

Designer Note: Insert into contracts with precast concrete or cast-in-place box culvert having a skew >30 degrees and a design fill ≤ 5 feet. Also, read All Bridge Designer Memo for LRFD Design Requirements for Precast and CIP Concrete Box Culverts to ensure the proper information is shown on the plans.

CONCRETE BOX CULVERTS WITH SKEWS > 30 DEGREES AND DESIGN FILLS ≤ 5 FEET (BDE)

Effective: April 1, 2012

Revised: April 1, 2014

Revise the second paragraph of Article 540.04 of the Standard Specifications to read:

"Unless otherwise noted on the plans, the Contractor shall have the option, when a cast-in-place concrete box culvert is specified, of constructing the box culvert using precast box culvert sections when the design cover is 6 in. (150 mm) minimum. The precast box culvert sections shall be designed for the same design cover shown on the plans for cast-in-place box culvert; shall be of equal or larger size opening, and shall satisfy the design requirements of ASTM C 1577."

Add the following after the seventh paragraph of Article 540.06 of the Standard Specifications:

"Precast concrete box culverts with skews greater than 30 degrees and having design covers less than or equal to 5 feet are not covered by the standard design table shown in ASTM C 1577. The design table provided herein is provided to address this design range. The same notes, reinforcement configurations, clearances, and requirements of ASTM C 1577 apply to this special design table. A box designated 7' x 6' x 8" indicates a span of 7 ft., a rise of 6 ft., and top slab, bottom slab, walls and haunches of 8 in. unless otherwise noted on the tables.

3 ft. by 2 ft. by 4 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.168	0.900	0.295	0.096	0.269	0.168	0.853	0.144	
2<3	0.134	0.180	0.182	0.096					31
3-5	0.096	0.115	0.117	0.096					29

*top slab 7 in., bottom slab 6.0 in.

3 ft. by 3 ft. by 4 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.168	0.956	0.326	0.096	0.290	0.168	0.849	0.144	
2<3	0.101	0.214	0.218	0.096					31
3-5	0.096	0.136	0.140	0.096					31

*top slab 7.0 in., bottom slab 6.0 in.

4 ft. by 2 ft. by 5 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.204	0.790	0.262	0.120	0.268	0.180	0.846	0.144	
2<3	0.201	0.203	0.196	0.120					32
3-5	0.129	0.134	0.136	0.120					32

*top slab 7.5 in., bottom slab 6.0 in.

4 ft. by 3 ft. by 5 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.180	0.876	0.303	0.120	0.305	0.180	0.831	0.144	
2<3	0.160	0.245	0.238	0.120					38
3-5	0.120	0.161	0.165	0.120					35

*top slab 7.5 in., bottom slab 6.0 in.

4 ft. by 4 ft. by 5 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.180	0.927	0.334	0.120	0.327	0.180	0.822	0.144	
2<3	0.130	0.277	0.270	0.120					38
3-5	0.120	0.181	0.188	0.120					38

*top slab 7.5 in., bottom slab 6.0 in.

5 ft. by 3 ft. by 6 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.197	0.682	0.269	0.144	0.280	0.192	0.705	0.168	
2<3	0.206	0.259	0.246	0.144					37
3-5	0.144	0.180	0.179	0.144					35

*top slab 8.0 in., bottom slab 7.0 in.

5 ft. by 4 ft. by 6 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.192	0.735	0.299	0.144	0.307	0.192	0.693	0.168	
2<3	0.180	0.294	0.282	0.144					46
3-5	0.144	0.204	0.205	0.144					40

*top slab 8.0 in., bottom slab 7.0 in.

5 ft. by 5 ft. by 6 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.192	0.774	0.324	0.144	0.327	0.192	0.685	0.168	
2<3	0.155	0.322	0.312	0.144					45
3-5	0.144	0.224	0.228	0.144					45

*top slab 8.0 in., bottom slab 7.0 in.

6 ft. by 3 ft. by 7 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.270	0.566	0.257	0.168	0.263	0.192	0.575	0.168	
2<3	0.260	0.269	0.273	0.168					41
3-5	0.186	0.192	0.197	0.168					39

*top slab 8.0 in.

