LANE

Design Manual

Welded Wire Mesh Gabions and Gabion Mattress

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1.0 Lane Gabion Product Information

A gabion may be defined as a heavy-duty, rectangular wire-mesh basket filled with rocks and used to construct walls and other earth retaining or erosion control structures.

In constructing walls, individual gabions are used as construction blocks. These blocks are filled incrementally and tied together with heavy wire as construction progresses to form the complete structure. Multiple layers or courses are used to achieve the desired height. The layers may be arranged to form a vertical, stepped, or battered face on the wall. The wall may be designed as a simple gravity wall, or may have wire mesh layers to act as soil reinforcement or tie backs.

Each gabion is usually divided into compartments or cells by internal wire mesh diaphragms that serve to stiffen and strengthen them. Gabions in each layer are joined to each other at the vertical corners with spiral binders. Successive layers are joined to underlying completed layers with wire ties.

STANDARD SIZES OF LANE GABIONS - Galvanized 11 Gage, PVC 12 Gage		
Dimension (LxWxH)	Number of Cells	Capacity (Cu. Yds.)
12' X 3' X 3'	4	4.00
9' X 3' X 3'	3	3.00
6' X 3' X 3'	2	2.00
12' X 3' X 1.5'	4	2.00
9' X 3' X 1.5'	3	1.50
6' X 3' X 1.5'	2	1.00
12' X 3' X 1'	4	1.33
9' X 3' X 1'	3	1.00
6' X 3' X 1'	2	0.67
MATTRESSES - Galvanized 13.5 Gage, PVC 13.5 Gage		
Dimension (LxWxH)	Number of Cells	Capacity (Cu. Yds.)
12' X 6' X 9"	4	2.00
9' X 6' X 9"	3	1.50
12' X 6' X 6"	4	1.33
9' X 6' X 6"	3	1.00

1.1 Lane Gabion Specifications

Lane gabions are manufactured to the requirements of ASTM A974 and are available in plain galvanized or PVC coated welded wire mesh in both standard and custom sizes. Additional protection can be achieved through the use of epoxy coatings. This added service is available upon request.

2.1 Foundation

Foundation requirements, which must be established by the engineer, will vary with site conditions, height of gabions, etc. As a minimum, the top layers of soil must be stripped until a layer of the required bearing strength is reached. In some cases, the foundation may consist of suitable fill material compacted to a minimum of 95° of Proctor density.

2.2 Assembly

To assemble each gabion, fold out the four sides and the ends; fold adjacent sides up and join edges with temporary fasteners; lift attached diaphragms to a vertical position and fasten with temporary fasteners. Place the gabions in the desired pattern on the foundation. When the entire first course is in position, permanently secure adjacent gabions by installing vertical spiral binders running full height at all corners. Similarly secure both edges of all diaphragms with spiral binders. Crimp ends of all spiral binders. Preformed corner stiffeners are then installed diagonally across the corners on 1’ centers (not used for gabions less than 3’ high). The stiffeners must be hooked over crossing wires and crimped closed at both ends. Final alignment must be checked before filling begins.

2.3 Filling

Fill material must be as specified by the engineer. It must have suitable compressive strength and durability to resist the loading, as well as the effects of water and weathering. Usually, 3-1/2” to 12” clean stone is called for. A well graded fill increases density. Place the stone in 12” lifts with power equipment, but spread out evenly by hand to minimize voids and ensure a pleasing appearance along exposed faces. Keep baskets square and diaphragms straight. The fill in adjoining cells should not vary in height by more than 1’. Overfill slightly to allow for future settlement. Lower lids and bind along all edges and at diaphragms with tie wire.

2.4 Successive Courses

Place the next course of empty gabions on top of the filled course. Stagger so that the vertical sides of the gabions do not lie in the same plane. Bind the empty baskets to the filled ones below with tie wire at all external bottom edges. Permanently secure adjacent gabions by installing vertical spiral binders and continue with the same steps as for the first layer. Successive courses are placed in like manner until the structure is complete.

2.5 Soil Reinforcement

On some structures, flat layers of welded wire mesh may be specified as soil reinforcement to tie the gabion wall into the backfill. In such cases the mesh must be joined securely to the gabions with tie wire at the specified elevations as layers of backfill are placed and compacted.

