MULYE – Paris Dilip

Unified Numerical Modeling of Forming and Consolidation of Thermoplastic Composites with Prepreg Patches

Résumé

'Quilted Stratum Process' (QSP®) uses strategically placed thermoplastic prepreg patches in its stack to form a part. Thus, even though it shares several features with the standard composite thermostamping process; there are some additional challenges that arise due to the usage of prepreg patches, along with the inability to use a blank holder, possible long distance sliding of prepreg patches and the transverse squeeze flow occurring during consolidation especially for UD patches. A novel semi-empirical contact mechanism to model the interply adhesion is developed in the commercial code of Altair Radioss™ which has improved the prediction of patch positions and fibre orientations significantly. A new full-integration shell element with the capability of transverse normal stress and selective mass scaling is developed by modifying the shell element in Altair Radioss™ for the numerical modeling of consolidation where the classic shells cannot be used due to their plane-stress assumption. An elasto-plastic constitutive model for the new shell element is developed in order to model the behavior of the melt thermoplastic polymer during consolidation. A practical method for its characterization is proposed. Finally, using these developments, a unified approach is developed for the numerical modeling of forming and consolidation. It is validated on an industrial part and results are found to be in good agreement with the experimental observations.

Mots-clés : process simulation, interply adhesion, forming, consolidation, shell element, prepregs