Master thesis : Mould compensation for thermoset composites parts

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Mold compensation for thermoset composite parts

Samtech, a company whose main activity is the development of a FE software named `Samcef`, is interested in gaining know-how about mold compensation techniques for thermoset composites parts. For the latter purpose, an internship stage of 4 months has been dedicated to study the subject with Siemens's software `NX`, which includes `Samcef` capabilities.

After a bibliographical research on the mold compensation techniques, it has been found that the main methods available in the literature are: CAD-based and mesh-based strategies. A first numerical model has been developed in order for the mold compensation techniques to be implemented. An easy geometry with a predictable deformation has been selected – the deformation mode has been controlled with the composition of the employed laminate on the part. After refinement of the model, the mold compensation techniques have been carried out for the first time and a methodology, i.e. a set of steps and tasks, has been defined for each of them.

With the first simple geometry and laminate, the compensated mold has been found with the different compensation strategies. With these results, a first comparison of the methods has been done. Following that, different geometries with more complex deformation modes have been studied: the first geometry and a different one have been used with 4 different laminates. The compensation methods have suffered some modifications to adapt the new geometries and deformation modes, and success has not always been achieved. Besides, some restrictive factors have limited the application of some methods to some cases.

The results obtained have been valuable and varied enough to extract thorough conclusions on the strengths and weaknesses of the methods: their robustness, universality, accuracy, total time necessary or complexity have been analyzed. Finally, some proposals on the future continuation of the thesis have been discussed.

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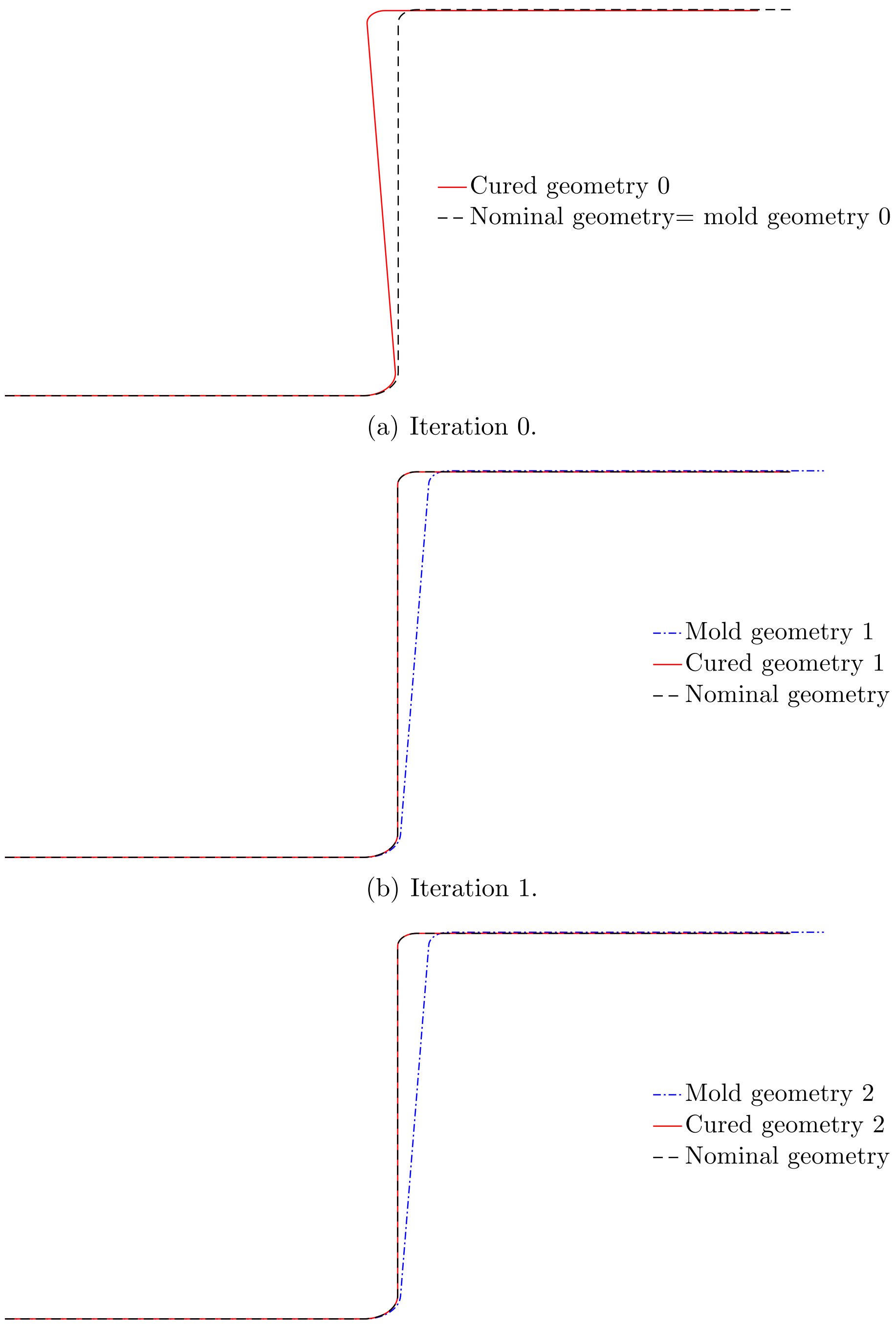
Representative Illustrations



(a) Iteration 0.

