**Introduction to Flight**
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**Lecture Number 02.3**
**Aircraft Component Nomenclature:**
**Tail Plane and its Components**

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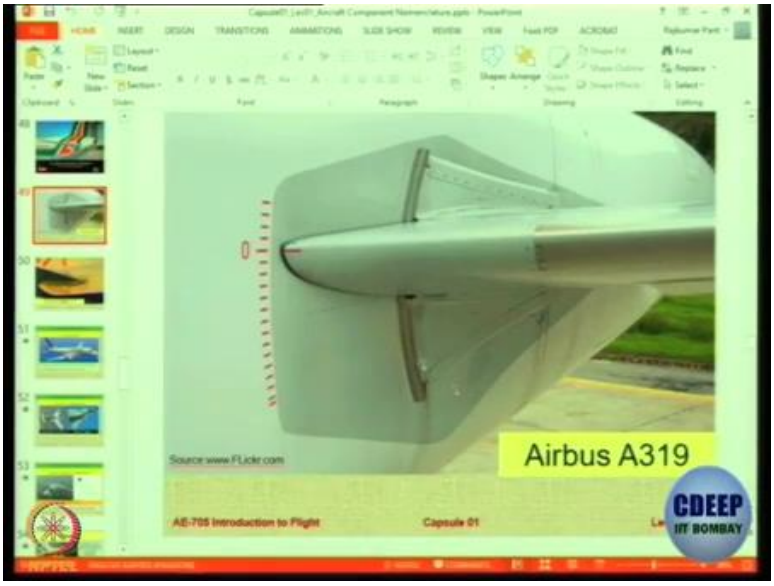


We can see the close-up of the Airbus A319 with these positions at which the pilot can or the flight operator can prefix it.

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And this is on Embraer EMB 170 again you have up and down controls on the angles.

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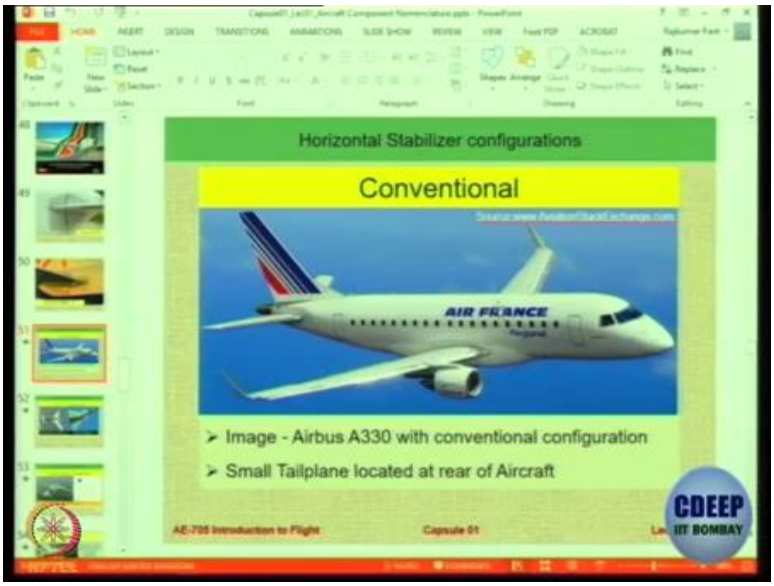


This is conventional where you have a Tail plane here and the wings here.

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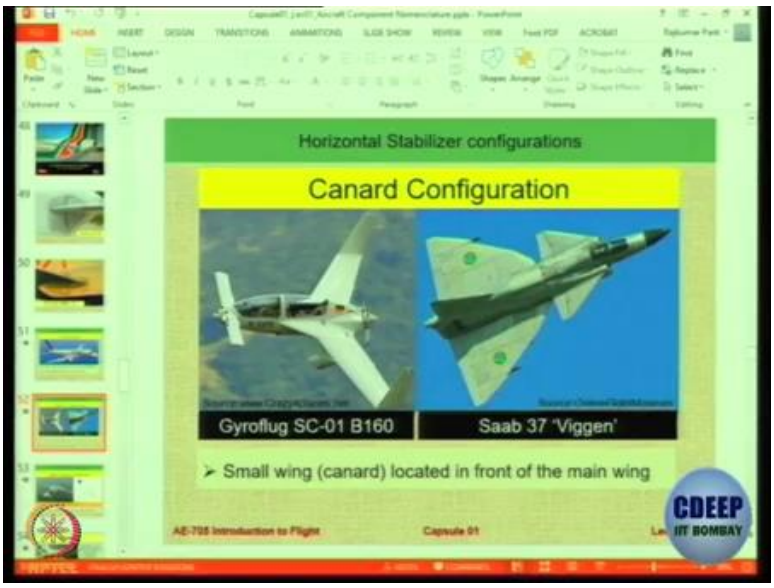


