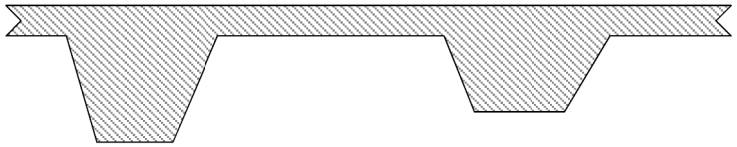
OPTIMAL INNER PANEL DESIGN

Problem: what is the appropriate optimization model for inner panels ?

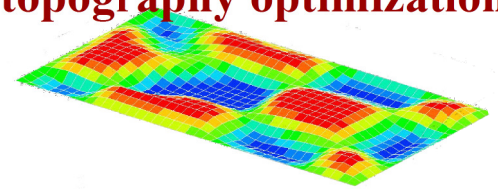
solid ribs (e.g. composite panels)



topometry/free sizing optimization

stamped wedges (e.g. phonic absorbers)

topography optimization

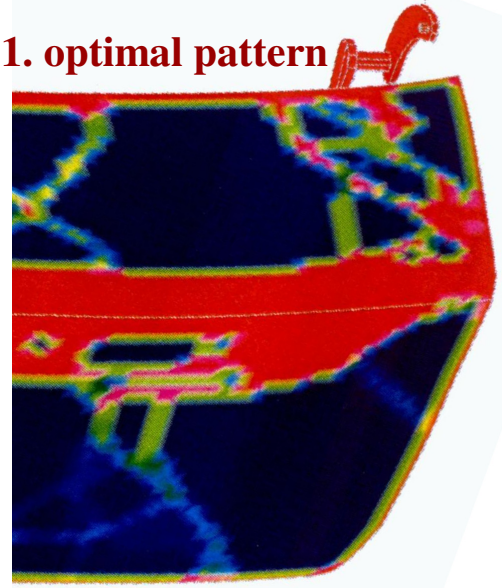


outer skin + inner panels

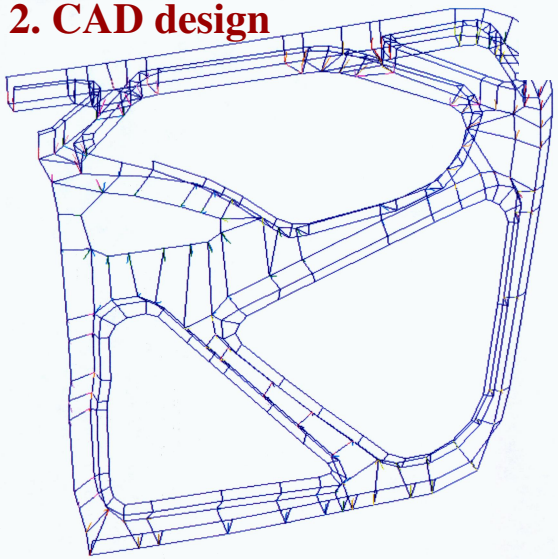
?

Inner panel design is usually based on solid rib patterns obtained from topology or topometry optimization

