Introduction to Aircraft Design
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Lecture - 20
Types of Military Aircraft

Hello, let us have a look at a few types of military aircraft. When we attempt to do a design of a military aircraft, we should be aware of what kind of types of aircraft are there.

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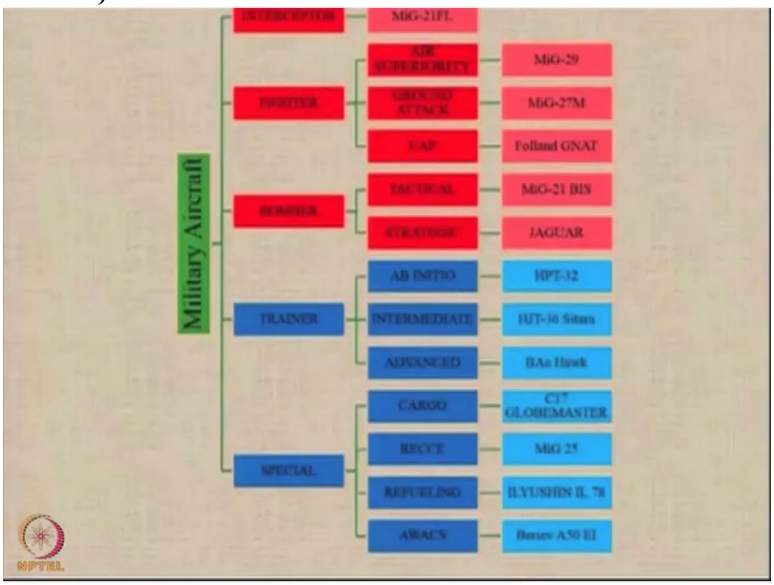

So, this particular chart actually tries to show a complete description of the various types of the aircraft and also gives an example of 1 aircraft of a particular type which can be categorized under each special category. We will look at these aircraft with these types in more detail.

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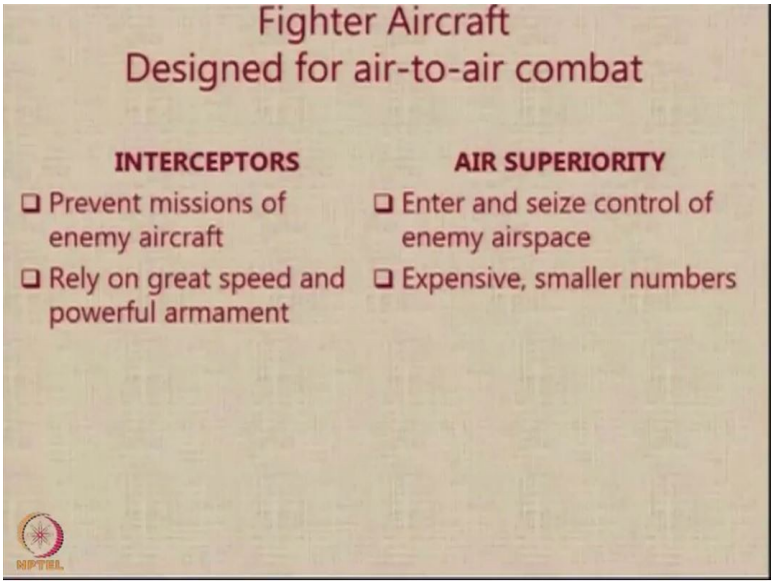

So, fighter aircraft are essentially designed for air to air combat so we have one category called interceptors, and their aim is if there is an enemy aircraft entering into our territory, we are supposed to use interceptors as the first port of defense to prevent the missions of the enemy aircraft. Such aircraft they rely on great speed and powerful armament, but the armament is dedicated to only attacking enemy aircraft. So there will be more equipped with the air to air weapons rather than any other heavy weapons.

You also have a air superiority aircraft where you are supposed to enter and seize control of the enemy airspace. So these are aircraft which are expensive, normally we have them in only few numbers so let us look at some examples.

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So, we have Mig-21 Fl also called as Badal in air force as a typical interceptor aircraft, you can notice that the aircraft is very sleek, almost like a tube with a wing. And Sukhoi SU 30 MKI is a dedicated air superiority fighter.

