engineering manual

STEEL DECK INSTITUTE sdi®

DIAPHRAGM DESIGN

EDITION

SUPPLEMENT FOR CONCRETE FILLED DIAPHRAGMS

REVISIONS TO AISI S310 FOR CONCRETE FILLED DIAPHRAGMS

The 2020 edition of AISI S310 North American Standard for the Design of Profiled Steel Diaphragm Panels changes the design resistance for structural concrete filled diaphragms to reflect a composite section approach that is applicable to structural concrete on both composite and non-composite deck. This change also separates the limit states to diagonal tension in the field of the diaphragm (Section D4.1.1) and a limit state controlled by fasteners at locations where forces are transferred into or out of the diaphragm (Section D4.1.2).

Supplement 1 to AISI S310-20 further clarifies the design requirements for Section D4.1.2 by clarifying the safety and resistance factors for fasteners other than headed shear studs.

Tables 1.1 through 1.5 in this document show the nominal resistance for limit state of diagonal tension along with the associated safety and resistance factors. These tables would replace the nominal shear resistance for deck filled with normal-weight and lightweight structural concrete in the Diaphragm Design Manual, 4th Edition (DDM04) on pages 11-23 through 11-39 and 12-60 through 12-122. The portions of these tables for the bare deck diaphragm are still applicable. Note that for structural concrete filled diaphragms, the controlling equation does not consider contribution of the fasteners because of the overwhelming stiffness of the concrete slab as compared to the fasteners.

Tables 2.1 through 2.5 and 3.1 through 3.2 in this document will assist in selecting fasteners for the limit state of force transfer by providing the nominal shear resistance of headed studs, screws, and welds. The use of proprietary fasteners is permitted and reference should be made to manufacturer's literature and/or evaluation reports. The designer should use basic engineering mechanics principles to determine the required force transfer at the necessary locations, and to select the type, number, and spacing of fasteners as required. This limit state must be addressed in addition to the limit state of diagonal tension in the field of the diaphragm.

Subsequent to the publication of Supplement 1, the AISI Committee on Specifications has passed a ballot which simplifies the calculation of the diaphragm shear stiffness in Section D5.4.1 using a composite section approach similar to that of Section D4.1.1. This change is expected to be published in the 2024 edition of AISI S310. Tables 4.1 through 4.5 tabulate the revised structural concrete filled diaphragm stiffnesses. The information in these Tables would replace the calculation of G' for a structural concrete filled diaphragm as shown on DDM04 page 9-4.

Excerpt from AISI S310-20 w/S1

D4.1.1 Diagonal Tension Limit State

For the limit state of diagonal tension in the field of the *diaphragm*, the *nominal shear strength* [*resistance*] per unit length of *diaphragms* with *structural concrete* fill shall be calculated using Eq. D4.1.1-1.

$$S_n = k_c \lambda_{LW} b t_e \sqrt{f'_c} \qquad \text{(Eq. D4.1.1-1)}$$

Ω = 2.00 for *ASD*
ϕ = 0.80 for *LRFD*
= 0.75 for *LSD*

where

S_n = *Nominal shear strength* [*resistance*] per unit length of *diaphragm* system with *structural concrete* fill, kip/ft (kN/m)
k_c = Factor for *structural concrete* strength
= 3.2/1000 For U.S. Customary units (*Eq*. D4.1.1-2a)
= 0.266/1000 For SI units (*Eq*. D4.1.1-2b)
λ_{LW} = Factor for lightweight concrete
= 1.0 For normal-weight concrete
= 0.75 For lightweight concrete
= 0.85 For sand-lightweight concrete
b = Unit width of *diaphragm* with *structural concrete* fill, 12 in. for U. S. Customary units and 1000 mm for SI units
t_e = Equivalent transformed concrete thickness, in. (mm)

