Example Problem: Calculate Quantities for Box Bridge (Fill)

Given:

Structure 144 LF of 6’ x 3’ (cell width x cell height) Reinforced Concrete Box Culvert

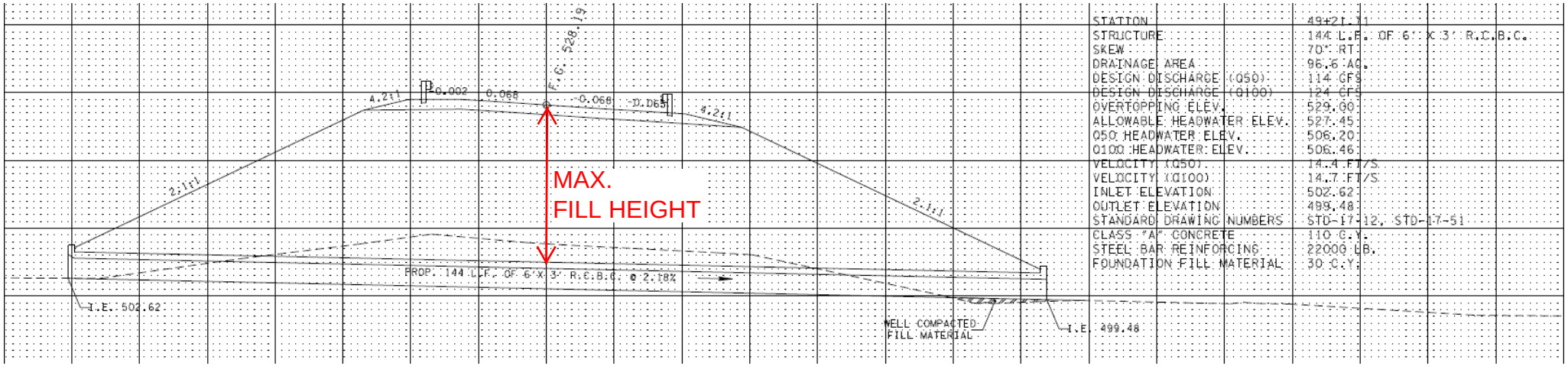
Skew 70°

Maximum Fill Height = 24’

Measure at the center of box culvert from top of slab to final grade

Slope = 2:1

Per Typical Sections in plans



Solution:

Calculate box bridge quantities.

Refer to Standard Drawing STD-17-51

1 @ 6 x 3 REINFORCED CONCRETE BOX BRIDGE

Maximum Fill Height ft.	Dimensions				Bars TST				Bars TSB				Bars BST				Bars BSB				Bars EWE				Bars EWI				Bars LNT	Bars LND	Bars WS	Concrete CY/LF	Reinf. Steel LB/LF
	ST in.	SB in.	WT in.	BW ft.	Size	No.	Spacing in.	Length ft.	Size	No.	Spacing in.	Length ft.	Size	No.	Spacing in.	Length ft.	Size	No.	Spacing in.	Length ft.	Size	No.	Spacing in.	Length ft.	Size	No.	Spacing in.	Length ft.	No.	No.	No.		
No Fill	8.5	9	8	7.33	4	1	12	6.83	6	2	6	6.83	5	2	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	35	12	4	0.57	142
3	10	10	8	7.33	4	1	12	6.83	6	2	6	6.83	7	1	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	35	12	4	0.63	141
5	8	9	8	7.33	4	1	12	6.83	5	2	6	6.83	5	2	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.56	132
10	8	9	8	7.33	4	1	12	6.83	5	2	6	6.83	7	1	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.56	132
20	8	9	8	7.33	4	1	12	6.83	6	2	6	6.83	6	2	6	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.56	146
30	11	13	8	7.33	4	1	12	6.83	6	2	6	6.83	8	1	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.73	143
40	14	15	8	7.33	4	1	12	6.83	6	2	6	6.83	8	1	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.85	143
50	16	17	8	7.33	4	1	12	6.83	6	2	6	6.83	8	1	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.95	143
60	17	18	8	7.33	4	1	12	6.83	7	2	6	6.83	6	2	6	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	1.00	153

Use table for 1 @ 6 x 3 Box Bridge

Since Maximum Fill Height (FT) = 24 FT, which is between 20 FT and 30 FT in the table, use values for the larger fill height of 30 FT

Therefore,

Concrete = 0.73 CY/LF

Reinforcing Steel = 143 LB/LF

The box bridge is 144 FT long, therefore,

Concrete = 0.73 CY/LF * 144 FT = 105.12 CY

Reinforcing Steel = 143 LB/LF * 144 FT = 20592 LB

Calculate the wing wall quantities.

Since the skew = 70°, round to the nearest skew value (90°, 75°, 60°, 45°). Use values for skew = 75°.

Refer to Standard Drawing STD-17-12, the quantities given in the tables in Standard Drawing STD-17-12 are for **ALL FOUR WINGWALLS**.

