

2P04 Lab 4

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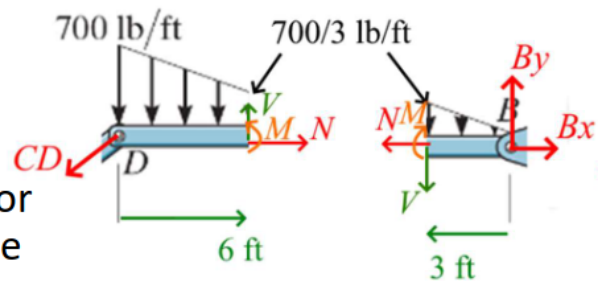
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1 Lecture 12

1.1 Lecture Questions

Example:

Find the internal force and moment 3 ft left of point B for the actual loading and for the “equivalent” point load.



We can start by first solving for this system as a whole without considering the internal forces. Then, we can switch and use one half of the right side where we can consider the internal forces and in doing so, we can solve for the internal forces. We can write out the following Maple code for this:

```
# Lecture 12 lecture question
```

```
# Solve for outside values
```

```
restart: p:=700*(1-x/9):  
solve([  
-CD*4/5+Bx,  
-CD*3/5-int(p,x=0..9)+By,  
-int(x*p,x=0..9)+9*By]); assign(%):
```

```
# Solve for internal values
```

```
solve([  
-4/5*CD+N,  
-3/5*CD-int(p,x=0..6)+V,  
-int(x*p,x=0..6)+6*V+M]);
```

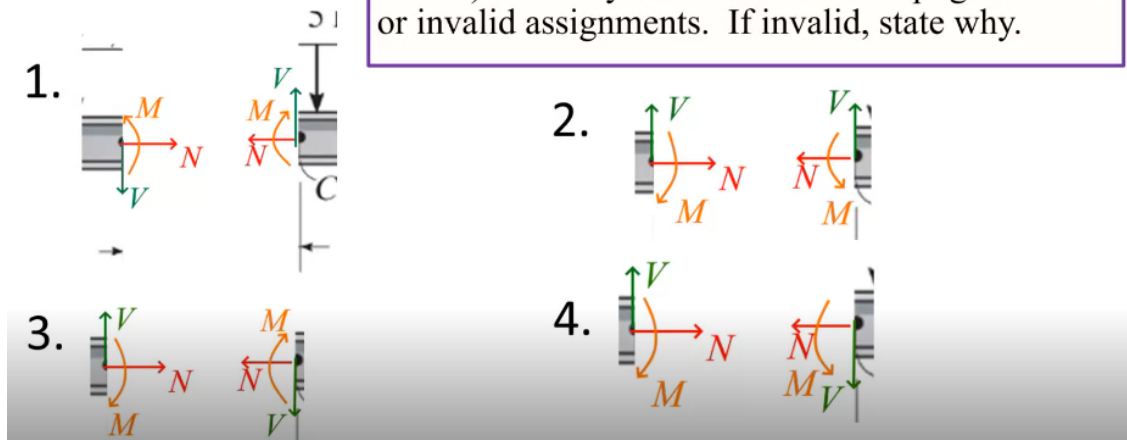
```
{Bx = -2800, By = 1050, CD = -3500}  
{M = 2800, N = -2800, V = 700}
```

Therefore, we get that the shear force at the internal point is 700 N upwards, the normal force is 2800 N towards the right, and the moment is 2800 N*m out of the page.

1.2 Quiz and Reflection

2P L12 Quiz:

Each of the 4 following FBDs are attempting to assign internal force and moment directions at some point in a beam (rest of the beam not shown). Identify whether each attempt gave valid or invalid assignments. If invalid, state why.



Assignment 1: Valid since Newton's third law is applied here.

Assignment 2: Invalid since the shear force at one point does not oppose the shear force at another point. Violates Newton's third law.

Assignment 3: Invalid since the Moment's are both clockwise and do not oppose each other.

Assignment 4: Valid since Newton's 3rd law is applied here.

Reflection: In this lecture, we learned about how to solve for internal forces in a system by first solving for the system as a whole and then solving for the internal forces. This is a very useful technique that can be used to solve for internal forces in a system.

