PAVEMENT DESIGN WORKSHEET FOR *DRIVABLE GRASS®* PAVING SYSTEM

Structural pavement design sections should be calculated by a qualified design engineer based upon site specific conditions with consideration for usage of the ***Drivable Grass®*** product. The suggested/recommended aggregate base thickness can be determined through use of the gravel equivalence pavement design method as outlined below:

GE_{Total} = 0.0032 * (TI) * (100 – R) (ft)

where: GE_{Total} = Gravel Equivalence Total for Pavement Section

TI = Traffic Index

R = R Value of Subgrade Soils

Notes:	Typical values for TI: • 4.0 for parking stalls • 5.0 for fire lanes with infrequent usage • 5.5 for travelled ways • 6.0 for fire lanes with frequent usage • Site specific calculation for heavier loading/usage applications (See attached worksheet)
	Typical R-Values for subgrade soils (R): • Gravels/Clean Sand – Range from 30 to 70 • Silty to Clayey Sands – Range from 10 to 40 • Clays/Silts – Range from 5 to 15 (potentially less in continuously saturated areas) • Consult a geotechnical engineer for site specific testing • Correlation formula between California Bearing Ratio (CBR) and R-Value (See attached worksheet)

Calculations:

GE_{Total} = 0.0032 * (TI) * (100 – R) = 0.0032 * (______) * (100 - _____) = ________________________ (ft)

Gravel Equivalence for Aggregate Base (GE_{AB}) = GE_{Total} - ***Drivable Grass®*** Structural Component (GE_{DG})**

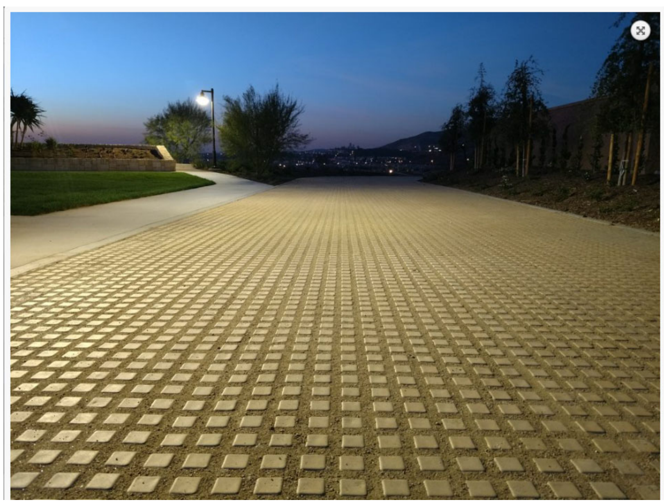
GE_{AB} = GE_{Total} - GE_{DG} = ________________ - ____________________ = __________________________ (ft)

See attached table for recommendations for ***Drivable Grass®* Structural Component (GE_{DG})

Aggregate Base Thickness ($AB_{THICKNESS}$) = GE_{AB} / GF_{AB} = __________ / _________ = ________________ (ft)

= __________________ (inches)

Where: GF_{AB} = Gravel Equivalence Factor for Aggregate Base = 1.1

Notes:	***Drivable Grass®*** Structural Component (GE_{DG}) may be variable based upon usage and finish. The typical ***Drivable Grass®*** pavement surface section consists of the 1.5" concrete pavement mat and 0.5 to 2-inch sand bedding layer (depending upon application) over the underlying structural aggregate base section. Recommended ***Drivable Grass®*** Structural Component (GE_{DG}) options are as follows:	
		***Drivable Grass®*** with ***Drivable Turf®*** (GE_{DG-DT}) for High End Driveway: **GE_{DG-DT} = 0**
		***Drivable Grass®*** with Decomposed Granite Infill (GE_{DG-DG}): GE_{DG-DG} = ***Drivable Grass®*** Mat Thickness GE_{DG-DG} = (1.5 inches / [12 inches/ft]) GE_{DG-DG} **= 0.125 ft**
		***Drivable Grass®*** with Grass Seed Infill (GE_{DG-NG}) GE_{DG-NG} = 2 * (1.5 inches / [12 inches/ft]) **GE_{DG-NG} = 0.25 ft**

TRAFFIC INDEX WORKSHEET FOR HEAVIER LOADING/USAGE APPLICATIONS

From ASCE 68-18, the following guideline is provided for Traffic Index (TI) considering Equivalent Single Axle Load (ESALs) counts:

Table 4-1. Roadway and Pavement Classifications and Typical Design Traffic

Pavement Class	Description	Design ESALs	Design TI
Arterial	Through traffic with access to high-density, regional, commercial, and office developments or downtown streets. General traffic mix.	9,000,000	11.5
Major collector	Traffic with access to low-density, local, commercial, and office development or high-density, residential subdivisions. General traffic mix.	3,000,000	10
Minor collector	Through traffic with access to low-density, neighborhood, commercial development or low-density, residential subdivisions. General traffic mix.	1,000,000	9
Bus passenger drop-off	Public transport centralized facility for buses to pick up passengers from other modes of transport, or for parking of city or school buses.	500,000	8.5
Local commercial	Commercial and limited through traffic with access to commercial premises and multi-family and single-family residential roads. Used by private automobiles, service vehicles and heavy delivery trucks This category includes large parking lots at commercial retail facilities.	330,000	8
Residential (Alley, Courtyard)	No through traffic with access to multi-family and single-family residential properties. Used by private automobiles, service vehicles and light delivery trucks, including limited construction traffic.	110,000	7
Facility parking and alleys	Parking areas for private automobiles at large facilities with access for emergency vehicles and occasional use by service vehicles or heavy delivery trucks.	90,000	7
Commercial parking	Restricted parking and drop-off areas associated with business premises, mostly used by private automobiles and occasional light delivery trucks. No construction traffic over finished surfaces.	30,000	6
Commercial plaza	Predominantly pedestrian traffic, but with access for occasional heavy maintenance and emergency vehicles. No construction traffic over finished surfaces.	10,000	5

Source: Courtesy of Brick Industry Association (2003); reproduced with permission.

One ESAL is equal to a single 18,000-lb axle load. A simplified method for calculating a site-specific TI based on anticipated ESALs is included below. This method is primarily intended for infrequently used fire access lanes. Minimum TI values listed above should be considered by the designer as well as environmental considerations for drainage and/or other conditions.

Traffic Index (TI) = 9.0 * (ESAL * LDF / 10^6) $^{0.119}$

Where: ESAL = Equivalent Single Axle Load

LDF = Lane Distribution Factor = Typically 1

ESAL = LEF * (# Trips/Day) * (# days/year) * Pavement Service Life

Where: LEF = Load Equivalence Factor – ESAL/truck (per attached table)

Example Design Axle Load – 40 kips/axle (for H-25 or HS-25 loading) – LEF = 39.3

ESAL = _______ * (_______ / day) * (_______ days / year) * (________ years) = ______________ ESALs

Traffic Index (TI) = 9.0 * (______________*__________ / 10^6) $^{0.119}$ = _______________

Note: *More detailed ESAL and TI calculations are available through publicly available sources.*

WORKSHEET FOR CORRELATION OF CALIFORNIA BEARING RATIO (CBR) TO R-VALUE

From ASCE 68-18, the information below can be used to correlate California Bearing Ratio (CBR) to R-Value for pavement design using the Gravel Equivalence Method.

Resilient modulus (M_R) is calculated through the following expressions (expressed in psi) for both CBR and R-Value:

$$M_R = 2{,}555 * (CBR)^{0.64}$$

$$M_R = 1{,}155 + 555*(R)$$

As a result, CBR and R-Value can be generally correlated between the two formulas as follows:

$$R = [2{,}555 * (CBR)^{0.64} – 1{,}155] / 555$$

R = [2,555 * (_____)$^{0.64}$ – 1,155] / 555 = ___________________

APPENDIX 76.A

Axle Load Equivalency Factors for Flexible Pavements
(single axles and p_t of 2.5)

axle load (kips)	pavement structural number (SN)					
	1	2	3	4	5	6
2	0.0004	0.0004	0.0003	0.0002	0.0002	0.0002
4	0.003	0.004	0.004	0.003	0.002	0.002
6	0.011	0.017	0.017	0.013	0.010	0.009
8	0.032	0.047	0.051	0.041	0.034	0.031
10	0.078	0.102	0.118	0.102	0.088	0.080
12	0.168	0.198	0.229	0.213	0.189	0.176
14	0.328	0.358	0.399	0.388	0.360	0.342
16	0.591	0.613	0.646	0.645	0.623	0.606
18	1.00	1.00	1.00	1.00	1.00	1.00
20	1.61	1.57	1.49	1.47	1.51	1.55
22	2.48	2.38	2.17	2.09	2.18	2.30
24	3.69	3.49	3.09	2.89	3.03	3.27
26	5.33	4.99	4.31	3.91	4.09	4.48
28	7.49	6.98	5.90	5.21	5.39	5.98
30	10.3	9.5	7.9	6.8	7.0	7.8
32	13.9	12.8	10.5	8.8	8.9	10.0
34	18.4	16.9	13.7	11.3	11.2	12.5
36	24.0	22.0	17.7	14.4	13.9	15.5
38	30.9	28.3	22.6	18.1	17.2	19.0
40	39.3	35.9	28.5	22.5	21.1	23.0
42	49.3	45.0	35.6	27.8	25.6	27.7
44	61.3	55.9	44.0	34.0	31.0	33.1
46	75.5	68.8	54.0	41.4	37.2	39.3
48	92.2	83.9	65.7	50.1	44.5	46.5
50	112	102	79	60	53	55