

Meteorology

Wind Shear

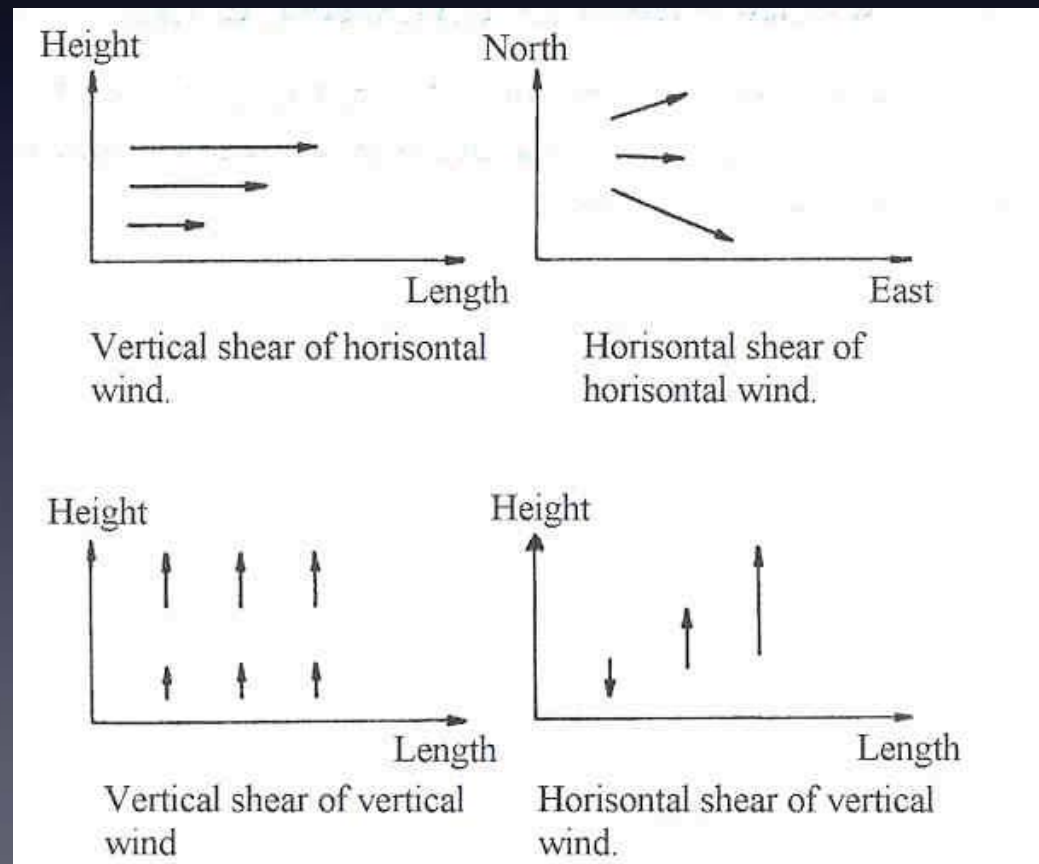


Wind Shear

Wind shear is a sudden change of direction and/or speed of the airflow.

Wind shear is the difference between the wind in 2 points divided by the distance between them.

(horizontal - vertical wind shear)



Wind Shear

The following criteria of the wind change per 1000 ft may be used for the intensity of wind shear :

Light 0 - 4 kt

Moderate 5 - 12 kt

Severe > 12 kt

A wind shear taking place below 1600 ft is called a low level wind shear

Wind Shear with Local Obstacles

When the wind near the earth is severe, it will result in local areas of turbulence and wind shear. This is first due to mechanical turbulence.

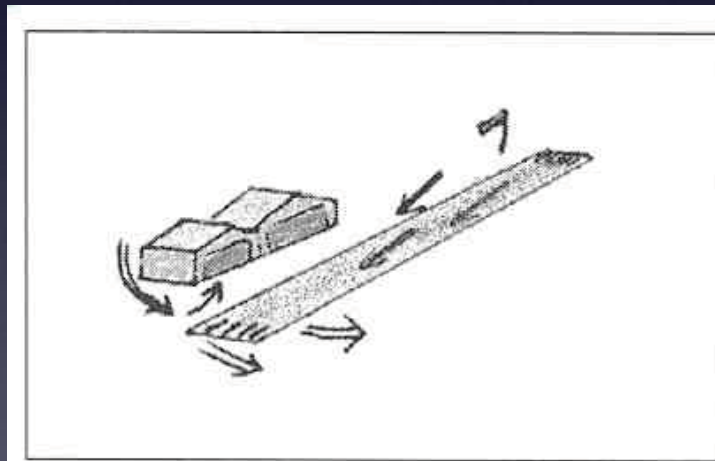


Fig. 16.6.
Windshear near buildings, etc.

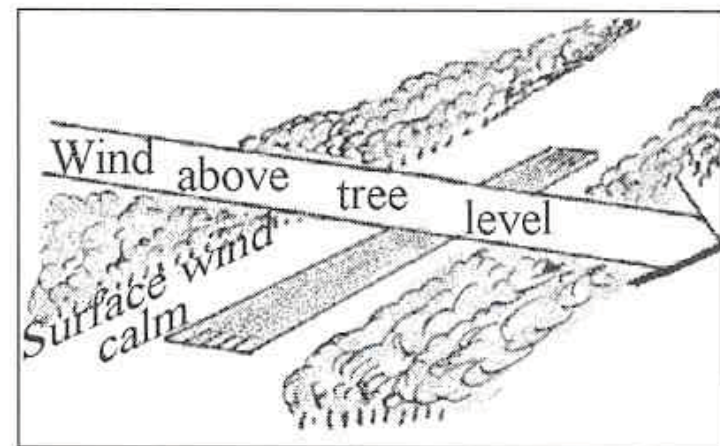
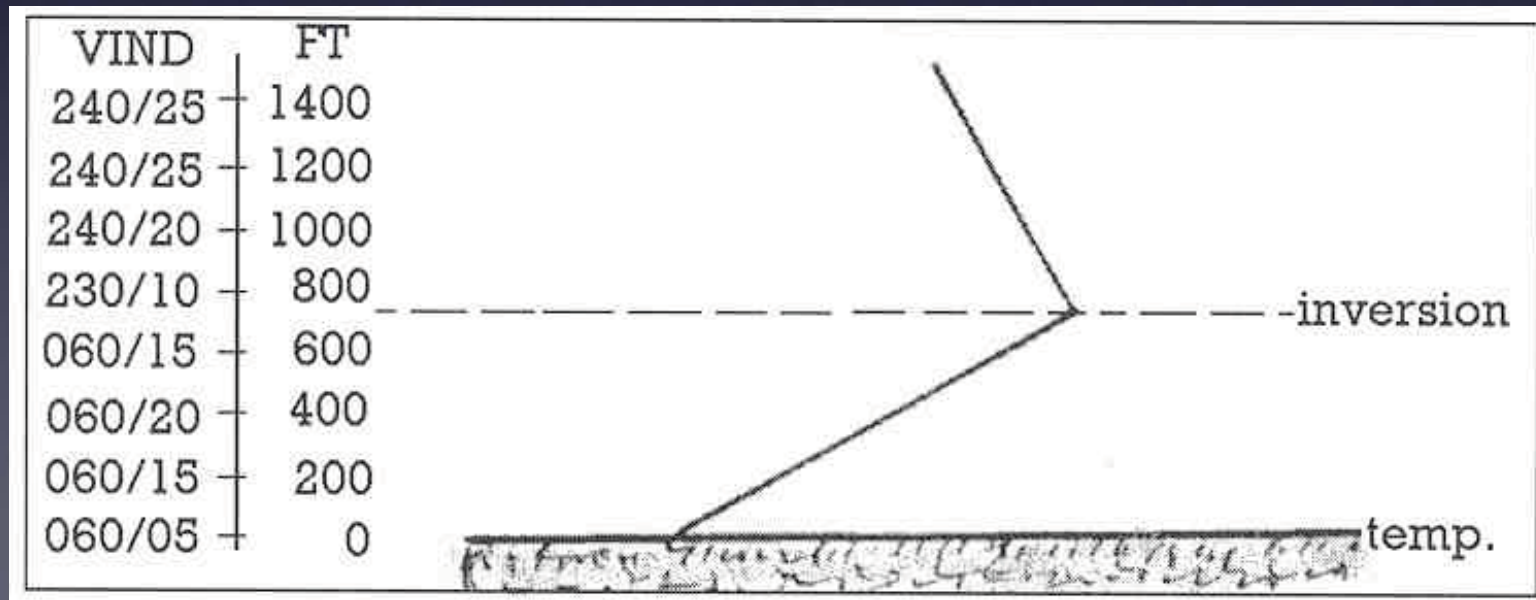