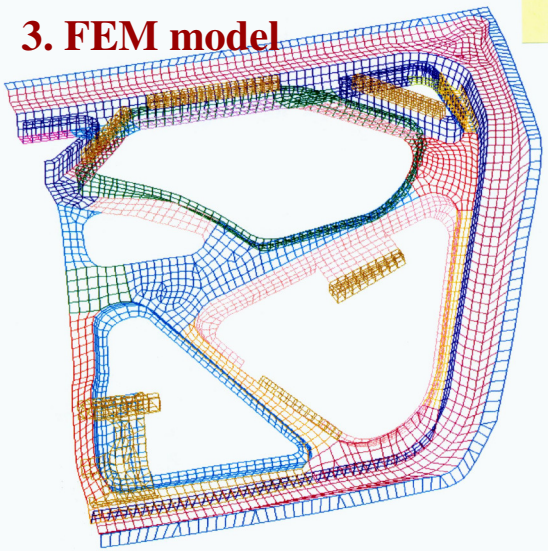
1. optimal pattern



2. CAD design



3. FEM model

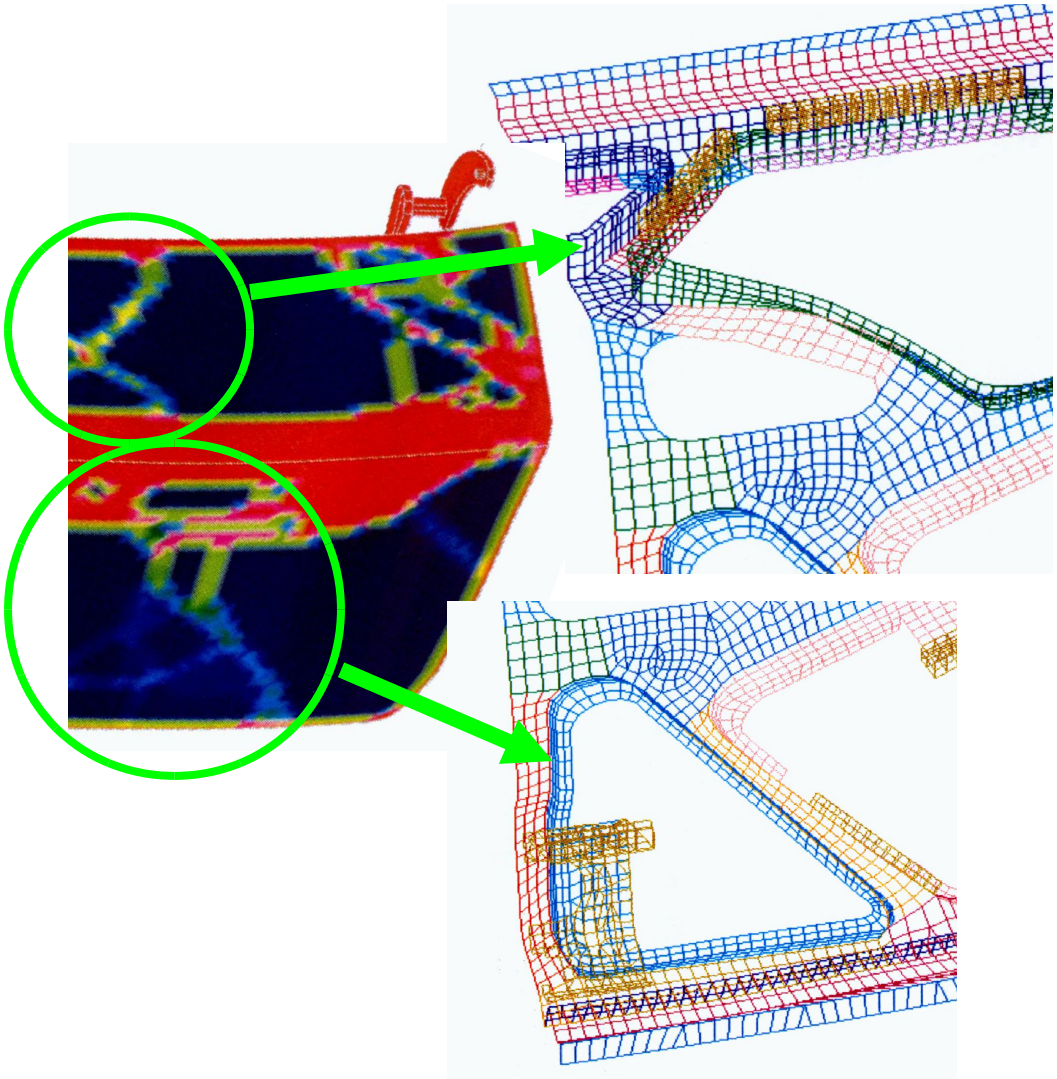


Problem: a solid rib is different than a rib of a inner panel:

- It is stiffer
- It is isotropic

As a result:

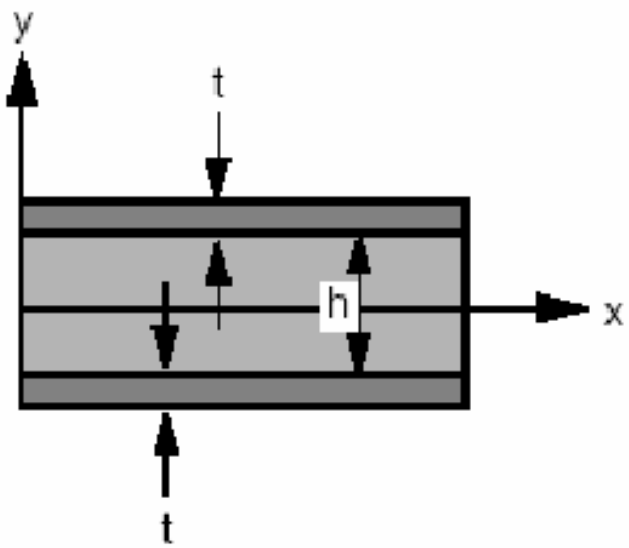
- Shallow solid ribs become thick inner panel ribs
- Sometimes, long shallow ribs must be redesigned with traditional methods



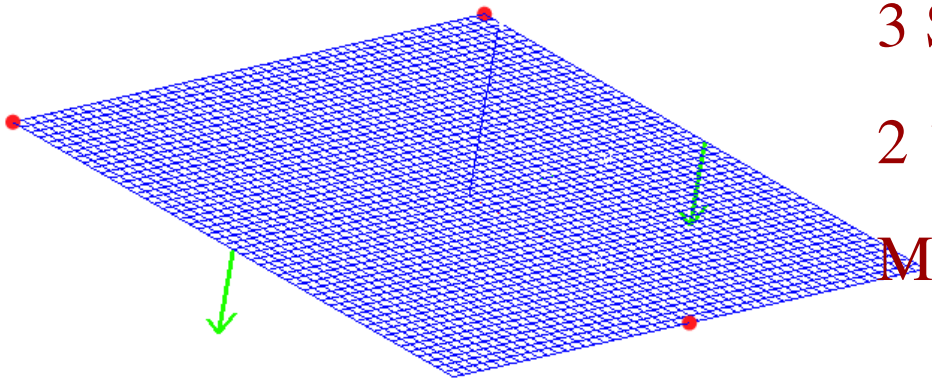
SimTech has developed an inner panel model suitable for topometry optimization.

The design variable is h, the local height of the rib.

The behavior changes when h goes to zero, and the bottom panel disappears.



Example: plate under lateral flexural loads (simplified car hood)



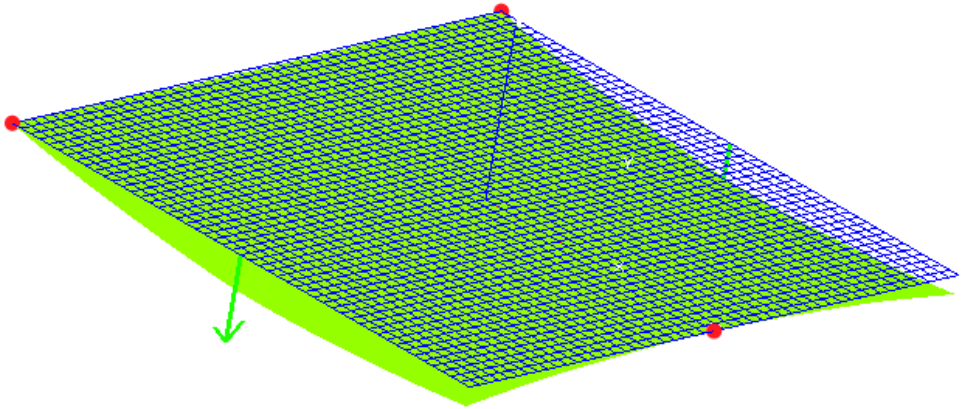
3 SPCs (2 hinges, 1 lock)

