ESR Rated Product Capacity Comparison
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ESR reports are used by engineer and building officials to determine the capacity, limits and installation procedures of a product. It's a vital tool that provides consistency, reliability and quality of the product being specified. Helical piles are no exception. Helical piles were first used more than 175 years ago. However, it wasn't until 2007 when the International Code Council (ICC) adopted an acceptance criterion for helical piles (AC358) that the industry had a unified standard for measuring and evaluating the capacity of a helical system.

We have already seen and will continue to see competitors marketing their products as meeting or complying with AC358. However, most of the helical manufacturers claiming this do not have an Evaluation Service Report (ESR) issued to them by ICC. Here is one example.

> ✓ MEETING MODERN STANDARDS
> Magnum is one of the first manufacturers to apply for ICC-ES evaluation under the new AC358 criteria. Magnum's products have been have been designed to meet or exceed ICC-ES AC358 criteria and have been tested by an IAS accredited laboratory in accordance with AC358. The ICC-ES evaluation under the new AC358 criteria means that you will be specifying products that meet or exceed the most up-to-date industry standards, which gives you a high level of assurance that the product will perform as designed.

Several helical pile manufacturers are marketing with similar tactics. You will need to address this with your client or engineer. Just saying that your product meets a few of the criteria requirements doesn't mean a product meets all of them. My question would be, "If their products were truly tested and met the criterion of AC358, why hasn't ICC recognized their product and capacities by issuing them an ESR report?"

As of February 1, 2014, there are only four helical manufacturers that hold ESR reports evaluated per AC358, Ram Jack, MacLean-Dixie, Chance and Foundation Supportworks. We are seeing more and more engineers and building officials requiring ESR recognized products. This trend will continue. It's becoming more and more vital to understand the basics of what is reported in an ESR report and to be able to tell the differences between manufacturer's reports. If you don't understand the basics and differences between the ESR reports, you are going to be at a great disadvantage.

Since there are now four manufacturers with ESR reports, I thought it was a good time to breakdown the capacities of each manufacturer's product and see how the products ranked against each other. Attached are three tables, Table 1 – Side Load Brackets, Table 2 – New Construction (compression) and Table 3 – New Construction (tension). Even though I have summarized the key capacities in the footnotes under each table, I wanted to provide you with a more in depth explanation of the capacities shown in the tables and what they represent so you have an understanding of the data presented.

System Capacity – Section 3.1 of AC358 requires the capacities of the four primary structural elements of a helical pile system to be evaluated. These elements are: Bracket Capacity, Pile Shaft Capacity, Helix Plate Capacity and Soil Capacity. The allowable capacity of the helical pile system is the lowest structural element value.

Shaft Capacity – This represents the structural capacity of the pile shaft. There is some variance in how this was reported in the different ESR reports. Chance was the only manufacturer that elected to have their system evaluated as a fully braced system. Therefore in order to make a fair comparison, all the shaft capacities listed in the table are for a fully braced pile shaft. It should be noted that MacLean-Dixie's report (ESR-3032) did not list the actual shaft capacity. Their shaft capacities are related to the maximum capacity they obtained from their verification tests (see soil capacity). It is also important to note that since Chance chose to evaluate their system as a fully braced system, ICC placed additional restrictions on situations where their piles can be used. Section 4.1.3 of ESR-2794 states, no portion of Chance's pile may stand in air, water or fluid soil. In Section 4.1.8 part 4, ICC requires the engineer of record to detail the bracing of the pile for compliance with Section 1810.2.2 of the IBC.

Bracket Capacity – AC358 allows the manufacturer to perform full scale load tests as prescribed in AC358 or calculations per applicable code standards. All the manufacturers provided capacity calculations for their new construction brackets. However, Chance was the only manufacturer that provided design calculations for their side load brackets. The other manufacturers chose to test their brackets per AC358 with a minimum 5-foot unbraced length per the IBC.

