COURSE OVERVIEW SE0030-4D
Durability of Reinforced Concrete Structures
Assessment, Repair & Risk-Based Inspection

Course Title
Durability of Reinforced Concrete Structures:
Assessment, Repair & Risk-Based Inspection

Course Reference
SE0030-4D

Course Duration/Credits
Four days/2.4 CEUs/24 PDHs

Course Date/Venue

Session(s)	Date	Venue
1	Febrary 05-08, 2024	Business Center, Concorde Hotel Doha, Doha, Qatar
2	May 13-16, 2024	Ajman Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE
3	August 12-15, 2024	Jubail Hall, Signature Al Khobar Hotel, Al Khobar, KSA
4	December 16-19, 2024	Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE

Course Description

This practical and highly-interactive course includes real-life case studies and exercises where participants will be engaged in a series of interactive small groups and class workshops.

Nowadays, there is a large stock of reinforced concrete structures such as commercial buildings, marine structures, bridges, water transportation pipelines, waste water treatment plants etc, which are all beginning to show signs of deterioration, particularly those over 30 years age. Collapses, premature demolitions, unforeseen extensive maintenance work all over the world created great concern about the durability and safety on the reinforced concrete structures.

The Middle East construction boom will be affected without better concrete quality and protection. The service life of reinforced concrete structures is significantly lower in the Middle East than in other parts of the world. There is a tendency to use a 'trial and error' approach to materials and processes which have not been standardised or fully tested as these processes are applied without supervision, which results in poor service life. Therefore, a more professional approach is needed, with special attention to the entire service life, starting from the design phase.

The root of the problem lies in a number of factors, including:

- The harsh, high salinity of the environment in the Middle East.
- Designers specifying concrete in an insufficient manner
- A workforce in the Middle East dominated by the expatriates with differing qualifications, knowledge, training and experience.

Engineers need therefore newer and more suitable solutions to prolong the service life of new structures, both using supplementary preventative techniques and adopting efficient maintenance and repair techniques.

As far as the use of supplementary techniques is concerned, this course gives updated suggestions for the use of stainless and galvanized steel, for the adoption of cathodic prevention systems, for the use of particular surface treatments and for the use of corrosion inhibitors in the mix: all described measures are able, in controlled conditions, to strongly prolong the service-life of the new constructions.

In case of existing structures with corrosion problems, maintenance may be performed by means of electrochemical techniques, such as chloride removal and realkalization, or with conventional repair methods. However, only cathodic protection is considered a suitable and reliable means for ensuring the corrosion stopping.

In case of existing structures with concrete damage problems, rehabilitation may be performed by means of several techniques, including the protection against aggressive substances, the moisture control, the strengthening of components, and the improvement of physical and chemical resistance of the concrete.

The development of cost-effective strategies for maintenance of reinforced concrete structures necessitates the acquisition of reliable information on the extent and rate of damages. If the corrosion risk of the reinforcement is detected sufficiently early, damage can be avoided or reduced significantly, residual life of the structure predicted and relatively simple maintenance measures or repair systems can be used.

Although reinforcement corrosion and concrete damage are recognized to be deterioration processes with important economical consequences, their effective measurement is actually very scarce.

The course will provide updated information on diagnosis of the reinforced concrete structures at different levels, starting with a simple or low-level form of periodic visual inspections, until the use of sensors for the new and existing structures. The course therefore covers the principles of a wide range of the latest techniques and illustrates practical applications related to the use of equipments for corrosion and mechanical testing and monitoring in concrete structures on site. These modern techniques can provide rapid and sensitive measurements and detection of damages in concrete structures.

Experimental tests will enable the participants to gain hands on experience in using the state-of-the-art equipment for corrosion testing and monitoring in concrete structures.

