

LRFD
10TH EDITION

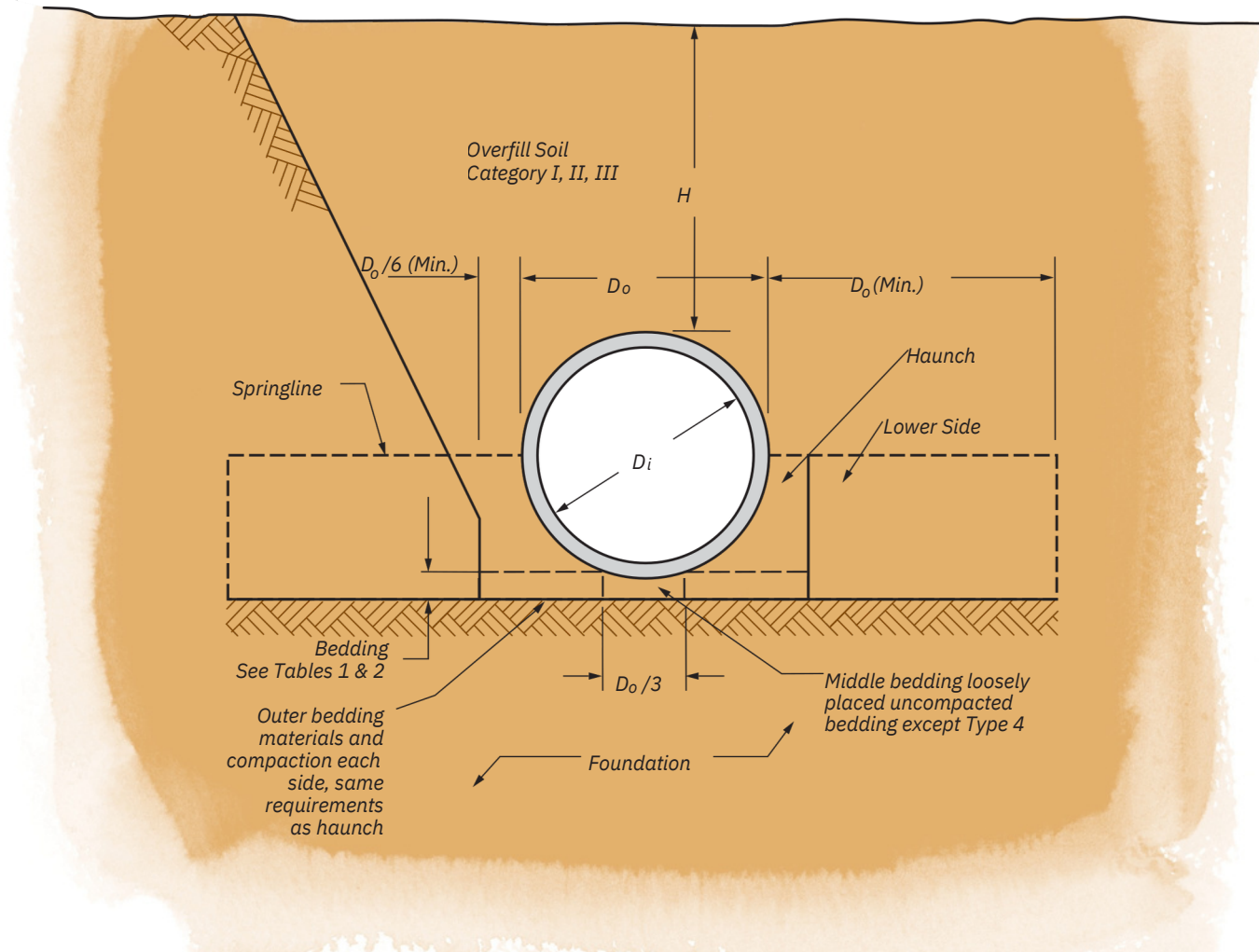
FOR CONCRETE PIPE

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 four types of Standard Installations, each with its own soil and compaction requirements. Type 1 bedding provides the most support using highly compacted granular material, while Type 4 provides for less support allowing the use of silts and clay soils with little or no compaction. These four 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 diameter are provided numerically and the class of pipe per ASTM C76 (AASHTO M 170) 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 1	D _o /24 minimum, not less than 3" (75 mm), If rock foundation, use D _o /12 minimum, not less than 6" (150 mm)	95% Category I	90% Category I 95% Category II or 100% Category III
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
Type 4	No bedding required except if rock foundation, use D _o /12 minimum, not less than 6" (150 mm)	No compaction required, except if Category III, use 85%	No compaction required, except if Category III, use 85%

Reference: ASCE 15-17, "Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)", 2017.

Table 3: Reinforced Pipe Classes for 0.01 inch Crack Per ASTM C 76 (lbs/ft/ft)

Class I	≤800
Class II	≤1000
Class III	≤1350
Class IV	≤2000
Class V	≤3000
Special Design	> 3000

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
Not Allowed for Haunch or Bedding	CH	A7	100 95 90 45	90 85 80 40

Reference: ASCE 15-17, "Standard Practice for Direct Design of Buried Precast Concrete Pipe Using Standard Installations (SIDD)", 2017.

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.

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. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A Type 1 installation requires greater soil stiffness from the surrounding soils than the Type 2, 3, and 4 installations, and is thus harder to achieve.
Therefore, field verification of soil properties and compaction levels should be performed.