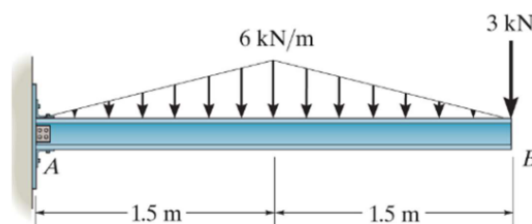
1.3 Question Bank Problems

2 Lecture 13

2.1 Lecture Questions

*IFM Diagram e.g.2

Find equations for the internal shear force and bending moment, and plot them over the beam.



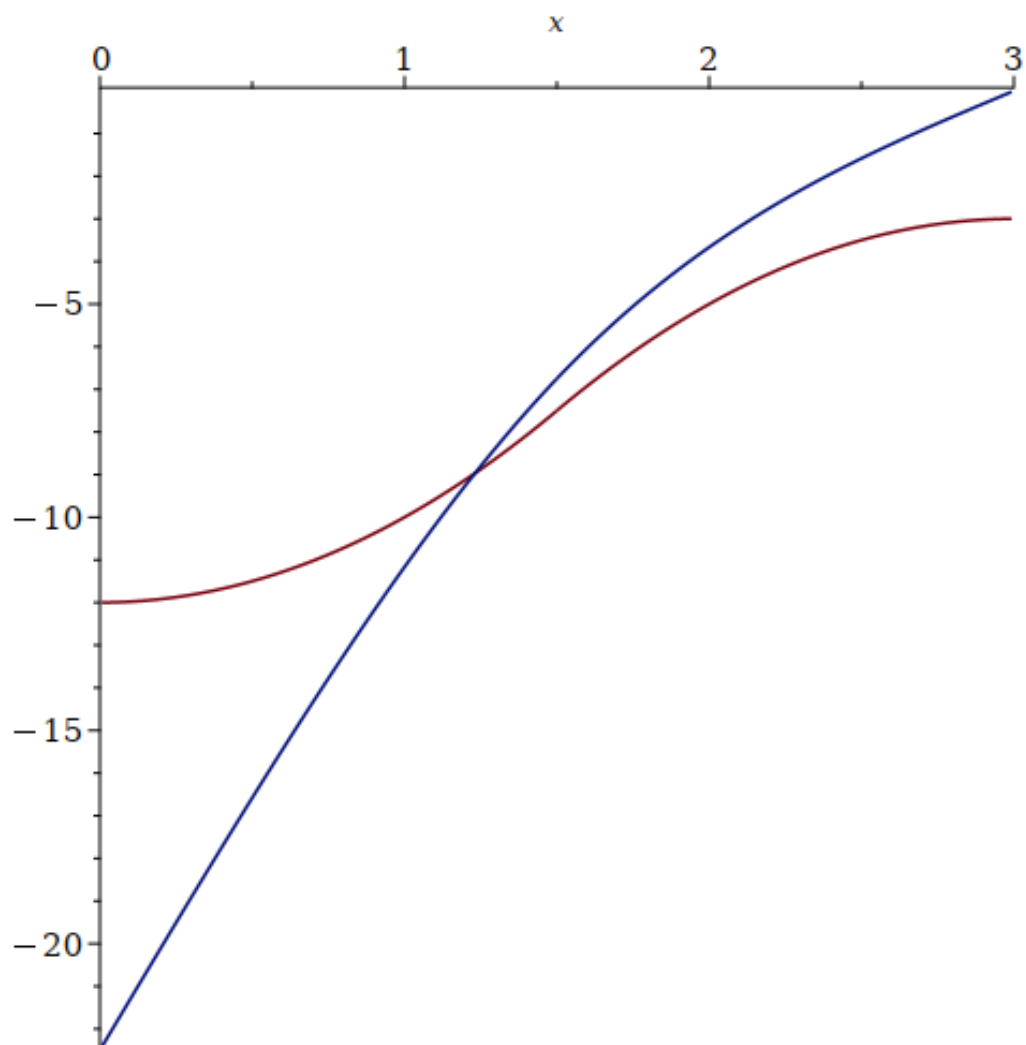
We can move from left to right which means that we need to solve for the reaction forces at point A. Given the reaction forces, we can then move left to right and solve for the moment and the shear force. The following Maple code can be used to solve this:

```
restart: p:=piecewise(x<1.5, 6*x/1.5, x>=1.5, 12-6*x/1.5):
solve([
Ay=int(p,x=0..3)-3,
MA=int(x*p,x=0..3)-3*3]): assign(%);
solve([
```

```

Ay=int (p,x=0..x)+V,
MA=int (x*p,x=0..x)+x*V+M], [V,M]): assign(%):
plot ([V,M], x=0..3);

