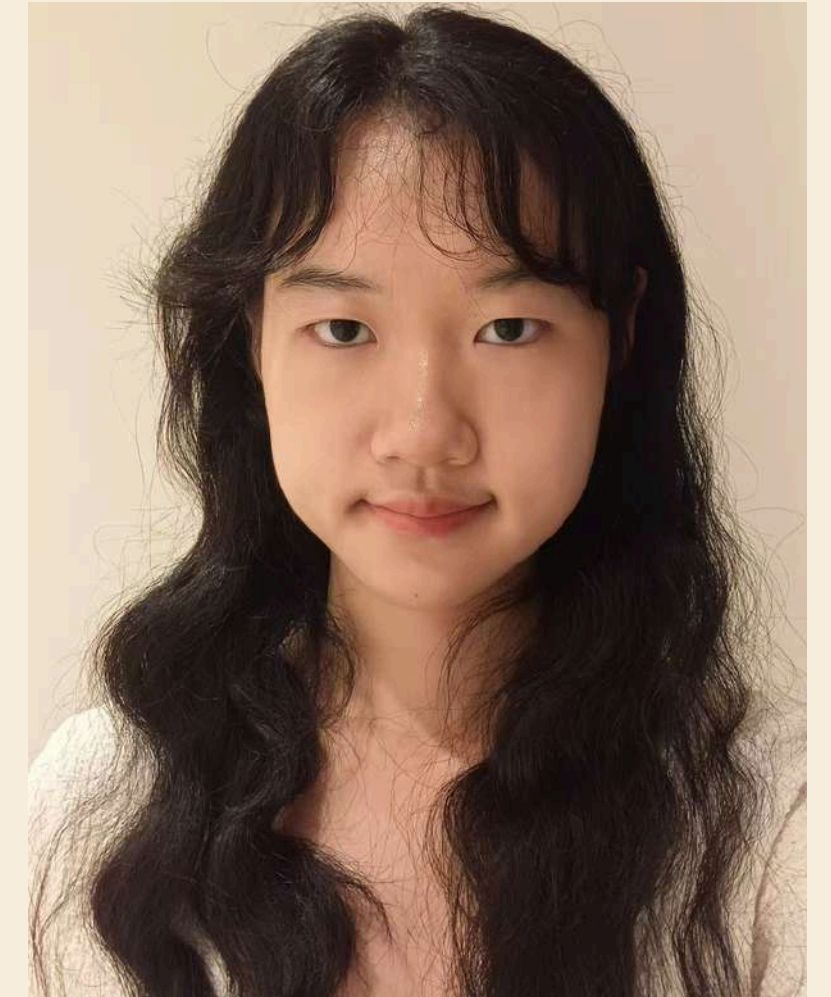# Project Porfolio

Zhao Zehui (Leila)

Mechanical Engineering (Year 4)

The University of Hong Kong

About Me

Interested Direction: Aerospace/Mechanical Engineering in Aerospace field, particularly CFD, aerodynamic analysis and structure

Skills:
- SolidWorks (Experience: 2, Proficient)
- AutoCAD (Experience: 1, Proficient)
- MATLAB/Simulink (Experience: 6 months, working level)
- Xflr5 (Experience: 3 months, proficient)
- Ansys (Experience: 1 month, working level)
- Arduino (Experience: 1 month, working level)
- Laser-cutting machine, Workbench tools, lathe machine, drilling machine

Project 1: AIAA Aerodynamic Analysis

- Airfoil aerodynamic analysis and comparison under different configurations, factors including Deflected flaps and Reynolds numbers
- Comparison on aerodynamic performance for mainwing and empennage on XFlr5, factors including chord length, thickness, cruising speed and angle of attack, dihedral angle, with and without flaps and ailerons, etc
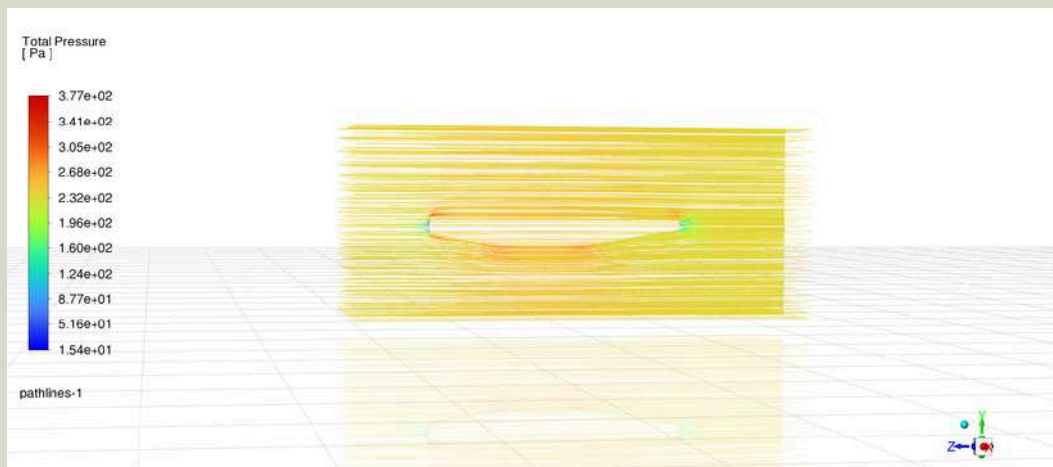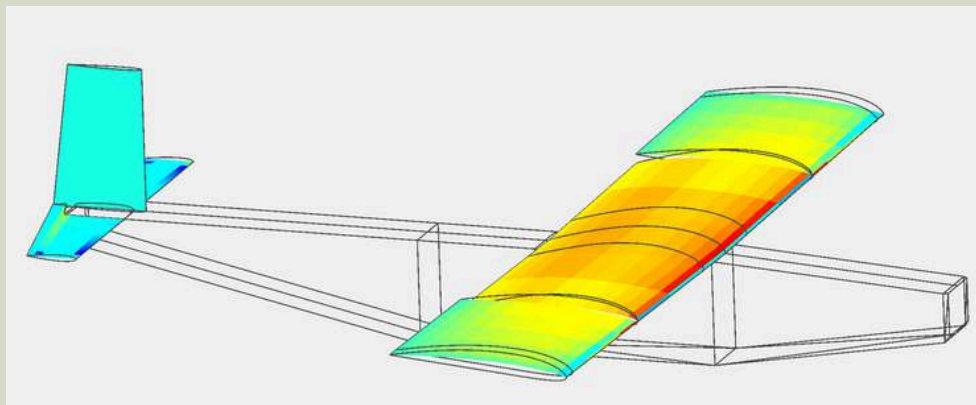
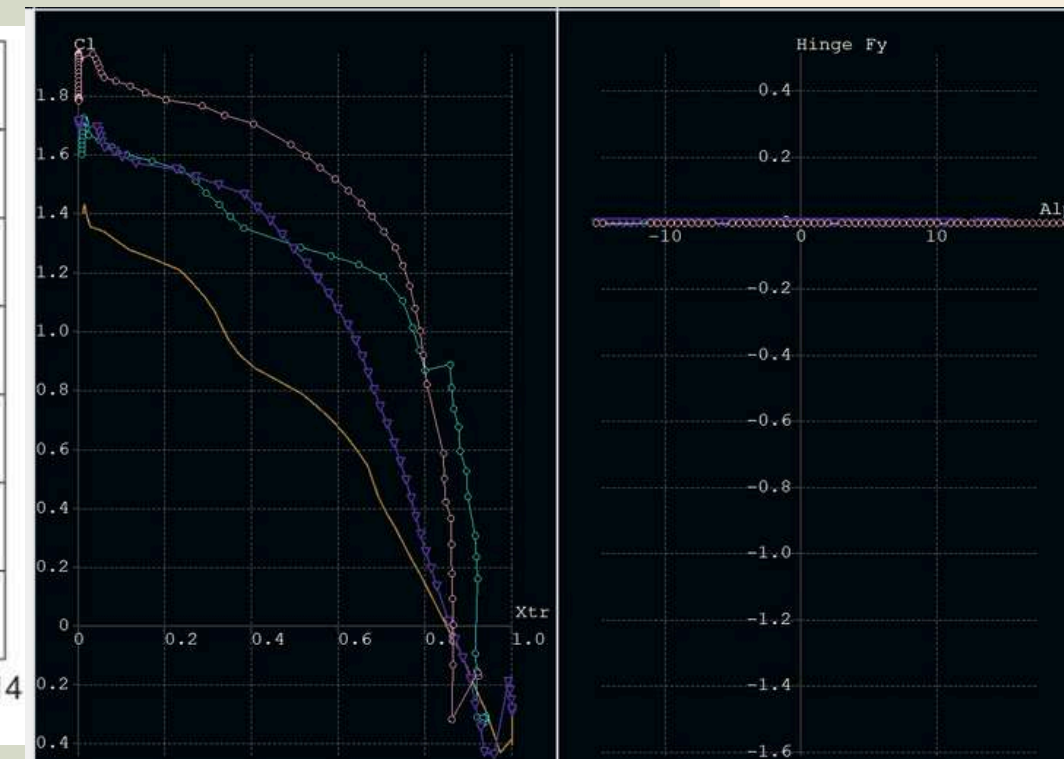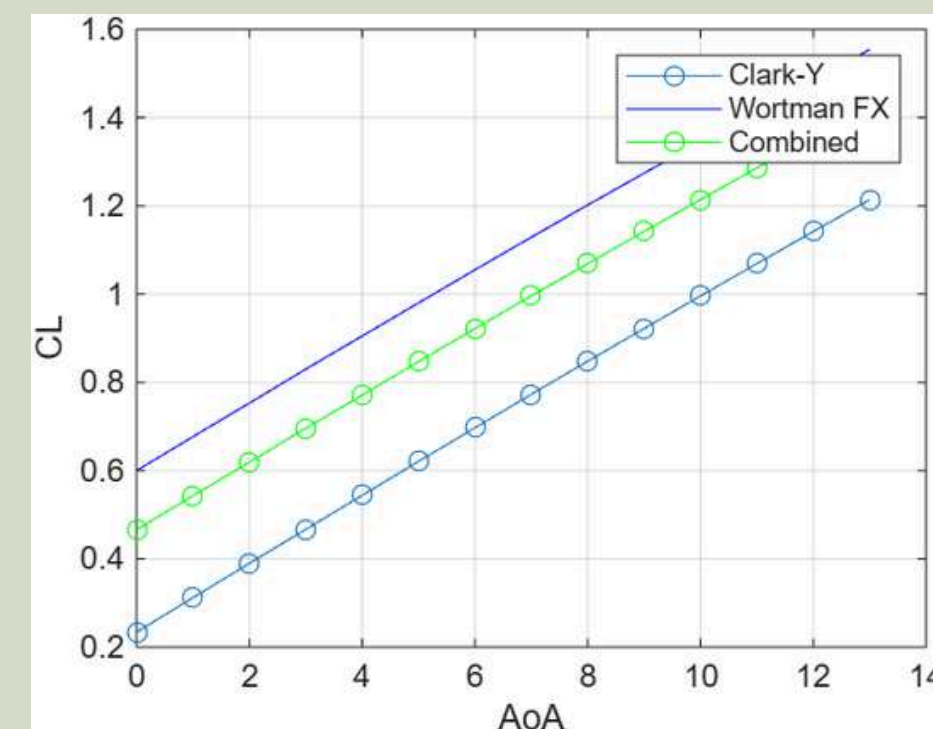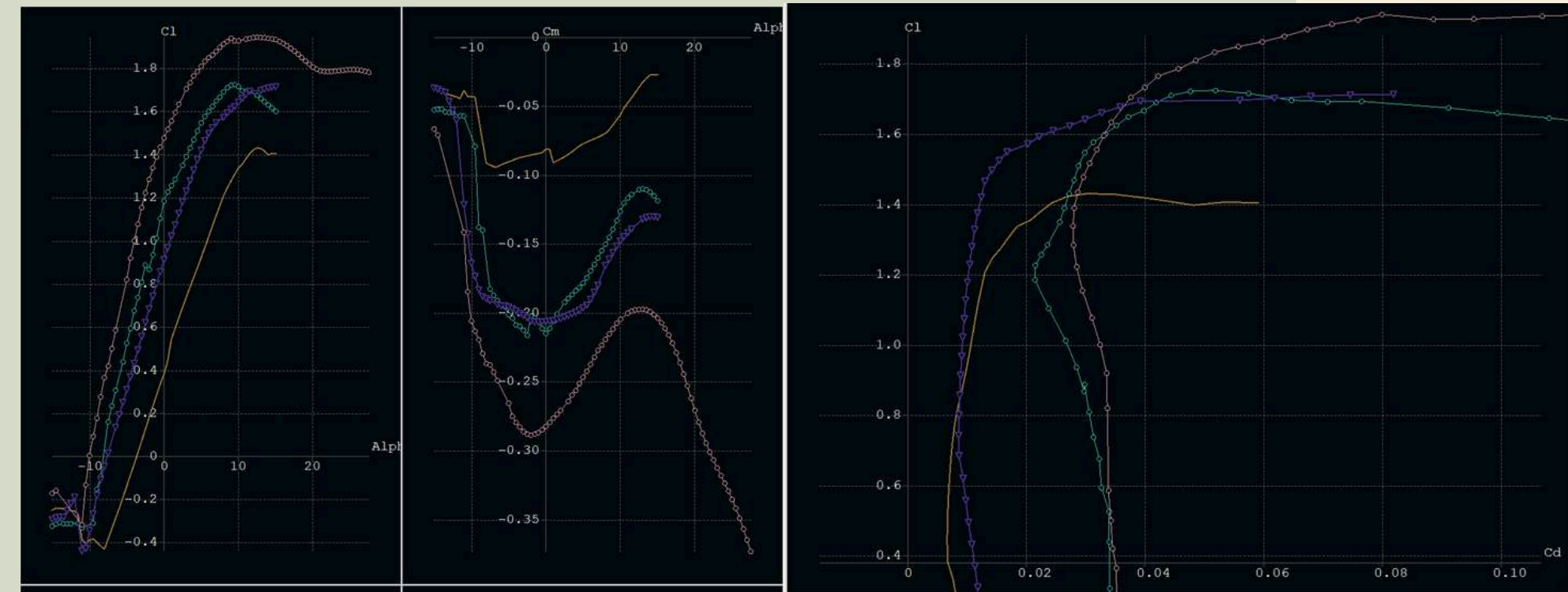# Project 1: Banner mechanism & Drag test simulation

