School of Engineering

COURSEWORK BRIEFING SHEET

COURSE MODULE:	**CIVE233 - Structural Engineering in the Built Environment 2**
ASSIGNMENT TITLE:	**General analysis and analyses prediction and checking.**
Discipline:	**Year 2 – Civil Engineering programmes - BEng/MEng**
Lecturers responsible:	**Dr G Beattie**
Date set:	**Thursday 4th March 2021**
Required dates of submission:	**Friday 14th May 2021**

Penalty Scheme for late submission: **University Standard Scheme.**

Aims:

At the end of the assignment a student should be able to:

- Produce simple analysis models using GSA and use qualitative understanding to check models.
- Use GSA to solve simple structural problems.
- Identify errors and check models.
- Produce a professional report.

Instructions

1. Below are two **2D** plane frame structures (FRAME 1 and 2):

   You are required (before completing any analysis by hand or using GSA) to qualitatively draw the deflected shape, bending moment, shear force and axial force diagrams for each structure (FRAME 1 and 2).

   You should then change the supports from encastre to pin supports and repeat the same qualitative exercise described above.

   Once you have completed the above – create an analysis model of each structure (FRAME 1 and 2) and analyse them using GSA. Compare your qualitative results with those from GSA and describe and explain any differences observed. Do not worry if your qualitative results differ (that is expected) – the important thing is to reason why to demonstrate learning.

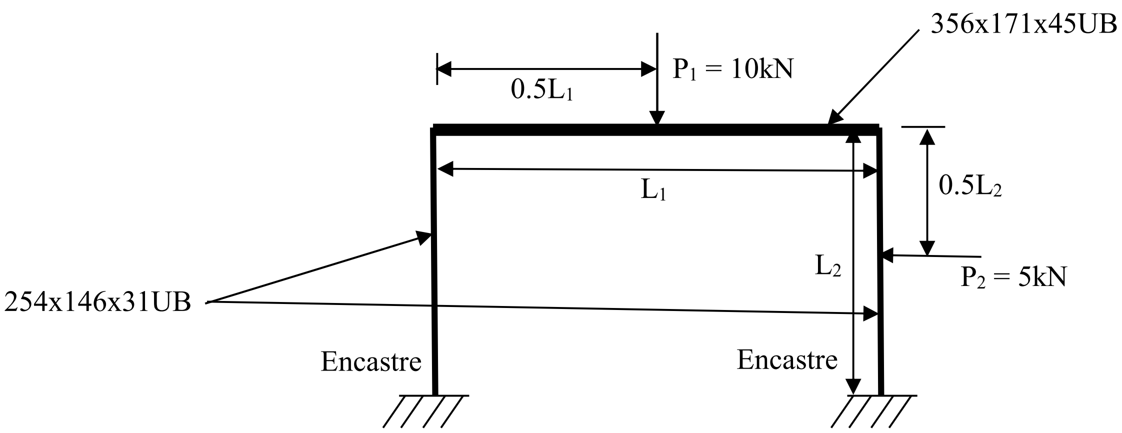
   Note: you are free to choose the length of elements L1 and L2 (suggest between 5 and 10m).

   Show how you have checked your GSA models for both frames and report on this.

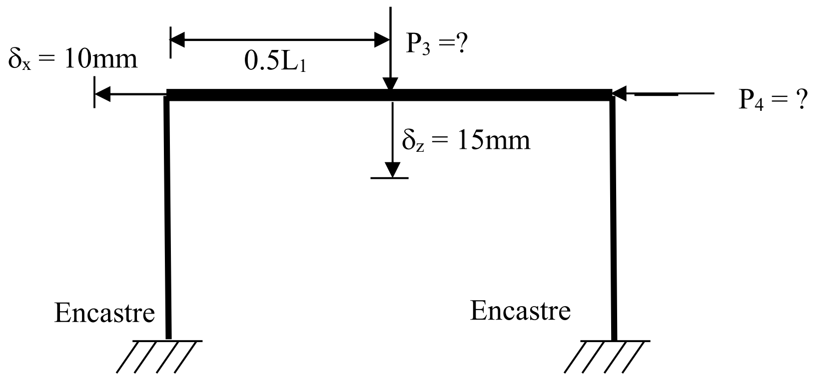
   For FRAME 1 **ONLY** determine what value of P_3 and P_4 will give you a horizontal deflections δ_x = 10mm and vertical deflection δ_z = 15mm (see FRAME 1 Fig. b for reference). Note that both forces are applied simultaneously.

   When completed –move force P_4 to the mid-point of the column on the right hand side. Re-run the analysis with the loads you have determined to give the correct displacements in the previous step. Are your overall displacements different? Either way explain why.