Soil Capacity – A series of full scale load tests are performed in compression and tension to verify the default torque correlation factor (K_t) for each pile shaft. Verification tests are also performed on piles with single 8-inch and 14-inch diameter helical plates in tension and compression. The verification tests are full scale load tests and the piles are installed to the maximum torsional rating of the pile shaft. The torque correlation method is used to predict the load capacity of the pile. If the pile did not meet or exceed the predicted load capacity during the verification test, the maximum allowable load of the pile shaft in compression and/or tension is reported in the manufacturer's ESR report. These are the values listed in the soil capacity column in the attached tables.

Helix Plate Capacity – The helix plate capacity for all the manufacturers exceeded the system capacity ratings for their respective system. Therefore, I didn't include the helix plate ratings for any of the manufacturers in the attached tables.

In order to be fair and objective, I pulled the data from the reports with the same criteria, (piles installed in firm soil, minimum compressive strength of concrete 2,500 psi and minimum width of grade beam for new construction brackets to be 14-inches. I think the Tables are useful as they line up the products to ensure capacity requirements can be met.

As the attached comparison tables show, all helical piles are not created equal.

Below is an executive summary of key points and highlights you should find in the comparison tables and know about the different ESR reports.

- Ram Jack has the highest torsional rating on a 2 $^{7}/_{8}$" pile
- Ram Jack has the highest torsional rating of any pile recognized by ICC (3 ½" pile)
- Ram Jack has the highest rated side load bracket with the 4021.55 (3 ½" pile).
- Foundation Supportworks has the highest rated side load bracket for the 2 $^{7}/_{8}$" pile. FSW's galvanized side load bracket is rated at 35.1 kips. Ram Jack's 4021.1 bracket is rated at 33.7 kips. There's only a 1.4 kip difference.
- Foundation Supportworks had their products rated for uncoated (bare steel) and galvanized steel. The galvanization appears to add some capacity to the steel.
- Ram Jack's 4079.1 new construction bracket (2 $^{7}/_{8}$" pile) has a higher system rating than all of our competitors in compression and tension
- Ram Jack had the highest system rating for a new construction bracket (4076.1 bracket on a 3 ½" pile) at 49 kip compression and 44.8 kip in tension
- Ram Jack and MacLean-Dixie were the only two manufacturers that had their systems evaluated under lateral loads. Therefore, we are the only ones that should be allowed to distribute lateral loads to our piles.
- Ram Jack is the only manufacturer to have a floor slab bracket recognized by ICC
- Ram Jack is the only manufacturer to have a wall tieback system recognized by ICC
- Chance piles were evaluated as a fully braced system. Therefore, no portion of their piles can be exposed to air, water or fluid soil. This means they are not allowed to use their system when penetrating peat bogs, liquefaction zones, boardwalks, under crawl space structures,… unless an engineered means of bracing the pile is provided.
- Chance and Foundation Supportworks only provided localized limit states such as mechanical strength of steel components and concrete bearing for their new construction brackets. The engineer of record will be required to calculate the minimum embedment for punching shear and other limit states referenced in their respective ESR reports.
- All the manufacturers use a standard external sleeve over their pile shafts with their side load brackets ranging from 18 to 48 inches. Even though the ESR reports for MacLean-Dixie, Chance and Foundation Supportworks don't address the issue. The through bolts on their couplers protrude past the plane of their pile shaft which would prevent the sleeve from being placed. How do they install an external sleeve over their pile when the couplers are within the zone of the pile the sleeve must be placed.

Table 1: Allowable Load Capacity of Side Load Brackets per ESR Reports Compliant with AC358 [1]