$$= t_a + n_{sc} t \frac{d}{s} \qquad \text{(Eq. D4.1.1-3)}$$

t_a = Average thickness of *structural concrete*, calculated as the cross-sectional area of the *structural concrete* over one *deck panel* divided by the width of the *deck panel*, in. (mm)
n_{sc} = Modular ratio of steel *deck* to concrete

$$= \frac{E}{E_c} \qquad \text{(Eq. D4.1.1-4)}$$

E = Modulus of elasticity of steel
E_c = Modulus of elasticity of concrete in accordance with ACI 318
t = Base steel *thickness* of *panel*, in. (mm)
d = *Panel* corrugation *pitch*. See Figure D2-1, in. (mm)
s = Developed flute width per *pitch*. Defined in Section D2, in. (mm)
f'_c = Specified concrete compressive strength, psi (MPa)

Table 1.1
1.5x6 Composite Deck and 1.5x6 Inverted Non-Composite Deck Diaphragm (all F_y)

(Wide Flange of Deck Up)

Limit State of Diagonal Tension

Ω = 2.00 (ASD) Φ= 0.80 (LRFD)

3000 psi NW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
1.5x6Cx22 ga	5699	6750	7802	8854	9905	10957	12008
1.5x6Cx20 ga	5789	6841	7893	8944	9996	11047	12099
1.5x6Cx18 ga	5956	7008	8059	9111	10163	11214	12266
1.5x6Cx16 ga	6134	7186	8238	9289	10341	11392	12444

3000 psi LW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
1.5x6Cx22 ga	4406	5195	5984	6772	7561	8350	9139
1.5x6Cx20 ga	4502	5291	6080	6869	7657	8446	9235
1.5x6Cx18 ga	4680	5468	6257	7046	7834	8623	9412
1.5x6Cx16 ga	4869	5658	6446	7235	8024	8812	9601

4000 psi NW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
1.5x6Cx22 ga	6515	7729	8943	10158	11372	12586	13801
1.5x6Cx20 ga	6605	7820	9034	10248	11463	12677	13891
1.5x6Cx18 ga	6772	7986	9201	10415	11629	12844	14058
1.5x6Cx16 ga	6950	8165	9379	10593	11808	13022	14236

4000 psi LW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
1.5x6Cx22 ga	5018	5929	6840	7750	8661	9572	10483
1.5x6Cx20 ga	5114	6025	6936	7847	8757	9668	10579
1.5x6Cx18 ga	5292	6202	7113	8024	8934	9845	10756
1.5x6Cx16 ga	5481	6392	7302	8213	9124	10034	10945

Note: Table values are nominal resistances in pounds per linear foot (plf).

Table 1.2
1.5x6 Inverted Composite Deck and 1.5x6 Non-Composite Deck Diaphragm (all F_y)

(Narrow Flange of Deck Up)

Limit State of Diagonal Tension

Ω = 2.00 (ASD) Φ= 0.80 (LRFD)

3000 psi NW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
1.5x6Fx22 ga	6716	7768	8820	9871	10923	11974	13026
1.5x6Fx20 ga	6807	7859	8910	9962	11013	12065	13117
1.5x6Fx18 ga	6974	8025	9077	10129	11180	12232	13283
1.5x6Fx16 ga	7152	8204	9255	10307	11358	12410	13462

3000 psi LW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
1.5x6Fx22 ga	5169	5958	6747	7536	8324	9113	9902
1.5x6Fx20 ga	5266	6054	6843	7632	8421	9209	9998
1.5x6Fx18 ga	5443	6231	7020	7809	8598	9386	10175
1.5x6Fx16 ga	5632	6421	7209	7998	8787	9576	10364

4000 psi NW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
1.5x6Fx22 ga	7690	8904	10118	11333	12547	13761	14976
1.5x6Fx20 ga	7780	8995	10209	11423	12638	13852	15066
1.5x6Fx18 ga	7947	9161	10376	11590	12804	14019	15233
1.5x6Fx16 ga	8125	9340	10554	11768	12983	14197	15411

4000 psi LW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
1.5x6Fx22 ga	5900	6810	7721	8632	9542	10453	11364
1.5x6Fx20 ga	5996	6906	7817	8728	9639	10549	11460
1.5x6Fx18 ga	6173	7084	7994	8905	9816	10726	11637
1.5x6Fx16 ga	6362	7273	8184	9094	10005	10916	11826

Note: Table values are nominal resistances in pounds per linear foot (plf).

