## COURSE OVERVIEW FE0114

# Design of Liquid Retaining Structures

**Course Title**
Design of Liquid Retaining Structures


**Course Date/Venue**
Session 1: June 22-26, 2025/Boardroom 1, Elite Byblos Hotel Al Barsha, Sheikh Zayed Road, Dubai, UAE
Session 2: November 17-21, 2025, 2025/Fujairah Meeting Room, Grand Millennium Al Wahda Hotel, Abu Dhabi, UAE


**Course Reference**
FE0114

**Course Duration/Credits**
Five days/3.0 CEUs/30 PDHs

**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.***

This course is designed to provide participants with a detailed and up-to-date overview of Design of Liquid Retaining Structures. It covers the importance of liquid retaining structures in petroleum and industrial applications; the types of liquid retaining structures, key design considerations and differences between liquid and ordinary structural designs; the types of liquid retaining structures, structural behavior and load considerations; the material selection and durability considerations; the design standards and codes for liquid retaining structures; and the design of reinforced concrete liquid retaining tanks and steel liquid retaining tanks.

Further, the course will also discuss the seismic design considerations for liquid retaining structures and foundation design for liquid retaining structures; the design of bunds and secondary containment systems including structural modeling and finite element analysis (FEA); the waterproofing strategies for liquid retaining structures, corrosion protection and cathodic protection systems; the leak detection and monitoring systems, crack prevention and remediation techniques; and the fire protection and safety considerations, risk assessment, failure prevention and construction methods for liquid retaining structures.

During this interactive course, participants will learn the proper testing and quality control in liquid retaining structures; the tank commissioning, operational readiness and maintenance strategies for long-term integrity; the digitalization and smart monitoring technologies; the structural analysis and load calculations; and the risk management and emergency response, leak and spill management and emergency shutdown procedures

## Course Objectives

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

- Apply and gain a good working knowledge on design of liquid retaining structures
- Discuss the importance of liquid retaining structures in petroleum and industrial applications
- Identify the types of liquid retaining structures, key design considerations and differences between liquid and ordinary structural designs
- Recognize the types of liquid retaining structures, structural behavior and load considerations
- Apply material selection and durability considerations and review design standards and codes for liquid retaining structures
- Illustrate the design of reinforced concrete liquid retaining tanks and design of steel liquid retaining tanks
- Recognize the seismic design considerations for liquid retaining structures and foundation design for liquid retaining structures
- Describe the design of bunds and secondary containment systems including structural modeling and finite element analysis (FEA)
- Apply waterproofing strategies for liquid retaining structures, corrosion protection and cathodic protection systems
- Employ leak detection and monitoring systems, crack prevention and remediation techniques
- Apply fire protection and safety considerations, risk assessment, failure prevention and construction methods for liquid retaining structures
- Implement proper testing and quality control in liquid retaining structures
- Carryout tank commissioning, operational readiness and maintenance strategies for long-term integrity
- Discuss digitalization and smart monitoring technologies and apply structural analysis and load calculations
- Apply risk management and emergency response, leak and spill management and emergency shutdown procedures

## 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**

this course provides an overview of all significant aspects and considerations of for design of liquid retaining structures for mechanical engineers, civil engineers, environmental engineers, structural designers and consultants, project managers in construction and infrastructure and other technical staff.

**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: -

- 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.

  Haward Technology Middle East will award **3.0 CEUs** (Continuing Education Units) or **30 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.

- 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.

## 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. Geoff Kaschula**, is a **Senior Inspection & Welding Engineer** with over **45 years** of extensive experience within the **Oil & Gas**, **Petrochemical**, **Process** and **Power Industries**. His fields of specialization widely cover in the areas of Risk Based Inspection (**RBI**), Fitness-For-Service (**FFS**), **Welding & Fabrication** Engineering, **Welding & Cutting Welding** Technology, **Fabrication & Welding** Inspection, **Design**, **Fabrication**, **Construction**, **Installation**, **Commissioning**, **Inspection** & **Maintenance** of **Process Equipment**, Factory Acceptance Test (**FAT**), **Boilers**, **Pressure Vessels**, **Piping Systems**, **Structures** & **Storage Tanks**; **Condition Assessment** of Rotating & Auxiliary Equipment like **Compressors**, **Steam Turbines**, **Pumps**, **Heat Exchangers** & **Valves**; **In-Service Inspection & Condition** Assessment, **Steam Drums & Pressure Vessels**, **Tanks**, **Piping** Inspection, Advanced Integrity Management for **Corrosion** & Inspection, **Failure Analysis**, Flaw Evaluation, Remnant Life Determination, Capacity Reviews for Process and Power Equipment, Asset Management and Project Management. He has also worked extensively with international industry standards such as ASME VIII div 1 & 2, TEMA, BS/EN 13445, BS/EN 12952, API 650, API 653, ANSI B31.1, ANSI B31.3, PD5500, AWS D1.1, SANS 10162, just to name a few. Mr. Kaschula is currently the **Director** of **RBI-Asset Management** wherein he provides technical support and consultancy services in the field of physical infrastructure asset management.