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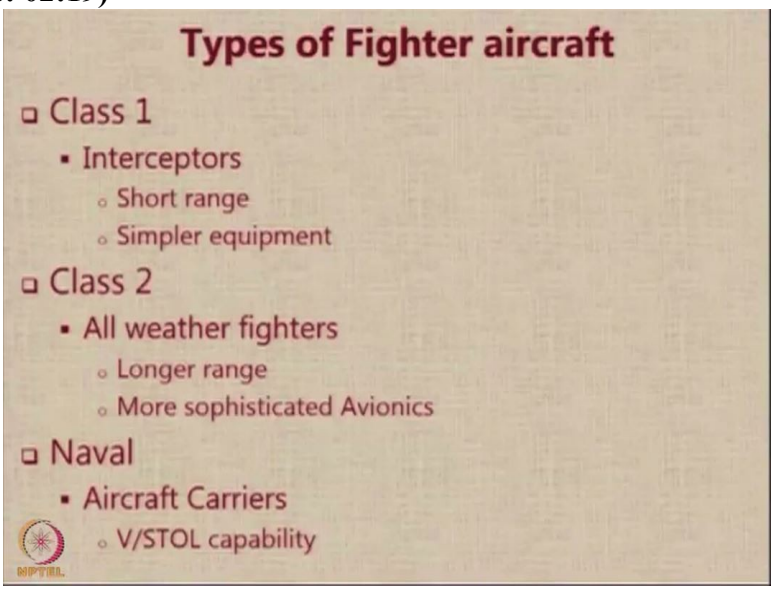

So you have class 1 fighters, interceptors as I already mentioned, the interceptors are short range and simpler equipment. Then you have 2 fighters, which are all weather fighters, they are typically having larger range and more sophisticated avionics and then you have a naval aircraft, which are used on the aircraft carriers and they need to have either vertical or at least short takeoff and landing capability.

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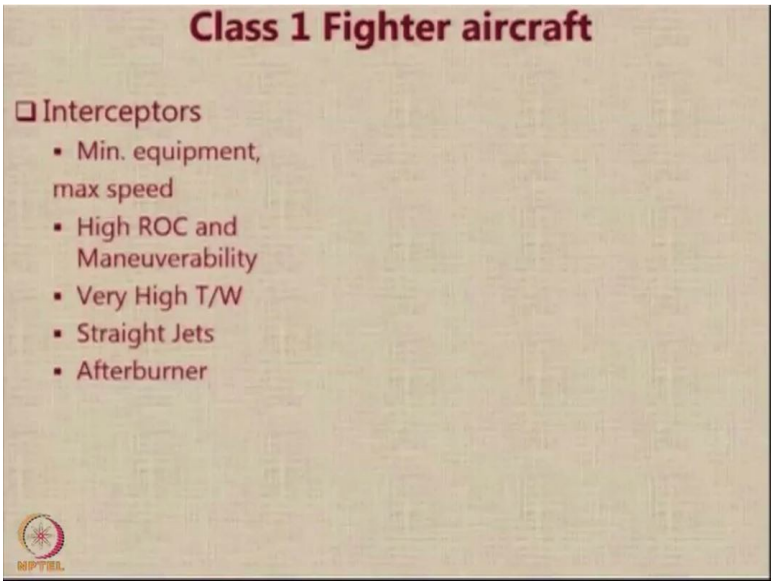

So, in the interceptors, which are the category 1 class 1 fighter aircraft, high rate of climb and maneuverability are the key requirements. So, from the time when you are given the Go ahead, and you are asked to scramble within least possible time, you should be able to climb to an altitude at which your enemy aircraft is operating, intercept it and shoot it down that is the purpose of interceptor. So they generally have very high thrust to weight ratios.

So that they can have very high climb rates. They are generally straight jets because of the brute thrust that is required and they generally use afterburners. Mig 21 Fl badal is a good example of a dedicated interceptor aircraft under class 2 fighter aircrafts, we are looking at all weather capability these tend to be large, heavy complex and expensive and they use low bypass turbofans.

