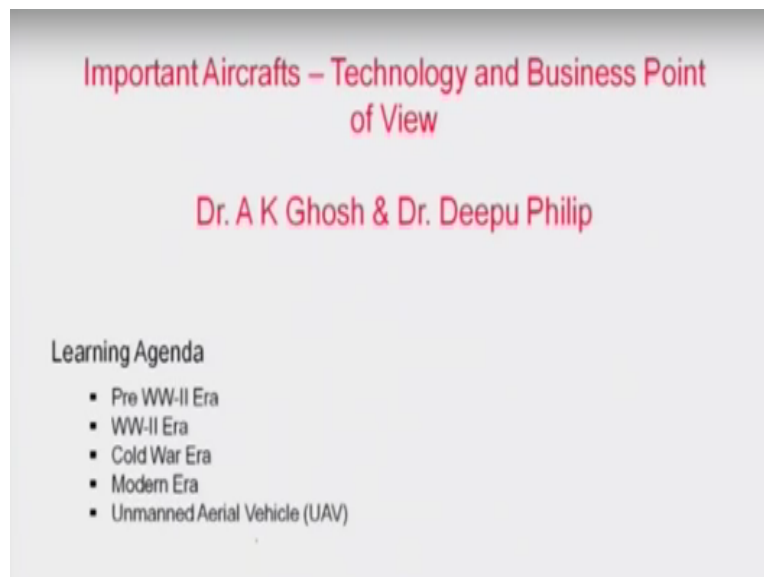


Aircraft Stability and Control
Prof. Deepu philip
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Lecture – 60
History of Aviation

So today we will discuss about important aircrafts from the technology and business stand point for our course. We are trying to do it in actually the pre -world war era where we started the aviation then we talk about the world war two era and then cold war and modern era this will be the mixture of both.

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This will be the mixture of both commercial simple and as well as military aviation aircraft, and finally we will conclude the discussions with the help of unmanned aerial vehicles.

(Refer Slide Time:00:47)

Wright Flyer

- Also called as Flyer I or 1903 Flyer – Dec 17, 1903 – Kitty Hawk, NC, USA
- First successful powered aircraft
 - Built using spruce wood
 - Powered by sprocket chain drive – powering twin propellers
 - First biplane with a canard (fore plane) configuration
- Flew for 59 seconds to a distance of 852 feet – operated by Wilbur
 - However, first successful flight was made by Oliver – 12 seconds (120 feet)



So we all know that, the importance of Wright Brothers in the development of air aviation industry. The one that you see here is the Wright flyer also known as the Flyer one the first aircraft that is actually to fly ok. It happened in the north Korea in USA 1903, December 17 th. This was the aircraft that was built using wood and as well as chain and sprocket drive for running the propellers and as well as they growth to cover the aerofoil you can see that its actually a bi plane.


Bi plane means you have two aero foils connected highlighted by the red color. and the propeller in the back and you can see here that all over lying down and operating the propeller. And also see that this aircraft also has two four planes and canons in the front which is used for controlling the direction. That's why interesting story in this aircraft because both the Brothers, Wright brothers finally took a task who will fly that.

The toss was won by Oliver he flew for 12 seconds and then he crashed but it was very small air flight 120 feet and their wing was damaged and they repaired it. And Since, Oliver got the first chance and Wilbur do the second one he flew for 59 second to a distance of 852 feet that is recorded as first official flight of human begins.


(Refer Slide Time:02:26)

Curtiss Pusher D

- First real mass produced airplane
 - Known as pusher because engine & propeller behind pilot seat
- First aircraft to do landing and takeoff from a ship - (USS Birmingham and USS Pennsylvania)
 - First aircraft to incorporate a tail-hook for cable arrested landing.
- Set the basis of design and production of world's first seaplane – Curtiss Triad



Capacity:	1 pilot + 1 passenger
L x H (m):	8.92 x 2.39
Wingspan (m):	11.66
Weight (lbs) (Empty/ Loaded):	700/1300
Engine:	Curtiss E-4, 40 hp
Max. Speed:	50 mph
Flight duration:	2.5 hours



So next one we will talk about another important aircraft called as Curtiss Pusher D. Lot of the UAV that you have seen unmanned air vehicles which do not have any pilot on board that operates on pusher configuration and this is the also from the business stand point. This is where the mass production of the aircrafts happened, mass production means large scale production and this is also called pusher because you can see that the engine is at the back.

So I am high lighting the engine, the propeller on the engine with the red colour and this behind the pilot seat. And it is also the first aircraft to do the naval operation. Naval operation means take off and landing from the ship and you can see that the first landing was USS Birmingham it is an American aircraft carrier and after that it also took off from USS Pennsylvania. So, in a way this is the first aircraft to do the naval operations.

