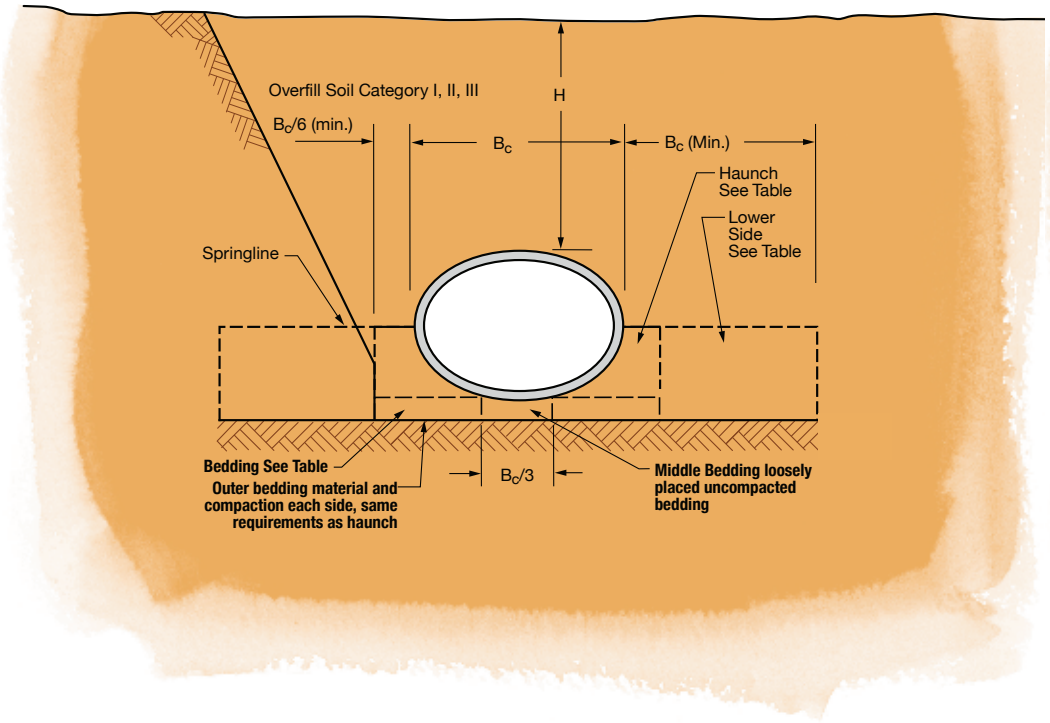
FOR HORIZONTAL ELLIPTICAL AND ARCH CONCRETE PIPE

