Live Loads for Bridges

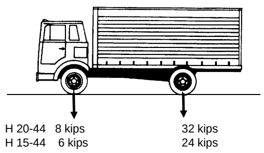
- In our previous discussions we mentioned that the primary live loads on bridge spans are due to traffic.
- The heaviest loads are those produced by large transport trucks.
- The American Association of State and Highway Transportation Officials (AASHTO) has a series of specifications for truck loadings.

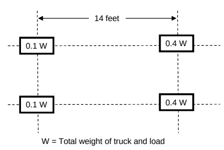
Live Loads for Bridges

- 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

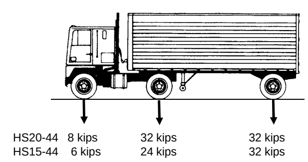
- The size of the "*standard truck*" and the distribution of its weight is reported in the AASHTO code.
- The "H" loading consists of two-axial truck
- The number following the H designation is the gross weight in tons of the standard truck





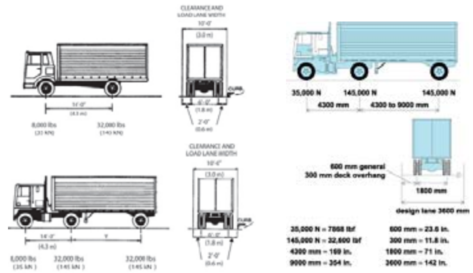
Live Loads for Bridges

- 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 standard H20 and HS20 trucks



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

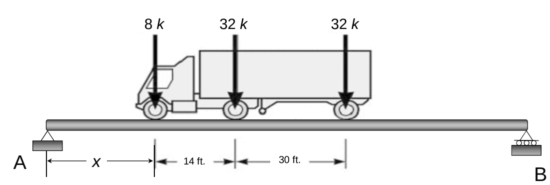
Live Loads for Bridges

Impact shall not be included in loads transferred to footings or 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

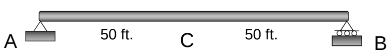
Live Loads for Bridges

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



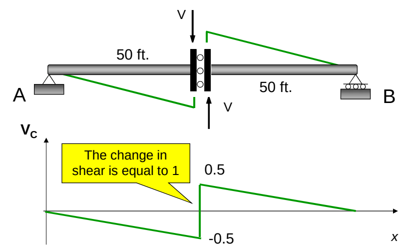
Live Loads for Bridges

- ***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

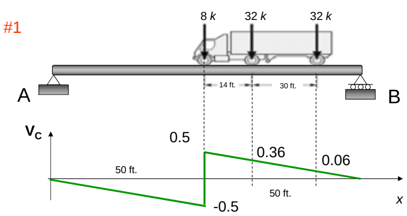
Using the Muller-Breslau principle construct the influence line for the shear at point C



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

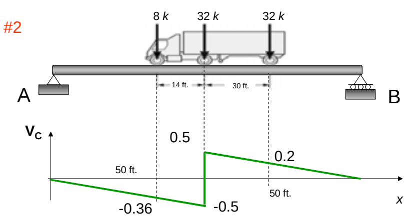


$$(V_C)_{Case\,1} = 8k(0.5) + 32k(0.36) + 32k(0.06) \quad = 17.44k$$

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

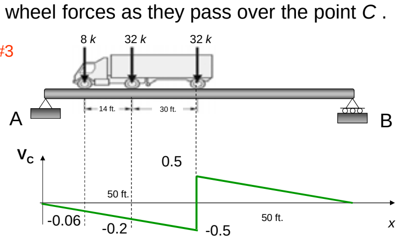


$$(V_C)_{Case\,2} = 8k(-0.36) + 32k(0.5) + 32k(0.2) \quad = 19.52k$$

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



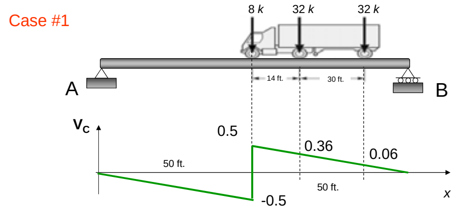
$$(V_C)_{Case\,3} = 8k(-0.06) + 32k(-0.2) + 32k(0.5) \quad = 9.12k$$

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

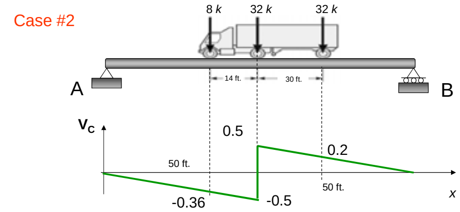
- Let's try to find the maximum *negative* shear at point *C*.
- There are three cases to examine, one for each of the three wheel forces as they pass over the point *C* .



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

Live Loads for Bridges

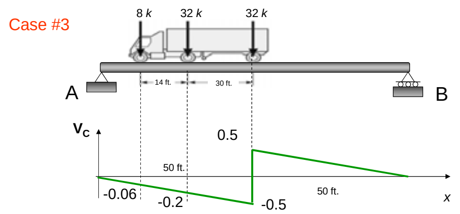
- Let's try to find the maximum *negative* shear at point *C*.
- There are three cases to examine, one for each of the three wheel forces as they pass over the point *C* .



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

Live Loads for Bridges

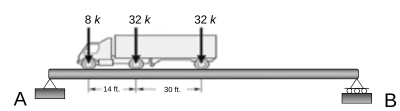
- Let's try to find the maximum *negative* shear at point *C*.
- There are three cases to examine, one for each of the three wheel forces as they pass over the point *C* .



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

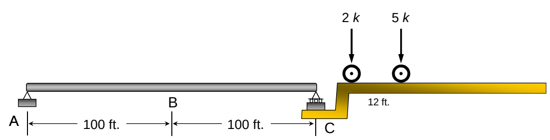
Live Loads for Bridges

- 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



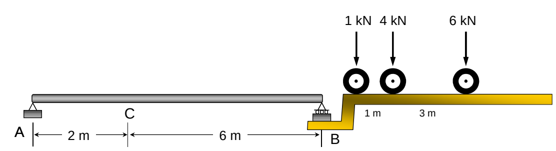
Live Loads for Bridges

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.



Live Loads for Bridges

Example: Determine the maximum shear created at point C 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?