RELATION BETWEEN SURFACE ROUGHNESS INDICATORS AND STATIC STRENGTH OF DRILLED LAMINATES

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Summary. The aim of this research is to establish a link between the surface roughness of a drilled hole in a laminate and the static strength of the drilled structure. A map of the defects is determined for different cutting parameters by using a surface tester. Then several static tests will be conducted and a relevant surface roughness indicator will be proposed.

With the increasing use of composite materials in aerospace structures, carbon-fibre reinforced plastics (CFRP) assemblies are more and more present. Drilling, the most commonly process used for joining structures can induce damages in composites structures like delamination, surface cracking, fibre breakage, fibre-matrix debonding... [1]. Under service conditions, which include applied loading (thermal and static/dynamic mechanical loads) and working environment (temperature and humidity), these defects may have significant effect on the mechanical properties and the response behaviour of composite structures, e.g., load bearing capacity, fatigue life, quasi-static resistance, and impact resistance. In this type of assemblies, the load transfer occurs by direct contact between bolt and the hole wall. The hole wall integrity is usually quantified by its roughness Ra [2] used in metallic according to different ISO norms. However, if this indicator is certainly efficient for metallic structures subjected to fatigue loading, it seems to have no sense for composite laminates.

Indeed, the damages of the machined hole can be rated as following [3]:

- Damages that occur at drill entry.
- Damages of the hole wall (local delamination, fibre pull-out, located overheating,…).
- Damages at drill exit (Delamination at the last interface)

The influence of large delamination that can occur at the drill entry or exit is already known and these kinds of defect are not the core of the study. Thus, in this research, the question is to assess the influence of the hole wall integrity on structure’s behaviours. It may conduct to define new surface indicator. Several investigations are conducted. First, the holes are machined with different drilling conditions. Then a complete map of the hole is established with a specific device (figure 1) and by using a surface tester. Comparisons are also made with SEM observations to identify the real damage (figure 2) and to correlate the results. Then mechanical tests are carried out: open and filled hole compression, pull-through and bearing tests.

![Figure 1: Surface map for a drilled hole.](image1)

![Figure 2: Comparison between SEM micrography and surface roughness map.](image2)

Preliminary results confirm that a new surface indicator should be used.

REFERENCES