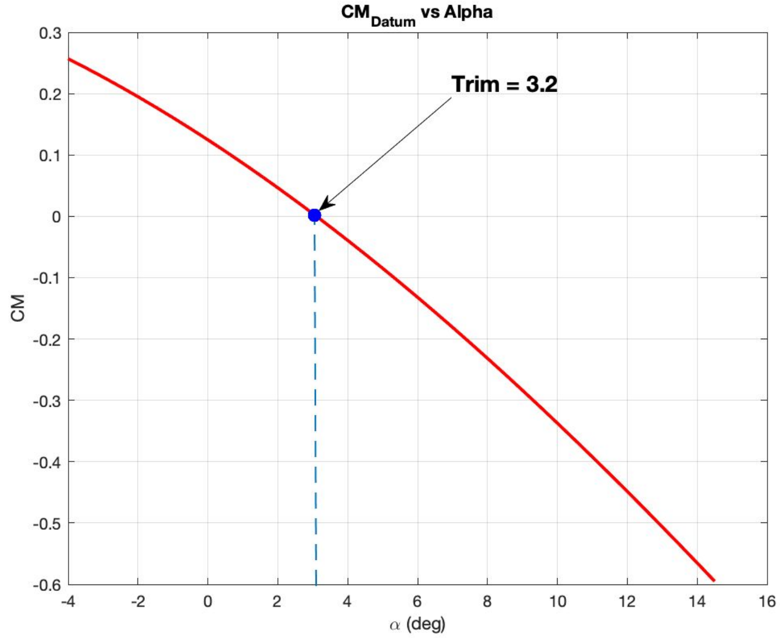
XFLR5 Values and Graph

Table 1.1 – XFLR5 Values

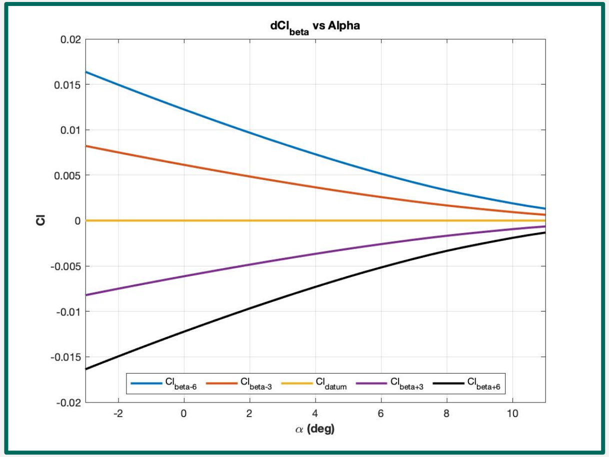
Parameter	Value	Unit
Initial Mass	27016	kg
$[X_{cog}, Y_{cog}, Z_{cog}]$	$[-0.886, 0, -0.631]$	m
X_{np}	-1.862	m
Density	1.225	$\frac{kg}{m^3}$
Cruise Speed	180	$\frac{m}{s}$
MAC	2.59	m
Span	30.54	m
Ref Area	75.59	m^2

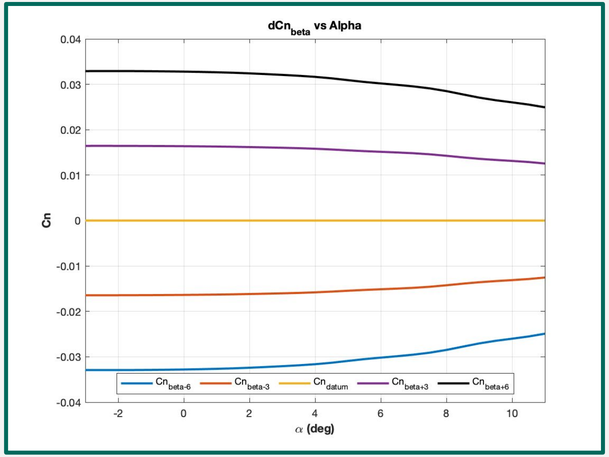
$$\begin{bmatrix} I_{xx} & I_{xy} & I_{xz} \\ I_{yx} & I_{yy} & I_{yz} \\ I_{zx} & I_{zy} & I_{zz} \end{bmatrix} = \begin{bmatrix} 229042 & 0 & 264144 \\ 0 & 1444714 & 0 \\ 264144 & 0 & 1531691 \end{bmatrix} \begin{bmatrix} kg.m^2 \\ kg.m^2 \\ kg.m^2 \end{bmatrix}$$



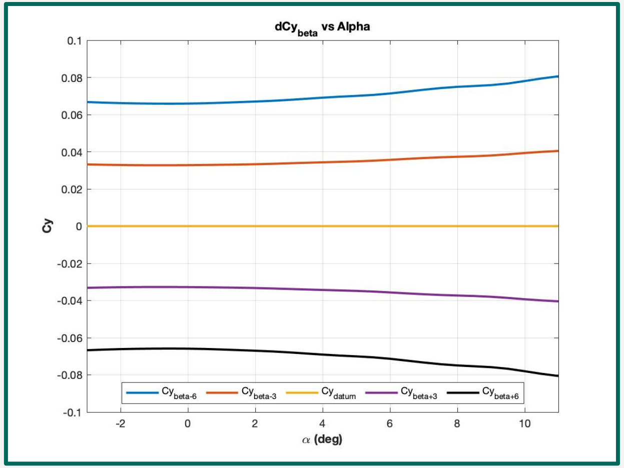
Aerodynamic Coefficients

There are 12 more graphs of the remaining coefficients in our report.

