Hoyt Engineering Associates

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August 28, 2009

Evaluation of Tension, Compression, Flexure and Torsion Strengths of Helical Anchors, Inc. Helical Pier Shafts

At the request of Helical Anchors, Inc., I supervised physical testing and conducted structural analyses of their helical pier shaft assemblies to establish ultimate strength ratings in tension, compression, flexure and torsion. "Ultimate strength" is the maximum load that is reached in a strain-controlled test. Where ratings were established by testing, statistical analysis of the results was used to determine the 5% exclusion limit for the ultimate strength. Where ratings were established by calculation, the analyses were directed at predicting the 5% exclusion limit that could be expected to result from statistical analysis of laboratory test results from a statistically meaningful group of samples. The 5% exclusion limit is the strength that 95% of a total population of like products would be expected to meet or exceed. The resulting strength ratings should not be assumed to meet the requirements of the American Institute of Steel Construction's Allowable Strength Design (ASD), Load & Resistance Factor Design (LRFD), or 360-05 integrated design specifications, none of which apply to portions of structural elements that are embedded in the earth.

The results of the evaluations are given in the table below. These mechanical strength estimates form upper bounds to the ultimate loads that can be achieved in the field. Other limit states that may be the controlling factor in any specific project include pullout, plunging or overturning due to exceeding the soil's bearing capacity and shaft buckling under compressive loading, all of which must be evaluated in light of the soil profile in which the elements will be embedded. Serviceability limit states must also be considered in the determination of allowable loads for specific projects.

Shaft Designation	Calculated Minimum Ultimate Strength			
	Tension (lbs)	Compression (lbs)	Flexure (lb-in)	Torsion* (lb-ft)
2-3/8 x 0.190	125,000	100,000	70,000	7500
2-3/8 x 0.254	125,000	135,000	90,000	9000
2-3/8 x 0.280	125,000	140,000	90,000	8000
2-7/8 x 0.217	180,000	140,000	120,000	13,000
2-7/8 x 0.276	180,000	180,000	150,000	16,000
3-1/2 x 0.254	250,000	210,000	210,000	18,000
3-1/2 x 0.368	250,000	290,000	290,000	27,000
4-1/2 x 0.337	360,000	350,000	470,000	48,000

*Value determined by statistical analysis of laboratory testing results

Robert M. Hoyt, PE, F.ASCE
President/Principal
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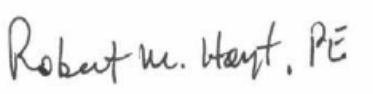
I certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Professional Engineer under the laws of the State of Minnesota.



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Date: 28 Aug 2009 License # 46668

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October 16, 2009

Evaluation of Flexural Strengths of Helical Anchors, Inc. Helical Pier Helix Plates

At the request of Helical Anchors, Inc., I supervised physical testing of their helical pier shaft/helix plate assemblies and conducted data analyses to determine the average ultimate strengths thereof in flexural loading. "Ultimate strength" in this case was established as specified in the International Codes Council Evaluation Service's Acceptance Criteria AC358. That is, it was the maximum load that was reached in a strain-controlled laboratory test using a defined test fixture. The raw ultimate strength data was then normalized for the effects of corrosion over a 50-year lifetime as specified in AC358.

The normalized ultimate strength averages for the various combinations of plate OD, shaft OD and plate thickness are given in Table 1 below. These mechanical strengths, or appropriate sums thereof for multi-helix piers, form upper bounds to the ultimate load that can be achieved in the field. Other limit states that may be the controlling factor in any specific project include pullout, plunging or overturning due to exceeding the soil's bearing capacity and shaft buckling under compressive loading, all of which must be evaluated in light of the soil profile in which the elements will be embedded. Shaft coupling strength may be the controlling limit state for tension loading. Serviceability limit states must also be considered in the determination of allowable loads for specific projects.

Table 1: Mean Ultimate Strengths for Helix Plates and Helix Plate/Shaft Joints (lbs)

Helix Plate OD x Thickness (in)	Shaft OD			
	2-3/8 (in)	2-7/8 (in)	3-1/2 (in)	4-1/2 (in)
8 x 3/8	97,000	112,000	Not Tested	Not Tested
10 x 3/8	78,000	84,000	91,000	Not Tested
12 x 3/8	66,000	82,000	83,000	Not Tested
14 x 3/8	52,000	65,000	68,000	Not Tested
16 x 3/8	Not Tested	Not Tested	46,000	Not Tested
8 x 1/2	Not Tested	151,000	Not Tested	Not Tested
10 x 1/2	Not Tested	97,000	108,000	Not Tested
12 x 1/2	Not Tested	100,000	113,000	105,000
14 x 1/2	Not Tested	80,000	104,000	96,000
16 x 1/2	Not Tested	Not Tested	82,000	102,000

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Date: 16 Oct 2009 License # 46668