6 ft. by 4 ft. by 7 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.245	0.617	0.297	0.168	0.293	0.192	0.565	0.168	
2<3	0.225	0.305	0.313	0.168					42
3-5	0.168	0.220	0.227	0.168					41

*top slab 8.0 in.

6 ft. by 5 ft. by 7 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.226	0.657	0.331	0.168	0.317	0.192	0.551	0.168	
2<3	0.198	0.338	0.348	0.168					59
3-5	0.168	0.242	0.252	0.168					48

*top slab 8.0 in.

6 ft. by 6 ft. by 7 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2*	0.208	0.692	0.363	0.168	0.337	0.192	0.540	0.168	
2<3	0.176	0.364	0.379	0.168					52
3-5	0.168	0.261	0.275	0.168					52

*top slab 8.0 in.

7 ft. by 4 ft. by 8 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.339	0.599	0.372	0.192	0.271	0.192	0.697	0.192	
2<3	0.287	0.335	0.342	0.192					44
3-5	0.206	0.241	0.248	0.192					42

7 ft. by 5 ft. by 8 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.317	0.637	0.417	0.192	0.293	0.192	0.684	0.192	
2<3	0.256	0.370	0.381	0.192					49
3-5	0.192	0.266	0.276	0.192					46

7 ft. by 6 ft. by 8 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.296	0.672	0.458	0.192	0.312	0.192	0.658	0.192	
2<3	0.230	0.401	0.416	0.192					59
3-5	0.192	0.288	0.302	0.192					55

7 ft. by 7 ft. by 8 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.276	0.703	0.496	0.192	0.330	0.192	0.653	0.192	
2<3	0.210	0.428	0.447	0.192					59
3-5	0.192	0.307	0.326	0.192					59

8 ft. by 4 ft. by 8 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.397	0.510	0.400	0.192	0.283	0.192	0.568	0.192	
2<3	0.399	0.415	0.423	0.192					45
3-5	0.285	0.298	0.306	0.192					45

8 ft. by 5 ft. by 8 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.368	0.555	0.446	0.192	0.305	0.192	0.559	0.192	
2<3	0.360	0.458	0.470	0.192					48
3-5	0.259	0.328	0.340	0.192					45

8 ft. by 6 ft. by 8 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.342	0.596	0.488	0.192	0.325	0.192	0.556	0.192	
2<3	0.328	0.496	0.512	0.192					56
3-5	0.237	0.355	0.371	0.192					50

8 ft. by 7 ft. by 8 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.319	0.633	0.527	0.192	0.343	0.192	0.555	0.192	
2<3	0.301	0.529	0.551	0.192					65
3-5	0.219	0.379	0.399	0.192					61

8 ft. by 8 ft. by 8 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.297	0.668	0.565	0.192	0.360	0.192	0.531	0.192	
2<3	0.280	0.560	0.587	0.192					65
3-5	0.204	0.400	0.427	0.192					65

9 ft. by 5 ft. by 9 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.361	0.411	0.416	0.216	0.275	0.216	0.465	0.216	
2<3	0.425	0.484	0.496	0.216					49
3-5	0.306	0.348	0.360	0.216					49

9 ft. by 6 ft. by 9 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.335	0.439	0.455	0.216	0.294	0.216	0.467	0.216	
2<3	0.390	0.524	0.541	0.216					55
3-5	0.282	0.376	0.393	0.216					52

9 ft. by 7 ft. by 9 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.313	0.464	0.491	0.216	0.311	0.216	0.453	0.216	
2<3	0.360	0.561	0.583	0.216					64
3-5	0.262	0.402	0.423	0.216					58

9 ft. by 8 ft. by 9 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.286	0.488	0.514	0.216	0.327	0.216	0.454	0.216	
2<3	0.336	0.594	0.621	0.216					72
3-5	0.244	0.426	0.453	0.216					73

9 ft. by 9 ft. by 9 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.274	0.511	0.557	0.216	0.342	0.216	0.452	0.216	
2<3	0.316	0.625	0.659	0.216					72
3-5	0.231	0.448	0.481	0.216					72