- CAD Design for attach and release mechanism
- Prototype demonstration using Arduino
- Ready to conduct drag test using Ansys (Unsteady CFD Solver) and real life testing using Arduino, load cell, pitot tube, piezoelectric tape, motor driver to conduct pressure measurement, drag measurement for different sizes and design of the banner
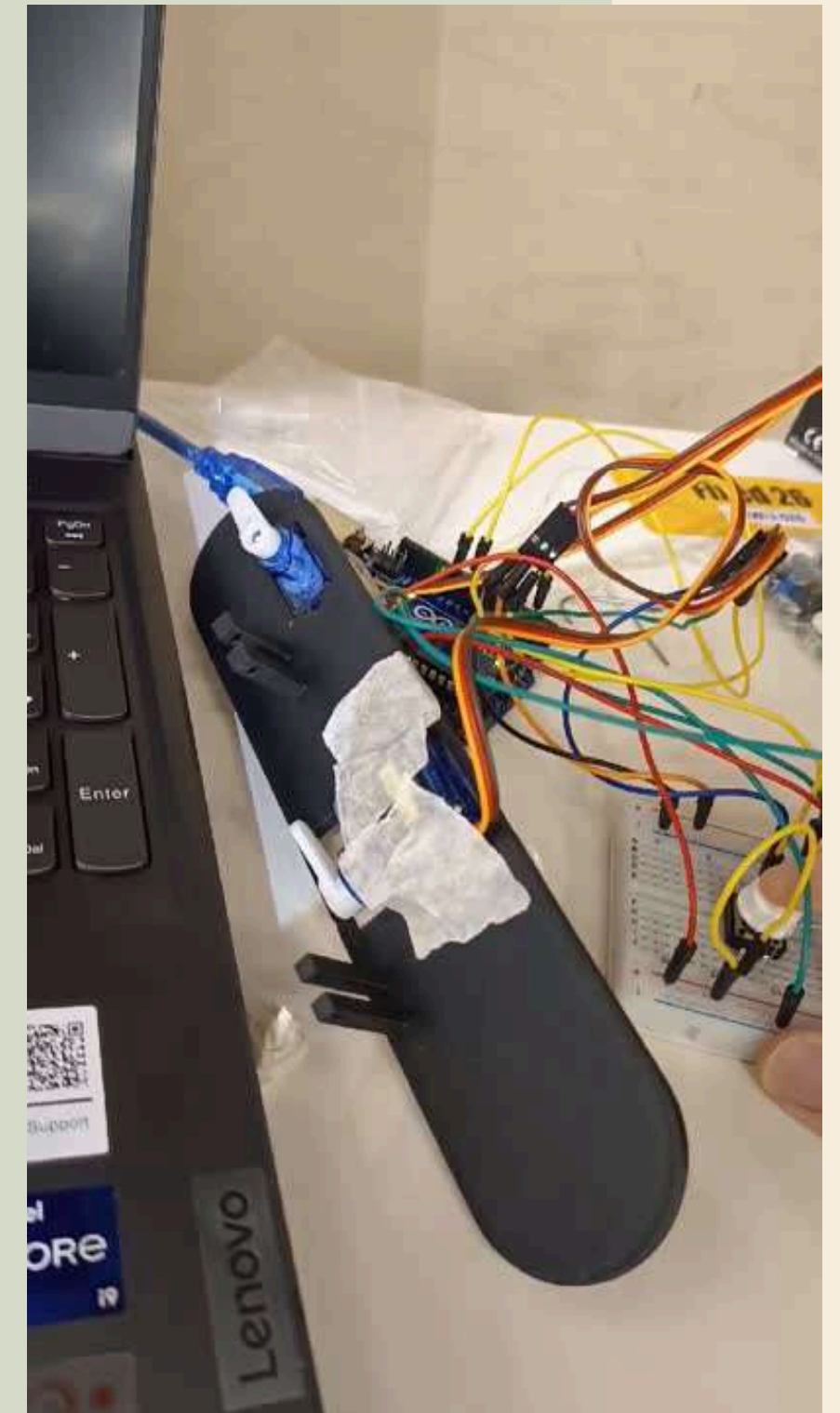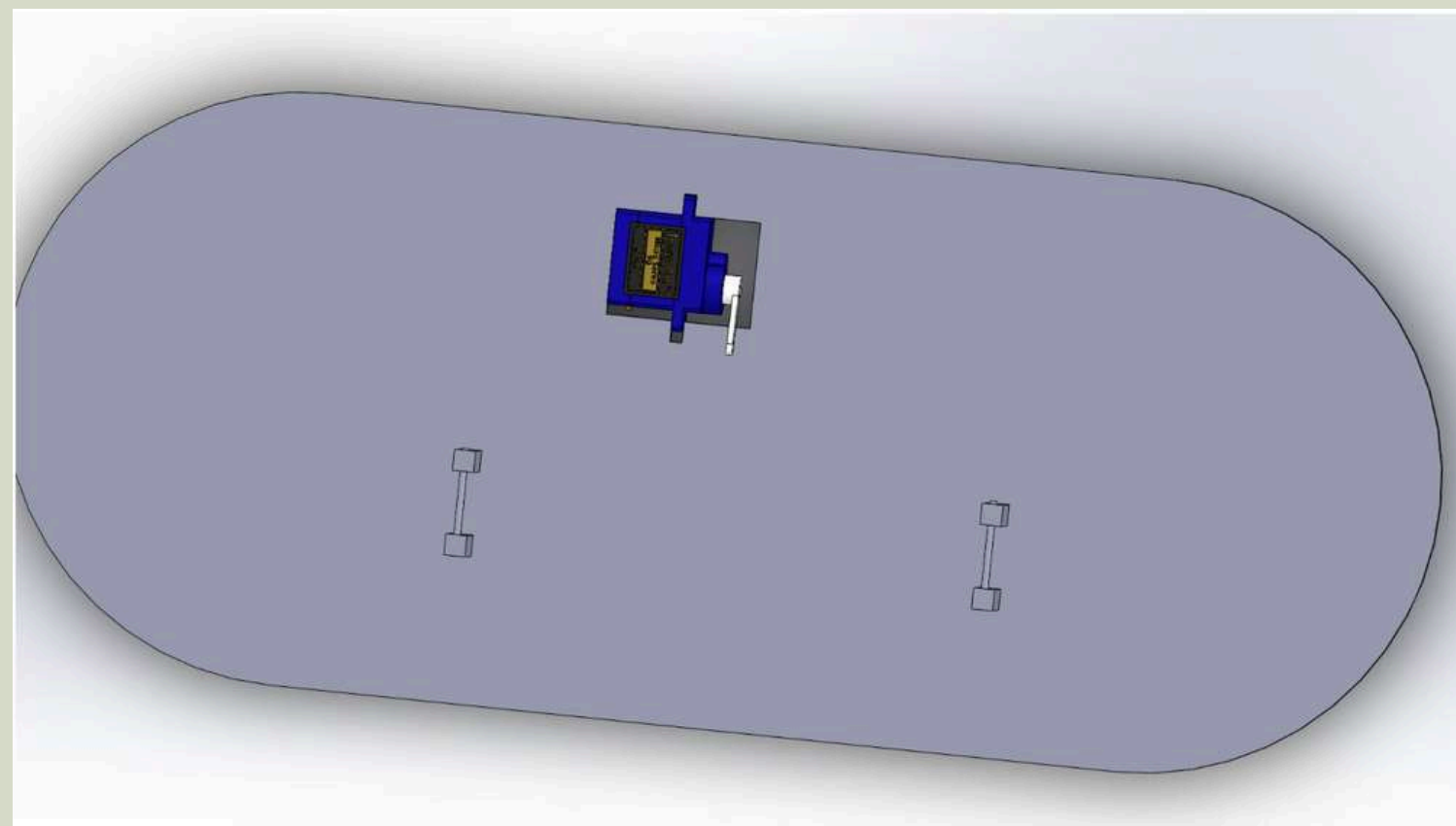
# Project 2: Power transmission unit system design

