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APPENDIX GA36a

LEVEL 4 ASSESSMENT SPECIFICATION

Student name:	Grant Morgan	Student ID number:	
Programme:	HNC/D MECHANICAL ENGINEERING		
Module:	ENGINEERING SCIENCE 1		
Module code:	M4X00385	Contribution to Overall Module Assessment (%):	30%
Lecturer:	Emily Nyathi	Internal Verifier:	Nigel Evans
Assignment Title:	PRACTICALS I & II (SIMPLE HARMONIC MOTION AND BENDING MOMENT)	Word count (or equivalent):	
Submission deadline:	13/01/2020	Return date of provisional marks & written feedback:	21/01/2020
Submission method:	All written assessments, where practical and possible, must be submitted via Turnitin unless otherwise instructed by the Lecturer. (Please DO NOT put this assessment specification into Turnitin or it will match many similarities with other students' submissions.) Alternative submission method (if applicable): Late submission of the assessment will result in a late penalty mark. Penalties for late submission: Up to one-week late, maximum mark of 40%. Over one week late, 0%. Only the Extenuating Circumstances Panel may approve a change to submission dates.		
Academic honesty / referencing:	Academic honesty is required. In the main body of your submission you must give credit to authors on whose research and ideas your work is based. Append to your submission a reference list that indicates the books, articles, etc. that you have used, cited or quoted in order to complete this assessment.		

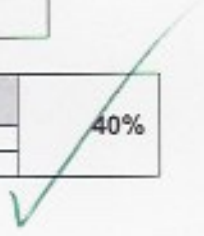
STUDENT FEEDBACK FORM

This section details the *extent* to which the assessment criteria are demonstrated by you, which in turn determines your mark. The marks available for each category of skill are shown. Lecturers will use the space provided to comment on the achievement of the task(s), including those areas in which you have performed well and areas that would benefit from development/improvement

Generic Assessment Criteria	Marks available	Marks awarded
1. Engagement with Literature Skills		
Your background theory should be supported by scholarly material. This includes referencing your work in text and a reference list.	25	7
2. Knowledge and Understanding Skills		
You have shown some understanding of the basic SHM and Bending moment theory. However, you need to work on the analysis of your findings.	30	11
3. Cognitive and Intellectual Skills		
You have presented your results using tables, graphs and diagrams, however, drawing a Free Body Diagram for your beam showing all the forces acting on it and analysing what was happening at the "cut" in detail could have scored you more marks.	15	8
4. Practical Application Skills		
Giving examples of real-life applications of the BM applications in the Engineering Industry could have scored you more marks here. Work on your presentation skills.	25	12
5. Transferable Skills for Life and Professional Practice		
Demonstrates the basic skills for employment requiring the exercise of personal responsibility and decision-making. Presentation skills need to improve though.	5	2

Part A	Part B	Part C
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Assessment Mark (Assessment marks are subject to ratification at the Exam Board. These comments and marks are to give feedback on module work and are for guidance only until they are confirmed.)	Late Submission Penalties (tick if appropriate)		40%
	Up to 1 week late (40% Max)		
	Over 1 week late (0%)		



Grant Morgan

Engineering science level 4

Simple harmonic motion, simple pendulum and Hooke's law

Abstract

In mechanics and physics harmonic motion is a special type of period motion or oscillation where the restoring force is directly proportional to the displacement and acts in the direction opposite to that of displacement. *Ref*

Simple harmonic motion or SHM can serve as a mathematical model for a variety of motions, such as the oscillation of a spring it can also be used for a simple pendulum. *Ref?*

• SHM is typified by the motion of a mass on a spring when it is subjected to linear elastic restoring force given by Hooke's law.

For SHM to be accurate model for a pendulum the net force on the object at the end of the pendulum must be proportional to the displacement. this is a good approximation when the angle of the swing is small. *Ref.*

Hooke's law is a law of physics that states the force F needed to extend or compress a spring by some distance scales linearly with respect to that distance

Theory

Simple pendulum

A simple pendulum is a mass M hanging from a fixed point of length L it is then lifted to an angle and released to measure the oscillation in a given time. this should show how a pendulum works as a harmonic oscillator.

