

PAPER A



TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology
DEPARTMENT OF BUILDING AND CIVIL ENGINEERING
UNIVERSITY EXAMINATION FOR:

BACHELOR OF TECHNOLOGY IN CIVIL ENGINEERING
TCV 4418 : BRIDGE ENGINEERING
END OF SEMESTER EXAMINATION

SERIES: APRIL 2025

TIME: 2 HOURS

Instructions to Candidates

You should have the following for this examination

-Answer Booklet, examination pass and student ID

This paper consists of five questions.

Attempt question ONE (Compulsory) and any other TWO questions.

Do not write on the question paper.

QUESTION ONE (COMPULSORY) 20 marks

Reinforced concrete bridge (beam and slab deck) is to be constructed across a river spanning 50m, to carry traffic on a two-lane highway in Kenya as shown in **Figure Q1**.

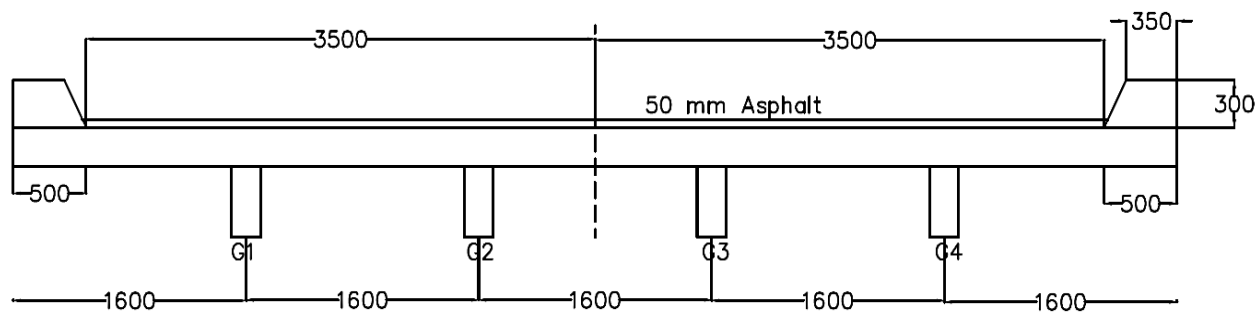


Figure Q1

Carriageway width = 7000 mm

Girder spacing = 1600 mm

Effective span/Loaded length = 25 m

Concrete Density= 24 KN/m³

Density of Asphalt Concrete= 20 KN/m³

As the bridge Engineer, using **BS 5400** as the design standard;

- i. Conduct the preliminary beam and slab sizing and determine the design loading on the bridge deck including dead loads, normal (HA) and abnormal traffic loading (HB). (Putter charts provided for wheel loading)
- ii. Carry out the load effect analysis on the deck slab of all the Ultimate Design Loadings to obtain the span and support moments and determine which load combination controls design for flexure and shear design.

(20 Marks)

QUESTION TWO (20 Marks)

- a) Planning for a bridge is an important aspect of bridge design and construction which occupies the initial stages of design. In order to have proper planning for design and construction of a bridge, several elements must be accomplished. Discuss five (5) preliminary requirements that need to be considered in the planning phase of bridge design.

(10 marks)

- b) Prestressed concrete bridges are of preference today because of the many advantages associated with them. There are different ways that prestressing can be accomplished.

- i. Discuss the available ways of prestressing concrete.
- ii. Discuss five advantages associated with post tensioning of bridges.

(10 Marks)

QUESTION THREE (20 Marks)

- a) There are different types of bridges each serving a specific purpose and selected at different situations. Discuss the four (4) major types of bridges highlighting with aid of diagrams the different structural forms in each.

(10 Marks)

- b) When designing for a bridge, various bridge loads are considered. Discuss the primary and secondary bridge loads that are applicable to bridge design.

(10 Marks)

QUESTION FOUR (20 Marks)

The assumed geometry for a bridge structure is as shown in **Figure Q4**. The pier is a circular pier of diameter 2100 mm with cantilevered pier head. The footing is a square 4000mm by 4000 mm. The slab deck dead and live loads are given below.

