Introduction
Precast Wind Tower Foundations
Mobile Precast as the Foundation of Wind Power

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PRECAST WIND & U.S. ELECTRIC MARKET

2014

SAND
EI
PT

75% Less Concrete

C&I

Google
Warren Buffett

RUTE wind

2018
GE 2.5 > Ø116m
90mIII

RUTE wind

POST-TENSIONING INSTITUTE
Strength in Concrete
AASHTO
American Segmental Bridge Institute
"[Wind towers] don't make sense without the tax credit."

NYMEX GAS FUTURES DETERMINE POWER PURCHASE RATES
U.S. WIND

<table>
<thead>
<tr>
<th>Wind Power Concrete Market Data</th>
<th>Wind Farm Market Data</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>U.S.</strong></td>
<td><strong>Iowa</strong></td>
</tr>
<tr>
<td>15</td>
<td>1</td>
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<tr>
<td>123</td>
<td>50</td>
</tr>
<tr>
<td>2,700,000</td>
<td>180,000</td>
</tr>
<tr>
<td>801,000</td>
<td>6,000</td>
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<tr>
<td>$162.0</td>
<td>$10.8</td>
</tr>
<tr>
<td>22</td>
<td>2</td>
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<td>3,806</td>
<td>309</td>
</tr>
</tbody>
</table>

- 180 CY: concrete per megawatt (MW)
- 4044 SF: Area of foundation
- 3 MW: Average WTG Size
- $200: $/ton of cement
- 600: pcy: cement portion

- $21.0: $/yr, Wind Farm CAPEX Annually
- $14: $/yr, Wind Farm Foundation CAPEX Annually

FORCES

- @6MW ~ 950CY
- @6MW ~ 150,000 kNm (111,000 kip-ft)

PHYSICS

- A VOLUME PROBLEM

BX

- Modern Bridge Box Girder Segment
- RUTE BX Install 2018
Mobile Precast Manufacturing

**TYPICAL PROJECT SPECS:**
- 50 foundations, customer wants 1 per day
- 3 foundation/wk output, begin operations min 2 months prior to start of WF construction
- 10 ksi concrete
- 190 cy batched and poured each day, 10 castings per day

**ESTIMATED UNIT COST:**
- $1000/cy incl fixed, OH and variable costs

**TECHNICAL ELEMENTS OF PLANT:**
- Form system
- **Matchcast** process
- **Heat MGT** of forms to regulate temperature gradients
- Curing chamber means 2x handling
- **Integrated PT** system ~400 270 ksi 0.6 strands per foundation
- Batching consistency - **Sand & Gradation Quality**
**Mobile Precast Manufacturing**

*75% Less Concrete*

**Benefits of going mobile**

- Reduced Risk to Customer
  - transportation costs and associated emissions
- Stockpiled product near job site
- Cost Advantage

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**Key Elements of Mobile Precast Box Girder Production**

1. Reliable Mix for Strength & Flow
2. Concrete Placement
3. Control Temperature Gradients
4. Efficient PT Anchorage System
5. Cost Efficient Handling System
6. Curing
7. Match Cast Tolerance QA Capability
8. 3 Per Week Throughput

**Key Solutions**

1. Great Sand & Aggregate Gradation
2. No Pumps or Conveyors
3. Heated Forms - Pump System
4. Integrated PT
5. Custom Gantry Jacks
6. Separate Cure Chamber Building
7. Test Fit Yard
8. 2 Month Jump on the Wind Farm
Integrated PT System

The opposite case of a bridge.

Bridge = Long tendons, few anchorages

BX = Short tendons, lots of anchorages