AEROTERN INTERNSHIP REPORT

(29/11/2021 - 03/01/2021)

Submitted by: V. SRIRAM (19101043)

IN PARTIAL FULFILLMENT OF THE AWARD OF THE DEGREE OF

B. TECH IN AERONAUTICAL ENGINEERING WITH HONORS IN DESIGN (THIRD YEAR)

FROM

HINDUSTAN INSTITUTE OF TECHNOLOGY AND SCIENCE

I HAVE COMPLETED THIS INTERNSHIP UNDER THE SUPERVISION OF

Mr. DHANUSH KR

PROJECT DEVELOPMENT ENGINEER

ZIEGLER AEROSPACE KONDAPUR, HYDERABAD, INDIA

Offer Letter

Working with Ziegler Aerospace is an opportunity, not an obligation. Being part of this journey is earned every day by every team member.

ZIEGLER AEROSPACE

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Internship offer letter

REF: ZA / INTERN / HYD / NOV21 / 1930 Date: 26-11-2021

Mr. Sriram V,
Hindustan Institute of Technology and Science,

We would like to congratulate you on being shortlisted for the Fall Internship with Ziegler Aerospace. Your internship is scheduled for a period of 5 weeks Full-time, scheduled from 29th November 2021 to 03rd January 2022.

You need to report to our Engineering office (3rd Floor, Ravi Enclave, Kothaguda near Aparna Towers, Kondapur, Hyderabad, and Telangana 500084) during this period as per guidance from Reporting Manager.

During the internship, you would be assigned tasks that improve your understandings of the concepts you learned in college and therefore you would be expected to put your best efforts in executing the assignments given to you. Your major responsibilities include in this program, Acquire Aviation Skills & experience.

As you will be gaining industrial Experience & Knowledge from this program and you will be not paid during the program. During your internship, you will have an access to company's clients and confidential information. You agree that you will keep all this information strictly confidential and will not share it with anyone outside the company.

Congratulations and Welcome to Ziegler Aerospace Family!!

I hope that your association with the company will be successful and rewarding. Please indicate your acceptance of this offer by signing below.

Sincerely / Acceptance
I accept the terms of Internship set forth in this offer and will begin on 29th November 2021.

Full Name: Sriram.V
Date: 26th November,2021
Signature: V. Sriram

Arpana Sanker
Arpana Sanker
Authorised Signatory
For Ziegler Aerospace Private Limited

"CC": Head of HR (UK) / Engineering (IND) / Legal (UK)

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ACKNOWLEDGEMENT

First and foremost, I would like to thank **Mr. Naresh S Solipur**, CEO of Ziegler Aerospace for Initiating the Aeroterns Program - A unique Internship program for Aeronautical Engineering Students. I would like to **Ms. Arpana Sanker**, Executive Director of Ziegler Aerospace for giving me the opportunity to do an internship within the organization.

I am highly indebted to **Mr Dhanush K** for the facilities provided and constructive criticism to accomplish this internship.

I would like to thank **Ms. Sini, Ms. Aayushi** and **Mr. Sarath Kumar** for their support and advices during the period of the internship at their organisation.

I am extremely great full to my college **Hindustan Institute of Technology and Science** and friends who directly/indirectly helped me in successful completion of this internship.

I also would like all the people that worked along with me at Ziegler Aerospace with their patience and openness they created an enjoyable working environment.

INTERNSHIP DESCRIPTION

Internships are generally thought of to be reserved for college students looking to gain experience in a particular field. However, a wide array of people can benefit from Training Internships in order to receive real world experience and develop their skills.

My internship at Ziegler Aerospace is one of its kind training program that gives engineering students exposure to realtime Airline Design and Layout of Passenger Accomdation projects and also gain the work experience.I underwent the internship program for a period of 5 weeks (29/11/2021 to 31/12/2021) under the supervision of Mr.Dhanush KR.The internship was also a part of my curriculum for my B.Tech Aeronautical Engineering degree with honours in Design at Hindustan Institute of Technology and Science,Chennai.

This is my very 1st Internship and this experience is totally new and I have learnt many new things.I alredy knew the basics of 3D designing and Drafting.Ziegler Aerospace has helped me improve my designing skills and present my deigns and drawings in a professional way.

ZIEGLER AEROSPACE

Ziegler Aerospace is an ingenious Aerospace company offering a unique range of Engineering Services to cater for the needs of Airlines, MRO's & EASA, FAA and CAA & GCAA organizations. ZA Strength revolves around a knowledgeable, professional and highly experienced team that has the capability to produce a full suite (design and plan, produce and install, maintain, repair and certify) of multi-disciplined Minor and Major (STC) aircraft modifications (interiors, avionics, structures). On schedule and cost-effective implementation and certification of customer Modifications and projects according to the EASA, FAA and CAA & GCAA regulations**.**

Ziegler Aerospace is a truly Global Aerospace Company, operating under the EASA Part 21 framework and headquartered in the United Kingdom. Our experienced Engineering Team is engaged in the design and certification of Structural and Cabin Interiors repairs and modifications for all types of Large Aircraft.

With the Aircraft Design and Engineering capabilities, ZA solves complex aircraft modification and certification challenges for aircraft manufacturers, suppliers, airlines, and aviation authorities all over the world. Based upon the extensive experience and using the structured and multi-disciplinary systems engineering approach

WEEK 1

CODE OF CONDUCT AND NON-DISCLOSURE AGREEMENT

The Non-Disclosure Agreement is a contract by which one or more parties agree not to disclose confidential information that they have shared with each other as a necessary part of doing business together.

AVIATION MARKET

The aviation market is divided into 3 parts:

Before market: It includes all the processes that occurs before the aircraft enters the market for sale. It starts from a concept and it continues till the idea is certified and mass production is started.

Market/Use: It includes of the buyer and the seller which is mainly the airlines and the company

Aftermarket: It includes all the process that is followed after the sale of an aircraft. It is almost like a secondary supply of spare parts and also includes the following services

- MRO (Maintenance, Repair and Overhaul)
- Customization
- Modification

Use of airplane other than passenger aviation are: Military for surveillance and stealth, for research of new technologies like zero emission engines and for useful purposes like spraying water or fertilizers over vast areas. It is also used for entertainment purposes like Airshow and Sporting events.

BEFORE MARKET

The various stages that go in the before market for a product are as follows:

1. **Concept:** An idea or a plan which is the core for developing the product is found out. Further research and scientific basis are collected and are worked on to fit the new product.
2. **Development:** The idea is further enhanced and the required research is carried out before the production and testing
3. **Prototype production:** A prototype is a look-alike or a copy of a part that demonstrates the product features and explores all possibilities before investing money in mass production of the product.
4. **Testing:** Testing phase involves various tests or statutory requirements for which the product is tested. If the product is successful, it moves on to the next step. If it does not pass, necessary amendments/changes are made and they are tested again. This process is repeated until the product passes all the required tests.
5. **Certification:** After testing, if the product meets all the required parameters, it is certified under a governing body which determines the tests. Some of the regulatory bodies are listed below

WEEK 1

Name of the Organization	Area of Governance
Federal Aviation Administration (FAA)	USA
Civil Aviation Authority (CAA)	UK
International Civil Aviation Organization (ICAO)	Across the globe
European Aviation Safety Agency (EASA)	Europe
Joint Aviation Authorities	Part of EASA responsible for Technical Publications and other documents
Directorate General of Civil Aviation (DGCA)	India
Japan Civil Aviation Bureau (JCAB)	Japan
Civil Aviation Administration of China	China

6. Series Production: Once the product passes all the tests and requirements and it is certified, it is moved into the production unit for mass production. It is manufactured in parts and assem bled in the same location or can be shipped to another location for final assembly. Once the assembly is done, it is ready to be sold at the market.
7. Use: After the sale of the product, it is then put to the use for which it was produced
8. Support: Even after the product is sold, further support is provided in the form of maintenance and replacement of parts that require constant timely replacement. For example: Brake shoe in aircraft landing gear.

Refurbishing Process of an Aircraft:

1. Design Phase: The company and the customer hold a brief discussion and decide on the personalized design, powerplant, color scheme and the custom interiors.
2. Firewall Forward Phase: The engine is removed and sent for an Overhaul. Other components like engine mount, exhaust systems and vacuum pump are replaced before the engine is fitted back.
3. Airframe Phase: The aircraft structures are tested following the standard testing procedures and the defects are fixed. All the bolts and rivets are tightened or sometimes replaced.
4. Paint Phase: All the exterior features like the fuselage and control surfaces are repainted with new colors based on the customer requirements.
5. Avionics Phase: Based on the customers requirements the front panel and the aircraft instruments are other upgraded or it is replaced or reset.

6. Interior Phase: Finally, the interiors like the carpet and the seats are either repaired and replaced or a new set of seats are fixed based on requirements.