D-Load (lb/ft/ft) for Type 1 Installation

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet													
Pipe Size (in)	1	2	3	4	5	6	7	8	9	10	11	12	13
12	1612	1399	888	695	633	620	635	661	700	743	788	835	883
15	1546	1344	856	673	614	602	617	644	682	723	767	813	860
18	1462	1307	836	660	604	593	608	634	672	713	756	802	848
21	1309	1281	823	653	598	588	604	630	668	709	752	797	843
24	1287	1262	814	648	595	587	603	629	667	708	751	796	842
27	1442	1264	815	653	599	591	608	634	671	707	750	795	842
30	1581	1272	819	660	605	598	615	640	678	718	761	805	852
33	1443	1222	798	651	599	596	615	641	679	720	763	808	855
36	1329	1187	780	643	595	595	616	643	682	723	767	813	860
42	1151	1099	745	627	587	591	613	641	680	722	766	812	860
48	1019	961	713	614	582	589	612	641	681	723	768	815	863
54	969	919	689	604	578	589	613	643	684	727	772	819	867
60	994	890	670	596	577	590	615	646	687	731	777	825	874
66	946	865	657	589	576	592	618	651	692	737	783	832	881
72	881	844	647	584	578	595	622	656	698	744	791	839	889
78	827	823	637	582	579	597	625	659	702	748	796	845	895
84	782	805	629	580	580	600	628	664	707	753	801	851	901
90	744	789	622	580	582	603	632	668	712	759	807	857	908
96	712	749	616	580	585	606	637	673	718	765	814	864	915
102	685	723	623	587	592	614	645	682	727	774	823	873	925
108	662	711	629	595	600	623	654	691	736	783	832	883	935
114	642	715	636	603	609	631	663	700	745	793	842	893	945
120	625	720	642	609	617	640	672	709	755	802	852	903	955
126	611	726	649	617	625	649	681	719	764	812	862	913	966
132	599	731	651	625	634	658	690	728	774	822	872	924	976
138	589	736	645	633	643	667	699	738	784	832	883	934	987
144	580	742	651	642	652	676	709	747	794	843	893	945	998

CPDPGN029-3 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A Type 1 installation requires greater soil stiffness from the surrounding soils than the Type 2, 3, and 4 installations, and is thus harder to achieve. Therefore, field verification of soil properties and compaction levels should be performed.

D-Load (lb/ft/ft) for Type 1 Installation

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Pipe Size (in)	Fill Height in Feet														
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
12	933	985	1037	1090	1143	1198	1252	1308	1363	1419	1475	1532	1588	1645	1702
15	909	959	1009	1061	1113	1166	1219	1273	1327	1381	1436	1490	1545	1601	1656
18	896	945	995	1046	1098	1150	1202	1255	1308	1361	1415	1469	1523	1577	1632
21	891	940	989	1040	1091	1142	1194	1246	1299	1352	1405	1459	1513	1567	1621
24	890	939	988	1038	1089	1141	1192	1245	1297	1350	1403	1456	1510	1564	1618
27	890	939	988	1039	1090	1141	1193	1245	1298	1351	1404	1458	1511	1565	1619
30	899	948	997	1048	1098	1150	1202	1254	1306	1359	1412	1466	1519	1574	1628
33	903	952	1002	1053	1104	1156	1208	1260	1313	1366	1420	1474	1528	1582	1636
36	909	958	1008	1059	1111	1163	1216	1269	1322	1376	1430	1484	1538	1593	1648
42	909	958	1009	1060	1112	1164	1217	1270	1323	1377	1431	1485	1539	1594	1649
48	912	962	1013	1064	1116	1168	1221	1274	1328	1382	1436	1490	1545	1600	1654
54	917	967	1018	1070	1122	1175	1228	1282	1336	1390	1444	1499	1554	1608	1663
60	924	974	1026	1078	1131	1184	1237	1291	1345	1400	1455	1509	1564	1619	1675
66	931	983	1035	1087	1140	1194	1248	1302	1357	1412	1467	1522	1577	1632	1688
72	940	992	1045	1098	1151	1205	1260	1314	1369	1425	1480	1535	1591	1647	1703
78	946	998	1051	1104	1158	1212	1267	1322	1377	1432	1488	1544	1599	1655	1711
84	953	1005	1058	1112	1166	1220	1275	1330	1386	1441	1497	1553	1608	1664	1721
90	960	1013	1066	1120	1174	1229	1284	1339	1395	1450	1506	1562	1618	1674	1731
96	967	1020	1074	1128	1183	1238	1293	1349	1404	1460	1516	1572	1629	1685	1741
102	977	1030	1084	1138	1193	1248	1304	1360	1416	1472	1528	1584	1640	1697	1754
108	987	1041	1094	1149	1204	1259	1315	1371	1427	1483	1540	1596	1653	1709	1766
114	998	1051	1105	1160	1215	1271	1326	1383	1439	1495	1552	1608	1665	1722	1779
120	1008	1062	1116	1171	1226	1282	1338	1394	1451	1507	1564	1621	1678	1735	1792
126	1019	1073	1127	1182	1238	1294	1350	1407	1463	1520	1577	1634	1691	1748	1806
132	1030	1084	1139	1194	1250	1306	1362	1419	1476	1533	1590	1647	1705	1762	1820
138	1041	1095	1150	1206	1262	1318	1375	1432	1489	1546	1603	1661	1718	1776	1834
144	1052	1107	1162	1217	1274	1330	1387	1444	1502	1559	1617	1674	1732	1790	1848

CPDPGN029-3 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A Type 1 installation requires greater soil stiffness from the surrounding soils than the Type 2, 3, and 4 installations, and is thus harder to achieve. Therefore, field verification of soil properties and compaction levels should be performed.