During his career life, Mr. Kaschula has gained his practical and field experience through his various significant positions and dedication as the **Director/Owner**, **Project Manager**, **QE Division Manager**, **Resident Inspection Engineer**, **Refurbishment Inspection Engineer**, **Inspection Engineer**, **Welding Engineer**, **QA/QC Engineer**, **Appointed Statutory Management Representative**, **Technical Assessor** and **Senior Instructor/Trainer** for numerous international companies like the Parsons Brinckerhoff Africa, Weltech CC., Projects Expedited (Pty) Ltd., Airtec Davidson (Pty) Ltd. and Hubert Davies, Arnot & Hendrina Power Station, Projects Expedited, Airtech Davidson & the Department of Transport.

Mr. Kaschula has a **National Diploma** (**Welding Engineer**) and a **Registered Professional Technologist** and **International Welding Technologist**. Further, he is a **Certified Instructor/Trainer**, a **Certified Internal Verifier/Assessor/Trainer** by the **Institute of Leadership & Management** (**ILM**), a **Certified API 510 Pressure Vessel Inspector**, a **Certified API 570 Piping Inspector**, a **Certified API 580 Risk Based Inspector**, a **Registered Inspector** & **Competent Person** for Boilers, Pressure Vessels & Pressure Equipment, an ISO 9001 Lead Auditor and a member of South African Institute of Welding. He has further delivered numerous trainings, courses, seminars, conferences and workshops internationally.

## Accommodation

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

## 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

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

## 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 to Liquid Retaining Structures***<br>*Definition & Importance in Petroleum & Industrial Applications • Types of Liquid Retaining Structures (Tanks, Reservoirs, Sumps, Bunds) • Key Design Considerations for Company's Operations • Differences Between Liquid & Ordinary Structural Designs* |
| *0930 - 0945* | *Break* |
| *0945 – 1045* | ***Types of Liquid Retaining Structures***<br>*Reinforced Concrete Tanks (Above-Ground & Underground) • Steel Tanks (Fixed Roof, Floating Roof) • Pre-Stressed Concrete Tanks & Modular Storage Units • Secondary Containment Systems (Bund Walls & Dykes)* |
| *1045 - 1145* | ***Structural Behavior & Load Considerations***<br>*Hydrostatic & Hydrodynamic Pressure Effects • Earthquake & Seismic Loading Considerations (API 650, ACI 350) • Soil & Settlement Effects on Foundations • Impact of Temperature Variations on Retaining Walls & Tanks* |
| *1145 - 1230* | ***Material Selection & Durability Considerations***<br>*Reinforced Concrete & Its Properties in Liquid Retaining Applications • Steel Grades for Liquid Storage Tanks • Waterproofing Materials (Membranes, Epoxy Coatings) • Corrosion Protection & Cathodic Protection Systems* |
| *1230 – 1245* | *Break* |
| *1245 – 1330* | ***Design Standards & Codes for Liquid Retaining Structures***<br>*ACI 350: Environmental Engineering Concrete Structures • API 650: Welded Tanks for Oil Storage • BS 8007: Code of Practice for Water Retaining Structures • Regulatory Requirements & Compliance* |

