

## Chalmers wind turbine at Björkö, Göteborg, Sweden



### **General description of turbine**

Chalmers wind turbine has variable speed operation with a direct driven generator and a frequency converter, it also has a digital control system developed by Chalmers. The wind turbine has a rated power of 45 kW and rated speed of 75 rpm. The wooden tower is 30 m high, the blades of carbon fibres are 7.5 m long, and the turbine diameter is 15.9 m. The individually blade pitch system is electrical. The wind turbine is simulated in FAST and Ashes.

### **Location of Chalmers wind turbine**

The turbine is situated on the island Björkö at Skarviksvägen, 20 km west of Göteborg city. The site is available by public transportation and some walking. The coordinates are: 57.71818820625921, 11.683382148764485

### **Control and measurements equipment at Chalmers wind turbine**

The wind turbine is equipped with a measurement and control system built up around the hardware Compact Rio from National Instrument. The code is made in Labview. The system has a control loop with the sampling period of 10 ms. Some measurements are done with the rate of 5 ms. As can be seen in Figure the turbine controller with measurements is connected via EtherCat bus to an expansion chassis in the nacelle and tower.

## Measurement and Control System at Chalmers Wind Turbine

### Meteorological Mast

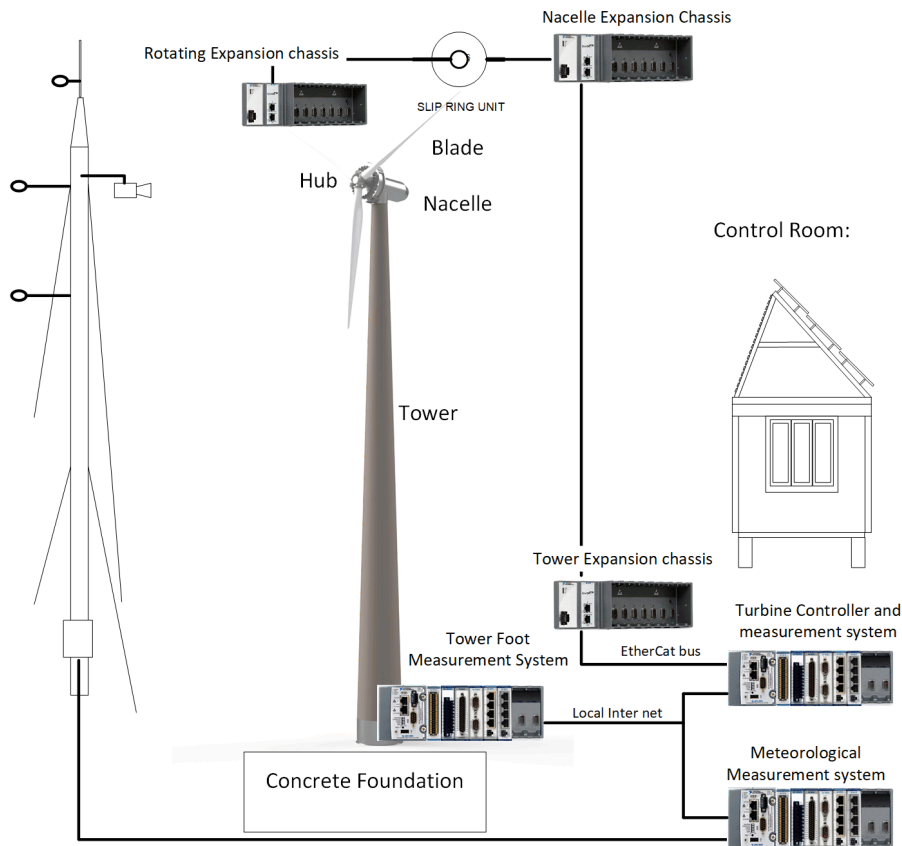


Figure 1. Layout of the control and measurement system of Chalmers wind turbine.

## Measurements and control signals at Chalmers wind turbine

### Hub and Blades

Pitch angles x 3  
8 strain gauge sensors in each blade  
Shaft torque sensor

### Nacelle:

Control of yawing & yaw damping by hydraulic valves  
Yaw position and No. of turns  
Generator temperature x4  
Turbine speed, two sensors  
Accelerometers, x,y,z in direction

### Tower foot:

Generator coil voltage & current  
Tower steel base of 2 m; strain gauge sensors E-W, N-S and torsion, five signals  
Wood tower; strain gauge sensors at 5m & 10m, 8 signals  
Foundation; 4 strain gauge sensors on the reinforcing bars

### Control room:

Analog input: grid voltages & currents  
Analog input: DC-link voltage & current  
Analog input: DC-link current reference  
Digital inputs: Cable twist, converter ok  
Digital outputs: converter on/off, mechanical brakes on/off

### Meteorological mast:

3 ultrasonic anemometers, high resolution wind speed and wind direction at 3 different heights  
Air pressure, temperature, humidity  
Precipitation  
Network camera of wind turbine

**Total of 64 signals to measurements files.**

## **Research possibilities**

Chalmers with its partners have designed and erected the wind turbine, with full control of design, drawings, hardware, and software. Turbine simulation models have been developed in FAST, Ashes and Vidyn. The control program is developed and implemented by the staff of Chalmers. The wind turbine can be used for different types of wind turbine research. Research collaborations can be small investigations, for example checking tower eigenfrequencies, or a larger one about for example lifetime estimation of pitch bearings due to frequency control or wake development in complex terrain. There can also be a project with the wind turbine in a micro grid and control of the voltage in the grid by reactive power control from the converter.

## **Contact data and more information**

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