

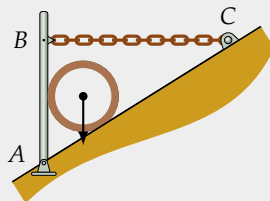
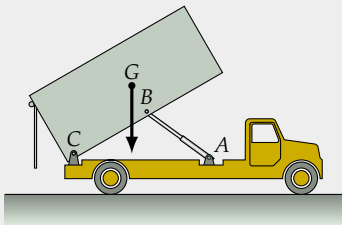
09 Complex Frames

Engineering Statics

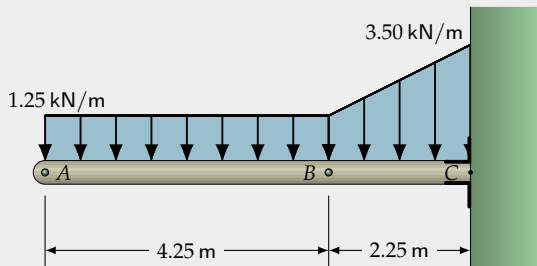
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Simple Frames

- ▶ In the problems we investigated in the module on the equilibrium of rigid bodies, there was a structural member, acted upon by a force, or forces, each with a known magnitude and direction (such as weight and/or applied loads).
- ▶ There was a single force with a known direction but unknown magnitude (such as a hydraulic hoist, or a chain in tension, . . .) and a reaction with unknown x - and y -components.
- ▶ We are limited, by the equations of equilibrium, to solving for a maximum of three unknowns. These problems can be considered **simple frames**.

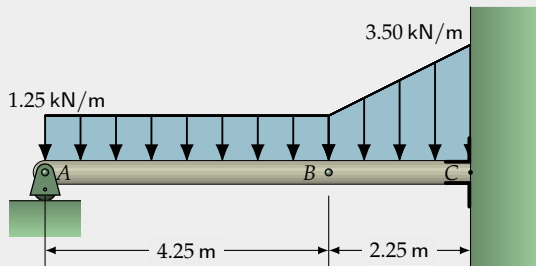


Static Determinancy

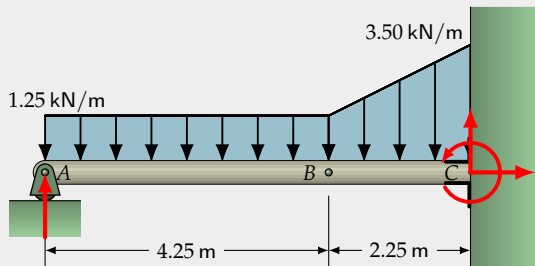


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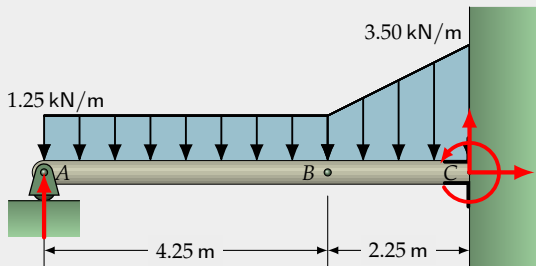


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But how about now? How many unknowns are there?



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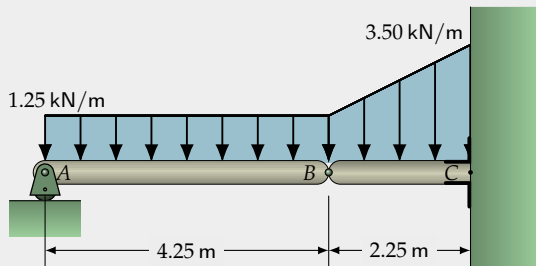
But how about now? How many unknowns are there? **Four!**



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With the three equations of statics, we can only solve for three unknowns. We cannot solve this with statics alone. This is a **statically indeterminate** problem.



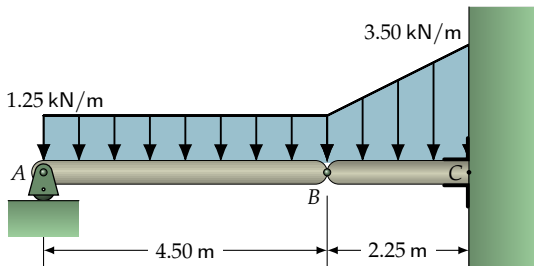
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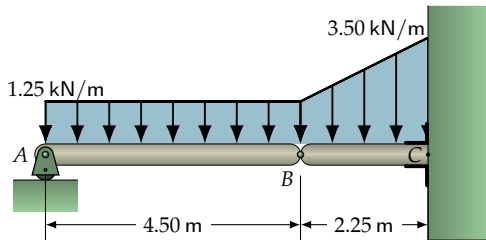
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But this is a complex frame and we **can** solve this!

