



University Of Technology
Building and Construction Eng. Dept.
Final Exam

2015/2016

Subject : Quality Control

Class: 3rd

Division: Building Eng. & Projects management

Time : 3 Hours

Examiner : MAAN S. HASSAN (PhD)

Date : /6/ 2016

[Answer 4 questions only] [اجب عن اربعة اسئلة فقط]



Q1: Explain the following terms (Answer two only):

- a) Contractually defective
- b) Contract review According to the ISO 9001
- c) Rejection of cement criteria

25%

Q2: The following chemical and physical test results have been reported from a construction laboratory for an ordinary Portland cement sample (Type I). Evaluate the results and indicate whether they comply with the ASTM C150 & Iraqi specifications?

Note: Assume $C_3A = 7\%$

Chemical analysis

Oxide	Abbreviation	Cement sample	ASTM specification C150	Iraqi specification	Notes
SiO ₂ (%)	S	21.2			
Al ₂ O ₃ (%)	A	4.1			
Fe ₂ O ₃ (%)	F	4.8			
CaO (%)	C	65.6			
SO ₃ (%)	S	2.0			
MgO (%)		2.0			
Na ₂ O (%)		0.39			
K ₂ O (%)		0.5			
Insoluble residual (%)	I.R	1.0			
Loss on ignition (%)	L.O.I	2.74			

Physical results

Test	Cement sample	ASTM Specification C150	Iraqi Specification	Notes
Fineness (Blaine method) m ² /kg	308			
Autoclave expansion (%)	0.41			
Compressive strength N/mm ²				
3 days	17			
7 days	24.3			
28 days	33.5			
Time of setting				
Initial set	55 min.			
Final set	11 hr			

25%

Q3: what are the QC requirements for the placing and compaction of fresh concrete?

25%

Q4: What are the quality control requirements for the construction joints?

25%

Q5): The following results are the 7 and 28 days concrete compressive strength, for the previous and current months.

- Draw Cusum control chart and indicate the change point (if any) for both 7 days and 28 days test results indicated below.
- Discuss the results. Is there any correlation between them?

Sample No.	Previous month (N/mm ²)										Current month (N/mm ²)									
	1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8	9	10
7-day age Strength	22	23	20	24	23	25	21	22	23	23	21	20	23	22	20	21	19	20	22	23
28-day age Strength	36	37	34	37	37	39	35	34	37	36	35	34	36	36	35	35	34	34	33	33

25%

Solutions:

Q1):

A. Contractually defective. Concrete is that which, while capable of serving its intended purpose, is not quite of the specified quality. A small proportion of such concrete may be incorporated in the structure with little detriment. There is usually a substantial margin between the two and if no contractually defective concrete is accepted without some penalty or substantial expense and inconvenience to the contractor, no structurally defective concrete is produced.

B. Contract review. The supplier shall establish and maintain documented procedures for contract review and for the coordination of these activities. Before submission of a tender, or the acceptance of a contract or order (statement of requirement), the tender, contract or order shall be reviewed by the supplier to ensure that:

- The requirements are adequately defined and documented; where no written statement of requirement is available for an order received by verbal means, the supplier shall ensure that the order requirements are agreed before their acceptance;
- Any differences between the contract or order requirements and those in the tender are resolved;
- The supplier has the capability to meet the contract or order requirements.

C. Rejection of cement

1 The cement shall be rejected if it fails to meet any of the requirements of the specification.

2 At the option of the purchaser, retest, before using, cement remaining in bulk storage for more than 6 months or cement in bags in local storage in the custody of a vendor for more than 3 months after completion of tests and reject the cement if it fails to conform to any of the requirements of this specification.

Cement so rejected shall be the responsibility of the owner of record at the time of resampling for retest.

3 Packages shall identify the mass contained as net weight. At the option of the purchaser, packages more than 2 % below the mass marked thereon shall be rejected and if the average mass of packages in any shipment, as shown by determining the mass of 50 packages selected at random, is less than that marked on the packages, the entire shipment shall be rejected.

Q2): Note: $C_3A = 7\%$

Chemical analysis

Oxide	Abbreviation	Cement sample	ASTM specification C150	Iraqi specification	Notes
SiO ₂ (%)	S	21.2	--	-	-
Al ₂ O ₃ (%)	A	4.1	-	-	-
Fe ₂ O ₃ (%)	F	4.8	-	-	-
CaO (%)	C	65.6	-	-	-
SO ₃ (%)	S	2.0	max. = 3	max. = 2.8	OK for both
MgO (%)		2.0	max. = 6	max. = 5	OK for both
Na ₂ O (%)		0.39	-	-	-
K ₂ O (%)		0.5	-	-	-
Insoluble residual (%)	I.R	1.0	max. = 0.75	max. = 1.5	OK for IS NG for ASTM
Loss on ignition (%)	L.O.I	2.74	max. = 3	max. = 4	OK for both

Physical results

Test	Cement sample	ASTM specification C150	Iraqi specification	Notes
Fineness (Blaine method) m ² /kg	308	min. 280	min. 230	OK for both
Autoclave expansion (%)	0.41	max. 8	max. 8	OK for both
Compressive strength N/mm ²				
3 days	17	min. 12	min. 15	OK for both
7 days	24.3	min. 17	min. 23	OK for both
28 days	33.5	-	-	
Time of setting				
Initial set	55 min.	min. 45 min	min. 45 min	OK for both
Final set	11 hr	max. 6.25 hr.	max. 10 hr.	OK for both

