5) LOW-SPEED CONSIDERATIONS

NASA Question:

A key to making "four times the speed of highways" accessible for more people is to provide aircraft with high cruise speeds, yet with low approach and landing speeds. For decades the ratio of cruise to stall speed for light aircraft has been stuck at about 3:1. The last significant advancement in speed ratio occurred for the Piper Malibu. Is now the time to consider alternatives to traditional high lift systems for light aircraft? Can landing speeds of 50 kts (or slower) on a 300 kts (or faster) aircraft be practically (affordably) achieved?

Roskam's Response: My response is in three parts.

5.1) Discussion of small airplane design design practice

For most small airplanes a typical ratio of cruise speed to landing stall speed is 3:1.

The Beech/Raytheon Bonanza has a trimmed maximum lift coefficient of about 2.0 and a cruise speed to landing stall speed ratio of 3.5.

For the SOCATA TBM-700 this ratio is 4.9. The latter is achieved with a take-off wing loading of 34 psf and 67% span single slotted Fowler flaps with a trimmed maximum lift coefficient of 2.6.

The NASA funded KU Redhawk project of the early 70's pioneered this type of flap and wing-loading combination on a modified Cessna Cardinal airframe.

It is interesting to note that airplanes like the Piper Malibu and the SOCATA TBM-700 are the only types which have applied this simple design philosophy.

5.2) Discussion of jet transport design practice

In transport jets ratios of cruise speed to landing stall speed of 5 are fairly typical. In these cases wing loadings are typically in the range of 100-140 psf and maximum trimmed lift coefficients are as high as 3.2. The latter are achievable with trailing edge, slotted Fowler flaps and appropriately designed leading edge devices. The Airbus A320 has a trimmed maximum lift coefficient of 3.2.

5.3) Discussion of future small airplane design practice

In future light airplanes there is no reason at all why maximum trimmed lift coefficients of at least 2.6 with mechanical flaps should not be considered.

A recent design study of a four-engine STOL transport by my students has shown that by using all the fan-air of two of these four engines and blowing it at the flaps can result in a trimmed maximum lift coefficient of 5.5-6.0. This would result in take-off and landing distances of around 200-300 ft.