You could have canard in which the tail is in the front like this or like this. These two canards are different. One of them is a control canard, one of them is a lifting canard. Now this distinction I do not want to tell you, I want you to figure out on Moodle and tell me. In fact, there are three types of canards. There is a close coupled canard. There is a lifting canard and then there is also a control canard. So, you have to tell me what the differences are and how they are?

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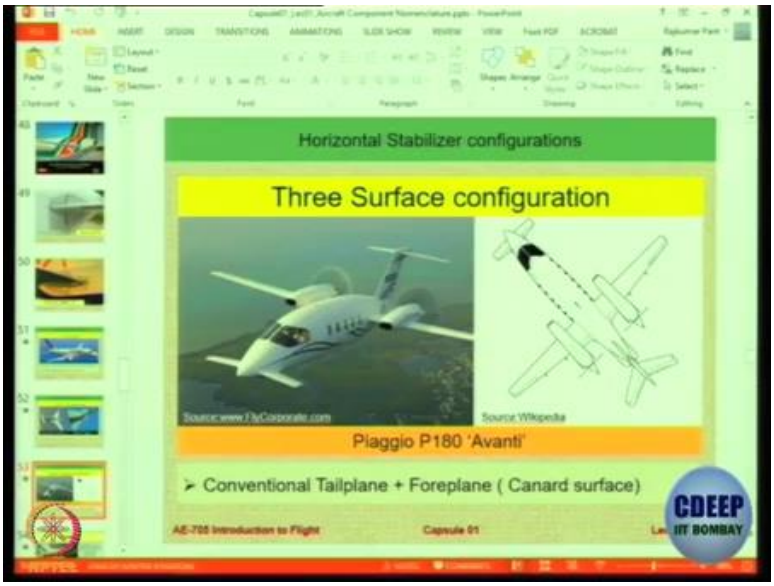


It is a very interesting plane which has got a canard also and a conventional tail also. So we call this as a three surface aircraft. We have canard, wing and tail and we talk about this aircraft a lot

in our aircraft design course. I do want to spend that much time here because in the aircraft design course off course this will be covered in more details.

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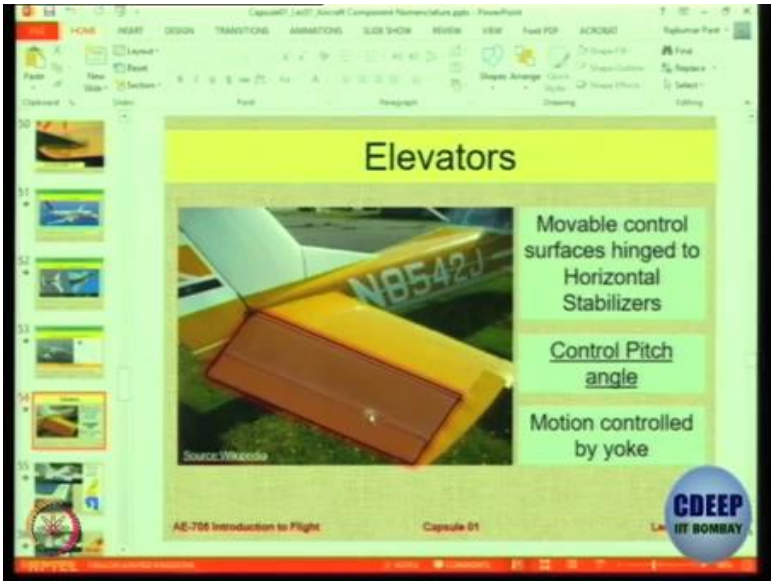


Then you have Elevators. This part is a Elevator which is the movable part of a tail. Sometimes we have all moving tails also. Mostly in military aircrafts but transport aircraft normally you have a fixed part called as a Stabilizer or a fin and the moving part called as the Elevator.

