NELSON STUD WELDING

PROPERTIES GUIDE

Physical Properties of Shear Connectors

Diameter	A_s Nominal Area mm²	$A_s f_y$ Yield Kg (min)	$A_s f_s$ Tensile Kg (min)
M13	126.7	4,445	5,334
M16	198.0	6,963	8,355
M19	285.0	10,024	12,029
M22	388.0	13,630	16,356

A_s Area of stud shank

f_s Ultimate strength (tensile):

M13, M16, M19 and M22	420 Mpa min
f_y Yield strength	345 Mpa min
Elongation	20%
Reduction Area	50% min

Cold Finished low carbon steel

C	0.23 max
Mn	0.90 max
P	0.04 max
S	0.05 max

Welded Headed Stud in Solid Slabs

NZS 2327:2017, Clause 3.6.2.3

Design Shear Capacity (kN) – welded headed stud in solid slabs (Φ = 0.8)[1]

Diameter	Length after weld (mm)[2]	C25	C30	C35	C40
M16[3]	63	47.92	54.90	59.46	59.46
	100	47.92	54.90	59.46	59.46
M19[4]	80	68.43	78.39	84.91	84.91
	92	68.43	78.39	84.91	84.91
	100	68.43	78.39	84.91	84.91
	105	68.43	78.39	84.91	84.91
	125	68.43	78.39	84.91	84.91
	150	68.43	78.39	84.91	84.91
	175	68.43	78.39	84.91	84.91
	200	68.43	78.39	84.91	84.91
M22[5]	100	93.42	107.02	115.92	115.92
	175	93.42	107.02	115.92	115.92
	200	93.42	107.02	115.92	115.92

NOTES:

1. Refer to NZS 2327:2017, Clause 3.6.2 and 3.6.4 for detailing of shear connectors
2. Stock anchor size - satisfied the conditions in the standard only
3. Minimum 280mm concrete edge distance for M16 stud
4. Minimum 330mm concrete edge distance for M19 stud
5. Minimum 390mm concrete edge distance for M22 stud
6. For concrete edge distance less than the above requirement, it is recommended to use the Cast-in anchor table for conservative design
7. Normal weight concrete
8. Check the tension capacity (if applicable) according to NZS 2327:2007, Clause 3.6.2.5

$$\left[\frac{N_u^*}{0.85P_{Rd}}\right]^{5/3} + \left[\frac{V_L^*}{P_{Rd}}\right]^{5/3} \leq 1.0$$

Welded Headed Stud in Composite Slabs

NZS 2327:2017, Clause 3.6.2.4

Design Shear Capacity (kN) – welded headed stud in solid slabs (Φ = 0.8)[1]
Sheeting with ribs parallel to the supporting beams

Diameter	Length after weld (mm)[2]	Tray-dec type	C25	C30	C35	C40
M16[3]	100	TD60	45.20	51.78	56.09	56.09
		TD300	47.92	54.90	59.46	59.46
M19[4]	100	TD60	64.55	73.94	80.09	80.09
		TD300	68.43	78.39	84.91	84.91
	105	TD60	68.43	78.39	84.91	84.91
		TD300	68.43	78.39	84.91	84.91
	125	TD60	68.43	78.39	84.91	84.91
		TD80	41.30	47.31	51.25	51.25
		TD300	68.43	78.39	84.91	84.91
	150	TD60	68.43	78.39	84.91	84.91
		TD80	64.77	74.19	80.36	80.36
		TD300	68.43	78.39	84.91	84.91
	175 or 200	TD60	68.43	78.39	84.91	84.91
		TD80	68.43	78.39	84.91	84.91
		TD300	68.43	78.39	84.91	84.91
M22[5]	175 or 200	TD60	93.42	107.02	115.92	115.92
		TD80	93.42	107.02	115.92	115.92
		TD300	93.42	107.02	115.92	115.92

NOTES:

1. Refer to NZS 2327:2017, Clause 3.6.2 and 3.6.4 for detailing of shear connectors
2. Stock anchor size - satisfied the conditions in the standard only
3. Minimum 280mm concrete edge distance for M16 stud
4. Minimum 330mm concrete edge distance for M19 stud
5. Minimum 390mm concrete edge distance for M22 stud
6. For concrete edge distance less than the above requirement, it is recommended to use the Cast-in anchor table for conservative design
7. Normal weight concrete
8. Check the tension capacity (if applicable) according to NZS 2327:2007, Clause 3.6.2.5

$$\left[\frac{N_u^*}{0.85P_{Rd}}\right]^{5/3} + \left[\frac{V_L^*}{P_{Rd}}\right]^{5/3} \leq 1.0$$

