



**INSTITUTE OF CONCRETE TECHNOLOGY
CONCRETE TECHNOLOGY & CONSTRUCTION**

**Stage 1
CONCRETE PRACTICE
Learning objectives Revision 3 (2020)**

<p>1.</p> <p>1.1</p> <p>1.2</p> <p>1.3</p>	<p>Introduction to the course</p> <p>Understand the aims, objectives and content of the course.</p> <p>Understand methods of teaching and learning to be used on the course.</p> <p>Plan for career progression and further training following successful completion of the course.</p>
<p>2.</p> <p>2.1</p> <p>2.2</p>	<p>Health and safety</p> <p>Be aware of potential risks to health when handling cement, concrete, mortars, admixtures and any other constituent material of concrete, and identify measures that should be taken to minimize risk to health.</p> <p>Identify sources of danger in the operation of plant and equipment used in concrete operations and identify precautions to be taken to ensure safe working.</p>
<p>3.</p> <p>3.1</p> <p>3.2</p> <p>3.3</p> <p>3.4</p>	<p>Sustainability</p> <p>Understand the definition of sustainability in relation to concrete.</p> <p>Identify main sustainability issues associated with the sourcing of constituent materials.</p> <p>Identify environmental impacts of concrete production and supply.</p> <p>Identify environmental benefits of the use of recycled concrete.</p>
<p>4.</p> <p>4.1</p> <p>4.2</p> <p>4.3</p>	<p>Types of concrete and its constituents</p> <p>Identify definitions of plain concrete, reinforced concrete, in situ concrete, precast concrete, prestressed concrete, non-structural concrete, lightweight and heavy-weight concrete and self-compacting concrete.</p> <p>Identify and recognise constituents of concrete.</p> <p>Identify suitable construction applications for the following types of precast elements: paving slabs, kerbs, blocks, pipes and cladding.</p>
<p>5.</p> <p>5.1</p> <p>5.2</p> <p>5.3</p> <p>5.4</p> <p>5.5</p> <p>5.6</p> <p>5.7</p> <p>5.8</p> <p>5.9</p> <p>5.10</p>	<p>Cementitious materials</p> <p>Identify the common cement types.</p> <p>Identify effects on properties of concrete of using different types of cement.</p> <p>Identify the principal raw materials of CEM I (Portland cement) and its normal production process.</p> <p>Identify the effect of fineness of cement on the strength development of concrete.</p> <p>Identify differences between CEM I, CEM II (Portland-composite cement), CEM III (blast furnace cement), CEM IV (pozzolanic cement) and CEM V (composite cement).</p> <p>Identify the most appropriate cement for use in a particular situation, given essential information about the conditions.</p> <p>Identify normal methods of cement supply and storage.</p> <p>Identify satisfactory or unsatisfactory condition of cement by image or description.</p> <p>Identify the definition of additions in concrete.</p> <p>Understand the production, properties and use of fly ash (pulverised-fuel ash) and ground granulated blast-furnace slag in concrete.</p>

