) on acquiring its own Royal Charter and introduced the title 'Chartered Engineer'. |
| 1974 | A degree in engineering (or equivalent education standard) became mandatory for registration as Chartered Engineer |
| **1975** | Chilver Committee in its report (**The Chilver Report**) for ICE outlined the required competencies of civil engineers and routes to achieve them. |
| **1980** | Finniston Committee in its published report (**The Finniston Report**) recommended the setting up of a statutory engineering authority to regulate the engineering profession, noting that the profession was the key to economic well-being of the UK. The system of four part acquisition of knowledge of engineering application (EA1, EA2, EA3, EA4) was introduced. |
| 1981 | The Engineering Council (EC) was formed with Royal Charter to replace CEI |
| **1984** | EC published the policy statement Standards and Routes to Registration (**SARTOR**) |
| **1990** | EC published the second version of SARTOR (**SARTOR2**) |
| **1997** | EC published the third version of SARTOR (**SARTOR3**). MEng (or equivalent academic standard) became mandatory for registration as Chartered Engineer |
| **2003** | EC published the UK Standard for Professional Engineering Competence (**UK-SPEC**) to replace SARTOR |
| **2006** | ICE replaced 2000 series documents by **3000 series** to match UK-SPEC directives. |

## DEVELOPMENT OF CIVIL ENGINEERING TRAINING AND QUALIFICATION IN THE UK

The concept of regulating and upholding the quality of engineers through the functions of professional institutions started when the Institution of Civil Engineers was formed in 1818 as the first professional body of its kind in the world. Its significance was recognized soon after and it was granted the Royal Charter in 1828. Since then, institutions representing different engineering disciplines have been established and later some of them formed joint organizations for the betterment of the related engineering practice and development. One great step was the introduction of the title 'Chartered Engineer' shortly after the Council of Engineering Institutions (CEI) received its Royal Charter in 1965, thus enabling people to refer to a commonly recognized standard of competency for engineers.

### *Chilver Report*

Noting the vital role it would be playing in setting the qualifying standard of civil engineers, the ICE appointed A. H. Chilver to chair a committee to examine the broad education and training requirements for civil engineers. The committee's findings (Chilver Report) was formally published by the ICE in 1975 [2]. The report affected much of the civil engineering profession at the time as it was the first instance that professional competencies of civil engineers were specified and the routes to achieve such competencies were suggested in a structured manner. For admission to membership of the ICE, one had to meet the following criteria:

(a) possession of sound scientific knowledge and understanding of civil engineering principles beyond first degree level;
(b) ability to put knowledge to creative and imaginative use;
(c) ability to benefit from experience;
(d) possession of good engineering judgement and sound common sense;
(e) ability to work independently, reliably and responsibly;
(f) ability to organize, administer and control the work of others;
(g) ability to communicate with others within and beyond engineering environment;
(h) active interest in corporate life and development of the profession.

In order to meet these criteria, a graduate must learn:

(a) the purposes of investigations, feasibility studies, comparative assessments, and how to apply their results to solve problems;
(b) how to define problems clearly and to understand the appropriate processes for their solutions;
(c) how to apply theoretical knowledge to prepare detailed designs that meet specific practical demands;
(d) the value of good engineering judgement;
(e) the principles of organizing an efficient design office and the control of its output;
(f) the major factors such as cost, safety, environmental and resource conservation that influence design;
(g) estimating and methods of measurement;
(h) relevant statutory requirements, standards,

codes of practice and regulations that affect design.

And that apart from design work, practical training should also cover the following:

(a) planning, programming and reporting project work;
(b) progressing projects, setting out, inspection and measurement of works, variations, safety and safe working;
(c) contractual relationships including those between employers, engineers, contractors and the public;
(d) specifications;
(e) methods of construction and the use of mechanical plant;
(f) labour relations and people management;
(g) preliminary budgetary control, costing, finance and accountancy.