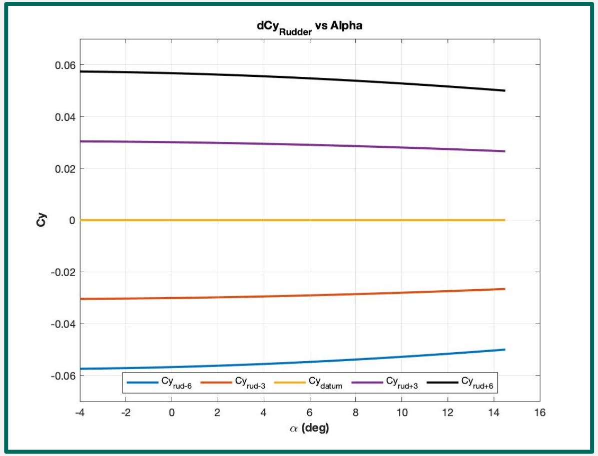


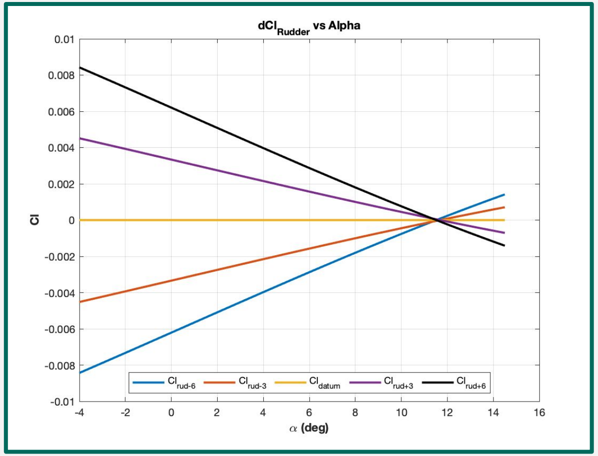


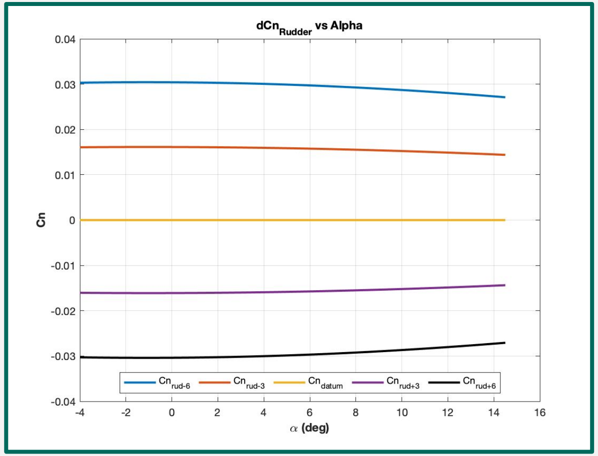
Control	Deflection (deg)
Beta	-6, -3, 0, 3, 6
Ailerons	-10, -5, 0, 5, 10
Rudder	-6, -3, 0, 3, 6
Elevator	-5, -3, 0, 3, 5