Table 1.3
2x12 Composite Deck and 2x12 Non-Composite Deck Diaphragm (all F_y)

Limit State of Diagonal Tension

Ω = 2.00 (ASD) Φ= 0.80 (LRFD)

3000 psi NW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
2x12x22 ga	6781	7833	8884	9936	10987	12039	13091
2x12x20 ga	6882	7933	8985	10036	11088	12140	13191
2x12x18 ga	7067	8118	9170	10222	11273	12325	13377
2x12x16 ga	7265	8316	9368	10420	11471	12523	13575

3000 psi LW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
2x12x22 ga	5233	6021	6810	7599	8387	9176	9965
2x12x20 ga	5339	6128	6917	7706	8494	9283	10072
2x12x18 ga	5536	6325	7114	7902	8691	9480	10268
2x12x16 ga	5746	6535	7324	8113	8901	9690	10479

4000 psi NW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
2x12x22 ga	7757	8971	10186	11400	12614	13829	15043
2x12x20 ga	7858	9072	10286	11501	12715	13929	15144
2x12x18 ga	8043	9257	10472	11686	12900	14114	15329
2x12x16 ga	8241	9455	10670	11884	13098	14313	15527

4000 psi LW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
2x12x22 ga	5965	6875	7786	8697	9608	10518	11429
2x12x20 ga	6072	6982	7893	8804	9714	10625	11536
2x12x18 ga	6268	7179	8090	9000	9911	10822	11733
2x12x16 ga	6479	7389	8300	9211	10121	11032	11943

Note: Table values are nominal resistances in pounds per linear foot (plf).

Table 1.4
3x12 Composite Deck and 3x12 Non-Composite Deck Diaphragm (all F_y)

Limit State of Diagonal Tension

Ω = 2.00 (ASD) Φ= 0.80 (LRFD)

3000 psi NW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3.25	4.25	4.5	5.25	6
3x12x22 ga	7788	8839	10417	12520	13046	14623	16201
3x12x20 ga	7879	8930	10508	12611	13137	14714	16292
3x12x18 ga	8046	9098	10675	12779	13305	14882	16459
3x12x16 ga	8226	9277	10855	12958	13484	15061	16639

3000 psi LW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3.25	4.25	4.5	5.25	6
3x12x22 ga	5974	6762	7946	9523	9917	11100	12284
3x12x20 ga	6070	6859	8042	9620	10014	11197	12380
3x12x18 ga	6248	7037	8220	9798	10192	11375	12558
3x12x16 ga	6439	7227	8411	9988	10382	11565	12748

4000 psi NW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3.25	4.25	4.5	5.25	6
3x12x22 ga	8927	10141	11962	14391	14998	16820	18641
3x12x20 ga	9018	10232	12053	14482	15089	16911	18732
3x12x18 ga	9185	10400	12221	14650	15257	17078	18900
3x12x16 ga	9364	10579	12400	14829	15436	17257	19079

4000 psi LW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3.25	4.25	4.5	5.25	6
3x12x22 ga	6828	7739	9105	10926	11382	12748	14114
3x12x20 ga	6925	7835	9201	11023	11478	12844	14210
3x12x18 ga	7103	8013	9379	11201	11656	13022	14388
3x12x16 ga	7293	8204	9570	11391	11847	13213	14579

Note: Table values are nominal resistances in pounds per linear foot (plf).

