**Introduction:** this test aims to calculate the shear and moments for a simply supported beam. During this test we will calculate and compare the theoretical and experimental values for the shear and moment at the cut of the beam. The values will be discussed according to the graphs also the procedure of the experiment will be declared the causes of the errors in addition to all the mathematical equations involved in this test finally the conclusion of the whole test and its data sheet

**List of equipments used:** for the first case: 2 roller supports

 Beam with 2 load cells

 Weight of 10and 20N

 For the second: 2 roller supports

 Beam with 2 load cells

 2 weights of 10 and 2of 20N

**Theoretical analysis:**

For the first case : in this case we want to determine the internal shear force and bending moment at a distance of 27 cm from the left of the simply supported beam using concentrated load. The equations involved are:

∑F = 0

And ∑M = 0

Here we are also using the cutting principle.

For the second case: in this case same equations apply as the first case except that here we have a symmetric loading.

**Discussion of the work done:**

**NB:** the beam used in our experiment had problems in reading the moment and shear forces so all the values are gassed hence the interpretation will not be as good as it should be.

For the first case: the results obtained for the shear forces seems to be reasonable compared to the theoretical values calculated that what is also proofed by the first graph of the shear versus the distance as for the errors it seems that it has a big value that about 40% average for the 20N case the values are more accurate since the average error decreases to 30%.the shear force graph should reach its peak at 300mm and start decreasing till the distance 700mm but in our case it has 2 peaks as for the moment the graph should reach its peak at 350mm and decrease till the end of the beam in our case the moment graph has no peak instead it has a platform between the 250 and 450mm

for the second case: the values of the shear forces were very close to the theoretical ones except for the last position which was after the cut where the percentage of the error reaches 65% same for the moment where for the last position the error is 45% we realize that the values are a bit far from the theoretical ones.

