TECHNICAL PRESENTATION

SAEISS aerodesign challenge 2022 – Regular class

TOPICS COVERED

- DESIGN REQUIREMENTS AND CHALLENGES
- INNOVATIONS
- MATERIAL SELECTION
- AVIONICS DESIGN CONFIGURATION
- STRUCTURAL ANALYSIS OF LANDING GEAR
- FABRICATION PROCESS
- DYNAMIC STABILITY ANALYSIS
- FINAL AIRCRAFT LAYOUT

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DESIGN REQUIREMENTS

FLIGHT PLAN	DIMENSIONS	AIRCRAFT
Takeoff in 100ft	Aircraft length + width + height must not be greater than 431.8 cm	Weigh more the 2 Kg and weigh less than 5 Kg, without using fibre–reinforced plastics
Attain stable fight within 400 ft and turn	Make payload bay as per prescribed dimensions for payload – 25.4 cm x 10.16cm x 10.16cm	Powered by commercially available Li–Po batteries
Carry out to a safe landing after turn within 400ft		Use A single electric motor for propulsion

Innovations

Additive manufacturing

Parasol wing design

INNOVATIONS:

Additive Manufacturing Augments Weight Reduction

Parasol wing maximizes lift per area of wing

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MATERIAL SELECTION

	MATERIAL	DENSITY (g/cm3)	TENSILE STRENGTH (MPa)
WOOD	Balsa	0.14	13.2
	Plywood	0.50	27.6
PLASTICS	PLA (Polylactic Acid)	1.25	35.1
METAL	Aluminium 6061	2.70	90

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MATERIAL SELECTION

PLYWOOD

Strength characteristics make it suitable for high stress applications– used as motor mount support, landing gear panel

ALUMINIUM

Low density, malleability and strength makes it the best material to hold the aircraft – used as landing gear plates

MATERIAL SELECTION

POLYLACTIC ACID (PLA)

To reduce weight and support the plane together – used as wing spars

BALSA WOOD

Primary material in building the aircraft due to low density and high strength – used as ribs and fuselage panels

AVIONICS DESIGN CONFIGURATION

MOTOR	SunnySky X3250 BLDC	
PROPELLER	APC Propeller 13X8	
BATTERY	Lemon 4200mAh 3S 25C/50C LiPo Battery	
ESC	Readytosky 80A ESC	
SERVO	Tower Pro SG90 Servo	

Total Take-Off Weight = 9730.5 (approx)

Assumed T : W=0.4

- Thrust Required = 9730.5 * 0.4g = 3892.2 g
- Current Required = 44 A
- Time of Flight (ToF) = 10000 * 0.001 * 60 / 44 = 13.63 mins

