

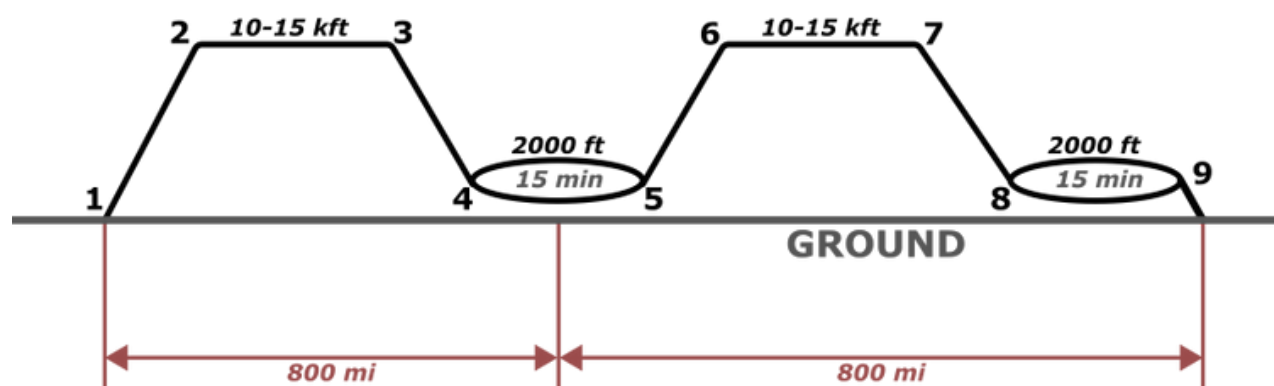
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PROBLEM DEFINITION

During the last decades, natural disasters on Earth including floods, fires, tornados and earthquakes have increased making people requiring of aid. The objective of this project is to address natural disaster relief with a fleet of airplanes that are specifically designed to continuously provide humanitarian aid, including fresh water, food and medical resources.

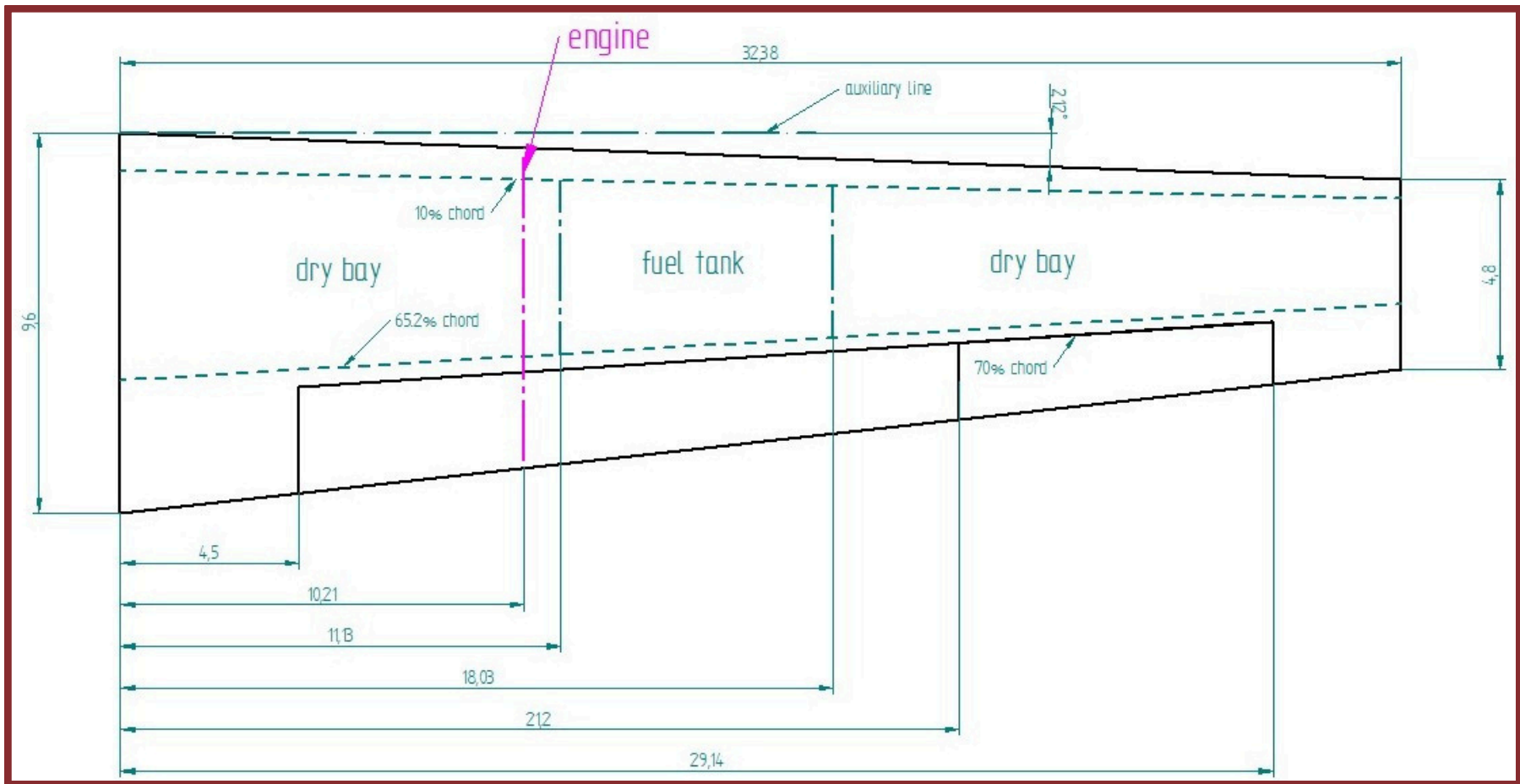
The airplane must be able to respond to short takeoff and landing (STOL) capability from tarmac runways, it must have efficient cargo transport as well as reliable operation in different environments and unforeseen conditions.