Cabin interiors also includes various types of markings which is essential for the passengers and as well as the engineers for easy identification. There are various types of markings on an aircraft

Markings on an airplane

- **Placards:**It is instructions printed on a pastic board and pasted onto the aircraft
- **Decals:**They are engraved intructions,used at places of high temperature,where plastic melts
- **Stencils:** They are cutouts that are used to paint a specific shape on a airplane
- **Livery:** It refers to the external paint/design on the aircraft which is done according to the customer requirements

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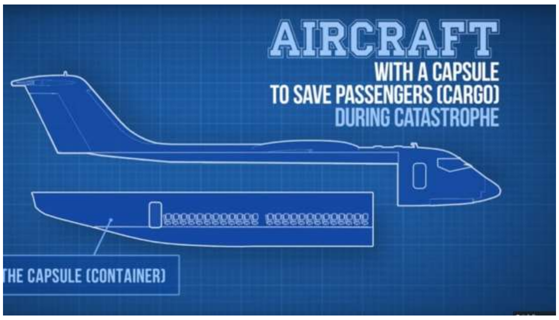
What happens to Decommissioned Aircraft: After they are retired, they are sent to a storage area called as the aircraft boneyard. They maintain the aircraft in operational status waiting for buyers. Eventually they are dismantled and useful parts are extracted and the remaining parts are sent to recycle.

Case Study-Turn the Tide on Plastic Livery

Hi Fly, a charter airline based in Portugal. To raise awareness against plastic floating in the world's oceans, the airline cooperated with a Portuguese boat with the same name as the livery. The boat competed in the Volvo Ocean Race in 2017-2018, finishing 5th in the competition. The airline painted the aircraft differently in each side. On the dark blue side, the ocean is portrayed as polluted and dirty. The other side is a clean and plastic-free ocean, painted in a lighter shade of blue. Both the airline and the boat are raising awareness on a very important issue. Plastic pollution in oceans has already had a lot of negative impact on the wildlife that roams the waters of the Earth. Fortunately, you can still see this plane flying around the world. Though the airline has no regularly scheduled flights, as it operates charter services.

WEEK 1

Case Study: Passenger Capsule Aircraft



This is a conceptual idea of a Ukrainian flight inventor. This one has a cabin that detaches from the cockpit when the flight goes belly-up. The idea is at times of emergency, the cabin is detached from the plane at the command of the pilot and it lands safely on the ground with a set of safety par achutes attached to it. The cabin also has attached inflatable tubes in case of emergency landing on water. The idea is still a concept due to the expected structural weakness due to a lot of joints between the detachable cabin and the main body. Also, the concept may not be successful unless and until it is a flat terrain or it is a water landing. Also, the cabin capsule is at danger if the parachutes does not deploy on time. The pilots would be stranded in the main body which is not preferable as there would be no one to safely guide and land the passenger module.

AIRCRAFT CHECKS

A Checks

The A check is performed approximately every 400-600 flight hours, or every 200–300 flights, depending on aircraft type. A check maintenance is typically done at a hangar and can take a minimum of 10 working hours depending on the services needed. Sometimes, this maintenance is done overnight as to not interrupt the schedule that airlines keep. The maintenance work during A checks often covers:

- general inspections of the interior and the aircraft hull for evidence of damage, deformation, corrosion, missing parts
- service, engine, and function checks
- Checking emergency lights
- Lubricating nose gear retract actuator
- Checking parking brake accumulator pressure

B Checks

B check is performed every 6-8 months. It takes about 160-180 labor hours, depending on the aircraft, and can be completed within 1–3 days at an airport hangar.
Typical work completed during B checks are tasks such as:

- checking alignment and torquing of the nose landing gear spotlight
- inspecting the wheel well hydraulic tubing for condition, corrosion, and fluid leakage.

C Checks

C and D checks typically fall under "heavy maintenance," and are much more extensive than the B check. The C check requires an aviation maintenance technician to perform a deep inspection of a

majority of the aircraft's parts. Also, the C maintenance check can often take the aircraft out of service for 1–2 weeks.
C check is done every 2 years. This type of check often requires an aircraft to stay at a maintenance facility for the necessary space/tools/maintenance technician working hours/materials. Up to 6,000 maintenance hours are typically needed for C checks.
Aviation maintenance technicians will perform certain tasks during C checks, such as:

- examination of structures (load-bearing components on the fuselage and wings) and functions for corrosion and damage
- checking the operation of the DC bus tie control unit
- in-depth lubrication of all fittings and cables

D Checks
Lastly, the so-called "heavy maintenance visit" occurs every 6-10 years depending on the aircraft. D checks are comprehensive inspections and repairs of the entire aircraft and can mean taking apart the aircraft to inspect for damage and corrosion. The process can take upwards of 30,000 to 50,000 labour hours over a period of four to six weeks.
With the entire aircraft stripped down and equipment removed, airlines often decide to refurbish aircrafts' interiors and upgrade them altogether during D checks.

Non-Destructive Testing

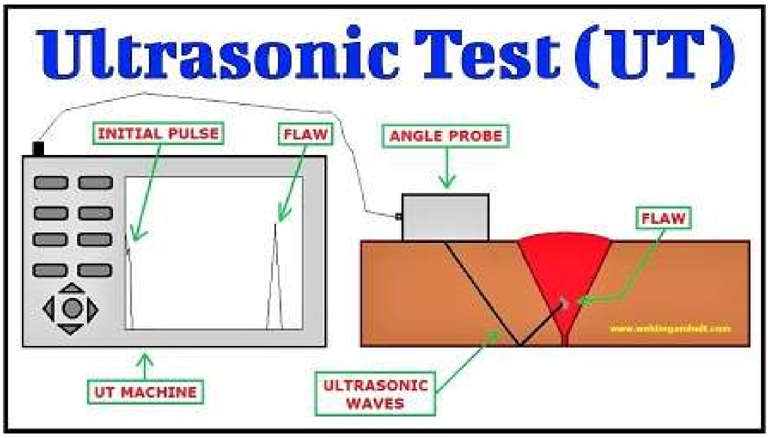
Testing methods that do not compromise the structural integrity of the parts being tested are called **non-destructive tests (NDT)**. NDT employs various inspection techniques to evaluate the components, individually or collectively. It uses different principles in scientific fields (physics, chemistry, and mathematics) to test the components.

NDT can also be referred to as non-destructive evaluation/examination (NDE) or non-destructive inspection (NDI). The distinct advantage of NDT is the reusability of the tested components. On top of that, non-destructive testing can often be employed on components that are still in operation. Devices and testing equipment used to conduct most methods of NDT are compact and portable. This makes it easier to test components in a working machine.

Below, we discuss the most common NDT methods that have a broader application.

1) Visual inspections
Visual inspection is by far the simplest non-destructive testing method. It is often classified as a part of routine maintenance work. Maintenance professionals use it on a daily basis to check for common signs of wear and tear. Depending on its application, it may or may not be conducted while the machine is in operation. In scenarios where direct access to the test object is not available, robots and drones fitted with cameras can be used to perform visual inspections remotely.

2) Ultrasonic testing



Ultrasonic testing is based on the principle of propagation and reflection of high-frequency sound waves. It can be used for flaw detection/evaluation, dimensional measurements, material characterization, and more. Testing is performed with an ultrasonic receiver and transmitter. Ultrasonic soundwaves are transmitted through the tested material. The sound propagates through the component and reflects off the rigid surface placed at the opposite end of the transmitter. The time required to transmit and receive the sound waves is measured. The variance in the time at different sections of the component can be used to identify the defects in the material. Mechanical components that operate with heavy workloads are regularly tested with ultrasonic testing.

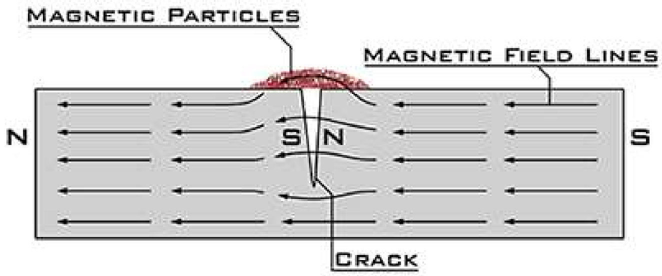
3) Vibration analysis

Vibration a n alysis is a commonly used method to monitor the condition of rotating components in operation. The underlying principle of vibration analysis is that different materials have different vibration signatures.

Aside from a vibration meter device, there are different types of sensors that can be installed to measure vibrations. They are designed to measure displacement, velocity and acceleration, misalignments, looseness, and similar faults that rotating equipment can experience.

Vibration analysis, like every other technique we are discussing here, provides valuable data that is used for condition monitoring and predictive maintenance.

4) Magnetic particle testing



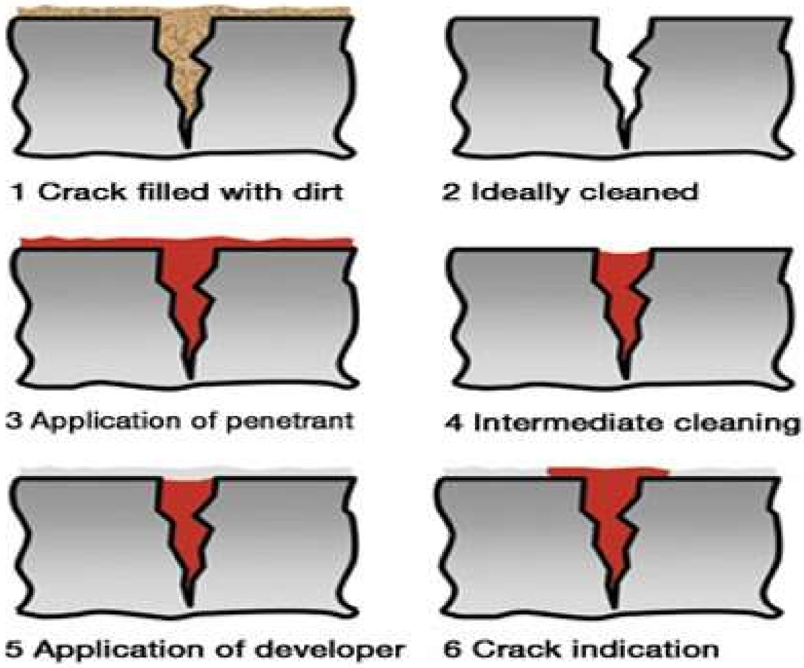
Magnetic particle testing is used to detect near-surface defects in ferromagnetic materials. The test piece is kept between the two poles of an electromagnet and a suspension of magnetic particles is poured over the test piece. This testing method is based on the effect of a magnetic field on ferromagnetic materials.