**Data sheet and graphs:**

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Case 1 |  |  |  |  |  |  |  |
| F=10N |  |  |  |  |  |  |  |
| x(mm) Load Location | Support reaction at A (N) | V(N) exp | V(N) theo | %error | M(N.mm) Arm=100mm (Exp) x 100 | M(N.mm) Arm=100mm (Theo) x 100 | %error |
| 100 | 8.75 | 2 | 1.25 | 37.500 | 4 | 6.625 | 39.623 |
| 150 | 8.125 | 2.5 | 1.875 | 25.000 | 5 | 9.938 | 98.750 |
| 200 | 7.5 | 4 | 2.5 | 37.500 | 6 | 13.250 | 54.717 |
| 250 | 6.875 | 5 | 3.125 | 37.500 | 7 | 16.563 | 57.736 |
| 300 | 6.25 | 2 | 6.25 | 68.000 | 7 | 16.875 | 58.519 |
| 350 | 5.625 | 4 | 5.625 | 28.889 | 6 | 15.188 | 60.494 |
| 400 | 5 | 3.5 | 5 | 30.000 | 5 | 13.500 | 62.963 |
| 450 | 4.375 | 4 | 4.375 | 8.571 | 5 | 11.813 | 57.672 |
| 500 | 3.75 | 2 | 3.75 | 46.667 | 5 | 10.125 | 50.617 |
| 550 | 3.125 | 2 | 3.125 | 36.000 | 4 | 8.438 | 52.593 |
| 600 | 2.5 | 1.5 | 2.5 | 40.000 | 4 | 6.750 | 40.741 |
| 650 | 1.875 | 1 | 1.875 | 46.667 | 3 | 5.063 | 40.741 |
| 700 | 1.25 | 0.5 | 1.25 | 60.000 | 2 | 3.375 | 40.741 |
|  |  |  | Average % error: | 38.638 |  | Average % error: | 55.070 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| F=20N |  |  |  |  |  |  |  |
| x(mm) Load Location | Support reaction at A (N) | V(N) exp | V(N) theo | %error | M(N.mm) Arm=100mm (Exp) x 100 | M(N.mm) Arm=100mm (Theo) x 100 | %error |
| 100 | 17.5 | 4 | 2.5 | 37.500 | 4 | 13.25 | 69.811 |
| 150 | 16.25 | 5 | 3.75 | 25.000 | 6 | 19.875 | 69.811 |
| 200 | 15 | 7 | 5 | 28.571 | 8 | 26.5 | 69.811 |
| 250 | 13.75 | 8 | 6.25 | 21.875 | 10 | 33.125 | 69.811 |
| 300 | 12.5 | 6 | 12.5 | 52.000 | 10 | 33.75 | 70.370 |
| 350 | 11.25 | 9.8 | 11.25 | 12.889 | 10 | 30.375 | 67.078 |
| 400 | 10 | 8 | 10 | 20.000 | 9 | 27 | 66.667 |
| 450 | 8.75 | 6.5 | 8.75 | 25.714 | 4.5 | 23.625 | 80.952 |
| 500 | 7.5 | 5.5 | 7.5 | 26.667 | 8 | 20.25 | 60.494 |
| 550 | 6.25 | 4.5 | 6.25 | 28.000 | 7 | 16.875 | 58.519 |
| 600 | 5 | 3.5 | 5 | 30.000 | 5 | 13.5 | 62.963 |
| 650 | 3.75 | 2 | 3.75 | 46.667 | 4 | 10.125 | 60.494 |
| 700 | 2.5 | 1 | 2.5 | 60.000 | 3 | 6.75 | 55.556 |
|  |  |  | Average % error: | 31.914 |  | Average % error: | 66.334 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| F=20N |  |  |  |  |  |  |  |
| x(mm) Load Location | Support reaction at A (N) | V(N) exp | V(N) theo | %error | M(N.mm) Arm=100mm (Exp) x 100 | M(N.mm) Arm=100mm (Theo) x 100 | %error |
| 100 | 17.5 | 4 | 2.5 | 37.500 | 4 | 13.25 | 69.811 |
| 150 | 16.25 | 5 | 3.75 | 25.000 | 6 | 19.875 | 69.811 |
| 200 | 15 | 7 | 5 | 28.571 | 8 | 26.5 | 69.811 |
| 250 | 13.75 | 8 | 6.25 | 21.875 | 10 | 33.125 | 69.811 |
| 300 | 12.5 | 6 | 12.5 | 52.000 | 10 | 33.75 | 70.370 |
| 350 | 11.25 | 9.8 | 11.25 | 12.889 | 10 | 30.375 | 67.078 |
| 400 | 10 | 8 | 10 | 20.000 | 9 | 27 | 66.667 |
| 450 | 8.75 | 6.5 | 8.75 | 25.714 | 4.5 | 23.625 | 80.952 |
| 500 | 7.5 | 5.5 | 7.5 | 26.667 | 8 | 20.25 | 60.494 |
| 550 | 6.25 | 4.5 | 6.25 | 28.000 | 7 | 16.875 | 58.519 |
| 600 | 5 | 3.5 | 5 | 30.000 | 5 | 13.5 | 62.963 |
| 650 | 3.75 | 2 | 3.75 | 46.667 | 4 | 10.125 | 60.494 |
| 700 | 2.5 | 1 | 2.5 | 60.000 | 3 | 6.75 | 55.556 |
|  |  |  | Average % error: | 31.914 |  | Average % error: | 66.334 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| Case 2 |  |  |  |  |  |  |  |
| F=2(10N) |  |  |  |  |  |  |  |
| x(mm) Distance from both supports | Support reaction at A (N) | V(N) Exp | V(N) Theo | % error | M (N.mm) Arm=100mm (Exp) x 100 | M (N.mm) Arm=100mm (Theo) x 100 | % error |
| 50 | 10 | 1 | 0 | 100.000 | 2 | 5 | 60.000 |
| 100 | 10 | 1.5 | 0 | 100.000 | 4 | 10 | 60.000 |
| 150 | 10 | 2 | 0 | 100.000 | 5 | 15 | 66.667 |
| 200 | 10 | 1.5 | 0 | 100.000 | 7 | 20 | 65.000 |
| 250 | 10 | 1 | 0 | 100.000 | 11 | 25 | 56.000 |
| 300 | 10 | 6 | 10 | 66.667 | 12 | 27 | 55.556 |
|  |  |  |  |  |  | Average % error: | 60.537 |

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| F=2(20N) |  |  |  |  |  |  |  |
| x(mm) Distance from both supports | Support reaction at A (N) | V(N) Exp | V(N) Theo | % error | M (N.mm) Arm=100mm (Exp) x 100 | M (N.mm) Arm=100mm (Theo) x 100 | % error |
| 50 | 20 | 2.5 | 0 | 100.000 | 5 | 10 | 50.000 |
| 100 | 20 | 2.5 | 0 | 100.000 | 8 | 20 | 60.000 |
| 150 | 20 | 2.5 | 0 | 100.000 | 11 | 30 | 63.333 |
| 200 | 20 | 2.5 | 0 | 100.000 | 14 | 40 | 65.000 |
| 250 | 20 | 2.5 | 0 | 100.000 | 36 | 50 | 28.000 |
| 300 | 20 | 14 | 20 | 42.857 | 37 | 54 | 31.481 |
|  |  |  |  |  |  | Average % error: | 49.636 |

**The graphs are the following:**

**Conclusion**

From the first case:

 As we pass the cut the shear force become equal to the reaction

For the second case:

 The dimensions of the beam and the modulus of elasticity are not needed since the shear and the moment are related directly to the load

 In a symmetric load the support forces are the same along the beam and when the load is doubled the reactions are doubled.

**References**

R.C Hibbler "Mechanics of materials" 2nd edition section 6.1 and 6.2 .