Below I shall write the harmonic oscillation calculation.

$$T = 2\pi\sqrt{\frac{L}{g}}$$

The mass length and angle can be changed through this equation the string must be light and be able to hold variable mass without snapping a good clamp

Reference 5.

should be used to reduce movement in the experiment .so when one of these condition is changes the results should be different.

Period of oscillation or the swing of the pendulum depends on a couple of things such as length acceleration and what angle it is released from.

Theory simple spring

Imagine a spring that is hanging vertically from a support when no mass hangs at the end of it is has a length when a mass is added to the spring its length increases by $(\Delta)L$.the equilibrium position of the mass is now a distance of $L+(\Delta)L$ from the springs support .

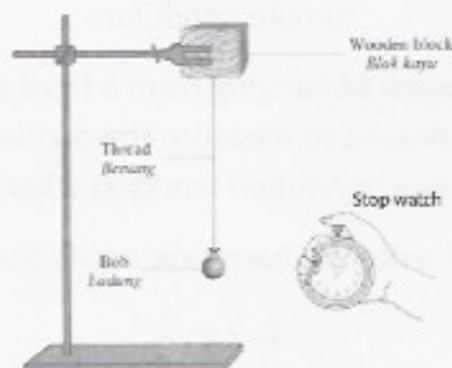
As the mass oscillates the energy changes between kinetic energy and some form of potential energy .when the mass is at its highest point the gravitational potential energy is at its maximum and when it's at the lowest point the elastic potential energy is at its maximum.

Procedure for pendulum

So the procedure for the pendulum experiment is as follows a stand with a clamp at the top is required with a weighted bob at the end of the spring make sure that it has plenty of room to swing and nothing can interfere with the experiment. Lift the mass to a specific angle release the mass and by using a stopwatch count how many times it takes to complete 10 swings back and forth .repeat this procedure by using different lengths of string and different masses and different angles

Below is a picture I got off the internet of the experiment

Apparatus



Results simple pendulum

Theoretical pendulum period example calculation

The pendulum length=300mm

Acceleration due to gravity =9.81ms²

$$l/g=0.3/9.81=0.0306$$

$$\sqrt{0.0306}=0.175$$

$$2\pi 0.175=1.1 \text{ seconds theoretical period}$$

Test results.

Column1	Length(mm)	Time (10 Oscillations)	Period (Seconds)	Theoretical Period (Seconds)
150g 40	310	13.86	1.386	1.116
50g 40	310	12.8	1.28	1.116
100g 40	310	13.26	1.326	1.116
200g 40	310	13.4	1.34	1.116
150g 40	225	12.95	1.295	0.951
50g 40	225	12.03	1.203	0.951
100g 40	225	12.37	1.237	0.951
200g 40	225	12.6	1.26	0.951
200g 30	225	12.67	1.267	0.951
100g 30	225	12.385	1.238	0.951
50g 30	225	12.18	1.218	0.951
150g 30	225	12.24	1.224	0.951
200g 20	150	10.62	1.064	0.776
100g 20	150	10.79	1.079	0.776
50g 20	150	10.65	1.065	0.776
150g 20	150	10.96	1.096	0.776

Simple pendulum conclusions

The pendulum has a length of string with a mass at the end of it if you pull it and let it go it will swing from side to side due to the restoring effects of gravity the time taken for it to swing from one side to the other is called a period

Gravity affects the swing the length affects the time it takes to swing the longer the pendulum and less acceleration would give it a longer period so if you change the length or mass it should prove this

This experiment may be simple to do but there are potentially a lot of errors that can occur during this test

Such as the person using the stopwatch has slow reaction the stand being on an uneven surface even the measurements of the string can be inaccurate