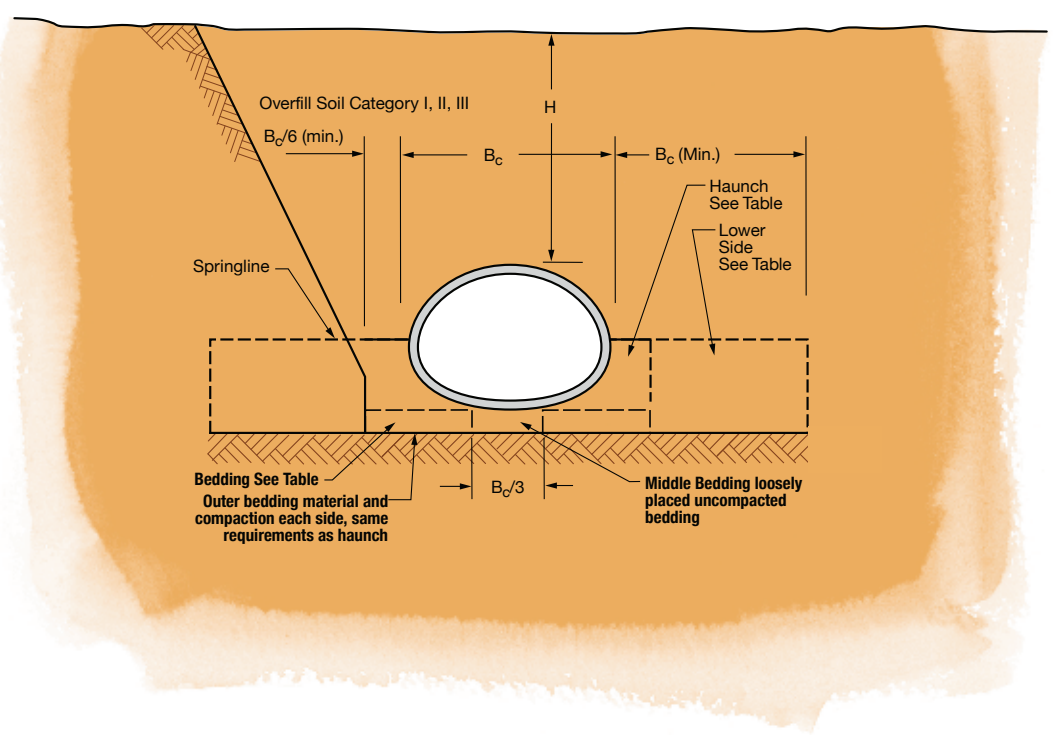
ACPA
American Concrete Pipe Association

LRFD FILL HEIGHT TABLES

Standard Trench/Embankment Installation

Concrete pipe should be installed in accordance with the AASHTO LRFD Bridge Construction Specifications, Section 27 or ASTM C1479. Figure 1 shows the basic pipe and soil terminology.





There are two types of Standard Installations for horizontal elliptical and arch concrete pipe, each with its own soil and compaction requirements. Type 2 bedding provides better support using well compacted granular material, while Type 3 provides for less support allowing the use of silts. These choices provide flexibility and versatility for the designer and contractor, as well as performance and economy for the owner that are not available with other types of pipe.

The soil and compaction requirements are provided in Table 1. Table 2 shows the equivalent soil designations per the Unified Soil Classification System (USCS) and AASHTO.

To facilitate your selection of the proper reinforced concrete pipe using the most beneficial Standard Installation for the conditions at the site, fill height tables are provided on the following pages. The required 0.01 inch crack D-Loads in units of lbs per linear foot per foot of span are provided numerically and the class of pipe per ASTM C506 (AASHTO M 206) or ASTM C507 (AASHTO M 207) meeting this requirement is designated by color of the cell.

Table 1: Standard Installation Soils and Minimum Compaction Requirements			
Installation Type	Bedding Thickness	Haunch and Outer Bedding	Lower Side
Type 2	D_o/24 minimum, not less than 3" (75 mm) If rock foundation, use D_o/12 minimum, not less than 6" (150 mm)	90% Category I or 95% Category II	85% Category I, 90% Category II, or 95% Category III
Type 3	D_o/24 minimum, not less than 3" (75 mm) If rock foundation, use D_o/12 minimum, not less than 6" (150 mm)	85% Category I, 90% Category II, or 95% Category III	85% Category I, 90% Category II, or 95% Category III

Reference: AASHTO LRFD Bridge Construction Specifications, Section 27

Table 3: Reinforced Pipe Classes for 0.01 inch Crack Per ASTM C 506 (lbs/ft/ft)	
Class A-II	≤ 1000
Class A-III	≤ 1350
Class A-IV	≤ 2000
Special Design	> 2000

Table 4: Reinforced Pipe Classes for 0.01 inch Crack Per ASTM C 507 (lbs/ft/ft)	
Class HE-A	≤ 600
Class HE-I	≤ 800
Class HE-II	≤ 1000
Class HE-III	≤ 1350
Class HE-IV	≤ 2000
Special Design	> 2000

Table 2: Equivalent USCS and AASHTO Soil Classifications for Standard Installation Soil Designations				
Representative Soil Types			Percent Compaction	
SIDD	USCS	AASHTO	Standard Proctor	Modified Proctor
Gravelly Sand (Category I)	SW, SP, GW, GP	A1, A3	100 95 90 85 80 61	95 90 85 80 75 59
Sandy Silt (Category II)	GM, SM, ML, Also GC, SC with less than 20% passing #200 sieve	A2, A4	100 95 90 85 80 49	95 90 85 80 75 46
Silty Clay (Category III)	CL, MH, GC, SC	A5, A6	100 95 90 85 80 45	90 85 80 75 70 40
	CH Not allowed for haunch or bedding	A7	100 95 90 45	90 85 80 40

Reference: AASHTO LRFD Bridge Construction Specifications, Section 27

NOTES:
1. Compaction and soil symbols – i.e. "95% Category I" refers to Category I soil material with a minimum Standard Proctor compaction of 95%. See Table 2 for equivalent Modified Proctor values.
2. Soil in the outer bedding, haunch, and lower side zones shall be compacted to at least the same compaction as the majority of soil in the overfill zone.