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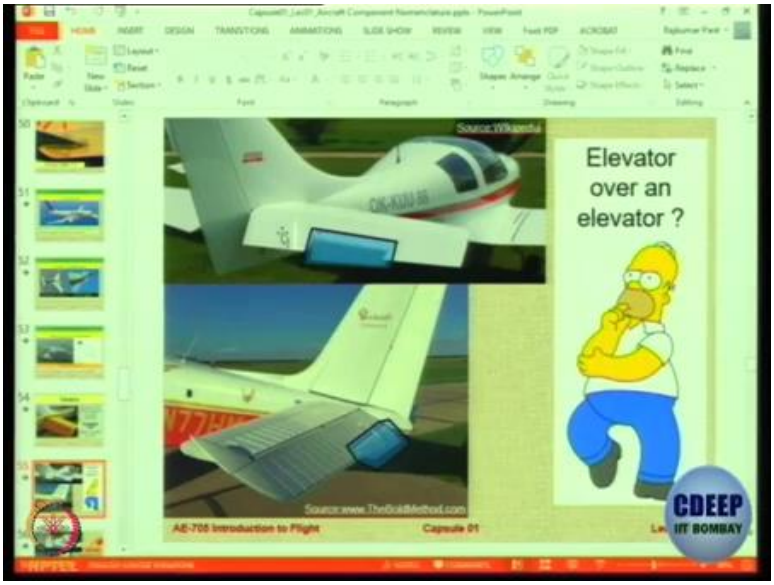


Alright so now the interesting thing is that here you have a Elevator and you have a small deflecting surface over the Elevator. So what is this? A small Elevator on the Elevator. This is a trim tab this

is a tab which is a small deflecting surface but a fixed surface. So, you deflect it at some angle and lock it. It is used to reduce the hinge moment required to operate the Stabilizer. We will study about this more when do the stability. Ok the trim tabs basically they reduce the force on the Control Yoke or Control Stick and they are meant for trimming the aircraft.

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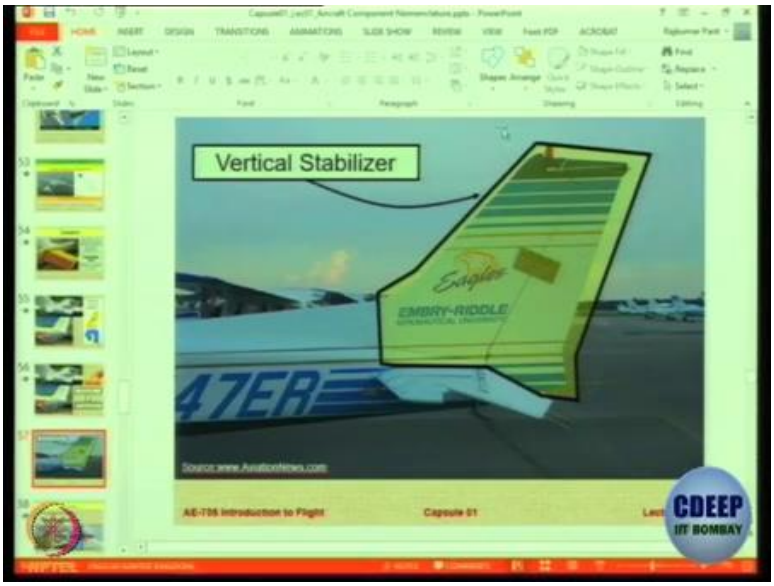


Alright this is the vertical stabilizer, which is a flat surface sometimes one, sometimes two, sometimes three. On the centerline of the aircraft, on the rear side, in the front. It gives directional stability so it gives you the tendency to avoid going into a yaw uncontrolled, if there is a disturbance you will fly straight. If there is a disturbance you will avoid going this far. You may go and then comeback, okay that is called stability we will discuss about it. But it also has a small moving part called as a rudder which is meant for intentional motion. So, the pilot deflects the rudder to intentionally go into a roll or into a yaw. But the fin or the vertical tail is needed for stability.

