GEOSTRUCTURAL SOLUTIONS

NUCOR®

SKYLINE

NUCOR SKYLINE, YOUR TRUE PROJECT PARTNER

Offering the broadest range of steel foundation and geostructural products in the industry

Nation-wide manufacturing, fabrication, coating, and engineering expertise

Part of the Nucor family, North America's most diversified steel and steel products company

We are a premier steel foundation manufacturer and supplier, serving the North American market. Our flagship products include an unparalleled assortment of:

- H-Piles
- Pipe Piles
- Micropiles
- Solar Piles
- Piling Accessories
- Steel Sheet Piles
- Threaded Bars
- Combined Wall Systems
- Wide Flange and other Structural Sections

Nucor Skyline's knowledgeable engineering team works with owners, engineers, and contractors long before ground is broken. To ensure seamless project coordination and completion, our engineers propose solutions throughout all aspects of design, material selection, installation, and construction sequencing. Nucor Skyline's engineering support is extended even further to include provision of onsite assistance after a project has started. Our relationships extend beyond sales – we are your true project partner.

GEOSTRUCTURAL SOLUTIONS FROM NUCOR SKYLINE

As a premier steel foundation supplier and manufacturer, Nucor Skyline is proud to offer its comprehensive line of geostructural products to complement our core piling business.

At Nucor Skyline, we have a group of geostructural industry specialists dedicated to providing superior service to this growing market. We are able to support the needs of our customers with manufacturing facilities from coast to coast. Our production teammates can do it all - from large cages, domestic, fully-traceable micropile casing, to bar and strand ground anchors.

Nucor Skyline is the trusted advisor in the specialty products described in this brochure and we are dedicated to partnering with our customers to deliver high quality products and cost effective solutions.

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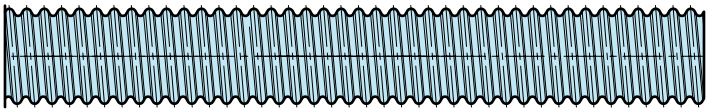
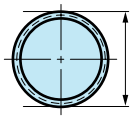
REINFORCING STEEL GRADE / COLD ROLLED

FULLY THREADED BAR





Grade 80 ksi Yield Strength / 100 ksi Ultimate Strength									
Bar Designation	**Nominal Diameter** in mm	**Grade**	**Min. Net Area Thru Threads** in^2 mm^2	**Min. Ultimate Strength** kips kN	**Min. Yield Strength** kips kN	**Nominal Weight** lbs/ft kg/m	**Approx. Major Thread Diameter** in mm	**Thread Orientation**	**Max. Length** ft m
#14	1 ¾ 45	80	2.250 1452.0	225.0 1001	180.0 801	7.65 11.4	1.875 47.6	Right Hand	60 18.3
#18	2 ¼ 55	80	4.000 2581.0	400.0 1779	320.0 1423	13.60 20.2	2.438 62.0	Right Hand	60 18.3
#20	2 ½ 64	80	4.910 3168.0	491.0 2184	392.8 1747	16.69 24.8	2.750 70.0	Right Hand	60 18.3
#24	3 76	80	7.070 4561.0	707.0 3145	565.6 2516	24.10 35.9	3.250 82.6	Right Hand	60 18.3
#28	3 ½ 89	80	9.610 6200.0	961.0 4275	768.8 3420	32.70 48.7	3.750 95.3	Right Hand	60 18.3

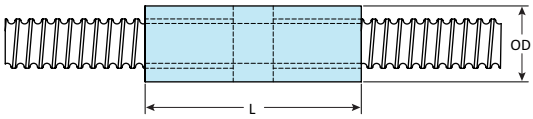
Cold rolled threaded bars conform to the physical and chemical requirements of ASTM A615 Grade 80 ksi "Standard Specification for Deformed Carbon Steel Bars for Concrete Reinforcement".

Contact your sales representative for information on hot dip galvanized and epoxy coated bars.

REINFORCING STEEL GRADE / COLD ROLLED

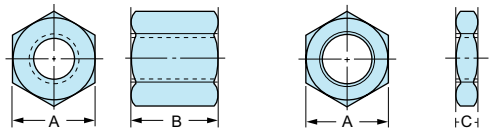
FULLY THREADED BAR

COUPLER



Grade 80 Bar – ASTM A108 / A576			
Bar Designation	OD in mm	L in mm	Weight lbs kg
#14	3.000 76.2	7.875 200.0	10.4 4.7
#18	3.500 88.9	9.125 231.8	13.93 6.32
#20	4.000 101.6	9.500 241.3	19.86 9.01
#24	4.750 120.6	10.750 243.0	31.01 14.07
#28	5.500 139.7	12.000 304.8	46.20 20.96

FULL LOAD HEX NUT AND JAM NUT

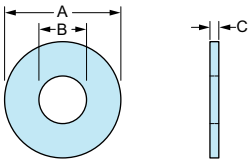


Full Load Hex Nut Jam Nut

Grade 80 Bar – ASTM A108 / A576**					
Bar Designation	A in mm	B in mm	C in mm	Weight lbs / kg Full	 Jam
#14	3.000 76.2	3.250 82.6	0.938 23.8	5.30 2.40	0.9 0.4
#18	3.500 89.0	3.500 89.0	1.000 25.4	5.70 2.60	1.81 0.82
#20	4.000 101.6	4.500 114.3	1.125 28.6	10.00 4.50	2.76 1.25
#24*	4.750 120.6	4.500 114.3	1.500 38.1	12.98 5.89	4.33 1.96
#28*	5.500 139.7	6.000 152.4	1.563 39.7	23.10 10.48	6.02 2.73

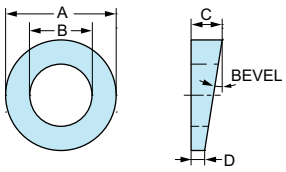
* Round collar nut with flats ** #18 & #20 - ASTM A536.

HARDENED WASHER



Grade 80 Bar – ASTM F436				
Bar Designation	A in mm	B in mm	C in mm	Weight lbs kg
#14	3.750 95.250	2.125 53.975	0.178 4.521	0.380 0.17
#18	4.500 114.300	2.657 67.488	0.240 6.096	0.710 0.32
#20	5.500 139.700	3.157 80.188	0.240 6.096	1.090 0.49
#24	6.000 152.400	3.625 92.075	0.375 9.525	1.910 0.87
#28	7.000 177.800	4.125 104.775	0.375 9.525	2.680 1.22

BEVELED WASHER



Grade 80 Bar – ASTM F436 / A536, 80-55-06 Ductile Cast Iron						
Bar Designation	A in mm	B in mm	C in mm	D in mm	Bevel degrees	Weight lbs kg
#14	4.00 101.60	2.13 54.10	1.29 32.77	0.23 5.84	15	1.94 0.88
#18	4.60 116.84	2.63 66.80	1.18 29.97	0.37 9.40	10	2.32 1.05
#20	5.00 127.00	3.00 76.20	1.31 33.27	0.43 10.92	10	2.83 1.28
#24	8.00 203.20	3.50 88.90	1.75 44.45	0.43 10.92	10	12.58 5.71
#28	8.00 203.20	4.00 101.60	2.25 57.15	0.84 21.34	10	16.54 7.50

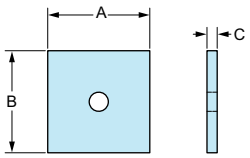
NOTE: Couplers available as "stop type" or "tap through." Tap through couplers require the bars to be torqued against each other at the halfway point in the coupler and fixed with set screws or jam nuts to ensure proper engagement.

† Contact your sales representative for information on hot dip galvanized and epoxy coated hardware (available upon request).

REINFORCING STEEL GRADE / COLD ROLLED

FULLY THREADED BAR

BEARING PLATE*

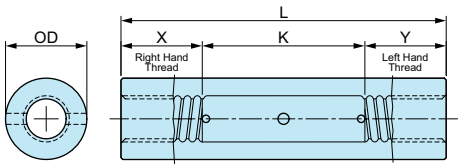


Grade 80 Bar – ASTM A572 (Grade 50 - A588)				
Bar Designation	A in mm	B in mm	C in mm	Weight lbs kg
#14	10 254.00	10 254.00	1 ½ 38.10	41.37 18.76
#18	10 254.00	10 254.00	2 50.80	54.21 24.59
#20	10 254.00	10 254.00	2 ½ 63.50	67.06 30.42
#24	10 254.00	10 254.00	2 ½ 63.50	65.46 29.69
#28	12 304.80	12 304.80	2 ¾ 69.85	104.26 47.29

Bearing plate dimensions reflect typical sizes. Actual design criteria should be used for specific plate sizing.

* Non-inventory items; made to order

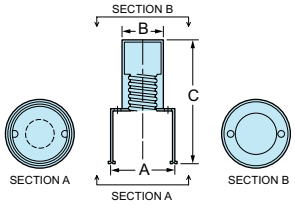
TURNBUCKLE



Bar Designation	OD in mm	L in mm	X in mm	Y in mm	K in mm
#14	3.000 76.2	14.0 355.6	3.25 82.6	3.25 82.6	7.50 190.5
#18	3.500 88.9	16.5 419.1	3.50 88.9	3.50 88.9	9.50 241.3
#20	4.000 101.6	21.0 533.4	4.50 114.3	4.50 114.3	12.0 304.80
#24	4.750 120.7	21.5 546.1	4.75 120.7	4.75 120.7	12.0 304.80
#28	5.500 139.7	24.0 609.6	6.00 152.4	6.00 152.4	12.0 304.80

Note: Only cold rolled threads are suitable for use with turnbuckles. The thread direction on the bars must be opposite to each other in order for the turnbuckle to function.

HDPE PLASTIC NUT CAP*



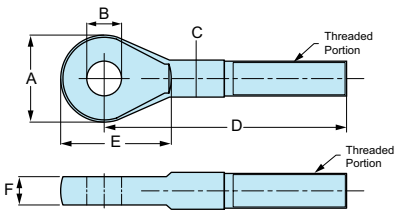
HDPE Plastic Nut Caps for Grade 80 Bars			
Bar Designation	A in mm	B in mm	C in mm
#14 – #24	6.5 165.1	4.25 108.0	10.25 260.4

* "O" ring seal in base of cap.

REINFORCING STEEL GRADE / COLD ROLLED

FULLY THREADED BAR

FORGED EYE

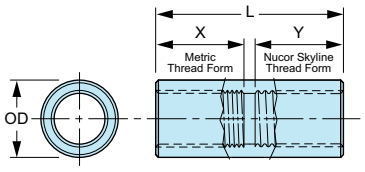


Bar Designation	A in mm	B in mm	C in mm	D in mm	E in mm	F in mm	Weight lb kg
#14 – #18	6.1 155	2.5 63	2.4 60	19.9 505	8.1 207	2.0 50	34.6 15.7
#20 – #24	7.1 180	3.0 76	3.0 76	20.5 520	9.8 248	2.5 63	60.4 27.4
#28	9.2 230	3.5 88	3.5 90	22.2 565	12.3 312	3.0 75	103.0 46.7

Made in Germany. Threads on forged eyes will be metric. Conversion couplers (transitions) available for all Nucor Skyline thread forms.

Contact your Nucor Skyline sales representative for assistance with connection details.

TRANSITIONAL COUPLER FOR FORGED EYE



Bar Designation	OD in mm	L in mm	X in mm	Y in mm	Weight lb kg
M56 – #14	3.50 88.90	9.8 248.92	4.00 101.6	4.57 116.0	18.4 8.4
M56 – #18	3.50 88.90	9.8 248.92	4.00 101.6	4.57 116.0	15.6 7.1
M72 – #20	4.75 120.65	12.0 304.80	5.38 136.5	5.38 136.5	39.2 17.8
M72 – #24	4.75 120.65	12.0 304.80	5.38 136.5	5.38 136.5	34.9 15.8
M85 – #28	5.50 139.70	13.3 337.82	6.00 152.4	6.00 152.4	48.5 22.0

CORROSION PROTECTION

All threaded bars can be supplied with a protective smooth-walled PVC tube. While the standard PVC tube is 0.035 inches thick, other options are available upon request.

The following additional corrosion protection options are available for all threaded bars:

Single Corrosion Protection (SCP)

Double Corrosion Protection (DCP)

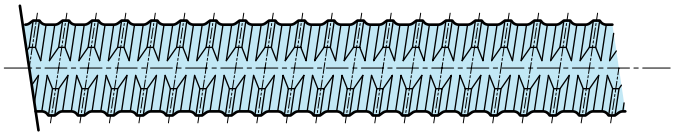
- Encapsulating: Grease or Grout
- Epoxy Coating
- Galvanizing
- Painting
- Plating
- Taping

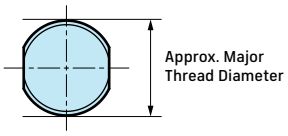
Oversized accessories are provided to accommodate galvanized and coated bars.

Please contact your Nucor Skyline Geostructural Solutions Representative for recommendations on the system that will best suit your requirements.

REINFORCING STEEL GRADE / HOT ROLLED

FULLY THREADED BAR





Grade 80 ksi Yield Strength / 100 ksi Ultimate Strength									
Bar Designation	**Grade**	**Nominal Diameter** in mm	**Min. Net Area Thru Threads** in² mm²	**Min. Ultimate Strength** kips kN	**Min. Yield Strength** kips kN	**Nominal Weight** lbs/ft kg/m	**Approx. Major Thread Diameter** in mm	**Thread Orientation**	**Max. Length** ft m
#6	80	¾ 20	0.44 284	44 196	35.2 157	1.5 2.2	0.86 21.8	Left Hand	60 18.3
#7	80	⅞ 22	0.60 387	60 267	48.0 214	2.0 3.0	0.99 25.1	Left Hand	60 18.3
#8	80	1 25	0.79 510	79 351	63.2 281	2.7 4.0	1.12 28.4	Left Hand	60 18.3
#9	80	1 ⅛ 28	1.00 645	100 445	80.0 356	3.4 5.1	1.26 32	Left Hand	60 18.3
#10	80	1 ¼ 32	1.27 819	127 565	101.6 452	4.3 6.4	1.43 36.3	Left Hand	60 18.3
#11	80	1 ⅜ 35	1.56 1006	156 694	124.8 555	5.3 7.9	1.61 40.9	Left Hand	60 18.3
#14	80	1 ¾ 45	2.25 1452	225 1001	180.0 801	7.7 11.4	1.86 47.2	Right Hand	60 18.3
#18	80	2 ¼ 55	4.00 2581	400 1779	320.0 1423	14.7 21.9	2.50 63.5	Right Hand	60 18.3
#20	80	2 ½ 64	4.91 3168	491 2184	392.8 1747	17.7 26.3	2.70 68.6	Left Hand	60 18.3

Hot rolled threaded bars conform to the physical and chemical requirements of ASTM A615 Grade 80 ksi "Standard Specification for Deformed Carbon Steel Bars for Concrete Reinforcement".