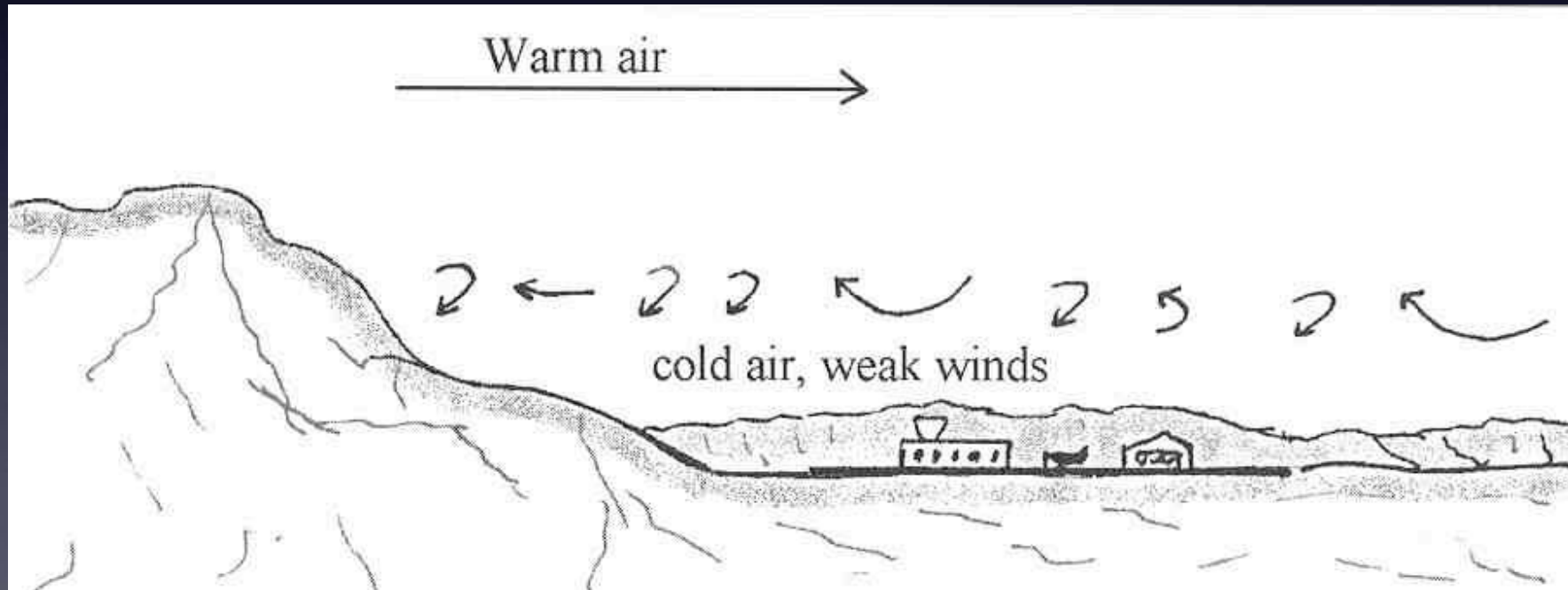
Fig. 16.7.
Windshear near trees.

Wind Shear with Surface Inversion

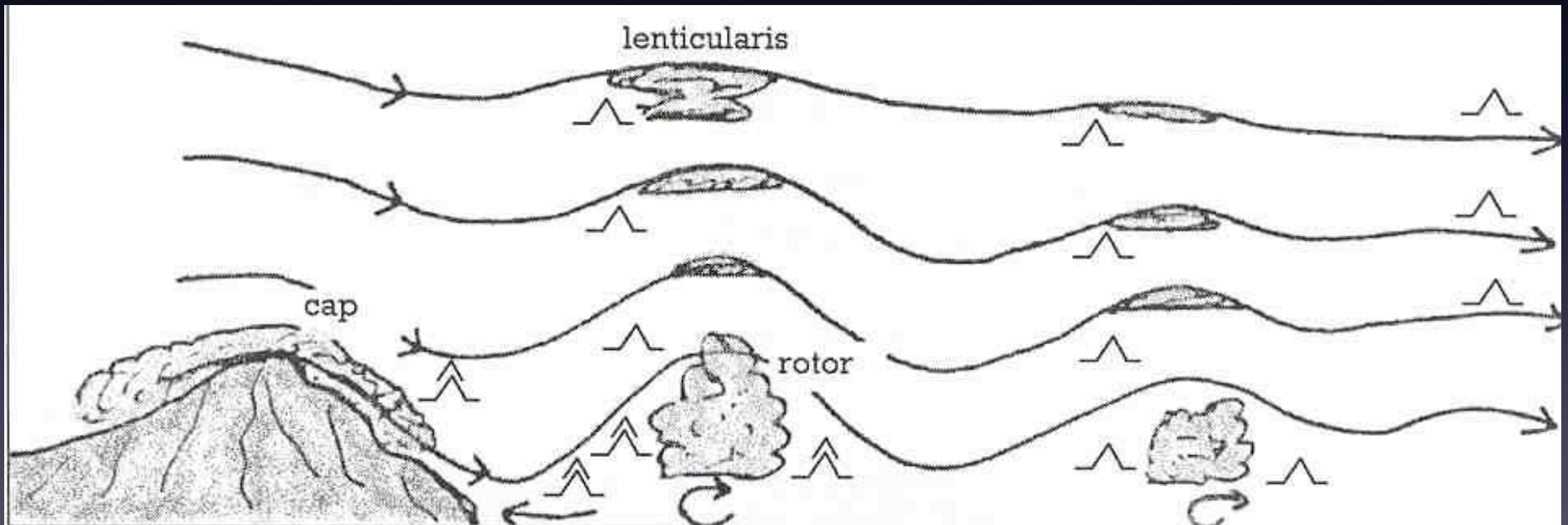
The cooling of the earth results in a cold stable layer in the lower layer. The larger the temp. change between surface and top of the inversion layer, the larger the possibility of a wind shear in the intermediate layer between the weak wind in the inversion layer and the severe wind above the inversion.



