Live Loads for Bridges

- In our previous discussions, we mentioned that the primary live loads on bridge spans are due to traffic.
- The heaviest loads are those produced by large transport trucks.
- The ***American Association of State and Highway Transportation Officials*** (AASHTO) has a series of specifications for truck loadings.

1

Live Loads for Bridges

- For two-axial trucks, AASHTO designates these vehicles as ***H-series trucks***.
- For example, an ***H15-44*** is a 15-ton truck as reported in the 1944 specifications.
- Trucks that pull trailers are designated as HS, for example, ***HS 20-44*** (a 20-ton semi-trailer truck).
- In general, a truck loading depends on the type of bridge, its location, and the type of traffic anticipated.

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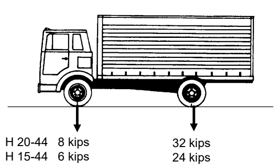
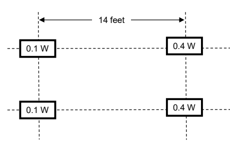
Live Loads for Bridges

- The size of the "***standard truck***" and the distribution of its weight are reported in the AASHTO code.
- The "***H***" loading consists of a two-axial truck
- The number following the ***H*** designation is the gross weight in tons of the standard truck

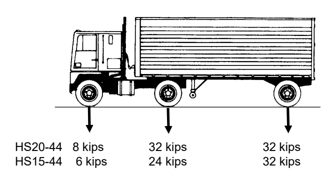




3

Live Loads for Bridges

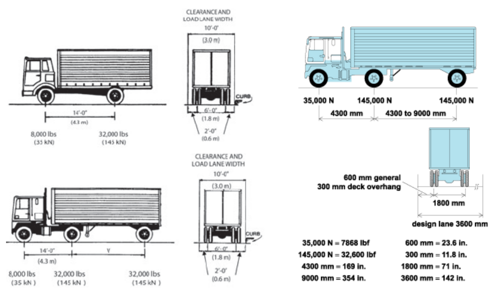
- The "HS" loading consists of tractor truck with semi-trailer
- The number following the HS designation is the gross weight in tons of the standard truck



4

Live Loads for Bridges

The AASHTO standard H20 and HS20 trucks



5

Live Loads for Bridges

The AASHTO specifications also allow you to represent the truck as a single concentrated load and a uniform load.

For ***H20-44*** and ***HS20-44***:

- Concentrated load 18 kips for moment
  26 kips for shear
- Uniform loading 640 lb./ft. of the load lane

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Live Loads for Bridges

The AASHTO specifications also allow you to represent the truck as a single concentrated load and a uniform load.

For ***H15-44*** and ***HS15-44***:

- Concentrated load 13.5 kips for moment
  19.5 kips for shear
- Uniform loading 480 lb./ft. of the load lane

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Live Loads for Bridges

- You can probably see that once the loading has been selected, you have to determine the critical position of the truck on the structure (bridge).
- This is an excellent application for ***influence lines***.

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Live Loads for Bridges

- In many cases, vehicles may bounce or sway as they move over a bridge.
- This motion produces an *impact* load on the bridge.
- AASHTO has developed an ***impact factor*** to increase the live load to account for the bounce and sway of vehicles.

$$I = \frac{50}{L+125} \leq 0.3$$

where L is the length of the span in feet

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Live Loads for Bridges

Impact loading is intended to transfer loads from the superstructure to the substructure.

- Superstructures, including legs of rigid frames
- Piers excluding footings and those portions below the ground line
- Portions above ground line of concrete and steel piles that support the superstructure

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Live Loads for Bridges

Impact shall not be included in loads transferred to footings or to those parts of piles or columns that are below ground.

- Abutments, retaining walls, and piles except as specified before
- Foundation pressures and footings
- Timber structures
- Sidewalk loads
- Culverts and structures having 3 ft. or more of cover

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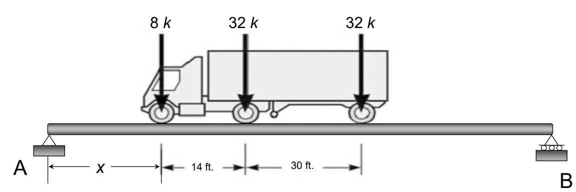
Live Loads for Bridges

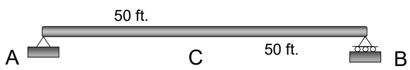
Example: Consider our standard AASHTO ***HS20-44*** truck traveling over the span of some structure.



12

Live Loads for Bridges

- ***Shear*** - To examine how a series of concentrated loads affects the shear, let's consider our "standard truck" and its effect on the ***shear at point C*** on the beam shown above



- First, we need the influence line for the shear at point C.

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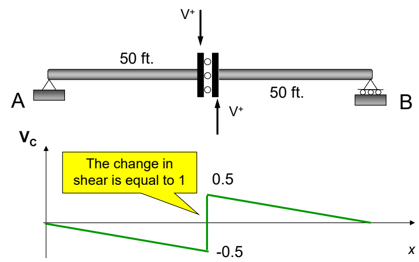
Live Loads for Bridges

Using the Muller-Breslau principle construct the influence line for the ***shear at point C***



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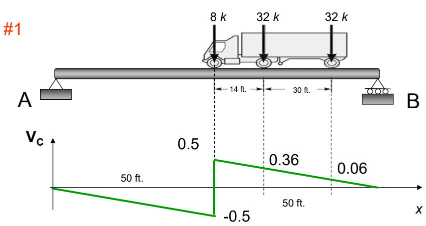
Live Loads for Bridges

- Let's try to find the maximum ***positive shear at point C.***
- There are three cases to examine, one for each of the three-wheel forces as they pass over the point *C*.