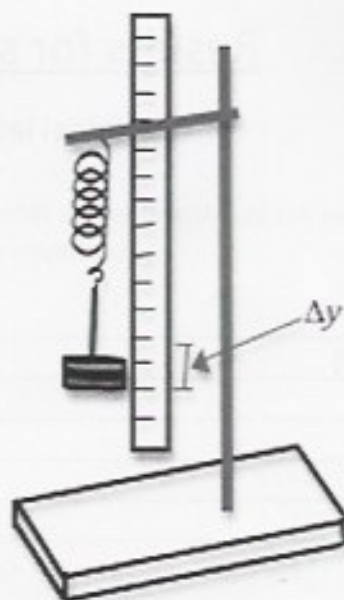
Procedure simple spring

To do the spring test you will need a stand with a clamp at the top so you can hang the spring from it again make sure your work area is clear and enough drop for the spring to fall without hitting the bottom before you start the experiment you need to measure the original length of the spring because you will need this for your results you will then attach a mass hanger to the bottom of the spring and measure this will be your zero measurement.

Now add mass recording the stretch of the spring after each equilibrium this will be in mm if using grams record the mass in kg by dividing grams by 1000 then calculate the weight in newton's mass x acceleration



(a)



(b)

Results simple spring

Finding theoretical mass spring period

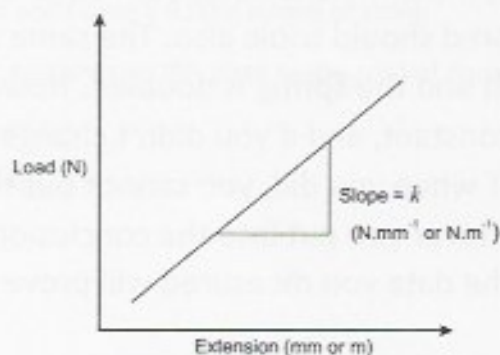
The spring rate (k) = 31 N.m^{-1} .

The mass used (m) = 0.3 (300g).

$$m/k = 0.3/31 = 0.00097$$

$$\sqrt{0.00097} = 0.0983$$

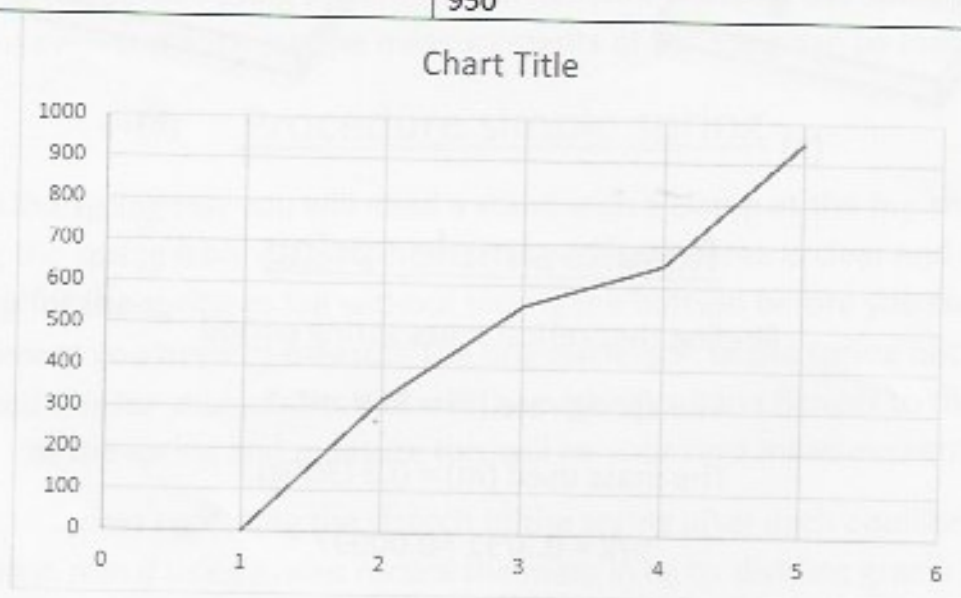
$$2\pi \cdot 0.0983 = 0.617 \text{ seconds theoretical period.}$$