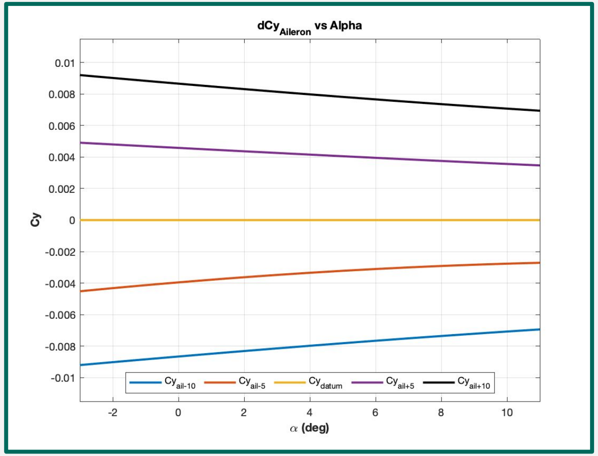


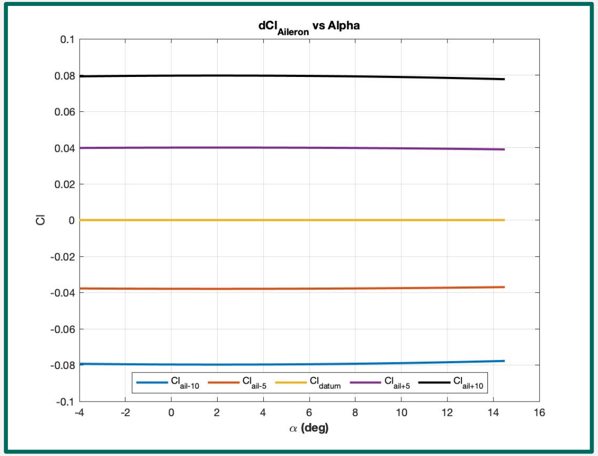
Aerodynamic Coefficients

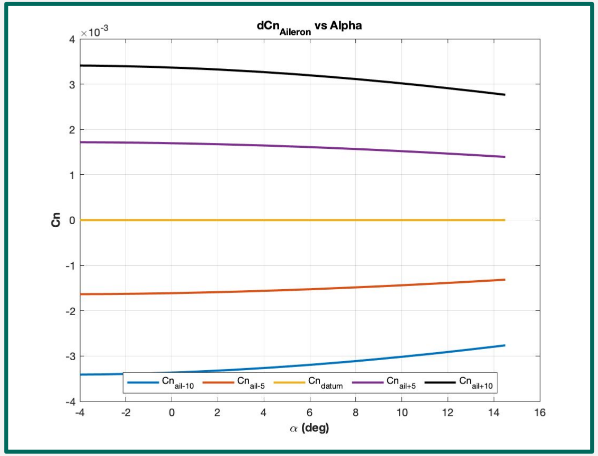




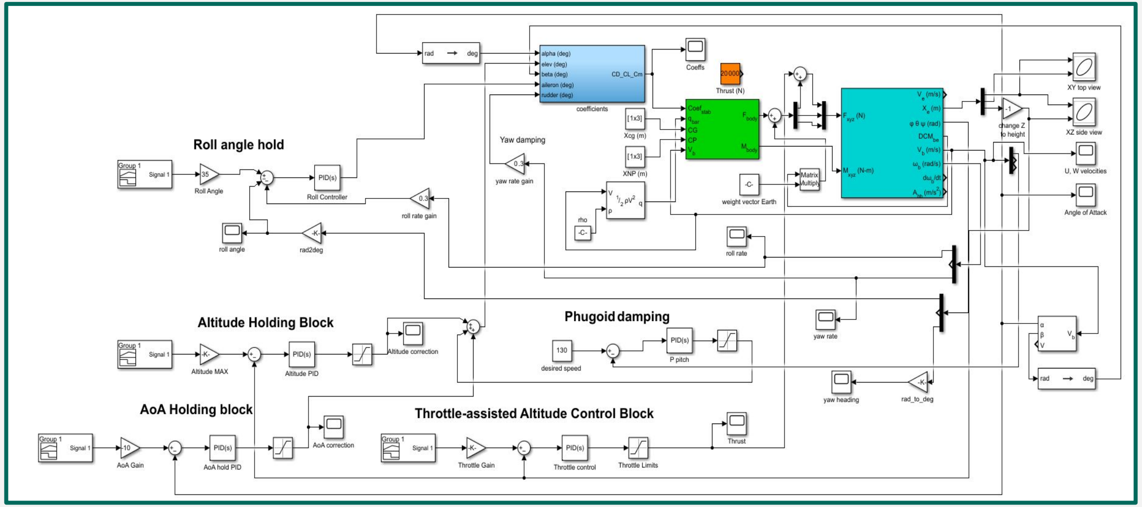


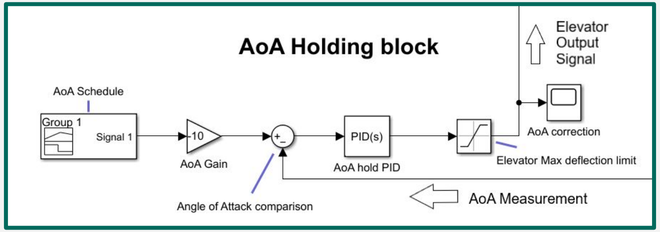


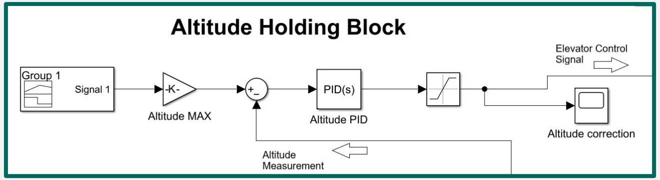


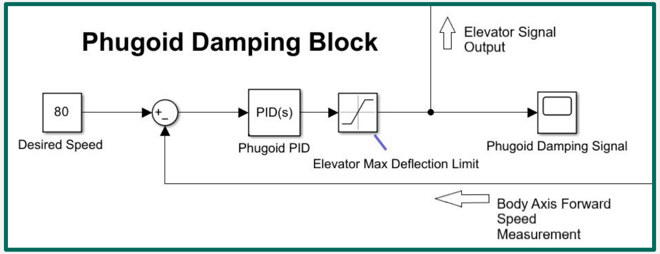


