15 Calculating Pipe Lengths

Example Problem

Skew Pipes

CHAPTER FIFTEEN:
CALCULATING PIPE LENGTHS

Pipe lengths are calculated using the elevation differences of the pipe and the roadway grade above the pipe.

Three items are required to figure the pipe length.

1) The inlet and outlet elevations of the pipe

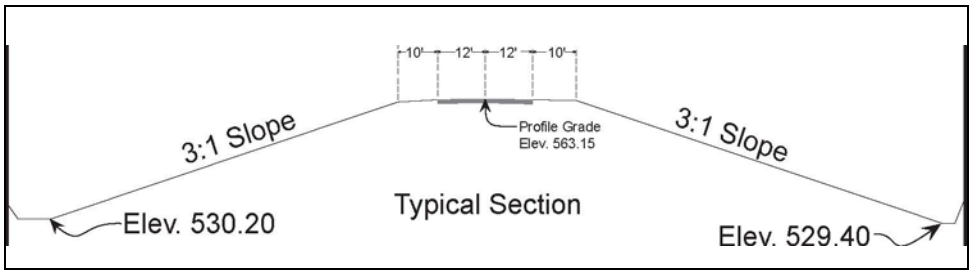
2) The profile grade of the roadway at the station of the pipe

3) The typical cross section for the roadway

EXAMPLE PROBLEM

A 24 in. CS pipe is to be placed under the fill at station 12+25 at an elevation of 563.15. The typical section is indicated below:

There is a 2 ½ in. crown in the pavement. Shoulders slope at ½ in. per ft and the side slopes are 3:1.



STEP 1

Fill in the profile grade and determine the shoulder elevation. (Figure 15-1). Mark the left and right side of the form.

2 ½ in. crown = (2.5 in./12) = 0.2083 ft = 0.21 ft

563.15 -0.21 = 562.94 Edge of Pavement Elevation
10 ft x 0.5 in./ft = 5 in. = 0.42 ft
562.94 – 0.42 = 562.52 ft Shoulder Elevation
Place this elevation on the form

Pipe Length

Contract Number _____ Project Number _____

Structure Number _____ Station _____ Line _____

Plan Length _____ Calculated Length _____

LEFT				RIGHT
563.15	Profile Grade			563.15
562.52	Shoulder Elevation			562.52
530.20	Flow Line Elevation			529.40
32.32	Gross Fill (ft)			33.12
2.00	Deduction for Pipe (ft)			2.00
30.32	Net Fill (ft)			31.12
90.96	3:1	Slope	3:1	93.36
22.00	Distance from C.L. to Shoulder (ft)			22.00
112.96	Total (ft)			115.36
Total Length of Pipe (ft)	112.96 + 115.36 = 228.32 ft			
Skew Factor				
Total Length of Pipe with Skew (ft)				

Order _____**228**_____ ft

Connect to Structure No. _____ Inlet Type _____

Figure 15-1. Pipe Length Problem

STEP 2

Place the inlet and outlet elevations on the proper sides of the form on the flowline elevation lines (inlet on the left and outlet on the right). Subtract this elevation from the shoulder elevation to obtain the gross fill.

inlet: 562.52- 530.20 = 32.32 ft

outlet: 562.52 - 529.40 = 33.12 ft

STEP 3

Deduct the diameter of the pipe from the gross fill to obtain the net fill for each half of the roadway (24 in. pipe = 2 ft). Place this figure on the net fill line for each side.

inlet: 32.32 - 2.00 = 30.32 ft

outlet: 33.12 - 2.00 = 31.12 ft

STEP 4

Place the rate of slope in the parentheses on the next line for the 3:1 slope. Multiply this times the net fill for each side:

Left = 30.32 ft x 3 = 90.96 ft

Right = 31.12 ft x 3 = 93.36 ft

Place these values on the slope line for each side. These values represent the length of the pipe required for the point from the shoulder break to the end of the pipe for each side.

STEP 5

Place the distance from the centerline to the shoulder on the next line:

12 ft lane + 10 ft shoulder = 22 ft

This is the same for each side. Add this to the slope distance computed in Step 4:

Left = 90.96 ft + 22.00 ft = 112.96 ft

Right = 93.36 ft + 22.00 ft = 115.36 ft

STEP 6

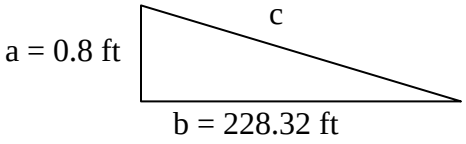
Add the two sides together for the total length:

112.96 ft + 115.36 ft = 228.32 ft

Check for an increase in length due to pipe fall:

530.2 ft inlet elevation – 529.4 ft outlet elevation = 0.8 ft fall

Use $a^2 + b^2 = c^2$, where



$c^2 = (0.8)^2 + (228.32)^2$

$= 0.64 + 52130.022 = 52130.662$

c = 228.32 ft (no substantial increase)

The amount of pipe to order is 228 ft.

SKEW PIPES

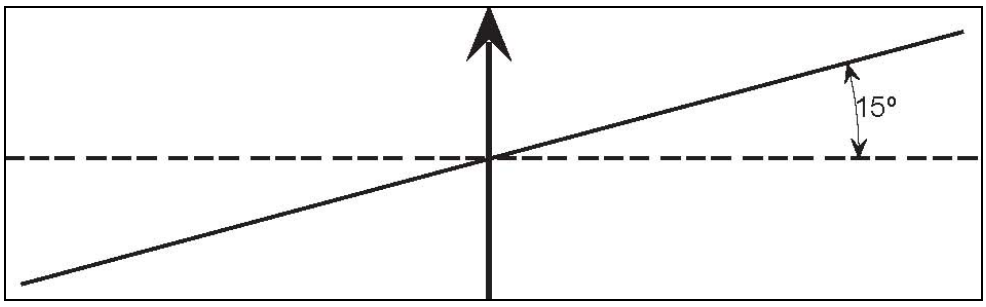
For pipes on a skew, the calculations are the same as before except the length of pipe is calculated using the skew angle as follows:

length on skew = perpendicular length / cos skew angle

EXAMPLE:

Using the previous example, all of the data is the same except the pipe is skewed 15 degrees to the left.

Plan View



The length of skew is calculated as follows:

length of skew = 228.32/cos 15 degrees

= 228.32/ 0.965925826

= 236.37 ft

Round to 236 ft. This is the length of pipe to order (Figure 15-2).

If riveted pipe is used, the pipe is required to be ordered in even 2 ft lengths. Spiral crimped seam pipe may be ordered to the nearest 1 ft length.

Pipe Length

Contract Number _____ Project Number _____

Structure Number _____ Station _____ Line _____

Plan Length _____ Calculated Length _____

LEFT				RIGHT
563.15	Profile Grade			563.15
562.52	Shoulder Elevation			562.52
530.20	Flow Line Elevation			529.40
32.32	Gross Fill (ft)			33.12
2.00	Deduction for Pipe (ft)			2.00
30.32	Net Fill (ft)			31.12
90.96	3:1	Slope	3:1	93.36
22.00	Distance from C.L. to Shoulder (ft)			22.00
112.96	Total (ft)			115.36
Total Length of Pipe (ft)	112.96 + 115.36 = 228.32 ft			
Skew Factor	0.965925826			
Total Length of Pipe with Skew (ft)	236.37			

Order **236** ft

Connect to Structure No. _____ Inlet Type _____

Figure 15-2. Pipe Length Problem with Skew