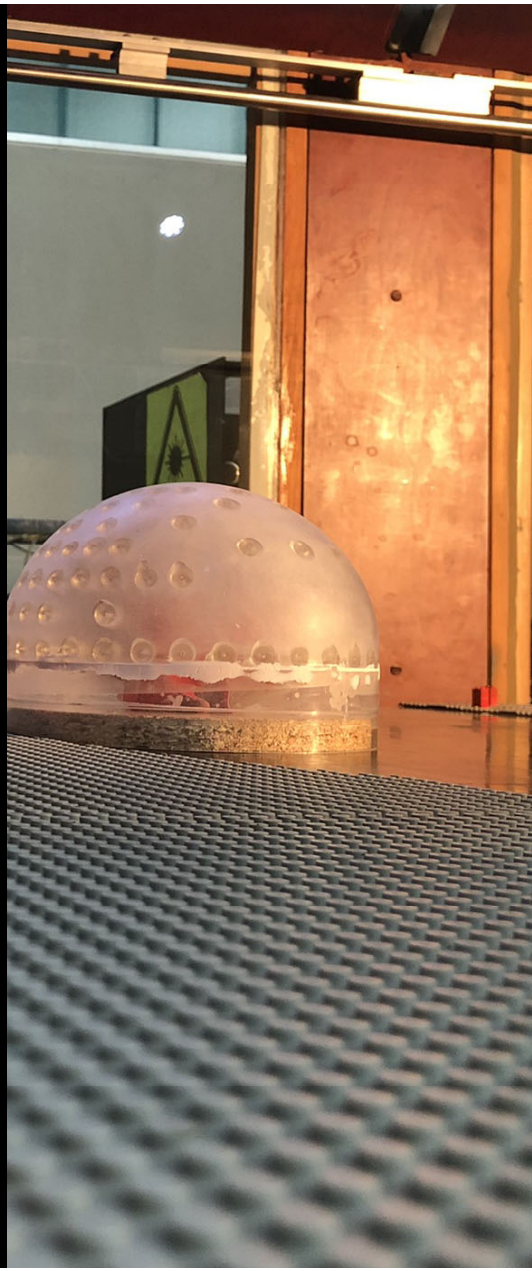
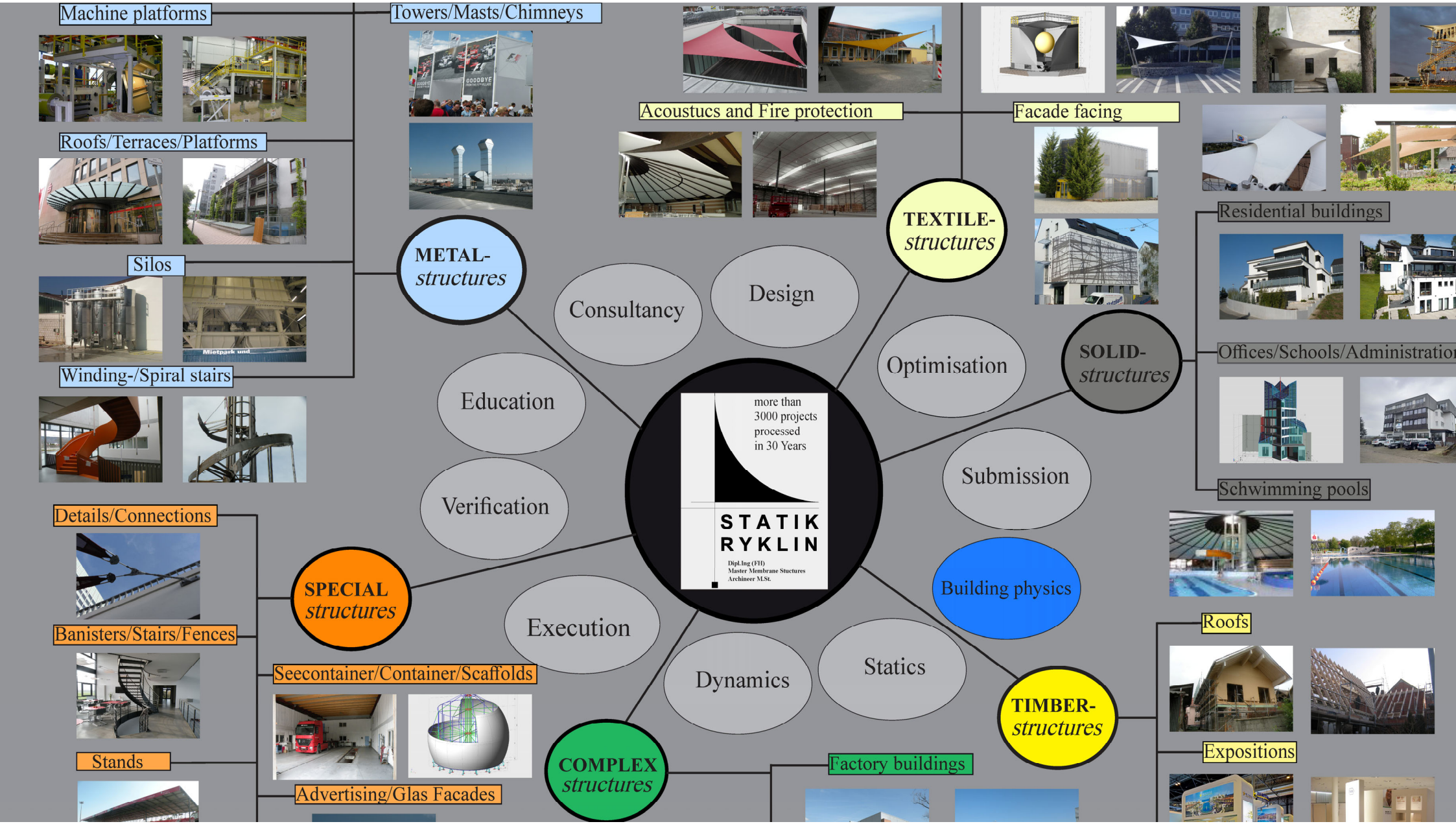
DWA Conform Static Dimensioning of Gas Storages

