

SULIT



First Semester Examination
Academic Session 2020/2021

February 2021

EAS665 – Bridge Engineering

Duration : 2 hours

Please check that this examination paper consists of **SEVEN (7)** pages of printed material before you begin the examination.

Instructions : This paper contains **SIX (6)** questions. Answer **FOUR (4)** questions

Each question **MUST BE** answered on a new page.

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- (1). A dual-carriageway of a bridge deck as shown in **Figure 1** is to be analysed for design purpose. The design data are as given in **Table 1 (a)**, **(b)** and **(c)**. Evaluate the maximum shear force acting on each abutment due to the combination of HA and HB load type. The position of leading axle of the HB loading is at 18.30 m from the left end abutment. Use the HB loading with the 6.0 m inner axle spacing.

[25 marks]

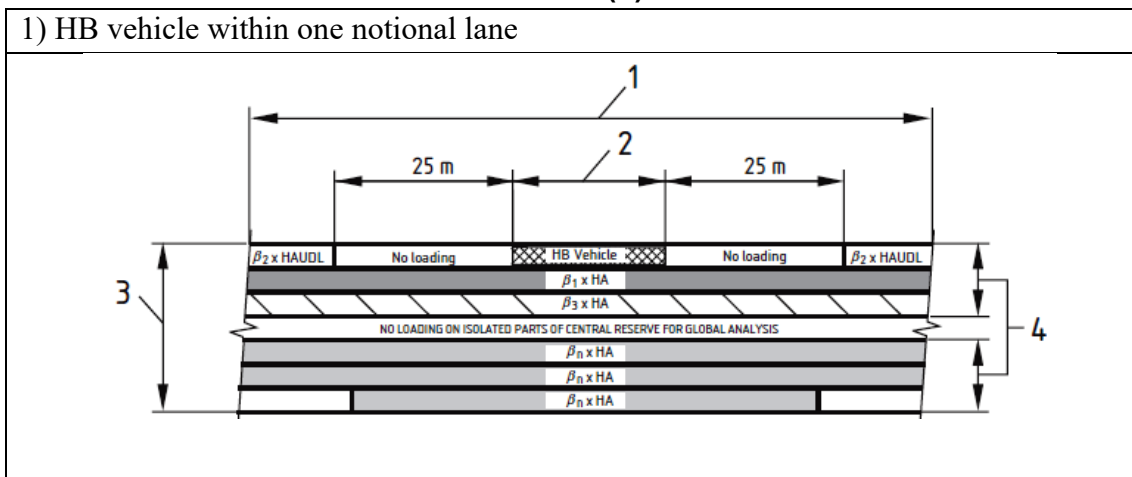
Table 1(a)

Span	34.0 m
Skew	0°
Width	17.98 m
Live loads	HA loading (UDL = $336 \left(\frac{1}{L}\right)^{0.67}$) HB loading (30 units) (use inner axle spacing of 6.0 m)

Table 1(b)

