LRFD
10TH EDITION

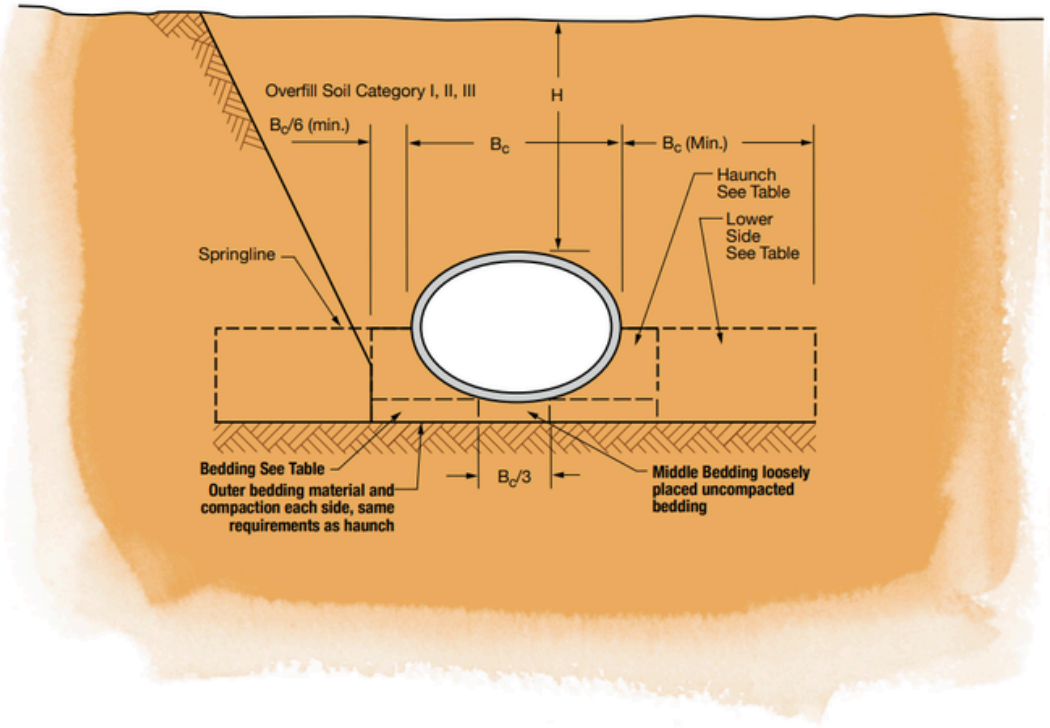
LRFD FILL HEIGHT TABLES

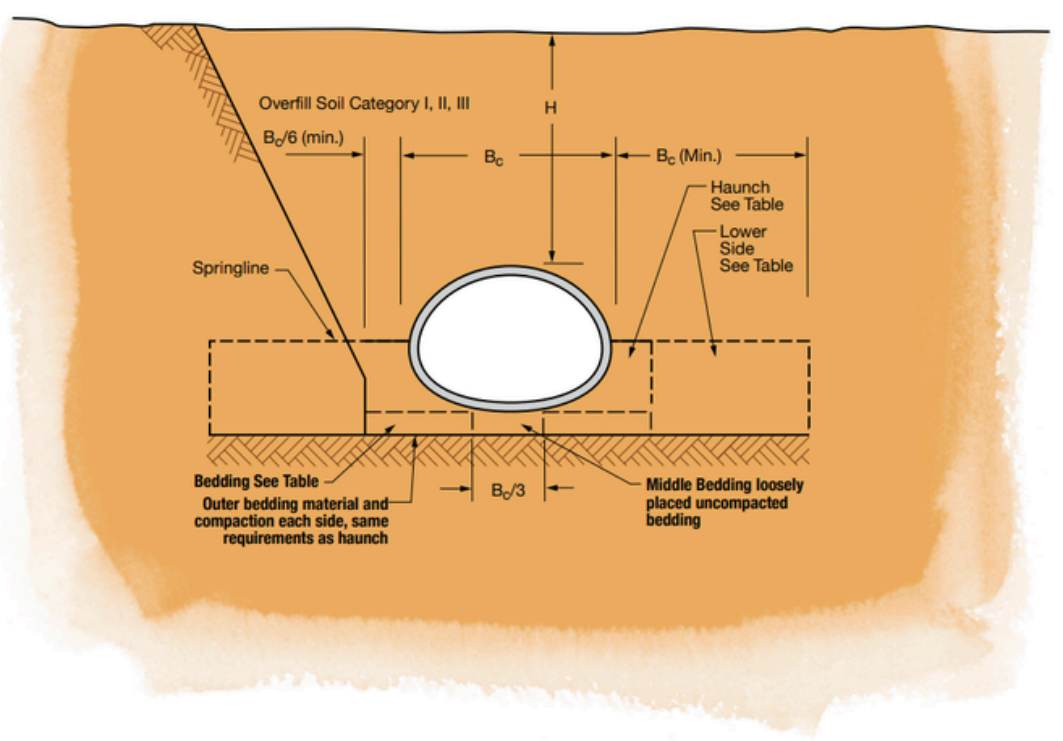
FOR HORIZONTAL ELLIPTICAL AND ARCH CONCRETE PIPE