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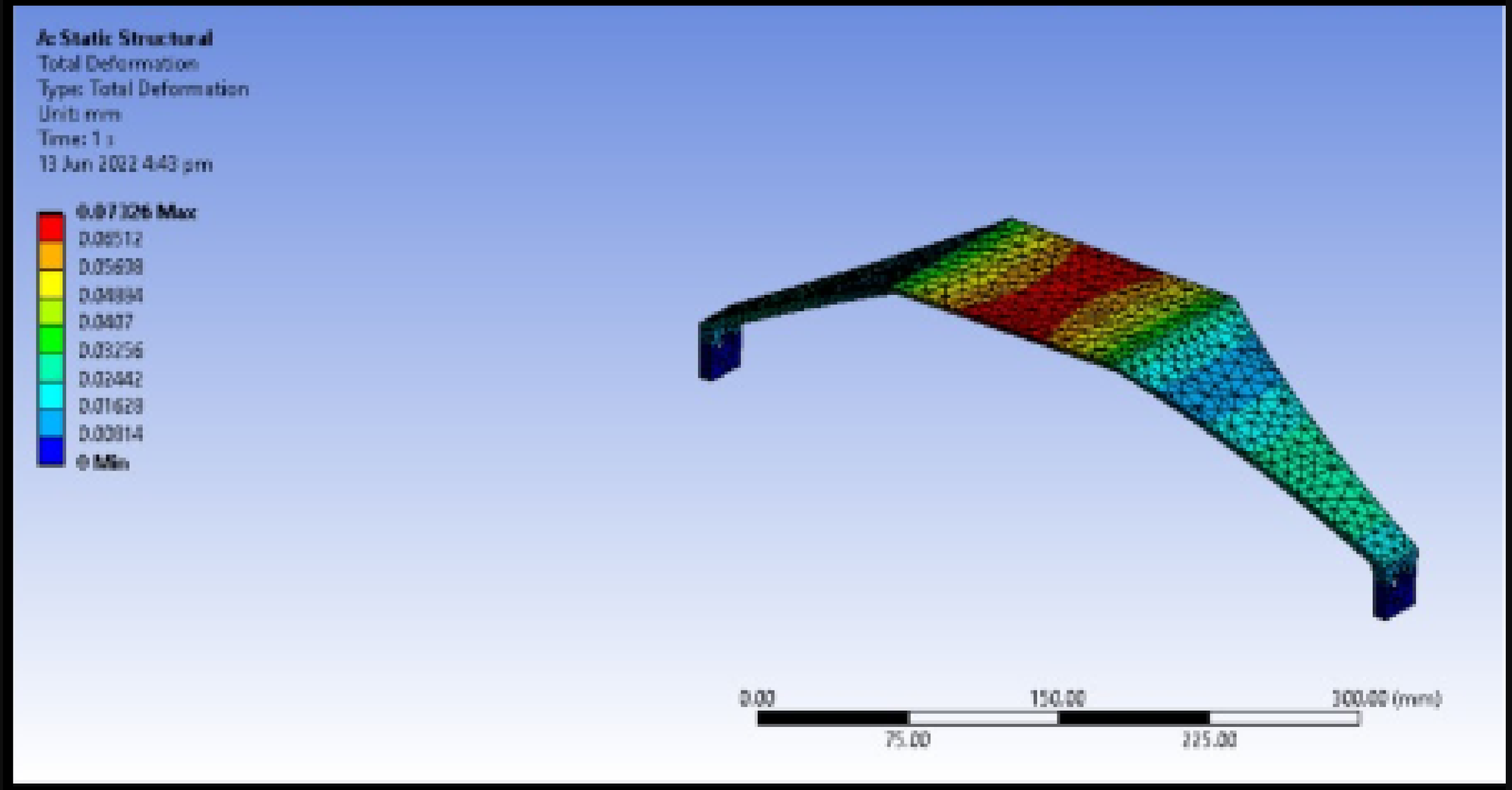
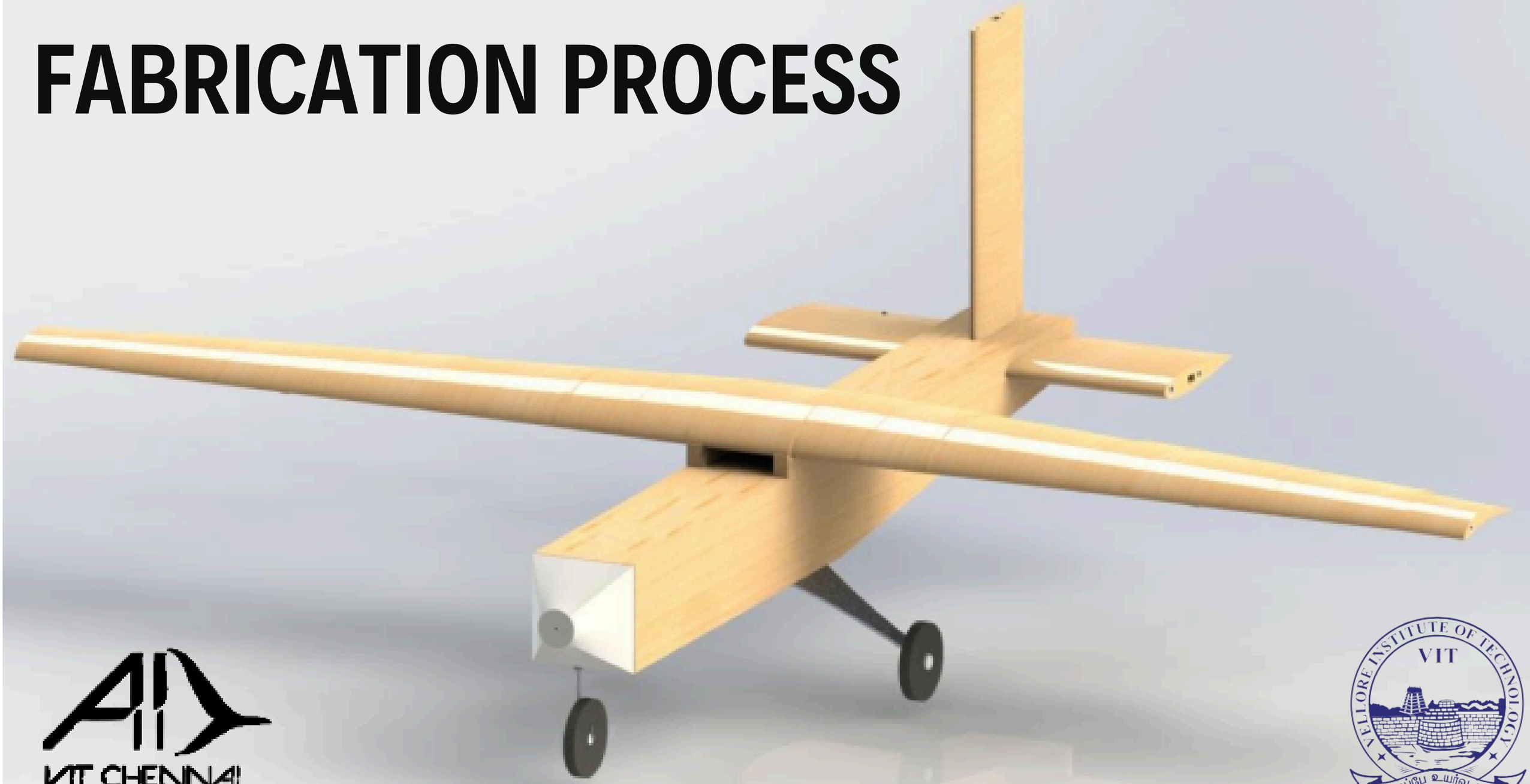
PARAMETERS	AILERONS	ELEVATORS	RUDDERS
A	1.25	1.25	1.25
Sa/Ca	0.5	0.5	1
Chord	6 cm (2.3622 in)	4 cm (1.57 in)	3 cm (1.18 in)
Span	40 cm (15.748 in)	44 cm (17.32 in)	40 cm (15.748 in)
τmin	1.33 Kg−cm18.58 Oz − In	0.64 Kg−cm8.89 Oz − In	0.6575 Kg−cm9.13 Oz − In

