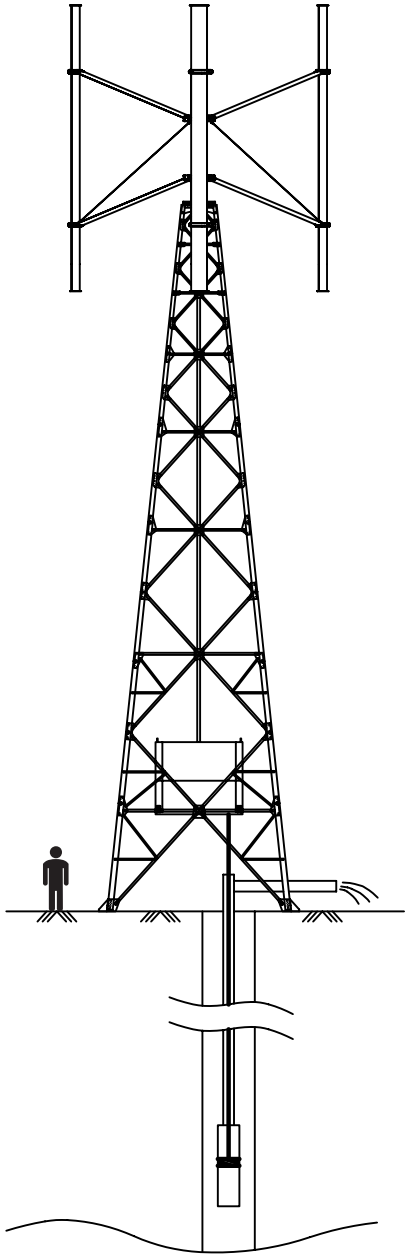
Yelkapan®

New Generation
Water Pumping Wind Turbine

ena | Wind Turbine Technologies



Yelkapan®

General Description

- Special purpose wind machine design for water pumping
- Higher flow rate capacity compared to traditional mechanical windmills
- Pumping capacity for the water demand of a village with a population of 3.000

Innovations

- *OptiStroke® Technology*: Unique design for variable stroke piston pump
- *Regenerative brake technology* for overspeed control and battery charge
- *Counter-weight technology* for uniform loading of wind rotor
- *Tandem pump technology* for big size pump at narrow wells

Benefits of the Innovations

- The most efficient way to pump water by using wind energy
- Smoothing the rotor loads by regenerative brake and counterweight technologies
- Elimination of unnecessary energy conversion loss (mechanical&electrical) by direct coupling of rotor shaft and piston pump

Design and Technology

- Maximum power point tracking system for the wind rotor
- PLC based multi-purpose electronic control unit
- Mechanical connection between wind rotor and piston pump
- Independence from the direction of the wind with vertical axis wind rotor
- Automatic start-up at low wind speeds
- Shifting from pump to electric generator when the water reservoir is full
- Robust mechanical design for extreme wind speeds
- Composite rotor blades

Innovative Technologies of Yelkapan®


OptiStroke® Technology

It is also called as "varriable stroke technology". The main idea of the innovative OptiStroke® technology is to change stroke of the piston pump according to wind speed by using a PLC based electronic control system.

In traditional wind driven piston pump technology, the rotor can not keep the optimum speed. So there is a huge aerodynamic efficiency loss in traditional windmills because of uncontrolled wind rotor. If pumping volume is increased parallel to the increasing wind speed, it creates braking effect; and speed up of wind rotor is prevented. So the wind rotor can keep the optimum tip speed ratio and extract maximum energy from the wind.

Operation without necessity of high starting torque is an other benefit of the OptiStroke® technology. So it allows us to use high efficiency class wind rotors (like Darrieus type wind rotor) to drive a piston pump in order to traditional low efficiency multibladed wind-wheels with high starting torque.

Tandem Pump Technology

It is also called as "Single Pile Multi-piston Pump Technology". Innovative pump design allows reaching a high pump capacity in narrow drilled wells. As the Yelkapan® can extract more energy from the wind, especially at high wind speeds, the Yelkapan® needs bigger size pump to use this amount of energy. The innovative pump design allows to increase rotor size. So it is possible to design the powerful windpump Yelkapan®.

Regenerative Brake Technology

A small size electric generator is connected to the same rotor shaft where the piston pump is already connected. The generator can also be used as electric motor. Speed and torque of the generator/motor is controlled by PLC.