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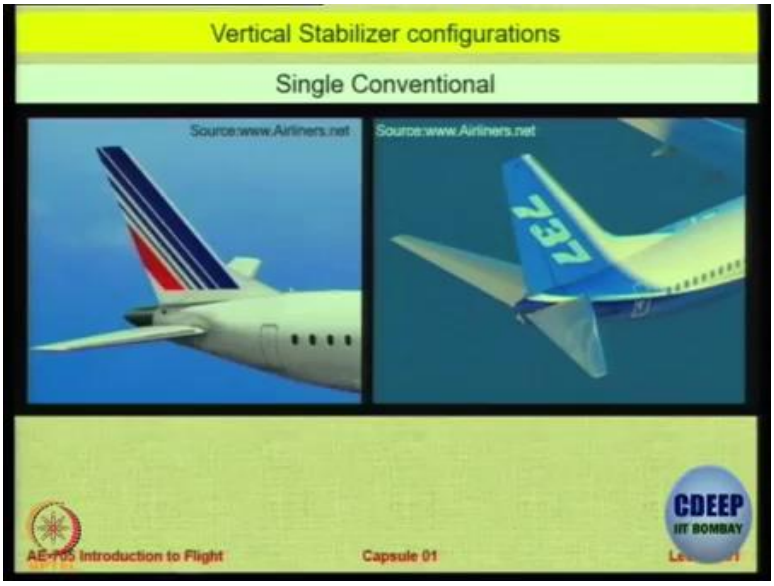


Okay so vertical tail can also be conventional like this, just a single one. Okay, directly on the empennage, most common most common configuration.

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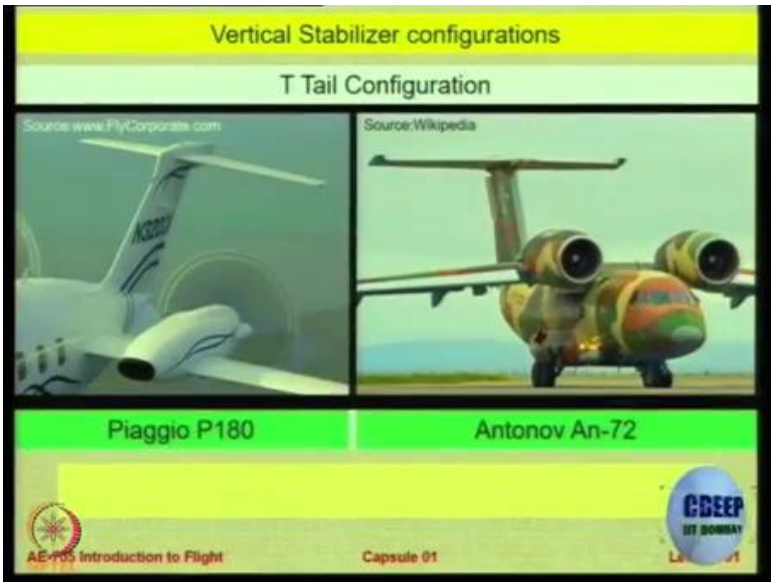


But you may also have a T tail. That looks like a T. This is also a tail. But the horizontal tail is moved up and away.

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You can also have a Twin tail. That means you have two tails mounted at the ends and why do we have them? What is the advantage etc? that we will discuss in the aircraft design course.

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Then you can have a again the Twin Boom, Twin tail.

