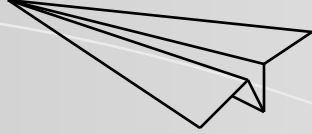


# ***Paper Airplanes***

**KEN BLACKBURN**

**NCASE**

**Atlanta, GA March 2004**



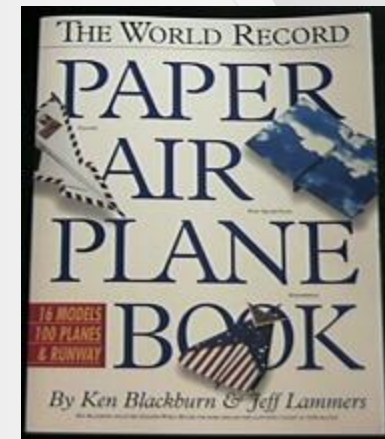
# Paper Airplanes

- Who is Ken Blackburn?
- Basics of Flight
- Secrets to making great paper airplanes



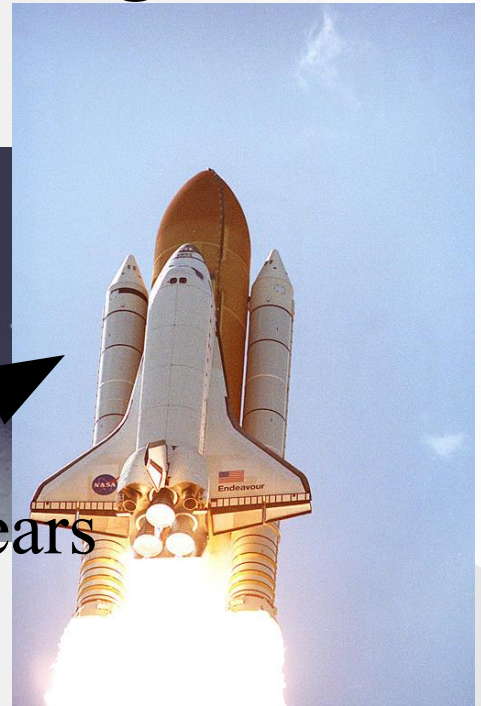
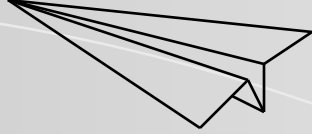
# Who is Ken Blackburn

- Paper Airplanes
  - Guinness Record 27.6 seconds, 10/08/98
  - World Record Paper Airplane Book
- Homebuilt Aircraft
  - Moni, Formula 1 Air Racer
- Boeing Engineer 18 years



[WWW.PAPERPLANE.ORG](http://WWW.PAPERPLANE.ORG)

