

AMTAS Spring Meeting, 4/23/09
Feedback from ranking and evaluating proposed new projects

Presentations were made on the following 6 proposed projects:

- Improved Repair Process using a Pressurized Repair Clave (Lin)
- Effects of Moisture Diffusion in Sandwich Composites (Tuttle)
- Consideration of the Maximum Strain as a General First Ply Failure Criterion in Laminated Composites (Smith)
- Development of Bonded Repair Qualification Test Coupon(s) (Flinn)
- Crack Development in Cyclically Loaded Pressurized Cylindrical Carbon-Fiber Shell Structures (McDaniel)
- Bird Strike Simulation (Rassiain)

Statistical Conclusions:

Group consensus was that Moisture, Bird Strike and Bonded Repair were the top three new project priorities, followed by Repair Clave, Max Strain and Press Cylinder.

A valid statistical analysis of the feedback received from meeting participants is difficult, because only 31 of 67 packets distributed were returned. **Thus, these conclusions should serve only as guidelines for future evaluation.**

Methodology:

Evaluation packets (consisting of an evaluation sheet for each project plus an overall ranking sheet) were given to participants. The results were tabulated.

Notes:

- Not all projects were evaluated.
- Not all questions were answered for each project, resulting in a varying number of responses.
- Not all projects were ranked. Of those that were, some people did not rank projects from 1–6; instead, accorded the same ranking number on multiple projects.
- The following pages list the tabulated results, including comments, as well as a graph representing the overall rank and ratings. The bar chart numbers were tabulated using the averages of the responses for **overall ranking** (listed on page 10) and **overall rating** (question 5 on project evaluation sheets).

AMTAS Proposed New Projects Evaluation Sheet

Project Name: Improved Repair Process using a Pressurized Repair Clave — 26 responses

YOUR FAMILIARITY

Please indicate your level of knowledge in the technical area represented by the project.

Very familiar (6) Good familiarity (9) Broad knowledge (11) Not familiar (0)

Comments:

- I missed the presentation.
- Very effective in preventing skin disbond due to moisture in the core in undamaged area.
- Most repairs (very large majority) are due to field damage, and thus it is not desirable to remove parts to repair. This would be a low priority compared to other repair issues.

The primary evaluation criteria (of equal importance) are:

1. The novelty, scientific and technical merits of the proposed project.

highest

lowest

1 (3)

2 (11)

3 (11)

4 (1)

Comments:

- Critical to safety and certification of damages primary structure.
- Assuming it is affordable for composite repair depots and airlines.
- What is the typical size of repair structure?
- Approach is standard; industry demand?

2. The potential contributions of the proposed project to the mission of FAA as relates to AMTAS.

1 (6)

2 (11)

3 (9)

4 (0)

Comments:

- High quality repairs.
- If there is operator pull, OK.

3. The likelihood of the proposed effort to produce the desired results and to broaden the university research base in composite materials and structures used in transport aircraft.

1 (5)

2 (10)

3 (9)

4 (1)

Comments:

- With the proper bagging materials and methods.
- Seems like a good master's thesis research.
- Desired result, yes; broaden research base, probably not.

4. The likelihood of the proposed effort to advance the state of the art and to contribute to the education of future engineers/ scientists in the AMTAS program.

1 (5)

2 (10)

3 (9)

4 (2)

Comments:

- As support to structural repair manuals from Boeing or other airframe makers.
- Education, OK project.

5. OVERALL RATING:

1 (5)

2 (10)

3 (10)

4 (1)

OVERALL COMMENTS ON STRENGTHS AND WEAKNESSES:

- Could contribute to better quality repairs for airlines and MROs who cannot otherwise afford an autoclave.
- Not sure this is needed as an AMTAS project; other industry work exists or trumps this.
- I can't see a downside to this except that it is limited to composite parts that can be removed from A/P.
- Repair clave has tremendous potential for field repairs where debulking methods do not work or have not been developed.
- They also have potential for repetitive part repairs (i.e., rotocraft example).
- How different than existing data on autoclave repair methods?
- Better to spend money on materials designed to eliminate autoclave and money to characterize these materials.
- Seems straight forward enough, with solid potential for meaningful results. What are the methods used to determine interlaminar properties?
- How often could this repair approach be used?