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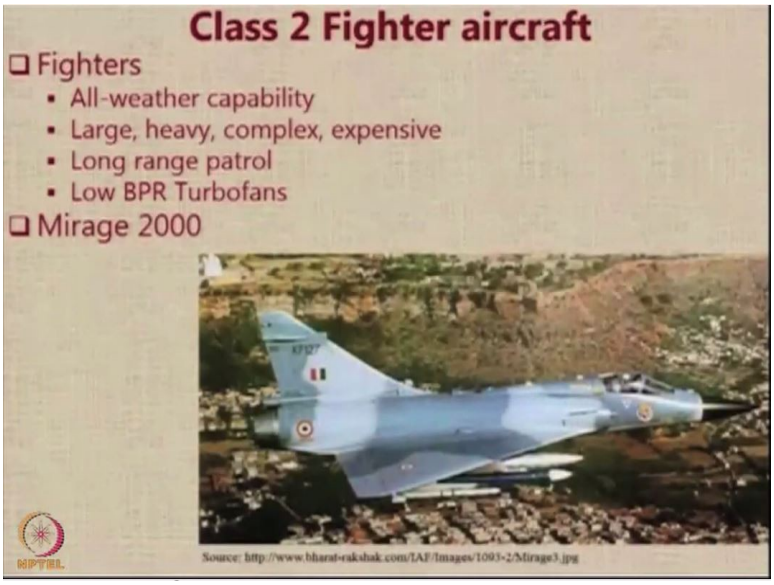

Low BPR turbo fans, because they are going to go for long range patrolling, so they need to have lower fuel consumption compared to interceptors, Mirage 2000 from the table of Indian Air Force is a good example of a class 2 fighter aircraft.

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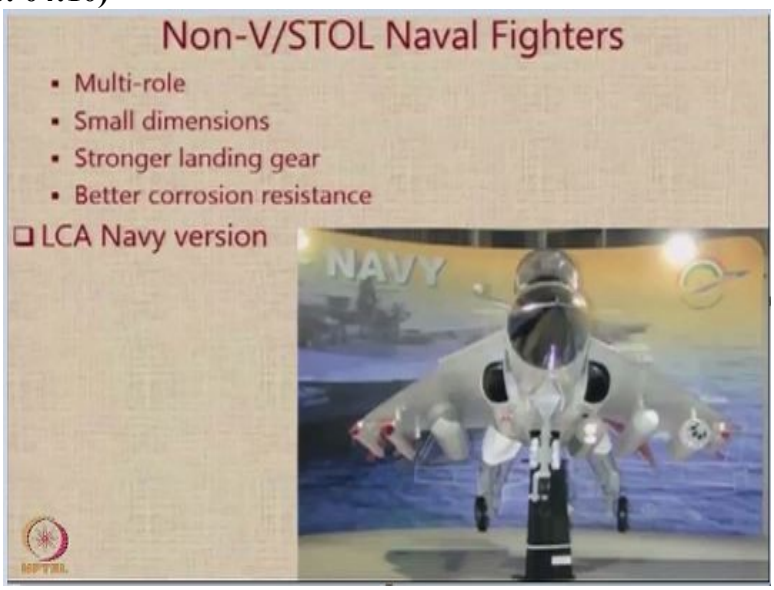

Then we have Non V STL Naval fighters, these are aircraft which are used by the Indian Navy for multiple roles, they generally have to be small dimensioned because they are to be mounted on aircraft carriers where space is at a premium, they need to have a strong landing gear because they will be operating on an aircraft carrier and the aircraft carrier is also going to be generally moving with the disturbance on the sea.

So, the landing gears the landing velocities and the descent rates are going to be higher. Plus, because they involve they operate in the naval environment, they need to have a very good corrosion resistance. So they have to be either coated with special coatings to ensure they do not corrode or the material to be used itself has to be of that type. So, the Navy version of the Light Combat Aircraft is an example of an aircraft that is suited for this particular role.

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When we look at aircraft data, you will find that there are so called generations of fighter aircraft. So, you have 1st generation 2nd generation, 3rd generation 4th generation and then you have a 4.5 generation and then etc. So, now, we are looking at aircraft which are now the 5th generation aircraft and aircraft will come after 2025 will be called as the 6th generation aircraft.

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So, under the 1st generation fighter aircraft, which were more prominent during the Second World War and the Korean War, these are some of the very famous first generation fighter aircraft the F 86 Sabre the Messerschmitt Me 262 Schwalbe and the Gloster Meteor.