Table 1.5
9/16 x 2-1/2 Non-Composite Deck Diaphragm (all F_y)

Limit State of Diagonal Tension

Ω = 2.00 (ASD) Φ= 0.80 (LRFD)

3000 psi NW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
9/16x2.5x26 ga	5070	6122	7174	8225	9277	10328	11380
9/16x2.5x24 ga	5162	6213	7265	8316	9368	10420	11471
9/16x2.5x22 ga	5247	6298	7350	8402	9453	10505	11557

3000 psi LW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
9/16x2.5x26 ga	3888	4676	5465	6254	7043	7831	8620
9/16x2.5x24 ga	3985	4773	5562	6351	7139	7928	8717
9/16x2.5x22 ga	4075	4864	5652	6441	7230	8019	8807

4000 psi NW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
9/16x2.5x26 ga	5813	7027	8241	9456	10670	11884	13098
9/16x2.5x24 ga	5904	7118	8332	9547	10761	11975	13190
9/16x2.5x22 ga	5989	7203	8418	9632	10846	12061	13275

4000 psi LW	Concrete Cover (inches)						
Sn (plf)	2	2.5	3	3.5	4	4.5	5
9/16x2.5x26 ga	4444	5355	6266	7177	8087	8998	9909
9/16x2.5x24 ga	4541	5452	6363	7273	8184	9095	10006
9/16x2.5x22 ga	4632	5542	6453	7364	8275	9185	10096

Note: Table values are nominal resistances in pounds per linear foot (plf).

Excerpt From AISI S310-20 w/S1

D4.1.2 Fastener Strength Limit State

For the limit state of fastener strength at locations where forces are transferred into or out of the *diaphragm*, the number of fasteners to resist the *required shear strength* [shear force due to *factored loads*] at locations where *structural concrete* filled steel *deck diaphragms* are connected to the *lateral force resisting system* parallel or perpendicular to the deck span shall be determined based on the *available shear strength [factored resistance]* of the individual fasteners determined in accordance with D4.1.2.1 or D4.1.2.2.

User Note:
Fasteners to attach the deck sheets to supporting members and to adjacent sheets in accordance with applicable codes and standards are required in addition to those required for shear transfer to the *lateral force-resisting system*. At locations where those support fastener locations coincide, the fasteners used for shear transfer may replace the other fasteners.

D4.1.2.1 Steel Headed Stud Anchors

The *available strength* [*factored resistance*] of steel headed stud anchors shall be determined using the *nominal strength* [*resistance*] in accordance with ANSI/AISC 360, and the *safety* and *resistance factors* given in this section. The maximum and minimum spacing and the edge distance shall be limited in accordance with ANSI/AISC 360. The welding of the steel headed stud anchors to the supporting material shall be in accordance with ANSI/AWS D1.1.

$\Omega = 3.00$ for *ASD*
$\phi = 0.55$ for *LRFD*
$= 0.50$ for *LSD*

D4.1.2.2 Welds, Screws or Other Fasteners

The individual weld or screw *available shear strength* [*factored resistance*] shall be determined in accordance with AISI S100 Chapter J.

The individual fastener *available shear strength* [*factored resistance*] for other fasteners shall be determined by testing in accordance with AISI S100 Sections K1 and K2. The *safety* and *resistance factors* shall be as determined in accordance with AISI S100 Eqs. K2.1.2-2 and K2.1.1-2.

Table 2.1
Shear Transfer Attachment - Headed Studs (Stud F_u = 65 ksi)

Ω = 3.00 (ASD) Φ= 0.55 (LRFD)

3000 / 4000 psi NW and LW – Deck Perpendicular to Beam – All Profiles

Stud Spacing	Sn (PLF)			
	Stud Anchor Diameter (inches)			
	3/8	1/2	5/8	3/4
36" on center	1425	2534	3959	5701
24" on center	2138	3801	5938	8551
12" on center	4276	7601	11877	17103
2 studs per rib (2x12 or 3x12)	7323	13018	20341	29290
3 studs per rib (2x12 or 3x12)	9046	16081	25127	36182
10" on center (9/16 x 2.5)	5131	9122	14252	20523
6" on center (1.5 x 6)	8551	15203	23754	34206

Note: Table values are nominal resistances in pounds per linear foot (plf).