Welded Headed Stud in Composite Slabs

NZS 2327:2017, Clause 3.6.2.4

Design Shear Capacity (kN) – welded headed stud in solid slabs (Φ = 0.8)[1]
Sheeting with ribs transverse to the supporting beams, 1 stud connector per rib

Diameter	Length after weld (mm)[2]	Tray-dec type	C25	C30	C35	C40
M16[3]	100	TD60	40.73	46.66	50.54	50.54
		TD300	47.92	54.90	59.46	59.46
M19[4]	100 or 105	TD60	58.16	66.63	72.17	72.17
		TD300	68.43	78.39	84.91	84.91
	125	TD60	58.16	66.63	72.17	72.17
		TD80	48.18	55.20	59.79	59.79
		TD300	68.43	78.39	84.91	84.91
	150	TD60	58.16	66.63	72.17	72.17
		TD80 - 0.95t	58.16	66.63	72.17	72.17
		TD80 - 1.2t	68.43	78.39	84.91	84.91
		TD300	68.43	78.39	84.91	84.91
	175	TD60	58.16	66.63	72.17	72.17
		TD80 - 0.95t	58.16	66.63	72.17	72.17
		TD80 - 1.2t	68.43	78.39	84.91	84.91
		TD300	68.43	78.39	84.91	84.91
	200	TD60	58.16	66.63	72.17	72.17
		TD80 - 0.95t	58.16	66.63	72.17	72.17
		TD80 - 1.2t	68.43	78.39	84.91	84.91
		TD300	68.43	78.39	84.91	84.91

NOTES:

1. Refer to NZS 2327:2017, Clause 3.6.2 and 3.6.4 for detailing of shear connectors
2. Stock anchor size - satisfied the conditions in the standard only
3. Minimum 280mm concrete edge distance for M16 stud
4. Minimum 330mm concrete edge distance for M19 stud
5. Normal weight concrete
6. Check the tension capacity (if applicable) according to NZS 2327:2007, Clause 3.6.2.5

$$\left[\frac{N_u^*}{0.85P_{Rd}}\right]^{5/3} + \left[\frac{V_L^*}{P_{Rd}}\right]^{5/3} \leq 1.0$$

Welded Headed Stud in Composite Slabs

NZS 2327:2017, Clause 3.6.2.4

Design Shear Capacity (kN) – welded headed stud in solid slabs (Φ = 0.8)[1]
Sheeting with ribs transverse to the supporting beams, 2 or more stud connectors per rib

Diameter	Length after weld (mm)[2]	Tray-dec type	C25	C30	C35	C40
M16[3]	100	TD60	33.54	38.43	41.62	41.62
		TD300	47.92	54.90	59.46	59.46
M19[4]	100 or 105	TD60	47.90	54.87	59.44	59.44
		TD300	68.43	78.39	84.91	84.91
	125	TD60	47.90	54.87	59.44	59.44
		TD80	34.07	39.03	42.28	42.28
		TD300	68.43	78.39	84.91	84.91
	150	TD60	47.90	54.87	59.44	59.44
		TD80 - 0.95t	47.90	54.87	59.44	59.44
		TD80 - 1.2t	53.43	61.21	66.30	66.30
		TD300	68.43	78.39	84.91	84.91
	175	TD60	47.90	54.87	59.44	59.44
		TD80 - 0.95t	47.90	54.87	59.44	59.44
		TD80 - 1.2t	54.74	78.39	67.93	67.93
		TD300	68.43	78.39	84.91	84.91
	200	TD60	47.90	54.87	59.44	59.44
		TD80 - 0.95t	47.90	54.87	59.44	59.44
		TD80 - 1.2t	54.74	62.71	67.93	67.93
		TD300	68.43	78.39	84.91	84.91

NOTES:

1. Refer to NZS 2327:2017, Clause 3.6.2 and 3.6.4 for detailing of shear connectors
2. Stock anchor size - satisfied the conditions in the standard only
3. Minimum 280mm concrete edge distance for M16 stud
4. Minimum 330mm concrete edge distance for M19 stud
5. Normal weight concrete
6. Check the tension capacity (if applicable) according to NZS 2327:2007, Clause 3.6.2.5

$$\left[\frac{N_u^*}{0.85P_{Rd}}\right]^{5/3} + \left[\frac{V_L^*}{P_{Rd}}\right]^{5/3} \leq 1.0$$