2 100 N loads

Material: 1.25 mm Aluminum

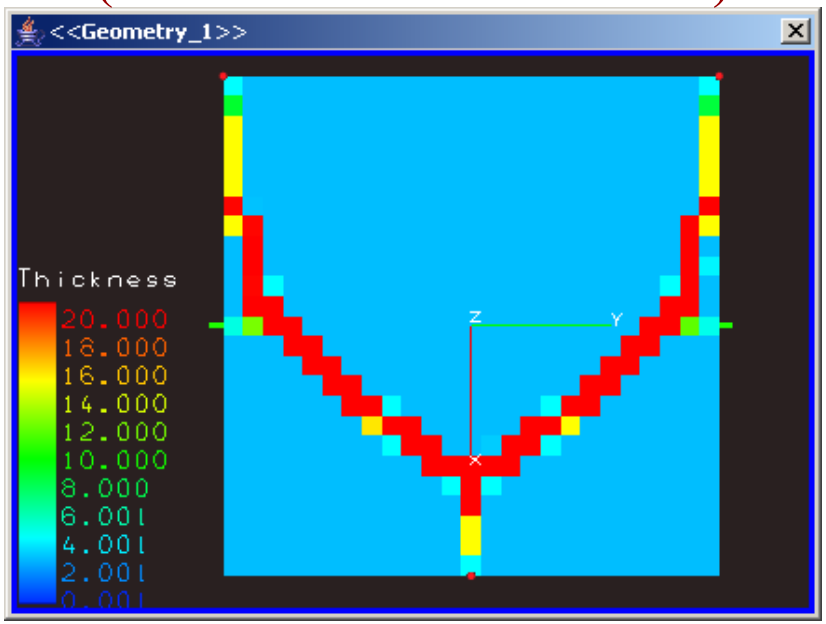
Target mid-span displacement : 2 mm

Displacement without reinforcements : 715 mm



Optimization results

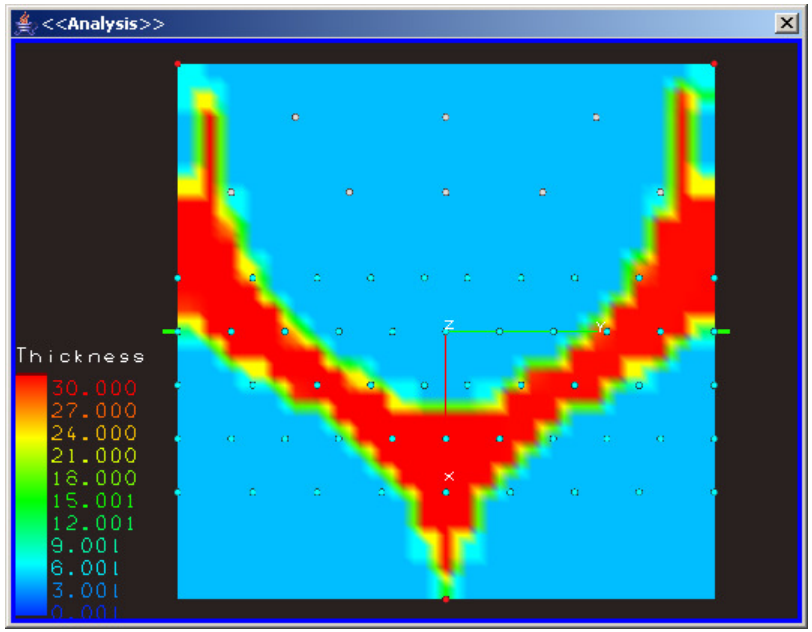
standard topometry (thickness = solid thickness)



Mid-span displacement = 2mm

Structure mass = 5.8 Kgs

inner panel formulation (thickness = rib height)