3.1 Gravity Wall Design

Lane gabion walls are generally analyzed as gravity retaining walls, that is, walls which use their own weight to resist the lateral earth pressures. The use of horizontal layers of wire mesh as a horizontal tie-back or soil reinforcement is discussed separately. This material is presented for the use of a qualified engineer that is familiar with traditional procedures for retaining wall design.

Gabion walls may be stepped on either the front or the back (soil side) face as illustrated. The design of both types is based on the same principles.

Design begins with the selection of trial dimensions for a typical vertical cross section through the wall. Four main steps must then be followed:

1. Determine the forces acting on the wall.
2. Check that the resisting moment exceeds the overturning moment by a suitable safety factor.
3. Check that sliding resistance exceeds the active horizontal force by a suitable safety factor.
4. Check that the resultant vertical force is within the middle third of the foundation and that the maximum bearing pressure is within the allowable limit.

These steps are repeated iteratively until a suitable design that meets all criteria is achieved. The wall stability, as defined in steps 2 through 4, must be checked at the base and at each course. Pertinent equations are given below and an application is illustrated in Example 1 on page 6.

3.2 Forces Acting on Wall

As shown in Figure 1A and Figure 1B on page 4, the main forces acting on gabion walls are the vertical forces from the weight of the gabions and the lateral earth pressure acting on the back face. These forces are used herein to illustrate the main design principles. If other forces are encountered, such as vehicular loads or seismic loads, they must also be included in the analysis.

The weight of a unit length (one foot) of wall is simply the product of the wall cross section and the density of the gabion fill. The latter value may be conservatively taken as 100 lb./cu. ft. for typical material (w_g).

EQUATION 1 - The lateral earth pressure is usually calculated by the Coulomb equation. Although based on granular material, it is conservative for cohesive material. According to Coulomb theory, the total active force of the triangular pressure distribution acting on the wall is:

$$P_a = K_a w_s H^2/2$$

where w_s is the soil density, H is the wall height and K_a is the coefficient of active soil pressure. The soil density is often taken as 120 lb./cu. ft. where a specific value is not available.

EQUATION 1A - If a uniformly distributed surcharge pressure (q) is present on top of the backfill surface, it may be treated as an equivalent layer of soil that creates a uniform pressure over the entire height of the wall. Equation 1 is modified to:

$$P_a = K_a(w_s H^2/2+qH)$$

EQUATION 2 - The pressure coefficient K_a is given by:

$$K_a = \frac{\cos^2(\text{Ø}-\beta)}{\cos^2\beta\cos(\delta+\beta)\left[1+\sqrt{\frac{\sin(\text{Ø}+\delta)\sin(\text{Ø}-\alpha)}{\cos(\delta+\beta)\cos(\alpha+\beta)}}\right]^2}$$

Where:

α = slope angle of backfill surface

β = acute angle of back face slope with vertical (- value when as in Figure 1A; + value when as in Figure 1B) = angle of wall friction

Ø = angle of internal friction of soil

P_a is inclined to a line normal to the slope of the back face by the angle δ. However, because the effect of wall friction is small, δ is usually taken as zero. Typical values of Ø for various soils are given in Table I on page 10. Values of K_a for various combinations of β, Ø and α are given in Table II on page 10.

EQUATION 3 - The horizontal component of P_a is:

$$P_h = P_a \cos \beta$$

The vertical component of P_a is usually neglected in design because it reduces the overturning moment and increases the sliding resistance.

3.3 Overturning Moment Check

EQUATION 4 - The active soil pressure force tends to overturn the wall and must be properly balanced by the resisting moment developed from the weight of the wall and other forces. Using basic principles of statics, moments are taken about the toe of the wall to check overturning. This check may be expressed as:

$$M_r \geq SF_o M_o$$

where M_r is the resisting moment, M_o is the overturning moment and SF_o is the safety factor against overturning (typically 2.0). Each moment is obtained by summing the products of each appropriate force times its perpendicular distance to the toe of the wall.

