Wind Turbine Foundation Systems

- Foundation Anchor Bolts
- Prestressed Ground Anchors
- High Strength Grouts
- Concrete Forming Accessories
Advantages of Using Williams Anchor Bolts

- Extensive quality control and manufacturing program produces the highest quality bolts in the market
- Eight manufacturing plants throughout North America allow for the most efficient distribution network and timely deliveries
- Anchor bolts have been cold temperature tested to assure full load retention and reliability in harsh environments
- Advanced engineered components maintain strict tolerances to ensure the highest product standards
- Leading anchor bolt manufacturer in the industry with over 20 years experience
- Technically advanced sales staff and best customer service in the industry
- Custom anchor diameters and grades available upon customer request
- Shipments are custom packaged per customer's requirements
- Anchor bolt bundles include bar code tags for positive US steel mill traceability
- Anchor bolts can be chamfered to assist tower installation
- Anchor bolts can be color coded or include Q/C tag on bolt end for jobsite identification after installation
- Special A193 B7 150 KSI High Impact Steel available upon request

Williams Form Engineering pioneered the heavy duty thread forms present on the Grade 75 and 150 KSI anchor bolts three decades ago for use in the civil construction industry. The anchor bolts gained popularity due to the rugged nature of the thread form and concentric thread design. The wide thread pitch allows for fast hex nut engagement while still allowing precise adjustments when necessary. These factors contributed to designer acceptance of the Williams Grade 75 and 150 KSI threaded bars in the late 1990’s as renewable energy started to gain wide range acceptance. Today each wind tower supported by a Williams foundation anchor bolt can be relied upon to perform flawlessly throughout the life of the turbine.

### Advantages of Using Williams Anchor Bolts

**Bar Designation & Nominal Diameter** | **Pitch** | **Minimum Net Area Through Threads** | **Minimum Ultimate Strength** | **Minimum YIELD Strength** | **Nominal Weight** | **Approx. Thread Major Diameter** | **Part Number**
--- | --- | --- | --- | --- | --- | --- | ---
#7 - 7/8” (22 mm) | 5 | 0.60 in² (387 mm²) | 60 kips (267 kN) | 45 kips (200 kN) | 2.0 lbs/ft (3.0 kN/m) | 1” (25 mm) | R61-07
#8 - 1” (25 mm) | 3-1/2 | 0.79 in² (510 mm²) | 79 kips (351 kN) | 59 kips (264 kN) | 2.7 lbs/ft (3.9 kN/m) | 1-1/8” (29 mm) | R61-08
#9 - 1-1/8” (32 mm) | 3-1/2 | 1.00 in² (645 mm²) | 100 kips (445 kN) | 75 kips (334 kN) | 3.4 lbs/ft (5.1 kN/m) | 1-1/4” (32 mm) | R61-09
#10 - 1-1/4” (3-1/2 mm) | 3 | 1.27 in² (819 mm²) | 127 kips (565 kN) | 95 kips (424 kN) | 4.3 lbs/ft (6.5 kN/m) | 1-3/8” (38 mm) | R61-10
#11 - 1-3/8” (43 mm) | 3 | 1.56 in² (1006 mm²) | 156 kips (694 kN) | 117 kips (521 kN) | 5.3 lbs/ft (8.5 kN/m) | 1-1/2” (36 mm) | R61-11
#12 - 1-1/4” (43 mm) | 3 | 2.25 in² (1452 mm²) | 225 kips (980 kN) | 169 kips (750 kN) | 7.6 lbs/ft (11.8 kN/m) | 1-7/8” (48 mm) | R61-14

**R61 Grade 75 Anchor Bolts - ASTM A615**

**1-3/8” 150 KSI Anchor Bolt**

**11 Grade 75 Anchor Bolt**

**#11 Grade 75 Anchor Bolt**

**R71 150 KSI Anchor Bolts - ASTM A722**

**3-1/2” 150 KSI Anchor Bolt**

**#11 Grade 75 Anchor Bolt**

**R91 Grade 90 Anchor Bolts**

**8.8 Equivalent Bolts**

**Grade 8.8 Equivalent Bolts**

**Grade 10.9 Equivalent Bolts**

* The 2-1/4” bar is not covered under ASTM A722
Anchor Bolt Accessories

All Williams fasteners are designed to provide 100% of the guaranteed ultimate strength of the bar and meet ACI 318 Section 25.5.7.1 for mechanical rebar connections. Tower Positioning Nuts are used to secure the bolt to the embedment ring during assembly and placement, or for leveling the template rings. They can not be substituted for full strength nuts.

### Full Strength Hex Nuts

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### Hardened Washers

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* Hardware dimensions shown are for standard carbon steel and can be provided galvanized or uncoated.
Corrosion Protection

**PVC Sleeve**

The Williams Tower End Cap was designed to protect the foundation anchor bolts from harsh weather conditions. This resilient cap is made from high impact resistant polypropylene with UV inhibitors and attaches to the bolt for a great fit. The caps include a rubber o-ring to positively seal the cap against the tower flange, and can accommodate up to 3 extra thick hardened washers if needed.

For proper installation, Williams recommends pushing the cap fully onto the anchor bolt, followed by turning in the direction of the threads to completely engage. Also recommended is the application of grease or some other corrosion inhibiting compound to the bolt prior to cap installation.