Q3):

Quality control guidance on placing and compaction

a) Care should be taken to avoid displacing reinforcement, tendon, ducts and anchorages, or formwork, and damage to the faces of formwork, particularly when the concrete is allowed to fall freely through the depth of lift. In such cases a cohesive, non-segregating mix is required. The depth of lift to be concreted should be agreed and consideration given to the effect of lift height in massive sections on the temperature rise of the concrete.

b) Concrete should not be moved across the surface of open textured formwork by means of internal vibration as this may lead to localized honey-combing and inadequate bonding between the concrete and the reinforcement.

c) No concrete should be placed in flowing water. Under water, concrete should be placed in position by tremies or by pipeline from the mixer and never allowed to fall freely through the water unless specifically designed for this purpose.

d) Concrete should be thoroughly compacted by vibration or other means during placing, and worked around the reinforcement, tendons or duct formers, embedded fixtures and into corners of the formwork to form a solid void-free mass having the required surface finish. When vibrators are used, vibration should be applied until the expulsion of air has practically ceased and in a manner that does not promote segregation. Over-vibration should be avoided to minimize the risk of forming a weak surface layer.

e) Air-entraining admixtures and plasticizing admixtures can improve the handling and placing characteristics of fresh concrete.

f) When external vibrators are used, the design of formwork and disposition of vibrators should be such as to ensure efficient compaction and to avoid surface blemishes.

g) Where permanent formwork is incorporated in the structure, its energy absorption should be taken into account when deciding on the method of vibration to be used. Extra care is required to ensure full compaction of the concrete since this cannot be checked when the formwork is removed.

Q4): Construction joints

The number of construction joints should be kept to the minimum necessary for the execution of the work. Their location should be carefully considered and agreed before concrete is placed. They should normally be at right angles to the general direction of the member.

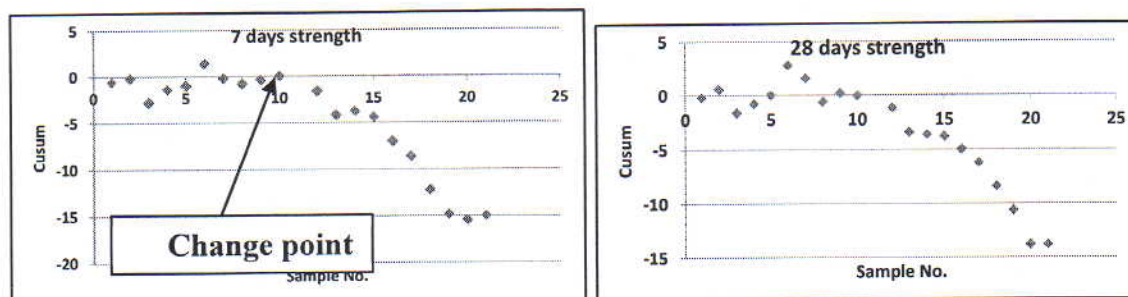
The concrete at the joint should be bonded with that subsequently placed against it, without provision for relative movement between the two. Concrete should not be allowed to run to a feather-edge and vertical joints should be formed against a stop end. High quality workmanship is necessary when forming the joints to insure that the load-bearing capacity of the concrete in the area of the joint is not impaired.

The top surface of a layer of concrete should be level and reasonably flat unless design considerations make this undesirable. If a kicker, i.e. a starter stub, is used, it should be at least 70 mm high and carefully constructed. It is sometimes necessary for a kicker to be cast with the previous concrete.

Care should be taken that the joint surface is clean immediately before the fresh concrete is placed against it. It may need to be slightly wetted prior to the new concrete being placed, to prevent excessive loss of mix water into it by absorption. Particular care should be taken in the placing of new concrete close to the joint to ensure that it has an adequate fines content and is fully compacted and dense.

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Q5):



One change point was appeared in each of the Cusum control chart strength results. Correlation was observed in the cusum control charts.

Sample No.	7 d	$\bar{x}-x$	cus	28 d	$\bar{x}-x$	cus
1	22	-0.6	-0.6	36	-0.2	-0.2
2	23	0.4	-0.2	37	0.8	0.6
3	20	-2.6	-2.8	34	-2.2	-1.6
4	24	1.4	-1.4	37	0.8	-0.8
5	23	0.4	-1	37	0.8	0
6	25	2.4	1.4	39	2.8	2.8
7	21	-1.6	-0.2	35	-1.2	1.6
8	22	-0.6	-0.8	34	-2.2	-0.6
9	23	0.4	-0.4	37	0.8	0.2
10	23	0.4	0	36	-0.2	0
11	21	-1.6	-1.6	35	-1.2	-1.2
12	20	-2.6	-4.2	34	-2.2	-3.4
13	23	0.4	-3.8	36	-0.2	-3.6
14	22	-0.6	-4.4	36	-0.2	-3.8
15	20	-2.6	-7	35	-1.2	-5
16	21	-1.6	-8.6	35	-1.2	-6.2
17	19	-3.6	-12.2	34	-2.2	-8.4
18	20	-2.6	-14.8	34	-2.2	-10.6
19	22	-0.6	-15.4	33	-3.2	-13.8
20	23	0.4	-15	33	-3.2	-17