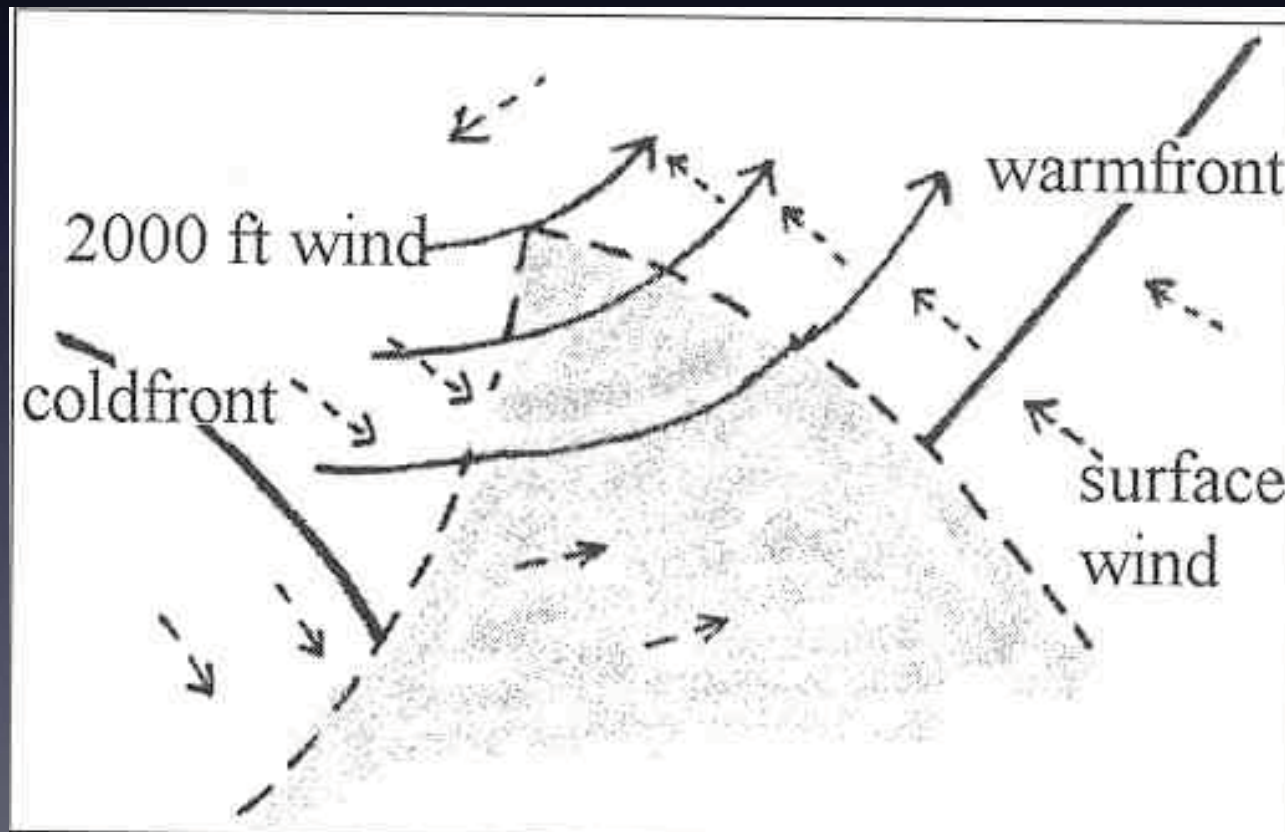
Wind Shear with Kata-Anabatic Wind



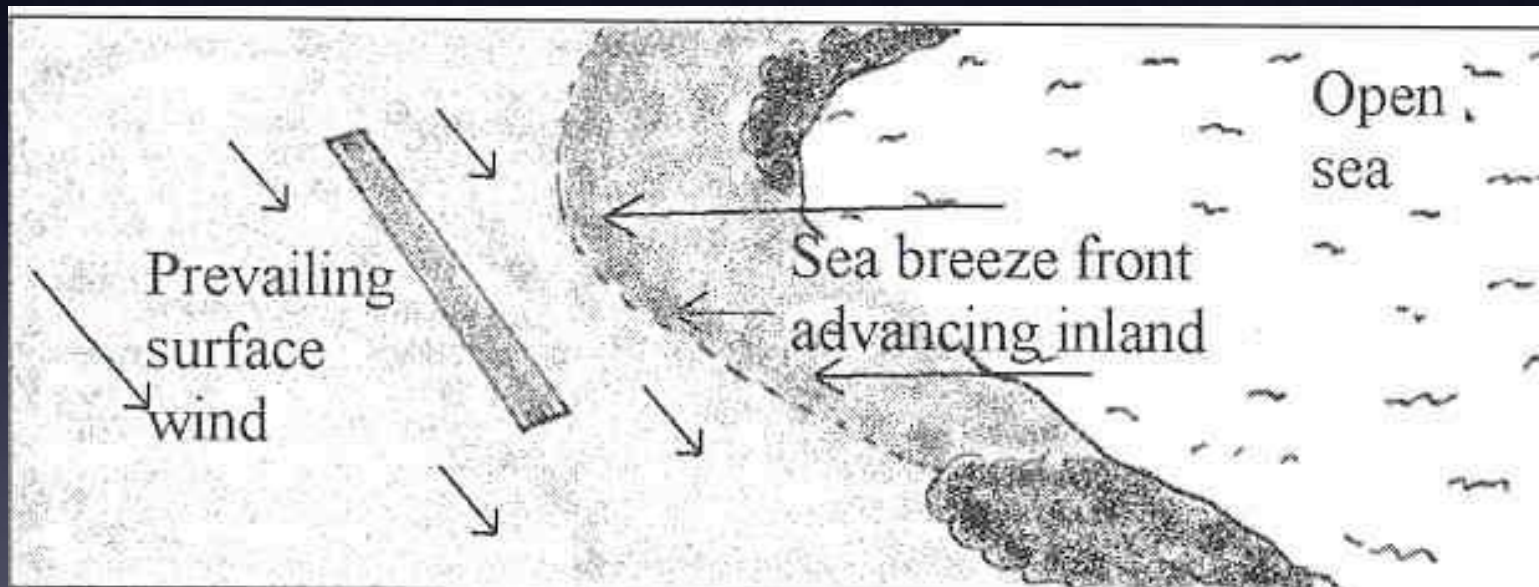
Wind Shear with Mountains Waves



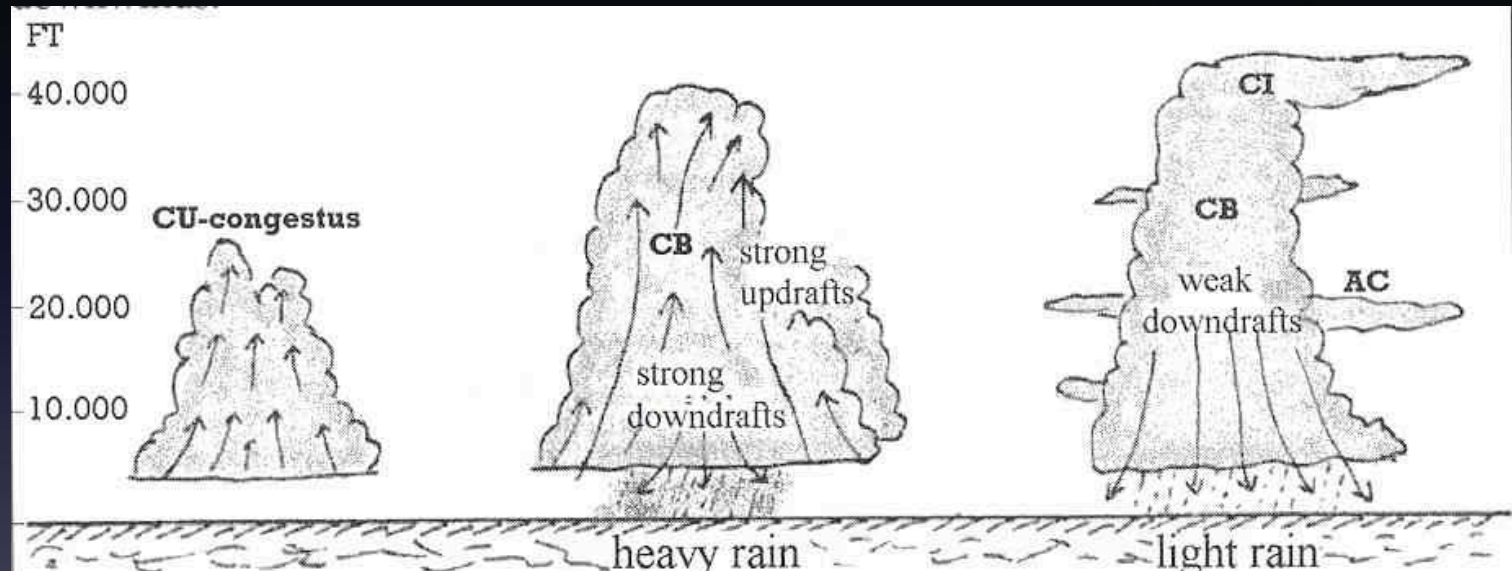
Wind Shear with Frontal Surface



Wind Shear with Sea - Land Breeze



Wind Shear with Cu fr Clouds



Cumulus Congestus (TCu)

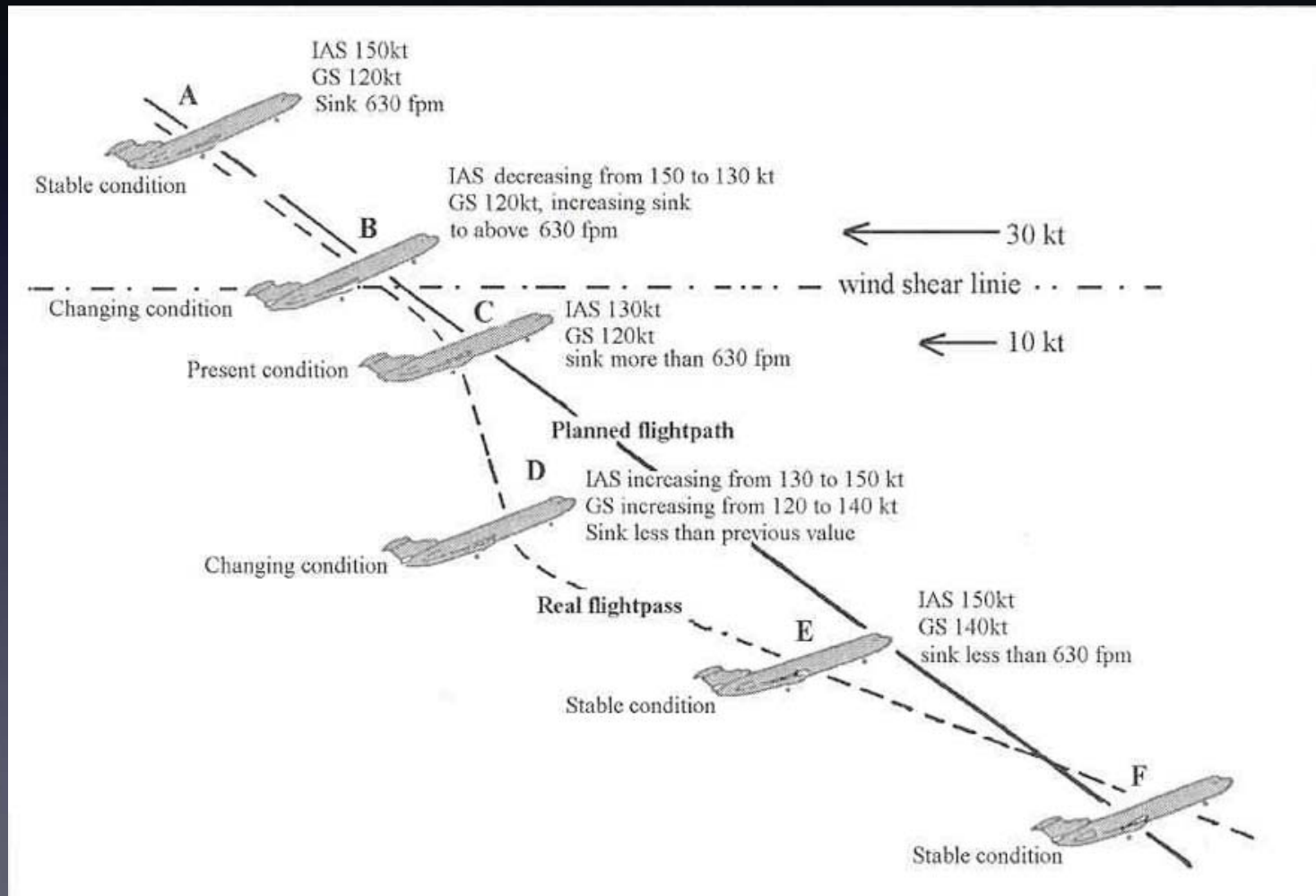


Cumulus Fractus (Cu fr)

