DEPARTMENT
OF
AEROSPACE ENGINEERING

(AERO3) **TEAM 4**
AERO REFORESTATION

Miguel Abad, Ignacio Colmenero, Samuel Ramos,
Fernando Rayo, Ignacio Rubio and Aviel Zuri-Shaday

A. JAMES CLARK
SCHOOL OF ENGINEERING

Problem Definition

• **The Challenge:** Wildfires and deforestation are outpacing manual restoration efforts. Current methods lack the speed and reach required for remote or degraded areas.

•**The Solution:** An AI-integrated reforestation platform designed for high-volume seed deployment.

• **Technical Approach:** By adapting the robust **PZL M-18 Dromader** airframe, we have developed a system that uses AI-driven sensing to identify optimal planting zones and a gated hopper to automate the dispersal of up to 3,000 capsules per minute.

REQUIREMENT	RATIONALE
500 to 600 km operating distance +90 min loiter	Enables reforestation of remote areas from provisional airfields and bigger-scale airports
Takeoff and landing in unpaved or grassy runways <=2000 ft	Enables using varying runways from zones close to target areas
AI-based seed deployment system in areas under lack of trees	Allows a payload availability of a maximum of 3000 capsule seeds in a minute, reducing number of flights and costs
LIDAR, multispectral and RGB technology	Makes precise examination of topology, terrain vegetation and meteorology
Single-engine turboprop (PT6A/140)	Provides confidence in hot and dry areas where fires are more prone to occur
Conventionally-piloted with help of AI assistance (1 crew)	Bypasses stringent BVLOS (Beyond Visual Line of Sight) waivers and UAV regulations despite automating the seeding process

Design Calculations & Analysis

Wing Sizing

PARAMETER	VALUE
Wing Area	65044.8 in^2
Wingspan	712.32 in
Aspect Ratio	7.80
Taper Ratio	0.95
Root Chord	25.62 in
Leading Edge Sweep	0.19°
Type of Airfoil	NACA 4412
Dihedral	4°
Fuel Tank Capcity	Jet-A (6.71 lb/gal) 202 gal = 46656 in^3
Flaps	Single-Slotted, 15° (take off) & 35°- 40° (Landing)

Performance and Mass

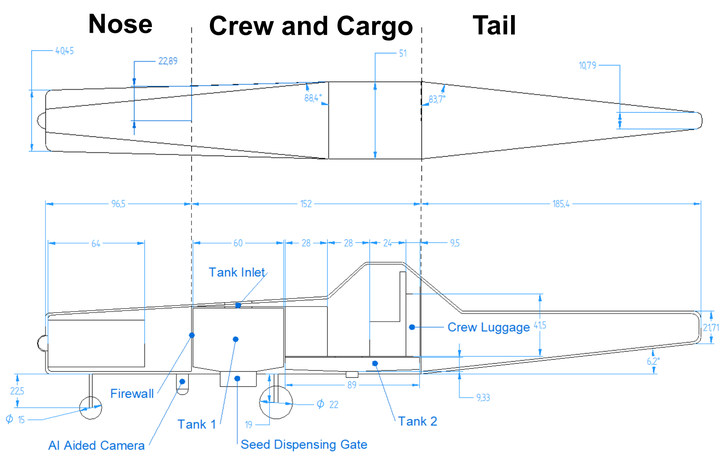
PARAMETER	VALUE
Fuel Weight	1349 lb
Payload Weight	2976 lb
Empty Weight	4934 lb
MTOW	9259 lb
Wing Loading	20.5 lb/ft^2
Power Loading	0.0836 hp/lb
Engine Type	PT6A-140

Fuselage Parameters

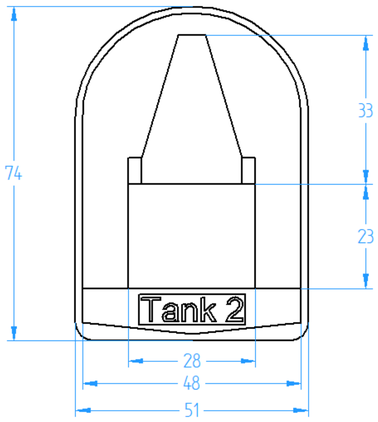
PARAMETER	VALUE
Total Length	433.90 in
Lenght to Span Ratio	0.61
Equivalent d_f	61.30 in
$\frac{l_f}{d_f}$	7.10
$\frac{l_{fc}}{d_f}$	3.02
Cross-Section Type	Half-Round Rectangle
Over-nose Visibility	8° (Limited by nose length, targeting vision is managed by AI camera)
Firewall Thickness (Divides nose and tank 1)	0.02 in
Capacity Tank 1	131580 in^3 (64303 seeds)
Capacity Tank 2	42349 in^3 (20697 seeds)
Touchdown Pitch Angle	6.2°
Estimated Fuselage Weight	1296.3 lb
Truss Structure	4130 Steel Tubular Frame
Crew Luggage Capacity	6 ft^3 $(9.5 \cdot 26.3 \cdot 41.5) in^3$
Fuselage Thickness	1.5 in
Engine Dimensions	$(31.2 \cdot 31.2 \cdot 64) in^3$

