## Concrete Technology Course (CTC) – Detailed Learning Outcomes

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| Block 1: Course Introduction | **Module 1**: Concrete Technology Course (CTC) Introduction | 1. About Cement, Concrete & Aggregates Australia (CCAA) 2. CCAA Concrete Technology Course | At the completion of this module you will be able to:  
• Identify the key PPE requirements for working with concrete – at the concrete plant or on-site  
• Understand what safety precautions are necessary when working with concrete  
• Explain the key factors addressed in typical Environmental Protections Acts  
• Identify precautions that can be taken at a concrete plant in each area of environmental importance |
| | **Module 3**: Concrete Sustainability / Green Star | 1. Challenges for the Concrete Industry 2. Sustainability Benefits from Concrete Use 3. Competitor Materials 4. Meeting the Challenges 5. Green Star 6. Life Cycle Assessment | At the completion of this module you will be able to:  
• Discuss the competing considerations relating to ‘concrete sustainability’ – including both the positive and negative aspects of concrete from an environmental perspective  
• Understand some of the changes being made or considered in concrete technology to reduce environmental impacts  
• Understand methods of producing ‘green cements/concretes’ – approaches being taken and applications to date  
• Discuss some approaches being used to reduce the environmental impact of concrete and their applicability |
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| Block 2: Concrete Materials | Module 4a: Cementitious Materials (Portland and Blended Cements) | 1. History of Cement  
2. Manufacture of Portland Cement  
3. The Cement Manufacturing Process  
4. Environmental Aspects of Cement Manufacture  
5. Chemistry of Portland Cement  
6. Reportable Properties and Materials  
7. Types of Cement  
8. Other Cements  
9. The Hydration and Setting of Portland Cement  
10. Hydration Characteristics of Portland Cement  
11. The Hardening of Cement  
12. Impacts on Concrete Performance  
13. Special Properties of Cement  
14. Storage Sampling and Testing of Cement | At the completion of this module you will be able to:  
• Describe the general use of 'cements' in ancient times.  
• Describe the manufacturing processes involved in making Portland cement.  
• Comment on the environmental issues associated with cement manufacture  
• Describe in general terms, the mineralogy and chemistry of Portland cement  
• Define the types of cement and the important characteristics of each type.  
• Describe the different stages in the cement hydration reaction  
• Understand the reasons certain concrete properties are affected by various cement characteristics  
• Describe in general terms, the nature of ASR and sulfate attack on concrete  
• Describe the important requirements for the proper storage of cement |
| Module 4b: Cementitious Materials (Introduction to Supplementary Cementitious Materials) | 1. How SCMs Work  
2. Reasons for Use of SCMs  
3. Properties of Concrete  
4. Impact on Chemical Admixtures  
5. Australian Standards for SCMs  
6. Testing | At the completion of this module you will be able to:  
• Describe the typical SCM-types used in Australia.  
• Explain how SCM's work in concrete.  
• Describe the benefits of using SCM’s in both the plastic and hardened states of concrete.  
• Explain the specific advantages to plastic and hardened state concrete properties from using the various SCM's.  
• Nominate the relevant Australian Standard series specific to SCM's. |
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| Block 2: Concrete Materials | Module 5: Fly Ash | 1. Benefits  
2. Concerns  
3. The Material  
4. Standards Requirements  
5. Production  
6. Properties  
7. Use of Fly Ash  
8. Transporting and Handling Fly Ash  
9. How Does Fly Ash Work in Concrete  
10. Use with Chemical Admixtures  
11. Properties of Fly Ash Concrete  
12. Curing  
13. Formwork Stripping Times  
14. High Volume Fly Ash Concrete  
15. Testing Fly Ash | At the completion of this module you will be able to:  
- Describe the way in which fly ash is formed  
- Explain the benefits of using fly ash in concrete in both the plastic and hardened states  
- Explain how fly ash reacts and how this leads to improved concrete performance  
- List the concrete durability improvements derived from using fly ash  
- Describe the relative handling characteristics of fly ash (compared to cement) and how it should be stored and transported  