Results for simple spring experiment

Original length = 0mm as a datum point

Force (N)	Displacement (mm)
1N	320
1.75N	550
2N	650
3N	950



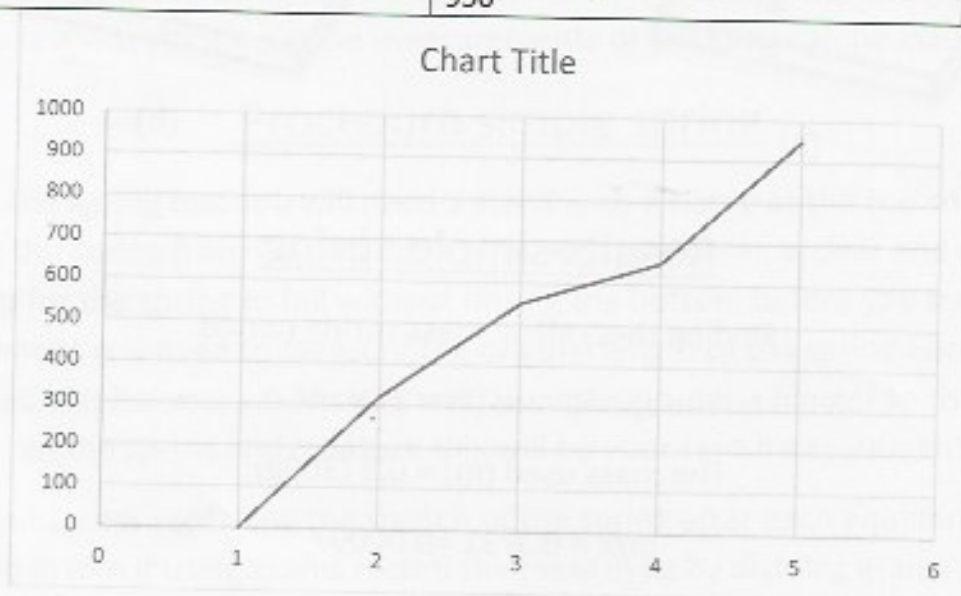
Conclusion for simple harmonic motion

Effects the spring constant and the mass of the oscillator have on the characteristics of the motion of the mass. The square of the time T for one cycle of the motion should be directly proportional to both the mass value and the spring constant that is, if the mass is doubled, T squared should double. If the mass is trebled T squared should triple also. The same thing should happen if the mass stays constant and the spring is doubled. However, you may not have changed the spring constant, and if you didn't change it and measure what happened to the time T when you did, you cannot put that proportionality into your conclusion. Whatever you put into the conclusion must be something, which the data you measured will prove support

Results for simple spring experiment

Original length = 0mm as a datum point

Force (N)	Displacement (mm)
1N	320
1.75N	550
2N	650
3N	950



Conclusion for simple harmonic motion

Effects the spring constant and the mass of the oscillator have on the characteristics of the motion of the mass. The square of the time T for one cycle of the motion should be directly proportional to both the mass value and the spring constant that is, if the mass is doubled, T squared should double. If the mass is trebled T squared should triple also. The same thing should happen if the mass stays constant and the spring is doubled. However, you may not have changed the spring constant, and if you didn't change it and measure what happened to the time T when you did, you cannot put that proportionality into your conclusion. Whatever you put into the conclusion must be something, which the data you measured will prove support

1. The period of oscillation of an ideal, simple pendulum depends on the length L of the pendulum and the acceleration of gravity g and is given by the following equation:

$$T = 2\pi\sqrt{L/g}$$

Using the above equation solve for g

$$G = \frac{4\pi^2 L}{T^2}$$

2. Is the period of a simple pendulum dependent on the mass?

No it does depend on the mass it depends on the length and acceleration due to gravity.

3. How long must a simple pendulum be to have a period of 1.5s?

You have to rearrange the first equation I give for L

$$L = \frac{T^2 g}{4\pi^2}$$

What it means is one swing would take 2 seconds for one complete oscillation.

$$L = \frac{2(2) \times 9.8}{4 \times 3.14(2)} = 1m$$

4. Assuming you are safely located on the moon and are provided with a simple pendulum, stopwatch, and meter rule. is it possible to determine the acceleration due to gravity of the moon using only these three items?