2025 Spring

- Designed a gear box for power transmission unit system mainly for mining industry
- Responsibilities:

Layout of the system
Chain drive calculation
Chain drive market research
Gear design & calculation
Shaft design & calculation
Shafts model & landscape drawing
Shaft market research
Bearing calculation
Key & Keyseat design & calculation
Key & Keyseat model & landscape drawing
Key & Keyseat market research

- Course result: A+

- Skills: Market research, SolidWorks model design, Engineering calculation
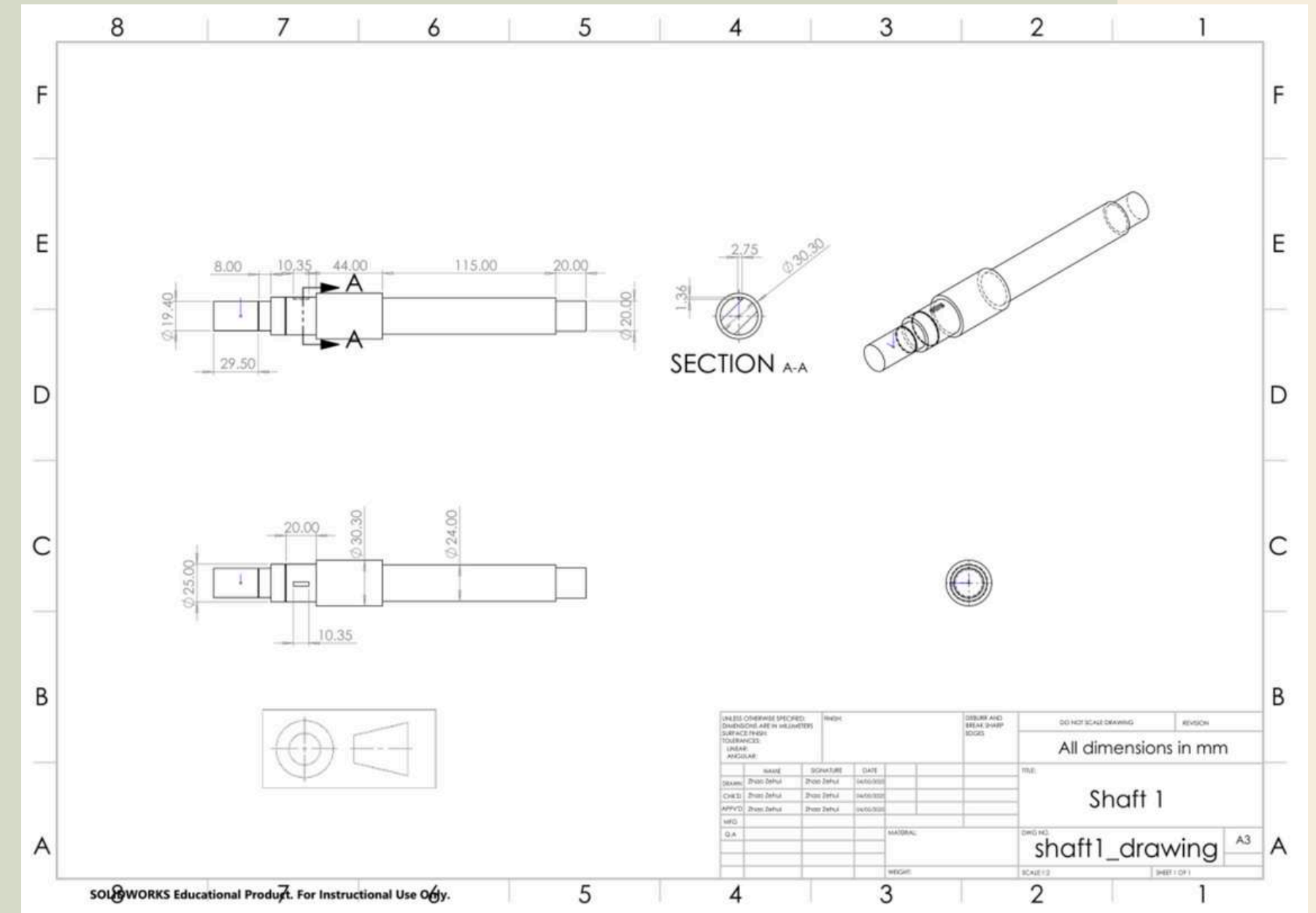
| MECH 2404 | Drawing and elements of design | 2023-24 Sem 1 | A+ | 6.00 |
| MECH 3427 | Design and Manufacture | 2024-25 Sem 2 | A+ | 6.00 |