ACPA
American Concrete Pipe Association

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, 10th Edition, 2024.

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 Installation

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

	Fill Height (feet)												
Pipe Size (in)	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10
12 x 19	1955	1296	1089	1233	998	860	741	732	761	815	879	953	1030
14 x 23	1976	1140	1044	1160	942	815	714	709	742	797	860	933	1009
19 x 30	1650	1464	1323	1168	945	817	719	710	743	796	857	928	1002
22 x 34	1511	1298	1291	1112	910	789	703	698	733	788	849	919	992
24 x 38	1404	1168	1196	1071	879	765	690	688	726	781	842	912	985
27 x 42	1373	1063	1091	1023	838	737	671	674	714	768	828	898	970
29 x 45	1372	1002	1030	987	838	739	679	684	726	782	844	915	988
32 x 49	1339	928	956	908	813	720	668	678	721	777	839	910	983
34 x 53	1300	865	893	864	780	699	659	672	717	773	835	906	979
38 x 60	1234	882	826	833	733	676	647	666	713	770	833	904	977
43 x 68	1205	851	826	798	705	655	633	658	707	765	828	899	973
48 x 76	1206	777	803	767	681	637	621	652	703	761	825	896	970
53 x 83	1212	726	753	746	665	626	617	651	702	761	825	897	971
58 x 91	1142	678	705	724	645	612	610	647	699	759	824	896	970
63 x 98	1076	644	672	697	637	606	610	648	701	761	826	898	973
68 x 106	1011	611	639	665	638	607	612	651	704	764	829	901	975
72 x 113	965	588	617	656	643	610	617	656	709	769	835	907	981
77 x 121	917	564	594	659	647	611	619	659	712	773	838	910	984
82 x 128	883	548	578	661	643	615	620	662	715	776	841	913	987
87 x 136	847	531	561	662	626	616	621	663	717	777	843	914	988
92 x 143	821	520	550	667	627	609	626	668	722	783	848	920	994
97 x 151	793	507	538	670	631	612	628	671	726	787	852	924	998
106 x 166	752	491	522	679	641	623	634	679	734	796	862	934	1008
116 x 180	724	483	514	689	653	636	648	689	745	807	873	945	1020

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 0.9.