Course Objectives

Upon the successful completion of this course, each participant will be able to:-

- Apply an in-depth knowledge in the durability of reinforced concrete structure and design concrete structures for durability
- Implement the risk-based maintenance strategies by identifying the required repair time, the required corrosion time and the required deterioration time including the cost analysis for different protection methods
- Discuss the corrosion of concrete reinforcement, passivity, carbonation, stray currents, hydrogen embrittlement and macrocells
- Employ additional preventative measures for concrete structures as well as surface treatments and cathodic prevention for the prevention of corrosion
- Perform damage assessment by means of visual inspection, physical test, chemical test, electrochemical test, potential mapping and monitoring movements.
- Apply various rehabilitation approaches as well as the latest reinforced concrete monitoring techniques
- Implement proper procedures for the assessment of reinforced concrete structures conditions
- Apply correct approaches and methods for rehabilitation of damaged concrete
- Present practical cases on the rehabilitation of reinforced concrete structures
- Recognize the value of quality control in the construction of concrete structure

Exclusive Smart Training Kit - H-STK®

*Participants of this course will receive the exclusive "Haward Smart Training Kit" (**H-STK®**). The **H-STK®** consists of a comprehensive set of technical content which includes **electronic version** of the course materials conveniently saved in a **Tablet PC**.*

Who Should Attend

The course provides an overview of all significant aspects and considerations of durability of reinforced concrete structures for those who are involved in assessment, repair and risk-based inspection of concrete structures. This includes design engineers, construction engineers, civil engineers, inspection engineers, project engineers, site engineers, material engineers and other technical staff who are responsible for the integrity of reinforced concrete structures (buildings, bridges, pipelines, tanks, foundations, etc.).

Course Certificate(s)

Internationally recognized certificates will be issued to all participants of the course who completed a minimum of 80% of the total tuition hours.

Certificate Accreditations

Certificates are accredited by the following international accreditation organizations: -

- The International Accreditors for Continuing Education and Training (IACET - USA)

  Haward Technology is an Authorized Training Provider by the International Accreditors for Continuing Education and Training (IACET), 2201 Cooperative Way, Suite 600, Herndon, VA 20171, USA. In obtaining this authority, Haward Technology has demonstrated that it complies with the **ANSI/IACET 2018-1 Standard** which is widely recognized as the standard of good practice internationally. As a result of our Authorized Provider membership status, Haward Technology is authorized to offer IACET CEUs for its programs that qualify under the **ANSI/IACET 2018-1 Standard**.

  Haward Technology's courses meet the professional certification and continuing education requirements for participants seeking **Continuing Education Units** (CEUs) in accordance with the rules & regulations of the International Accreditors for Continuing Education & Training (IACET). IACET is an international authority that evaluates programs according to strict, research-based criteria and guidelines. The CEU is an internationally accepted uniform unit of measurement in qualified courses of continuing education.

  Haward Technology Middle East will award **2.4 CEUs** (Continuing Education Units) or **24 PDHs** (Professional Development Hours) for participants who completed the total tuition hours of this program. One CEU is equivalent to ten Professional Development Hours (PDHs) or ten contact hours of the participation in and completion of Haward Technology programs. A permanent record of a participant's involvement and awarding of CEU will be maintained by Haward Technology. Haward Technology will provide a copy of the participant's CEU and PDH Transcript of Records upon request.

- British Accreditation Council (BAC)

  Haward Technology is accredited by the **British Accreditation Council** for **Independent Further and Higher Education** as an **International Centre**. BAC is the British accrediting body responsible for setting standards within independent further and higher education sector in the UK and overseas. As a BAC-accredited international centre, Haward Technology meets all of the international higher education criteria and standards set by BAC.