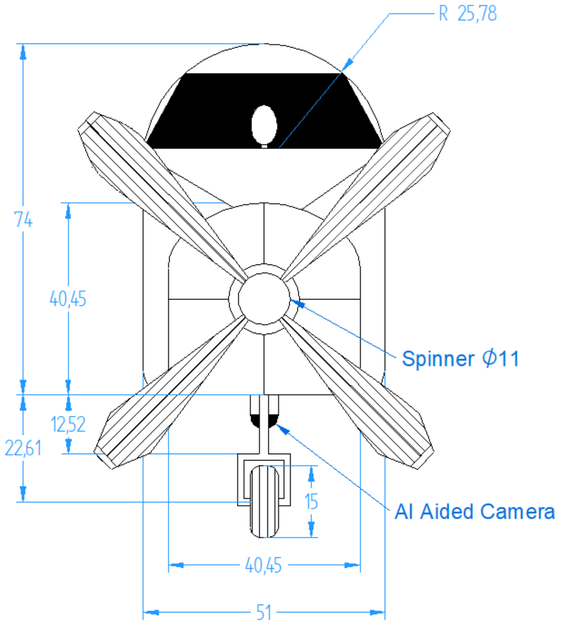
Empennage Sizing

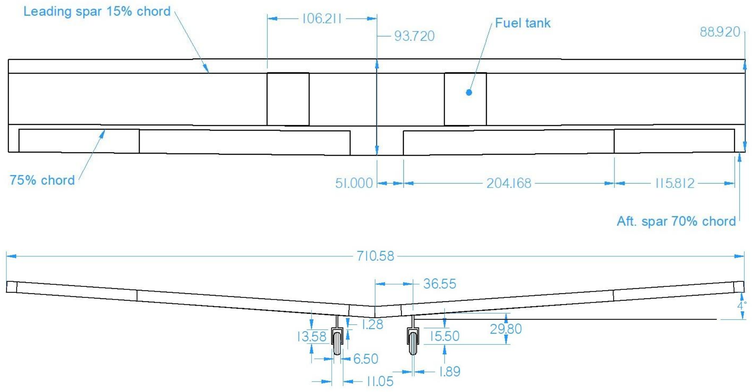
SURFACE	AREA	SPAN	ASPECT RATIO	SWEEP
Horizontal Tail	13464 in^2	239.16 in	4.25	5°
Vertical Tail	5500.8 in^2	92.28 in	1.55	0°

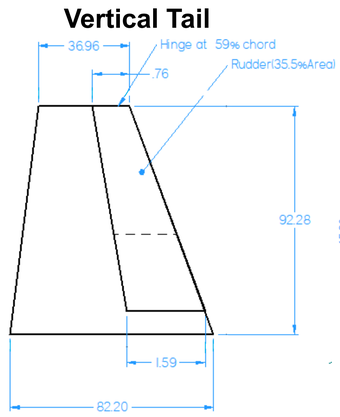


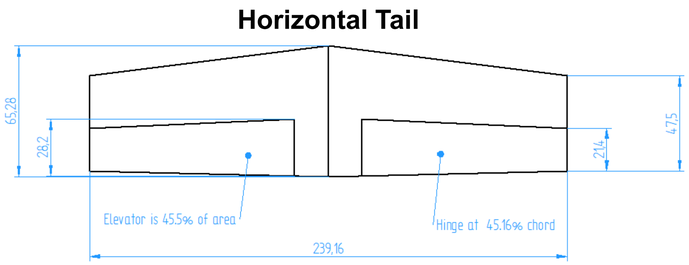
Final Design





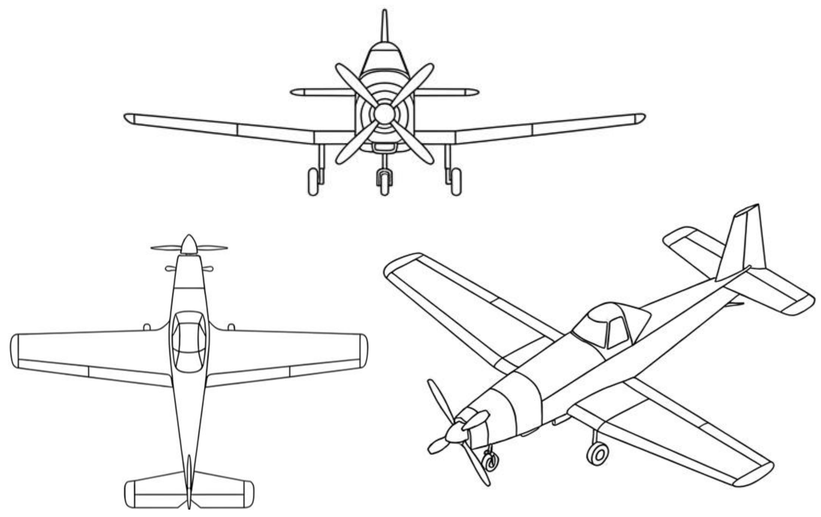






Landing Gear Parameters

PARAMETER	VALUE
Main Gear	151.36 in
Nose Gear	30.76 in
Main Gear Strut (x2)	Diameter: 2.66 in Stroke: 7.00 in
Main Gear Strut (x2)	Diameter: 1.89 in Stroke: 3.00 in
Main Gear Max Load	5208 lbs (per strut)
Nose Gear Max Load	1841 lbs
Main Tires (x2)	$(22 \cdot 6.5) in^2$
Nose Tire (x1)	$(15 \cdot 6) in^2$



Prototype & Test Results

- **High-Volume Reforestation:** ability to carry 2,800 lb of seeds per mission, covering approximately 77 acres per flight.
- **AI-Precision:** LIDAR and multispectral cameras allow for analysis of soil health and enhancing pilots' visibility via AI-managed targeting.
- **Structural integrity:** Welded 4130 steel truss structure can sustain the 9259 lb (MTOW), and the PT6A-140 engine ensures reliable performance for heavy-lift operations.
- **Short Field Capability:** Capable of operating from unpaved airfields with a wing loading of 20.5 $\frac{lb}{ft^2}$ and a single-slotted flap configuration (15° for takeoff).