$$\tau_{min} = \frac{A * Chord^2 * Span * S_a}{3 * C_a}$$

STRUCTURAL ANALYSIS OF LANDING GEAR



FABRICATION PROCESS



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FABRICATION

OBTAIN MATERIALS

Source materials previously discussed through local and online means

LASER CUT BALSA WOOD

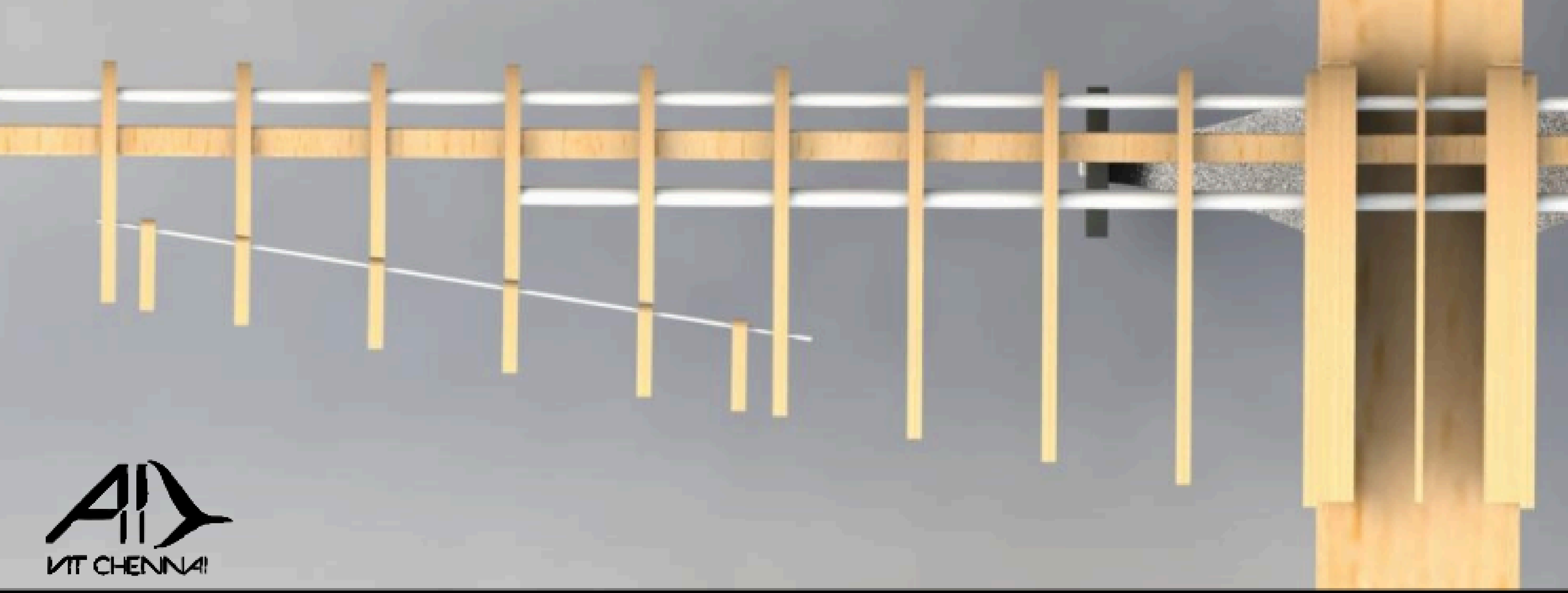
Use engineering drawings to cut balsa wood to specified shape and dimension

