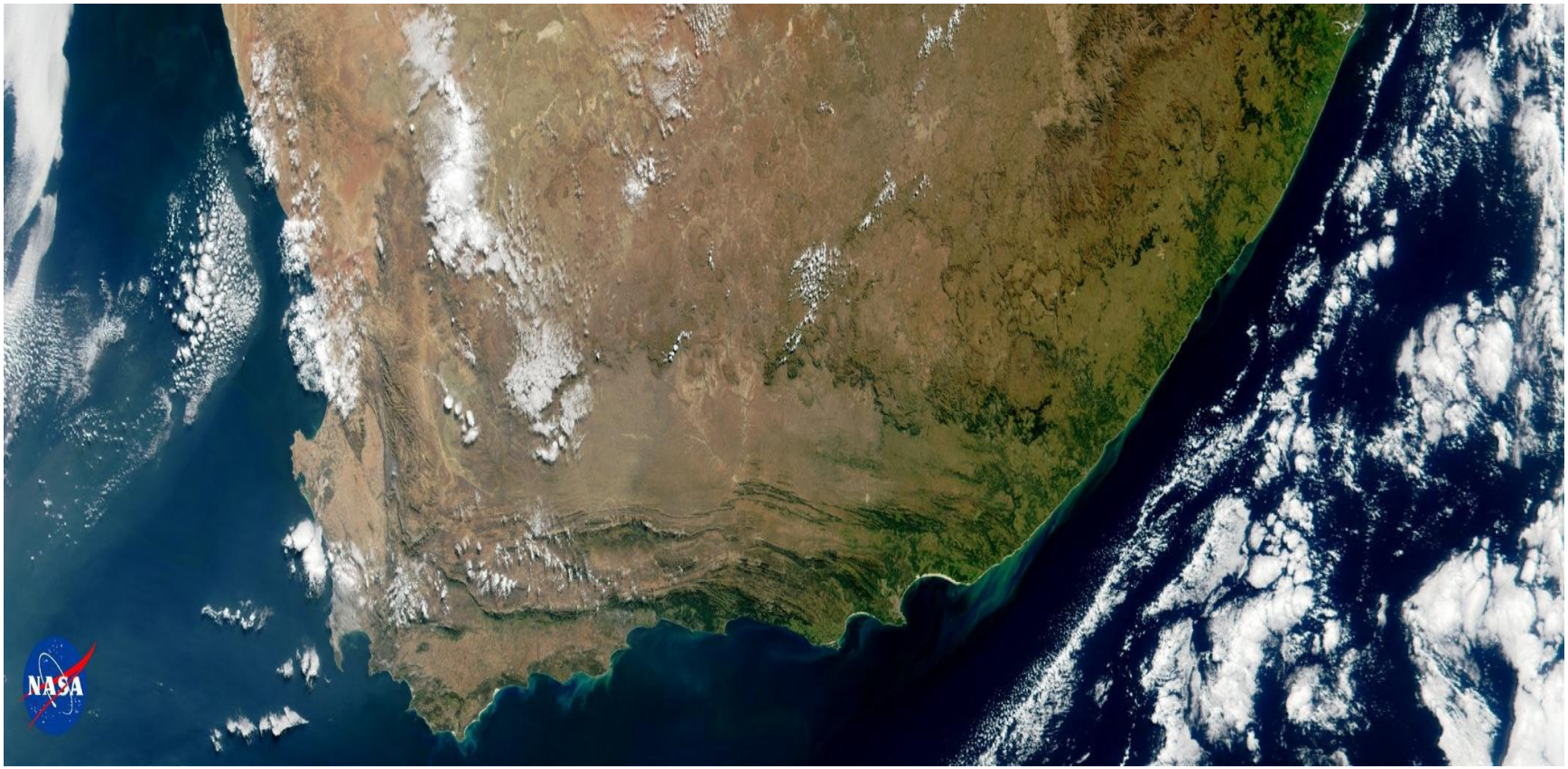
CARL VON OSSIETZKY universität OLDENBURG

