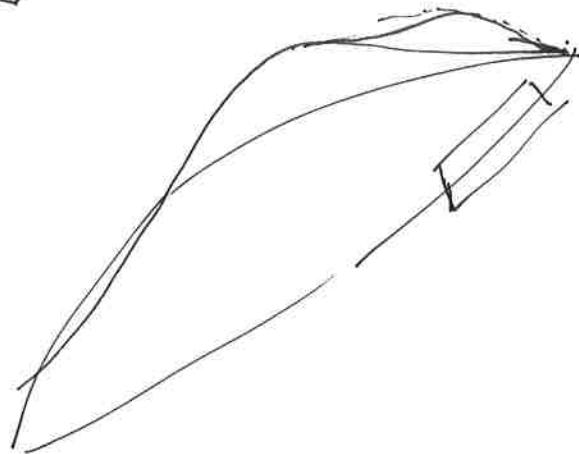
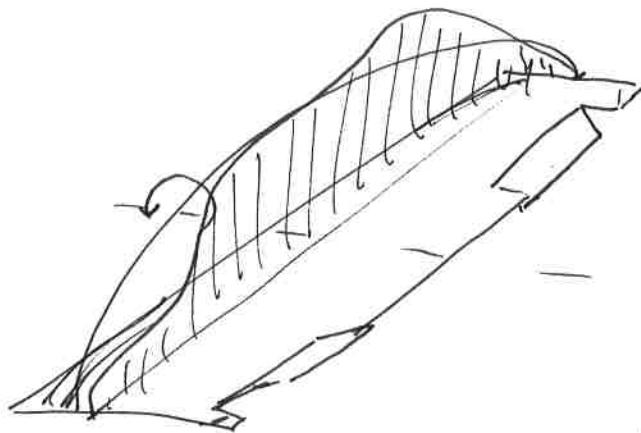
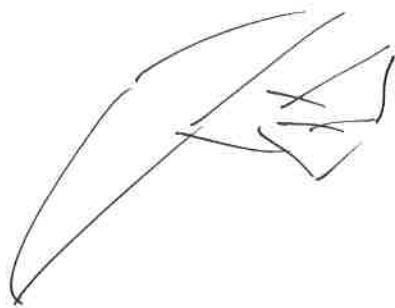


Q: Why do birds not have vertical stabilizers?



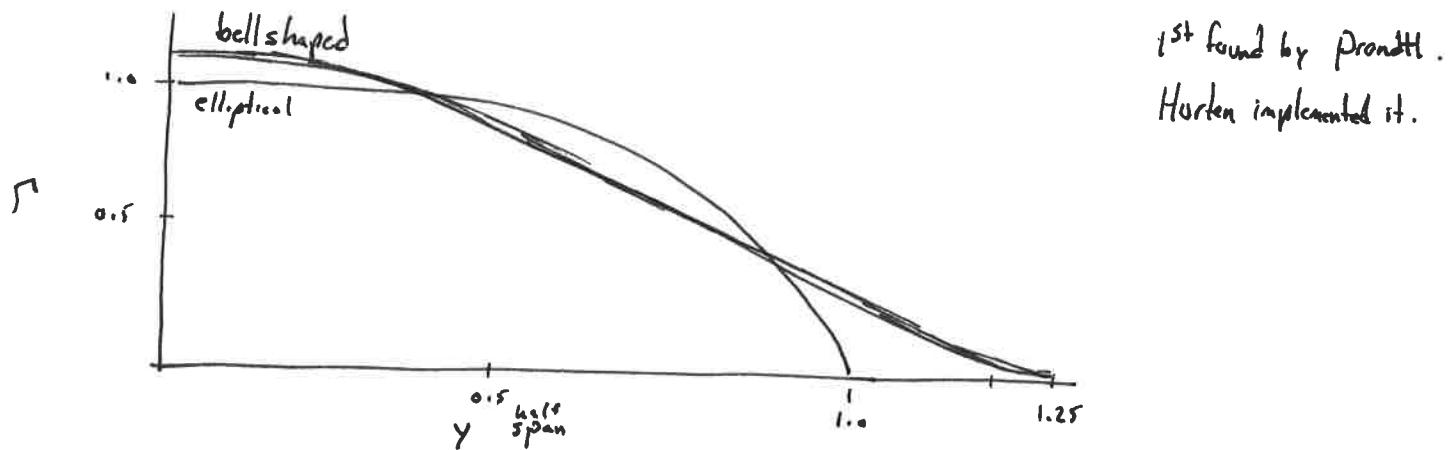
Bell Shaped Lift Distribution

We know that the elliptical lift distribution gives the lowest induced drag for a given span.

But what if span is not the structurally limiting factor? Often the root bending moment is the critical structural constraint.



Let's match the total lift and the bending moment and allow span and lift distribution to vary. What is the optimal lift distribution?



The bell shaped distribution has 85% of the induced drag for the same lift and moment at the root!

Additionally, the bell shaped lift distribution has proverse yaw rather than adverse yaw.

tiny.cc/AEM614Bell

Adverse yaw is a result of induced drag (and a bit of profile)

Horten's wings have no vertical. Birds don't have verticals either.