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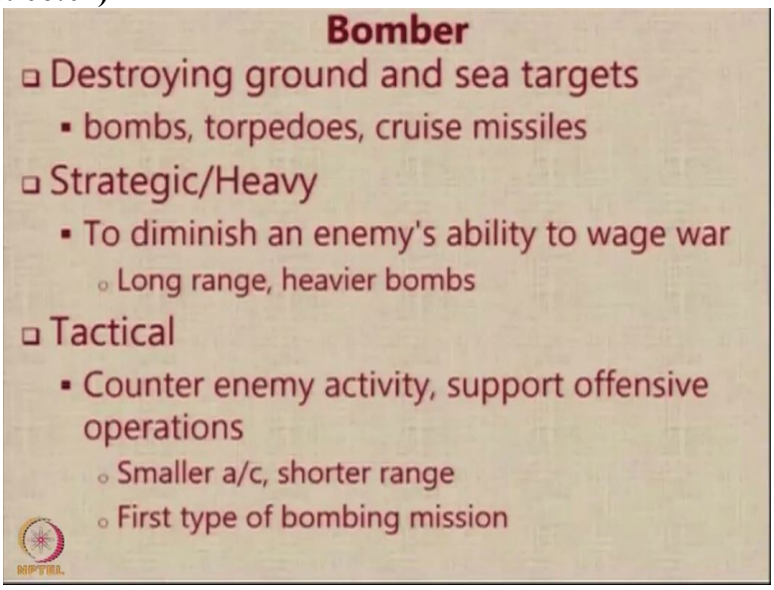

Now, bombers are aircraft which are supposed to destroy the ground and sea targets they normally carry bombs, torpedoes, cruise missiles, rockets, they are of 2 categories, either you can have a strategic or a heavy bomber. The aim is to diminish the enemy's ability to continue waging the war. These are long range aircraft and they have heavier bombs or you have a tactical bomber, a bomber that is going to be operated only to counter known enemy activity and to support the army for the offensive operations.

These aircraft tend to be smaller in size and shorter range and they are normally the first type of bombing mission that is encountered in any scenario.

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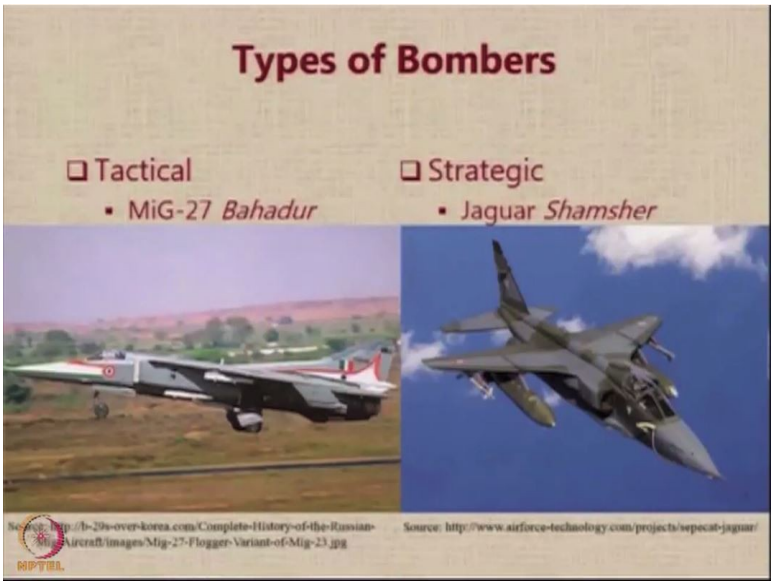

So, here is an example of a very good tactical bomber the Mig 27 Bahadur and we have a Jaguar Shamsher which is the strategic bomber, which is meant for deep penetration.

