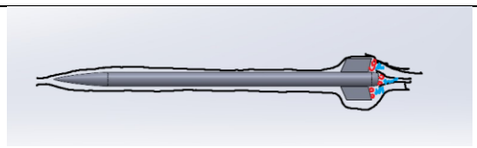
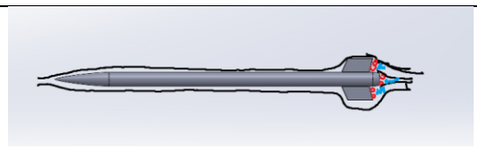
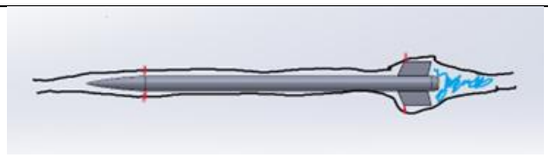
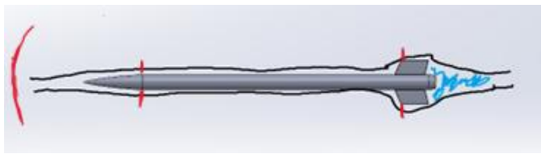
Characteristics	0.1	0.2
Understanding the aerodynamics		
[1] Flow Picture		
[2] Describe the flow in words	The flow is Subsonic, turbulent, and incompressible. The rocket is a streamlined body and thus most of the drag comes from skin friction, though pressure drag is also present especially in protrusions such as the camera mount. The flow separates in the wake region creating some pressure drag.	The flow is Subsonic, turbulent, and incompressible. The rocket is a streamlined body and thus most of the drag comes from skin friction, though pressure drag is also present especially in protrusions such as the camera mount. The flow separates in the wake region creating some pressure drag, this wake region increases in length and becomes narrower as compared to 0.1M.
[3] Regions of interest	Wake Region	Wake Region
[4] Incompressible/ Compressible	Incompressible	Incompressible
[5] Laminar/Turbulent	Turbulent	Turbulent
Operating Conditions/Expectations (Example from IREC 2025 comp. rocket)		
[6] Pressure Density	■■■■■■■ *redacte*	■■■■■■■ *redacte* ■■■■■■■ *redacte* ■■■■■■■ *redacte*
[7] Velocity Mach	■■■■■■■ *redacte*	■■■■■■■ *redacte* ■■■■■■■ *redacte* ■■■■■■■ *redacte*
[8] Temp Reynolds	■■■■■■■ *redacte*	■■■■■■■ *redacte* ■■■■■■■ *redacte* ■■■■■■■ *redacte*
[9] AOA/Viscosity	■■■■■■■ *redacte*	■■■■■■■ *redacte* ■■■■■■■ *redacte* ■■■■■■■ *redacte*
[10] Open Rocket Drag	■■■■■■■ *redacte*	■■■■■■■ *redacte* ■■■■■■■ *redacte* ■■■■■■■ *redacte*
[11] Acceptable $y+$	$y+ = 30 - 300\ (calc\ for\ 200)$	$y+ = 30 - 300\ (calc\ for\ 200)$
[12] Aprox. first layer, Number of layers, and growth rate	$y_1 = 0.00605$ $L = 6$ $Gr = 1.19$	$y_1 = 0.00306$ $L = 8$ $Gr = 1.20$
Geometry Setup		
[13] Domain shape and size	Cylindrical domain 10RD in front of nose and 50RD behind the rocket with a diameter of 40RD(1RD=■■■■■■■■)	Cylindrical domain 10RD in front of nose and 50RD behind the rocket with a diameter of 40RD(1RD=■■■■■■■■)
[14] Geometry Simplifications	None (all attached) Had to fill camera mount hole Guides on rail buttons filled	None (all attached) Had to fill camera mount hole Guides on rail buttons filled
[15] Symmetry applied?	No	No
[16] Repair Geometry Used	No	No
[17] Named Selections	Inlet, Outlet, Walls, fins, fin brackets, camera mount, rail buttons, non protrusions	Inlet, Outlet, Walls, fins, fin brackets, camera mount, rail buttons, non protrusions

Mesh Setup		
Characteristics	0.1	0.2
[18] Face Sizing's	non protrusions, camera mount, fins: 0.02m rail buttons: 0.04m Fin brackets: 0.06m	non protrusions, camera mount, fins: 0.02m rail buttons: 0.04m Fin brackets: 0.06m
[19] Virtual BOI's	Wake region: xmin/max: 0.25, 0.25. ymin/ymax: 0.25, 0.25. zmin/zmax: 0.6, -1 size 0.04m scaled by all labels attached to rocket	Wake region: xmin/max: 0.25, 0.25. ymin/ymax: 0.25, 0.25. zmin/zmax: 0.6, -1 size 0.04m scaled by all labels attached to rocket
[20] Curvature/Proximity local sizing	Proximity: min size 0.02m cells per gap 10 label fins	Proximity: min size 0.02m cells per gap 10 label fins
[21] Other local sizing's	N/A	N/A
[22] Surface Mesh Settings	Curvature only of 12 degrees *improve surface mesh task with target 0.7*	Curvature only of 12 degrees *improve surface mesh task with target 0.7*
[23] Define Geometry	Only fluid regions with no voids: no, no, no	Only fluid regions with no voids: no, no, no
[24] Boundary Layer	Smooth 8 layer on fins, fin brackets, and rail buttons Uniform 8 layer of first height 0.002 on selected label camera mount and non-protrusion	Smooth 8 layer on fins, fin brackets, and rail buttons Uniform 8 layer of first height 0.002 on selected label camera mount and non-protrusion
[25] Volume Mesh	Default *Improve volume mesh task with target 0.15*	Default *Improve volume mesh task with target 0.15*
Physics Setup		
[26] Scale Applied?	No (Don't have enough knowledge to do this)	No (Don't have enough knowledge to do this)
[27] Solver type	Pressure-Based	Pressure-Based
[28] Steady or Transient	Steady	Steady
[29] Viscous Model	SST-K-OMEGA	SST-K-OMEGA
[30] Energy Equation used?	No	No
[31] Air Material Properties	Density constant and equal to operating cond. Viscosity constant and equal to operating cond.	Density constant and equal to operating cond. Viscosity constant and equal to operating cond.
