EXAMPLE 1-030

FRAME – MOVING LOADS

IMPORTANT NOTE

This example applies to CSiBridge only. Starting with Sap2000 version 15.00 the example does not apply to Sap2000 because it uses features that are not supported in Sap2000.

EXAMPLE DESCRIPTION

This example uses a 40-foot-long simple span bridge (beam) to test moving load load cases. Moving load cases use defined vehicle loads and defined lanes (rather than the load cases that are used by other analysis types) to calculate the most severe response resulting from vehicle live loads moving along lanes on the structure.

A single 12-foot-wide lane with a maximum discretization length of 2 feet is defined along the center line of the bridge structure. An H20-44 truck load vehicle and an H20-44L lane load vehicle are created and a vehicle class containing both the H20-44 and H20-44L vehicles is defined. The moving load analysis considers both vehicles separately and reports the worst-case response.

In addition to the moving load case, this example also includes a multi-step static analysis for the H20-44 vehicle. This analysis simulates the truck moving across the bridge.

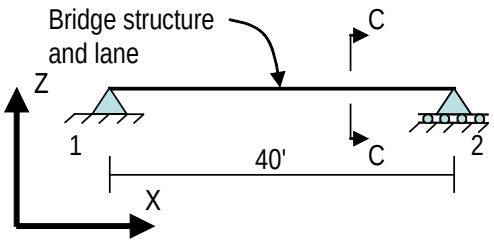
For each of the load cases the maximum moment and maximum reaction are compared with independent results that are either presented in Appendix A of AASHTO 1990 or hand calculated.

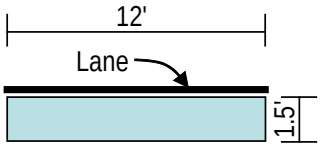
Output stations along the frame element modeling the bridge are specified to be at a maximum spacing of 2 feet.

TECHNICAL FEATURES OF SAP2000 TESTED

- Moving load case
- Multi-step static load case for vehicles

GEOMETRY, PROPERTIES AND LOADING





Section C-C

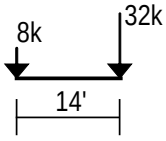
Material Properties
E = 518,400 k/ft^2
v = 0.2

Section Properties
b = 12 ft
d = 1.5 ft

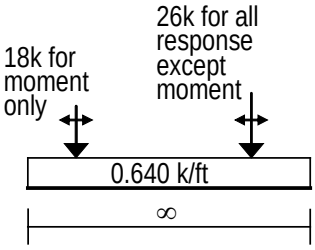
Analysis Cases

MOVEINF: Moving load analysis case; each vehicle is run forward (from joint 1 to 2) and backward along the lane

MOVEMS: Multi-step static analysis case; H20-44 vehicle is run forward along the lane



H20-44 Truck Load



H20-44 Lane Load

RESULTS COMPARISON

The independent results for all items, except the maximum reaction for the MOVEMS load case, are taken from tables in Appendix A of AASHTO 1990. The independent results for the MOVEMS load case are hand calculated.

Load Case	Output Parameter	SAP2000	Independent	Percent Difference
MOVEINF Moving load case	Max Moment k-ft	345.6	346.0	-0.1%
	Max Reaction kips	38.789	38.8	0%
MOVEMS Multi-step static load case	Max Moment k-ft	345.5	346.0	-0.1%
	Max Reaction kips	37.192	37.2	0%

The maximum moment in the MOVEINF load case is controlled by the H20-44 truck load. It is the same as the maximum moment in the MOVEMS load case, which considers only the truck load.

The maximum reaction in the MOVEINF load case is controlled by the H20-44L lane load. It is larger than the maximum reaction in the MOVEMS load case, which considers only the truck load.

COMPUTER FILES: Example 1-030

CONCLUSION

The SAP2000 results show an acceptable match with the independent results.

HAND CALCULATION

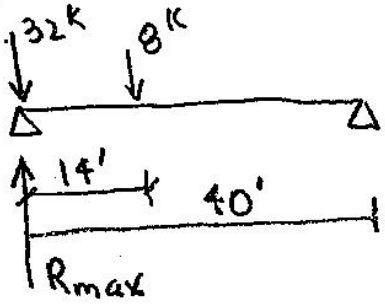
Reference: AASHTO Standard Specification for Highway Bridges 14th Edition as amended by Interim Specifications - Bridges - 1990 By AASHTO Subcommittee on Bridges and Structures

For HS20 truck and lane load:

Max Moment = 346.0 K-ft controlled by truck

Max Reaction = 38.8 K controlled by lane load

For HS20 truck alone the maximum end reaction is determined by hand calculation. By inspection, the maximum end reaction occurs when the 32^K axle load is directly over the support and the 8^K load is on the span.



$$R_{max} = 32 + \frac{8 \times 26}{40}$$

$$R_{max} = 37.2^K$$

for truck alone without lane load