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High Lift Devices (Flaps)

What is the Flap?

- The flap is placed on the outside edge of an airplane's wing.
- You can find it between the fuselage and ailerons.
- Large jetliners have as many as three parts to their flaps; these are extended in sections on takeoff and landing, as needed.
- Small aircraft have appropriately sized flaps which attach to the wing with a hinge.
- Flaps help to either increase or decrease the camber, or surface area, of the airplane wing.
- Camber includes how convex the upper part of the wing is, as well as the concavity of the lower half.
- Wing flaps are a significant part of the takeoff and landing process.
- When the airplane is taking off, the flaps help to produce more lift.
- Conversely, flaps allow for a steep but controllable angle during landing.
- During both, efficient use of flaps help to shorten the amount of runway length needed for takeoff and landing.

1.Plain Flap

PLAIN FLAP (maximum increment in Lift coefficient occurs at 80° deflection angle)

Geometry Alteration effect: Increases the effective camber of the airfoil.

Boundary Layer Control:There is no effect over the behavior of the boundary layer.

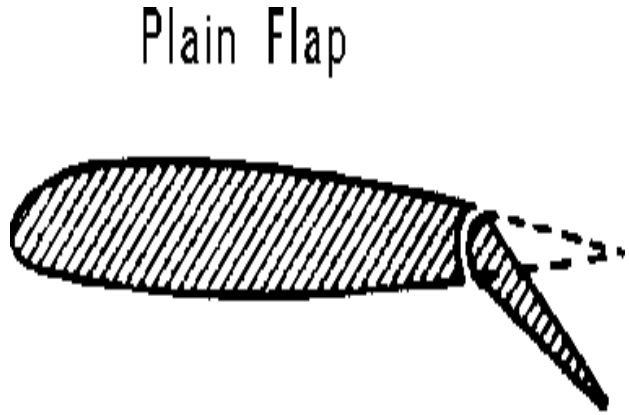


Figure 1-21

EFFECTS

- Reduces the zero lift angle of attack to a much lower point increases the coefficient of lift compared to unflapped airfoil. C_{Lmax} is obtained at much lower angle of attack.
- Reduction in the stall angle of incidence helps in low nose up attitude flight during landing and take-off maneuver advantageous in pilot's perspective for he can have a good visibility.
- Coefficient of Pressure is varied in the presence of flap effecting an aft movement of the centre of pressure, causing a nose down moment requiring adjustment by the pilot. (for pressure plot look at Aerodynamics by L J Clancy)

2.SPLIT FLAP

Geometry Alteration effect: Increases the effective camber of the airfoil as plain flap.

Boundary Layer Control: No special effect.

To overcome the separation effect in the plain flap a split flap is adapted with curvature of the airfoil being unaffected even at the time of deflection of the flap.