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

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

	Fill Height (feet)														
Pipe Size (in)	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
12 x 19	1108	1189	1271	1353	1437	1522	1607	1693	1779	1865	1952	2039	2127	2215	2303
14 x 23	1086	1165	1246	1327	1410	1493	1576	1661	1745	1831	1916	2002	2088	2174	2260
19 x 30	1077	1154	1233	1313	1393	1475	1557	1639	1722	1806	1890	1974	2058	2142	2227
22 x 34	1067	1144	1222	1302	1382	1462	1544	1626	1708	1791	1874	1958	2041	2125	2209
24 x 38	1060	1136	1214	1293	1373	1453	1534	1616	1697	1780	1862	1945	2028	2112	2195
27 x 42	1044	1119	1196	1274	1352	1432	1512	1592	1673	1754	1835	1917	1999	2081	2163
29 x 45	1064	1141	1219	1298	1379	1459	1541	1623	1705	1788	1871	1954	2037	2121	2205
32 x 49	1059	1136	1214	1293	1373	1453	1534	1616	1698	1780	1863	1946	2029	2112	2196
34 x 53	1055	1131	1209	1288	1368	1448	1529	1610	1692	1774	1856	1939	2022	2105	2188
38 x 60	1053	1129	1207	1286	1365	1446	1526	1607	1689	1771	1853	1935	2018	2101	2184
43 x 68	1048	1125	1202	1281	1360	1440	1521	1601	1683	1764	1846	1928	2011	2093	2176
48 x 76	1045	1121	1199	1278	1357	1437	1517	1598	1679	1760	1842	1924	2006	2088	2170
53 x 83	1046	1123	1201	1279	1359	1439	1519	1599	1680	1762	1844	1925	2007	2089	2172
58 x 91	1045	1122	1200	1278	1357	1437	1517	1598	1679	1760	1842	1923	2005	2087	2169
63 x 98	1048	1125	1203	1282	1361	1441	1521	1602	1683	1764	1845	1927	2009	2090	2172
68 x 106	1051	1128	1206	1284	1363	1443	1523	1603	1684	1765	1846	1928	2009	2091	2173
72 x 113	1057	1133	1211	1289	1368	1448	1528	1608	1689	1770	1851	1933	2014	2096	2177
77 x 121	1060	1136	1214	1292	1371	1451	1530	1611	1692	1772	1853	1935	2016	2097	2179
82 x 128	1062	1139	1216	1294	1373	1452	1531	1612	1692	1772	1853	1934	2015	2096	2177
87 x 136	1063	1139	1216	1294	1372	1451	1530	1610	1690	1770	1851	1931	2012	2093	2173
92 x 143	1069	1145	1222	1300	1379	1457	1537	1616	1696	1777	1857	1938	2018	2099	2180
97 x 151	1073	1149	1226	1304	1382	1461	1540	1620	1700	1780	1861	1941	2022	2102	2183
106 x 166	1083	1159	1237	1314	1393	1471	1551	1630	1710	1790	1871	1951	2032	2112	2193
116 x 180	1095	1172	1249	1327	1405	1484	1563	1643	1723	1803	1884	1964	2045	2125	2206

Horizontal Elliptical Pipe

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 0.5.

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

	Fill Height (feet)												
Pipe Size (in)	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10
12 x 19	2049	1336	1142	1300	1078	955	863	881	938	1019	1110	1212	1316
14 x 23	2004	1182	1099	1228	1023	910	835	857	917	999	1089	1189	1292
19 x 30	1681	1511	1382	1239	1030	915	843	861	920	1000	1087	1184	1284
22 x 34	1543	1348	1352	1186	997	889	828	849	911	991	1079	1175	1275
24 x 38	1437	1220	1259	1147	968	866	816	840	905	985	1072	1169	1268
27 x 42	1406	1116	1157	1101	928	839	799	826	892	972	1058	1153	1250
29 x 45	1407	1057	1099	1068	932	845	811	842	910	992	1079	1177	1276
32 x 49	1375	984	1027	991	909	828	802	837	906	988	1076	1173	1272
34 x 53	1337	923	967	950	878	810	794	833	903	985	1073	1170	1269
38 x 60	1273	943	905	924	836	791	787	831	904	986	1074	1171	1270
43 x 68	1245	914	909	894	813	775	777	827	901	984	1073	1169	1268
48 x 76	1249	841	887	868	794	762	770	825	901	984	1073	1170	1268
53 x 83	1256	794	840	852	783	756	771	829	905	989	1078	1175	1274
58 x 91	1187	747	795	832	769	746	768	829	906	990	1080	1177	1276
63 x 98	1125	716	765	809	766	746	773	835	912	997	1087	1184	1283
68 x 106	1062	684	734	779	771	752	780	842	920	1004	1094	1191	1290
72 x 113	1018	664	714	773	779	761	790	852	930	1014	1104	1201	1300
77 x 121	973	642	693	778	785	768	798	860	937	1022	1112	1209	1307
82 x 128	942	628	680	783	784	774	803	868	945	1029	1119	1215	1314
87 x 136	908	612	664	786	770	778	809	874	951	1035	1124	1220	1318
92 x 143	885	603	656	794	773	773	820	884	961	1045	1135	1231	1329
97 x 151	860	592	646	799	779	779	828	892	970	1054	1143	1239	1337
106 x 166	824	579	634	812	794	796	844	911	989	1073	1162	1258	1356
116 x 180	802	574	631	828	812	814	865	932	1010	1094	1184	1280	1378

