Wingshape Trade Study
AIAA DFB 2023-2024

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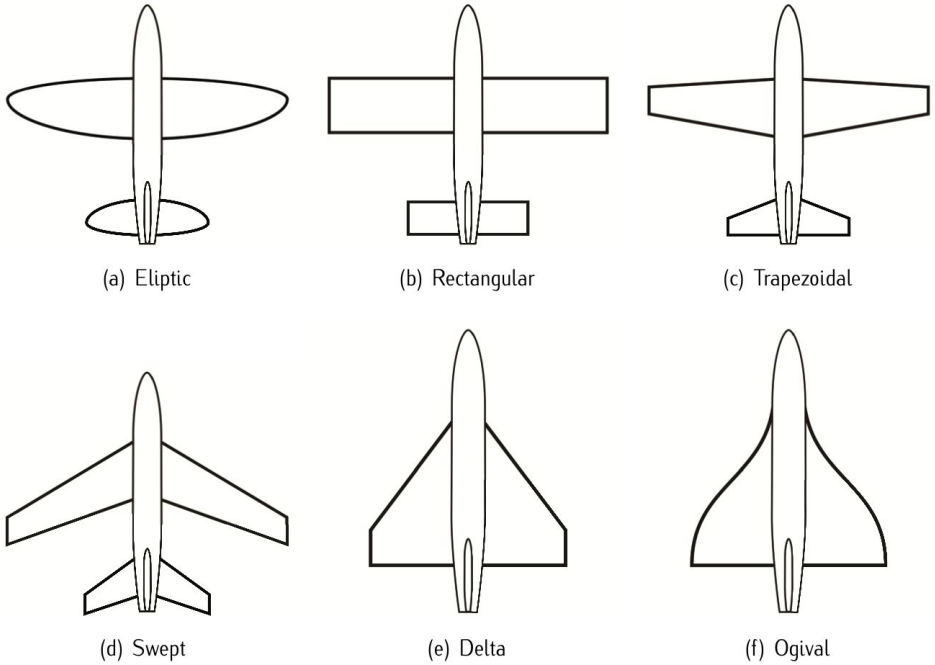
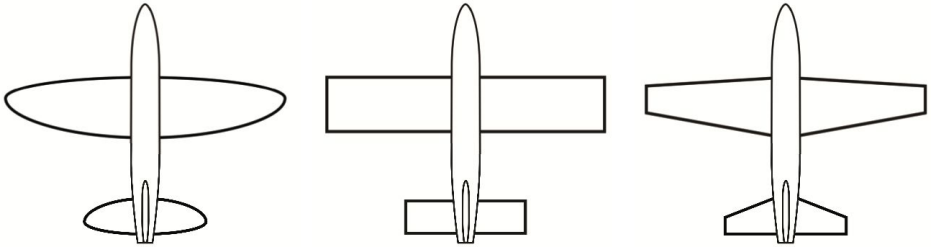
Factors to consider

1. Lift Coefficient
2. Drag Coefficient
3. mass
4. stability
5. Manufacturability & Feasibility
6. Overall Aerodynamic efficiency



Candidates

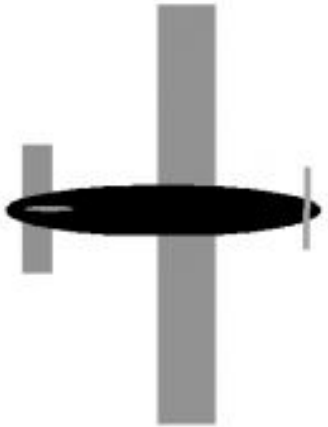
Explanation: Considering our specific constraints, which include but are not limited to the need for high lift at low speeds, efficient lift distribution, enhanced stability, manufacturability and feasibility these three configurations represent the optimal candidates.



(a) Eliptic (b) Rectangular (c) Trapezoidal

- Rectangular (Constant Chord)
- Trapezoidal (Tapered)
- Elliptical

Rectangular (constant chord)



Rectangular

Pros:

1. Feasibility - Easy to design, build and maintain.
2. High Lift - advantageous for STOL operations
3. Low Stall Speed - Aircraft can maintain controlled flight at lower speeds
4. Predictable handle and control - could be advantageous for faster lap times.

Cons:

1. Less efficient than tapered and elliptical wings
2. Lower maneuverability due to square tips

Rectangular Wing - Slight Tip

adding wingtips to a rectangular wing can be a valuable modification to enhance the wing's performance and characteristics.

1. In addendum with previous slide:
    a. Reduced Induced Drag
    b. Increase lift
    c. Enhances control
    d. Reduces wingtip Vortices
    e. Improved Stability and Safety

Trapezoidal (Tapered)

Tapered

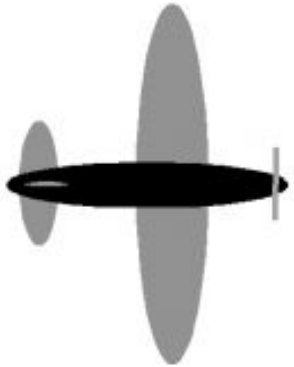
Pros:

1. More aerodynamically efficient than rectangular wings leading to better speed and efficiency.
2. Improved glide ratio
3. Maneuverability - allow for tighter turns and more dynamic flight capabilities.

Cons:

1. More difficult to construct than rectangular
2. Higher stall speeds than rectangular wing

Elliptical



Elliptical

Pros:

1. Aerodynamically efficient - lower induced drag and better efficiency.
2. Excellent Glide ratio
3. Smooth Handling

Cons:

1. Difficult to construct, more difficult than rectangular and tapered wing
2. Higher stall speeds
3. Reduced maneuverability compared to a trapezoidal and rectangular wing

Order of best options

1. Rectangular
    a. Rectangular With a slight tip at the end
2. Tapered
3. Elliptical

Conclusion

Given our figures of merit such as mass, ease of manufacturing, drag and stability, the rectangular wing may be a suitable choice due to its simplicity and potentially lighter weight. If minimizing drag and maximizing stability are of the highest priorities a elliptical wing could be the best choice, but it is far too complex to manufacture and has a higher mass. The tapered wing could provide us with a balanced approach of aerodynamic efficiency and stability but a higher difficulty of manufacturing.

References:

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AIAA DFB 2023-2024 Rules