0:00

All right, for this problem we have a trailer. This trailer consists of a deck that weighs 250 pounds, and the wheel-and-axle assembly weighs 350 pounds. What we can change is the axle location. We can weld the axle anywhere along the trailer deck. We want the tongue force—the force the trailer exerts on the trailer hitch of the towing vehicle—to be 50 pounds. The rest of the weight will be supported by the wheels. Our goal is to adjust distance D so that the tongue force is 50 pounds.

0:30

If we move the axle farther back, more weight shifts toward the front. If we move it forward, the trailer begins to tilt the other direction. We can draw a free-body diagram. This is an extended body equilibrium problem.

1:00

We have the deck of the trailer, and at some point we place the wheel-and-axle assembly. Several forces act on the system: the weight of the deck (250 pounds), the weight of the axle assembly (350 pounds), the normal force on the rear tires, and the tongue weight, which we call F_T. We want F_T to be 50 pounds.

1:30

The weight of the trailer deck acts at its center, which is halfway along its length. This is 6 feet from the front of the trailer. What we do not know is D, the distance from the front of the trailer to the axle.

2:00

Now we have our free-body diagram with all forces and distances labeled. We need to determine D so that the tongue force is 50 pounds. Using the moment equation, we take moments about point B, the axle location. For equilibrium, the sum of moments about B must be zero.

2:30

Two forces create a moment about point B: the 50■pound tongue force and the 250■pound deck weight. The normal force on the wheels and the weight of the wheels do not create a moment about point B because they act at that point. Point A is the front of the trailer; point B is the axle.

3:00

The tongue force creates a negative (clockwise) moment: –50·D. The deck weight creates a positive (counterclockwise) moment: +250·(D – 6).

3:30

Setting the sum of moments equal to zero: –50D + 250(D – 6) = 0 Expanding: –50D + 250D – 1500 = 0 This simplifies to: 200D = 1500 So: D = 7.5 feet

4:30

This may look like a complicated problem, but with one equation we can solve for the axle location needed to achieve a 50■pound tongue weight.

5:00

Thank you for watching, and I hope to see you again.