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 Installation

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

Fill Height (feet)										
Pipe Size (in)	11	12	13	14	15	16	17	18	19	20
12 x 19	1422	1530	1639	1750	1861	1973	2086	2199	2312	2427
14 x 23	1396	1502	1610	1718	1828	1938	2048	2160	2271	2383
19 x 30	1386	1490	1595	1701	1808	1916	2025	2134	2243	2353
22 x 34	1376	1479	1583	1689	1795	1902	2010	2118	2227	2336
24 x 38	1369	1471	1575	1680	1785	1892	1999	2106	2214	2323
27 x 42	1350	1451	1553	1657	1761	1866	1971	2077	2184	2290
29 x 45	1378	1481	1585	1690	1797	1904	2011	2119	2227	2336
32 x 49	1373	1476	1580	1685	1791	1897	2004	2112	2220	2328
34 x 53	1370	1472	1576	1681	1786	1892	1999	2106	2214	2322
38 x 60	1371	1474	1577	1682	1787	1893	1999	2106	2213	2321
43 x 68	1369	1471	1574	1679	1784	1889	1995	2101	2208	2315
48 x 76	1369	1471	1574	1678	1783	1888	1994	2100	2206	2313
53 x 83	1375	1477	1580	1684	1788	1893	1999	2105	2211	2318
58 x 91	1377	1479	1582	1686	1790	1895	2000	2106	2213	2319
63 x 98	1384	1486	1589	1693	1797	1902	2008	2114	2220	2327
68 x 106	1391	1492	1595	1699	1803	1908	2013	2118	2225	2331
72 x 113	1401	1502	1605	1708	1813	1917	2022	2128	2234	2340
77 x 121	1408	1509	1612	1715	1819	1923	2028	2134	2239	2345
82 x 128	1414	1515	1617	1720	1823	1927	2032	2137	2242	2348
87 x 136	1418	1518	1620	1722	1825	1929	2033	2137	2242	2347
92 x 143	1428	1529	1631	1733	1836	1940	2044	2148	2253	2358
97 x 151	1437	1537	1639	1741	1844	1948	2051	2156	2261	2366
106 x 166	1456	1556	1658	1760	1863	1967	2070	2175	2279	2384
116 x 180	1478	1578	1680	1782	1885	1988	2092	2197	2301	2406

Arch 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 0.9.