AMTAS Proposed New Projects Evaluation Sheet

Project Name: Effects of Moisture Diffusion in Sandwich Composites — 25 responses

YOUR FAMILIARITY

Please indicate your level of knowledge in the technical area represented by the project.

Very familiar (3) Good familiarity (15) Broad knowledge (7) Not familiar (0)

Comments:

The primary evaluation criteria (of equal importance) are:

1. The novelty, scientific and technical merits of the proposed project.

highest

1 (9)

2 (15)

3 (1)

lowest

4 (0)

Comments:

- There is successful initial work in this area.
- Impressed with good data/theory agreement; what is the temp. dependance of diffusivity?; Does the moisture absorbed result in ϵ_3 (detectable)?; (wondering out loud: can it be measured by NDI?)
- Need experimental M&P to be above reproach

2. The potential contributions of the proposed project to the mission of FAA as relates to AMTAS.

1 (7)

2 (12)

3 (5)

4 (0)

Comments:

- Disbanding between facesheet and core is safety issue.
- How moisture degrades sandwich structure.

3. The likelihood of the proposed effort to produce the desired results and to broaden the university research base in composite materials and structures used in transport aircraft.

1 (9)

2 (11)

3 (5)

4 (0)

Comments:

- If we can include laminates of different thicknesses representing sandwich panel facesheet, for inclusion of resulting data into the future predictive model.
- Make sure tests are added to correlate "real" environments, i.e., ground-air-ground.

4. The likelihood of the proposed effort to advance the state of the art and to contribute to the education of future engineers/ scientists in the AMTAS program.

1 (8)

2 (12)

3 (4)

4 (0)

Comments:

- Tidy MS project.

5. OVERALL RATING:

1 (8)

1.5 (2)

2 (11)

3 (4)

4 (0)

OVERALL COMMENTS ON STRENGTHS AND WEAKNESSES:

- Hexcel may be interested in supporting this project.
- This data could help optimize primary structure that uses H/C sandwich construction.
- Moisture studies need to use realistic aircraft cycles for humidity because they breathe. Studies that use a continuous moisture exposure and result in a “concern” will just create more unresolved arguments. Data should exist on numerous existing structures to show evidence whether or not this is really a problem of high concern.
- Consider ~3-ply facesheet configuration to support secondary structure.
- Understanding of this mechanism will be very useful/necessary, especially the long-term effects of pressure cycling on mechanical durability of sandwich composites.
- Good in background data; good plans—well thought out; should be working with Dan Adams at U. Utah.
- Great project. I recommend funding.
- Tie-in with U of U good; repair structures?
- Significant improvement in understanding of material property behavior due to long-term exposure (environment); should go forward.

AMTAS Proposed New Projects Evaluation Sheet

Project Name: Consideration of the Maximum Strain as a General First Ply Failure Criterion in Laminated Composites
— 22 responses

YOUR FAMILIARITY

Please indicate your level of knowledge in the technical area represented by the project.

Very familiar (5)

Good familiarity (12)

Broad knowledge (5)

Not familiar (3)

Comments:

The primary evaluation criteria (of equal importance) are:

1. The novelty, scientific and technical merits of the proposed project.

highest

1 (1)

2 (15)

3 (4)

lowest

4 (2)

Comments:

- Novelty?

2. The potential contributions of the proposed project to the mission of FAA as relates to AMTAS.

1 (3)

2 (10)

3 (8)

4 (0)

Comments:

3. The likelihood of the proposed effort to produce the desired results and to broaden the university research base in composite materials and structures used in transport aircraft.

1 (1)

2 (13)

3 (5)

4 (1)

Comments:

4. The likelihood of the proposed effort to advance the state of the art and to contribute to the education of future engineers/ scientists in the AMTAS program.