Horizontal Elliptical Pipe

The following Fill Height Tables have been developed by the American Concrete Pipe Association (ACPA) using the indirect design method in accordance with Section 12.10.4.3 of the AASHTO LRFD Bridge Design Specification, 7th Edition, 2014.

Fill Height Tables are based on:

1. γ_s = 120 pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A projection ratio of 0.9.

D-Load (lb/ft/ft) for Type 2 Bedding

Class HE-A
Class HE-I
Class HE-II
Class HE-III
Class HE-IV
Special Design

Inside Rise x Inside Span (inches)	Fill Height (feet)														
	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10	11	12
14 x 23	1308	1140	1044	1160	942	815	714	709	742	797	860	813	901	989	1078
19 x 30	1445	1464	1323	1168	945	817	719	710	743	796	857	805	892	979	1065
22 x 34	1278	1298	1291	1112	910	789	703	698	733	788	849	801	887	973	1059
24 x 38	1148	1168	1196	1071	879	765	690	688	726	781	842	798	884	969	1054
27 x 42	1042	1063	1091	1023	838	737	671	674	714	768	828	789	873	957	1041
29 x 45	979	1002	1030	987	838	739	679	684	726	782	844	806	892	978	1063
32 x 49	904	928	956	908	813	720	668	678	721	777	839	805	890	976	1061
34 x 53	948	865	893	864	780	699	659	672	717	773	835	804	889	974	1059
38 x 60	925	882	826	833	733	676	647	666	713	770	833	808	892	977	1061
43 x 68	827	851	826	798	705	655	633	658	707	765	828	809	893	977	1061
48 x 76	751	777	803	767	681	637	621	652	703	761	825	810	894	978	1062
53 x 83	699	726	753	746	665	626	617	651	702	761	825	815	899	983	1066
58 x 91	650	678	705	724	645	612	610	647	699	759	824	818	901	985	1068
63 x 98	616	644	672	697	637	606	610	648	701	761	826	898	907	990	1073
68 x 106	582	611	639	665	638	607	612	651	704	764	829	901	975	993	1076
72 x 113	559	588	617	656	643	610	617	656	709	769	835	907	981	999	1082
77 x 121	534	564	594	659	647	611	619	659	712	773	838	910	984	1060	1085
82 x 128	518	548	578	661	643	615	620	662	715	776	841	913	987	1062	1139
87 x 136	501	531	561	662	626	616	621	663	717	777	843	914	988	1063	1139
92 x 143	489	520	550	667	627	609	626	668	722	783	848	920	994	1069	1145
97 x 151	477	507	538	670	631	612	628	671	726	787	852	924	998	1073	1149
106 x 166	460	491	522	679	641	623	634	679	734	796	862	934	1008	1083	1159
116 x 180	451	483	514	689	653	636	648	689	745	807	873	945	1020	1095	1172

Horizontal Elliptical Pipe

D-Load (lb/ft/ft) for Type 2 Bedding

Class HE-A
Class HE-I
Class HE-II
Class HE-III
Class HE-IV
Special Design

Fill Height Tables are based on:

1. γ_s = 120 pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A projection ratio of 0.9.