It is a single solution for different problems :
1) Overspeed protection problem
2) Self starting problem of Darrieus rotor
3) Smoothing the rotor load because of crank-piston system
4) Fine tuning for "maximum power point track" system
5) Electricity demand problem of control system

Counterweight Technology

A piston pump does not need energy during suction phase, but wind rotor keeps to extract energy from the wind. Counterweight technology provides short term energy storage like flywheel. By the way smooth loading of the system could be possible. This feature prevented ossilating of the wind rotor and aerodynamic efficiency loss because of oscillating. It also eliminates fatique loads and improves the pumping capacity of the wind pump.

Milestones of Yelkapan® Design

The very first spark in 1998

Necessity of wind driven water pump stations through the cattle roads in Sudan, the necessity encouraged us to start the design works.

Establishing the ENA company based on innovative wind-pump idea in 2004

We established the company ENA to develop our unique wind-pump technology named as **"Yelkapan®"** at the technology incubator of Middle East Technical University. Technical institutions of Turkish Government (TÜBİTAK and KOSGEB) have financially supported our innovative wind-pump project since 2004.

First test station started to run in 2008

Our first test station has 100 m water level depth. It has two bucket Savonius rotor on 10m lattice tower. Swept area of the rotor was 10 m2. It has pumped water from 100 m water-well. Field tests and design developments have focused on OptiStroke® technology and have continued untill 2010.

New design of Yelkapan® : 2011-2013

Field tests shown us that mimimum economical size of the technology is 10 kW. Our focus was more powerfull rotor during the new design period of Yelkapan®. New design works of Yelkapan® was run with cooperation of Izmir Institute of Technology.

Test station for the new Yelkapan® design : 2014

We are constructing a 30 kW test station for the new Yelkapan® design at the campus of Izmir Institute of Technology where is at the most windy region of Turkey. The test station will supply half of the water demand of the university campus with a population of 6.000. The pumping head is 75 m. Total budget of the project is more than 700.000 USD during the ten years of project period.

Technical Description

ROTOR

Type	Darrieus type vertical axis wind turbine
Overspeed Protection	Regenerative brake and emergency disc brake
Start-up System	Electric motor supported starting system
Speed Control	Rotor speed is controlled according to wind speed by using OptiStroke® control system.
Blade Material	Composite
Blade Number	3 bladed

Model	**D36 / 15** **D49 / 15**	**D64 / 30** **D81 / 30**
Rated Wind Speed	13 m/s (47 km/h) 11,7 m/s (42 km/h)	13,5 m/s (48,6 km/h) 12,5 m/s (45 km/h)
Rated Power	15 kW	30 kW
Rotor Mass	1000 kg	1200 kg
Swept Area	36 m^2 49 m^2	64 m^2 81 m^2
Diameter	6 m 7 m	8 m 9 m
Hight	6 m 7 m	8 m 9 m
Rotational Speed	Varriable speed Maximum 150	Varriable speed Maximum 120 RPM

TOWER

Type	Galvanized steel, lattice tower	
Model	**D36 / 15** **D49 / 15**	**D64 / 30** **D81 / 30**
Height	15 m	20 m
Weight	3500 kg	5000 kg
Foundation	13 m3 (30 tons) concrete	18 m3 (44 tons) concrete

DRIVE TRAIN

Weight	800 kg	900 kg

Drive train includes rotor connection shaft, power transmission chains and sprockets, generator, OptiStroke® mechanism, electronic control unit and batteries

PUMP

Type	Single pile multi piston pump	
Stroke	Variable (max 60 cm)	
Piston Rode Force	35 kN	70 kN
Avarage Capacity Factor	18.000	33.000

Avarage daily capacity calculation example for 50 m depth:

Q [m3/day] = A.C.F. / H [m]

