

## Analysis of possible aircraft configurations

### Critical aspects of mission profile

- Energy efficient long-distance flight (10km)
- Identifying of 1x1m markers on the ground
- Vertical take-off and landing

### Possible aircraft configurations

#### Quadplane

- Separate systems for hovering and horizontal flight
- Four motors in vertical direction one motor for horizontal flight
- Low complexity (separate propulsion systems)
- Stable hovering flight
- Additional mass and drag of the motors → reduces efficiency

#### Tilt Wing / Rotor

- Swiveling rotors / wings with two or more motors (typically four)
- High efficiency (theoretically)
- High complexity of the rotation system → difficult to implement

#### 2-Motor Tailsitter

- Vertical orientation of the aircraft for take-off and landing (tailsitter)
- Attitude is controlled by motor thrust and rudder deflection
- Transition into horizontal flight: aircraft tilts forward by 90 degrees
- Low mass and high efficiency
- Lags a stable hover flight

#### 4-Motor Tailsitter

- Two more motors compared to two-motor tailsitter
- Additional motors → stability and maneuverability during hover phase
- More mass and air resistance
- Horizontal cruise flight: two motors can be switched off to increase efficiency
- Concept offers thrust surplus for a safe hover flight

## Configurations evaluation (optional)

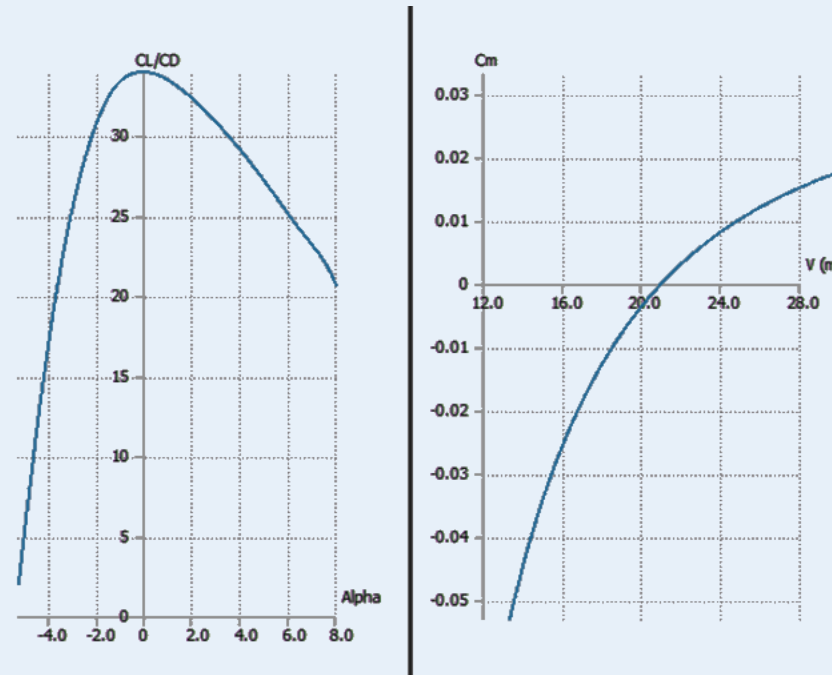
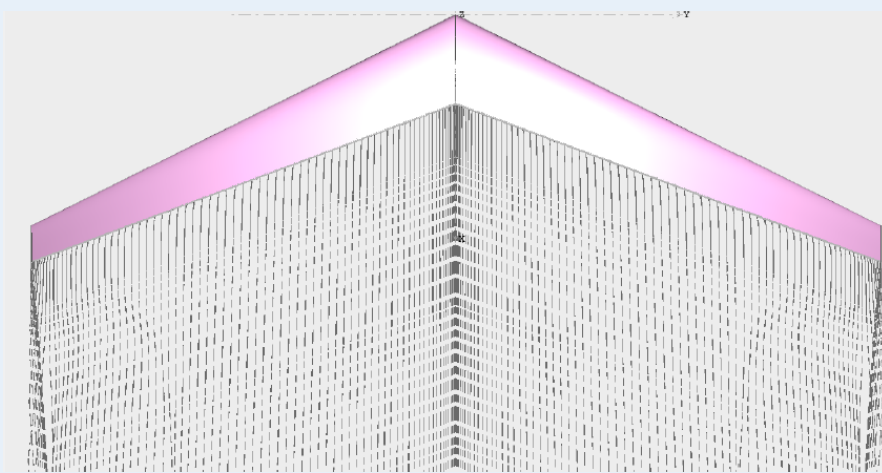
Evaluation criteria	Quadplane	Tilt wing / rotor	2-Motor Tailsitter	4-Motor Tailsitter
Energy efficiency	1	7	3	1
Stable hovering	7	3	1	7
Manufacturing complexity	3	1	7	7
<b>Sum</b>	<b>11</b>	<b>11</b>	<b>11</b>	<b>15</b>

## Wing and empennage design

Profile	RS005A	Unit
Mass	8.5	[kg]
Wing area	0.675	[m <sup>2</sup> ]
Wing span	3.0	[m]
Chord (root)	0.320	[m]
Chord (tip)	0.130	[m]
Angle (root)	5.2	[°]
Angle (tip)	-0.9	[°]