MISSION PROFILE

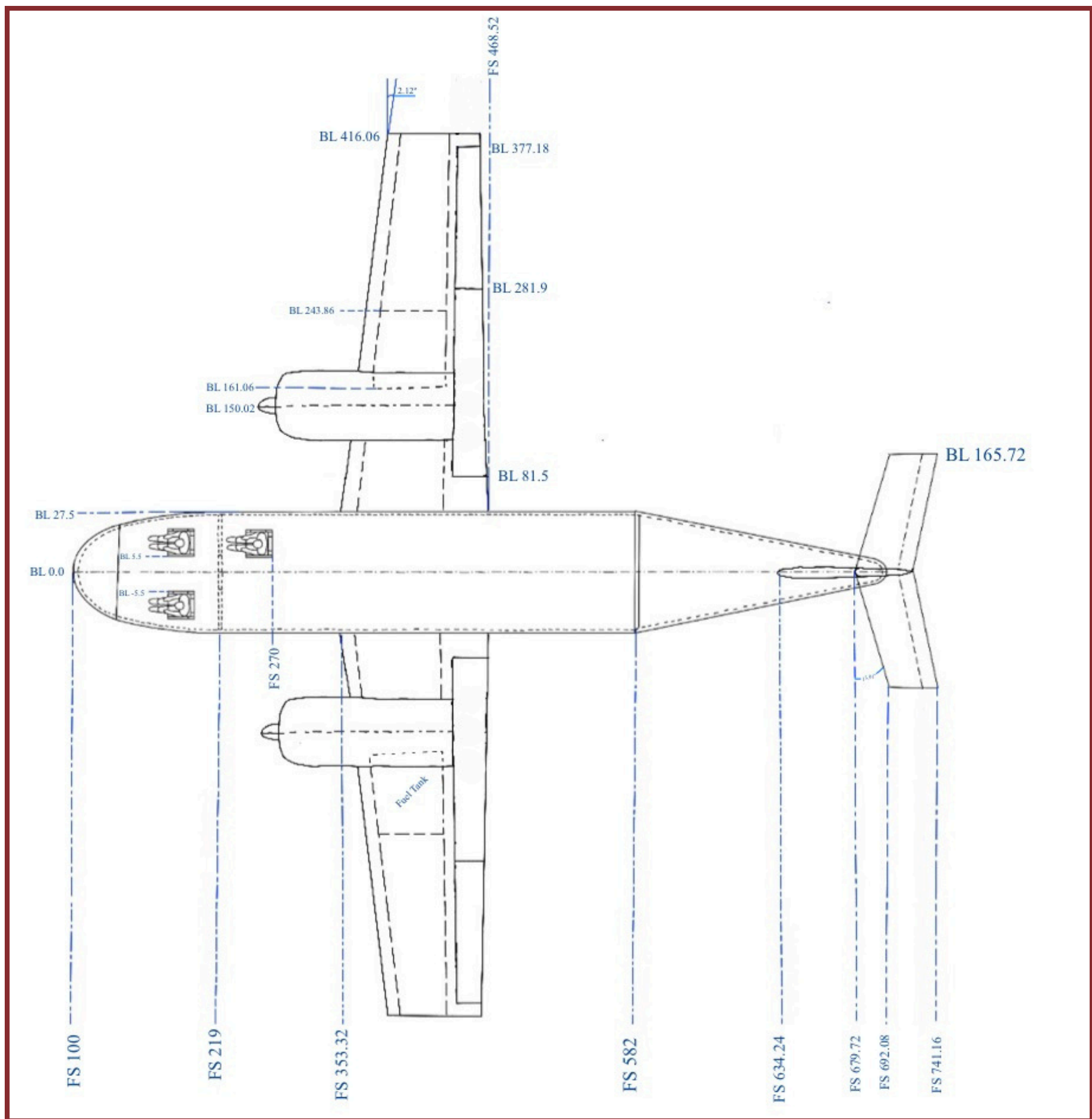


REQUIREMENTS

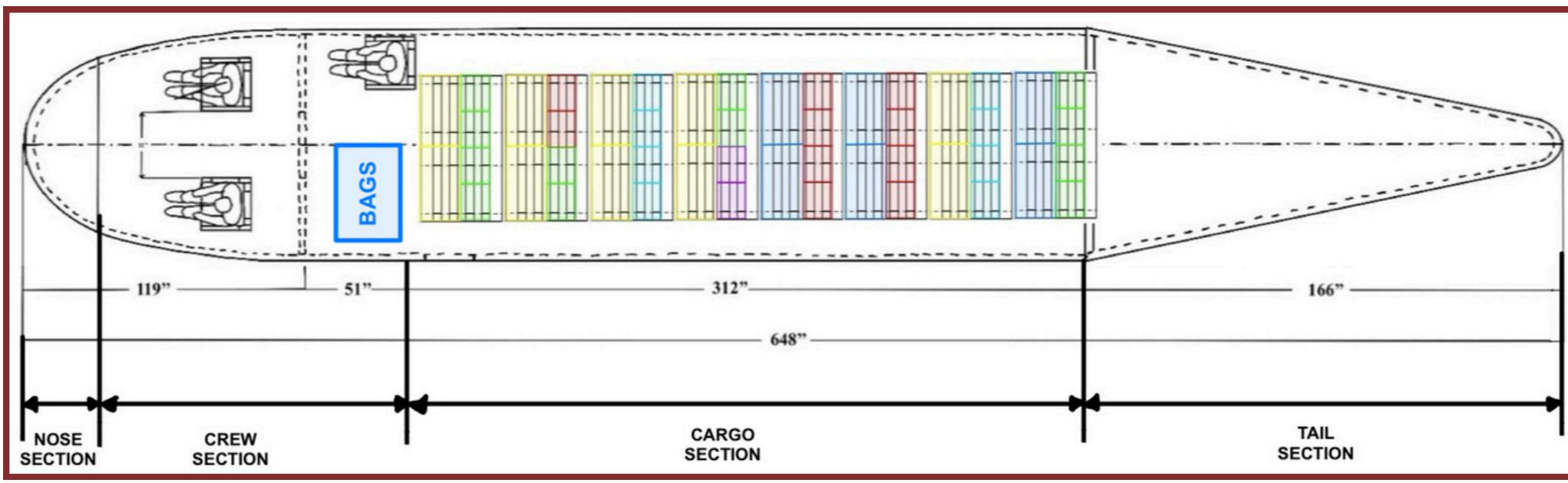
Field Performance		Cargo	
Takeoff/Landing altitude	2,250 - 5000 fts MSL	Crew	600 lbs
Day Temperature	90 °F	Bags	90 lbs
Physical Constraints		Total cargo allocation	1500 lbs
Wingspan	< 70 ft	Engine	
Special performance		Certified and readily available (off-the-shelf)	
Operational ceiling	30,000 ft		