Although the implementation of lengthy training and process of qualifying as suggested by the Chilver Report was not well-received at the time, the professional competencies as listed above became the basis of training civil engineers. The further development of competencies during an engineer's career through continuous learning by experience and keeping oneself up-to-date with the advance of knowledge as stated in the report laid the foundation for the concept of CPD.

*Finniston Report*

Two years after the publication of the Chilver Report, Montague Finniston was invited by the then Secretary of State for Industry to chair a committee to carry out an extensive inquiry into the engineering profession, as it was believed that it was key to the well-being of the then declining manufacturing industry. The committee submitted its report (the Finniston Report) [3] after deliberating over 700 written submissions of evidence from individuals, organizations and institutions together with views collected from 16 open meetings organized by CEI and 46 company visits.

The Finniston Report identified general agreement that an engineer cannot be trained by academic studies alone, and that it was crucial to have industrial training and work experience. Employers should accept responsibility for this, but it was not happening too often. With this finding, the report recommended the setting up of a new authority to establish and regulate the rules and policies in relation to the training of engineers of all disciplines. It also defined a four-module system in the acquisition of engineering knowledge:

(a) EA1—Introduction to fabrication (properties) and use of materials;
(b) EA2—Application of engineering principles to the solution of practical problems based upon engineering systems and processes;
(c) EA3—Structured introduction to industry involving a range of practical assignments under supervision;
(d) EA4—Specific preparation for a post carrying responsibility for a period under decreasing supervision.

With this framework, EA1 and EA2 can be acquired in accredited engineering degree programmes whilst EA3 and EA4 can be acquired during practical training and experience after graduation. Most UK engineering institutions as well as the HKIE now follow this framework.

The report also expressed and reinforced the need for systematic continuing formation of engineers through CPD activities of various kinds.

*Standards and Routes to Registration (SARTOR)*

Following the suggestions of the Finniston Report, the Engineering Council (EC) was established with Royal Charter in 1981 to replace the CEI. Apart from inheriting most of the functions of the CEI, the EC reviewed the policies on education, training and qualification of engineers and published Standards and Routes to Registration (SARTOR) in 1984 [4]. A second version of the policy statement (SARTOR2) was published in 1990 [5] and the third version (SARTOR3) was published in 1997 [6].

Although the organization, style and terminology of the three documents were different, the elements of practical training for engineers of all disciplines to acquire Charter status had been basically followed. For example, SARTOR specified that trainees should have reached standards that would enable them to:

(a) apply the code of professional conduct of a Chartered Engineer;
(b) make appropriate provision in engineering projects to ensure safety and the required standards of quality and reliability;
(c) fulfil responsibilities to their employers, colleagues, customers, other engineers and the community at large;
(d) apply theoretical knowledge to the design, manufacture, construction, marketing, operation and maintenance of the particular products or services with which their employing organizations are concerned;
(e) have a working knowledge of the general factors affecting an industrial organization, such as:
    (i) financial, economic, environmental and commercial constraints;
    (ii) limitations imposed by the qualities of the manpower and materials available;
    (iii) operational and maintenance requirements that may affect engineering decisions.
(f) understand the vital importance of good industrial relations, safety, health and welfare not only to employees but also to the general public;
(g) understand the point of view of others and promote good personal relationship at all levels within an organization.

(h) exercise sound judgement and accept responsibility for decisions;
(i) exercise good engineering practice and develop their leadership abilities to the best advantage.

SARTOR3 specified the achievement of learning objectives, through practice integrated with instruction, that enable trainees to:

(a) demonstrate an understanding of the 'life-cycle' of the engineering processes relevant to the sector of industry;
(b) attain competence in the work of the engineering specialization;
(c) work effectively within an appropriate financial, commercial and legal framework;
(d) organize work to establish priorities and manage time effectively;
(e) co-operate successfully with colleagues, and with those in related fields and disciplines, in the achievement of business objectives;
(f) communicate clearly, whether verbally, in writing or by use of drawings, sketches or IT based methods, in a manner which is appropriate to the industry and organization in which employed;
(g) take personal responsibility for their own learning and prepare themselves for future professional development.