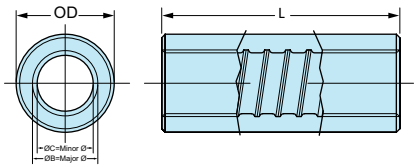
Grade 100 ksi Yield Strength / 115 ksi Ultimate Strength									
Bar Designation	**Grade**	**Nominal Diameter** in mm	**Min. Net Area Thru Threads** in² mm²	**Min. Ultimate Strength** kips kN	**Min. Yield Strength** kips kN	**Nominal Weight** lbs/ft kg/m	**Approx. Major Thread Diameter** in mm	**Thread Orientation**	**Max. Length** ft m
#11	100	1 ⅜ 35	1.56 1006	179.4 798	156.0 694	5.3 7.9	1.61 40.9	Left Hand	60 18.3
#14	100	1 ¾ 45	2.25 1452	258.6 1150	225.0 1001	7.7 11.4	1.86 47.2	Right Hand	60 18.3
#18	100	2 ¼ 55	4.00 2581	460.0 2046	400.0 1779	14.7 21.9	2.50 63.5	Right Hand	60 18.3
#20	100	2 ½ 64	4.91 3168	564.7 2512	491.0 2184	17.7 26.3	2.70 68.6	Left Hand	60 18.3

Hot rolled threaded bars conform to the physical and chemical requirements of ASTM A615 Grade 100 ksi "Standard Specification for Deformed Carbon Steel Bars for Concrete Reinforcement".

REINFORCING STEEL GRADE / HOT ROLLED

FULLY THREADED BAR

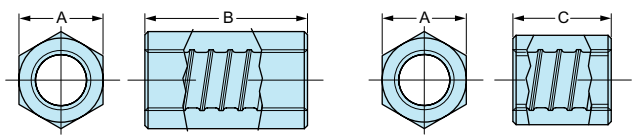
COUPLER



Grade 80/100 – ASTM A576, A108				
Bar Designation	Nominal Diameter in mm	OD in mm	L in mm	Weight lbs kg
#6	¾ 20	1.25 31.75	3.125 79.37	0.62 0.28
#7	⅞ 22	1.50 38.10	3.75 95.25	0.93 0.42
#8	1 25	1.625 41.27	4.00 101.60	1.37 0.62
#9	1 ⅛ 28	1.875 47.62	5.00 127.00	2.31 1.05
#10	1 ¼ 32	2.00 50.80	5.75 146.05	2.77 1.26
#11	1 ⅜ 35	2.25 57.15	6.40 162.56	3.79 1.72
#14	1 ¾ 45	2.88 73.15	7.85 192.53	5.49 2.49
#18*	2 ¼ 55	3.75 95.25	12.00 304.8	21.9 9.93
#20	2 ½ 64	4.25 107.95	10.15 257.81	25.1 11.39

* Length (L) shown is for oversized coupler. Standard length (L) is 9.75 in.

FULL LOAD HEX NUT AND JAM NUT

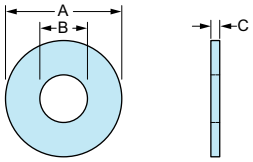


Full Load Hex Nut Jam Nut

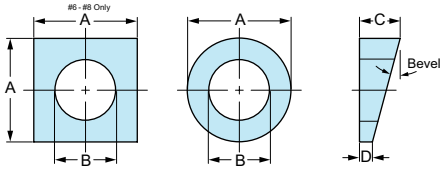
Grade 80/100 – ASTM A576, A108						
Bar Designation	Nominal Diameter in mm	A in mm	B in mm	C in mm	Weight lbs / kg	
					Full	Jam
#6	¾ 20	1.125 28.57	1.45 36.83	0.87 22.10	0.26 0.12	0.16 0.07
#7	⅞ 22	1.375 34.92	1.75 44.45	0.87 22.10	0.43 0.20	0.21 0.10
#8	1 25	1.50 38.10	2.50 63.50	0.87 22.10	0.56 0.25	0.26 0.12
#9	1 ⅛ 28	1.75 44.45	2.25 57.15	0.87 22.10	0.97 0.43	0.37 0.17
#10	1 ¼ 32	2.00 50.80	2.50 63.50	1.00 25.40	1.43 0.65	0.56 0.25
#11	1 ⅜ 35	2.25 57.15	2.75 69.85	1.00 25.40	1.52 0.69	0.53 0.24
#14	1 ¾ 45	2.50 63.50	3.60 91.44	1.00 25.40	3.02 1.37	0.82 0.37
#18**	2 ¼ 55	3.75 95.25	4.88 123.23	1.50 38.1	8.8 3.99	2.71 1.23
#20**	2 ½ 64	4.25 107.95	4.25 257.81	1.50 38.1	12.3 5.58	4.34 1.97

* Round collar nut with flats.

HARDENED WASHER



BEVELED WASHER



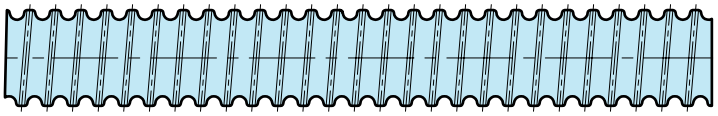
Grade 80/100 – ASTM F436						
Bar Designation	Nominal Diameter in mm	A in mm	B in mm	C in mm	Weight lbs kg	
#6	¾ 20	1.75 44.45	0.938 23.83	0.136 3.45	0.07 0.03	
#7	⅞ 22	2.00 50.80	1.063 27.00	0.136 3.45	0.09 0.04	
#8	1 25	2.25 57.15	1.188 30.18	0.136 3.45	0.11 0.05	
#9	1 ⅛ 28	2.50 63.50	1.375 34.92	0.136 3.45	0.13 0.06	
#10	1 ¼ 32	2.75 69.85	1.531 38.89	0.136 3.45	0.16 0.07	
#11	1 ⅜ 35	3.00 76.20	1.625 41.27	0.136 3.45	0.19 0.09	
#14	1 ¾ 45	3.75 95.25	2.125 53.975	0.178 4.521	0.38 0.17	
#18	2 ¼ 55	6.00 152.40	3.625 92.075	0.375 9.525	1.91 0.87	
#20	2 ½ 64	7.00 177.80	4.125 104.775	0.375 9.525	2.68 1.22	

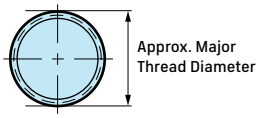
Grade 80/100 – F 436, A536 80-55-06								
Bar Designation	Nominal Diameter in mm	A in mm	B in mm	C in mm	D in mm	Bevel degrees	Weight lbs kg	
#6	¾ 20	1.75 44.45	0.95 24.13	0.78 19.81	0.32 8.13	15	0.32 0.15	
#7	⅞ 22	1.75 44.45	1.14 28.96	0.78 19.81	0.32 8.13	15	0.37 0.17	
#8	1 25	1.75 44.45	1.14 28.96	0.78 19.81	0.23 5.84	15	0.37 0.17	
#9	1 ⅛ 28	2.63 66.80	1.38 31.75	0.93 23.62	0.23 5.84	15	0.64 0.29	
#10	1 ¼ 32	2.75 69.85	1.63 41.40	0.97 24.64	0.23 5.84	15	0.66 0.30	
#11	1 ⅜ 35	3.09 78.49	1.75 44.45	1.06 26.92	0.23 5.84	15	0.93 0.45	
#14	1 ¾ 45	4.00 10.16	2.13 54.10	1.29 32.77	0.23 5.84	15	1.94 0.88	
#18	2 ¼ 55	4.60 116.84	2.63 66.80	1.18 29.97	0.37 9.40	10	12.58 5.71	
#20	2 ½ 64	5.00 127.00	3.00 76.20	1.31 33.27	0.43 10.92	10	16.54 7.50	

NOTE: Couplers available as "stop type" or "tap through." Tap through couplers require the bars to be torqued against each other at the halfway point in the coupler and fixed with set screws or jam nuts to ensure proper engagement.

HIGH STRENGTH STEEL / COLD ROLLED

FULLY THREADED BAR

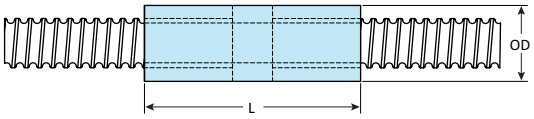




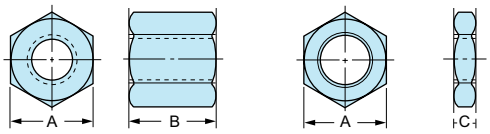
Grade 120 ksi Yield Strength / Grade 150 ksi Ultimate Strength								
Nominal Diameter in mm	Grade	Min. Net Area Thru Threads in² mm²	Min. Ultimate Strength kips kN	Min. Yield Strength kips kN	Nominal Weight lbs/ft kg/m	Approx. Major Thread Diameter in mm	Thread Orientation	Max. Length ft m
1 ¼ **32**	150	1.250 807	188 834	150 667	4.5 6.7	1 ½ 38.1	Left Hand	60 18.3
1 ⅜ **36**	150	1.580 1019	237 1054	190 843	5.7 8.5	1 ⅝ 41.3	Left Hand	60 18.3
1 ¾ **46**	150	2.600 1677	390 1735	320 1423	9.1 13.5	2 50.8	Left Hand	60 18.3
2 ¼ **57**	150	4.000 2581	600 2669	480 2135	13.6 20.2	2 ⁷⁄₁₆ 62.0	Left Hand	60 18.3
2 ½ **65**	150	5.190 3350	778 3457	622 2766	18.3 27.2	2 ¾ 69.9	Left Hand	60 18.3
3 **75**	150	7.060 4554	1059 4702	847 3766	24.0 35.7	3 ¼ 82.6	Left Hand	60 18.3

Nucor Skyline's high strength threaded bar is cold roll threaded, quenched and tempered grade 4140 smooth rounds.

COUPLER



FULL LOAD HEX NUT AND JAM NUT



Full Load Hex Nut Jam Nut

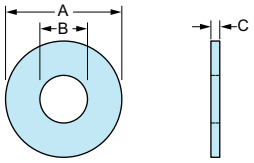
High Strength Threaded Bar – ASTM A108 / A576			
Nominal Diameter in mm	OD in mm	L in mm	Weight lbs kg
1 ¼ **32**	2.125 54.0	5.250 133.4	3.11 1.41
1 ⅜ **36**	2.375 60.3	5.750 146.1	4.22 1.91
1 ¾ **46**	3.00 76.2	8.500 215.9	9.98 4.53
2 ¼ **57**	4.00 101.6	9.000 228.6	21.45 9.73
2 ½ **65**	4.50 114.4	10.000 254.0	28.8 13.1
3 **75**	5.00 127.0	12.000 308.0	41.24 18.71

High Strength Threaded Bar – ASTM A108 / A576					
Nominal Diameter in mm	A in mm	B in mm	C in mm	Weight lbs / kg	
				Full	Jam
1 ¼ **32**	2.250 57.2	2.500 63.5	0.625 15.9	2.07 0.94	0.52 0.24
1 ⅜ **36**	2.500 63.5	2.750 69.9	0.750 19.1	2.78 1.26	0.75 0.34
1 ¾ **46**	3.000 76.2	3.500 88.9	1.250 31.8	4.83 2.19	1.70 0.77
2 ¼ **57**	4.000 101.6	4.250 107.95	1.500 38.10	11.68 5.30	4.09 1.86
2 ½ **65**	4.000 101.6	4.750 120.7	1.750 44.45	10.82 4.91	3.99 1.81
3 **75**	5.000 127.0	6.000 152.4	2.000 50.8	20.62 9.35	5.11 2.32

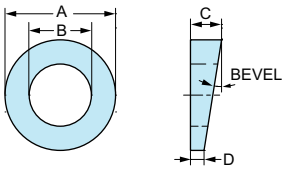
NOTE: Couplers available as "stop type" or "tap through." Tap through couplers require the bars to be torqued against each other at the halfway point in the coupler and fixed with set screws or jam nuts to ensure proper engagement.

FULLY THREADED BAR

HARDENED WASHER



ROUND BEVELED WASHER



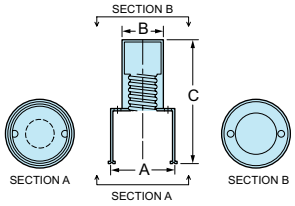
High Strength Threaded Bar – ASTM F436

Nominal Diameter in mm	A in mm	B in mm	C in mm	Weight lbs kg
1 ¼ **32**	2.750 69.850	1.531 38.887	0.136 3.454	0.160 0.07
1 ⅜ **36**	3.250 82.550	1.770 44.958	0.178 4.521	0.300 0.13
1 ¾ **46**	4.000 101.600	2.407 61.138	0.240 6.096	0.550 0.25
2 ¼ **57**	4.500 114.300	2.657 67.488	0.240 6.096	0.710 0.32
2 ½ **65**	5.500 139.700	3.157 80.188	0.240 6.096	1.090 0.49
3 **75**	6.000 152.400	3.625 92.075	0.375 9.525	1.910 0.87

High Strength Threaded Bar – ASTM F436 / A536, 80-55-06 Ductile Cast Iron

Nominal Diameter in mm	A in mm	B in mm	C in mm	D in mm	Bevel degrees	Weight lbs kg
1 ¼ **32**	2.75 69.85	1.63 41.40	0.97 24.64	0.23 5.84	15	0.66 0.30
1 ⅜ **36**	3.09 78.49	1.75 44.45	1.06 26.92	0.23 5.84	15	0.93 0.42
1 ¾ **46**	4.00 101.60	2.13 54.10	1.29 32.77	0.23 5.84	15	1.94 0.88
2 ¼ **57**	4.60 116.84	2.63 66.80	1.18 29.97	0.37 9.40	10	2.32 1.05
2 ½ **65**	5.00 127.00	3.00 76.20	1.31 33.27	0.43 10.92	10	2.83 1.28
3 **75**	8.00 203.20	3.50 88.90	1.75 44.45	0.43 10.92	10	12.58 5.71

HDPE PLASTIC NUT CAP*

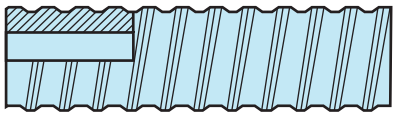


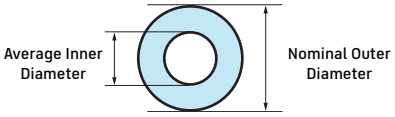
HDPE Plastic Nut Cap for High Strength Bar

Nominal Diameter in mm	A in mm	B in mm	C in mm
1 ¼ – 1 ⅜ **26 – 36**	3.5 88.9	2.25 57.2	6.75 171.5
1 ¾ – 3 **46 – 75**	6.5 165.1	4.25 108.0	10.25 260.4

* "O" ring seal in base of cap.

