Speed Camera

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Objective: How quickly a vehicle traveling above the speed limit would move out of the camera's range.

Problem Setup

- **Speed (v):** Different speeds above the limit (e.g., 36 MPH, 41 MPH).
- **Camera Height (H):** Let's assume the camera is mounted at a height of 12 feet.
- **Field of View Angle (θ):** Assume a half-angle $\theta = 30^\circ$ for the camera's vertical field of view.
- **Video Duration (t):** The different durations for which the camera records the violation (e.g., 6 seconds, 10 seconds, 15 seconds).

Calculate the Vertical Coverage Distance (D) of the Camera

The vertical coverage distance D is how far in front of the camera the field of view extends. Using trigonometry:

$$D = H \times \tan(\theta)$$

Given:

- **Height of Camera (H):** 12 feet
- **Angle (θ):** $\theta = 30^\circ$

$$D = 12 \times \tan(30^\circ) \approx 12 \times 0.577 = 6.924 \text{ feet}$$

This means the camera can see approximately 6.924 feet ahead of itself vertically.

Calculate the Time to Move Out of the Camera's Vertical Range

To determine when a vehicle moving at different speeds will move out of the camera's range, we calculate how long it will take to cover this vertical coverage distance D.

1. For a Vehicle Traveling at 36 MPH:

Convert Speed to FPS:

$$v = 36 \times \frac{5280}{3600} \approx 52.8 \text{ FPS}$$

Time to Exit Camera Range (t):

$$t = \frac{D}{v} = \frac{6.924 \text{ feet}}{52.8 \text{ FPS}} \approx 0.131 \text{ seconds}$$

So, at 36 MPH, it takes about 0.131 seconds for the car to move out of the camera's vertical range.

2. For a Vehicle Traveling at 41 MPH:

Convert Speed to FPS:

$$v = 41 \times \frac{5280}{3600} \approx 60.27 \text{ FPS}$$

Time to Exit Camera Range (t):

$$t = \frac{D}{v} = \frac{6.924 \text{ feet}}{60.27 \text{ FPS}} \approx 0.115 \text{ seconds}$$

At 41 MPH, it takes about 0.115 seconds for the car to move out of the camera's vertical range.

Step 3: Compare with Video Duration

If the camera records a violation for, say, 10 seconds:

- **For 36 MPH:** The car would have left the vertical coverage zone in 0.131 seconds, meaning it's well out of range long before the video finishes.
- **For 41 MPH:** The car would have left the vertical coverage zone in 0.115 seconds, even faster than at 36 MPH.

Final Word

For vehicles traveling at high speeds, they will exit the camera's vertical coverage zone very quickly—within fractions of a second. This means that the camera must capture the violation almost immediately, or the vehicle will no longer be visible within the camera's field of view. Given the video durations of 6 to 15 seconds, these vehicles are likely out of the camera's view long before the recording ends.