3D PRINTING SPARS

Use 3D printing to make spars that can withstand the aircraft stresses

ASSEMBLY

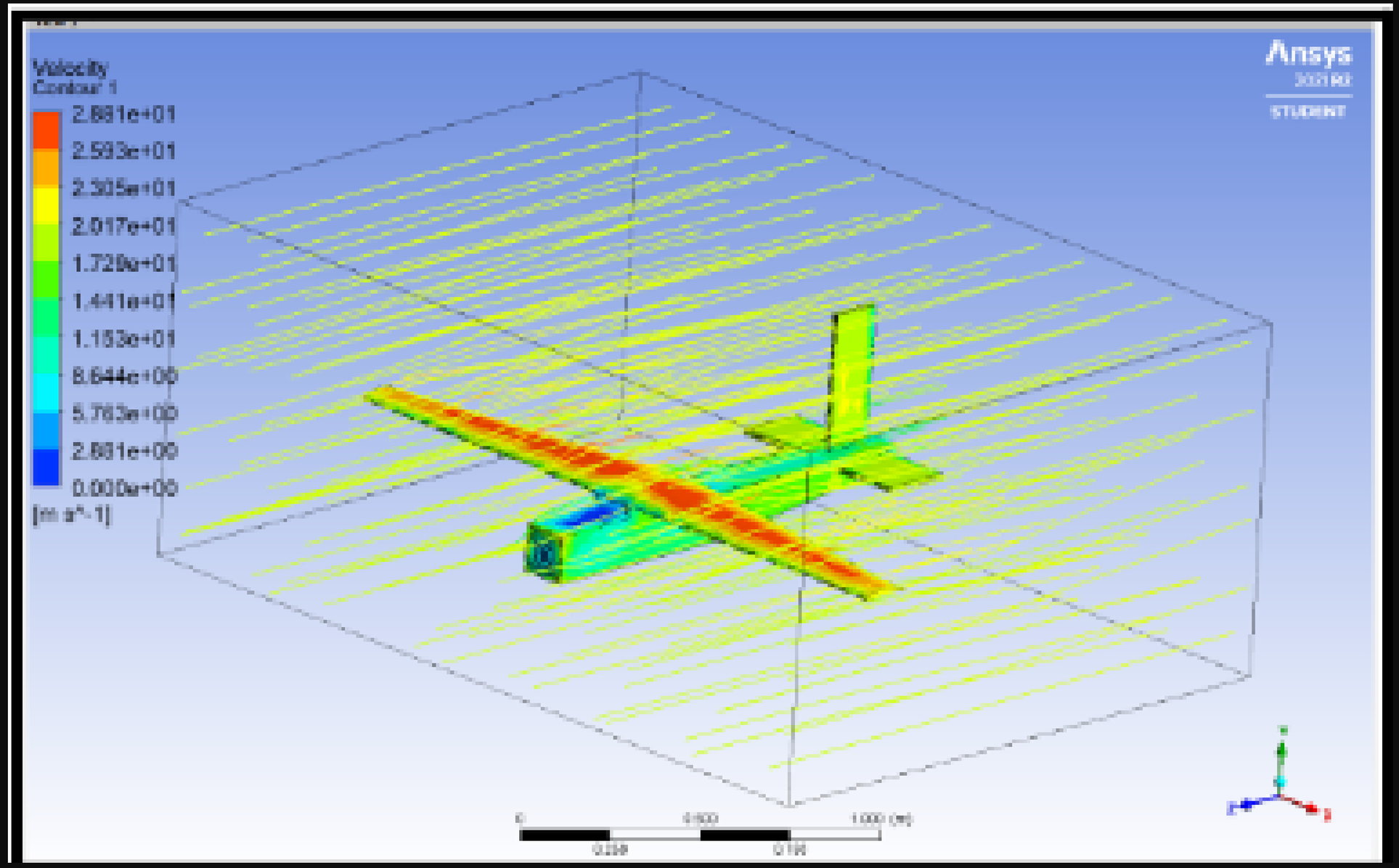
Put the pieces together using Anabond, Araldite, nuts and bolts