Having a pendulum with different masses and lengths you are able to calculate the approximate acceleration due to gravity anywhere including the moon if I was on the moon I would use a mass attached to a string I would lift it and drop it and measure the period.

So if the period was 3 seconds and I used a 0.50m length of string

So I would re arrange the first equation on this page to the second equation on this page

And I would replace $T=3$ and $L=0.50$

$$G = \frac{4\pi(2)(0.50m)}{3(2)}$$

$$G = \frac{19.74m}{9s(2)}$$

5. Consider your $t(2)$ vs l graph what are the slope values? Show that the slope is $\frac{4\pi(2)}{g}$ compare each graph value to the accepted value

$$T = 2\pi\sqrt{l/g}$$

$$T^2 = \frac{4\pi^2}{g} \cdot l$$

Comparing t squared to l gives a straight line graph where the gradient is $\frac{4\pi^2}{g}$

Level 4 engineering science

Grant Morgan

Bending moments in beams

Aim of experiment

The aim of this experiment is to study the effects of force magnitude on bending moments of a beam

Introduction

This experiment is about studying the effects of force on a beam, the beam will be supported on either side weights will be added also either side and a mechanism will be used to calculate the force through the beam

Background theory of experiment

Beams

A beam is object used to bear loads for a structural design, there are many types of beams cantilever, simple support beams etc. Ref?

Bending of a beam

When a load is too much for the beam to take and it displaces it from its present place and axis this is called bending moment Ref?

Bending moments

To keep it simple bending moments is force is applied to the beam and either edge of the beam

Formula used for bending moments

The formula I found was on the internet and it will help me with calculations of bending moments. *Reference?*

$$F=MA$$

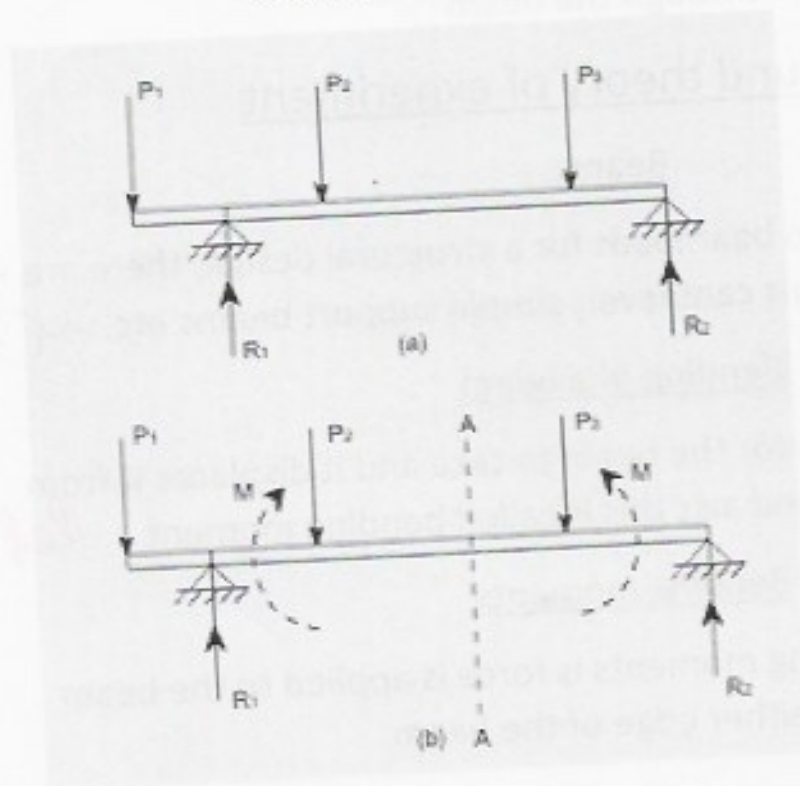
$$F=\text{FORCE}$$

$$M=\text{MASS}$$

$$A=\text{ACCELERATION}$$

$$\frac{M}{I} = \frac{\sigma}{y} = \frac{E}{R}$$

Above is the standard bending equation



Above is a picture I found on the internet of how bending moments work *Reference?*

ne forces going up equal forces going down as you can also see in this drawing it has clockwise moments and anti-clockwise moments