Deck dead loads			Deck live loads		
Load type	ULS load (KN/m ²)	Unfactored load (KN/m ²)	Load type	ULS load (KN/m ²)	Unfactored load (KN/m ²)
Slab	7.2	5.1	HA UDL	22.55	13.5
Surfacing	2.3	1.4	HA KEL	2.65	1.75
Kerbs	2.5	1.6	HB UDL	107.3	90.5
Girder	15.9	12.4			

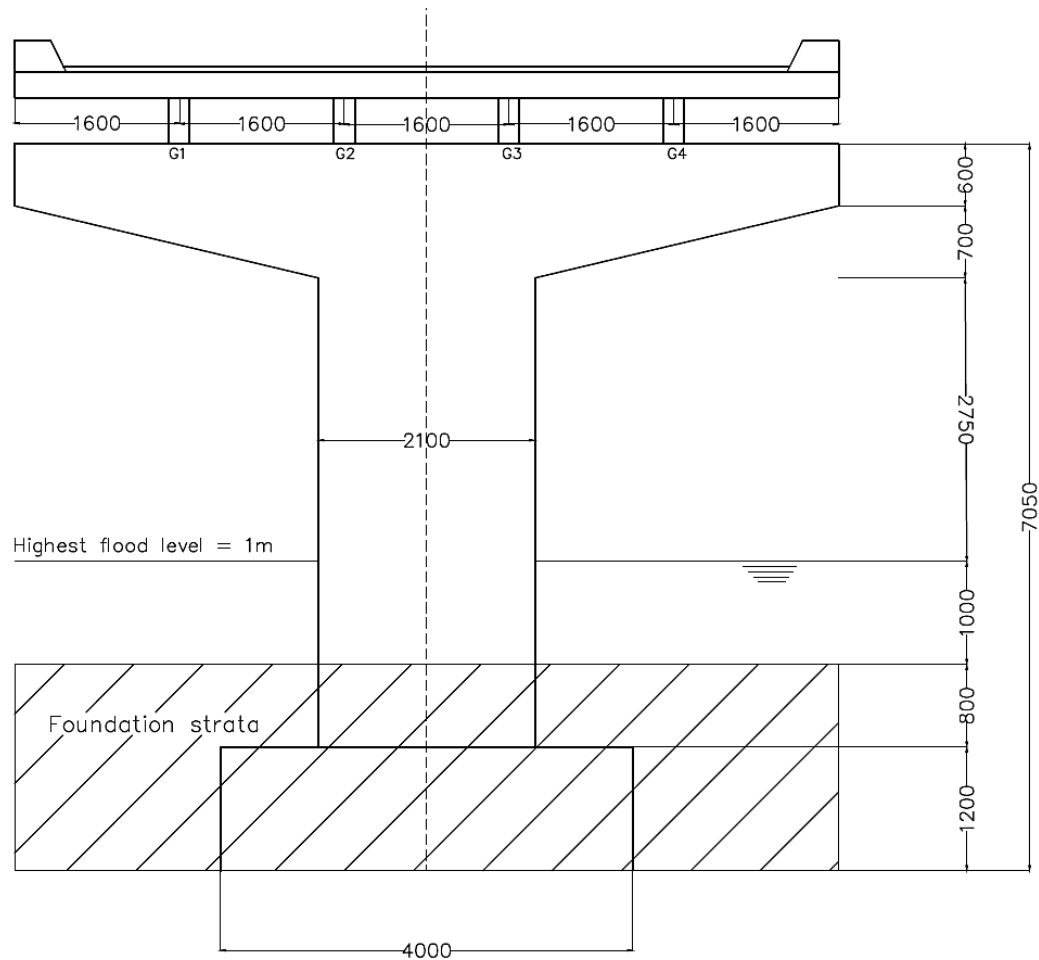


Figure Q4

- i. Using influence lines, determine the load distribution to the girders and calculate the span moment for design of reinforcements given that total bridge span is 40 m and effective span is 20 m.

(10 Marks)

- ii. Determine the restoring and overturning forces and moments of the pier and check the adequacy of the assumed geometry in terms of stability and slenderness.

(10 Marks)

QUESTION FIVE (20 Marks)

You have been appointed to lead a team of Bridge Inspectors for the inspection of a Reinforced Concrete Slab/Girder bridge.

