

Muddy Card Responses Lecture M10

Why is the answer 5? (with reference to the last pair of PRS questions) I don't understand how there can be no displacement. Admittedly the idea of the pins sitting on rigid supports is an idealization (nothing can be perfectly rigid), but given that the supports are rigid, the bar is prevented from extending or contracting axially.

Are there any other constitutive laws for bars besides: $\Delta = \frac{FL}{AE} + \alpha \Delta TL$? We will meet some other constitutive laws later this term, and next term. However, this one is the most useful for the bars in trusses.

Could you put the concept questions on the web? Certainly.

What is superposition? I like colored chalk. I am glad you like the chalk - I hope that it clarifies things. Superposition refers to the idea that we can break down complicated loading and or support conditions to a linear combination of simpler ones. This is due to the fact that the structures are linear and elastic.

Displacement diagrams are just greatly scaled ways of demonstrating how the joints move, is that correct? Yes.

Do they really move like that or is it just a theoretical representation, or do they really move like that but on a much smaller scale? The second. Trusses such as the one you have tested in the truss lab are quite stiff, so the deflections are small. The displacements are measured in mm while the bar lengths are 0.5-1 m. This means that the deflections and displacements are very small. However, a truss that conforms to the pin-jointed model, will really deform in this way.

Superposition. I don't quite understand what you were talking about, but I imagine you will cover it further later on. We will indeed meet superposition on several occasions in the future. I brought it up today because some people find it easier to think about statically determinate structures by superimposing statically determinate cases.

Equation (1) (for the restrained thermal expansion problem) in the last part said

$F_x = 0, F_B - F_C = 0, F_B - F_C = F_{\text{bar}}$. Either you or I wrote this down incorrectly. It should have been $F_B = F_C = F_{\text{bar}}$ and F_C are the reactions at B and C, F_{bar} is the internal force in the bar.

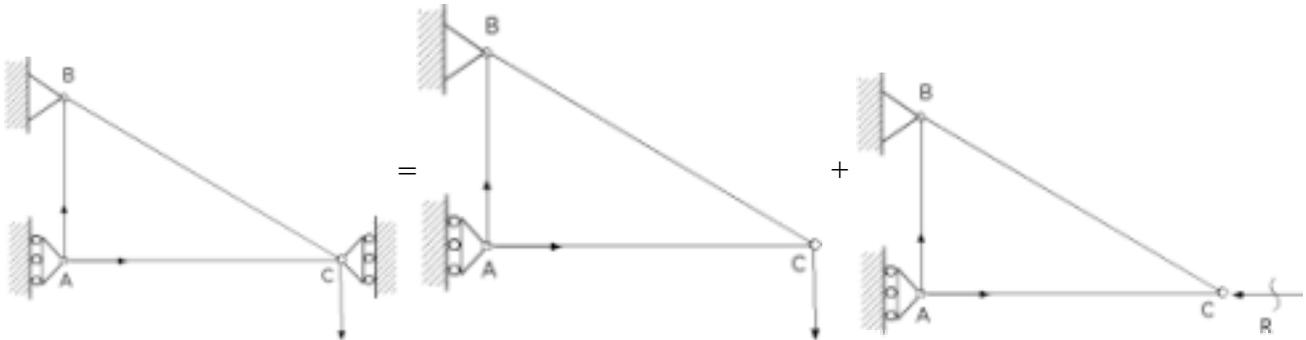
Superposition not clear. Can you please do an example? We will cover this in recitation next week. It is not a core concept for this part of Unified M&S, but we will meet it again when we see beams, and it will be more important then.

Although I got it for the single bar, I am generally confused on how to apply superposition. See comments above.

One small thing: Superposition seems like a very inefficient way to solve a problem unless you're a computer. Not necessarily, it allows us to break complicated problems down into simpler ones, which we are generally more accurate at solving. In addition, some people

see problems in terms of superposition of simpler loading cases and it provides them with insight and intuition to think of the problems this way.