Nelson Mandela Metropolitan University for tomorrow

2KW WEC ANALYSIS AND SITE PLANNING

Practical Training Presentation
Federico Montealegre
2010

Introduction



“2KW Wind Turbine Prototype Implementation”

OVERVIEW

- Wind Measurements
- Site Planning
- System Integrity
- WEC system
- Power estimation
- Electrical System
- Data Aquisition
- Blade Balance and wind noise minimization
- Dynamic Loads and foundations
- Arrangement

Wind Measurements

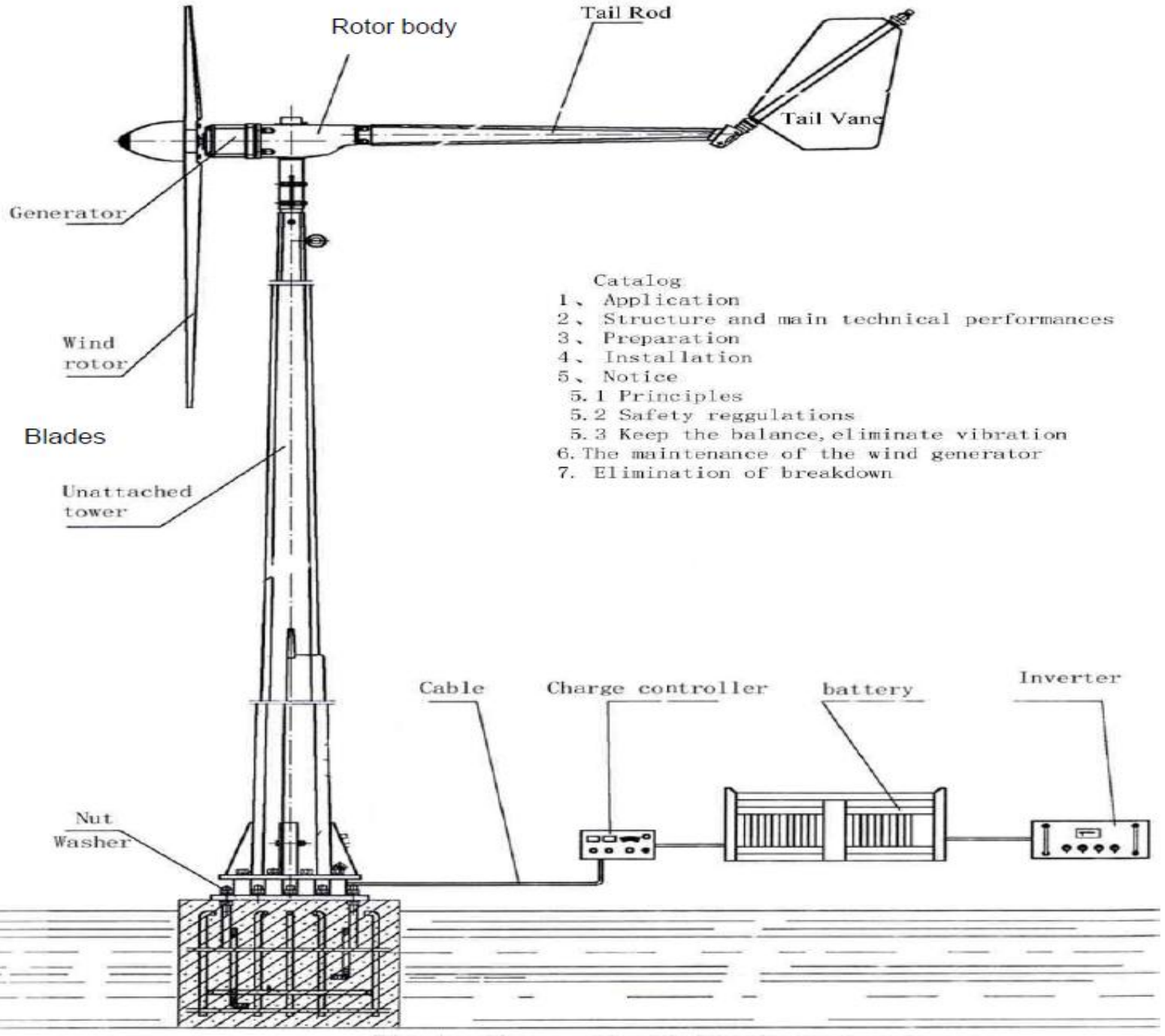
YEAR	AVERAGE	HI PEAK	DATE	DIR
2010	***11.4***	***61.2***	***FEB***	***WSW***
2009	10.64	64.35	OCT	WSW
2008	10.34	49.05	NOV	ENE
2007	12.1	55.34	FEB	WSW

