

As suggested by the title this should not be taken as a comprehensive guide to T-tail aerodynamics. Little research is published on the subject; hence, all that is discussed here is theoretical in nature. In no way should this text be considered anything other than a guide and in no way should it excuse a lack of further research by the reader.

Summary

The physics of the T-tail differ from a straight tail in a number of ways:

- The T-tail is not in the prop wash.
- The T-tail is influenced little by ground effect.
- The T-tail is influenced little by downwash from the main wing.

This can be summarised by saying that, because of its location, the T-tail is nearly^j in the free stream airflow and independent of the rest of the airplane.

The logical consequences of this are:

- The T-tail in some ways can be considered more ideal in that it is acting nearly independently of such things as altitude, power setting, configuration, et cetera.
- The T-tail is less effective resulting in less control authority.

Flight Characteristics

There are several scenarios that must be considered for a T-tail aircraft due to its differences from a straight tail.

Rotation

During the takeoff in a straight tail (ST) airplane the horizontal control surface is located in the accelerated airflow of the prop wash. This serves to increase the control effectiveness of the control surface. The T-tail does not benefit from any effect of the prop wash. Hence, a T-tail aircraft will require, what may be a surprising amount of backpressure to rotate. Holding such a large amount of backpressure may result in over rotation.

Configuration Changes

In a high wing ST airplane extending the flaps can cause significant changes to the trim balance of the airplane, especially when producing non-zero power^l. Since the T-tail is not directly located in the wash from the main wing the effects of configuration are reduced. This will be seen most significantly during stall recovery where flaps are retracted at slow speed with full power. In this case retraction of flaps will result in minor changes in control pressures for the T-tail.

Center of Gravity

Violation of the forward center of gravity (CG) limit for a T-tail should be considered an extremely serious situation. During take-off and (especially) landing the lack of control authority in pitch may be of critical concern. In a ST airplane, particularly during landing, it may be possible for the pilot to increase control authority by using power, resulting in increase airflow over the tail. This is not an option in a T-tail airplane.

Go-Around

In most aircraft, during a go-around, there is a resultant pitch up or pitch down moment. Whether the total moment induces pitch up or pitch down is dependant on a number of aerodynamic factors. However, in these airplanes, after the application of full power there will be a resulting pitch down moment from the main wing and a pitch up moment from the tail. In the T-tail there is no accelerated flow over the tail leaving only the pitch down moment from the prop wash over the main wing.

Spins

During a spin and during recovery, the T-tail behaves differently than a ST airplane especially when producing non-zero power¹. The effect of the propeller(s) is to induce a rotational component to the airflow. This slipstream rotation changes the airflow direction at the tail.

Structural Integrity

The T-tail by nature of being located on top of a long narrow structure (the vertical stabiliser) is a weak point of the aircraft. In T-tail aircraft there is often a compromise in the design of the vertical stabiliser. Usually the compromise is to make the vertical section thicker than is aerodynamically optimal.

j In the vicinity of the horizontal control surface the effect of the main wing is minimal. This can be demonstrated on NASA's FoilSim Java applet program. <http://www.grc.nasa.gov/WWW/K-12/FoilSim/>

l Non-zero power can be considered as anytime that the propeller(s) is having a large effect on the resulting airflow.

Reference:

[Aerodynamics For Naval Aviators](#); H. H. Hurt, Jr.

See [How It Flies](#); John S. Denker. <http://www.monmouth.com/~jsd/how/>

For further reference on new aircraft familiarization please see:

<http://www.monmouth.com/~jsd/how/htm/maneuver.html#sec-familiarization>

<http://www.monmouth.com/~jsd/how/htm/landing.html#sec-learn-to-land>