This appears different in wording but substantially similar in content. The major difference between SARTOR3 and its two earlier versions is that the educational requirement for an engineer to reach Chartered status changed from three years' academic study to four. This can be met by completing either a four-year accredited MEng degree programme or a three-year accredited BEng(Hons) degree programme plus one year of additional learning to achieve MEng equivalence. Following the general training policies as outlined in these documents, the Institution of Civil Engineers has been adapting its own set of core objectives for its graduate training scheme continuously to suit. The latest version to match SARTOR3 was ICE2011 RevB [7], with the following core objectives to be attained by trainees for their Chartered Membership:

P1 demonstrate a knowledge and understanding of the history, role and purpose of the institution;
P2 demonstrate a knowledge and understanding of civil engineering procedures through statutory, technical, financial and commercial developments;
P3 demonstrate a knowledge and understanding of local, national and international current affairs and how they affect the profession;
P4 work and communicate with others at all levels orally, in writing and by presentation. Identify and agree team targets;
P5 develop constructive working relationships with colleagues, superiors and others;
P6 maintain personal commitment to the profession and to the employer;
P7 contribute to the management of the administration of projects;
E1 identify civil engineering problems and define possible solutions;
E2 conduct appropriate research and analyses to evaluate possible solutions to problems;
E3 produce and present solutions to problems;
E4 manage contractual issues by having practical experience of administration of forms of contract;
E5 establish and manage systems to ensure transfer of information to practical effect;.
E6 plan, organize, manage and control multidisciplinary resources;
E7 manage and apply safe systems of work;
M1 demonstrate a knowledge and understanding of how projects are financed and how funds are obtained and managed;
M2 manage the application and know the limitations of established best practice as defined by Standards and Codes;
M3 manage quality plans. Bring about continuous improvement through quality management;
M4 withdrawn, as subject already covered by E6
M5 take proper account of relevant regulations and best practice concerning sustainable development in deriving engineering solutions;
M6 produce engineering solutions in compliance with relevant regulations concerning safety and risk;
M7 measure and record work done for payment purposes;
M8 contribute to the management of the commercial aspects of projects by ensuring effective use of resources.

*UK Standard for Professional Engineering Competence (UK-SPEC)*

In 2003, EC issued the UK Standard for Professional Engineering Competence (UK-SPEC) [8] to succeed SARTOR3. It set out the threshold standards of competence and commitment of Chartered Engineers as follows:

A Use a combination of general and specialist engineering knowledge and understanding to optimize the application of existing and emerging technology.
  A1 Maintain and extend a sound theoretical approach in enabling the introduction and exploitation of new and advancing technology and other relevant developments.
  A2 Engage in the creative and innovative development of engineering technology and continuous improvement systems.
B Apply appropriate theoretical and practical methods to the analysis and solution of engineering problems.
  B1 Identify potential projects and opportunities.

- B2 Conduct appropriate research, and undertake design and development of engineering solutions.
- B3 Implement design solutions, and evaluate their effectiveness.

C Provide technical and commercial leadership.
- C1 Plan for effective project implementation.
- C2 Plan, budget, organize, direct and control tasks, people and resources.
- C3 Lead teams and develop staff to meet changing technical and managerial needs.
- C4 Bring about continuous improvement through quality management.

D Demonstrate effective interpersonal skills.
- D1 Communicate in English with others at all levels.
- D2 Present and discuss proposals.
- D3 Demonstrate personal and social skills.

E Demonstrate a personal commitment to professional standards, recognizing obligations to society, the profession and the environment.
- E1 Comply with relevant codes of conduct.
- E2 Manage and apply safe systems of work
- E3 Undertake engineering activities in a way that contributes to sustainable development.
- E4 Carry out continuous professional development necessary to maintain and enhance competence in own area of practice.

They are directly related to the learning objectives of SARTOR3 except that the range of competencies has been broadened while emphasizing responsibilities and obligations undertaken by professionally qualified engineers.