Case #1



$$(V_C)_{Case\ 1} = 8k(0.5) + 32k(0.36) + 32k(0.06) \quad = 17.44k$$

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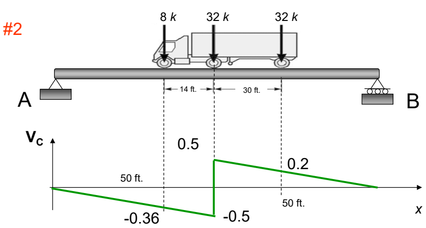
Live Loads for Bridges

- Let's try to find the maximum ***positive shear at point C***.
- There are three cases to examine, one for each of the three-wheel forces as they pass over the point *C* .

Case #2



$$(V_C)_{Case\ 2} = 8k(-0.36) + 32k(0.5) + 32k(0.2) \quad = 19.52k$$

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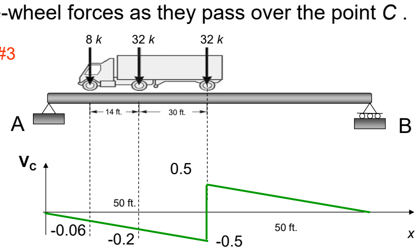
Live Loads for Bridges

- Let's try to find the maximum ***positive shear at point C.***
- There are three cases to examine, one for each of the three-wheel forces as they pass over the point *C* .

Case #3



$$(V_C)_{Case\ 3} = 8k(-0.06) + 32k(-0.2) + 32k(0.5) \quad = 9.12k$$

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Live Loads for Bridges

- The maximum positive shear at point C is 19.52k
- Let's rework the previous problem to find the maximum ***negative*** shear at point C.
- There are three cases to examine, one for each of the three-wheel forces as they pass over the point C.
- In this case, use the largest ***negative*** value from the influence line

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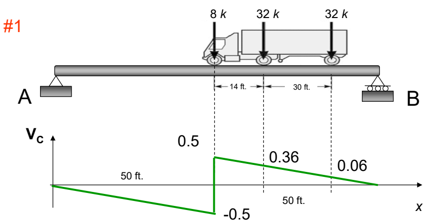
Live Loads for Bridges

- Let's try to find the maximum ***negative shear at point C***.
- There are three cases to examine, one for each of the three-wheel forces as they pass over the point *C*.

Case #1



$$(V_C)_{Case\,1} = 8k(-0.5) + 32k(0.36) + 32k(0.06) \quad = 9.44k$$

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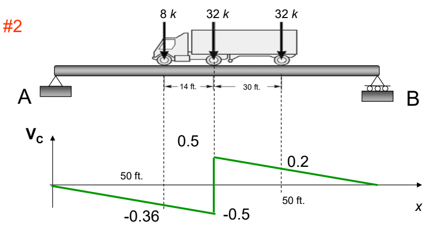
Live Loads for Bridges

- Let's try to find the maximum ***negative shear at point C.***
- There are three cases to examine, one for each of the three-wheel forces as they pass over the point *C*.

Case #2



$$(V_C)_{Case\,2} = 8k(-0.36) + 32k(-0.5) + 32k(0.2) \quad = -12.48k$$

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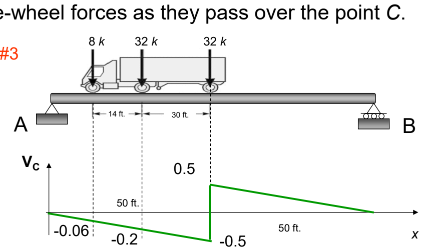
Live Loads for Bridges

- Let's try to find the maximum ***negative shear at point C.***
- There are three cases to examine, one for each of the three-wheel forces as they pass over the point *C*.

Case #3



$$(V_C)_{Case\,3} = 8k(-0.06) + 32k(-0.2) + 32k(-0.5) \quad = -22.88k$$

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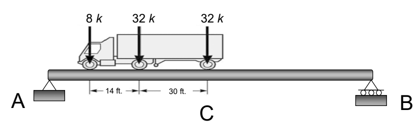
Live Loads for Bridges

- The maximum ***negative*** shear at C is -22.88k
- In this case, the largest shear at C is the largest ***negative*** value, or V_{max} = -22.88k



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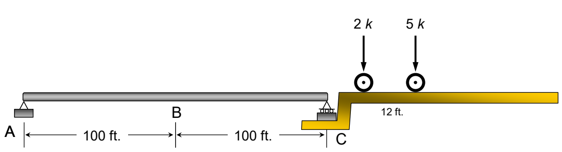
Live Loads for Bridges

Example: Determine the ***maximum moment at point B*** in the beam below due to the wheel loads of a moving truck. The truck travels from right to left.



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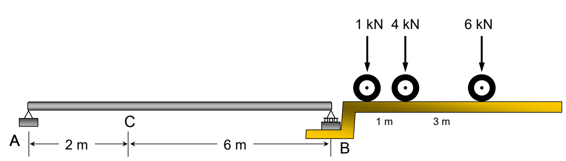
Live Loads for Bridges

Example: Determine the ***maximum shear at point C*** in the beam below due to the wheel loads of a moving truck. The truck travels from right to left.



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End of Influence Lines - Part 3

Any questions?

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