Table 2.2
Shear Transfer Attachment - Headed Studs (Stud F_u = 65 ksi)

Ω = 3.00 (ASD) Φ= 0.55 (LRFD)

3000 psi LW – Deck Parallel to Beam – All Profiles

Stud Spacing	Sn (PLF)			
	Stud Anchor Diameter (inches)			
	3/8	1/2	5/8	3/4
36" on center	1425	2534	3959	5701
24" on center	2138	3801	5938	8551
12" on center	4276	7601	11877	17103
6" on center	8551	15203	23754	34206

Note: Table values are nominal resistances in pounds per linear foot (plf).

Table 2.3
Shear Transfer Attachment - Headed Studs (Stud F_u = 65 ksi)

Ω = 3.00 (ASD) Φ= 0.55 (LRFD)

3000 psi NW – Deck Parallel to Beam – All Profiles except 1.5x6 with narrow flange down

Stud Spacing	Sn (PLF)			
	Stud Anchor Diameter (inches)			
	3/8	1/2	5/8	3/4
36" on center	1753	3117	4870	7013
24" on center	2630	4676	7306	10520
12" on center	5260	9351	14611	21040
6" on center	10520	18702	29222	42080

Note: Table values are nominal resistances in pounds per linear foot (plf).

Table 2.4
Shear Transfer Attachment - Headed Studs (Stud F_u = 65 ksi)

Ω = 3.00 (ASD) Φ= 0.55 (LRFD)

4000 psi NW and LW – Deck Parallel to Beam – All Profiles except 1.5x6 with narrow flange down

Stud Spacing	Sn (PLF)			
	Stud Anchor Diameter (inches)			
	3/8	1/2	5/8	3/4
36" on center	1768	3144	4912	7074
24" on center	2653	4716	7369	10611
12" on center	5305	9432	14737	21221
6" on center	10611	18863	29474	42443

Note: Table values are nominal resistances in pounds per linear foot (plf).

Table 2.5
Shear Transfer Attachment - Headed Studs (Stud F_u = 65 ksi)

Ω = 3.00 (ASD) Φ= 0.55 (LRFD)

3000 / 4000 psi NW and 4000 psi LW – Deck Parallel to Beam – 1.5x6 with narrow flange down

Stud Spacing	Sn (PLF)			
	Stud Anchor Diameter (inches)			
	3/8	1/2	5/8	3/4
36" on center	1425	2534	3959	5701
24" on center	2138	3801	5938	8551
12" on center	4276	7601	11877	17103
6" on center	8551	15203	23754	34206

Note: Table values are nominal resistances in pounds per linear foot (plf).

Table 3.1
Shear Transfer Attachment - Screws

Ω = 3.00 (ASD) Φ= 0.50 (LRFD)

Deck – F_y = 40 ksi, F_u = 50 ksi

Screw Diameter	Nominal Shear Strength per Screw (lbs)			
	Deck Gage			
	16 ga	18 ga	20 ga	22 ga
#10 Screw	1534	1216	918	757
#12 Screw	1744	1382	1044	860
#14 Screw	1938	1536	1160	956
¼" Screw	2018	1600	1208	996

Deck – F_y = 50 ksi, F_u = 60 ksi

Screw Diameter	Nominal Shear Strength per Screw (lbs)			
	Deck Gage			
	16 ga	18 ga	16 ga	22 ga
#10 Screw	1841	1459	1102	908
#12 Screw	2093	1659	1253	1032
#14 Screw	2325	1843	1392	1147
¼" Screw	2422	1920	1450	1195

