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Aeronautical structural analysis of bonded joints reinforced by doublers

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Abstract. In the aircraft industry the use of bonded, riveted, bolted and welded joints at the junction of structural parts are extremely important in aircraft design. However, due their advantages, bonded joints, represent one of the main technologies available for the exploration of new materials and to the development of innovative structural configurations. Although the aviation industry represents one of the largest consumers of adhesive materials, few applications currently involve structural bonded joints. Nowadays, main applications are reinforcements located in areas of high stress concentration. Thus, to avoid chemical milling, in some critical areas of the fuselage, are installed additional plates. These plates are called doublers, and are bonded in the base plate as reinforcement located to reduce the stress level. Therefore, the use of bonded doublers is a very effective alternative to replace other alternatives present today in the aviation industry, promoting greater efficiency in load transfer, lower cost, high corrosion resistance, lower crack propagation and greater integration of parts. Thus, this work aims to study aeronautical metal structural joints reinforced by bonded doublers, through the analysis by analytical, numerical and experimental models, with emphasis on stress analysis of adhesive. In addition, software was created with a friendly interface gathering the most important analytical models in the analysis of bonded doublers, and allowing within this software to make the comparison with numerical models. Due the lack of standard tests and its relatively new study, new proceedings were created. These techniques were developed by the use of digital image processing and strain gage. Several subcomponents were designed and tested to simulate the actual application of bonded doublers, through the development of an optimization process in order to reduce weight of the aircraft.