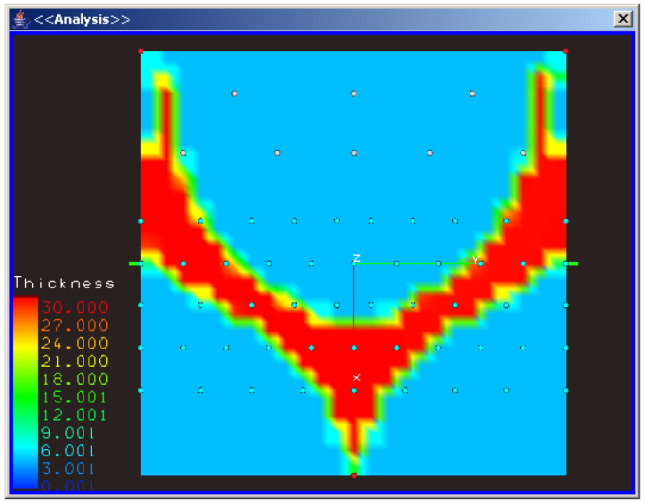


Mid-span displacement = 2 mm

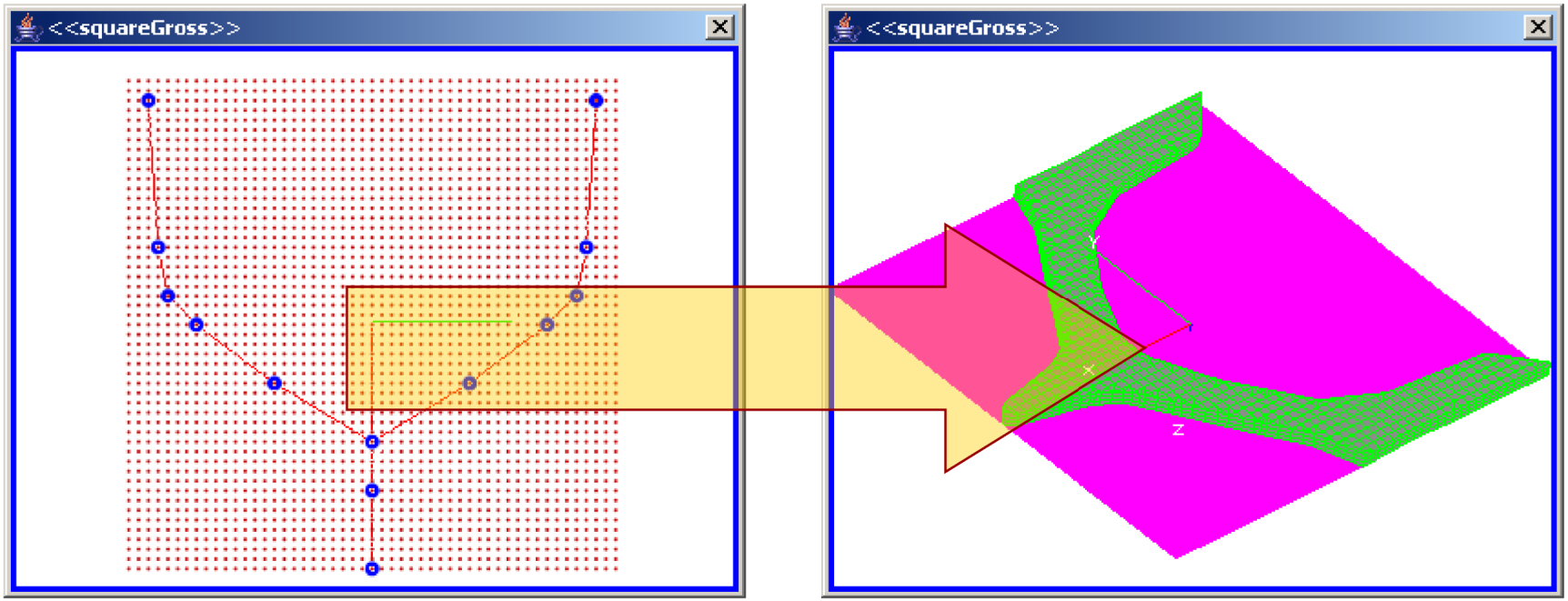
Structure mass = 4.3 Kgs

The result of the inner panel optimization is a good layout for a real inner panel.

