



EXAMINATION PAPER: **ACADEMIC SESSION 2020/2021**

Campus	Medway
Faculty	Engineering & Science
Level	7
Exam Session	May 2021
MODULE CODE	CIVI1021
MODULE TITLE	ANALYSIS AND MANAGEMENT OF RISK IN CIVIL ENGINEERING
Exam Type	Online Exam
Duration	Original Exam Duration 2 hours (now 3 hours)

Instructions to Candidates

Answer **FOUR** questions out of **FIVE**.

Students will be required to achieve an overall grade of 50% to achieve a pass.

Q1. Identification of Risk – Railway Bridge

Figure Q1(a) below is an image of a 130-year-old Plate Girder Railway Bridge which is to be replaced. There are serious structural concerns on the abutment and wing walls as well as the excessive corrosion on the parrass wall plates as shown in Figure Q1(b). Therefore, there are significant risks associated with the bridge decommissioning works and replacement.

- (a) Explain what you understand by the word 'risk'.
[3 marks]
- (b) Discuss the risks that the deterioration of the abutment/wing walls will pose for the train operator.
[4 marks]
- (c) Considering that the design life of a bridge project is 125 years, identify at least **FOUR** stakeholders who might be involved in risk management of this kind of project.
[4 marks]
- (d) For each of the stakeholders identify **TWO** risks that would need to be considered in a risk management process.
[4 marks]
- (e) Propose a risk assessment methodology, which could be used to characterise the severity of the risks associated with this bridge to the general public. Assume the bridge has not yet been replaced.
[10 marks]

[Total 25 marks]

Q1 continued overleaf

Q1 continued



Figure Q1(a)A Plate Girder Bridge in Need of Replacement

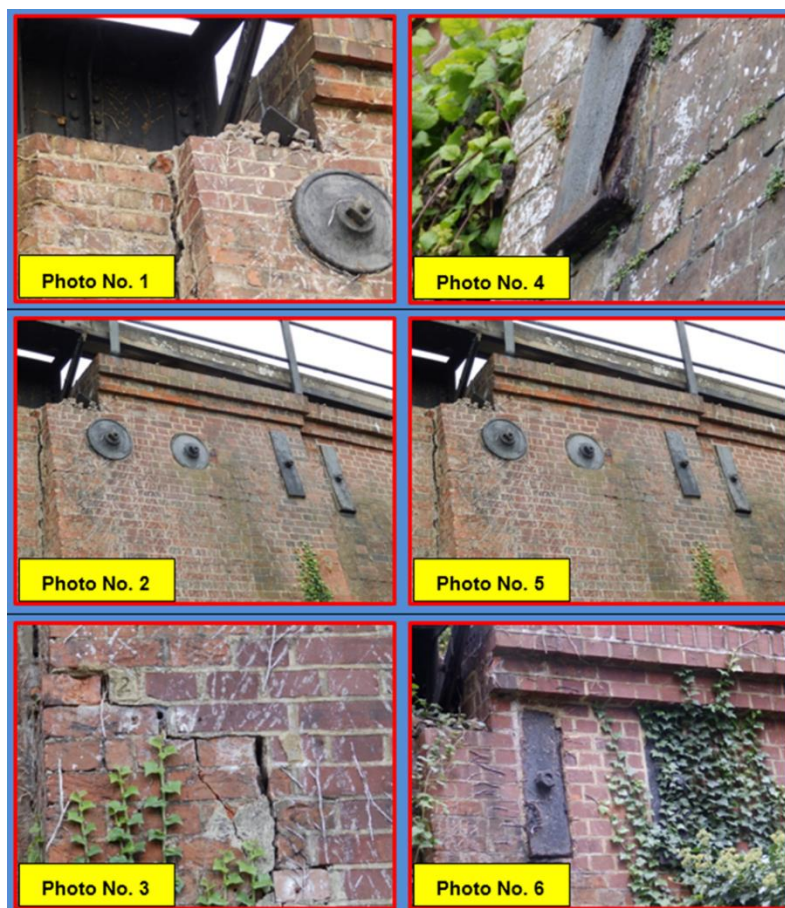


Figure Q1(b)Wing Wall/Abutment & Pattress Wall Plate Deterioration

Q2. Contract & Risk

You are advising the client of a construction project who are entering into a contract for the construction of a town centre multi-storey car park as shown highlighted in Figure Q2. The construction will also include lifts, stairways and CCTV camera systems and round the clock security.