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

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

	Fill Height (feet)												
Pipe Size (in)	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10
11 x 18	1889	1295	1058	1175	953	824	719	714	747	802	866	940	1016
13 1/2 x 22	2023	1133	1037	1152	935	810	709	704	737	791	853	926	1001
15 1/2 x 26	1846	1184	1077	1119	908	786	690	684	716	768	828	898	969
18 x 28 1/2	1717	1394	1208	1157	939	812	714	707	740	793	854	924	998
22 1/2 x 36 1/4	1469	1224	1251	1085	891	774	695	691	728	783	843	913	986
26 5/8 x 43 3/8	1396	1029	1057	1015	836	737	675	679	720	775	835	905	978
31 5/16 x 51 1/8	1343	896	923	873	795	704	659	671	714	770	831	901	974
36 x 58 1/2	1263	867	824	834	733	677	646	664	710	766	828	898	971
40 x 65	1262	890	825	810	716	664	639	662	710	767	830	900	973
45 x 73	1210	808	824	778	691	646	627	656	706	763	827	897	970
54 x 88	1179	700	727	733	655	619	616	651	703	762	826	897	971
62 x 102	1050	634	662	687	642	612	617	655	708	768	833	905	979
72 x 115	948	577	606	648	636	602	609	648	701	760	825	897	970
77 1/2 x 122	910	559	588	653	641	605	614	653	706	766	831	903	976
87 1/8 x 138	835	523	553	659	619	609	618	660	713	774	839	910	984
96 7/8 x 154	778	498	529	665	626	607	623	666	720	781	847	918	992
106 1/2 x 168 3/4	740	482	512	663	627	609	620	665	719	779	844	914	986

Arch 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 0.9.

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

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

	Fill Height (feet)														
Pipe Size (in)	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
11 x 18	1094	1174	1255	1338	1421	1505	1589	1674	1759	1845	1931	2018	2105	2191	2279
13 1/2 x 22	1078	1156	1236	1316	1398	1480	1563	1647	1730	1815	1899	1984	2069	2155	2240
15 1/2 x 26	1043	1119	1195	1273	1352	1431	1511	1591	1672	1753	1835	1916	1998	2081	2163
18 x 28 1/2	1073	1150	1228	1308	1388	1469	1551	1633	1716	1799	1882	1966	2050	2134	2218
22 1/2 x 36 1/4	1060	1136	1214	1292	1371	1451	1532	1613	1695	1777	1859	1942	2024	2107	2191
26 5/8 x 43 3/8	1052	1128	1205	1283	1362	1442	1522	1603	1684	1765	1847	1929	2011	2094	2177
31 5/16 x 51 1/8	1048	1124	1201	1279	1357	1437	1517	1597	1678	1759	1840	1922	2004	2087	2169
36 x 58 1/2	1045	1121	1198	1276	1355	1434	1514	1594	1675	1756	1837	1919	2000	2082	2165
40 x 65	1048	1124	1201	1279	1358	1437	1517	1597	1678	1759	1840	1922	2004	2086	2168
45 x 73	1045	1121	1198	1276	1355	1434	1514	1594	1675	1755	1837	1918	2000	2081	2163
54 x 88	1046	1122	1200	1278	1356	1436	1515	1596	1676	1757	1838	1919	2001	2082	2164
62 x 102	1054	1131	1208	1286	1365	1444	1524	1604	1685	1766	1847	1928	2009	2091	2172
72 x 115	1045	1121	1198	1276	1354	1433	1512	1591	1671	1752	1832	1912	1993	2074	2155
77 1/2 x 122	1051	1127	1204	1282	1360	1439	1518	1598	1678	1758	1838	1919	1999	2080	2161
87 1/8 x 138	1059	1135	1212	1289	1367	1446	1525	1605	1685	1765	1845	1925	2006	2086	2167
96 7/8 x 154	1067	1143	1220	1297	1376	1454	1533	1613	1692	1772	1852	1933	2013	2094	2174
106 1/2 x 168 3/4	1060	1134	1210	1286	1362	1439	1517	1595	1673	1751	1830	1908	1987	2066	2145

Arch 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 0.9.