- Describe the concept of Proven and Unproven Sources  
- Discuss the environmental benefits from using fly ash |
| | Module 6: Slag | 1. Benefits  
2. Concerns  
3. The Materials  
4. Standards Requirements  
5. Production  
6. Properties  
7. Transport and Handling of GGBFS  
8. Use of GGBFS  
9. Blast Furnace Slag Cement  
10. How Does GGBFS Work?  
11. Properties of Slag Concrete  
12. Curing / Strength Development  
13. GGBFS Replacement Ration  
14. Testing | At the completion of this module you will be able to:  
- Describe the process in which slag is formed  
- Explain the difference between GBFS and GGBFS  
- Explain the benefits of using GGBFS in concrete in both the plastic and hardened states  
- Explain how GGBFS reacts and how this leads to improved concrete performance  
- List the concrete durability improvements derived from using GGBFS  
- Describe the relative handling characteristics of GGBFS (compared to cement) and how it should be stored and transported  
- Describe the concept of Proven and Unproven Sources  
- Discuss the environmental benefits from using GGBFS |
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| Block 2: Concrete Materials | Module 7: Amorphous Silicas | 1. Benefits  
2. Concerns  
3. The Materials  
4. Standards Requirements  
5. Production  
6. Properties  
7. Use  
8. Handling Amorphous Silica  
9. Health and Safety  
10. Amorphous Silica Reactions  
11. Properties of Concrete Containing Amorphous Silica  
12. Durability  
13. Curing  
14. Use of Chemical Admixtures  
15. Testing | At the completion of this module you will be able to:  
- Distinguish between the various sources of amorphous silica materials.  
- Describe the different physical forms in which silica fume might be supplied to the concrete market.  
- Describe the benefits of using amorphous silicas and possible concerns.  
- Describe important aspects of the handling and storage of amorphous silicas  
- Discuss how amorphous silicas react in a concrete mix, and the nature of their effects on the plastic and hardened states of concrete.  
- Discuss the key ways in which silica fume affects compressive strength and durability performance of concrete.  
- Describe any limitations or effects resulting from the use of amorphous silicas on concrete admixture use and performance. |
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| Block 2: Concrete Materials | Module 8: Concrete Aggregates | 1. Classification of Aggregates  
2. Density  
3. Specification of Aggregates  
4. Water Absorption  
5. Dimensional Aggregate Properties  
6. Particle Shape and Texture  
7. Hardness  
8. Strength  
9. Durability  
10. Alkali Aggregate Reaction (AAR)  
11. Other Deleterious Substances  
12. Slag Aggregate  
13. Typical Sources of Aggregate  
14. Influence on Concrete Properties  
15. Testing Aggregate | At the completion of this module you will be able to:  
- Understand the importance of the role aggregates play in concrete performance  
- Be able to explain the specific impacts that aggregates can have on plastic and hardened concrete performance  
- Understand the different sizes of aggregate materials and how they are prepared.  
- Describe the key properties of aggregate materials, how they affect concrete performance and how they are measured.  
- Understand the importance of aggregate grading – for both the individual materials and of the combined grading when they are combined in a concrete mix  
- Understand the need for aggregates to have good durability performance and how this relates to concrete performance.  
- Understand what ‘manufactured sand’ is and how it is tested.  
- Understand in general terms, the wide variety of geological materials that are available – including those that are acceptable as concrete aggregates and those that are unsuitable.  
- Understand how aggregates affect Alkali Aggregate Reaction/ Alkali Silica Reaction (AAR / ASR) and what testing is available to determine potential aggregate reactivity.  
- Describe the Australian Standards used to specify aggregate characteristics and performance and the relevant test methods. |
| | Module 9: Water and Concrete | 1. Water Quality Issues  
2. Water Quality Criteria  
3. Effect of Major Impurities in Mixing Water  
4. Limits on Impurities  
5. Implications of Water Quality  
6. The Role/s of Water in Concrete | At the completion of this module you will be able to:  
- List the two ways in which AS 1379 Specification and Supply of Concrete deems water to be acceptable for concrete  
- Understand the reason for limits on chlorides in mixing water  
- State the effect of salt(s) on concrete strength and setting time  
- Explain how to check water for suitability in concrete if laboratory water analysis is not available  
- Understand some of the direct effects that water has on the most basic elements of concrete performance. |
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|       | Module 10: Admixtures | 1. History  
2. Types of Admixtures  
3. Mechanisms for Admixture Reactions  
4. Air Entraining Admixtures (Type AEA)  
5. Set Controlling Admixtures  
6. Water Reducing Admixtures  
7. Other Admixtures  
8. Hydration Control Admixtures (Type HCA)  
9. Anti Washout Admixtures (Type AWA)  
10. Permeability Reducing Agents  
11. Internal Curing Admixtures  
12. Antifreeze Admixtures  
13. Foaming Admixtures  
14. Guidance on Use of Admixtures  
15. Checklist  
16. Australian Standard AS 1478.1  
17. Choosing an Admixture  
18. Admixture Dose | At the completion of this module you will be able to:  
- Discuss the role that admixtures can play in improving concrete performance.  
