

SURVEYING PRINCIPLES

for Civil Engineers

Second Edition

**Review for the Engineering
Surveying Section of the
California Special Civil
Engineer Examination**

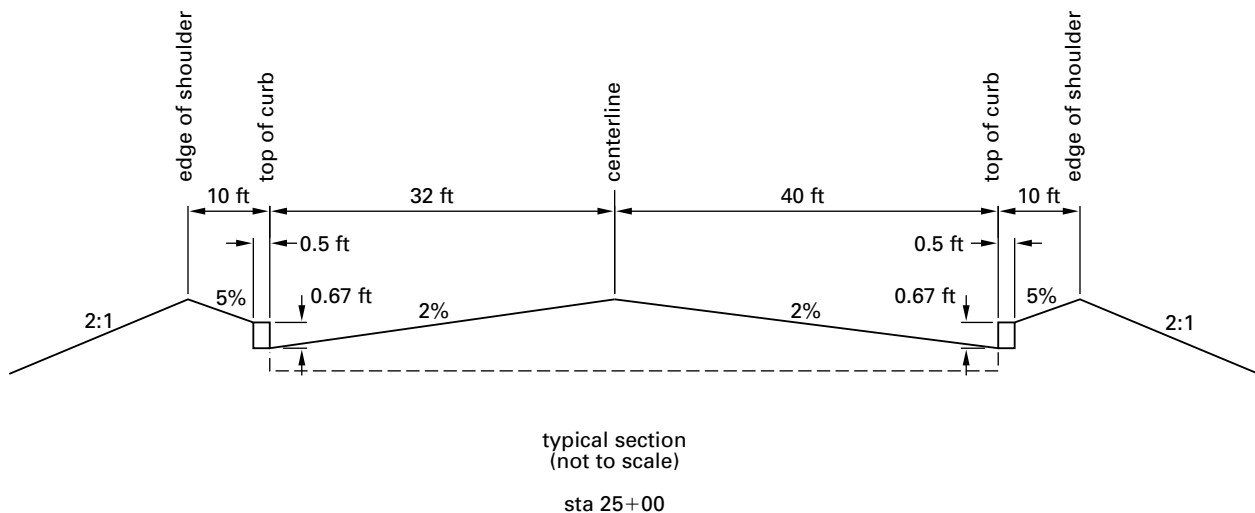
Paul A. Cuomo, PLS

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2. Compute the deflection angles needed to lay out the centerline on half-stations, starting at the BC.
3. Compute the outside chord lengths needed to stake the left curb on a 5.00 ft offset outside.
4. Compute the inside chord lengths needed to stake the right curb on a 5.00 ft offset inside.
5. The designed top of curb grade on the left, at sta 17+50, EVC, is 611.45 ft and at sta 20+00, BVC, is 614.58 ft. The HI of the instrument is 620.75 ft. If the ground rod on the offset stake at sta 19+00 is 6.10 ft, what is the cut or fill to the top of curb from that stake?
 - (A) F 1.32
 - (B) C 1.32
 - (C) F 3.20
 - (D) C 3.20
6. The centerline elevation at sta 25+00 is 500.25. What is the elevation at the left edge of shoulder?
 - (A) 499.73 ft
 - (B) 499.75 ft
 - (C) 500.76 ft
 - (D) 500.78 ft
7. The elevation of the right slope stake is 465.3. What is the distance from the slope stake to the centerline?
 - (A) 69.4 ft
 - (B) 111.4 ft
 - (C) 120.6 ft
 - (D) 129.4 ft
8. How would the front of the slope stake in Prob. 7 be marked?

Use the following illustration for Probs. 6 through 8.



5. Determine the gradient or rate of slope between sta 17+50 and sta 20+00.

$$\begin{aligned}
 S &= \frac{\text{difference in elevation}}{\text{distance}} \\
 &= \frac{614.58 \text{ ft} - 611.45 \text{ ft}}{\text{sta } 20+00 - \text{sta } 17+50} = \frac{3.13 \text{ ft}}{250 \text{ ft}} \\
 &= 0.0125 \quad (+1.25\%)
 \end{aligned}$$

Determine the design top of the curb grade at sta 19+00 left.

$$\begin{aligned}
 \text{difference in grade} &= (\text{distance between stations})s \\
 &= (\text{sta } 19+00 - \text{sta } 17+50)(0.0125) \\
 &= (150 \text{ ft})(0.0125) \\
 &= +1.88 \text{ ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{grade at sta } 19+00 &= 611.45 \text{ ft} + 1.88 \text{ ft} \\
 &= 613.33 \text{ ft}
 \end{aligned}$$