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

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

	Fill Height (feet)												
Pipe Size (in)	0.5	1	1.5	2	2.5	3	4	5	6	7	8	9	10
11 x 18	2026	1335	1111	1241	1032	917	840	862	922	1004	1095	1196	1300
13 1/2 x 22	2052	1174	1091	1219	1016	904	829	851	910	991	1081	1180	1281
15 1/2 x 26	1875	1227	1132	1187	989	879	809	828	886	964	1049	1144	1242
18 x 28 1/2	1748	1441	1267	1229	1023	910	838	857	916	995	1082	1180	1279
22 1/2 x 36 1/4	1503	1276	1314	1161	979	875	821	843	907	987	1073	1169	1267
26 5/8 x 43 3/8	1431	1084	1125	1095	929	842	805	835	901	981	1068	1164	1262
31 5/16 x 51 1/8	1381	954	997	959	893	813	794	830	899	980	1067	1162	1260
36 x 58 1/2	1303	928	904	924	836	791	785	828	899	980	1068	1163	1261
40 x 65	1304	954	909	906	823	783	783	830	904	986	1074	1169	1268
45 x 73	1254	874	910	880	804	770	775	829	903	986	1074	1170	1268
54 x 88	1226	770	818	843	778	754	773	833	909	992	1082	1178	1276
62 x 102	1102	709	758	803	777	758	785	847	924	1008	1098	1194	1293
72 x 115	1001	652	702	763	770	752	781	843	919	1003	1092	1188	1286
77 1/2 x 122	965	636	687	771	778	761	791	853	930	1014	1103	1199	1297
87 1/8 x 138	895	603	656	781	761	770	805	870	946	1030	1119	1215	1313
96 7/8 x 154	844	581	635	792	773	773	822	886	963	1047	1136	1232	1330
106 1/2 x 168 3/4	810	568	623	794	777	779	826	892	968	1050	1138	1231	1327

Arch 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 ration of 0.5.

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

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

Pipe Size (in)	Fill Height (feet)									
	11	12	13	14	15	16	17	18	19	20
11 x 18	1405	1512	1620	1730	1840	1951	2063	2175	2288	2401
13 1/2 x 22	1385	1490	1596	1704	1812	1921	2031	2141	2251	2362
15 1/2 x 26	1342	1443	1545	1649	1753	1858	1963	2070	2176	2283
18 x 28 1/2	1381	1484	1589	1695	1801	1909	2017	2125	2234	2343
22 1/2 x 36 1/4	1368	1470	1573	1678	1783	1889	1995	2103	2210	2318
26 5/8 x 43 3/8	1362	1463	1566	1670	1775	1880	1986	2092	2199	2306
31 5/16 x 51 1/8	1360	1461	1564	1668	1772	1877	1982	2088	2195	2301
36 x 58 1/2	1361	1462	1564	1668	1772	1877	1982	2088	2194	2300
40 x 65	1367	1469	1571	1675	1779	1884	1989	2095	2201	2307
45 x 73	1368	1469	1572	1675	1779	1883	1988	2094	2199	2306
54 x 88	1376	1478	1580	1683	1787	1892	1996	2102	2207	2314
62 x 102	1393	1495	1597	1700	1804	1909	2013	2119	2224	2330
72 x 115	1385	1486	1588	1690	1793	1897	2001	2105	2210	2315
77 1/2 x 122	1396	1497	1598	1701	1804	1908	2012	2116	2221	2326
87 1/8 x 138	1412	1513	1614	1717	1819	1923	2027	2131	2236	2340
96 7/8 x 154	1429	1530	1631	1733	1836	1939	2043	2147	2251	2356
106 1/2 x 168 3/4	1424	1523	1622	1722	1822	1923	2025	2127	2229	2331

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/ft³ 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 mm	Minor Axis mm	Major Axis mm	Minimum Wall Thickness mm	Waterway Area m^2	Approximate Mass Kg/m
450	365	575	69	0.17	290
600	490	770	82	0.31	446
675	550	865	88	0.38	543
750	610	960	94	0.47	640
825	670	1055	94	0.59	707
900	730	1150	113	0.68	930
975	795	1250	119	0.82	1071
1050	855	1345	125	0.95	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/ft³ 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, m²	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	26⅝	43¾	4	6.4	525
42	31 5/16	51⅛	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	87⅛	138	10	66.0	4125
120	96⅞	154	11	81.8	5050
132	106½	168¾	10	99.1	4970

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