- i. Discuss five details that you should take into account when conducting the inspection works

(5 Marks)

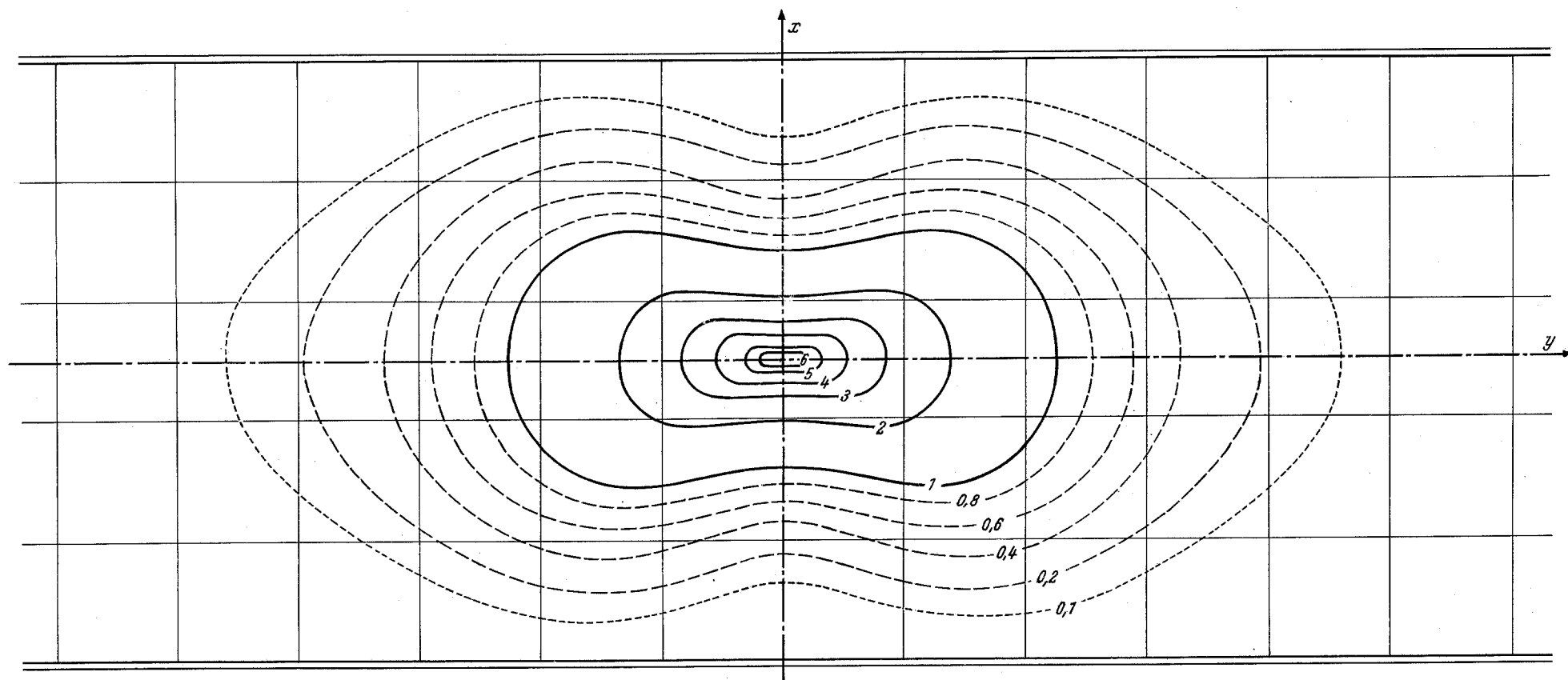
- ii. If the assessment works leads to a conclusion that the bridge is substandard and needs major maintenance measures, discuss;
 - a) the repair methods that can be applied for the reinforced concrete deterioration.
 - b) strengthening methods that you will consider for both the superstructure and the substructure.

