General Stiffness Equations

Bare Deck:

$$G' = \frac{K_2}{K_4 + \frac{0.3D_{xx}}{L_v} + 3K_1L_v}$$

Filled Deck:

$$G' = \frac{K_2}{K_4 + 3K_1L_v} + K_3$$

For US units, L_v is purlin or joist spacing in feet.

For SI units, L_v is purlin or joist spacing in meters.

D_{xx}: select the appropriate value of D_{xx} from Table 9-6, ft.

K_1: see load tables for the value, ft^{-1}

(To convert to m^{-1} multiply K_1 from load table by 0.305)

Table 9-1 Value of K_2

Gage	Thickness		K_2	
	in.	mm.	kip/in.	kN/mm
26	0.0179	0.45	528	91
24	0.0239	0.60	705	122
22	0.0295	0.75	870	152
20	0.0358	0.91	1056	185
18	0.0474	1.20	1398	244
16	0.0598	1.52	1764	309

Table 9-2 Value of K_3

Concrete Type	f'_c		K_3	
	psi	MPa	kip/in.	kN/mm
Insulating concrete	125	0.86	260	46
Structural concrete	3000	21	2380	430

9/16" x 2 1/2" x 22 Ga.
Design thickness = 0.0295 in.
Support fastening: #12 screws
Side-lap fastening: #10 screws
Minimum support thickness: 0.074 in.

F_u= 62 ksi
F_y= 60 ksi

Bare Deck Diaphragm			Filled Diaphragm		
Loading	ϕ_{df}	Ω_{df}	Loading	ϕ_{df}	Ω_{df}
Seismic	0.65	2.50	Seismic	0.50	3.25
Wind	0.70	2.35	Wind	0.50	3.25
Other	0.65	2.50	Other	0.50	3.25

Type of Fill	Fastener Layout	Side-lap Conn/Span	Nominal Shear Strength, S_{nf}, plf[1,2] Span, ft. 2	2.5	3	3.5	4	4.5	5	5.5	6	K_1 1/ft
No Fill (Bare Deck)	35/8	0	1100	910	770	670	590	525	475			0.494
		1	1295	1090	930	815	720	645	585	535	490	0.385
		2	1465	1250	1080	950	845	760	690	630	580	0.315
		3	1615	1395	1215	1075	960	870	790	725	665	0.267
		4	1735	1520	1340	1195	1075	970	885	815	750	0.231
	35/7	0	1055	880	750	655	580	520	470			0.527
		1	1230	1045	905	790	705	630	575	525	485	0.404
		2	1380	1190	1040	920	820	740	675	620	570	0.328
		3	1500	1320	1165	1040	935	845	770	710	655	0.276
		4	1605	1425	1275	1145	1035	940	865	795	735	0.238
	35/5	0	790	670	575	505	445	400	365			0.719
		1	940	815	715	630	565	510	465	425	390	0.508
		2	1050	930	830	745	670	610	560	515	475	0.393
		3	1135	1025	925	840	765	700	645	595	555	0.321
		4	1195	1100	1005	925	850	780	725	675	625	0.271
	30/7	0	1015	835	705	610	540	480	430			0.659
		1	1220	1020	870	760	670	600	540	495	450	0.497
		2	1405	1190	1025	895	795	715	650	590	545	0.399
		3	1560	1340	1165	1030	915	825	750	685	635	0.334
		4	1690	1475	1295	1150	1030	930	850	780	720	0.286
	30/5	0	785	655	555	485	430	380	345			0.878
		1	965	820	710	625	555	495	450	410	380	0.613
		2	1110	965	845	750	670	605	550	505	465	0.470
		3	1220	1080	960	860	775	705	645	595	550	0.382
		4	1305	1175	1060	960	875	800	735	680	630	0.321
	30/4	0	670	565	485	425	375	335	305			0.988
		1	820	715	625	555	495	445	405	370	345	0.664
		2	930	830	740	665	600	545	500	460	425	0.500
		3	1010	915	835	760	690	635	585	540	505	0.401
		4	1065	985	910	835	770	715	660	615	575	0.335
2-1/2" NW Conc. (Above Deck)	30/4	0	5695	5535	5430	5355	5295	5255	5220			0.988
		1	5980	5765	5620	5520	5440	5380	5335	5295	5260	0.664
		2	6270	5995	5810	5680	5585	5510	5450	5400	5355	0.500
		3	6535	6225	6005	5845	5730	5635	5565	5505	5455	0.401
		4	6535	6455	6195	6010	5870	5765	5680	5610	5550	0.335
2-1/2" LW Conc. (Above Deck)	30/4	0	4250	4095	3990	3915	3855	3815	3780			0.988
		1	4540	4325	4180	4080	4000	3940	3895	3855	3820	0.664
		2	4615	4555	4370	4240	4145	4070	4010	3960	3915	0.500
		3	4615	4615	4565	4405	4290	4195	4125	4065	4015	0.401
		4	4615	4615	4615	4570	4430	4325	4240	4165	4110	0.335
Type I Insul. Fill	30/4	0	1235	1075	970	895	840	795	760			0.988
		1	1525	1305	1165	1060	985	925	875	835	805	0.664
		2	1810	1535	1355	1225	1130	1050	990	940	900	0.500
		3	2100	1765	1545	1390	1270	1180	1105	1045	995	0.401
		4	2385	1995	1740	1555	1415	1305	1220	1150	1090	0.335

[1] Nominal shear strength of bare deck shown above may be limited by shear buckling. See Table below.

