

School of Engineering

**1E10 Assignment.**

**A4. Structural Engineering Component**

**Design against failure under *dynamic* actions**

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Question 1.

Given: d = 0.006m, L=0.25m and P = 47N.

Formula: , where is the static failure stress, P is the failure load, L is the span length, and d is the diameter of the timber beam.

Static failure stress = 1.38 x 108 N/m2.

Question 2.

This plot shows that the weight dropped is inversely proportional to the height to failure, although not directly so. As the height increases, the weight decreases, but at a slower rate with increased heights.

Compared to the static failure load of 47N, the magnitudes of these loads are very small, in this graph ranging from 6N down to 3N. As the graph has not levelled off fully yet it is clear that the required dynamic failure load could be even lower at increased heights, although we are told that it will not reach 2N.  
  
The fact that the magnitudes of the loads are so small shows that a drop from any height has a huge impact on the effective stress caused by the load.

Question 3.

|  |  |  |  |
| --- | --- | --- | --- |
| **Weight (N)** | **Height Failure (m)** | **g (m/s2)** | **v (m/s)** |
| 3 | 0.35 | 9.81 | 2.620496 |
| 4 | 0.25 | 9.81 | 2.214723 |
| 5 | 0.2 | 9.81 | 1.980909 |
| 6 | 0.175 | 9.81 | 1.852971 |

As in the plot in question 2 above, the weight is inversely proportional to the velocity at impact. This is due to the fact that the velocity at impact is almost directly proportional to the height in the case of this experiment.

Question 4.

From above: Static Failure stress = 1.38 x 108 N/m2.

Given: DMF = 2, L = 0.25m, d = 0.006m.

Formulae:

σdynamic = 6.93 x 107

P = 5.875 N

Question 5.

Given: L = 0.3m, d = 0.006m, mass = 0.0047kg, load = 0.046107 N.

Formulae:

Volume = 8.48 x 10-6 m3

Mass Density = 554.09 kg/m3

Mass per unit length = 1.566 x 10-2 kg/m

Load per unit length = 0.15369 N/m

Question 6.

Given: Etimber = 1 x 1010 N/m2, L2 = 0.2m, d = 0.006m.

From above: mpl = 1.566 x 10-2 kg/m.

Formulae:

Po = 0.030738 N

I = 6.36 x 10-11

δstatic = 1.288 x 10-4

Question 7.

From above: δstatic = 1.288 x 10-4

Formula:

|  |  |
| --- | --- |
| **v (m/s)** | **DMF** |
| 2.6205 | 74.7147 |
| 2.2147 | 63.3026 |
| 1.9809 | 56.7269 |
| 1.8530 | 53.1290 |

Question 8.

Given: L = 0.2m, d = 0.006m.

From above: DMF = 63.3, ω = 0.15369, σfail dynamic = 6.93 x 107.

Formulae:

= 1.449 x 105

= 9.17 x 106

The dynamic failure stress is much greater than the dynamic stress caused on impact by the velocity corresponding to the drop height of 0.25m, and so the cantilever will not fail on impact.