
Concrete Durability and Mix Performance for Infrastructure Projects Course

18 – 22 July 2027
Muscat





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Ref: 117_14470 Date: 18 – 22 July 2027 Location: Muscat Fees: 4300 GBP

Programme Summary

Concrete durability and mix performance for infrastructure projects is a five-day training course for engineering and construction leaders at managerial level, culminating in a durability specification and quality plan for a structure in their own portfolio. Bridges, marine works, tunnels and industrial structures in hot or aggressive environments often deteriorate decades before their design life because materials, mixes, placing and curing were chosen for initial cost rather than service performance. The approach links cement chemistry, mix design, deterioration mechanisms and site control to specification decisions. Mars Training Centre UK delivers this programme in concrete durability.

The Business Case

Concrete repair and early replacement are among the largest avoidable costs an infrastructure owner faces, and they usually trace back to decisions taken before the first pour. Leaders who can set exposure-based requirements, judge a mix design, insist on proper curing and read test results protect asset life and reduce disputes over defective work, while lowering the embodied carbon of what they build.

- Asset Service Life: Extends as cover, binder type and permeability are specified against the actual exposure.
- Repair and Defect Cost: Falls as cracking, poor curing and non-conforming concrete are prevented or caught early.
- Embodied Carbon of Structures: Reduces as supplementary cementitious materials replace part of the clinker without loss of performance.

Principles and Evidence Base

- ACI 201.2R Guide to Durable Concrete: Frames the deterioration mechanisms and protective measures examined in Session 2.
- EN 206 Exposure Classes: Link environmental conditions to limiting values for mix composition when requirements are set in Sessions 2 and 3.
- ACI 305R-20 Guide to Hot Weather Concreting: Guides the placing, temperature control and curing practice reviewed in Session 4.
- Service Life Design in the fib Model Code: Shapes the performance-based approach to specifying concrete for a target life in Session 3.



Intended Participants

- Leaders accountable for the long-term performance of concrete infrastructure assets.
- Directors who approve concrete specifications, mix designs and supplier choices on major projects.
- Heads of materials and quality who set testing, acceptance and non-conformance rules.
- Asset owners and client representatives who must judge contractor proposals and defect claims.

The programme serves transport and highways, ports and marine works, water and wastewater infrastructure, and industrial and energy facilities.

Learning Outcomes

1. Participants will be able to evaluate how cement, supplementary materials and admixtures affect fresh and hardened concrete.
2. Participants will be able to diagnose chloride, sulphate, carbonation and alkali-silica deterioration from site evidence.
3. Participants will be able to judge a performance-based mix design against exposure and service life requirements.
4. Participants will be able to prioritise hot-weather placing and curing controls for a project.
5. Participants will be able to construct a testing and acceptance regime for concrete supply.
6. Participants will be able to justify a durability specification and quality plan to project stakeholders.

Programme Structure

Day 1: Concrete Materials and Mix Performance

How do binders, aggregates and admixtures determine concrete behaviour?

- Cement Hydration and Microstructure
- Fly Ash, Slag and Silica Fume as Supplementary Materials
- Aggregate Quality and Grading
- Chemical Admixtures and Workability
- Water-Binder Ratio and Strength Development

Day 2: Concrete Durability Mechanisms

Why does concrete deteriorate, and how is each mechanism recognised?

- Chloride Ingress and Reinforcement Corrosion
- Carbonation and Cover Depth
- Sulphate and Chemical Attack
- Alkali-Silica Reaction
- Plastic and Thermal Cracking



Day 3: Specifying Concrete for Service Life

How are exposure and design life turned into mix requirements?

- Exposure Classification of Structural Elements
- Prescriptive Versus Performance-Based Specification
- Durability Indicators: Permeability, Chloride Diffusion and Resistivity
- High-Performance and Self-Compacting Concrete
- Low-Carbon Mix Options and Their Limits

Day 4: Hot-Weather Concreting, Curing and Quality Control

How is specified performance achieved on site in demanding conditions?

- Concrete Temperature Control and Retarders
- Placing, Compaction and Mass Concrete Thermal Control
- Curing Methods and Duration
- Sampling, Testing and Statistical Acceptance
- Non-Conformance and Core Testing Decisions

Day 5: Applying the Durability Specification and Quality Plan

How are materials, mechanisms, specification and site control combined for one structure?

- Exposure Review of a Participant Structure
- Mix and Specification Choices
- Site Control and Testing Priorities
- Peer Challenge of Durability Plans
- Durability Specification and Quality Plan Presentation

Methodology

The programme relies on case analysis supported by data exercises. Participants examine specifications, mix designs, test records and condition surveys from bridges, marine structures and industrial plants, trace defects to their causes and rebuild requirements that would have prevented them.

- Suggested activity: Assigning exposure classes to the elements of a coastal structure.
- Suggested activity: Comparing three mix designs for durability, cost and carbon.
- Suggested activity: Deciding acceptance of a non-conforming concrete batch from test data.



Capstone Output

Each participant completes a durability specification and quality plan for a structure they own or deliver. It sets exposure classes, mix and cover requirements, hot-weather and curing controls and the testing and acceptance regime, ready for use in tender documents or a contractor review.

Frequently Asked Questions

Is concrete durability training suitable for directors who are not materials specialists?

Yes. It suits engineering, construction and asset leaders who decide on concrete specifications and quality. It assumes experience of construction projects but no specialist concrete technology training.

Which guides underpin concrete durability and mix performance in this course?

It draws on ACI 201.2R on durable concrete, EN 206 exposure classes, ACI 305R-20 on hot weather concreting and the service life design approach of the fib Model Code.

How is the concrete durability specification and quality plan used at work?

You take back a plan for a real structure that can be placed in tender documents or used to review contractor proposals.

How does concrete durability training differ from structural design courses?

It concentrates on materials, mixes, deterioration and site quality rather than on calculating structural members and reinforcement.