To prove it, we generate an inner panel along this layout.



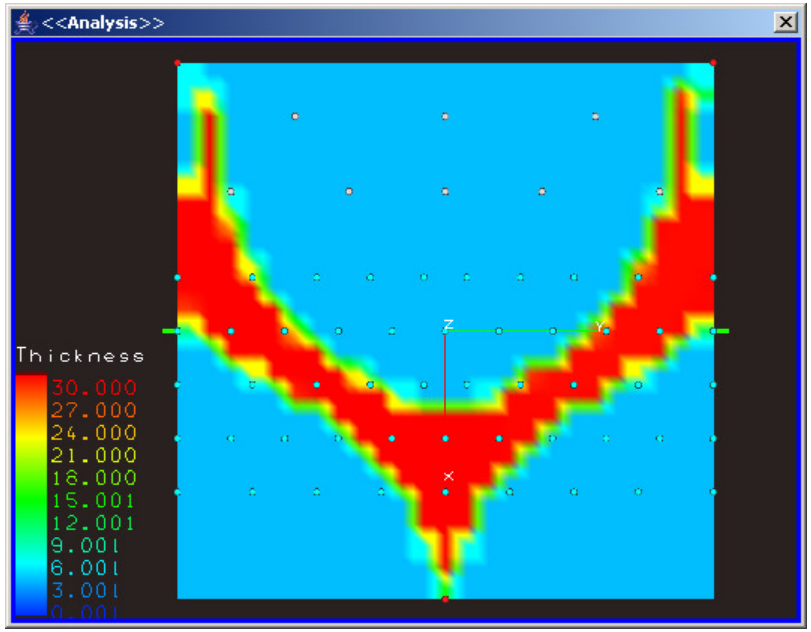
The panel is generated automatically using ENKIDOU tools

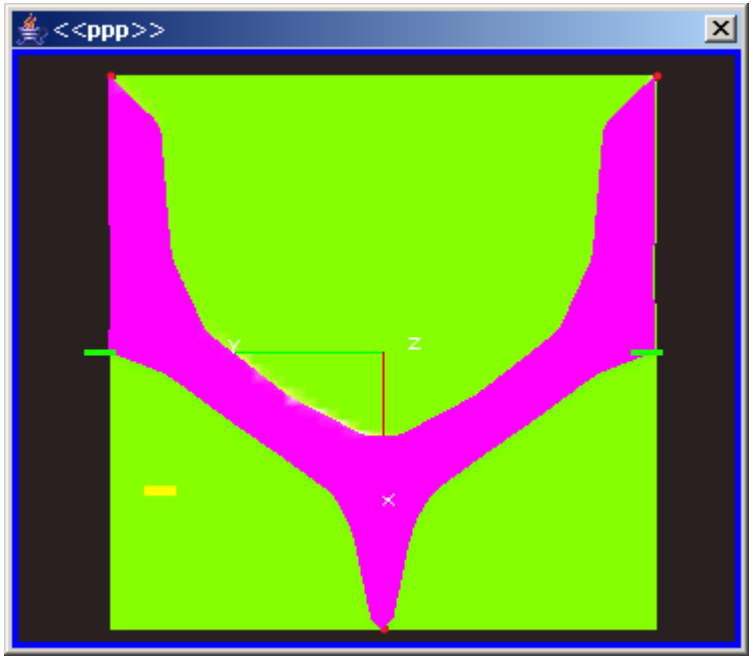


bar layout (manual generation)

inner panel (automatic generation)

The physical inner panel has the same size (width, height) of the numerical panel generated by GENESIS topometry