Site Planning

WEC system

- **MAIN TECHNICAL WEC CHARACTERISTICS**

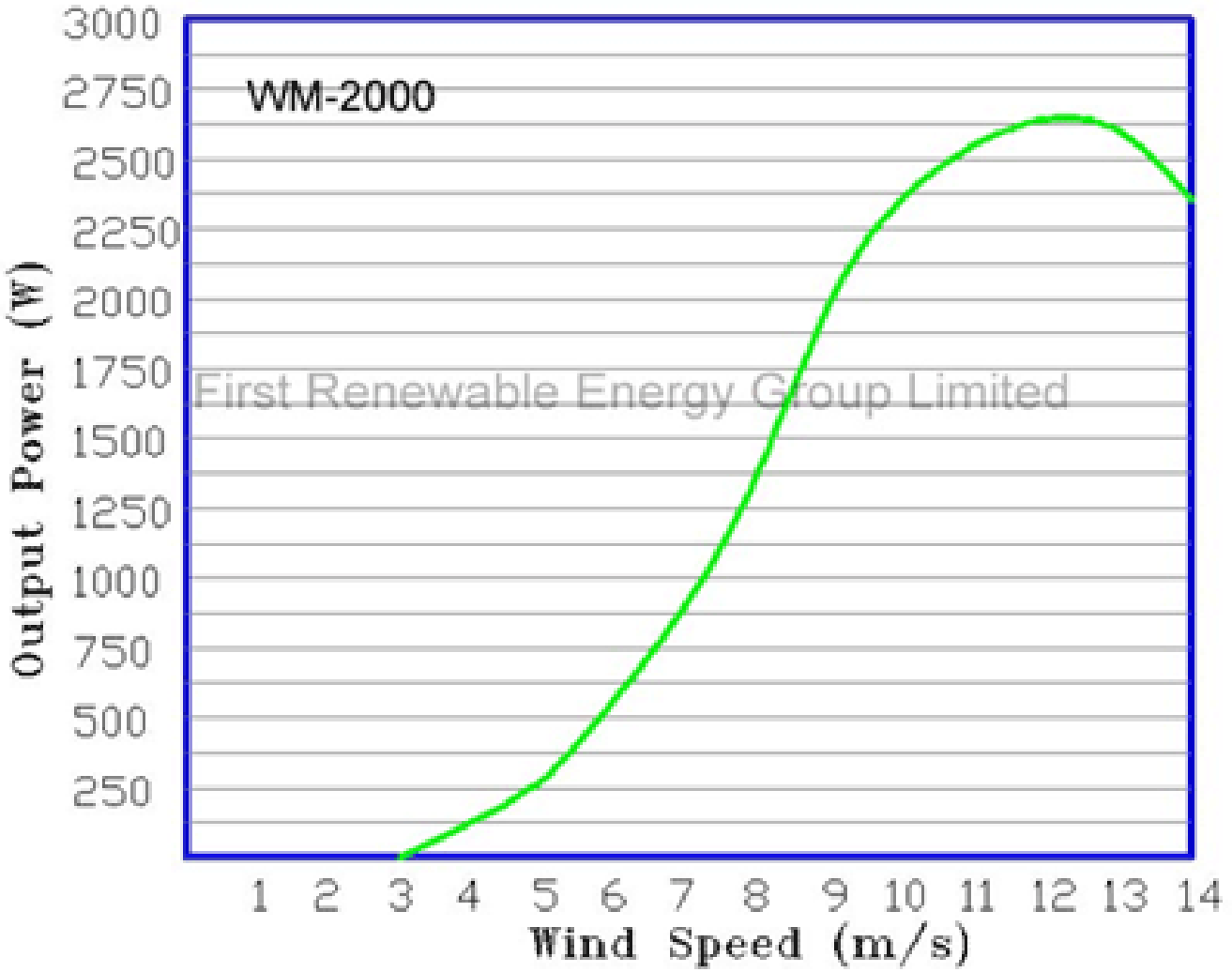
- Model Windworker - 2000
- Rotor Diameter (m) 3.8
- Material of the blades & Number of blades FRB 3PCs
- Rated power/Max power (w) 2000/2800
- Rated rotate speed (r/min) 400
- Rated wind speed (m/s) 8 (30km/h)
- Starting wind speed (m/s) 2.5 (9km/h)
- Working wind speed (m/s) 3 -30 (10.8-108km/h)
- Survived wind speed (m/s) 50 (180km/h)
- Working voltage 48VDC/240VAC
- Generator style Three phase, Permanent magnet A.C
- Tower height (m): 9
- Weight (kg)(exclude batteries and inverter) 88
- Speed regulation method: Yaw
- Stop method: Automatic Furl / Manual Electronic brake