Cast-in Anchor

NZS 3101:2006, Clause 17.5.8

Design Shear Capacity[1] (kN) – Assume C_1[2-4] = 150mm (Φ = 0.65)[5]

Diameter	Length after weld (mm)[6]	Factored steel shear strength	C25	C30	C35	C40
M13	50	34.59	16.79	18.39	19.87	21.24
	100	34.59	19.29	21.13	22.82	24.40
	150	34.59	19.35	21.20	22.90	24.48
M16	63	54.05	18.81	20.61	22.26	23.80
	100	54.05	20.63	22.60	24.41	26.10
M19	75	77.81	20.55	22.51	24.31	25.99
	80	77.81	20.82	22.80	24.63	26.33
	92	77.81	21.41	23.45	25.33	27.08
	100	77.81	21.77	23.84	25.76	27.53
	105	77.81	21.98	24.08	26.01	27.80
	125	77.81	22.69	24.85	26.85	28.70
	150	77.81	22.69	24.85	26.85	28.70
	175	77.81	22.69	24.85	26.85	28.70
	200	77.81	22.69	24.85	26.85	28.70
M22	100	105.92	22.69	24.85	26.85	28.70
	175	105.92	22.69	24.85	26.85	28.70
	200	105.92	22.69	24.85	26.85	28.70

NOTES:

1. Pry-out strength not considered
2. C_1: Distance from the centre of resistance of an anchor to the edge of the concrete in the direction which load is applied; For C_1>150mm, a factor of (C_1/150)^1.5 may be multiplied by the concrete breakout strength, and the factored steel shear strength can govern
3. The other direction edge distance C_2 is assumed to be at least 1.5C_1
4. The thickness of concrete h is assumed to be at least 1.5C_1; For h<1.5C_1, a factor of h/1.5C_1 may be multiplied by the concrete breakout strength
5. Refer to NZS 3101:2006, Clause 17.5.8 for detailing of the cast-in headed stud
6. Stock anchor size satisfied the conditions in the standard
7. Normal weight concrete
8. Spacing 4 times diameter between studs in plane perpendicular to the shear force and 6 times diameter in the direction of the shear force is generally adequate to develop full stud capacity
9. Check the combined tension and shear capacity according to NZS 3101:2006, Clause 17.5.6.6

$$\frac{N^*}{\phi N_n} + \frac{V^*}{\phi V_n} \leq 1.2$$

Cast-in Anchor

NZS 3101:2006, Clause 17.5.7

Design Tension Capacity[1] (kN) (Φ = 0.75 for steel, 0.65 for concrete)[2]

Diameter	Length after weld (mm)[3]	Factored steel shear strength	C25	C30	C35	C40
M13	50	39.91	11.49	12.59	13.60	14.53
	100	39.91	32.50	35.60	38.45	39.91
	150	39.91	32.50	35.60	38.45	39.91
M16	63	62.37	16.25	17.80	19.23	20.56
	100	62.37	32.50	35.60	38.45	41.11
M19	75	89.78	21.11	23.12	24.98	26.70
	80	89.78	23.76	25.47	27.52	29.42
	92	89.78	28.68	31.42	33.93	36.28
	100	89.78	32.50	35.60	38.45	41.11
	105	89.78	34.97	38.31	41.37	44.23
	125	89.78	45.42	49.76	53.74	57.45
	150	89.78	59.71	65.40	70.65	75.52
	175	89.78	75.24	82.42	89.02	89.78
	200	89.78	89.78	89.78	89.78	89.78
M22	100	122.22	32.50	35.60	38.45	41.11
	175	122.22	75.24	82.42	89.02	95.17
	200	122.22	91.92	100.70	108.77	116.28

NOTES:

1. Pullout and side face blowout strength not considered
2. Refer to NZS 3101:2006, Clause 17.5.8 for detailing of the cast-in headed stud
3. Stock anchor size satisfied the conditions in the standard
4. Normal weight concrete
5. Assume edge distance as at least 1.5 times effective anchor embedment depth
6. Assume adequate spacing for full capacity development
7. Check the combined tension and shear capacity according to NZS 3101:2006, Clause 17.5.6.6

$$\frac{N^*}{\phi N_n} + \frac{V^*}{\phi V_n} \leq 1.2$$