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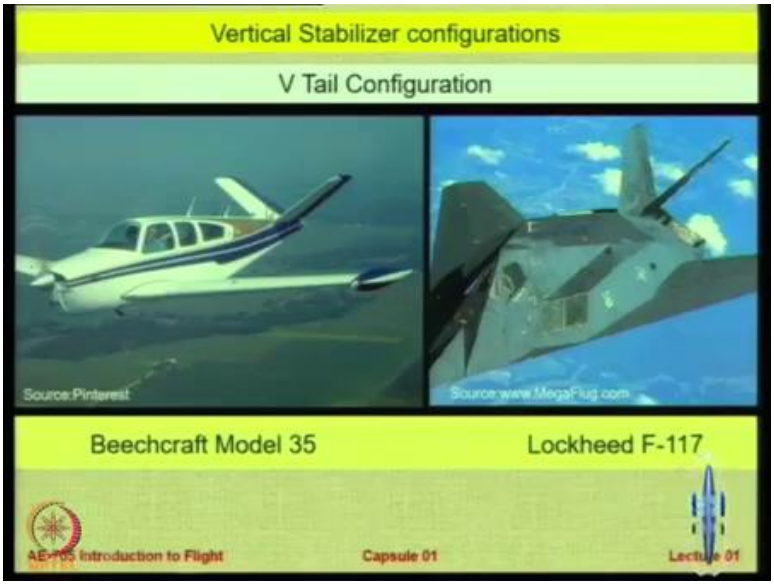


And you can also have something like a V tail. This is F-117 A and this is the Beechcraft Model 35 it has got a Butterfly or a V tail. Here instead of three surfaces vertical one and two horizontal you have just two surfaces. So apparently it reduces on weight and reduces on drag. Okay but read about this more it is a very interesting configuration and there are not many aircraft there are only about four aircraft that I know which have a vertical tail.

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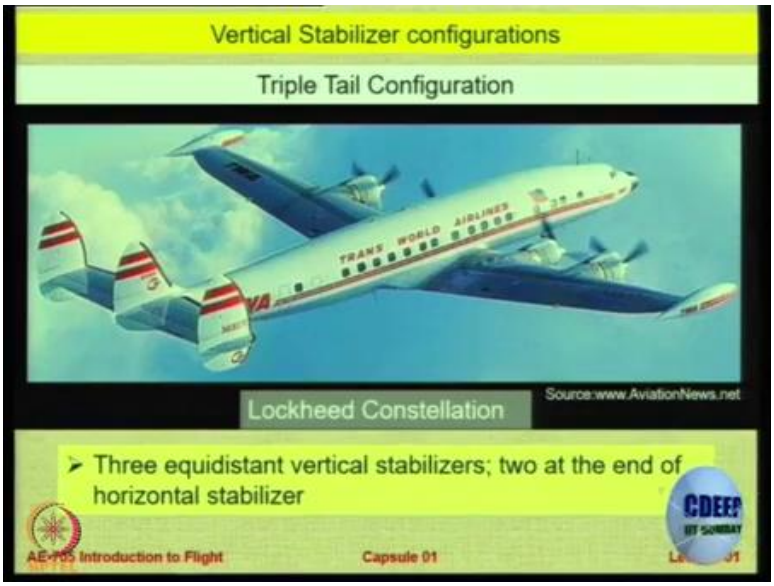


Then you have a triple tail again I have not seen a quadruple tail. Although there are some aircraft in the beginning which had multiple tails just for trial purposes. Like the (loobz). Okay, now in

this picture I want you to focus your attention on the part which is required when the tail is not enough, then you have to have extra things and that is a Ventral fin.

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This is the MiG 23 with a Ventral fin. Okay, what is a Ventral fin? Something mounted at the rear under side of the fuselage. It improves responsiveness towards rolling. We will see this when we look at the stability classes and it also improves the directional stability of the aircraft. That means if the aircraft has a tendency to go into this kind of a motion it will have a force acting on the back, on the bottom it will try to bring it back on its own.

So, it is not common in many aircraft in some aircraft like in MiG 27 it has a very interesting configuration that as soon as aircraft touches down. The Ventral fin will bend 90 degrees. Because if it does not bend it will hit the ground and it may break especially at high angle. So, we wanted to have a large Ventral fin. But we did not have space to mount two of them. There is only one in the center so they have a coupling system. The moment landing gear is hitting the ground. It is sensed that it is touched the ground by some pressure and a switch is activated. The Ventral fin becomes 90 degrees bent. That was a interesting configuration.

