

Cork Institute of Technology

Bachelor of Engineering in Building Services Engineering – Award
(National Diploma in Engineering in Building Services Engineering – Award)

(NFQ – Level 7)

Autumn 2005

Construction Technology

(Time: 3 Hours)

Instructions
Answer **FIVE** questions.
All questions carry equal marks.

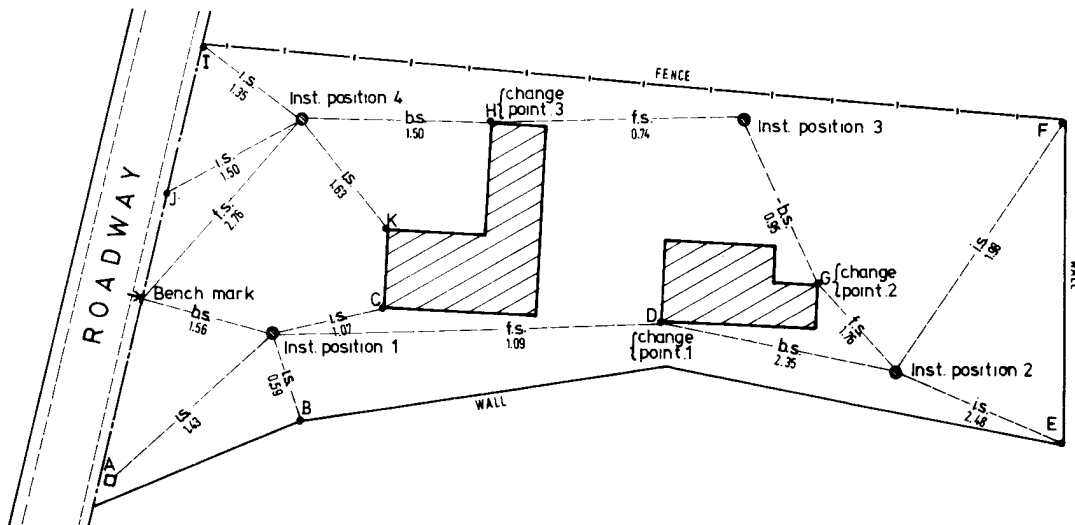
Examiners: Mr. T. Dunne
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Q1.

The attached figure shows a small site where reduced levels are required around the perimeter at various identifiable features e.g. “*A-Manhole cover*”, “*C- Corner of building*”, “*I-Fence*” and so on. One benchmark is available which has a reduced level of 35.27m.

- (a) Starting with the Bench mark point, book or record the readings according to standard levelling procedure using either the height of collimation method or rise and fall method using the levelling booking sheet at the back of this paper. **(6 Marks)**
- (b) Determine the reduced levels of the points A-K. **(6 Marks)**
- (c) Perform all necessary numerical checks and determine the error in the levelling exercise by calculating the reduced level of the benchmark at K from instrument position 4. **(3 Marks)**
- (d) A drainage pipe is running parallel to the roadway beneath the ground from points **I** to **A** over a distance of 100m. The top of the pipe is located 1.0m below the surface of the ground at point **I** and was originally laid to a uniform fall of 1:80 from **I** to **A**. Before the surveying instrument was moved from position 1 to position 2 to complete the survey of the site, the manhole cover was removed at **A** and a staff inserted into the inspection chamber onto the top surface of the pipe. If an intersight reading was taken to the top of the pipe from position 1 to confirm that the gradient was indeed 1:80, what should the reading on the staff be ? **(5 Marks)**

Note for clarity the staff readings at each level position (1-4) are reproduced in tabular form below



