CINEC CAMPUS

Faculty of Engineering & Technology

Department of Civil Engineering

BSc Hons (Eng) Civil Engineering

Semester 5 First Sit - Final Examination 2025

Module Code	:	CE3315
Module Title	:	Surveying II
Date	:	7th February 2025
Examiners	:	Buddhika Weerasinghe
Time Allowed	:	(09 00 am - 11.30 am)- 2 ½ hrs

Instructions to Candidates:

- This is a close book exam.
- This paper consists of Four (06) questions in five pages. Answer any **five (05)** questions only.
- All the questions carry equal marks.
- Use only the answers booklet, additional papers for your answers.
- Write clearly and legibly with a blue or black pen.
- Write your name and student number on all sheets.
- Answers to different parts of the same question (other than any graph sheets used) should not be scattered.
- Marks will be deducted for missing or incorrect measuring units.
- You are advised to make a clear diagram for each question, where appropriate. This will help you to perform calculations correctly.

Question 01

(a) Briefly Describe the two methods of measurement in Electro Magnetic Distance Measurement (EDM). **(04 marks)**

(b) Briefly describe *Zero Error* in EDM instruments and how to calculate its magnitude using a field method. **(04 marks)**

(c) A line AB was measured using EDM. The instrument was set up at X in line with PQ on the side of P remote from Q. The wavelength of frequency 1 (f_1) is 10 m exactly. Frequency 2 (f_2) is (9/10) f_1 and that of frequency 3 (f_3) is (99/100) f_1. Calculate the accurate length of PQ that is known to be less than 200 m, from the phase difference readings given in Table Q1. **(12 marks)**

Table Q1

Line	Phase Differences (m)		
	f_1	f_2	f_3
XA	4.337	7.670	0.600
XB	7.386	1.830	9.911

Question 02

(a) Briefly describe how a circular curve can be set out using theodolite and a tape. **(04 marks)**

(b) The chainage of the intersection point of two straights is 1060.00 m, and the angle of intersection is 120°. If the radius of a circular curve to be set out between these two straights is 570 m, at the peg interval of 30 m, determine the following.

(i) the tangent length **(01 marks)**

(ii) the length of the curve **(01 marks)**

(iii) the chainages at the tangent points **(02 marks)**

(iv) the length of the long chord **(01 marks)**

(v) the lengths of the sub-chords **(02 marks)**

(vi) the total number of chords **(01 marks)**

(vii) Tabulate the data required to set out this curve using the tangential angle method. **(08 marks)**

Question 03

(a) Briefly describe the following types of transition curves.

(i) Compound transition curves **(02 marks)**

(ii) Fully transition curve **(02 marks)**

(b) On a proposed road having a design speed of 100 km/h and a carriageway width of 7.30 m, a composite curve consisting of two transition curves and a central circular arc of radius 750 m is to join two intersecting straights having a deflection angle of 09°34"28'. The rate of change of radial acceleration for the road is to be 0.3 ms^{-3}. The superelevation should be introduced at a rate of no more than 1%.

(i) Calculate the amount of superelevation that must be built into the central circular arc. **(04 marks)**

(ii) Check that the transition curves are long enough for the superelevation to be introduced. **(06 marks)**

(iii) Calculate the amount of superelevation that should be constructed along the entry transition curve at 20 m intervals from the entry tangent point. **(06 marks)**

Question 04

(a) Briefly explain the following related to the design of vertical curves.

(i) Stopping Sight Distance (SSD) **(02 marks)**

(ii) Full Overtaking Sight Distance (FOSD) **(02 marks)**

(b) The reduced level of an intersection of a rising gradient of 1.5% and a falling gradient of 1.0% on a proposed motorway is 93.60m. Given the K value for this particular road is 55, the through chainage of the intersection is 671.34m and the vertical curve is to have equal tangent lengths, calculate:

(i) the through chainages of the tangent points of the vertical curve if the minimum required length is to be used **(04 marks)**

(ii) the reduced level of the tangent points and the reduced levels at exact 20m multiples of through chainage **(08 marks)**

(iii) the position and reduced level of the highest point on the curve **(04 marks)**

Question 05

(a) A new 100 m long road is to be constructed with formation width of 18 m, side slopes of 1 vertical to 2horizontal. The heights of fill at the center line of three successive cross sections, 50 m apart, are 3.2 m, 3.9 m, and 4.2 m, respectively. The existing ground has a cross fall of 1 in 10. Calculate the volume of fill required. **(12 marks)**

(b) Figure Q5 shows 10 m square grids with reduced levels marked at each grid intersection.

