A Possible Solution to Tip Stalling in Swept 'Wings

Last time we presented a simple solution to a yawing problem and promised to describe an effective solution for tip stalling in swept wing tailless.

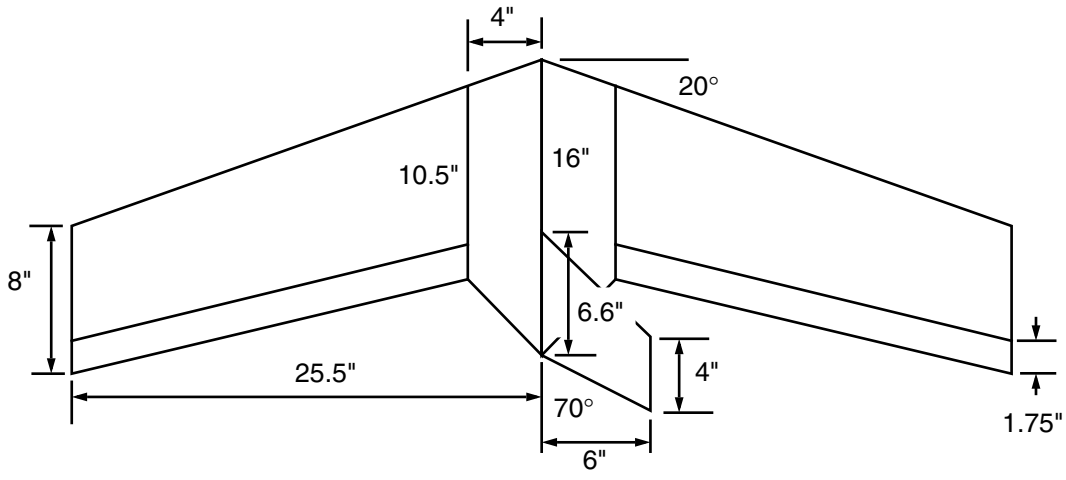
Alan Halleck, a fellow enthusiast of tailless planforms, some years ago cut a foam core for a swept wing planform. This was one of the first planforms Alan designed using the Panknin computer program which he and Bill wrote. The cut wing was stored away and Alan built several other wings before coming back to it. Alan's ideas are always in flux, and so it was no surprise to hear he had trimmed the wing down to a smaller size before 'glassing it.

The wing was to be built light, as Alan had planned it as a thermal 'ship. Since the wing twist started at the half span point, the removal of the wing tips substantially reduced the built in washout. This latter point didn't seem to bother Alan as he was sure he had put in a bit more twist than needed.

At the thermal field, the foreshortened wing, when banked for a tight thermal turn, tip stalled viciously, taking nearly a full turn and a lot of altitude to recover. Alan's 'phone call to us, while not an act of desperation, was clearly highly motivated. Alan covered the relevant points: the tip chord, due to the shortened span, was broader than originally anticipated for the design; straight and level flight posed no problems, so pitch stability was sufficient; the CG was in the correct position.

Since no solutions immediately came to mind, the conversation drifted to other topics. Alan started talking about his computer radio and all of the exciting things it could do, like mixing differential into and between various control surfaces. This got our attention! It turned out Alan had put nearly 2:1 differential in the aileron function of the transmitter. After some discussion, it was decided the differential was most likely the problem, and Alan decided he would try flying his creation with all of the differential removed.

Removal of all aileron differential completely eliminated the tip stalling problem, and turned an otherwise nasty airplane into a relatively docile flyer. Alan has since flown the 'wing successfully both at the slope during light lift conditions and in a thermal environment.



Alan Halleck's Thermal Soarer

This episode has illustrated several points to be considered during design, construction and test flying of swept wing tailless sailplanes:

- match tip chord and minimum flying speed — make sure the chosen section can operate effectively at the expected low Reynolds number conditions;
- compute sweep angle, wing washout, and CG location accurately — check these again during construction and once again before flight;
- perform initial test flights with no aileron differential — any addition of aileron differential for subsequent flying should be approached with caution.

Following the above guidelines should prevent or eliminate tip stalling.

Specific information on how aileron differential may degrade the performance of planks and swept wings may be found in our "On the 'Wing..." column in the August 1992 issue of *RC Soaring Digest*. This column is also available as a reprint in "On the 'Wing... the book."