Okay, Podded Engines is basically a jet engine inside a pod. Which is basically a nacelle about which we have already spoken. There are many many variants you have under wing mounted, which is most common. And the Boeing aircraft company was the first aircraft company to try out

these kind of configurations. Below the wing podded engines. And they made it work very well from Boeing 707. After that every jet engine normally has this.

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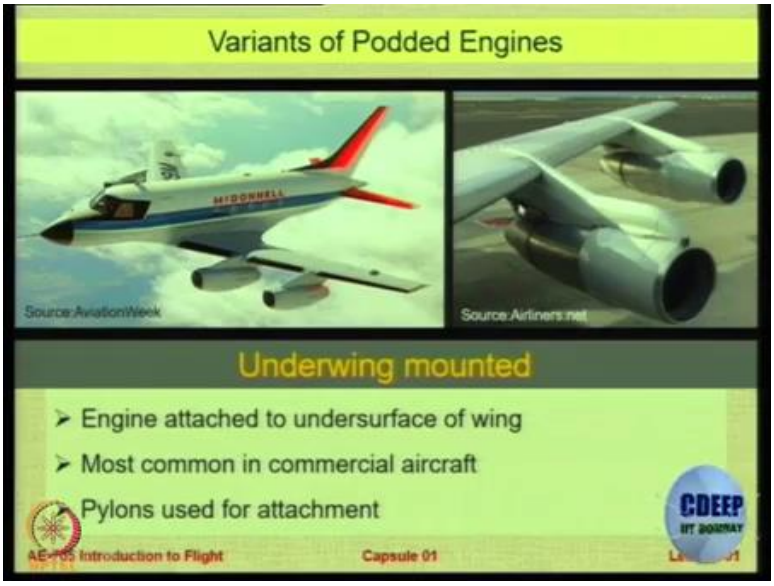


And there is a member there is a member, there is a member which connects the wing to the engine. And that member is this particular component. And that component we can see it here also. This is called as a pylon. Okay because it is used to pile the engine on the aircraft. That's why it is a pylon. It is the way I remember it. Okay, you can have a pylon for any external store like a bomb or a missile or a rocket part. That will contain the electronics, weapon control system and other devices.

In many aircraft stores or armament. You need to have an ejector. So that you can push the store down. To avoid the store hitting the aircraft. You know, if you release a bomb. A bomb is aerodynamic body. And it is a body which can actually start floating up because of the aerodynamic forces. So must so that it may hit the aircraft which launched it. There have been such cases where you have damaged your own aircraft by launching an armament.

The worst offender are the drop tanks because drop tanks are basically external fuel tanks, which are mounted generally on the bottom of the fuselage or on the two wings, below the wings. They carry extra fuel so if you want to have a larger range, especially in military aircraft. What they do is they mount one or three drop tanks. And then they consume the fuel from drop tanks first and then you release them and then you switch over to internal fuel. So, by the time you take off, climb

and reach some place you now have full internal fuel for the mission. Now these drop tanks are light weight now because fuel is gone. Large aerodynamic bodies they float and they may hit. There have been many studies. One of the last things I did when I was in HAL Nashik was to look at the aerodynamics of store separation and today also it is a big area of study.

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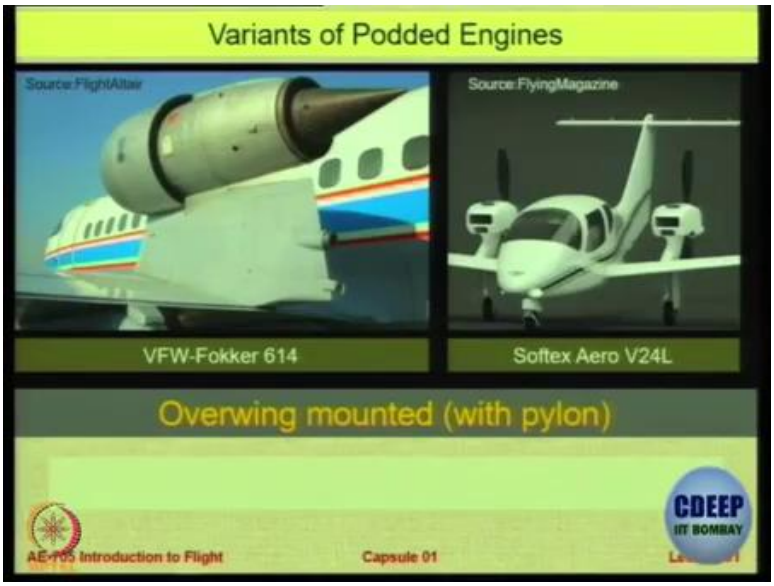