Fill Height (feet)													
Inside Rise x Inside Span (inches)	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
14 x 23	1166	1255	1343	1431	1520	1608	1697	1785	1873	1962	2050	2139	2227
19 x 30	1152	1239	1326	1413	1500	1586	1673	1760	1847	1934	2020	2107	2194
22 x 34	1145	1231	1317	1403	1489	1575	1661	1747	1833	1919	2005	2092	2178
24 x 38	1140	1225	1311	1396	1482	1567	1653	1738	1823	1909	1994	2080	2165
27 x 42	1126	1210	1294	1378	1462	1546	1630	1714	1798	1882	1967	2051	2135
29 x 45	1149	1235	1320	1406	1492	1577	1663	1748	1834	1920	2005	2091	2177
32 x 49	1146	1231	1316	1402	1487	1572	16578	1742	1828	1913	1998	2083	2168
34 x 53	1144	1229	1314	1399	1483	1568	1653	1738	1823	1907	1992	2077	2162
38 x 60	1146	1230	1315	1399	1484	1568	1653	1737	1822	1906	1990	2075	2159
43 x 68	1145	1229	1313	1397	1481	1565	1649	1733	1817	1901	1985	2069	2153
48 x 76	1145	1229	1313	1396	1480	1563	1647	1731	1814	1898	1981	2065	2148
53 x 83	1150	1233	1317	1400	1484	1567	1651	1734	1817	1901	1984	2068	2151
58 x 91	1151	1235	1318	1401	1484	1568	1651	1734	1817	1900	1983	2067	2150
63 x 98	1157	1240	1323	1406	1489	1572	1655	1738	1822	1905	1988	2071	2154
68 x 106	1159	1242	1325	1408	1491	1574	1657	1740	1823	1905	1988	2071	2154
72 x 113	1165	1248	1331	1413	1496	1579	1662	1745	1828	1911	1993	2076	2159
77 x 121	1168	1251	1333	1416	1499	1582	1664	1747	1830	1912	1995	2078	2160
82 x 128	1170	1253	1335	1418	1500	1583	1665	1747	1830	1912	1994	2077	2159
87 x 136	1216	1253	1335	1417	1499	1581	1663	1745	1827	1909	1991	2073	2155
92 x 143	1222	1259	1341	1423	1506	1588	1670	1752	1834	1916	1998	2080	2161
97 x 151	1226	1304	1345	1427	1509	1591	1673	1755	1837	1919	2001	2083	2165
106 x 166	1237	1314	1393	1438	1520	1602	1684	1766	1847	1929	2011	2093	2175
116 x 180	1249	1327	1405	1484	1563	1614	1696	1778	1860	1942	2024	2106	2188

Horizontal Elliptical Pipe

Fill Height Tables are based on:

1. γ_s = 120 pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A projection ratio of 0.5.

D-Load (lb/ft/ft) for Type 3 Bedding

Class HE-A
Class HE-I
Class HE-II
Class HE-III
Class HE-IV
Special Design

Fill Height (feet)															
Inside Rise x Inside Span (inches)	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
14 x 23	1336	1182	1099	1228	1023	910	835	857	917	999	1089	1069	1184	1300	1415
19 x 30	1475	1511	1382	1239	1030	915	843	861	920	1000	1087	1061	1174	1288	1401
22 x 34	1310	1348	1352	1186	997	889	828	849	911	991	1079	1057	1169	1282	1394
24 x 38	1180	1220	1259	1147	968	866	816	840	905	985	1072	1055	1166	1278	1389
27 x 42	1076	1116	1157	1101	928	839	799	826	892	972	1058	1044	1154	1263	1373
29 x 45	1014	1057	1099	1068	932	845	811	842	910	992	1079	1068	1180	1291	1403
32 x 49	940	984	1027	991	909	828	802	837	906	988	1076	1068	1179	1290	1401
34 x 53	985	923	967	950	878	810	794	833	903	985	1073	1068	1179	1290	1400
38 x 60	964	943	905	924	836	791	787	831	904	986	1074	1075	1185	1295	1405
43 x 68	867	914	909	894	813	775	777	827	901	984	1073	1079	1188	1298	1407
48 x 76	793	841	887	868	794	762	770	825	901	984	1073	1084	1193	1302	1411
53 x 83	743	794	840	852	783	756	771	829	905	989	1078	1093	1202	1311	1420
58 x 91	695	747	795	832	769	746	768	829	906	990	1080	1099	1208	1316	1425
63 x 98	664	716	765	809	766	746	773	835	912	997	1087	1184	1218	1326	1434
68 x 106	633	984	734	779	771	752	780	842	920	1004	1094	1191	1290	1333	1441
72 x 113	612	664	714	773	779	761	790	852	930	1014	1104	1201	1300	1343	1451
77 x 121	591	642	693	778	785	768	798	860	937	1022	1112	1209	1307	1408	1458
82 x 128	577	628	680	783	784	774	803	868	945	1029	1119	1215	1314	1414	1515
87 x 136	562	612	664	786	770	778	809	874	951	1035	1124	1220	1318	1418	1518
92 x 143	554	603	656	794	773	773	820	884	961	1045	1135	1231	1329	1428	1529
97 x 151	543	592	646	799	779	779	828	892	970	1054	1143	1239	1337	1437	1537
106 x 166	532	579	634	812	794	796	844	911	989	1073	1162	1258	1356	1456	1556
116 x 180	529	574	631	828	812	814	865	932	1010	1094	1184	1280	1378	1478	1578