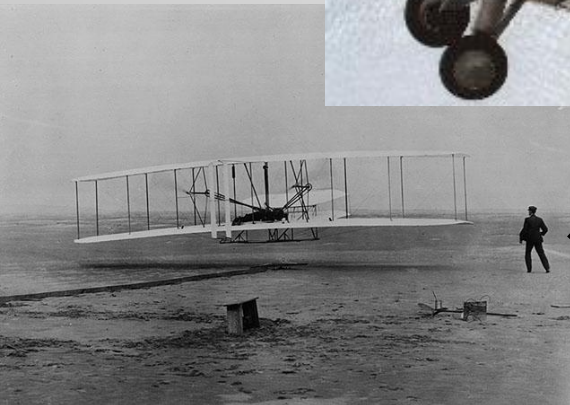
# 100 Years of Flight



34 Years



20 Years



24 Years

# Aircraft Design ... Applies No Matter the Size

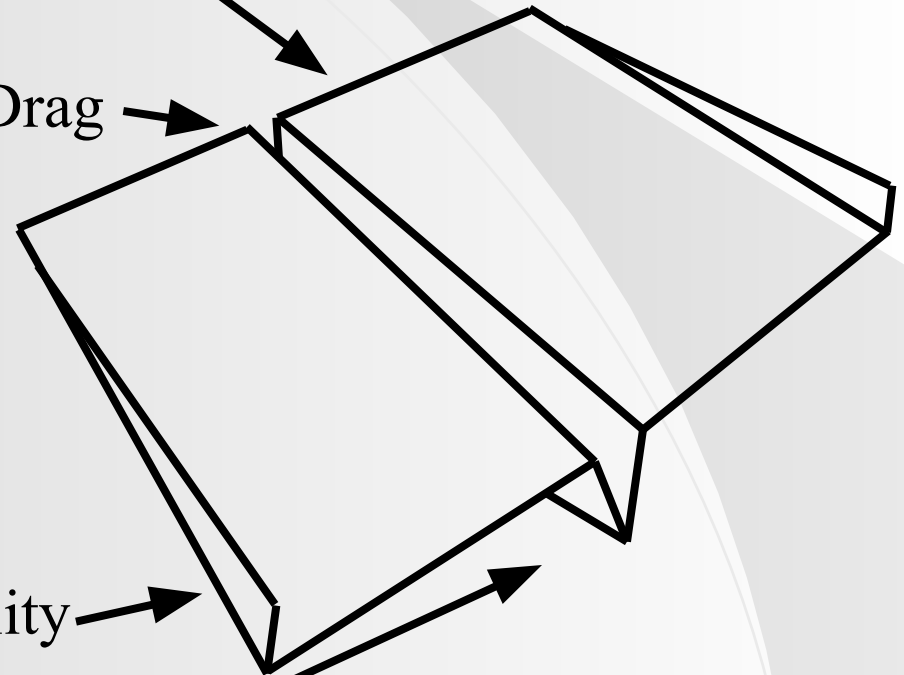


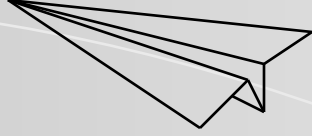