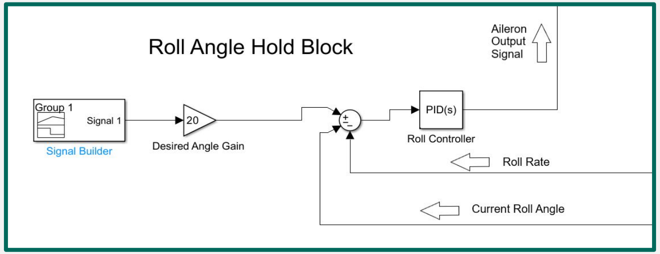
Feedback Controllers





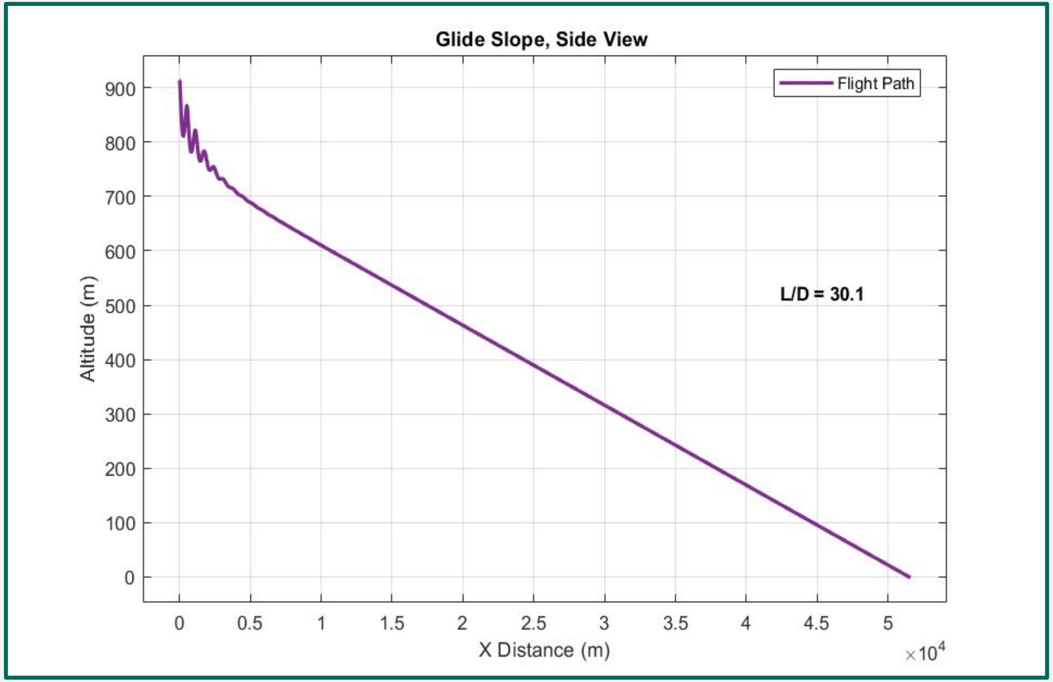






- PID Controllers for elevator, throttle, and aileron control.
- Saturation blocks to limit elevator deflection and throttle.
- Signal Builders to schedule desired gain.

