CIVL473 – Fundamentals of Steel Design - TERM PROJECT 2

1. Aims of the Term Project
   1. To prepare the final year students to working life.
   2. To do manual and computer aided design of a multi-story steel framed building within a team.
   3. To understand the importance of individual element design as part of a multi-story building.
   4. To achieve better understanding of the structural behaviour under vertical and horizontal applied loading so that the most efficient bracing system can be selected to provide the stability for the building.
   5. Once the project is complete then to be able to do a presentation where it is clearly explained how all the above-mentioned tasks are completed.

2. Outline of the Project
   1. Manual design of the selected elements of a building.
   2. Computer aided design using ETABS.
   3. Presenting the project using MS Power Point.

3. General Requirements
   A neatly prepared proper report should be submitted. Important references to design code and other books should be given on the calculation sheets. Whenever necessary, sketches should be drawn with a ruler. Report should include a copy of this project paper, calculation sheets, ETABS important input/output tables and sketches.

4. Project Execution
   Teams are formed of three students. Each student is fully responsible from one part of the project while helping with the rest of the project parts. This means that the student responsible from one part of a project will get the penalty in case of not completing that part of the project. The team members should submit the names of the responsible students to the course lecturer within two days of receiving the project.

<table>
<thead>
<tr>
<th>Main parts of the project</th>
<th>No. of responsible students</th>
</tr>
</thead>
<tbody>
<tr>
<td>Determining the layout of the floors</td>
<td>1 member of the team</td>
</tr>
<tr>
<td>Manual design of the elements of the building</td>
<td>1 members of the team</td>
</tr>
<tr>
<td>Computer aided design using ETABS</td>
<td>1 member of the team</td>
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5. Project Evaluation
   While evaluating the project the following will be among the important items to be considered:
   • Correct manual design with proper sketches and references to relevant documents.
   • Correct modeling of the building using ETABS and provision of the input, output data and important drawings.
   • Complete report with traditional titles, layout of the report, presentation of the report in front of the classroom using Microsoft Office Power Point.
   • Correct answers to the questions during presentation.
6. Design Brief
Details of the building under consideration are given on the following pages. The building has two parts, multi-story building and multi-function hall. Figs. 1 show the typical floor plan layout, Fig. 2 gives the south elevation of the building.

- Lateral stability will be provided by the vertical and plan bracings.
  Select appropriate locations for vertical bracings.
- One-way spanning composite slab with steel decking will be used as flooring for the multi-storey building. A suitable steel deck with adequate reinforced concrete slab can be found from the attached technical data of Richard Lees Steel Decking. Composite slab spanning onto steel beams provide full lateral restraint for these beam members.
- The floor design loads are valid for all the floors, except for the multi-function hall, whilst the elevation load is valid for the whole of the elevation.

Assume Grade S275 material for all the design calculations and design checks. Use the following information to design the building. Use lattice girder or trusses to cover the roof area for the multi-function hall. Above all make sure that your design would achieve the lightest possible steel frame.

- Assume that the lightweight partition of 1.4 kN/m² will be used for all the internal walls and all the external beams would carry a load of 7.5 kN/m due to the perimeter walls.
- Curtain wall and glazing of 0.75 kN/m², on the elevation, will be carried by the columns.
- Self-weight of the structural members and floors should be added to the relevant loads during the design calculations.
- 1st to 3rd floors will be offices with 3.5 kN/m² live loads.
- The lattice girders are part of the multi-function hall’s Roof where live loads are for maintenance access only, 0.75 kN/m², and the dead loads can be taken as 2.0 kN/m².
- Dead load for the roof is same as the typical floors, however, the live loads are for maintenance access only, 0.75 kN/m².
- Use DL=3.0 kN/m² and LL=3.5 kN/m² for the staircase design.
- Ignore wind loads other than for the bracing calculations.

ASSIGNMENT

1. Use BS 5950: Part 1: 1990 to design the following:
   a) At least two representative beams from two different floors
   b) At least two columns, one internal and one external or corner column
   c) Vertical wind bracings
   d) At least one beam to column and one beam to beam connections for beams in section a)
   e) Base plates for columns in section b)
   f) Lattice girder design for multi-function hall
   g) Plan bracings on the roof of the multi-function hall

1. Project that achieves the following will get the highest points.
   a) Minimum steel weight/m² for the Building
   b) Minimum steel weight/m² for the Multifunction hall
   c) Lightest and the shallowest 5m cantilever canopy
Fig. 1 Typical Floor Plan Layout
PROJECT 2

wind pressure, q  kN/m²

0.90
1.05
1.2

Ground Fl  0.00
1st Fl  +5.25
2nd Fl +9.25
3rd Fl +13.25
Roof +17.25

Fig. 2 South Elevation