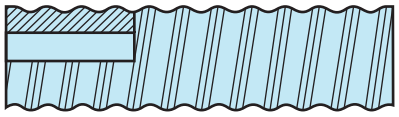
HOLLOW BAR SYSTEMS

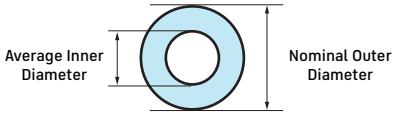




"T" Threaded Hollow Bar Systems

Bar Designation	Nominal Outer Diameter in mm	Average Inner Diameter in mm	Cross Sectional Area in² mm²	Ultimate Load kips kN	Yield Load kips kN	Approx Major Thread Diameter in mm	Nominal Weight lbs/ft kg/m
T76S	2.99 76	1.65 42	3.813 2460	427.1 1900	337.2 1500	2.99 76	16.83 25
T103S	4.06 103	2.05 52	8.06 5200	831.8 3700	600.2 2670	4.06 103	26.93 40



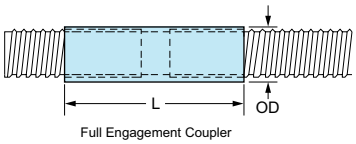


"R" Threaded Hollow Bar

Bar Designation	Nominal Outer Diameter in mm	Average Inner Diameter in mm	Cross Sectional Area in² mm²	Ultimate Load kips kN	Yield Load kips kN	Approx. Major Thread Diameter in mm	Nominal Weight lbs/ft kg/m
R38Nx19mm	1.50 38	0.75 22	1.178 590	112.4 500	90 400	1.5 37	4.04 4.7
R51N	2.01 51	1.26 32	1.457 940	180 800	141.6 630	2.01 49	5.05 7.4

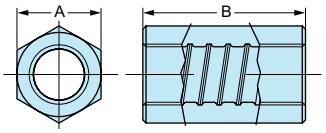
HOLLOW BAR SYSTEMS

COUPLER

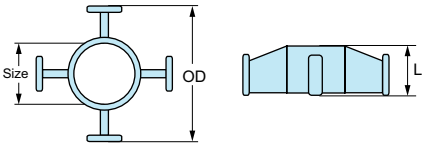


Full Engagement Coupler

HEX NUT



CENTRALIZER



"T" Threaded Hollow Bar Coupler

Bar Designation	OD in mm	L in mm	Weight lbs kg
T76	3.8 97	8.7 220	10.2 4.54
T103	5.2 132	11.5 292	30.5 13.8

"T" Threaded Hollow Bar Hex Nut

Bar Designation	A in mm	B in mm	Weight lbs kg
T76	4.0 102.0	3.1 80.0	6.2 2.81
T103	5.25 133.0	5.125 130	13.0 5.90

Hollow Bar Centralizer

Size	OD in mm	L in mm	Weight lbs kg
T76	5.00 130	1.75 45	2.0 0.89
T103	6.40 165	3.20 80	6.5 2.94

"R" Threaded Hollow Bar Coupler

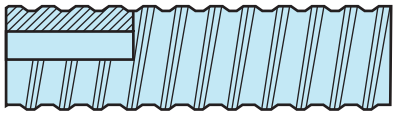
Bar Designation	OD in mm	L in mm	Weight lbs kg
R38Nx19mm	2.01 51	7.09 180	1.1 1.68
R51N	2.5 64	8.0 200	4.2 1.91

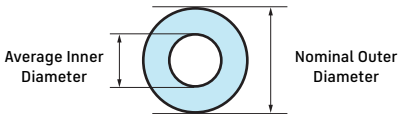
"R" Threaded Hollow Bar Hex Nut

Bar Designation	A in mm	B in mm	Weight lbs kg
R38Nx19mm	2.0 51.0	2.0 60.0	1.3 0.59
R51N	3.0 76.0	2.76 70.0	3.5 1.59

* Dimensions of nuts and couplers are for standard thread sizes. Contact your local Nucor Skyline representative for coated or galvanized bar values.

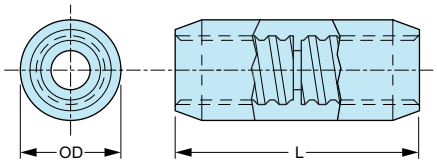
HOLLOW BAR SYSTEMS





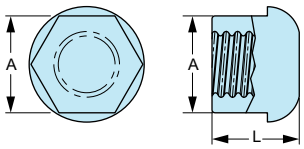
"T" Threaded Hollow Bar Systems*							
Bar Designation	Nominal Outer Diameter in mm	Average Inner Diameter in mm	Cross Sectional Area in² mm²	Minimum Ultimate Load kips kN	Minimum Yield Load kips kN	Approx. Major Thread Diameter in mm	Nominal Weight lbs/ft kg/m
T40/20	1.58 40	0.79 20	1.13 729	121 538	95.6 425	1.58 40	3.5 5.2
T40/16	1.58 40	0.63 16	1.36 877	148.4 660	118 525	1.58 40	4.04 6
T52/26	2.05 52	1.18 30	1.783 1150	209 930	164 730	2.05 52	6.06 9
T76/51	3.00 76	1.93 49	3.224 2080	310 1379	252 1121	2.99 76	10.97 16.3
T76/45	3.00 76	1.66 42	3.81 2460	390 1467	330 1467	3.00 76	13.2 19.7

COUPLER



"T" Threaded Hollow Bar Coupler*			
Bar Designation	OD in mm	L in mm	Weight lbs kg
HBCPL 40	2.25 57	5.50 140	4.7 2.1
HBCPL 40C	2.50 64	5.50 140	5.1 2.31
HBCPL 52	2.7 68.5	6.25 160	5.2 2.36
HBCPL 76	4.0 101.6	8.5 215.9	13.6 6.2

ANCHOR HEX NUT



"T" Threaded Hollow Bar Anchor Hex Nut*			
Bar Designation	A in mm	L in mm	Weight lbs kg
HBHN 40	2.52 64	2.68 68	2.87 1.3
HBHN 52	3.2 81	2.5 63.5	5.1 2.31
HBHN 76	4.0 102	3.1 80	6.2 2.81

* Meets "Buy America" requirements.

HOLLOW BAR SYSTEMS

Carbide Cross, Steel Cross Cut , and Button Bits		
Bar Sizes	Size in mm	Weight lbs/unit kg/unit
T40	3.5 88.9	3.5 1.59
	4.0 101.6	5.5 2.49
	4.5 114.3	7.0 3.18
	5.0 127.0	10.5 4.76
	6.0 152.4	13.0 5.90
T52	4.5 114.3	7.0 3.18
	5.0 127.0	10.5 4.76
	6.0 152.4	13.0 5.90
T76	5.0 127.0	10.5 4.76
	6.0 152.4	13.0 5.90
	7.0 177.8	14.5 6.58
	8.0 203.2	16.0 7.26
T103	7.0 175.0	23.45 10.64
	8.0 200.0	27.9 12.66
	10.0 250.0	44.45 20.16
R38	3.0 76.2	2.9 1.32
	3.5 88.9	3.5 1.59
R51	4.0 101.6	5.5 2.49
	4.5 114.3	7.0 3.18
	5.0 127.0	10.5 4.76
	6.0 152.4	13.0 5.90

All bits subject to availability. Call for stock quantities. Specialty bits available upon request.

Drill Bit Adaptors	
Adaptors	Weight lbs/unit kg/unit
R32 x R38	0.20 0.09
R38 x R51	0.30 0.13
T30 x T40	0.30 0.13

Call for job specific quotes. Price depends on quantities.

PRODUCT DETAIL

HOLLOW BAR SYSTEMS

Hollow bars are fully threaded, "disposable" drill rods capable of drilling holes utilizing sacrificial bits that will advance the drill string to the required depth and then allow them to be grouted in place. This process creates the steel reinforcing portion of an anchor or pile. Hollow bar products are a valuable and multi-functional addition to the geotechnical contractor's toolbox. They can be used as tie back or tie down anchors, rock anchors, soil nails and micropiles in a large array of challenging applications.

There are three basic types of drill bits for use with hollow bars: versatile cross cut bits in carbide or hardened steel, button bits for intact rock in carbide or hardened steel, and steel stepped clay bits for cohesive soils. The selection of the drill bit type and size is based on the material that is being drilled through and the desired borehole diameter. A larger borehole diameter provides greater load carrying capacity and greater grout cover. Grout cover protects the anchor rod from corroding. Depending on the actual soil type, a 2.5 inch diameter bit can produce a 6 to 8 inch diameter grout column.

Production rates are increased through the use of hollow bar systems, as compared to traditional solid bar anchors. This is especially true when drilling through difficult conditions. In sites with low headroom, large scale drilling rigs and hole casing systems can be avoided. With drill rigs where "through the head grouting" is not available, grout swivels can be used to retrofit standard rotary percussion drills.

HOLLOW BAR CORROSION PROTECTION

The level of corrosion protection is dependent on the anticipated service life of the anchor, installation methods, and the corrosion potential (aggressiveness) of the environment. The FHWA has studied the effects of installation on both galvanized and epoxy coated bars as reported in FHWA CFL/TD10-002. This study revealed epoxy coatings were both partially and completely removed at the leading edge of the screw profile and around the couplings.

The installations were constructed using hollow bars as both the drill rod and reinforcement. The effects of the removal reduced the service life of the bar substantially by creating concentrated locations for potential corrosion. As such, the designer should evaluate all possibilities when determining the level of corrosion protection required.

HOT DIPPED GALVANIZING

Hot dipped galvanizing is a form of galvanization and is the process of coating a base metal such as steel with molten zinc. The zinc acts as a sacrificial material to the steel. The galvanized coating is manufactured in accordance with ASTM A53 standards and is more resistant to handling than epoxy coatings.

SACRIFICIAL STEEL

Using sacrificial steel as a form of corrosion protection requires a geotechnical evaluation of the corrosivity of the soils. The estimated loss of steel thickness is calculated and then the hollow bar is designed with the additional increase in thickness.

STEEL THICKNESS REDUCTION VALUES DUE TO CORROSION

LOSS OF THICKNESS DUE TO CORROSION FOR PILES IN SOIL WITH OR WITHOUT GROUNDWATER

Required design working life	5 Years	25 Years	50 Years	75 Years	100 Years
	in / mm				
Undisturbed natural soils (sand, clay, schist, ...)	0.000 0.00	0.012 0.30	0.024 0.60	0.035 0.90	0.047 1.20
Polluted natural soils and industrial grounds	0.006 0.15	0.030 0.75	0.059 1.50	0.089 2.25	0.118 3.00
Aggressive natural soils (swamp, marsh, peat, ...)	0.008 0.20	0.039 1.00	0.069 1.75	0.098 2.50	0.128 3.25
Non-compacted and non-aggressive fills (clay, schist, sand, silt, ...)	0.007 0.18	0.028 0.70	0.047 1.20	0.067 1.70	0.087 2.20
Non-compacted and aggressive fills (ashes, slag, ...)	0.020 0.50	0.079 2.00	0.128 3.25	0.177 4.50	0.226 5.75

Notes:
1. Corrosion rates in compacted fills are lower than those in non-compacted ones. In compacted fills, the figures in the table should be divided by two.
2. The values given are only for guidance. Local conditions should be considered because they may affect the actual corrosion rate, which can be lower or higher than the average value given in the table.
3. The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

LOSS OF THICKNESS DUE TO CORROSION FOR PILES IN FRESH WATER OR IN SEA WATER

Required design working life	5 Years	25 Years	50 Years	75 Years	100 Years
	in / mm				
Common fresh water (river, ship canal, ...) in the zone of high attack (water line)	0.006 0.15	0.022 0.55	0.035 0.90	0.045 1.15	0.055 1.40
Very polluted fresh water (sewage, industrial effluent, ...) in the zone of high attack (water line)	0.012 0.30	0.051 1.30	0.091 2.30	0.130 3.30	0.169 4.30
Sea water in temperate climate in the zone of high attack (low water and splash zones)	0.022 0.55	0.074 1.90	0.148 3.75	0.220 5.60	0.295 7.50
Sea water in temperate climate in the zone of permanent immersion or in the intertidal zone	0.010 0.25	0.035 0.90	0.069 1.75	0.102 2.60	0.138 3.50

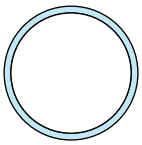
Notes:
1. The highest corrosion rate is usually found at the splash zone or at the low water level in tidal waters. However, in most cases, the highest stress es are in the permanent immersion zone.
2. The values given are only for guidance. Local conditions should be considered because they may affect the actual corrosion rate, which can be lower or higher than the average value given in the table.
3. The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

PRIME DOMESTIC

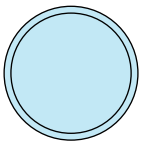
MICROPILE CASING

Outside Diameter in mm	Thickness in mm	Inside Diameter in mm	Weight lbs/ft kg/m	Cross Sectional Area in^2 cm^2	Total Area of Pile in^2 cm^2	Internal Volume ft^3/ft m^3/m	External Surface Area ft^2/ft m^2/m	Moment of Inertia in^4 cm^4	SECTION MODULUS Elastic in^3 cm^3	SECTION MODULUS Plastic in^3 cm^3
7 **177.8**	0.5 12.7	6 152.4	34.74 51.71	10.21 65.87	38.48 248.29	0.196 0.018	1.83 0.56	54.24 2257.7	15.5 253.96	21.17 346.86
8.625 **219.075**	0.5 12.7	7.625 193.675	43.43 64.63	12.76 82.34	58.43 376.94	0.32 0.029	2.26 0.69	105.72 4400.36	24.51 401.65	33.05 541.58
9.625 **244.475**	0.5 12.7	8.625 219.075	48.77 72.59	14.33 92.47	72.76 469.42	0.406 0.038	2.52 0.77	149.63 6228.24	31.09 509.52	41.67 682.92
10.75 **273.05**	0.5 12.7	9.75 247.65	54.79 81.54	16.1 103.88	90.76 585.56	0.518 0.048	2.81 0.86	211.95 8822.03	39.43 646.18	52.57 861.52
12.75 **323.85**	0.5 12.7	11.75 298.45	65.48 97.45	19.24 124.14	127.68 823.72	0.753 0.07	3.34 1.02	361.54 15048.59	56.71 929.36	75.07 1230.22
14 **355.6**	0.5 12.7	13 330.2	72.16 107.4	21.21 136.81	153.94 993.15	0.922 0.086	3.67 1.12	483.76 20135.45	69.11 1132.48	91.17 1493.95
16 **406.4**	0.5 12.7	15 381	82.85 123.31	24.35 157.08	201.06 1297.17	1.227 0.114	4.19 1.28	731.94 30465.73	91.49 1499.3	120.17 1969.18

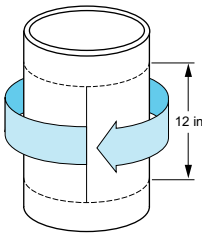
Contact your Nucor Skyline representative for additional diameters, lengths, and starter details.



