

Request for Proposal

Design of Non-Circular Fuselage with Aft-Mounted Engines

Background

The "double-bubble" fuselage design is a novel concept for a high-efficiency, subsonic transport with the potential to move more passengers while reducing emissions. The aerodynamic shape of the fuselage has been studied by NASA and Aurora Flight Sciences in their D8 model. An additional feature of the D8 is the integrated engines in the aft of the fuselage structure. To achieve the necessary fuselage shape and engine integration poses a significant structural challenge.

This Request for Proposal (RFP) is for the structural design of a "double-bubble" fuselage with aft-mounted, integrated engines. The fuselage must bear the aerodynamic and pressure loads from a range of passenger aircraft maneuvers, meet or exceed fatigue limits, and use composite materials. The detailed requirements are provided in the following tables including the aerodynamic geometry.

Requirements

General Characteristics

Wing Span	170 ft
Fuselage Width	21 ft
Fuselage Height	14 ft
Fuselage Length	130 ft
OEW / MTOW	0.5
Powerplant	3 x integrated turbofans, bypass ratio = 20
Passengers	180

Performance

Cruise Speed	Mach 0.74
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Operating Ceiling	47,000 ft
Dry Thrust (per engine)	38 kN
Range	3,000 nmi
Cabin Pressure	6,000 ft
Fatigue Life	50,000 cycles

Proposal and Design Data Requirements

The technical proposal shall present the design of this aircraft fuselage structure clearly and concisely; it shall cover all relevant aspects, features, and disciplines. Pertinent analyses and studies supporting design choices shall be documented.

Full descriptions of the aircraft fuselage structure are expected along with performance capabilities and operational limits. These include, at a minimum

1. Mass distribution
2. Structural loads analysis (e.g. V-n diagram)
3. Stress analysis under cruise, climb, banking
4. Detailed framing diagram for all components such as stringers, longerons, frames, cut-outs
5. Thermal analysis
6. Estimate aerodynamic loads
7. Manufacturing plan
8. Design of joints
9. Cost analysis
10. Vibration analysis
11. Composite material selection
12. Composite material lay-up

Additional Contacts

All technical questions pertaining to this RFP should be directed to Craig Merrett via e-mail at: cmerrett@clarkson.edu.

Any updates to this RFP will be posted on the AIAA Design Competitions web site
<http://www.aiaa.org/DesignCompetitions/>

Design Competition Rules

Eligibility Requirements

- All AIAA Student members are eligible and encouraged to participate. Membership with AIAA must be current to submit a report and to receive any prizes.
- Students must submit their letter of intent and final report via the online submission to be eligible to participate. **No extensions will be granted.**
- More than one design may be submitted from students at any one school.
- If a design group withdraws their final report from the competition, the team leader must notify AIAA Headquarters immediately.
- Design projects that are used as part of an organized classroom requirement are eligible and encouraged for competition.

Schedule

- Letter of Intent — 10 February 2018 (11:59 pm Eastern Time)
- Proposal delivered to AIAA Headquarters — 10 May 2018 (11:59 pm Eastern Time)
- Announcement of Winners — 31 August 2018 (11:59 pm Eastern Time)
 - Engine Design Competition dates
 - Letter of Intent – 14 February 2018 (11:59 pm Eastern Time)
 - Proposal submitted, via online submission site to AIAA Headquarters – 16 May 2018 (11:59 pm Eastern Time)
 - Round 1 evaluations completed – 30 June 2018 (11:59 pm Eastern Time)

Round 2 presentations at AIAA Propulsion and Energy Forum 2018

Categories/Submissions

- Team Submissions
 - Team competitions will be groups of not more than ten AIAA Student Members per entry.
- Individual Submissions
 - Individual competitions will consist of only one AIAA Student member per entry.
- Graduate
 - Graduate students may participate in the graduate categories only.
- Undergraduate
 - Undergraduate students may participate in the undergraduate categories only.
- Letter of Intent (LOI)
 - A Letter of Intent indicating interest in participating in the design competitions is required before submitting a final report.
 - All Letters of Intent must be submitted through the online submission system.

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- Letter of Intent must include student's names, emails, AIAA membership numbers, faculty advisor(s) names, emails, and project advisor(s) names and emails. Incomplete LOI's will result in the Team or Individual being ineligible to compete in the competition.
- Submission of Final Design Report
Each team or individual must provide an electronic copy their design report as outlined below to the online Submission site
 - An electronic copy of the report in Adobe PDF format must be submitted to AIAA using the online submission site. Total size of the file cannot exceed 20 MB.
 - Electronic report files must be named: "2018_[university]_DESIGN_REPORT.pdf"
 - A "Signature" page must be included in the report and indicate all participants, including faculty and project advisors, along with students' AIAA member numbers and signatures.
 - Electronic report should be no more than 100 pages, double-spaced (including graphs, drawings, photographs, and appendices) if it were to be printed on 8.5"x11.0" paper, and the font should be no smaller than 10 pt. Times New Roman.
 - Engine Design Competition is limited to 50 pages.