Horizontal Elliptical Pipe

D-Load (lb/ft/ft) for Type 3 Bedding

Fill Height Tables are based on:
1. γ_s = 120 pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A projection ratio of 0.5.

Class HE-A
Class HE-I
Class HE-II
Class HE-III
Class HE-IV
Special Design

Fill Height (feet)								
Inside Rise x Inside Span (inches)	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
14 x 23	1530	1646	1761	1876	1992	2107	2223	2338
19 x 30	1514	1628	1741	1854	1967	2081	2194	2307
22 x 34	1506	1618	1731	1843	1955	2067	2180	2292
24 x 38	1501	1612	1724	1835	1947	2058	2170	2281
27 x 42	1483	1593	1702	1812	1922	2031	2141	2251
29 x 45	1515	1627	1738	1850	1962	2074	2185	2297
32 x 49	1512	1624	1735	1846	1957	2068	2179	2291
34 x 53	1511	1622	1732	1843	1954	2064	2175	2286
38 x 60	1516	1626	1736	1846	1956	2067	2177	2287
43 x 68	1517	1627	1736	1846	1955	2065	2174	2284
48 x 76	1520	1629	1738	1847	1956	2065	2174	2283
53 x 83	1528	1637	1746	1855	1964	2073	2181	2290
58 x 91	1533	1642	1750	1859	1967	2076	2184	2293
63 x 98	1543	1651	1759	1868	1976	2084	2193	2301
68 x 106	1549	1657	1765	1873	1981	2089	2197	2305
72 x 113	1559	1667	1775	1883	1991	2099	2206	2314
77 x 121	1566	1673	1781	1889	1997	2104	2212	2320
82 x 128	1571	1678	1786	1893	2000	2108	2215	2322
87 x 136	1620	1681	1788	1895	2002	2109	2215	2322
92 x 143	1631	1692	1799	1906	2013	2119	2226	2333
97 x 151	1639	1741	1807	1914	2020	2127	2234	2341
106 x 166	1658	1760	1863	1933	2039	2146	2253	2359
116 x 180	1680	1782	1885	1988	2092	2168	2275	2381

Arch Pipe

D-Load (lb/ft/ft) for Type 2 Bedding

Class A
Class I
Class II
Class III
Class IV
Special Design

Fill Height Tables are based on:
1. γ_s = 120 pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A projection ratio of 0.9.