Some of these competencies had already been catered for by the Institution of Civil Engineers in ICE2011 RevB as described above. An example is Core Objective M3 which introduced continuous improvement as highlighted in UK-SPEC. However, to harmonize the established Core Objectives and their groupings with the UK-SPEC competencies as much as possible, the ICE reshuffled the Core Objectives into newly arranged Development Objectives and contained them in one of its 3000-Series documents, the ICE 3005 [9], issued in 2006. The Development Objectives for trainees to become Chartered Civil Engineers are:

- A1 broaden and deepen engineering knowledge;
- B1 identify engineering problems and define possible solutions;
- B2 conduct appropriate research and analysis relating to engineering problems;
- B3 implement solutions to problems and evaluate their effectiveness;
- C1 plan for effective project implementation;
- C2 control budgets, tasks, people and resources;
- C3 develop people to meet changing technical and managerial needs;
- C4 bring about continuous improvement through quality management;
- C5 manage contractual issues;
- D1 communicate with others at all levels;
- D2 demonstrate personal and social skills;
- E1 comply with relevant codes of conduct;
- E2 manage and apply safe systems of work;
- E3 contribute to sustainable development through engineering activities;
- E4 manage own continuing professional development, and assist others;

The content and numbering of these Development Objectives are almost identical to those of the UK-SPEC as listed above.

*Summary*

The qualities of Chartered Engineers and the ways of acquiring them have been reviewed repeatedly, and sometimes intensively, in the UK for more than a quarter of a century. The four-module concept as proposed by the Finniston Report is still being utilized in the education and training of engineers, particularly EA3 covered by training schemes of engineering institutions. The Institution of Civil Engineers has been following the developments closely throughout the period and adjusted its training scheme to suit. Together with the requirement that every trainee has to reach an adequate standard for all training objectives [10], the ICE scheme is fitting the purpose of training civil engineering graduates to become Chartered Civil Engineers.

## HOW IS THE HONG KONG TRAINING SCHEME FULFILLING THE PURPOSE?

The training objectives of the HKIE Civil Training Scheme [11] comprise the set of Common Core Objectives (CCO) and the Core Objectives (CO) of the civil engineering discipline.

The CCOs are common to all 17 engineering disciplines that the Institution is administering. They include:

- CCO1.1 knowledge of the history, role and organization of the HKIE, and participation in its activities;
- CCO1.2 respect for professionalism including observance of the responsibilities of professional engineers, the HKIE 'Rules of Conduct' and the latest related technical development;
- CCO1.3 general personal development through keeping up-to-date with local, regional and international current affairs, and involvement with local organization or community services;
- CCO1.4 development of personal qualities such as innovative abilities, interpersonal, negotiation and time management skills;
- CCO1.5 knowledge of responsibilities of professional engineers and relevant legislation in occupational safety and health, and a

good grasp of safety management systems;
CCO1.6 knowledge of legislation relevant to the environment and the inter-relationship of technology with environment;
CCO1.7 good command of oral and written communication in English;
CCO1.8 knowledge of general human resource matters such as employment criteria, labour deployment and staff training;
CCO1.9 general understanding of what leadership and management skills are about and their relationship;
CCO1.10 good understanding of the trainee's own organization in various aspects;
CCO1.11 general understanding of the engineering business operation.

Whereas the COs of the civil engineering discipline include:

CO1.1 general understanding of civil engineering procedures;
CO1.2 experience in identifying and defining a problem accurately;
CO1.3 capability in the identification and evaluation of alternative solutions to a problem gained through involvement;
CO2.1 application of appropriate local and international standards and knowledge of their limitations;
CO2.2 capability in producing the solution to a problem;
CO2.3 capability in presenting the solution to a problem;
CO2.4 appreciation of how environmental issues affect the solution of an engineering problem;
CO2.5 appreciation of the importance of technical specification as part of the solution through involvement;
CO2.6 experience in estimating cost of solutions to problems by standard methods;
CO2.7 capability in applying relevant regulations to meet safety requirements in solving engineering problems;
CO3.1 knowledge of how contractual parties exercise their rights and duties through application of various documents of a civil engineering works contract;
CO3.2 involvement in site documentary control such as registration and filing of instructions, drawings and their amendments;
CO3.3 capability of keeping accurate site daily records of events and instructions;
CO3.4 capability of reading/coordinating drawings and implementing work instructions;
CO3.5 capability of participating in dimensional control of works with appropriate accuracy;
CO3.6 knowledge of the use, performance and cost of equipment/plant in solution implementation;
CO3.7 capability of programme preparation and progress monitoring/reporting;
CO3.8 capability of measuring and recording, or independently checking, work done for payment purposes;
CO3.9 capability of observing safe working practices through critical approach to safety matters in the implementation process;
CO3.10 experience in the use of quality assurance tools and procedures in construction.

These together constitute the threshold competencies for civil engineering graduates to complete their training. Although there was no previous in-depth review of these training objectives, they are comparable to the ICE Development Objectives or formerly Core Objectives. In fact, except for competencies related to health, safety, environmental conservation, sustainability and quality assurance that were new, emphases in the last two decades, the HKIE Training Scheme objectives, the UK-SPEC-based ICE 3005 Development Objectives, previous SARTOR-based ICE 2011 Core Objectives and even the outlined competencies in Appendix 3 of the historical Chilver Report are comparable to each other as demonstrated in Table 2.

With tight control of the process by the HKIE and continuous supervision by the trainees' supervisors, the Training Scheme is certainly meeting the same training requirements as those in the UK. A trainee completes his/her Training Scheme when all the common core objectives, core objectives and company-specified specific objectives have been achieved and endorsed by an engineering supervisor. After another year of responsible experience, he/she can sit for the Professional Assessment to determine whether he/she has reached the required standard of a professional engineer. For its class of member, HKIE adopted the following definition of a professional engineer [12] used by the Conference of Engineering Societies of Western Europe and the United States of America (EUSEC):

> A professional engineer is competent by virtue of his fundamental education and training to apply the scientific method and outlook to the analysis and solution of engineering problems. He is able to assume personal responsibility for the development and application of engineering science and knowledge, notably in research, designing, construction, manufacturing, superintending, managing and in the education of other engineers. His work is predominantly intellectual and varied, and not of a routine mental or physical character. It requires the exercise of original thought and judgement and the ability to supervise the technical and administrative work of others.
>
> His education will have been such as to make him capable of closely and continuously following progress in his branch of engineering science by consult-