Okay but you could also have engines over the wings. Like these two examples, there are also more examples and then you can have engines over the wings or half way over the wings in the front. This particular variation is called as the upper surface blowing or USB. Where the exhaust of the engines is used to flow it over the wing. So this is called as the Powered Lift. You combine the propulsion with the aerodynamics by using the exhaust of the hot engine flowing over the wing. Okay again there are many variations. You could have engines mounted on the back with pylons coming out. Such as in this particular example.

Okay now the question is why are this configurations normally seen only on small jet planes? Do not answer it now read about it and answer on the Moodle page. Why is it so that most large transport aircraft they will have engines below the wing? But most or many small jet engine aircraft especially business jets, luxury jets they may have engines mounted in this fashion. Okay so what could be the reason? You have to figure out by looking at the Moodle.

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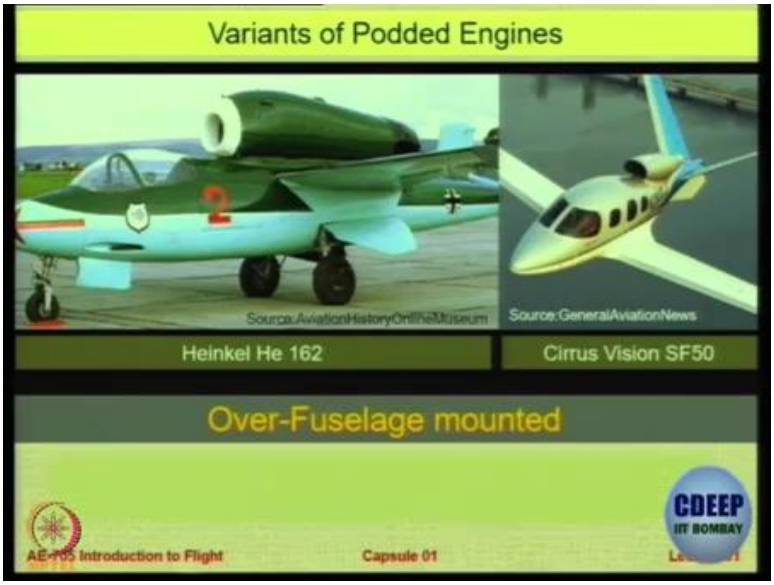


Again more variation single engine mounted above with a butterfly tail.

Yes Yeah

Yes MD90 see MD80 there is one variation which has got one in the tail and two in the fuselage. Okay, that is not a very small jet but generally you will find large jets we do not have like MD 90. Normally they are mounted below the wings. It is only in the small jets that you basically have examples of this.

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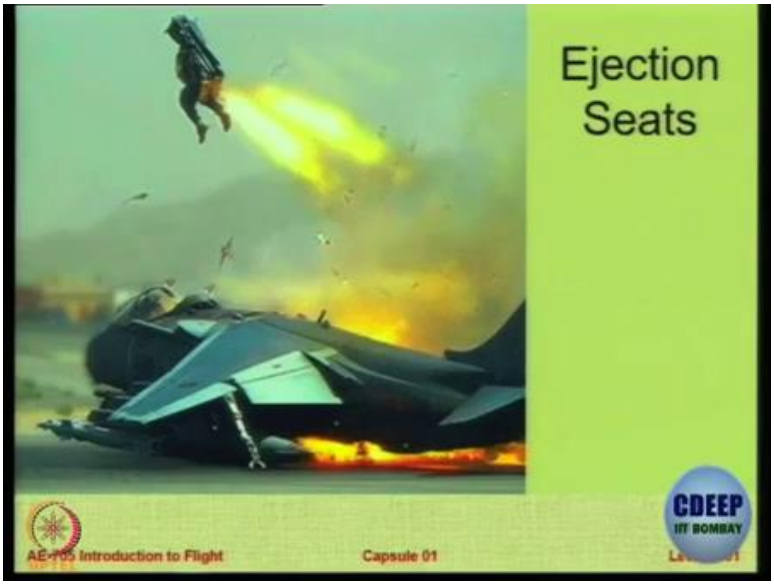

Okay this is the most useful thing as the pilot is concerned. In case of any emergency the pilot uses this to save life. This is the ejection seat. I do not know whether we have the video of this embedded.