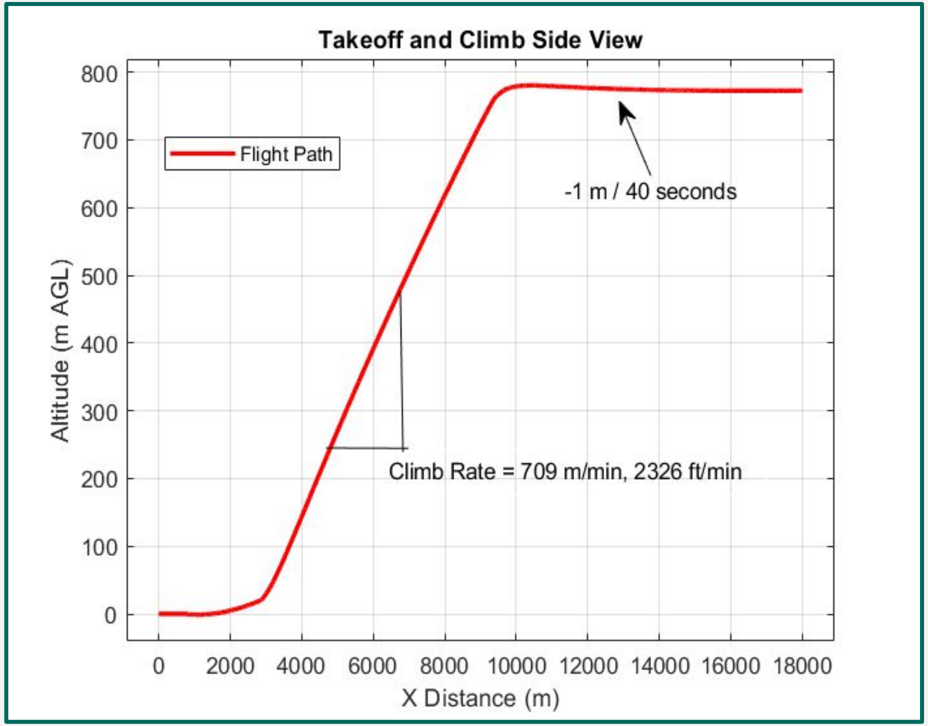
Gliding Flight

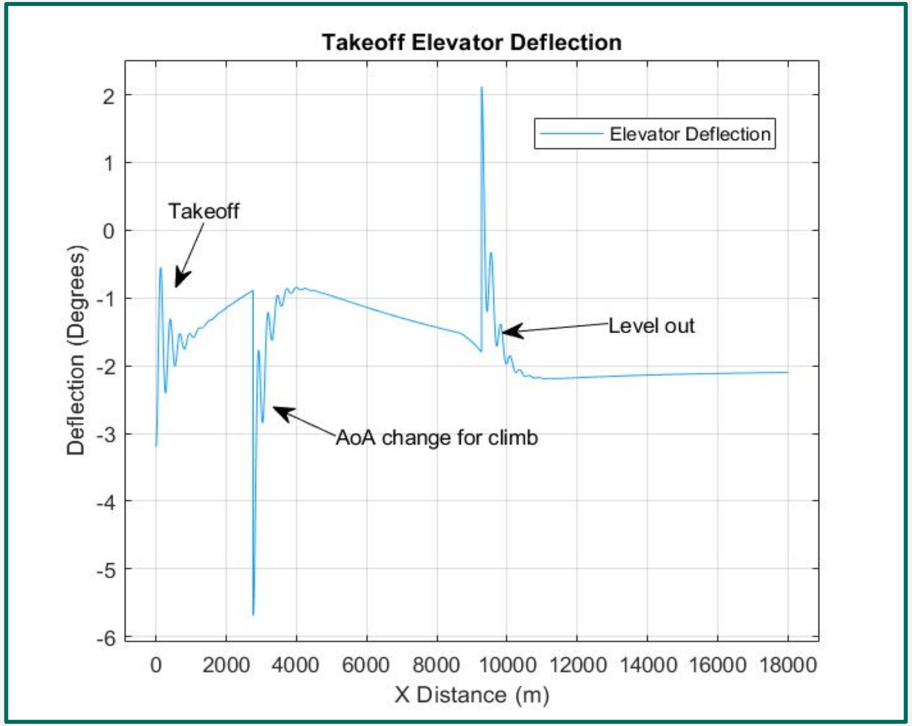


Control Surfaces	Deflection (deg)
Elevator	-3.23
Ailerons	0
Rudder	0
L/D = 30.1	

Initial Speed: 180 m/s
Thrust: 0 N

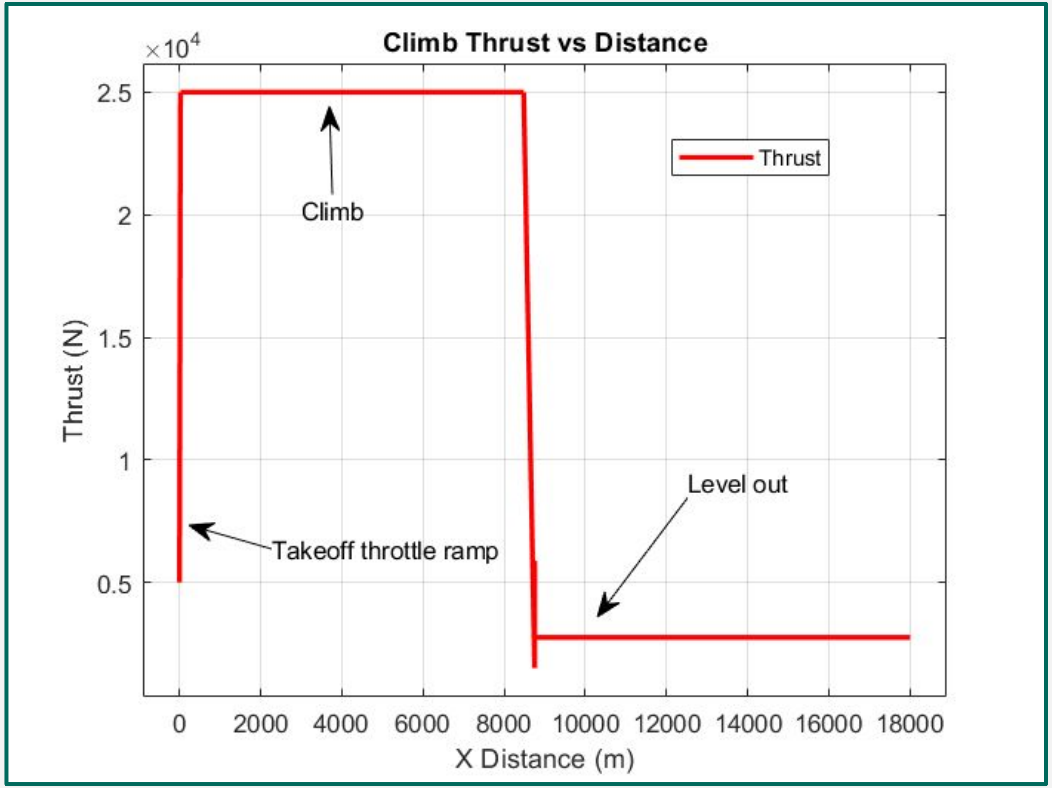
Takeoff and Climb





Climb Rate: **2326 ft/min (709 m/min)**

Takeoff and Climb