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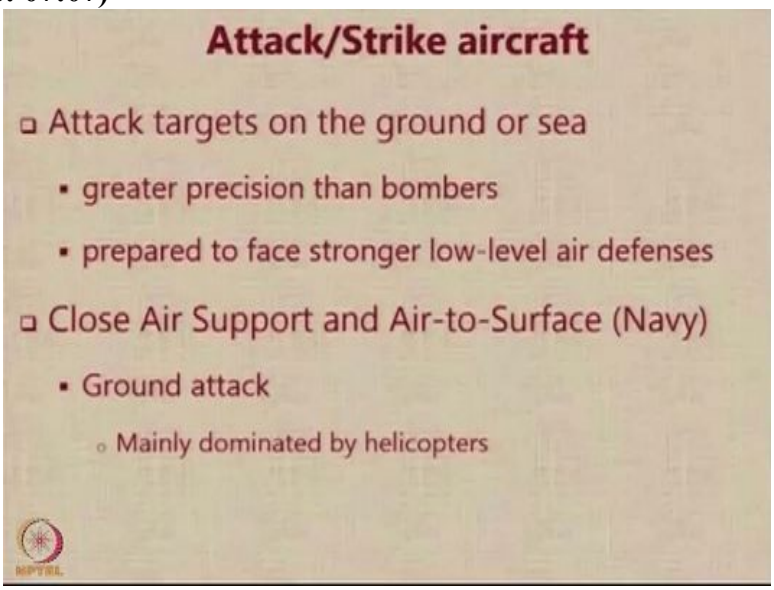

We have attack or strike aircraft, they attack targets on the ground or the sea they have to be more precise than the bombers because they are going to attack moving and very specific targets and they have to also be prepared to face stronger low level air defenses because they are going to operate in a scenario where there are troops or ground ready to attack at them. We also have close air support aircraft and air to surface aircraft used by the Navy mainly these are for ground attack and dominated by helicopters.

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So, here are some examples of one example of a very famous ground attack aircraft, the A 10 Thunderbolt aircraft and then we have the AV 8B Harrier mounted and used by the Indian Navy both of these are ground attack aircraft.

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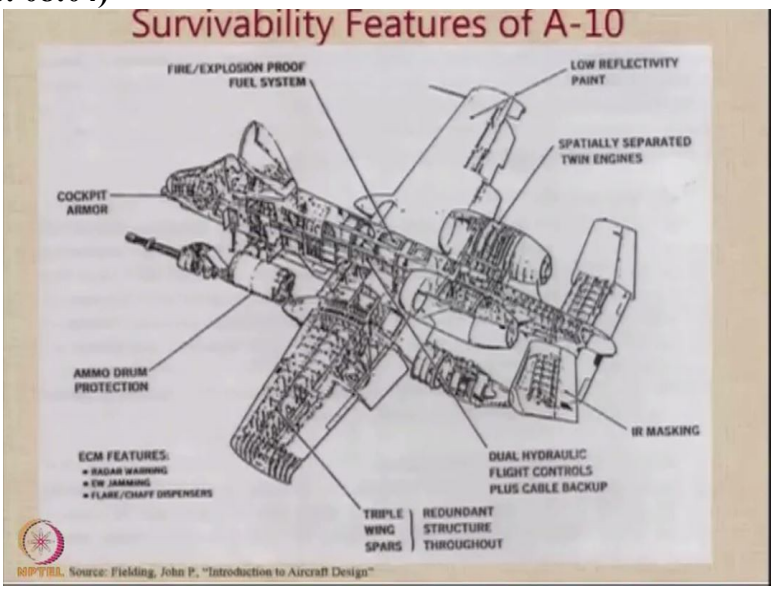

Let us look at the survivability features of one of the most advanced ground attack aircraft or the A 10 this aircraft is having so many features that increase its survivability. First of all, the 2 engines itself provide redundancy and these engines are spatially separated. So that one strike of enemy weapon does not take out both the aircraft both the engines, so, they are separated spatially they are painted with a low reflectivity paint so that they are not very much visible they have a fire or explosion proof fuel system.

Because it is expected that they will be hit by many ground artillery and therefore, it is important to have fireproof fuel system the 2 tails they use this aircraft uses a twin vertical tail or H tail configuration where you can see that the 2 vertical tails are offset and there is a horizontal tail in between. Now one of the interesting purposes of this particular configuration is to shield so notice that the engines are going to give out hot exhaust.

And this exhaust becomes source for the heat seeking missiles to home on so in the direction other than these, you know the vertical tails, these 2 vertical tails they are going to actually shield the engine exhaust of the engines from the enemy heat seeking missiles. The aircraft has a dual hydraulic flight control and there is also a Cable backup in case the hydraulic system fails completely, the aircraft can be brought home with only a cable based control system. There are 3 spars in the wing this gives you a redundant structure.