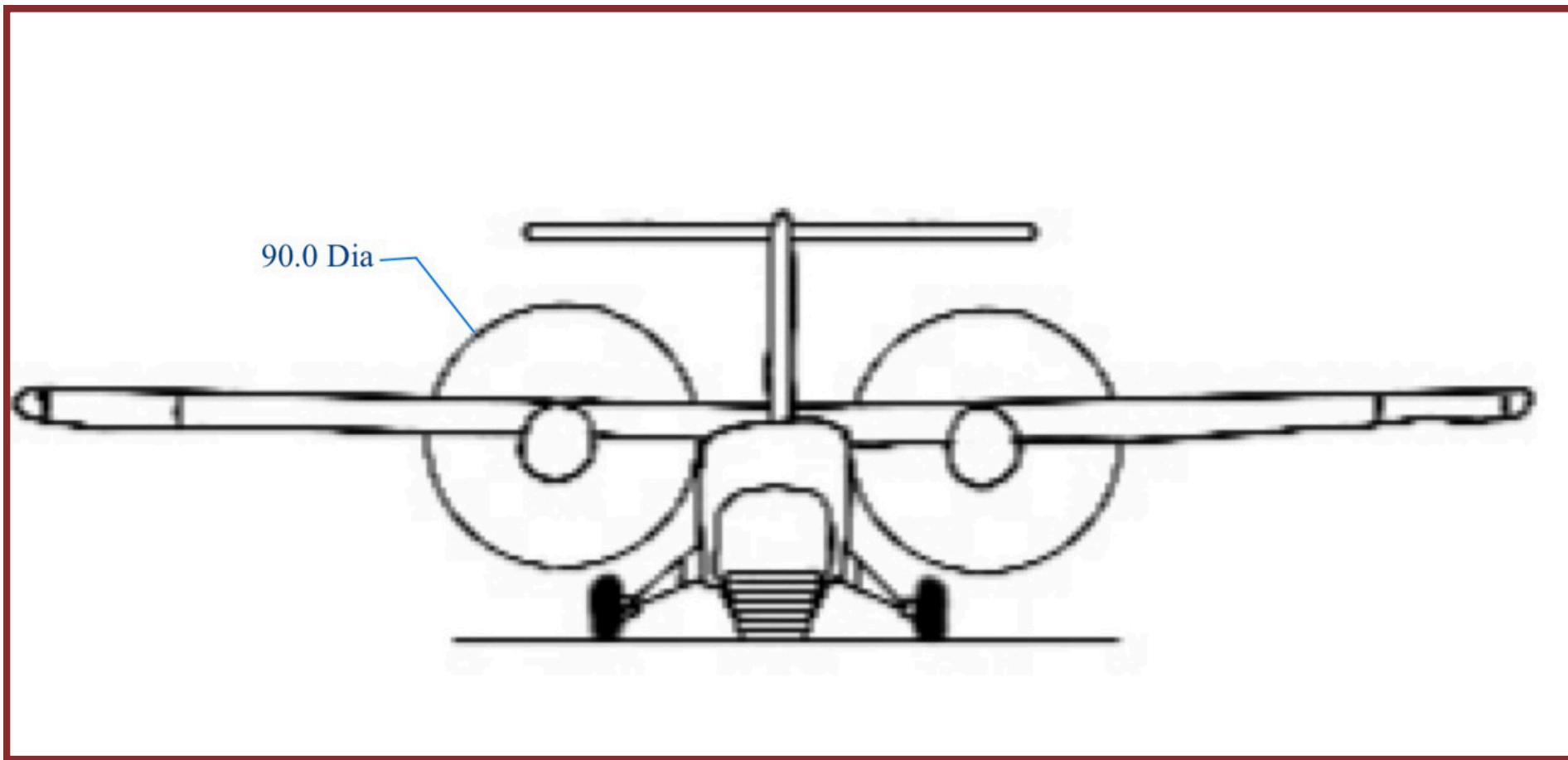
WING PLANFORM



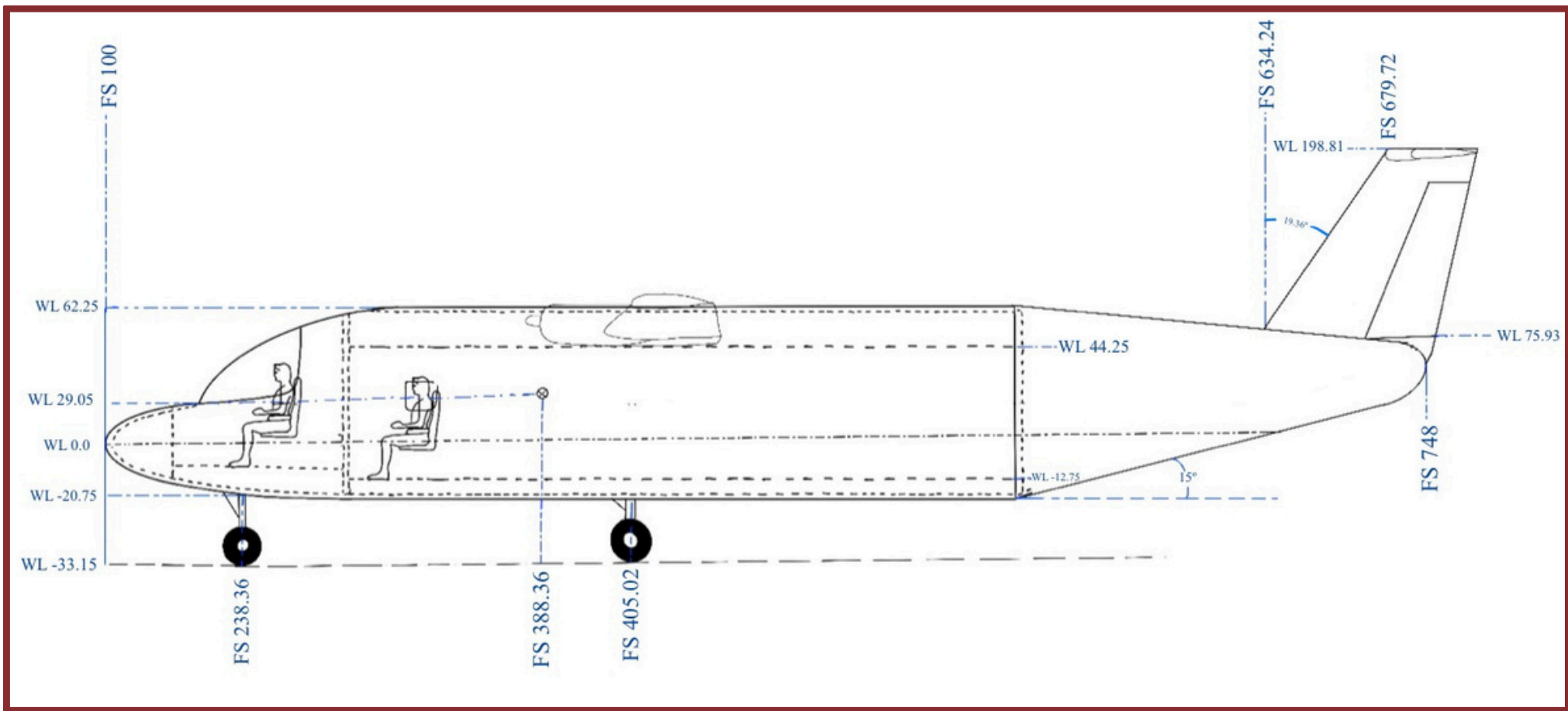
TOP VIEW



AIRCRAFT DISTRIBUTION



BACK VIEW (WITH CARGO RAMP DEPLOYED)



