

Golden, Colorado

## Hybrid Concrete/Steel Wind Turbine Tower

### CLIENT

National Renewable Energy Laboratory  
Golden, Colorado

### REFERENCE

Alan Laxton  
Technical Monitor

### PROJECT FEATURES

- 100-meter hub height towers
- All prestressed concrete
- Prestressed concrete/steel hybrid
- 1.5-, 3.6-, and 5.0-megawatt turbines

### SERVICES BY BergerABAM

- Concept Development
- Static and Dynamic Analysis
- Constructability Analysis
- Construction Logistics
- Construction Cost Estimating
- Construction Scheduling
- Tower Design

### PROJECT DATES

2002 to 2004

### KEY STAFF

Markus Wernli  
Mike LaNier  
Bob Mast



*The concrete/steel tower concept was developed to allow installation of the nacelle at the 50-meter elevation and subsequent self-erection to the 100-meter hub height level.*

BergerABAM was retained by the National Renewable Energy Laboratory (NREL) to develop a series of wind turbine tower concepts suited to 1.5-, 3.6-, and 5.0-megawatt turbines at 100-meter hub height. The project focused on the economical application of prestressed concrete, both for all concrete towers and for hybrid concrete/steel towers. The results of this effort are given in NREL Report NREL/SR-500-36777. The report includes a detailed methodology for design of prestressed concrete wind turbine towers, comparative cost estimates of different tower concepts, and comparative construction schedules for concrete towers as part of the installation of large wind turbine farms. Designs are based on the public domain wind loads from the NREL WindPACT Turbine Rotor Design Study.

A concept was developed to allow installation of the heavy turbine nacelle at the 50-meter elevation with self-erection (no crane required) to the final 100-meter hub height elevation. This concept was compared against all steel towers and all prestressed concrete towers for the same set of turbine sizes and tower height.

BergerABAM's background in prestressed and precast concrete design, coupled with an ability to perform complex dynamic analysis, allows development of economical and long-lasting large-scale towers for wind energy development.