The defects on the surface of the material will be highlighted as the magnetic particles cluster near defects and cracks. For better visibility, ultraviolet light is used to observe defects.

This method may be used for the inspection of items such as:

- internal and external surfaces of boiler and pressure vessels
- components subjected to fire damage

5) Penetrant testing



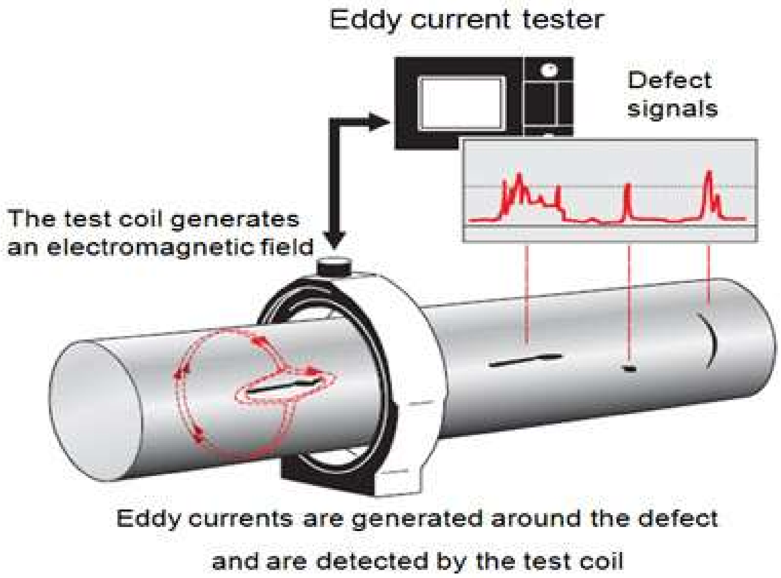
Penetrant testing can be used where magnetic particle testing is not feasible. A clean work surface is required to conduct penetrant testing.

During a penetrant inspection, a liquid dye penetrant is sprayed over the area to be tested and left untouched in the open air. The time required to leave the penetrant to work (a.k.a. dwell time) on the surface could be anywhere from 10 minutes to an hour. It depends on the characteristics of the tested material.

The liquid penetrant is removed from the work surface with a dry lint-free cloth. A light application of developer liquid is sprayed over the tested work surface. If there are defects on the tested surface, the liquid dye will be brought to the surface after the developer liquid is applied.

Liquid penetrant testing is commonly employed to test welded surfaces and works on the principle of capillary action.

6) Eddy current testing



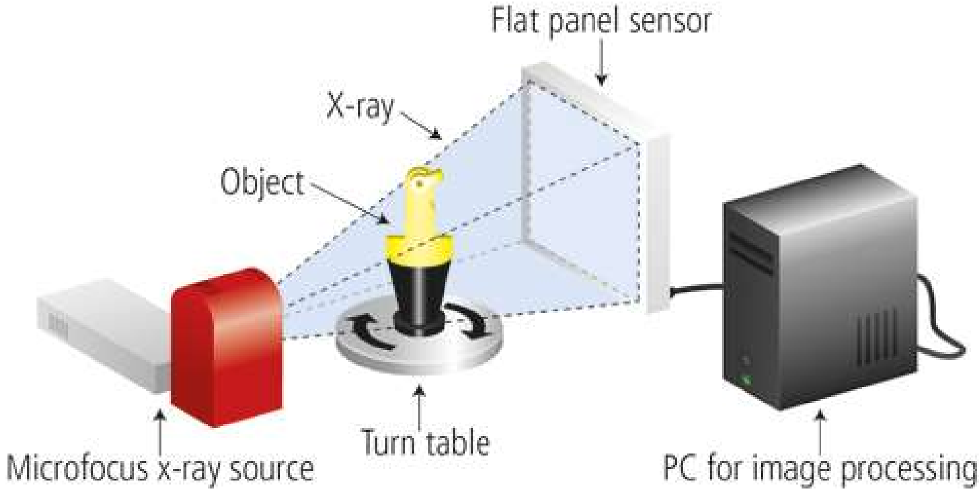
Eddy current testing is a common NDT technique used in both manual and automated testing scenarios. It is based on the principle of electromagnetic induction.

When electric voltage is applied across a coil, it generates a strong magnetic field. When metal is introduced inside the coil, the magnetic field fluctuates and the current flowing through the circuit increases. This is due to the eddy current flow inside the metal.

When there is a defect or cavity in the material, the current consumption increases. The eddy current has to travel a longer distance – increasing the resistance that manifests as increased current consumption. The variance in current consumption across different cross-sections of the material can be used to identify the location and the dimensions of the defect.

This type of non-destructive examination is performed with eddy current testing equipment, which can include electromagnetic probes, current flaw detectors, ECT conductivity meters, and other accessories. These tools are used to perform different types of electromagnetic inspections, such as surface scanning, subsurface inspection, weld inspection, fastener hole inspection, tube inspection, heat treatment verification, and metal grade sorting.

7) X-ray inspe ction and industrial computed tomography



X-rays and other tomography techniques are widely used in the medical field. However, some of the same techniques are also used in industrial applications as a part of non-destructive testing.

X-rays and CT scans can be used in industrial radiography to see the detailed images of the tested material. X-rays are passed through the components and the image can be imprinted on film or viewed in real-time using a computer.

Computed tomography technology can also color-coded the various objects according to the composite metals or the cavities present. X-rays can be sent from different angles on the test object to gain images with higher details. X-ray testing and computed tomography fall under the broader category of radiographic testing, where different types of ionizing radiation can be used.

DIFFERENCE IN DESIGN OF AIRBUS AND BOEING AIRCRAFTS

The best ways to spot the difference between an A320 and a B737 is by looking at the nose, engines and wing tips.

NOSE

The A320 has a much more rounded nose which isn't very long. The nose on the B737 is somewhat longer making it look a bit sleeker.

ENGINES

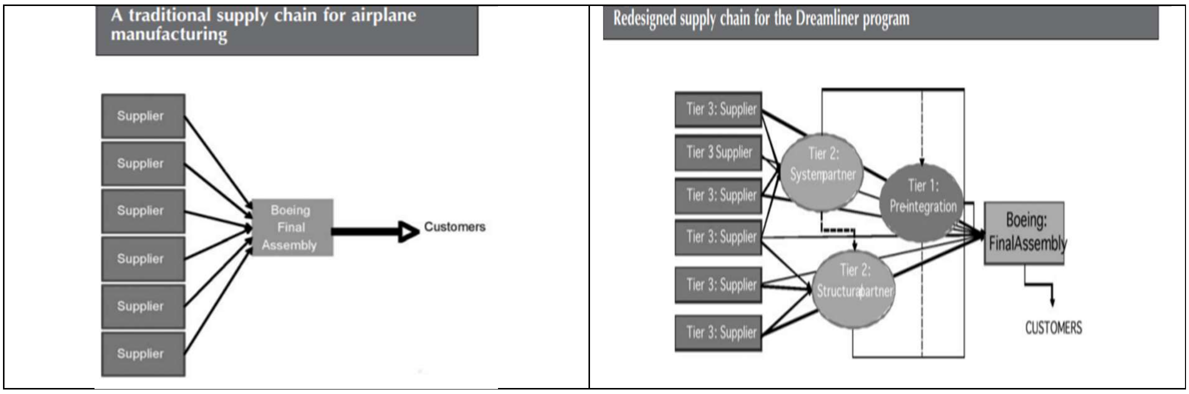
The A320 engines look larger and are symmetrically rounded when viewed from the front. The B737 engines appear a bit smaller and have a ‘flatter’ spot on the bottom of the engines when looking at them head on. This is because the B737 sits lower to the ground than the taller A320, meaning its engines are also closer to the ground. This flat area on the bottom of the engine helps to protect against a ‘pod strike’ where the engines could make contact with the ground on take-off or landing due to inadvertent roll.

WINGTIPS

Both Airbus and Boeing use wingtip devices which reduce drag and increase fuel efficiency. The B737NG and older Airbus’s are easy to tell apart as one uses wing fences and the other uses winglets. However, b oth al so use Winglets (Boeing) and Sharklets (Airbus) which look very similar and are difficult to tell apart.