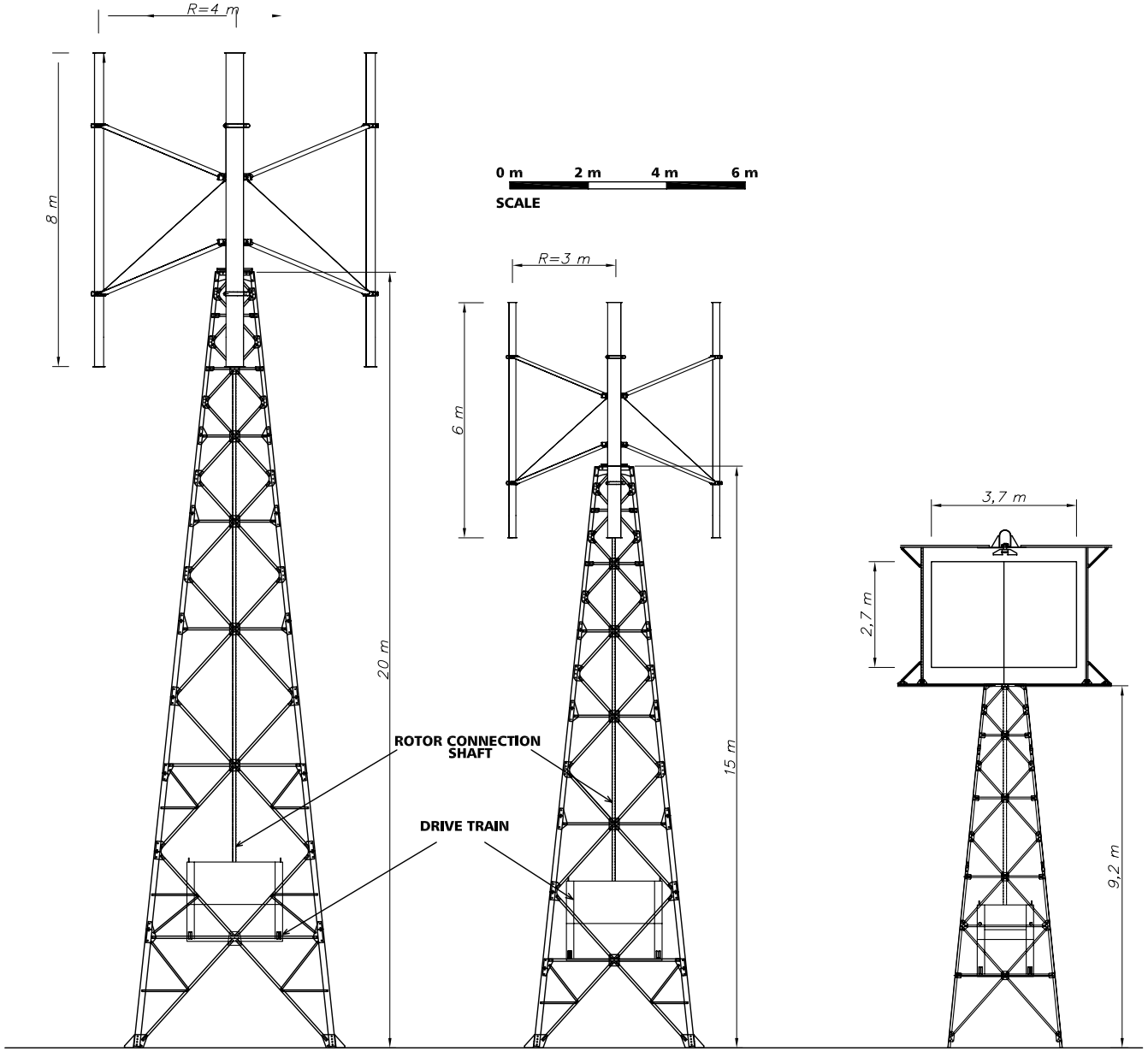
Q = 18000 / 50 Q = 33000 / 50

Q = 360 m3/day Q = 660 m3/day

Average capacity factors were calculated according to annual wind speed distribution with Weibull factors C=6,8 k=1,73 and avarage wind speed 6 m/s

OPTISTROK® SYSTEM
(DRIVE TRAIN & PLC UNIT)

OLD DESIGN



NEW DESIGN
MODEL: D64 / 30

NEW DESIGN
MODEL: D36 / 15

OLD DESIGN

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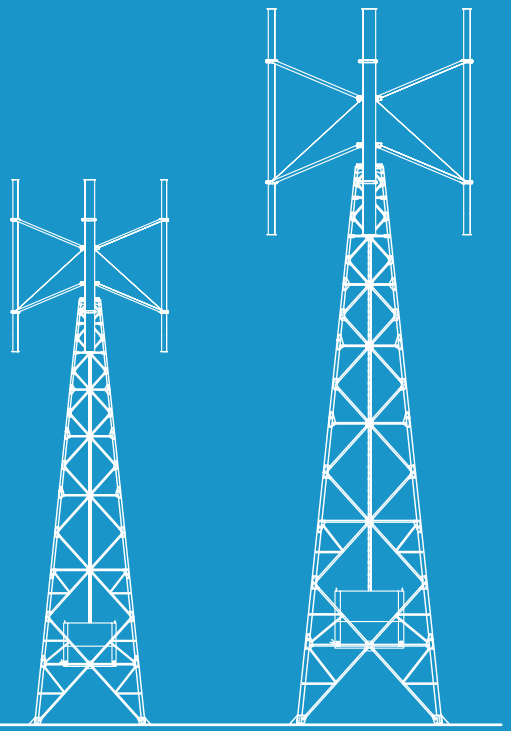

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