(i) Calculate the total cut volume involved if the formation level of the excavation is 0 m. **(04 marks)**

(ii) The area is to be graded to form a horizontal plane at a level where cut and fill are balanced. Assuming no bulking or shrinking of the excavated earth and neglecting any effects of side slopes, determine the design level. **(04 marks)**

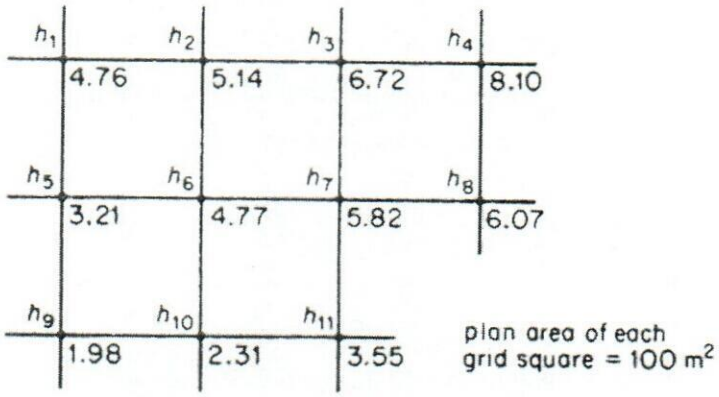

Figure Q5

Question 06

(a) List out the three main segments of a Global Navigation Satellite System (GNSS) and briefly describe their functions. **(06 marks)**

(b) List out four (04) factors to be considered in selecting the receiver type for a GNSS system. **(04 marks)**

(c) Briefly describe why at least four satellites are required to obtain the precise position of a survey point in GNSS survey. **(02 marks)**

(d) Briefly describe the following errors related to the GNSS survey.

(i) Ionospheric error **(02 marks)**

(ii) Multipath **(02 marks)**

(e) Briefly describe the following differential positioning systems used for carrier phase measurements in GNSS survey.

(i) Static positioning **(02 marks)**

(ii) Real Time Kinematic positioning (RTK) **(02 marks)**

-End of Question-

CINEC CAMPUS
Beyond A Graduate

Faculty of Engineering & Technology

Department of Civil Engineering

BSc Hons (Eng) Civil Engineering

Semester 5 First Sit - Final Examination 2025

Module Code	:	**CE3314**
Module Title	:	**Structural Design II**
Date	:	**05th February 2025**
Examiners	:	**Dr Sumudu Herath**
Time Allowed	:	**(09.00 am - 12.00 pm) - 3 hrs**

Instructions to Candidates:

- This open-book paper consists of Three (03) questions. Answer **all three** questions.
- Use only the answers booklet and additional papers for your answers.
- Write clearly and legibly with a blue or black pen.
- Write your name and student number on all sheets.
- Answers to different parts of the same question should not be scattered.
- Marks will be deducted for missing or incorrect measuring units.
- You are advised to make a clear diagram for each question, where appropriate. This will help you to perform calculations correctly.
- If you have any doubt regarding the interpretation of the wording of a question, make your own assumptions and clearly state it on the answer script.

Question 1

a) Figure Q1 shows a schematic of a steel tower (or referred to as a pylon) to be designed as a part of a proposed electricity transmission project. The following details are given to you as the junior design engineer.

Density = 78.5 kN/m^3 *S275 grade steel* *Angle (L-shaped) sections*

i. State four types of loading that should be considered in the member design of this tower. *[06 marks]*

ii. If all joints are idealised as pinned, name six failure modes that you would expect in the member/connection design process of the tower. *[06 marks]*

iii. Explain the nature of the design internal forces you will expect in the design process of member CD. You may refer to the applicable design load combinations as per EN EN1990. *Hint*: Wind loads could be from any direction. *[05 marks]*

iv. The critical internal force of member CD (see Figure Q1) is obtained as 516 kN in pure axial compression. If the angle section to be used is selected as 150x150x10 (having an equal leg width of 150 mm, and thickness of 10 mm), classify whether it is a slender or non-slender section. *[06 marks]*

v. A third-year trainee student working in your team proposes using Square Hollow Sections (SHSs) instead of angle sections. Do you agree with him/her? State four structurally important differences you would expect from this change. *[06 marks]*