Figure 1A

Gravity Wall Design, Stepped Front Face

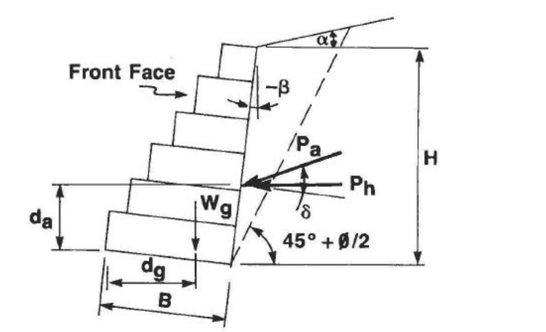
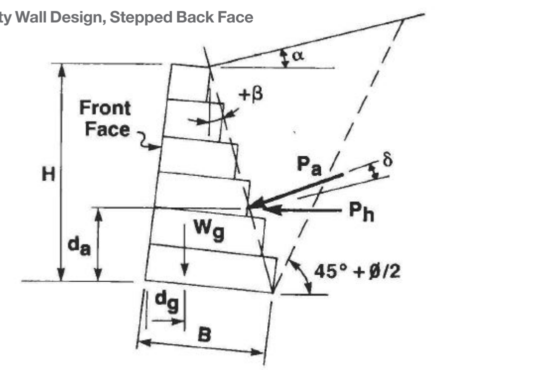


Figure 1B

Gravity Wall Design, Stepped Back Face



EQUATION 5 - Neglecting wall friction, the active earth force acts normal to the slope of the back face at a distance $H/3$ above the base. When a surcharge is present, the distance of the total active force above the toe becomes:

$$d_a = \frac{H\,(H + 3q/w_s)}{3\,(H + 2q/w_s)} + B \sin \beta$$

EQUATION 6 - The overturning moment is:

$$M_o = d_a P_h$$

The weight of the gabion wall (W_g) acts vertically through the centroid of its cross section area. The horizontal distance to this point from the toe of the wall (d_g) may be obtained from the statical moment of wall areas. That is, moments of areas about the toe are taken, then divided by the total area, as shown in Example 1 on page 6.

EQUATION 7 - The resisting moment is the sum of the products of the vertical forces or weights per unit length (W) and their distance (d) from the toe of the wall:

$$M_r = \Sigma\, d\, W$$

EQUATION 7A - For the simple gravity wall, the resisting moment is provided entirely by the weight of the wall and:

$$M_r = d_g W_g$$

3.4 Sliding Resistance Check

EQUATION 8 - The tendency of the active earth pressure to cause the wall to slide horizontally must be opposed by the frictional resistance at the base of the wall. This may be expressed as:

$$\mu W_v \geq SF_s P_h$$

where μ is the coefficient of sliding friction (tan of angle of friction of soil), W_v is the sum of the vertical forces (W_g in this case) and SF_s is the safety factor against sliding (typically 1.5).

3.5 Check Bearing Pressure

EQUATION 9 - First check to determine if the resultant vertical force lies within the middle third of the base. If B denotes the width of the base, the eccentricity, e, of the vertical force from the mid-width of the base is:

$$e = B/2 - (M_r - M_o)/W_v$$

EQUATION 10 - For the resultant force to lie in the middle third:

$$-B/6 \le e \le B/6$$

EQUATION 11 - The maximum pressure under the base, p, is then:

$$p = (W_v/B)\ (1=6e/B)$$

EQUATION 12 - This pressure must not exceed the allowable soil bearing pressure, P_b:

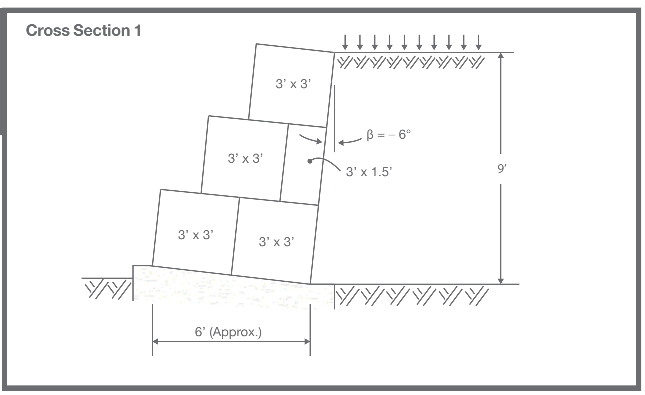
$$P \le P_b$$

The safety factor must be included in P_b.