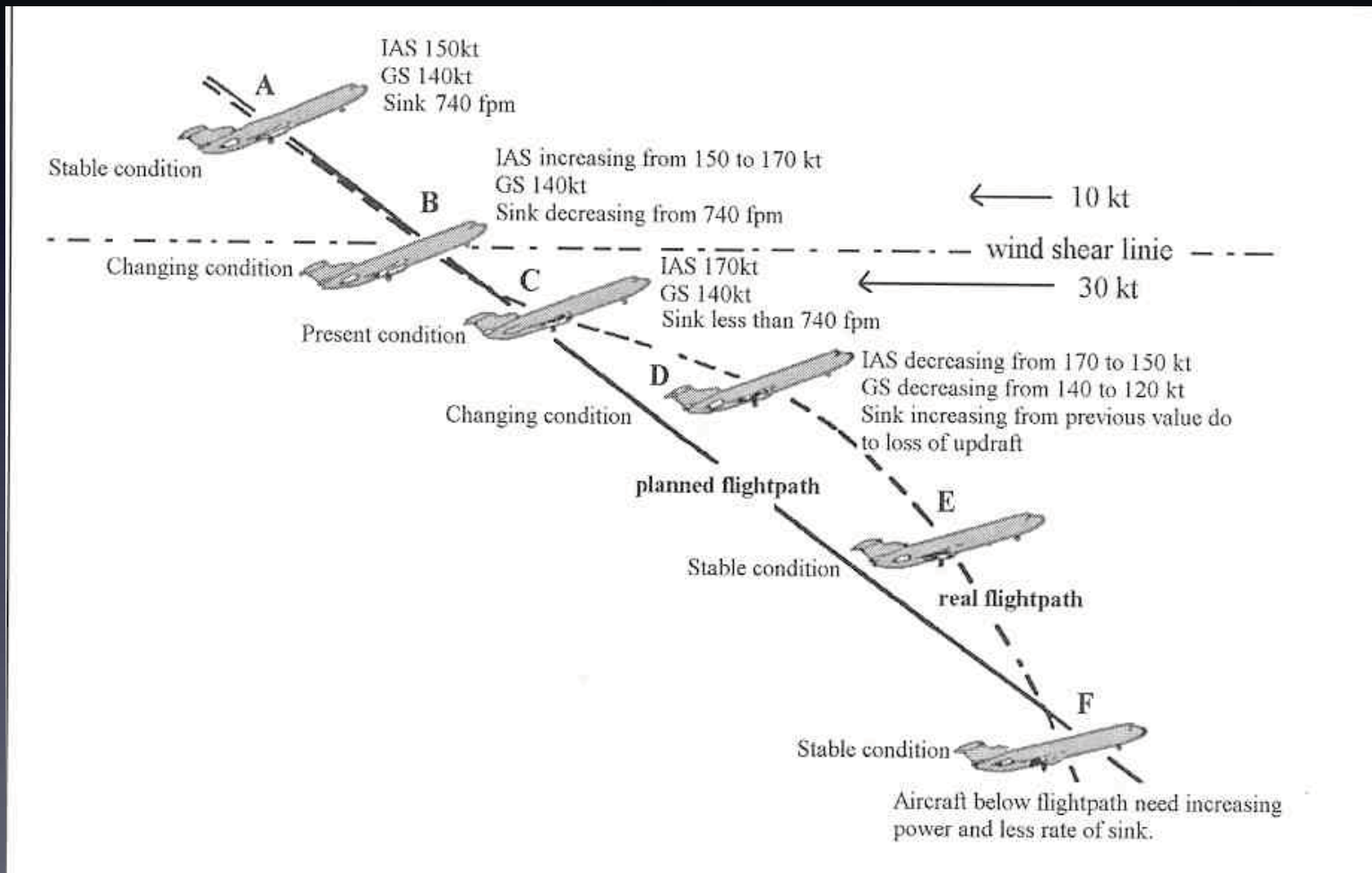


Fractus clouds are small, ragged cloud fragments which, usually found under an ambient cloud base, form or have broken off a larger cloud, and are generally sheared by and shredded-looking due to strong winds.

Consequences of Wind Shear

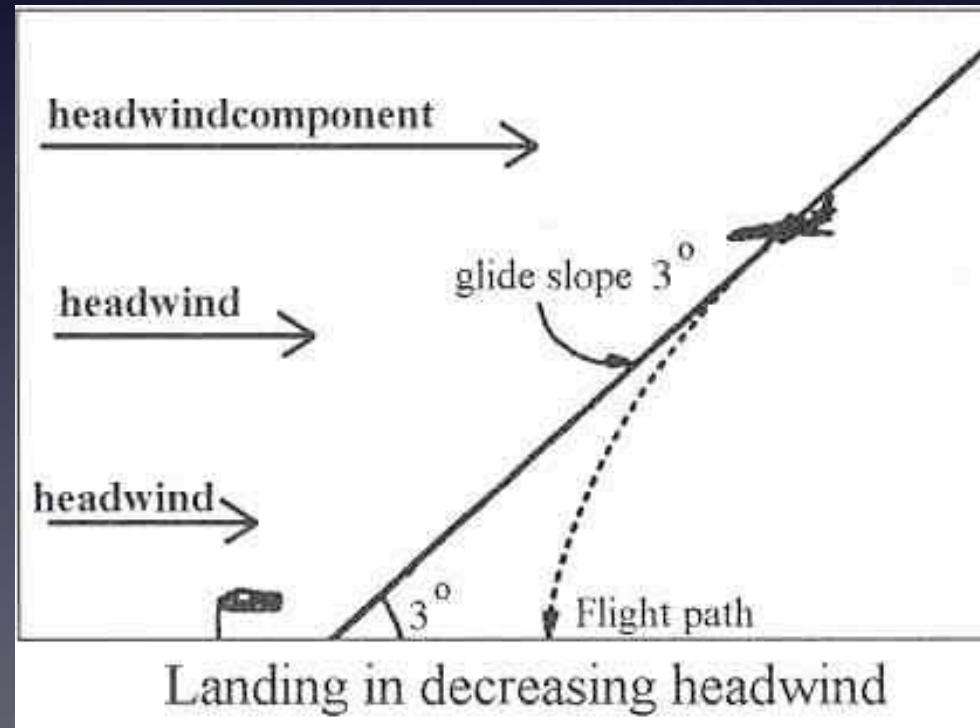


Consequences of Wind Shear



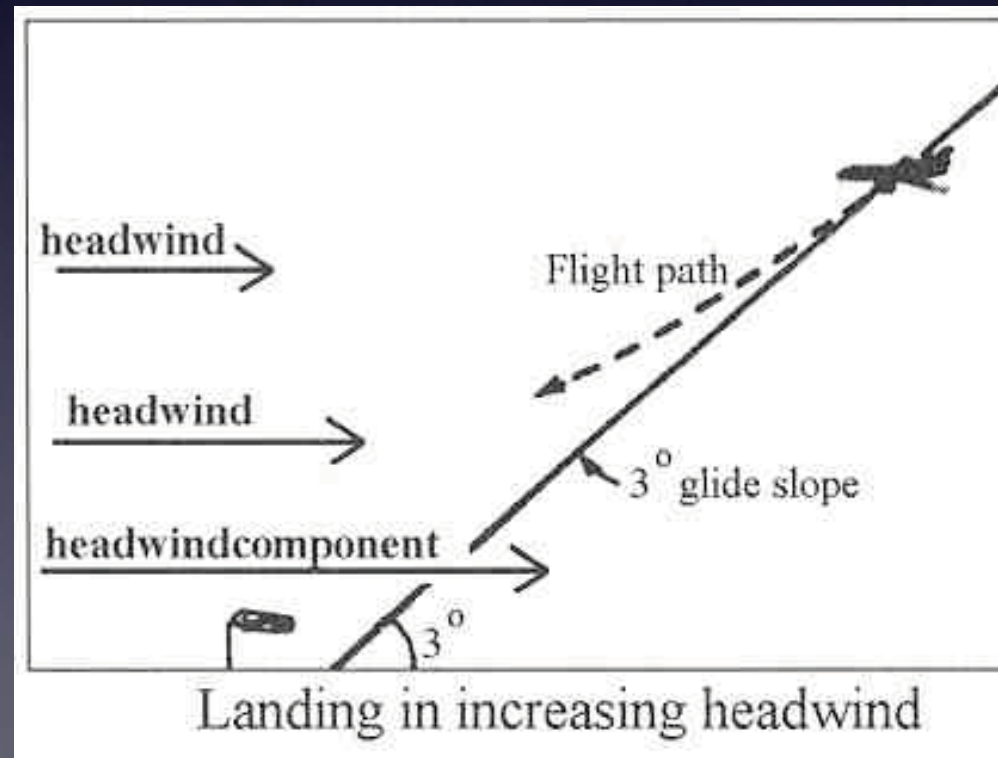
Consequences of Wind Shear

With a decreasing headwind component, the result may be a landing before the threshold



