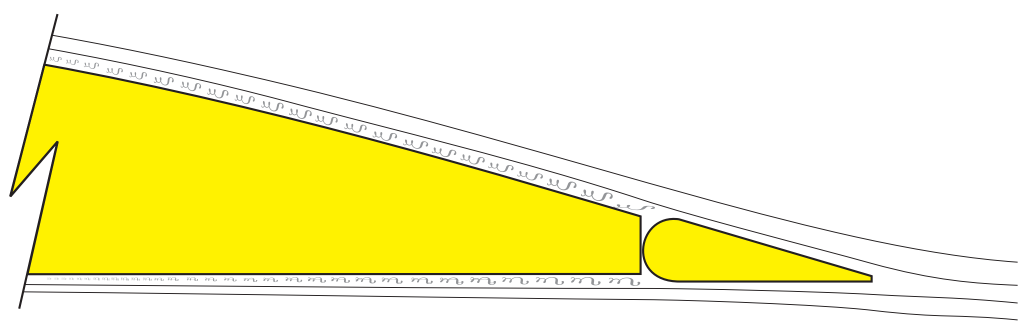
Improving Airplane Performance

Thicker Control Surfaces



Improving Airplane Performance

In this section: B-28 illustrates a factor to be considered called *skin friction*, and its effect upon disrupting the airflow over the surfaces of the wing, tail group, and control surfaces. Also, how the traditional practice of *beveling* the leading edge of the control surfaces disrupts the airflow even further.

The resulting irregular and sluggish control responses brought on by the control surfaces being entirely surrounded by disturbed air is most undesirable in novice flight training, since so much of the flying is done at slower speeds, where even more control is required (especially in a full-time Flight School where windy conditions often require immediate and positive corrections in order to train effectively).

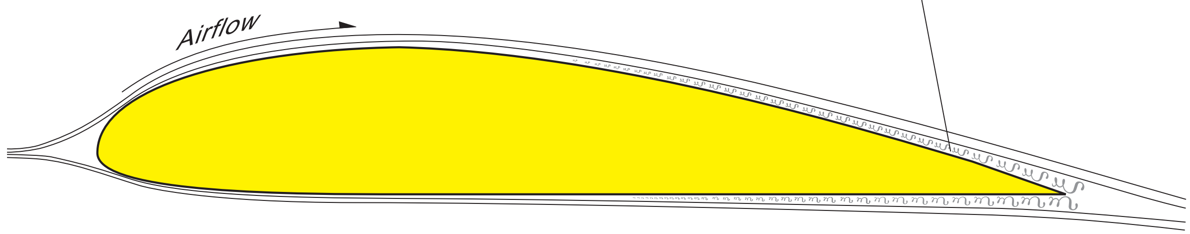
B-29 illustrates the recommended practice of thicker control surfaces with round leading edges to improve flight control and stability as much as 50%!

1st U.S. R/C Flight School's one week to solo program is predicated on an approach that one improvement is only that, yet several improvements can add up to have a real impact. Thicker control surfaces improve the student's ability to maintain positive control during stalls, in wind, and while landing—as well as providing in-flight results that better reflect the exact types of inputs made by the pilot.

KPTR: Thicker control surfaces are most beneficial for those who fly slow and in wind while learning to fly.

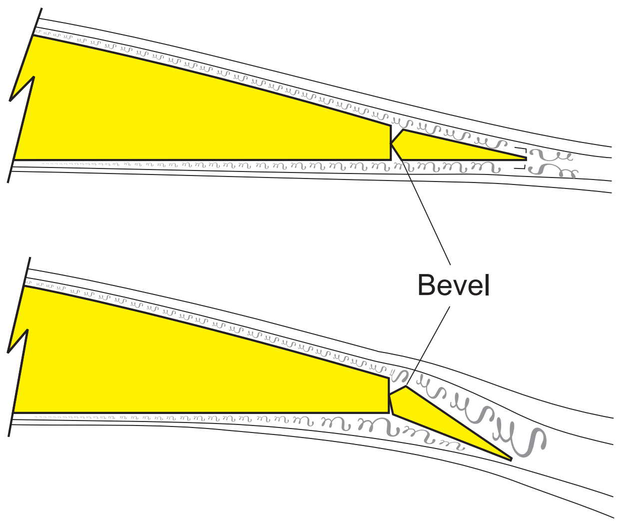
Skin Friction and Beveled Control Surfaces Disturbing Airflow

The air encounters friction (just like your hand would) as it moves over the surface or skin of the wing, tail, etc.. *Skin friction* causes the air at the surface to become disturbed or turbulent, and the further along the air flows over a surface, the greater the area of disturbed air becomes.