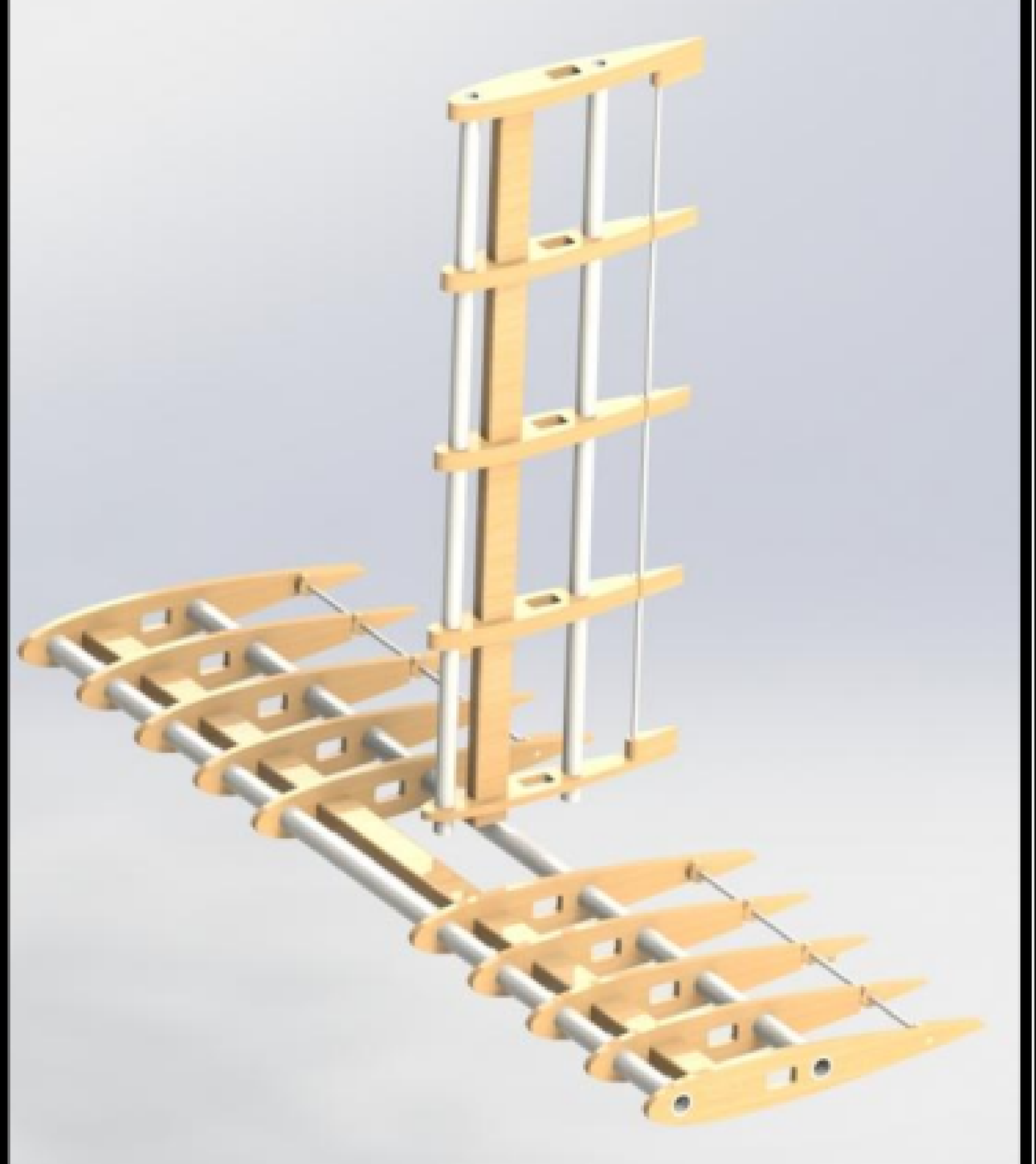
MAIN WING

The parasol wing allows for increased lift per surface area of wing, maximizeing lift per unit of weight

E423 airfoil used due to its high stall angle and



CFD of aircraft to check parasol characteristics



EMPENNAGE

Ribs and spars were assembled together and then coated with monokote sheet as protection

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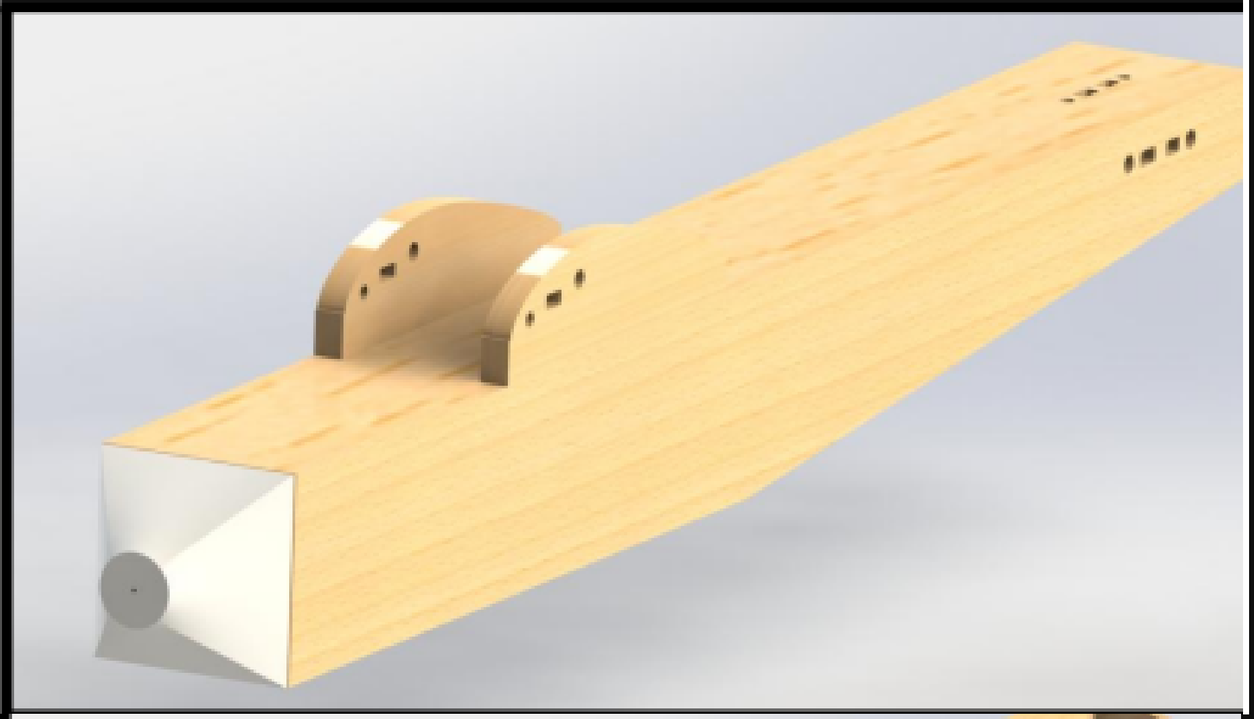

