Muddy Card Responses Lecture M4

Lot's of mud on the last PRS question. We will go over this on Monday. The question was designed to make you think before I go over the material . You should also look at the lecture notes for lecture M4, which gives the explanations for the three types of problem that were referred to in the question.

The explanation is provided in the notes On the PRS question the roller provides a vertical force. Since there's a vertical component applied at that point, does this force change at all? Or do we treat it like a snapshot of forces?. This is an important question. The answer is that that the forces (applied forces and reactions from supports) acting at a point add up (parallelogram rule in 2-D, vector addition in 3-D) and could be replaced by a single resultant force (and moment if appropriate). In the interests of being methodical in drawing free body diagrams (i.e. "FBD's" - to clarify someone elses question) it is usually advisable to keep the forces separate at this stage in the analysis process.

Why in the PRS question could we take moments when we said that pin supports could not support moment reactions? (several people asked variations on this) This is another important point. Although pins (and rollers) cannot provide a pure moment reaction on their own, the reaction forces that they apply do exert moments about other points. You might think of the reverse problem. If I were to open a door supported by a hinge I will pull or push on the handle by exerting a (linear) force, because this force exerts a moment about the hinge the door rotates.

How did you figure out what reaction forces applied to each idealization? Purely physical reasoning - a roller can only support a force normal to the plane it rolls on, a hinge cannot support a moment, but can support in plane forces, and a clamp can support both components of in plane forces and a moment.

Do rollers allow free rotation?. Yes are a effectively a pin and a roller combined

I don't understand exactly what the tildes/squiggles on some of the forces were in your diagrams?. This is the notation that I use to indicate reaction forces (as opposed to applied loads) - which occurs when I replace an idealized support by its equivalent reaction forces/moments.

Please explain what is physically going on in clamps, pin/hinges, rollers, frictional surfaces? Please come and talk to me, or better still perform some experiments for yourself. A door has a good hinge. Anything on wheels acts like a roller, a beam sticking out from a wall is effectively clamped - there are structures all around us!

Why do we always use reaction forces? These replace idealized support conditions, which in turn allow us to separate the part of a structure that we want to analyze from the rest of the structure (world, universe) that we do not want to analyze.

In the PRS what was "A" (H_A, V_A, M_A)? This just reflects that I labeled the left hand end of the beam as point "A", so H_A is the horizontal reaction at A etc.

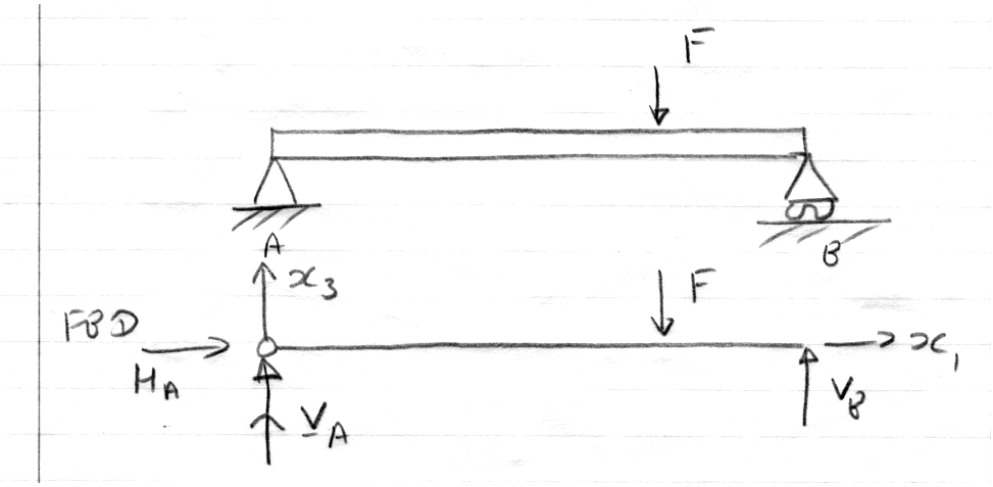
Why do you only label the reaction moment on the free body diagrams and not the moment from the applied force? At the stage of creating a free body diagram I am simply reproducing the forces applied to the structure from the physical idealization of the real structure. When we consider equilibrium of moments we will consider the moment due to each of the applied loads.

Why does it matter whether it is a roller or a hinge. Aren't they essentially the same thing? Absolutely not. A roller can roll along one axis and can rotate, whereas a hinge can only rotate. The hinge is therefore more constrained in its motions than the roller, which corresponds to the additional reaction force that it can apply to a structure.

How did you know which direction the reaction moment went in M4CQ1? It was arbitrary, I just picked a direction (generally I choose unknown moments to be counterclockwise in 2-D - this corresponds to a following the right hand rule in 3-D). When I solve the equilibrium equations the true direction (sign) of the moments and forces will become clear.

Why are there no moments in pin & roller while there is one in a clamp. Just consideration of the physical reality of a roller, hinge and clamp should lead you to believe this conclusion. Can a door hinge support a moment? Can a diving board? Can a skateboard support a lateral force along its length?

Given the following diagram:



At point B there is a vertical reaction, at point A there is both a horizontal and vertical reaction. Can we assume that at point A is stationary (not moving =) or not accelerating. If poin A is not moving can we assume that point B is not moving because the beam is rigid? This is all true, but a little unnecessary at this stage. We are still only considering the overall equilibrium of the body, so it is enough to know that the whole structure is not accelerating, and this then allows us to apply the equations of equilibrium to solve for the support reactions etc.

Could you do some examples of how you choose to model different situations and als could you do examples of multiple things in connection We will get on to this in due course.

Class is too early. My engineering colleagues at Boeing typically start work between 6 AM and 7 AM, if not earlier, so you might consider a 10 AM start rather gentle by comparison!

What soccer team do you support? Arsenal - go Gunners!