- Elaborate on the various types of admixtures – where they are typically used, their primary role, advantages that they may confer on concrete performance, performance effects from their mis-use.  
- Understand which Australian Standards are used to specify admixture performance requirements and test admixtures.  
- Discuss the requirements for choosing an admixture or set of admixtures and assessing how they might be expected to perform.  
- Be aware of the potential for interaction between admixtures with potentially beneficial and detrimental effects. |
2. Portland and Blended Cement  
3. Concrete Testing  
4. Supplementary Cementitious Materials  
5. Fly Ash  
6. Ground Granulated Iron Blast Furnace Slag (Slag)  
7. Amorphous Silica | At the completion of this module you will be able to:  
- Discuss fundamental requirements for managing a laboratory to ensure test results are reliable and consistent.  
- Understand the key properties required to be tested for all cementitious materials.  
- Discuss key issues in each of the test methods used for cement and the SCM’s.  
- Discuss the concept of Proven and Unproven Sources and their impact on testing frequencies.  
- Outline the requirements for test reports for the various cementitious materials. |
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| Block 3: Producing and Testing Concrete | **Module 12: Specification and Supply** | 1. Specification of Concrete  
2. Standard Strength Grades  
3. Classes of Concrete  
4. Accuracy and Calibration of Measuring Equipment in the Concrete Batch Plant  
5. Tolerance on Batching  
6. Mixing of Concrete  
7. Delivery  
8. Identification Certificate  
9. Assessment of Concrete  
10. Rejection of Concrete | At the completion of this module you will be able to:  
- Understand the differences between Normal Class and Special Class concrete.  
- Understand the key test types used in the specification of concrete and their Normal class limits.  
- Understand the calibration requirements for concrete plant weighing and metering systems.  
- Understand the batching accuracy requirements for pre-mixed concrete.  
- Understand the minimum requirements for mixing of concrete prior to delivery into forms.  
- Understand the allowable delivery timing of Normal Class concrete.  
- Understand the test methods specified for assessing the mixing of plastic concrete.  
- Understand the basis of assessment of specified concrete properties and actions to be taken on non-conforming product. |
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• Explain the difference between QA and QC.  
• Identify the standards QA systems are based on.  
• Explain how the customer attitude affects QA.  
• Identify management steps a typical process of continual improvement involve.  
• Identify stages of a QC process.  
• Identify some of the inherent variations in concrete that must be recognised in setting limits in QC.  
• Explain the difference between mean strength and characteristic strength.  
• Explain standard deviation.  
• List some things that can affect SD.  
• Explain how coefficient of variation is linked to standard deviation.  
• Explain what aspect of a Normal Distribution Curve of test results demonstrates good control.  
• Explain how the target strength calculated.  
• Explain what a controlled grade or associated grade of concrete is.  
• Explain what is considered an acceptable sample size for assessing a controlled grade of concrete. |
## Block 3: Producing and Testing Concrete

### Module 14: Concrete Properties

1. Plastic State Properties
2. Hardened Concrete Properties
3. Strength
4. Durability
5. Permeability, Sorptivity and Carbonation
7. Corrosion of Reinforcement
8. Supplementary Cementitious Materials (SCMs)
9. Chemical Attack
10. Volume Change
11. Drying Shrinkage
12. Creep
13. Thermal Movement
14. Abrasion Resistance
15. Freeze Thaw Resistance
16. Alkali Aggregate Reaction (AAR)
17. Properties of Prestressed and Post-tension concrete

### Learning Outcomes from Each Module

At the completion of this module you will be able to:

- Identify the common tests for measuring plastic properties of concrete
- Identify the two major strength properties of concrete.
- List 4 factors that affect the compressive strength of concrete.
- List 3 factors that affect the workability of concrete as measured with the slump test.
- Identify the affects that SCM’s have on the concrete compressive strength
- Identify the difference between workability and consistency of plastic concrete
- Identify the key mix design ingredient that affects cohesiveness of concrete
- Identify any relationship between flexural strength and compressive strength
- Identify 3 aggregate types that can be used to create high density or heavyweight concrete
- Explain the exposure classifications for concrete as listed in AS 3600.