But you should also be surprised to know that the concept of Tail- Hook arrangement, which means the hook that is at the back of the aircraft that drags that connects to a landing wire the cable for arresting the landing. This was the first aircraft actually developed it and that the same technology used for naval aircraft naval ship aircraft also this became the fore father for the world's first sea plane called Curtiss Triad this aircraft the important features are there is a pilot plus one so that one passenger can travel in this one.


It has wing span of 11.66 meter so that big aircraft. We can again see inspiration of Wright Brother, you can see the one aerofoil on the top and second aero foil on the bottom connected by the same way Wright Brothers have connected their aircraft. It has a E -4, 40 hp engine which actually turn the propeller and it could fly at the maximum speed of 50 minutes and we see that from the 950 meters 59 seconds of flight.

You can see that this aircraft can fly upto 2 .5 hours.

(Refer Slide Time:04:45)

Junkers J1

- World' s first all-metal flying aircraft – later first to do transatlantic flight (J33)
 - Initially built using electric steel
- Designed by Hugo Junkers
 - Later designed the first aircraft using Duralumin (Aluminum, Copper, Manganese, Magnesium) – still used widely
- First aircraft to use cantilever structure for wings – still followed by many manufacturers



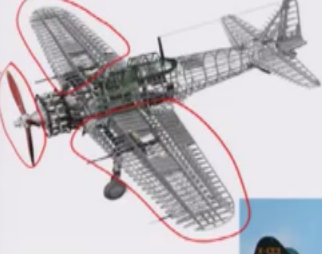
Capacity: 1 pilot
L x H (m): 8.64 x 2.49
Wingspan (m): 12.92
Weight (lbs) (Empty/ Loaded): 920/1080
Engine: Mercedes D-II - water cooled piston engine, 120 hp
Max. Speed: 106 mph
Major flight: 7 km, up to 985 feet, top speed 106 mph

Now we will talk about another aircraft. This is also an important aircraft in the case of the human begin because up to this point people were making aircraft using wood and cloth. This is the first aircraft converted moved from wood and cloth to metal.

(Refer Slide Time:05:03)

Mitsubishi A6M Zero

- Helm of Japanese World War II air capabilities – Mitsubishi Heavy Industries
 - Largest number ever manufactured in Japan – about 11,000 - operated between 1940 - 45
- First naval fighter that can outperform land fighters
- Speeds up to 350 mph and range close to 2000 miles – first realized the concept of long range naval fighter – combined with excellent manoeuvrability



Specs of A6M Zero

Capacity: 1 pilot

L x H (m): 9.06 x 3.05

Wingspan (m): 12.0

Weight (lbs) (Empty/Loaded): 3,704/5,313


Engine: 1 x Nakajima Sakae 12 radial engine, 950 hp

Max. Speed (mph): 331

Range (miles): 1,929

Ceiling (ft): 35,000

Weapons: 2 x 7.7 mm Type 97 light machine guns, 2 x 20 mm Type 99-1 cannon in the wings, 2 x 60 kg bombs




This is a Junkers aircraft as well as the engine here in the pusher it is actually in the front like a puller engine. This aircraft large extent I will put it here because it has its significant with respective Indian independence.

(Refer Slide Time:05:21)

Viscount

- Manufactured by Vickers-Amstrong – the first turboprop airliner
 - First flown in 1948, thus replacing the conventional piston engines
 - Initial design for 24 passenger – first prototype 32 passengers
- First aircraft to have a pressurized cabin and large panoramic windows
 - Type 630 – Also called as Viceroy (Lord Mountbatten) – India Independence
- Most successful and profitable first generation post-war transport aircraft
 - 445 Viscounts were built for different commercial airlines



Specs of Type 610

Capacity: 75 passengers + 2 pilots + cabin crew

L x H (m): 26.11 x 8.15

Wingspan (m): 28.56

Weight (lbs) (Empty/ Loaded): 41,276/67,500

Engine: Rolls-Royce Dart RDa.7/1 Mk 525 1990 hp

Max. Speed (mph): 310

Range (miles): 1380

Ceiling (ft): 25,000

In most of the independence pictures of India you actually can see this for the discount for the Vickers Armstrong of turboprop air carft (R.S.T= 05:19 – 05:20). This aircraft has lot of importance in the commercial aviation field. There some important factors is, it is the first turboprop aircraft. This is the first aircraft that is used as turboprop airliner to transport people from one location to another.

It was flown in 1948, and it replacing the conventional piston engines with the turboprop engine. It was initially design for 24 passengers later it grow it upto 32 passengers. In Indian independence actually see Lord Mountbatten getting out of this aircraft as the last viceroy of India. So, the three major aspects are created by aircraft. Three, four of the pressurized cabin. Early cabin of the aircraft are never use to be pressurized.