Climb Thrust: **25,000 N**

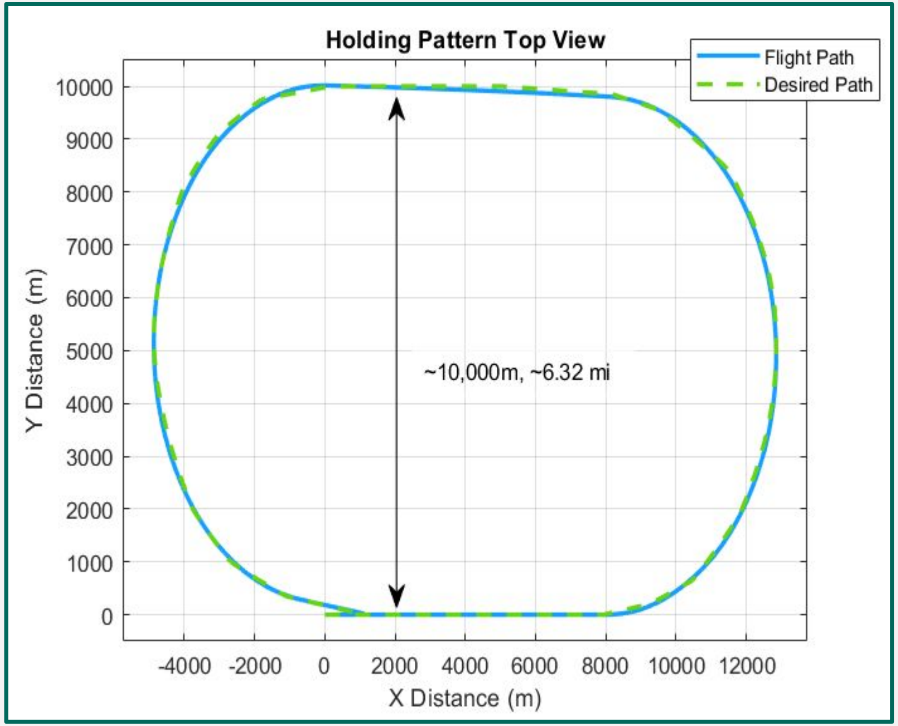
Elevator Deflection: **2 Degrees**

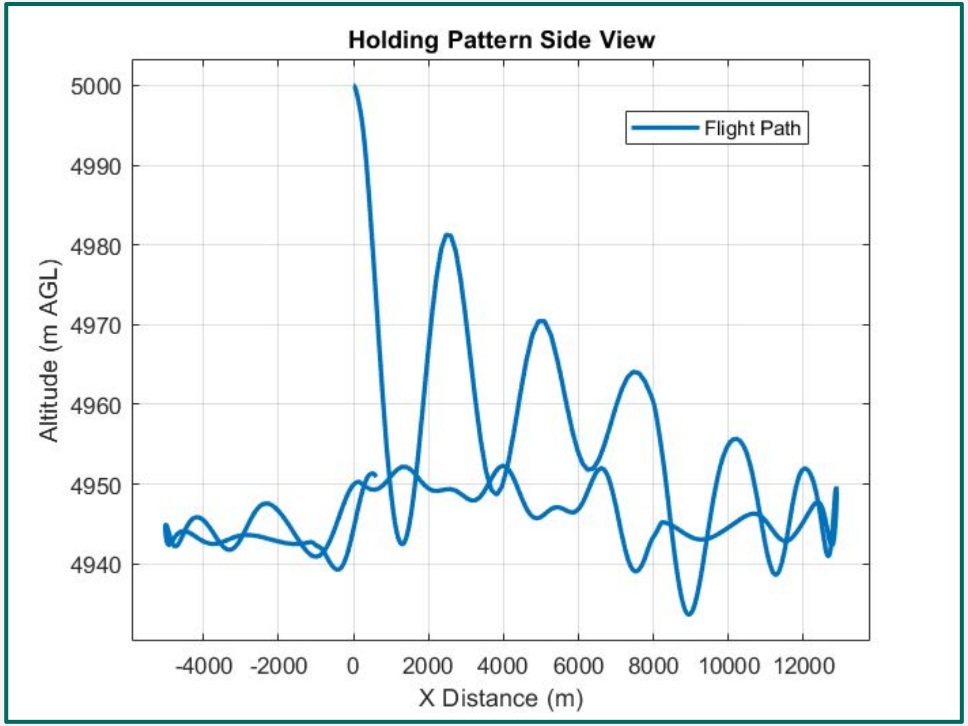
Climb AoA: **- 3 Degrees**

Takeoff AoA Max: **- 7.5 Degrees,**

Excessive climb rate due to using maximum thrust during climb, and modelling limitations related to drag and stall.