CROSS SECTIONAL AREA



TOTAL AREA OF PILE



EXTERNAL SURFACE AREA

MICROPILE CASING ACCESSORIES

Nucor Skyline's Geostructural Group delivers complete accessory packages with your threaded casing. We understand the urgency of your project and stock a wide range of casing accessories for immediate delivery.

TOOLING ITEMS

In-house custom fabrication and machining is available for duplex and flange adapters to match casing and drill system requirements. We can also fabricate crossover subs to fit any existing tooling items. Nucor Skyline offers API drill rods, bits, and tool subs with select items in stock.

Nucor Skyline can provide threaded micropile casing up to 40 feet.

Female and male casing, cut and bundled to specifications

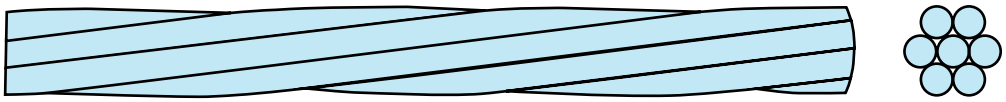
Casing accessories include duplex and flange adapters

API drill rods and casing subs are typical tooling items

Saver-subs available to fit all sizes of casing

Please note: As we continuously improve the design of our products, product details are subject to change.

MULTI-STRAND ANCHORS



Multi-Strand Anchors - ASTM A416						
No. of 0.6" Strands	Nominal Cross Section Area (Aps) in² mm²	Ultimate Strength (Fpu x Aps) kips kN	Maximum Jacking Load (0.8 x Fpu x Aps) kips kN	Maximum Design Load (0.6 x Fpu x Aps) kips kN	Minimum Lockoff Load (0.5 x Fpu x Aps) kips kN	Nominal Steel Weight (Bare Strand) lbs/ft kg/m
1	0.217 140	58.6 261	46.9 209	35.2 156	29.3 130	0.74 1.10
2	0.434 280	117.2 521	93.8 417	70.3 313	58.6 261	1.48 2.20
3	0.651 420	175.8 782	140.6 626	105.5 469	87.9 391	2.22 3.31
4	0.868 560	234.4 1043	187.5 834	140.6 626	117.2 521	2.96 4.41
5	1.085 700	293.0 1303	234.4 1043	175.8 782	146.5 652	3.70 5.51
6	1.302 840	351.6 1564	281.3 1251	211.0 938	175.8 782	4.44 6.61
7	1.519 980	410.2 1825	328.2 1460	246.1 1095	205.1 912	5.18 7.71
8	1.736 1120	468.8 2085	375.0 1668	281.3 1251	234.4 1043	5.92 8.82
9	1.953 1260	527.4 2346	421.9 1877	316.4 1408	263.7 1173	6.66 9.92
10	2.170 1400	586.0 2607	468.8 2085	351.6 1564	293.0 1303	7.40 11.02
11	2.387 1540	644.6 2867	515.7 2294	386.8 1720	322.3 1434	8.14 12.12
12	2.604 1680	703.2 3128	562.6 2503	421.9 1877	351.6 1564	8.88 13.22
13	2.821 1820	761.8 3389	609.4 2711	457.1 2033	380.9 1694	9.62 14.33
14	3.038 1960	820.4 3649	656.3 2920	492.2 2190	410.2 1825	10.36 15.43
15	3.255 2100	879.0 3910	703.2 3128	527.4 2346	439.5 1955	11.10 16.53
16	3.472 2240	937.6 4171	750.1 3337	562.6 2503	468.8 2085	11.84 17.63
17	3.689 2380	996.2 4432	797.0 3545	597.7 2659	498.1 2216	12.58 18.73
18	3.906 2520	1054.8 4692	843.8 3754	632.9 2815	527.4 2346	13.32 19.84
19	4.123 2660	1113.4 4953	890.7 3962	668.0 2972	556.7 2476	14.06 20.94

Aps = Area Prestressing Steel, Fpu = Minimum Ultimate Tensile Strength
Strand Anchors utilize 0.6" (15.2mm) dia. 7-wire, Low Relaxation 270 KSI Steel Strand conforming to ASTM A416.
*Maximum lockoff load shall not exceed (0.7 x Fpu x Aps), maximum jacking load shall not exceed (0.8xFpu x Aps)
Now available: Hot Melt Extrusion Coated Strand. Consult your sales representative for information on load distributive or removable strand anchors.

MULTI-STRAND ANCHORS

MULTI-STRAND GROUND ANCHORS

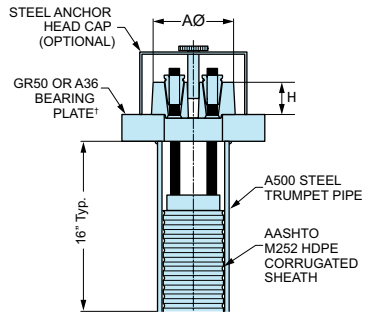
As a result of recent technological developments in the structural post-tensioning industry, the production of ground anchors with a very high capacity is possible. The use of strand anchors in rock and soil anchor applications has become a well respected tool in the geotechnical engineer's arsenal of solutions. By utilizing the combined load carrying capacity of multiple 0.6 inch diameter prestressing steel strands, loads which greatly exceed the tensile strength of any single bar can be achieved.

Strand anchors can be produced in extremely long lengths. For instance, strand anchors measuring anywhere from 100 to 200 feet in length can be assembled, coiled and banded in one of our manufacturing locations and shipped on wooden pallets via conventional flat-bed trucks.

In addition, many of the strand anchors used in temporary excavation support consist of seven strands or less. These anchors can often be uncoiled and installed by hand. Strand anchors also generally require much less site storage space and handling than bar anchors. We offer customized strand anchor manufacturing which allows for the design to be optimized in terms of both load carrying capacity and geometry to meet the requirements of specific site conditions. Nucor Skyline is committed to bringing the latest developments in global strand anchoring technology to the North American geotechnical construction industry. Innovations such as load distributive and removable strand anchors are available from Nucor Skyline. A key element in being able to use these technologies is having the practical installation equipment to test and lock off these types of anchors.

Multi-strand anchors having individual strands of different lengths can pose many challenges when using traditional hollow ram jacks. Nucor Skyline offers a unique multi-ram manifold jack system that is capable of maintaining an equal load in each strand, independent of the elongation.

PTI CLASS I DCP STRAND ANCHOR HEAD



† Nucor Skyline can provide a customized bearing plate solution.

Anchor Head & Duct Dimensions for DCP Strand Anchors

Max. No. of Strands	Corrugated Sheath		Trumpet Pipe		Anchor Head		Anchor Head Cap	
	OD	ID	OD	ID	AØ	H	OD	Height
	in mm	in mm	in mm	in mm	in mm	in mm	in mm	in mm
2-3*	2.33 59.18	2.00 50.80	4.00 101.60	3.548 90.12	4.70 119.38	1.80 45.72	5.56 141.29	3.50 88.90
4**	3.00 76.20	2.50 63.50	4.00 101.60	3.548 90.12	4.70 119.38	1.80 45.72	5.56 141.29	3.50 88.90
6*	3.00 76.20	2.50 63.50	4.00 101.60	3.548 90.12	5.61 142.49	2.20 55.88	6.63 168.28	4.50 114.30
8**	3.60 91.44	3.00 76.20	4.50 114.30	4.026 102.26	6.33 160.78	2.06 52.32	6.63 168.28	4.50 114.30
12**	4.60 116.84	4.00 101.60	5.56 141.29	5.047 128.18	6.50 165.10	1.69 42.93	8.63 219.08	4.50 114.30
19**	5.63 142.88	5.00 127.00	6.63 168.28	6.065 154.05	8.78 223.01	4.00 101.60	10.75 273.05	6.00 152.40

* Based on ½" ID PE Grout Tube. ** Based on ¾" ID PE Grout Tube. Note: Consult your sales representative about additional variations.

APPLICATIONS

PILE REINFORCEMENT

Nucor Skyline's fully threaded bars may be coupled by screw-on, sleeve-type couplers at any point. Hex nuts and jam nuts may also be used, providing great versatility in the fabrication of structural columns or pile reinforcing steel. The Nucor Skyline-manufactured grade 80 ksi threaded bar system meets the ASTM A615 Standard Specification for Deformed Carbon-Steel Bars for Concrete Reinforcement requirements.

PRE-ASSEMBLED REINFORCING BAR CAGES

Nucor Skyline is a leader in custom-manufactured steel products for the foundation industry. We are able to produce pre-assembled configurations of fully threaded bars at our multiple manufacturing locations. Overhead bridge cranes and large steel warehouses facilitate the assembly of bars, custom spacer rings, and top and bottom structural plates. High tensile strap bands are used to stabilize the cages for lifting and transport. With our extensive expertise and infrastructure, we are able to fabricate and ship large foundation steel components to just about anywhere in the United States.

For example, cage assemblies over 65 ft long, with 18 circumferential #18 grade 80 bars, have been transported over 1,000 miles with only minor field adjustments required upon arrival. Cages measuring 130 feet in length have been produced in our Camp Hill, PA manufacturing facility and shipped directly to the job site in Manhattan, NY.

ADVANTAGES

- Factory fabrication provides efficiency at the jobsite resulting in cost savings on the project
- In-factory assembly prevents production schedule delays due to site weather or laydown conditions
- Reinforcing with Nucor Skyline Grade 80 ksi provides a larger range of bar sizes than traditional rebar
- The coupling of the bars is pre-done and held in a thread locked condition, eliminating concerns of becoming loose
- Spacer rings and steel banding provide a stable arrangement of bar cages, which facilitates crane pick up and lowering

APPLICATIONS

- Pre-assembled Concrete Reinforcement for Large Drilled Shaft Piles
- Augercast Pile Reinforcement Cages
- Micropile Reinforcement

APPLICATIONS

GROUND ANCHORS

Over the past 50 years, fully threaded, high strength threaded bar and multi-strand anchor systems with corrosion protection have developed into the most accepted and highly reliable ground anchorages available. As the leading steel supplier in the United States' foundation industry, Nucor Skyline manufactures the most extensive selection of cold and hot rolled, high strength, fully threaded bars; available in both 80 ksi and 150 ksi steel grades.