```

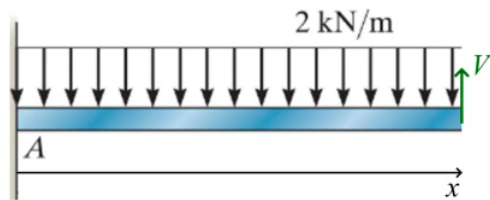
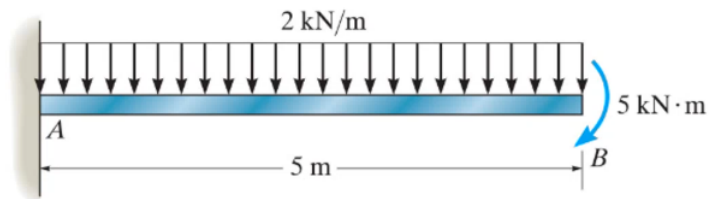


We have a plot for the sheer force and the moment as a function of x.

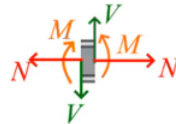
2.2 Quiz and Reflection

2P L13 Quiz:

For the shear force sign convention shown below, find and plot the internal shear force vs. position x in the top beam.



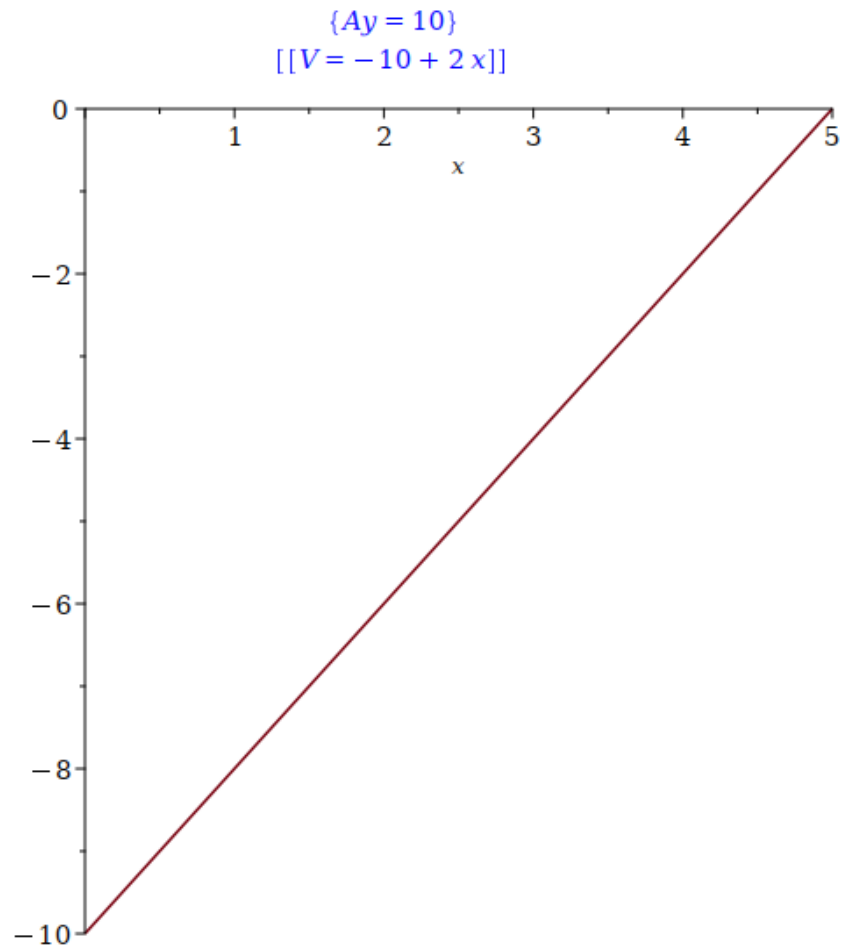
i.e.,



We can start by solving for the reaction forces at point A. Then, we can move from left to right and solve for the moment and the shear force. The following Maple code can be used to solve this:

```
# Quiz
restart:
solve([Ay-int(2,x=0..5)], Ay); assign(%);

solve([Ay+V-int(2, x=0..x)], [V]);
assign(%); plot(V, x=0..5);
```



We can see that the shear force goes to 0 as we travel from left to right.