Muddy Card Responses Lecture M17

***Are all of the moduli valid for 3 dimensions, i.e. Young's modulus E=□/□ I mean, do we find E for each direction?. How then does a material have just one E?** This is an important question, and I hope by the end of term you will have a complete idea of the answer. There are a couple of points that are worth making now. First, the Young's modulus is defined as the constant of proportionality between a uniaxial applied stress and the resulting axial strain when a material is loaded in uniaxial loading. Second, for materials which have the same structure and bonding in all directions, there is just a single value of the Young's modulus. We will see that if we have a microstructure with some orientation (e.g. aligned fibers reinforcing a matrix material) the Young's modulus may be different depending on the direction that we load the material in. This is another example of why it is important to know something about the underlying structure of a material before one embarks on a process of structural design with it.

***What does □ stand for?.** This is the Greek letter, "nu". It is used to denote the Poisson's ratio, i.e. the ratio between the transverse strain and the longitudinal strain in a specimen that is loaded in the longitudinal direction. It is defined as being the negative of this ratio, since an axial tensile loading usually results in a transverse contraction (negative strain) for most materials.

Still a little fuzzy on the mechanics of tensors. I get the concept, but it just seems like overkill for our application. We are not using anything like the full power of tensors. All we are effectively doing is using it to represent a system of linear equations. We could do almost everything using a matrix representation. However, it is easier using tensor notation – but you will have to trust me on this (we will see what the matrix representation looks like next lecture).

Fell asleep for 2nd round of first concept question concerning what the answer was. Was it 3 and why? Please take a look at the question and answer, and see if you can work it out for yourself when you are more awake - it is exactly what you did in the strain lab, so you should be familiar with this already.

Would the three strain gauge system be effective on measuring a mass-grav at a point (a given distance)? Could you do it with fewer gauges. I have no idea what mass-grav means. Please clarify the question.

Can strain gauges be used to experimentally find both K and G. Yes, although not directly and we will need to know something about how materials behave first.

Mud: What are the units of strain? Strain does not have units. It is a change in length per length, or change in angle (also a ratio of lengths)

What could I read to review the basics of stress and strain. See Crandall, Dahl and Lardner chapter 4.

I need stuff written on board, otherwise just copying what's on the web. My intention is to allow you to focus on what I am saying and the concepts. I am lecturing at the same pace

as when I wrote everything on the board, but I have far more time to answer questions and enter into discussions with students. I hope that this is better for most people.

Can you explain how a material expands in the transverse direction under a tensile stress applied stress? Very few materials do this. The only example I can give is a foam that has been engineered to have a very particular structure. The vast majority of materials contract in the transverse direction when a tensile stress is applied.

Can you tell whether deformation is occurring due to temp change (Bulk modulus) or due to an applied load? I think that you are confusing a couple of ideas here. The coefficient of thermal expansion links strain to a temperature change. Just by measuring the strain you cannot tell whether it was due to a change in temperature or a change in load. For that matter, we can't tell, without other information, whether a strain is due to a load being applied in that direction, or due to the Poisson contraction in a transverse direction.

Tensor and Engineering notation. Should I assume engineering is used more in industry or is one of the two more common in different fields of work or countries. I think that engineering notation is probably more commonly used in practice. However, tensor notation is more straightforward to learn and understand.

The strain matrix looks very useful? Should we use it's eigenvalues to find principal stresses? If you are confident working with eigenvalues and eigenvectors, this is a very straightforward way to determine the principal stresses/strains and their directions. It is particularly convenient if you are used to working with Matlab.

I would assume that the bulk modulus is useful in applications like deep sea exploration. Are there any other high pressure applications of interest /use that you know of? Yes quite a few. It matters in deforming metals (such as rolling aluminum to make aircraft structure. It plays an important role in determining the selection of materials for use in hydraulic systems. It also plays a role in the transmission of sound waves or shock waves through materials.

The problem set said something about $\Delta V/V = \varepsilon_1+\varepsilon_2+\varepsilon_3$, is this the same as the volumetric strain, ε as in $p=K\varepsilon$? Yes it is exactly the same quantity.

I know that we aren't going to do anything with this, but a "yes" or a "no" will do… In the compatibility occasion I used n=2, k=2, m=1,l=1 just checking: are we assuming? (The equations were reproduced). I am not sure what the question is – it would probably be easier to have a chat before or after tomorrow's lecture.

Explain again why L is unimportant for CQ. L would come in if the strain gauges measured displacements, so the strain is already calculated. We just need to turn the force into a stress - which does not involve L.

Did the US have a team in the rugby world cup? Yes. They did quite well. They beat Japan, and only narrowly lost to Fiji (who are quite strong). They gave Scotland a good game and lost by a wider margin to France.

Also, explain why Liverpool played to a tie … because I definitely don't understand that. And if I remember correctly it was against Middlesborough. How does Liverpool tie 'boro? Clearly Liverpool have found their level - sad that it is !

19 cards with no mud, or positive comments, particularly about England winning the Rugby World Cup!