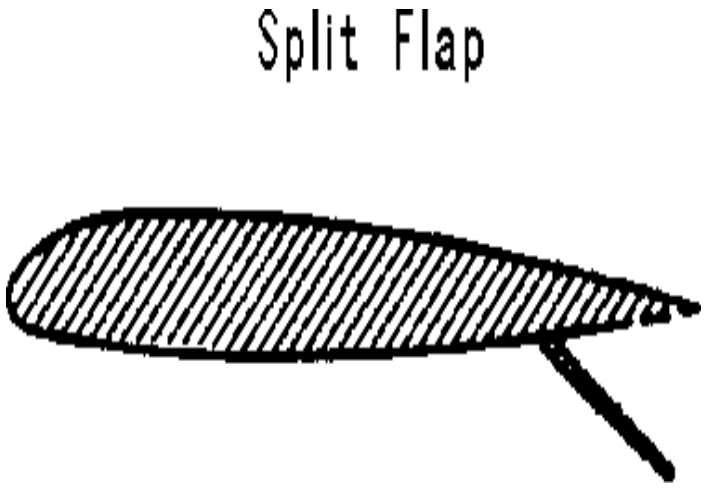


Figure 1-22

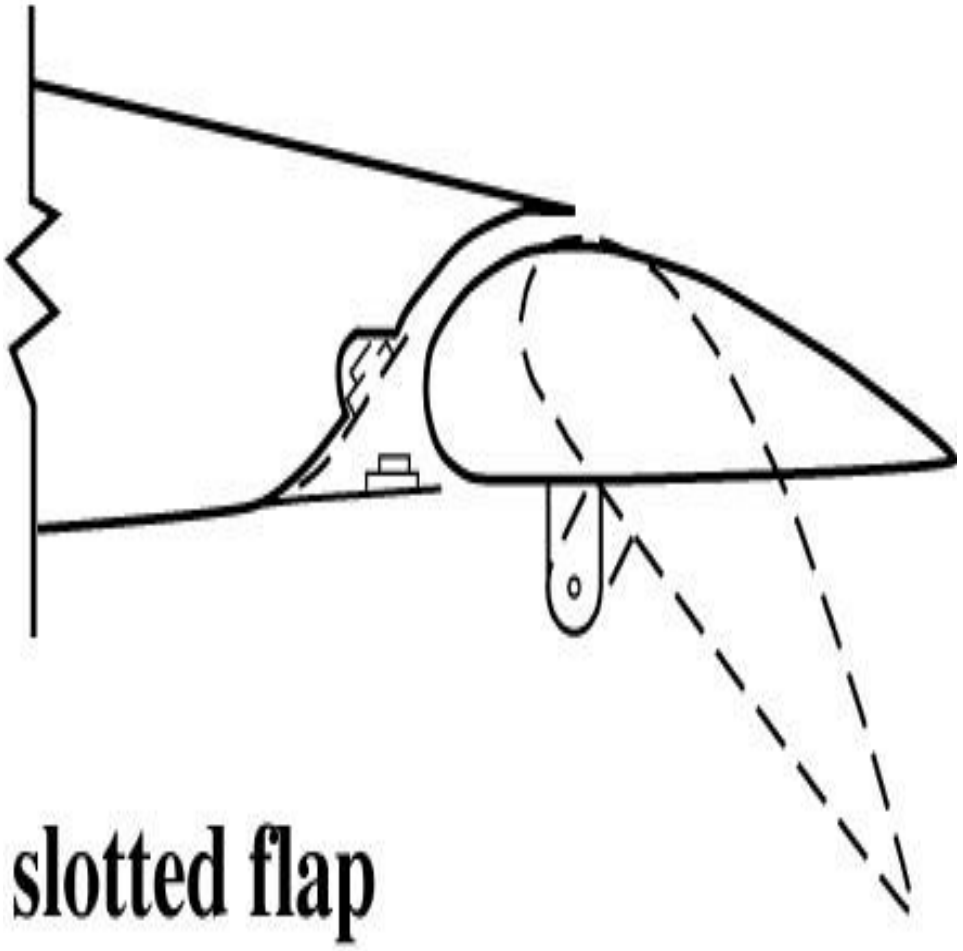
EFFECTS

- ***The lift slope curve is slightly increased, because the flap performs better at high than at low incidence***
- ***The zero lift angle is reduced, but not by quite so much as is the case with a plain flap.***
- ***The stalling angle is less than with flap neutral, but higher than the corresponding value for a plain flap.***
- ***The increment in maximum lift coefficient is bigger than with a plain flap.***
- ***The effect on pitching moment is similar but less marked.***
- ***Bigger Increase in drag than with a plain flap because of the large wake.***

3. THE SLOTTED FLAP

Geometry: Increases the effective camber of the airfoil.

BL Control: The air passing through the slot re-energizes the boundary layer and prevents separation.



EFFECT:

- **Zero lift angle is still reduced. Maximum lift coefficient is appreciably bigger than that in the previous cases**

Drag is much lesser since it prevents separation. (Pressure drag is reduced)

- **Moment is still large.**

4. LEADING EDGE SLOT

LEADING EDGE SLOT

Geometry alteration: Negligible or unnoticed alteration in the geometry of the airfoil.

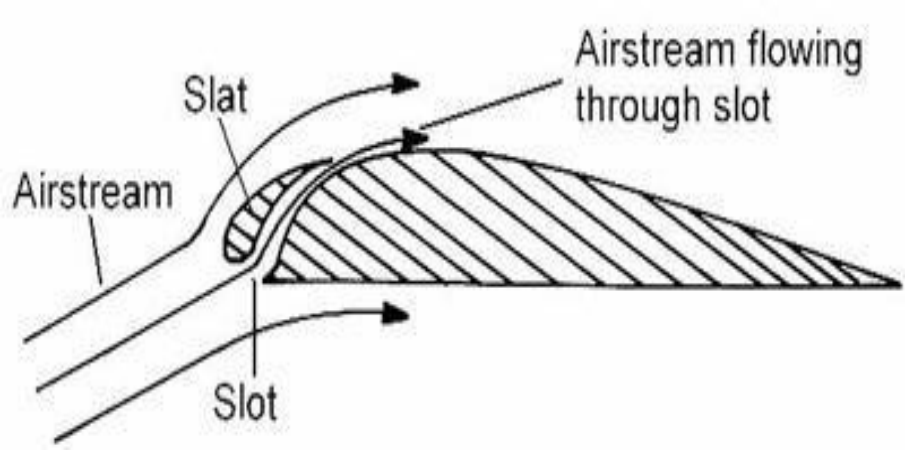
B L Control: The BL is re-energized by the airflow.