D-Load (lb/ft/ft) for Type 1 Installation

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Pipe Size (in)	Fill Height in Feet														
	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43
12	1760	1817	1875	1933	1990	2048	2106	2164	2222	2280	2339	2397	2455	2513	2572
15	1712	1768	1824	1880	1936	1992	2049	2105	2161	2218	2274	2331	2387	2444	2501
18	1687	1742	1797	1852	1907	1963	2018	2073	2129	2184	2240	2296	2351	2407	2463
21	1675	1730	1784	1839	1894	1948	2003	2058	2113	2168	2223	2279	2334	2389	2444
24	1672	1726	1781	1835	1890	1944	1999	2054	2108	2163	2218	2273	2328	2383	2438
27	1673	1728	1782	1837	1891	1946	2000	2055	2110	2165	2220	2275	2330	2385	2440
30	1682	1736	1791	1845	1900	1955	2009	2064	2119	2174	2229	2284	2339	2394	2449
33	1691	1746	1800	1855	1910	1965	2020	2075	2130	2185	2240	2296	2351	2406	2462
36	1703	1758	1813	1868	1923	1978	2034	2089	2144	2200	2255	2311	2367	2422	2478
42	1703	1758	1813	1868	1923	1979	2034	2089	2145	2200	2255	2311	2366	2422	2478
48	1709	1764	1819	1874	1929	1985	2040	2095	2151	2206	2262	2317	2373	2428	2484
54	1718	1773	1829	1884	1939	1995	2050	2106	2161	2217	2272	2328	2384	2439	2495
60	1730	1785	1841	1896	1952	2007	2063	2119	2175	2230	2286	2342	2398	2454	2510
66	1743	1799	1855	1911	1966	2022	2078	2134	2190	2246	2303	2359	2415	2471	2527
72	1758	1814	1871	1927	1983	2039	2095	2152	2208	2264	2321	2377	2434	2490	2547
78	1767	1823	1879	1936	1992	2048	2105	2161	2218	2274	2331	2387	2444	2500	2557
84	1777	1833	1889	1946	2002	2059	2115	2172	2228	2285	2342	2398	2455	2512	2568
90	1787	1843	1900	1956	2013	2070	2126	2183	2240	2297	2353	2410	2467	2524	2581
96	1798	1855	1911	1968	2025	2081	2138	2195	2252	2309	2366	2423	2480	2537	2594
102	1810	1867	1924	1981	2037	2094	2151	2208	2265	2323	2380	2437	2494	2551	2608
108	1823	1880	1937	1994	2051	2108	2165	2222	2280	2337	2394	2451	2509	2566	2623
114	1836	1893	1950	2007	2065	2122	2179	2237	2294	2351	2409	2466	2524	2582	2639
120	1849	1907	1964	2021	2079	2136	2194	2251	2309	2367	2424	2482	2540	2597	2655
126	1863	1921	1978	2036	2093	2151	2209	2267	2324	2382	2440	2498	2556	2614	2672
132	1877	1935	1993	2050	2108	2166	2224	2282	2340	2398	2456	2514	2572	2630	2689
138	1892	1949	2007	2065	2123	2182	2240	2298	2356	2414	2473	2531	2589	2648	2706
144	1906	1964	2022	2081	2139	2197	2256	2314	2372	2431	2489	2548	2607	2665	2724

CPDPGN029-3 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions
4. A Type 1 installation requires greater soil stiffness from the surrounding soils than the Type 2, 3, and 4 installations, and is thus harder to achieve. Therefore, field verification of soil properties and compaction levels should be performed.

D-Load (lb/ft/ft) for Type 1 Installation

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet											
Pipe Size (in)	44	45	46	47	48	49	50	51	52	53	54
12	2630	2689	2747	2805	2864	2923	2981	3040	3098	3157	3216
15	2557	2614	2671	2728	2784	2841	2898	2955	3012	3069	3126
18	2519	2574	2630	2686	2742	2798	2854	2910	2966	3022	3078
21	2500	2555	2610	2666	2721	2776	2832	2887	2943	2998	3054
24	2493	2548	2603	2659	2714	2769	2824	2879	2935	2990	3045
27	2495	2550	2605	2660	2715	2771	2826	2881	2936	2992	3047
30	2504	2559	2615	2670	2725	2781	2836	2891	2947	3002	3057
33	2517	2573	2628	2684	2739	2795	2850	2906	2961	3017	3073
36	2534	2590	2645	2701	2757	2813	2869	2925	2981	3037	3092
42	2533	2589	2645	2700	2756	2812	2867	2923	2979	3035	3091
48	2540	2595	2651	2707	2763	2818	2874	2930	2986	3042	3097
54	2551	2607	2663	2719	2774	2830	2886	2942	2998	3054	3110
60	2566	2622	2678	2734	2790	2846	2902	2959	3015	3071	3127
66	2584	2640	2696	2753	2809	2865	2922	2978	3035	3091	3147
72	2604	2660	2717	2773	2830	2887	2943	3000	3057	3114	3170
78	2614	2670	2727	2784	2841	2897	2954	3011	3068	3125	3181
84	2625	2682	2739	2796	2853	2909	2966	3023	3080	3137	3194
90	2638	2695	2752	2809	2866	2923	2980	3037	3094	3151	3208
96	2651	2708	2765	2823	2880	2937	2994	3051	3108	3166	3223
102	2666	2723	2780	2838	2895	2952	3010	3067	3124	3182	3239
108	2681	2738	2796	2853	2911	2968	3026	3083	3141	3198	3256
114	2697	2754	2812	2870	2927	2985	3043	3100	3158	3216	3273
120	2713	2771	2829	2886	2944	3002	3060	3118	3176	3234	3292
126	2730	2788	2846	2904	2962	3020	3078	3136	3194	3252	3310
132	2747	2805	2863	2922	2980	3038	3096	3155	3213	3271	3330
138	2764	2823	2881	2940	2998	3057	3115	3174	3232	3291	3349
144	2782	2841	2900	2958	3017	3076	3134	3193	3252	3311	3369

CPDPGN029-3 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions

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

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet													
Pipe Size (in)	1	2	3	4	5	6	7	8	9	10	11	12	13
12	1492	1322	880	727	694	705	741	788	847	908	972	1037	1105
15	1434	1272	851	707	676	688	724	771	828	888	950	1015	1080
18	1358	1240	834	697	668	680	717	763	820	880	942	1005	1070
21	1220	1218	824	692	665	678	715	762	819	878	940	1004	1069
24	1202	1203	818	690	665	680	717	764	822	882	944	1007	1072
27	1344	1205	819	694	668	684	721	768	824	884	945	1009	1073
30	1471	1213	823	701	674	690	727	773	829	888	949	1012	1077
33	1347	1168	805	693	669	688	727	773	830	889	951	1014	1079
36	1244	1137	789	687	665	687	728	775	832	892	954	1017	1082
42	1084	1059	759	673	659	685	726	773	831	890	953	1016	1081
48	966	935	732	663	655	684	726	774	832	892	954	1018	1083
54	923	899	712	655	654	685	728	777	835	896	958	1023	1088
60	948	875	696	650	654	688	731	781	840	901	964	1029	1094
66	906	855	687	646	655	691	736	787	846	907	971	1036	1102
72	850	837	679	643	658	696	741	793	853	915	979	1044	1111
78	802	820	672	642	660	697	744	796	856	918	982	1047	1114
84	763	805	665	641	661	700	747	799	859	921	986	1051	1118
90	730	791	660	641	664	703	750	803	863	926	990	1055	1122
96	703	756	655	642	666	706	754	807	867	930	994	1060	1127
102	679	734	662	649	674	714	761	814	875	937	1002	1067	1134
108	660	723	668	657	681	721	769	822	882	945	1009	1074	1141
114	643	729	675	665	689	729	776	830	890	952	1016	1082	1148
120	629	734	682	670	697	737	784	837	898	960	1024	1089	1156
126	617	740	689	678	705	744	792	845	905	968	1032	1097	1163
132	607	745	691	686	712	752	800	853	913	976	1039	1105	1171
138	599	751	686	694	720	760	808	861	921	983	1047	1112	1178
144	592	757	692	701	728	768	816	869	929	991	1055	1120	1186

CPDPGN029-3 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions

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

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet															
Pipe Size (in)	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
12	1173	1242	1313	1384	1455	1528	1600	1673	1747	1820	1894	1968	2043	2117	2192
15	1147	1215	1284	1353	1423	1493	1564	1635	1707	1779	1851	1923	1996	2069	2142
18	1136	1203	1271	1340	1409	1479	1549	1619	1690	1761	1833	1904	1976	2048	2120
21	1135	1201	1269	1338	1407	1476	1546	1616	1687	1757	1828	1900	1971	2043	2115
24	1139	1206	1274	1342	1411	1481	1551	1621	1692	1763	1834	1905	1977	2048	2120
27	1139	1206	1273	1342	1410	1480	1549	1619	1690	1760	1831	1902	1973	2045	2117
30	1142	1209	1276	1344	1413	1482	1552	1621	1692	1762	1833	1904	1975	2046	2118
33	1145	1211	1279	1347	1416	1485	1555	1625	1695	1765	1836	1907	1979	2050	2122
36	1148	1215	1283	1352	1421	1490	1560	1630	1701	1771	1842	1914	1985	2057	2129
42	1147	1214	1282	1350	1419	1488	1558	1628	1698	1769	1840	1911	1982	2053	2125
48	1150	1217	1285	1353	1422	1491	1561	1631	1701	1771	1842	1913	1984	2056	2127
54	1154	1222	1290	1358	1427	1497	1566	1636	1707	1777	1848	1919	1991	2062	2133
60	1161	1229	1297	1365	1435	1504	1574	1644	1715	1786	1857	1928	1999	2071	2142
66	1169	1237	1305	1374	1444	1514	1584	1654	1725	1796	1868	1939	2010	2082	2153
72	1178	1246	1315	1384	1454	1524	1595	1666	1737	1808	1880	1951	2023	2095	2166
78	1181	1249	1318	1387	1457	1527	1598	1668	1739	1811	1882	1953	2025	2096	2168
84	1185	1253	1322	1391	1461	1531	1601	1672	1743	1814	1885	1956	2027	2099	2170
90	1189	1258	1326	1395	1465	1535	1605	1676	1747	1818	1889	1960	2031	2102	2174
96	1194	1262	1331	1400	1470	1540	1610	1681	1751	1822	1893	1964	2035	2106	2178
102	1201	1269	1338	1407	1476	1546	1616	1687	1757	1828	1899	1970	2040	2112	2183
108	1208	1276	1344	1413	1483	1553	1623	1693	1763	1834	1905	1975	2046	2117	2188
114	1215	1283	1351	1420	1490	1559	1629	1700	1770	1840	1911	1982	2052	2123	2194
120	1223	1290	1359	1427	1497	1566	1636	1706	1776	1847	1917	1988	2059	2129	2200
126	1230	1298	1366	1435	1504	1573	1643	1713	1783	1854	1924	1995	2065	2136	2207
132	1238	1305	1373	1442	1511	1581	1650	1720	1790	1861	1931	2001	2072	2143	2213
138	1245	1313	1381	1450	1519	1588	1658	1728	1798	1868	1938	2008	2079	2149	2220
144	1253	1321	1389	1457	1526	1596	1665	1735	1805	1875	1945	2016	2086	2156	2227