Structure

Drag

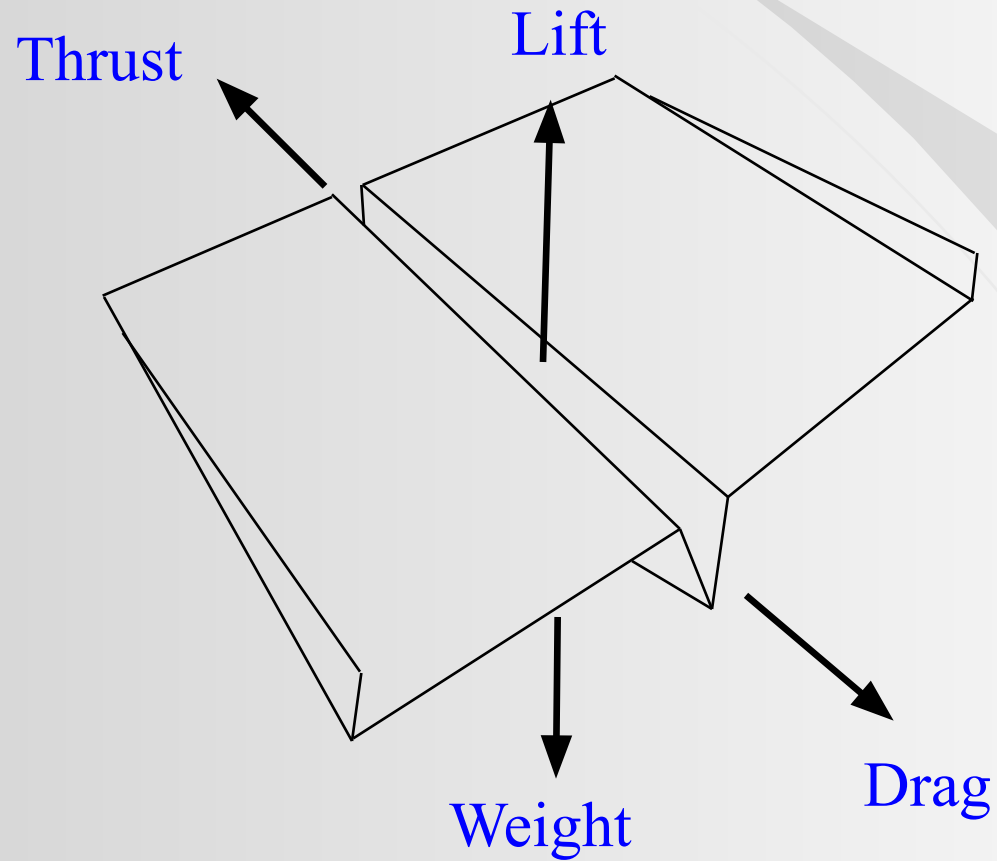
Stability

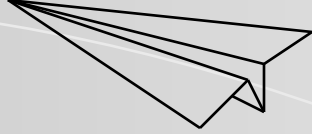
Launch



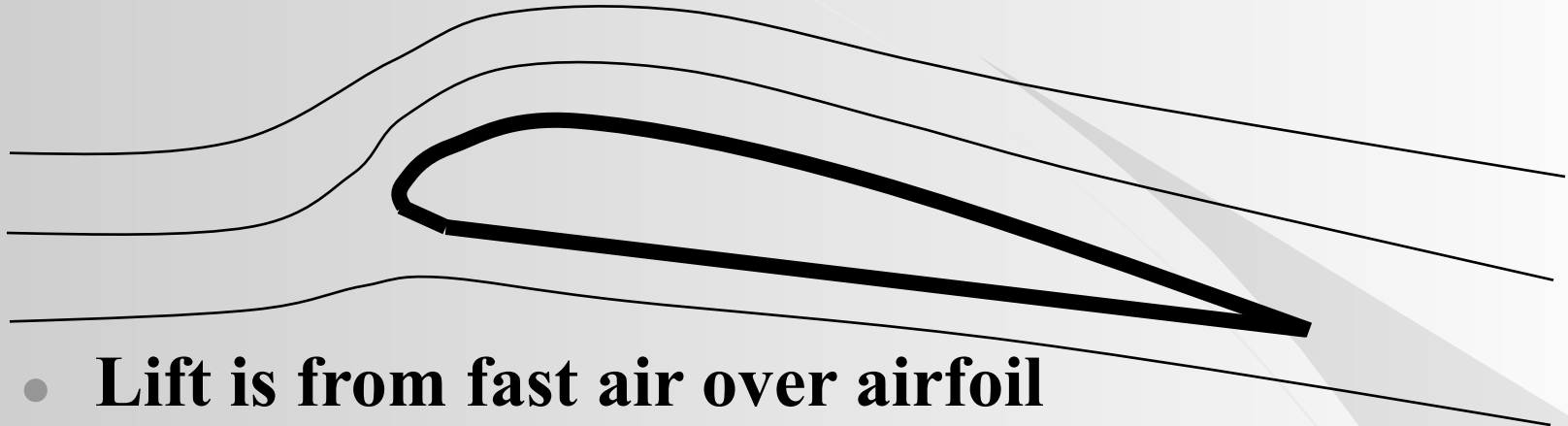


# Forces Of Flight

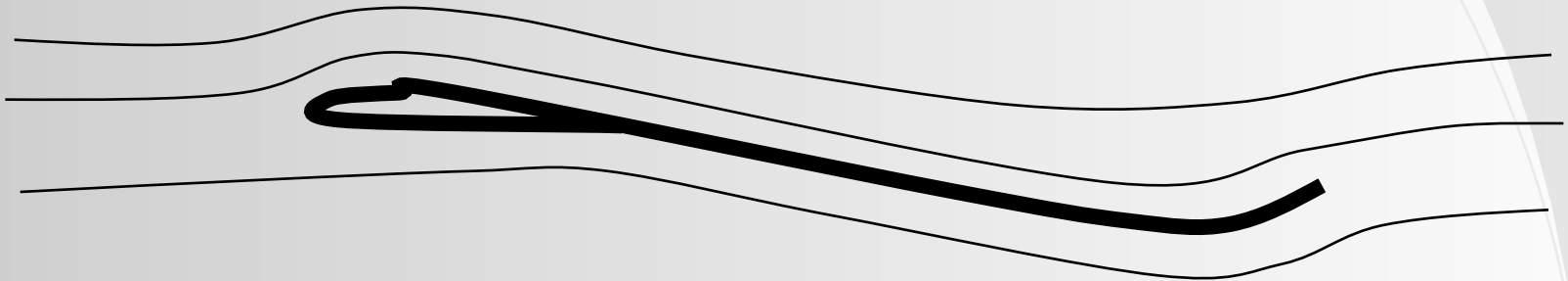


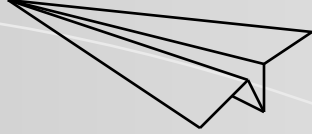


# LIFT



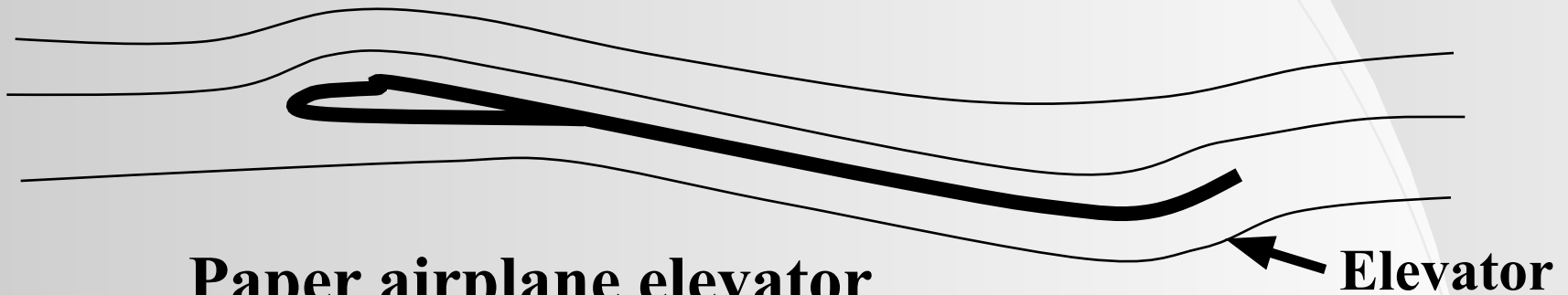
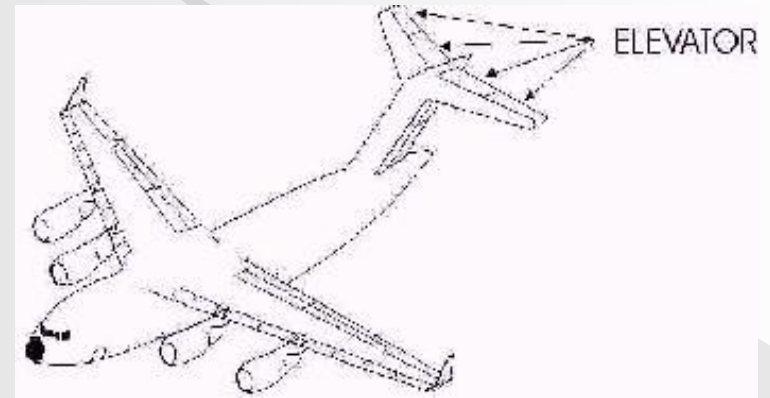
- **Lift is from fast air over airfoil**
- **Fast air comes from curvature and nose up at an angle**





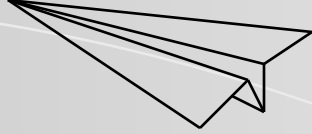
# FLAPS

## Elevator – Pitch/airspeed



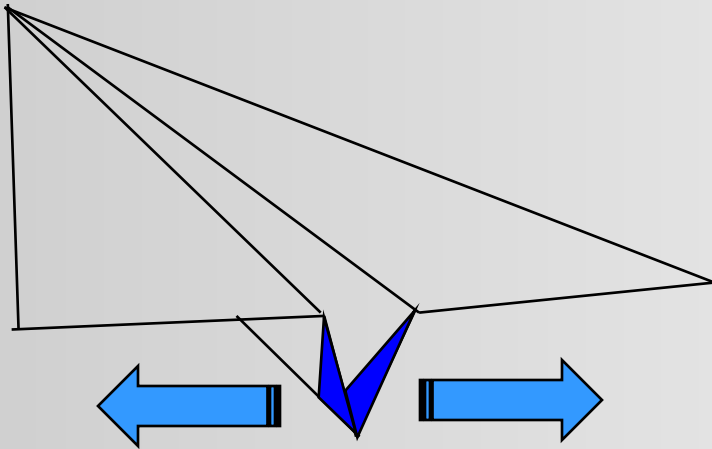
**Paper airplane elevator  
keeps nose up at an angle**





# FLAPS

## Rudder – yaw/turns

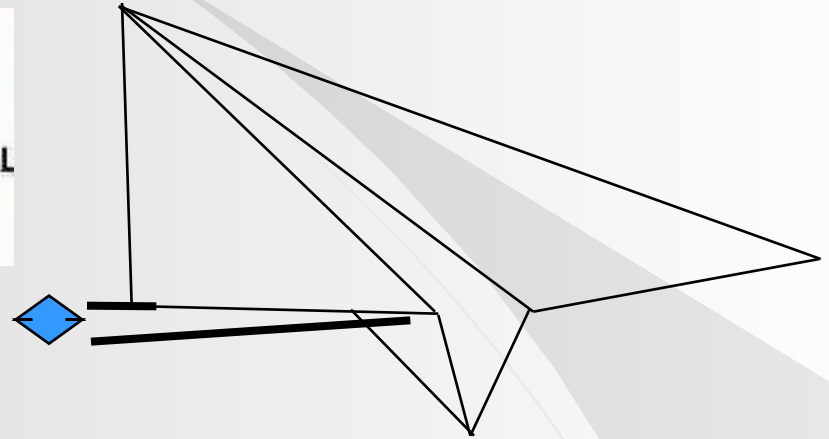


Rudder

- Most important for low speed turns
- Paper airplane rudder
- Bend right to turn right, left to go left

# Wing Angle

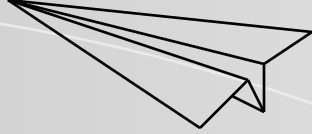
## Dihedral



**Keeps plane from rolling over**



**AV-8B wings angle down for cross wind in hover**



# Balance

Nose heavy is stable

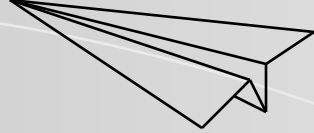


Heaviest part  
forward



Wing moved aft





# Wing Shape

0 mph

500

1200

1600

Supersonic



Long straight wings best <400 mph



Long wings + small sweep = 500 mph & good mpg



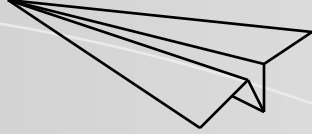
Short wings + small sweep = 1200 mph & good low speed flying



Short wings + large sweep = 1600 mph

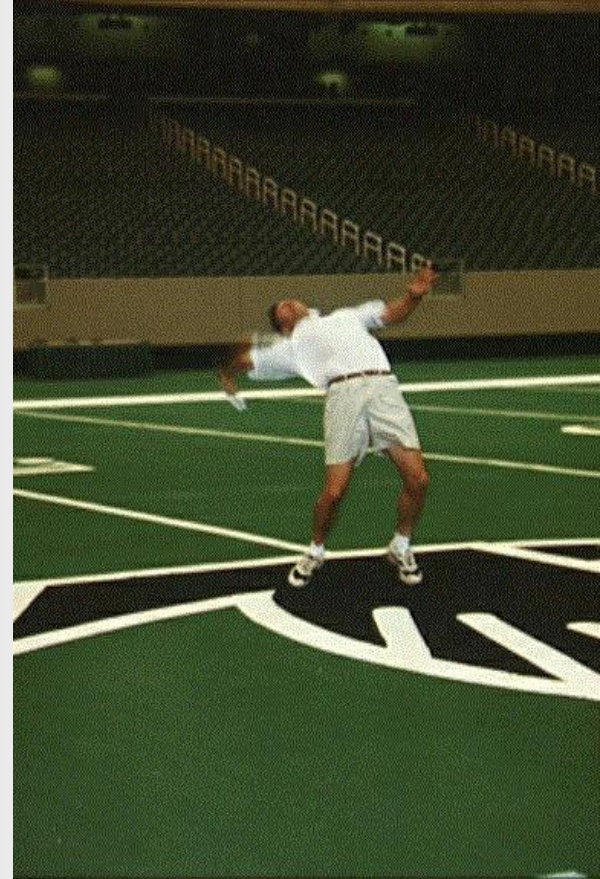


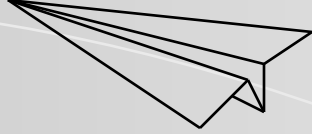
Short wings + large sweep = looks good



# Guinness Record - Time Aloft

- 1 sheet of paper (some tape allowed)
- Indoors
- Throw from floor
- Timed from leaving hand to contact with any object
- Witnesses and news media
- Photos and video tape required



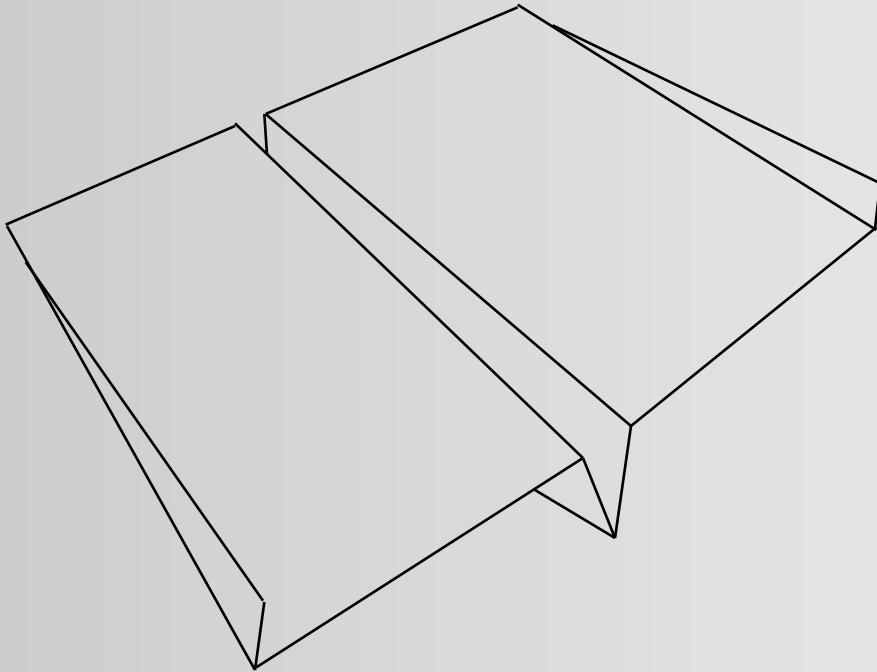


# How I Set the Record

- Developed the World Record airplane at 13
- Set record in 1983 - 16.89 seconds
- Reset record in 1987 - 17.2 seconds
- Reset record in 1994 - 18.80 seconds
- British set record in 1996 - 20.9 seconds
- Regained record in 1998 - 27.6 seconds



# The World Record Airplane



- From The World Record Paper Airplane Book
- Good Duration and Aerobatic Flyer



# Folding the World Record Airplane

1. Fold along lines 1 & 2



2. Fold along line 3 to 4



3. Continue folding lines 4 to 9



4. Fold line 10



5. Flip over plane and fold in half along line 11



6. Fold wing down along line 12



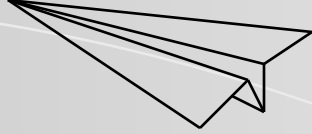
7. Flip plane over and fold other wing down along line 13



8. Fold wing tips up along lines 14 & 15







# Paper Airplane Adjustments

- “Y” Shape - Lateral stability
- Up Elevator - Prevents nose dive
- Weight on the Nose - Greater stability