
CHAPTER 5: TRENCH LOAD TABLES



Figure 5-1: 30-inch pipe installed in a vee trench in Linda, CA.

The load tables are based on Marston’s Equations for loads on rigid conduit. The tables show the loads imposed upon pipe by four primary soil groups. Loads are calculated using 100 lbs/ft³ soil weight (See Table 4-1 on page 4-7).

When the actual soil weight is known, the tabulated loads may be adjusted by direct ratio.

The tables list loads on pipe diameters of 6- through 48-inches. (For a discussion on embankment loads, see page 4-8).

“TRENCH LOAD,” a Computer Design Trench Load Program

NCPI has developed an online application for trench load design (TRENCH LOAD) based upon the Marston Equations and the pipe bedding classes described in ASTM C12 *Standard Practice for Installing Vitrified Clay Pipe Lines*.

“TRENCH LOAD” accepts project specific input data and yields safety factors for combinations of trench depth and width, soil types and densities. Live loads and impact factors may also be included at trench depths less than 8 feet.

“TRENCH LOAD” is available online at ncpi.org/toolbox.



LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.

| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | |
|---|--------------------------------------|-------------|-------------|-------------|-------------|------------------|--|--------------------------------------|-------------|-------------|-------------|-------------|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | Transition Width |
| | 18 | 24 | 30 | 36 | 42 | | | 18 | 24 | 30 | 36 | 42 | |
| 5 | 450 | 500 | | | | 1.59' | 5 | 480 | 500 | | | 1.55' | |
| 6 | 500 | 600 | | | | 1.69' | 6 | 520 | 600 | | | 1.64' | |
| 8 | 560 | 800 | | | | 1.86' | 8 | 600 | 790 | | | 1.80' | |
| 10 | 600 | 980 | 990 | | | 2.02' | 10 | 650 | 990 | | | 1.95' | |
| 12 | 640 | 1050 | 1190 | | | 2.17' | 12 | 680 | 1110 | 1190 | | 2.09' | |
| 14 | 650 | 1090 | 1390 | | | 2.31' | 14 | 700 | 1170 | 1390 | | 2.22' | |
| 16 | 660 | 1130 | 1590 | | | 2.44' | 16 | 720 | 1210 | 1590 | | 2.34' | |
| 18 | 670 | 1150 | 1720 | 1790 | | 2.56' | 18 | 730 | 1240 | 1790 | | 2.46' | |
| 20 | 670 | 1160 | 1760 | 1990 | | 2.68' | 20 | 740 | 1270 | 1900 | 1990 | 2.57' | |
| 22 | 670 | 1180 | 1790 | 2190 | | 2.80' | 22 | 740 | 1290 | 1940 | 2190 | 2.68' | |
| 24 | 680 | 1190 | 1820 | 2390 | | 2.91' | 24 | 750 | 1300 | 1970 | 2390 | 2.79' | |
| 26 | 680 | 1200 | 1840 | 2570 | 2590 | 3.01' | 26 | 750 | 1300 | 1990 | 2590 | 2.89' | |
| 28 | 680 | 1200 | 1850 | 2600 | 2790 | 3.12' | 28 | 750 | 1310 | 2010 | 2790 | 2.98' | |
| 30 | 680 | 1200 | 1850 | 2630 | 2990 | 3.22' | 30 | 750 | 1320 | 2030 | 2850 | 2990 | 3.08' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | Transition Width |
| | 18 | 24 | 30 | 36 | 42 | | | 18 | 24 | 30 | 36 | 42 | |
| 5 | 500 | | | | | 1.49' | 5 | 490 | | | | 1.42' | |
| 6 | 560 | 590 | | | | 1.57' | 6 | 590 | | | | 1.49' | |
| 8 | 650 | 790 | | | | 1.72' | 8 | 710 | 790 | | | 1.63' | |
| 10 | 720 | 990 | | | | 1.85' | 10 | 780 | 990 | | | 1.75' | |
| 12 | 760 | 1190 | | | | 1.98' | 12 | 850 | 1190 | | | 1.86' | |
| 14 | 790 | 1290 | 1390 | | | 2.10' | 14 | 890 | 1390 | | | 1.97' | |
| 16 | 810 | 1350 | 1590 | | | 2.21' | 16 | 920 | 1510 | 1590 | | 2.07' | |
| 18 | 820 | 1390 | 1790 | | | 2.32' | 18 | 950 | 1570 | 1790 | | 2.17' | |
| 20 | 840 | 1420 | 1990 | | | 2.42' | 20 | 970 | 1620 | 1990 | | 2.26' | |
| 22 | 850 | 1450 | 2160 | 2190 | | 2.52' | 22 | 980 | 1650 | 2190 | | 2.35' | |
| 24 | 850 | 1470 | 2210 | 2390 | | 2.62' | 24 | 990 | 1690 | 2390 | | 2.44' | |
| 26 | 860 | 1480 | 2240 | 2590 | | 2.71' | 26 | 1000 | 1720 | 2550 | 2590 | 2.52' | |
| 28 | 860 | 1500 | 2270 | 2790 | | 2.80' | 28 | 1010 | 1740 | 2660 | 2790 | 2.60' | |
| 30 | 860 | 1510 | 2300 | 2990 | | 2.89' | 30 | 1010 | 1750 | 2640 | 2990 | 2.68' | |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)

For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4

LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.



| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | |
|---|--------------------------------------|------------|-------------|-------------|-------------|-------------|------------------|--|--------------------------------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width |
| | 18 | 24 | 30 | 36 | 42 | 48 | | | 18 | 24 | 30 | 36 | 42 | 48 | |
| 5 | 450 | 650 | | | | | 1.93' | 5 | 480 | 650 | | | | | 1.88' |
| 6 | 500 | 760 | 780 | | | | 2.03' | 6 | 520 | 780 | | | | | 1.98' |
| 8 | 560 | 890 | 1040 | | | | 2.22' | 8 | 600 | 930 | 1040 | | | | 2.16' |
| 10 | 610 | 980 | 1300 | | | | 2.40' | 10 | 650 | 1030 | 1300 | | | | 2.32' |
| 12 | 640 | 1050 | 1510 | 1560 | | | 2.56' | 12 | 680 | 1110 | 1570 | | | | 2.47' |
| 14 | 650 | 1090 | 1600 | 1830 | | | 2.71' | 14 | 700 | 1170 | 1700 | 1830 | | | 2.62' |
| 16 | 660 | 1130 | 1660 | 2090 | | | 2.86' | 16 | 720 | 1210 | 1780 | 2090 | | | 2.76' |
| 18 | 670 | 1150 | 1720 | 2350 | | | 3.00' | 18 | 730 | 1240 | 1840 | 2350 | | | 2.89' |
| 20 | 670 | 1160 | 1760 | 2430 | 2610 | | 3.13' | 20 | 740 | 1270 | 1900 | 2590 | 2610 | | 3.01' |
| 22 | 670 | 1180 | 1790 | 2480 | 2870 | | 3.26' | 22 | 740 | 1290 | 1940 | 2670 | 2870 | | 3.13' |
| 24 | 680 | 1190 | 1820 | 2540 | 3140 | | 3.38' | 24 | 750 | 1300 | 1970 | 2730 | 3130 | | 3.25' |
| 26 | 680 | 1200 | 1840 | 2570 | 3400 | | 3.50' | 26 | 750 | 1300 | 1990 | 2770 | 3390 | | 3.36' |
| 28 | 680 | 1200 | 1850 | 2600 | 3450 | 3650 | 3.62' | 28 | 750 | 1310 | 2010 | 2820 | 3660 | | 3.47' |
| 30 | 680 | 1200 | 1850 | 2630 | 3490 | 3920 | 3.73' | 30 | 750 | 1320 | 2030 | 2850 | 3770 | 3920 | 3.58' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width |
| | 18 | 24 | 30 | 36 | 42 | 48 | | | 18 | 24 | 30 | 36 | 42 | 48 | |
| 5 | 500 | 650 | | | | | 1.81' | 5 | 530 | 650 | | | | | 1.75' |
| 6 | 560 | 770 | | | | | 1.90' | 6 | 600 | 780 | | | | | 1.82' |
| 8 | 650 | 990 | 1040 | | | | 2.06' | 8 | 710 | 1040 | | | | | 1.97' |
| 10 | 720 | 1120 | 1300 | | | | 2.21' | 10 | 780 | 1220 | 1300 | | | | 2.10' |
| 12 | 760 | 1220 | 1570 | | | | 2.35' | 12 | 850 | 1330 | 1560 | | | | 2.23' |
| 14 | 790 | 1290 | 1820 | | | | 2.48' | 14 | 890 | 1430 | 1820 | | | | 2.34' |
| 16 | 810 | 1350 | 1950 | 2080 | | | 2.61' | 16 | 920 | 1510 | 2080 | | | | 2.46' |
| 18 | 820 | 1390 | 2030 | 2350 | | | 2.73' | 18 | 950 | 1570 | 2260 | 2350 | | | 2.56' |
| 20 | 840 | 1420 | 2100 | 2610 | | | 2.84' | 20 | 970 | 1620 | 2350 | 2610 | | | 2.67' |
| 22 | 850 | 1450 | 2160 | 2870 | | | 2.95' | 22 | 980 | 1650 | 2430 | 2870 | | | 2.77' |
| 24 | 850 | 1470 | 2210 | 3030 | 3130 | | 3.06' | 24 | 990 | 1690 | 2500 | 3130 | | | 2.86' |
| 26 | 860 | 1480 | 2240 | 3100 | 3390 | | 3.16' | 26 | 1000 | 1720 | 2550 | 3390 | | | 2.95' |
| 28 | 860 | 1500 | 2270 | 3160 | 3660 | | 3.26' | 28 | 1010 | 1740 | 2600 | 3570 | 3650 | | 3.04' |
| 30 | 860 | 1510 | 2300 | 3210 | 3920 | | 3.36' | 30 | 1010 | 1750 | 2640 | 3640 | 3920 | | 3.13' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4



LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.

| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | |
|---|--------------------------------------|-------------|-------------|-------------|-------------|-------------|------------------|--|--------------------------------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width |
| | 24 | 30 | 36 | 42 | 48 | 54 | | | 24 | 30 | 36 | 42 | 48 | 54 | |
| 5 | 680 | 800 | | | | | 2.25' | 5 | 700 | 790 | | | | | 2.20' |
| 6 | 760 | 950 | | | | | 2.36' | 6 | 790 | 960 | | | | | 2.30' |
| 8 | 890 | 1240 | 1280 | | | | 2.56' | 8 | 930 | 1280 | | | | | 2.49' |
| 10 | 980 | 1390 | 1600 | | | | 2.75' | 10 | 1030 | 1450 | 1600 | | | | 2.67' |
| 12 | 1050 | 1510 | 1930 | | | | 2.92' | 12 | 1110 | 1590 | 1920 | | | | 2.83' |
| 14 | 1090 | 1600 | 2150 | 2250 | | | 3.09' | 14 | 1170 | 1700 | 2240 | | | | 2.99' |
| 16 | 1130 | 1660 | 2250 | 2560 | | | 3.25' | 16 | 1210 | 1780 | 2390 | 2570 | | | 3.13' |
| 18 | 1150 | 1720 | 2350 | 2890 | | | 3.40' | 18 | 1240 | 1840 | 2500 | 2890 | | | 3.28' |
| 20 | 1160 | 1760 | 2430 | 3150 | 3210 | | 3.54' | 20 | 1270 | 1900 | 2590 | 3210 | | | 3.41' |
| 22 | 1180 | 1790 | 2480 | 3250 | 3540 | | 3.68' | 22 | 1290 | 1940 | 2670 | 3460 | 3530 | | 3.54' |
| 24 | 1190 | 1820 | 2540 | 3330 | 3850 | | 3.81' | 24 | 1300 | 1970 | 2730 | 3570 | 3850 | | 3.67' |
| 26 | 1200 | 1840 | 2570 | 3390 | 4170 | | 3.94' | 26 | 1300 | 1990 | 2770 | 3640 | 4170 | | 3.79' |
| 28 | 1200 | 1850 | 2600 | 3450 | 4360 | 4500 | 4.07' | 28 | 1310 | 2010 | 2820 | 3710 | 4500 | | 3.91' |
| 30 | 1200 | 1850 | 2630 | 3490 | 4440 | 4820 | 4.19' | 30 | 1320 | 2030 | 2850 | 3770 | 4770 | 4820 | 4.02' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width |
| | 24 | 30 | 36 | 42 | 48 | 54 | | | 24 | 30 | 36 | 42 | 48 | 54 | |
| 5 | 730 | 790 | | | | | 2.13' | 5 | 770 | 790 | | | | | 2.05' |
| 6 | 830 | 960 | | | | | 2.22' | 6 | 880 | 950 | | | | | 2.14' |
| 8 | 990 | 1270 | | | | | 2.39' | 8 | 1060 | 1280 | | | | | 2.29' |
| 10 | 1120 | 1560 | 1600 | | | | 2.55' | 10 | 1220 | 1600 | | | | | 2.43' |
| 12 | 1220 | 1720 | 1920 | | | | 2.70' | 12 | 1330 | 1850 | 1920 | | | | 2.57' |
| 14 | 1290 | 1840 | 2240 | | | | 2.84' | 14 | 1430 | 2020 | 2250 | | | | 2.69' |
| 16 | 1350 | 1950 | 2570 | | | | 2.98' | 16 | 1510 | 2150 | 2570 | | | | 2.81' |
| 18 | 1390 | 2030 | 2730 | 2890 | | | 3.11' | 18 | 1570 | 2260 | 2890 | | | | 2.93' |
| 20 | 1420 | 2100 | 2850 | 3210 | | | 3.23' | 20 | 1620 | 2350 | 3150 | 3210 | | | 3.04' |
| 22 | 1450 | 2160 | 2950 | 3530 | | | 3.35' | 22 | 1650 | 2430 | 3280 | 3530 | | | 3.15' |
| 24 | 1470 | 2210 | 3030 | 3860 | | | 3.46' | 24 | 1690 | 2500 | 3380 | 3850 | | | 3.25' |
| 26 | 1480 | 2240 | 3100 | 4240 | 4170 | | 3.58' | 26 | 1720 | 2550 | 3480 | 4180 | | | 3.35' |
| 28 | 1500 | 2270 | 3160 | 4120 | 4500 | | 3.69' | 28 | 1740 | 2600 | 3570 | 4500 | | | 3.45' |
| 30 | 1510 | 2300 | 3210 | 4210 | 4820 | | 3.79' | 30 | 1750 | 2640 | 3640 | 4720 | 4820 | | 3.54' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)

For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4

LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.



| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | | | | |
|---|--------------------------------------|------------|-------------|-------------|-------------|-------------|-------------|-------|--|---|--------------------------------------|-------------|-------------|-------------|-------------|----|-------|--|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | 24 | 30 | 36 | 42 | 48 | 54 | 60 | 24 | | | 30 | 36 | 42 | 48 | 54 | 60 | | | |
| 5 | 680 | 920 | 950 | | | | | 2.57' | 5 | 700 | 940 | 950 | | | | | 2.51' | | |
| 6 | 760 | 1040 | 1140 | | | | | 2.68' | 6 | 790 | 1070 | 1140 | | | | | 2.62' | | |
| 8 | 890 | 1240 | 1530 | | | | | 2.90' | 8 | 930 | 1290 | 1520 | | | | | 2.83' | | |
| 10 | 980 | 1390 | 1820 | 1910 | | | | 3.10' | 10 | 1030 | 1450 | 1890 | 1900 | | | | 3.01' | | |
| 12 | 1050 | 1510 | 2000 | 2290 | | | | 3.29' | 12 | 1110 | 1590 | 2100 | 2300 | | | | 3.19' | | |
| 14 | 1090 | 1600 | 2150 | 2670 | | | | 3.46' | 14 | 1170 | 1700 | 2260 | 2680 | | | | 3.35' | | |
| 16 | 1130 | 1660 | 2250 | 2890 | 3060 | | | 3.63' | 16 | 1210 | 1780 | 2390 | 3040 | 3060 | | | 3.51' | | |
| 18 | 1150 | 1720 | 2350 | 3040 | 3450 | | | 3.79' | 18 | 1240 | 1840 | 2500 | 3210 | 3440 | | | 3.66' | | |
| 20 | 1160 | 1760 | 2430 | 3150 | 3830 | | | 3.94' | 20 | 1270 | 1900 | 2590 | 3350 | 3830 | | | 3.80' | | |
| 22 | 1180 | 1790 | 2480 | 3250 | 4060 | 4210 | | 4.09' | 22 | 1290 | 1940 | 2670 | 3460 | 4210 | | | 3.94' | | |
| 24 | 1190 | 1820 | 2540 | 3330 | 4180 | 4600 | | 4.23' | 24 | 1300 | 1970 | 2730 | 3570 | 4450 | 4600 | | 4.08' | | |
| 26 | 1200 | 1840 | 2570 | 3390 | 4280 | 4980 | | 4.37' | 26 | 1300 | 1990 | 2770 | 3640 | 4570 | 4980 | | 4.21' | | |
| 28 | 1200 | 1850 | 2600 | 3450 | 4360 | 5340 | 5360 | 4.51' | 28 | 1310 | 2010 | 2820 | 3710 | 4680 | 5370 | | 4.34' | | |
| 30 | 1200 | 1850 | 2630 | 3490 | 4440 | 5450 | 5740 | 4.64' | 30 | 1320 | 2030 | 2850 | 3770 | 4770 | 5750 | | 4.46' | | |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | 24 | 30 | 36 | 42 | 48 | 54 | 60 | 24 | | | 30 | 36 | 42 | 48 | 54 | 60 | | | |
| 5 | 730 | 950 | | | | | | 2.44' | 5 | 770 | 950 | | | | | | 2.37' | | |
| 6 | 830 | 1120 | 1140 | | | | | 2.54' | 6 | 880 | 1140 | | | | | | 2.45' | | |
| 8 | 990 | 1360 | 1520 | | | | | 2.72' | 8 | 1060 | 1440 | 1520 | | | | | 2.62' | | |
| 10 | 1120 | 1560 | 1910 | | | | | 2.89' | 10 | 1220 | 1660 | 1910 | | | | | 2.77' | | |
| 12 | 1220 | 1720 | 2240 | 2290 | | | | 3.05' | 12 | 1330 | 1850 | 2290 | | | | | 2.91' | | |
| 14 | 1290 | 1840 | 2430 | 2670 | | | | 3.20' | 14 | 1430 | 2020 | 2620 | 2680 | | | | 3.04' | | |
| 16 | 1350 | 1950 | 2600 | 3060 | | | | 3.34' | 16 | 1510 | 2150 | 2820 | 3060 | | | | 3.17' | | |
| 18 | 1390 | 2030 | 2730 | 3440 | | | | 3.48' | 18 | 1570 | 2260 | 3000 | 3450 | | | | 3.29' | | |
| 20 | 1420 | 2100 | 2850 | 3640 | 3820 | | | 3.61' | 20 | 1620 | 2350 | 3150 | 3830 | | | | 3.41' | | |
| 22 | 1460 | 2160 | 2950 | 3790 | 4220 | | | 3.74' | 22 | 1650 | 2430 | 3280 | 4170 | 4220 | | | 3.52' | | |
| 24 | 1470 | 2210 | 3030 | 3920 | 4600 | | | 3.86' | 24 | 1690 | 2500 | 3380 | 4340 | 4600 | | | 3.63' | | |
| 26 | 1480 | 2240 | 3100 | 4020 | 4980 | | | 3.98' | 26 | 1720 | 2550 | 3490 | 4480 | 4980 | | | 3.74' | | |
| 28 | 1500 | 2270 | 3160 | 4120 | 5160 | 5370 | | 4.10' | 28 | 1740 | 2600 | 3570 | 4610 | 5360 | | | 3.84' | | |
| 30 | 1510 | 2300 | 3210 | 4210 | 5270 | 5750 | | 4.21' | 30 | 1750 | 2640 | 3640 | 4720 | 5750 | | | 3.95' | | |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4



LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.

| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | | |
|---|--------------------------------------|------|-------------|-------------|-------------|-------------|-------------|------------------|--|--------------------------------------|-------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width |
| | 30 | 36 | 42 | 48 | 54 | 60 | 72 | | | 30 | 36 | 42 | 48 | 54 | 60 | 72 | |
| | 5 | 920 | 1150 | 1170 | | | | | | | 3.04' | 5 | 940 | 1170 | | | |
| 6 | 1040 | 1320 | 1410 | | | | | 3.16' | 6 | 1070 | 1360 | 1410 | | | | | 3.10' |
| 8 | 1240 | 1600 | 1890 | | | | | 3.40' | 8 | 1290 | 1650 | 1890 | | | | | 3.32' |
| 10 | 1390 | 1820 | 2260 | 2370 | | | | 3.61' | 10 | 1450 | 1900 | 2350 | 2370 | | | | 3.52' |
| 12 | 1510 | 2000 | 2520 | 2850 | | | | 3.81' | 12 | 1590 | 2100 | 2630 | 2840 | | | | 3.71' |
| 14 | 1600 | 2150 | 2720 | 3330 | | | | 4.00' | 14 | 1700 | 2260 | 2850 | 3320 | | | | 3.88' |
| 16 | 1660 | 2250 | 2890 | 3550 | 3800 | | | 4.18' | 16 | 1780 | 2390 | 3040 | 3730 | 3800 | | | 4.05' |
| 18 | 1720 | 2350 | 3040 | 3750 | 4280 | | | 4.36' | 18 | 1840 | 2500 | 3210 | 3950 | 4280 | | | 4.22' |
| 20 | 1760 | 2430 | 3150 | 3920 | 4720 | 4750 | | 4.52' | 20 | 1900 | 2590 | 3350 | 4150 | 4760 | | | 4.37' |
| 22 | 1790 | 2480 | 3250 | 4060 | 4920 | 5240 | | 4.68' | 22 | 1940 | 2670 | 3460 | 4310 | 5190 | 5230 | | 4.52' |
| 24 | 1820 | 2540 | 3330 | 4180 | 5080 | 5720 | | 4.84' | 24 | 1970 | 2730 | 3570 | 4450 | 5390 | 5710 | | 4.67' |
| 26 | 1840 | 2570 | 3390 | 4280 | 5230 | 6190 | | 4.99' | 26 | 1990 | 2770 | 3640 | 4570 | 5560 | 6190 | | 4.81' |
| 28 | 1850 | 2600 | 3450 | 4360 | 5340 | 6380 | 6670 | 5.14' | 28 | 2010 | 2820 | 3710 | 4680 | 5700 | 6670 | | 4.95' |
| 30 | 1850 | 2630 | 3490 | 4440 | 5450 | 6530 | 7140 | 5.28' | 30 | 2030 | 2850 | 3770 | 4770 | 5840 | 6960 | 7150 | 5.08' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | | |
| Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width |
| | 30 | 36 | 42 | 48 | 54 | 60 | 72 | | | 30 | 36 | 42 | 48 | 54 | 60 | 72 | |
| | 5 | 970 | 1170 | | | | | | | | 2.91' | 5 | 1020 | 1170 | | | |
| 6 | 1120 | 1400 | 1410 | | | | | 3.01' | 6 | 1170 | 1420 | | | | | | 2.92' |
| 8 | 1360 | 1730 | 1890 | | | | | 3.21' | 8 | 1440 | 1820 | 1890 | | | | | 3.10' |
| 10 | 1560 | 2010 | 2370 | | | | | 3.39' | 10 | 1660 | 2120 | 2370 | | | | | 3.26' |
| 12 | 1720 | 2240 | 2780 | 2850 | | | | 3.56' | 12 | 1850 | 2390 | 2850 | | | | | 3.41' |
| 14 | 1840 | 2430 | 3050 | 3320 | | | | 3.72' | 14 | 2020 | 2620 | 3260 | 3320 | | | | 3.55' |
| 16 | 1950 | 2600 | 3270 | 3800 | | | | 3.88' | 16 | 2150 | 2820 | 3530 | 3800 | | | | 3.69' |
| 18 | 2030 | 2730 | 3470 | 4240 | 4280 | | | 4.02' | 18 | 2260 | 3000 | 3770 | 4280 | | | | 3.82' |
| 20 | 2100 | 2850 | 3640 | 4470 | 4760 | | | 4.17' | 20 | 2350 | 3150 | 3990 | 4760 | | | | 3.95' |
| 22 | 2160 | 2950 | 3790 | 4680 | 5230 | | | 4.30' | 22 | 2430 | 3280 | 4170 | 5110 | 5240 | | | 4.07' |
| 24 | 2210 | 3030 | 3920 | 4860 | 5720 | | | 4.44' | 24 | 2500 | 3390 | 4340 | 5330 | 5720 | | | 4.19' |
| 26 | 2240 | 3100 | 4020 | 5020 | 6060 | 6190 | | 4.56' | 26 | 2550 | 3490 | 4480 | 5530 | 6190 | | | 4.30' |
| 28 | 2270 | 3160 | 4120 | 5160 | 6240 | 6670 | | 4.69' | 28 | 2600 | 3570 | 4610 | 5720 | 6670 | | | 4.42' |
| 30 | 2300 | 3210 | 4210 | 5270 | 6420 | 7150 | | 4.81' | 30 | 2640 | 3640 | 4720 | 5880 | 7080 | 7150 | | 4.53' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4

LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.



| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | |
|---|--------------------------------------|-------------|-------------|-------------|-------------|-------------|------------------|--|--------------------------------------|-------------|-------------|-------------|-------------|-------------|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width |
| | 36 | 42 | 48 | 54 | 60 | 72 | | | 36 | 42 | 48 | 54 | 60 | 72 | |
| | 5 | 1150 | 1400 | 1400 | | | | | | 3.51' | 5 | 1180 | 1400 | | |
| 6 | 1320 | 1600 | 1690 | | | | 3.65' | 6 | 1360 | 1640 | 1700 | | | 3.59' | |
| 8 | 1600 | 1970 | 2270 | | | | 3.90' | 8 | 1650 | 2030 | 2270 | | | 3.82' | |
| 10 | 1820 | 2260 | 2730 | 2850 | | | 4.13' | 10 | 1900 | 2350 | 2820 | 2840 | | 4.03' | |
| 12 | 2000 | 2520 | 3050 | 3420 | | | 4.34' | 12 | 2100 | 2630 | 3170 | 3420 | | 4.23' | |
| 14 | 2150 | 2720 | 3320 | 3940 | 4000 | | 4.55' | 14 | 2260 | 2850 | 3470 | 4000 | | 4.42' | |
| 16 | 2250 | 2890 | 3560 | 4240 | 4570 | | 4.74' | 16 | 2390 | 3040 | 3730 | 4430 | 4570 | 4.60' | |
| 18 | 2350 | 3040 | 3750 | 4500 | 5140 | | 4.92' | 18 | 2500 | 3210 | 3950 | 4710 | 5150 | 4.77' | |
| 20 | 2430 | 3150 | 3920 | 4720 | 5550 | 5720 | 5.10' | 20 | 2590 | 3350 | 4150 | 4970 | 5720 | 4.94' | |
| 22 | 2480 | 3250 | 4060 | 4920 | 5800 | 6300 | 5.27' | 22 | 2670 | 3460 | 4310 | 5190 | 6100 | 6300 | 5.10' |
| 24 | 2540 | 3330 | 4180 | 5080 | 6020 | 6870 | 5.44' | 24 | 2730 | 3570 | 4450 | 5390 | 6360 | 6870 | 5.26' |
| 26 | 2570 | 3390 | 4280 | 5230 | 6220 | 7440 | 5.60' | 26 | 2770 | 3640 | 4570 | 5560 | 6580 | 7440 | 5.41' |
| 28 | 2600 | 3450 | 4360 | 5340 | 6380 | 8020 | 5.76' | 28 | 2820 | 3710 | 4680 | 5700 | 6780 | 8030 | 5.56' |
| 30 | 2630 | 3490 | 4440 | 5450 | 6530 | 8600 | 5.91' | 30 | 2850 | 3770 | 4770 | 5840 | 6960 | 8600 | 5.70' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width |
| | 36 | 42 | 48 | 54 | 60 | 72 | | | 36 | 42 | 48 | 54 | 60 | 72 | |
| | 5 | 1200 | 1400 | | | | | | | 3.38' | 5 | 1250 | 1400 | | |
| 6 | 1400 | 1690 | | | | | 3.50' | 6 | 1450 | 1690 | | | | 3.40' | |
| 8 | 1730 | 2110 | 2270 | | | | 3.71' | 8 | 1820 | 2200 | 2270 | | | 3.59' | |
| 10 | 2010 | 2470 | 2840 | | | | 3.90' | 10 | 2120 | 2600 | 2850 | | | 3.76' | |
| 12 | 2240 | 2780 | 3330 | 3420 | | | 4.08' | 12 | 2390 | 2950 | 3420 | | | 3.92' | |
| 14 | 2430 | 3050 | 3670 | 4000 | | | 4.25' | 14 | 2620 | 3260 | 3910 | 3990 | | 4.07' | |
| 16 | 2600 | 3270 | 3970 | 4570 | | | 4.41' | 16 | 2820 | 3530 | 4250 | 4570 | | 4.21' | |
| 18 | 2730 | 3470 | 4240 | 5030 | 5150 | | 4.57' | 18 | 3000 | 3770 | 4570 | 5150 | | 4.35' | |
| 20 | 2850 | 3640 | 4470 | 5330 | 5720 | | 4.72' | 20 | 3150 | 3990 | 4850 | 5720 | | 4.49' | |
| 22 | 2950 | 3790 | 4680 | 5600 | 6300 | | 4.87' | 22 | 3280 | 4170 | 5110 | 6060 | 6300 | 4.62' | |
| 24 | 3030 | 3920 | 4860 | 5840 | 6860 | 6870 | 5.01' | 24 | 3380 | 4340 | 5330 | 6350 | 6870 | 4.75' | |
| 26 | 3100 | 4020 | 5010 | 6060 | 7120 | 7450 | 5.15' | 26 | 3480 | 4480 | 5530 | 6620 | 7450 | 4.87' | |
| 28 | 3160 | 4120 | 5160 | 6240 | 7370 | 8020 | 5.28' | 28 | 3570 | 4610 | 5720 | 6860 | 8020 | 4.99' | |
| 30 | 3210 | 4210 | 5270 | 6410 | 7590 | 8600 | 5.41' | 30 | 3640 | 4720 | 5880 | 7080 | 8330 | 8600 | 5.11' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)

For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4



LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.

| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | | | | |
|---|--------------------------------------|-------------|-------------|-------------|-------------|--------------|--------------|----|--|---|--------------------------------------|------|-------------|-------------|-------------|--------------|--------------|--|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | 36 | 42 | 48 | 54 | 60 | 72 | 84 | 36 | | | 42 | 48 | 54 | 60 | 72 | 84 | | | |
| 5 | 1150 | 1400 | 1630 | | | | | | 3.97' | 5 | 1180 | 1430 | 1630 | | | | | | 3.91' |
| 6 | 1320 | 1600 | 1890 | 1960 | | | | | 4.12' | 6 | 1360 | 1640 | 1930 | 1970 | | | | | 4.05' |
| 8 | 1600 | 1960 | 2350 | 2640 | | | | | 4.39' | 8 | 1650 | 2030 | 2410 | 2630 | | | | | 4.30' |
| 10 | 1820 | 2260 | 2730 | 3190 | 3310 | | | | 4.63' | 10 | 1900 | 2350 | 2820 | 3290 | 3310 | | | | 4.53' |
| 12 | 2000 | 2520 | 3050 | 3590 | 3980 | | | | 4.85' | 12 | 2100 | 2630 | 3170 | 3720 | 3980 | | | | 4.74' |
| 14 | 2150 | 2720 | 3320 | 3940 | 4570 | 4650 | | | 5.07' | 14 | 2260 | 2850 | 3470 | 4100 | 4650 | | | | 4.94' |
| 16 | 2250 | 2890 | 3550 | 4240 | 4940 | 5330 | | | 5.27' | 16 | 2390 | 3040 | 3730 | 4430 | 5140 | 5320 | | | 5.13' |
| 18 | 2350 | 3040 | 3750 | 4500 | 5260 | 6000 | | | 5.46' | 18 | 2500 | 3210 | 3950 | 4710 | 5500 | 6000 | | | 5.31' |
| 20 | 2430 | 3150 | 3920 | 4720 | 5550 | 6660 | | | 5.65' | 20 | 2590 | 3350 | 4150 | 4970 | 5830 | 6670 | | | 5.48' |
| 22 | 2480 | 3250 | 4060 | 4920 | 5800 | 7340 | | | 5.83' | 22 | 2670 | 3460 | 4310 | 5190 | 6100 | 7340 | | | 5.65' |
| 24 | 2540 | 3330 | 4180 | 5080 | 6020 | 7990 | 8010 | | 6.01' | 24 | 2730 | 3570 | 4450 | 5390 | 6360 | 8010 | | | 5.82' |
| 26 | 2570 | 3390 | 4280 | 5230 | 6220 | 8300 | 8680 | | 6.18' | 26 | 2770 | 3640 | 4570 | 5560 | 6580 | 8680 | | | 5.98' |
| 28 | 2600 | 3450 | 4360 | 5340 | 6380 | 8570 | 9350 | | 6.34' | 28 | 2820 | 3710 | 4680 | 5700 | 6780 | 9040 | 9350 | | 6.13' |
| 30 | 2630 | 3490 | 4440 | 5450 | 6530 | 8820 | 10020 | | 6.50' | 30 | 2850 | 3770 | 4770 | 5840 | 6960 | 9320 | 10020 | | 6.28' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | 36 | 42 | 48 | 54 | 60 | 72 | 84 | 36 | | | 42 | 48 | 54 | 60 | 72 | 84 | | | |
| 5 | 1220 | 1620 | | | | | | | 3.83' | 5 | 1250 | 1500 | 1620 | | | | | | 3.75' |
| 6 | 1400 | 1690 | 1970 | | | | | | 3.96' | 6 | 1450 | 1750 | 1960 | | | | | | 3.87' |
| 8 | 1730 | 2110 | 2490 | 2640 | | | | | 4.19' | 8 | 1820 | 2200 | 2590 | 2640 | | | | | 4.06' |
| 10 | 2010 | 2470 | 2940 | 3310 | | | | | 4.39' | 10 | 2120 | 2600 | 3080 | 3310 | | | | | 4.24' |
| 12 | 2240 | 2780 | 3330 | 3890 | 3980 | | | | 4.58' | 12 | 2390 | 2950 | 3520 | 3980 | | | | | 4.41' |
| 14 | 2430 | 3050 | 3670 | 4320 | 4650 | | | | 4.76' | 14 | 2620 | 3260 | 3910 | 4560 | 4650 | | | | 4.57' |
| 16 | 2600 | 3270 | 3970 | 4700 | 5320 | | | | 4.93' | 16 | 2820 | 3530 | 4250 | 4990 | 5320 | | | | 4.72' |
| 18 | 2730 | 3470 | 4240 | 5030 | 5840 | 6000 | | | 5.09' | 18 | 3000 | 3770 | 4570 | 5380 | 6000 | | | | 4.87' |
| 20 | 2850 | 3640 | 4470 | 5330 | 6220 | 6670 | | | 5.25' | 20 | 3150 | 3980 | 4850 | 5750 | 6650 | 6670 | | | 5.01' |
| 22 | 2950 | 3790 | 4680 | 5600 | 6550 | 7340 | | | 5.41' | 22 | 3280 | 4170 | 5110 | 6060 | 7050 | 7340 | | | 5.15' |
| 24 | 3030 | 3920 | 4860 | 5840 | 6860 | 8010 | | | 5.55' | 24 | 3380 | 4340 | 5330 | 6350 | 7410 | 8010 | | | 5.28' |
| 26 | 3100 | 4020 | 5020 | 6060 | 7120 | 8680 | | | 5.70' | 26 | 3480 | 4480 | 5530 | 6620 | 7750 | 8680 | | | 5.41' |
| 28 | 3160 | 4120 | 5160 | 6240 | 7370 | 9350 | | | 5.84' | 28 | 3570 | 4610 | 5720 | 6860 | 8050 | 9350 | | | 5.54' |
| 30 | 3210 | 4210 | 5270 | 6420 | 7590 | 10020 | | | 5.98' | 30 | 3640 | 4720 | 5880 | 7080 | 8330 | 10020 | | | 5.66' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4

LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.



| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | | | | |
|---|--------------------------------------|------|-------------|-------------|-------------|--------------|--------------|----|--|---|--------------------------------------|-------|-------------|-------------|-------------|--------------|----|----|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | | 42 | 48 | 54 | 60 | 72 | 84 | 96 | | | | 42 | 48 | 54 | 60 | 72 | 84 | 96 | |
| | 5 | 1400 | 1640 | 1830 | | | | | | | | 4.39' | 5 | 1430 | 1670 | 1830 | | | |
| 6 | 1600 | 1890 | 2180 | 2230 | | | | | 4.58' | 6 | 1640 | 1930 | 2230 | 2230 | | | | | 4.51' |
| 8 | 1960 | 2350 | 2730 | 3000 | | | | | 4.86' | 8 | 2030 | 2410 | 2790 | 3000 | | | | | 4.77' |
| 10 | 2260 | 2730 | 3190 | 3660 | 3760 | | | | 5.11' | 10 | 2350 | 2820 | 3290 | 3760 | 3770 | | | | 5.01' |
| 12 | 2520 | 3050 | 3590 | 4150 | 4540 | | | | 5.35' | 12 | 2630 | 3170 | 3720 | 4280 | 4530 | | | | 5.23' |
| 14 | 2720 | 3320 | 3940 | 4570 | 5300 | | | | 5.57' | 14 | 2850 | 3470 | 4100 | 4740 | 5300 | | | | 5.43' |
| 16 | 2890 | 3550 | 4240 | 4940 | 6060 | | | | 5.78' | 16 | 3040 | 3730 | 4430 | 5140 | 6060 | | | | 5.63' |
| 18 | 3040 | 3750 | 4500 | 5260 | 6830 | | | | 5.98' | 18 | 3210 | 3950 | 4710 | 5500 | 6830 | | | | 5.82' |
| 20 | 3150 | 3920 | 4720 | 5550 | 7280 | 7590 | | | 6.18' | 20 | 3350 | 4150 | 4970 | 5830 | 7580 | 7590 | | | 6.01' |
| 22 | 3250 | 4060 | 4920 | 5800 | 7650 | 8360 | | | 6.37' | 22 | 3460 | 4310 | 5190 | 6100 | 8010 | 8360 | | | 6.18' |
| 24 | 3330 | 4180 | 5080 | 6020 | 7990 | 9130 | | | 6.55' | 24 | 3570 | 4450 | 5390 | 6360 | 8380 | 9120 | | | 6.35' |
| 26 | 3390 | 4280 | 5230 | 6220 | 8300 | 9890 | | | 6.73' | 26 | 3640 | 4570 | 5560 | 6580 | 8730 | 9890 | | | 6.52' |
| 28 | 3450 | 4360 | 5340 | 6380 | 8570 | 10650 | | | 6.90' | 28 | 3710 | 4680 | 5700 | 6780 | 9040 | 10650 | | | 6.68' |
| 30 | 3490 | 4440 | 5450 | 6530 | 8820 | 11240 | 11420 | | 7.07' | 30 | 3770 | 4770 | 5840 | 6960 | 9320 | 11420 | | | 6.84' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | | 42 | 48 | 54 | 60 | 72 | 84 | 96 | | | | 42 | 48 | 54 | 60 | 72 | 84 | 96 | |
| | 5 | 1460 | 1710 | 1830 | | | | | | | | 4.25' | 5 | 1500 | 1750 | 1830 | | | |
| 6 | 1690 | 1990 | 2230 | | | | | | 4.41' | 6 | 1750 | 2050 | 2230 | | | | | | 4.31' |
| 8 | 2110 | 2490 | 2880 | 3000 | | | | | 4.65' | 8 | 2200 | 2590 | 2980 | 3000 | | | | | 4.53' |
| 10 | 2470 | 2940 | 3420 | 3770 | | | | | 4.86' | 10 | 2600 | 3080 | 3560 | 3770 | | | | | 4.71' |
| 12 | 2780 | 3330 | 3890 | 4470 | 4530 | | | | 5.06' | 12 | 2950 | 3520 | 4080 | 4530 | | | | | 4.89' |
| 14 | 3050 | 3670 | 4320 | 4970 | 5300 | | | | 5.25' | 14 | 3260 | 3910 | 4560 | 5220 | 5300 | | | | 5.05' |
| 16 | 3270 | 3970 | 4700 | 5430 | 6070 | | | | 5.43' | 16 | 3530 | 4250 | 4990 | 5750 | 6060 | | | | 5.21' |
| 18 | 3470 | 4240 | 5030 | 5840 | 6830 | | | | 5.60' | 18 | 3770 | 4570 | 5380 | 6220 | 6830 | | | | 5.37' |
| 20 | 3640 | 4470 | 5330 | 6220 | 7590 | | | | 5.76' | 20 | 3980 | 4850 | 5750 | 6650 | 7590 | | | | 5.51' |
| 22 | 3790 | 4680 | 5600 | 6550 | 8360 | | | | 5.92' | 22 | 4170 | 5110 | 6060 | 7050 | 8360 | | | | 5.66' |
| 24 | 3920 | 4860 | 5840 | 6860 | 8950 | 9120 | | | 6.08' | 24 | 4340 | 5330 | 6350 | 7410 | 9120 | | | | 5.79' |
| 26 | 4020 | 5020 | 6060 | 7120 | 9360 | 9890 | | | 6.23' | 26 | 4480 | 5530 | 6620 | 7750 | 9890 | | | | 5.93' |
| 28 | 4120 | 5160 | 6240 | 7370 | 9730 | 10660 | | | 6.38' | 28 | 4610 | 5720 | 6860 | 8050 | 10500 | 10650 | | | 6.06' |
| 30 | 4210 | 5270 | 6420 | 7590 | 10070 | 11420 | | | 6.52' | 30 | 4720 | 5880 | 7080 | 8330 | 10910 | 11420 | | | 6.19' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4



LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.

| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | | | | |
|---|--------------------------------------|------|------|-------------|-------------|--------------|--------------|----|--|---|--------------------------------------|------|-------------|-------------|-------------|--------------|--------------|-------|------------------|
| Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | | 42 | 48 | 54 | 60 | 72 | 84 | 96 | | | | 42 | 48 | 54 | 60 | 72 | 84 | 96 | |
| 5 | 1400 | 1640 | 1880 | 1960 | | | | | 4.65' | 5 | 1430 | 1670 | 1910 | 1960 | | | | 4.59' | |
| 6 | 1600 | 1890 | 2180 | 2480 | 2500 | | | | 5.04' | 6 | 1640 | 1930 | 2230 | 2500 | | | | 4.96' | |
| 8 | 1960 | 2350 | 2730 | 3110 | 3370 | | | | 5.34' | 8 | 2030 | 2410 | 2790 | 3170 | 3370 | | | 5.25' | |
| 10 | 2260 | 2730 | 3190 | 3660 | 4240 | | | | 5.61' | 10 | 2350 | 2820 | 3290 | 3760 | 4230 | | | 5.50' | |
| 12 | 2520 | 3050 | 3590 | 4150 | 5100 | | | | 5.85' | 12 | 2630 | 3170 | 3720 | 4280 | 5100 | | | 5.73' | |
| 14 | 2720 | 3320 | 3940 | 4570 | 5850 | 5960 | | | 6.08' | 14 | 2850 | 3470 | 4100 | 4740 | 5970 | | | 5.94' | |
| 16 | 2890 | 3550 | 4240 | 4940 | 6380 | 6830 | | | 6.30' | 16 | 3040 | 3730 | 4430 | 5140 | 6610 | 6830 | | 6.15' | |
| 18 | 3040 | 3750 | 4500 | 5260 | 6850 | 7690 | | | 6.51' | 18 | 3210 | 3950 | 4710 | 5500 | 7120 | 7690 | | 6.34' | |
| 20 | 3150 | 3920 | 4720 | 5550 | 7280 | 8550 | | | 6.72' | 20 | 3350 | 4150 | 4970 | 5830 | 7580 | 8560 | | 6.54' | |
| 22 | 3250 | 4060 | 4920 | 5800 | 7650 | 9420 | | | 6.91' | 22 | 3460 | 4310 | 5190 | 6100 | 8010 | 9420 | | 6.72' | |
| 24 | 3330 | 4180 | 5080 | 6020 | 7990 | 11060 | 10270 | | 7.10' | 24 | 3570 | 4450 | 5390 | 6360 | 8380 | 10280 | | 6.90' | |
| 26 | 3390 | 4280 | 5230 | 6220 | 8300 | 10490 | 11140 | | 7.29' | 26 | 3640 | 4570 | 5560 | 6580 | 8730 | 10970 | 11140 | 7.07' | |
| 28 | 3450 | 4360 | 5340 | 6380 | 8570 | 10880 | 12000 | | 7.47' | 28 | 3710 | 4680 | 5700 | 6780 | 9040 | 11420 | 12000 | 7.24' | |
| 30 | 3490 | 4440 | 5450 | 6530 | 8820 | 11240 | 12860 | | 7.65' | 30 | 3770 | 4770 | 5840 | 6960 | 9320 | 11820 | 12860 | 7.41' | |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | | | | |
| Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | | 42 | 48 | 54 | 60 | 72 | 84 | 96 | | | | 42 | 48 | 54 | 60 | 72 | 84 | 96 | |
| 5 | 1460 | 1710 | 1960 | 1960 | | | | | 4.51' | 5 | 1500 | 1750 | 1960 | | | | | 4.42' | |
| 6 | 1690 | 1990 | 2280 | 2500 | | | | | 4.87' | 6 | 1750 | 2050 | 2340 | 2500 | | | | 4.77' | |
| 8 | 2110 | 2490 | 2880 | 3270 | 3370 | | | | 5.13' | 8 | 2200 | 2590 | 2980 | 3370 | | | | 5.00' | |
| 10 | 2470 | 2940 | 3420 | 3900 | 4230 | | | | 5.35' | 10 | 2600 | 3080 | 3560 | 4050 | 4240 | | | 5.20' | |
| 12 | 2780 | 3330 | 3890 | 4470 | 5100 | | | | 5.56' | 12 | 2950 | 3520 | 4090 | 4660 | 5100 | | | 5.38' | |
| 14 | 3050 | 3670 | 4320 | 4970 | 5970 | | | | 5.75' | 14 | 3260 | 3910 | 4560 | 5220 | 5960 | | | 5.55' | |
| 16 | 3270 | 3970 | 4700 | 5430 | 6820 | | | | 5.94' | 16 | 3530 | 4250 | 4990 | 5750 | 6830 | | | 5.71' | |
| 18 | 3470 | 4240 | 5030 | 5840 | 7500 | 7690 | | | 6.11' | 18 | 3770 | 4570 | 5380 | 6220 | 7690 | | | 5.87' | |
| 20 | 3640 | 4470 | 5330 | 6220 | 8020 | 8550 | | | 6.29' | 20 | 3980 | 4850 | 5750 | 6650 | 8510 | 8550 | | 6.03' | |
| 22 | 3790 | 4680 | 5600 | 6550 | 8510 | 9420 | | | 6.45' | 22 | 4170 | 5110 | 6060 | 7050 | 9060 | 9420 | | 6.17' | |
| 24 | 3920 | 4860 | 5840 | 6860 | 8950 | 10270 | | | 6.61' | 24 | 4340 | 5330 | 6350 | 7410 | 9580 | 10280 | | 6.32' | |
| 26 | 4020 | 5020 | 6060 | 7120 | 9360 | 11140 | | | 6.77' | 26 | 4480 | 5530 | 6620 | 7750 | 10050 | 11140 | | 6.46' | |
| 28 | 4120 | 5160 | 6240 | 7370 | 9730 | 12000 | | | 6.93' | 28 | 4610 | 5720 | 6860 | 8050 | 10500 | 12000 | | 6.60' | |
| 30 | 4210 | 5270 | 6420 | 7590 | 10070 | 12660 | 12870 | | 7.08' | 30 | 4720 | 5880 | 7080 | 8330 | 10910 | 12860 | | 6.73' | |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4

LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.



| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | | | | |
|---|--------------------------------------|------|-------------|-------------|-------------|--------------|--------------|----|---|---|--------------------------------------|------|-------------|-------------|-------------|--------------|--|--|------------------|
| Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | 48 | 54 | 60 | 72 | 84 | 96 | 108 | 48 | | | 54 | 60 | 72 | 84 | 96 | 108 | | | |
| 5 | 1640 | 1880 | 2080 | | | | | | 4.92' | 5 | 1670 | 1910 | 2090 | | | | | | 4.86' |
| 6 | 1890 | 2180 | 2480 | 2690 | | | | | 5.37' | 6 | 1930 | 2230 | 2520 | 2700 | | | | | 5.30' |
| 8 | 2350 | 2730 | 3110 | 3730 | | | | | 5.80' | 8 | 2410 | 2790 | 3170 | 3720 | | | | | 5.70' |
| 10 | 2730 | 3190 | 3660 | 4620 | 4690 | | | | 6.08' | 10 | 2820 | 3290 | 3760 | 4690 | | | | | 5.96' |
| 12 | 3050 | 3590 | 4150 | 5270 | 5640 | | | | 6.33' | 12 | 3170 | 3720 | 4280 | 5420 | 5640 | | | | 6.20' |
| 14 | 3320 | 3940 | 4570 | 5850 | 6610 | | | | 6.57' | 14 | 3470 | 4100 | 4740 | 6040 | 6610 | | | | 6.43' |
| 16 | 3550 | 4240 | 4940 | 6380 | 7560 | | | | 6.80' | 16 | 3730 | 4430 | 5140 | 6610 | 7570 | | | | 6.64' |
| 18 | 3750 | 4500 | 5260 | 6850 | 8490 | 8520 | | | 7.02' | 18 | 3950 | 4710 | 5500 | 7120 | 8520 | | | | 6.84' |
| 20 | 3920 | 4720 | 5550 | 7280 | 9060 | 9470 | | | 7.23' | 20 | 4150 | 4970 | 5830 | 7580 | 9400 | 9480 | | | 7.04' |
| 22 | 4060 | 4920 | 5800 | 7650 | 9580 | 10440 | | | 7.43' | 22 | 4310 | 5190 | 6100 | 8010 | 9970 | 10440 | | | 7.23' |
| 24 | 4180 | 5080 | 6020 | 7990 | 10060 | 11390 | | | 7.63' | 24 | 4450 | 5390 | 6360 | 8380 | 10500 | 11390 | | | 7.42' |
| 26 | 4280 | 5230 | 6220 | 8300 | 10490 | 12340 | | | 7.82' | 26 | 4570 | 5560 | 6580 | 8730 | 10970 | 12350 | | | 7.60' |
| 28 | 4360 | 5340 | 6380 | 8570 | 10880 | 13280 | 13300 | | 8.01' | 28 | 4680 | 5700 | 6780 | 9040 | 11420 | 13300 | | | 7.77' |
| 30 | 4440 | 5450 | 6530 | 8820 | 11240 | 13760 | 14250 | | 8.19' | 30 | 4770 | 5840 | 6960 | 9320 | 11820 | 14260 | | | 7.94' |

| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | | | | |
|---|--------------------------------------|------|-------------|-------------|--------------|--------------|-----|----|--|---|--------------------------------------|------|-------------|-------------|--------------|--------------|--|--|------------------|
| Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | 48 | 54 | 60 | 72 | 84 | 96 | 108 | 48 | | | 54 | 60 | 72 | 84 | 96 | 108 | | | |
| 5 | 1710 | 1960 | 2090 | | | | | | 4.77' | 5 | 1750 | 2000 | 2090 | | | | | | 4.69' |
| 6 | 1990 | 2280 | 2570 | 2690 | | | | | 5.20' | 6 | 2050 | 2340 | 2640 | 2690 | | | | | 5.10' |
| 8 | 2490 | 2880 | 3270 | 3720 | | | | | 5.58' | 8 | 2590 | 2980 | 3370 | 3720 | | | | | 5.45' |
| 10 | 2940 | 3420 | 3900 | 4690 | | | | | 5.81' | 10 | 3080 | 3560 | 4050 | 4680 | | | | | 5.66' |
| 12 | 3330 | 3890 | 4470 | 5620 | 5650 | | | | 6.03' | 12 | 3520 | 4080 | 4660 | 5650 | | | | | 5.85' |
| 14 | 3670 | 4320 | 4970 | 6300 | 6610 | | | | 6.23' | 14 | 3910 | 4560 | 5220 | 6570 | 6610 | | | | 6.03' |
| 16 | 3970 | 4700 | 5430 | 6920 | 7570 | | | | 6.42' | 16 | 4250 | 4990 | 5750 | 7260 | 7560 | | | | 6.20' |
| 18 | 4240 | 5030 | 5840 | 7500 | 8520 | | | | 6.61' | 18 | 4570 | 5380 | 6220 | 7910 | 8520 | | | | 6.36' |
| 20 | 4470 | 5330 | 6220 | 8020 | 9470 | | | | 6.78' | 20 | 4850 | 5750 | 6650 | 8510 | 9480 | | | | 6.52' |
| 22 | 4680 | 5600 | 6550 | 8510 | 10430 | | | | 6.96' | 22 | 5110 | 6060 | 7050 | 9060 | 10430 | | | | 6.67' |
| 24 | 4860 | 5840 | 6860 | 8950 | 11120 | 11390 | | | 7.12' | 24 | 5330 | 6350 | 7410 | 9580 | 11390 | | | | 6.82' |
| 26 | 5020 | 6060 | 7120 | 9360 | 11670 | 12350 | | | 7.29' | 26 | 5530 | 6620 | 7750 | 10050 | 12350 | | | | 6.96' |
| 28 | 5160 | 6240 | 7370 | 9730 | 12180 | 13300 | | | 7.45' | 28 | 5720 | 6860 | 8050 | 10500 | 13040 | 13300 | | | 7.10' |
| 30 | 5270 | 6420 | 7580 | 10070 | 12660 | 14260 | | | 7.60' | 30 | 5880 | 7080 | 8330 | 10910 | 13600 | 14260 | | | 7.24' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4



LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.

| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | | |
|---|--------------------------------------|------|------|-------------|-------------|--------------|--------------|------------------|--|--------------------------------------|------|-------------|-------------|--------------|--------------|--------------|------------------|
| Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width |
| | 48 | 54 | 60 | 72 | 84 | 96 | 108 | | | 48 | 54 | 60 | 72 | 84 | 96 | 108 | |
| 5 | 1640 | 1880 | 2130 | 2220 | | | | 5.17' | 5 | 1670 | 1910 | 2160 | 2220 | | | | 5.11' |
| 6 | 1890 | 2180 | 2480 | 2840 | | | | 5.61' | 6 | 1930 | 2230 | 2520 | 2830 | | | | 5.54' |
| 8 | 2350 | 2730 | 3110 | 3880 | 4050 | | | 6.22' | 8 | 2410 | 2790 | 3170 | 3960 | 4060 | | | 6.13' |
| 10 | 2730 | 3190 | 3660 | 4620 | 5110 | | | 6.51' | 10 | 2820 | 3290 | 3760 | 4720 | 5110 | | | 6.40' |
| 12 | 3050 | 3590 | 4150 | 5270 | 6160 | | | 6.78' | 12 | 3170 | 3720 | 4280 | 5420 | 6160 | | | 6.65' |
| 14 | 3320 | 3940 | 4570 | 5850 | 7170 | 7210 | | 7.03' | 14 | 3470 | 4100 | 4740 | 6040 | 7210 | | | 6.88' |
| 16 | 3550 | 4240 | 4940 | 6380 | 7860 | 8250 | | 7.26' | 16 | 3730 | 4430 | 5140 | 6610 | 8100 | 8250 | | 7.10' |
| 18 | 3750 | 4500 | 5260 | 6850 | 8490 | 9300 | | 7.49' | 18 | 3950 | 4710 | 5500 | 7120 | 8780 | 9300 | | 7.31' |
| 20 | 3920 | 4720 | 5550 | 7280 | 9060 | 10340 | | 7.70' | 20 | 4150 | 4970 | 5830 | 7580 | 9400 | 10350 | | 7.51' |
| 22 | 4060 | 4920 | 5800 | 7650 | 9580 | 11390 | | 7.91' | 22 | 4310 | 5190 | 6100 | 8010 | 9970 | 11390 | | 7.71' |
| 24 | 4180 | 5080 | 6020 | 7990 | 10060 | 12190 | 12440 | 8.12' | 24 | 4450 | 5390 | 6360 | 8380 | 10500 | 12440 | | 7.90' |
| 26 | 4280 | 5230 | 6220 | 8300 | 10490 | 12750 | 13480 | 8.31' | 26 | 4570 | 5560 | 6580 | 8730 | 10970 | 13290 | 13490 | 8.08' |
| 28 | 4360 | 5340 | 6380 | 8570 | 10880 | 13280 | 14530 | 8.51' | 28 | 4680 | 5700 | 6780 | 9040 | 11420 | 13870 | 14530 | 8.26' |
| 30 | 4440 | 5450 | 6530 | 8820 | 11240 | 13760 | 15570 | 8.70' | 30 | 4770 | 5840 | 6960 | 9320 | 11820 | 14410 | 15570 | 8.44' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | | |
| Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width |
| | 48 | 54 | 60 | 72 | 84 | 96 | 108 | | | 48 | 54 | 60 | 72 | 84 | 96 | 108 | |
| 5 | 1710 | 1960 | 2200 | 2220 | | | | 5.03' | 5 | 1750 | 2000 | 2220 | | | | | 4.94' |
| 6 | 1990 | 2280 | 2570 | 2840 | | | | 5.44' | 6 | 2050 | 2340 | 2640 | 2840 | | | | 5.34' |
| 8 | 2490 | 2880 | 3270 | 4060 | | | | 6.00' | 8 | 2590 | 2980 | 3370 | 4050 | | | | 5.87' |
| 10 | 2940 | 3420 | 3900 | 4870 | 5110 | | | 6.25' | 10 | 3080 | 3560 | 4050 | 5020 | 5110 | | | 6.09' |
| 12 | 3330 | 3890 | 4470 | 5620 | 6160 | | | 6.47' | 12 | 3520 | 4080 | 4660 | 5820 | 6160 | | | 6.29' |
| 14 | 3670 | 4320 | 4970 | 6300 | 7210 | | | 6.68' | 14 | 3910 | 4560 | 5220 | 6570 | 7210 | | | 6.47' |
| 16 | 3970 | 4700 | 5430 | 6920 | 8260 | | | 6.88' | 16 | 4250 | 4990 | 5750 | 7260 | 8250 | | | 6.65' |
| 18 | 4240 | 5030 | 5840 | 7500 | 9190 | 9300 | | 7.07' | 18 | 4570 | 5380 | 6220 | 7910 | 9300 | | | 6.81' |
| 20 | 4470 | 5330 | 6220 | 8020 | 9880 | 10350 | | 7.25' | 20 | 4850 | 5750 | 6650 | 8510 | 10350 | | | 6.98' |
| 22 | 4680 | 5600 | 6550 | 8510 | 10520 | 11390 | | 7.43' | 22 | 5110 | 6060 | 7050 | 9060 | 11120 | 11390 | | 7.13' |
| 24 | 4860 | 5840 | 6860 | 8950 | 11120 | 12440 | | 7.60' | 24 | 5330 | 6350 | 7410 | 9580 | 11800 | 12440 | | 7.29' |
| 26 | 5020 | 6060 | 7120 | 9360 | 11670 | 13480 | | 7.77' | 26 | 5530 | 6620 | 7750 | 10050 | 12440 | 13480 | | 7.43' |
| 28 | 5160 | 6240 | 7370 | 9730 | 12180 | 14520 | | 7.93' | 28 | 5720 | 6860 | 8050 | 10500 | 13040 | 14530 | | 7.58' |
| 30 | 5270 | 6420 | 7590 | 10070 | 12660 | 15330 | 15570 | 8.09' | 30 | 5880 | 7080 | 8330 | 10910 | 13600 | 15580 | | 7.72' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 - 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 - 4

LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.



| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | | | | |
|---|--------------------------------------|------|-------------|-------------|--------------|--------------|--------------|----|--|---|--------------------------------------|------|-------------|-------------|--------------|--------------|--|--|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | 54 | 60 | 72 | 84 | 96 | 108 | 120 | 54 | | | 60 | 72 | 84 | 96 | 108 | 120 | | | |
| 5 | 1880 | 2130 | 2350 | | | | | | 5.43' | 5 | 1910 | 2160 | 2340 | | | | | | 5.37' |
| 6 | 2180 | 2480 | 2980 | | | | | | 5.86' | 6 | 2230 | 2520 | 2980 | | | | | | 5.79' |
| 8 | 2730 | 3110 | 3880 | 4380 | | | | | 6.64' | 8 | 2790 | 3170 | 3960 | 4380 | | | | | 6.55' |
| 10 | 3190 | 3660 | 4620 | 5540 | | | | | 6.95' | 10 | 3290 | 3760 | 4720 | 5530 | | | | | 6.83' |
| 12 | 3590 | 4150 | 5270 | 6420 | 6670 | | | | 7.22' | 12 | 3720 | 4280 | 5420 | 6570 | 6670 | | | | 7.09' |
| 14 | 3940 | 4570 | 5850 | 7170 | 7810 | | | | 7.48' | 14 | 4100 | 4740 | 6040 | 7370 | 7810 | | | | 7.33' |
| 16 | 4240 | 4940 | 6380 | 7860 | 8940 | | | | 7.72' | 16 | 4430 | 5140 | 6610 | 8100 | 8950 | | | | 7.55' |
| 18 | 4500 | 5260 | 6850 | 8490 | 10080 | | | | 7.95' | 18 | 4710 | 5500 | 7120 | 8780 | 10090 | | | | 7.77' |
| 20 | 4720 | 5550 | 7280 | 9060 | 10890 | 11220 | | | 8.17' | 20 | 4970 | 5830 | 7580 | 9400 | 11220 | | | | 7.98' |
| 22 | 4920 | 5800 | 7650 | 9580 | 11570 | 12350 | | | 8.39' | 22 | 5190 | 6100 | 8010 | 9970 | 11990 | 12360 | | | 8.18' |
| 24 | 5080 | 6020 | 7990 | 10060 | 12190 | 13490 | | | 8.60' | 24 | 5390 | 6360 | 8380 | 10500 | 12660 | 13490 | | | 8.38' |
| 26 | 5230 | 6220 | 8300 | 10490 | 12750 | 14620 | | | 8.80' | 26 | 5560 | 6580 | 8730 | 10970 | 13290 | 14620 | | | 8.57' |
| 28 | 5340 | 6380 | 8570 | 10880 | 13280 | 15750 | | | 9.00' | 28 | 5700 | 6780 | 9040 | 11420 | 13870 | 15760 | | | 8.75' |
| 30 | 5450 | 6530 | 8820 | 11240 | 13760 | 16370 | 16890 | | 9.19' | 30 | 5840 | 6960 | 9320 | 11820 | 14410 | 16890 | | | 8.93' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | | Transition Width |
| | 54 | 60 | 72 | 84 | 96 | 108 | 120 | 54 | | | 60 | 72 | 84 | 96 | 108 | 120 | | | |
| 5 | 1960 | 2200 | 2340 | | | | | | 5.28' | 5 | 2000 | 2250 | 2350 | | | | | | 5.20' |
| 6 | 2280 | 2570 | 2980 | | | | | | 5.69' | 6 | 2340 | 2640 | 2980 | | | | | | 5.59' |
| 8 | 2880 | 3270 | 4060 | 4380 | | | | | 6.42' | 8 | 2980 | 3370 | 4160 | 4380 | | | | | 6.28' |
| 10 | 3420 | 3900 | 4870 | 5530 | | | | | 6.68' | 10 | 3560 | 4050 | 5020 | 5530 | | | | | 6.52' |
| 12 | 3890 | 4470 | 5620 | 6670 | | | | | 6.91' | 12 | 4080 | 4660 | 5820 | 6670 | | | | | 6.72' |
| 14 | 4320 | 4970 | 6300 | 7640 | 7810 | | | | 7.12' | 14 | 4560 | 5220 | 6570 | 7810 | | | | | 6.91' |
| 16 | 4700 | 5430 | 6920 | 8440 | 8950 | | | | 7.33' | 16 | 4990 | 5750 | 7260 | 8800 | 8950 | | | | 7.09' |
| 18 | 5030 | 5840 | 7500 | 9190 | 10080 | | | | 7.52' | 18 | 5380 | 6220 | 7910 | 9620 | 10080 | | | | 7.27' |
| 20 | 5330 | 6220 | 8020 | 9880 | 11220 | | | | 7.71' | 20 | 5750 | 6650 | 8510 | 10390 | 11210 | | | | 7.43' |
| 22 | 5600 | 6550 | 8510 | 10520 | 12350 | | | | 7.89' | 22 | 6060 | 7050 | 9060 | 11120 | 12350 | | | | 7.59' |
| 24 | 5840 | 6860 | 8950 | 11120 | 13330 | 13480 | | | 8.07' | 24 | 6350 | 7410 | 9580 | 11800 | 13480 | | | | 7.75' |
| 26 | 6060 | 7120 | 9360 | 11670 | 14040 | 14620 | | | 8.24' | 26 | 6620 | 7750 | 10050 | 12440 | 14620 | | | | 7.90' |
| 28 | 6240 | 7370 | 9730 | 12180 | 14710 | 15760 | | | 8.41' | 28 | 6860 | 8050 | 10500 | 13040 | 15620 | 15750 | | | 8.05' |
| 30 | 6420 | 7590 | 10070 | 12660 | 15330 | 16890 | | | 8.57' | 30 | 7080 | 8330 | 10910 | 13600 | 16350 | 16890 | | | 8.20' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 - 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 - 4



LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.

| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | |
|---|--------------------------------------|-------------|-------------|-------------|--------------|--------------|------------------|--|--------------------------------------|-------------|--------------|--------------|--------------|-------|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width |
| | 60 | 72 | 84 | 96 | 108 | 120 | | | 60 | 72 | 84 | 96 | 108 | 120 | |
| 5 | 2130 | 2540 | | | | | 5.83' | 2160 | 2540 | | | | | 5.77' | |
| 6 | 2480 | 3060 | 3220 | | | | 6.25' | 2520 | 3110 | 3220 | | | | 6.17' | |
| 8 | 3110 | 3880 | 4660 | 4770 | | | 7.14' | 3170 | 3960 | 4740 | 4770 | | | 7.05' | |
| 10 | 3660 | 4620 | 5580 | 6160 | | | 7.60' | 3760 | 4720 | 5700 | 6170 | | | 7.48' | |
| 12 | 4150 | 5270 | 6420 | 7440 | | | 7.89' | 4280 | 5420 | 6570 | 7440 | | | 7.75' | |
| 14 | 4570 | 5850 | 7170 | 8510 | 8720 | | 8.15' | 4740 | 6040 | 7370 | 8710 | | | 8.00' | |
| 16 | 4940 | 6380 | 7860 | 9370 | 9990 | | 8.41' | 5140 | 6610 | 8100 | 9630 | 9990 | | 8.24' | |
| 18 | 5260 | 6850 | 8490 | 10160 | 11250 | | 8.65' | 5500 | 7120 | 8780 | 10470 | 11260 | | 8.46' | |
| 20 | 5550 | 7280 | 9060 | 10890 | 12530 | | 8.88' | 5830 | 7580 | 9400 | 11260 | 12530 | | 8.68' | |
| 22 | 5800 | 7650 | 9580 | 11570 | 13590 | 13800 | 9.10' | 6100 | 8010 | 9970 | 11980 | 13800 | | 8.89' | |
| 24 | 6020 | 7990 | 10060 | 12190 | 14360 | 15060 | 9.32' | 6360 | 8380 | 10500 | 12660 | 14870 | 15070 | 9.09' | |
| 26 | 6220 | 8300 | 10490 | 12750 | 15080 | 16330 | 9.53' | 6580 | 8730 | 10970 | 13290 | 15650 | 16340 | 9.29' | |
| 28 | 6380 | 8570 | 10880 | 13280 | 15750 | 17610 | 9.74' | 6780 | 9040 | 11420 | 13870 | 16380 | 17610 | 9.48' | |
| 30 | 6530 | 8820 | 11240 | 13760 | 16370 | 18870 | 9.94' | 6960 | 9320 | 11820 | 14410 | 17070 | 18880 | 9.67' | |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | Transition Width |
| | 60 | 72 | 84 | 96 | 108 | 120 | | | 60 | 72 | 84 | 96 | 108 | 120 | |
| 5 | 2200 | 2540 | | | | | 5.68' | 2250 | 2540 | | | | | 5.59' | |
| 6 | 2570 | 3170 | 3220 | | | | 6.07' | 2640 | 3220 | | | | | 5.97' | |
| 8 | 3270 | 4060 | 4770 | | | | 6.91' | 3370 | 4160 | 4780 | | | | 6.78' | |
| 10 | 3900 | 4870 | 5850 | 6160 | | | 7.32' | 4050 | 5020 | 6010 | 6160 | | | 7.16' | |
| 12 | 4470 | 5620 | 6770 | 7440 | | | 7.57' | 4660 | 5820 | 7000 | 7440 | | | 7.38' | |
| 14 | 4970 | 6300 | 7640 | 8720 | | | 7.79' | 5220 | 6570 | 7930 | 8720 | | | 7.58' | |
| 16 | 5430 | 6920 | 8440 | 9990 | | | 8.00' | 5750 | 7260 | 8800 | 9980 | | | 7.76' | |
| 18 | 5840 | 7500 | 9190 | 10900 | 11260 | | 8.21' | 6220 | 7910 | 9620 | 11260 | | | 7.94' | |
| 20 | 6220 | 8020 | 9880 | 11770 | 12520 | | 8.40' | 6650 | 8510 | 10390 | 12310 | 12530 | | 8.12' | |
| 22 | 6550 | 8510 | 10520 | 12570 | 13800 | | 8.59' | 7050 | 9060 | 11110 | 13210 | 13800 | | 8.28' | |
| 24 | 6860 | 8950 | 11120 | 13330 | 15070 | | 8.77' | 7410 | 9580 | 11800 | 14050 | 15070 | | 8.44' | |
| 26 | 7120 | 9360 | 11670 | 14040 | 16330 | | 8.95' | 7750 | 10050 | 12440 | 14860 | 16340 | | 8.60' | |
| 28 | 7370 | 9730 | 12180 | 14710 | 17280 | 17610 | 9.13' | 8050 | 10500 | 13040 | 15620 | 17610 | | 8.76' | |
| 30 | 7590 | 10070 | 12660 | 15330 | 18060 | 18870 | 9.30' | 8330 | 10910 | 13600 | 16350 | 18880 | | 8.91' | |

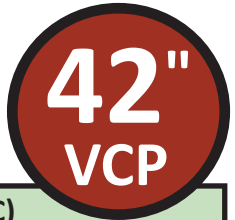
*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4

LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.



| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | | |
|---|--------------------------------------|-------|-------------|-------------|--------------|--------------|--------------|------------------|--|--------------------------------------|-------|-------------|-------------|--------------|--------------|--------------|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width |
| | 60 | 72 | 84 | 96 | 108 | 120 | 132 | | | 60 | 72 | 84 | 96 | 108 | 120 | 132 | |
| | 5 | 2130 | 2630 | 2690 | | | | | | | 6.13' | 5 | 2160 | 2650 | 2690 | | |
| 6 | 2480 | 3060 | 3390 | | | | | 6.54' | 6 | 2520 | 3110 | 3390 | | | | | 6.47' |
| 8 | 3110 | 3880 | 4660 | 4990 | | | | 7.42' | 8 | 3170 | 3960 | 4740 | 4990 | | | | 7.32' |
| 10 | 3660 | 4620 | 5580 | 6550 | 6630 | | | 8.07' | 10 | 3760 | 4720 | 5700 | 6630 | | | | 7.95' |
| 12 | 4150 | 5270 | 6420 | 7570 | 8010 | | | 8.38' | 12 | 4280 | 5420 | 6570 | 7730 | 8010 | | | 8.24' |
| 14 | 4570 | 5850 | 7170 | 8510 | 9390 | | | 8.65' | 14 | 4740 | 6040 | 7370 | 8710 | 9390 | | | 8.50' |
| 16 | 4940 | 6380 | 7860 | 9370 | 10760 | | | 8.91' | 16 | 5140 | 6610 | 8100 | 9630 | 10770 | | | 8.74' |
| 18 | 5260 | 6850 | 8490 | 10160 | 11860 | 12140 | | 9.16' | 18 | 5500 | 7120 | 8780 | 10470 | 12140 | | | 8.97' |
| 20 | 5550 | 7280 | 9060 | 10890 | 12750 | 13510 | | 9.40' | 20 | 5830 | 7580 | 9400 | 11260 | 13140 | 13500 | | 9.19' |
| 22 | 5800 | 7650 | 9580 | 11570 | 13590 | 14870 | | 9.63' | 22 | 6100 | 8010 | 9970 | 11980 | 14040 | 14880 | | 9.41' |
| 24 | 6020 | 7990 | 10060 | 12190 | 14360 | 16240 | | 9.85' | 24 | 6360 | 8380 | 10500 | 12660 | 14870 | 16240 | | 9.62' |
| 26 | 6220 | 8300 | 10490 | 12750 | 15080 | 17450 | 17620 | 10.07' | 26 | 6580 | 8730 | 10970 | 13290 | 15650 | 17620 | | 9.82' |
| 28 | 6380 | 8570 | 10880 | 13280 | 15750 | 18270 | 18990 | 10.28' | 28 | 6780 | 9040 | 11420 | 13870 | 16380 | 18940 | 18980 | 10.02' |
| 30 | 6530 | 8820 | 11240 | 13760 | 16370 | 19040 | 20350 | 10.49' | 30 | 6960 | 9320 | 11820 | 14410 | 17070 | 19780 | 20360 | 10.21' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width |
| | 60 | 72 | 84 | 96 | 108 | 120 | 132 | | | 60 | 72 | 84 | 96 | 108 | 120 | 132 | |
| | 5 | 2200 | 2690 | | | | | | | | 5.98' | 5 | 2250 | 2680 | | | |
| 6 | 2570 | 3170 | 3390 | | | | | 6.37' | 6 | 2640 | 3230 | 3380 | | | | | 6.26' |
| 8 | 3270 | 4060 | 4840 | 4990 | | | | 7.19' | 8 | 3370 | 4160 | 4950 | 4990 | | | | 7.05' |
| 10 | 3900 | 4870 | 5850 | 6620 | | | | 7.79' | 10 | 4050 | 5020 | 6010 | 6630 | | | | 7.63' |
| 12 | 4470 | 5620 | 6770 | 7950 | 8010 | | | 8.05' | 12 | 4660 | 5820 | 7000 | 8020 | | | | 7.86' |
| 14 | 4970 | 6300 | 7640 | 9000 | 9390 | | | 8.29' | 14 | 5220 | 6570 | 7930 | 9300 | 9390 | | | 8.07' |
| 16 | 5430 | 6920 | 8440 | 9980 | 10770 | | | 8.51' | 16 | 5750 | 7260 | 8800 | 10350 | 10760 | | | 8.26' |
| 18 | 5840 | 7500 | 9190 | 10900 | 12130 | | | 8.71' | 18 | 6220 | 7910 | 9620 | 11360 | 12140 | | | 8.45' |
| 20 | 6220 | 8020 | 9880 | 11770 | 13510 | | | 8.91' | 20 | 6650 | 8510 | 10390 | 12310 | 13510 | | | 8.62' |
| 22 | 6550 | 8510 | 10520 | 12570 | 14650 | 14870 | | 9.11' | 22 | 7050 | 9060 | 11110 | 13210 | 14880 | | | 8.79' |
| 24 | 6860 | 8950 | 11120 | 13330 | 15580 | 16250 | | 9.29' | 24 | 7410 | 9580 | 11800 | 14050 | 16250 | | | 8.96' |
| 26 | 7120 | 9360 | 11670 | 14040 | 16460 | 17620 | | 9.48' | 26 | 7750 | 10050 | 12440 | 14860 | 17310 | 17610 | | 9.12' |
| 28 | 7370 | 9730 | 12180 | 14710 | 17280 | 18980 | | 9.66' | 28 | 8050 | 10500 | 13040 | 15620 | 18250 | 18980 | | 9.28' |
| 30 | 7590 | 10070 | 12660 | 15330 | 18060 | 20360 | | 9.83' | 30 | 8330 | 10910 | 13600 | 16350 | 19130 | 20350 | | 9.43' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 - 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 - 4



LOADS CAUSED BY BACKFILLING WITH VARIOUS MATERIALS

(In Pounds Per Linear Foot)

100 Pounds Per Cubic Foot Backfill Material*

Bold figures represent maximum loads on pipe at and beyond transition trench width. Transition Width Column represents the trench width where trench loads reach a maximum and are equal to the embankment load.

| GRAVELS (GW, GP, GM, GC) $K\mu' = 0.165$ | | | | | | | | | SANDS (SW, SP, SM, SC) $K\mu' = 0.150$ | | | | | | | | |
|---|--------------------------------------|-------|-------------|-------------|--------------|--------------|--------------|------------------|--|--------------------------------------|-------|-------------|--------------|--------------|--------------|--------------|------------------|
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width |
| | 72 | 84 | 96 | 108 | 120 | 132 | 144 | | | 72 | 84 | 96 | 108 | 120 | 132 | 144 | |
| 5 | 2620 | 3120 | 3360 | | | | | 8.00' | 5 | 2650 | 3150 | 3600 | | | | | 7.83' |
| 6 | 3070 | 3660 | 4250 | 4360 | | | | 8.16' | 6 | 3110 | 3700 | 4300 | 4300 | | | | 8.16' |
| 8 | 3880 | 4670 | 5450 | 5890 | | | | 8.58' | 8 | 3660 | 4740 | 5530 | 5890 | | | | 8.50' |
| 10 | 4620 | 5520 | 6560 | 7410 | | | | 8.83' | 10 | 4720 | 5690 | 6670 | 7410 | | | | 8.75' |
| 12 | 5270 | 6420 | 7570 | 8740 | 8940 | | | 9.16' | 12 | 5410 | 6570 | 7730 | 8900 | 8940 | | | 9.08' |
| 14 | 5860 | 7170 | 8510 | 9860 | 10470 | | | 9.50' | 14 | 6040 | 7370 | 8710 | 10070 | 10470 | | | 9.25' |
| 16 | 6380 | 7870 | 9370 | 10890 | 11990 | | | 9.75' | 16 | 6610 | 8110 | 9630 | 11160 | 11990 | | | 9.58' |
| 18 | 6860 | 8490 | 10160 | 11860 | 13520 | | | 10.00' | 18 | 7120 | 8780 | 10470 | 12180 | 13520 | | | 9.75' |
| 20 | 7280 | 9070 | 10900 | 12760 | 14640 | 15040 | | 10.25' | 20 | 7590 | 9400 | 11260 | 13140 | 15040 | 15040 | | 10.08' |
| 22 | 7660 | 9590 | 11570 | 13590 | 15640 | 16570 | | 10.50' | 22 | 8010 | 9970 | 11980 | 14030 | 16110 | 16570 | | 10.25' |
| 24 | 8000 | 10060 | 12190 | 14360 | 16580 | 18100 | | 10.67' | 24 | 8390 | 10490 | 12660 | 14870 | 17110 | 18100 | | 10.50' |
| 26 | 8300 | 10490 | 12760 | 15080 | 17450 | 19620 | | 11.00' | 26 | 8730 | 10970 | 13290 | 15650 | 18050 | 19620 | | 10.67' |
| 28 | 8570 | 10880 | 13280 | 15750 | 18280 | 20840 | 21150 | 11.16' | 28 | 9040 | 11410 | 13870 | 16380 | 18940 | 21150 | | 10.83' |
| 30 | 8810 | 11240 | 13770 | 16370 | 19040 | 21760 | 22670 | 11.33' | 30 | 9320 | 11820 | 14410 | 17070 | 19780 | 22540 | 22670 | 11.08' |
| SILTS AND CLAYS (CL, ML) $K\mu' = 0.130$, L.L. Less Than 50 | | | | | | | | | SILTS AND CLAYS (CH, MH) $K\mu' = 0.110$, L.L. Greater Than 50 | | | | | | | | |
| Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width | Depth of Backfill Over Top of Pipe (Feet) | Trench Width At Top Of Pipe (inches) | | | | | | | Transition Width |
| | 72 | 84 | 96 | 108 | 120 | 132 | 144 | | | 72 | 84 | 96 | 108 | 120 | 132 | 144 | |
| 5 | 2700 | 3190 | 3600 | | | | | 7.83' | 5 | 2740 | 3240 | 3600 | | | | | 7.75' |
| 6 | 3170 | 3770 | 4360 | | | | | 8.00' | 6 | 3230 | 3830 | 4360 | | | | | 7.83' |
| 8 | 4060 | 4850 | 5640 | 5890 | | | | 8.33' | 8 | 4160 | 4950 | 5750 | 5890 | | | | 8.16' |
| 10 | 4870 | 5850 | 6830 | 7410 | | | | 8.58' | 10 | 5020 | 6010 | 6990 | 7410 | | | | 8.50' |
| 12 | 5610 | 6780 | 7950 | 8940 | | | | 8.83' | 12 | 5830 | 7000 | 8180 | 8940 | | | | 8.66' |
| 14 | 6300 | 7640 | 9000 | 10360 | 10470 | | | 9.08' | 14 | 6570 | 7930 | 9300 | 10470 | | | | 8.83' |
| 16 | 6920 | 8440 | 9980 | 11530 | 11990 | | | 9.25' | 16 | 7260 | 8800 | 10360 | 11920 | 11990 | | | 9.08' |
| 18 | 7500 | 9190 | 10900 | 12630 | 13520 | | | 9.58' | 18 | 7910 | 9620 | 11360 | 13110 | 13520 | | | 9.25' |
| 20 | 8030 | 9880 | 11770 | 13680 | 15040 | | | 9.75' | 20 | 8500 | 10390 | 12310 | 14240 | 15040 | | | 9.50' |
| 22 | 8510 | 10520 | 12570 | 14650 | 14570 | | | 10.00' | 22 | 9060 | 11120 | 13210 | 15320 | 16570 | | | 9.58' |
| 24 | 8950 | 11120 | 13330 | 15580 | 17850 | 18100 | | 10.16' | 24 | 9580 | 11800 | 14060 | 16340 | 18100 | | | 9.75' |
| 26 | 9360 | 11670 | 14040 | 16450 | 18890 | 19620 | | 10.25' | 26 | 10060 | 12440 | 14860 | 17320 | 19620 | | | 10.00' |
| 28 | 9730 | 12190 | 14710 | 17280 | 19900 | 21150 | | 10.50' | 28 | 10500 | 13030 | 15620 | 18250 | 20910 | 21150 | | 10.08' |
| 30 | 10070 | 12660 | 15330 | 18060 | 20830 | 22670 | | 10.66' | 30 | 10920 | 13600 | 16340 | 19130 | 21960 | 22670 | | 10.25' |

*Adjust loads to actual trench backfill weight (see examples 4-5 and 4-6 starting on page 4 – 17)
For information regarding the equations used to compute these loads, see the Marston Equation section starting on page 4 – 4