APPLICATIONS

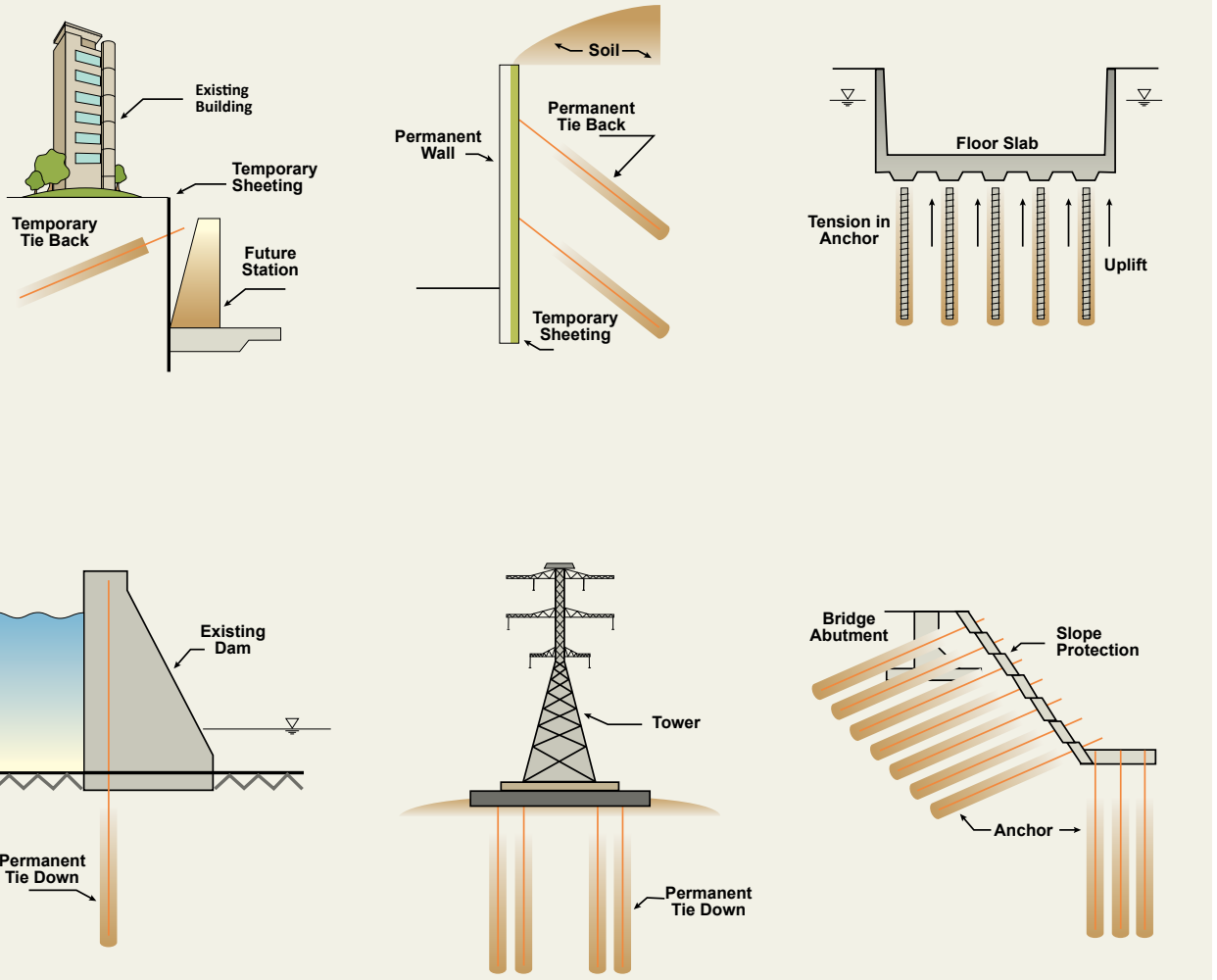
- Retaining Walls: Tie backs are used as either a permanent or temporary anchor system for permanent retaining walls or support of excavation
- Resist Uplift: Used to resist hydrostatic uplift pressures on a slab, structural force, or wind loads on a structure
- Sloped Surface Stabilization
- Landslide Mitigation
- Foundation Stabilization

ADVANTAGES

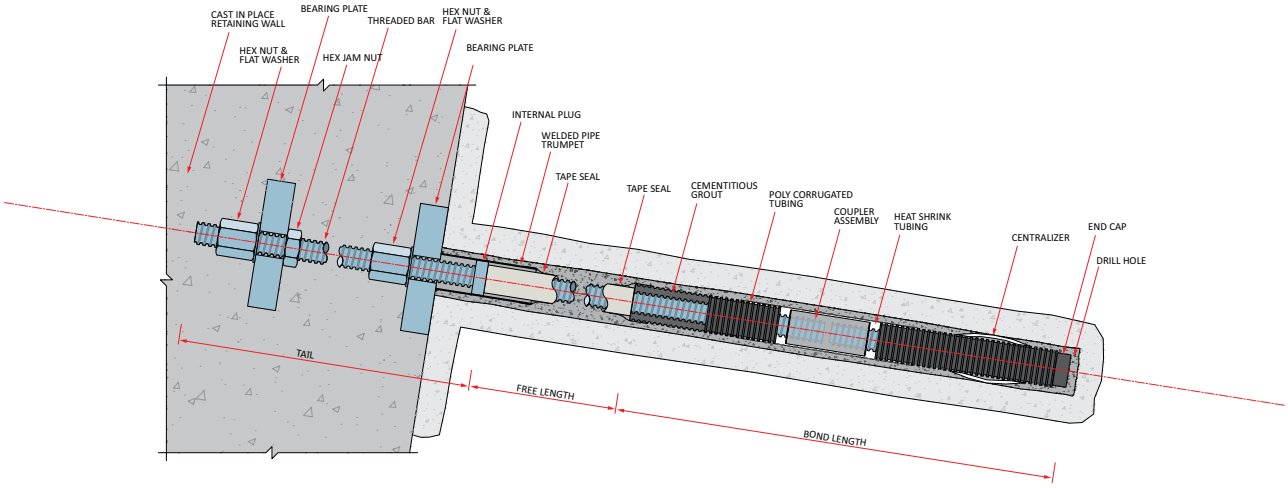
- Highly versatile and well proven method of transferring tension forces to the ground
- Used in a wide array of installation techniques developed to drive cost-efficient construction in the geotechnical industry
- Tie back installations eliminate internal bracing and rakers which typically congest the excavation. This dramatically increases the efficiency of material removal by the contractor during temporary excavation
- Reliable permanent anchors, with decades of proven performance, allow engineers to confidently design structural and slope stabilization projects
- Tie down applications often replace mass concrete, reducing construction costs

GROUND ANCHORS

Typical Uses for Ground Anchors



GROUND ANCHORS



Typical Grouted Class I Permanent Anchor

TIE BACK OR TIE DOWN ANCHORS

Tie backs are fully threaded steel bars that are bored, cast-in-place elements designed to resist tension forces resulting from the support of earth retention systems, such as foundation walls or retaining walls.

Tie backs are commonly used to support temporary walls for excavations in congested urban areas. One type of temporary wall is a beam and lagging wall. The use of tie downs in this application reduces the amount of soil disturbed during excavation and decreases the disturbance on adjacent structures. In this very common application, H-piles are tremie concreted into drilled holes in a vertical orientation, along the perimeter of the intended excavation. Wood lagging is installed horizontally to retain the soil behind and between the piles as the top-down excavation takes place.

Anchor design is based on well-documented and proven principles. Once the structural loading has been identified, the geotechnical information available from the site can be used to determine the appropriate anchor design, as recommended in the PTI Manual "Recommendations of Rock and Soil Anchors".

The design must take the variability that occurs throughout most sites into consideration. For example, the Great Lakes Region is a region where glaciers traversed the landscape, carving and filling vast areas with sand, clay, gravel and countless combinations of all soil types. Soils may contain boulders, cobbles, gravel and other obstructions which make it challenging to drill holes. As a result, soil conditions vary drastically from site to site. For example, in parts of Texas, Oklahoma and in the upper Missouri Valley, clay soils may be expansive and may dominate the design of ground anchors.

Soil borings and laboratory testing should be used to verify the actual soil conditions in the location of a proposed anchor.

Prior to starting a tie back or tie down anchor design, a licensed geotechnical engineer should be consulted. A simple, standardized design process may be applied using a prescribed method such as the following:

GEOTECHNICAL CONSIDERATIONS

- Soils: Cohesive, cohesionless or rock
- Design life: Permanent or temporary (less than 2 years)
- Loading type: Tensile, compressive or lateral
- N-values: Obtained from STP test
- Termination depth
- Corrosion potential

STRUCTURAL CONSIDERATIONS

- Surface surcharge loading type: Tensile, compressive or lateral
- Groundwater
- Soil properties
- Buckling

FIELD QUALITY CONTROL

- Site access
- Installation methods
- Load testing requirements

GROUND ANCHORS

CORROSION PROTECTION

Corrosion protection is a technique used to extend the design life of an anchor. It is extremely important to protect the integrity of the steel which could be significantly damaged if a method of corrosion protection is not utilized. The level of corrosion protection varies and is controlled by the aggressiveness of the environment and the desired design life. It is the responsibility of the design engineer to select an appropriate level of protection.

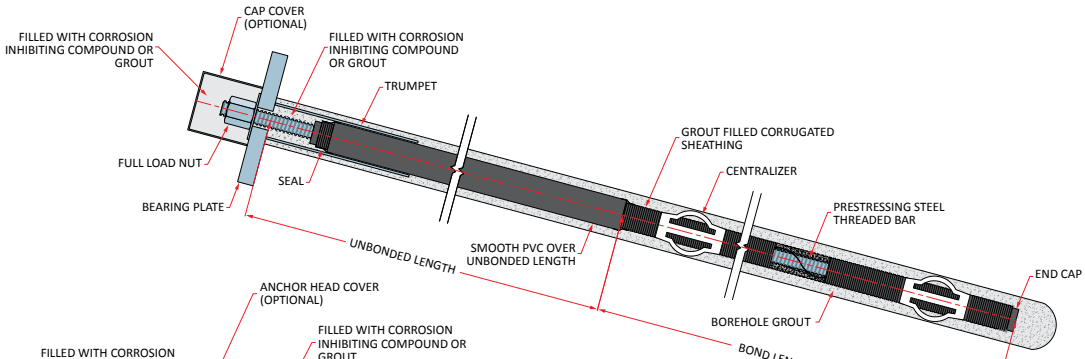
All bar and strand anchors can be supplied with a protective smooth-walled PVC tube. While the standard PVC tube is 0.035 inch thick, other options are available upon request.

The following corrosion protection options are available for all bars and strands:

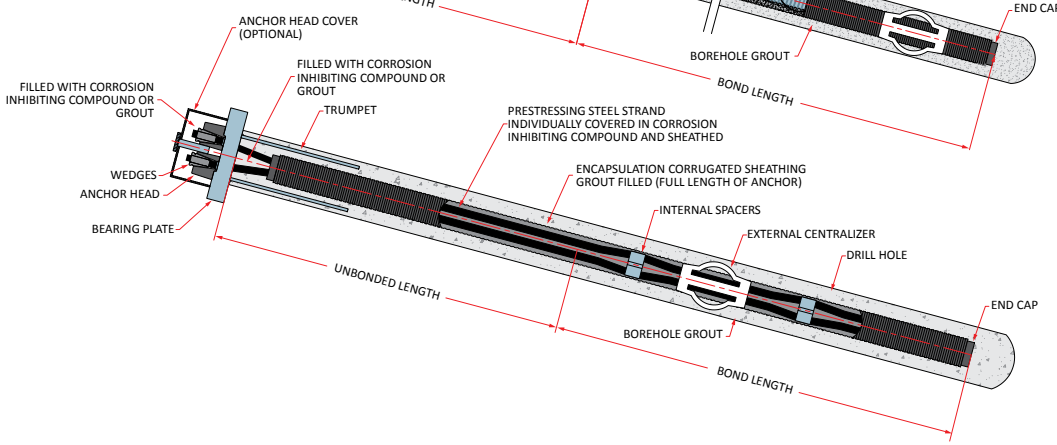
DOUBLE CORROSION PROTECTION (DCP)/PTI CLASS I

With Double Corrosion Protection, the threaded bar is typically encased in a factory grouted, PVC or HDPE corrugated plastic. DCP fabrication is used mainly for permanent applications or in uncertain and aggressive environments. For strand anchors, the strand is placed in the corrugated duct in the factory and grouted entirely in the field.

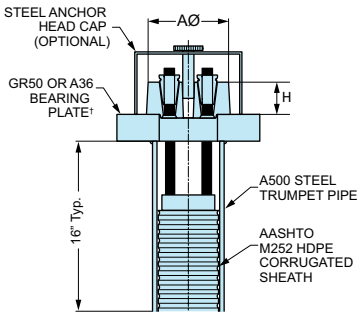
CLASS I PROTECTION: BAR ANCHOR (DCP)



CLASS I PROTECTION: STRAND ANCHOR (DCP)



PTI CLASS I DCP STRAND ANCHOR HEAD



† Nucor Skyline can provide a customized bearing plate solution.

Anchor Head & Duct Dimensions for DCP Strand Anchors

Max. No of Strands	Corrugated Sheath OD	Corrugated Sheath ID	Trumpet Pipe OD	Trumpet Pipe ID	Anchor Head AØ	Anchor Head H	Anchor Head Cap OD	Anchor Head Cap Height
	in mm	in mm	in mm	in mm	in mm	in mm	in mm	in mm
2-3*	2.33 59.18	2.00 50.80	4.00 101.60	3.548 90.12	4.70 119.38	1.80 45.72	5.56 141.29	3.50 88.90
4**	3.00 76.20	2.50 63.50	4.00 101.60	3.548 90.12	4.70 119.38	1.80 45.72	5.56 141.29	3.50 88.90
6*	3.00 76.20	2.50 63.50	4.00 101.60	3.548 90.12	5.61 142.49	2.20 55.88	6.63 168.28	4.50 114.30
8**	3.60 91.44	3.00 76.20	4.50 114.30	4.026 102.26	6.33 160.78	2.06 52.32	6.63 168.28	4.50 114.30
12**	4.60 116.84	4.00 101.60	5.56 141.29	5.047 128.18	6.50 165.10	1.69 42.93	8.63 219.08	4.50 114.30
19**	5.63 142.88	5.00 127.00	6.63 168.28	6.065 154.05	8.78 223.01	4.00 101.60	10.75 273.05	6.00 152.40

* Based on ½" ID PE Grout Tube. ** Based on ¾" ID PE Grout Tube. Note: Consult your sales representative about additional variations.

GROUND ANCHORS

SINGLE CORROSION PROTECTION (SCP)/PTI CLASS II

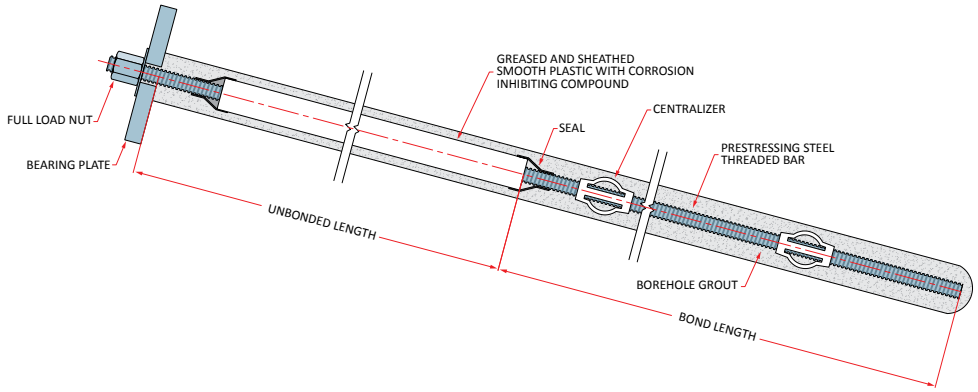
In a Single Corrosion Protection (SCP) system, the bar or strand is sleeved with a HDPE or PVC plastic sheath through the free length of the anchor. SCP fabrication is used primarily for temporary applications, but can also be leveraged for non-aggressive, permanent applications.