Equipment used and procedure of experiment

For this particular experiment a 1m long beam was used and two stands were placed at either end of the beam once the beam was in place on the stand hangers where we put a certain point on the beam and weights were added to the hangers to make the beam bend and at the centre of the beam where it was split a spring showing how much force was being applied to the beam when weight was added, a level was used to make sure the beam was level then a tape was used to measure the length of the beam and to measure the distance of the hangers and where the split was on the beam. During this experiment we had to make sure the work area was clear so nothing could affect the results of this test while we carried out the experiment we also wrote our results down in our note book so we could look back later and compare results.



Reference?

The picture above is not the exact apparatus we used in the experiment but it's the closest I could find on the internet

Results of experiment

Overall length of beam = **1000mm**

Load 1 = **10N**

Load 2 = **20N**

Load 3 = **10N**

The next measurement are working from left to right of the beam

Point 1 = **100mm**

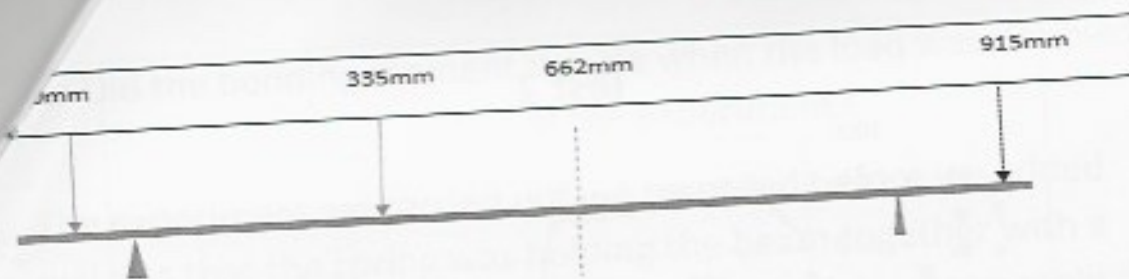
Point 2 = **203mm**

Point 3 = **355mm**

Point 4 = **662mm**

Point 5 = **868mm**

Point 6 = **915mm**

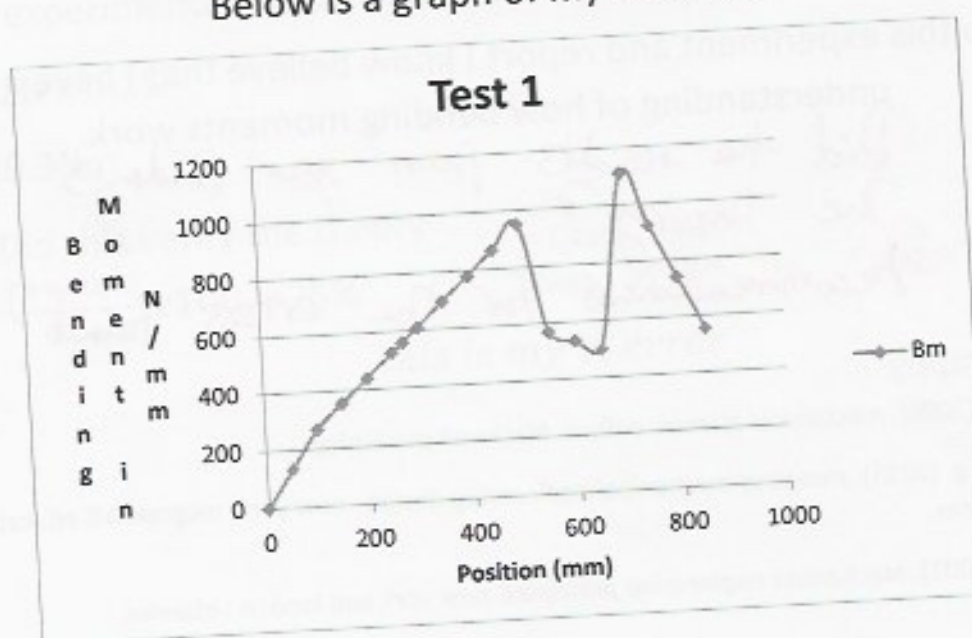


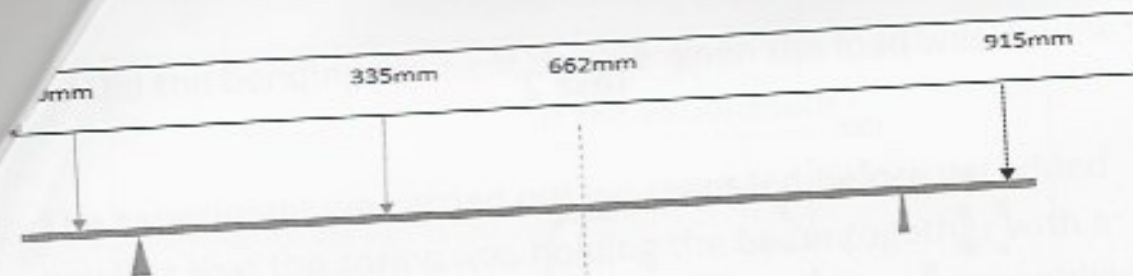
You could have added a FBD here showing all the forces acting on your beam.

I collected my data and put it into excel so it's easier to understand and follow and compare against other results.

	L	A	B	W1(KG)	P1	W2(KG)	P2	W3(KG)	P3	Before (N/m)	After
Test 1	1000	203	150	1	100	2.4	355	1	915	3	2
Test 2	850	270	150	0.51	100	2.55	500	0.51	700	1	3.3
Test 3	700	200	150	1.02	50	1.02	300	0.51	500	0.6	1.65
Test 4	700	200	150	0.51	50	0.51	300	2.04	500	0.6	3