SIDE VIEW

1

DATA:		Aircraft Category		Regional turboprop		Growth factor		4.982			
Weight Data			Engine			Empty and fuel weight fractions			0.799		
W _{T0}		12515.92 lbs		W _F		2810.38 lbs		Power required		1082.62 HP	
W _E		7205.54 lbs		W _P		2500 lbs		Engine selected		PT6A-21	
						Risk			High		

2

WING:		Wing area		466.1 ft ²							
Aspect ratio		9		Quarter chord sweep		0		Airfoil		NACA23015	
Taper ratio		0.5		Aileron area/Wing area		0.06		Fuel tank capacity		519.95 US gallons	

3

FLAPS:		Type		Single-slotted flap											
Takeoff			Landing												
Wing ΔC _{Lmax}		0.3903		δ		15°		Wing ΔC _{Lmax}		0.8043		δ		50°	
ΔC _{D0}		0.0096						ΔC _{D0}		0.095					

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VERTICAL EMPENNAGE:				Tail volume		0.069					
Aspect ratio		1.5		Quarter chord sweep		15°		Airfoil		NACA 64-012	
Taper ratio		0.5		Rudder area/ Tail area		0.3		L _v /b		0.375	

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HORIZONTAL EMPENNAGE:				Tail volume		0.995					
Aspect ratio		6		Quarter chord sweep		12°		Airfoil		NACA 0010	
Taper ratio		0.8		Elevator area/ Tail area		0.33		L _H /(MAC) _w		3.643	

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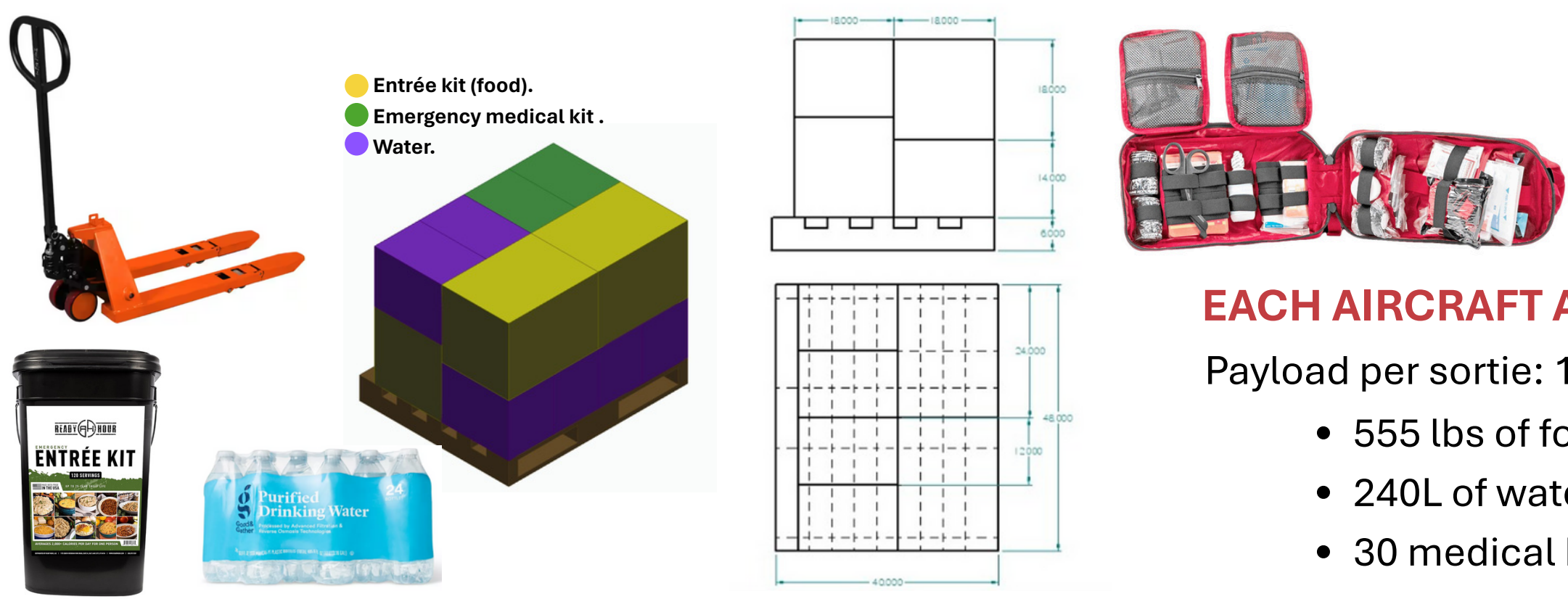
GEAR SIZING:		h _{cg}		62.2 inches		Track		106.43 inches							
Main Gear		s _s		6.189 inches		Nose Gear		s _s		1.302 inches					
l _m		16.67 inches		Tire		15,00-10 rated at 8850 lbs (type III)		l _n		150 inches		Tire		9,00-6 rated at 4000 lbs (type III)	
P _m		6698.27 lbs		Tire diameter		34.8 inches		P _n		2750.54 lbs		Tire diameter		22.4 inches	

