

FiberSIM Producibility and Flattening

In composites design with FiberSIM, a draping simulation is used to generate fiber paths, identify areas of wrinkling and bridging, develop flat patterns, and allow the prediction of accurate local laminate mechanical properties such as stiffness, permeability, volume fraction, and thickness. The simulation guides the lay-up process, ensures repeatability and minimizes material waste. In woven fabrics, drapability is facilitated by the fabric ability to undergo large in-plane shear deformations due to a trellising action of warp and weft yarns. In unidirectional fabrics, fibers slide relative to one another for in-plane shear to occur, and it is generally assumed that the distance between the fibers remains constant whereas the fibers of the woven fabric come closer to each other under shearing. On compound curved surfaces, fiber paths depend on the fabric deformations and on the lay-up process. The ability to predict fiber paths using the appropriate mapping model has important practical applications:

- Knowledge of fiber paths and shear deformations allows prediction of wrinkling and bridging in the fabric and indicates locations for the cutting of relief darts,
- Exact fabric flat patterns can be developed from the simulation,
- The simulation can help define the best lay-up start point and keep track of this information to assure repeatability of draping,
- A number of secondary physical properties can be determined for the simulation: ply thickness, fiber volume fraction, outside mold definition, mass properties,
- The simulation can be used as a design tool for optimizing a draping in terms of minimized total fabric shear deformation or specified fiber orientations at points on the surface, or for positioning unavoidable darts and splices at uncritical areas of the part.

FiberSIM Material Database

Properties for the FiberSIM materials database are generated based on the following information:

Material thickness

The nominal thickness of the uncured material.

Deformation Limit Angle

This angle specifies the angle past which the material will wrinkle when deformed. In general, it is best to set the limit angle conservatively to guarantee that the part will be manufacturable. This angle is measured as shown in Figure 1 and is specified in FiberSIM in units of degrees.

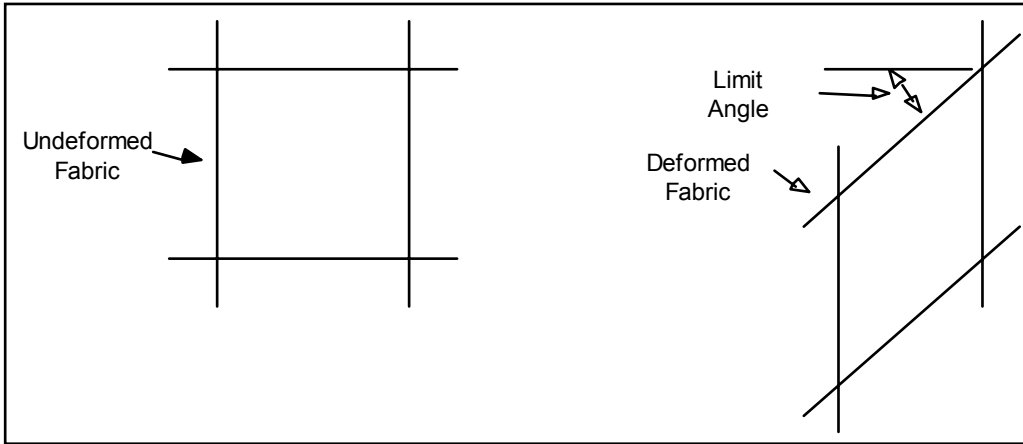


Figure 1: Definition of woven material limit

FiberSIM utilizes the Deformation Limit Angle to display areas on a composite ply where the material will wrinkle when it is laid down on to a complex curvature surface. For the areas of the ply that deform beyond the Deformation Limit Angle, the representative fiber paths are typically displayed by FiberSIM in the color red.