ANGULAR MOTION: $V_{linear} = R\,\omega$ Unit 13 & 16

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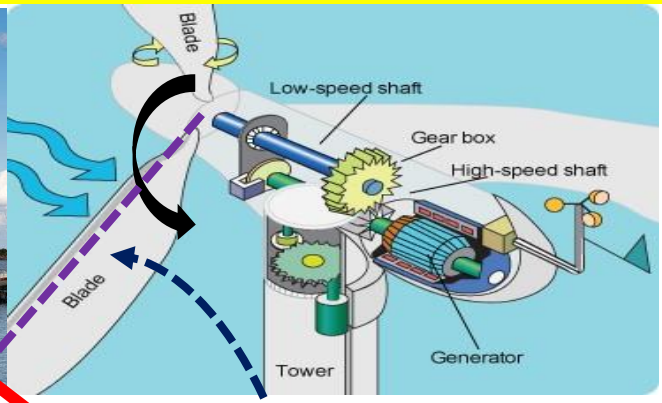
& New York Times , August 18, 2016 by Stanley Reed. This application dedicated to Michael faraday & Joseph Henry who first discovered that changing a magnetic field through a coil of wire produced an electromotive force(voltage).

A Danish Wind Turbine Maker Harnesses Data in a Push to Stay Ahead



Vestas windmills at Provestenen near Copenhagen.
The global nature of the industry plays to the strengths of a company like Vestas.

AARHUS, Denmark — The company(Vestas) is at the forefront of efforts to make wind a competitive source of energy, rather than just a subsidized experiment. In doing so, it has become a model for the renewables industry, which has struggled at times to remain viable while facing cuts in government subsidies and volatile oil and gas prices.

Vestas understands the fickleness of the renewable energy business. The broader industry is in better shape, as well. The revenues of **a group of eight large turbine makers, including Vestas, grew 17 percent last year to €27 billion,** according to David Vos, a renewable energy analyst at Barclays in London.

It is competitive with fossil fuels even in oil-rich places like the Texas Panhandle in the United States, the company's largest market. Under favorable circumstances, Mr. Vos **(((pegs *Panhandle wind costs at about $29 a megawatt*-hour, a wholesale measurement, over the life of a project, *compared with $33 a megawatt-hour for a new gas-fired plant* in the United States.)))**

It began experimenting with wind turbines in the 1970s as an alternative energy source for local farmers during an era of volatile oil prices. The first turbine it sold, which was based on a design by local blacksmiths, had a rotor just 10 meters, or 33 feet, in diameter. Now, its turbines are not only far bigger but also much more productive. The company installs giant turbines that may stretch more than 500 feet into the air, with **(((individual blades nearly 190 feet long, whirring at over 180 miles per hour,)))** Its latest devices generate 25 times as much electricity over a year as those made in the 1980s. Crucial to that progress has been data collection, which Vestas has been doing for years on a large scale.

Part of 190 ft. turbine blade

QUESTIONS: (a) Convert 180 mph to ft./s.?, (b)Find angular velocity ω (rad./s.) of turbine blade?, (c) Find frequency f (in rev./s. & RPM)?, (d) Find period T (in seconds) of turbine blades?,(e) Find circumference of circle the tip of blade makes (in ft. & miles) in one rotation?

HINTS: 60 mph = 88 ft./s., $\omega = 2\pi f$, $f = 1/T$, $T = 1/f$, 5280 ft. = 1 mile , $C = 2\pi R$

ANSWERS: (a)220 ft./s., (b) ω = 1.39 rad./s. , (c) f = 0.221 rev./s. or 13.27 RPM, (d) Period T = 4.52 s., (e) C = 1193.2 ft. or 0.226 miles

COMMENT: Literature reports wind turbine blades usually turn at ~ 14 RPM. Thus, this articles blades being 190 ft. long turning at tip speeds of 180 mph is quite normal. 180 mph initially sounds quite high, but that speed is at the tip of a 190 ft. blade.