Catalog

1、Application
2、Structure and main technical performances
3、Preparation
4、Installation
5、Notice
5.1 Principles
5.2 Safety reggulations
5.3 Keep the balance, eliminate vibration
6. The maintenance of the wind generator
7. Elimination of breakdown

Power Curve


WM-2000
First Renewable Energy Group Limited
Output Power (W)
3000
2750
2500
2250
2000
1750
1500
1250
1000
750
500
250
1 2 3 4 5 6 7 8 9 10 11 12 13 14
Wind Speed (m/s)

Electrical System AC SIDE

- Nominal output voltage of the wind turbine: **240VDC**
- Rated output power of the wind turbine: **2KW, 2.85 KVA**
- Maximum power output: **2.7 KW**
- Maximum current: **11.25A @ 240VAC**
- Voltage drop length: **60m** estimated
- Voltage drop estimated: 3% minimum
- Thermomagnetic protection / Main disconnecting device: **3 phase, 20A, 240VAC**

- **Wiring**:
- **3 X #10AWG from wind turbine to controller.** Conductor derating factor (temperature): 0.91
- **1 X #10AWG for grounding conductor.**
- **Delta string 1.5m configuration 3 X Cupperweld grounded**

Electrical System DC SIDE

- Nominal output voltage of the converter: **48VDC**
- Rated output power of the wind turbine: **2KW, 2.85 KVA**
- Maximum power output: **2.7 KW**
- Maximum current: **60A @ 48VDC**
- Voltage drop length: none
- Wire protection / Main disconnecting device: **2 wire, 60A, 48VDC FUSE LINKS with manual blade switch.**

Electrical System – GROUNDING THE TOWER

- provide static protection, as well as lightning protection for the turbine, tower and the whole system
- **All the metal parts of the system should be interconnected to a single grounding point. Live** conductors should never be spanned or suspended from the turbine structure and should be buried at least one half metre deep in a suitable plastic or steel conduit.
- recommended that a commercial lightning surge arrestor or transient voltage surge suppressor (TVSS) based on metal-oxide varistors (MOV's) or silver fuselinks with high purity, is installed and fitted at the bottom of the structure or pole or at the wind control system input.
- Three 1.5 m copperweld delta configuration ground rods shall be driven into the terrain near the tower base

