

# MAX EBB

The rest of the assemblage, not knowing any other arguments to make on the subject, expressed agreement: The foil limitations should go.

"Oh come on, guys," Lee broke in. "You've got two rudders total and you want to control two degrees of freedom: yaw and pitch. I mean, like, what's the problem? Were you all asleep in physics class when they did dimensional dynamics?"

"You can't control pitch with rudders that only steer," I argued. "You need something like an airplane elevator back there." But Lee was acting like Lee again, not playing the role of some bimbo bartender, and I had a feeling this would end badly for my line of reasoning.

"Two degrees of freedom, two movable control surfaces," Lee repeated.

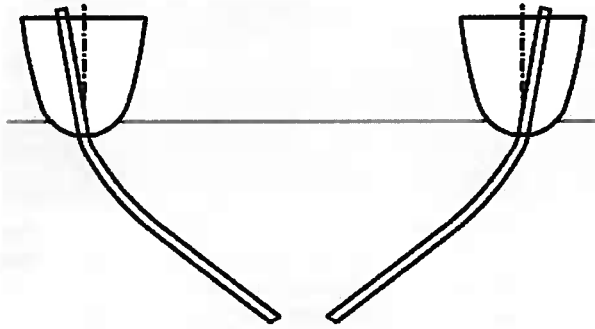
We still didn't get it.

"Anyone remember the V-tail Bonanza?"

"Why, that's my airplane!" exclaimed the surgeon, and before anyone could

say anything else he had his wallet out, spewing a dozen fold-out pictures of his private plane and one or two of grandchildren.

Prompted by the pictures, I remem-



*The V-tail Bonanza's rudder configuration. By actively controlling the tie bar length, two rudders can control both pitch and yaw with almost the same efficiency as separate rudders and elevators.*

bered those airplanes with that tail configuration. Instead of a conventional vertical stabilizer and elevator, this plane

had two fins at 45 degree angles.

"You get pitch and yaw out of two control surfaces," Lee explained. "And you can do the same on a big catamaran. Just angle both rudder blades in at 45°.

When they turn together, they steer. When they toe-in or toe-out, they lift up or pull down. Simple."

"Works fine on my airplane," observed the surgeon.

"But you lose efficiency because of the angle," noted the software guy. "Only 71% of the turning force for the same drag."

"That's if you want lift only or steering only," said Lee. "In practice there will be a combination of vertical and horizontal force required, and it's just as likely that the V configuration will be more efficient than separate vertical and horizontal yaw and pitch control foils. Just like the V-tail airplane, which needs a combination of up-elevator and positive rudder during a turn."

"Don't the two rudders have to be locked together?" asked the boat driver.

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