Helical Manufacturer	Pile Type	Torque Rating	K_t	Shaft Capacity [2]	Bracket Number	External Sleeve (diameter = Ø)	Bracket Capacity (Compression)	Soil Capacity [3]	System Capacity [4]
Ram Jack (ESR-1854)	2 7/8" dia.	8,200 ft-lbs	9	60.0 k	4021.1	3 1/2"Ø x 4'-0	33.7 k	36.9 k	33.7 k
					4038.1	None	19.7 k		19.7 k
					4039.1	3 1/2"Ø x 4'-0	32.1 k		32.1 k
	3 1/2" dia.	14,000 ft-lbs	7		4021.55	4 1/2"Ø x 4'-0	55.1 k	49.0 k	49.0 k
MacLean Dixie (ESR-3032)	1 1/2" sq. Bar	5,500 ft-lbs	10	27.5 k	Dixie 350-B4	2 7/8"Ø x 3'-4	24.0 k	27.5 k	24.0 k
	1 3/4" sq. Bar	9,000 ft-lbs		45.0 k	Dixie 350-B5	3 1/2"Ø x 3'-4	38.5 k	45.0 k	38.5 k
	2 7/8" dia.	7,500 ft-lbs	9	27.3 k	Dixie 350-B6	3 1/2"Ø x 3'-4	30.0 k	27.3 k	27.3 k
	3 1/2" dia.	10,400 ft-lbs	7	30.3 k	Dixie 350-B7	4"Ø x 3'-4	37.0 k	30.3 k	30.3 k
Chance [5] (ESR-2794)	1 1/2" sq. Bar	5,700 ft-lbs	10	varies: 22.1 k to 35.0 k	C1500121	2 5/8"Ø x 1'-6	21.7 k	28.5 k	21.7 k
					C1500121	2 5/8"Ø x 1'-6	32.8 k		28.5 k
					C1500738	Incl w/ bracket	30.5 k		28.5 k
	1 3/4" sq. Bar	10,500 ft-lbs		varies: 33.1 k to 60.0 k	C1500299	2 7/8"Ø x 1'-6	36.8 k	31.4 k	31.4 k
					C1500147	3 1/4"Ø x 2'-10	54.4 k		31.4 k
Foundation Supportworks [6] (ESR-3074)	2 7/8" dia.	7,898 ft-lbs	9	60.0 k	FS288B	3 1/2"Ø x 2'-6	24.9 k	35.5 k	24.9 k
					FS288B-G		27.9 k		27.9 k
					FS288B	3 1/2"Ø x 4'-0	31.4 k		31.4 k
					FS288B-G		35.1 k		35.1 k
					FS288BL	3 1/2"Ø x 2'-6	25.3 k		25.3 k
					FS288BL-G		28.2 k		28.2 k
Cantsink	2 7/8" dia.	6,000 ft-lbs	9	30.0 k	Repair Brack.	None	18.0 k	27.5 k	18.0 k

[1] The purpose of Table 1 is to compare the ICC recognized capacities of remedial repair side load bracket with current ESR reports compliant with AC358. In order to provide a level playing field for comparison, the capacities shown are based on piles installed in firm soil (N-value $\geq$ 5) and a minimum concrete compressive strength of 2,500 psi.

[2] Section 3.8 of AC358 limits the maximum allowable axial capacity of a helical pile evaluated per AC358 criterion to a maximum of 60 kips.

[3] Soil capacity is based on torque correlation method with piles installed at maximum torque rating. If the piles tested less than this, the lower values are listed in each ESR report.

[4] AC358 and the ESR reports require the allowable capacity of a system to be taken as the lowest capacity of the bracket capacity, pile shaft capacity, helix plate capacity, and soil capacity. The helix plate capacity did not govern the system capacity for any of the manufacturers. Therefore, helix plate capacities were excluded from Table 1.

[5] Chance is the only helical manufacturer that elected to have their system evaluated as a fully braced system. Therefore, they have additional restrictions. No portion of their piles may stand in air, water or fluid soil (Section 4.1.3 of ESR-2794). Per Section 4.1.8 the engineer must show pile bracing details on their drawings compliant with Section 1810.2.2 of the IBC.

[6] Foundation Supportworks bracket numbers with a "G" suffix indicate hot-dipped galvanized coating. Part numbers without a "G" suffix indicate plain steel.