<p>6.</p> <p>6.1</p> <p>6.2</p> <p>6.3</p> <p>6.4</p> <p>6.5</p> <p>6.6</p> <p>6.7</p> <p>6.8</p> <p>6.9</p> <p>6.10</p> <p>6.11</p> <p>6.12</p> <p>6.13</p> <p>6.14</p>	<p>Natural aggregates</p> <p>Identify the main types of natural aggregates and understand their production and processing.</p> <p>Identify crushed stone and gravel aggregate from image or description.</p> <p>Differentiate between coarse and fine aggregates.</p> <p>Identify coarse and fine aggregate classifications in terms of size and grading.</p> <p>Identify field tests for aggregates for concrete and understand reasons for tests.</p> <p>Understand the main standard tests on aggregates for concrete and their limiting values.</p> <p>Understand how to take a representative sample of aggregate from bulk supply in accordance with standard methods.</p> <p>Demonstrate knowledge of how to prepare and sieve a sample of aggregate in accordance with standard methods, including calculation of results.</p> <p>Understand methods of determining the moisture content of aggregates.</p> <p>Identify shape of aggregate particles from sample images.</p> <p>Identify dirty aggregates, major differences in aggregate grading, the presence of large proportions of flaky particles, from image or description.</p> <p>Understand the main impurities associated with aggregates and their possible effects on concrete.</p> <p>Understand how the properties of aggregates affect their handling and storage and what actions may be taken to minimize any problem.</p> <p>Identify properties of aggregates that affect properties of concrete and understand their impact.</p>
<p>7.</p> <p>7.1</p> <p>7.2</p> <p>7.3</p> <p>7.4</p> <p>7.5</p>	<p>Admixtures</p> <p>Identify definitions of water reducer (plasticiser), high range water reducer (superplasticiser), air entrainer, set retarder and set accelerator.</p> <p>Understand reasons for the importance of following specifications and manufacturers' instructions regarding dosage rates.</p> <p>Demonstrate knowledge of typical air contents for air-entrained concrete.</p> <p>Understand the impact on entrained air of fine aggregate grading, concrete consistence, mixing time, pumping and compaction.</p> <p>Understand the effects of the admixtures in 7.1 on the properties of fresh and hardened concrete.</p>
<p>8.</p> <p>8.1</p> <p>8.2</p>	<p>Water</p> <p>Understand requirements for water to be satisfactory for use in concrete.</p> <p>Identify when it is necessary to carry out chemical and physical tests in order to determine whether water is suitable for use in concrete.</p>
<p>9.</p> <p>9.1</p> <p>9.2</p> <p>9.3</p> <p>9.4</p> <p>9.5</p> <p>9.6</p> <p>9.7</p> <p>9.8</p>	<p>Concrete properties</p> <p>Understand the nature and physical composition of concrete and basic principles of the process of hydration.</p> <p>Identify the fresh, hardening and hardened states of concrete from image or description.</p> <p>Identify important properties of concrete in the states defined in 9.2.</p> <p>Understand the effect of temperature on hydration and the strength development of concrete.</p> <p>Identify the definition of compressive strength in terms of maximum load and area on which the load acts and demonstrate the ability to calculate compressive strength.</p> <p>Identify the typical range of concrete compressive strengths.</p> <p>Identify the definition of density and demonstrate knowledge of the density of water and the particle densities of cement, natural aggregates, fly ash and ground granulated blastfurnace slag.</p> <p>Identify the range of densities of normal-weight, lightweight and heavy-weight concretes.</p>
<p>10.</p> <p>10.1</p> <p>10.2</p> <p>10.3</p> <p>10.4</p> <p>10.5</p>	<p>Reinforcement</p> <p>Distinguish simple definitions of compression, tension and shear in concrete.</p> <p>Understand the concept of reinforcement bond as applied to structural concrete.</p> <p>Distinguish between steel bar, fabric and fibre reinforcement and identify appropriate applications.</p> <p>Demonstrate knowledge of how reinforcement is secured for simple structural concrete members.</p> <p>Understand reasons for providing cover to reinforcement.</p>