So when you are flying at the altitude first difference start hurting your ear top avoid that the aircraft cabin started to get pressurized and that was first achieved by the aircraft also most of the time that the all the aircraft you might have seen in the pictures no windows. This was the aircraft came with the large panoramic window which means we can also sit inside and see the external views which reduce the fatigue of transportation.

And so that way this aircraft to large extent paved the way for being starting the aviation industry where moving the people from one location to another by using an aircraft. This was very profitable and successful business aircraft and there were about 455 were built and they were heavily used by lot of commercial airlines.

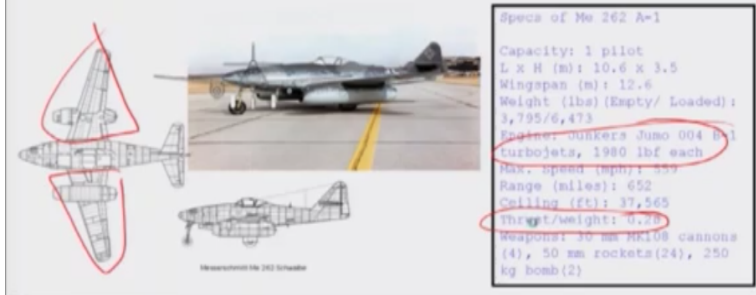
The world of era of commercial air transport originated with Viscount aircraft. We can see that different version are there the specs given here are the type 810 which upgraded all the 75 passengers. 75 passengers in 1948, was a big achievement for many aircraft plus 2 pilot in cabin Crew it has the wing span of 28.56 you can again handle your design. It is also aircraft were Rolls –Royce entered into the business of manufacturing aircraft engines.

So these were 1990 hp engine made by Rolls- Royce and it could fly at the altitude of 25,000 feet and that is the reason why cabin was pressurized to make the flight off people comfortable.

(Refer Slide Time:08:00)

Me 262 Schwalbe

- First operational jet powered fighter airplane – 1942 – German Luftwaffe (Air Force) – nicknamed swallow
 - Achieved operational status in 1944
 - First jet engine was built by Hans Joachim Ohain – 1936 – Germans realized potential
- After WW-II the design “influenced” F-86 Sabre and B-47 Stratojet
- If Hitler had not asked to convert the fighter to a bomber – WW-II result could have been something else



This aircraft Schwalbe Me 262 is an important aircraft because it is also the predecessor of a lot of the fighter aircrafts in the world. This is the first operational jet powered aircraft at this point we were talking about piston engines then turboprops. Now here is when we are introducing the concept of jet power or the jet engine was built by Ohain in 1936 and Germans were the first people to realize the potential of the jet engine and this was the aircraft where jet engine is integrated to it.

It achieved its operation status in 1944 and we can see that the nick name of the aircraft is called Swallow because this was designed as the fighter aircraft and if this aircraft really materialized the way it was people still say that the world war two result would have been something else. It was designed as a fighter but the Hitler wanted to convert into a bomber in the process he turned up it took more time to do the development.

But you should understand if you look at this aircraft have again handle your wings just as we show from the Junkers design and as well as it also had some very important characteristics it has the Junkers turboprop 1980 pound feet of. It could reach the speed of 550 plus mile per hour it could reach the altitude of 37,000 feet.

It actually first aircraft you can think of it having a thrust weight ratio because of the jet engine the first aircraft of the jet engine. The German air force landed up using this but by the time this

aircraft was ready the result of the world war two was something else. So there is lot of discussions happening on this aircraft by the way whatever is available were taken by the United states and to the large extent lot of the modern fighter where the jet aircrafts are still inspired by design of this particular aircraft.

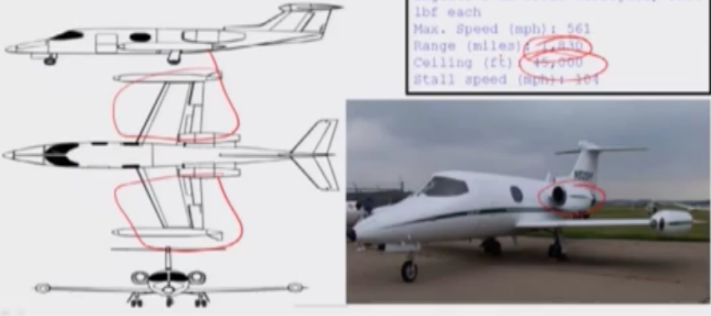
(Refer Slide Time:10:20)

Learjet 23

- Originating from the abandoned Swiss fighter program FFA P-16, William Powell Lear recognized the design potential and bought it
 - Started company in Wichita, Kansas
 - First model 23 in 1962 – total 104 built
- Started the market of fast and efficient business/corporate travel

Specs of Learjet 23

Capacity: 2 pilots + 6 passengers
L x H (m): 13.10 x 3.84
Wingspan (m): 10.84
Weight (lbs) (empty / Loaded):
6,150/12,499
Engine: 2 GE CJ610 turbojets, 2850
lbf each
Max. Speed (mph): 561
Range (miles): 1,800
Ceiling (ft): 45,000
Stall speed (mph): 101



The slide contains technical diagrams of the Learjet 23, including a top-down view, a side profile, and a front view. A photograph of the aircraft is also included. Red circles highlight the wing-mounted engines and the wingspan in both the diagrams and the photograph.