	Fill Height (feet)														
Inside Rise x Inside Span (inches)	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
11 x 18	1403	1295	1058	1175	953	824	719	714	747	802	866	818	908	997	1086
13½ x 22	1368	1139	1037	1163	946	819	711	706	739	793	855	807	894	982	1069
15½ x 26	1276	1184	1077	1119	908	786	690	684	716	768	828	781	865	950	1034
18 x 28½	1373	1394	1208	1157	939	812	714	707	740	793	854	803	890	976	1063
22½ x 36¼	1204	1224	1251	1085	891	774	695	691	728	783	843	798	883	968	1053
26 5/8 x 43 3/8	1007	1029	1057	1015	836	737	675	679	720	775	835	797	882	966	1051
31 5/16 x 51 1/8	907	896	923	873	795	704	659	671	714	770	831	799	883	967	1051
36 x 58½	948	867	824	834	733	677	646	664	710	766	828	802	886	970	1053
40 x 65	866	890	825	810	716	664	639	662	710	767	830	808	892	976	1059
45 x 73	782	808	824	778	691	646	627	656	706	763	827	810	894	977	1060
54 x 88	673	700	727	733	655	619	616	651	703	762	826	819	902	985	1068
62 x 102	605	634	662	678	631	607	617	651	704	765	830	902	913	996	1079
72 x 115	548	577	606	618	603	576	609	644	693	751	817	889	963	1039	1070
77½ x 122	530	559	588	653	641	605	614	653	706	766	831	903	976	1051	1076
87 1/8 x 138	493	523	553	659	619	609	618	660	713	774	839	910	984	1059	1135
96 7/8 x 154	467	498	529	665	626	607	623	666	720	781	847	918	992	1067	1143
106½ x 168¾	452	482	512	663	627	609	620	665	719	779	844	914	986	1060	1134

Arch Pipe

D-Load (lb/ft/ft) for Type 2 Bedding

Class A
Class I
Class II
Class III
Class IV
Special Design

Fill Height Tables are based on:
1. γ_s = 120 pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A projection ratio of 0.9.

	Fill Height (feet)												
Inside Rise x Inside Span (inches)	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**	**21**	**22**	**23**	**24**	**25**
11 x 18	1175	1264	1353	1443	1532	1621	1710	1799	1889	1978	2067	2156	2245
13½ x 22	1157	1244	1332	1419	1507	1595	1682	1770	1857	1945	2032	2120	2208
15½ x 26	1119	1203	1287	1372	1456	1541	1625	1709	1794	1878	1962	2047	2131
18 x 28½	1149	1235	1322	1408	1494	1581	1667	1753	1840	1926	2013	2099	2185
22½ x 36¼	1138	1224	1309	1394	1479	1564	1649	1735	1820	1905	1990	2075	2160
26 5/8 x 43 3/8	1135	1220	1304	1388	1473	1557	1642	1726	1811	1895	1979	2064	2148
31 5/16 x 51 1/8	1135	1219	1303	1387	1471	1555	1639	1723	1807	1891	1975	2058	2142
36 x 58½	1137	1220	1304	1388	1471	1555	1638	1722	1805	1889	1973	2056	2140
40 x 65	1143	1226	1310	1393	1477	1560	1644	1727	1810	1894	1977	2061	2144
45 x 73	1143	1227	1310	1393	1476	1559	1642	1726	1809	1892	1975	2058	2141
54 x 88	1151	1233	1316	1399	1482	1565	1647	1730	1813	1896	1978	2061	2144
62 x 102	1162	1244	1327	1410	1493	1575	1658	1741	1823	1906	1988	2071	2154
72 x 115	1152	1234	1316	1398	1480	1562	1644	1726	1808	1890	1972	2054	2136
77½ x 122	1158	1240	1322	1405	1487	1569	1651	1733	1815	1897	1979	2061	2143
87 1/8 x 138	1212	1248	1330	1412	1494	1576	1658	1740	1822	1903	1985	2067	2149
96 7/8 x 154	1220	1297	1338	1420	1502	1584	1666	1747	1829	1911	1993	2074	2156
106½ x 168¾	1210	1286	1362	1406	1487	1567	1647	1727	1807	1887	1967	2047	2127

Arch Pipe

D-Load (lb/ft/ft) for Type 3 Bedding

Class A
Class I
Class II
Class III
Class IV
Special Design

Fill Height Tables are based on:
1. γ_s = 120 pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A projection ratio of 0.9.