Project 3: Material & 3D-Model Design

School Project: Design, Build and Fly Team-Aircraft Design

- A material study and testing on Weight reduction design, Structure Analysis on ribs using 3D print filament material for testing
- Hardness test study

Relevant courses:

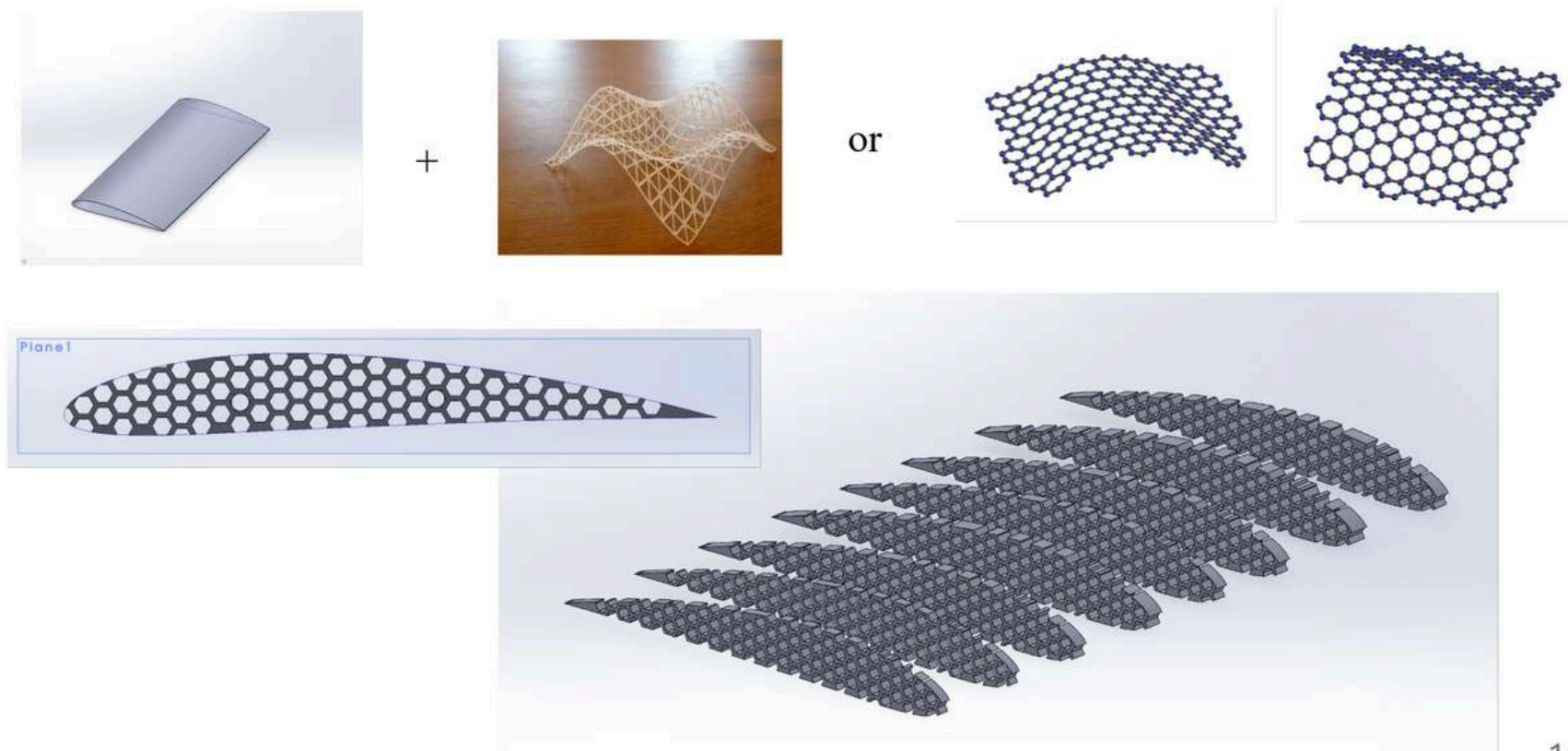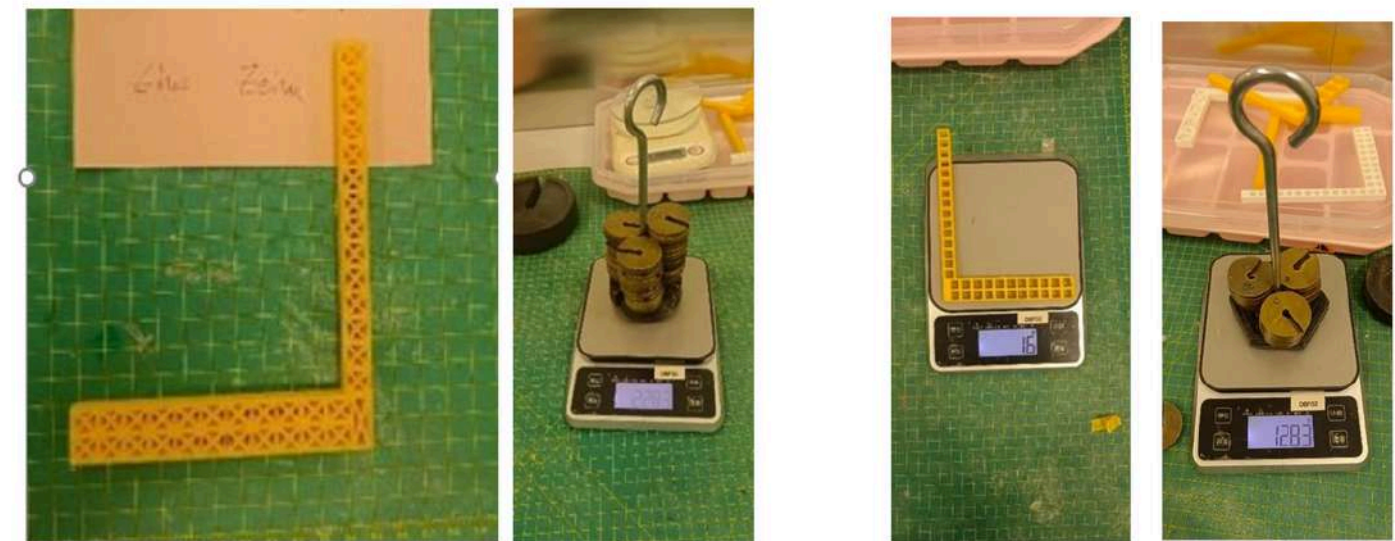Mech2419: Properties of Materials: B+

MechH2418: Training (P/F): Passed

Mech3409: Mechanics of Solid: A

Wing Structure Design: Mesh shape and graphene shape

15

Hardness Test Analysis in 2418 Training

22 g, 2283g payload without breaking, >3000 gram until it breaks
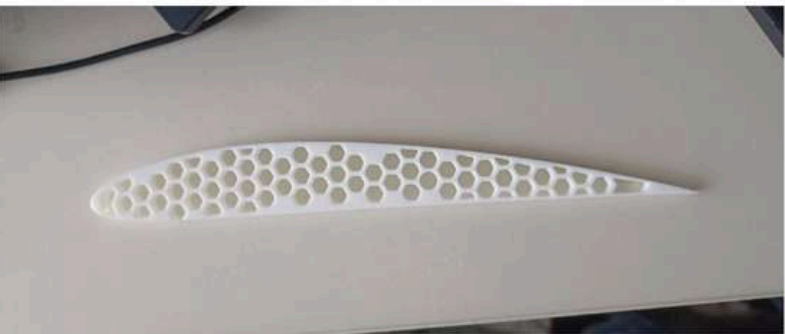
16g, rectilinear pattern, 1283g payload until it breaks

| MECH 2418 | Engineering training | 2023-24 Sum Sem | P | 6.00 | ✓ |

3D Material & 3D-Model Design

3D Print Study: Weight Reduction

3D Printing Filament Used: Bambu PLA Basic

Mass: 10.09g
Wing span: ~20cm
Infill pattern: Grid

Mass: 10.09g
Wing span: ~20cm
Infill density: 10%

Infill pattern:
Concentric, Rectilinear, Grid, Line, Cubic, Triangles, Tri-hexagon, Gyroid, Honeycomb, Adaptive Cubic, Aligned Rectilinear, 3D Honeycomb, Hilbert Curve, Archimedean Chords, Octagram Spiral

Support Cubic, Lightning, Cross Hatch

5

Comparison Table on Weight of Different Materials

Type of Material	Weight (gram)
Basic PLA	~7.7 grams
Generic PLA (PPA)	~7.3 grams
Balsa Wood	2.34 grams
ASA Aero	~4.46gram (grid pattern), <4 gram if (gyroid pattern)
PolyAir	Not yet tested
PolyLight	Not yet tested
SLA	2.5gram (1:2 scale), ~20 gram (1:1 scale)

Result Of Material Testing: PPA vs PLA

Comparison on current existed PLA filament:
PPA(Generic PLA) VS Basic PLA

Left one is PPA (~7.3g) and the right one is basic PLA (~7.7g)