When you use superposition such that:



Why don't you include the pins here (roller and pin on the RH supports). I should have done, see the figure above.

What is the definition of a truss? See lecture M5. Pin jointed trusses have straight bars joined by hinges (pins). The diagram you drew is of a beam, which we will discuss in detail next term.

I didn't understand the last PRS question, concept question 4. This was the case of the bar restrained from expanding when a temperature was applied.

This was an example of applying the three great principles in parallel.

- 1) equilibrium: $\sum F_x = 0, F_B - F_C = 0, F_B = F_C = F_{\text{bar}}$
 - 2) $\Delta = \frac{FL}{AE} + \alpha \Delta T L$
 - 3) compatibility: $\Delta = 0$, i.e the deflection of the bar must be compatible with its ends being fixed.
- Inserting the bar force from (1) into (2) and setting $\Delta = 0$ from 3, we obtain $F = \frac{\alpha \Delta T L}{\alpha} AE \Delta T L$

If in the truss there are two different types of joints (drawing indicates one end of a truss like the truss lab truss on rollers, the other on pins), is this truss still symmetric? (assume lengths are equal). This is a good question. Technically it is not exactly symmetric. However if it is only loaded vertically and symmetrically it will behave as though it is symmetric – as you will have found in analyzing this truss in M7. If you are ever in doubt, assume that it is not symmetric.

Is the rotational part for solving deflections only approximated as a 90° angle? Is there a better way? Actually this approximation is extraordinarily good. You could assume that it the rotation results in a displacement along a circular arc, but you would find that this is quite tedious to calculate, and would provide no additional accuracy.

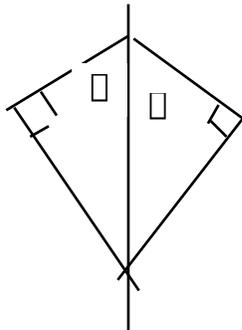
Not clear why the displacements cancel each other out on the last PRS? They didn't. The ends of the bar are fixed, so there is no displacement.

You may be referring to my illustration of how to solve this by superposition. In which case, if the right hand end of the bar was not fixed, the bar would extend by an amount, $\Delta = \frac{FL}{AE}$. If I was solving this by superposition, then I would need to apply a force that would result in an equal and opposite displacement, so that the sum of the two displacements would be zero. Thus the force I would need to apply would be $F = \frac{FL}{AE}$, which is as I calculated by setting up the three great principles in parallel.

Could you give an example of how to do this problem (the last PRS) by superposition? You said you could see what F is needed to make sure that $\Delta = 0$, but this can you elaborate on this more? Sounds like I will need to start tomorrow's lecture with this.

I didn't understand the last concept question. Does the bar tend to warp when it feels a compressive force? Is there no apparent change in its geometry? If the bar is only capable of carrying axial loads (as we have been assuming up to this point) then it will not bend (or warp, or buckle). We will reconsider this assumption next term when we learn about bending and buckling.

In the first PRS question, why is there always a right angle if Δ can vary?



This is because the displacement of the end of a bar in a pin jointed truss is always made up of two components: the extension/contraction along the bar and rotation about the joint at the other end of the bar. Since the extensions and displacements are small, the rotation can be represented the tangent to the circular arc (which would be the exact solution to the displacement) which is a line perpendicular to the original direction of the bar.

Why does Unified make us learn 3 subjects at a time and have tests 10 days after last lectures? You should make Unified more similar to regular classes. The scheduling is a bit constraining, so it is more or less inevitable that three classes will be taught together at some point. Regarding having tests 10 days after the last lectures I am not sure what the complaint is. Is this too quick or too long? I would personally rather have a longer time between the lectures and the test – to provide more time for the concepts to sink in. I sense that you may feel the opposite. I hope that we can always keep Unified from becoming a “regular” class!

15 cards with no mud, or positive comments about the lecture. Thanks!