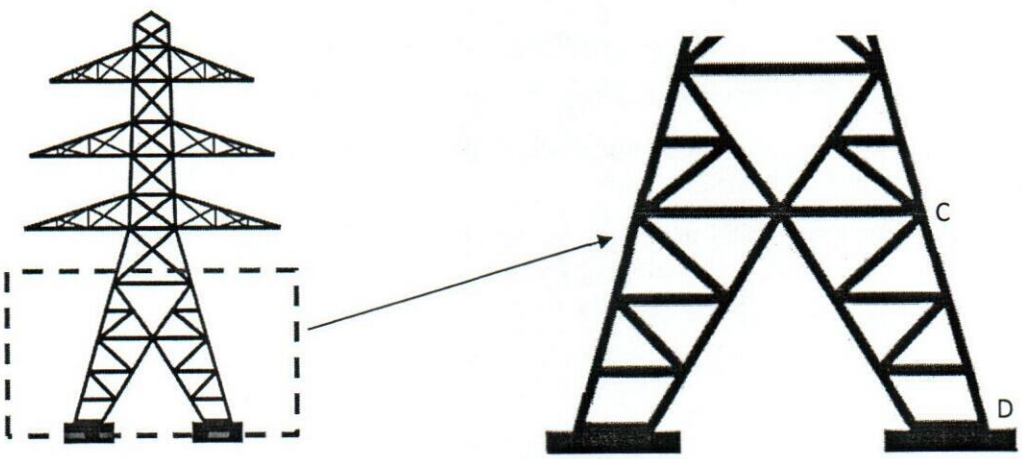

Figure Q1

b) Sketch two other structural forms (member layout) to perform the same functions that you may consider as an alternative to the form given in Figure Q1. *[06 marks]*

[Total of 35 marks for Question 1]

Question 2

a) Explain why section classification is important for members in flexure and axial compression, but not for members in axial tension. You may use any Universal Beam (UB) section to aid your answers. *[05 marks]*

b) Using sketches, explain why UB sections have thicker flanges and thinner webs. *[04 marks]*

c) A sketch of two axially loaded steel members (both UB 305x127x48) connected to each other using a splice plate connection is shown in Figure Q2. All steel members are of grade S235 and bolts are of 16 mm diameter.

i. Explain why bolt-hole deductions are ignored in the design of axially loaded members in pure compression. *[04 marks]*

ii. If the design tensile force to be transferred between the two members is 480 kN, recommend the minimum thickness of the two splice plates to be used. Available plate thicknesses in the market are given to you as 6 mm, 8 mm and 10 mm. *[08 marks]*

iii. Calculate the utilisation ratio of the splice plates you recommended in ii. *[03 marks]*

iv. Due to limited availability of 8 mm and 10 mm thick plates, the connection in Figure Q2 is to be assembled using two 6 mm splice plates. Calculate the new utilisation ratio of the splice plates in transferring the design tensile force 480 kN. What is your interpretation of this new utilisation ratio? *[05 marks]*

v. Explain three modifications with sketches you propose to this connection as per your interpretation in iv. *[06 marks]*

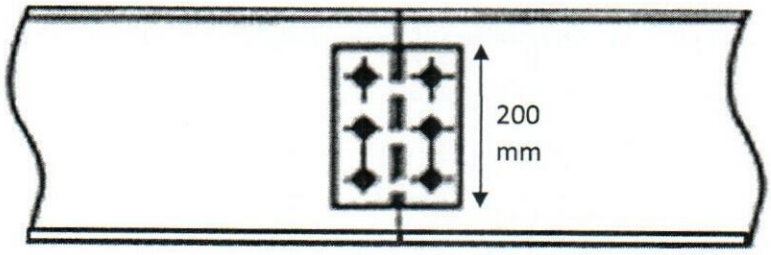

Figure Q2

[Total of 35 marks for Question 2]

Question 3

a) Utilisation ratios of various simply supported floor beams in three buildings are presented in Table Q3. All members are UB sections, S275 grade and are loaded by uniformly distributed loads. Further, all compression flanges are fully laterally restrained by the concrete slabs and hence not critical for lateral torsional buckling.

Building Number	$M_{Ed}/M_{pl,Rd}$	$V_{Ed}/V_{pl,Rd}$	$\delta_{max}/\delta_{allowable}$
01	0.7	0.4	0.95
02	0.3	0.3	0.1
03	0.4	0.8	0.3

i. List two reasons for the observed higher utilisation ratio for deflections in Building 01. *[04 marks]*

ii. What is your engineering judgment on the beam in Building 02? *[03 marks]*

iii. Is the beam in Building 03 low- or high-shear? What is the structural implication of your answer? *[03 marks]*

iv. Using neat sketches, explain how the concrete slabs reduce the risk of lateral torsional buckling failure of simply supported UBs. *[04 marks]*

b) Learning from historical structural failures helps the engineers to refine their knowledge of structural strength, stability, stiffness and their optimal synergy for future structural designs.

i. The Pigeon Island bridge in Matara collapsed after extreme levels of corrosion. It was noted that this bridge was not maintained regardless of its exposure to salt water, wind loads etc. Discuss why periodic maintenance and health monitoring are important for steel structures exposed to severe corrosive environments. *[04 marks]*

ii. State four ways that corrosion in steel structures changes the assumed (or idealised) mechanics and analysis at the design stage which could lead to failure. *[04 marks]*

iii. In 1954, Comet 1 aircraft crashed due to the initiation and propagation of fatigue cracks across its fuselage (main body of the aircraft). Explain how fatigue failures may occur in commercial aircrafts which fly over 30,000 ft. *[04 marks]*

iv. Give four types/examples of steel structures that may be critical for fatigue failure. *[04 marks]*

[Total of 30 marks for Question 3]