Data Aquisition

- Mean wind speed
- Rotational speed
- Maximum three-second gust wind speed (max wind speed)
- True standard deviation of wind speed
- Mean wind direction
- Mean temperature
- Logger DC battery voltage
- Baterry control unit
- Dump Load controll unit

System Integrity

Loads

- **dynamic load and eigenmodes => resonances**

$$m(r)\mu(r)\ddot{f}_J(t) + \hat{c}(r)\mu(r)\dot{f}_J(t) + m(r)\omega^2\mu(r)f_J(t)$$
$$= q(r.t) - m(r)\mu_{TJ}(r)\ddot{f}_T(t) - \hat{c}(r)\mu_{TJ}(r)\dot{f}_T(t)$$

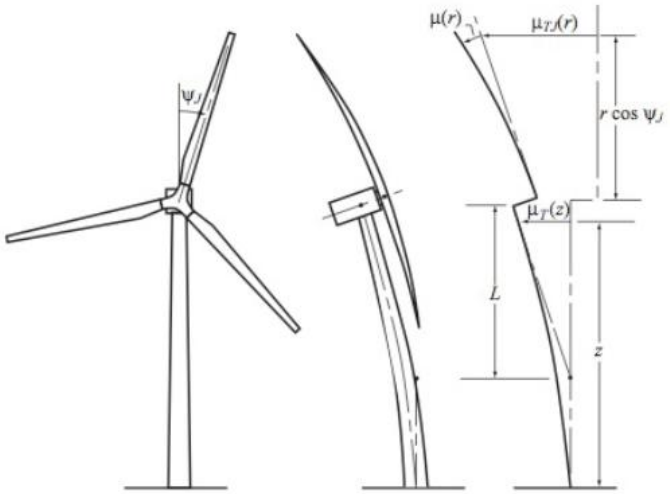


Figure 5.31 Fundamental Mode Shapes of Blade and Tower

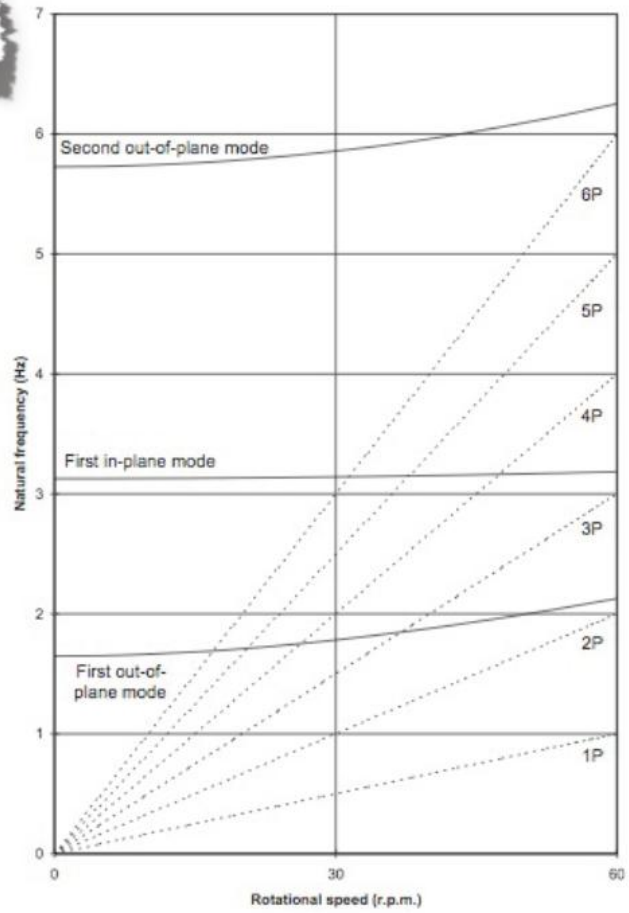
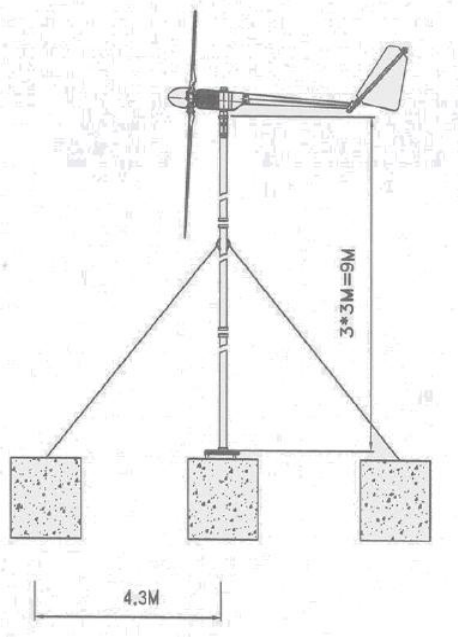
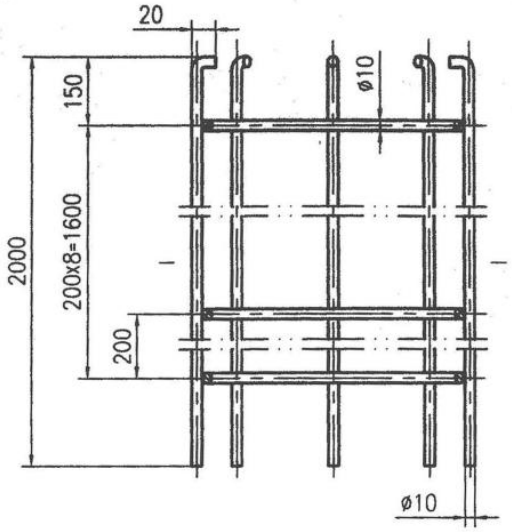
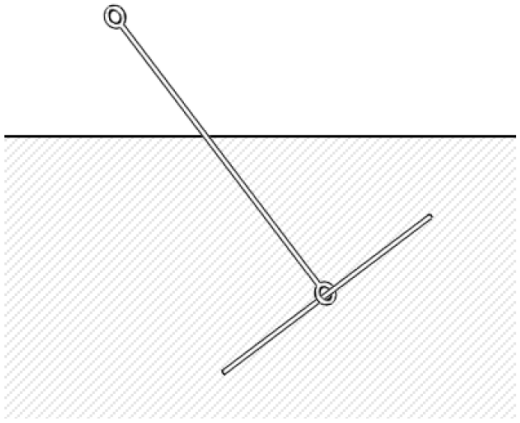