EXAMPLE 1 – Given Data (see Cross Section 1)

Wall Height	H = 9 ft
Surcharge	q = 300 psf
Backfill slope angle	α = 0 deg.
Back Face slope angle	β = -6 deg.
Soil friction angle	Ø = 35 deg.
Soil density	w_s = 120 pcf
Gabion fill density	w_g = 100 pcf
Soil bearing pressure	P_b = 4000 psf

Figure 2



Determine if safety factors are within limits:

Pressure coefficient from Equation 2 is

$$K_a = 0.23$$

Active earth force from Equation 1A is

$$P_a = 0.23(120X9^2/2 + 300x9) = 1739 \text{ lb/ft}$$

Horizontal component from Equation 3 is

$$P_h = 1739 \text{ Cos}6 = 1730 \text{ lb/ft}$$

Vertical distance to P_h from Equation 5 is

$$d_a = \frac{9(9 + 3x300/120)}{3(9 + 2x200/120)} + 6 \sin(-6) = 2.91\text{ft}$$

Overturning moment from Equation 6 is

$$M_o = 2.91x1730 = 5034 \text{ ft-lb/ft}$$

Weight of gabions for a 1' unit length is

$$W_g = (18 + 13.5 + 9)100 = 40.5 \text{ x } 100 = 4050 \text{ lb/ft}$$

Horizontal distance to W_g is

$$d_g = \Sigma Ax/\Sigma A = [18(3\cos6 = 1.5\sin6) = 13.5(3.75\cos6 + 4.5\sin6) + 9(4.5\cos6 = 7.5\sin6)]/40.5 = 3.96 \text{ ft}$$

Resisting moment from Equation 7 is

$$M_r = 3.96 \text{ x } 4050 = 16{,}038 \text{ ft-lb/ft}$$

Safety factor against overturning from Equation 4 is

$$SF_o = M_r/M_o = 16{,}038/5034 = 3.19 > 2.00 \text{ OK}$$

Safety factor against sliding from Equation 8 is

$$SF_s = \mu W_g/P_h = \tan35 \text{ x } 4050/1730 = 1.64 > 1.50 \text{ OK}$$

Reaction eccentricity from Equation 9 is

$$e = 6/2 - (16{,}038 - 5034)/4050 = 0.283 \text{ ft}$$

Limit of eccentricity from Equation 10 is

$$-1 \le e \le 1 \text{ ft OK}$$

Maximum base pressure from Equation 11 is

$$P = (4050/6)(1 + 6x.283/6) = 866 \text{ psf} < 4000 \text{ psf OK}$$

All safety factors are within limits. Stability checks at intermediate levels in the wall show similar results.

3.6 Reinforced Soil Walls

To increase the efficiency of Lane gabion walls, layers of wire mesh may be attached to the front face and embedded in the backfill. The wire mesh layers in this reinforced soil wall will resist the active soil force, by a combination of friction on the wire surface and mechanical interlock with the soil. Reinforced soil walls generally use a single thickness of gabions. Design consists of: (1) wall stability checks similar to that for gravity walls, assuming the gabions and the reinforced soil act together as one unit; (2) checks for strength and pullout resistance of the reinforcement layers to ensure such action. The considerations that differ from gravity wall design are discussed below.

Walls will typically be 6 degrees from vertical. To simplify calculations, assume wall is vertical for certain calculations as indicated in Example 2 below.

In checking overturning, sliding and bearing the weight of the soil in the reinforced zone is included with the weight of the wall.

The tensile force in each layer of reinforcement is assumed to resist the active earth force over an incremental height of wall. Its calculated value must be limited to the tensile strength of the mesh divided by the safety factor (typically 1.85).
Therefore: 3000/1.85 = 1620 lb/ft.