1 (3)

2 (12)

3 (5)

4 (2)

Comments:

5. OVERALL RATING:

1 (1)

2 (12)

2.5 (2)

3 (6)

4 (1)

OVERALL COMMENTS ON STRENGTHS AND WEAKNESSES:

- Detecting (and defining) first ply (or other) failure is key to the success of this project.
- Could help to optimize composite fuselage design.
- Need to concentrate on ultimate strength prediction (i.e., max load) from a stress concentration (notch or hole); unless project emphasizes ultimate strength, low priority.
- Interesting, but really can't take us where we need to go unless it gets us to 2-piece failure. Might be more interesting if there was a more complete proposal with contextual background.
- The proposal project seems too broad and seems to have little chance of answering specific question.
- Need to describe testing in more detail.

AMTAS Proposed New Projects Evaluation Sheet

Project Name: Development of Bonded Repair Qualification Test Coupon(s) — 20 responses

YOUR FAMILIARITY

Please indicate your level of knowledge in the technical area represented by the project.

Very familiar (4)

Good familiarity (8)

Broad knowledge (6)

Not familiar (3)

Comments:

The primary evaluation criteria (of equal importance) are:

1. The novelty, scientific and technical merits of the proposed project.

highest

1 (1)

2 (12)

3 (5)

lowest

4 (1)

Comments:

2. The potential contributions of the proposed project to the mission of FAA as relates to AMTAS.

1 (2)

2 (14)

3 (3)

4 (0)

Comments:

3. The likelihood of the proposed effort to produce the desired results and to broaden the university research base in composite materials and structures used in transport aircraft.

1 (7)

2 (7)

3 (4)

4 (1)

Comments:

4. The likelihood of the proposed effort to advance the state of the art and to contribute to the education of future engineers/ scientists in the AMTAS program.

1 (3)

2 (11)

3 (4)

4 (0)

Comments:

5. OVERALL RATING:

1 (3)

2 (11)

3 (5)

4 (0)

OVERALL COMMENTS ON STRENGTHS AND WEAKNESSES:

- Could improve training and development of new materials or processes. Not practical for field repair.
- A method to assess scarf bonds would be beneficial.
- I like the emphasis of fracture mechanics.
- Good educational work; not good for practical field repair. Cost and extra steps would make it undesirable in factory.
- Pitch was actually a proposal!
- Bond strength certification is a tough task and it may take several items like this to bring the industry to accept lower cost processes.
- Seems to have broad variability and lacks clear focus. Thermal edge effect?
- Has plan to incorporate training directly; need to find right scarf angles.
- Percent error the coupon traveler represents repair? How confident can you be with this method?

AMTAS Proposed New Projects Evaluation Sheet

Project Name: Crack Development in Cyclically Loaded Pressurized Cylindrical Carbon-Fiber Shell Structures —
21 responses

YOUR FAMILIARITY

Please indicate your level of knowledge in the technical area represented by the project.

Very familiar (3)

Good familiarity (3)

Broad knowledge (7)

Not familiar (8)

Comments:

The primary evaluation criteria (of equal importance) are:

1. The novelty, scientific and technical merits of the proposed project.

highest

1 (0)

2 (6)

2.5 (1)

3 (12)

lowest

4 (0)

Comments:

2. The potential contributions of the proposed project to the mission of FAA as relates to AMTAS.

1 (4)

2 (5)

3 (10)

4 (1)

Comments:

3. The likelihood of the proposed effort to produce the desired results and to broaden the university research base in composite materials and structures used in transport aircraft.

1 (1)

2 (11)

3 (6)

4 (1)

Comments:

4. The likelihood of the proposed effort to advance the state of the art and to contribute to the education of future engineers/ scientists in the AMTAS program.