- Identify the most aggressive environment for concrete in AS3600.
- List the two things that can destroy the passive layer the surrounds reinforcing steel and protects it.
- Name two things that can be done to improve the sulphate resistance of concrete.
- Identify two methods that can be used to reduce the drying shrinkage of.
- Identify the key things that provide concrete with high abrasion resistance?
- Identify two things that need to be done to prevent damage from Freeze Thaw
- Identify two strategies in concrete mix design that will reduce the risk of damage to concrete from ASR.
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|                       | Module 15: Testing Concrete | 1. Properties Tested  
2. Australian Standards  
3. NATA  
4. Sampling  
5. Standard Tests  
6. Repeatability and Reproducibility  
7. Equipment  
8. Consistency Tests  
9. Strength Testing  
10. Plastic Concrete Tests  
11. Hardened Concrete Tests  
12. Modulus of Elasticity (AS 1012 Part 17)  
13. Volume of Permeable Voids (AS 1012.21)  
14. Sulfate and Chloride (AS 1012.20)  
15. Superworkable Concrete Testing | At the completion of this module you will be able to:  
- Explain the function of the organization called NATA.  
- Give some of the reasons for undertaking testing of concrete.  
- Explain the key aim of taking a sample of concrete.  
- Define the difference between a grab and a composite sample.  
- Explain when and how a sample of concrete should be taken on site.  
- Explain what the two most common tests done on concrete are and what their significance is.  
- Explain what the two common tests used to determine the tensile strength of concrete are.  
- Explain why standard conditions are adopted for assessment of concrete properties.  
- Explain what 600 microstrain drying shrinkage means.  
- Explain the method for performing a slump test.  
- Explain how concrete test cylinders are compacted.  
- Explain three methods that can be used for capping or creating plane ends on concrete test cylinders for compression testing.  
- Explain the terms repeatability and reproducibility.  
- Detail the five tests in AS 1012 for consistency of concrete.  
- Explain how a bleed test is carried out on concrete.  
- Explain how a setting time test is carried out on concrete.  
- Explain the tests for Slump Flow, T500 and J-Ring and what properties they measure. |
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|       | Module 16: Non-Destructive Testing (NDT) | 1. Equipment  
2. Location and Number of Tests  
3. Interpretation of Results  
4. Basic Tools  
5. Plan of Action  
6. Strength Evaluation  
7. Methods  
8. Applications  
9. Test Methods  
10. Impact Echo  
11. Reinforcement Electrical Potential  
12. Ground Penetration Radar  
13. Concrete Resistivity  
14. Polarisation Resistance  
15. Rebound Hammer  
16. Ultrasonic Pulse Velocity  
17. Covermeter  
18. Other Tests  
19. Digital Improvements  
20. Core Testing  
21. Interpretation | At the completion of this module you will be able to:  
- Give reasons why NDT may need to be used.  
- Explain the basic equipment that should be used prior to any sophisticated testing.  
- Explain the key methods that would be applicable to a strength investigation.  
- Explain the key methods that are applicable to assessing cracking and voids in concrete.  
- Explain the procedure for correct use of a rebound hammer.  
- Explain when a core testing program would be requested.  
- Explain the main factors that affect core test results.  
- Advise if it is possible to test cores that are not the standard diameter or L/D ratio.  
- Detail the steps to prepare cores for compression testing.  
- Advise when or if cores should be tested wet or dry.  
- Advise what happens if a core shows heavily uncompacted concrete or contains a reinforcing bar. |
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| Block 3: Producing and Testing Concrete | Module 17: Concrete Mix Design | 1. Preparation of Mix Design  
2. Use of Mix Design Information  
3. Presentation of Mix Design  
4. Aim of Mix Design  
5. Influences on a Mix Design  
6. Basic Factors  
7. The Process  
8. Mix Design Input  
9. Project Documents  
10. Other Hardened Concrete Properties  
11. Site Requirements  
12. Mix Design Procedure  
13. Developing First Trial Mix Proportions  
14. Trial Testing Data  
15. Yield Calculations | At the completion of this module you will be able to:  
- Explain the common method of presenting the components of a concrete mix design.  
- Explain the aims of a concrete mix design.  
- Identify the key factors that influence a mix design.  
- Identify the 6 common steps in mix design.  
- Explain what is meant by “Wet Density” of concrete.  