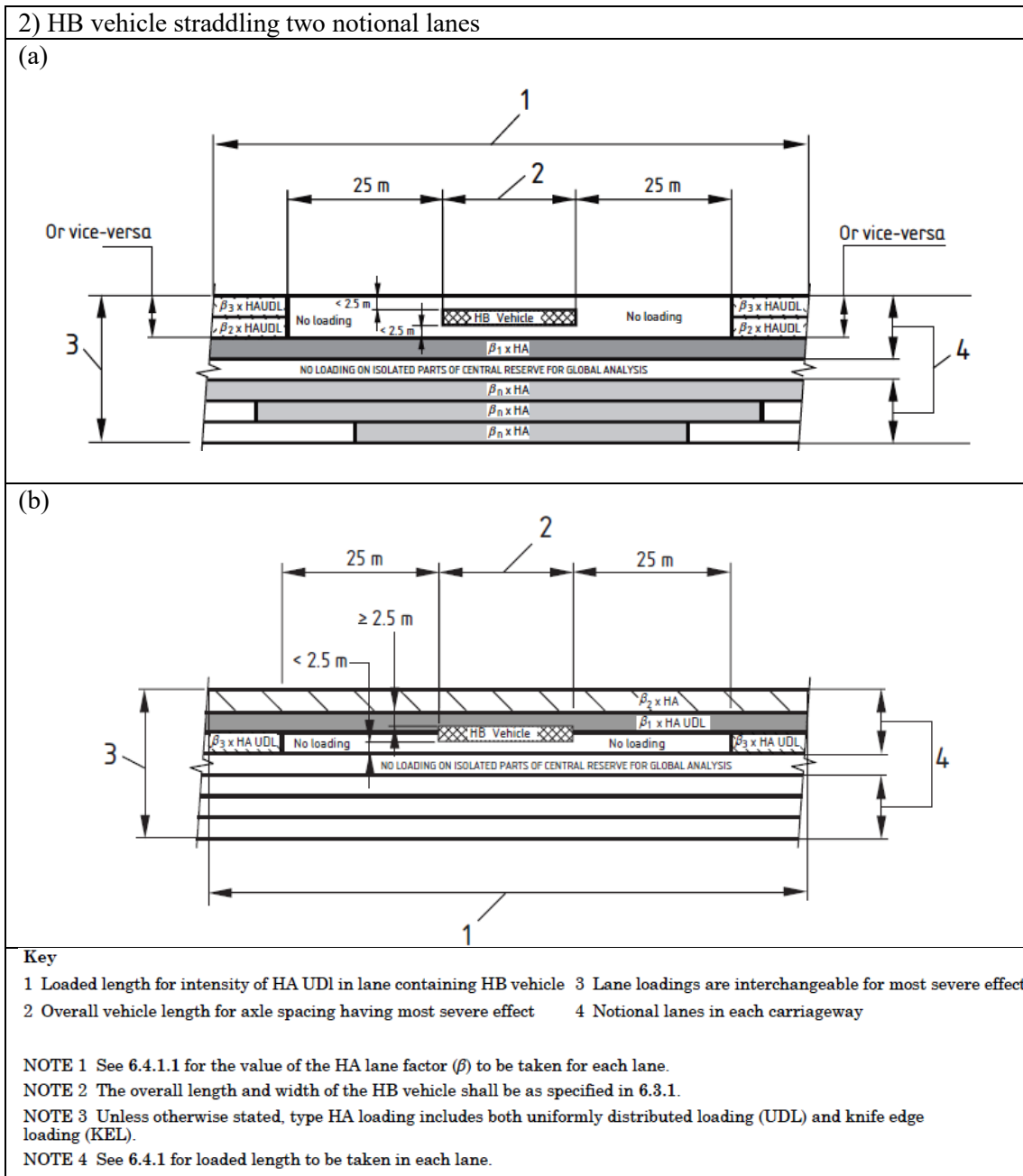
Carriageway width, b_L (m)	No. of notional lane
$5.00 \leq b_L \leq 7.50$	2
$7.50 \leq b_L \leq 10.95$	3
$10.95 \leq b_L \leq 14.60$	4
$14.60 \leq b_L \leq 18.25$	5
$18.25 \leq b_L \leq 21.90$	6
Lane no.	Lane factor
1	$\beta_1 = \alpha_2 = 0.0137[b_L(40 - L) + 3.65(L - 20)]$
2	$\beta_1 = \alpha_2 = 0.0137[b_L(40 - L) + 3.65(L - 20)]$
3	0.6
4 and above	$0.6\alpha_2$

Table 1(c)



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Table 1(c) (continued)