1 (0)

2 (7)

3 (10)

4 (1)

Comments:

5. OVERALL RATING:

1 (1)

2 (6)

3 (12)

4 (1)

OVERALL COMMENTS ON STRENGTHS AND WEAKNESSES:

- Could help to optimize fuselage design. Might need to simulate some other type of damage. However, other impact analysis research could obviate need for this.
- I suggest simpler tests on crack tips. Along the lines of the current OSU project with large notches in bending. Possibly consider testing of large notches in mode III; however, Boeing and FAA have already spoken to OSU about this.
- Needed work, but think the scale of testing is too small.
- Weak in real application and getting good results.
- Need to see more detailed statement of work. Needs to be stiffened. Look at scale and static vs. dynamic.

AMTAS Proposed New Projects Evaluation Sheet

Project Name: Bird Strike Simulation — 26 responses

YOUR FAMILIARITY

Please indicate your level of knowledge in the technical area represented by the project.

Very familiar (4) Good familiarity (6) Broad knowledge (10) Not familiar (4)

Comments:

The primary evaluation criteria (of equal importance) are:

1. The novelty, scientific and technical merits of the proposed project.

<u>highest</u>				<u>lowest</u>
1 (8)	2 (10)	3 (5)		4 (0)

Comments:

- Approach seems well thought out and covers almost all technical issues.
- Success of this project will result in optimum design.
- Is there criteria for bird strike in metal structure?

2. The potential contributions of the proposed project to the mission of FAA as relates to AMTAS.

1 (13)	2 (5)	3 (4)	4 (0)
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Comments:

- Safer airplane due to better maintenance plan.

3. The likelihood of the proposed effort to produce the desired results and to broaden the university research base in composite materials and structures used in transport aircraft.

1 (10)	2 (7)	3 (6)	4 (0)
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Comments:

4. The likelihood of the proposed effort to advance the state of the art and to contribute to the education of future engineers/ scientists in the AMTAS program.

1 (8)	2 (11)	2.5 (1)	3 (4)	4 (1)
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Comments:

5. OVERALL RATING:

1 (10)	2 (10)	2.5 (1)	3 (3)	4 (0)
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OVERALL COMMENTS ON STRENGTHS AND WEAKNESSES:

- Could be useful data for designing a blended wing/lifting body design (angled impact).
- Need to validate material failure models used. Sensitivity to mesh density, etc.
- Results of program offer a great PR opportunity for the general public and safety awareness.
- Important. Go do it.
- Maybe use BMS 8-256 or some toughened system still used in new composite design. 8-212 is obsolete for new design. ALB specimen—pretty small Canadian goose.
- Adequate techniques are lacking for good accurate/quick approach. Drives a lot of art based on conservative assumptions used today.
- Assessment of damage is difficult; large # of parameters, but seems solid and well thought out.
- No engines! Extend to GA? Big project.
- An interesting subject and needed research. The presenter was very well prepared. Demonstrated knowledge and good approach.

AMTAS Proposed New Projects Ranking Tabulation

Given the fact that FAA funds are limited and may not accommodate any new topics next year, please rank the proposed projects in order of priority. Please circle the appropriate numbers.

	<u>highest</u>					<u>lowest</u>
1. Bird Strike Simulation (Rassain)	1 (8)	2 (6)	3 (4)	4 (1)	5 (2)	6 (2)
2. Effects of Moisture Diffusion in Sandwich Composites (Tuttle)	1 (6)	2 (11)	3 (4)	4 (4)	5 (0)	6 (0)
3. Development of Bonded Repair Qualification Test Coupon(s) (Flinn)	1 (3)	2 (6)	3 (8)	4 (2)	5 (1)	6 (2)
4. Improved Composite Process using a Pressurized Repair Clave (Lin)	1 (3)	2 (3)	3 (10)	4 (3)	5 (1)	6 (5)
5. Consideration of the Maximum Strain as a General First Ply Failure Criterion in Laminated Composites (Smith)	1 (3)	2 (3)	3 (4)	4 (5)	5 (4)	6 (4)
6. Crack Development in Cyclically Loaded Pressurized Cylindrical Carbon-Fiber Shell Structures (McDaniel)	1 (0)	2 (3)	3 (5)	4 (4)	5 (7)	6 (2)

Note: total # of votes differs

