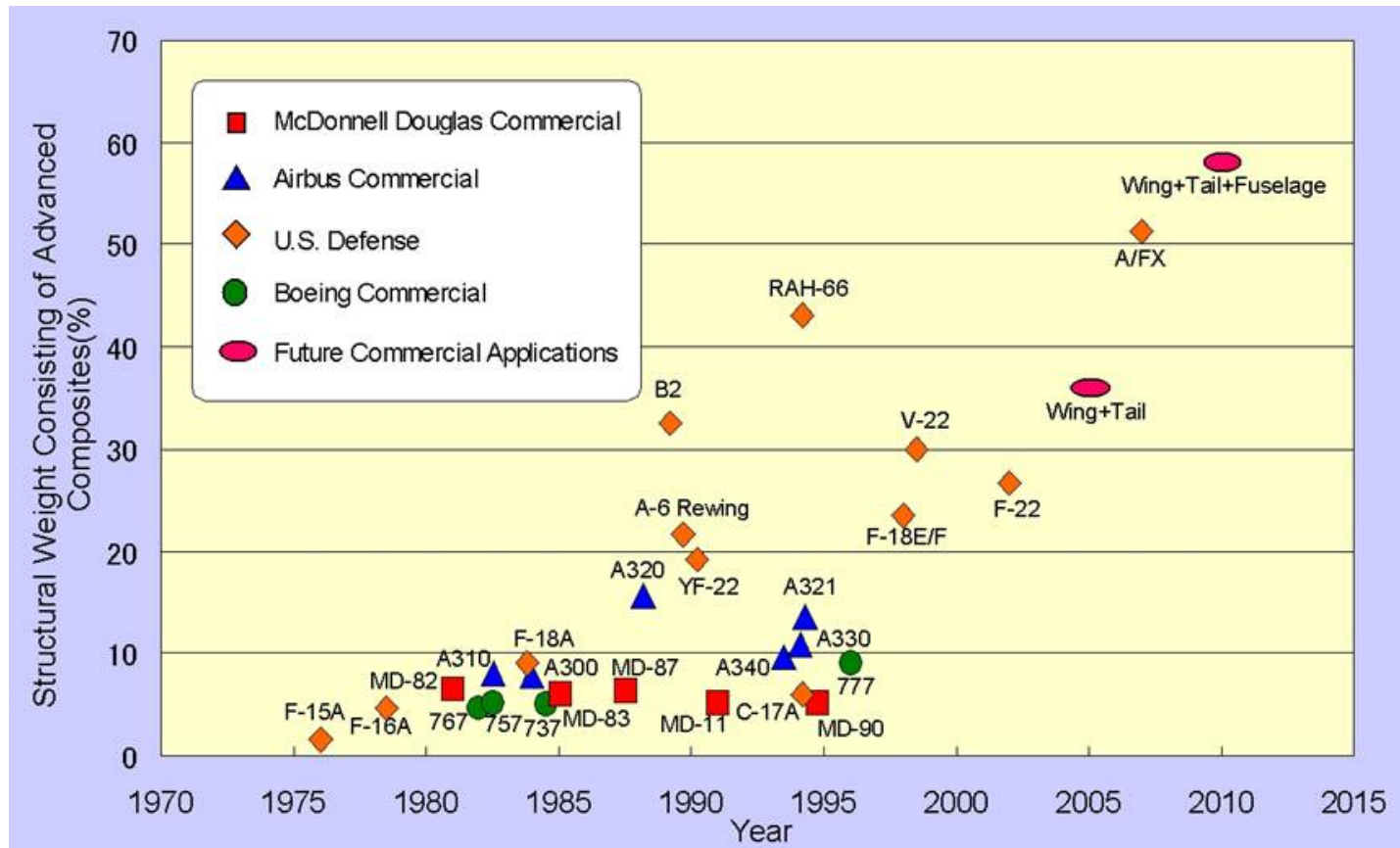


# *JCAB Perspectives on Safe Composite Aircraft Structure*

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Application of composite material to aircraft structure

Wide range of its application:

Engine nacelle, Radome, Horizontal stabilizer, Aileron, Bulkhead, Floor panel, etc.

Points to take care of:

Primary structure or not?

What kind of **load** occurs?

How is its maintenance conducted? Life limited ? Maintained by inspection and repair?

Etc.

Examples:

Pressure bulkhead: Stress by pressurization, Constant amplitude, Fatigue

Wing: Stress by its own weight, gust and maneuver, Variable amplitude, Fatigue

Upper surface: compressive mean stress

Lower surface: tensile mean stress

To achieve its structural integrity:

The assumed load needs to be coincide with the actual situation. But it is difficult even for traditional metal structure.

Although full scale fatigue test has conducted, unforeseen damage occurs during operation.

Load path around the repaired area was not properly predicted (Lusaka accident).