When we talk about all type of airplane we cannot really ignore the aircraft company Learjet and its products. The concept of business travel originated from Learjet this was the entrepreneur person who actually had William Powell Lear who understood the concept of large business corporations having executives business executives.

Who want to travel for one location to another quickly without getting tired and what he doing. He took abandoned Swiss fighter program FFAP – 16 and what he did is he took that design and then he built the business jet remember this was in 1962 which is the same place where it has been still getting built. You can see that it can carry two pilots, six passengers same again designer handle your wings which most of the air plane still follows.

This hours the engine built on the body so the engine on the body allows you to the engines are actually shielded by the wing in this regard. 10 meter 10 plus meter wing span and general electrics started providing wing engine for this stuff this aircraft. This started flying at the

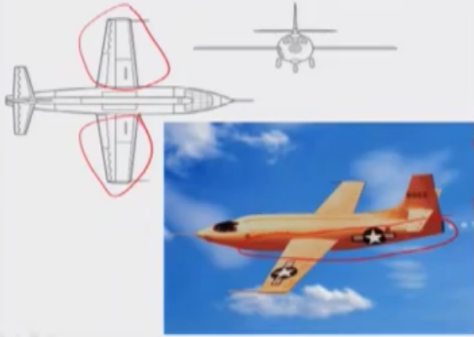
altitude of 45,000 feet. It also has the range of 1,830 miles and had a maximum speed of 560 mile per hour.

This created the world the particular business category called corporate travel using business jets. So Learjet 23 is the important aircraft in this life in the history of aviation.

(Refer Slide Time:12:12)

Bell X1

- First aircraft to fly faster than the speed of sound – controlled level flight
 - Part of the secret rocket planes (X planes) project of US Army & Air Force
 - Built in 1945 and reached 1000 mph in 1948
 - Produced by Bell Aircraft Company
- Though not mass produced, the flight data obtained from the flights gave the edge to all future aviation programs of USA



Capacity:	1 pilot
L x H (m):	9.4 x 3.3
Wingspan (m):	8.5
Weight (lbs) (Empty/ Loaded):	7,000/12,225
Engine:	Reaction Motors XLR-11-RM3 liquid fuel rocket
	6000 lbf per chamber
Max. Speed (mph):	957
Range (mins):	5
Ceiling (ft):	71,900
Thrust/weight:	0.49

We cannot really call this as an aircraft constraining the fact that when it does not actually take off from the ground. This aircraft was the first one to fly faster than the speed of sound Bell X 1. It is experimental aircraft so aircraft to be carried by the another aircraft to the sky and then dropped from the altitude and then it used to fly.

So what is the rocket engine I can see that the engine itself the rocket set in the bottom and when it reaches the point of time you let the aircraft go and the pilot takes the rocket and then you fly. The aim was to break the speed of sound so this is the first aircraft that was faster than sound to obtain the controlled level flight.

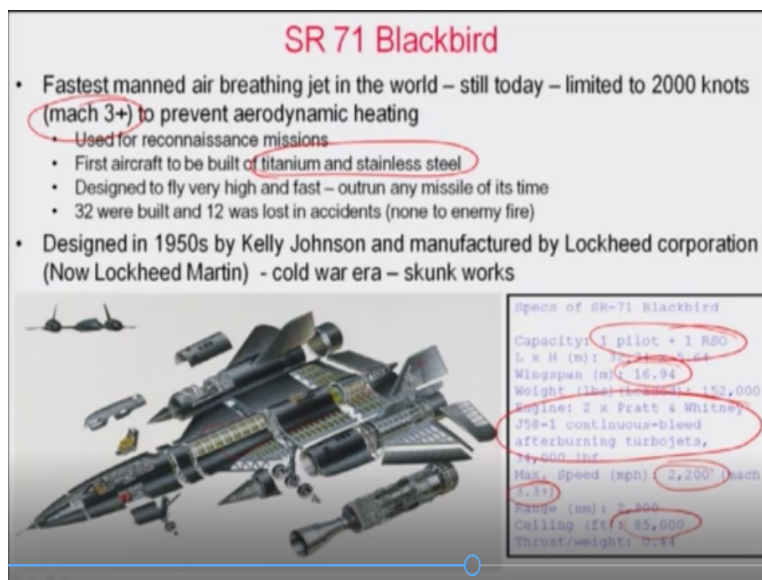
Remember this was built in 1945 it was able to do this break the speed of sound in 1948 it was done by Bell aircraft company and to the large extent the data obtained by this flight by the United States air force was one of the reason you it is still nasty whole the advantages super

-sonic aircraft. Lot of datas are available. You can see handle your design and it is not a turbo jet actually a rocket engine.