Parameter	Value	Unit
Sweep	25.0	[°]
Twist	-6.1	[°]
Aspect ratio	13.33	[-]
Taper ratio	0.41	[-]
Mean aero chord	238	[m]
Center of gravity	371	[m]
Neutral point	390	[m]
Static margin	8.0	[%]

\*relative to the profile nose in the plane of symmetry

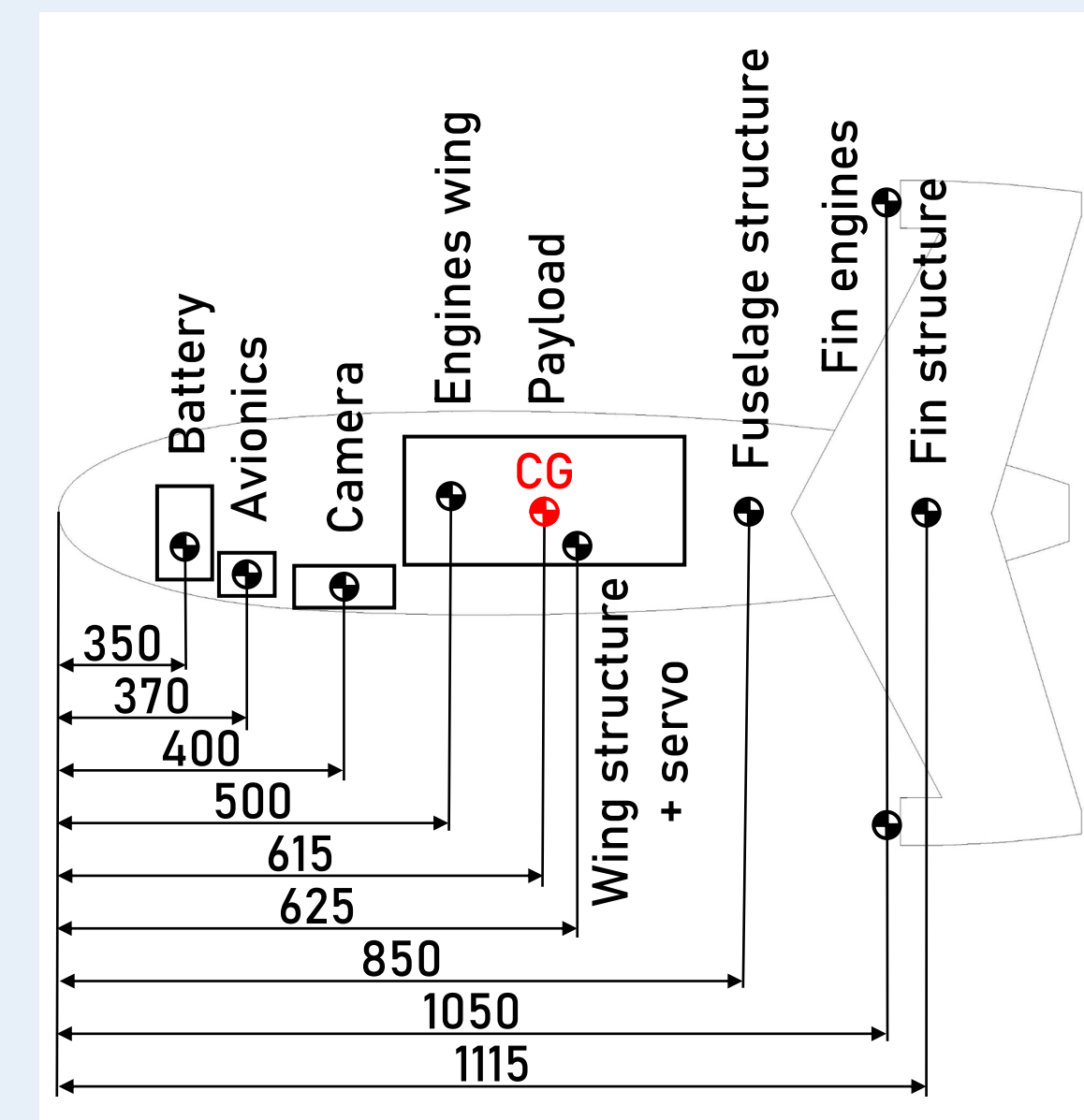


## Estimated flight parameters

Parameter	Value	Unit
Max. flight speed	40.2	[m/s]
Min. flight speed	15.8	[m/s]
Max. flight distance	11	[km]

## Mass and center of gravity estimation

Component	m [g]	hx [mm]
Wing structure	1500	620
Fin structure	450	1115
Fuselage structure	1350	850
Servo	120	660
Engines (wing)	800	450
Engines (fin)	800	1050
Payload block	2000	665
Battery	1000	290
Camera	215	340
Avionics	265	370
<b>Total</b>	<b>8500</b>	<b>665</b>



## Cost estimation

Item	Cost [€]
RTK system	600
Autopilot system	500
Engines and battery	700
Other electronics	500
Mission sensor	400
Carbon fiber and core material (wing + fuselage)	1,000
Wood and other materials	400
Material for molds	800
Machines and tools	600
Prototypes	500
<b>Total</b>	<b>6,000</b>