Example: Tail rotor blade strap of rotorcraft

## Load and deformation act on strap:

Rotation of tail rotor blade: Tensile load, Constant amplitude, Fatigue

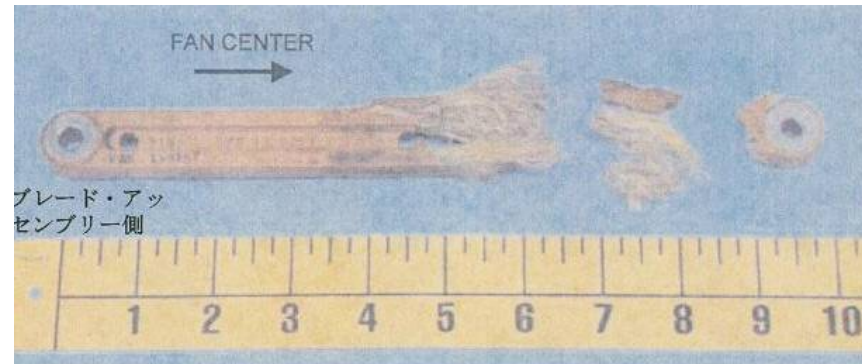
Induce pitch angle of tail rotor blade: Torsion deformation, Variable amplitude, Fatigue

These load and deformation occur **simultaneously** and **separately**.

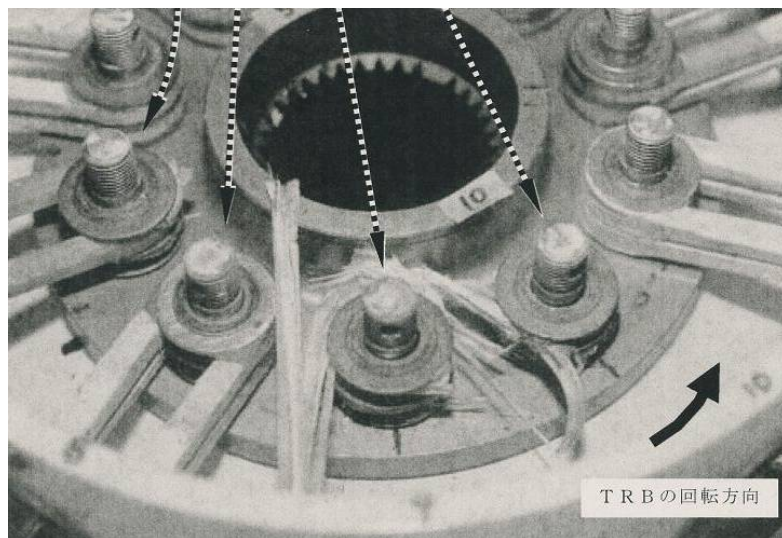
Principle stress for tensile load with torsion deformation is higher than that in case tensile load and torsion deformation applied separately.

What kind of load is critical for the composite structure used for the blade strap?

## Examples for failure of blade strap:

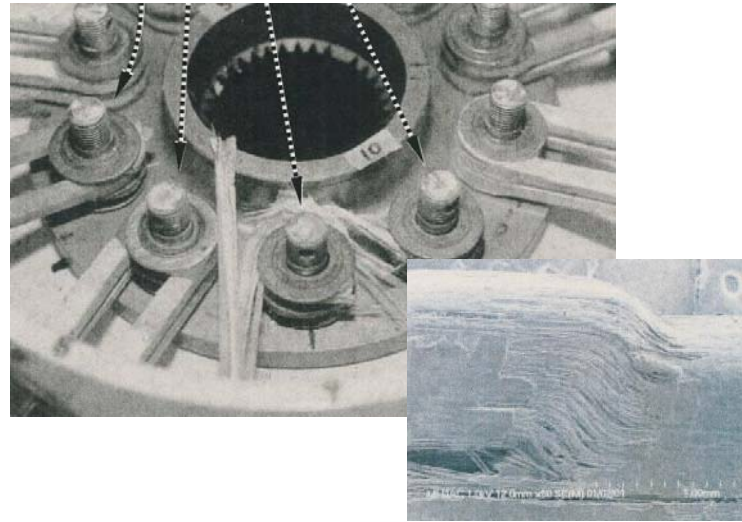
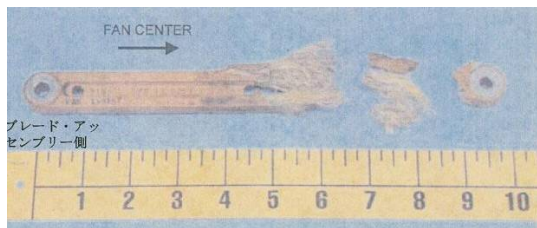


Example A



Example B

## Examples for failure of blade strap:



Failure: Delamination and crack growth cutting strap.

**Its failure mode is unique for composite materials.**

It was found that compressive stress on strap caused by its torsion deformation induced delamination and kink band formation (shown in this slide), and strap cutting.

Torsion deformation without tensile stress is much critical than that with tensile stress for this failure mode.



It is imperative to understand what kind of load is critical to the objective structure. In general, environmental effect is also important. Furthermore, we need to know about its failure mode.

The fatigue life (and its inspection interval) has to be evaluated using the critical load and environment during its operation.

## To achieve structural integrity:

Knowledge for

What kind of damage will occur.

What types of load and environment will cause damage.

How is it observed or detected.

Manufacturer: Provide above information to operator and  
authority

Operator: Conduct maintenance based on above information

Authority: Provide above information and Work to build  
scheme to prevent discrepancy.