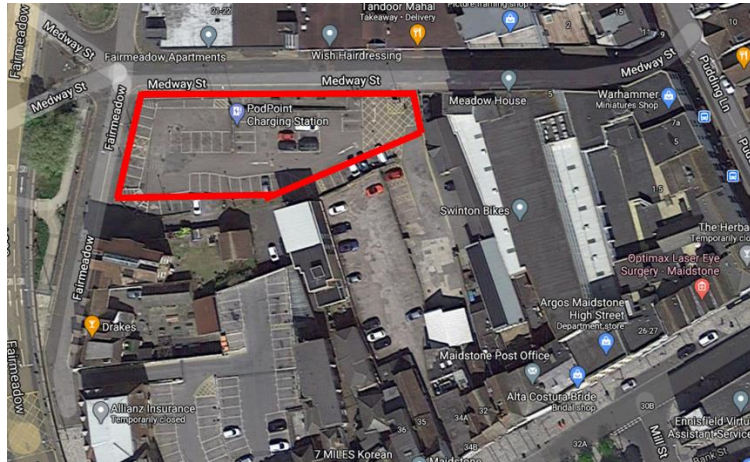


Figure Q2 Location of Multi-Storey

- (a) As the adviser of the client, you are proposing a standard form of contract for this project. What benefits will this type of contract give to your client in managing their risks? Give **FOUR** reasons.

[3 marks]

- (b) In relation to cost and quality risk appetite, and selecting TWO distinct contract form, describe how the contract form allocates risks for the client.

[7 marks]

- (c) By identifying **TWO** major stakeholder risks with this construction project, briefly explain how standard contract clauses can be used to address these risks.

[7 marks]

- (d) What emergency procedures and means of escape would you recommend that your client have in place with the Principal Contractor during the construction phase?

[8 marks]

[Total 25 marks]

Q3. Execution Programme – Road Bridge

Figure Q3 shows the proposed road bridge which is to be constructed for a local authority. The construction work is divided into four phases and these also represent the sequence in which this bridge is to be constructed;

Phase 1 – Ground works and foundation excavation

Phase 2 – Piling and pile caps

Phase 3 – Abutment & piers

Phase 4 – Superstructure – bridge deck

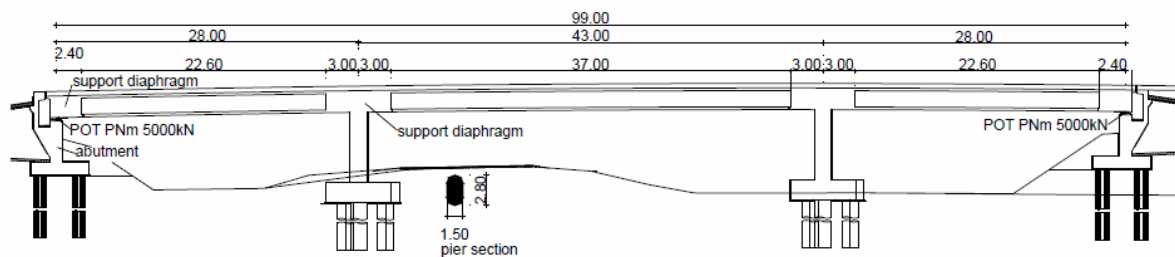


Figure Q3 Longitudinal Cross-Section

The construction activities and their probabilities for completion of the bridge are shown in Table Q3. The construction works have independent risks but the first three works (1-3) must be completed in the sequence before the construction of the superstructure (4) can commence.

Table Q3 Construction Work Duration & Probabilities

Construction Activity & Sequence		Duration [Weeks]	Probability of Completion [0 - 1]
1	Ground works & foundation excavation	7	0.45
		8	0.55
2	Piling and pile caps	12	0.2
		14	0.8
3	Abutment & Piers	10	0.3
		11	0.7
4	Superstructure - bridge deck	15	0.4
		17	0.6

Q3 Continued overleaf

Q3 continued

- (a) As project manager explain which of the first three activities should attract your attention and why?

