



JETS Challenge 112

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Antique US Road

Construction of the National Road (today's rte 40 in Pennsylvania) began TWO CENTURIES ago in March, 1806!!! The 620 mile (1000km) road provided a portage between the Potoma and Ohio Rivers and a gateway to the West for thousands of settlers. It was the first US road to use the new Macadam road surfacing. Macadam is a type of road construction pioneered by John Loudon McAdam in the late 1700's. This design consists of three layers of stones laid on a sloped subgrade, with side ditches for drainage. The first two layers are angular aggregate hand-broken to a maximum diameter of 75 mm for a total depth of 200 mm each. The third layer was about 30 mm thick with a maximum aggregate size of 25 mm. The width of the road was 11 m. The layers would be compacted with a heavy roller. A cubic meter of rock weighs 2.4 tons/m³.

The Challenge: How many metric tons of rock was required to complete the total length of the road?

$$\text{Height} = 50\text{mm} + 200\text{mm} + 200\text{mm} = 450 \text{ mm} = 0.45 \text{ m}$$

$$\begin{aligned} \text{Total volume} &= 1,000,000\text{m} \times 11 \text{ m} \times 0.45 \\ &= 4,950,000\text{m}^3 \end{aligned}$$

$$\text{Weight} = 2.40 \text{ tons/m}^3 \times 4,950,000\text{m}^3 = 11.88 \text{ tons}$$

ANSWER:

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JETS Challenge problems are generously provided by Dave Meredith, Associate Professor, Penn State University-Fayette