Holding Pattern



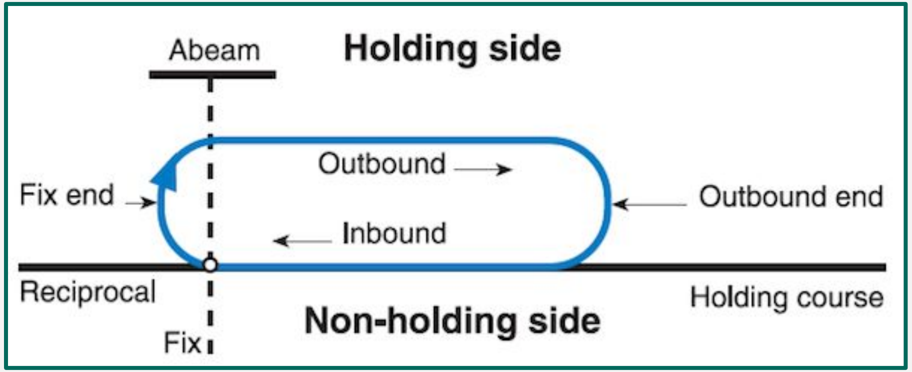


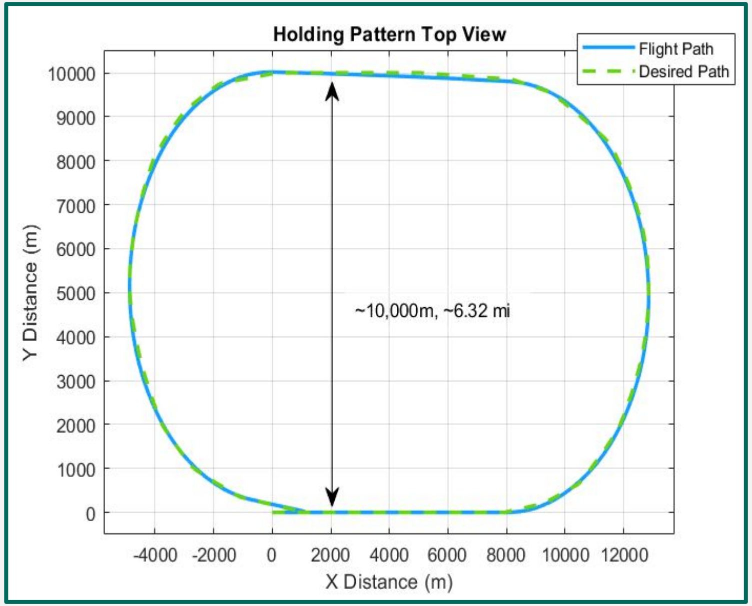
Bank Angle: **25 degrees**

Altitude deviation: **+/- 40 ft (12 m)**

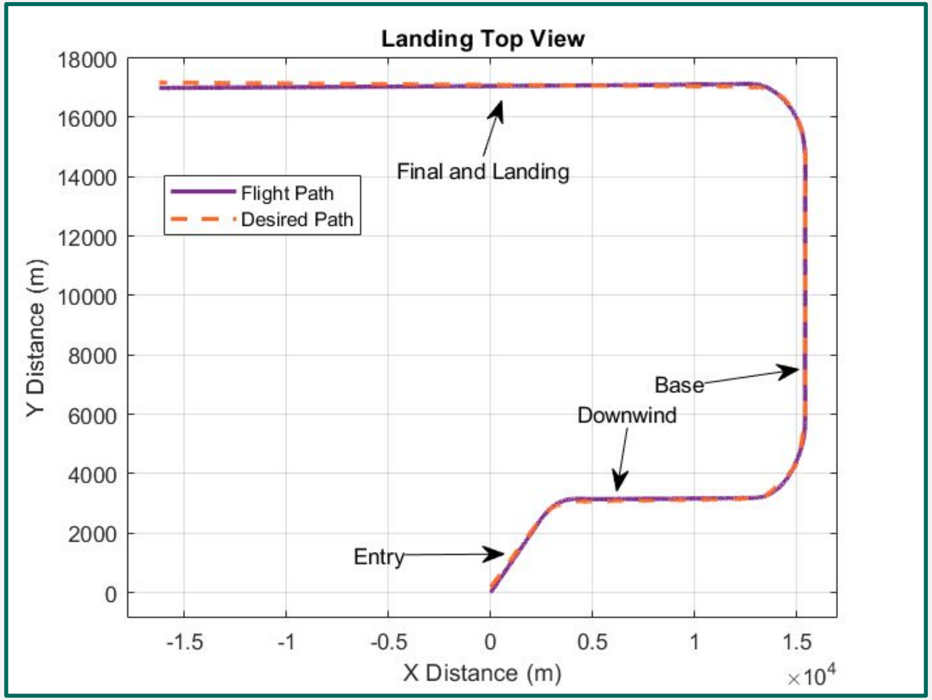
Holding Pattern

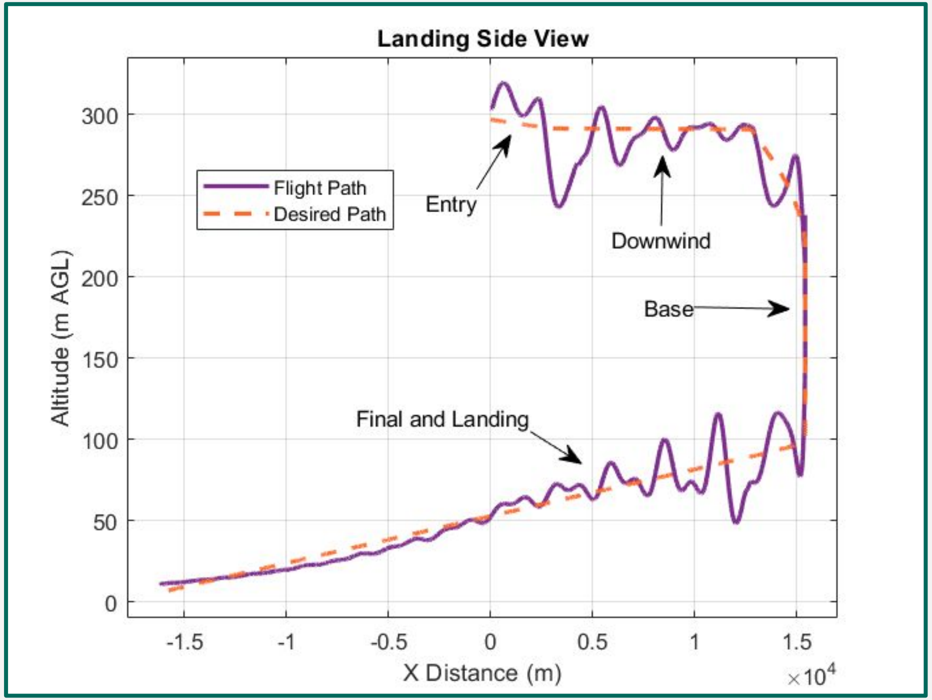
- Phugoid motion is introduced from the roll
- Damps out during straight and phugoid returns during the rolls
- Pattern is repeatable
- Bank angle - 25 degrees