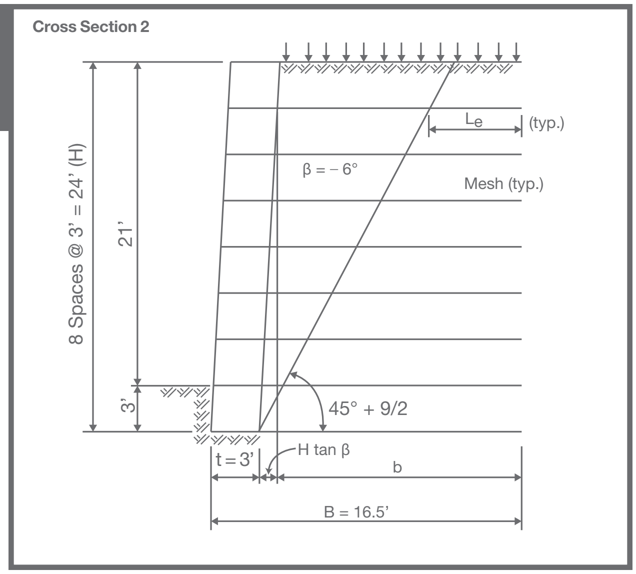
As in gravity wall design, the wall is designed to resist the force generated by a sliding wedge of soil as defined by Coulomb. The reinforcement at each layer must extend past the wedge by at least 3' and by a distance sufficient to provide anchorage in the adjacent soil. Generally this results in a B distance of 0.5 to 0.7 times the height of the wall.

Additional equations used in the design of reinforced soil walls, derived from statics, are given in Example 2

EXAMPLE 2 – Given Data (see Cross Section 2)

Wall Height .... $H = 24$ ft (21 ft + 3 ft embedment)
Wall Thickness .... $t = 3$ ft
Surcharge .... $q = 300$ psf
Backfill slope angle .... $\alpha = 0$ deg.
Back Face slope angle .... $\beta = -16$ deg.
Soil friction angle .... $\text{Ø} = 35$ deg.
Soil density .... $w_s = 120$ pcf
Gabion fill density .... $w_g = 100$ pcf
Soil bearing pressure .... $P_b = 4000$ psf

Figure 3



Part 1. Determine if safety factors are within limits:

The trial value for dimension B was selected as 16.5, approximately 0.7H. Also see note near the end of part 2 below on trial selection of B to provide adequate embedment length. In these calculations, positive values are used for the sin and tan of β and the sign in the equation changed as necessary.

Pressure coefficient from Equation 2 is

$$K_a = 0.23$$

Active earth force from Equation 1 A is

$$P_a = 0.23(120X24^2/2 + 300x24) = 9605 \text{ lb/ft}$$

Vertical distance to P_a from Equation 5 is

$$d_a = \frac{24(24 + 3x300/120)}{3(24 + 2x200/120)} = 9.22 \text{ ft}$$

Overturning moment from Equation 6 is

$$M_o = 9.22x9605$$
$$= 88{,}600 \text{ ft-lb/ft}$$

Weight of gabions is

$$W_g = 3x24x100$$
$$= 7200 \text{ lb/ft}$$

Horizontal distance to W_g is

$$d_g = t/2 = (H/2)\tan\beta$$
$$= 3/2 + (24/)\tan\beta$$
$$= 2.79 \text{ ft}$$

Weight of surcharge is

$$W_g = qb$$
$$= q(B - t - H \tan\beta)$$
$$= 300(16.5 - 3 - 24\tan6) = 300(10.98)$$
$$= 3290 \text{ lb/ft}$$

Horizontal distance to W_q is

$$d_q = b/2 = H\tan\beta = t$$
$$= 10.98/2 + 24\tan6 = 3$$
$$= 11.01 \text{ ft}$$

Weight of soil wedge is

$$W_s = (H\tan\beta/2 = b)\ Hw_s$$
$$= (24\tan6/2 = 10.98)\ 24x120$$
$$= 35{,}250 \text{ lb/ft}$$

Horizontal distance to W_s is

$$d_s = [(H^2\tan\beta)\ (H\tan\beta/3{=}t) = (Hb)\ (b/2 = H\tan\beta = t)]w_s/W_s$$
$$= [(24_2\tan6)\ (24\tan6/3 = 3) = (24x10.98)$$
$$(10.98/2 + 24\tan6 = 3)]\ \frac{120}{35250}$$
$$= 10.67 \text{ ft}$$

Resisting moment from Equation 7 is

$$M_r = W_sd_s + W_gd_g + W_qd_q$$
$$= 35{,}250x10.67 + 7200x2.76 + 3290x11.01$$
$$= 376{,}100 + 19{,}900 + 36{,}200$$
$$= 432{,}200 \text{ ft-lb/ft}$$