Factory-issued corrosion protection options include:

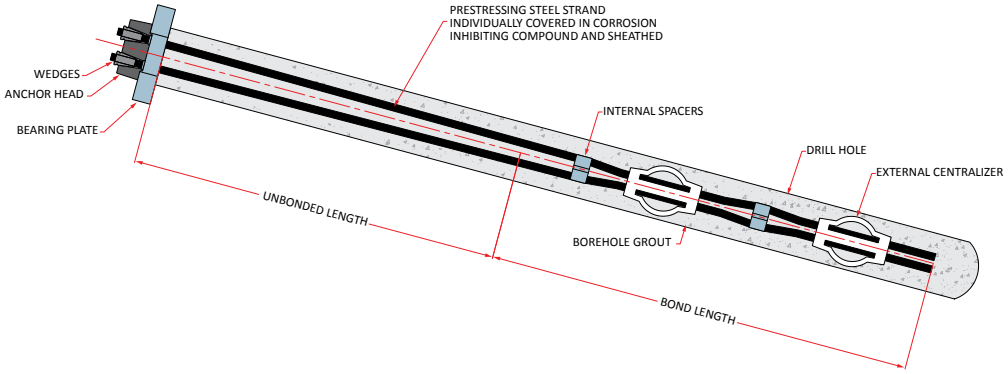
- Encapsulating: Grease or Grout
- Hot Melt Fusion-bonded Epoxy Coating
- Coal Tar Epoxy Coating
- Hot Dip Galvanizing
- Multi-layer Painting
- Heat Shrink Seals
- Mastic Backed Tape Systems (i.e. DENSO™)

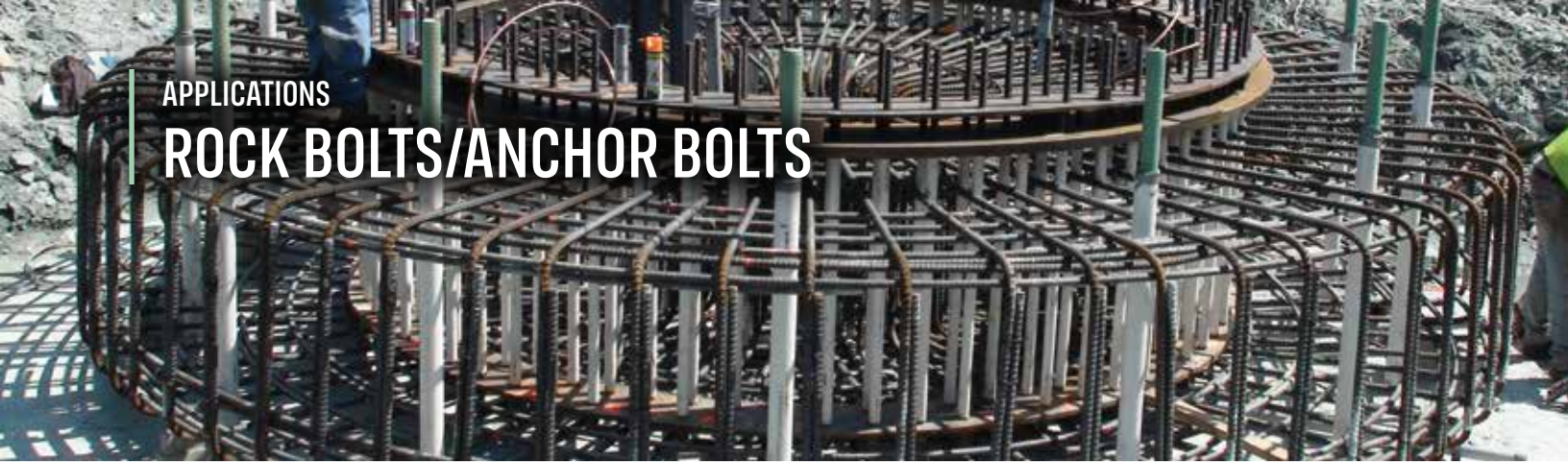
Oversized accessories are provided to accommodate galvanized and coated bars.

CLASS II PROTECTION: BAR ANCHOR (SCP)



CLASS II PROTECTION: STRAND ANCHOR (SCP)





APPLICATIONS

ROCK BOLTS/ANCHOR BOLTS

Rock bolts support the face of a rock slope or cut. When securing the face of an excavation, rock bolts are used to retain the unstable rock on the surface to the more stable rock behind the excavation. Roof bolts anchor the overhead portion of the tunnel excavation to the more stable rock above it. Anchor bolts serve to connect a structure to its foundation and can be used when securing wind turbines, tower structures, sign posts, stairways, and buildings.

ADVANTAGES

- Threaded bar rolling facilities manufacture anchor bolts to strict tolerances
- Large diameter anchor bolts can be designed to meet minimum yield strengths of up to 847 kips, with an ultimate strength of 1,059 kips or over 500 tons

APPLICATIONS

- Wind Turbine Anchor Bolts
- Utility Tower Anchor Bolts
- Sloped Surface and Rock Face Stabilization

APPLICATIONS

SOIL NAILS

APPLICATIONS

- Temporary Support of Excavation
- Permanent Retaining Walls
- Slide Stabilization

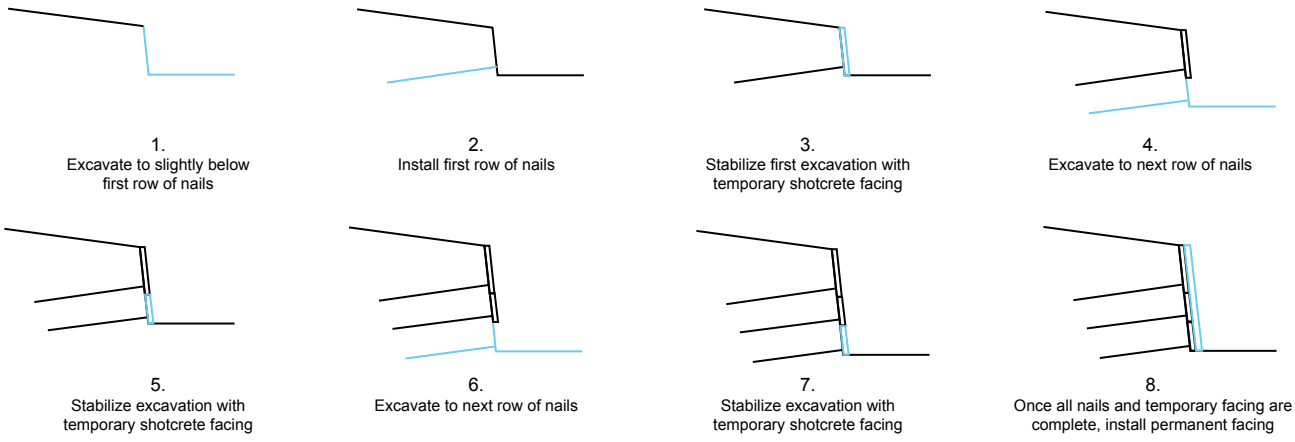
Soil nails are bars installed within an excavation or slope to provide reinforcement to an earth retention structure. They differ from tie backs as they are considered passive elements and are not actively loaded in tension like a prestressed ground anchor. Soil nails are used in combination with a steel grid cover and shotcrete. As a system, the soil nail, grid cover, and shotcrete act as a coherent mass with enough strength to resist the overburdening pressure of the surrounding soil mass, as well as any surcharge pressure.

In comparison to tie back anchors, soil nails have a few significant benefits. The equipment required to install soil nails is relatively small and mobile, providing a distinct advantage for applications with tight spaces or noise control issues. Using soil nails is typically a more flexible construction technique, allowing for simpler on-site modifications. Also, soil nails are installed early on in the construction process, limiting the disturbance on adjacent structures.

ADVANTAGES

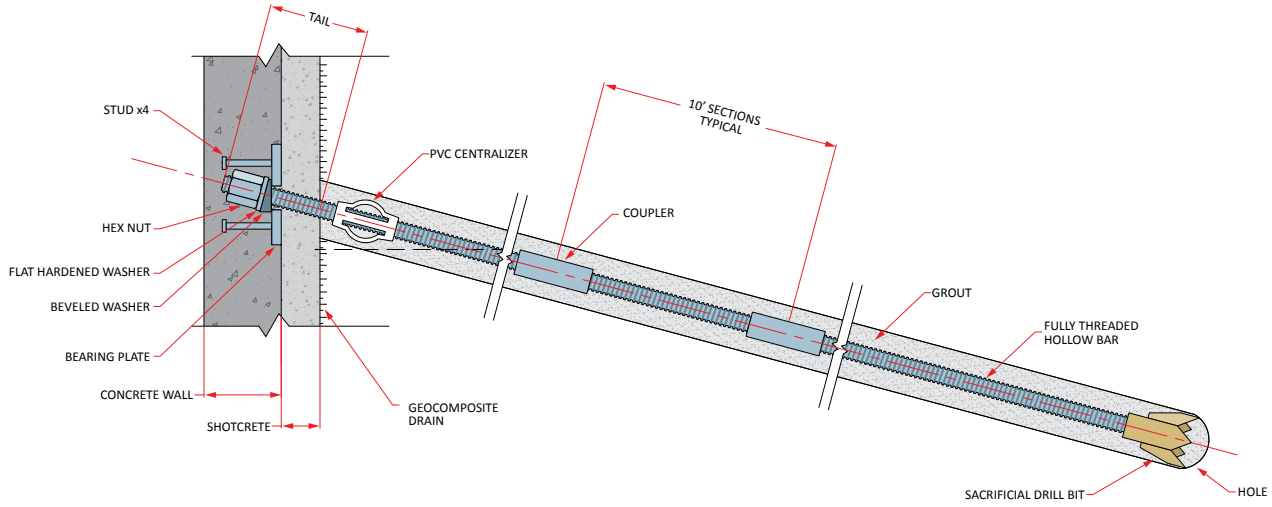
- Cutting-edge manufacturing process eliminates material loss
- Left- and right-hand thread configurations optimize threading flexibility
- Various grade options offer flexibility in yield strength
- Wide range of sizes
- Fully threaded bars provide the ability to cut bars to desired lengths
- Ability to supply single bar lengths of up to 60 feet
- Wide variety of corrosion protection options available
- Complete range of accessories available to complement our threaded bars

Typical Top Down Construction Sequence

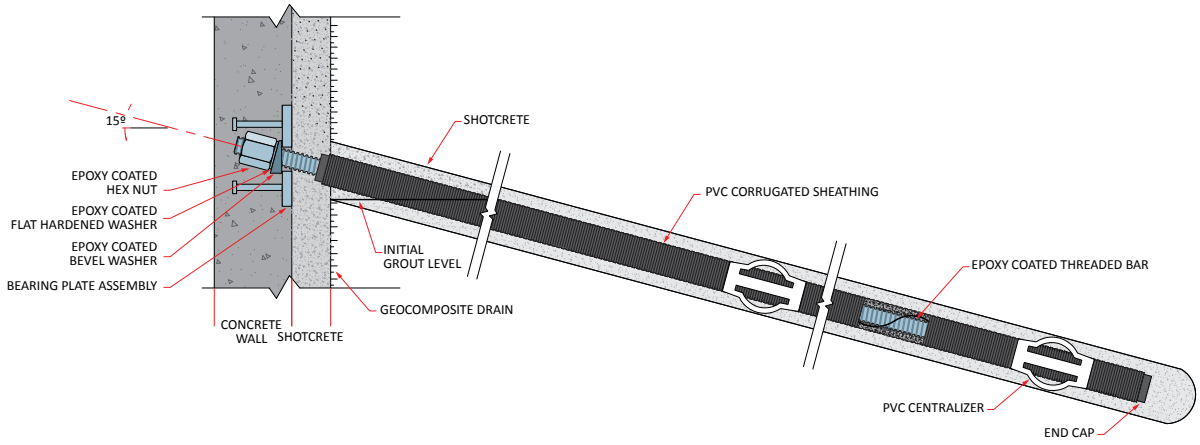


SOIL NAILS

Soil Nail with Hollow Bar



Typical DCP Soil Nail



APPLICATIONS

TIE RODS

Threaded bars from Nucor Skyline are ideal as tie rods for retaining walls. In addition to being the North American market leader in steel sheet piling, Nucor Skyline also manufactures and supplies several types of tie rods. Continuously threaded cold rolled bar is made at our manufacturing facilities. Nucor Skyline works with Nucor to supply hot rolled threaded bar. The tie rods supplied by Nucor Skyline give our customers the widest range of choices and best value in the industry.