Table 2. Comparison of required competencies and training objectives

| Competencies | Chilver Report Appendix 3 | ICE 2011 | ICE 3005 | HKIE Scheme A (Civil) |
|---|---|---|---|---|
| **General** | | | | |
| Institution matters | | P1 | E1 | CCO1.1 |
| Professional ethics, conduct and responsibilities | 11 | P3, P6 | E1 | CCO1.2 |
| Communication skills | 10 | P4 | D1 | CCO1.7 |
| Management and interpersonal skills | 10, 11 | P4, P5, M8 | C2, C3, D2 | CCO1.4, 1.8, 1.9 |
| Business operation | 7(e) | P7, M1, M8 | C2, C3 | CCO1.10, 1.11 |
| Continuously knowledge acquisition | 8.5–8.10* | P3 | A1, E4 | CCO1.2, 1.3, 1.4 |
| Occupational satefy and health | | E7 | E2 | CCO1.5 |
| Environment | | M5 | E3 | CCO1.6 |
| Quality assurance | | P7, M3 | B2, C4 | CCO1.10 |
| Sustainability | | M5 | B2, E3 | |
| **Engineering solution** | | | | |
| Overall civil engineering procedures | 7(a) | P2 | A1 | CO1.1 |
| Problem definition | 7(b), 7(d) | E1 | B1 | CO1.2 |
| Alternative solutions | 7(b), 7(d) | E1, E2 | B1 | CO1.3 |
| Codes, standards and statutory requirements | 7(c), 7(d), 7(h) | E3, M2 | A1, B1 | CO2.1 |
| Detailed design and cost estimation | 7(c), 7(d), 7(g), 10 | E3 | B2 | CO2.2, 2.6 |
| Drawing and specification | 7(c), | E3 | B2 | CO2.3, 2.5 |
| Cost in design | 7(f) | E2 | B2 | CO1.3 |
| Safety in design | 7(f) | M6 | B2, E2 | CO2.7 |
| Environment in design | 7(f) | M5 | B2, E3 | CO2.4 |
| **Implementation** | | | | |
| Documents of a contract | 10, 11 | E4 | B3, C1, C5 | CO3.1 |
| Parties and their contractual relationship | 10, 11 | E4 | B3, C1, C5 | CO3.1 |
| Design information administration for construction | 10 | E5 | C1, C5 | CO3.2, 3.4 |
| Site records | 10 | P7 | C1, C5 | CO3.2, 3.3 |
| Methods and plants of construction | 10 | E6 | B3, C1, C2 | CO3.6 |
| Works inspection, measurement and dimension control | 10 | M7 | B3 | CO3.5 |
| Planning, programming, progress monitoring/reporting | 10 | E6 | C1, C2 | CO3.7 |
| Cost, payments, claims and variations | 10 | E4, M1, M7 | C2, C5 | CO3.8 |
| Safe working practices | 10 | E7 | B3, E2 | CO3.9 |
| Quality assurance | | E5, M3 | B3, C2, C4 | CO3.10 |

* Section numbers in asterisk are from the main text of Chilver Report, not from Appendix 3.

ing newly published works on a world-wide basis, assimilating such information and applying it independently. He is thus placed in a position to make contributions to the development of engineering science or its applications.

His education and training will have been such that he will have acquired a broad and general appreciation of the engineering sciences as well as a thorough insight into the special features of his own branch of engineering. In due time he will be able to give authoritative technical advice and to assume responsibility for the direction of important tasks in his branch.

The major part of the professional assessment is an interview of about an hour conducted by two assessors who are well-qualified and experienced civil engineers. A candidate is examined in several aspects as listed on a standard proforma [13] which is restricted for use by assessors only. These aspects are adapted and summarized as follows:

I. Professional and General

(a) Knowledge and attitude towards Rules of Conduct
(b) Understanding of responsibilities of Professional Engineers and its limits
(c) Attitude and work towards quality - extent of participation and commitment
(d) Appreciation of engineering matters in general and keeping abreast of his own field and beyond
(e) Scientific insights
(f) Communication skills
(g) Interpersonal skills and relationship

II. Engineering practice and applications

(a) Ability to understand the Client's need
(b) Exercise original thought and engineering judgement
(c) Feasibility of solutions to problems technically and financially
(d) Ability to appraise, review and check
(e) Technical capabilities
(f) Considerations in safety issues
(g) Considerations in environmental issues

III. Civil Engineering Process and Management

(a) Understanding of functions and characteristics of various stages of civil engineering process
(b) Organization and supervisory abilities
(c) Attitude and practice towards the training of others
(d) Project management skills
(e) Other general management skills