You can see that the reaction motor XLR liquid fuel rockets were used in the engine and you can see that the speed is up to 957 miles per hour more than the speed of sound and it could fly to the altitude of 71,000 feet and the range it was in the minutes 5 minutes so once the rocket is burned off it come land and recover the aircraft that was the idea.

So if anybody understands the concept of reaching the speed breaking the speed of sound it was initially achieved using rocket engine meter developed with the concept of after burning turbo jets and that's how we can break the speed of sound.

(Refer Slide Time:14:19)



SR 71 Blackbird

- Fastest manned air breathing jet in the world – still today – limited to 2000 knots (mach 3+) to prevent aerodynamic heating
- Used for reconnaissance missions
- First aircraft to be built of titanium and stainless steel
- Designed to fly very high and fast – outrun any missile of its time
- 32 were built and 12 was lost in accidents (none to enemy fire)
- Designed in 1950s by Kelly Johnson and manufactured by Lockheed corporation (Now Lockheed Martin) - cold war era – skunk works

Specs of SR-71 Blackbird

- Capacity: 1 pilot + 1 RSO
- L x H (m): 37.21 x 8.24
- Wingspan (m): 16.94
- Weight (lbs) (loaded): 132,000
- Engine: 2 x Pratt & Whitney J58-1 continuous-bleed afterburning turbojets, 15,000 lbr
- Max. Speed (mph): 2,200 (mach 3.3)
- Range (nm): 2,300
- Ceiling (ft): 85,000
- Thrust/weight: 0.44

This aircraft, it is a kind of tricky aircraft. This is not really a commercial aircraft needed as the passenger or anything like that but it is actually a aircraft that created the new world of observing from the altitude called survey lines. The field of survey lines actually came with two aircraft SR 71. This is still fastest than anything aircraft in the world. It can fly three times with the speed of sound mach 3 plus ok.

This is typically used for reconnaissance missions. Reconnaissance mission means human begins fly the aircraft over the planes and you look for information that patenting to security like enemy

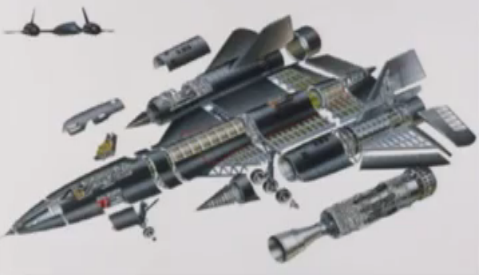
force movement and anything and from there you decide how do we compare that. It was also the first aircraft was to be built to this point we were talking about electric steel first we are talking about wood and cloth and e move to electric steel from electric steel we actually move to duralumin.

From duralumin we move to titanium and stainless steel because the speed it was going it was hard to actually many of the reading edge were they aircraft to be filled with built using titanium and stainless steel. This aircraft has to fly very high and fast it has no defense it has outer any missile available at that time. Remember this is actually built in 1950's so it is an old aircraft.

(Refer Slide Time:15:53)

SR 71 Blackbird

- Fastest manned air breathing jet in the world – still today – limited to 2000 knots (mach 3+) to prevent aerodynamic heating
 - Used for reconnaissance missions
 - First aircraft to be built of titanium and stainless steel
 - Designed to fly very high and fast – outrun any missile of its time
 - 32 were built and 12 was lost in accidents (none to enemy fire)
- Designed in 1950s by Kelly Johnson and manufactured by Lockheed corporation (Now Lockheed Martin) - cold war era – skunk works



Specs of SR-71 Blackbird	
Capacity:	1 pilot + 1 RSO
L x H (m):	32.74 x 5.64
Wingspan (m):	16.94
Weight (lbs) (Loaded):	152,000
Engine:	2 x Pratt & Whitney J58-1 continuous-bleed afterburning turbojets, 34,000 lbf
Max. Speed (mph):	2,200 (mach 3.3)
Range (nm):	2,900
Ceiling (ft):	85,000
Thrust/weight:	0.44

But still you know significant aircraft 32 aircraft were built and 12 lost none of them lost their missiles. All lost during landing and take off. You can see that the particular shape of the aircraft makes the most of the cumbersome aircraft to fly. It is a kind of a delta shaped aircraft. It has one pilot and one RSO. RSO is the person who actually do the surveillance operations handle the radar and all those things.

It had an 17 meter wings approximately and this aircraft was the first aircraft was Pratt Whitney a company developing high performance engine. To achieve very high speed flight. It could fly 3.3 times than speed of sound 2,200 mile per hour. It had an operating sealing of 85,000 feet from which is very very high and it has the range of 3000 nautical miles.