Determine the grade rod at sta 19+00.

$$\begin{aligned}
 \text{grade rod} &= \text{HI} - \text{designed grade} \\
 &= 620.75 \text{ ft} - 613.33 \text{ ft} \\
 &= 7.42 \text{ ft}
 \end{aligned}$$

Determine the cut or fill at sta 19+00.

$$\begin{aligned}
 \text{cut or fill} &= \text{grade rod} - \text{ground rod} \\
 &= 7.42 \text{ ft} - 6.10 \text{ ft} \\
 &= 1.32 \text{ ft}
 \end{aligned}$$

Since the grade rod is greater than the ground rod, this is a cut situation.

Answer (B)

6. Using the cross fall gradients, compute the difference in grade from the centerline to the shoulder.

The centerline to the bottom of curb is

$$\begin{aligned}
 -2\% &= -0.02s \\
 (-0.02)(32 \text{ ft}) &= -0.64 \text{ ft} \\
 \text{curb height} &= +0.67 \text{ ft bottom to top of curb}
 \end{aligned}$$

The top of curb to shoulder is

$$\begin{aligned}
 (+5\%)(9.5 \text{ ft}) &= (0.05)(9.5 \text{ ft}) = +0.48 \text{ ft} \\
 \text{difference} &= -0.64 \text{ ft} + 0.67 \text{ ft} + 0.48 \text{ ft} \\
 &= +0.51 \text{ ft} \\
 \text{shoulder grade} &= \text{centerline grade} + \text{difference} \\
 &= 500.25 \text{ ft} + 0.51 \text{ ft} \\
 &= 500.76 \text{ ft}
 \end{aligned}$$

Answer (C)

7. Compute the grade at the right edge of shoulder.

$$\begin{aligned}
 \text{centerline grade} &= 500.25 \text{ ft} \\
 \text{bottom of curb} &= 500.25 \text{ ft} - ((40.00 \text{ ft})(0.02\%)) \\
 &= 499.45 \text{ ft} \\
 \text{top of curb} &= 499.45 \text{ ft} + 0.67 \text{ ft} \\
 &= 500.12 \text{ ft} \\
 \text{shoulder grade} &= 500.12 \text{ ft} + ((9.50 \text{ ft})(0.05\%)) \\
 &= 500.60 \text{ ft}
 \end{aligned}$$

Compute the fill at the slope stake.

$$\begin{aligned}
 \text{fill} &= \text{shoulder grade} - \text{slope stake elevation} \\
 &= 500.60 \text{ ft} - 465.3 \text{ ft} \\
 &= 35.30 \text{ ft}
 \end{aligned}$$

Compute the distance from the slope stake to the shoulder.

$$\begin{aligned}
 \text{distance} &= (\text{fill})(2) \quad [2:1 \text{ slope}] \\
 &= (35.30 \text{ ft})(2) \\
 &= 70.60 \text{ ft}
 \end{aligned}$$

Compute the distance from the stake to the centerline.

$$\begin{aligned}
 \text{distance to centerline} &= \text{distance to shoulder} \\
 &\quad + \text{roadway width (right)} \\
 &= 70.60 \text{ ft} + 50 \text{ ft} \\
 &= 120.60 \text{ ft}
 \end{aligned}$$

Answer (C)

8. There are several options available regarding how to mark the stake.

$$\begin{aligned}
 \text{F } 35^3 \text{ @ } 2:1 &\quad [\text{no distance}] \\
 \text{F } 35^3 \text{ @ } 70^6 \text{ ES } 2:1 &\quad [\text{distance to shoulder}] \\
 \text{F } 35^3 \text{ @ } 120^6 \text{ L } 2:1 &\quad [\text{distance to centerline}]
 \end{aligned}$$

9. Compute the slope of the pipe.

$$\begin{aligned}
 \text{slope} &= \frac{\text{difference in elevation}}{\text{distance between manholes}} \\
 &= \frac{120.79 \text{ ft} - 117.91 \text{ ft}}{\text{sta } 120+25 - \text{sta } 16+75} \\
 &= \frac{2.88 \text{ ft}}{350 \text{ ft}} \\
 &= 0.0082 \quad (0.82\%)
 \end{aligned}$$