Parameters	Conceptual	Preliminary	Parameters	Conceptual	Preliminary
Clean zero lift drag	0.02705	0.02705	Flap Lift Increment for Landing	0.9	0.8043
Wing Aspect Ratio	9	9	Flap Drag Increment for Landing	0.08	0.095
Span efficiency	0.8	0.82	Propeller efficiency	0.75	0.75
Clean maximum lift coefficient	1.3	1.328	SFC	0.63	0.63
Drag increment due to LG.	0.02	0.02	Wing Area	472.2988	467.4081
Flap Lift Increment for Takeoff	0.42	0.3903	Power Required	1082.63	1071.42
Flap Drag Increment for Takeoff	0.01	0.0096	TOGW	12515.92	12386.31

RESULTS

- Natural disaster problem:** Volcanic eruption on La Palma, Spain. 7,000 people affected.
- Distance from base:** 800 milles
- Cruise Speed:** 182 KTS (209.5 mph) at an altitude of 12,500 fts.
- Transit time (one-way):** 4h 10 min
- Turn-around time:** 25-30 minutes
- Refuel time:** Single-point pressure refuel → 8-10 min
- Reload time:** > refuel time → 15 min
- 1 airplane total time** = 2 × Transit + Turn-around + Refuel / Reload ≈ 9h
- Scenario:** Each aircraft can help 60 people with the supplies given each time it arrives to the island. Families have supplies for 2 days with the help given. In 2 days, each airplane can make 5 sorties (48h / 9h ≈ 5.33 sorties). Therefore, each aircraft would be able to help 60 people x 5 sorties / per 2 days = 300 people. 7000 / 300 ≈ 24 aircrafts.
- Fleet size: 25 aircrafts** (taking into account an extra one in case needed).
- Crewing:** Each airplane requires a 3-person crew (captain, first-officer, load-master). Taking into account each crew must rest during 10 hours, 3 crews per aircraft would be needed.
- Total numbers of crews:** 25 aircrafts x 3 crews = **75 3-member crews** (without including ground-staff).

CARGO DISPLAY



EACH AIRCRAFT AID (for 60 people)

- Payload per sortie: 1500 lbs
- 555 lbs of food supplies (~4.5lbs per person per day) → food for 2 days
 - 240L of water (~2L per day per person) → water for 2 days
 - 30 medical kits → 1 per family