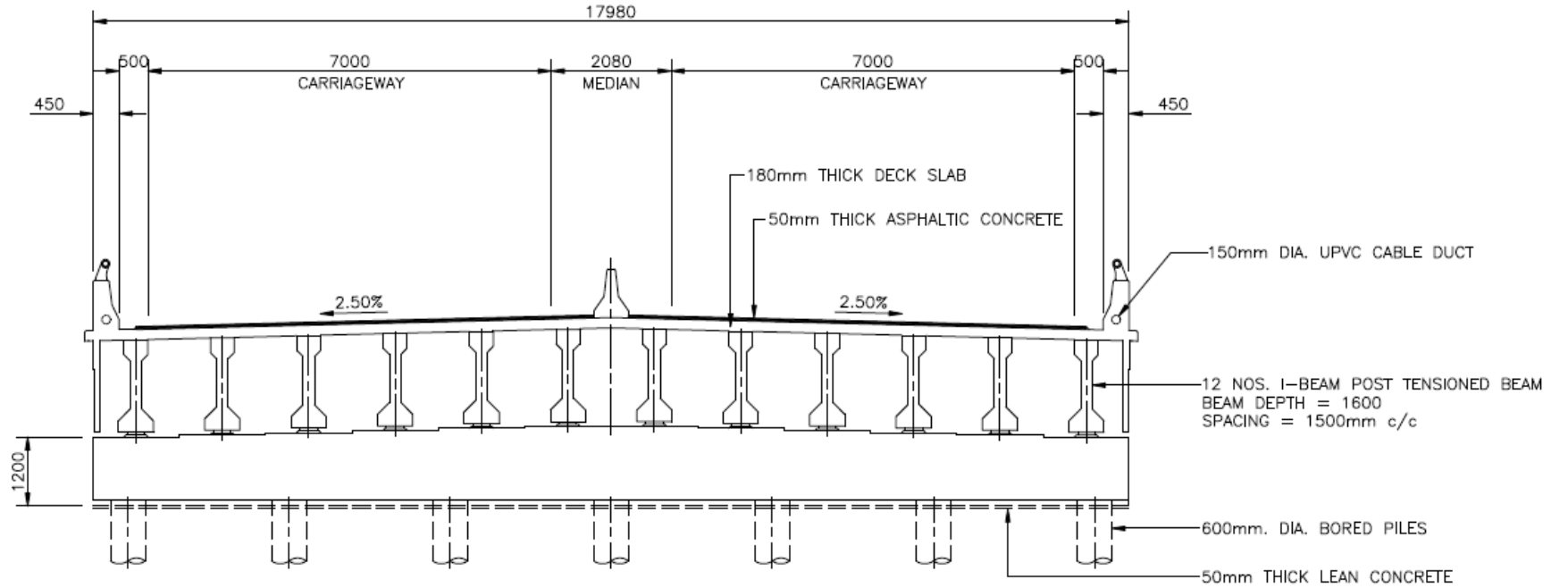


Figure 1 : A bridge deck with the post-tensioned I-beam type

- (2). (a). Explain briefly, the benefits of.
- (i). Assigning the central pier and the abutment as fixed piers?
[7 marks]
 - (ii). Piers constructed monolithically with the bridge deck over usage of bearings?
[8 marks]
- (b). Discuss the consideration in the selection of wing walls in the design of bridge abutments.
[10 marks]
- (3). (a). Steel bridges normally result in light superstructures which in turn lead to smaller, economical foundations. They are normally prefabricated in sections in a factory environment under strict quality control, transported to site in manageable units and bolted together in situ to form the complete bridge structures. Using this construction method the erection of a steel bridge is usually rapid, resulting in minimal disruption to traffic. With this understanding of steel bridge system, discuss on the appropriate application of truss, plate and box girder bridges. Highlight the basic principle of each type of steel bridge.
[15 marks]
- (b). In order to ensure the sustainability and serviceability of the bridges, maintenance, repair, strengthening and rehabilitation must be properly equipped with inventory database of the bridges. Without inventory database, the preventives measures would be impossible. Discuss the important information for inventory database for any decision to be taken for further action.
[10 marks]

- (4). Bridge decks are subject to translation and rotational movements and to forces from gravity, traffic, wind and friction. In supporting bridge decks, bearings have to cater for these forces and movements. It is designed and chosen based on its ability to carry designed load and movement capabilities. In accommodating dimensional stability and deformation of superstructure or substructure components i.e. concrete material due to short-term and long-term deformation, the chosen bearing should be capable to accommodate those movements. With the aid of sketch, briefly explain **FIVE (5)** types of bearing normally used for concrete bridge in terms of its advantageous and disadvantageous.

