# COMPARISON OF MODELING APPROACHES TO RESIN FLOW SIMULATION IN LAYERED DRAPED TEXTILE PREFORMS

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## INTRODUCTION

**Objective:**
Liquid Composite Molding (LCM) simulation of structural parts with a complex and compound curvature using bidirectional woven fabrics reinforcements.

**Issue:**
This type of reinforcements undergoes a certain amount of deformation which may significantly affect the local values of permeability and fiber volume fraction (fvf).

**Approach:**
Following three modeling approaches are conducted and the results are compared:
- 3D flow simulation in which each sheared layer of fabric is assigned a permeability and a fvf based on the local shear.
- 3D flow simulation in which the permeability and the fvf of all the layers through the thickness is averaged.
- 2D flow simulation in which the permeability and the fvf of the various layers is averaged.

## METHOD

- **Material Permeability and Volume fraction evolution with the shearing angle**
- **Local fibers orientation** (FIBERSIM2009)
- **2D Finite Element Model** (ABAQUS)

**CONVERTER TOOL**

- Ply by ply element permeability
- Ply by ply (fvf)

### RESULTS: FILLING TIME

(time to fill in seconds)

**PLATE:**
- No shearing
- Only layup effect

**HEMISPHERE:**
- Layup and shearing due to draping effects

### RESULTS :THROUGH THE THICKNESS FLOW PATTERN:

- **PLATE:**
  - Averaged Model: No effect of the shearing and the draping.
  - Ply by Ply Model: Effect of the shearing and the draping.

- **HEMISPHERE:**
  - Averaged Model: No effect of the shearing and the draping.
  - Ply by Ply Model: Effect of the shearing and the draping.

### RESULTS: THROUGH THE THICKNESS FLOW PATTERN:

- **HEMISPHERE**
  - Averaged Model: No effect of the shearing and the draping.

### CONCLUSIONS

- With the ply by ply model, the effects of the shearing and the draping are clearly visible and potential defects can occur due to non-uniform flow through the thickness.

- Three dimensional modeling is important and necessary to predict the fill time when the injection gate is restricted to one of the surfaces.

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