- Identify types of chemical admixtures that can be used to change the wet density of the concrete.  
- Explain what is meant by the “Yield” of concrete.  
- List the three basic factors that must be considered when doing a mix design.  
- List site requirements and placing factors that will influence a mix design.  
- List factors that can change the wet density of the concrete.  
- List the important things to check in a mix design when checking initial mix proportions.  
- Explain how to adjust an initial mix design when the batch weights of the concrete components exceed the trial mix wet density.  
- Carry out a trial mix design using the method proposed in this module. |
| Block 4: Placing and Finishing Practices | Module 18: Hot and Cold Weather Concrete | **Hot Weather Concreting**  
1. Effect of Increased Temperature  
2. Prevention of Plastic Cracking  
3. Assessment of Drying Conditions  
4. Temperature Limit  
5. Contributions to Concrete Temperature  
6. Controlling Concrete Temperature  
**Cold Weather Concreting**  
1. Impact of Low Temperatures  
2. Precautions in Cold Weather | At the completion of this module you will be able to:  
- Explain the consequences of increasing temperature on concrete.  
- Explain the important factors that influence the surface drying of concrete and the likelihood of plastic cracking.  
- Identify three methods of reducing concrete temperature at placement.  
- List the effects of lower concrete temperatures on concrete properties.  
- Identify methods of offsetting the lower strength gain in concrete due to lower temperatures.  
- Explain how stripping of formwork and back-propping is affected by cold air temperatures. |
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| Block 4: Placing and Finishing Practices | Module 19: Compaction of Concrete | 1. Objective of Compaction  
2. Stages of Compaction  
3. Effect on Hardened Concrete  
4. Methods of Compaction  
5. Other Forms of Compaction  
6. Re-vibration | At the completion of this module you will be able to:  
- Name two methods of compacting concrete and indicate where you would use each.  
- List the two stages of compaction of concrete that are evident with immersion vibration.  
- Explain the difference between Entrained Air and Entrapped Air in concrete.  
- Explain when vibrating screeds are used and where poker vibrators also are used with them.  
- Explain the concern about over vibration and the steps in mix design that can correct any of these concerns. |
| | Module 20: Curing of Concrete | 1. Requirements for Curing  
2. Effect of Curing on Concrete Properties  
3. Curing Methods  
4. Heat Accelerated Curing  
5. Curing Period  
6. Air Curing  
7. Selection of Method of Curing | At the completion of this module you will be able to:  
- Explain what is meant by the term curing.  
- Explain why curing is important  
- Describe the three basic methods of curing concrete.  
- Explain the term ponding and the precautions that need to be taken when using this method.  
- Explain the requirements for effective curing with polythene sheet.  
- Comment on the key types of liquid membrane-forming curing compounds ability to comply to AS 3799  
- Explain the efficiency rating for a curing compound  
- Explain the two things required to enable cement to react properly in concrete  
- Explain the reasons for using heat accelerated curing for precast, prestressed concrete  
- Identify the key stages in a steam curing process  
- Explain how ‘maturity’ of concrete is determined |
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2. Choice of Materials for Formwork  
3. Formwork for Precast Concrete  
4. Design of Formwork  
5. Preparation for Concreting  
6. Formwork Stripping  
7. Special Off Form Finishes in Concrete  
8. Methods of Surface Treatment  
9. Test panels  
10. Requirements for Good Finishes  
11. Formwork Standard  
12. Concrete Materials  
13. Mix Design  
14. Batching  
15. Delivery and Placement Time  
16. Testing  
17. Formwork detailing for Construction  
18. Joints and Construction Process  
19. Surface Finish Forms – Basic Needs  
20. Release Agents  
21. Concrete Placement  
22. Curing  
23. Evaluation of Surface Finishes  
24. Defects | At the completion of this module you will be able to:  
• Identify which parts of formwork provide the temporary structural strength  
• Identify four reasons for choosing a specific material as formwork for a concrete element  
• Explain why formwork must be rigid and appropriately sealed  
• Explain method of choosing a release agent be used for special off form finish  
• Identify two things that place load on formwork for a suspended floor  
• Identify what changes the sideways pressure on the forms for a wall  
• Explain why formwork stripping times are related to ambient temperature  
• Explain why test panels are essential for special finishes.  
• Identify how many classes of concrete surface finish AS 3610.1 lists  
• Identify what classes of finish can have colour control specified  
• Identify the things that need to be watched with concrete materials to produce consistent off form concrete.  