CPDPGN029-3 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions

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

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Pipe Size (in)	Fill Height in Feet													
	29	30	31	32	33	34	35	36	37	38	39	40	41	42
12	2267	2342	2418	2493	2568	2644	2719	2795	2871	2946	3022	3098	3174	3250
15	2215	2288	2362	2435	2509	2582	2656	2730	2804	2878	2951	3025	3099	3173
18	2192	2265	2337	2410	2483	2555	2628	2701	2774	2847	2920	2993	3066	3139
21	2187	2259	2331	2404	2476	2548	2621	2693	2766	2839	2911	2984	3057	3130
24	2193	2265	2337	2410	2482	2554	2627	2700	2772	2845	2918	2991	3064	3136
27	2188	2259	2332	2404	2477	2549	2621	2693	2766	2838	2911	2983	3056	3128
30	2190	2261	2333	2405	2477	2549	2621	2694	2766	2838	2911	2983	3055	3128
33	2194	2265	2337	2409	2481	2554	2626	2698	2770	2843	2915	2987	3060	3132
36	2201	2273	2345	2417	2489	2561	2634	2706	2779	2851	2924	2996	3069	3141
42	2197	2268	2340	2412	2484	2556	2628	2700	2772	2844	2916	2988	3061	3133
48	2199	2270	2342	2413	2485	2557	2629	2701	2773	2845	2917	2989	3061	3133
54	2205	2276	2348	2419	2491	2563	2635	2707	2779	2851	2923	2995	3067	3139
60	2214	2285	2357	2429	2501	2573	2645	2717	2789	2861	2933	3005	3077	3149
66	2225	2297	2369	2441	2513	2585	2657	2729	2801	2873	2946	3018	3090	3162
72	2238	2310	2382	2455	2527	2599	2671	2744	2816	2888	2961	3033	3106	3178
78	2240	2312	2383	2455	2527	2599	2671	2744	2816	2888	2960	3032	3105	3177
84	2242	2314	2385	2457	2529	2601	2673	2745	2817	2889	2961	3033	3105	3177
90	2245	2317	2388	2460	2532	2603	2675	2747	2819	2891	2963	3034	3106	3178
96	2249	2320	2392	2463	2535	2607	2678	2750	2822	2893	2965	3037	3109	3181
102	2254	2325	2397	2468	2539	2611	2682	2754	2826	2897	2969	3040	3112	3184
108	2259	2331	2402	2473	2544	2616	2687	2759	2830	2902	2973	3045	3116	3188
114	2265	2336	2407	2478	2550	2621	2692	2764	2835	2906	2978	3049	3121	3192
120	2271	2342	2413	2484	2555	2627	2698	2769	2840	2912	2983	3054	3126	3197
126	2277	2348	2419	2490	2561	2632	2704	2775	2846	2917	2988	3060	3131	3202
132	2284	2355	2426	2497	2568	2639	2710	2781	2852	2923	2994	3065	3137	3208
138	2291	2361	2432	2503	2574	2645	2716	2787	2858	2929	3000	3071	3143	3214
144	2298	2368	2439	2510	2581	2652	2723	2793	2864	2935	3007	3078	3149	3220

