Emerging Technologies in the Concrete Industry

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Concrete Wind Turbine Towers
Opportunities and Road Blocks
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The Opportunity

Where the Wind Blows

U.S. Wind Power Installations by State
AWEA Fourth Quarter 2011 Market Report
Potential Growth of Wind Industry

Total Accumulative Capacity as of June, 2012: 49,802 MW

Development Path of Wind Turbines

Performance Improvement of Wind Turbines

Turning Point

Development of Tower Height

Current Proprietary Tower Systems on the Market
The Strategic Goal

On April 25, 2012, the Strategic Development Council of the ACI Foundation identified Concrete for Wind Turbine Towers as an Industry Critical Technology.

Strategic Goal for the SDC

1. Concrete shall be a widespread used material for the construction of towers for wind turbines.
   - Competitive concrete tower component market
   - Market for technology providers selling/licensing proprietary towers system

2. The market condition shall foster innovation, fair competition, and an environment that leads to safe and reliable concrete towers.
   - Protection of public domain knowledge
   - Protection of proprietary systems
   - Providing a procedure for fast technology deployment
   - Certification of concrete contractors and precasters

Benefits to the Concrete and Construction Industry

Benefits to Other Stakeholders

The Road Blocks
**The Road Blocks**

- Technical Complexity and Risks
- High Capital Investment
- Energy Policy
- Lack of U.S. Certification Program
- Intellectual Property Claims
- Standards and Guidelines
- Industry Collaboration

**The Deployment Plan**

- Initial Output
  - State-of-the-Art and Risk Analysis Report for Turbine Towers Made of Concrete (FIB-TG 6.14)
  - Definition of Concrete Tower Supply Chain (ACI/AWEA)
  - Business Case for Turbine Towers Made of Concrete (ACI/PCI, NREL)
  - Joint Industry Agreements on Intellectual Property (SDC/AWEA)

- Guidelines and Standards
  - Guideline to the Design of Concrete and Concrete/Steel Hybrid Wind Turbine Towers with Sample Details and Design Examples (ACI)
  - Several ASTM standards to address the heightened requirements on fatigue performance of construction materials (ASTM)
  - Design Criteria and Load Assumptions for Wind Turbine Towers (ASCE/ICE/AWEA)
  - Guideline to the Qualification of Concrete Components for Wind Turbine Towers (NIST, ICC-ES)
  - Guideline to the Dynamic Characterization of Concrete Towers for Wind Turbines (NIST)

- Practice Manuals
  - Manual of Practice for Standard Detailing for Wind Turbine Towers Made with Precast Concrete Elements (PCI)
  - Manual of Practice for the Erection of Wind Turbine Towers Made with Precast Concrete Elements (PCI)
  - Manual of Practice for the Construction of Cast-in-Place Concrete Towers for Wind Turbines (NRMCA)
  - Quality Control Manual for the Construction of Concrete Towers for Wind Turbines (ACI)
  - Quality Control Manual for the Fabrication and Erection of Wind Turbine Towers Made with Precast Concrete Elements (PCI)
Industry Certification Programs

- Certification program for tower component precast plants (PCI)
- Certification program for tower concrete contractors (NRMCA)
- Certification program for concrete tower component erectors (PCI)
- Certification programs for proprietary components and details (ICC-ES)

Conclusions

There are currently about 3000 turbines erected on steel towers annually, a $750 million industry for tower manufacturing alone.

The concrete industry has to take a joint initiative if it wants to become a bigger contributor to the wind turbine tower market.