75° SKEW

2:1 SLOPE						
H	WL	hl	WS	hs	CONCRETE (C.Y.)	REINF. STEEL (LBS.)
4	6.00	2.25	4.50	1.75	2.6	641
4.5	6.75	2.50	5.25	2.00	4.7	710
5	7.50	2.75	5.75	2.25	5.5	790
5.5	8.50	3.00	6.50	2.50	6.7	935
6	9.25	3.25	7.25	2.50	7.7	1,019
6.5	10.00	3.75	7.75	2.75	8.9	1,096
7	11.00	4.00	8.50	3.00	10.8	1,408
7.5	11.75	4.25	9.00	3.25	12.1	1,515
8	12.50	4.50	9.75	3.50	13.6	1,626
8.5	13.50	4.75	10.25	3.75	15.3	1,773
9	14.25	5.00	11.00	4.00	18.1	2,646
9.5	15.00	5.50	11.50	4.25	20.0	2,725
10	16.00	5.75	12.25	4.50	22.2	3,018
10.5	16.75	6.00	12.75	4.75	24.2	3,146
11	17.50	6.25	13.50	4.75	28.1	3,503
11.5	18.50	6.50	14.25	5.00	31.3	4,373
12	19.25	6.75	14.75	5.25	33.6	4,638
12.5	20.00	7.25	15.50	5.50	37.0	4,832
13	20.75	7.50	16.00	5.75	42.0	5,744
13.5	21.25	7.75	16.75	6.00	44.8	6,169
14	22.50	8.00	17.25	6.25	48.4	6,454
14.5	23.25	8.25	18.00	6.50	51.5	6,822
15	24.25	8.75	18.50	6.75	58.5	7,370
15.5	25.00	9.00	19.25	7.00	63.9	8,362
16	25.75	9.25	19.75	7.00	67.3	8,778
16.5	26.75	9.50	20.50	7.25	71.8	10,207
17	27.50	9.75	21.00	7.50	78.2	11,200
17.5	28.25	10.00	21.75	7.75	82.6	11,188
18	29.25	10.50	22.50	8.00	88.0	11,667
18.5	30.00	10.75	23.00	8.25	92.4	11,878
19	30.75	11.00	23.75	8.50	104.9	13,387
19.5	31.75	11.25	24.25	8.75	110.2	15,072
20	32.50	11.50	25.00	9.00	116.7	15,803
20.5	33.25	11.75	25.50	9.00	121.6	16,206
21	34.00	12.25	26.25	9.25	136.2	17,837

3:1 SLOPE						
H	WL	hl	WS	hs	CONCRETE (C.Y.)	REINF. STEEL (LBS.)
4	7.25	2.50	5.75	2.25	4.5	691
4.5	8.25	3.00	6.75	2.50	5.7	761
5	9.00	3.25	7.50	2.75	7.2	861
5.5	10.00	3.75	8.25	3.00	8.5	1,017
6	11.00	4.00	9.00	3.25	9.9	1,122
6.5	12.00	4.25	9.75	3.50	11.4	1,207
7	13.00	4.75	10.50	3.75	13.6	1,537
7.5	14.00	5.00	11.25	4.00	15.7	1,672
8	15.00	5.25	12.00	4.25	17.7	1,801
8.5	15.75	5.75	12.75	4.75	19.7	1,987
9	16.75	6.00	13.75	5.00	23.3	3,019
9.5	17.75	6.25	14.50	5.25	25.7	3,112
10	18.75	6.75	15.25	5.50	28.3	3,426
10.5	19.75	7.00	16.00	5.75	31.4	3,627
11	20.75	7.50	16.75	6.00	35.5	4,061
11.5	21.50	7.75	17.50	6.25	39.5	4,904
12	22.50	8.00	18.25	6.50	42.7	5,207
12.5	23.50	8.50	19.00	6.75	46.3	5,388
13	24.50	8.75	19.75	7.00	53.2	6,454
13.5	25.50	9.00	20.75	7.50	55.3	6,892
14	26.50	9.50	21.50	7.75	64.5	7,348
14.5	27.50	9.75	22.25	8.00	68.8	7,780
15	28.25	10.00	23.00	8.25	74.7	8,379
15.5	29.25	10.50	23.75	8.50	79.6	9,359
16	30.25	10.75	24.50	8.75	84.4	9,839
16.5	31.25	11.00	25.25	9.00	92.9	11,836
17	32.25	11.50	26.00	9.25	101.8	12,984
17.5	33.25	11.75	26.75	9.50	107.4	12,925
18	34.00	12.25	27.75	9.75	111.4	13,414
18.5	35.00	12.50	28.50	10.25	119.7	13,702
19	36.00	12.75	29.25	10.50	131.7	15,117
19.5	37.00	13.25	30.00	10.75	142.2	17,331
20	38.00	13.50	30.75	11.00	151.8	18,121
20.5	39.00	13.75	31.50	11.25	158.9	18,687
21	39.75	14.25	32.25	11.50	176.7	20,378