This same principle (friction) is what causes wind to create ripples at the upwind end of a lake that develop into waves further downwind.

The skin friction air disturbance surrounds all the control surfaces around neutral!



Aileron example: Small aileron deflections (stick movements) provide sluggish responses. To begin achieving positive control, the pilot needs to apply larger inputs in order to deflect the surface up into the smoother air.

Traditional *beveled* control surfaces help to disrupt the already turbulent airflow even further when the air catches or trips over the squared corners of the bevel (as would your fingertips).

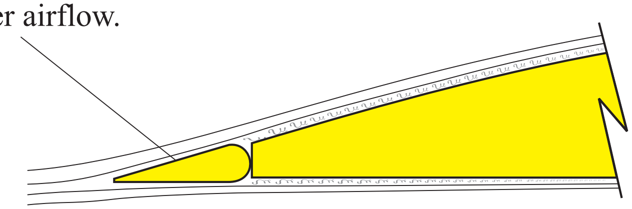
Because the area of disrupted air grows worse at slower speeds, one of the most noticeable and frankly annoying aspects of flying with conventional control surfaces is the *response rate* noticeably speeds up and slows down as the plane speeds up and slows down—thus interfering with the pilot's ability to fully predict what results he will get from his inputs.

Note: The skin friction air disturbance and beveling increase the potential for control surface **flutter!**

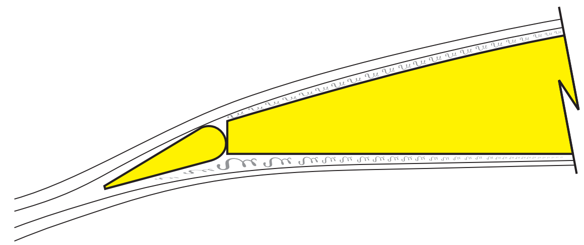
KPTR: Traditional beveled surfaces produce an initial sluggish response and require the pilot to apply larger inputs.

Thicker Control Surfaces Improving Control

Slightly away from the surface of the wing or tail, the smoother and more layered the air flows. By incorporating slightly thicker control surfaces, the physical surfaces of the ailerons, elevator, and rudder will be flush with the smoother airflow.



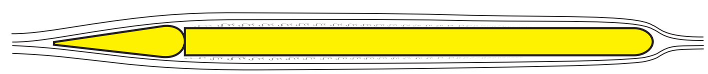
Notice: The airflow does not bump into the aileron's raised leading edge since the air is disturbed in that area.



A round leading edge applied to a control surface provides a smoother contour for the airflow to pass smoothly over the surface (as would your fingertips).

The primary benefits of control surfaces with round leading edges and increased thickness are:

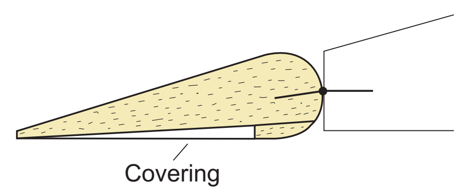
- Improved pilot-airplane correlation. The degree of airplane response will more closely match the stick input, especially small inputs.
- The *flight envelope* is expanded! The minimum controllable airspeed is lowered on all models.
- Smoother and more positive responses, as required on windy days or when flying low to the ground.
- The potential for flutter is significantly reduced. (The practice of sealing the gaps is unnecessary.)



Horizontal or vertical stabilizer flat-plate airfoil

.40 - .1.20 models: Aileron, elevator, and rudder raised approx. 1/16" each side - 3/32" to 1/8" thicker overall.

While 1st U.S. R/C Flight School utilizes the above techniques on all control surfaces, the ailerons are most important. For your model, you could purchase thicker tapered aileron-elevator balsa, or, build up the leading edge of the provided ailerons with strips of balsa to achieve the increased thickness, and then re-center the hinge.



 KPTR: Thicker control surfaces achieve a smoother airflow over them—providing a full range of improved control.