Course Instructor(s)

This course will be conducted by the following instructor(s). However, we have the right to change the course instructor(s) prior to the course date and inform participants accordingly:

Mr. Alvero Poulos, PEng, MSc, BSc, is a **Senior Structural & Civil Engineer** with more than **20 years** of extensive **Onshore & Offshore** experience within the **Oil & Gas**, **Petroleum** and **Refinery** industries. His expertise widely covers in the areas of **Concrete Structural Design, Concrete Maintenance & Reliability Analysis**, **Civil Engineering** Drawings, Standards & Codes, **Civil Engineering** Design, Petrochemical Plant Structure Design & Remediation, Elements of **Applied Civil Engineering**, **Dynamic Analysis of Rotating Equipment** Foundations **& Structural Steel Piperacks**, **Concrete & Structural Steel Design**, **Steel Structure Design**, Advanced **Building Construction Technology**, **Structural Engineering** Techniques, **Structural Renovation of Buildings**, **Earthwork & Structural Maintenance**, **Surface Drainage**, **Drainage System**, **Building Envelopes & Finishes**, **Landscaping & Roofing** System, **Seismic Design** for Buildings, Advanced **Seismic & Wind Design of Reinforced Concrete**, **Structural** Systems & Components, Design of **Concrete Columns & Beam Frames**, Design of **Foundations & Equipment Footings**, **Maintenance of Concrete Structure**s, **Structural Reliability Assessment**, **Codes & Structural Reliability**, Probabilistic Evaluation of Existing Structures, **Structural Steel** and **Precast Concrete**. Further, he is also well-versed in Procedures & Specification Issuance, **Precast & Prestressed Concrete Elements Design**, Troubleshooting & Problem Resolution, **Detailed Engineering**, **Seismic Design**, **Rotating & Reciprocating**, **Machinery Foundations Design**, **Above Ground Storage Tanks & Foundation Design**, **Piperack Design**, **Fixed Offshore Platforms**, **Engineering Management**, **Project Management**, **EPC Contracts**, **Construction Management**, **Cost Reduction Strategies**, **Budgeting**, **Scheduling** and **International Standards and Codes** such as **Eurocodes**, **British Standards**, **ACI**, **ASCE**, **AISC**, **AWS**, **UBC97**, **IBC**, **ASTM**, **AWWA**, **API**, **ICAO**, **FAA**, **AASHTO**, **Agip Standards** and **ARAMCO Standards**. Currently, he is the **Architecture & Engineering Manager** of DAR Al Riyadh wherein he is responsible for the infrastructure projects and proposals.

During his career life, Mr. Poulos has gained his practical and field experience through his various significant positions and dedication as the **Civil Engineering Manager**, **CAD Manager**, **BIM Manager**, **Construction Manager**, **Procurement Manager**, **Contracts Manager**, **Civil Department Engineering Manager**, **Engineering Manager**, **Senior Structural Site Engineer**, **Senior Structural Engineer**, **Senior Civil & Structural Engineer**, **Senior Project Engineer**, **Senior Structural/Civil & Erection Engineer**, **Senior Engineer**, **Architectural Engineer**, **Structural Design Engineer**, **Senior Consultant** and **Erector** for various companies such as DUQM Refinery, EPC, J&P Energy, VVTI, ENI, REPSOL-AKAKUS, WAHA Oil Company, BAUER HAUS, Athlisis Consortuim, LSTK Contractor and BI.ME.KAT.

Mr. Poulos is a **Registered Professional Engineer** and has a **Master's** degree in **Structural Engineering** and a **Bachelor's** degree in **Civil Engineering** from the **Aristotle University of Thessaloniki**, **Greece**. Further, he is a **Certified Instructor/Trainer** and has further delivered numerous trainings, courses, seminars, workshops and conferences internationally.

Training Methodology

All our Courses are including **Hands-on Practical Sessions** using equipment, State-of-the-Art Simulators, Drawings, Case Studies, Videos and Exercises. The courses include the following training methodologies as a percentage of the total tuition hours:-

30% Lectures
20% Practical Workshops & Work Presentations
30% Hands-on Practical Exercises & Case Studies
20% Simulators (Hardware & Software) & Videos

In an unlikely event, the course instructor may modify the above training methodology before or during the course for technical reasons.

Course Fee

Doha	**US$ 5,500** per Delegate. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Abu Dubai	**US$ 4,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Al Khobar	**US$ 4,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day.
Dubai	**US$ 4,500** per Delegate + **VAT**. This rate includes H-STK® (Haward Smart Training Kit), buffet lunch, coffee/tea on arrival, morning & afternoon of each day

Accommodation

Accommodation is not included in the course fees. However, any accommodation required can be arranged at the time of booking.