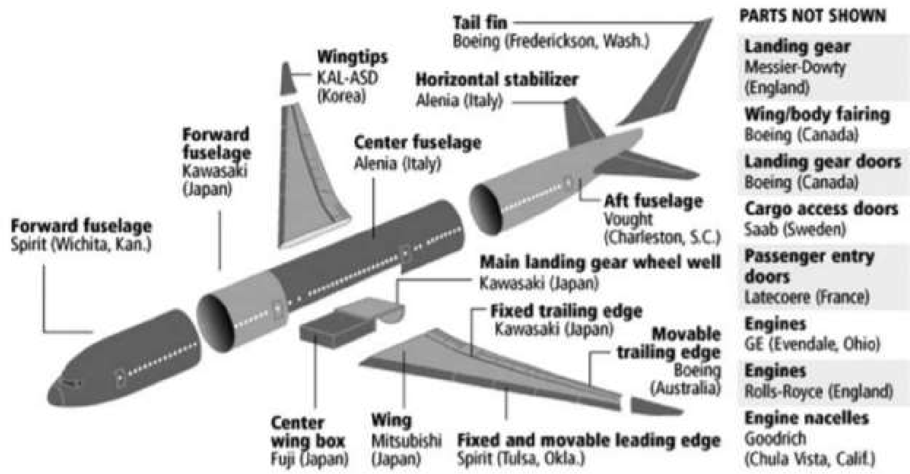
Challenges in Supply chain management of Boeing 787 Dreamliner

To reduce the 787's development time from six to four years and development cost from $10 to $6 billion, Boeing decided to develop and produce the Dreamliner by using an unconventional supply chain new to the aircraft manufacturing industry. The 787's supply chain was envisioned to keep manufacturing and assembly costs low, while spreading the financial risks of development to Boeing's suppliers. Unlike the 737's supply chain, which requires Boeing to play the traditional role of a key manufacturer who assembles different parts and subsystems produced by thousands of suppliers, the 787's supply chain is based on a tiered structure that would allow Boeing to foster partnerships with approximately 50 tier-1 strategic partners. These strategic partners serve as "integrators" who assemble different parts and subsystems produced by tier-2 suppliers. The 787-supply chain depicted resembles Toyota's supply chain, which has enabled Toyota to develop new cars with shorter development cycle times



By outsourcing 70% of the development and production activities under the 787 program, Boeing can shorten the development time by leveraging suppliers' ability to develop different parts at the same time. Also, Boeing may be able to reduce the development cost of the 787 by exploiting suppliers' expertise. As Boeing outsourced more, communication and coordination between Boeing and its suppliers became critical for managing the progress of the 787 development program. To facilitate the coordination and collaboration among suppliers and Boeing, Boeing implemented a web-based tool called Exostar that is intended to gain supply chain visibility, improve control and integration of critical business processes, and reduce development time and cost Manufacturing Business Technology, 2007).

Dreamliner subassembly plan *(Source:,www.Boeing.com)*



The Dreamliner's supply chain risks: Although the 787 supply chain has great potential for reducing development time and cost, there are various underlying supply chain risks. As described in Sodhi and Tang (2009 a), there are many types of supply chain risks ranging from technology to process risks, from demand to supply risks, and from IT system to labour risks. In this section, we shall present some of the risks and actual ev ents that caused major delays in the Dreamliner's development program. The 787 Dreamliner involves the use of various unproven technologies. Boeing encountered the following technical problems that led to a series of delays.

- **Composite Fuselage Safety Issues:** The Dreamliner contains 50% composite material (carbon fibre reinforced plastic), 15% aluminium, and 12% titanium. The composite material has never been used on this scale and many fear that creating an airplane with this mixture of materials is not feasible. Also, lightning strikes are a safety concern for wings made out of this composite material because a lightning bolt would potentially travel through the wing-skin fasteners
- **Engine Interchangeability Issues:** One of the key benefits of the 787's modular design concept was to allow airlines to use two different types of engines (Rolls-Royce and GE)

interchangeably. Due to recent technical difficulties and part incongruity, it would take 15 days to change engines from one model to the other instead of the intended 24 hours

- **Computer Network Security Issues:** The current configuration of electronics on the Dreamliner puts passenger electronic entertainment on the same computer network as the flight control system. This raises a security concern for terrorist attacks
- **Supply Risks:** Boeing is relying on its tier-1 global strategic partners to develop and build entire sections of the Dreamliner that are based on unproven technology. Any break in the supply chain can cause significant delays of the overall production. In early September 2007, Boeing announced a delay in the planned first flight of the Dreamliner citing ongoing challenges including parts shortages and remaining software and systems integration activities. Even using Exostar, a web-based planning system, to coordinate the supplier development activities, coordination is only possible when accurate and timely information is provided by different suppliers. For example, one of the tier-1 suppliers, Vought, hired Advanced Integration Technology (AIT) as a tier-2 supplier to serve as a system integrator without informing Boeing. AIT is supposed to coordinate with other tier-2 and tier-3 suppliers for Vought. Additionally, due to cultural differences, some tier-2 or tier-3 suppliers do not often enter accurate and timely information into the Exostar system. As a result, various tier-1 suppliers and Boeing were not aware of the delay problems in a timely fashion, which makes it difficult for Boeing to respond to these problems quickly.
- **Process Risks:** The underlying design of the 787 supply chain is likely to cause major delays because its efficiency depends on the synchronized just-in-time deliveries of all major sections from Boeing's tier-1 strategic partners. If the delivery of a section is delayed, the delivery schedule of the whole aircraft is delayed. Unless Boeing keeps some safety stocks of different complete sections, it is likely that Boeing will face late delivery. Also, under the risk sharing contract, none of the strategic partners will get paid until the first completed plane is certified for flight.
- **Management Risks:** As Boeing used an unconventional supply chain structure to develop and build its Dreamliner, it is essential for Boeing to assemble a leadership team that includes some members who have a proven supply chain management record with expertise to prevent and anticipate certain risks as well as to develop contingency plans to mitigate the impact of different types of risks. However, Boeing's original leadership team for the 787 program did not include memb ers with expertise on supply chain risk management. Without the requisite skills to manage an unconventional supply chain, Boeing was undertaking a huge managerial risk in uncharted waters.
- **Labour Risks:** As Boeing increased its outsourcing effort, Boeing workers became concerned about their job security. Their concerns resulted in a strike by more than 25,000 Boeing employees
- **Demand Risks:** As Boeing announced a series of delays, some customers lost their confidence in Boeing's aircraft development capability. In addition, there is a growing concern about the fact that the first 787s are overweight by about 8%, or 2.2 metric tons, which can lead to a 15% reduction in range of flight.

Supply Chain of Airbus A380

Tier 1 suppliers: A380 components are provided by suppliers from around the world; the four largest contributors, by value, are Rolls-Royce, Safran, United Technologies and General Electric. Thales and Diehl Aerospace were the main suppliers of the Avionics

Each A380 is made up of 4-million individual parts, but the plane itself is assembled in six sections that are built at five different plants around Europe and then transported by land, sea and air to a final assembly line in Toulouse. The other massive sections of the world's largest passenger plane are brought by sea, aboard specially designed Airbus vessels. Every A380 has 4.5-million individual parts, and because the plane is so big, it needs to be built in four pre-fabricated sections, which are then all shipped or flown to the A380 Final Assembly Line (FAL) at Airbus' Jean-Luc Lagardere plant. It is a facility built for this express purpose at Toulouse-Blagnac Airport in southern France.

It's also the site of the Airbus corporate HQ and flight test department, and where single-aisle A320s and wide-body A330 and A350s are built.

Arnaud Cazeneuve, oversize surface transportation manager for Airbus, tells CNN that he doesn't see a mega airliner of 4-million parts when he looks at an A380, he sees just six parts. "One A380, to me, is six components — three fuselage sections, two wings, and the horizontal tailplane," he says. The FAL in Toulouse is essentially a giant, highly sophisticated do-it-yourself plane assembly kit, with the six major components all coming in by sea, except for the vertical tailfin, which is flown to Toulouse aboard one of Airbus' specially designed Beluga air freighters. The other massive sections of the world's largest passenger plane are brought by sea, aboard specially designed Airbus vessels, to Pauillac, where Airbus has its own dock, where parts can be rolled off and, on the vessels, aboard custom-made trailers.The six components come from five Airbus plants around Europe, each of which it itself getting supplies for parts from 1,500 companies from 30 countries around the world.The A380's wings are built in Broughton, Wales, while the fuselage sections come from Hamburg, Germany and Saint-Nazaire, France. The horizontal tailplane is made in Cadiz, Spain; and the vertical tail fin is also manufactured in Hamburg.Airbus has a fleet of three custom-designed breakbulk vessels for transporting airplane parts by sea, while five Beluga's are used to fly sections around Europe.The roll-on, roll-off — or ro-ro — ships carry the six completed A380 sections from Airbus facilities in Wales, Germany, France, Italy and Spain, with no cranes or direct handling needed as the sections are grafted onto a transport jig at the plant where it is produced.In Pauillac the six sections are unloaded, and then moved to one of two barges for the next stage of the trip up river to Toulouse. Both barges make four return trips over eight days on the Garonne River, carrying the sections to Langon, 240-kilometres from the FAL in Toulouse.

In Langon, the sections are transferred to specially designed trailers for the overland part of the trip. It takes two full days to cover the distance, because the convoy of A380 parts can only be moved at night, when they'll cause the least disruption.

The 240-kilometre route is closed in sections throughout each of the two nights, as the convoy is too wide to allow any other traffic. A calendar showing the planned convoy dates is made available to local residents, and they're warned three days before each convoy via roadside display boards. Once it reaches to the FAL in Toulouse, the sections are brought together on a giant assembly line.

