

WSMC High School State Competition

The Railroad Bypass Problem

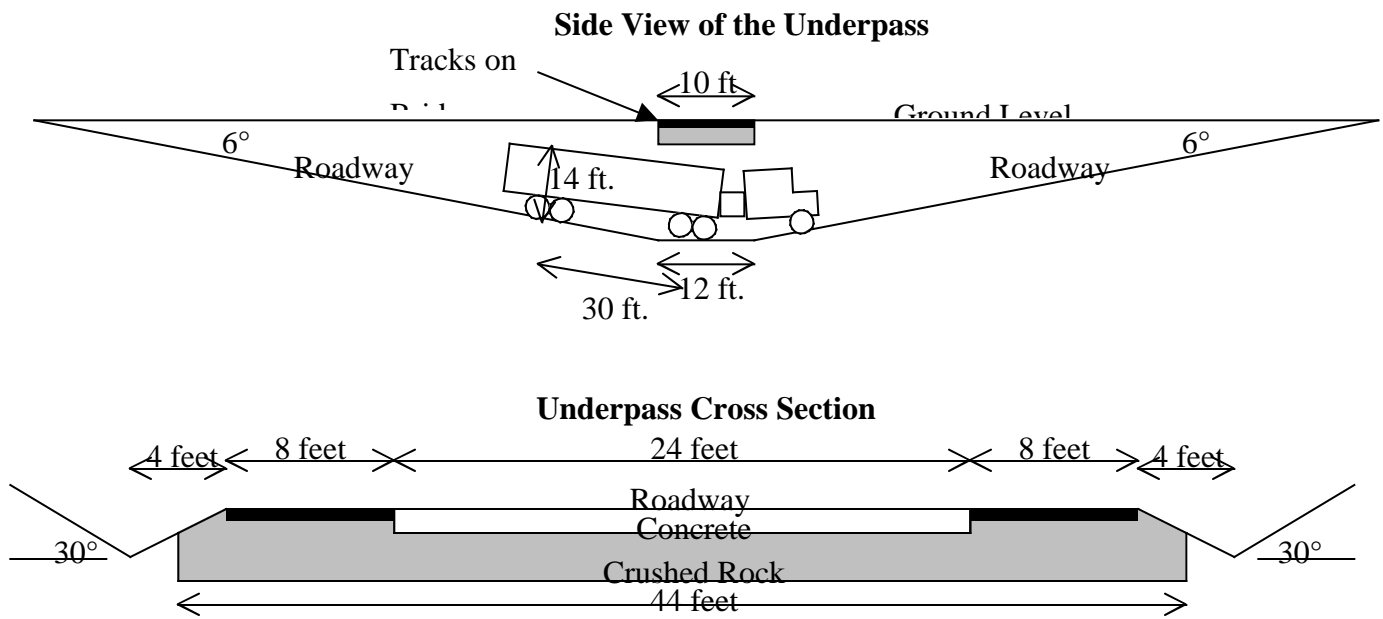
Team Problem

March 17, 2004

The heavily traveled two-lane road crosses the very busy railroad tracks in flat terrain near a town. The DOT (Department of Transportation) has decided that an underpass must be built. The specifications have been drawn up and it is your team's job to estimate the costs. Be sure to provide enough details in your calculations to allow the DOT officials (and scorers) to follow your processes and procedures but you must also fit **all** of your work on the **front** of the answer page. Any work not on the front of the answer sheet will be ignored by the scorers.

In the design of the underpass, the railroad tracks are left undisturbed at grade. Enough earth is removed from underneath the tracks to allow vehicles to pass underneath the tracks. The tracks are supported by a bridge that is three feet thick (three feet below original grade). The cost for the bridge will be \$2500 per linear foot. All banks will be graded to a 30-degree slope and the underpass roadway slope shall be a 6-degree slope. The roadway will be reinforced concrete 8 inches thick and 24 feet wide on top of 12 inches of crushed rock. The shoulders are 16 inches of crushed rock topped with 4 inches of asphalt and are 8 feet wide. The total width of the roadway is 40 feet plus four feet on each side for ditching.

A 14 foot high semi truck with a 30 foot wheel base must be able to pass under the railroad bridge.



At this site it will cost approximately \$4.35 per cubic yard to remove earth. Crushed rock is \$6.50 per ton and there are 1.5 tons per cubic yard. There is a 75% additional cost for spreading and compacting the crushed rock. Asphalt 4 inches thick cost \$1.05 per square foot to be laid and 40% for preparation work. Concrete is \$70 per cubic yard and there is a 240% additional charge for reinforcement, preparation, and pouring (placement and finishing). The total construction cost is increased by another 30% for administration costs and other incidental costs creating the project bid total.

The scoring rubric is summarized on the next page.

Scoring Rubric Summarized

Be sure to:

Solve Problems – Measurement – Number Sense

✓ 4 points

Show how you arrived at the correct clearance for the underpass.

✓ 9 points

Show the calculations for the dimensions/area/volume for earth moving, concrete, asphalt, crushed rock and bridge/trestle.

✓ 8 points

Show the calculations for the costs for earth moving, concrete, asphalt, crushed rock and bridge.

✓ 2 points

Show calculations for the final costs.

Measurement

✓ 2 points

Use appropriate formulas and conversions.

Communication

✓ 3 points

Present work in an organized, clear, and logical manner and label appropriately.