	ϕ_{db}	Ω_{db}
Buckling	0.80	2.00

Deck Profile	I in⁴/ft	Nominal Shear Due to Panel Buckling, S_{nb}, plf[2] Span, ft 2	2.5	3	3.5	4	4.5	5	5.5	6
9/16	0.021	7350	4705	3265	2400	1835	1450	1175	970	815

[2] Design Strengths:
ASD Required strength (Service Applied Load) <= Min {S_{nf}/Ω_{df}, S_{nb}/Ω_{db}}
LRFD Required strength (Factored Applied Load) <= Min {$\phi_{df}S_{nf}$, $\phi_{db}S_{nb}$}

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Table 9-3 Value of K_4

Deck Profile	K_4
1.5 NR roof deck	3.62
1.5 IR roof deck	3.45
1.5 WR roof deck	3.55
3 DR roof deck	4.18
9/16" x 2.5" form deck	3.20
1.5" x 6" composite deck	3.55
2" x 12" composite deck	3.14
3" x 12" composite deck	3.54

Table 9-4 Default Deck Thickness and Strength

Deck Gage / Deck Thickness, in. / F_y, ksi / F_u, ksi										
Form Deck			Roof Deck				Composite Deck			
26	24	22	22	20	18	16	22	20	18	16
0.0179	0.0239	0.0295	0.0295	0.0358	0.0474	0.0598	0.0295	0.0358	0.0474	0.0598
60	60	60	33	33	33	33	40	40	40	40
62	62	62	45	45	45	45	52	52	52	52

Table 9-5 Deck Moment of Inertia

Deck Type	Deck Profile	Moment of Inertia (in^4/ft) / Deck Gage						
		26	24	22	22	20	18	16
1.5" Roof Deck	WR	--	--	--	0.173	0.210	0.279	0.353
	IR				0.125	0.151	0.201	0.254
	NR				0.114	0.138	0.184	0.233
3" Roof Deck	DR	--	--	--	0.808	0.989	1.323	1.672
9/16" Form Deck	2.5" Pitch	0.013	0.017	0.021	--	--	--	--
Comp. Deck	1.5" x 6"	--	--	--	0.173	0.210	0.279	0.353
	2" x 12"				0.303	0.377	0.500	0.632
	3" x 12"				0.755	0.939	1.266	1.601

Table 9-6 Deck Warping Factors

Typical Fastener Patterns													
Deck Type	Deck Profile	Fastener Pattern	α	$\Sigma(x/w)^2$	N 1/ft	s/d	A	Warping Constant, D_{xx}, ft					
								D26	D24	D22	D20	D18	D16
1.5" Roof Deck	WR	36/9	3.000	1.278	2.333	1.365	2	--	--	103	77	51	36
	IR					1.325				186	139	92	65
	NR					1.393				318	238	156	110
	WR	36/7	2.000	0.778	2.000	1.365	1	--	--	103	77	51	36
	IR					1.325				186	139	92	65
	NR					1.393				318	238	156	110
	WR	36/5	1.667	0.722	1.333	1.365	1	--	--	607	454	298	210
	IR					1.325				637	477	313	221
	NR					1.393				857	641	421	297
	WR	36/4	1.333	0.556	1.000	1.365	1	--	--	860	643	422	298
	IR					1.325				863	645	424	299
	NR					1.393				1126	842	553	390
	WR	30/6	1.800	0.700	2.000	1.365	1	--	--	103	77	51	36
	IR					1.325				186	139	92	65
	NR					1.393				318	238	156	110
	WR	30/4	1.600	0.680	1.200	1.365	1	--	--	1102	824	541	382
	IR					1.325				1090	815	535	377
	NR					1.393				1410	1054	692	488
3" Roof Deck	DR	24/4	1.333	0.556	1.500	1.608	1	--	--	603	451	296	209
9/16" Form Deck	2.5" Pitch	35/8	2.286	0.857	2.400	1.232	1	97	63	46	--	--	--
		35/7	2.143	0.847	2.057			143	93	68			
		35/6	1.714	0.674	1.714			190	124	90			
		35/5	1.571	0.663	1.371			277	181	131			
		30/7	2.000	0.778	2.400	1.232	1	97	63	46	--	--	--
		30/5	1.500	0.625	1.600			205	134	97			
		30/4	1.333	0.556	1.200			331	216	156			
1.5" Comp. Deck	6" Pitch	36/4	1.333	0.556	1.000	1.365	1	--	--	860	643	422	298
2" Comp. Deck	12" Pitch	36/4	1.333	0.556	1.000	1.206	1	--	--	139	104	68	48
		24/3	1.000	0.500	1.000	1.206							
3" Comp. Deck	12" Pitch	36/4	1.333	0.556	1.000	1.360	1	--	--	271	203	133	94
		24/3	1.000	0.500	1.000	1.360							