Example 1

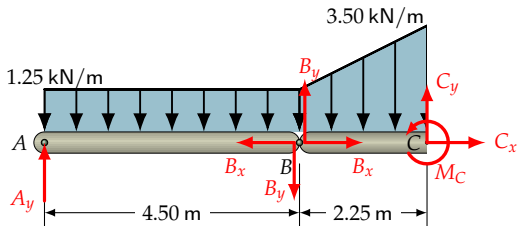


There is a rocker at A , a pinned connection at B and a fixed connection at C . Determine the reactions at A and C .



Example 1: Solution

1. How many unknowns are there?

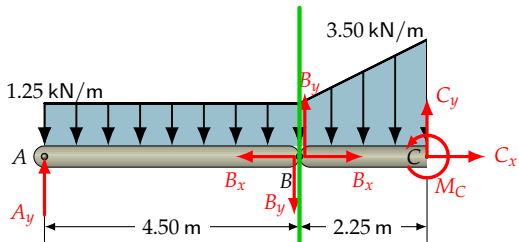


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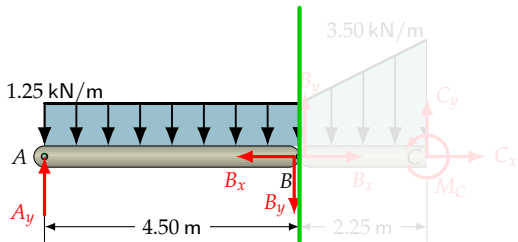
Notice that member AB exerts an equal and opposite force (with components B_x and B_y) on member BC . This is a necessary condition for equilibrium at B .

A_y , B_x , B_y , C_x , C_y and M_C makes 6 unknowns.



Example 1: Our Method

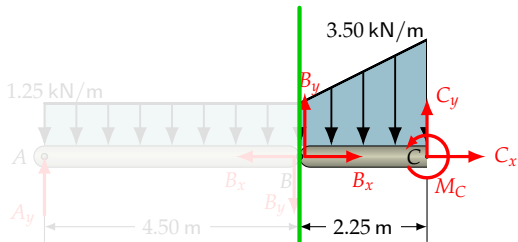
Consider a vertical section through B.



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The portion to the left of the section (that is, member AB) is in equilibrium. It has three unknowns: A_y , B_x and B_y . We can solve for these.

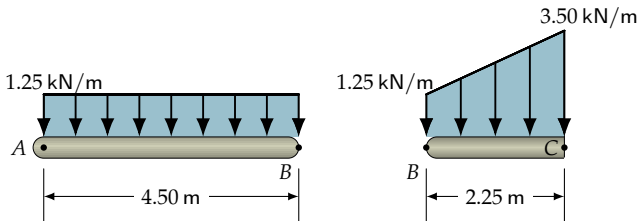


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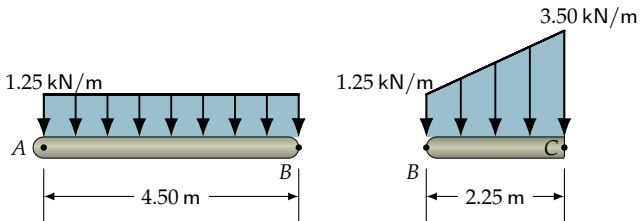
The portion to the left of the section (that is, member AB) is in equilibrium. It has three unknowns: A_y , B_x and B_y . We can solve for these.

The portion to the right of the section (member BC), now that we know B_x and B_y , has three remaining unknowns: M_C , C_x and C_y . We can solve for these.



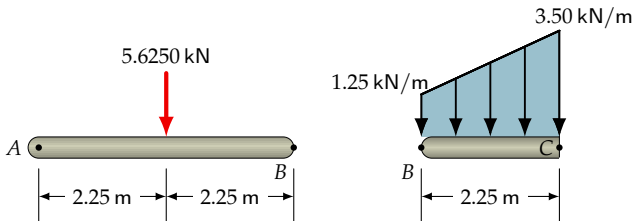
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