Landing

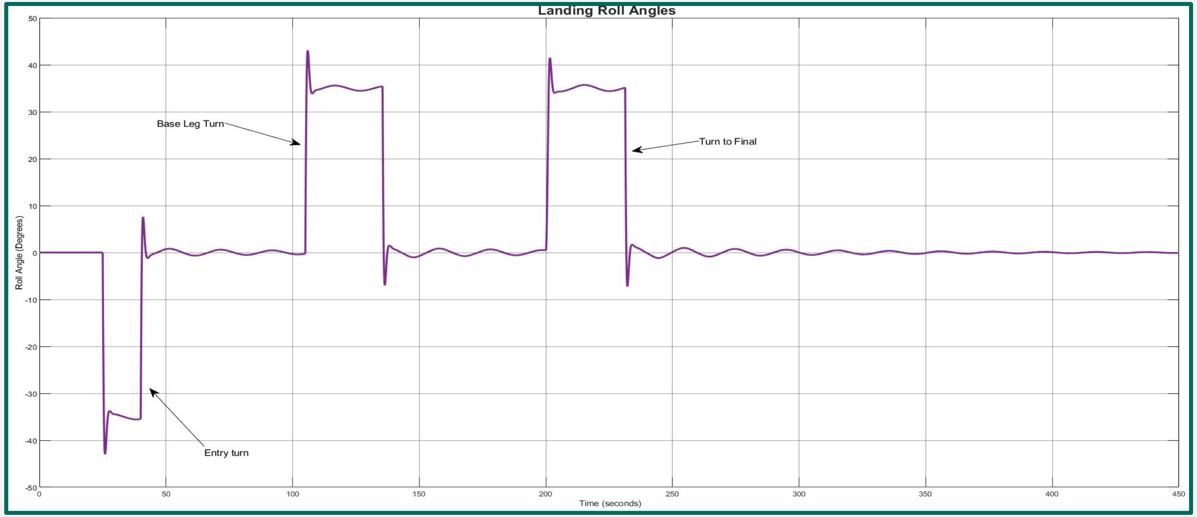




Bank angle: **35 degrees**

Landing

- Roll angle - 35 degrees
- Modelled with step function
- Rolling introduces phugoid, but damps out during descent



Risk Assessment

Hazard	Assessment	Risk	Mitigation
Pre Flight (testing, maintenance, simulation)			
Operational Cost	B2	Delayed project timeline	Clarified method on fund acquisition & allocation
System Design (Manufacturing Mishaps)	A4	Hinder project timeline, and delivery	Controlled and designated resource - allocation. Supply chain
Faulty component	B1	Fatal crash, death, serious environmental impact	Beforehand testing, and maintenance work
Technology Limitation	B4	Not meeting the 2035 entry	Active RnD researchs, Mindful design
In Flight (live operation and performance)			
Electrical, Fuel, & Hydraulic issue	B1	Cause fatal crash or damage of the plane	Backup controls, separate power - systems, proper insulation
Thermal (Fire) Issues	B3	Engine, Electrical, Mechanical - parts damage causing crash	Hybrids are usually less prone to fire, but - IMT-22 will utilise double wall bumpers
Foreign Airplanes	E1	Mid air collision, causing fatal crash	Active tracking of other airplanes, Instrument ratings
Descend Flight (landing, taxi)			
Possible Engine Loss	B1	Crash landing, Environmental damage, Fire	IMT-22 is designed to fly & land on single engine. Can glide up to 30.2 miles as well.
Vibrational Wear out	B3	Structural and payload damage	Incorporate shock absorbers. Distribute static loads if possible.
Control Burnout	B4	Minor effects on landing performance	Provide engineered stall warning Pilot stick shake feedback Proper signs and warning alerts.

		Risk Severity			
		Catastrophic (1)	Major (2)	Minor (3)	Negligible (4)
Risk Probability	Frequent (A)	A1	A2	A3	A4
	Probable (B)	B1	B2	B3	B4
	Improbable (E)	E1	E2	E3	E4

Summary

- **IMT-22 flies as specified in the preliminary design**
- Take off in about 2500 ft
- Has a 1200 nautical mile range
- Reduced fuel consumption by 27% compared to current turboprop competitors

Limitations:

- Viscous effects. XFLR limitation → L & D affected, Viscous drag modelling.
- MATLAB → Stall prediction, and compressibility.