SR 71 though used for military purpose it was one of the very well guarded secrets of air force for some time. But this was the first aircraft to do the job of survey lines and reconnection operations were used the aircraft to observe an enemy countries.

(Refer Slide Time:17:24)

U2 Dragon Lady

- Highest flying single engine reconnaissance aircraft ever built – **over 70,000 feet**
 - Built by Lockheed corporation (Now Lockheed Martin) – operated for more **than 50 years**
- Designed and developed in 1950s by Lockheed corporation – cold war surveillance – USAF and CIA
- One was shot down in USSR by SAM

Specs of U2S Dragon Lady

Capacity: **1 pilot**

L x H (m): 19.3 x 4.88

Wingspan (m): **31.4**

Weight (lbs) (Empty/Loaded): 14,300/40,000

Engine: 1 x General Electric F118-101 turbofan, 19,000 lbf

Max. Speed (mph): **500**

Range (miles): **6,500**

Ceiling (ft): **70,000**

Flight endurance (hours): 12

U-2 MODULAR PAYLOAD ARRANGEMENT

G-BAY PAYLOAD

Another aircraft similarly what we call it as U 2 Dragon Lady. It is the single engine that is the distinction of this aircraft is the highest flying single engine reconnaissance aircraft ever built the previous one S R 71 had a turbo jet engine in that. But this is the single engine aircraft it could fly above 70,000 feet. It was built by Lockheed corporation actually called as Lockheed martin.

It is built in 1950 during the cold war time and UASF and CIA were using it to observe Russia, Russian nuclear missiles specifically. There was one aircraft that was shot down by Russians using the surfaced air missile. You read that time history you see almost created another world war because United States demand the aircraft and Russians denied the whole thing.

Any way if you look at this is, this is operated by one pilot and you can see that 31.4 meter wing span this is pretty big wings long wings in generate electric power it has single engine turbo fan with this aircraft and also it has the range of about 6,500 miles 70,000 and it can fly up to endurance of 12 hours. So this was the aircraft that assure the world the concept of long term long duration survey lines 12 S R 71 could fly for few hours which could actually.

Do half a missions so long duration survey lines was introduced by U 2 Dragon Lady.

(Refer Slide Time:19:06)

Boeing B-52

- Largest bomber aircraft ever built – operated by USAF & NASA – developed during cold war era – military strike aircraft role
 - Range greater than 10,000 miles
 - Ceiling greater than 50,000 feet
 - Bomb payload of 70,000 lbs
 - Longest operational history – 50 years+
- First aircraft to have eight engines
 - Carry a large payload of nuclear bombs
 - Have LITENING advanced targeting system
 - Sniper advanced targeting pod

Specs of B-52 Stratofortress

Capacity: 5 (pilot, copilot, radar navigator, navigator, electronic warfare officer)

L x H (m): 48.5 x 12.4

Wingspan (m): 56.4

Weight (lbs Empty/Loaded): 185,000 / 488,000

Engines: 8 x Pratt & Whitney TF33-P3-103 turbofans, 17,000 lbf each


Max. speed (mph): 650

Range (miles): 10,115

Ceiling (ft): 50,000

Thrust/weight: 0.31

Armament: 1 x 20 mm M61 Vulcan cannon, total 70,000 lbs of bombs



Similarly another aircraft this picture. Itself is many of this know about this aircraft form the Vietnam war got this distinction one of the largest bombers ever built but also this is one of the largest aircraft longest operational aircraft in the world as well. So it is a very good design very well thoughtful design as long as bomber aircraft ever built. It also has longest operation history still operating more than 50 years old.

This aircraft have 5 people to operate it one pilot, co pilot and radar officer and electronic war office and also navigational indicator. You can see that this aircraft can carry a huge amount of pay load. The empty weight of aircraft is 185,000 pounds and then fully loaded weight is 488,000 pounds which is approximately three times the weight and this is also the only aircraft which actually carry eight engines in it. So each one of this set with two engines.

(Refer Slide Time:20:21)

Boeing B-52

- Largest bomber aircraft ever built – operated by USAF & NASA – developed during cold war era – military strike aircraft role
 - Range greater than 10,000 miles
 - Ceiling greater than 50,000 feet
 - Bomb payload of 70,000 lbs
 - Longest operational history – 50 years+
- First aircraft to have eight engines
 - Carry a large payload of nuclear bombs
 - Have LITENING advanced targeting system
 - Sniper advanced targeting pod

Specs of B-52 Stratofortress

Capacity: 5 (pilot, copilot, radar navigator, navigator, electronic warfare officer)