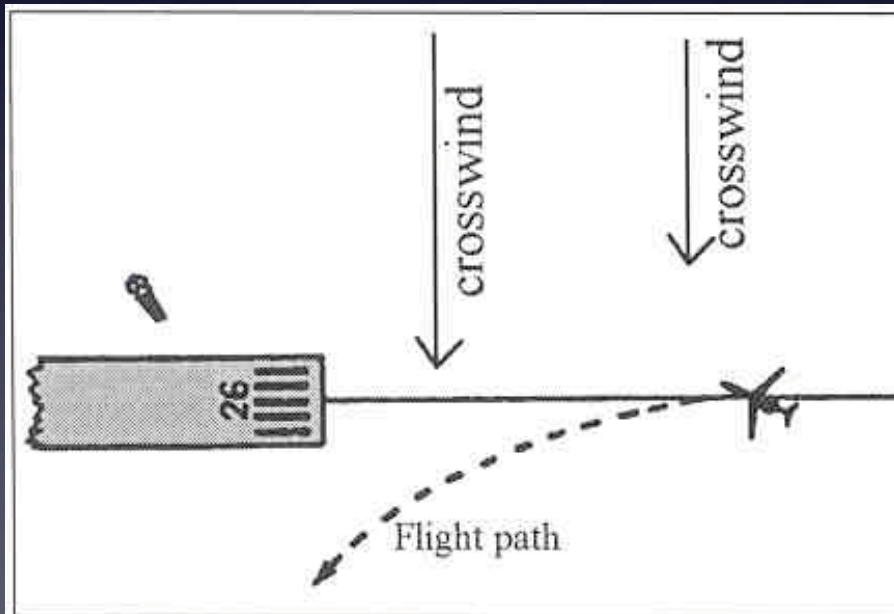
Consequences of Wind Shear

With an increasing headwind component the aircraft may land later on and exceed the runway

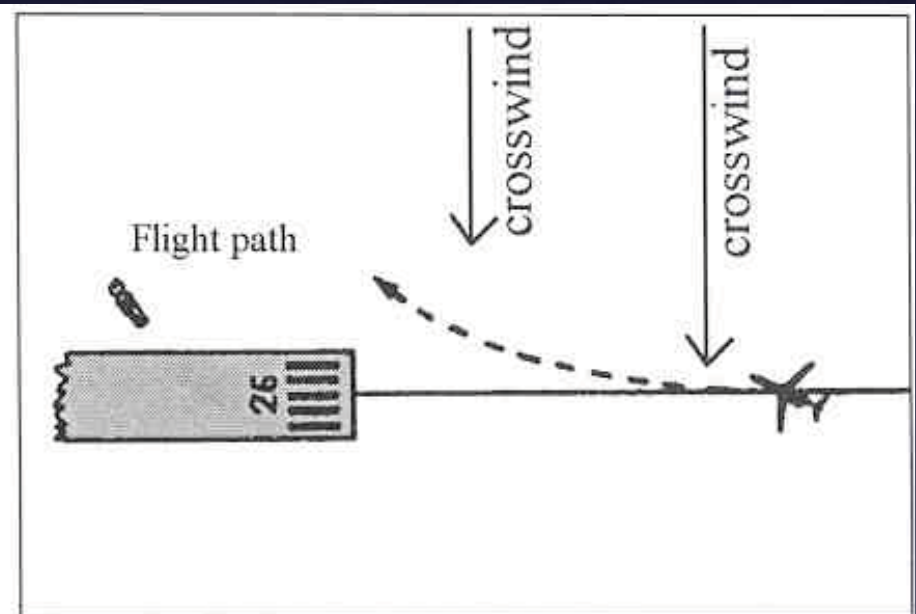


Consequences of Wind Shear

With the effect of a crosswind shear, the pilot will have to change the heading of the aircraft in order to keep on track

