Live Loads for Bridges

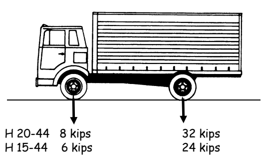
- In our previous discussions we mentioned that the primary live loads on bridge spans are due to traffic.
- The heaviest loads are those produced by large transport trucks.
- The American Association of State and Highway Transportation Officials (AASHTO) has a series of specifications for truck loadings.

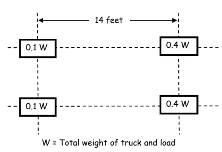
Live Loads for Bridges

- For two-axial trucks AASHTO designates these vehicles as H series trucks.
- For example, a 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.

Live Loads for Bridges

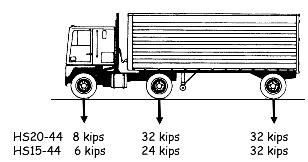
- The size of the "*standard truck*" and the distribution of its weight is reported in the AASHTO code.
- The "H" loading consists of two-axial truck
- The number following the H designation is the gross weight in tons of the standard truck





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



Live Loads for Bridges

- The AASHTO specifications also allow you to represent the truck as a single concentrated load and an uniform load.
- For H20-44 and HS20-44:
  - Concentrated load 18 kips for moment
    26 kips for shear
  - Uniform loading 640 lb/ft of load lane

Live Loads for Bridges

- The AASHTO specifications also allow you to represent the truck as a single concentrated load and an 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 load lane

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***.

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 develop 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

Live Loads for Bridges

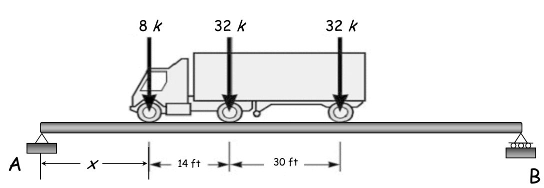
- Impact loading is intended to transfer loads from the superstructure to the substructure
  - Superstructures including legs of rigid frames
  - Piers excluding footings and those portions below ground line
  - Portions above ground line of concrete and steel piles that support the super structure

Live Loads for Bridges

- Impact shall not be included in loads transferred to footings not to those parts of piles or columns that are below ground
  - Abutments, retaining walls, piles excepts as specified before
  - Foundation pressures and footings
  - Timber structures
  - Sidewalk loads
  - Culverts and structures having 3 feet or more of cover

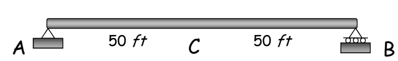
Live Loads for Bridges

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



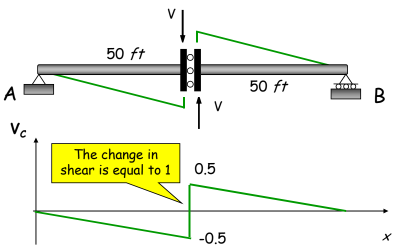
Live Loads for Bridges

- ***Shear*** - To examine how a series of concentrated loads effect the shear lets 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*.



Live Loads for Bridges

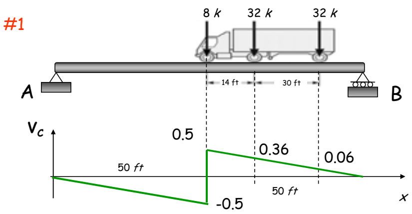
- Using the Muller-Breslau principle construct the influence line for the shear at point C



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

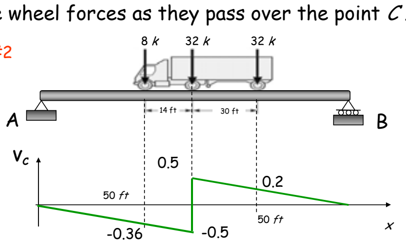


$$(V_C)_{Case\ 1} = 8k(0.5) + 32k(0.36) + 32k(0.06) = 17.44k$$

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

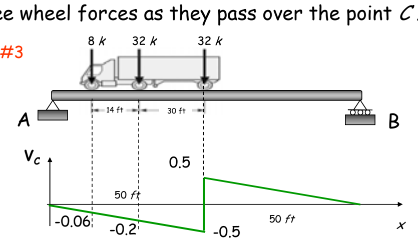


$$(V_C)_{Case\ 2} = 8k(-0.36) + 32k(0.5) + 32k(0.2) = 19.52k$$

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



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

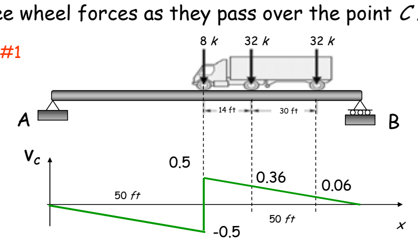
Live Loads for Bridges

- 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

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

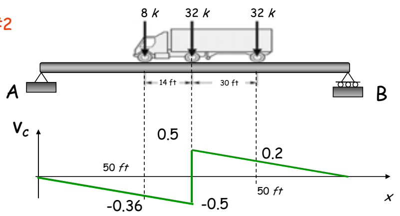


$$(V_C)_{Case\ 1} = 8k(-0.5) + 32k(0.36) + 32k(0.06) = 9.44k$$

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

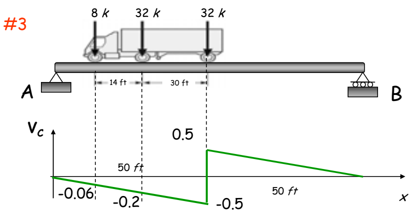


$$(V_C)_{Case\,2} = 8k(-0.36) + 32k(-0.5) + 32k(0.2) = -12.48k$$

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*.

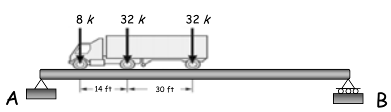
Case #3



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

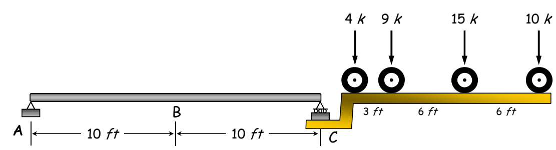
Live Loads for Bridges

- 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



Live Loads for Bridges

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



End of Influence Lines – Part 3

Any questions?