[25 marks]

- (5). The final elements that are needed in box girder are the intermediate cross-frames or diaphragms and bearing diaphragms. It is required to resist lateral forces and transfer loads to support or bridge pier. Diaphragm can be in the form of normal reinforced concrete structures, post-tensioned or steel truss. With the aid of sketch, discuss specifically the function and mechanism of diaphragm in steel box girder bridges to resist and transferring the loads.

[25 marks]

- (6). **Figure 2** is a cross section of a bridge deck slab. By using the Westergaard's method, Calculate:

- (a). the maximum moment in the deck for local effect when load P_1 and P_3 at the center line of the girder

[15 marks]

- (b). influence in moment M_{ox} and M_{oy} of load P_1 due to P_3 at the longitudinal direction

[5 marks]

- (c). moment M'_{ox} and M'_{oy} due to continuity effect at support

[5 marks]

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Given data

- (i). Wheel load for HB is 45 unit
- (ii). Contact pressure 1.1 N/mm²
- (iii). Average surfacing thickness = 60mm

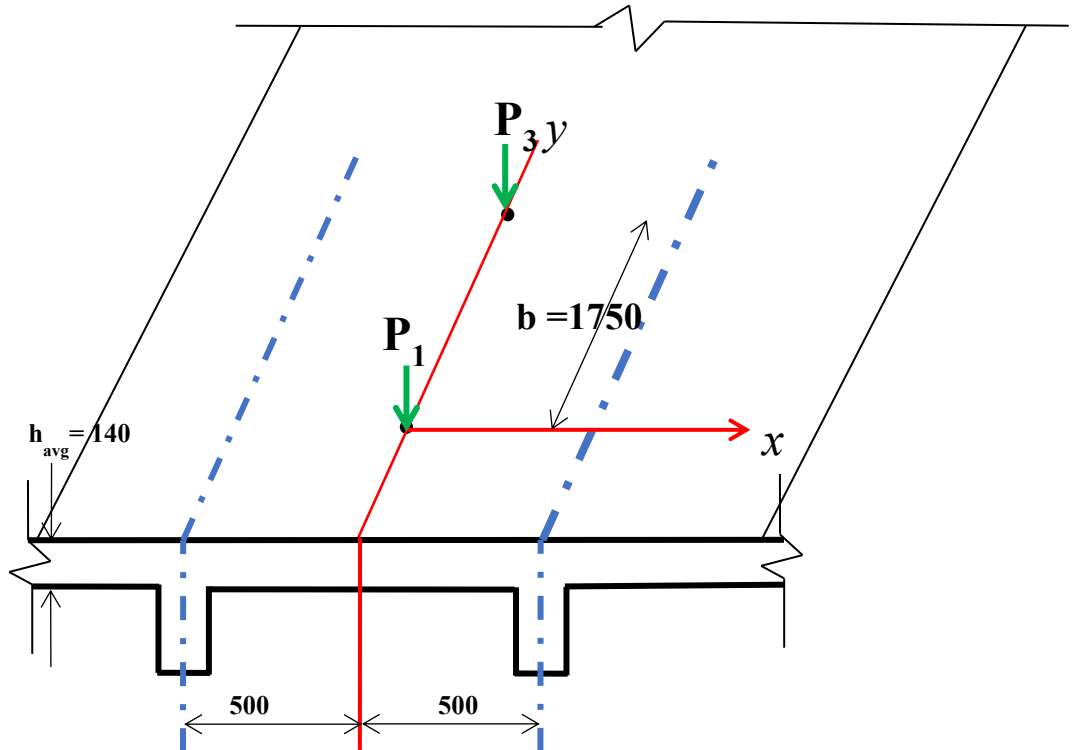


Figure 2

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