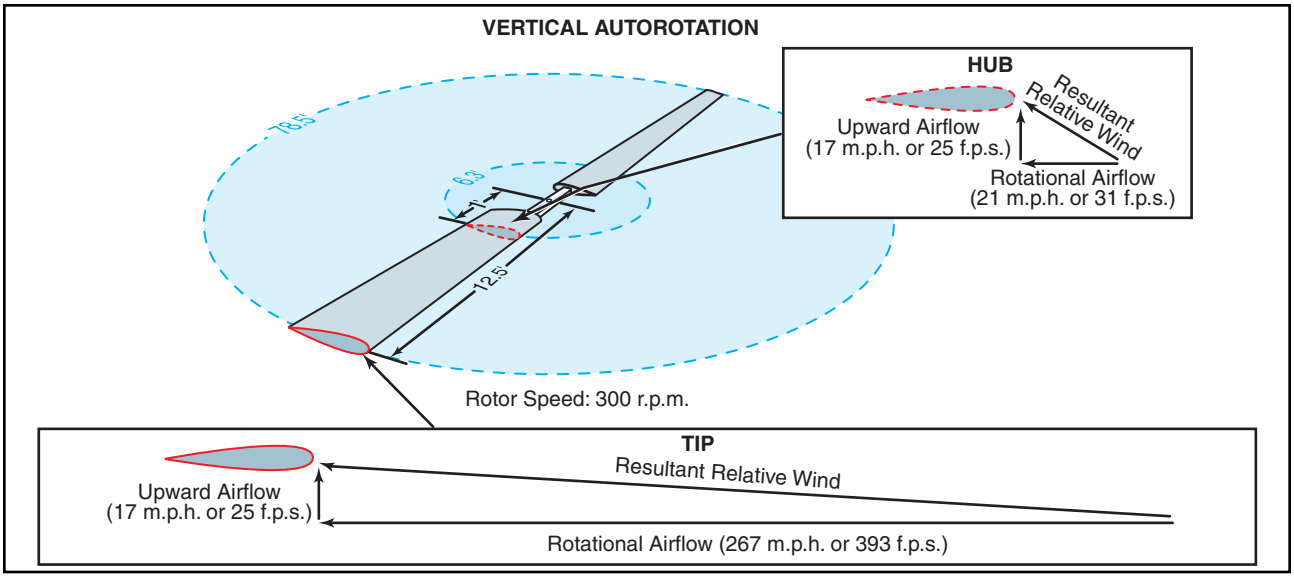

Figure 16-3. Moving outboard on the rotor blade, the rotational velocity increasingly exceeds the upward component of airflow, resulting in a higher relative wind at a lower angle of attack.

speed of 393 feet per second, or 267 m.p.h. The result is a higher total relative wind, striking the blades at a lower angle of attack. [Figure 16-3]

ROTOR DISC REGIONS

As with any airfoil, the lift that is created by rotor blades is perpendicular to the relative wind. Because the relative wind on rotor blades in autorotation shifts from a high angle of attack inboard to a lower angle of attack outboard, the lift generated has a higher forward component closer to the hub and a higher vertical component toward the blade tips. This creates distinct regions of the rotor disc that create the forces necessary for flight in autorotation. [Figure 16-4] The autorotative region, or driving region, creates a total aerodynamic force with a forward component that exceeds all rearward drag forces and keeps the blades spinning. The propeller region, or driven region, generates a total aerodynamic force with a higher vertical component that allows the gyroplane to remain aloft. Near the center of the rotor disc is a stall region where the rotational component of the relative wind is so low that the resulting angle of attack is beyond the stall limit of the airfoil. The stall region creates drag against the direction of rotation that must be overcome by the forward acting forces generated by the driving region.

AUTOROTATION IN FORWARD FLIGHT

As discussed thus far, the aerodynamics of autorotation apply to a gyroplane in a vertical descent. Because gyroplanes are normally operated in forward flight, the component of relative wind striking the rotor blades as a result of forward speed must also be considered. This component has no effect on the aerodynamic principles that cause the blades to autorotate, but causes a shift in the zones of the rotor disc.

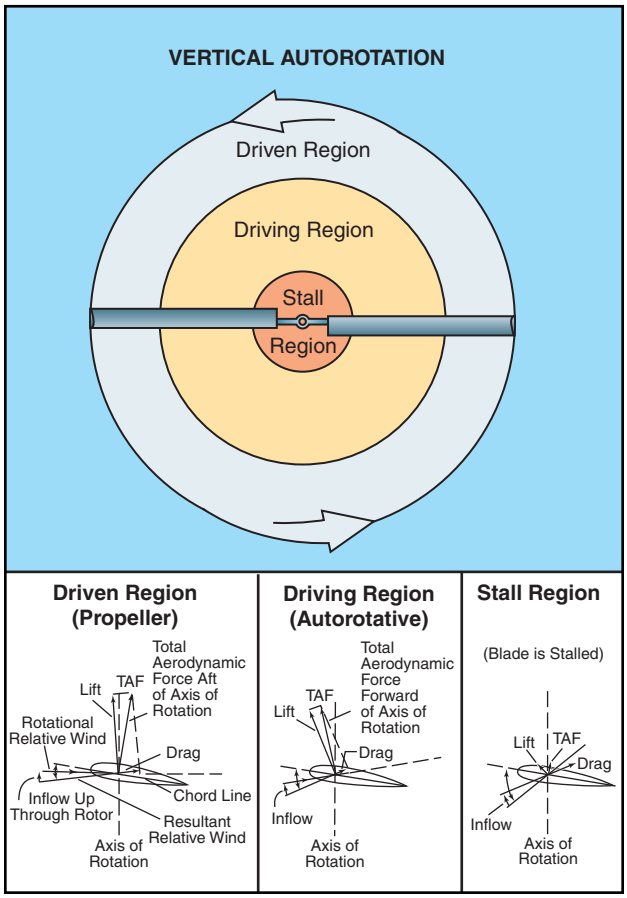

Figure 16-4. The total aerodynamic force is aft of the axis of rotation in the driven region and forward of the axis of rotation in the driving region. Drag is the major aerodynamic force in the stall region. For a complete depiction of force vectors during a vertical autorotation, refer to Chapter 3—Aerodynamics of Flight (Helicopter), Figure 3-22.

As a gyroplane moves forward through the air, the forward speed of the aircraft is effectively added to the