Balsa Wood

Mass properties of Part2
Configuration: Default
Coordinate system: -- default --

Density = 0.00 grams per cubic millimeter

Mass = 2.34 grams

Volume = 14623.70 cubic millimeters

Surface area = 15174.91 square millimeters

Center of mass: (millimeters)
X = 78.72
Y = 6.46
Z = 5.00

Principal axes of inertia and principal moments of inertia: (grams * square millimeters)
Taken at the center of mass.
Ix = (1.00, 0.01, 0.00)   Px = 149.41
Iy = (-0.01, 1.00, 0.00)   Py = 5541.71
Iz = (0.00, 0.00, 1.00)   Pz = 5652.12

Moments of inertia: (grams * square millimeters)
Taken at the center of mass and aligned with the output coordinate system. (Using positiv
Lxx = 149.78   Lxy = 44.57   Lxz = -0.03
Lyx = 44.57   Lyy = 5541.35 Lyz = 0.00
Lzx = -0.03   Lzy = 0.00   Lzz = 5652.12

Moments of inertia: (grams * square millimeters)
Taken at the output coordinate system. (Using positive tensor notation)
Ixx = 305.87   Ixy = 1234.09   Ixz = 920.88
Iyx = 1234.09   Iyy = 20097.79 Iyz = 75.56
Izx = 920.88   Izy = 75.56   Izz = 20247.67

New Material Choice

- ASA Aero: Self-foaming material, Expands when heating, so the density is low

- ASA Aero- Bambu Lab

Product Features
- Tough with Good Impact Resistance
- Ultra-lightweight & Low Density
- Water & UV Resistance
- Comes with High Temperature Reusable Spool
- Diameter: 1.75 mm +/- 0.03 mm

Cautions for Use
- Dry out before Use
- AMS Compatible
- Enclosure Printers Required

	Bambu ASA Aero	Bambu PLA Aero	Wood PLA
Toughness (Impact Strength - XY)	32.0 kJ/m²	24.5 kJ/m²	7.9 kJ/m²
Layer Adhesion (Impact Strength - Z, Dry State)	3.4 kJ/m²	2.5 kJ/m²	1.1 kJ/m²
Layer Strength (Bending Strength - Z)	24 MPa	15 MPa	15 MPa

School Training: Basic Electronics

- Training module includes:
- Understanding the usage of LabVIEW, data acquisition board to perform different virtual simulations, such as temperature input, frequency, pneumatic and LED control using relay
- Understanding the usage of operational amplifier, with different logic gate design
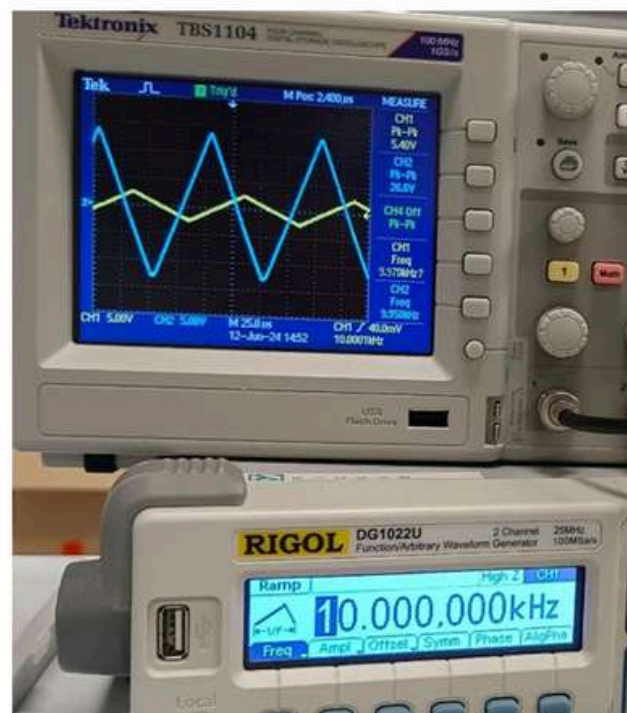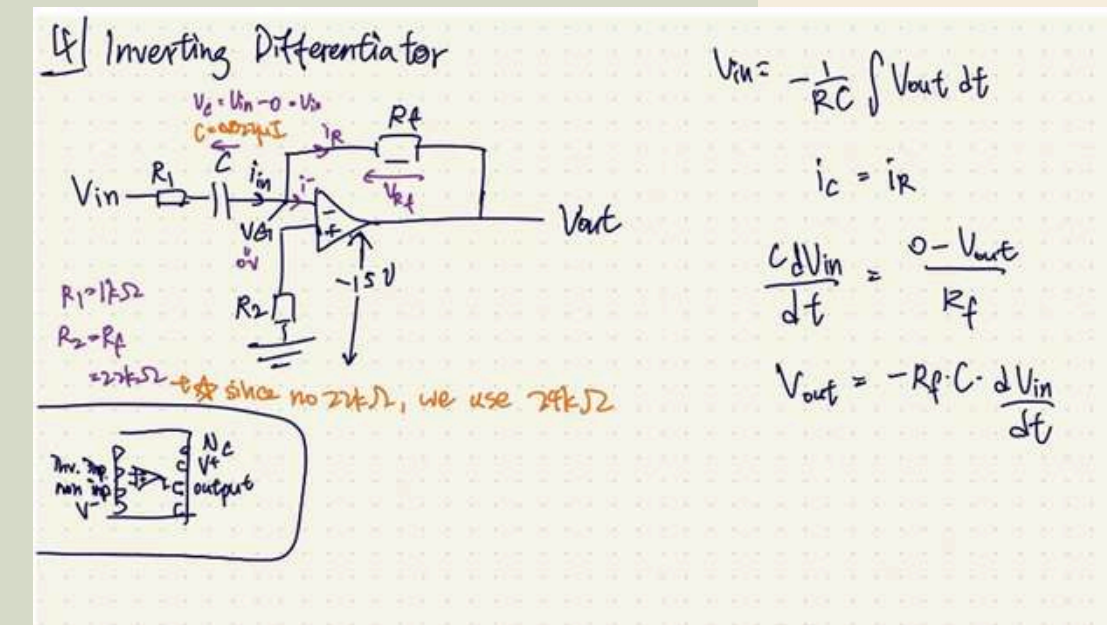
2024 Summer

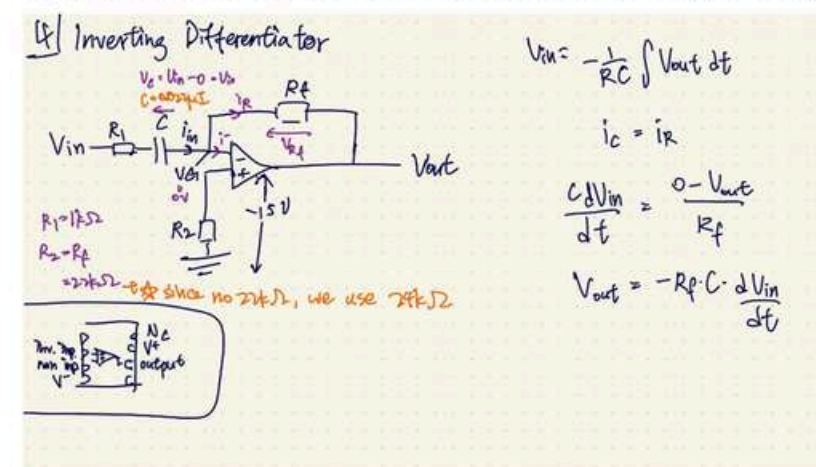Figure 171 Waveform when frequency is 10kHz
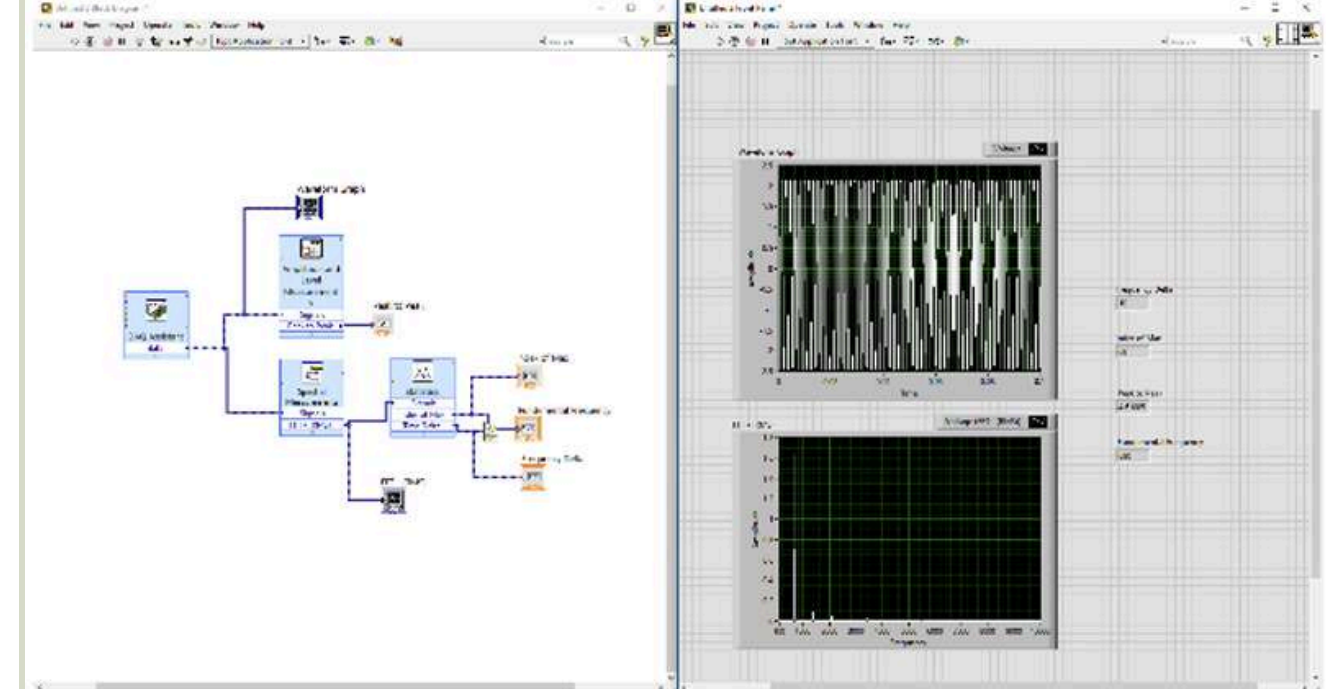