Refer to Standard Drawings STD-17-51 and STD-17-8, use H = 5 FT

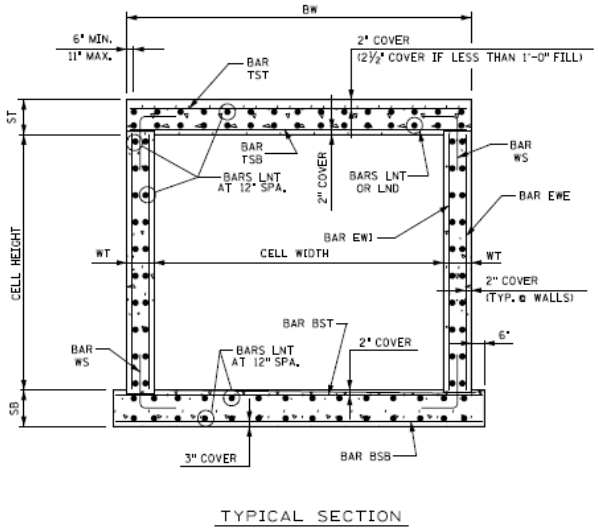
H = CELL HEIGHT + ST + CURB = 3 FT +11 IN (1 FT / 12 IN) + 1 FT = 4.92 FT, use 5 FT

If box bridge has a guardrail, use STD-17-7 instead of STD-17-8.

1 @ 6 x 3 REINFORCED CONCRETE BOX BRIDGE

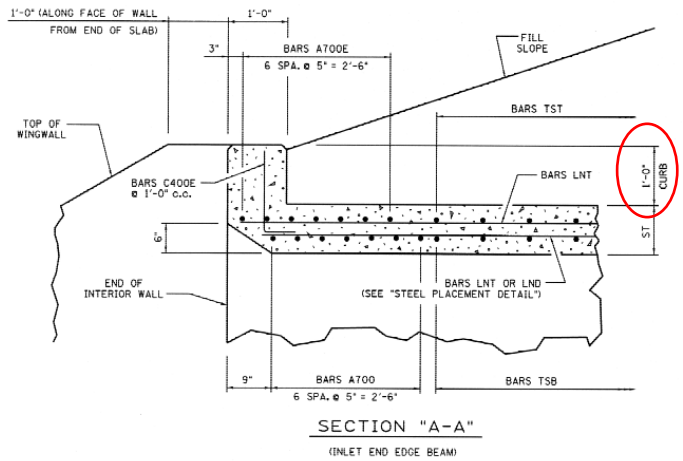
Maximum Fill Height ft.	Dimensions ST in.	SB in.	WT in.	BW ft.	Bars TST Size	No.	Spacing in.	Length ft.	Bars TSB Size	No.	Spacing in.	Length ft.	Bars BST Size	No.	Spacing in.	Length ft.	Bars BSB Size	No.	Spacing in.	Length ft.	Bars EWE Size	No.	Spacing in.	Length ft.	Bars EWI Size	No.	Spacing in.	Length ft.	Bars LNT No.	Bars LND No.	Bars WS No.	Concrete CY/LF	Reinf. Steel LB/LF
No Fill	8.5	9	8	7.33	4	1	12	6.83	6	2	6	6.83	5	2	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	35	12	4	0.57	142
3	10	10	8	7.33	4	1	12	6.83	6	2	6	6.83	7	1	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	35	12	4	0.63	141
5	8	9	8	7.33	4	1	12	6.83	5	2	6	6.83	5	2	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.56	132
10	8	9	8	7.33	4	1	12	6.83	5	2	6	6.83	7	1	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.56	132
20	8	9	8	7.33	4	1	12	6.83	6	2	6	6.83	6	2	6	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.56	146
30	11	13	8	7.33	4	1	12	6.83	6	2	6	6.83	8	1	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.73	143
40	14	15	8	7.33	4	1	12	6.83	6	2	6	6.83	8	1	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.85	143
50	16	17	8	7.33	4	1	12	6.83	6	2	6	6.83	8	1	12	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	0.95	143
60	17	18	8	7.33	4	1	12	6.83	7	2	6	6.83	6	2	6	7.83	4	1	12	7.83	4	2	12	3.00	5	2	12	3.00	42	0	4	1.00	153

Use Table from STD-17-51



TYPICAL SECTION

Use Typical Section from STD-17-51



SECTION "A-A"
(INLET END EDGE BEAM)

Use Section "A-A" from STD-17-8

Therefore,

Concrete = 5.5 CY

Reinforcing Steel = 790 LB

The quantities given in tables in Standard Drawing STD-17-12 are for

ALL FOUR WINGWALLS.

Therefore,

TOTAL CONCRETE = 105.12 CY + 5.5 CY = 110.62 CY

TOTAL REINFORCING STEEL = 20592 LB + 790 LB = 21382 LB