In the skies over Calgori an F18 pilot practices maneuvers for an airshow; with being cheating death.

Lost control

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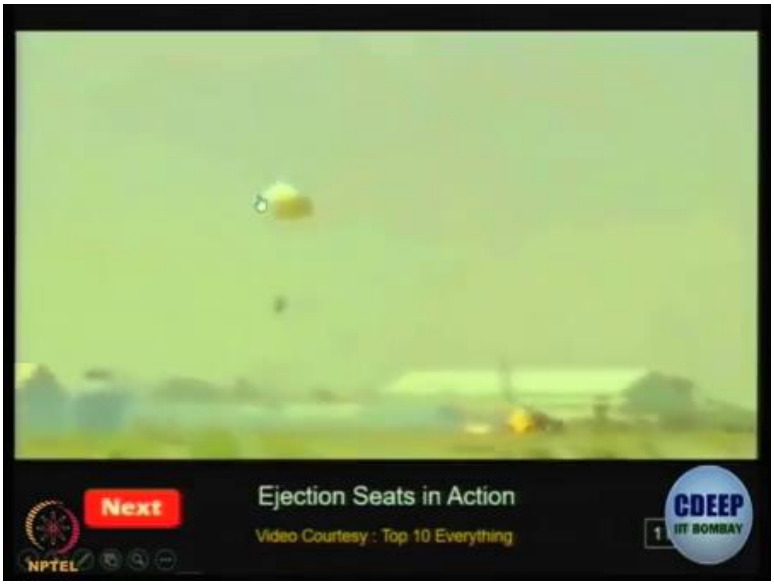


Harrier crash landing, nose broken. The pilot is still waiting; the plane is on fire. But when the pilot reaches there then the pilot will eject. Very risky to wait for so long till the fire is coming in the front.

Okay so all these are ejection seats and many a times they happen accidentally also. While doing maintenance some mechanic or someone does something and then another mechanic is launched. It has happened. We are laughing but people have died. I know of cases in HAL where there was a false ejection like this and the poor mechanic hit the ceiling and he was literally unrecognizable because of the shear force.

Okay, so one ejection took place by wing commander Rakesh Sharma when I was the aerodynamicist also he was coming in to land. And ten kilometers before the Ozar runway there was some problem which was further investigated but he was able to eject. After ejecting he came

down and he got stuck in a tree and then from tree he had a fall so he broke his ankle. He was without flying for about three or four months. But then obviously he came to the HAL and there was a huge party for the ejection cell team. Because the ejection seat worked and saved his life.

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Okay right I would like to just spend very few minutes about a well while collecting data for this particular course. I came across this very nice documentary of the first female fighter pilot in Asia. Okay Lieutenant Marium Mukhtiar who was from Pakistan. So there is a very interesting story.

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That this is a FT-7PG is a Chinese Aircraft. You can see there are two, what do you see? Two ventral fins are mounted and what about the intake? It is a nose mounted intake. So this is an authorized, licensed version of a Chinese aircraft which was a copy of a Russian aircraft.

Okay it took off with one Squadron Leader as the teacher and Marium Mukhtiar as a flying officer. And you know, there was a crash and there is a very beautiful documentary documenting her life and also this whole incident. The most nice thing to know is that she could have saved her life by ejecting early but she decided to divert the plane away from the population. And in the process saved the life of the people on the ground. Because she was going to hit a school and she said that there are going to be many casualties of young children and instead of that she tried to steer the plane which is having a malfunction. Her captain has ejected and he saved his life. But she ejected late and she gave her life for the welfare of the people on the ground. Okay so this was the first martyr also.