Below is a graph of my first test





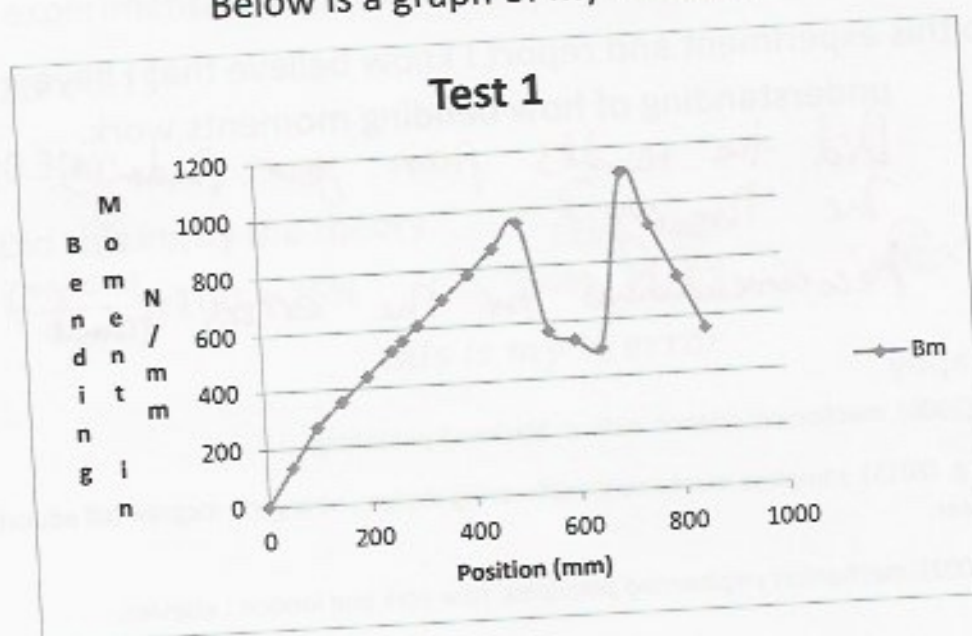
1/2
ye
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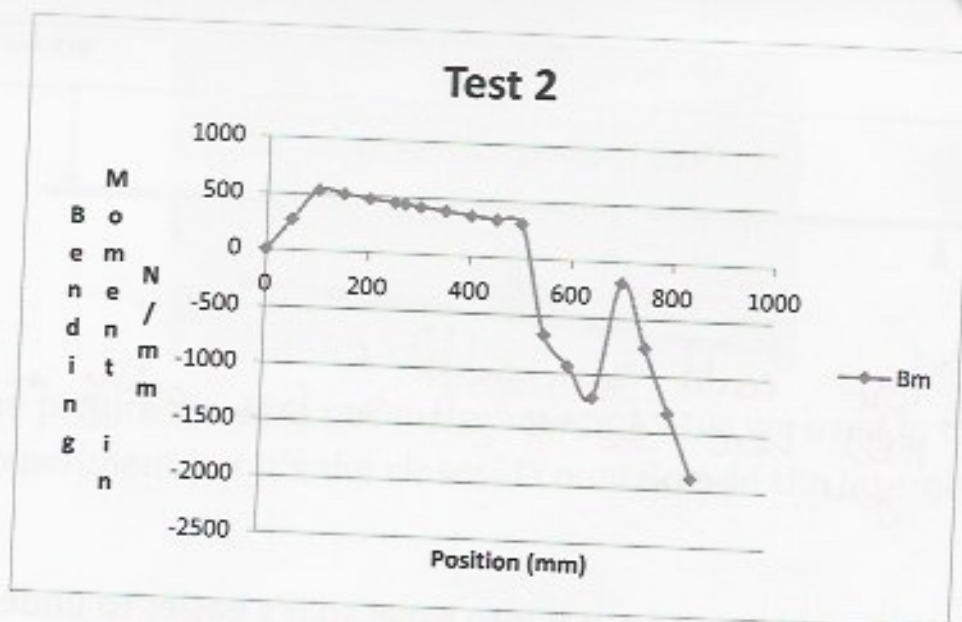
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Test 4	700	200	150	0.51	50	0.51	300	2.04	500	0.6	3

Below is a graph of my first test





Observations

While I'm more than pleased how the experiment I am concerned that a few errors might have occurred due to outside factors such as the work tables being on a uneven surface and the too work top not being levelled there was also some issues with the apparatus that we used so I believe the results won't be 100% accurate.

Conclusion

Due to this experiment and report I know believe that I have a better understanding of how bending moments work.

Did the results from your findings support the theory?
Recommendations for the errors found?

Bibliography

- bolton, w. (2006). *mechanical science*. oxford: blackwell publishing.
- budynas, r. g. (2015). *shingleys mechanical engineering design*. new york: mcgraw hill education center.
- ross, j. b. (2002). *mechanical engineering principles*. new york and london : elsevier.

1. Did the bending moment double when the load was doubled in part 1 of the experiment?

The experiment we carried out we recorded before we added weights that the spring was holding the beam together with a force of 100N/M of force .and when the weights where applied to it you could see that the beam did bend as a result in increased by 100N/M of force when we done the experiment for a second time we re- positioned the stands and the beam did not bend so therefore positioning of the stands is crucial.

- 2 compute the average figure which expresses the comparison between the experimental and theoretical bending moments

My theoretical equation would be

$$M = Wa(L-a)$$

L

$$M = 2 \times 0.66(1000 - 662)$$

1000

$$M = 0.44 \text{ Nm}$$

My experimental bending moments

$$M = 2 \text{ N} \times 0.15$$

$$M = 0.3 \text{ Nm}$$

2. Did this verify the theory

$$\frac{0.44 - 0.33}{0.44} \times 100 = 25\%$$

this is my % error

did this
verify the theory?