



## **Why are City Windmills' wind turbines silent, versus the large propeller-style wind turbines??**

We have all heard the "dum-dum-dum.." of a helicopter hovering overhead... Or even a car wheel, when driving at speed, that appears to rotate backwards... What causes this?

Christian Doppler, eminent Austrian physicist, provided an explanation - when energy waves (sound, light etc..) are moving relative to the observer, we get an observed change in wavelength of the waves and hence frequency. A simple example, when an ambulance drives by, the pitch (ie. frequency) drops noticeably once past.. Why? As the ambulance approaches, the sound waves reaching you are compressed due to the ambulance moving towards you as well as the sound waves, so basically they get a little squashed (ie. shorter wavelength). Once the car has passed, the sound waves are stretched out a little (ie. the length increases between each sound wave emitted), so the pitch drops and we can hear this noticeable drop in pitch.. The Doppler Effect. Even in light waves, scientists can measure how fast parts of the universe are expanding away from us, this Doppler Effect being known as the "red shift" (red light has a longer wavelength than blue light).

Back to our helicopter - or even the blades of a large wind turbine.. We now introduce the concept of "beats". Herr Doppler has already told us that a receding blade and an oncoming blade will emit sound at a slightly different frequency as observed by our ear. And of course there is considerable power in transmission of sound from helicopter or large wind turbine blades.. When two sound waves of different frequency approach your ear, the interference between them causes the sound to be alternatively soft and loud - a phenomenon which is called "beating" or producing beats. The beat frequency is equal to the absolute value of the difference in frequency of the two waves. So while the blades might be rotating at 400 rpm, the slight difference in frequencies of the sound waves of receding and oncoming blades gives rise to a much lower frequency wave - the "dum-dum-dum.." we hear in overhead helicopters. And as architects found out through investigating "sick building syndrome", even the low-frequency throb of a powerful air-conditioning unit resonating in a building is enough to create beats that give rise to stomach upsets... Hence the need to position large wind turbines away from man and beast!!

In avoiding the pitfalls of large, propeller-style wind turbines, City Windmills has designed a small, roof-top mounted wind turbine that runs silently with lower rotational speeds. City Windmills turbines therefore lack the size or the rotational speed to create any discernible beats, hence our claim that they are silent. We also shroud the oncoming fans of our turbine for greater turbine efficiency, this we also dispel any possible soundwave Doppler Effect from our turbines.

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