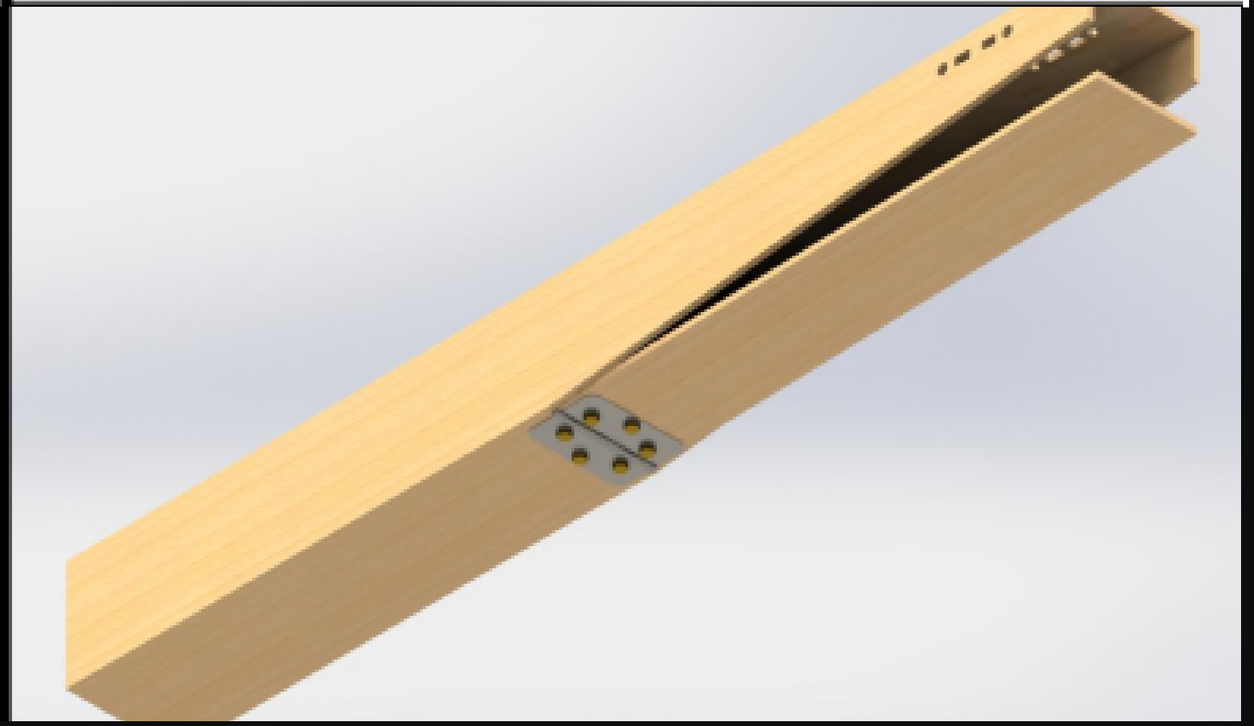

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FUSELAGE

Fabricated by assembling multiple balsa panels and adding cargo bay door with hinges