Deck – F_y = 60 ksi, F_u = 62 ksi

Screw Diameter	Nominal Shear Strength per Screw (lbs)			
	Deck Gage			
	16 ga	18 ga	16 ga	22 ga
#10 Screw	1902	1508	1139	938
#12 Screw	2162	1714	1294	1067
#14 Screw	2403	1904	1438	1185
¼" Screw	2503	1984	1498	1235

Note: Table values represent nominal resistances in pounds per screw, determined in accordance with AISI S100-16 w/ Supplement 1. The values assume a support thickness ≥ 2.5 times the deck thickness. For determination of shear strength per unit length along diaphragm chord, tie or collector members, apply the appropriate safety or resistance factor from the top of the table to the nominal strengths provided in the table and divide by the average fastener spacing along the member.

Table 3.2
Shear Transfer Attachment – Arc Spot Welds (F_{exx} = 60 ksi)

Ω = 2.55 (2.20) [2.80] Φ = 0.60 (0.70) [0.55]

Deck – F_y = 40 ksi, F_u = 50 ksi

	Gage	Nominal Shear Strength per Weld (lbs)			
		Visible Diameter (Inches)			
		0.5	0.625	0.75	1
Single Sheet	22	(1527)	[1900]	[1952]	[2055]
	20	(1828)	(2320)	[2794]	[2920]
	18	2673	(3012)	(3663)	[4903]
	16	2395	4176	(4540)	(6185)
Double Sheet	22	2417	4176	(4485)	(6107)
	20	2080	3851	6014	(7312)
	18	1526	3082	5179	10691
	16	1029	2354	4221	9579

Note: Table values represent nominal resistances in pounds per weld, determined in accordance with AISI S100-16 w/ Supplement 1. For determination of shear strength per unit length along diaphragm chord, tie or collector members, apply the appropriate safety or resistance factor from the top of the table to the nominal strengths provided in the table and divide by the average fastener spacing along the member.

Shear Transfer Attachment – Other Fasteners

AISI S310, Section D4.1.2.2, requires that the nominal resistance P_{nf} / P_{nfs} for a specific fastener be determined by testing, with safety/ resistance factors derived from the calibration of the test results in accordance with AISI S100 (-20 w/Supplement 1) , Section K.1 and K.2. Test-derived resistance values for various fasteners can be obtained using the equations in Section 6.6 of this document. However, safety and resistance factors are not provided. Manufacturers of proprietary fasteners may provide calibrated safety/resistance factors to be used with the P_{nf} values provided in the DDM, in their technical literature or in an independent evaluation report. Alternatively, manufacturers may provide both P_{nf} / P_{nfs} values and associated safety/ resistance factors in their technical literature or independent evaluation report. For determination of shear strength per unit length along diaphragm chord, tie or collector members, apply the appropriate safety or resistance factor to the provided nominal strengths and divide by the average fastener spacing along the member.

Content of New Text for AISI S310-24

D5.4.1 Shear Stiffness of Structural Concrete-Filled Diaphragms

The *diaphragm shear stiffness*, G′, shall be calculated in accordance with Eq. D5.4.1-1 for *diaphragms* with *structural concrete* fill over fluted *deck or cellular deck* and that satisfy the limits of applicability given in Section D4:

$$G' = K_{cs}\lambda_{LW}^{1.5} t_e \sqrt{f'_c} \qquad \text{(Eq. D5.4.1-1)}$$

where

G′ = *Diaphragm shear stiffness*, kip/in. (kN/m)
K_{cs} = Factor for concrete stiffness
= 22 for U.S. Customary units
= 1827 for SI units
λ_{LW} = Factor for lightweight concrete
= 1.0 for normal-weight concrete
= 0.75 for lightweight concrete
= 0.85 for sand-lightweight concrete
t_e = Equivalent transformed concrete thickness as defined in Section D4.1.1, in. (mm)
f'_c = Specified *structural concrete* compressive strength, psi (MPa)

Table 4.1
1.5x6 Composite Deck and 1.5x6 Inverted Non-Composite Deck Diaphragm (all F_y)

(Wide Flange of Deck Up)

Shear Stiffness

3000 psi NW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
1.5x6Cx22 ga	3256	3858	4461	5063	5666	6268	6871
1.5x6Cx20 ga	3306	3908	4511	5113	5716	6318	6921
1.5x6Cx18 ga	3398	4000	4603	5205	5808	6410	7013
1.5x6Cx16 ga	3496	4099	4701	5304	5906	6509	7111

3000 psi LW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
1.5x6Cx22 ga	2199	2590	2982	3373	3764	4156	4547
1.5x6Cx20 ga	2250	2641	3032	3424	3815	4206	4598
1.5x6Cx18 ga	2343	2734	3125	3517	3908	4299	4691
1.5x6Cx16 ga	2442	2833	3225	3616	4007	4399	4790

4000 psi NW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
1.5x6Cx22 ga	3729	4425	5121	5817	6512	7208	7904
1.5x6Cx20 ga	3781	4476	5172	5868	6564	7259	7955
1.5x6Cx18 ga	3875	4571	5267	5962	6658	7354	8049
1.5x6Cx16 ga	3976	4672	5368	6063	6759	7455	8150

4000 psi LW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
1.5x6Cx22 ga	2500	2952	3404	3856	4308	4760	5212
1.5x6Cx20 ga	2550	3002	3454	3906	4358	4810	5262
1.5x6Cx18 ga	2642	3094	3546	3998	4450	4902	5354
1.5x6Cx16 ga	2741	3192	3644	4096	4548	5000	5452

Table 4.2
1.5x6 Inverted Composite Deck and 1.5x6 Non-Composite Deck Diaphragm (all F_y)

(Narrow Flange of Deck Up)

Shear Stiffness

3000 psi NW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
1.5x6Fx22 ga	3839	4442	5044	5647	6249	6852	7454
1.5x6Fx20 ga	3889	4492	5094	5697	6299	6902	7504
1.5x6Fx18 ga	3981	4584	5186	5789	6391	6994	7596
1.5x6Fx16 ga	4080	4682	5285	5887	6490	7092	7695

3000 psi LW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
1.5x6Fx22 ga	2578	2970	3361	3752	4144	4535	4926
1.5x6Fx20 ga	2629	3020	3411	3803	4194	4585	4977
1.5x6Fx18 ga	2722	3113	3504	3896	4287	4678	5070
1.5x6Fx16 ga	2821	3212	3604	3995	4386	4778	5169

4000 psi NW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
1.5x6Fx22 ga	4403	5099	5795	6491	7186	7882	8578
1.5x6Fx20 ga	4455	5150	5846	6542	7238	7933	8629
1.5x6Fx18 ga	4549	5245	5941	6636	7332	8028	8723
1.5x6Fx16 ga	4650	5346	6041	6737	7433	8129	8824

4000 psi LW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
1.5x6Fx22 ga	2938	3390	3842	4294	4746	5197	5649
1.5x6Fx20 ga	2988	3440	3892	4344	4796	5247	5699
1.5x6Fx18 ga	3080	3532	3984	4436	4888	5339	5791
1.5x6Fx16 ga	3178	3630	4082	4534	4986	5438	5890

Table 4.3
2x12 Composite Deck and 2x12 Non-Composite Deck Diaphragm (all F_y)

Shear Stiffness

3000 psi NW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
2x12x22 ga	3875	4477	5080	5682	6285	6887	7490
2x12x20 ga	3930	4533	5135	5738	6340	6943	7545
2x12x18 ga	4033	4635	5238	5840	6443	7045	7648
2x12x16 ga	4142	4744	5347	5949	6552	7154	7757