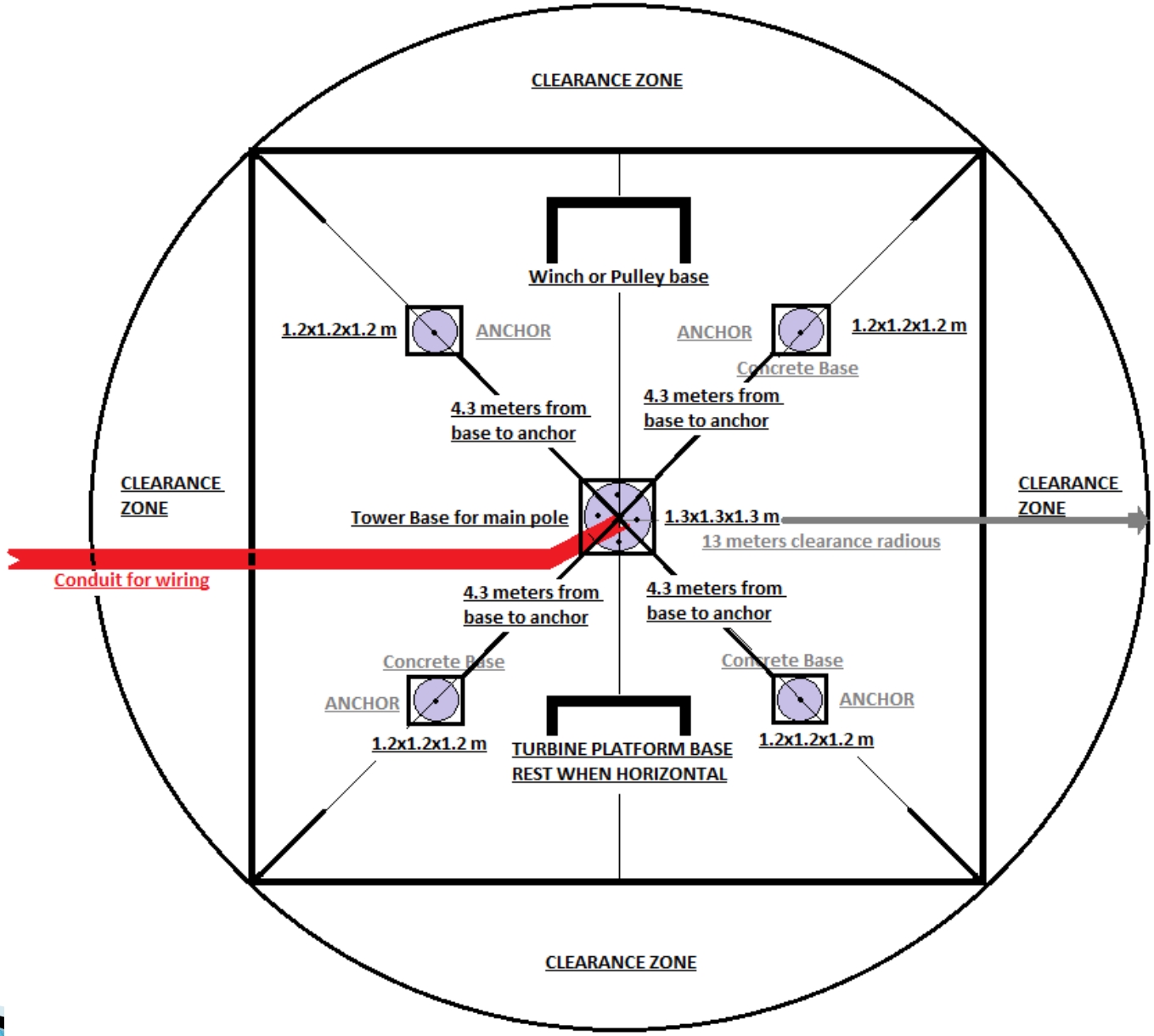
Figure 5.27 Campbell Diagram for Blade TR