| | |
|---|---|
| *1330 - 1420* | ***Case Studies of Failures in Liquid Retaining Structures***<br>*Case Study: Tank Collapse Due to Foundation Failure • Case Study: Seepage & Leakage in Concrete Reservoirs • Case Study: Roof Failure in Floating Roof Tanks • Lessons Learned & Design Improvements* |
| *1420 – 1430* | ***Recap***<br>*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 – 0830* | ***Design of Reinforced Concrete Liquid Retaining Tanks***<br>*Wall Thickness & Reinforcement Requirements • Base Slab & Wall Jointing Techniques • Crack Control & Leakage Prevention • Design for Shrinkage & Temperature Stresses* |
| *0830 – 0930* | ***Design of Steel Liquid Retaining Tanks***<br>*Cylindrical Tank Design & Shell Thickness Calculation • Roof & Bottom Plate Design Considerations • Floating Roof versus Fixed Roof Tank Design • Wind & Seismic Load Considerations* |
| *0930 - 0945* | *Break* |
| *0945 – 1045* | ***Seismic Design Considerations for Liquid Retaining Structures***<br>*Seismic Response of Liquid-Containing Structures • Base Isolation & Seismic Dampers • Sloshing Effects & Wave Impact on Walls • Dynamic Analysis Methods for Earthquake Resistance* |
| *1045 – 1145* | ***Foundation Design for Liquid Retaining Structures***<br>*Shallow versus Deep Foundation Systems • Pile Foundation for Large Storage Tanks • Soil Bearing Capacity & Settlement Analysis • Geotechnical Investigations & Risk Assessment* |
| *1145 – 1230* | *Break* |
| *1230 - 1330* | ***Design of Bunds & Secondary Containment Systems***<br>*Regulatory Requirements for Secondary Containment • Earth Berm vs. Concrete Bund Wall Designs • Liner Materials & Impermeability Considerations • Drainage & Spill Containment Planning* |
| *1330 - 1420* | ***Structural Modeling & Finite Element Analysis (FEA)***<br>*Use of Structural Analysis Software (SAP2000, ETABS, STAAD Pro) • Load Distribution & Stress Analysis • Crack Width Calculation & Control Measures • Case Study: Structural Simulation of a Liquid Retaining Structure* |
| *1420 – 1430* | ***Recap***<br>*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 – 0830* | ***Waterproofing Strategies for Liquid Retaining Structures***<br>*Types of Waterproofing Systems (Integral, Membrane, Surface Coatings) • Joint Treatment & Expansion Joint Design • Injection Grouting & Crack Repair Techniques • Case Study: Waterproofing Failures & Solutions* |
| *0830 – 0930* | ***Corrosion Protection & Cathodic Protection Systems***<br>*Corrosion Mechanisms in Liquid Retaining Structures • Protective Coatings & Linings for Steel & Concrete Tanks • Cathodic Protection: Sacrificial Anodes vs. Impressed Current Systems • Maintenance & Monitoring of Corrosion Protection Systems* |

| | |
|---|---|
| *0930 - 0945* | *Break* |
| *0945 – 1130* | ***Leak Detection & Monitoring Systems***<br>*Methods for Detecting Leaks in Liquid Storage Facilities • Use of Sensors & Acoustic Monitoring Systems • Secondary Containment Leak Detection Technologies • Leak Prevention & Response Strategy* |
| *1130 - 1230* | ***Crack Prevention & Remediation Techniques***<br>*Causes of Cracking in Liquid Retaining Structures • Crack Control Reinforcement Techniques • Use of Shrinkage-Reducing Admixtures • Repair Techniques for Cracked Tanks & Reservoirs* |
| *1230 - 1245* | *Break* |
| *1245 - 1330* | ***Fire Protection & Safety Considerations***<br>*Fire Risks in Liquid Retaining Structures for Petroleum Storage • NFPA 30: Flammable & Combustible Liquids Code • Fire Suppression Systems for Storage Tanks • Case Study: Tank Fire Incidents & Mitigation Strategies* |
| *1330 - 1420* | ***Risk Assessment & Failure Prevention***<br>*Risk-Based Inspection (RBI) for Storage Tanks • Root Cause Analysis for Structural Failures • Predictive Maintenance & Monitoring Techniques • Asset Integrity Management Framework* |
| *1420 – 1430* | ***Recap***<br>*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***