WEEK 2

HAZMAT

Governing Body: The United Nations Economic and Social Council issues the *UN Recommendations on the Transport of Dangerous Goods*, which form the basis for most regional, national, and international regulatory schemes. For instance, the International Civil Aviation Organization has developed dangerous goods regulations for air transport of hazardous materials that are based upon the UN model but modified to accommodate unique aspects of air transport. Individual airline and governmental requirements are incorporated with this by the International Air Transport Association to produce the widely used IATA *Dangerous Goods Regulations* (DGR).

Colour codes for Hazmat:

COLOUR CODE	MEANING	EXAMPLE
 ORANGE	Explosive Materials	dynamite, ammunition, or fireworks.
 RED	Flammable	gasoline, rubbing alcohol, paint, or acetone.

WEEK 2

 GREEN	Non-Flammable	compressed or liquefied gases.
 YELLOW	Oxidizers	oxidizers — like ammonium nitrate, potassium nitrate, or nitric acid — that are likely to combust when mixed with oxygen.
 WHITE	Poisonous and Bio-Hazards	dyes, aerosols, acids, and medical waste
 BLUE	Flammable when exposed to water	sodium, calcium, and potassium

WEEK 2

 HALF RED AND HALF WHITE	Flammable when exposed to air	aluminum and lithium alkyls or white phosphorous
 RED AND WHITE STRIPES	Flammable solids	matches and magnesium
 HALF RED AND HALF YELLOW	Flammable organic peroxides	methyl ethyl ketone peroxide and benzoyl peroxide
 HALF YELLOW AND HALF WHITE	Radioactive	Medical Equipment

 HALF WHITE AND HALF BLACK	Corrosive	batteries, hydrochloric acid, sulfuric acid, and sodium hydroxide
 WHITE AND BLACK STRIPES	Various non-classified dangerous goods	asbestos and dry ice

PLACARD PRINTERS

Some of the commercially available printers are as follows

SafetyPro Label Printer
SafetyPro is the name in dependable industrial label printing. Fast, crisp labels right from your PC! Available only with ribbon and tape orders. [More Info]

SafetyPro Plus 9G Label Printer
Wide format label and sign printing. Create 8in wide signs with ease, right from your PC! Available only with ribbon and tape orders. [More Info]

SafetyPro 300 Label Printer
High resolution label printer for extra-fine detail in printing. Suitable for product certification listing printing. Available only with ribbon and tape orders. [More Info]

Thermal Transfer Types of Label Printers

Thermal transfer (TT) types of label printers are the industry’s choice for high-quality, long-lasting labels.TT printers can range from low cost, entry-level desktop modelsThermal transfer printers utilize ink ribbons made of wax, resin, or a blend of wax and resin. It’s important to match the label material with the right ribbon to get the best print quality and durability so all of our labels come with ribbon recommendations.TT printers use lower heat settings than most other variable print technologies. This allows for the widest choice of facestock & adhesive options including paper, plastic, polyester, etc.

Direct Thermal Printers

- Direct thermal (DT) printers are much like thermal transfer printers, but do not require an ink ribbon. Instead, labels that pass through this type of printer have a special layer of chemicals beneath the label surface that are heat-activated to create printed images.

Laser Printers

- Laser and inkjet labels are ideal for utilizing your standard sheet-fed home or office printer. This makes label printing easy and inexpensive.
- Laser or inkjet labels sold in sheets are generally more economical and an excellent choice for on-site, on-demand printing.
- The durability of laser labels can vary from general indoor applications to wet or cold temperature applications.
- Laser sheets use dry toner – either in black only or full color that gives you the flexibility to add graphics and color coding. Print durability is quite good, even in UV light exposure, but laser labels are not recommended for rigorous chemical exposure.
- Inkjet label use a cartridge system of wet ink and generally have limited durability.

WEEK 2

DIFFE RENT MATERIALS USED FOR PLACARDS IN LAMINATION AND PRINTING

PRINTING:

Poly Carbonated Films - Lexan FR65

Polymeric Cast Vinyl Film -3M

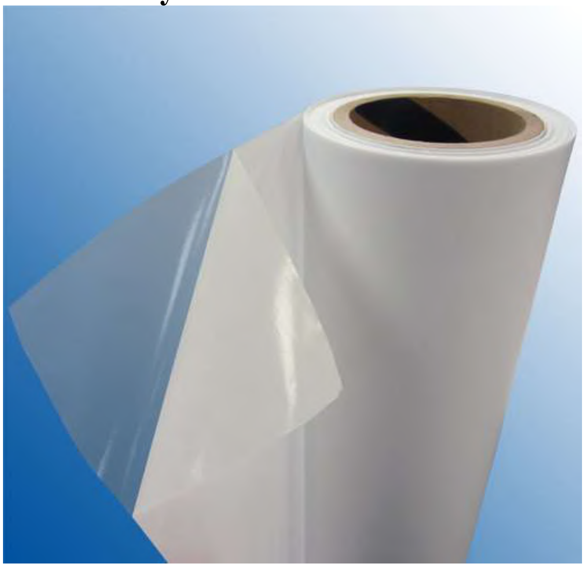
WEEK 2

LAMINATION:

Polyvinyl fluoride film

WEEK 2

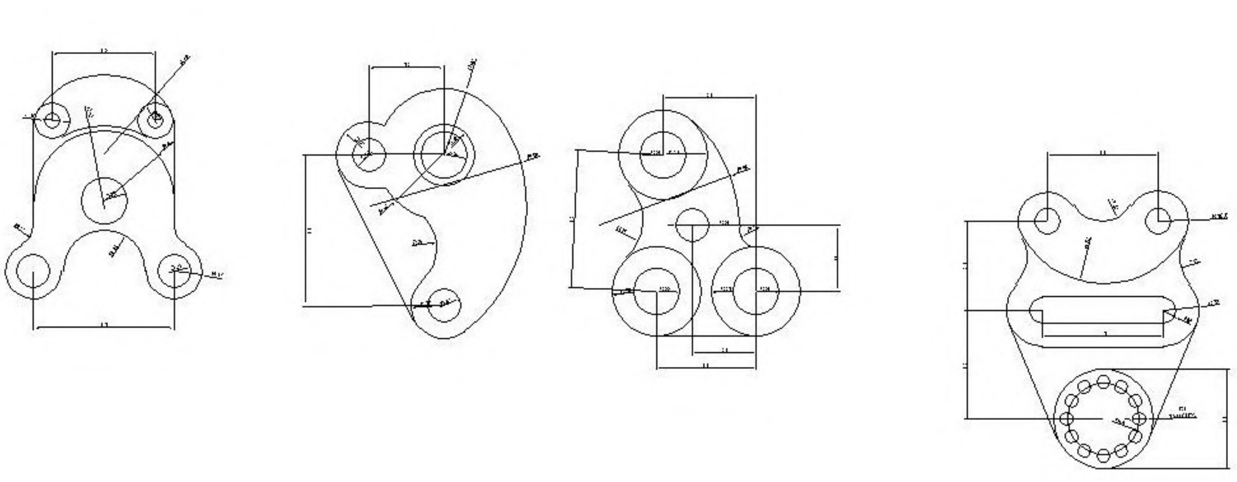
Vinyl over laminated film



AUTOCAD:

AutoCAD is a commercial computer-aided design (CAD) and drafting software application. Developed and marketed by Autodesk. We did a few drawings using the AutoCAD software to learn basics tools and draw the designs efficiently. Some of the designs are attached below:

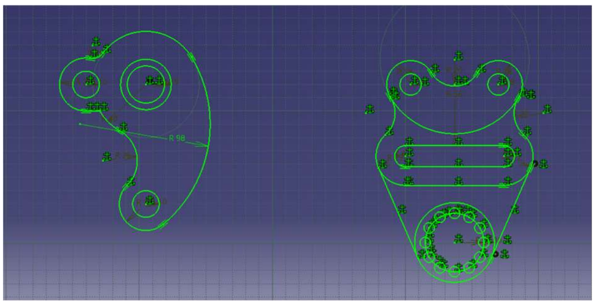
WEEK 2



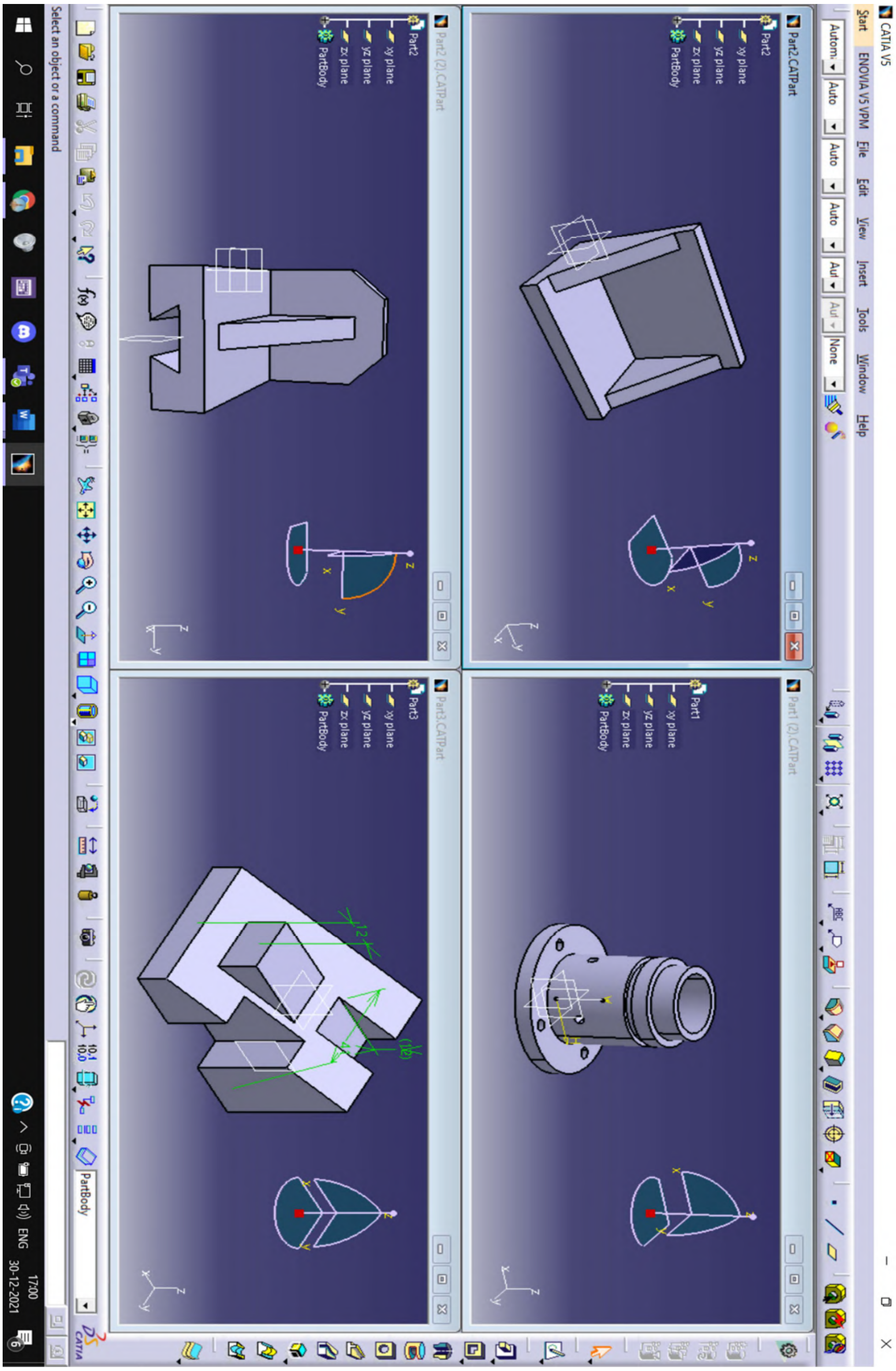
CATIA

CATIA (an acronym of computer-aided three-dimensional interactive application) is a multi-platform software suite for computer-aided design (CAD), computer-aided manufacturing (CAM), computer-aided engineering (CAE), 3D modeling and Product lifecycle management (PLM), developed by the French company Dassault Systems. Since it supports multiple stages of product development from conceptualization, design and engineering to manufacturing, it is considered a CAx-software and is sometimes referred to as a 3D Product Lifecycle Management software suite.

It is one of the leading and widely used 3D design software. We also did a few trial models in this software.



WEEK 2



CATIA V5
Start
ENOVIA V5 VPM
File
Edit
View
Insert
Tools
Window
Help
Part2.CATPart
Part1 (2).CATPart
Part2 (2).CATPart
Part3.CATPart
xy plane
yz plane
zx plane
PartBody
Select an object or a command

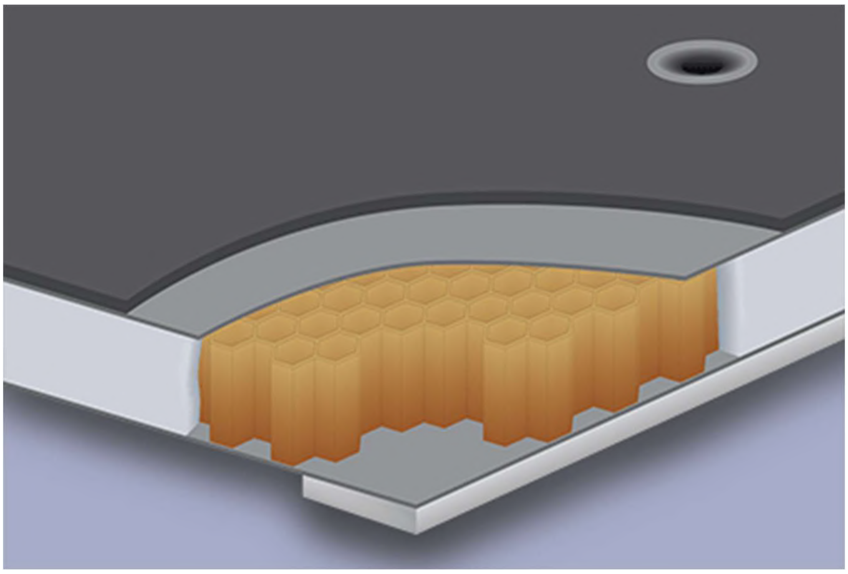
WEEK 2

INSERTS AND RIVETS

INSERTS: Known as a floor panel insert, it is primarily used to secure the floor panel. It's a temporary type that may be replaced, thus it's attached with an adhesive like epoxy. It's a sturdy, long-lasting fastener that can withstand loads and reduces shear stress on the floor panel.

RIVETS: It's for long-term joints that can't be replaced. It's used in the wings and fuselage of planes. Aluminum and stainless steel are used to construct it. Rivets are heavier and more expensive than inserts, but they are also significantly stronger.

FLOOR PANELS: I discovered that floor panels are useful for more than just providing a smooth surface to walk on. They are an integral part of the aircraft structure, which means they contribute to the aircraft's overall safety during regular operations, emergency landings, and fast decompression events. Modern panels may also feature extra functionality that improves cabin layout flexibility and conductivity. Floor panels, also known as floor boards, are attached to the aircraft's floor beams to provide a walking surface for people aboard as well as attachment points for various furnishings and other equipment. They must be robust and rigid enough to operate as a supporting framework; durable enough to sustain repeated usage; light enough to help keep aircraft weight low; and, in certain situations, adaptable enough to accommodate a range of cabin designs.
Design Template: Every design must be presented for certification and it must be submitted in a design template. The design template carries all the information about the part, its identification number, its dimensions, the number of modifications done to it and the Name of the design and certifying organizations



WEEK 2

Project 1: Airbus A320 Floor Panel Design in AutoCAD

With the contents I learnt in the basics of AutoCAD, I was able to successfully replicate a real A320 floor panel with the respective layers and was able to Plot it in a real design template. All the designs were verified by my mentor and was saved.

WEEK 3

INTRODUCTION TO LOPA

The acronym LOPA stands for "Location of Passenger Accommodations," which is an engineering schematic of an aircraft's interior design. The LOPA is an engineering schematic of the aircraft's cabin interior that shows where passenger and flight attendant seats, emergency equipment, exits, restrooms, and galleys are located, among other things. It is the document that validates the interior components and installation and guides the reviewer through the interior design/layout.

PROJECT 2: EMBRAER (E-170) LOPA IN AutoCAD

In AutoCAD, I created the LOPA E-170 design. My mentor examined my LOPA once I finished it. Because the job was confidential, it was completed in AutoCAD on the Ziegler Aerospace server.

FINAL PROJECT:DISCUSSION AND BRAINSTROMING

Mr. Dhanush, my project mentor, provided me with a full summary of the final project. He also handed me project guidelines and demanded that we prototype the A-320 aircraft and 3D print it.The Airbus A320 family are narrow-body airliners developed and produced by Airbus.

So, we started off planning with the base dimensions and the timeline of the project. We decided that we finish the complete 3D model in Autodesk Fusion 360 as it is easy to collaborate and work due to the availability of Cloud computing and storage.

We then started planning and deciding the dimensions of the aircraft and we were able to obtain it from various online sources. We consolidated all the information into a single document which was accessible by everyone in the team for reference.

The next step was to plan on how we are going to design, print and assemble the model. For the ease of assembly and design, the whole aircraft was split into six components namely:

1)Wings
2)Empennage
3)Fuselage
4)Cabin interiors and LOPA
5)Landing gear
6)Engine

I took the responsibility of designing the Engine along with Aamir Hamza and the Final integration of the whole model along with Srihari

FINAL DIMENSIONS

Fuselage:

Horizontal length - 37.57 (m)
Width (Fuselage) (Top view) - 3.95 (m)
Width (Fuselage) (Side view) (height) - 4.14 (m)
Width (Two extreme wings) - 34.10 (m)
Width (Two extreme sharklet (winglets)) - 12.45 (m)
Distance from front tire to the nose cone - 5.07 (m)
Engine from the fuselage - 5.755 (m)

Wing:

Symmetrical airfoil is used.
NACA0012 Wing span - 33.91 (m)
Taper ratio - 0.240
Root chord - 6.4 (m)
Tip chord - 1.49 (m)

Vertical Tail:

Symmetrical airfoil is used.
NACA009 Height - 6.26 (m)
Chord length - 2400 (mm)
Taper ratio - 0.303
Tail arm - 12.53 (m)

Horizontal Tail:

Symmetrical airfoil is used.
NACA009 Span - 12.45 (m)
Taper ratio - 0.256
Tail arm - 13.53 (m)
Root chord - 3200 (mm)
Tip chord - 1100 (mm)

Engine (pod):

Length (side view) - 4.44 (m)
Max. Width (front view) - 2.37 (m)
Max. Pod thickness - 0.462 (m)
Width in front - 2.2 (m)
Fan diameter - 1.73 (m)

WEEK 3

Inner exhaust diameter - 20 (cm)
Outer exhaust diameter - 100 (cm)

Cabin:

Length (top view) - 35 (m)
Length (front view) (more like breadth) - 3594.1 (mm)
Height (front view) - 3.7 (m)
Cabin wall thickness - 0.41(m).