L x H (m): 48.5 x 12.4

Wingspan (m): 56.4

Weight (lb/empty/Loaded): 185,000/198,000

Engines: 8 x Pratt & Whitney TF33-P3-103 turbofans, 17,000 lbf each

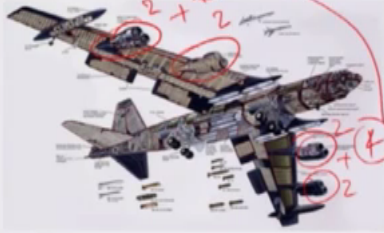

Max. Speed (mph): 650

Range (miles): 10,145

Ceiling (ft): 50,000

Thrust/weight: 0.31

Armament: 1 x 20 mm M61 Vulcan cannon, total 70,000 lbs of bombs

This is 2 plus 2 this is 2 engines this 2 engines 2 plus 2 , 4 engines in one side. Similarly this 2 this is 2 plus 2 then 4 engines in this side altogether 8 engines.is actually available with this aircraft and has sealing 50,000 feet and it has the range of 10,000 miles. You can see that it has bomb payload of 70,000 Ibs huge amount of bombs you can see how much it can actually carry the payload it can carry.

So it also came up with few more other things it was also the aircrafts which is actually came with the targeting system for dropping bombs now many people use that laser to designate the target but this was the first aircraft to introduce this concept into the world of warfare other than the significant as the air force based of bomber this aircraft also is one of the oldest longest operational history 50 years more than that.

That in itself shows the beauty of the design and how well thought through this aircraft was. We also know since we are in the large size aircraft lets also talk about C 17 Globemaster which is also military aircraft it is also largest transport aircraft, one of the largest aircraft. It is a strategic operational aircraft which means actually it is not a tactical it is large range aircraft.

It is built by McDonnell Douglas in some point of time and now it is his boy is doing that, this boy is bought up by McDonnell Douglas is called C – 17 Globemaster if you look at it is actually big aircraft 51.75 per wing span again handle your wing two engines these are turbo fans and two


candle wings you can see that high T tail available with this aircraft it has 4 patterned Whitney turbo fans at 44,000 pounds lbs.

It can fly 0.74 times the speed of sound 515 mile per hour it has the operation ceiling of 45,000 feet range up to 6000 miles and maximum wing loading 150 pounds per square feet. This aircraft also has one unique feature because it is built in for military conditions when you go and land in enemies scenario you might not have any apparatus to push you back this aircraft is capable of going backwards on its own power, So this is the first aircraft that can reverse by itself.

(Refer Slide Time:21:20)

McDonnell Douglas C-17 Globemaster

- Large military transport aircraft – strategic operations – largest in the US defense
- Now manufactured by Boeing – designed as STOL strategic airlifter, which involves troops and cargo – also do airdrop duties
- Thrust reversers that can be used in flight to rapidly slow down the aircraft during airdrop duties – first of its kind – can reverse the aircraft (no need to TUG)
- Runway requirement of 3500 feet only
- Used to ferry US presidential motorcade



Specs of C-17 Globemaster III

Crew:	2 pilots and 1 loadmaster
L x H (m):	53 x 16.8
Wingspan (m):	51.75
Weight (lbs) (Empty/Loaded):	282,500 / 585,000
Engine:	4 x Pratt & Whitney F117-PW-100 turbofans, 40,440 lbf each
Max. Speed (mph):	515 (Mach 0.74)
Range (miles):	2,875 - 6,000
Ceiling (ft):	45,000
Thrust/weight:	0.77
Max. Wing Loading:	150 lb/ft ²

It does not require a special equipment to move from one place to another or back it up. It allows to reverse by itself by its own engine power it also can take off from the short runway STOL because of landing 3500 feet very very short operation for the size and also this is you can that this is used for move troops and cargo it is called as strategic air filter so moving large amount of cargo and everything from one location to another.

C – 17 Globemaster plays an important role in the desert storm operation where the troops moved from united States all the way to Iraq during the first Gulf war. So that's when the importance of this large scale strategic air lift was emphasized.

(Refer Slide Time:23:44)

Lockheed Martin C-130 Hercules

- Four engine turboprop military transport aircraft – designed by Lockheed for USAF, now Lockheed Martin – is a tactical airlifter – also an aerial gunship (AC-130), search & rescue, airborne assault, aerial refueling, firefighting, etc.
- Capable of using unprepared runways for takeoff and landing – more than 2300 in service with different defense forces in the world
- Mechanism to change the blade pitch angle of propeller to assist in landing and takeoff – provides the effect of thrust reverser



Specs of C-130 Hercules	
Crew:	5 (two pilots, navigator, flight engineer and loadmaster)
L x H (m):	29.8 x 11.6
Wingspan (m):	40.4
Weight (lbs) (Empty/Loaded):	75,800 /155,000
Engine:	4 x Allison T56-A-15 turboprops, 4,590 hp each
Max. speed (mph):	330
Range (miles):	2,350
Ceiling (ft):	31,000
Takeoff distance (ft):	3,586

You also talk about another one which is (R.S.T = 23:45 – 23:46). India recently acquired from United States. This is also one important aircraft Lockheed Martin C – 130 Hercules it is not a turbo jet is a turbo prop that is using propellers it has 4 engine aircraft but the turbo prop. It is again a pretty bigger craft 40.4 meter wing span not as big as C -17 but it is big enough.