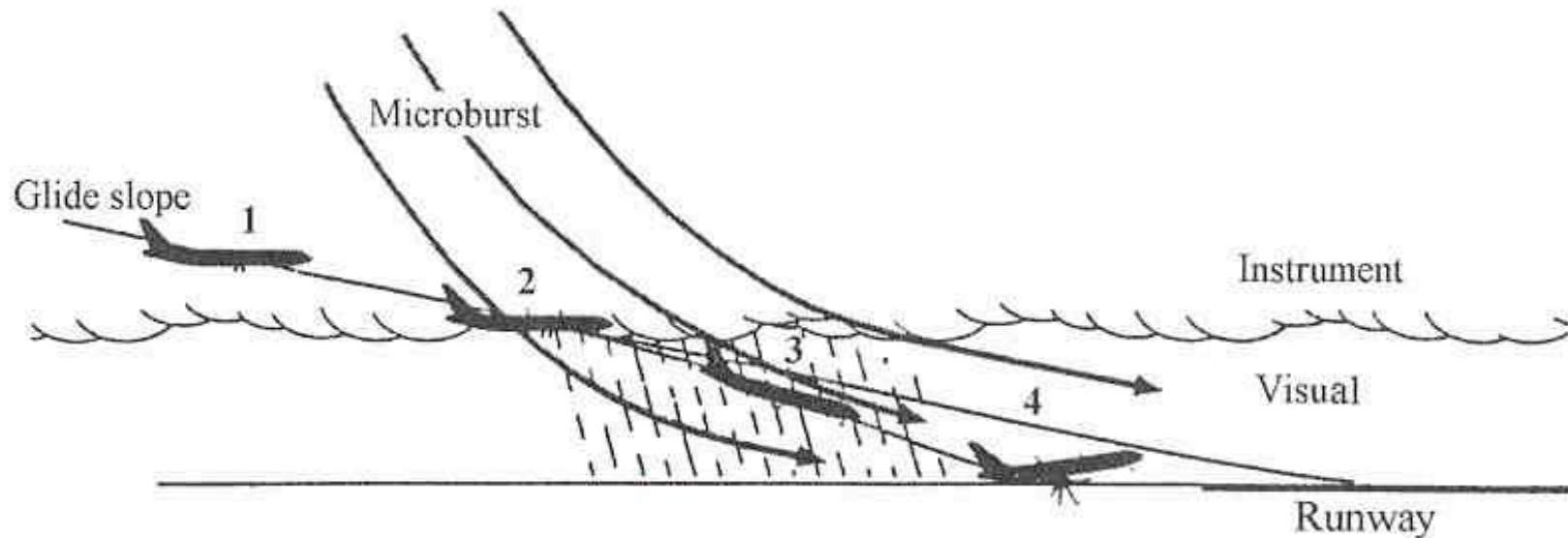


Increasing crosswind component



Decreasing crosswind component

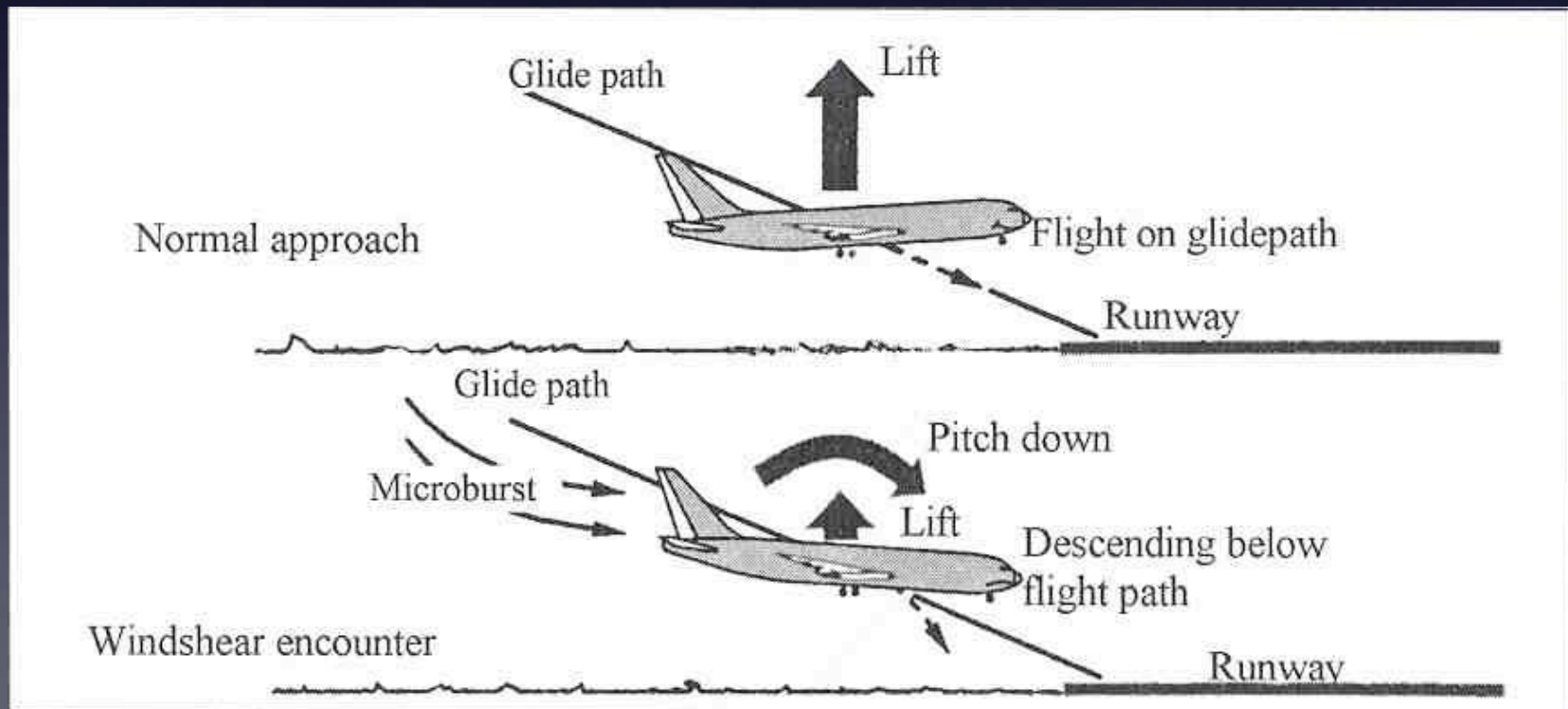
Consequences of Wind Shear



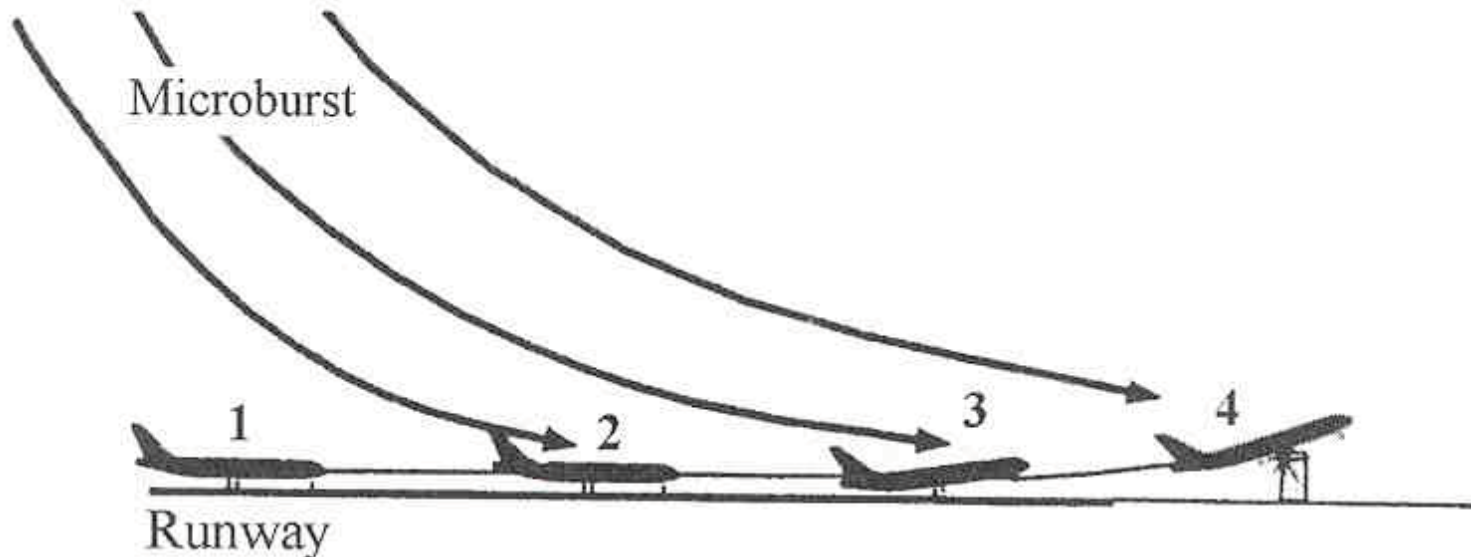
1. Normal approach.
2. Increasing downdraft and tailwind.
3. Decreasing airspeed and reduced visibility results in reduction of pitch attitude.
4. Aircraft crash short of approach end of runway.

Consequences of Wind Shear

Tailwind reduces airspeed and lift at normal attitude which results in pitch down tendency to regain airspeed



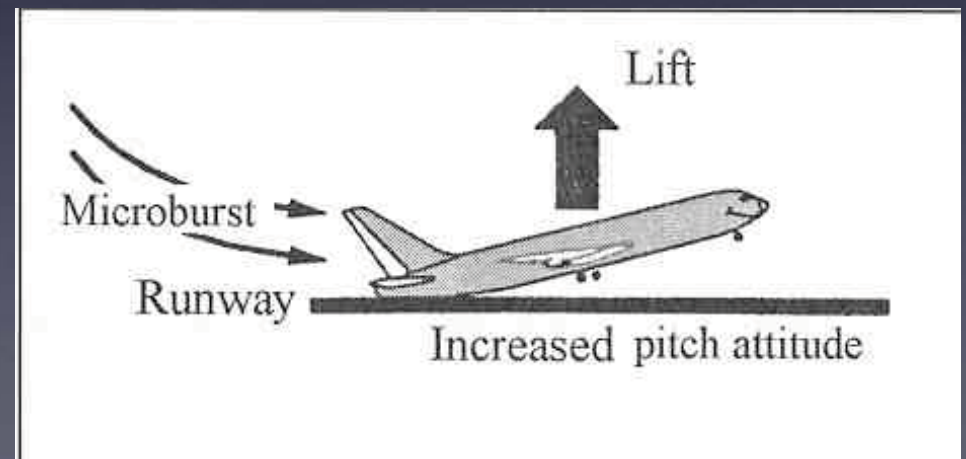
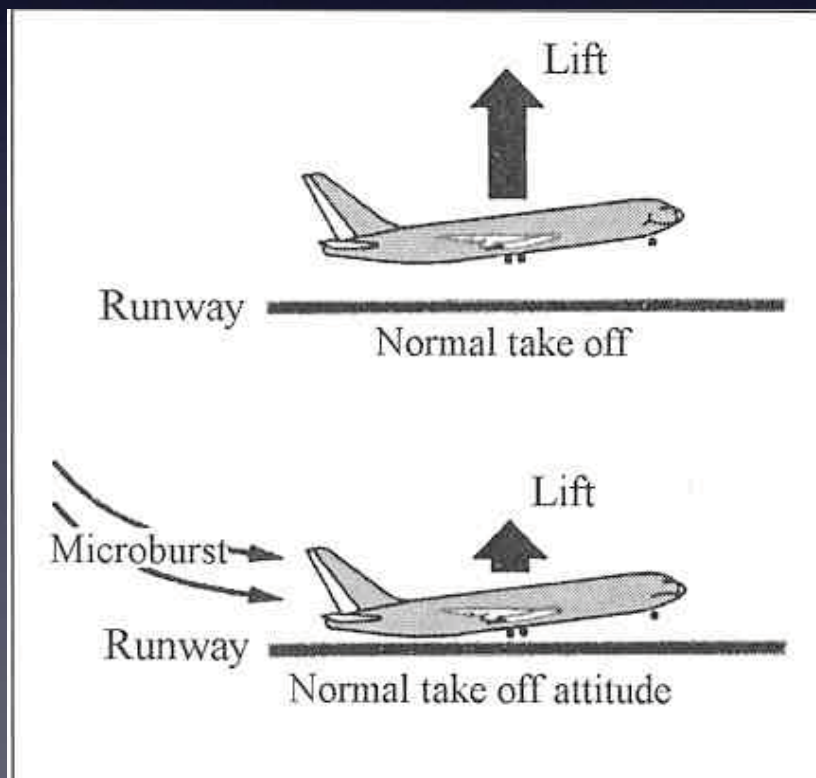
Consequences of Wind Shear