[32] Boundary Conditions	Velocity-Inlet at 34.3 m/s with directional components representing AOA at operating condition Pressure-outlet default Boundary walls are specified shear with 0 shear Any label attached to rocket should have specified surface roughness of 6e-5 or a known surface roughness	Velocity-Inlet at 68.6 m/s with directional components representing AOA at operating condition Pressure-outlet default Boundary walls are specified shear with 0 shear Any label attached to rocket walls should have specified surface roughness of 6e-5 or a known surface roughness
[33] Operating Conditions	Operating pressure equal to operating condition pressure	Operating pressure equal to operating condition pressure
[34] Dynamic Mesh Used?	No	No
[35] Reference Values	As needed (does not affect sim)	As needed (does not affect sim)
[36] Method Scheme	Default	Default
[37] Method Spatial Discretization	Default	Default
[38] Controls constants	Default	Default
[39] Report Definition	As needed (does not affect sim)	As needed (does not affect sim)
[40] Convergence Condition	Continuity should be <0.005 or 5e-3, rest are default	Continuity should be <0.005 or 5e-3, rest are default
[41] Initialization settings	Hybrid Initialization	Hybrid Initialization
[42] Run Calculation	Takes about 150 iterations to smooth	Takes about 150 iterations to smooth

Characteristics	0.9	1.0
Understanding the aerodynamics		
[1] Flow Picture		
[2] Describe the flow in words	The flow is Transonic, turbulent, and compressible. The rocket is a streamlined body and thus most of the drag comes from skin friction, though pressure drag is also present especially in protrusions such as the camera mount. The flow separates in the wake region creating some pressure drag, this wake region increases in length and becomes narrower as compared to 0.8M. Possible to have flow separation on fins and nose cone where normal shocks may form if the flow gets to the speed of sound in these areas.	The flow is Sonic, turbulent, and compressible. The rocket is a streamlined body and thus most of the drag comes from skin friction, though pressure drag is also present especially in protrusions such as the camera mount. The flow separates in the wake region creating some pressure drag, this wake region increases in length and becomes narrower as compared to 0.9M. Possible to have flow separation on fins and nose cone where normal shocks will start to form if the flow gets to the speed of sound in these areas. Bow shock in front of the rocket may also start to form.
[3] Regions of interest	Wake region, if shocks do form then at shock formation.	Wake region, on shocks
[4] Incompressible/ Compressible	compressible	compressible
[5] Laminar/Turbulent	Turbulent	Turbulent
Operating Conditions/Expectations (Example from IREC 2025 comp. rocket)		
[6] Pressure Density	[redacted]	[redacted]
[7] Velocity Mach	[redacted]	[redacted]
[8] Temp Reynolds	[redacted]	[redacted]
[9] AOA/Viscosity	[redacted]	[redacted]
[10] Open Rocket Drag	[redacted]	[redacted]
[11] Acceptable $y+$	$y+ = 30 - 300\ (calc\ for\ 200)$	$y+ = 30 - 300\ (calc\ for\ 200)$
[12] Aprox. first layer, Number of layers, and growth rate	$y_1 = 0.000448$ $L = 15$ $Gr = 1.21$	$y_1 = 0.000724$ $L = 14$ $Gr = 1.18$
Geometry Setup		
[13] Domain shape and size	Cylindrical domain 10RD in front of nose and 50RD behind the rocket with a diameter of 40RD(1RD=[redacted])	Cylindrical domain 10RD in front of nose and 50RD behind the rocket with a diameter of 40RD(1RD=[redacted])
[14] Geometry Simplifications	None (all attached) Had to fill camera mount hole Guides on rail buttons filled	None (all attached) Had to fill camera mount hole Guides on rail buttons filled
[15] Symmetry applied?	No	No
[16] Repair Geometry Used	No	No
[17] Named Selections	Farfield, non-protrusions, camera mount, rail buttons, fins (fins and fins bracket)	Farfield, non-protrusions, camera mount, rail buttons, fins (fins and fins bracket)