Figure 167 Circuit diagram of inverting differentiator

Figure 12 Ladder diagram for measurement for frequency of 0.1 – 10kHz
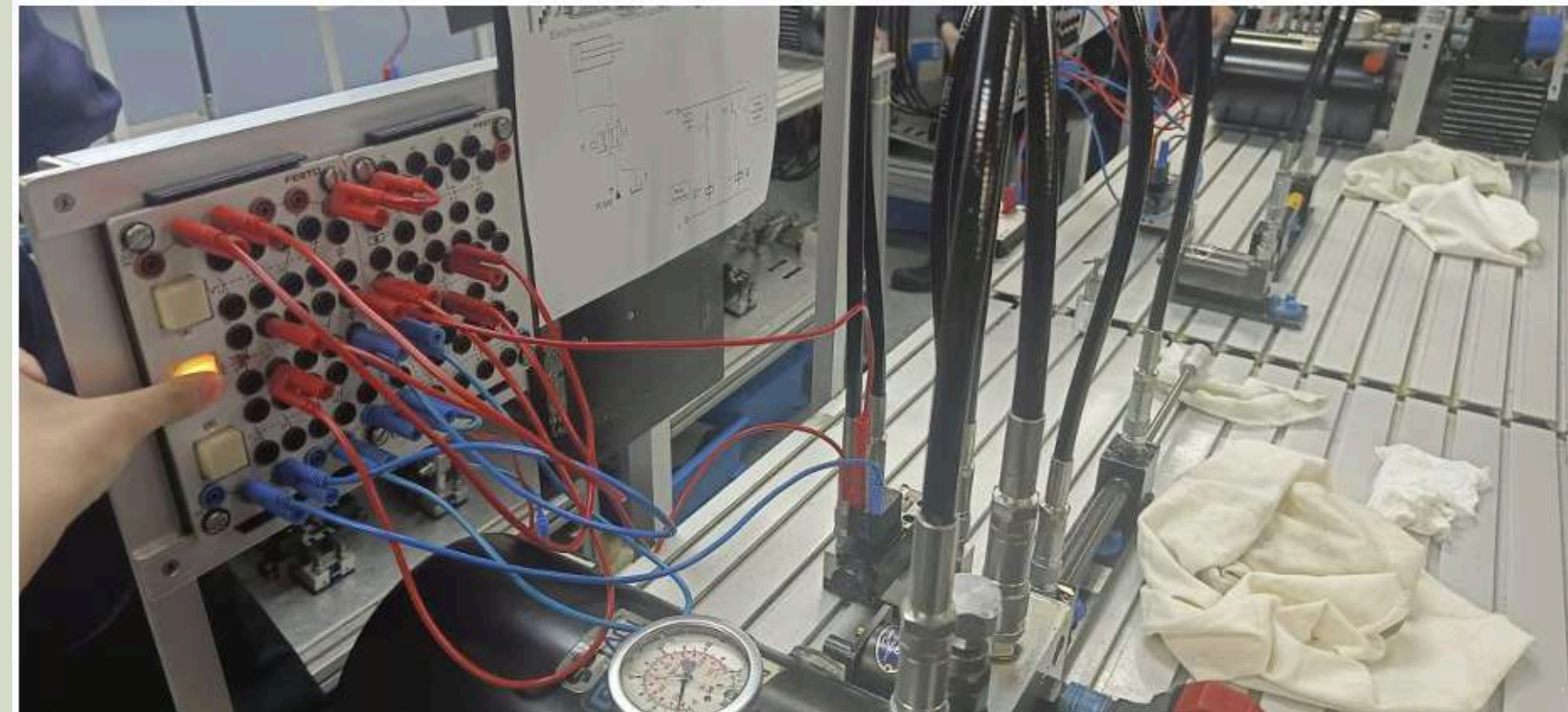
School Training: Workbench practice

- Training module includes:
- Hand-crafted a metal cover and also a metal box using mechanical tools, including hammer, metal sheet-cutting machine,
- Experience in making a hydraulic pump using circuits for electrical connection
- Experience in tapping-holes making using drilling machine



Department of Mechanical Engineering, HKU   Report for MECH2418

School Training: Workbench Practice

2024 Summer

- 3-person project of manufacturing a rack using workbench tools and aluminium metals
- Grinding machine practice to polish the surface of an aluminum block
- Issue appeared during the tapping process of my teammate; therefore, the screw was not able to fit into my part, which is the shaft part of the vise
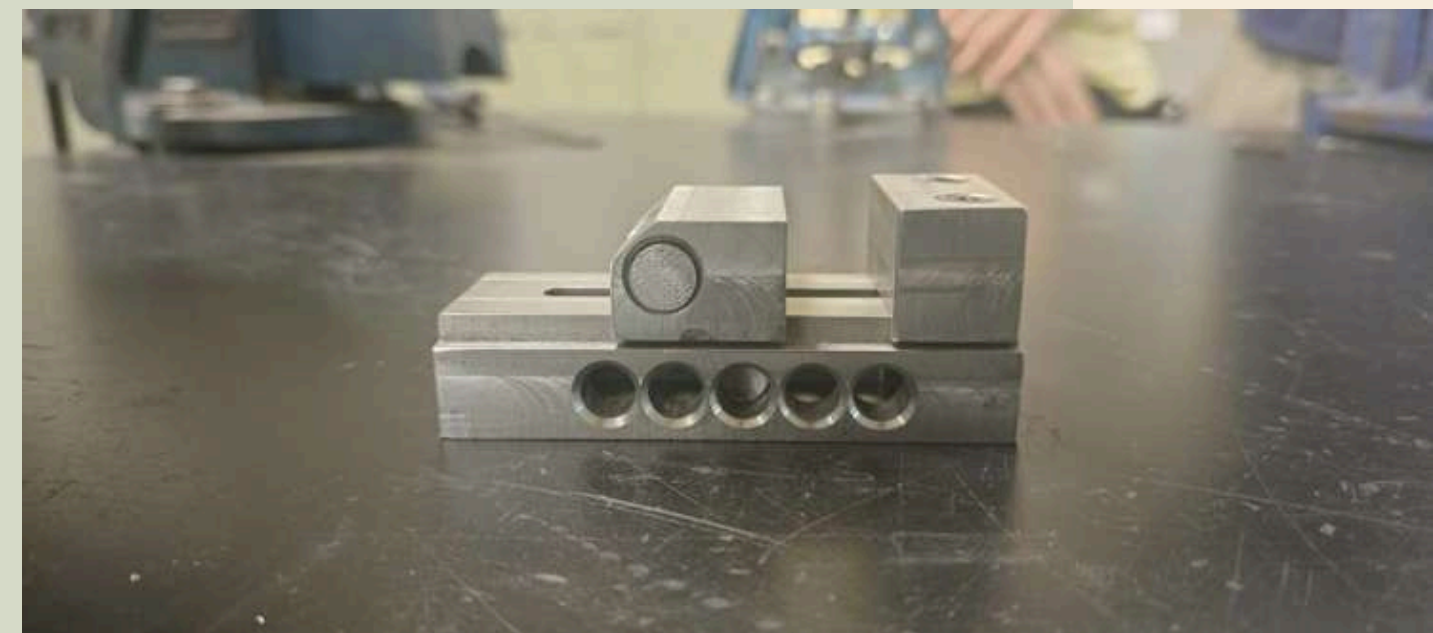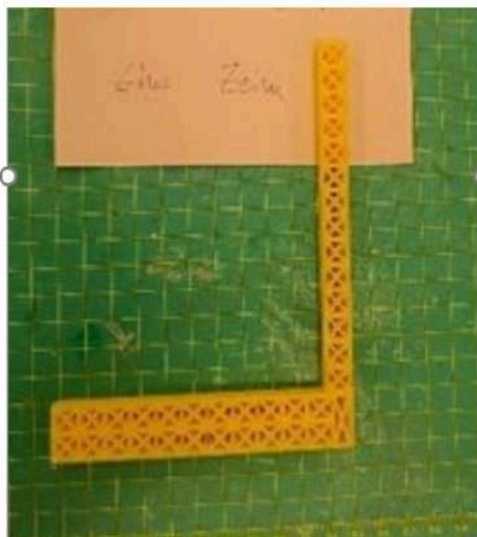
School Training: CAD/CAM