	Fill Height (feet)														
Inside Rise x Inside Span (inches)	**0.5**	**1**	**1.5**	**2**	**2.5**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
11 x 18	1430	1335	1111	1241	1032	917	840	862	922	1004	1095	1075	1191	1307	1424
13½ x 22	1396	1180	1091	1230	1026	913	831	854	913	993	1083	1060	1175	1289	1403
15½ x 26	1305	1227	1132	1187	989	879	809	828	886	964	1049	1028	1138	1248	1358
18 x 28½	1405	1441	1267	1229	1023	910	838	857	916	995	1082	1058	1171	1284	1397
22½ x 36¼	1237	1276	1314	1161	979	875	821	843	907	987	1073	1054	1165	1276	1387
26⁵/8 x 43³/8	1042	1084	1125	1095	929	842	805	835	901	981	1068	1056	1166	1276	1386
31⁵/16 x 51¹/8	945	954	997	959	893	813	794	830	899	980	1067	1061	1170	1280	1389
36 x 58½	988	928	904	924	836	791	785	828	899	980	1068	1067	1176	1285	1394
40 x 65	908	954	909	906	823	783	783	830	904	986	1074	1077	1186	1295	1404
45 x 73	826	874	910	880	804	770	775	829	903	986	1074	1083	1191	1300	1408
54 x 88	719	770	818	843	778	754	773	833	909	992	1082	1099	1207	1315	1423
62 x 102	657	709	758	794	766	753	785	843	920	1005	1095	1192	1227	1335	1443
72 x 115	601	652	702	734	737	725	781	838	911	993	1084	1180	1279	1379	1435
77½ x 122	585	636	687	771	778	761	791	853	930	1014	1103	1199	1297	1396	1446
87¹/8 x 138	554	603	656	781	761	770	805	870	946	1030	1119	1215	1313	1412	1513
96⁷/8 x 154	533	581	635	792	773	773	822	886	963	1047	1136	1232	1330	1429	1530
106½ x 168¾	522	568	623	794	777	779	826	892	968	1050	1138	1231	1327	1424	1523

Arch Pipe

D-Load (lb/ft/ft) for Type 3 Bedding

Class A
Class I
Class II
Class III
Class IV
Special Design

Fill Height Tables are based on:
1. γ_s = 120 pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A projection ration of 0.5.

Fill Height (feet)								
Inside Rise x Inside Span (inches)	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
11 x 18	1540	1657	1773	1889	2006	2122	2238	2355
13½ x 22	1517	1632	1746	1860	1975	2089	2203	2317
15½ x 26	1468	1579	1689	1799	1909	2019	2129	2239
18 x 28½	1509	1622	1735	1847	1960	2073	2186	2298
22½ x 36¼	1498	1609	1720	1831	1943	2054	2165	2276
26 5/8 x 43 3/8	1496	1606	1716	1837	1937	2047	2157	2267
31 5/16 x 51 1/8	1499	1608	1718	1837	1937	2046	2156	2265
36 x 58½	1503	1612	1721	1830	1939	2048	2157	2266
40 x 65	1513	1622	1731	1840	1948	2057	2166	2275
45 x 73	1517	1625	1734	1842	1950	2059	2167	2276
54 x 88	1531	1639	1747	1855	1963	2071	2179	2287
62 x 102	1551	1658	1766	1874	1982	2089	2197	2305
72 x 115	1542	1649	1756	1863	1970	2077	2183	2290
77½ x 122	1553	1660	1766	1873	1980	2087	2194	2301
87 1/8 x 138	1614	1676	1782	1889	1995	2102	2209	2315
96 7/8 x 154	1631	1733	1799	1905	2012	2118	2224	2331
106½ x 168¾	1622	1722	1822	1890	1995	2099	2203	2307

The preceding fill height tables are based on a concrete pipe installed in a positive projecting embankment installation with a soil unit weight of 120 lbs/ft^3 and HL-93 live load per the AASHTO LRFD Bridge Design Specifications at the surface. The required classes of pipe do not account for construction loads or any other load induced on the pipe prior to its completed installation, or live load in excess of HL-93.