APPLICATIONS

- Marine Bulkheads
- Earth Retaining Walls
- Bridge Abutments and Roadways
- Structural Ties (in slab)

ADVANTAGES

Cold Rolled Bars – ASTM A615 Gr. 80

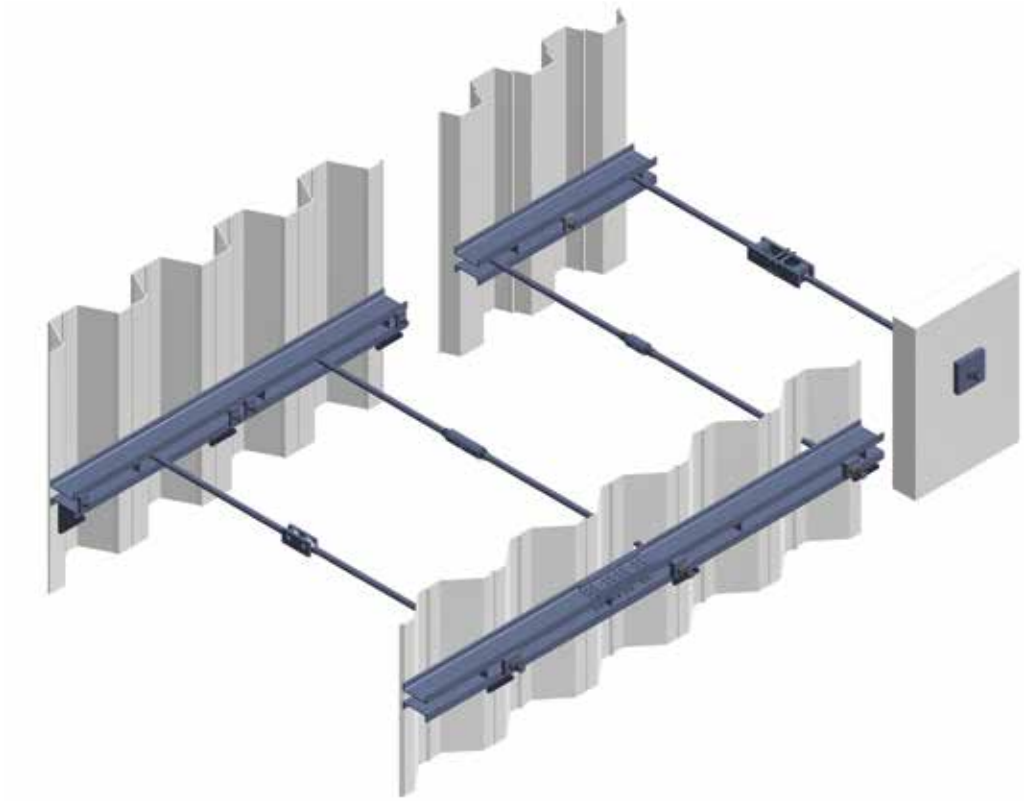
- Manufactured in USA by Nucor Skyline
- Continuously Threaded for Easy Cutting and Coupling
- Rolled Thread Reduces Local Stress Peaks
- 1.0 in. – 3.5 in. Diameter
- 36 – 432k Allowable Strength Range

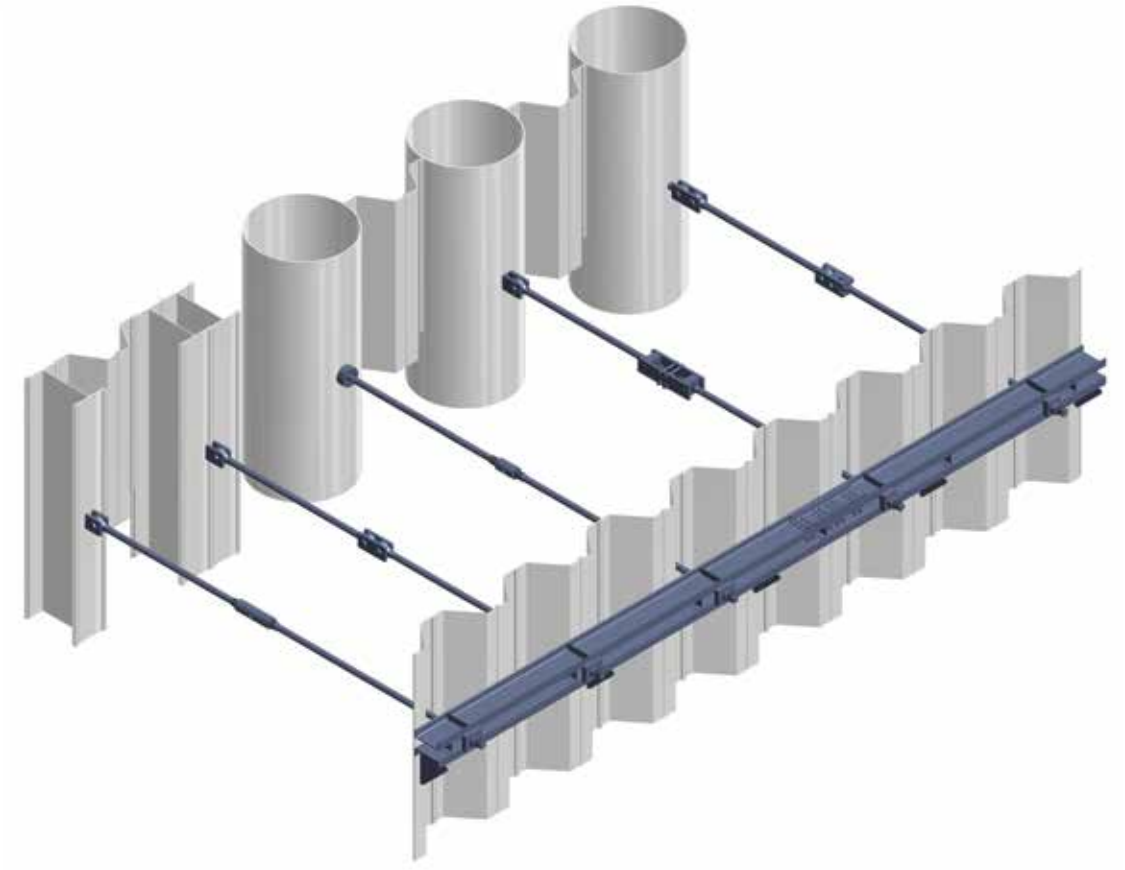
Hot Rolled Bars – ASTM A615 Gr. 80

- Manufactured in USA by Nucor
- Continuously Threaded for Easy Cutting and Coupling
- Robust Threads that Will not Jam
- 0.75 in. – 2.5 in. Diameter
- 20 – 101k Allowable Strength Range

APPLICATIONS

TIE RODS



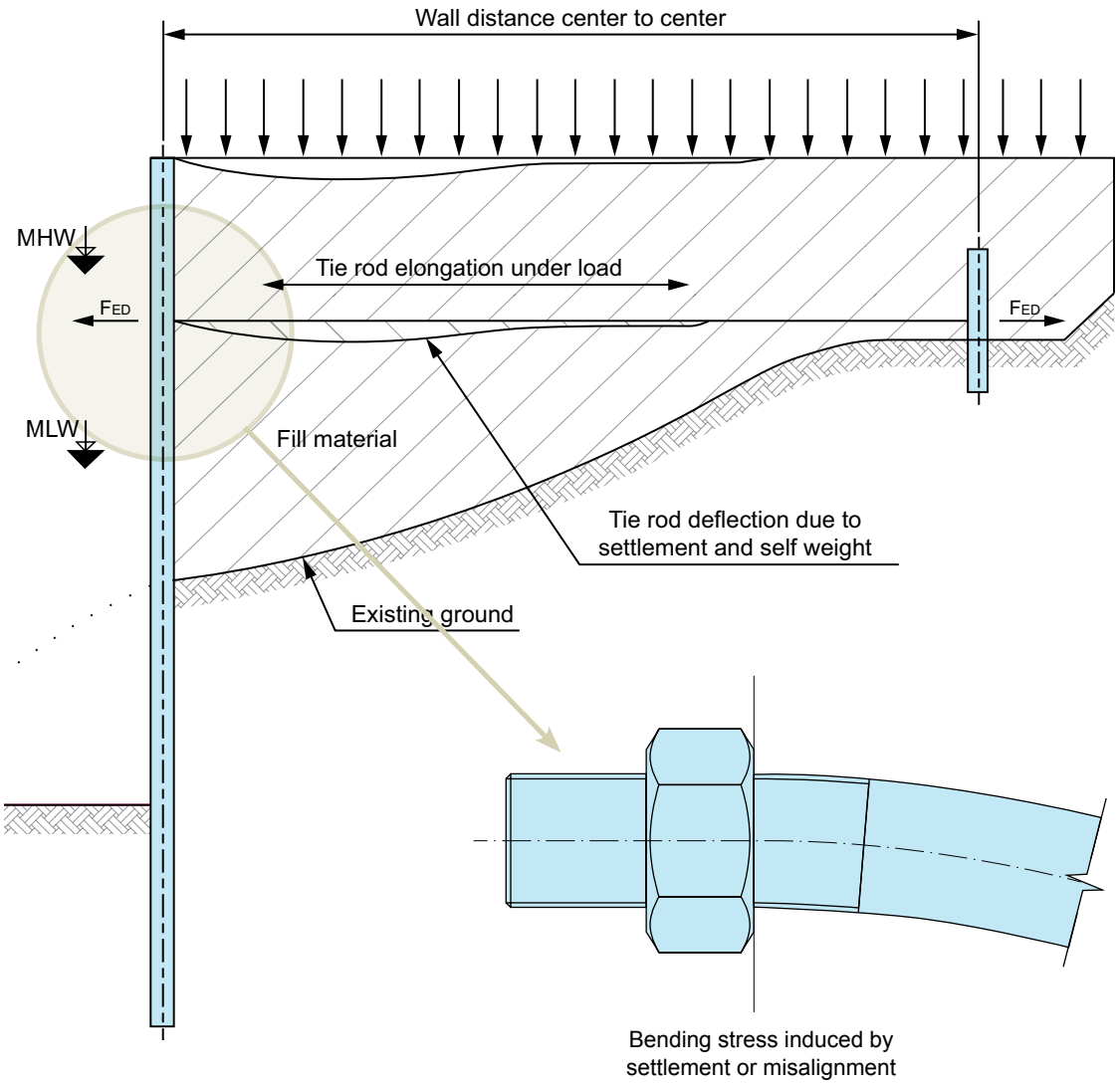


TIE RODS

TIE RODS FOR COMBINED WALL SYSTEMS

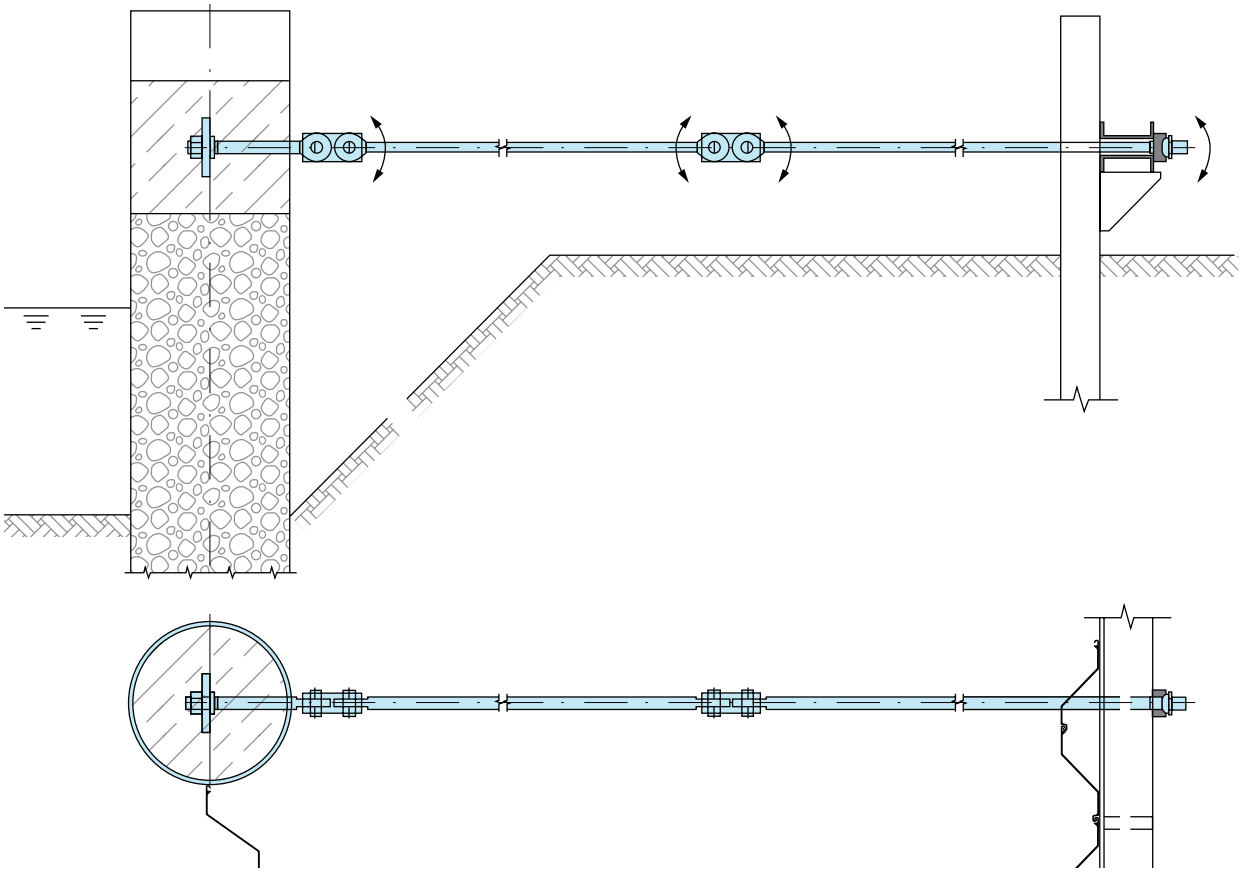
Combined wall systems usually require long, heavy tie rods. Most combined wall systems also have a lot of fill placed behind the wall and over the anchorage system. This fill, often placed over marine deposits, can cause settlement of the anchorage system. Tie rods are designed to take tension loads. The settlement of the bar or the deadman wall can put bending loads into the bars and increase the stresses significantly. Common solutions for this are to support the anchorage system, increase the cross section area of the bar, or provide a means of articulation for the tie rod.

Supporting the anchorage system is sometimes done with bearing piles and horizontal support beams. This system can reduce the bending in the bars, but it is also expensive and requires tight tolerances on the elevations of the support structure.

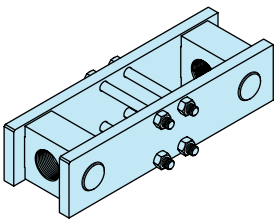


TIE RODS

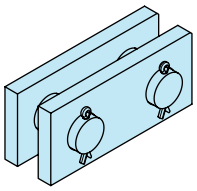
Typical King Pile Wall with Articulated Connections



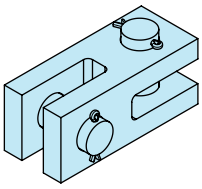
Consideration should also be given to articulation requirements along the length of the tie bar, particularly at points of maximum settlement or where the size of the tie bar and the site conditions mean that a pinned joint is easier to make than a threaded coupled joint. Several alternatives are available.



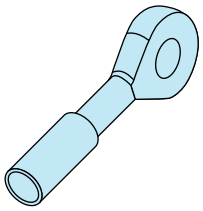
Articulated Turnbuckle
An adjustable turnbuckle allows length adjustment and articulation in one plane.



Link Plates
Together with forged eyes, link plates provide the most economic articulated joint and the simplest connection to achieve in site conditions.



