Materials 1: Mechanics of Materials
Experiment A — Pin-Jointed Truss

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Summary

The abstract is a summary of your entire report. It should be a stand-alone document that someone could read to get an overview. Be careful this is not a repetition of the introduction. You should write it after you have written your report. The abstract must include the aims and your most important conclusions. [1]

1 Introduction

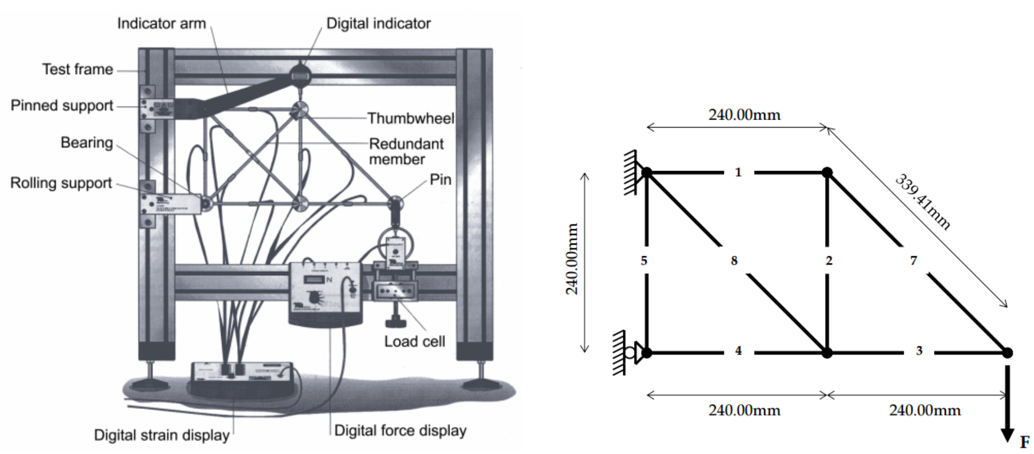
This experiment explores the force distribution throughout a pin jointed truss. These structural systems are utilised for many different applications, from automotive roll cages and suspension systems to truss bridge structures and bicycle frames.

Pin-jointed structures assume zero moments are transmitted through joints. This means that all structural actions throughout the structure are axial and no bending in the elements takes place unless an external load is applied along an element itself as opposed to at a joint.

This experiment compares individual element forces calculated from the analysis of elastic strains within the structure, using the materials Young's modulus, to calculated theoretical values calculated through basic statics. This comparison sheds light on the the approximation of pin-joints which are a simplification of the system as some joint moments are usually unavoidable, due to friction or joint detailing.

2 Experimental Set-up

The apparatus, shown in Figure 1, comprises a pin-jointed truss of 7 members (see Figure 1(b)) supported by an upper pinned support constrained against vertical displacement and a lower rolling pinned support providing only a horizontal constraint. The applied load is applied by a hand wheel that induces load into the structure by applying a forced displacement. The resultant force is measured in Newtons by a force ring load cell connected to a digital display. The strains in each member are measured by electric resistance strain gauges mounted in pairs to each structural element and are connected to a digital strain display measuring in micro strain, shown in Figure 1(a). The displacement of



(a) (b)

Figure 1: Experimental set-up (a) Overview, (b) Element numbers

the top node (between elements 1,2 and 6) was measured by an electronic displacement transducer mounted to the support frame.

2.1 Procedure

The experimental procedure is outlined below:

1. Firstly, a 50 N pre-load was applied to the test set-up to remove any slack from the joints and supports. The force transducer was then zeroed with this preload applied.

2. The loading wheel was turned to ensure the load transducer displayed 0 and the displacement traducer was set to zero as the datum.

3. Initial strain gauge readings were then taken from each gauge in turn using the gauge selector. This provided the offset required to calculate the strain change for each load increment.

4. The load was incremented in 50 N steps using the hand wheel. At each increment, the displacement was recorded

5. At 200 N all of the readings from the electrical resistance strain gauges were taken along with the final displacement.

6. The strains were then converted into the associated force using the Equation 1.

$$F = AE\epsilon \tag{1}$$

Where F is the force in the element, A is the cross-sectional area, E is the Young's modulus, and ϵ is the element strain. Note, microstrain should be converted to strain for use in this equation.

3 Results

This section focuses on your experiments measurements in the form of graphs or tables. You may explain them but detailed comments must be left to the discussion section. Summarise the key computed results in a table and/or graph, including errors. All graphs and tables must be labelled, numbered and given a title. Axes must be clearly marked with quantities and units.

4 Discussion

This is the most important section in your report where you discuss and criticise your results. Are your results what you expected? Explain good or bad results, strengths or weaknesses of the experimental procedures. Analysis of the errors involved in the experimental measurement. Comment on how your results compare to theoretical values, the quality of your results (considering any sources of uncertainty).

5 Conclusions

This section contains a concise presentation of your most important findings, this should relate to your objectives. You may include a brief summary of the work carried out and recommendations for future work.

References

[1] Bristol University mechanical engineering. `http://www.bristol.ac.uk/engineering/departments/mecheng/`. Accessed: 2016-11-04.

Table 1: Always have a caption for tables, this example is from the Wikibooks LaTeX page on tables.

Item		
Animal	Description	Price ($)
Gnat	per gram	13.65
	each	0.01
Gnu	stuffed	92.50
Emu	stuffed	33.33
Armadillo	frozen	8.99

6 SAMPLES PLEASE DELETE ALL OF THIS, JUST FOR YOUR REFERENCE

This template is for use with the Materials 1: Mechanics of Materials labs. One of the advantages of LaTeX is it allows content to be separated from style and formatting, so concentrate on the content and let LaTeX worry about the rest. LaTeX is well documented on the internet and the Wikibook is a good place to start. Another advantage of LaTeX is its ability to cross-reference section headings, equations and figures etc. This is Section 6. This equation,

$$E = mc^2, \tag{2}$$

is Equation 2. Remember equations are part of sentences and should be punctuated accordingly. Maths can also be written in the text like this $\beta = \frac{a}{b}$. Figures can be inserted as follows, see Figure . Again, LaTeX has rules about figure placement, so leave it to worry about that. Graphs should be inserted as either a high resolution `*.png` (bitmap) or preferably in vector format using `*.eps` or `*.pdf`.

Tables can be a little cumbersome, here is an example, see Table 1. There are three types of lists in LaTeX and below is also a good opportunity to show the different levels of headings:

6.1 Lists

6.1.1 Itemize

- Creates a list using bullet points
- two
- three

6.1.2 Enumerate

1. Creates a numbered list
2. two
3. three

6.1.3 Description

one Creates a list with titles

two b

three All lists can even be nested:

- one
- two
- three

A new paragraph is started with a double line break. Other peoples' work should be cited like this [**?**]. It is important that you get the commands correct otherwise the document can fail to compile. However, LaTeX document structure is logical and the error messages usually give line numbers for the cause of the error. Compile often to make error hunting easier for yourself. LaTeX needs to be compiled twice to get the internal numbering etc to work and BibTeX needs to be run as well and then a final LaTeX compile.

7 Guidance

You are required to submit a report (max. 4 pages total text (approx.) - not including figures and tables) online as an Assignment to the Materials 1 Blackboard site for each experiment within two weeks of carrying out the experiment. You should follow the guidance about writing lab reports already given to you (see your Course Handbook and the presentation slides about The Lab hosted on the Materials 1 Blackboard site).