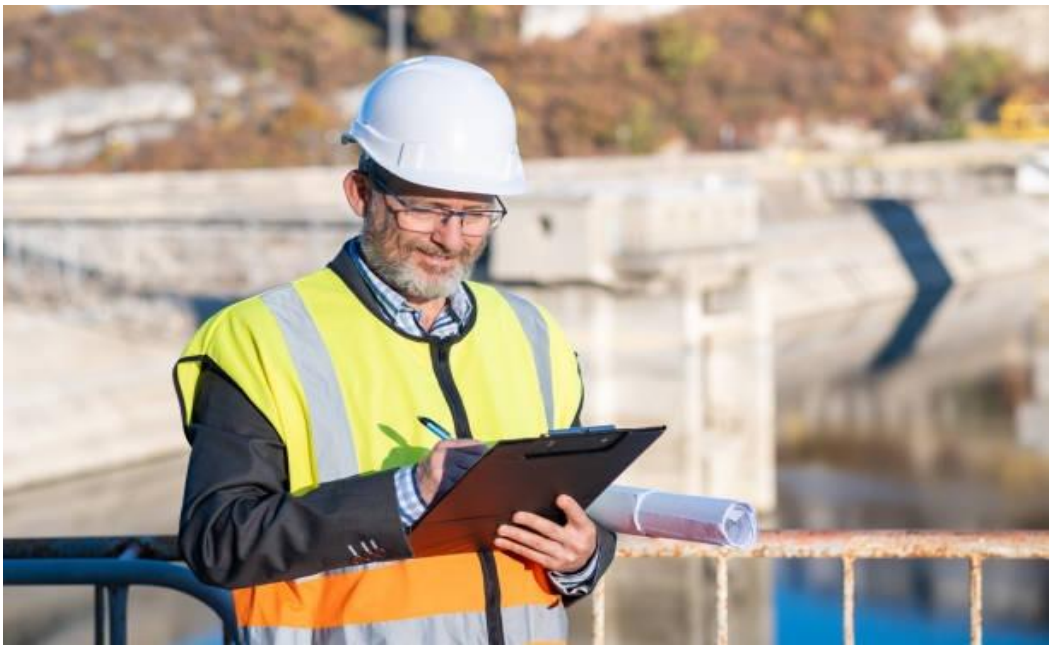
| | |
|---|---|
| *0730 – 0830* | ***Construction Methods for Liquid Retaining Structures***<br>*Precast vs. Cast-in-Place Concrete Tanks • Welding & Fabrication Techniques for Steel Tanks • Slip Forming & Pre-Stressed Concrete Construction • Construction Quality Assurance Standards* |
| *0830 – 0930* | ***Testing & Quality Control in Liquid Retaining Structures***<br>*Hydrostatic Testing & Leak Testing Procedures • Ultrasonic & Radiographic Testing for Welded Tanks • Concrete Strength Testing & Crack Inspection • Non-Destructive Testing (NDT) Techniques* |
| *0930 - 0945* | *Break* |
| *0945 – 1130* | ***Tank Commissioning & Operational Readiness***<br>*Pre-Operational Inspection & Safety Checks • Filling & Emptying Procedures for Initial Testing • Safety Precautions During Commissioning • Performance Validation & Final Approval* |
| *1130 - 1230* | ***Maintenance Strategies for Long-Term Integrity***<br>*Routine Inspection & Preventive Maintenance Plans • Cleaning & Sludge Removal Techniques for Tanks • Structural Monitoring & Integrity Assessment • Predictive Maintenance Strategy* |
| *1230 - 1245* | *Break* |
| *1245 – 1420* | ***Digitalization & Smart Monitoring Technologies***<br>*IoT-Based Monitoring Systems for Storage Tanks • Use of Drones for Structural Inspection • Digital Twin Technology for Predictive Analysis • Digitalization Approach for Asset Management* |
| *1420 – 1430* | ***Recap***<br>*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 Four* |

***Day 5***

| | |
|---|---|
| *0730 – 0930* | ***Case Studies on Liquid Retaining Structures***<br>*Large-Scale Storage Tank Projects • Lessons from Tank Failures & Design Improvements • Innovations in Liquid Storage Facilities • Future Trends in Infrastructure Development* |
| *0930 - 0945* | *Break* |
| *0945 – 1100* | ***Specific Design & Operational Guidelines Case Studies***<br>*Design Standards for Liquid Retaining Structures • Safety & Environmental Compliance Requirements • Best Practices in Tank Farm Operations • Case Study: Successful Liquid Storage Projects* |
| *1100 – 1230* | ***Practical Structural Analysis & Load Calculations***<br>*Structural Load Calculation Workshop • Crack Width & Expansion Joint Design Exercise • Seismic Load Consideration in Tank Design • Case Study Analysis for Design Optimization* |
| *1230 - 1245* | *Break* |
| *1245 - 1345* | ***Risk Management & Emergency Response Training***<br>*Leak & Spill Management Tabletop Exercise • Emergency Shutdown Procedures • Fire & Explosion Hazard Scenarios • Emergency Response Simulation* |
| *1345 – 1400* | ***Course Conclusion***<br>*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

Mari Nakintu, Tel: +971 2 30 91 714, Email: mari1@haward.org