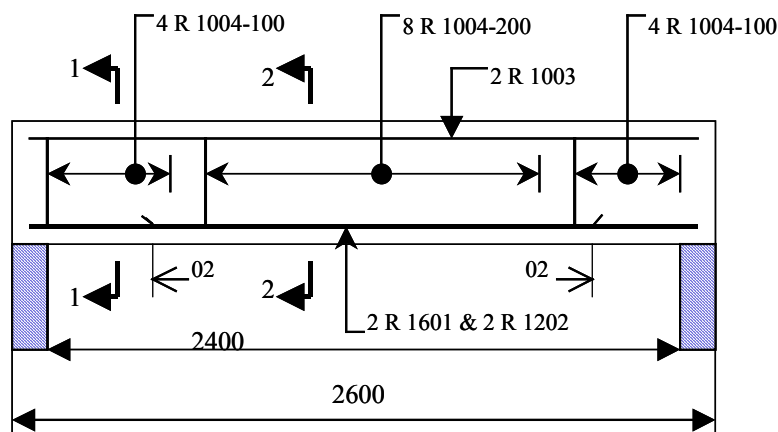
Reading (m)	Type	Inst. Position	Reading (m)	Type	Inst. Position	Reading (m)	Type	Inst. Position	Reading (m)	Type	Inst. Position
1.56	BS	1	2.35	BS	2	0.95	BS	3	1.50	BS	4
1.43	IS		2.48	IS		0.74	FS		1.35	IS	
0.59	IS		1.98	IS					1.50	IS	
1.07	IS		1.76	FS					1.63	IS	
1.09	FS								2.76	FS	

Q2.

(a) Differentiate between bar mark, bar schedule, bar type and bar cover in Reinforced Concrete detailing
(5 marks)

(b) The figure below shows an elevation detailing the reinforcement of a concrete beam of rectangular cross section 300 wide by 400mm deep. Draw cross sections through the beams at points 1 and 2 showing the details and marking of the reinforcement. Assume a standard cover to the bars.

(8 marks)



- (c) Create a bar bending schedule for four of these beams. Include bar mark, type and size, no in each, total no, length of each bar, and shape. **(7 marks)**

Q3.

- (a) Describe foundation or holding down bolts indicating common types, tightening constraints and their installation into concrete foundations. **(6 marks)**
- (b) Provide a detailed sketch of the holding down bolt detail of a steel column with a 25mm baseplate bolted to a concrete foundation using 4 bolts. **(8 marks)**
- (c) Describe any two precautions that should be taken if foundation bolts are required to accommodate shear loads up to 70% or the axial loads in the column. **(6 marks)**

Q4.

- (a) Describe the essential differences in the application and use of ordinary bearing bolts and HSFG bolts. **(8 marks)**
- (b) Provide a detailed sketch of a bolted eaves connection for a portal frame incorporating a haunch. Specify typical bolt details and their spacing, endplates, and stiffeners. What is the optimum length of the haunch ? **(12 marks)**

Q5.

- (a) Describe three methods whereby services may be accommodated in floors **(6 marks)**
- (b) Outline the benefits of accommodating services in ducts. **(4 marks)**
- (c) In large span buildings where there is a need to keep the floor depth to a minimum, propose and justify an effective means for accommodating services. **(5 marks)**
- (d) Identify and explain the implications of the use of haunched beams in long span construction for the supporting network of steel columns **(5marks)**

Q6.

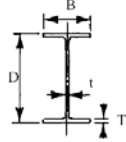
- (a) Describe the key benefits of natural ventilation in non domestic buildings **(6 marks)**
- (b) Explain what is meant by night cooling and describe how it can be achieved. **(4 marks)**
- (c) Describe the role that staff training can play in the ensuring a successful natural ventilation strategy **(10 marks)**

Q7.

- (a) What is a section factor and how is it employed in fire engineering protection. How does it differ from 3 sided to 4 sided protection. (6 marks)
- (b) Compute the section factor for a Universal Beam 457x191x74 kg/m which is to be protected on 3 sides. Hence or otherwise determine the required thickness of PYROK CV25, a sprayed vermiculite cement material to give a fire resistance of two hours. (8 marks)
- (c) Sketch the typical detail showing protection to a floor beam with a service penetration. (6 marks)

Note Beam table and partial Pyrok CV 25 data sheet provided as Tables 1 and 2 respectively.