Safety factor against overturning from Equation 4 is

$$SF_o = M_r/M_o$$
$$= 432{,}200/88{,}600$$
$$= 4.88 > 2.00 \text{ OK}$$

Total vertical weight is

$$W_v = W_s + W_g + W_q$$
$$= 35{,}250 + 7200 + 3290$$
$$= 45{,}740 \text{ lb/ft}$$

Safety factor against sliding from Equation 8 is

$$SF_s = \mu W_v/P_h$$
$$= \tan35 \text{ x } 45{,}740/9605$$
$$= 3.33 > 1.50 \text{ OK}$$

Reaction eccentricity from Equation 9 is

$$e = 16.5/2 - (432{,}200 - 88{,}600)/45{,}740$$
$$= 0.738 \text{ ft}$$

Limit of eccentricity from Equation 10 is

$$-2.75 \le e \le 2.75 \text{ ft OK}$$

Maximum base pressure from Equation 11 is

$$p = (45{,}740/16.5)\ (1 + 6x0.738/16.5)$$
$$= 3520 \text{ psf} < 4000 \text{ psf OK}$$

All safety factors are within limits. Stability checks at intermediate levels in the wall show similar results.

Part 2. Determine if reinforcement mesh is satisfactory:

The pressure on any layer a distance z (ft) below the surface is

$$f_v = w_s z + q$$
$$= 120z + 300 \text{ psf}$$

The tensile stress on any layer of reinforcement in a vertical segment of soil of thickness S_v (ft), centered about the reinforcement layer, is

$$T = S_v K_a f_v$$
$$= 0.23\, S_v f_v$$

Calculate T for each layer as follows:

Z, ft	S_v, ft	f_v, ft	T, lb/ft	T < 1620 lb/ft?
3	4.5	660	683	Y
6	3.0	1020	704	Y
9	3.0	1380	952	Y
12	3.0	1740	1200	Y
15	3.0	2100	1449	Y
18	3.0	2460	1697	N
21	3.0	2820	1946	N
24	1.5	3180	1097	Y

The tensile force at 18' and 21' exceeded the limit. Therefore, insert an intermediate layer at 19.5' and 22.5'.

Recalculate the following revised table:

Z, ft	S_v, ft	f_v, ft	T, lb/ft	T < 1620 lb/ft?
3.0	4.50	660	683	Y
6.0	3.00	1020	704	Y
9.0	3.00	1380	952	Y
12.0	3.00	1740	1200	Y
15.0	3.00	2100	1449	Y
18.0	2.25	2460	1273	Y
19.5	1.50	2640	911	Y
21.0	1.50	2820	973	Y
22.5	1.50	3000	1035	Y
24.0	0.75	3180	549	Y

The tensile force is now within the allowable limit at all layers.

The minimum embedment length past the wedge to provide a safety factor of 1.5 against pullout in any layer is

$$L_{em} = 1.5T/(2\Gamma f_v \tan Ø)$$

where Γ is a "scale correction factor" assumed as 0.65.

$$L_{em} = 1.5T/(2x.65 f_v \tan 35)$$
$$= 1.65T/f_v$$

At the top of the wall, the distance (X) to the wedge failure plane from the back of the wall is

$$X = H \tan(45 - Ø/2) - H \tan\beta$$
$$= 24 \tan(27.5) - 24 \tan(6)$$
$$= 11.54 \text{ ft}$$

At any layer, the length of embedment past the wedge is

$$L_e = B - t - X(H - z)/H$$
$$= 16.5 - 3 - 11.54(24 - z)/24$$
$$= 1.956 + .481z$$

NOTE: L_e can be calculated for the top layer of reinforcement initially, when selecting **B**, to make sure it is at least 3'. If not, increase **B** for the trial design.

Calculate L_e and L_{em} for each layer as follows:

Z, ft	f_v,psi	T, lb/ft	L_e, ft	L_{em}, ft	$L_e < L_{em}$
3.0	660	683	3.40	1.71	Y
6.0	1020	704	4.84	1.14	Y
9.0	1380	952	6.29	1.14	Y
12.0	1740	1200	7.73	1.14	Y
15.0	2100	1449	9.17	1.14	Y
18.0	2460	1273	10.62	0.85	Y
19.5	2640	911	11.34	0.59	Y
21.0	2820	973	12.06	0.59	Y
22.5	3000	1035	12.78	0.59	Y
24.0	3180	549	13.50	0.28	Y

The embedded length of reinforcement in each layer is greater than the minimum required for pullout and is also at least 3'. Reinforcement design is satisfactory with mesh added at the 19.5' and 22.5' levels.