This is actually find as a tactical air lifter the other C 17 is the strategic air lifter. Tactical is short duration operation is not meant for long duration operation. It is used in the typically transport, search and rescue when the Nepal earthquake happened lot of the supply from India Nepal was taken from this aircraft. It is also used for airborne assault, aerial gunship. It is also used for refueling other aircraft for the flight.

And it is also used in fighting 4 S fires big time in US and Canada and many other countries also used that. It can take off unprepared in one way. Not even required a concrete or paved runway to do this and reason services different forces including India across the world. This is the large number 2300 of them across different part of the world itself says versatility of this aircraft.




This aircraft also was the first one to come up with the changing the blade pitch angle in transport aircraft to assist landing and take off by allowing this it can actually reverse by it can also work as thrust reverse by itself so it can back off by its own power also you can see that it has 4 engines 4 allison, T 56 A 15, turbopropa, 4600 hp each. It does not fly that height but it is

33,000 feet altitude and also it is capable flying it about 2,360 miles in range which why it is also called as a tactical airlifter

(Refer Slide Time:25:54)

Antonov An-225 Mriya

- Largest airplane in the world – heaviest aircraft in the world
- Originally designed to transport the Buran Space Shuttle of USSR – only one built so far - **UR-82060** is the tail number
- Maximum takeoff weight of **640 tonnes** is unmatched still



Crew:	6
L x H (m):	84 x 18.1
Wingspan (m):	88.4
Weight (kg) (Empty/Loaded):	285,000 / 640,000
Engine:	6 x TMK Progress D-18
turbofans,	51,600 lb thrust each
Max. Speed (mph):	528 (Mach 0.74)
Range (miles):	9,500
Ceiling (ft):	36,000
Thrust/weight:	0.234
Max. Wing Loading:	135.8 lb/ft ²

And One more so we will be wondering what is the Russians were doing at the same time. This is another aircraft which is actually the heaviest largest airplane in the world that is only one available now because that is two are being built but only one in operation .

The UR 82060 aircraft The tail UR 82060 that is the tail number. You can see that it has 6 engines literally, but all these are turbofans. The wing span 88.4 meters is the largest in its kind. It is also the heaviest one because you can see that it has 640,000 pounds when fully loaded and each aircraft engine provide 51,000 pound feet of thrust and it can fly 0.74 times speed of sound or 528 mile per hour.

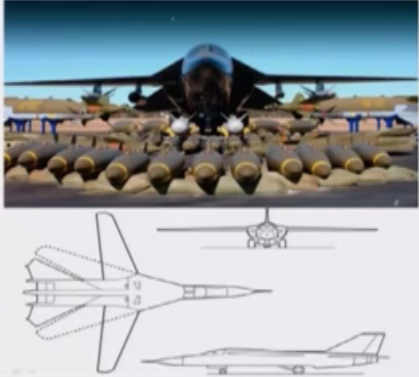
It has the range of about 10,000 miles and 9500 miles fly it in the altitude of 3600 feet and as well as the wing loading is 135.8 pounds per square feet which very similar to what the C 17 Globemaster is. It is also another strategic airlifter but the trick in the aircraft is, is the one that is available in the world not the multiple use was never built. This all aircraft has the very unique design of under carriage you can also see that how the under carriage was looks as the wings of the trim.

It is originally design to transport the plane shuttle of USSR which actually at the top of the aircraft. But never realized now there is one that is used 640 tonnes capability being flown. I think out of UK An 225 Mriya is the aircraft.

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F-111 Aardvark

- Pioneered major technologies in military aviation – manufactured by General Dynamics – First flight was in 1964
 - First production aircraft to have variable-sweep wings
 - First aircraft to introduce afterburning turbofan engines
 - First aircraft to introduce TFR (Terrain Following Radar)



Role:	Interceptor & Bomber
Capacity:	1 pilot + 1 WSO
L x H (m):	22.4 x 5.22
Wingspan (m):	19.2 (spread) / 9.75 (swept)
Weight (lbs) (Empty/ Loaded):	47,200/82,800
Engine:	2 x Pratt & Whitney TF30-F-100 turbofans, 17,900 lbf/25,100 lbf each
Max. Speed (mph):	1,650
Range (miles):	1,330
Ceiling (ft):	66,000
Thrust/weight:	0.61
Weapons:	1 x 20 mm M61 Gatling cannon, 9 x hard points to carry different bombs

We will stop here. Thank you.