[10 marks]

- (b) For scheduling purposes, you are required to assess the most likely time for delivery up to the completion of the Abutment and piers.

[8 marks]

- (c) Your client's risk appetite is for rapid delivery. Write a note to the client to indicate the risk that the first three construction activities will not be delivered this quickly giving an indication of the probably delivery time.

[2 marks]

- (d) List the methods you can use to manage risks and indicate a step you could take under each method to meet the client demand.

[5 marks]

[Total 25 marks]

Q4. Environmental Risk

A developer wishes to redevelop the brown field site in Rochester, Kent, indicated in the map below, Figure Q4.



Figure Q4 Rochester Brownfield Site for Housing Development

The results of a contamination survey have revealed some worrying results from a range of different trial pits in relation to the levels of dioxin like polychlorinated biphenyls as shown in Table Q4(a).

Table Q4(a) Results of Contamination Survey

TP1	TP2	TP3	TP4	TP5	TP6	TP7	TP8
13	17	10	5	9	3	6	4

Q4 continued overleaf

Q4 continued

Governmental guidance on the Soil Guideline Values (SGVs) are indicated for this contaminant family are given in Table Q4(b)

Table Q4(b) Soil Guideline Values

Land use	Soil Guideline Value ($\mu\text{g kg}^{-1}$ DW) ^{1,2,3,4}
	Sum of PCDDs, PCDFs and dioxin-like PCBs
Residential	8
Allotment	8
Commercial	240

- (a) Explain the purpose of an environmental management plan giving **FIVE** examples what the scope of the plan should consider.
[5 marks]
- (b) Statistically analyse the data provided in Table Q4(a) providing the mean, unbiased standard deviation and the normalised upper bound for 95th percentile confidence using the data in Table Q4(c).
[5 marks]
- (c) Use these statistics to justify your concerns why there might be a real contamination risk in the proposed residential development.
[5 marks]
- (d) Describe the range of risk management approaches that might be taken if a contaminant risk were to exist.
[5 marks]
- (e) Assuming that the need to clear the land of contaminants is understood, categorise and detail **THREE other risks** that a developer (the client) may identify in a Risk Register for a housing development on this site.
[5 marks]

[Total 25 marks]

Q4 continued overleaf

Q4 continued

Table Q4(c) Relationship between sample size (n) and t at the 95% confidence interval level

n	t	n	t	n	t
-	-	11	1.812	21	1.725
2	6.314	12	1.796	22	1.721
3	2.920	13	1.782	23	1.717
4	2.353	14	1.771	24	1.714
5	2.132	15	1.761	25	1.711
6	2.015	16	1.753	26	1.708
7	1.943	17	1.746	27	1.706
8	1.895	18	1.740	28	1.703
9	1.860	19	1.734	29	1.701
10	1.833	20	1.729	30	1.699

Q5. Structure Loading Risk & Temporary Works

Earthquakes can be considered as events often described using a Poisson distribution with time. For the event with the rate of occurrence λ in the Poisson process, the probability that k events occur in the period of time $(0, t)$ is calculated from:

$$p(k; (0, t), \lambda) = \frac{(\lambda t)^k}{k!} e^{-\lambda t}$$

In a region concerned, on average 3 damaging earthquakes occur every 30 years.

Determine:

- (a) The probability of no damaging earthquakes in 50 years. [5 marks]
- (b) The probability of having at least 1 damaging earthquake in 50 years. [5 marks]
- (c) Using the binomial distribution probability function equation,

$$P(x_i) = \frac{n!}{y! (n - y)!} p^y (1 - p)^{(n-y)}$$

What approximate return period event would occur in a temporary works period of 1 year giving the same probability the design seismic effect for the permanent works?

[10 marks]

- (d) What is design reliability; comment on what your results imply for the design of the temporary works in comparison to the permanent works? [5 marks]

[Total 25 marks]

END OF PAPER