Williams Tower End caps are for protection of the tower foundation anchor bolts. With application of sufficient corrosion protective compound and proper installation, these caps will protect the foundation anchor bolt protrusion above the tower base from corrosion. However, these caps are not warranted against damage caused by falling sheet ice, extraordinary occurrence such as, but not limited to fire, improper installation methods, or destructive actions by humans or animals.

**R79T Tower End Cap**

<table>
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<tr>
<th>Maximum Anchor Bolt Projection</th>
<th>Anchor Bolt Type</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>13&quot; (330 mm)</td>
<td>#10 &amp; #11 Grade 75 Rebar &amp; #11 Grade 90 Rebar</td>
<td>R79T2413</td>
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<tr>
<td>15&quot; (381 mm)</td>
<td>1-1/4&quot; &amp; 1-3/8&quot; 150 KSI Bar M36 - M42 Bolts</td>
<td>R79T2615</td>
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<tr>
<td>16&quot; (406 mm)</td>
<td>#14 Grade 75 Rebar 1-3/4&quot; 150 KSI Bar</td>
<td>R79T3216</td>
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**Corrosion Protected Tower Anchor Bolts**

When enhanced corrosion protection is required of wind turbine foundation anchors, Williams offers several types of corrosion protection options, see the Williams “Ground Engineering Systems” catalog for more details on corrosion resistance of our products.

- **Pre-Grouted Bolts** with corrugated sleeves meet Post-Tensioning Institute standards for prestressed rock and soil anchors.

- **Epoxy Coated Bolts** are fusion bonded to ASTM A775 or A934 and are available with oversize threaded full strength coated nuts.

- **Hot Dip Galvanized Bolts** to ASTM A153 with oversize threaded full strength coated nuts.

- **Pre-Greased Bolts** with Post-Tensioning Institute approved corrosion inhibitors are shipped within a smooth small diameter PVC sleeve.
Wind turbine foundations situated on difficult geological grades such as very stiff coarse-grained soils or rock are often tied down to the earth with deep-embedded, grout bonded anchors. These large diameter rock or soil anchors are installed around the perimeter of the turbine foundation. They require less excavation and a substantial reduction in the amount of poured concrete versus traditional reinforced concrete spread footing foundations. Williams offers rock and soil anchors in various size high strength 150 KSI grade bars or 270 KSI multi-strand tendons. See the Williams “Ground Engineering Systems” catalog for more details.
Concrete Accessories

**Ultra-Bond Epoxy**
Williams recommends Ultra-Bond Epoxy as an excellent choice when a high strength, fast setting adhesive is necessary. It is a two component (1:1 ratio) high modulus structural epoxy gel that provides maximum field reliability in a wide temperature (35 to 115 degree F) range with a minimum cure time. Talk to a Williams technical representative for more details concerning its use on wind turbine foundations.

**Williams Wind Foundation Non-Shrink Grout**
A high flow, high strength grout ideal for grouting wind tower foundations. Conforming to ASTM C-1107 with an ultimate average strength of 12,000 psi in 28 days and quick set times in temperatures as low as 35°F.

**Williams Wind Foundation Epoxy Grout**
A high performance, precision flowable epoxy grout engineered to meet the needs of the wind construction industry. Williams Wind Foundation Epoxy grout is an ideal product choice for turbine foundation grout pads when the schedule demands a quick turn around time. Average 24 hour strengths of 12,000 PSI and ultimate strengths up to 16,000 PSI means faster tower erection, quicker torque down time for foundation anchor bolts, greater dynamic loading, vibration dampening and reduced maintenance costs.

**Chemicals**
Williams distributes a full line of environmentally friendly construction chemicals, from VOC compliant high performance concrete sealers and curing compounds to biodegradable form-releases and evaporation retarders. All products are designed and supplied to meet today's jobsite environmental standards.

**Concrete Forms**
Williams Concrete Accessories Division can support a wide array of forming needs for today's foundation contractor, from custom steel pedestal forms to perimeter spread footing forms. Williams can provide a form package to keep your project on schedule. Our services include detailed drawings as well as forms for rental or purchase.

**Additional Concrete Accessories**
Additional items include a full line of concrete finishing tools, screeds, vibrators, mortar mixers, cold weather curing blankets, electric blankets and forming hardware.
Project: Bingham Wind Project
Contractor: Reed & Reed/Maine Drilling & Blasting
Designer: Barr Engineering
Location: Bingham, ME

Project: Peetz Colorado
Contractor: Blattner Energy Inc.
Location: Peetz, CO

Project: Rail Splitter Wind Farm
Contractor: White Construction, Inc.
Location: Delavan, IL

Project: Blue Trail Wind Farm
Contractor: TransAlta
Location: Ft. Macleod, AB

Project: Shilo II Wind Farm
Contractor: M.A. Mortenson Co.
Location: Rio Vista, CA
Photo: enXco & Mortenson Co.

Project: Windy Flats Wind Farm
Contractor: Dressel Enterprises, Inc.
Location: Goldendale, WA
Williams offers a full line of Ground Anchors, Concrete Anchors, Post-Tensioning Systems, Wind Turbine Foundation Systems, Marine Tieback Systems and Concrete Forming Hardware Systems for whatever your needs may be.

Also available from Williams are Rock & Soil Anchor Sample Specifications and High Capacity Concrete Anchor Sample Specifications.

FORM HARDWARE & ROCK BOLT (Canada) LTD.

We have representation in the following organizations: