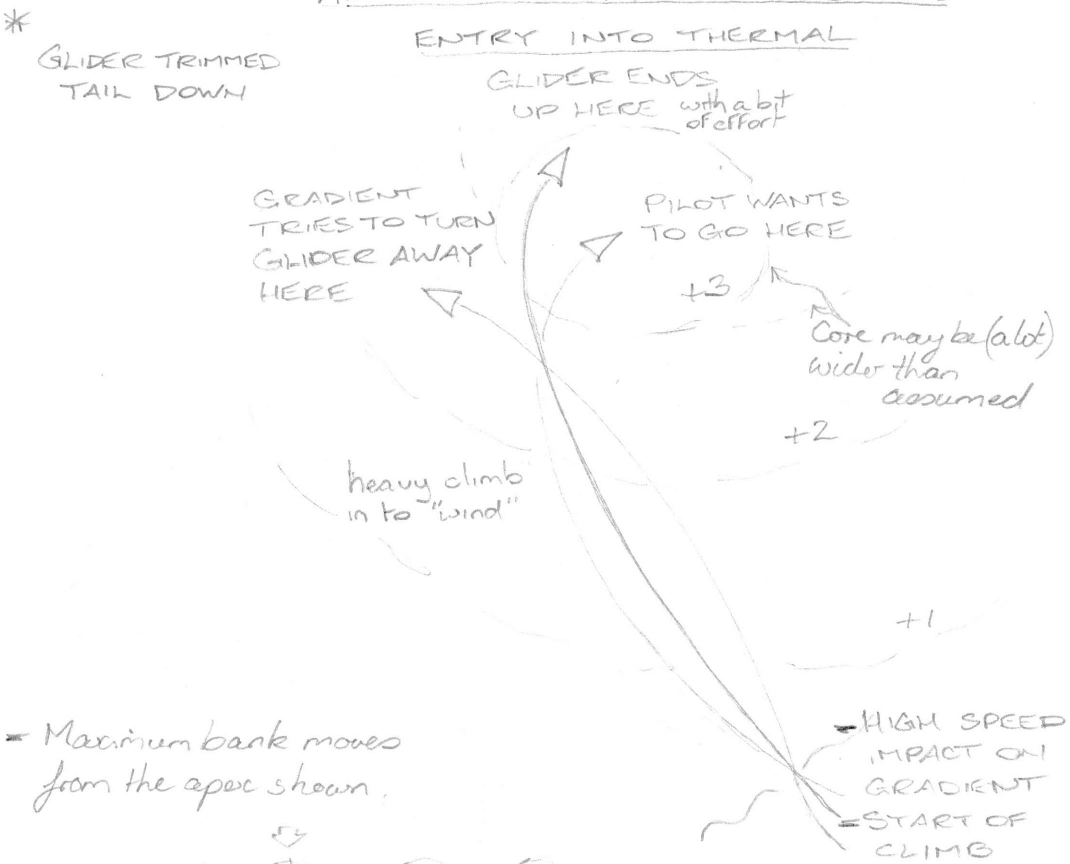
8 APRIL 2017

- Regular period associated with dutch roll, even taking each climb in isolation, helps with the impression that the pilot is working to a rhythm.

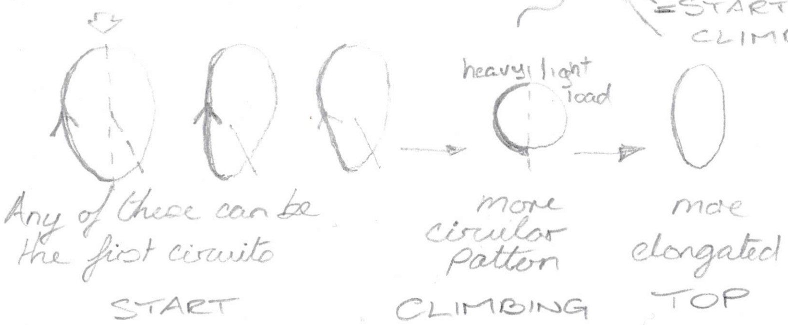
- Turning across the "wind" reduces the load on the glider = easier control
- When it turns "down wind" control is relatively easy and much lighter in roll – if the gradient is still there.

ALTERNATIVE PATHS ON OBLIQUE ENTRY INTO THERMAL



- Part of Dutch roll, – climbing and turning
  - Distorted wing at high angle of attack.
  - Distortion from impact / increased load in climb
  - Twisted across wing.
  - +ive/–ive dihedral changed. Increased dihedral acting as sweep back – (helps pilot)
  - climbing scrubbing of some of the excess speed
  - glider seems to be "flatter" in roll than in equivalent steady banked turn
  - weight right over as glider slows in climb

- Maximum bank moves from the apex shown.



Balance of

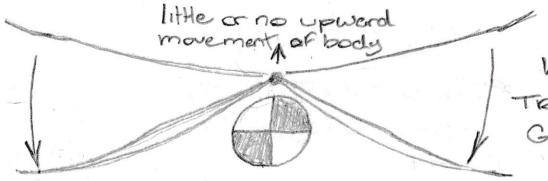
helps pilot hinders pilot

Single surface – feet thrown over first gives ... inspection.

BODY WEIGHT MASS REQUIRED FOR FLAPPING FLIGHT

H.G. MUSCLES ACT AGAINST BODY WEIGHT TO CHANGE THE ANGLE OF BANK, AND THE ANGLE OF ATTACK OF ATTACK
~ BODY WEIGHT GIVES THE MUSCLES SOMETHING TO WORK AGAINST ~ NO BODY WEIGHT — NO PILOT INPUT
Inertia - aerodynamic inertia?

① AS A SOURCE OF INERTIA TO INCREASE THE VERTICAL MOVEMENT OF THE WING DOWN THROUGH THE AIR



WING TIPS TRAVEL THROUGH GREATER ARC.

ROOT OF WING MOVING DOWN IS PREVENTED FROM MOVING UP BY BODY WEIGHT.

HANG GLIDER IS ONLY ONE SIDE OF THE WING

UPWARD MOVEMENT OF WING ROOT IS RESTRAINED BY BODY WEIGHT

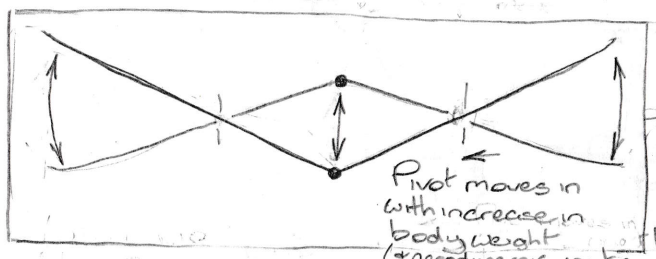
IN A GIVEN TIME THE PILOT TRIES TO MOVE THE TIP AND AS MUCH AS POSSIBLE OF THE WING DOWN THROUGH THE GREATEST DISTANCE POSSIBLE.

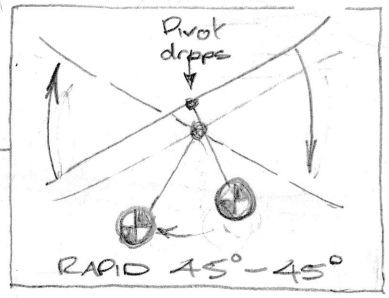
***MAXIMISE EFFECT OF VERTICAL GUST**

- DURATION AND DIRECTION (ANGLE OF ATTACK)

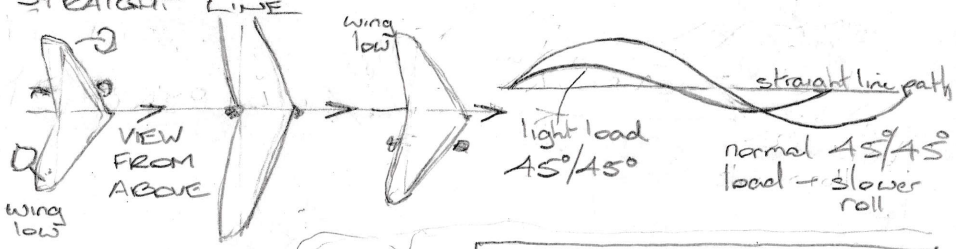
NR VERTICAL GUST HAS MOST EFFECT ON ANGLE OF ATTACK

vertical gust oriented to the glider so there is a more inc. in α and airspeed



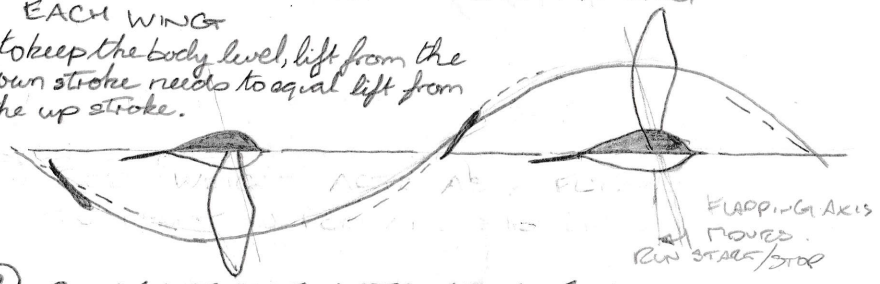


PILOT AVOIDS ROLLING THROUGH 45°/45° TRAVELLING IN A STRAIGHT LINE



WITH NO BODY MASS WINGS PIVOT AT ROUGHLY THE MIDPOINT ALONG EACH WING

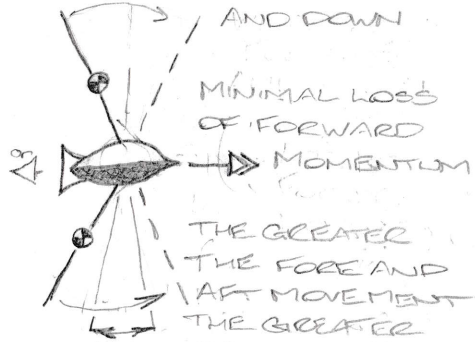
*to keep the body level, lift from the down stroke needs to equal lift from the up stroke.

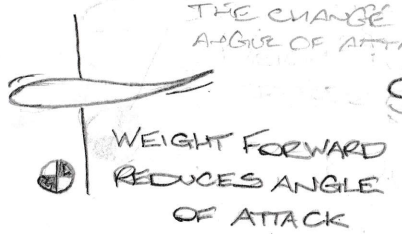


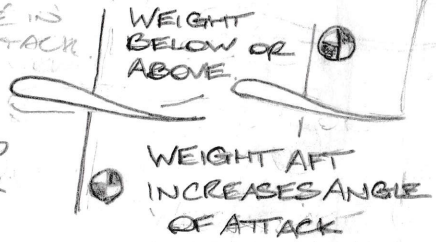
② BODY WEIGHT ACTS AS A FLYWHEEL TO MAINTAIN FORWARD MOMENTUM

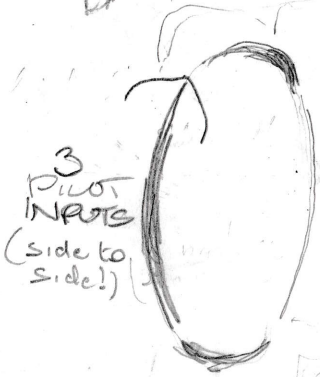
③ BODY WEIGHT AUTOMATICALLY ADJUSTS THE WINGS ANGLE OF ATTACK DEPENDING ON ITS POSITION TO THE WING (C.P.) FORE AND AFT

WING THROWN FORWARD AND DOWN









ENERGY INPUT IS MOVEMENT OF PILOTS INCREASED BODY WEIGHT. forces against the (RFA) or of steering Aero

$ PILOT INPUTS

energy input is the movement of pilots increased body weight against the aerodynamic forces on the wing (yaw and roll plane)

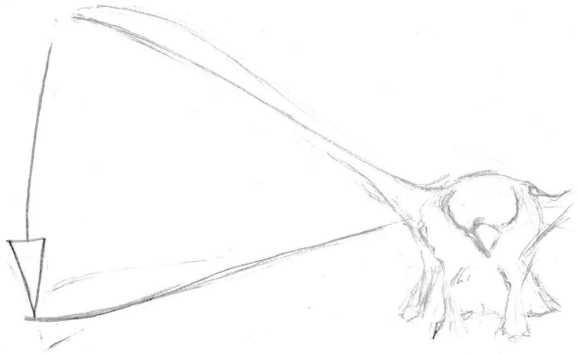
HG IS A BIRD WITH ONE WING THAT CAN FLAP OR GLIDE

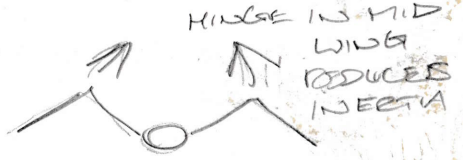
FROM GREEN FILE

WING CP/CG & PILOTS CG ARE SEPARATE SO POWER CAN BE PUT IN.

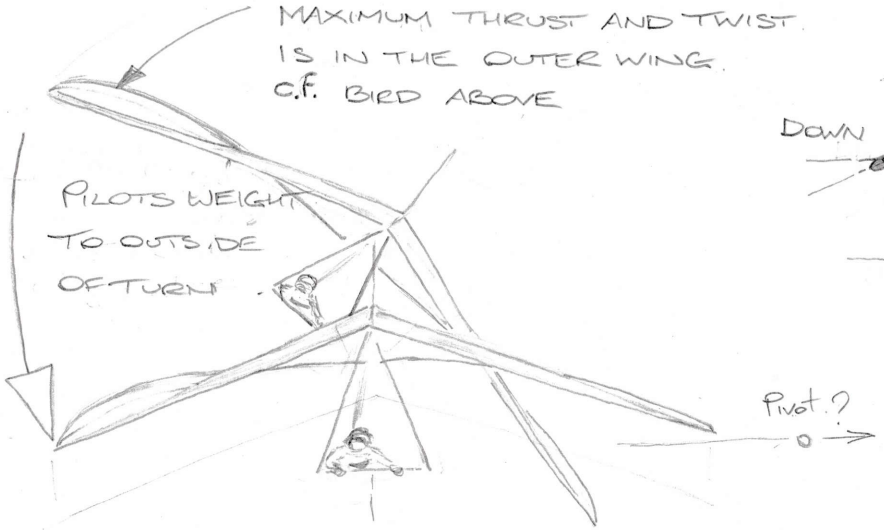
CRUISE ~ SHAPE OF BIRDS WING IS HELD IN POSITION AND MOVED BY THE FORCES ON IT FROM THE AIR IT IS MOVING THROUGH REQUIRING MINIMAL MUSCULAR INPUT, AND PUTTING MINIMAL MINIMAL STRAIN ON MUSCLES AND JOINTS

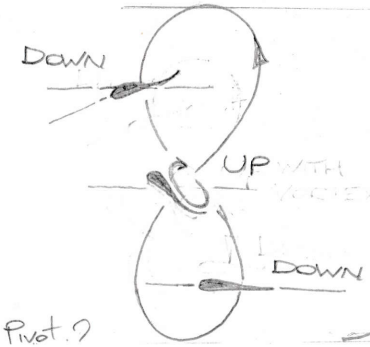
THE BIRD IS FIDGETING IN SLOW MOTION IE. ONLY A VERY SMALL INPUT OF ENERGY IS REQUIRED TO KEEP THE MOVEMENT GOING - FORCED OSCILLATIONS.





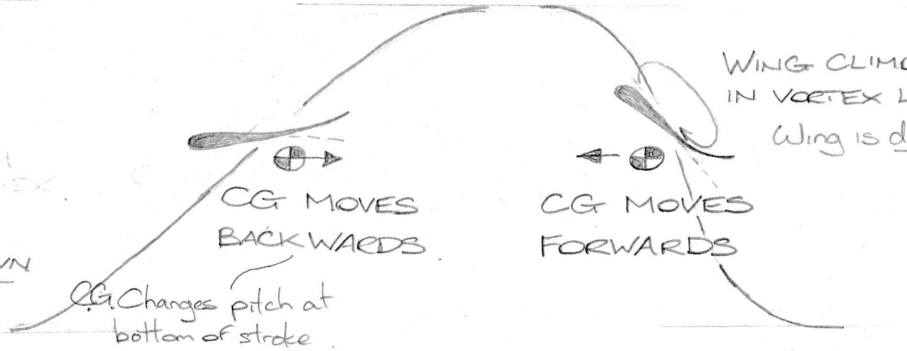
WHEN GLIDER IS BANGED FLAT Rolled?
MAXIMUM THRUST AND TWIST IS IN THE OUTER WING.
c.f. BIRD ABOVE





DOWN STROKE
WING ACCELERATES
LOW ANGLE OF ATTACK

UP STROKE
WING DECELERATES
HIGH ANGLE OF ATTACK

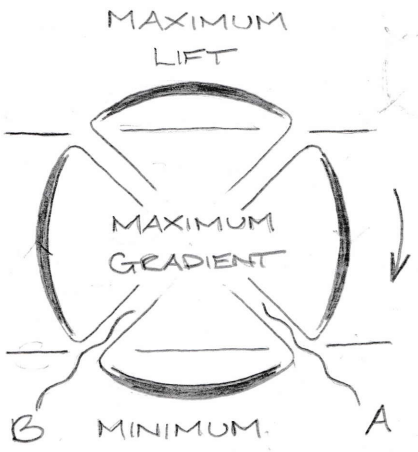


WING OF GULL MOVES FOREWARD AS IT IS PUSHED DOWN
* WING IS TURNING

WING MOVEMENT SUPERIMPOSED ON CHIM.

ADJUSTMENTS ~ MINIMUM CIRCUIT. (TIME)
MAXIMUM PILOT INPUT.

LESS PILOT INPUT NEEDED FOR BALANCED CIRCUIT.



MAXIMUM PILOT INPUT NEEDED FOR A SMOOTH CIRCUIT

CONSIDERED AS FIXED:

- THE ORIENTATION OF THE GRADIENT – THE AREA OF MAXIMUM CHANGE OF FLOW. ALSO GIVING THE APPROXIMATE END OF ROLL ASSISTANCE AND THE START OF PITCH UP ASSISTANCE.
- THE RESPONSE AND STABILITY, ESPECIALLY IN ROLL AND IN PITCH, FOR A GIVEN GLIDER TO A GIVEN PILOT WEIGHT.

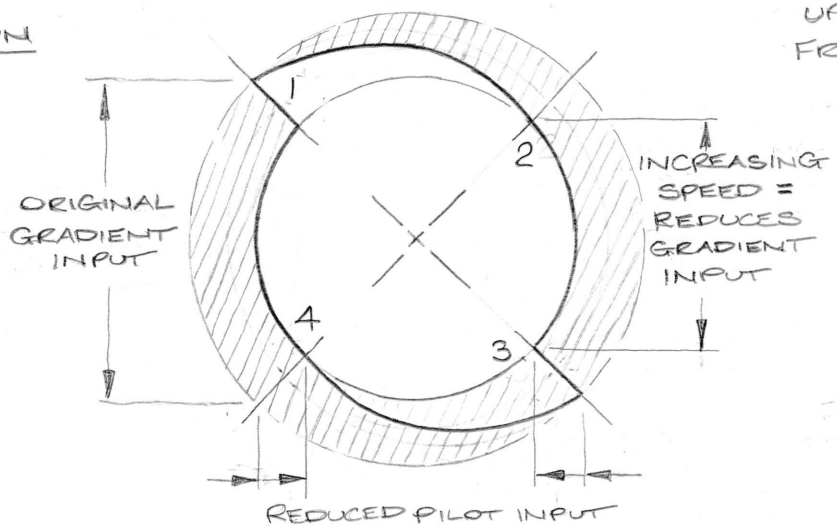
CONSIDERED AS GOOD AS FIXED:

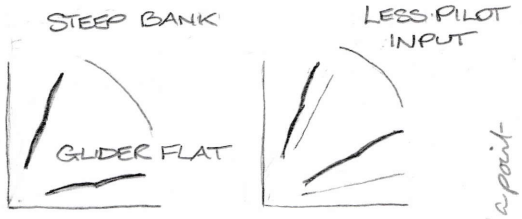
- THE GRADIENT AND LIFT CHANGE BETWEEN THE SAME POINT IN SUCCESSIVE CIRCUITS. (SAY EVERY 3–4 SECONDS)
- THE EFFORT OVER SEVERAL CIRCUITS THE PILOT IS ABLE OR FEELS LIKE PUTTING IN TO MAINTAIN AN EVEN CLIMB WITH SMOOTH QUICK CHANGES OF BANK

SYSTEM IS SELF ADJUSTING

B. START OF PITCH UP ASSISTANCE FROM GRADIENT | A. END OF ROLL ASSISTANCE FROM GRADIENT

RUN





↓ DROP
EASY AGREEABLE EFFECTIVE RHYTHM

↓ INCREASED DROP
SPEEDING UP DOES NOT ACHIEVE MORE

beyond a point - glider does not have enough time to go flat.

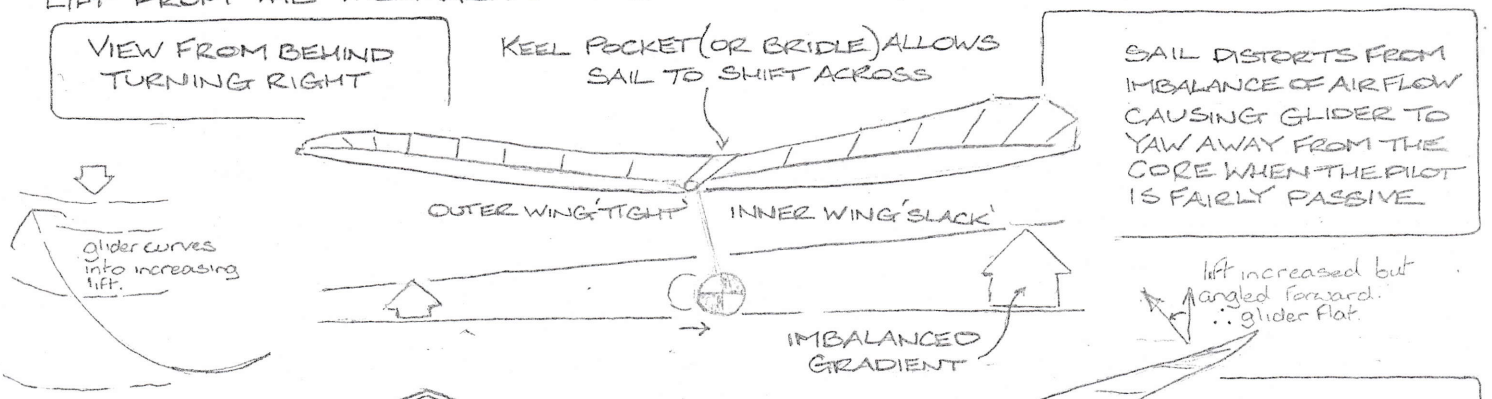
1. IF THE PILOT SPEEDS UP AND PUTS MORE EFFORT INTO TURNING,
2. IN THE NEXT QUADRANT THE GLIDER WILL FLY THROUGH LESS GRADIENT AND DOES NOT GET SO MUCH ENERGY INPUT OR SO MUCH ASSISTANCE IN ROLLING UP.
3. THERE IS LESS TIME FOR A CHANGE OF BANK FOR THE PILOT TO PUT POWER IN. HIS AVERAGE BANK WILL BE STEEPER AS WILL THE OVERALL SINK RATE HE IS TRYING TO RECOVER.
4. THE GLIDER WILL HAVE LESS TIME TO ROLL FLAT TO CONVERT DROP INTO FORWARD SPEED SO THE PILOT WILL HIT THE GRADIENT WITH LESS MOMENTUM.

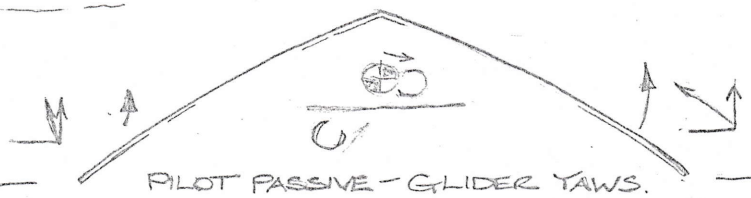
THERE IS A COMFORTABLE EFFECTIVE RHYTHM FOR A PARTICULAR GLIDER AND GRADIENT WHICH IS EASY FOR THE PILOT TO RECOGNISE. IF HE TRIES TO GREATLY SPEED UP OR PUT A LOT MORE EFFORT INTO HIS FLYING BEYOND THIS POINT, HE WILL NOT CLIMB MUCH HIGHER AND MAY EVEN LOSE HEIGHT.

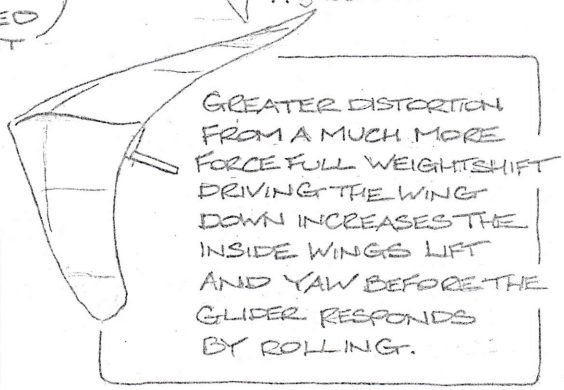
BUT IF THE PILOT IS FLYING WITH A LITTLE SPEED IN HAND HE CAN TAKE AN EASY CIRCUIT, HELPED BY THE EXTRA ENERGY FROM THE LARGER GRADIENT FLOWN THROUGH, WITHOUT LOSING HEIGHT IN THAT CIRCUIT. (cf RHYTHM OF ROWING)

FLAT CLIMB IN A THERMAL

AFTER THE RAPID ROLL FLAT AT THE BOTTOM TURN THE GLIDER IMPACTS THE GRADIENT, PITCHES UP AND STARTS CLIMBING STRONGLY.
THE PILOT HOLDS HIS WEIGHT FIRMLY FORWARD BALANCING THE INCREASING LIFT FROM THE THERMAL PUSHING UP ON THE INSIDE WING.



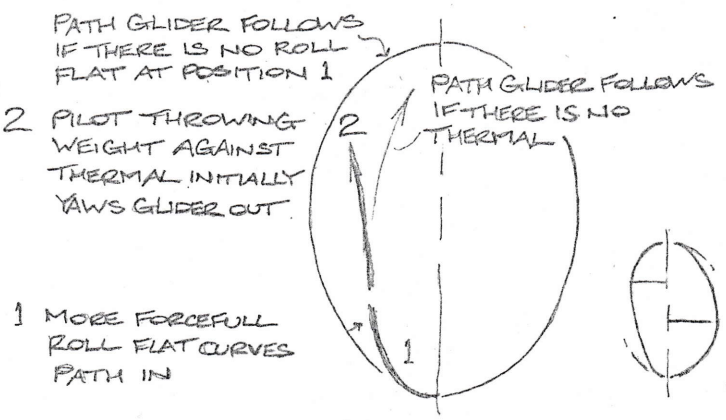


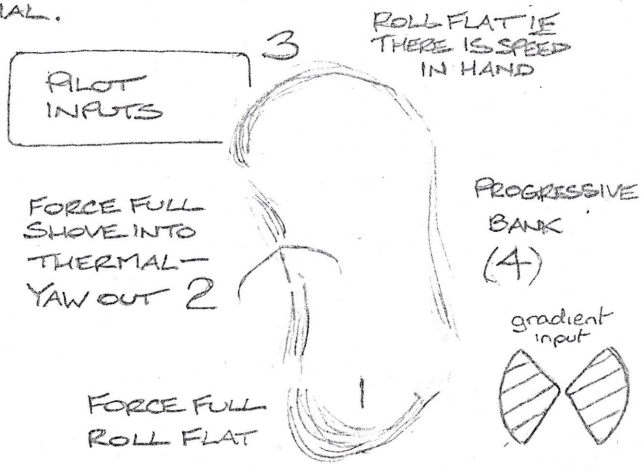


AS THE PILOT MOVES MOVES FIRMLY AND (CLOSED UP) FORCEFULLY ACROSS TO COUNTER THE EXPECTED LIFTING OF THE INSIDE WING* THE LOAD INCREASES ON THIS WING WHICH STARTS TO ACCELLERATE ; THE GLIDER YAWS.

IF THE PILOT IS QUICKER AND MORE FORCEFULL, THROWING HIS WEIGHT ACROSS THE WING BENDS AND THE SAIL GIVES AND DISTORTS AS IT IS DRIVEN DOWN THROUGH THE INCREASING FLOW OF RISING AIR. (*THE GLIDER IS FLYING MUCH FASTER)

BEFORE THE GLIDER STARTS TO ROLL INTO THE CORE THE CURVED PATH OF THE GLIDER IS STRAIGHTENED BY THE DOWNWARD AND FORWARD DRIVE FROM THE PILOT AGAINST THE UPWARD PUSH OF THE THERMAL.





CLIMBING, THE TAIL DOWN GLIDER IS STABLE AND SLOW TO RESPOND TO THE PILOT INPUT +(THE GLIDER WALLOWS) THE INCREASED LIFT IS TEMPORARILY CANTED FORWARDS WHILE THE WING IS BENT. THIS IS THE SECOND PILOT INPUT, IT IS SLOWER THAN THE FIRST INPUT SO THE GLIDER IS ABLE TO COVER MORE GROUND.

+ IF THE SPEED IS NOT HIGH ENOUGH

* PUSH INTO THERMAL IS PUSH "SIDEWAYS" "SHOULDERING" NOT PUSH OUT *