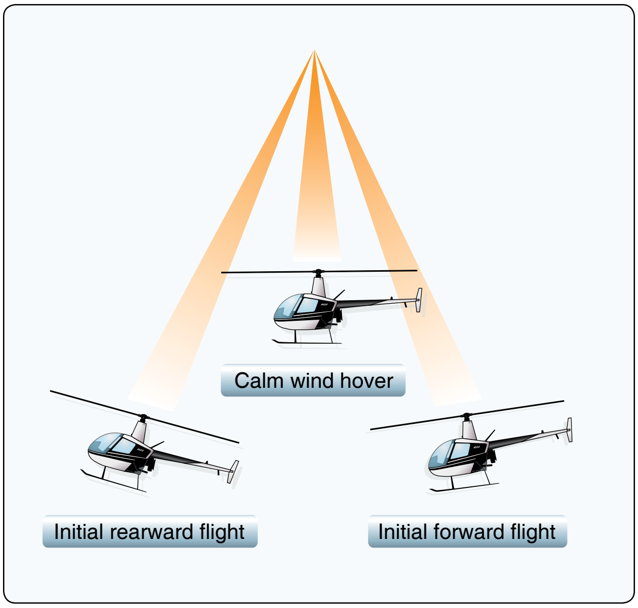

Figure 2-28. *Because the helicopter's body has mass and is suspended from a single point (the rotor mast head), it tends to act much like a pendulum.*

rearward flight groundspeed equals the windspeed, then the helicopter is merely hovering in a no-wind condition. However, rearward hovering into the wind requires considerable care and caution to prevent tail strikes.

It is important to note that there is a difference in the amount of pendular action between a semirigid system and a fully articulated system. Because of the hard connection (offset) of the latter, the centrifugal force pulling out on the blades is transferred to the fuselage, and the fuselage tends to follow the rotor attitude. The semirigid system is a true pendulum, with thrust required to create a moment around the fuselage CG to allow for control of the fuselage. This comes into play later when mast bumping is discussed.

Coning

In order for a helicopter to generate lift, the rotor blades must be turning. Rotor disk rotation drives the blades into the air, creating a relative wind component without having to move the airframe through the air as with an airplane or glider. Depending on the motion of the blades and helicopter airframe, many factors cause the relative wind direction to vary. The rotation of the rotor disk creates centrifugal force (inertia), which tends to pull the blades straight outward from the main rotor hub: the faster the rotation, the greater the centrifugal force, the slower the rotation, the smaller the centrifugal force. This force gives the rotor blades their rigidity and, in turn, the strength to support the weight of the helicopter. The maximum centrifugal force generated is determined by the maximum operating rotor revolutions per minute (rpm).

As lift on the blades is increased (in a takeoff, for example), two major forces are acting at the same time—centrifugal force acting outward, and lift acting upward. The result of these two forces is that the blades assume a conical path instead of remaining in the plane perpendicular to the mast. This can be seen in any helicopter when it takes off; the rotor disk changes from flat to a slight cone shape. *[Figure 2-29]*

If the rotor rpm is allowed to go too low (below the minimum power-on rotor rpm, for example), the centrifugal force becomes smaller and the coning angle becomes much larger. In other words, should the rpm decrease too much, at some point the rotor blades fold up with no chance of recovery.

Coriolis Effect (Law of Conservation of Angular Momentum)

The Coriolis Effect is also referred to as the law of conservation of angular momentum. It states that the value of angular momentum of a rotating body does not change unless an external force is applied. In other words, a rotating body continues to rotate with the same rotational velocity until some external force is applied to change the speed of rotation. Angular momentum is the moment of inertia (mass times distance from the center of rotation squared) multiplied by the speed of rotation.

Changes in angular velocity, known as angular acceleration and deceleration, take place as the mass of a rotating body is moved closer to or farther away from the axis of rotation. The speed of the rotating mass varies proportionately with the square of the radius.

An excellent example of this principle in action is a figure skater performing a spin on ice skates. The skater begins rotation on one foot, with the other leg and both arms extended. The rotation of the skater's body is relatively slow. When a skater draws both arms and one leg inward, the moment of inertia (mass times radius squared) becomes

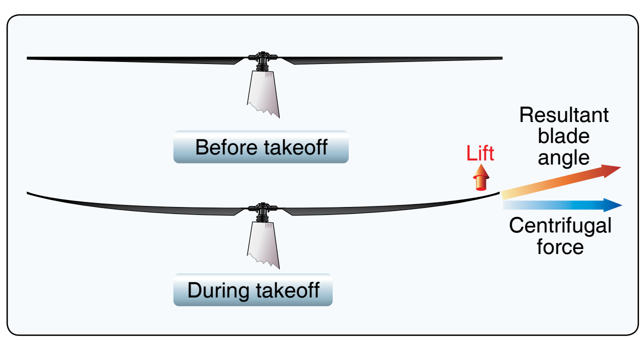

Figure 2-29. *During takeoff, the combination of centrifugal force and lift cause the rotor disk to cone upward.*