EFFECTS:

The stall angle is increased from, say, 15 to 25

degree The maximum lift coefficient is increased

by about 60%.



At low incidence slat ahead of the airfoil affects the flow over the rest of the wing and there is an appreciable increase in drag coefficient. Thus this device gives increase in the drag at wrong end of the speed range.

Maximum lift coefficient is obtained only at high incidence, so requires high nose up attitude at take-off and landing affecting the visibility of the pilot.

Drag at low speed is reduced which is again a disadvantage during landing where L/D should be too low as possible.

5.LEADING EDGE FLAP(Droop Snoot)

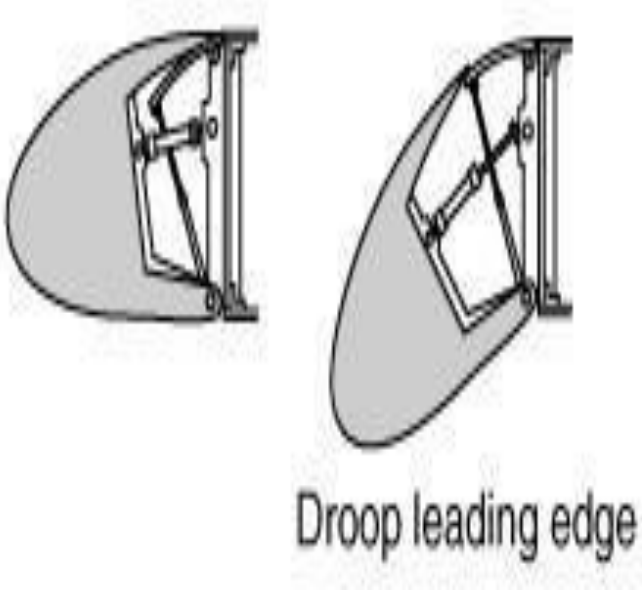
Another device which produces lift increments by helping to prevent flow separation is the leading edge flap, often colloquially referred to as the ‘droop-snoot’.

EFFECTS:

Same as that of the leading edge slot.

Effective at low speeds, thought the objective or design point is high speed purpose.

Lift curve is similar to that of the leading edge slot, but there is a small camber effect as well, and this causes the reduction in the zero lift angle (though not too large).