An attempt to compare different guidelines for the statical analysis of biogas storages




more than
3000 projects
processed
in 30 Years
STATIK
RYKLIN
Dipl.Ing (FH)
Master Membrane Stuctures
Archineer M.St.
METAL-
structures
TEXTILE-
structures
SOLID-
structures
TIMBER-
structures
COMPLEX
structures
SPECIAL
structures
Consultancy
Design
Optimisation
Submission
Building physics
Statics
Dynamics
Execution
Verification
Education
Machine platforms
Towers/Masts/Chimneys
Roofs/Terraces/Platforms
Silos
Winding-/Spiral stairs
Acoustucs and Fire protection
Facade facing
Residential buildings
Offices/Schools/Administration
Schwimming pools
Roofs
Expositions
Factory buildings
Details/Connections
Banisters/Stairs/Fences
Stands
Seecontainer/Container/Scaffolds
Advertising/Glas Facades

Biogas storages – in general

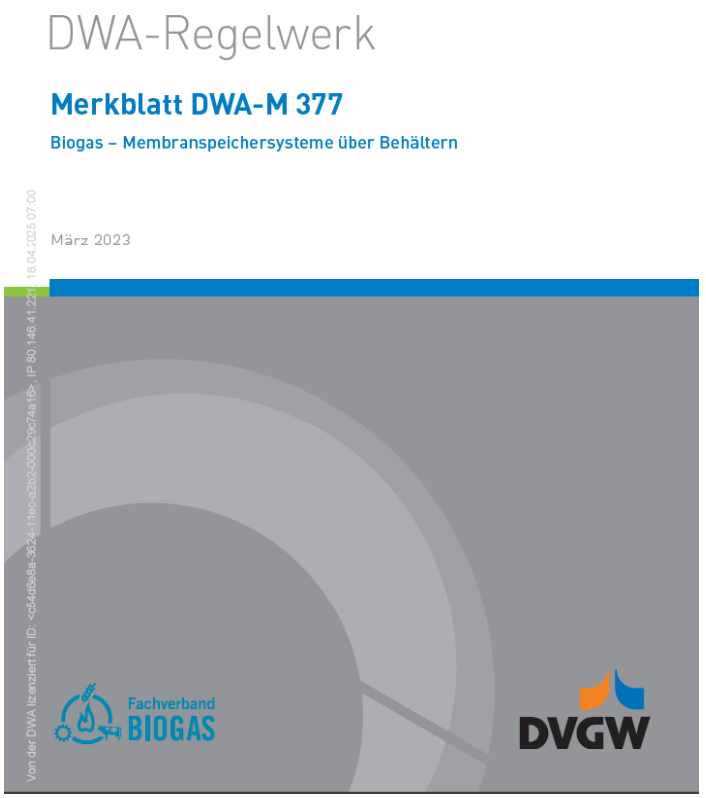
DWA-M 377 →Published in 2023

- in general:

  # defines load values

- for cones shaped:

  # mast skew -> l/200
  # mast dislocated -> d/300



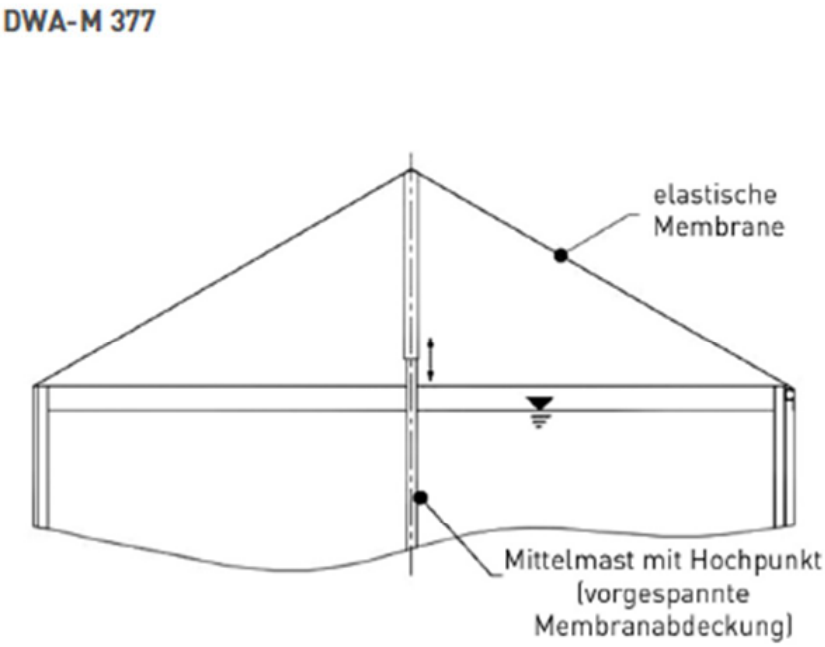
cone shaped - model

- cone geometry used for calculation:

  d=40m h=5m f=5,3m
  hight of mast 10,3m

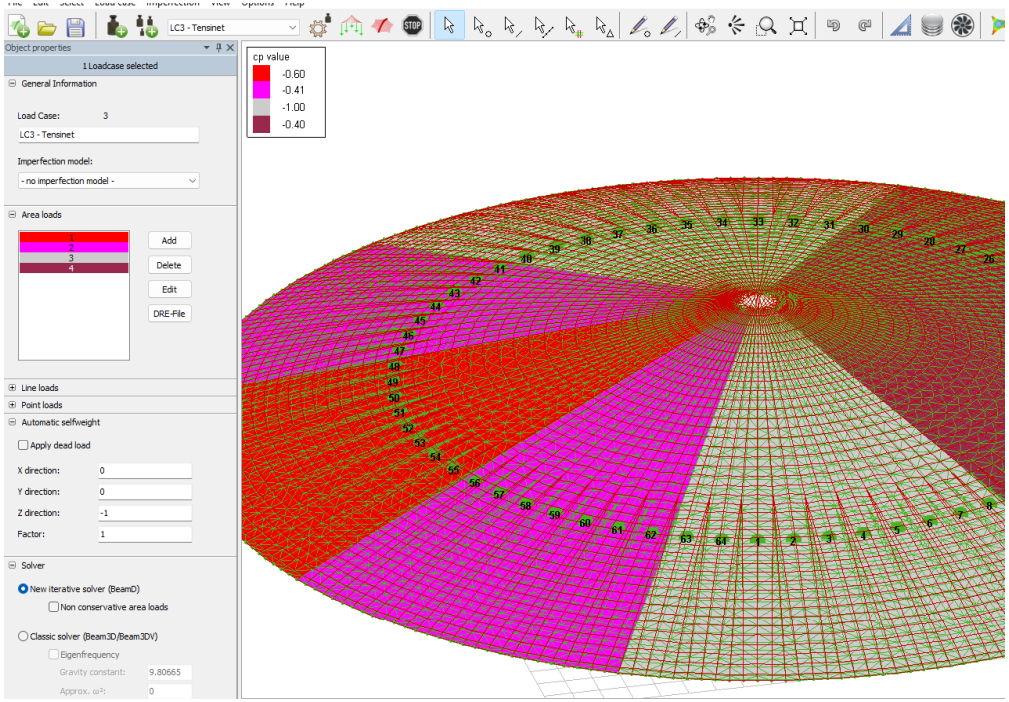
- membran with belts (x64) and mast

- inner pressure

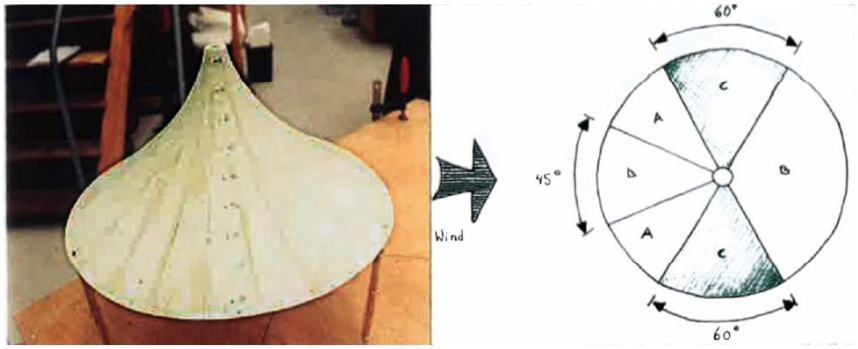


cone shaped – Easy model

Loadzones in Easy



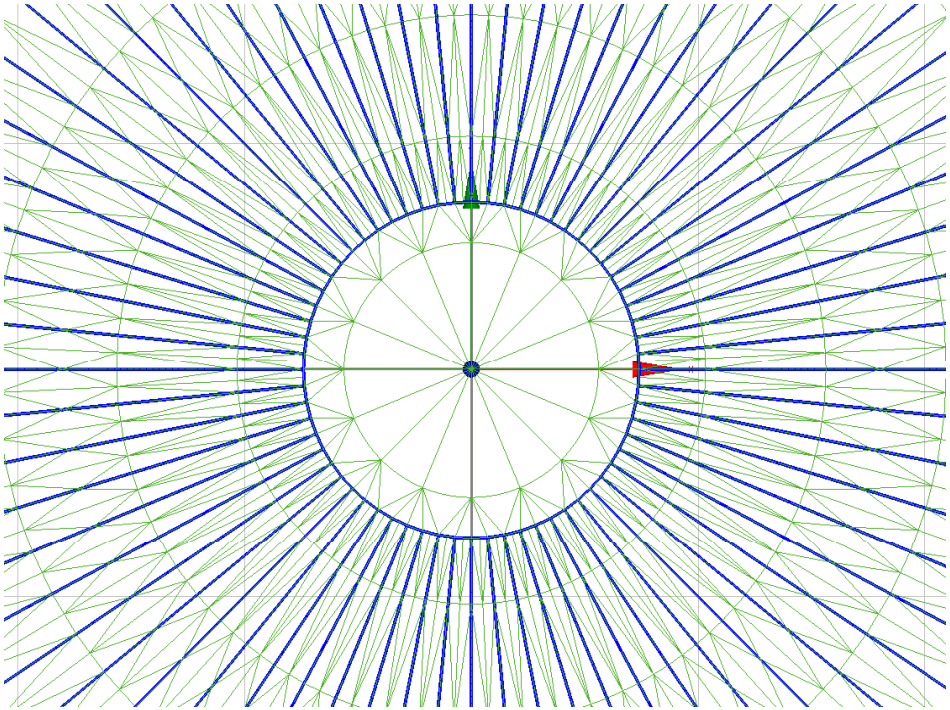
Wind loads according to Tensinet guide



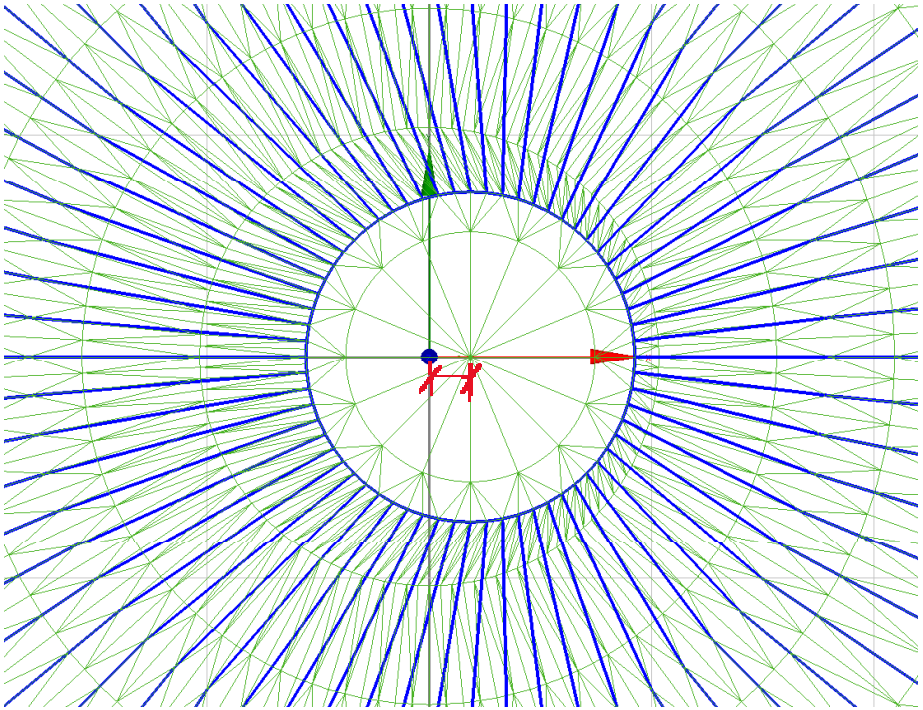
Bereich	A	B	C	D
c_{pa}-Wert	−0,41	−0,7	−1,0	+0,75/−0,6

