

### 4.5.1 Tail Functions

Raymer states that “the tails are also a key element of stability, acting much like the fins on an arrow to restore the aircraft from an upset in pitch or yaw”. That statement is certainly true of the vertical stabilizer which acts like the tail of a weathercock (in fact the directional stability of an aircraft is often referred to as “weathercock stability”). If you were to put the vertical stabilizer on the nose of an airplane, the plane would be directionally unstable.

The action of the horizontal stabilizer is much more complex, and involves a delicate balance of the pitching moment due to the location of the wing center of lift relative to the center of gravity, the inherent pitching moment of the wing, the pitching moment generated by the horizontal stabilizer, and the way these moments change with angle of attack. These issues are discussed in more detail in Raymer Section 16.3 and in the annotations to that section. Suffice to say here that the horizontal stabilizer can be placed at the nose of the airplane without the airplane becoming unstable in pitch, provided that the wing is also moved aft to the correct position relative to the airplane center of gravity, and provided that the canard surface operates at a higher angle of attack than the wing. This configuration is called a canard, which is French for “duck”, even though ducks don’t have canard surfaces. It also has the meaning of a hoax, or something that leads people astray, and perhaps the second meaning is more appropriate. Raymer mentions some of the advantages and disadvantages in the subsection on Tail Arrangements.