- Design a 2 version of L-beam structure with biggest loading
- Result: the one with crossed-section rhombus structure is able to withstand >3000 g payload, while the one with rectangular cross section rhombus structure was able to withstand 1283g payload
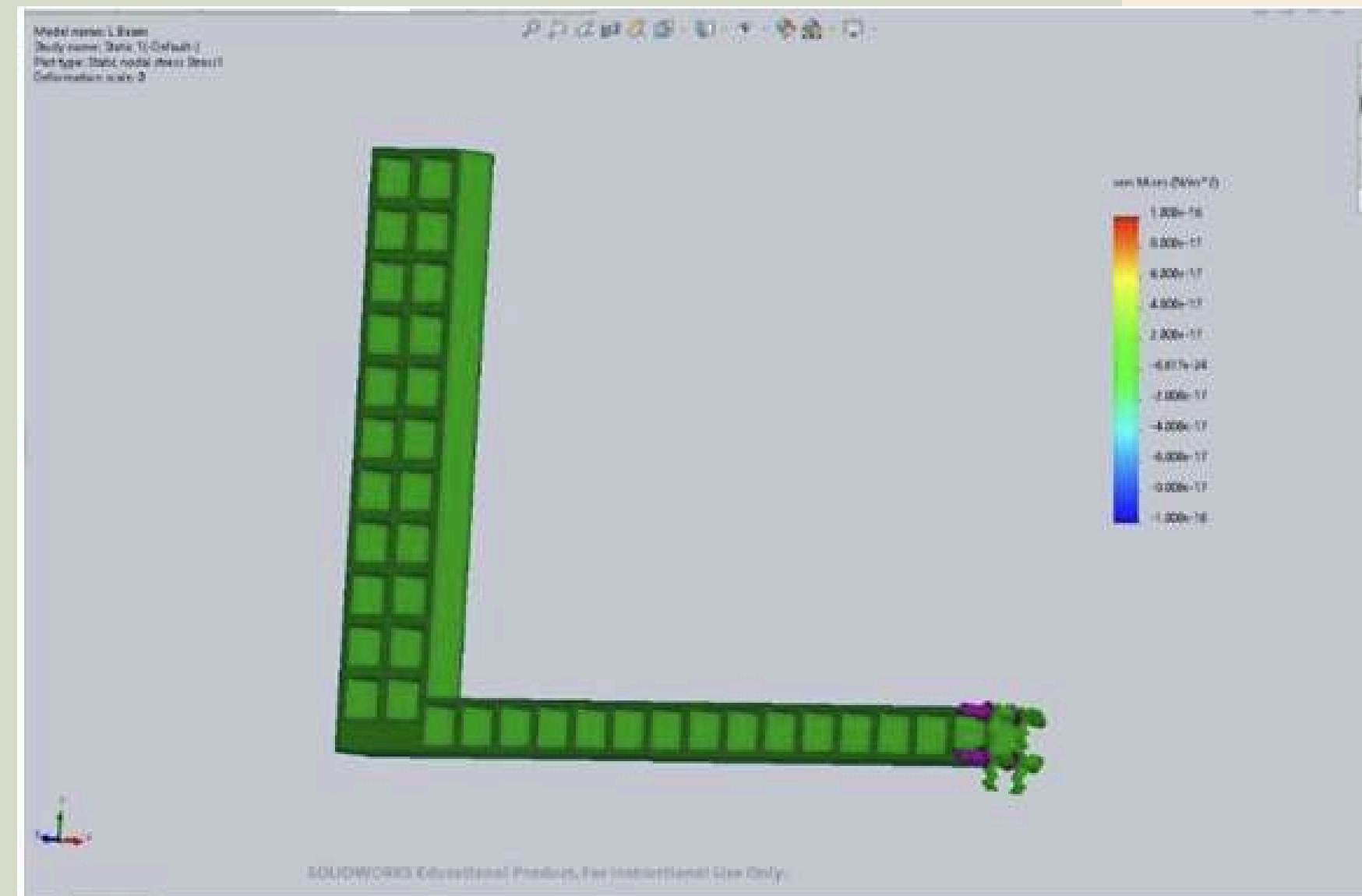

Hardness Test Analysis in 2418 Training

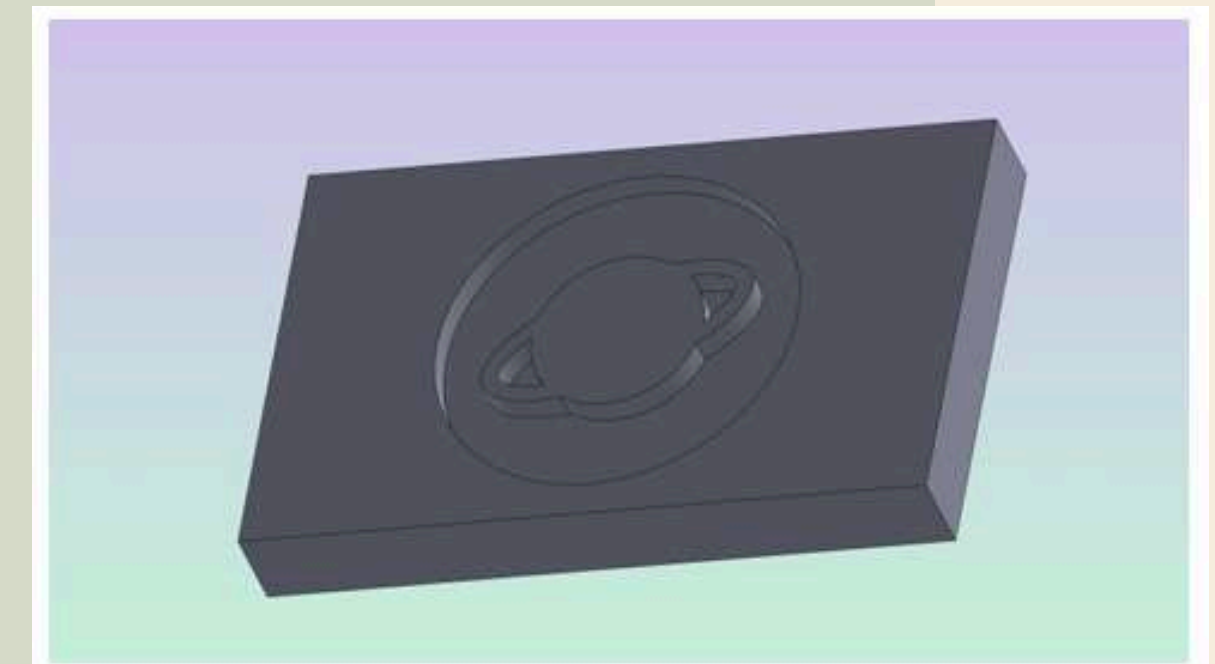22 g, 2283g payload without breaking, >3000 gram until it breaks

