



PROBABILISTIC APPROACHES BOMBARDIER THOUGHTS

FAA Workshop
Montreal
15-18th September 2015

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

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- ❑ 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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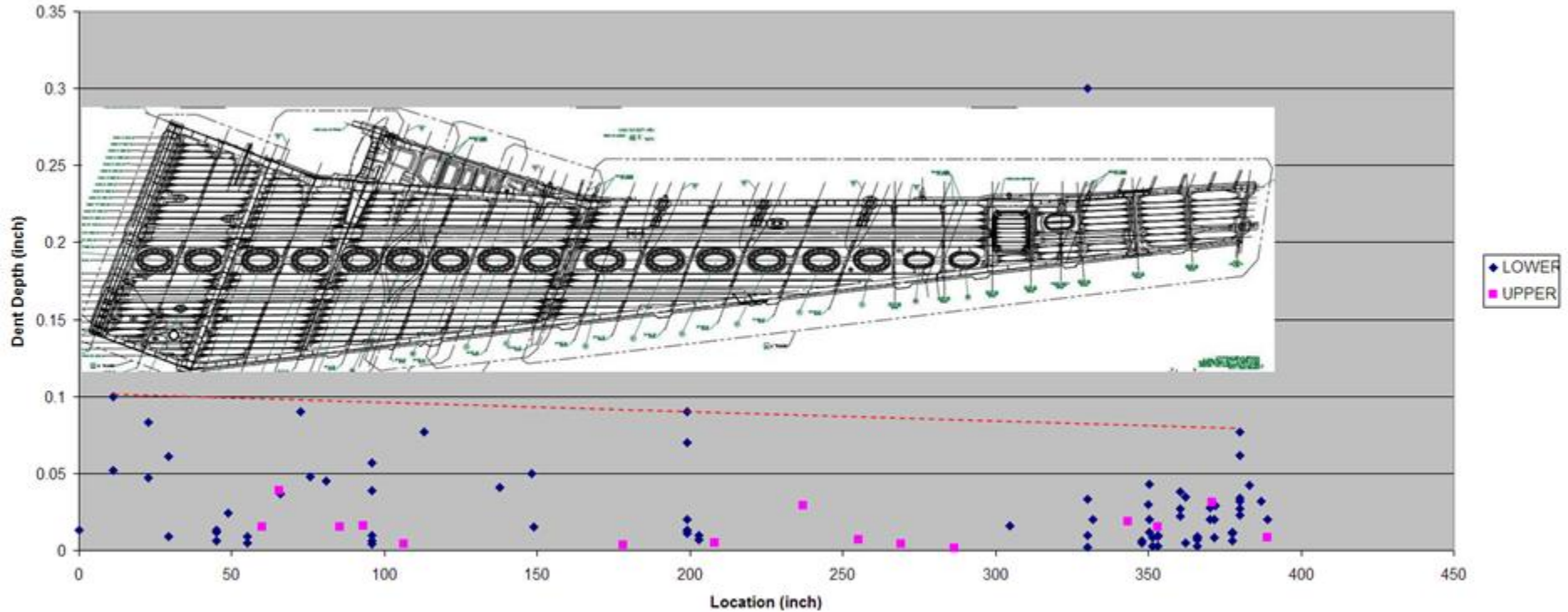
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- Likely to be studied to greater extent:
 - Probability of moisture content
 - Probability of Lightning strike energy
 - Probability of temperature (environment, system failures)
- Not likely to be used in foreseeable future
 - Probability of mechanical 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