**ENGN 2217 – Mechanical Systems and Design**

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**CLAB 1 Handout – Design of a crane frame**

Q1. What is the highest value of “maximum combined stress” in your loaded structure?​

Q2. Why are the values of combined stress and bending stress very close? ​

Q3. Compare the maximum stress result from the simulation with the failure stress for steel. What is the factor of safety for this structure?​

Q4.  What could you change in the design to increase the factor of safety?​

Q5: which member cross-section option would make your structure the strongest with respect to the loads considered in this tutorial? ​

Q6: which would make it the most expensive? (steel cost is a function of weight)

Q7. What is the value of load multiplier you have computed in your simulation?​

Q8. In terms of safety, how does the load multiplier compare with the safety margin you calculated earlier on? What type of failure will this structure exhibit most likely?​

Q9. What design changes could the structure undergo so that its cost may be reduced, without compromising safety?​

Diagram

Description automatically generated

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| ​ | unit​ | I beam tested this tutorial​ | Rotated section (H beam)​ | Double Width​ | Double flange thickness​ | Double total depth​ | Double web thickness​ |
| Total depth (W1) ​ | mm​ | 170 | 170 | 170 | 170 | 340 | 170 |
| Width (W2)​ | mm​ | 230 | 230 | 460 | 230 | 230 | 230 |
| Flange thickness (t1)​ | mm​ | 20 | 20 | 20 | 40 | 20 | 20 |
| Web thickness (t2)​ | mm​ | 15 | 15 | 15 | 15 | 15 | 30 |
| Area A​ | mm2​ | 11100 | 11100 | 20600 | 19700 | 13700 | 13100 |
| y (centroid distance)​ | mm​ | 85 | 115 | 85 | 85 | 170 | 85 |
| I (moment of inertia)​ | mm4​ | 54800000 | 40600000 | 108000000 | 81100000 | 270000000 | 57500000 |