cone shaped – Easy model

symmetrical model



unsymmetrical model

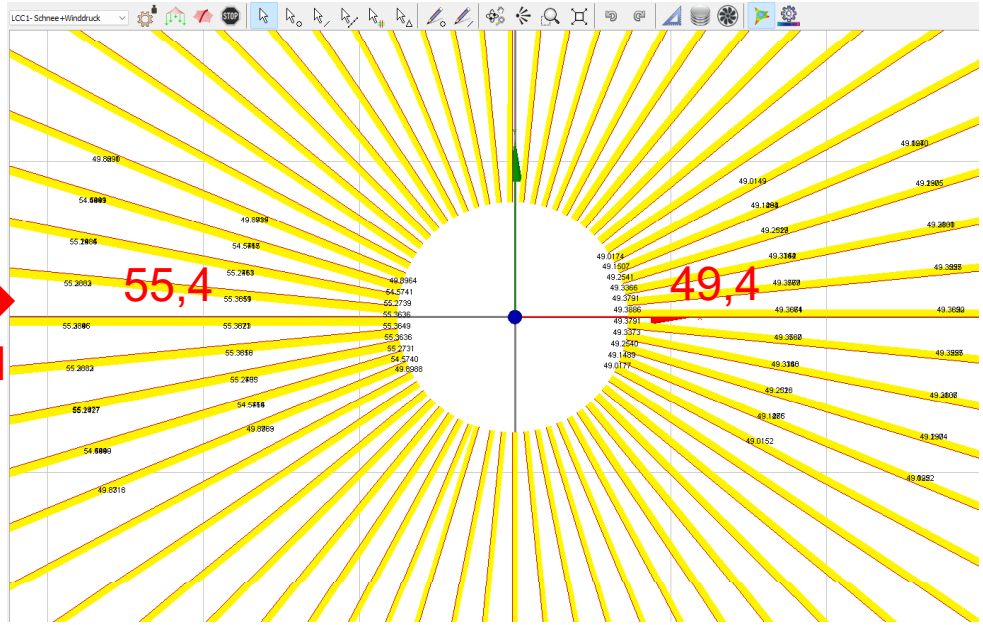


cone shaped – results: snow+wind pressure

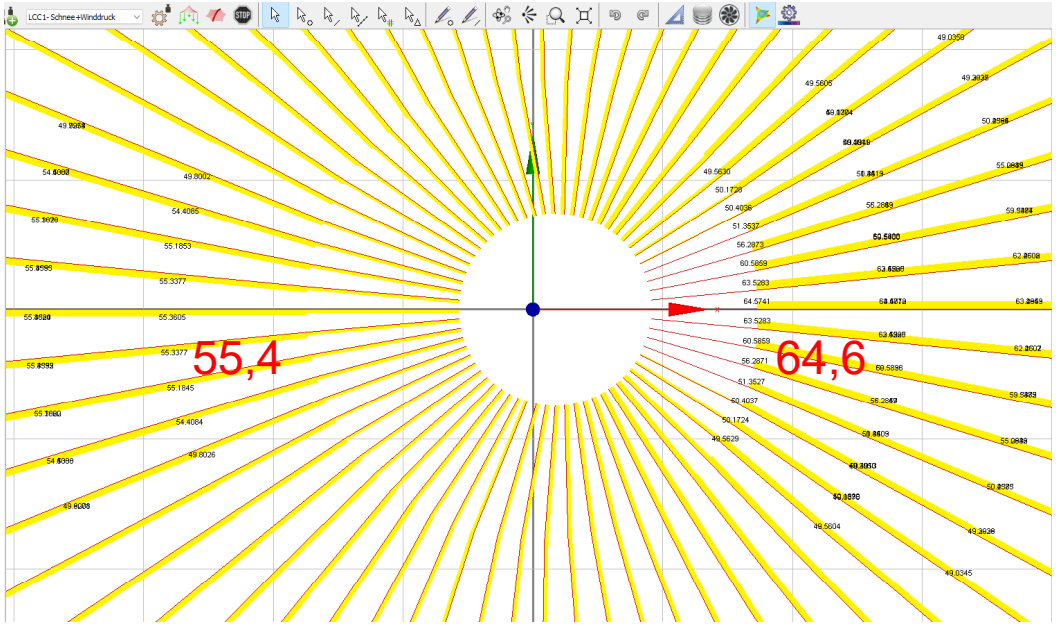
Parameters

Load Case	Factor
☑ LC1 - Eigengewicht	1.3500
☐ LC3 - Tensinet	1.0000
☐ LC4 - Schnee geteilt X- x1,0	1.0000
☑ LC2 - Schnee	1.5000
☐ LC5 - Innendruck	1.0000
☑ LC6 - Tensinet Druck	0.9000
☐ LC4 - Schnee geteilt X+ x1.(	1.0000