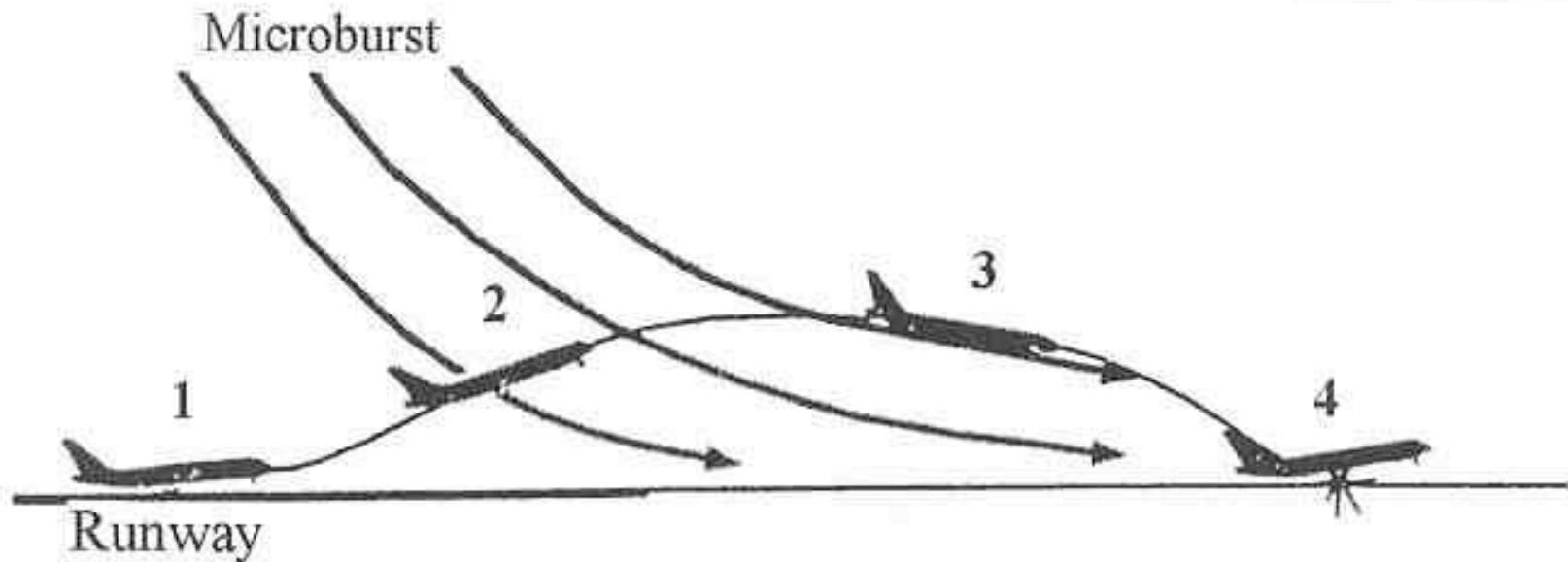
1. Normal take-off.
2. Decreasing airspeed due to windshear.
3. Aircraft reaches V_R near end of runway, lifted off but fails to climb.
4. Aircraft contacts obstacle off departure end of runway.

Consequences of Wind Shear

The tailwind increases the take-off speed and a normal take-off attitude will not be sufficient to make the aircraft climb.



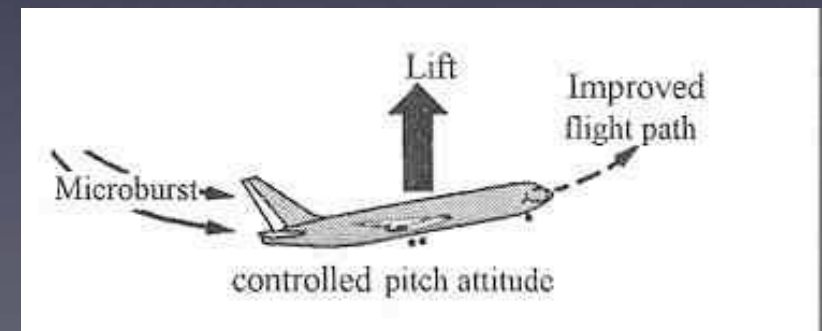
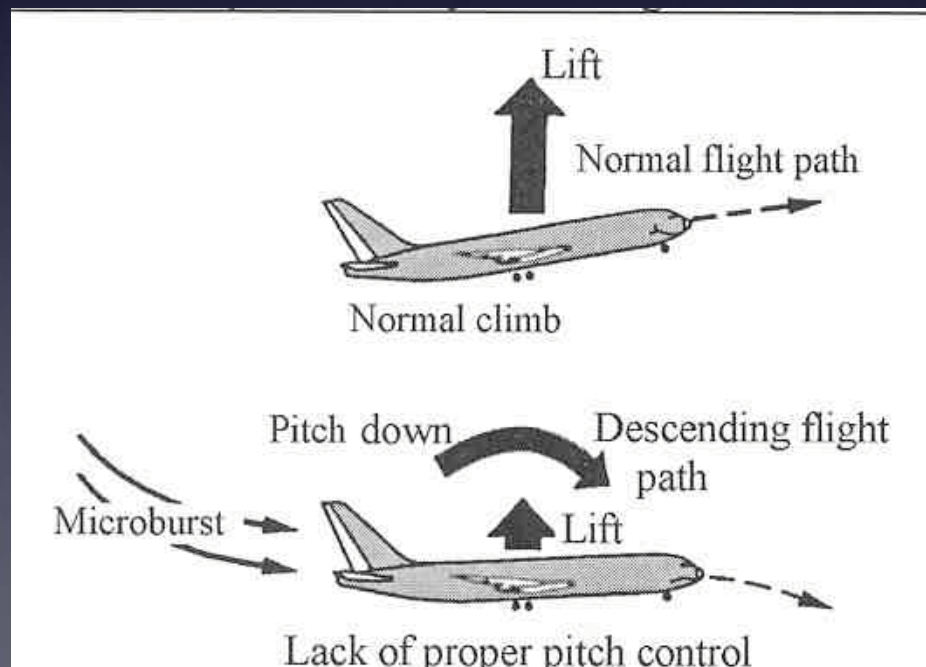
Consequences of Wind Shear



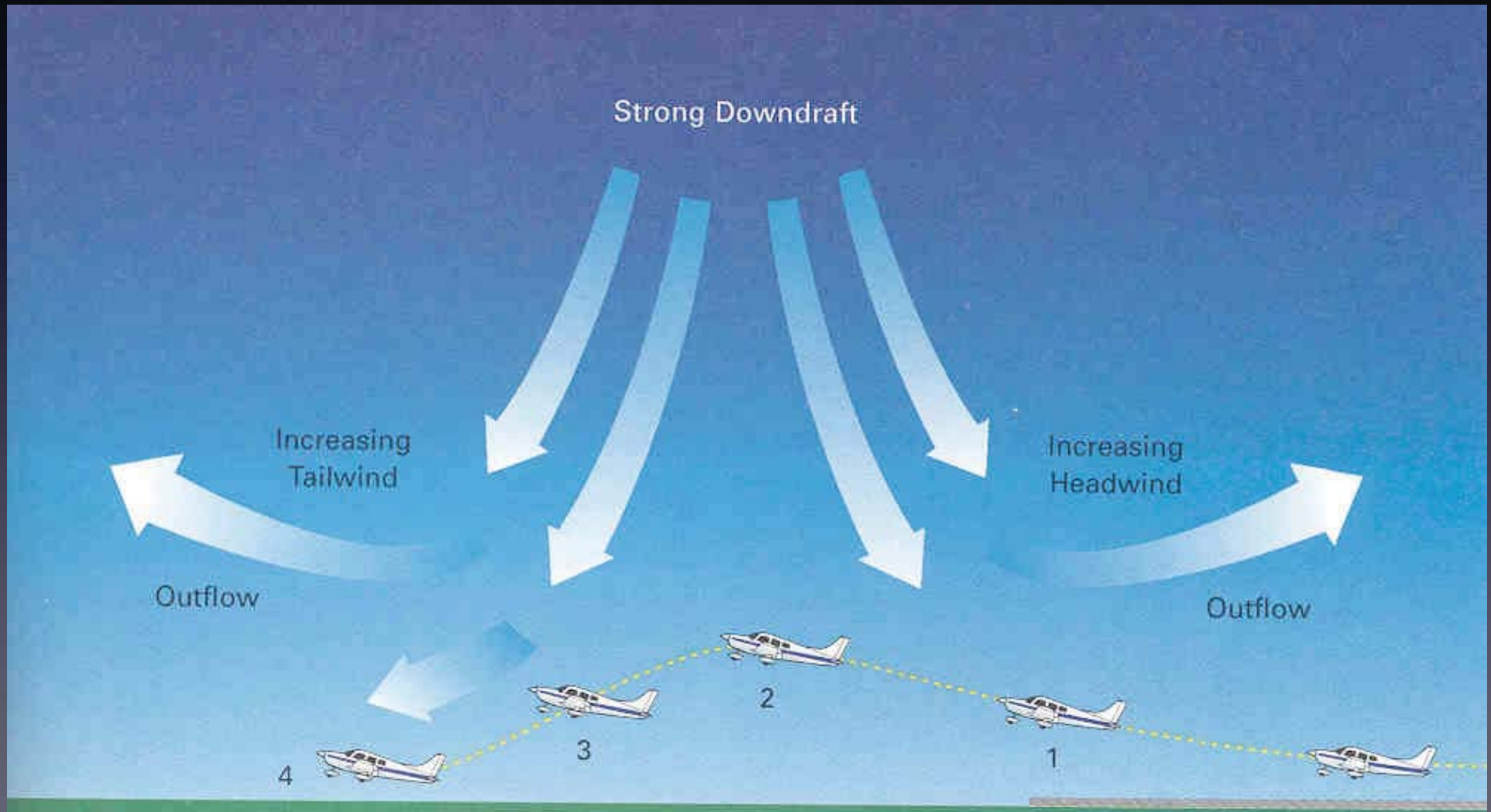
1. Normal take-off.
2. Tailwind-shear encountered just after liftoff.
3. Airspeed decrease results in pitch attitude reduction.
4. Aircraft crashes off departure end of runway 20 sec. after liftoff.