(10 Marks)

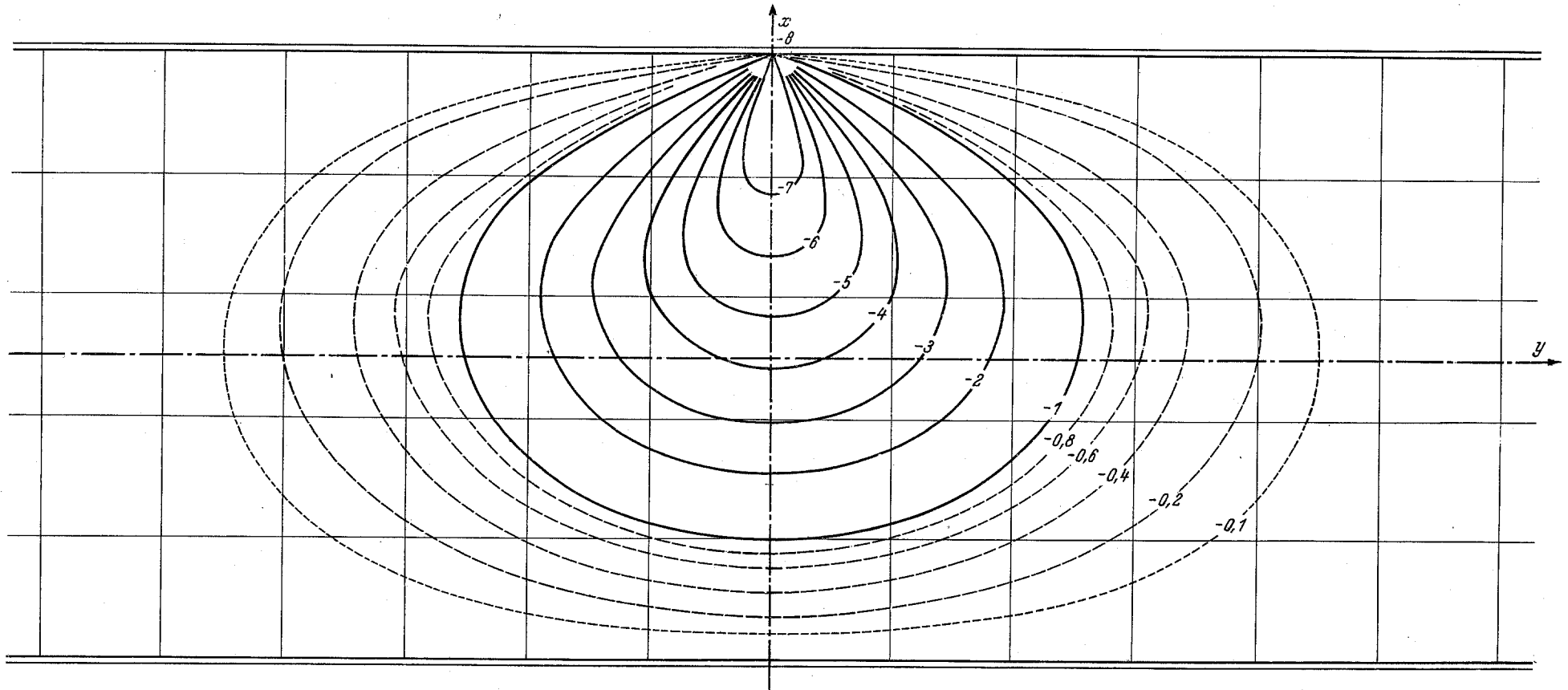
- iii. If during the bridge inspection process stains are observed, discuss five (5) methods of cleaning that can be employed to remove the stains to prevent deeper migration into the concrete.

(5 Marks)

Tafel 12. m_x -Einflussfeld für die Feldmitte eines Plattenstreifens mit zwei eingespannten Rändern (8π -fach)
 Chart 12. m_x -Influence surface for the center of a plate-strip with two restrained edges (8π -times)



Tafel 16. m_x -Stützmoment-Einflussfeld für den Rand eines Plattenstreifens mit zwei eingespannten Rändern (8π -fach)
 Chart 16. m_x -Support-moment influence surface for the edge of a plate-strip with two restrained edges (8π -times)



Tafel 17. m_x -Stützmoment-Einflussfeld für den eingespannten Rand eines auskragenden Plattenstreifens (Bereich $-1,3l < y < +1,3l$, 8 π -fach)
 Chart 17. m_x -Support-moment influence surface for the restrained edge of a cantilever plate-strip (range $-1,3l < y < +1,3l$, 8 π -times)