Table I - Angles of Internal Friction and Unit Weights of Soil*

Soil Type	Soil Condition	Angle of Internal Friction, Ø, deg.	Soil Density, w, lb/cu ft
Coarse sand, sand & gravel	Compact soil Loose	40 35	140 90
Medium sand	Compact soil Loose	40 30	130 90
Fine silty sand, sandy silt	Compact soil Loose	30 25	130 85
Uniform silt	Compact soil Loose	30 25	135 85
Clay-silt	Soft/medium	20	90/120
Silty clay	Soft/medium	15	90/120
Clay	Soft/medium	0/10	90/120

*F.S. Merritt, Ed., "Standard Handbook for Civil Engineers," McGraw-Hill, 1983.

GENERAL NOTE: Every effort has been made to ensure the accuracy and reliability of the information presented herein. Nevertheless, the user of this brochure is responsible for checking and verifying the data by independent means. Application of the information must be based on responsible professional judgement. No express warranties of merchantability or fitness are created or intended by this document. Specification data referring to mechanical and physical properties and chemical analyses relate solely to tests performed at the time of manufacture in specimens obtained from specific locations of the product in accordance with prescribed sampling procedures.

Table II – Active Pressure Coefficient, K_a

β	α	Ø=10	Ø=15	Ø=20	Ø=25	Ø=30	Ø=35	Ø=40
-6.	0.	.68	.56	.45	.37	.29	.23	.18
-6.	5.	.74	.60	.49	.39	.31	.24	.19
-6.	10.	.94	.67	.53	.42	.33	.26	.20
-6.	15.		.89	.59	.46	.35	.27	.21
-6.	20.			.82	.52	.39	.29	.22
-6.	25.				.75	.44	.32	.24
-6.	30.					.67	.37	.26
-6.	35.						.58	.30
-6.	40.							.49
0.	0.	.70	.59	.49	.41	.33	.27	.22
0.	5.	.77	.63	.52	.43	.35	.28	.23
0.	10.	.97	.70	.57	.46	.37	.30	.24
0.	15.		.93	.64	.50	.40	.32	.25
0.	20.			.88	.57	.44	.34	.27
0.	25.				.82	.50	.38	.29
0.	30.					.75	.44	.32
0.	35.						.67	.37
0.	40.							.59
5.	0.	.73	.62	.52	.44	.37	.31	.25
5.	5.	.80	.67	.56	.47	.39	.32	.26
5.	10.	1.00	.74	.61	.50	.41	.34	.28
5.	15.		.98	.68	.55	.45	.36	.29
5.	20.			.94	.62	.49	.39	.31
5.	25.				.89	.56	.43	.34
5.	30.					.83	.50	.37
5.	35.						.76	.43
5.	40.							.68
10.	0.	.76	.65	.56	.48	.41	.34	.29
10.	5.	.83	.70	.65	.51	.43	.36	.30
10.	10.	1.05	.78	.62	.55	.46	.38	.32
10.	15.		1.04	.74	.60	.50	.41	.34
10.	20.			1.02	.68	.55	.44	.36
10.	25.				.98	.63	.49	.39
10.	30.					.92	.57	.43
10.	35.						.86	.50
10.	40.							.79
15.	0.	.79	.69	.60	.52	.45	.39	.33
15.	5.	.87	.75	.65	.56	.48	.41	.35
15.	10.	1.10	.83	.71	.60	.51	.43	.37
15.	15.		1.11	.80	.66	.55	.47	.39
15.	20.			1.10	.75	.61	.51	.42
15.	25.				1.08	.70	.56	.45
15.	30.					1.04	.65	.50
15.	35.						.98	.58
15.	40.							.91

Lane Enterprises, Inc.
3905 Harzdale Drive, Suite 514
Camp Hill, PA 17011
P: 717.761.8175 • F: 717.761.5055
lane-enterprises.com