Cardan Joint
The cardan joint allows bars with forged eyes to articulate in both vertical and horizontal planes.



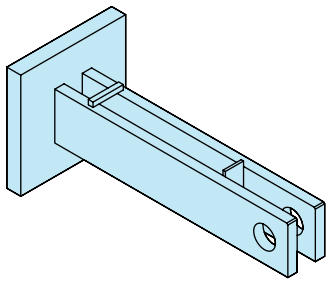
Forged Eye & Transition Coupler
The forged eye connects, via the transition coupler, to Nucor Skyline's cold and hot rolled bars and allows for full articulation.

TIE RODS

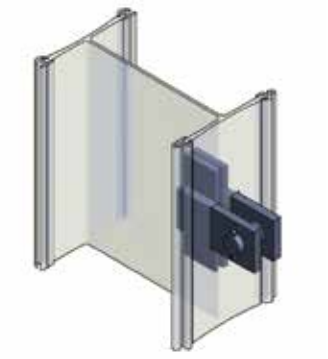
TYPICAL ARTICULATED WALL CONNECTION SOLUTIONS

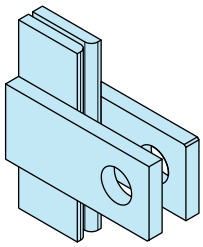
PIPE CONNECTORS

Cast T Plate



T-PLATES FOR BEAMS





TIE RODS

CORROSION PROTECTION – SACRIFICIAL STEEL

Corrosion protection of tie rods is an important consideration during the design process. Most tie rods are surrounded by clean fill so the corrosion rate is quite low, but regardless of the environment, corrosion must be accounted for. Corrosion rates are determined over the design life of the structure and added as additional steel to the bar and other components of the anchorage system.

There are a number of methods to protect the tie rod from corrosion such as wrapping or painting, but the best method is sacrificial steel. The use of upset forging technology allows this to be a very efficient solution since steel can be added where required. For example, additional material can be added at a vulnerable threaded end. Sacrificial steel is very forgiving; it cannot be applied incorrectly, forgotten or damaged during shipping and installation. It also allows for much quicker installation times than traditional wrapping systems. Once the whole tie bar cost is considered (material, handling, repair and installation), sacrificial steel is very economical.

LOSS OF THICKNESS DUE TO CORROSION FOR PILES IN SOIL WITH OR WITHOUT GROUNDWATER

Required design working life	5 Years	25 Years	50 Years	75 Years	100 Years
	in / mm				
Undisturbed natural soils (sand, clay, schist, ...)	0.000 0.00	0.012 0.30	0.024 0.60	0.035 0.90	0.047 1.20
Polluted natural soils and industrial grounds	0.006 0.15	0.030 0.75	0.059 1.50	0.089 2.25	0.118 3.00
Aggressive natural soils (swamp, marsh, peat, ...)	0.008 0.20	0.039 1.00	0.069 1.75	0.098 2.50	0.128 3.25
Non-compacted and non-aggressive fills (clay, schist, sand, silt, ...)	0.007 0.18	0.028 0.70	0.047 1.20	0.067 1.70	0.087 2.20
Non-compacted and aggressive fills (ashes, slag, ...)	0.020 0.50	0.079 2.00	0.128 3.25	0.177 4.50	0.226 5.75

Notes:
1. Corrosion rates in compacted fills are lower than those in non-compacted ones. In compacted fills, the figures in the table should be divided by two.
2. The values given are only for guidance. Local conditions should be considered because they may affect the actual corrosion rate, which can be lower or higher than the average value given in the table.
3. The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

LOSS OF THICKNESS DUE TO CORROSION FOR PILES IN FRESH WATER OR IN SEA WATER

Required design working life	5 Years	25 Years	50 Years	75 Years	100 Years
	in / mm				
Common fresh water (river, ship canal, ...) in the zone of high attack (water line)	0.006 0.15	0.022 0.55	0.035 0.90	0.045 1.15	0.055 1.40
Very polluted fresh water (sewage, industrial effluent, ...) in the zone of high attack (water line)	0.012 0.30	0.051 1.30	0.091 2.30	0.130 3.30	0.169 4.30
Sea water in temperate climate in the zone of high attack (low water and splash zones)	0.022 0.55	0.074 1.90	0.148 3.75	0.220 5.60	0.295 7.50
Sea water in temperate climate in the zone of permanent immersion or in the intertidal zone	0.010 0.25	0.035 0.90	0.069 1.75	0.102 2.60	0.138 3.50

Notes:
1. The highest corrosion rate is usually found at the splash zone or at the low water level in tidal waters. However, in most cases, the highest stresses are in the permanent immersion zone.
2. The values given are only for guidance. Local conditions should be considered because they may affect the actual corrosion rate, which can be lower or higher than the average value given in the table.
3. The values given for 5 and 25 years are based on measurements, whereas the other values are extrapolated.

TIE RODS

	TIE BARS WITH ARTICULATION										
	Bar	Thread Diameter	Shaft Diameter	THREAD			SHAFT			Recommended Design Capacity	
				Tensile Stress Area	Yield Capacity	Ultimate Capacity	Gross Area	Yield Capacity	Ultimate Capacity		
		D_t in mm	D_g in mm	A_s in² mm²	Th_y kips kN	Th_u kips kN	A_g in² mm²	Sh_y kips kN	Sh_u kips kN	ASD* kips kN	LRFD* kips kN
Cold/Hot Rolled Bars	#8	1.000 25	1.000 25	0.79 510	59.3 263.8	79 351.4	0.79 510	59.3 263.8	79 351.4	36 158	56 251
	#9	1.125 28	1.125 28	1.00 645	75.0 333.6	100 444.8	1.00 645	75.0 333.6	100 444.8	45 200	71 317
	#10	1.250 32	1.250 32	1.27 819	95.3 423.9	127 564.9	1.27 819	95.3 423.9	127 564.9	57 254	91 403
	#11	1.375 35	1.375 35	1.56 1,006	117.0 520.5	156 694.0	1.56 1,006	117.0 520.5	156 694.0	70 312	111 494
	#14	1.750 45	1.750 45	2.25 1,452	168.7 750.4	225 1,000.9	2.25 1,452	168.7 750.4	225 1,000.9	101 449	160 713
	#18	2.250 55	2.250 55	4.00 2,581	300.0 1,334.5	400 1,779.4	4.00 2,581	300.0 1,334.5	400 1,779.4	180 799	285 1,268
	#20	2.500 64	2.500 64	4.91 3,168	368.0 1,637.0	491 2,184.0	4.91 3,168	368.0 1,637.0	491 2,184.0	220 980	350 1,555
	#24	3.000 76	3.000 76	7.07 4,561	530.0 2,356.0	707 3,144.9	7.07 4,561	530.0 2,356.0	707 3,144.9	317 1,411	503 2,238
	#28	3.500 89	3.500 89	9.61 6,200	720.0 3,206.0	960 4,274.0	9.61 6,200	720.0 3,206.0	960 4,274.0	432 1,920	685 3,046

The recommended design capacities are based on AISC/ASD and AASHTO/LRFD design methodologies for steel structures and retaining walls. Additional reduction factors from EN1993-5 are applied to the tie rods based on their ability to articulate. Sample calculations can be found below and on pages 35 of this brochure.

SAMPLE CALCULATIONS

Fully Threaded Bar with Articulation

Bar Designation: #8 (1.0 in)

Yield / Tensile: 80 / 100 ksi

Thread & Shaft Properties

Tensile Stress Area (A_s) = 0.79 in²

Yield Capacity (Sh_y, Th_y) = (0.79 in²) * (80 ksi)
= 63.2 kips

Ultimate Capacity (Sh_u, Th_u) = (0.79 in²) * (100 ksi)
= 79 kips

Recommended Design Capacity (F_t)

ASD

F_t = Lesser of:

Sh_y / 1.67 = (0.79 in²) * (80 ksi) / 1.67
= 37.8 kips

0.9 * Th_u / 2 = 0.9 * (0.79 in²) * (100 ksi) / 2.0
= 35.6 kips

F_t = 35.6 kips

LRFD

F_t = Lesser of:

0.95 * Sh_y = 0.95 * (0.79 in²) * (80 ksi)
= 60 kips

0.9 * 0.8 * Th_u = 0.9 * 0.8 * (0.79 in²) * (100 ksi)
= 56.9 kips

F_t = 56.9 kips

TIE RODS

	TIE BARS WITHOUT ARTICULATION										
	Bar	Thread Diameter	Shaft Diameter	THREAD			SHAFT			Recommended Design Capacity	
				Tensile Stress Area	Yield Capacity	Ultimate Capacity	Gross Area	Yield Capacity	Ultimate Capacity		
		D_T in mm	D_g in mm	A_s in² mm²	Th_y kips kN	Th_u kips kN	A_g in² mm²	Sh_y kips kN	Sh_u kips kN	ASD* kips kN	LRFD* kips kN
Cold/Hot Rolled Bars	#8	1.000 25	1.000 25	0.79 510	59.3 263.8	79 351.4	0.79 510	59.3 263.8	79 351.4	24 105	38 169
	#9	1.125 28	1.125 28	1.00 645	75.0 333.6	100 444.8	1.00 645	75.0 333.6	100 444.8	30 133	48 214
	#10	1.250 32	1.250 32	1.27 819	95.3 423.9	127 564.9	1.27 819	95.3 423.9	127 564.9	38 169	61 271
	#11	1.375 35	1.375 35	1.56 1,006	117.0 520.5	156 694.0	1.56 1,006	117.0 520.5	156 694.0	47 208	75 333
	#14	1.750 45	1.750 45	2.25 1,452	168.7 750.4	225 1,000.9	2.25 1,452	168.7 750.4	225 1,000.9	68 300	108 480
	#18	2.250 55	2.250 55	4.00 2,581	300.0 1,334.5	400 1,779.4	4.00 2,581	300.0 1,334.5	400 1,779.4	120 534	192 854
	#20	2.500 64	2.500 64	4.91 3,168	368.0 1,637.0	491 2,184.0	4.91 3,168	368.0 1,637.0	491 2,184.0	147 655	236 1,048
	#24	3.000 76	3.000 76	7.07 4,561	530.0 2,356.0	707 3,144.9	7.07 4,561	530.0 2,356.0	707 3,144.9	212 943	339 1,510
	#28	3.500 89	3.500 89	9.61 6,200	720.0 3,206.0	960 4,274.0	9.61 6,200	720.0 6,206.0	960 4,274.0	288 1,282	461 2,052

The recommended design capacities are based on AISC/ASD and AASHTO/LRFD design methodologies for steel structures and retaining walls. Additional reduction factors from EN1993-5 are applied to the tie rods based on their ability to articulate. Sample calculations can be found below and on pages 34 of this brochure.

SAMPLE CALCULATIONS

Fully Threaded Bar without Articulation

Bar Designation: #8 (1.0 in)

Yield / Tensile: 80 / 100 ksi

Thread & Shaft Properties

Tensile Stress Area (A_s) = 0.79 in²

Yield Capacity (Sh_y, Th_y) = (0.79 in²) * (80 ksi)
= 63.2 kips

Ultimate Capacity (Sh_u, Th_u) = (0.79 in²) * (100 ksi)
= 79 kips

Recommended Design Capacity (F_t)

ASD

F_t = Lesser of:

Sh_y / 1.67 = (0.79 in²) * (80 ksi) / 1.67
= 37.8 kips

0.6 * Th_u / 2 = 0.6 * (0.79 in²) * (100 ksi) / 2.0
= 23.7 kips

F_t = 23.7 kips

LRFD

F_t = Lesser of:

0.95 * Sh_y = 0.95 * (0.79 in²) * (80 ksi)
= 60 kips

0.6 * 0.8 * Th_u = 0.6 * 0.8 * (0.79 in²) * (100 ksi)
= 37.9 kips

F_t = 37.9 kips

APPLICATIONS

MICROPILES

Micropiles are small diameter, bored cast-in-place piles, with most of the applied load being resisted by steel reinforcement. They are constructed by drilling a borehole, often using casing, then placing steel reinforcement and grouting the hole. Micropiles have a wide range of uses and are becoming a more mainstream method of supporting and resupporting foundations, seismic retrofits, stabilization of slopes and even earth retention.

Micropiles are usually designed in small clusters or groups with each typically carrying an equal amount of load. These piles may also be designed with a batter to improve the lateral rigidity of the group. They can be designed to resist a combination of compression, tension and lateral forces.

Micropiles are an ideal pile for complex sites where low vibration or low noise levels are required, or where limited access such as low headroom and drilling is difficult. Other site conditions that make micropiles attractive are: obstructions, large cobbles or boulders, nearby sensitive structures, karst topography or high groundwater conditions. The unique characteristics of micropiles make them a perfect solution when other deep foundation methods are not suitable.

APPLICATIONS

- Structural Support of Directly Loaded Pile
- New Foundations
- Underpinning of Existing Structures
- Seismic Retrofitting
- Reinforcement for Slope Stabilization and Settlement Reduction
- Support of Excavation – Soldier Piles
- Permanent Retaining Walls

ADVANTAGES

- Create piles with relatively high axial load capacity
- Work in compression and tension
- Lightweight rotary percussive equipment can be used
- Easily installed within confined spaces
- No harmful vibrations or noise to surrounding structures
- Minimal spoil generation on contaminated sites

MICROPILES

HOLLOW BARS: MICROPILES

Micropiles produced with hollow bars have been well proven and are widely accepted in private and public works in the United States. After extensive research, the system has been accepted by the Federal Highway Administration (FHWA).

In collapsing soils, the use of hollow bars to produce micropiles is ideal. Where open hole drilling may be limited in depth or temporary casing is required, hollow bars offer a single step process of grouting and reinforcing. In addition, higher values of ground to grout bond have resulted from the use of this method. The smaller, and often less expensive equipment, used with the hollow bar system allows for lower project costs and makes it easier for less specialized general contractors to use. This system is also perfect in sites with limited access or low headroom.

ADVANTAGES

- Work in compression and tension
- Potential for very high production rates
- The most efficient form of a pile in confined spaces
- Hollow bars form smaller pile groups
- Grouting while drilling provides a potential for densification of in-situ soils

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As we are constantly evolving, here is where you'll find our latest updates.

02/23 Edition