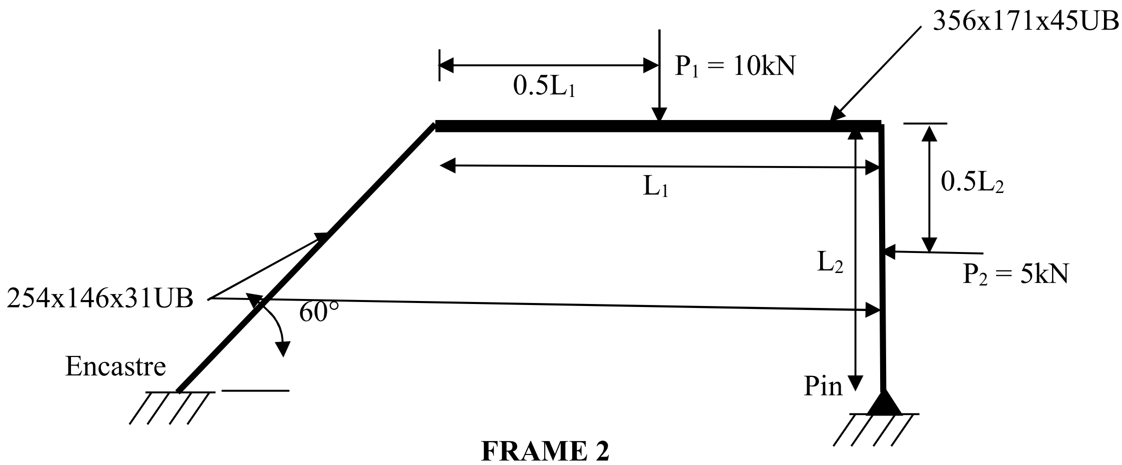
   In your final report (see below) you are expected to produce a front page for each model specifying the geometry you have chosen



FRAME 1 (Fig. a)



FRAME 1 (Fig. b)



FRAME 2

For FRAME 2, describe the effect that the changed geometry (sloping column) has on the deflection characteristics when compared to FRAME 1?

For both frames, describe other changes you could make to the structures to make them stiffer (i.e. less vertical and horizontal deflection – assume that the global geometry and loading cannot change)

2. Build and run a 3D GSA model of a simple truss bridge. See tutorial number 7 – your bridge spans 26m and is formed by 2 trusses connected together with a 3m space between them – just connect the floor and roof by beam elements in this exercise – there is no need to add in a floor or roof – just the structural skeleton.

Note – you will need to research truss bridges a bit to complete this exercise.

You are free to determine the height of your truss bridge and size of the bays between the vertical elements, and also the cross bracing orientation.

You are free to choose the overall dimensions and element sizes for this exercise, but the span must be 26m

Do you need cross bracing in the roof and floor?

You will load your structure as follows:

General	- Gravity	
Roof action	- purlins and sheeting (permanent)	0.5 kN/m^2
	- services (permanent)	0.1 kN/m^2
	- Roof imposed load (variable)	0.6 kN/m^2
Side walls	- wind (on long side only)	1.4 kN/m^2

Note: wind loading is combined for both faces and only needs to be applied to one face

Load cases:

In a real building there are many load combinations to check. For this exercise use the following but think about what combinations of load might create the most critical structural effects:

Deflection (SLS)	1.0 permanent + 1.0 variable (roof)
	1.0 permanent + 1.0 Wind (side)

The following rules must be observed (i.e. choose your structural members to satisfy):

- deflection does not exceed span/250 (vertical deflection)

Once you have analysed your bridge – re run it as a vierendeel truss bridge – research this but this is basically a truss with no diagonal bracing and therefore all connections are moment connections. Do not try to get deflection in limit if they are not – see below.

Submission requirements:

Question 1

- For section 1, you have been asked to complete a number of tasks, explain and answer a number of questions. You should ensure that your report includes all items asked for. The report should form section one of your overall report and have a clear introduction. It may be helpful to split the questions and report on it in sections. However, you have the freedom to format it as you wish.

  Please ensure for this question that you have read the question and provided all information required to demonstrate all tasks have been completed.

Question 2

- For question 2, your work for this exercise should be presented as a separate section within your overall report (see below) to a format of your choice. Marks will be allocated for presentation of the work. The report should include:
    - Clear calculations to show how you have calculated the loads to apply to the model elements – use sketches if necessary.
    - A GSA model of the pin truss bridge only - name it as your name (i.e. gbeattie.gwb) and submit by uploading to Canvas. If we do not receive a model from you or it is **not**

named correctly you will receive zero marks for it. We look at GSA models to check it's your own work.

- For the standard truss bridge - A deflection plot clearly showing that deformations are within tolerance (TIP: use arrow vectors or contour plots to do this).
- For the standard Truss bridge - A clear hand calculation to show that the total downward loads you are applying to the model are equal to the upward reactions from GSA (TIP: remember vertical equilibrium from Y1 i.e. sum of vertical forces = zero).
- For the standard truss bridge - A step by step explanation of how you built the model.
- For the standard truss bridge - Please ensure there is a section that clearly demonstrates that the output you have obtained from this analysis is correct – clearly show what you were anticipating and clearly show and describe what checks you have made to the analysis.
- A deflection comparison under same loading for the standard truss and the vierendeel truss bridges.

PLEASE NOTE YOUR REPORT/S SHOULD BE IN PDF FORMAT.

All your files should be contained in one .zip file and just this file uploaded.