Copyright

All submissions to the competition shall be the original work of the team members.

Authors retain copyright ownership of all written works submitted to the competition. By virtue of participating in the competition, team members and report authors grant AIAA non-exclusive license to reproduce submissions, in whole or in part, for all of AIAA's current and future print and electronic uses. Appropriate acknowledgment will accompany any reuse of materials.

Conflict of Interest

It should be noted that it shall be considered a conflict of interest for a design professor to write or assist in writing RFPs and/or judging proposals submitted if (s)he will have students participating in, or that can be expected to participate in those competitions. A design professor with such a conflict must refrain from participating in the development of such competition RFPs and/or judging any proposals submitted in such competitions.

Awards

The prize money provided for the competitions is funded through the AIAA Foundation. The monetary awards may differ for each competition, with a maximum award of \$1,000. The award amounts are listed below.

The top three design teams will be awarded certificates. One representative from the first place team *may be* invited by the Technical Committee responsible for the RFP to make a

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presentation of their design at an AIAA forum. A travel stipend *may be* available for some competitions, with a maximum travel stipend of \$750 which may be used to help with costs for flight, hotel, or conference registration to attend an AIAA forum.

Aircraft Design Competitions

- Graduate Team Aircraft - Advanced Pilot Training Aircraft
- Undergraduate Team Aircraft – Hybrid-Electric General Aviation Aircraft (HEGAA)
 - 1st Place: \$500; 2nd Place: \$250; 3rd Place: \$125
- Undergraduate Individual Aircraft – Close Air Support Aircraft (A-10 Replacement)
 - 1st Place: \$1,000; 2nd Place: \$500; 3rd Place: \$300

Engine Design Competition

- Undergraduate Team Engine –Candidate Engines for a Next Generation Supersonic Transport
 - 1st Place: \$500; 2nd Place: \$250; 3rd Place \$125

Space Transportation Competition

- Undergraduate Team Space Transportation – Pluto Orbiter
 - 1st Place: \$500; 2nd Place: \$250; 3rd Place: \$125

Space Design Competition

- Undergraduate Team Space Design – Lunar Prospecting
 - 1st Place: \$500; 2nd Place: \$250; 3rd Place: \$125

Structures Design Competition

- Graduate Team Structures – Fuselage Design
- Undergraduate Team Structures – Supersonic Wing
 - 1st Place: \$500; 2nd Place: \$250; 3rd Place: \$125

Proposal Requirements

The technical proposal is the most important factor in the award of a contract. It should be specific and complete. While it is realized that all of the technical factors cannot be included in advance, the following should be included:

- Demonstrate a thorough understanding of the Request for Proposal (RFP) requirements.

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- Describe the proposed technical approaches to comply with each of the requirements specified in the RFP, including phasing of tasks. Legibility, clarity, and completeness of the technical approach are primary factors in evaluation of the proposals.
- Particular emphasis should be directed at identification of critical, technical problem areas. Descriptions, sketches, drawings, systems analysis, method of attack, and discussions of new techniques should be presented in sufficient detail to permit engineering evaluation of the proposal. Exceptions to proposed technical requirements should be identified and explained.
- Include tradeoff studies performed to arrive at the final design.
- Provide a description of automated design tools used to develop the design.

Basis for Judging

The AIAA Technical Committee that developed the RFP will serve as the judges of the final reports. They will evaluate the reports using the categories and scoring listed below. The judges reserve the right to not award all three places. Judges' decisions are final.

1. Technical Content (35 points)

This concerns the correctness of theory, validity of reasoning used, apparent understanding and grasp of the subject, etc. Are all major factors considered and a reasonably accurate evaluation of these factors presented?

2. Organization and Presentation (20 points)

The description of the design as an instrument of communication is a strong factor on judging. Organization of written design, clarity, and inclusion of pertinent information are major factors.

3. Originality (20 points)

The design proposal should avoid standard textbook information, and should show the independence of thinking or a fresh approach to the project. Does the method and treatment of the problem show imagination? Does the method show an adaptation or creation of automated design tools?

4. Practical Application and Feasibility (25 points)

The proposal should present conclusions or recommendations that are feasible and practical, and not merely lead the evaluators into further difficult or insolvable problems.