*The data shown in the Table is from current ESR reports respective of the noted helical manufactuer as of January 7, 2015

Table 2: Allowable Compression Capacity of New Construction Brackets per ESR Reports Compliant with AC358 [1]

Helical Manufacturer	Pile Type	Torque Rating (ft-lbs)	K_t	Bracket Number	Bearing Plate Dimn. (in)	Min. Embedment [2] (in)	Allowable Compression Capacity			System Capacity [5]
							Pile Shaft [3]	Bracket	Soil [4]	
Ram Jack (ESR-1854)	2 7/8" dia.	8,200	9	4075.1	8 x 4 x 5/8"	8.0	60.0 k	18.2 k	36.9 k	18.2 k
				4079.1	8 x 8 x 5/8"	8.0		36.5 k	36.9 k	36.5 k
	3 1/2" dia.	14,000	7	4076.1	9 x 9 x 1"	10.0		49.5 k	49.0 k	49.0 k
MacLean Dixie (ESR-3032)	1 1/2" sq. Bar	5,500	10	NCB060604CP1	6 x 6 x 1/2"	8.6	27.5 k	25.6 k	27.5 k	25.6 k
	1 3/4" sq. Bar	9,000		NCB080806CP2	8 x 8 x 3/4"	9.7	45.0 k	35.0 k	45.0 k	35.0 k
	2 7/8" dia.	7,500	9	NCB060604CP1B	6 x 6 x 1/2"	11.0	27.3 k	30.0 k	27.3 k	27.3 k
	3 1/2" dia.	10,400	7	NCB080806CP2B	8 x 8 x 3/4"	15.0	30.3 k	40.0 k	30.3 k	30.3 k
Chance [6] (ESR-2794)	1 1/2" sq. Bar	5,700	10	C1500458G	6 x 6 x 1/2"	See Note 8	varies: 21.1 k to 35.0 k	33.7 k	28.5 k	28.5 k
				C1500465G						28.5 k
	1 3/4" sq. Bar	10,500		C1500459G	6 x 6 x 3/4"		varies: 33.1 k to 60.0 k	52.7 k	33.4 k	33.4 k
				C1500467G						33.4 k
Foundation Supportworks [7] (ESR-3074)	2 7/8" dia.	7,898	9	HP288NCB	6 x 6 x 1/2"	See Note 8	60.0 k	40.8 k	35.5 k	35.5 k
				HP288NCB-G				40.8 k		
				HP288NCB8	8 x 8 x 3/4"			43.1 k		
				HP288NCB8-G				46.5 k		
Cantsink	2 7/8" dia.	6,000	9	New Construction	8 x 8 x 3/8"	8	30.0 k	26.0 k	27.5 k	26.0 k

[1] The purpose of Table 2 is to compare the ICC recognized capacities of new construction brackets with current ESR reports compliant with AC358. In order to provide a level playing field for comparison, the capacities shown are based on piles installed in firm soil (N-values $\geq$ 5), min. foundation width of 14-inches and a min. concrete compressive strength of 2,500 psi.

[2] The minimum embedment shown for compression applications is measured from the top of the concrete foundation to the top of the bracket bearing plate. The bearing plate of all the brackets must be embedded a minimum of 3-inches from the bottom of the foundation. The embedment depth is based on minimum concrete cover for punching shear.

[3] Section 3.8 of AC358 limits the maximum allowable axial capacity of a helical pile evaluated per AC358 criterion to a maximum of 60 kips.

[4] Soil capacity is based on torque correlation method with piles installed at maximum torque rating. If the piles tested less than this, the lower values are listed in each ESR report.

[5] AC358 and the ESR reports require the allowable capacity of a system to be taken as the lowest capacity of the bracket capacity, pile shaft capacity, helix plate capacity, and soil capacity. The helix plate capacity did not govern the system capacity for any of the manufacturers. Therefore, helix plate capacities were excluded from Table 1.

[6] Chance is the only helical manufacturer that elected to have their system evaluated as a fully braced system. Therefore, they have additional restrictions. No portion of their piles may stand in air, water or fluid soil (Section 4.1.3 of ESR-2794). Per Section 4.1.8 the engineer must show pile bracing details on their drawings compliant with Section 1810.2.2 of the IBC.

[7] Foundation Supportworks bracket numbers with a "G" suffix indicate hot-dipped galvanized coating. Part numbers without a "G" suffix indicate plain steel.

[8] Chance and Foundation Supportworks bracket capacities are based on localized limit state of concrete in bearing only. All other limit states related to the concrete foundation, such as punching shear, were not evaluated in their ESR reports. Their ESR reports require an engineer to calculate the appropriate limit states of their brackets for each project.