10 ft. by 5 ft. by 10 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.370	0.393	0.392	0.240	0.263	0.240	0.240	0.240	
2<3	0.492	0.509	0.522	0.240					52
3-5	0.354	0.366	0.379	0.240					52

10 ft. by 6 ft. by 10 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.348	0.420	0.432	0.240	0.282	0.240	0.418	0.240	
2<3	0.455	0.552	0.570	0.240					56
3-5	0.329	0.397	0.414	0.240					52

10 ft. by 7 ft. by 10 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.321	0.445	0.463	0.240	0.298	0.240	0.240	0.240	
2<3	0.423	0.591	0.614	0.240					59
3-5	0.307	0.425	0.447	0.240					56

10 ft. by 8 ft. by 10 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.301	0.469	0.496	0.240	0.314	0.240	0.240	0.240	
2<3	0.394	0.627	0.655	0.240					72
3-5	0.288	0.451	0.478	0.240					66

10 ft. by 9 ft. by 10 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.284	0.492	0.527	0.240	0.329	0.240	0.240	0.240	
2<3	0.371	0.660	0.694	0.240					79
3-5	0.272	0.475	0.508	0.240					85

10 ft. by 10 ft. by 10 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.272	0.514	0.559	0.240	0.344	0.240	0.240	0.240	
2<3	0.353	0.691	0.732	0.240					79
3-5	0.259	0.497	0.537	0.240					79

11 ft. by 4 ft. by 11 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.414	0.341	0.333	0.264	0.264	0.264	0.264	0.264	
2<3	0.609	0.481	0.491	0.264					60
3-5	0.436	0.348	0.357	0.264					56

11 ft. by 6 ft. by 11 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.356	0.399	0.407	0.264	0.265	0.264	0.264	0.264	
2<3	0.521	0.580	0.597	0.264					56
3-5	0.377	0.418	0.435	0.264					56

11 ft. by 8 ft. by 11 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.314	0.449	0.471	0.264	0.298	0.264	0.264	0.264	
2<3	0.457	0.659	0.687	0.264					67
3-5	0.333	0.475	0.502	0.264					63

11 ft. by 10 ft. by 11 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.285	0.494	0.532	0.264	0.328	0.264	0.264	0.264	
2<3	0.409	0.727	0.769	0.264					86
3-5	0.300	0.524	0.565	0.264					86

11 ft. by 11 ft. by 11 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.276	0.516	0.562	0.264	0.342	0.264	0.264	0.264	
2<3	0.391	0.758	0.808	0.264					86
3-5	0.289	0.548	0.596	0.264					86

12 ft. by 4 ft. by 12 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.426	0.329	0.316	0.288	0.288	0.288	0.321	0.288	
2<3	0.682	0.503	0.512	0.288					64
3-5	0.489	0.364	0.373	0.288					60

12 ft. by 6 ft. by 12 in.

Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.367	0.385	0.387	0.288	0.288	0.288	0.320	0.288	
2<3	0.590	0.606	0.624	0.288					60
3-5	0.427	0.438	0.456	0.288					56

12 ft. by 8 ft. by 12 in.									
Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.326	0.435	0.449	0.288	0.288	0.288	0.288	0.288	
2<3	0.521	0.690	0.719	0.288					67
3-5	0.381	0.499	0.527	0.288					64

12 ft. by 10 ft. by 12 in.									
Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.298	0.481	0.507	0.288	0.305	0.288	0.288	0.288	
2<3	0.467	0.762	0.804	0.288					93
3-5	0.344	0.551	0.592	0.288					79

12 ft. by 12 ft. by 12 in.									
Design Earth Cover, ft.	Circumferential Reinforcement Areas, sq. in./ft.								"M", in.
	As1	As2	As3	As4	As5	As6	As7	As8	
0<2	0.288	0.525	0.566	0.288	0.333	0.288	0.288	0.288	
2<3	0.431	0.827	0.886	0.288					93
3-5	0.320	0.599	0.656	0.288					93"

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