ASPECT RATIO

By Mike Nassise

Model airplane wings can vary in shape from short and stubby to long and skinny. Does the difference in shape effect the model's performance? To answer that question we must first explain the term aspect ratio.

Aspect ratio is the ratio of a wing's length to its chord, or the number you obtain when you divide the wing span by the wing chord (width of the wing from the leading edge to the tailing edge). This is expressed as:

Aspect Ratio = length of the wing/width of the wing

However, this is true only if the wing chord is equal along the entire length of the wing. Because most wings come in various shapes (i,e. tapered wings), the aspect ratio becomes the wing span squared divided by the mean wing area when the wing chord varies along the wing. In this situation, the new formula is:

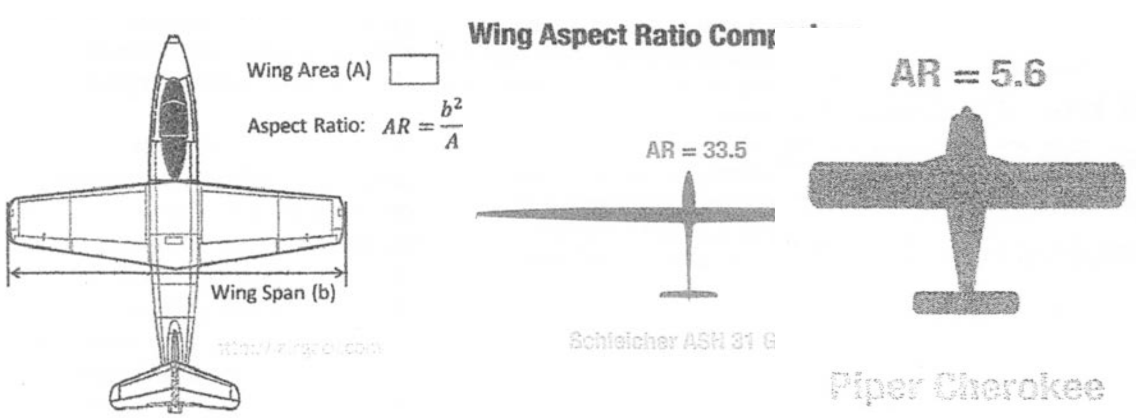
Aspect ratio = wing span squared/wing area

Doing the math, a wing that's long and skinny has a high aspect ratio, and a wing that's short and stubby has a low aspect ratio. So, what are the advantages/disadvantages of each type of wing? In general, the high aspect ratio wing:

1. Produces more lift at low angle of attack.
2. Produces less induced drag due to vortex generation at the tips.
3. Produces less induced drag due to vortex generation at the tips.
4. Are more subject to in-flight flexing loads.

In contrast, the low aspect ratio wing:

1. Operates better at higher angle of attack.
2. Operates better at higher angle of attack.
3. Requires less flexibility.
4. Can be designed more easily.



Putting it all together, high aspect ratio wings produce less drag which is most significant at low speeds and high altitude. They perform very well during aircraft climb, cruise and landing which are the major segments of free flight model operation. However, the longer the wing of an airplane, the stronger it needs to be. To overcome the bending produced by flight loads you must add more material to strengthen the wing. Adding more material to a wing the heavier it becomes, producing more induced drag in flight. In addition, high aspect ratio wings are more easily broken and less tolerant of poor engineering and building technique. Eventually, the structural needs of a high aspect ratio wing outweigh the benefits of its design.

Another major factor of high aspect ratio is maneuverability. The longer the wing is, the less maneuverable it is. That's because longer wings have a higher inertia (tendency to remain at rest). Obviously. this is more important in radio controlled models and full-scale aircraft than free flight models.

A low aspect ratio wing will have a higher roll rate than one of high aspect ratio because a high aspect ratio wing has a higher inertia to overcome. Low aspect ratio wings are usually used on fighter aircraft, not just for their higher roll rates (increased maneuverability), but particularly for their longer chords and thinner airfoils which are necessary for high speed flight.