Course Program

The following program is planned for this course. However, the course instructor(s) may modify this program before or during the course for technical reasons with no prior notice to participants. Nevertheless, the course objectives will always be met:

Day 1

0730 – 0800	*Registration & Coffee*
0800 – 0815	*Welcome & Introduction*
0815 – 0830	***PRE-TEST***
0830 – 0930	***Introduction*** *Course Overview • Reinforced Concrete Structures Service Life*
0930 – 0945	*Break*
0945 – 1215	***Structure & Properties of Concrete*** *Cements, Aggregates, Water, Admixtures • Fresh & Hardened Concrete Properties • Transport Processes in Concrete • Degradation of Concrete*
1215 – 1230	*Break*
1230 – 1330	***Corrosion of Concrete Reinforcement*** *Corrosion Principles • Passivity • Carbonation • Chloride Induced Corrosion • Stray Currents • Hydrogen Embrittlement • Macrocells*

1330 – 1420	***Design for Durability***
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day One*

Day 2

0730 – 0930	***Additional Preventative Measures*** *Controlled Permeability Formwork •Corrosion Resistant Reinforcement• Mixed in Corrosion Inhibitor • Surface Treatments • Cathodic Prevention*
0930 – 0945	*Break*
0945 – 1100	***Damage Assessment*** *Visual Inspection • Physical Tests • Chemical Tests • Electrochemical Tests • Potential Mapping • Monitoring Movements*
1100 – 1215	***Assessment of the Reinforced Concrete Structures Conditions*** *Inspection Phase • Structural Assessment • Assessment Report*
1215 – 1230	*Break*
1230 – 1420	***Assessment of the Reinforced Concrete Structures Conditions – Practical Cases***
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Two*

Day 3

0730 – 0930	***Reinforced Concrete Monitoring Techniques*** *Monitoring Objectives • Sensors • Practical Cases*
0930 – 0945	*Break*
0945 – 1100	***Principles of Rehabilitation*** *Choice of Principles & Methods of Rehabilitation • Products & Systems for Protection & Repair • Damages & Principles Applicable for Rehabilitation • Unintentional Effects*
1100 – 1215	***Assessment of the Reinforced Concrete Structures Conditions*** *In Situ Tests • Discussion of the Results of the Tests*
1215 – 1230	*Break*
1230 – 1420	***Principles & Methods for Rehabilitation of Damaged Concrete*** *Protection Against Aggressive Substances • Moisture Control • Replacement of Damaged Concrete • Strengthening of Building Components*
1420 – 1430	***Recap*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Topics that were Discussed Today and Advise Them of the Topics to be Discussed Tomorrow*
1430	*Lunch & End of Day Three*

Day 4

0730 – 0830	***Principles & Methods for Rehabilitation of Concrete Damage Due to Reinforcement Corrosion*** *Restoring Reinforcement Passivity • Cathodic Protection •Electrochemical Chloride Extraction • Use of Corrosion Inhibitors For Repair*
0830 – 0930	***Rehabilitation of Reinforced Concrete Structures*** *Practical Cases*
0930 – 0945	*Break*
0945 – 1215	***Risk-Based Maintenance Strategy*** *Present Value Method • Repair Time • Capacity Loss in Reinforced Concrete Sections • Required Time to Start of Corrosion • Time Required to Start of Deterioration • Cost Analysis for Different Protection Methods*
1215 – 1230	*Break*
1230 – 1345	***Quality Control***
1345 – 1400	***Course Conclusion*** *Using this Course Overview, the Instructor(s) will Brief Participants about the Course Topics that were Covered During the Course*
1400 – 1415	***POST-TEST***
1415 – 1430	*Presentation of Course Certificates*
1430	*Lunch & End of Course*

Practical Sessions

This practical and highly-interactive course includes real-life case studies and exercises:-

Course Coordinator

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