CPDPGN029-3 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions

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

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet													
Pipe Size (in)	1	2	3	4	5	6	7	8	9	10	11	12	13
12	1518	1369	947	817	805	838	896	964	1044	1127	1212	1299	1387
15	1459	1318	916	794	783	815	872	939	1016	1097	1180	1264	1350
18	1384	1285	897	781	772	804	860	926	1003	1082	1163	1246	1331
21	1247	1263	886	775	767	799	855	921	996	1075	1156	1238	1322
24	1229	1248	879	772	765	798	854	920	995	1074	1154	1236	1319
27	1372	1251	881	778	770	804	860	925	1000	1073	1154	1236	1319
30	1500	1260	887	786	777	812	868	933	1008	1085	1165	1247	1330
33	1378	1218	871	780	775	813	871	936	1011	1090	1170	1252	1336
36	1276	1189	857	776	774	815	875	941	1017	1096	1177	1260	1344
42	1119	1113	829	765	770	815	875	942	1018	1098	1179	1262	1346
48	1004	992	808	758	770	817	879	946	1023	1103	1184	1267	1352
54	963	958	791	753	771	822	884	953	1030	1110	1192	1276	1360
60	991	937	778	751	775	828	891	961	1039	1119	1202	1286	1371
66	952	920	772	751	779	835	900	970	1049	1130	1213	1298	1384
72	898	905	768	751	786	843	909	981	1060	1142	1226	1311	1398
78	853	890	762	752	790	847	913	985	1065	1147	1231	1316	1403
84	816	878	758	754	794	852	918	991	1070	1153	1236	1322	1408
90	786	866	755	756	798	857	924	996	1076	1159	1243	1328	1414
96	760	833	753	759	803	862	930	1003	1083	1165	1249	1334	1421
102	739	814	761	769	813	872	939	1012	1092	1174	1258	1343	1430
108	722	805	770	778	822	882	949	1022	1102	1184	1268	1353	1439
114	708	813	779	788	832	892	959	1032	1112	1194	1277	1362	1448
120	696	821	788	796	842	902	969	1042	1121	1203	1287	1372	1458
126	687	829	798	806	852	912	979	1052	1131	1213	1297	1382	1467
132	679	837	802	816	863	922	989	1062	1141	1223	1307	1391	1477
138	673	845	800	826	873	932	999	1072	1152	1233	1317	1401	1487
144	669	853	808	837	883	943	1010	1082	1162	1244	1327	1411	1497

CPDPGN029-3 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions

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

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Pipe Size (in)	Fill Height in Feet														
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28
12	1477	1568	1660	1752	1845	1939	2033	2128	2222	2318	2413	2509	2604	2700	2797
15	1437	1526	1615	1704	1795	1885	1977	2068	2160	2253	2345	2438	2531	2624	2717
18	1417	1503	1591	1679	1768	1857	1947	2037	2127	2218	2309	2400	2491	2582	2674
21	1407	1493	1579	1667	1755	1843	1932	2021	2110	2200	2290	2380	2471	2561	2652
24	1404	1490	1576	1663	1750	1838	1926	2015	2104	2193	2283	2373	2463	2553	2643
27	1404	1490	1576	1663	1750	1838	1926	2015	2104	2193	2283	2372	2462	2552	2642
30	1414	1499	1585	1672	1759	1847	1935	2024	2113	2202	2291	2381	2471	2561	2651
33	1420	1506	1593	1680	1767	1855	1944	2033	2122	2211	2301	2391	2481	2571	2662
36	1429	1515	1602	1690	1778	1866	1955	2044	2134	2224	2314	2404	2495	2586	2677
42	1431	1517	1604	1691	1779	1868	1956	2046	2135	2225	2315	2405	2495	2586	2676
48	1437	1523	1610	1698	1786	1874	1963	2052	2142	2232	2322	2412	2502	2593	2684
54	1446	1533	1620	1708	1796	1885	1974	2063	2153	2243	2334	2424	2514	2605	2696
60	1457	1545	1632	1720	1809	1898	1988	2077	2168	2258	2349	2439	2530	2621	2712
66	1471	1558	1646	1735	1824	1914	2003	2094	2184	2275	2366	2457	2548	2639	2731
72	1485	1573	1662	1751	1841	1931	2021	2112	2203	2294	2386	2477	2569	2660	2752
78	1490	1578	1666	1755	1845	1935	2025	2116	2207	2298	2389	2480	2571	2663	2754
84	1495	1583	1672	1761	1850	1940	2030	2121	2211	2302	2393	2484	2575	2666	2757
90	1501	1589	1678	1767	1856	1946	2036	2126	2217	2307	2398	2489	2580	2671	2762
96	1508	1596	1684	1773	1862	1952	2042	2132	2223	2313	2404	2494	2585	2676	2767
102	1517	1604	1693	1781	1870	1960	2050	2140	2230	2320	2411	2501	2592	2683	2774
108	1526	1613	1701	1790	1879	1968	2058	2148	2238	2328	2418	2509	2599	2690	2781
114	1535	1622	1710	1799	1888	1977	2067	2156	2246	2336	2426	2517	2607	2698	2788
120	1544	1632	1719	1808	1897	1986	2075	2165	2255	2345	2435	2525	2615	2705	2796
126	1554	1641	1729	1817	1906	1995	2084	2174	2264	2353	2443	2533	2623	2714	2804
132	1564	1651	1738	1826	1915	2004	2093	2183	2272	2362	2452	2542	2632	2722	2812
138	1573	1660	1748	1836	1925	2014	2103	2192	2282	2371	2461	2551	2641	2731	2821
144	1583	1670	1758	1846	1934	2023	2112	2202	2291	2381	2470	2560	2650	2740	2830

CPDPGN029-3 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition - this gives conservative results in comparison to trench conditions

