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ARAB ENGINEERING BUREAU

## 2 CONCRETE WORKS FOR PILING

### 2.1 GENERAL

#### 2.1.1 Scope

- 1 This part applies to cast in-situ as well as precast concrete work.
- 2 The purpose of QCS is to provide as a general technical guide for acceptable construction work practices in the State of Qatar, considering this; any addition for technology, material, specification, standard that are not mentioned in this section or their modification, shall be subject to approval as stated in the introduction of QCS (00-02).
- 3 Related Sections and Parts are as follows:

This Section

Part 1,..... General Requirements for Piling Work  
Part 3..... Shallow Foundations  
Part 4..... Deep Foundations  
Part 5..... Retaining Structures

Section 5      Concrete.

#### 2.1.2 References

- 1 The following Standards are referred to in this Part:

BS 8008 .....Safety precautions and procedures for the construction and descent of machine-bored shafts for piling and other purposes  
EN 197 .....Cement  
Standards that are mentioned in Section 5

### 2.2 MATERIALS

#### 2.2.1 Cementitious

- 1 All cementitious materials shall comply with the requirements of Section 5, Part 3.
- 2 All cementitious materials shall be stored in separate containers according to type in waterproof stores or silos.

#### 2.2.2 Aggregate

- 1 Aggregates shall comply with the requirements of Section 5, Part 2.

#### 2.2.3 Water

- 1 If water for the Works is not available from a public supply, approval shall be obtained regarding the source of water. For quality of water refer to Section 5, Part 4.

#### 2.2.4 Admixtures

- 1 Admixtures shall comply with the requirements of Section 5, Part 5

#### 2.2.5 Steel Reinforcement and Prestressing Steel

- 1 Steel reinforcement shall be stored in clean and dry conditions. It shall be clean, and free from loose rust and loose mill scale when installed in the Works. For requirements of steel reinforcement refer to Section 5, Part 11.

- 2 The number of joints in longitudinal steel bars shall be kept to a minimum. Joints in reinforcement shall be such that the full strength of each bar is effective across the joint and shall be made so that there is no detrimental displacement of the reinforcement during the construction of the pile.
- 3 For requirements of prestressing steel refer to Section 5, Part 18.

## **2.3 CONCRETE MIXES FOR PILING WORK**

### **2.3.1 General**

- 1 For general requirements of concrete mixes, trial mixes, batching, mixing and transportation of fresh concrete and testing of hardened concrete refer to Section 5.

### **2.3.2 Grade Designation**

- 1 Grades of concrete shall be as given in Section 5, Part 6.

### **2.3.3 Designed Mix**

- 1 The Contractor shall be responsible for selecting the mix proportions to achieve the required strength and workability.
- 2 Complete information on the mix and sources of aggregate for each grade of concrete and the water/cementitious ratio and the proposed degree of workability shall be approved before work commences.
- 3 Where low-alkali, sulphate-resisting cement to EN 197 or as per 2.2.1 above is specified, the alkali content (equivalent sodium oxide) of the cement shall not exceed 0.6 % by weight.
- 4 The Contractor shall submit the slump value for approval before work commences.

### **2.3.4 Durability**

- 1 For piles exposed to aggressive ground or groundwater, approved measures shall be taken to ensure durability. Reference shall be made to Section 5, Part 6.

### **2.3.5 Exposure Classes**

- 1 The minimum cementitious content and type and the concrete grades shall be specified based on the exposure classes as given in Table 6.8, Section 5, Part 6.

## **2.4 PLACING CONCRETE**

### **2.4.1 General**

- 1 The workability and method of placing and vibrating the concrete shall be such that a continuous monolithic concrete shaft of the full cross-section is formed.
- 2 The concrete shall be placed without such interruption as would produce a cold joint in the pile. The method of placing shall be approved.
- 3 The Contractor shall take all precautions in the design of the mix and placing of the concrete to avoid arching of the concrete in a temporary casing. No soil, liquid or other foreign matter which would adversely affect the performance of the pile shall be permitted to contaminate the concrete.