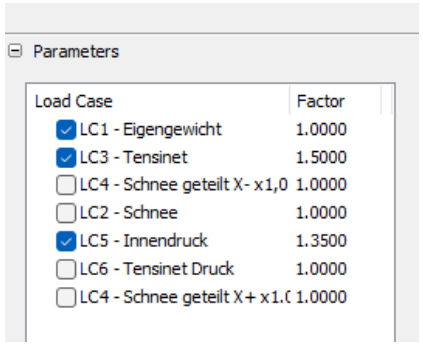
symmetrical



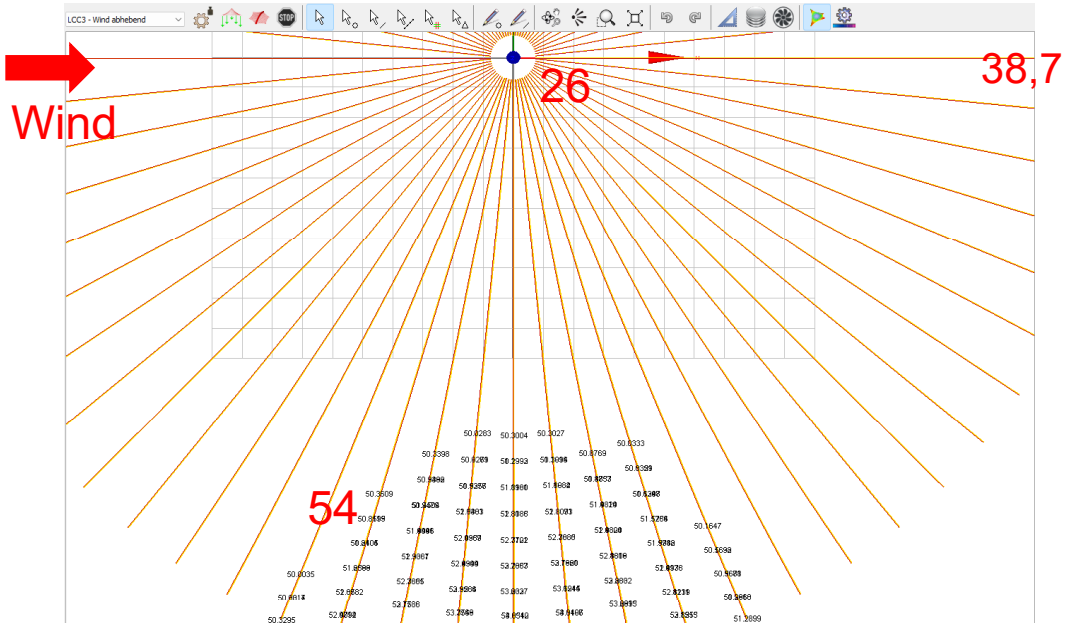
unsymmetrical



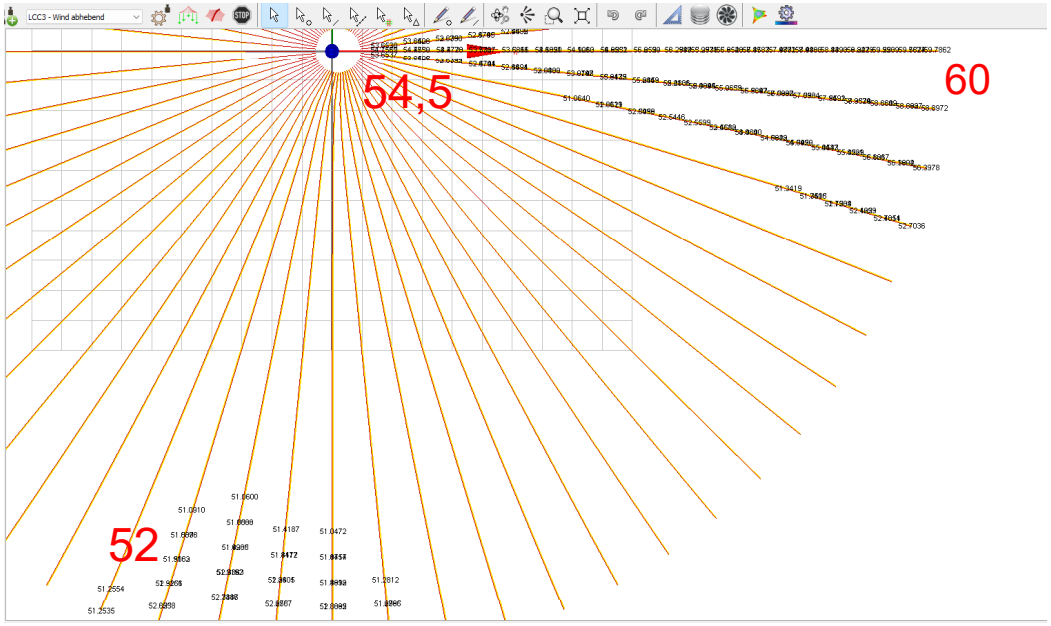
cone shaped – results: wind suction



symmetrical



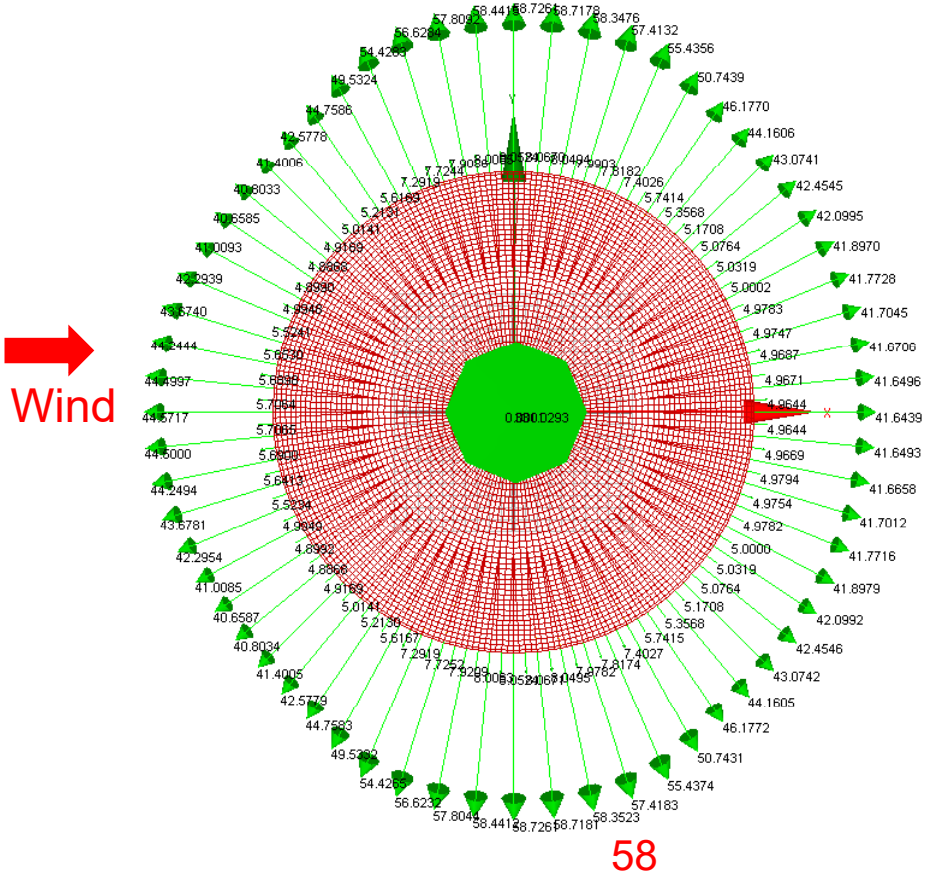