Table 3. Professional assessment and training objectives

| Qualities of Professional Engineer as defined by HKIE | Professional Assessment (Civil) | Scheme A (Civil) Training Objectives |
|---|---|---|
| Responsibility | | |
| Able to assume personal responsibility for the development and application of engineering science and knowledge, notably in research, designing, construction, manufacturing, superintending, managing and in the education of other engineers. | I(a), (b), (c)<br>III(c) | CCO1.2<br>CCO1.8 |
| Engineering Application | | |
| Competent to apply the scientific method and outlook to the analysis and solution of engineering problems. | II(a), (c)<br>II(e)<br>II(f)<br>II(g) | CO1.2, 1.3, 2.6<br>CO2.1, 2.2, 2.3, 2.5, 3.4, 3.5<br>CCO1.5 CO2.7, 3.9<br>CCO1.6 CO2.4 |
| Work is predominantly intellectual and varied, and not of a routine mental or physical character. | II(b) III(a) | CO1.1, 1.2, 1.3, 2.1, 3.1, 3.6 |
| Requires the exercise of original thought and judgement. | | |
| Ability to supervise the technical and administrative work of others | II(d)<br>I(f), (g) III(b), (d), (e) | CO1.3, 2.2, 3.5, 3.8, 3.10<br>CCO1.7, 1.8, 1.9, 1.10, 1.11<br>CO3.1, 3.2, 3.3, 3.7 |
| Personal Development | | |
| A thorough insight into the special features of his own branch of engineering. | I(d), (e) | CCO1.2, 1.3, 1.4 |
| Capable of closely and continuously following progress in his branch of engineering science by consulting newly published works on a world-wide basis, assimilating such information and applying it independently. | | |
| Acquired a broad and general appreciation of the engineering sciences. | | |
| Becoming a Professional Engineer | | |
| Placed in a position to make contributions to the development of engineering science or its applications. | Upon passing the Professional Assessment | |
| In due time he will be able to give authoritative technical advice and to assume responsibility for the direction of important tasks in his branch. | | |

These aspects correspond to the general qualities of a professional engineer as in the above definition. It is shown in Table 3 that the assessment of these aspects is a verification of whether a candidate has achieved the corresponding common core objectives or core objectives satisfactorily in their Training Scheme.

Hence, apart from meeting the same training requirements as those thoroughly reviewed in the UK, the Training Scheme ensures that trainees acquire the necessary qualities of a professional civil engineer as interpreted by the HKIE, which is fulfilling the purpose of training civil engineering graduates to become professional civil engineers.

## RECOGNITION OF THE TRAINING SCHEME BY COMPARABLE QUALIFYING ASSESSMENTS

There has been close collaboration between the HKIE and engineering institutions in the UK; many of them have reciprocal recognitions in the qualifications of membership upon regular comparison of mutual standards. Currently the passing of Professional Assessment of the HKIE or the Chartered Professional Review of the ICE are recognized by both institutions as satisfying the entry requirements for the grade of Member. The ICE also recognizes the completion of HKIE Training Scheme A (Civil) as equivalent to completion of its own Company Approved Training Scheme, hence trainees who have completed the Training Scheme can apply for the ICE's Chartered Professional Review.

Apart from the ICE, the Training Scheme is also recognized by the Institution of Structural Engineers as an Accredited Training Scheme to satisfy the Initial Professional Development requirements of structural engineers before attempting their Chartered Membership Examination. In fact, the Training Scheme is the only training scheme outside the UK that has such recognition by the IStructE.

## CONCLUSION

The policies and directions for the training of graduates to become professional engineers in the UK have not changed much in the past quarter of a century even though there were several thorough reviews by the Engineering Council or other specially appointed committees. The ICE has been following them closely in formulating and revising its training scheme.

The HKIE Training Scheme 'A' (Civil) is fitting the purpose of turning civil engineering graduates into professional engineers since it has similar content and control as those of the ICE training scheme. It was also demonstrated that on meeting the training objectives of the Training Scheme satisfactorily, a graduate should be able to demonstrate attainment of the qualities of a professional civil engineer in the Professional Assessment.

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**W. H. Fok** is the Principal of WH Fok Professional Services. He was the training leader of the 100-strong civil engineering group of Ove Arup and Partners Hong Kong Limited for more than ten years. He has been Engineering Supervisor of many graduates under HKIE Training Scheme A (Civil) and Mentor of trainees under IStructE's Individually Managed IPD, and has been lead assessor/reviewer for professional assessments/reviews for HKIE, ICE and IStructE for years. He is a Fellow of HKIE, ICE, IStructE, IHT and CIArb.