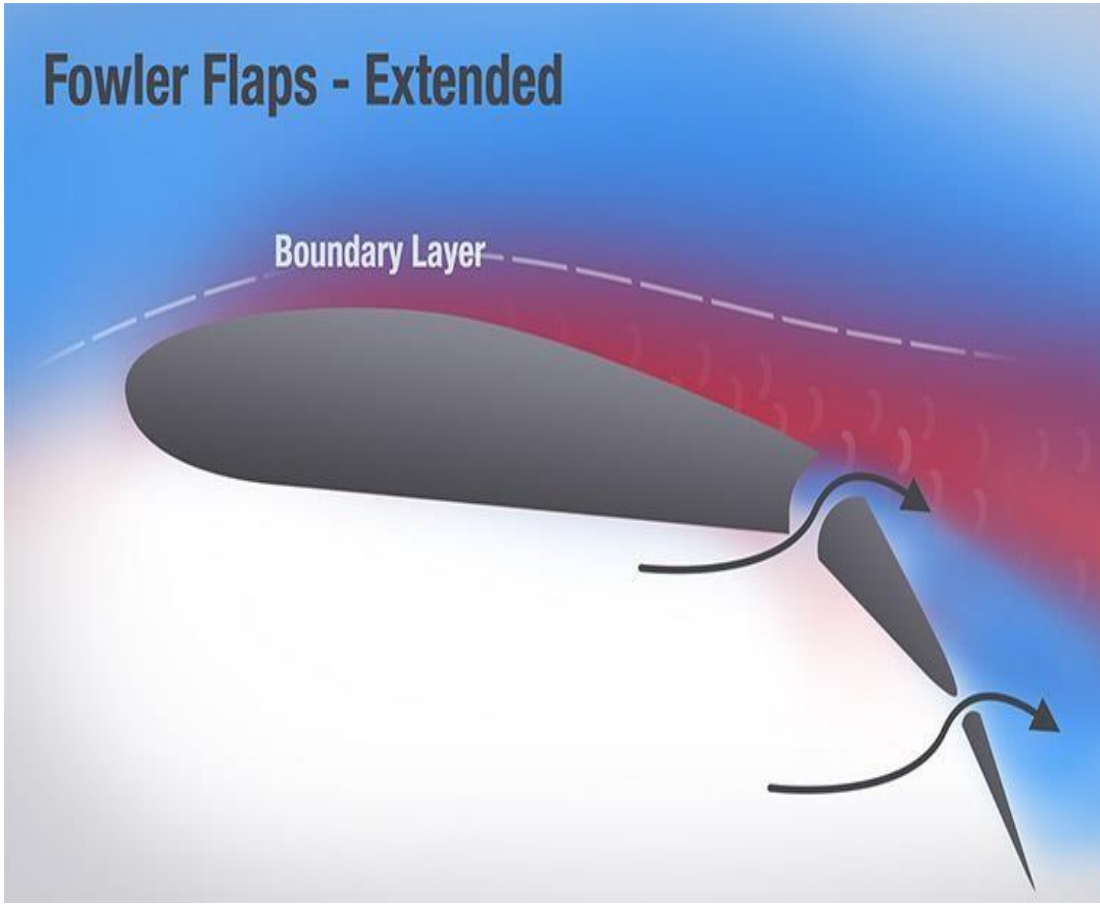
6.FOWLER FLAP

Geometry Alteration: Increases the camber, and also the effective area by deflecting backwards and downwards.

BL Control: B L is re-energized as in the case of slotted flap.

EFFECTS

- High lift increment compared to any of the flap considered.
- Reduction in the effective chord to thickness ratio, making the wing to stall earlier.
- Moment effect is large, because of high
  contribution of the flap,
- Drag Increment is small because of the slot effect andreduces t/c ratio.



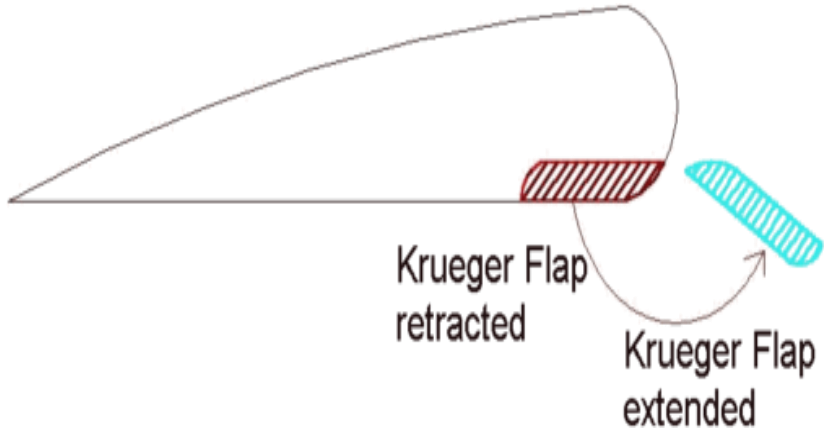
7.Krueger flap

•Krueger flaps are high lift devices that are fitted to all or part of the leading edge of the wings of some aircraft types.

•The aerodynamic effect of Krueger flaps is similar to that of slats; however, they are deployed differently.

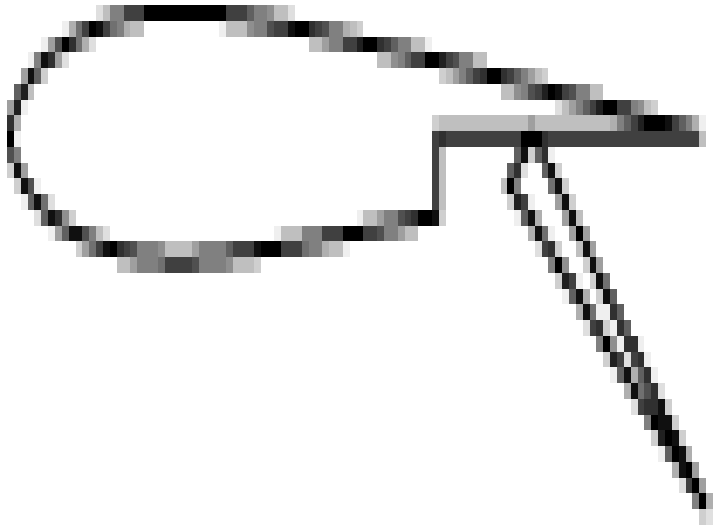
•Krueger flaps are mounted on the bottom surface of the wing and are hinged at their leading edges. Actuators extend the flap down and forwards from the under surface of the wing thus increasing the wing

•camber which, in turn.