Dimensions of Elliptical Concrete Pipe - Metric Units

Normal Equivalent Round size	Minor Axis, mm	Major Axis, mm	Minimum Wall Thick-ness, mm	Water-Way Area, m^2	Approximate Mass kg/m
450	365	575	69	.17	290
600	490	770	82	.31	446
675	550	865	88	.38	543
750	610	960	94	.47	640
825	670	1055	94	.59	707
900	730	1150	113	.68	930
975	795	1250	119	.82	1071
1050	855	1345	125	.95	1213
1200	975	1535	138	1.20	1488
1350	1095	1730	150	1.55	1838
1500	1220	1920	163	1.90	2195
1650	1340	2110	175	2.30	2597
1800	1465	2305	188	2.73	3036
1950	1585	2495	200	3.21	3497
2100	1705	2690	213	3.73	3988
2250	1830	2880	225	4.28	4538
2400	1950	3070	238	4.87	5089
2550	2075	3265	244	5.49	5543
2700	2195	3455	250	6.17	6026
2850	2315	3648	263	6.86	6652
3000	2440	3840	275	7.63	7336
3300	2680	4225	300	9.22	8780
3600	2925	4610	325	11.00	10416

Dimensions of Elliptical Concrete Pipe - Imperial Units

Equivalent Round Size, inches	Minor Axis, inches	Major Axis, inches	Minimum Wall Thickness, inches	Water-Way Area, square feet	Approximate Weight, pounds per foot
18	14	23	2¾	1.8	195
24	19	30	3¼	3.3	300
27	22	34	3½	4.1	365
30	24	38	3¾	5.1	430
33	27	42	3¾	6.3	475
36	29	45	4½	7.4	625
39	32	49	4¾	8.8	720
42	34	53	5	10.2	815
48	38	60	5½	12.9	1000
54	43	68	6	16.6	1235
60	48	76	6½	20.5	1475
66	53	83	7	24.8	1745
72	58	91	7½	29.5	2040
78	63	98	8	34.6	2350
84	68	106	8½	40.1	2680
90	72	113	9	46.1	3050
96	77	121	9½	52.4	3420
102	82	128	9¾	59.2	3725
108	87	136	10	66.4	4050
114	92	143	10½	74.0	4470
120	97	151	11	82.0	4930
132	106	166	12	99.2	5900
144	116	180	13	118.6	7000

The preceding fill height tables are based on a concrete pipe installed in a positive projecting embankment installation with a soil unit weight of 120 lbs/ft^3 and HL-93 live load per the AASHTO LRFD Bridge Design Specifications at the surface. The required classes of pipe do not account for construction loads or any other load induced on the pipe prior to its completed installation, or live load in excess of HL-93.

Dimensions of Arch Concrete Pipe - Metric Units

Normal Equivalent Round size	Minor Rise, mm	Major Span, mm	Minimum Wall Thick-ness, mm	Water-Way Area, m^2	Approximate Mass kg/m
375	280	460	57	0.1	187
450	345	560	63	0.15	252
525	395	660	69	0.2	321
600	460	725	75	0.26	390
750	570	920	88	0.41	570
900	675	1110	100	0.59	778
1050	795	1300	113	0.82	1021
1200	915	1485	125	1.06	1296
1350	1015	1650	138	1.33	1582
1500	1145	1855	150	1.64	1935
1800	1370	2235	175	2.38	2710
2100	1575	2590	200	3.21	3585
2250	1830	2920	213	4.13	4310
2400	1960	3100	225	4.8	4874
2700	2215	3505	250	6.13	6122
3000	2460	3910	275	7.6	7499
3300	2705	4285	250	9.21	7365

Dimensions of Arch Concrete Pipe - Imperial Units

Equivalent Round Size, inches	Minor Rise, inches	Major Span, inches	Minimum Wall Thickness, inches	Water-Way Area, square feet	Approximate Weight, pounds per foot
15	11	18	2¼	1.1	125
18	13½	22	2½	1.65	170
21	15½	26	2¾	2.2	215
24	18	28½	3	2.8	260
30	22½	36¼	3½	4.4	385
36	26 5/8	43¾	4	6.4	525
42	31 5/16	51 1/8	4½	8.8	690
48	36	58½	5	11.4	875
54	40	65	5½	14.3	1070
60	45	73	6	17.7	1310
72	54	88	7	25.6	1830
84	62	102	8	34.6	2415
90	72	115	8½	44.5	2910
96	77¼	122	9	51.7	3285
108	87 1/8	138	10	66.0	4125
120	96 7/8	154	11	81.8	5050
132	106½	168¾	10	99.1	4970

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