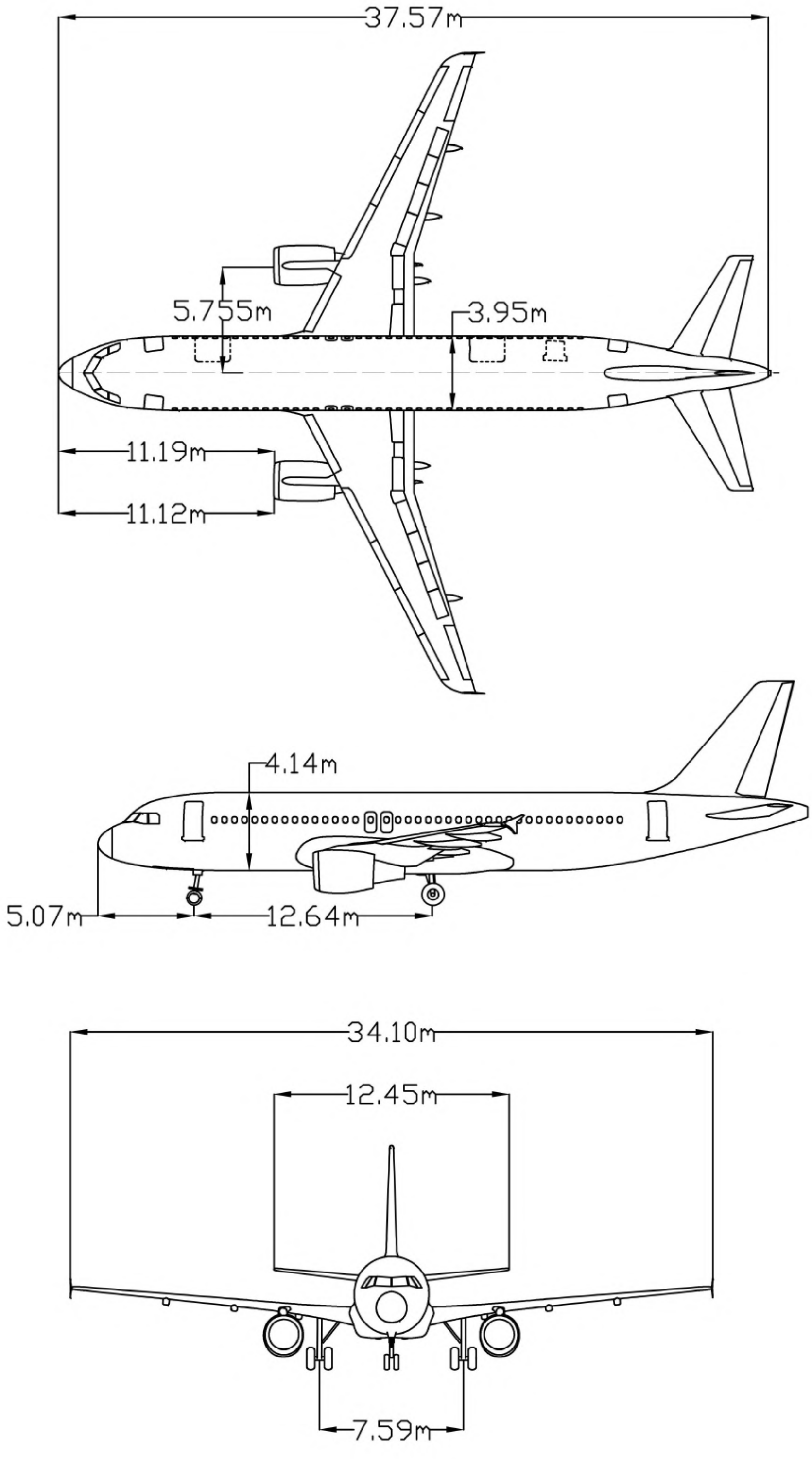
Seat:

Seat width - 18 (inch) - 457.2 (mm)
Pitch - 31 (inch) - 787.4 (mm)
Under seat dim - 18 x 16 x 11 (inch) - 457.2 x 406.4 x 279.4 (mm)

Landing gear:

Distance between front and rear tire - 12.64 (m) - 12640 (mm) It is from the center of the front tire to the center of the rear tire.
Diameter of the wheel - 1.143 (m)
Width of the wheel - 0.406 (m)

WEEK 3

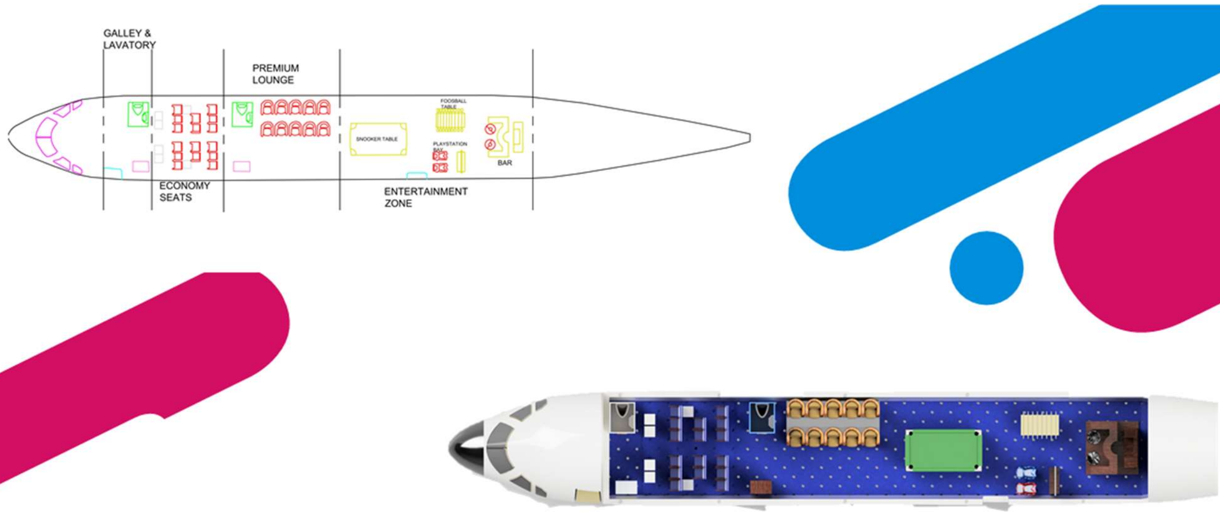

37.57m
5.755m
3.95m
11.19m
11.12m
4.14m
5.07m
12.64m
34.10m
12.45m
7.59m

WEEK 4 & 5

MODIFIFATIONS AND CUSTOMIZATION

LANDING GEAR: The landing gear was simplified into a simple shaft and wheel for the ease of 3D printing and assembly

CABIN INTERIORS: The cabin interiors were modified to be like a private jet that can carry up to 10 passengers with amenities like foosball table, snooker table, a private Bar and a PlayStation Bay. It also has 16 economy seats and 10 premium sofa seats.

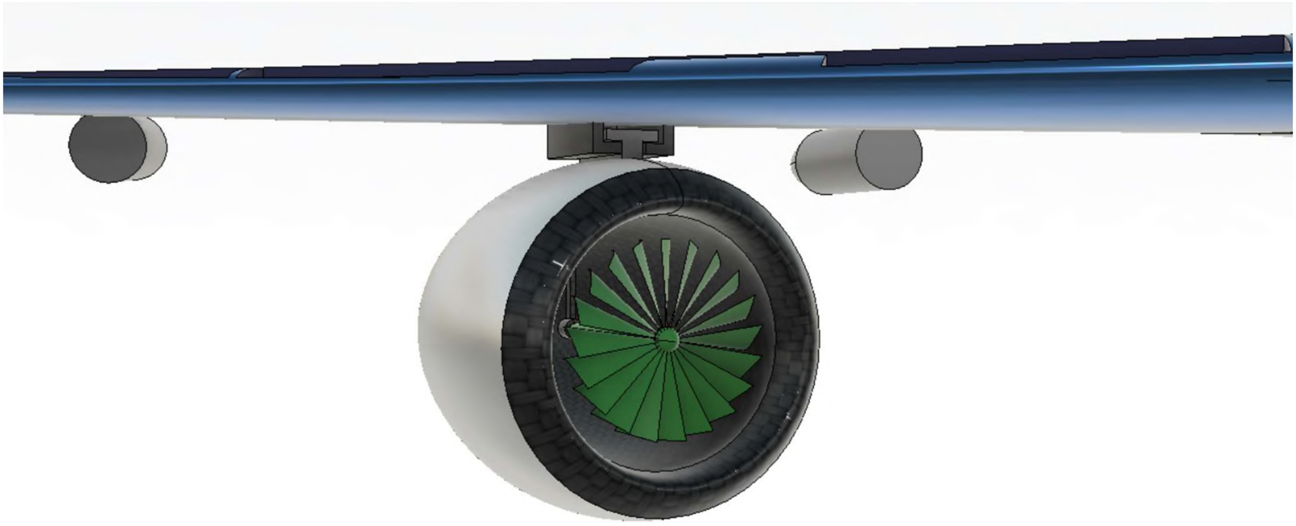


Layout of Passenger Accommodation(LOPA)

WEEK 4 & 5

MY ROLE IN THE PROJECT

I took the responsibility of designing the engine. The engine is the powerhouse of the whole aircraft and is thus one important part to be represented in a prototype. The Turbine blades was designed by my co-intern and was shared with me over cloud. I designed the outer casing of the engine and figured out a way to attach it to the wing during assembly. I used a slider joint using a T section and double L section.