3000 psi LW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
2x12x22 ga	2611	3002	3393	3785	4176	4567	4959
2x12x20 ga	2667	3058	3449	3841	4232	4623	5015
2x12x18 ga	2770	3161	3553	3944	4335	4727	5118
2x12x16 ga	2880	3272	3663	4054	4446	4837	5228

4000 psi NW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
2x12x22 ga	4441	5137	5832	6528	7224	7919	8615
2x12x20 ga	4498	5194	5889	6585	7281	7976	8672
2x12x18 ga	4603	5299	5994	6690	7386	8081	8777
2x12x16 ga	4715	5411	6106	6802	7498	8193	8889

4000 psi LW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
2x12x22 ga	2971	3423	3875	4327	4779	5230	5682
2x12x20 ga	3027	3478	3930	4382	4834	5286	5738
2x12x18 ga	3129	3581	4033	4484	4936	5388	5840
2x12x16 ga	3238	3690	4142	4594	5046	5497	5949

Table 4.4
3x12 Composite Deck and 3x12 Non-Composite Deck Diaphragm (all F_y)

Shear Stiffness

3000 psi NW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3.25	4.25	4.5	5.25	6
3x12x22 ga	4453	5055	5959	7164	7465	8369	9273
3x12x20 ga	4503	5105	6009	7214	7515	8419	9323
3x12x18 ga	4595	5198	6102	7307	7608	8512	9415
3x12x16 ga	4694	5297	6200	7405	7707	8610	9514

3000 psi LW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3.25	4.25	4.5	5.25	6
3x12x22 ga	2977	3368	3955	4738	4934	5521	6108
3x12x20 ga	3028	3419	4006	4789	4984	5571	6158
3x12x18 ga	3121	3512	4099	4882	5078	5665	6252
3x12x16 ga	3221	3612	4199	4982	5178	5765	6352

4000 psi NW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3.25	4.25	4.5	5.25	6
3x12x22 ga	5111	5807	6851	8242	8590	9633	10677
3x12x20 ga	5163	5859	6902	8293	8641	9685	10728
3x12x18 ga	5258	5953	6997	8388	8736	9780	10823
3x12x16 ga	5359	6055	7098	8490	8838	9881	10925

4000 psi LW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3.25	4.25	4.5	5.25	6
3x12x22 ga	3398	3850	4528	5432	5658	6335	7013
3x12x20 ga	3448	3900	4578	5482	5708	6386	7063
3x12x18 ga	3541	3993	4671	5574	5800	6478	7156
3x12x16 ga	3640	4092	4769	5673	5899	6577	7255

Table 4.5
9/16 x 2-1/2 Form Deck Diaphragm (all F_y)

Shear Stiffness

3000 psi NW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
9/16x2.5x26 ga	2899	3502	4104	4707	5309	5912	6514
9/16x2.5x24 ga	2949	3551	4154	4756	5359	5961	6564
9/16x2.5x22 ga	2996	3599	4201	4804	5406	6009	6611

3000 psi LW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
9/16x2.5x26 ga	1937	2329	2720	3111	3503	3894	4285
9/16x2.5x24 ga	1987	2379	2770	3161	3553	3944	4335
9/16x2.5x22 ga	2036	2427	2818	3210	3601	3992	4384

4000 psi NW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
9/16x2.5x26 ga	3328	4024	4720	5415	6111	6807	7503
9/16x2.5x24 ga	3379	4075	4771	5466	6162	6858	7553
9/16x2.5x22 ga	3428	4124	4820	5515	6211	6907	7602

4000 psi LW	Concrete Cover (inches)						
G' (k/in)	2	2.5	3	3.5	4	4.5	5
9/16x2.5x26 ga	2212	2664	3116	3567	4019	4471	4923
9/16x2.5x24 ga	2261	2713	3165	3617	4069	4521	4973
9/16x2.5x22 ga	2309	2761	3213	3665	4117	4569	5020