Application Tasks

8. Based on the information given in the problem, we know that the design limit load (DLL) is 7550N at the operational maximum g-capability (call this: Design Limit g = DLg) of 4.2g. Using a factor of safety (FOS) of 1.5, as required, the design ultimate load (DUL) is:

$$DUL = DLL \times FOS$$

$$\Rightarrow DUL = 7550N \times 1.5 = 11,325N$$

We also know that the ultimate margin of safety of the part is 18.2% (UMOS). Thus:

$$UMOS = \frac{\text{Tested Ultimate Load} - DUL}{DUL} = 0.182$$

$$\Rightarrow \text{Tested Ultimate Load} = 0.182\,DUL + DUL$$
$$= 1.182\,(11,325N)$$
$$= 13,386\,N$$

Tested Ultimate Load is load at which the part failed.

In the training exercise, the airplane sustained a maneuver of 4.6g. Thus the part saw this as well.

Thus, the airplane and the part exceeded the DLg by:

$$\frac{4.6g - 4.2g}{4.2g} = 0.0952 = 9.52\%$$

These are the facts based on the information given in the problem statement.

* Note: σ_{yield} and σ_{ult} play no role in this problem!

Now consider what these facts tells us with regard to whether the airplane can continue to be flown safely

→ UMOS and Failure Load

This information does not tell us much since the part did not fail.

→ DLL/DLg (Design Limit #'s)

DLL/DLg is the maximum load/g where the structure shows no permanent damage. Since the airplane exceeded DLg by 9.52% there may be some permanent deformation/damage. However, this information does not tell us whether the part, and thus the plane can

continue to be flown safely for two reasons:

1. We do not know if there is permanent deformation/damage
2. We do not know the effect of such deformation/damage if it exists.

Thus, what do we need to consider in order to assess whether the part and airplane can be flown safely?

- Need to consider the life to date of the airplane such as hours of use vs. design hours, maintenance and repair history, and non-destructive inspections (NDI) performed.
- NDI can be very useful to check for any damage and the extent of the damage. This will depend on the type of damage and the NDI technique available. The accessibility of the part (how easy to inspect) plays an important role here as well)
- Should check with the manufacturer of the airplane regarding their experience with this part for such a situation

- It is most likely that the part and the airplane will be able to sustain static loads at least as designed for. However, continued use of the airplane imposes cyclic loads. This is a/the key concern since any damage that may have occurred in the exceedance of limit in the 4.6g maneuver could propagate under cyclic loads.

⇒ Should use appropriate NDI to check for deformation / damage and reconsider question when that information can be acquired.