• Explain if fast or slow placement of concrete in walls and columns give better off form surface finish  
• Explain the main cause of blowholes  
• Explain what is meant by hydration staining.  
• Explain what is meant by viewing distance for assessment of finishes |
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|       | **Module 22: Industrial Floors and Pavements** | 1. Loads on Concrete Pavements  
2. Load Carrying Capacity  
3. Crack Control  
4. Joints  
5. Joint Layout  
6. Joint Sealants  
7. Slip Membranes  
8. Construction Activities | At the completion of this module you will be able to:  
- Achieve basic understanding of concrete floor and pavement composition, as well as the role of each structural layer  
- Provide appropriate selection and basic detailing of major structural layers  
- Conduct concept planning/layout for different pavement designs, joint types and joint arrangements  
- Provide concept planning/layout for special areas such as road intersections  
- Comprehend the overall construction process, from construction sequence, reinforcement and dowel arrangement, formwork installation, concrete placement and finishing techniques, curing, sawn joints and joint sealing |
|       | **Module 23: Special Paving Finishes** | 1. Range of Finishes  
2. Coloured Concrete  
3. Colouring Options for Concrete  
4. Patterned Paving  
5. Patterned Concrete Defects  
6. Exposed Aggregate Finishes  
7. Polished Concrete  
8. General Considerations | At the completion of this module you will be able to:  
- Achieve basic understanding of special concrete paving finishes  
- Conduct appropriate selection of materials for special paving finishes  
- Comprehend the techniques, along with basic sequence for each type of special paving finish  
- Provide a reasonable evaluation of special paving finishes, regarding their effects on structural performance of concrete pavement (e.g., mix design, reinforcement and joint arrangement) |
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| Block 5: Speciality Concrete Applications | **Module 24**: High Performance and Speciality Concrete | 1. High Strength Concrete and High Durability Concrete  
2. Special Mixes:  
   a) Super-Workable Concrete  
   b) Shotcrete / Sprayed Concrete  
   c) Kerb Concrete Produced by Extrusion Technique  
   d) Exposed Aggregate Concrete  
   e) Stamped/Stencilled Concrete  
   f) Honed and Polished Concrete  
   g) No Fines Concrete  
   h) Controlled Low Strength Fill  
   i) Lightweight Concrete  
   j) Heavyweight Concrete  
   k) Very High Strength Concrete  
   l) Underwater – Tremie Concrete  
   m) Mass Concrete | At the completion of this module you will be able to:  
   - Discuss the classification of different concrete types, in terms of their high and/or special performances in practice  
   - Understand the basics of mix design and material selection  
   - Understand the special testing methods needed to ensure the desired performance  
   - Understand the basics of construction techniques and methods of placing and curing for each type of high/special performance concrete |
|                        | **Module 25**: Reinforced and Pre-Stressed Concrete with Pre- and Post-Tensioning | 1. Reinforced concrete  
   a. Introduction  
   b. Structural design of reinforced concrete  
   c. Reinforced concrete detailing guidelines  
  2. Pre-stressed concrete  
   a. Basic concept and benefits of prestressing concrete  
   b. Types of prestressing technique – pre-tensioning and post-tensioning  
   c. Special considerations in the design of prestressed concrete  
   d. Construction | At the completion of this module you will be able to:  
   - Achieve a basic understanding of reinforcing concrete by steel and prestressing;  
   - Understand the key factors that make steel and concrete compatible;  
   - Understand the difference in process and relative advantages and uses of prestressed and post-tension structures.  