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

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet							
Pipe Size (in)	29	30	31	32	33	34	35
12	2893	2990	3086	3183	3273	3377	3474
15	2811	2905	2998	3092	3179	3280	3374
18	2766	2858	2950	3042	3128	3227	3319
21	2743	2834	2925	3016	3101	3199	3291
24	2734	2824	2915	3006	3090	3187	3278
27	2733	2823	2914	3004	3089	3186	3277
30	2741	2832	2922	3013	3097	3194	3285
33	2753	2843	2934	3025	3109	3207	3298
36	2768	2859	2950	3041	3126	3224	3315
42	2767	2858	2949	3040	3125	3222	3313
48	2774	2865	2956	3047	3132	3229	3320
54	2787	2878	2969	3060	3145	3242	3333
60	2803	2894	2985	3077	3163	3259	3351
66	2822	2914	3005	3097	3184	3280	3372
72	2844	2936	3028	3120	3207	3304	3396
78	2846	2937	3029	3121	3208	3304	3396
84	2849	2940	3032	3123	3211	3307	3398
90	2853	2944	3036	3127	3214	3310	3401
96	2858	2949	3040	3132	3219	3314	3405
102	2864	2955	3046	3137	3225	3320	3411
108	2871	2962	3053	3144	3231	3326	3417
114	2879	2969	3060	3151	3238	3332	3423
120	2886	2977	3068	3158	3245	3340	3430
126	2894	2985	3075	3166	3253	3347	3438
132	2903	2993	3083	3174	3261	3355	3446
138	2911	3002	3092	3182	3269	3363	3454
144	2920	3010	3100	3191	3277	3371	3462

CPDPGN019-2 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition -this gives conservative results in comparison to trench conditions

D-Load (lb/ft/ft) for Type 4 Installation

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet													
Pipe Size (in)	1	2	3	4	5	6	7	8	9	10	11	12	13
12	1579	1481	1111	1032	1071	1154	1264	1383	1514	1649	1785	1923	2063
15	1519	1426	1073	998	1036	1116	1221	1336	1462	1738	1722	1855	1989
18	1443	1391	1050	978	1015	1093	1195	1307	1430	1699	1682	1811	1942
21	1306	1366	1035	966	1002	1079	1179	1288	1408	1673	1656	1782	1910
24	1288	1349	1025	959	994	1070	1168	1276	1394	1656	1638	1762	1888
27	1431	1352	1025	960	993	1068	1165	1271	1387	1641	1623	1746	1871
30	1560	1360	1029	965	995	1070	1166	1270	1384	1640	1621	1742	1865
33	1437	1316	1010	955	988	1064	1160	1264	1378	1631	1613	1733	1855
36	1336	1285	993	947	982	1060	1157	1260	1373	1626	1607	1727	1848
42	1181	1211	966	935	976	1057	1153	1256	1368	1619	1600	1719	1839
48	1068	1090	941	927	973	1056	1152	1255	1367	1617	1598	1716	1835
54	1029	1058	925	921	973	1058	1154	1257	1369	1619	1599	1716	1835
60	1059	1038	912	918	975	1062	1158	1261	1372	1622	1602	1719	1838
66	1021	1022	906	917	978	1066	1163	1266	1377	1628	1607	1724	1842
72	969	1008	902	917	984	1072	1169	1272	1384	1635	1613	1730	1848
78	927	996	899	920	990	1079	1176	1280	1391	1643	1620	1737	1854
84	893	986	898	925	997	1086	1184	1288	1399	1652	1628	1744	1862
90	866	978	898	931	1004	1094	1192	1296	1408	1661	1636	1753	1871
96	844	948	899	936	1012	1102	1201	1305	1417	1671	1646	1762	1880
102	826	932	911	949	1024	1115	1214	1318	1429	1685	1657	1774	1891
108	812	927	923	962	1037	1128	1226	1330	1441	1698	1669	1786	1903
114	801	938	935	975	1050	1141	1239	1343	1454	1712	1682	1798	1915
120	793	949	947	986	1063	1154	1252	1356	1467	1726	1694	1810	1927
126	786	960	959	999	1076	1167	1265	1369	1480	1740	1707	1823	1940
132	782	971	967	1013	1090	1180	1278	1382	1493	1754	1720	1836	1952
138	779	982	968	1026	1103	1194	1292	1395	1506	1769	1733	1848	1965
144	778	994	980	1039	1116	1207	1305	1409	1519	1783	1746	1861	1978

CPDPGN029-3 (Revised 04/26).

Fill Height Tables are based on:

1. $\gamma_s = 120$ pcf
2. AASHTO HL-93 live load
3. Positive Projecting Embankment Condition -this gives conservative results in comparison to trench conditions