Consequences of Wind Shear

The tailwind reduces the airspeed and the lift at a normal attitude, which results in pitch down tendency to regain airspeed



Consequences of Wind Shear



Consequences of Wind Shear

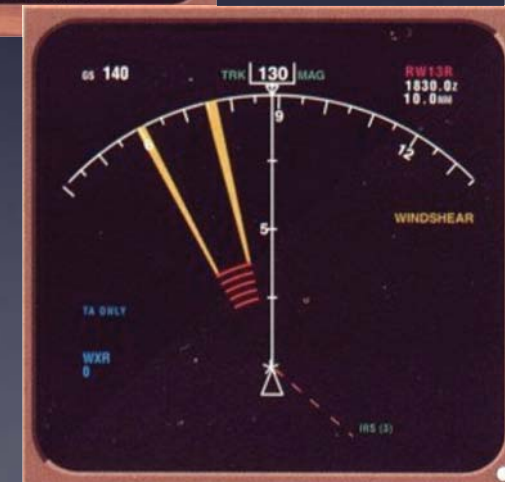
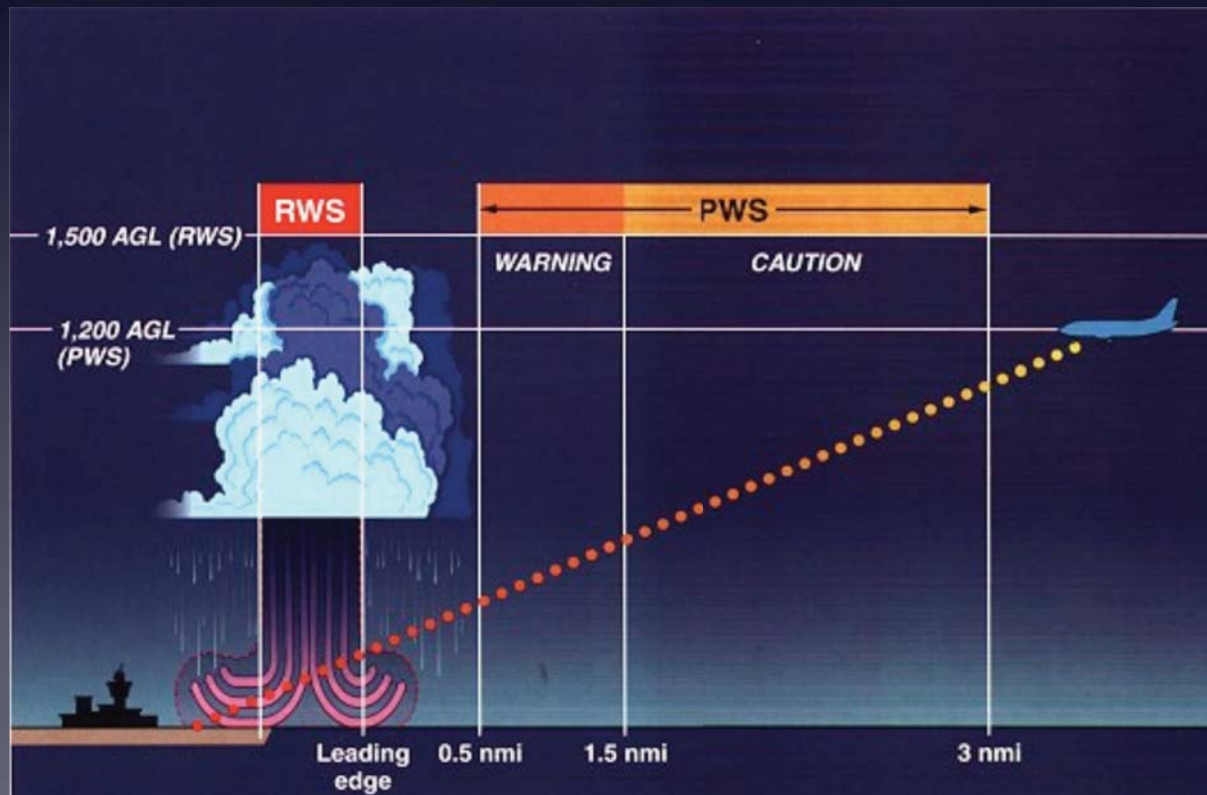


Consequences of Wind Shear



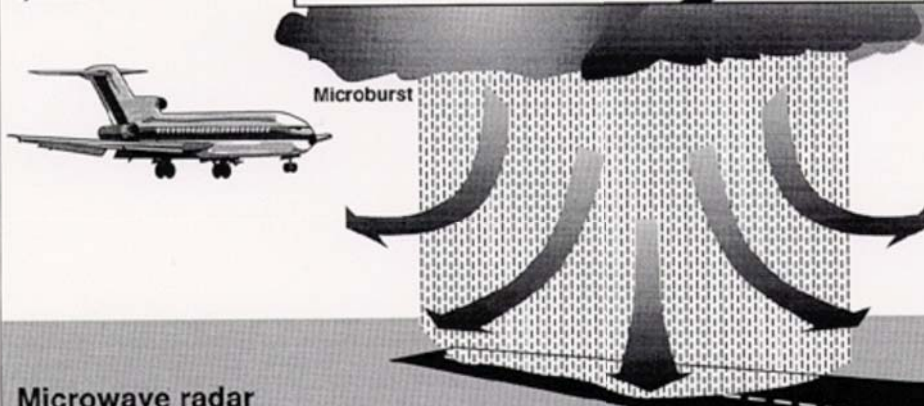
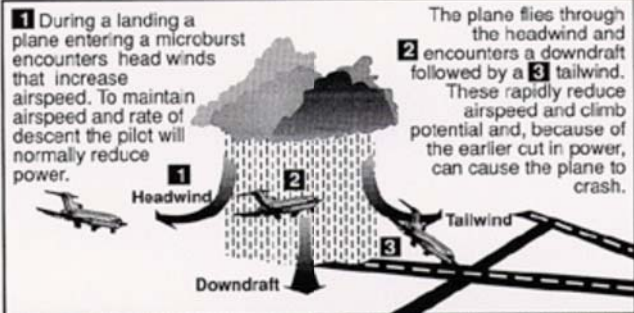
Wind Shear

Other than the Reactive Windshear System (RWS), the Predictive Windshear System (PWS) is able to provide a warning to the flight crew before the windshear condition becomes an immediate threat to the airplane.

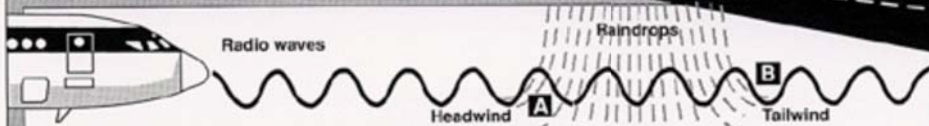


Onboard windshear warning systems

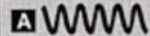
A microburst is a weather pattern that can create windshear. This condition has been linked to commercial plane crashes, especially during takeoffs and landings. Researchers feel that a 15- to 40-second warning will allow pilots to deal with this hazard. NASA Langley and the FAA are working on a variety of airborne detection and early warning systems. They include onboard microwave radar, infrared and LIDAR systems.



Microwave radar



Microwave radar emits radio waves at a uniform frequency and wavelength that are reflected back by raindrops. The returning signals' frequency is measured and compared with the emitted frequency to determine the direction and speed of the raindrops. A Doppler reading of varying wavelengths can indicate a wind shear condition.



The raindrops borne by headwinds return a shorter wavelength.



The raindrops borne by tailwinds return a longer wavelength.

Infrared

A small, relatively inexpensive system used to measure infrared radiation, which we feel as heat. A sensor measures the changes in temperature in front of a plane. These changes can be an indication of wind gusts. The sensor would activate a warning light in the cockpit.

LIDAR

LIDAR, short for Light Detecting and Ranging, uses light waves in the form of a laser beam much like Doppler radar uses radio waves. Instead of measuring the speed of raindrops, it measures the speed of aerosols and dust particles in the atmosphere to detect changes in the wind.

Wind Shear

Be Aware!