   - Have a basic knowledge of detailing requirements for reinforced and prestressed elements  
   - Have a basic knowledge of some key issues in the construction of reinforced and prestressed elements |
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|       | Module 26: Durability (Structural) | 1. Durability of Concrete Structures from Design and Manufacturing Process  
      a) Structural Design and Mix Design  
      b) Concrete Production and Curing  
      c) Mass Transport  
      2. Dimensional and Positional Stability  
      a) Formwork Movement – Foundation Movement  
      b) Overloading  
      c) Creep and Shrinkage-Swelling  
      d) Thermal Movement  
      e) Cracking Processes  
      3. Durability of Concrete Structures Under Environmental Impacts  
      a) Moisture  
      b) Raining – Flooding – (Short-Term) Immersion  
      c) Alternate Wetting and Drying  
      d) Frost Attack and Alternate Freezing-Thawing  
      e) Climate Change and Extreme Weather Patterns  
      4. Durability of Concrete Structures under Chemical Impacts  
      a) Sulfate Attack  
      b) Corrosion of Reinforcing Steel (including Steel Fibre) and Prestressing Steel  
      c) Alkali-Aggregate Reaction (AAR)  
      d) Acid Attack  
      5. Durability of Concrete Structures under Physical Impacts  
      a) Abrasion  
      b) Erosion  
      c) Physical Salt Attack (PSA)  
      6. Other Harmful Sources for Concrete Durability  
      a) Biological Processes  
      b) Fire  
      c) Earthquake  
      7. Durability of Special Concretes  
      a) Fibre-Reinforced Concrete (FRC)  
      b) Polymer-Modified Concrete | At the completion of this module you will be able to:  
  • Achieve initial knowledge regarding the assessment process of concrete durability  
  • Analyse the causes and mechanisms of different degradation types in concrete structures  
  • Propose suitable protection measures for different types of concrete deterioration  
  • Provide suitable techniques to improve concrete durability from design stages |
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| Block 6: Concrete Performance Characteristics | Module 27: Trouble Shooting, Investigations and Failure Modes | 1. Troubleshooting  
2. Procedure  
3. Testing  
4. Concrete Strengths Below Standard  
5. Cracking of Concrete  
6. Types of Cracking  
    a) Plastic Shrinkage Cracking  
    b) Plastic Settlement Cracking  
    c) Craze Cracking  
    d) Drying Shrinkage Cracking  
    e) Thermal Cracking  
    f) AAR/ASR Cracking  
7. Dusting Surfaces  
8. Curling  
9. Delamination of Slab Surfaces  
10. Problems with Finishing Slabs  
11. Rain Damage  
12. Efflorescence  
13. Uncompacted Concrete  
14. Concrete Short Supply | At the completion of this module you will be able to:  
- Understand the processes and activities required to undertake an investigation into concrete problems,  
- Understand the resources required to undertake an investigation into concrete problems, and  
- Understand key contributors to a wide range of common concrete issues and possible mitigation methodologies. |
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| Block 6: Concrete Performance Characteristics | Module 28: Alternative Binders-Alkali Activated Materials | 1. Major types and principles of alkali-activated materials (AAM’s)  
2. Important factors in mix design of alkali-activated materials (AAM’s)  
3. Properties of fresh and hardened alkali-activated materials (AAM’s)  
4. Durability of concrete made of alkali-activated materials (AAM’s)  
5. Current applications of alkali-activated materials (AAM’s) | At the completion of this module you will be able to:  
   • Understand the underlying reason to develop and major benefits of alternative binders  
   • Classify alternative binders with respect to the fundamental chemical reactions and compositions  
   • Familiarize with important design factors for each type of alternative binders  
   • Obtain initial understanding over properties and related durability issues of concrete made of alternative binders  
   • Recognize the current scope of application of alternative binders, as well as remaining issues to address to further develop and implement the materials |
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|       | Module A: Reporting and Report Writing – Technical Investigations | 1. General Commercial Considerations 2. Technical Considerations 3. Report Structure | At the completion of this module you will be able to:  
- Understand who the potential stakeholders are when carrying out a technical investigation.  
- Understand the assessment of risks associated with a site issue investigation and report.  
- Understand the general steps in developing a report for a site issue.  
- Understand the commercial and legal impacts associated with a site issue report.  
- Understand the technical considerations and professional standards associated with developing a report.  
- Understand the detail elements that should be contained in a site issue investigation report. |
|       | Module B: Laboratory Visit Notebook & Report Requirements | 1. Laboratory Visit Expectations 2. Laboratory Visit Report 3. Finding a Laboratory to Visit | At the completion of this module you will have:  
- Visited a construction-materials testing laboratory.  
- Noted the scope of work carried out by the laboratory and the range and type of materials tested.  
- Understood the nature of the laboratory customer base.  
- Become aware of the type of accreditation held by the laboratory and the requirements of the accrediting body.  
- Noted the sample receipt process(es) and the management of samples.  
- Understood the laboratory structure in terms of the separation of testing types, numbers of staff involved and the operational nature of the laboratory.  
- Understood the training program and processes – for new and existing staff.  
- Understood the process for test data recording and quality assessment and treatment of ‘doubtful data’.  
- Understood the nature of the Test Report process(es). |