D-Load (lb/ft/ft) for Type 4 Installation

	Class I		Class IV
	Class II		Class V
	Class III		Special Design

Fill Height in Feet												
Pipe Size (in)	14	15	16	17	18	19	20	21	22	23	24	25
12	2204	2346	2489	2633	2777	2922	3068	3213	3359	3506	3652	3799
15	2124	2261	2398	2536	2675	2814	2953	3093	3233	3374	3515	3656
18	2074	2206	2340	2474	2609	2744	2879	3015	3152	3288	3425	3562
21	2039	2169	2300	2431	2563	2696	2829	2962	3096	3229	3363	3498
24	2015	2143	2272	2401	2531	2662	2793	2924	3055	3187	3319	3451
27	1996	2123	2250	2378	2506	2635	2765	2894	3024	3154	3285	3415
30	1989	2114	2239	2365	2492	2620	2747	2876	3004	3133	3262	3391
33	1978	2102	2227	2352	2478	2604	2731	2858	2986	3113	3241	3370
36	1970	2093	2217	2342	2467	2593	2719	2845	2972	3098	3226	3353
42	1960	2082	2205	2329	2452	2577	2702	2827	2952	3078	3204	3330
48	1956	2077	2199	2322	2445	2568	2692	2816	2941	3066	3191	3316
54	1955	2076	2197	2319	2442	2564	2688	2811	2935	3059	3184	3308
60	1957	2077	2198	2320	2442	2564	2687	2810	2933	3057	3181	3304
66	1961	2081	2202	2323	2444	2566	2688	2811	2934	3057	3181	3304
72	1967	2086	2207	2327	2449	2570	2692	2815	2937	3060	3183	3306
78	1973	2093	2213	2333	2454	2576	2698	2820	2942	3064	3187	3310
84	1981	2100	2220	2340	2461	2582	2704	2826	2948	3070	3192	3315
90	1989	2108	2228	2348	2469	2590	2712	2833	2955	3077	3199	3321
96	1998	2117	2237	2357	2478	2599	2720	2841	2963	3085	3207	3329
102	2009	2128	2248	2368	2488	2609	2730	2851	2972	3094	3216	3337
108	2021	2140	2259	2379	2499	2619	2740	2861	2983	3104	3225	3347
114	2033	2151	2270	2390	2510	2631	2751	2872	2993	3114	3236	3357
120	2045	2163	2282	2402	2522	2642	2762	2883	3004	3125	3246	3367
126	2057	2176	2294	2414	2533	2654	2774	2895	3015	3136	3257	3378
132	2070	2188	2307	2426	2545	2665	2786	2906	3027	3148	3268	3389
138	2082	2200	2319	2438	2558	2678	2798	2918	3039	3159	3280	3401
144	2095	2213	2332	2451	2570	2690	2810	2930	3051	3171	3292	3412

CPDPGN029-3 (Revised 04/26).

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. Pipe outside diameters were based on a Wall C thickness since the larger outside diameters would represent the highest soil overburden load on the pipe. 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 Circular Concrete Pipe - Metric Units					
Designated Internal Diameter mm	Actual Internal Diameter mm	Wall B		Wall C	
		Minimum Wall Thickness mm	Average Weight kg/m	Minimum Wall Thickness mm	Average Weight kg/m
300	305	50	162	69	197
375	381	57	216	76	262
450	457	63	253	82	335
525	533	69	327	88	417
600	610	75	430	94	505
675	686	82	500	100	602
750	762	88	598	107	708
825	838	94	695	113	821
900	914	100	832	119	940
975	991	113	923	125	1090
1050	1067	117	1057	132	1207
1200	1219	125	1324	144	1504
1350	1372	138	1589	157	1829
1500	1524	150	1927	169	2192
1650	1676	163	2295	182	2582
1800	1829	175	2695	194	2998
1950	1981	188	3125	207	3457
2100	2134	200	3585	219	3943
2250	2286	213	4078	232	4460
2400	2438	225	4598	244	5009
2550	2591	238	5179	257	5595
2700	2743	250	5752	269	6202
3000	3048	279	6344	298	7521
3600	3658	330	8104	349	10,540

Dimensions of Circular Concrete Pipe - Imperial Units						
Internal Diameter Inches	Wall A		Wall B		Wall C	
	Minimum Wall Thickness Inches	Average Weight pounds per foot	Minimum Wall Thickness Inches	Average Weight pounds per foot	Minimum Wall Thickness Inches	Average Weight pounds per foot
12	1-3/4	79	2	93	2-3/4	133
15	1-7/8	103	2-1/4	127	3	177
18	2	131	2-1/2	168	3-1/4	226
21	2-1/4	171	2-3/4	214	3-1/2	281
24	2-1/2	217	3	264	3-3/4	341
27	2-5/8	255	3-1/4	322	4	406
30	2-3/4	295	3-1/2	384	4-1/4	476
33	2-7/8	336	3-3/4	451	4-1/2	552
36	3	383	4	524	4-3/4	633
42	3-1/2	520	4-1/2	686	5-1/4	811
48	4	683	5	867	5-3/4	1011
54	4-1/2	864	5-1/2	1068	6-1/4	1232
60	5	1064	6	1295	6-3/4	1473
66	5-1/2	1287	6-1/2	1542	7-1/4	1735
72	6	1532	7	1811	7-3/4	2023
78	6-1/2	1797	7-1/2	2100	8-1/4	2329
84	7	2085	8	2409	8-3/4	2656
90	7-1/2	2395	8-1/2	2740	9-1/4	3004
96	8	2710	9	3090	9-3/4	3374
102	8-1/2	3078	9-1/2	3480	10-1/4	3765
108	9	3446	10	3865	10-3/4	4178
114	9-1/2	3840	10-1/2	4278	11-1/4	4611
120	10	4263	11	4716	11-3/4	5066
126	10-1/2	4690	11-1/2	5175	12-1/4	5542
132	11	5148	12	5655	12-3/4	6040
138	11-1/2	5627	12-1/2	6156	13-1/4	6558
144	12	6126	13	6679	13-3/4	7098
150	12-1/2	6647	13-1/2	7223	14-1/4	7659
156	13	7190	14	7789	14-3/4	8242
162	13-1/2	7754	14-1/2	8375	15-1/4	8846
168	14	8339	15	8983	15-3/4	9471
174	14-1/2	8945	15-1/2	9612	16-1/4	10,117
180	15	9572	16	10,263	16-3/4	10,785



American Concrete Pipe Association

E-mail: acpa@concretepipe.org

www.concretepipe.org