unsymmetrical



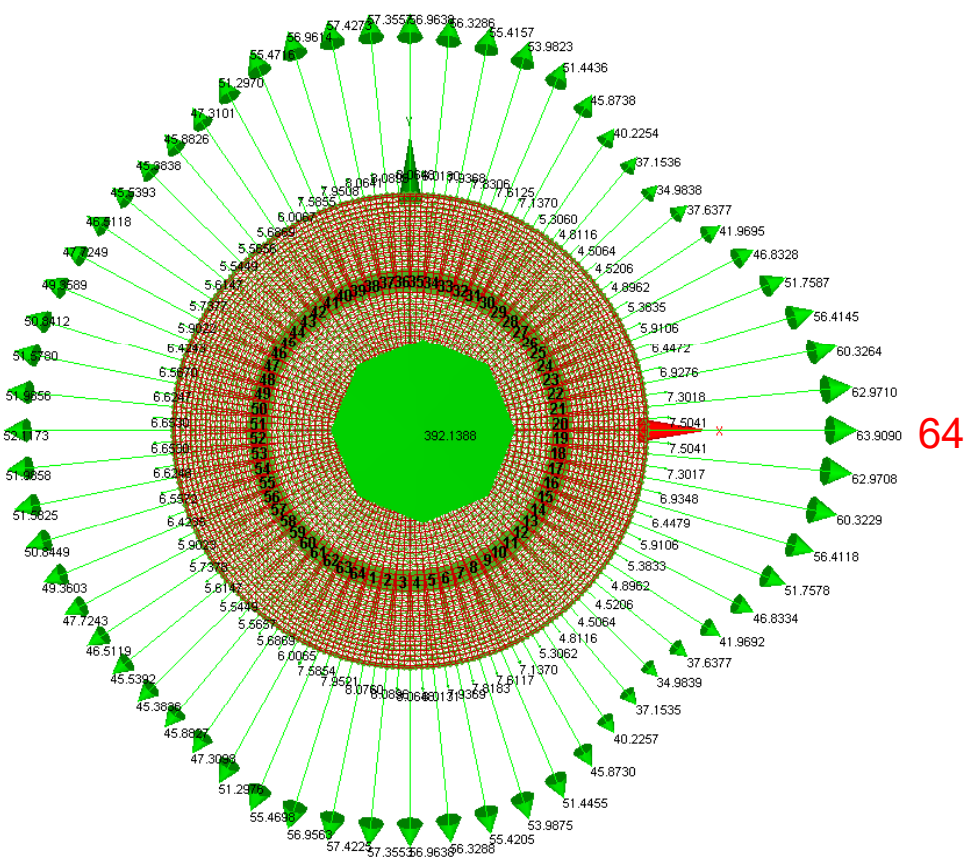
cone shaped – results: conclusion: wind suction

- Higher peak forces

symmetrical



unsymmetrical



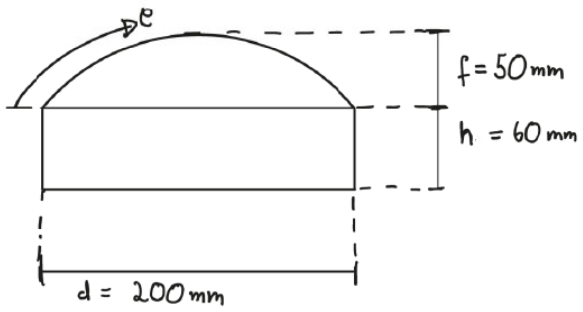
calotte - models

- geometry of models:

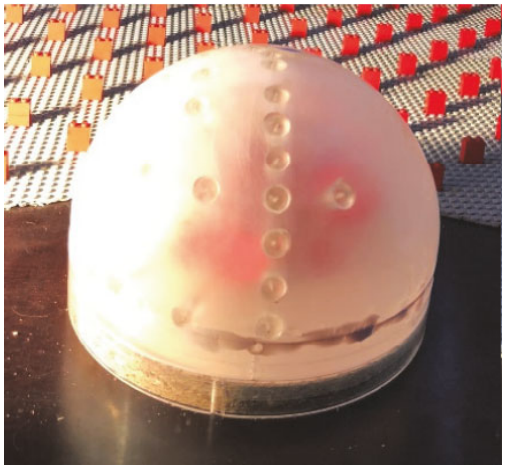
  hemisphere
  d=20m h=5m f=10m

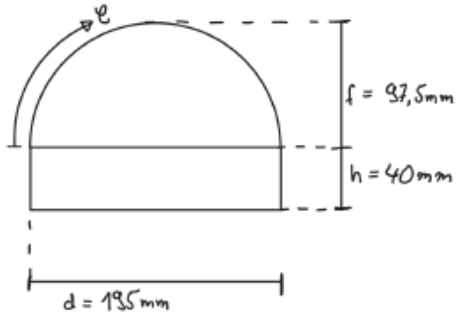
  ¼ calotte
  d=20m h=5m f=5m

¼ calotte



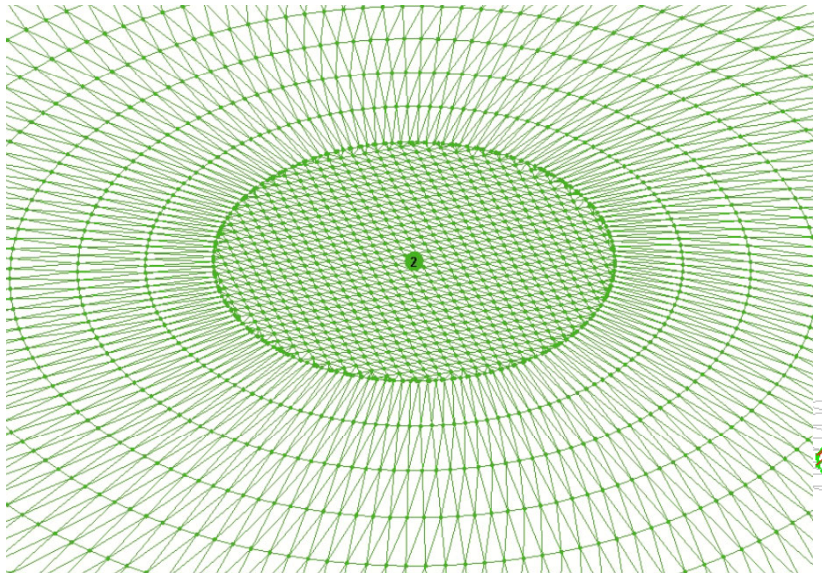
hemisphere



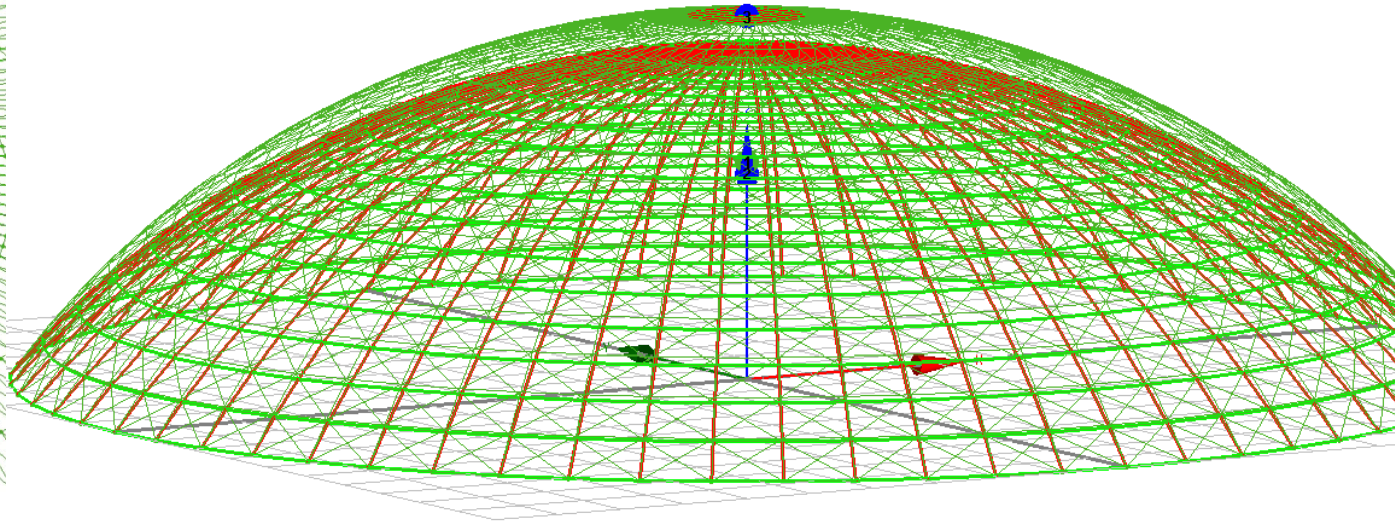


calculations via Easy – some impressions

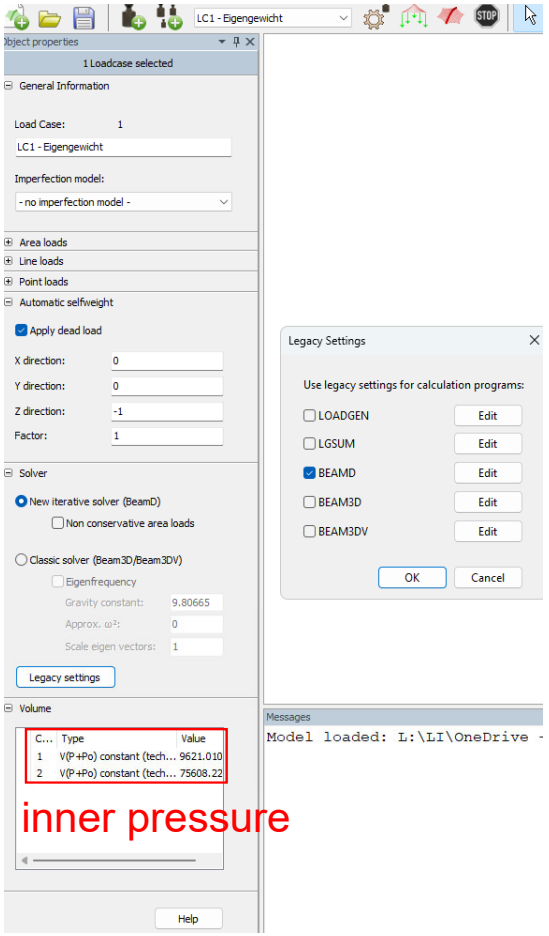
polcap at rooftop
“top cover“ 4x stiffness