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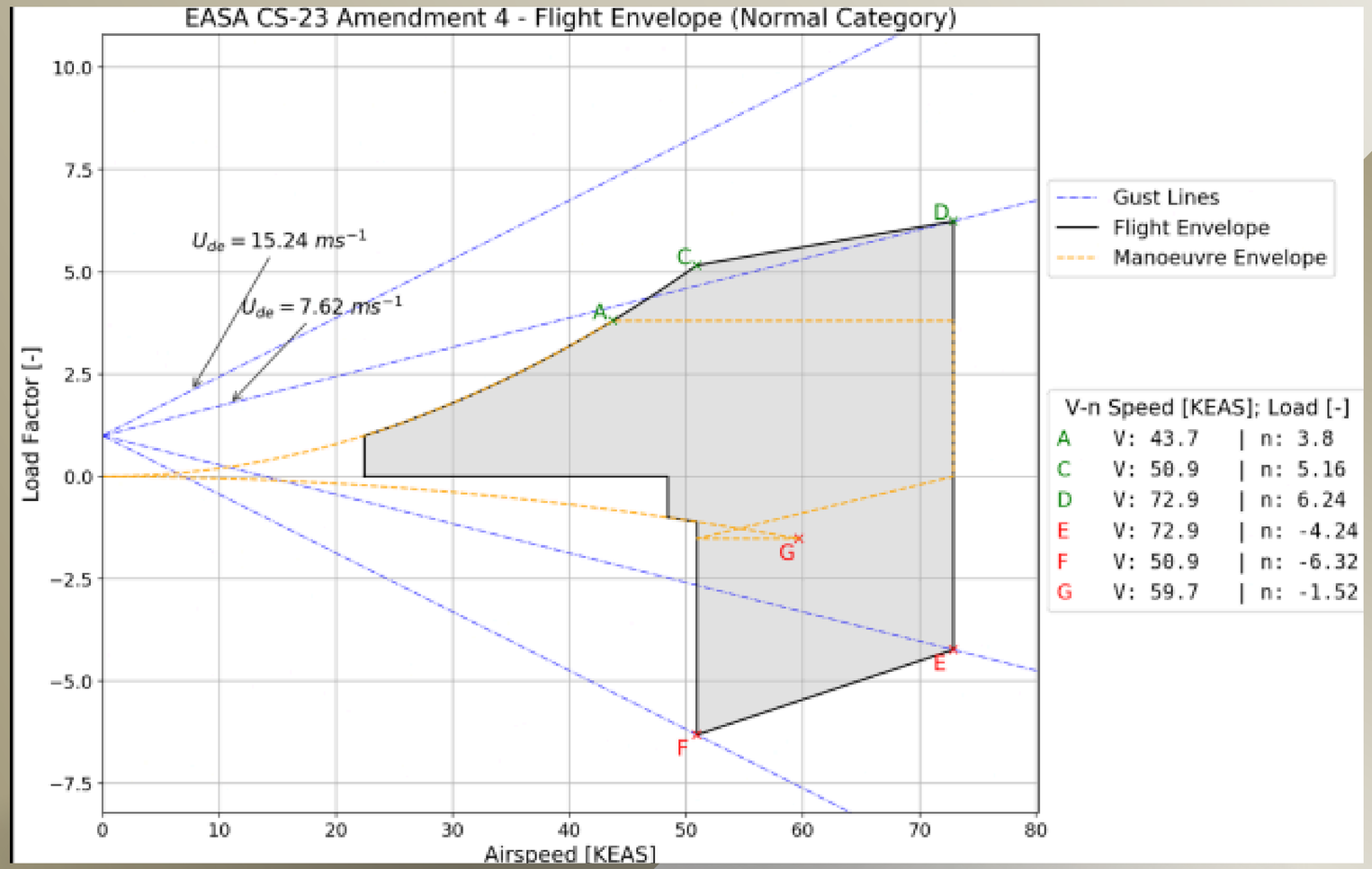
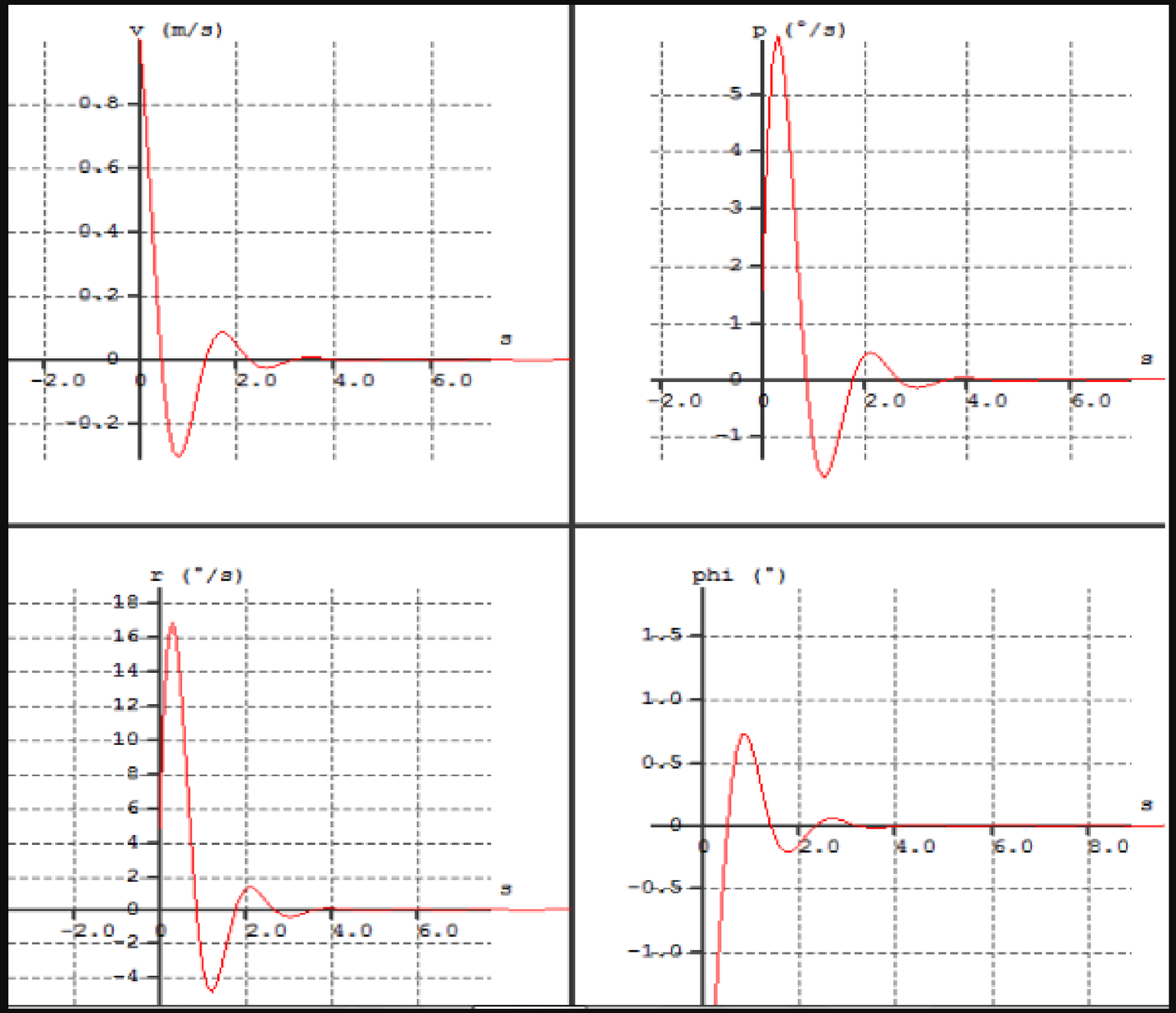
OPERATING ENVELOPE (Flight performance prediction)



DYNAMIC STABILITY ANALYSIS



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MODE	REQUIREMENTS	AIRCRAFT LEVEL	STABILITY ACHIEVEMENT
Phugoid	$\zeta > 0.04$	ζ =0.373	Level 1
Short period	$0.35 < \zeta < 1.3$	ζ =0.373	Level 1
Roll	$\tau < 1s$	τ =0.059	Level 1
Dutch Roll	$\zeta > 0.04\omega > 1$ rad/s$\zeta\omega > 0.35$ rad/s	ζ = 0.572ω = 2.532 rad/s$\zeta\omega$ = 2.199 rad/s	Level 1
Spiral	Tdouble > 20s	0.445	Functional