My next task was to make the individual components assembled into a single aircraft. I imported all the components into a single project file and stated giving relations between them using the JOINT command. I created a slot in the shape of airfoil on the fuselage where the wing is to be inserted and I attached the engine to the wing and also assembled the horizontal and vertical stabilizers. Furthermore, the, LOPA assembly was took over by my co-interns.

WEEK 4 & 5

FINAL MODEL

3D PRINTING THE PROTOTYPE

The production of a three-dimensional object from a CAD model or a digital 3D model is known as 3D printing or additive manufacturing. The phrase "3D printing" can refer to a number of procedures in which material is deposited, connected, or solidified under computer control to build a three-dimensional item, with materials (such as plastics) being added layer by layer. Ender-3 3D Printer Creality Ender-3 3D Printer was the 3D printer used by Ziegler Aerospace. The best 3d printer for beginners is an open-source 3d printer with exceptional printing precision and a low price. My CATIA design file was converted to a .stl file. The slicer software was used to turn the .stl file into a GCode file, which the 3D printer could read and begin printing with. The 3D printer setup was explained briefly to us by our mentors. The material used for our model in 3D printer was PLA (Poly lactic acid).

CONCLUSION

In this project we worked on the prototyping and modification of the Airbus A320 aircraft. We first designed the original Airbus A320 design and then started designing the modifications. We also scaled down my model to a certain length so it is desirable for the 3D printer. The designing took one week to complete. As this was my first project of proto-typing a whole aircraft, I learnt many new things that were very helpful to me.

WEEK 4 & 5

GEOMETRIC DIMENSIONING AND TOLERANCING

Geometric Dimensioning and Tolerancing (GD&T) is an engineering tolerance definition and communication method. It employs symbolic language to express nominal geometry and its permitted variation on engineering drawings and computer-generated three-dimensional solid models. It instructs the manufacturing workers and equipment on the level of accuracy and precision required for each part's regulated feature. The GD & T method is used to describe the nominal (theoretically ideal) geometry of components and assemblies, as well as the permissible variation in form and size of individual features and variation between features. The nominal, as-modeled, or as-intended geometry is defined by dimensional requirements. A fundamental dimension is an example. Individual feature tolerancing standards indicate the acceptable variation in shape and perhaps size, as well as the allowable variance in orientation and position across features. Linear dimensions and feature control frames with a datum reference are two examples. There are a number of international standards that outline the symbols and regulations used in GD & T. The American Society of Mechanical Engineers (ASME) Y14.5 is one such standard. The Y14.5 standard has the benefit of including all of the GD&T standards in one document. In contrast, ISO standards usually only cover a particular issue at a time. Each of the primary symbols has its own set of standards that supply the specifics. Geometric Dimensioning and Tolerancing (GD & T) is an engineering tolerance definition and communication method. It employs symbolic language to express nominal geometry and its permitted variation on engineering drawings and computer-generated three-dimensional solid models.

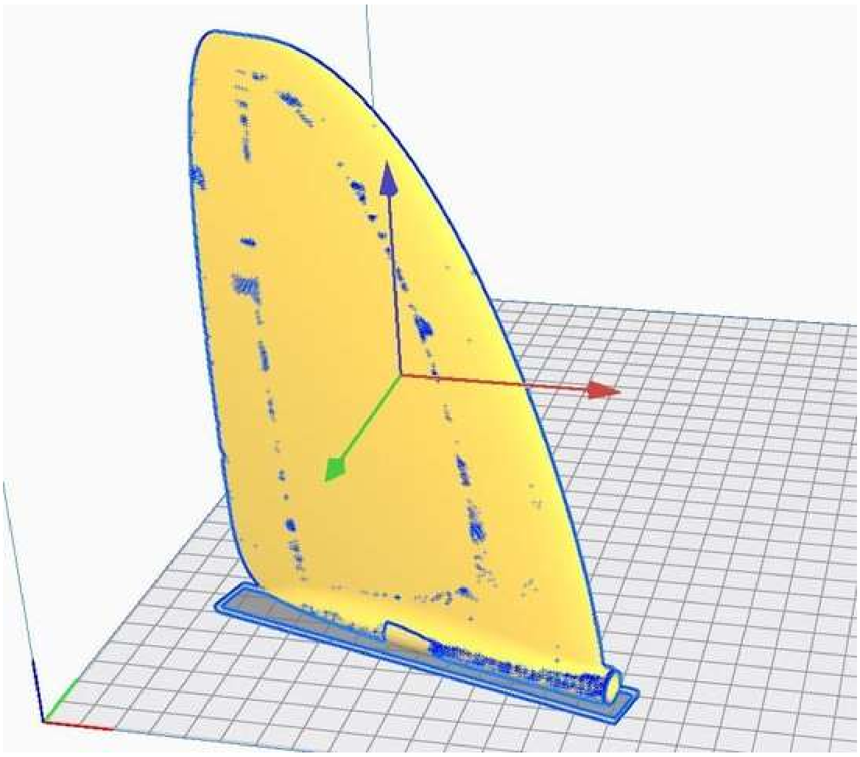
WEEK 4 & 5

SYMBOL	GEOMETRIC CHARACTERISTIC	TOLERANCE TYPE	CONTROL SUMMARY
⏥	FLATNESS	FORM (NO RELATION BETWEEN FEATURES)	CONTROLS FORM (SHAPE) OF SURFACES AND CAN ALSO CONTROL FORM OF AN AXIS OR MEDIAN PLANE DATUM REFERENCE IS NOT ALLOWED
⏤	STRAIGHTNESS		
⌭	CYLINDRICITY		
○	CIRCULARITY (ROUNDNESS)		
⊥	PERPENDICULARITY	ORIENTATION (NO RELATION BETWEEN FEATURES)	CONTROLS ORIENTATION (TILT) OF SURFACES, AXES, OR MEDIAN PLANES FOR SIZE AND NON-SIZE FEATURES DATUM REFERENCE REQUIRED
∥	PARALLELISM		
∠	ANGULARITY		
⌖	POSITION	LOCATION	LOCATES CENTER POINTS, AXES, AND MEDIAN PLANES FOR SIZE FEATURES ALSO CONTROLS ORIENTATION
⌓	PROFILE OF A SURFACE		LOCATES SURFACES ALSO CONTROLS SIZE, FORM, AND ORIENTATION OF SURFACES BASED ON DATUM REFERENCE
⌒	PROFILE OF A LINE		
⌰	TOTAL RUNOUT	RUNOUT	CONTROLS SURFACE COAXIALITY ALSO CONTROLS FORM AND ORIENTATION OF SURFACES
↗	CIRCULAR RUNOUT		
◎	CONCENTRICITY	LOCATION (DERIVED MEDIAN POINTS)	LOCATES DERIVED MEDIAN POINTS OF A FEATURE *NOT COMMON...CONSIDER USING POSITION, RUNOUT, OR PROFILE*
⌯	SYMMETRY		

ULTIMAKER CURA®

Cura is an open-source slicing application for 3D printers. It was created by David Brahm who was later employed by Ultimaker, a 3D printer manufacturing company, to maintain the software. Ultimaker Cura works by slicing the user's model file into layers and generating a printer-specific g-code. Once finished, the g-code can be sent to the printer for the manufacture of the physical object. The open-source software, compatible with most desktop 3D printers, can work with files in the most common 3D formats such as STL, OBJ, X3D, 3MF as well as image file formats such as BMP, GIF, JPG, and PNG.

Our team used the CURA software to slice and print the 3D model.



INTERNSHIP SUMMARY

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Overall, Ziegler Aerospace provided me with an incredible experience that I will never forget. I was made to learn how to use AutoCAD, CATIA, Fusion360, and Ultimaker CURA. During my internship, I learnt about the following topics: before market, aftermarket, BOM, Floor panels, E-170, and B-777 LOPAs. I was also required to participate in a group project in which I had to reconstruct an A320 with a modified cabin, as well as assist with engine design and final assembly. Mr. Dhanush KR, my mentor, was an unwavering supporter who managed my internship progress while working full-time and was always willing to assist. There is so much to learn and acquire here, and all of the teachers are so kind and appear to be one of us, which is one of the positive aspects of this place. Last but not least, the internship I completed here was extremely beneficial to me and my future career, for which I am grateful to Ziegler Aerospace. The internship was well organized and planned.