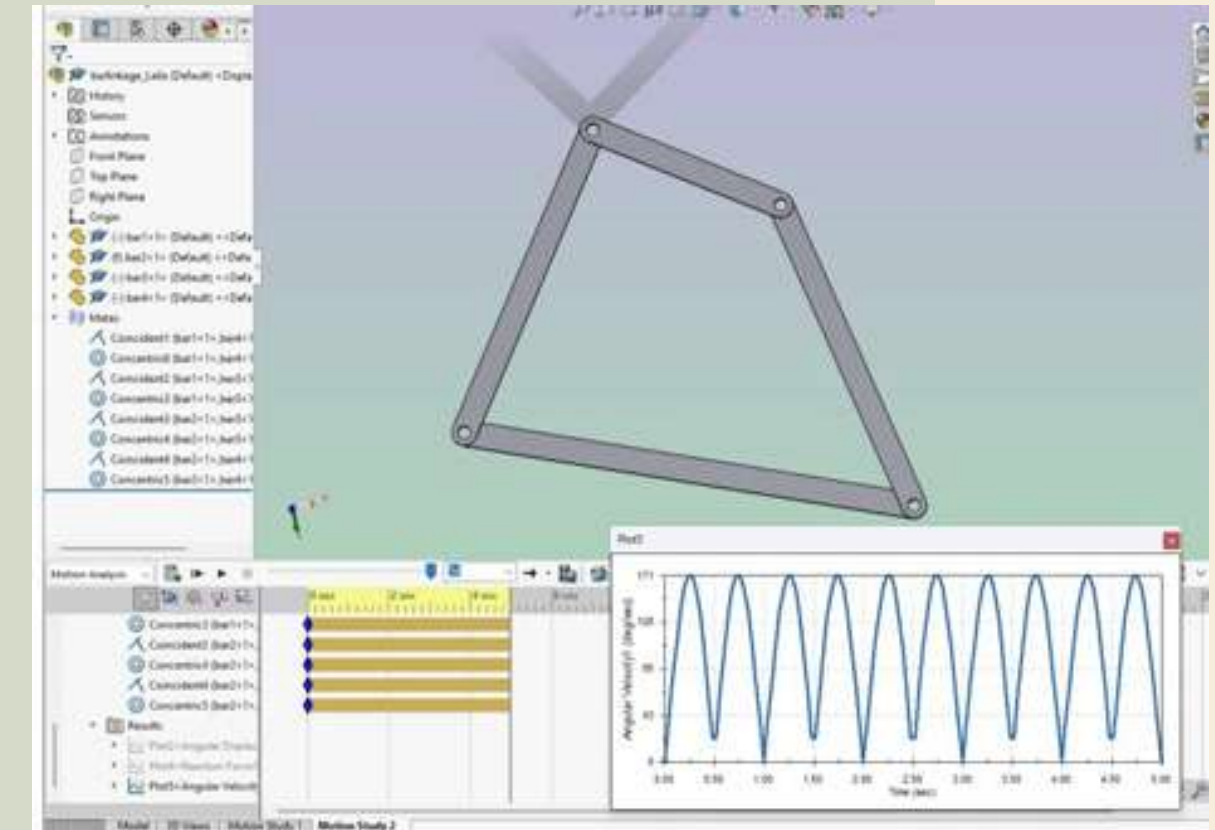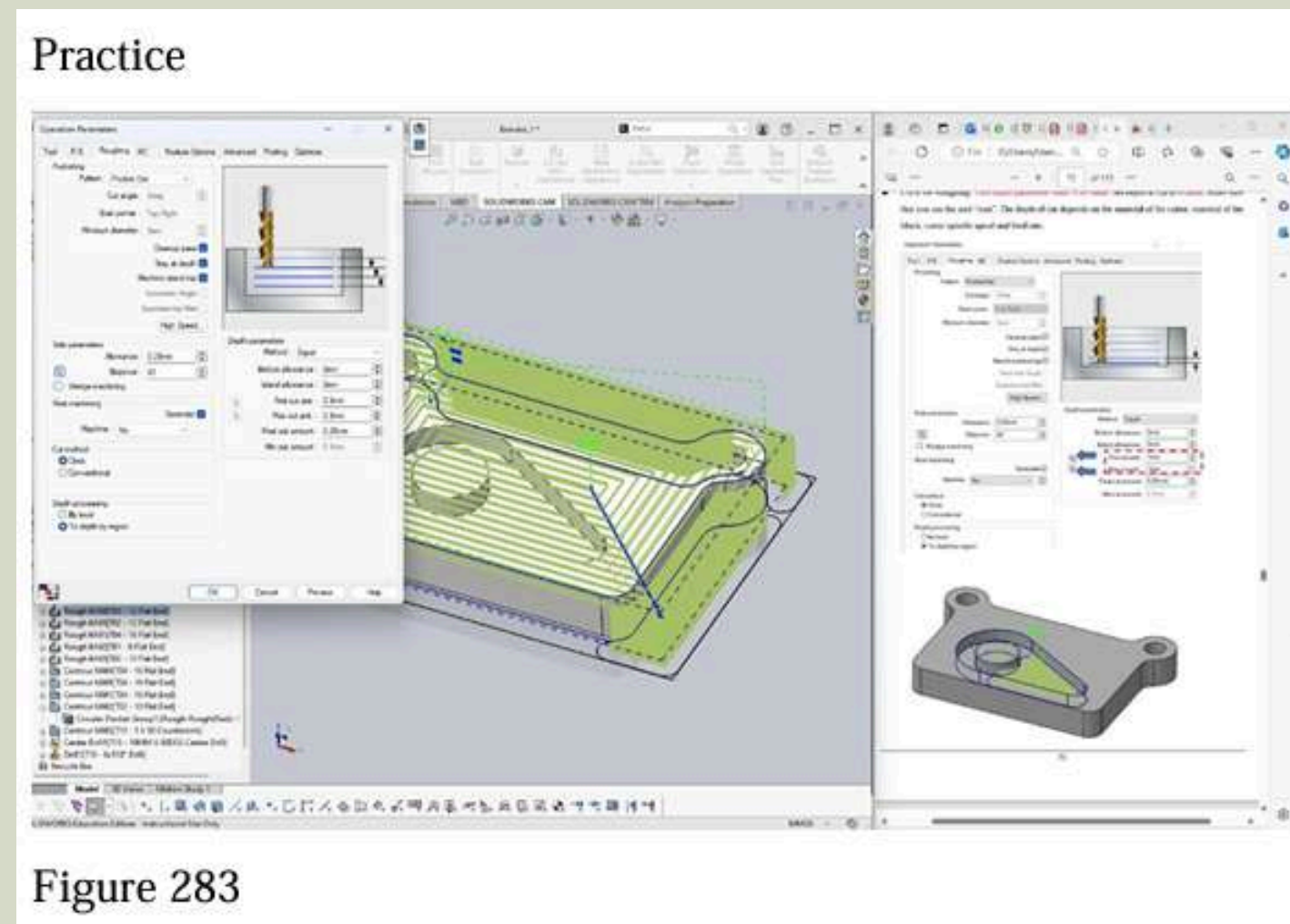16g, rectilinear pattern, 1283g payload until it breaks

School Training: CAD/CAM

- Learnt fundamentals of G-code and CNC milling
- Designed a block with a Saturn-shape curvature
- Learnt fundamentals of kinematic analysis on SW

Figure 283

Advanced Mechanical Engineering Core Course Performance

4) Discipline Core Courses - Advanced Courses (42 credits)

36.0 Credits Added

IP ---->   6.0 Credits

2401	MECH 3407	6.0	B-		Advanced partial differential
2401	MECH 3409	6.0	A		Mechanics of solids
2401	MECH 3418	6.0	A-		Dynamics and control
2402	MECH 3402	6.0	A-		Engineering thermodynamics
2402	MECH 3408	6.0	B-		Mechanics of fluids
2402	MECH 3427	6.0	A+		Design and Manufacture
2502	MECH 4410	6.0		IP	Engineering & technology mana

GPA for advanced courses: 3.52/4.3

Academic-Educational Project:

- Team leader of student team to plan, organize and hold academic workshops to stimulate students' interest in aviation and aerospace field
- Introduce SolidWorks, Aircraft Design, and hands-on skills for RC model aircraft manufacturing
- Lead lower-year students to join several aviation/aerospace related competitions
- Experiences in Canva, PowerPoint, Team management, Event planning
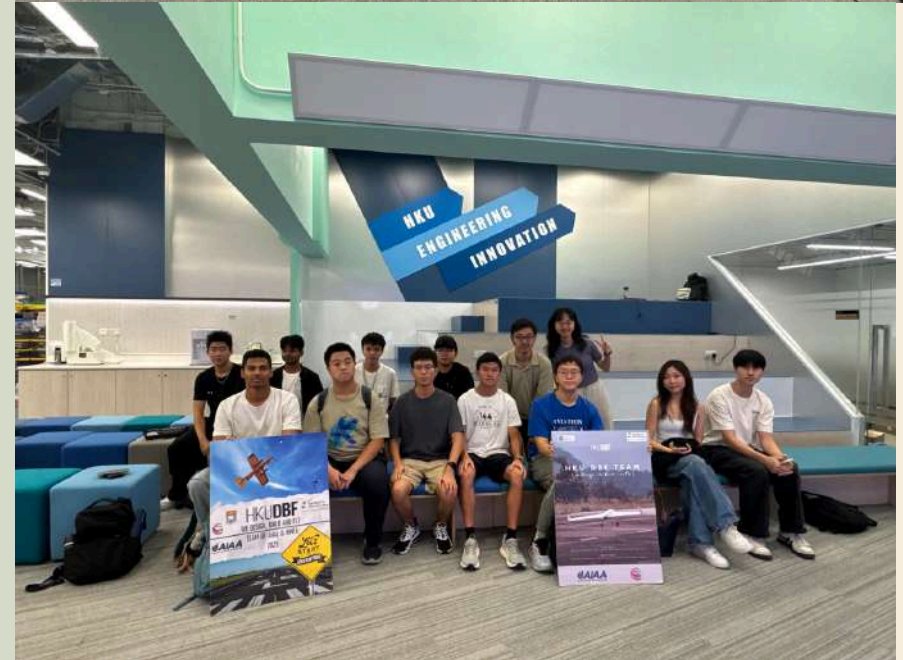
Aesthetic Design: Poster for DBF Team

- Designed the posters for team promotion
- The CFD simulation on the left poster was the workshop materials I conducted on SolidWorks in spring 2025

Thank you!