Table 1.
Universal beams



Designation		Depth of section D	Width of section B	Thickness		Area of section
Serial size	Mass per metre			Web t	Flange T	
mm	kg	mm	mm	mm	mm	cm ²
914×419	388	920.5	420.5	21.5	36.6	494.4
	343	911.4	418.5	19.4	32.0	437.4
914×305	289	926.6	307.8	19.6	32.0	368.8
	253	918.5	305.5	17.3	27.9	322.8
	224	910.3	304.1	15.9	23.9	285.2
	201	903	303.4	15.2	20.2	256.4
838×292	226	850.9	293.8	16.1	26.8	288.7
	194	840.7	292.4	14.7	21.7	247.1
	176	834.9	291.6	14	18.8	224.1
762×267	197	769.6	268	15.6	25.4	250.7
	173	762	266.7	14.3	21.6	220.4
	147	753.9	265.3	12.9	17.5	188.0
686×254	170	692.9	255.8	14.5	23.7	216.5
	152	687.6	254.5	13.2	21.0	193.8
	140	683.5	253.7	12.4	19.0	178.6
	125	677.9	253	11.7	16.2	159.6
610×305	238	633	311.5	18.6	31.4	303.7
	179	617.5	307	14.1	23.6	227.9
	149	609.6	304.8	11.9	19.7	190.1
610×229	140	617	230.1	13.1	22.1	178.3
	125	611.9	229	11.9	19.6	159.5
	113	607.3	228.2	11.2	17.3	144.4
	101	602.2	227.6	10.6	14.8	129.1
533×210	122	544.6	211.9	12.8	21.3	155.7
	109	539.5	210.7	11.6	18.8	138.5
	101	536.7	210.1	10.9	17.4	129.7
	92	533.1	209.3	10.2	15.6	117.7
	82	528.3	208.7	9.6	13.2	104.4
457×191	98	467.4	192.8	11.4	19.6	125.2
	89	463.6	192	10.6	17.7	113.9
	82	460.2	191.3	9.9	16.0	104.5
	74	457.2	190.5	9.1	14.5	94.98
	67	453.6	189.9	8.5	12.7	85.44
457×152	82	465.1	153.5	10.7	18.9	104.4
	74	461.3	152.7	9.9	17.0	94.99
	67	457.2	151.9	9.1	15.0	85.41
	60	454.7	152.9	8.0	13.3	75.93
	52	449.8	152.4	7.6	10.9	66.49
406×178	74	412.8	179.7	9.7	16.0	94.95
	67	409.4	178.8	8.8	14.3	85.49
	60	406.4	177.8	7.8	12.8	76.01
	54	402.6	177.6	7.6	10.9	68.42
406×140	46	402.3	142.4	6.9	11.2	58.96
	39	397.3	141.8	6.3	8.6	49.40
356×171	67	364	173.2	9.1	15.7	85.42
	57	358.6	172.1	8	13.0	72.18
	51	355.6	171.5	7.3	11.5	64.58
	45	352	171	6.9	9.7	56.96
356×127	39	352.8	126	6.5	10.7	49.40
	33	248.5	125.4	5.9	8.5	41.83
305×165	54	310.9	166.8	7.7	13.7	68.38
	46	307.1	165.7	6.7	11.8	58.90
	40	303.8	165.1	6.1	10.2	51.50
305×127	48	310.4	125.2	9.9	14.0	60.83
	42	306.6	124.3	8	12.1	53.18
	37	303.8	123.5	7.2	10.7	47.47
305×102	33	312.7	102.4	6.6	10.8	41.77
	28	308.9	101.9	6.1	8.9	36.30
	25	304.8	101.6	5.8	6.8	31.39
254×146	43	259.6	147.3	7.3	2.7	55.10
	37	256	146.4	6.4	10.0	47.45
	31	251.5	146.1	6.1	8.6	40.00
254×102	28	260.4	102.1	6.4	10.0	36.19
	25	257	101.9	6.1	8.4	32.17
	22	254	101.6	5.8	6.8	28.42
203×133	30	206.8	133.8	6.3	9.6	38.00
	25	203.2	133.4	5.8	7.8	32.31
203×102	23	203.2	101.6	5.2	9.3	29
178×102	19	177.8	101.6	4.7	7.9	24.2
152×89	16	152.4	88.9	4.6	7.7	20.5
127×76	13	127	76.2	4.2	7.6	16.8

Hp/A	Dry thickness in mm to provide fire resistance of					
	up to	½ hour	1 hour	1½ hour	2 hours	3 hours
30	10	10	10	10	15	25
50	10	10	10	14	21	29
70	10	10	12	17	27	36
90	10	10	14	20	31	42
110	10	10	16	22	34	47
130	10	10	17	24	37	51
150	10	11	18	25	40	54
170	10	12	19	27	42	57
190	10	12	20	28	44	59
210	10	13	21	29	45	
230	10	13	21	30	47	
250	10	14	22	31	48	
270	10	14	23	31	49	
290	10	14	23	32	50	
310	10	14	23	33	51	

Table 2 PYROK CV25

Sprayed vermiculite cement