*The data shown in the Table is from current ESR reports respective of the noted helical manufacturer as of January 7, 2015.

Table 3: Allowable Tension Capacity of New Construction Brackets per ESR Reports Compliant with AC358 [1]

Helical Manufacturer	Pile Type	Torque Rating (ft-lbs)	K_t	Bracket Number	Bearing Plate Dimn. (in)	Min. Embedment [2] (in)	Allowable Tension Capacity			System Capacity [5]
							Pile Shaft [3]	Bracket	Soil [4]	
Ram Jack (ESR-1854)	2 7/8" dia.	8,200	9	4075.1	8 x 4 x 5/8"	9.0	60.0 k	18.2 k	36.9 k	18.2 k
				4079.1	8 x 8 x 5/8"	10.0		36.5 k	36.9 k	36.5 k
	3 1/2" dia.	14,000	7	4076.1	9 x 9 x 1"	11.0		47.2 k	44.8 k	44.8 k
MacLean Dixie (ESR-3032)	1 1/2" sq. Bar	5,500	10	NCB060604CP1	6 x 6 x 1/2"	10.6	27.5 k	25.6 k	27.5 k	25.6 k
	1 3/4" sq. Bar	9,000		NCB080806CP2	8 x 8 x 3/4"	11.7	45.0 k	35.0 k	45.0 k	35.0 k
	2 7/8" dia.	7,500	9	NCB060604CP1B	6 x 6 x 1/2"	13.0	27.3 k	30.0 k	27.3 k	27.3 k
	3 1/2" dia.	10,400	7	NCB080806CP2B	8 x 8 x 3/4"	15.0	30.3 k	40.0 k	30.3 k	30.3 k
Chance [6] (ESR-2794)	1 1/2" sq. Bar	5,700	10	C1500465G	6 x 6 x 1/2"	See Note 8	varies: 21.1 k to 35.0 k	28.1 k	27.9 k	27.9 k
	1 3/4" sq. Bar	10,500		C1500467G	6 x 6 x 3/4"		varies: 33.1 k to 60.0 k	39.5 k	28.7 k	28.7 k
Foundation Supportworks [7] (ESR-3074)	2 7/8" dia.	7,898	9	HP288NCB	6 x 6 x 1/2"	See Note 8	60.0 k	29.9 k	27.6 k	27.6 k
				HP288NCB-G				29.9 k		
				HP288NCB8	8 x 8 x 3/4"			34.1 k		
				HP288NCB8-G				38.2 k		
Cantsink	2 7/8" dia.	* The tension capacity of new construction bracket and pile are not recognized by ICC-ES in ESR-1559 *								0.0 k

[1] The purpose of Table 2 is to compare the ICC recognized capacities of new construction brackets with current ESR reports compliant with AC358. In order to provide a level playing field for comparison, the capacities shown are based on piles installed in firm soil (N-values $\geq$ 5), min. foundation width of 14-inches and a min. concrete compressive strength of 2,500 psi.

[2] The minimum embedment shown for tension applications is measured from the bottom of the concrete foundation to the top of the bracket bearing plate. The bearing plate of all the brackets must be embedded a minimum of 3-inches from the bottom of the foundation. The embedment depth is based on minimum concrete cover for punching shear.

[3] Section 3.8 of AC358 limits the maximum allowable axial capacity of a helical pile evaluated per AC358 criterion to a maximum of 60 kips.

[4] Soil capacity is based on torque correlation method with piles installed at maximum torque rating. If the piles tested less than this, the lower values are listed in each ESR report.

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[7] Foundation Supportworks bracket numbers with a "G" suffix indicate hot-dipped galvanized coating. Part numbers without a "G" suffix indicate plain steel.

[8] Chance and Foundation Supportworks bracket capacities are based on localized limit state of concrete in bearing only. All other limit states related to the concrete foundation, such as punching shear, were not evaluated in their ESR reports. Their ESR reports require an engineer to calculate the appropriate limit states of their brackets for each project.

*The data shown in the Table is from current ESR reports respective of the noted helical manufacturer as of January 7, 2015.