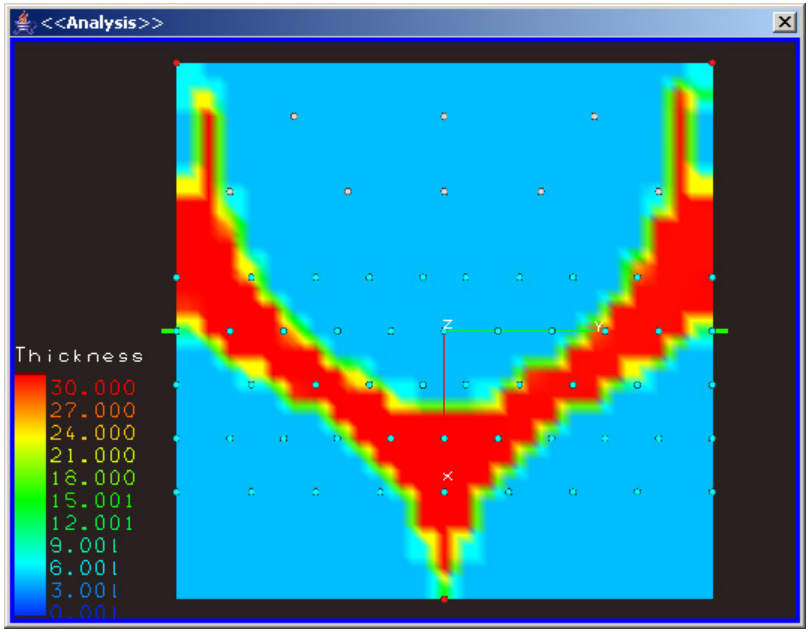


Rib height = 30 mm

Rib width: same for the two models

The physical panel (outer skin + inner panel) has the same behavior and mass of the single layer panel used in optimization.

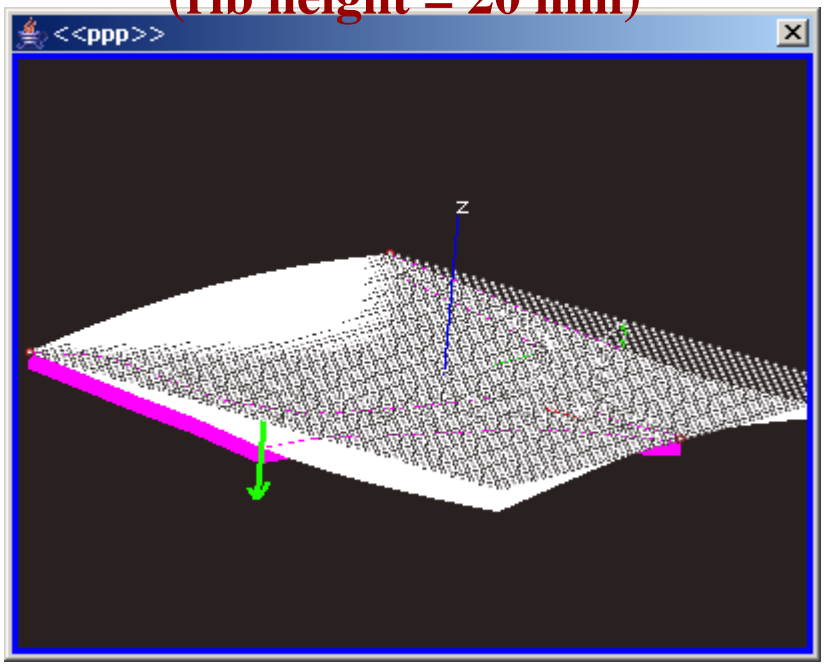
inner panel formulation (thickness = rib height)



Mid-span displacement = 2 mm

Structure mass = 4.3 Kgs

physical inner panel (rib height = 20 mm)



Mid-span displacement = 2.05 mm

Structure mass = 4.7 Kgs

we can optimize directly inner panels for car bodies and other applications !