**2.4.2 Inspection**

- 1 Each pile bore which does not contain standing water or drilling fluid shall be inspected directly or indirectly before concrete is placed in it. This inspection shall be carried out from the ground surface in the case of piles of less than 750 mm diameter. Torches or other approved means of lighting, measuring tapes, and a means of measuring verticality shall be provided. For piles of 750 mm diameter or larger, equipment shall be provided by the Contractor to enable his representatives and the Engineer to descend into the bore for the purpose of inspection. Any method of descent and the equipment used shall comply with the requirements of BS 8008.

**2.4.3 Cleanliness of Pile Bases**

- 1 On completion of boring and where inspection of a dry pile bore indicates the necessity, loose, disturbed or softened soil shall be removed from the bore. Where pile bores contain water or drilling fluid, a cleaning process shall be employed before concrete is placed, or the concrete shall be placed by tremie method. Large debris or accumulated sediment, or both of them, shall be removed using appropriate approved methods, which shall be designed to clean while at the same time minimising ground disturbance below the pile bases. Water or drilling fluid shall be maintained at such levels throughout and following the cleaning operation that stability of the bore is preserved.

**2.4.4 Workability of Concrete**

- 1 Slump measured at the time of discharge into the pile bore shall be in accordance with the standards shown in Table 2.1.

**2.4.5 Compaction**

- 1 Internal vibrators may be used to compact concrete, with the approval of the Engineer obtained in advance for each specific use.

Table 2.1  
Standards for Concrete Slump

Piling mix workability	Slump		Typical conditions of use
	Minimum mm	Range mm	
A	75	75-150	Placed into water-free unlined or permanently lined bore of 600 mm diameter or over, or where concrete is placed below temporary casing, and where reinforcement is widely spaced leaving ample room for free movement of concrete between bars.
B	100	100-200	Where reinforcement is not spaced widely, where concrete is placed within temporary casings, where pile bore is water-free, and the diameter less than 600 mm
C	150	150 or more	Where concrete is to be placed by tremie under water or drilling mud, or by pumping

**2.4.6 Placing Concrete in Dry Borings**

- 1 Approved measures shall be taken to ensure that the structural strength of the concrete placed in all piles is not impaired through grout loss, segregation or bleeding.
- 2 Concrete shall be placed by “elephant trunk”, and the free fall shall not exceed 1.2 m.

#### 2.4.7 Placing Concrete under Water or Drilling Fluid

- 1 Before placing concrete, measures shall be taken in accordance with Clause 2.4.3 to ensure that there is no accumulation of silt or other material at the base of the boring, and the Contractor shall ensure that heavily contaminated bentonite suspension, which could impair the free flow of concrete from the tremie pipe, has not accumulated in the bottom of the hole.
- 2 Concrete to be placed under water or drilling fluid shall be placed by tremie and shall not be discharged freely into the water or drilling fluid. Pumping of concrete may be approved where appropriate.
- 3 A sample of the bentonite suspension shall be taken from the base of the boring using an approved sampling device. If the specific gravity of the suspension exceeds 1.20 the placing of concrete shall not proceed. In this event the Contractor shall modify or replace the bentonite as approved to meet the specification.
- 4 The concrete shall be a rich, coherent mix and highly workable, and cement content shall be in accordance with Clause 2.3.5.
- 5 The concrete shall be placed in such a manner that segregation does not occur.
- 6 The hopper and pipe of the tremie shall be clean and watertight throughout. The pipe shall extend to the base of the bore and a sliding plug or barrier shall be placed in the pipe to prevent direct contact between the first charge of concrete in the tremie and the water or drilling fluid. The pipe shall at all times penetrate the concrete which has previously been placed and shall be withdrawn at a rate such that there shall be a minimum concrete cover of 2 m over the end of the tremie pipe, until completion of concreting. A sufficient quantity of concrete shall be maintained within the pipe to ensure that the pressure from it exceeds that from the water or drilling fluid. The internal diameter of the tremie pipe shall be not less than 150 mm, and the maximum sized aggregate shall be 20 mm. It shall be so designed that external projections are minimised, allowing the tremie to pass within reinforcing cages without causing damage. The internal face of the pipe of the tremie shall be free from projections.

END OF PART