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FINAL AIRCRAFT LAYOUT

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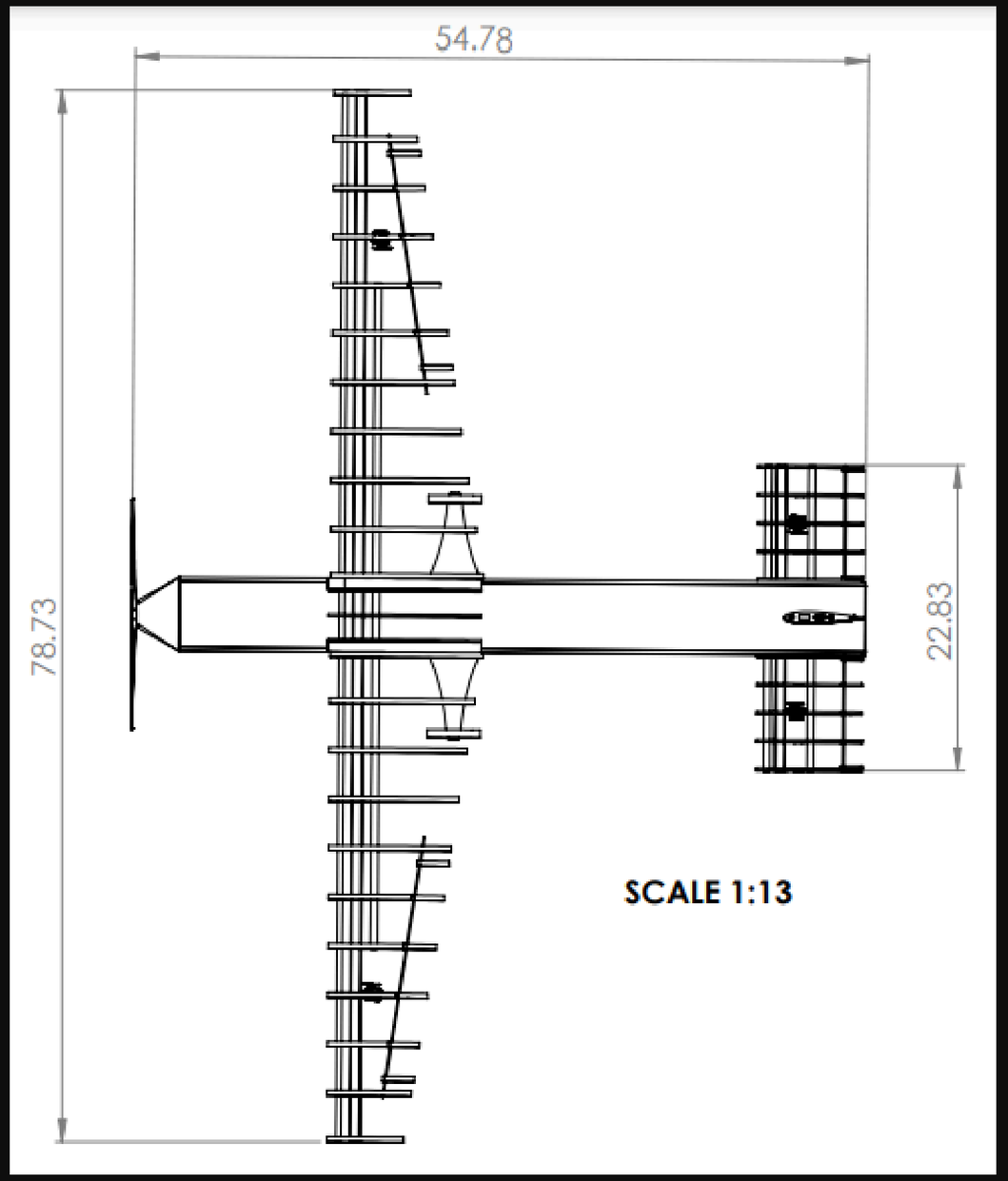
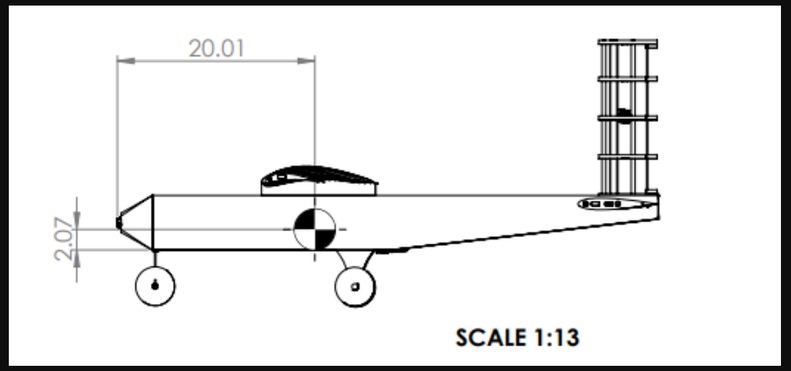
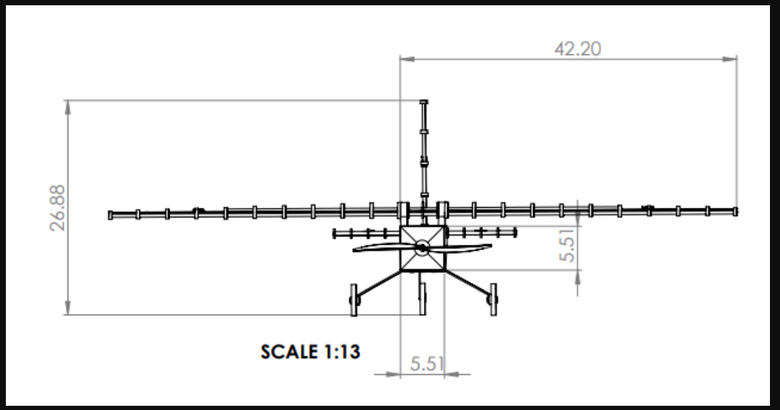


WING SPAN	78.73 in
EMPTY WEIGHT	10.4 lb





FINAL AIRCRAFT

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THANK YOU