<p>11. 11.1 11.2</p>	<p>Plant for batching and mixing Demonstrate knowledge of the principal types of batching and mixing equipment and recognise them from a description or illustration. Demonstrate knowledge of typical capacities of ready-mixed concrete trucks.</p>
<p>12. 12.1 12.2 12.3 12.4 12.5 12.6 12.7 12.8 12.9 12.10 12.11 12.12 12.13 12.14 12.15 12.16 12.17</p>	<p>Proportioning, batching and mixing Differentiate between proportions by weight and by volume. Recognise typical range of mix proportions in use, expressed either as ratios or quantities per unit volume. Distinguish between the terms 'total water', 'added water' and 'effective (free) water'. Understand the importance of water/cement ratio on fresh and hardened properties of concrete. Identify the main properties of concrete to be considered when selecting proportions or batch quantities. Understand key characteristics of constituents that influence mix design. Understand effects of changes in quantities of constituents on properties of concrete. Understand the methods and procedures for storing constituent materials. Identify effects on concrete due to changes in aggregate grading and moisture content. Demonstrate ability to calculate effective (free) water content of concrete from effective (free) water/cement ratio and cement content. From given parameters, such as water/cement ratio, aggregate/cement ratio and coarse/fine aggregate ratio, demonstrate ability to determine the quantities of dry materials needed to produce a cubic metre of concrete. Demonstrate ability to calculate adjustments to be made to batch quantities due to changes in moisture content of aggregate. Identify the definition of bulking of sand and understand adjustments to be made to batch quantities to allow for bulking. Understand procedures for batching and mixing concrete and identify precautions to be taken to maintain uniformity, for both site-mixed and ready-mixed concrete. Demonstrate ability to calculate volume of compacted concrete required to fill formwork of given dimensions. Identify differences between the terms 'designated', 'designed', 'prescribed', 'standardised prescribed' and 'proprietary' concretes. Identify the differences between prescription and performance specifications.</p>
<p>13. 13.1 13.2 13.3</p>	<p>Transporting and placing Understand the properties of concrete which could be affected during transporting and placing. Understand the precautions to be taken to avoid adverse effects during transporting and placing. Demonstrate knowledge of courses of action to be taken in the event of a delay in the discharge of concrete.</p>
<p>14. 14.1 14.2 14.3 14.4 14.5 14.6 14.7</p>	<p>Compaction Understand reasons for compacting concrete. Understand the effects of vibration on concrete. Distinguish when compaction of concrete is complete. Understand effects of under compaction. Demonstrate knowledge of the principal types of compacting equipment and their application. Identify the difference between internal and external vibration and understand reasons for the use of each method. Identify the definition of self-compacting concrete and understand reasons for its use.</p>
<p>15. 15.1 15.2 15.3 15.4</p>	<p>Curing Identify the definition of curing and understand the effects of curing on the properties of concrete. Identify factors affecting curing and understand the effects of each. Demonstrate an understanding of curing methods available, including special measures for extreme conditions. Demonstrate ability to select suitable curing methods for given situations.</p>

16.	Formwork and falsework
16.1	Identify definitions for 'formwork' and 'falsework' as applied to concrete construction.
16.2	Identify safe and unsafe conditions of formwork and falsework from images or description.
16.3	Identify checks of formwork and falsework necessary before concreting.
16.4	Demonstrate an understanding of the factors affecting formwork striking times.
17.	Surface finish
17.1	Demonstrate an understanding of methods for finishing the top surface of concrete.
17.2	Demonstrate an understanding of release agents, their properties, methods of storage and application.
17.3	Identify factors affecting the appearance of formed concrete surfaces.
18.	Joints
18.1	Distinguish definitions for contraction, expansion and construction joints and demonstrate an understanding of the purpose of each.
18.2	Identify methods of forming satisfactory horizontal and vertical construction joints in plain and reinforced concrete walls.
18.3	Identify methods of forming satisfactory construction joints in slabs, beams and columns.
18.4	Identify how a construction joint can be made watertight.
19.	Lightweight and heavy-weight concretes
19.1	Understand the properties of different types of lightweight and heavy-weight aggregates.
19.2	Demonstrate an understanding of the main applications of lightweight and heavy-weight concretes.
20.	Testing and inspection
20.1	Understand the importance of performing tests in accordance with standard procedures.
20.2	Identify procedures for sampling fresh concrete from a moving stream and from a heap, in accordance with standard procedures.
20.3	Identify the procedure for preparing a sample for tests on fresh concrete and identify the procedures for slump, flow table, slump-flow, density and air content tests.
20.4	Demonstrate an ability to identify typical ranges of results for the tests in 20.3.
20.5	Understand the principal purposes of cube or cylinder testing.
20.6	Understand the standard procedures for making and curing concrete cubes or cylinders.
20.7	Identify a 'no-fines' concrete test specimen from image or description.
20.8	Understand standard procedures for testing cubes or cylinders for compressive strength.
20.9	Identify normal and abnormal failure of test cubes and cylinders from image or description.
20.10	Identify action to be taken by a testing machine operator in the event of abnormal failure of a test cube or cylinder.
20.11	Demonstrate an understanding of the equipment required for accelerated curing of cubes or cylinders and identify the purpose of accelerated testing.
20.12	Identify the method and understand the purpose of tensile splitting strength testing.
20.13	Identify drilled concrete cores from image or description and identify reasons for taking and testing cores.
20.14	Understand the standard method for density of fresh concrete and its use in determining its yield.
20.15	Demonstrate an understanding of the non-destructive testing methods; rebound hammer, ultrasonic pulse velocity, pull-out and covermeter.
END OF STAGE 1	

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