(b) Iteration 1.

(c) Iteration 2.

Figure 1: Depiction of the iterative process followed to compensate the Z-shaped part under spring-in deformation with the Mirror Method (mesh-based strategy). A deformation factor of 10 is applied.

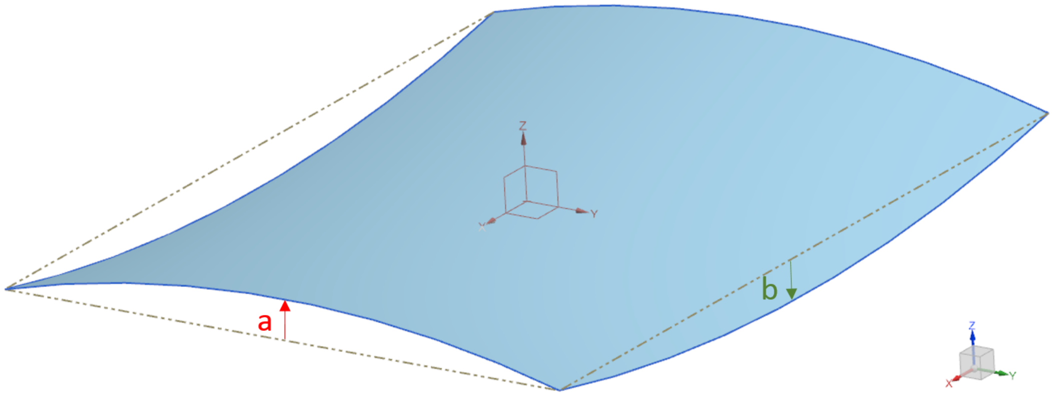


Figure 2: Parametrized model of the plate in which the curvatures κ_x and κ_y are modelled with the parameters a and b. Such a model is used for CAD-based strategies.

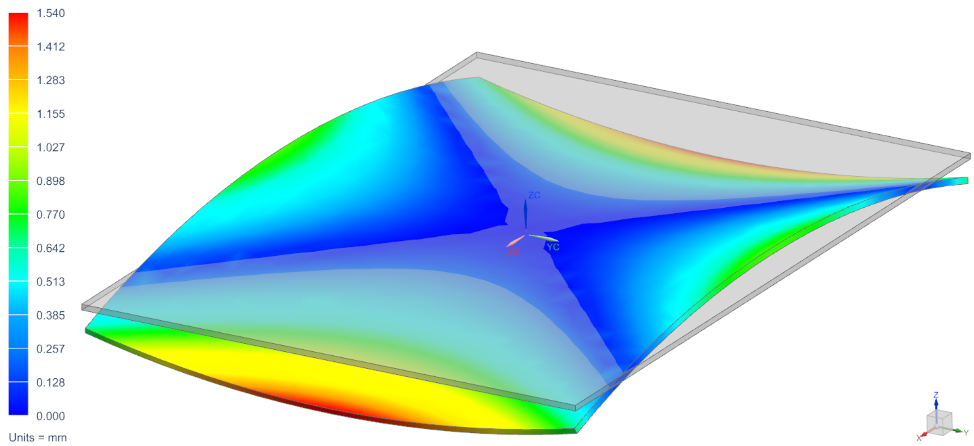


Figure 3: Cured geometry and mold geometry = nominal geometry (shaded) at iteration 0 of the Mirror Method for the flat plate under pure bending. A deformation factor of 10 is applied.

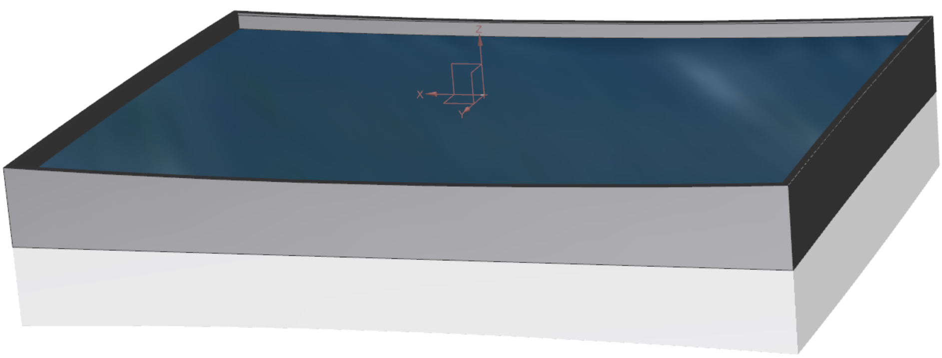


Figure 4: CAD model of the mold obtained using the Mirror Method for the flat plate under pure bending.