PROBABILISTIC APPROACHES BOMBARDIER THOUGHTS

FAA Workshop
Montreal
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PROBABILISTIC APPROACHES

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- Current programs typically based on deterministic evaluations and test demonstration at all locations determined to be critical by combining most adverse conditions (i.e. knock-down factors – moisture, temperature, damage etc.);

- Assumptions based on the simultaneous effects of loading (including temperature) at the most critical locations having largest anticipated damage (maximum reduction in RS).

- Damages (manufacturing and service) are assumed to exist in the structure at all critical locations without considering probability of existence (simultaneous presence of damages on a single structural component)

- Probabilistic design offers potential for structural optimization, but should be done in a very structured way in order to maintain robustness of current designs
The approach heavily relies on availability of data generated internally by the industry, field experience (history) and various publications and studies.

Efficiency of certificating process can be directly linked to the level of achieved standardization (generic databases).

Some element of probabilistic approach already captured by existing designs at different levels depending on OEM:
- Probability based inspection interval
- Probability of damage detection
- Probability of hail impact & hail size (ground and in-flight)
- Probability of impact energy
- Probability of runway debris (size)
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- Likely to be studied to greater extent:
  - Probability of moisture content
  - Probability of Lightning strike energy
  - Probability of temperature (environment, system failures)

- Not likely to be used in foreseeable future
  - Probability of mechanical load levels
  - Combined probability of mechanical & thermal loads

- Possible limitation
  - Probability based impact energy cut-off resulting into non-detectable damage (thick laminate problem).
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Extract from Wing Impact Survey (Metallic) – CRJ Fleet (Ref. Bombardier Database of reported damage)

Replicate (calibrate) damage on test panels & validate threat & distribution