8. Zap Flap

Flaps on the trailing edges of the wings. These increase the camber as well as the effective wing area. This results in much higher maximum lift and drag values than with camber or split flaps. Also called *zapp flaps*.



CL vs angle of

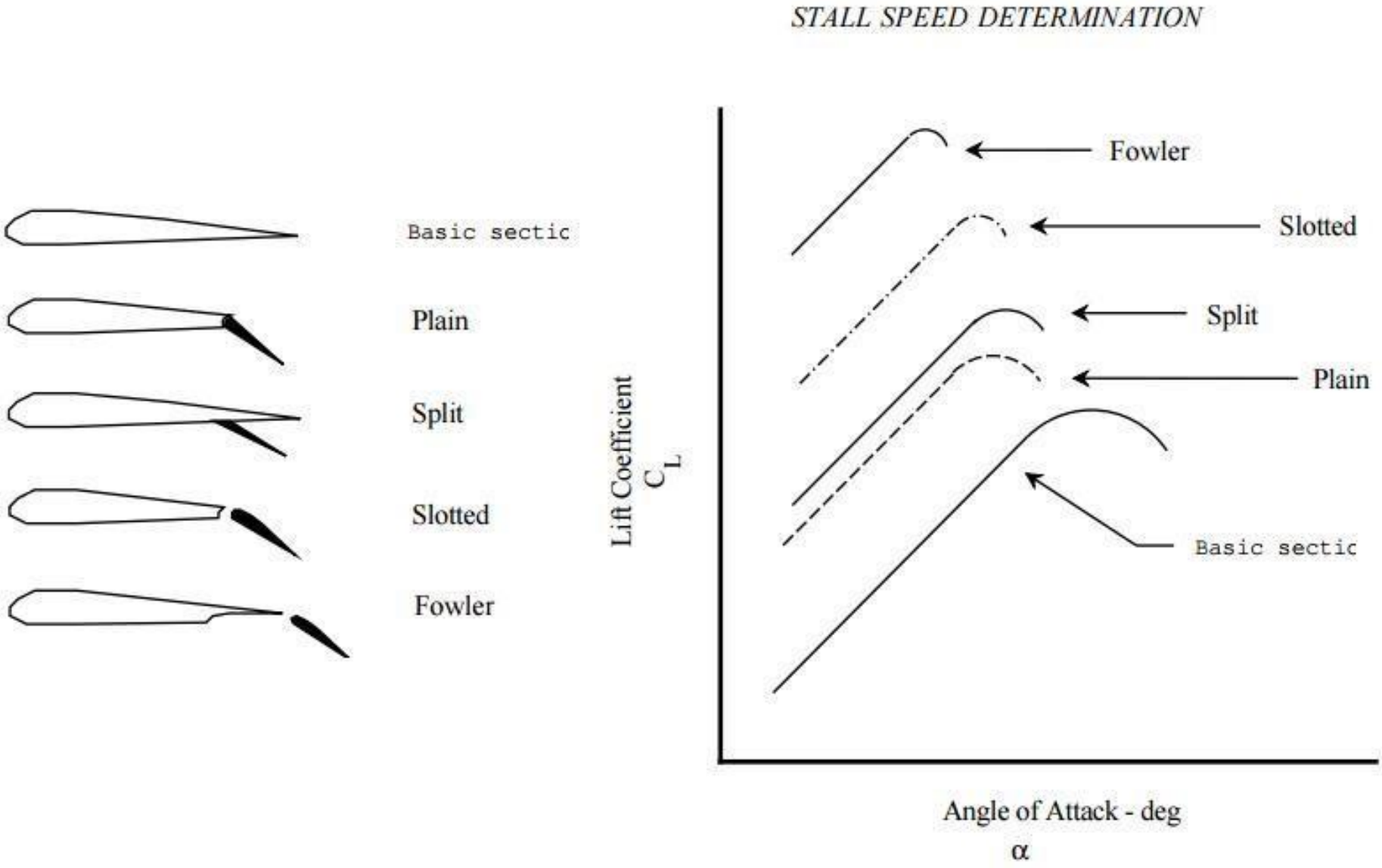


Figure 3.7

Today's Amazing Fact??????

At the time of W W II US manufactured average 130 planes per day

Any Questions?????

धन्यवाद

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