Muddy Card Responses Lecture M8

What were the three points for compatibility of displacements?. For the case of trusses, the displacements of a joint at the end of two or more bar are made up of two components: extension parallel to the axis of the bar, and a rotation that is perpendicular to the bar axis. In addition the two components of displacement must be compatible with the bars remaining joined at that joint.

The compatibility PRS question: did not understand? Look at the example of the use of compatibility for the three bar truss in lecture. We will do another example at the start of the next lecture.

Didn't understand the displacement diagram. See above comment.

How do we do rotations mathematically, what are they useful for? By making the assumption that we are dealing with small deflections and small displacements, the rotation can be reduced to a displacement perpendicular to the axis of the bar. This makes it easy to solve for the displacements by using trigonometry, or by drawing the displacement diagram to scale. They are useful because they allow us to calculate the deflection of the truss, which is a key component of the structural integrity that we are interested in.

What will we use the new point C′ (determined from expansion/compression/rotation) for? This is the displaced location of C. By determining where C′ is, we know the deflection of the truss. We will be asked to design structures to have deflections less than a certain amount, or bar forces less than a certain level, as part of ensuring structural integrity in the design process.

I didn't really understand your overhead diagram. How does the deflection end in right angles. The right angles were referring to the rotational component of the displacement. See comments above.

Does the Young's modulus only vary from material to material. Or do other parameters affect its value? The Young's modulus is a property of a particular material. However, other factors, notably temperature, can cause changes in the Young's modulus. We will talk more about this towards the end of term in the materials and elasticity lectures.

When it comes to finding the position of C; does it matter that A is a rolling joint and B is a pin joint? Why doesn't that change the geometry of C's movement. Good point. In general it would, and A is free to move vertically on its roller, but not move horizontally. However, in the particular case of the three bar truss we were considering, The force in Bar AB was zero, so the bar did not extend (or contract) so A was effectively fixed also.

Why was answer 2 in the concept question about compatibility an insufficient condition to find displacements. "Point A will move only vertically, point B will not move and point c will move toward B and away from A." This is all true, but it is not as useful as answer 3 which provides the key information about how C moves relative to A and B (by a combination of extensions and rotations).

What is Young's Modulus, just a brief idea to help my conceptual understanding? Try reading Ashby and Jones Chapter 3

What does a bar with a circle through it mean (on the diagram for the 3 bar truss from M5)? This is just my way of indicating that the bar AB has zero force in it.

Lecture Could go at a faster pace, but OK. It probably could, but judging by the number of muddy cards I am glad that I did not push through this material quicker. My experience is that displacement diagrams in particular need a bit of thought.

Will we deal with node stresses by the way? Large moments and rotational deflections of bars must put so much strain on joints that it requires more force to deflect the lengths our simple triangulation calculated? Actually the analysis works quite well. You do raise an important point, namely that any structure will tend to fail at the joints, since the stresses are higher at such locations.

Why did you choose to draw the arrows from B and A in the direction that you did, and how did you determine the amount of circle you put on the two rotations? Bar BC was contracting and bar AC was extending. So relative to A point C must move to the right (i.e. further away) and relative to B C must be moving nearer (up and to the left).

Can you have the lecture notes posted on the website before lecture? So far I have always managed to get them posted the day before lecture. In this case they were posted on Tuesday, so well ahead of the lecture.

Is this why roller joints are used? If so how do you decide which is a roller? I think that I answered this question at the end of the lecture. Roller joints are an idealization of the physical reality of a real joint. The idealization works quite well for structures like the one you are working on in the truss lab. If the idealization did not work well, then we would not use it. In selecting a hinge as an idealization we need to be sure that the joint will not be supporting significant moments in the structure.

Rotation is muddy. How can it rotate if it is in equilibrium? This is not a dynamic problem. The rotation is an angular displacement (i.e. static) as opposed to an angular velocity or acceleration (dynamic).

Confused on final slide. Please look at the notes and the displacement diagram before Monday's lecture. I will spend a little more time on this example then as well.

How would you calculate ΔC_X and ΔC_Y using trigonometry? By breaking the displacement diagram down into triangles and then calculating the unknown displacements from the known displacements (bar extensions) and angles (of the bars). We will do an example on Monday.

Class is too early. Sleeping here isn't as good as sleeping at home! Sorry to disturb you.

In the example you gave at the end of class, what if there were clamps in the structure? It wouldn't be able to deform, so would it just break? Not necessarily, but the more constrained the structure, in general the higher the loads (stresses) will be, so it would could well be more likely to break than with the statically determinate supports we considered.

If we calculate forces at their original (unstretched) positions, then allow for deflection, does this cause error in the values for the forces. Not worth worrying about. Think about the change in angle associated with deflections of the order of 0.5 mm on a bar 10 m long – it is less than 0.003°! The effect on the sine or cosine of that angle when we calculate the equilibrium of a joint or a section is negligible.

Clarification of compatibility: It's saying that all joints must remain joined; therefore string A's pull on string B mustn't break or pull out of the joint? This is true, but we are more interested in the fact that the extensions and rotations of bars AC and BC must be compatible with the bars remaining joined at C, in the example we considered.

21 cards indicating no mud, and/or with positive comments about the lecture. Thank you