And then the ammunition drum which carries the ammunition of the aircraft, it has a Gatling gun, this particular drum also is protected because that is the main ammunition of this aircraft and the weakest link in the whole aircraft is the pilot. So, the side of the fuselage is plated with armor to make the aircraft virtually immune from decapitation due to fire from the ground. So, to protect the pilot of the aircraft, they have put thick armor it leads to heavy weight, but it is required from function.

Other than that, the aircraft has many electronic countermeasure facilities, it has a rare warning system which was the pilot in advance about locking off by any other aircraft or even by the ground systems. It has electronic warfare jamming systems and it carries flare and shaft dispensers which will try to misguide the heat seeking missiles if they are launched.

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HAL has developed a ground attack helicopter LCH which is a Light Combat Helicopter and which also fits into this particular ground attack mission very well.

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We also have some aircraft which are meant for electronic warfare so their aim is to degrade the effectiveness of enemy's radar and the radio systems. One example is the Northrop Grumman EA 6B Prowler aircraft. So you can see the key features of this aircraft are to jam the enemy radar systems, they gather radio intelligence and they also have anti-radiation missiles.

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Then there are also some aircraft which are used for maritime patrol they operate over long durations of time over water and their real their application could be anti-submarine, anti-ship or search and rescue. The Tupolev 142M recently retired by the Indian Navy belongs to one such family where the aircraft can be could have been operated for approximately 16 to 17 hours nonstop very long range missions. The Boeing P8 Poseidon is conversion of transport aircraft into a military version for longtime maritime patrol. This is one of the modern aircraft of this category.

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In today's times, it is very difficult for any air force or any military agency to have funds where we can have separate line of interceptors separate line of bombers separate line of other types of aircraft. So today, the aim is to create what is called as a multi role combat aircraft where the

same aircraft can do multiple missions. So of course, it will be a compromise, but it cannot be there is no other option when asked to look at multiple role combat aircraft because it is just too difficult to have a fleet a serviceable fleet of various aircraft types ready.

So, the multi role combat aircraft is intended to perform different roles in combat. And you can have a fighter bomber you can have a Strike Fighter.

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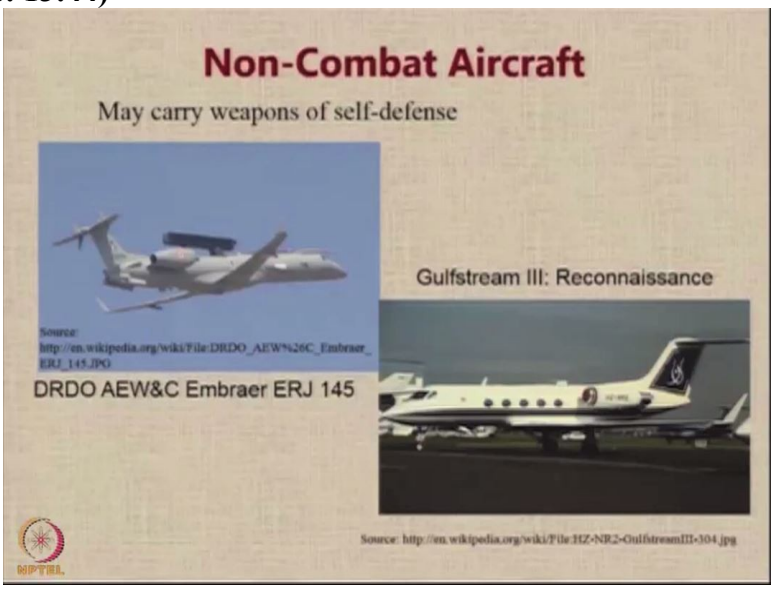

There are also some non-combat military aircraft, some of them may carry weapons for self-defense, but generally they are not. For example, one could use aircraft for reconnaissance missions, such as the Gulfstream 3 as shown in this figure, or we may use aircraft for Airborne Early Warning and Control. So Embraer has modified its ERJ 145 business jet into a ERJ into a AEW&C aircraft which the DRDO is planning to procure.

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You can also have to truth transport so and transportation equipment. So, the globe master and the Il 78 are examples of aircraft which are used as a tanker or as a transport aircraft.

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This slide shows a collection of various experimental aircraft operated by the US. Thank you, for your attention.