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Inclusion of Modern Composites Technology into a Federal Aviation Administration Airframe and Powerplant Curriculum

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FORUM

INCLUSION OF MODERN COMPOSITES TECHNOLOGY INTO A FEDERAL AVIATION ADMINISTRATION AIRFRAME AND POWERPLANT CURRICULUM

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Rapid growth in the use of composite materials in the last two decades has driven curriculum designers to combine the study of such materials with that of more traditional materials. Within the guidelines of the Federal Aviation Administration (FAA) Airframe and Powerplant Certification curriculum, in which hours and content are mandated rather inflexibly, this fact necessitates creative modification of current programs in order to add valuable new technologies to an already full schedule.

MAINTAINING EXCELLENCE

The FAA program at Parks College of Saint Louis University has always maintained the practice of integrating the latest technologies into its programs at the earliest opportunity. It was with this purpose in mind that courses were recently reorganized and rewritten to include the study of modern composite materials, fabrication process and repair procedures.

CHOOSING WHAT TO KEEP

A reorganization of the present FAA Part 65: the FAA maintenance regulations, is now pending. The implementation of Part 66, which replaces it, will necessitate many changes across the curricula. To stay ahead of these changes, Parks College reevaluated its strengths in light of the requirements of the real world. With the decline of steel tube structures in aircraft, welding is losing its importance as a necessary aircraft skill. Despite this fact, it is still required by the FAA guidelines. Parks College's welding curriculum was highly developed and included advanced techniques such as, MIG (Magnesium Inert Gas), TIG (Tungsten Inert Gas) and resistance welding, along with basic gas welding and brazing. Likewise, the non-metallic structures course included wood theory, techniques and applications, fabric covering practices, traditional and high-tech coating, and plastics practices.

Since both of the above courses required a semester to complete, and included areas with less critical technical skills, it was decided to reorganize them in such a way as to enrich their most practical sections, eliminate the less useful sections, and combine the resulting units with the desired composites curriculum to form two new courses.

The fact that wood is a natural composite material and that the techniques used to work with it are applicable to modern composites, led the curriculum writers to combine these two subjects into a single course. In this new course the characteristics of wood are compared to those of composites. The benefits, hazards, and procedures to deal with them apply to both materials and so learning in one material reinforces and reiterates that of the other.

FACILITIES AND SUPPLIES

To facilitate cleanliness, two separate laboratory areas are used and a third room houses an oven used to cure high-temperature composite lay-ups. Wall racks holding the rolls of fabrics and films needed for projects were easily and inexpensively constructed from galvanized pipe. Wall cabinets hold epoxies, fillers, hardeners, spreaders, sticky tape, and other supplies, freeing up floor space and making room for large work tables. Each table has a special protective sheet of material which keeps projects from sticking to the table.

Through the generosity of McDonnell Douglas Company (now Boeing), out-of-date high-temperature composite materials have been made available to the students for use in the oven. Most other materials can be purchased from the same suppliers that sell materials for the wood course, making orders easy to process.

SAFETY CONSIDERATIONS

Materials used in composite lay-ups are volatile and hazardous. Part of the curriculum is devoted to teaching safety practices. Protection is needed for hands, eyes, clothing, and adequate ventilation and breathing apparatus are necessary. The heating facilities were designed to eliminate any chance of room air coming in contact with flames. Smoking and fires of any sort are prohibited in the lab and signs are posted. Fire extinguishers are easily accessible. Material Safety Data Sheets (MSDS), which are available from the manufacturer or distributor, for all hazardous materials in use are located in the work area and well marked.

GENERAL ARRANGEMENT OF SUBJECTS

The section on wood is taught first because it deals with familiar materials and lays the groundwork for dealing with composites. Also, wood is a less expensive material to use when skills are not yet perfected. By ordering custom plywood, and through the use of a specially designed tool, the students are able to step-layer a repair in wood before they attempt the same repair in more expensive composite materials. A section on stop-drilling and repair of plastics prepares students for similar practices in composites, again using less expensive supplies at first.

Wood repairs, including splice and scarf joints; bonding practices and analysis of defects are taught and will transfer to the modern materials easily. After the mid-semester exams, students move into the composite laboratory and fabricate and repair lay-ups of either room-temperature or high-temperature cured materials.

CONCLUSION

The integration of modern composite materials curriculum into that of older wood structure teaching is a natural solution to the problem of how to include this innovative technology in the crowded curriculum. At Parks College, curriculum planners also combined the fabric/coatings section of the previous "non-metallic structures" course with an abbreviated welding section to make another new combination which benefitted from students being able to work in both labs simultaneously, lowering the density of students in each.

By carefully analyzing the needs and desires of the aircraft industry, and restructuring the previous curriculum arrangement, the goal of maintaining a quality education at the leading edge of technology while meeting the regulations required by the FAA guidelines was achieved.□

APPENDIX

COURSE OUTLINE for WOOD/COMPOSITES TECHNOLOGY

A. Introduction

1. Laboratory introduction
2. Tools and safety practices

B. Wood as a natural laminate composite

1. Interpret information in AC 65-15 and select appropriate wood samples for aircraft repair, including acceptable substitutes.

2. Identify wood types, describe strength characteristics and repair choices. Identify characteristics that make wood a natural composite, i.e. directional strengths and weaknesses of wood grains.

3. Describe types, characteristics, preparations, processes of wood glues and gluing. Understand assembly procedures and pressures. Understand similarities between composite and wood bonding.

4. Understand and construct splice joints on ribs and spars with appropriate materials. Correlate use of long bond lines with composite repairs.

5. Understand and construct skin damage repairs in wood. Correlate use of similar but greater ratios of bond lines in composite skin repairs.

C. Aircraft plastics

1. Identify characteristics of aircraft plastics and describe principle of matrix material relating plastics to composites.

2. Identify plastics machining techniques and correlation to composite techniques.

3. Inspect, install and repair aircraft windows.

D. Composite materials fundamentals

1. Discuss terminology and characteristics of composites. Identify basic types.

2. Identify step-layer, scarf, injection and bolt-on repairs and perform one of each to acceptable standards. Identify similarities to wood repairs.

3. Discuss and perform fastener installation and removal, using proper drilling techniques. Identify similarities to plastic machining practices.

E. Composites of the future

Discuss direction of current research and identify areas of future development.

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