Concrete Foundations

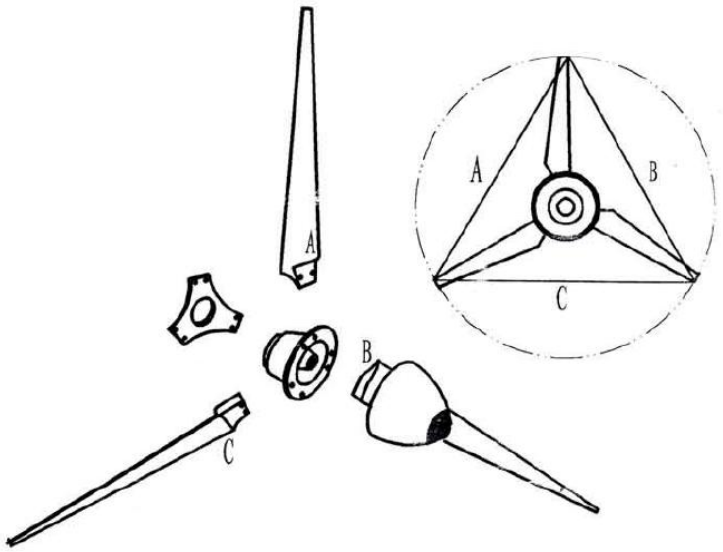


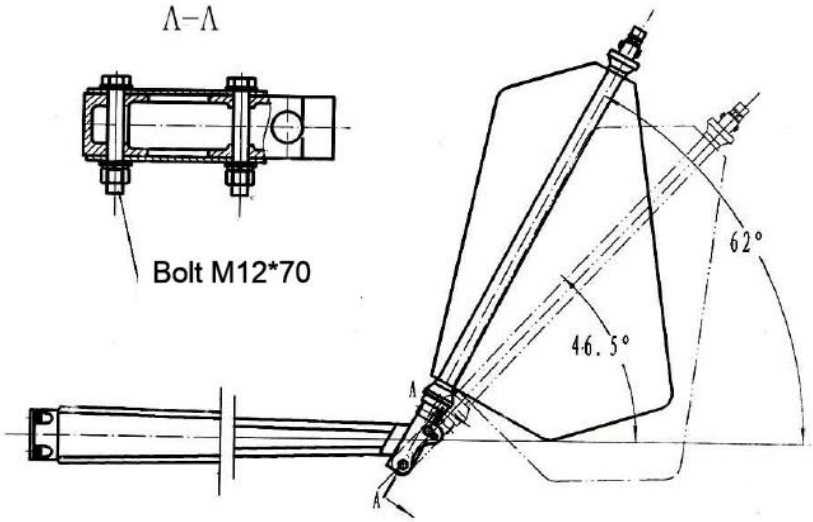





CLEARANCE ZONE
Winch or Pulley base
1.2x1.2x1.2 m
ANCHOR
ANCHOR
1.2x1.2x1.2 m
Concrete Base
4.3 meters from base to anchor
4.3 meters from base to anchor
CLEARANCE ZONE
CLEARANCE ZONE
Tower Base for main pole
1.3x1.3x1.3 m
13 meters clearance radious
Conduit for wiring
4.3 meters from base to anchor
4.3 meters from base to anchor
Concrete Base
Concrete Base
ANCHOR
ANCHOR
1.2x1.2x1.2 m
1.2x1.2x1.2 m
TURBINE PLATFORM BASE REST WHEN HORIZONTAL
CLEARANCE ZONE

Blade Balance and wind noise minimization





MAINTENANCE SCHEDULE DESIGN

- The wind turbine blades should be preventively and regularly checked for damage, and to ensure that they are in balance, and the structural parts (tower, guy wires, anchors etc) should be checked for structural damage, cracks etc
- Tighten all nuts and bolts, especially wire clips. Check for cracks and bent or broken parts at the anchors and base structure. Check for broken strands and tighten guys.
- Normal use of a wind turbine dictates that the turbine head will turn through 360 degrees from time to time. Check that the cables from the turbine do not become excessively twisted.
- WATCH AND LISTEN FROM THE TOWER BASE. Use binoculars. There should be no mechanical noise, rattle or vibration. The propeller and tail must not wobble. Lower or climb the tower for inspection, if indicated. There should be no buzzing either heard or felt with your hand on the tower mast.
- Before a severe storm, it is advised to lower the tower in order to avoid possible damage or loss.
- Also a periodic lubrication and tower and WEC antirust paint antirust and greasing on the surface of all fixed connecting parts once a year.
- Testing of emergency shutdown/overspeed system and adjustment/replacement of braking system (dump load control)
- Checking for possible replacement of bearings, brushes/sliprings.
- Check, clean and lubricate all the rotating parts annually. Before heavy rains cleaning the outside of the. Lubrication and maintain bearing of generator one time per operating year.

Federico Montealegre
BSc. Electrical Engineer
MSc. Renewable Energies

fedemontealegre@gmail.com