

A multi-span homogeneous beam is supported by roller supports at B, C and D, and a pin joint at H, where the roller joints constrain motion in both the positive and negative y -directions. The material of the beam has a Young's modulus of E and the cross-section of the beam has a second area moment of I throughout its length. A couple acts on the beam at H, as shown. It is desired to know the reactions on this beam at B, C, D and H.

- Draw a free body diagram of the beam (FBD).
- Write down the equilibrium equations for the bar from your FBD. What is the order of indeterminacy of the beam?
- Choose an appropriate set of redundant reactions for the beam. Write the equilibrium equations found in b) for the remaining reactions in terms of the redundant reactions.
- Write down the strain energy in the structure that involves only your redundant loads and the applied load. You may ignore the effects of shear in your strain energy function.
- Use Castigliano's theorem and the equilibrium equations to determine the reactions on the beam at B, C, D and H. Leave your answers in terms of, at most: E , I , M_0 and a .