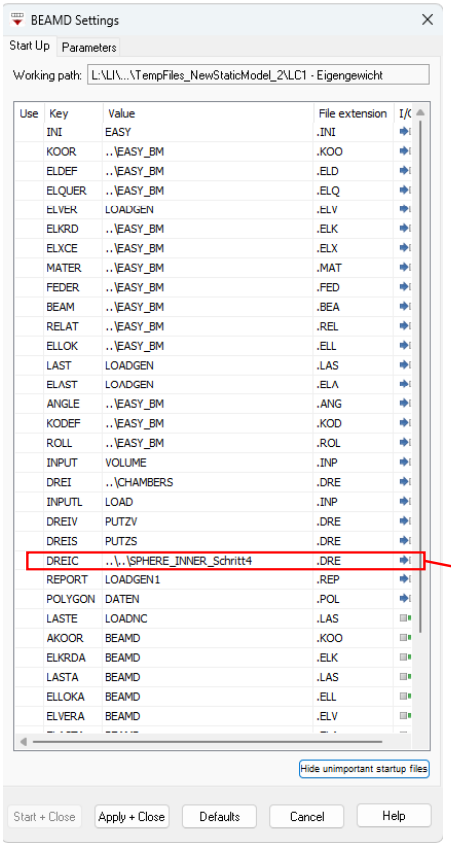


2 chambers and polcap

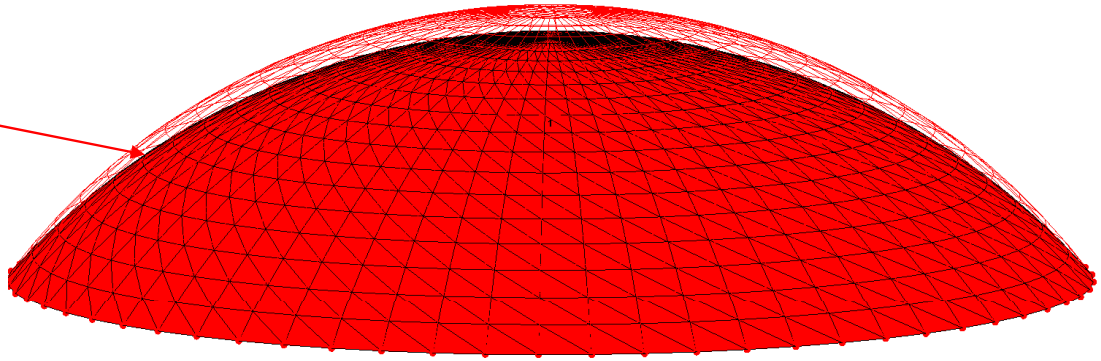


calculations via Easy – some impressions





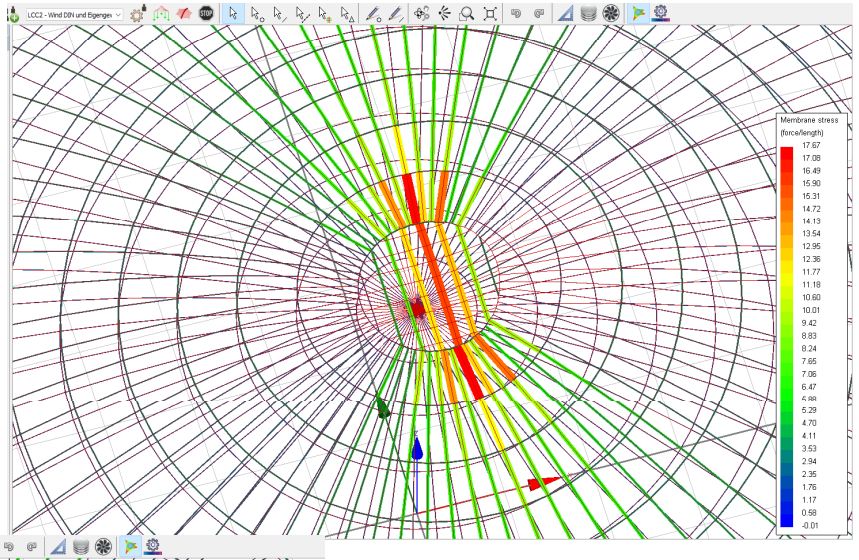
surface of inner membran



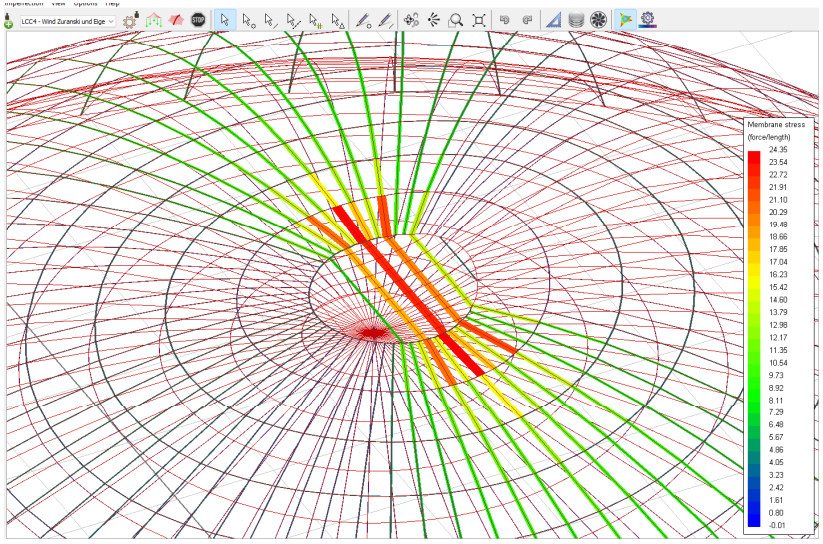
results – ¼ calotte stress

- wind x1,5 and selfweight x1,35
- DIN 4134 → stress: 15,24

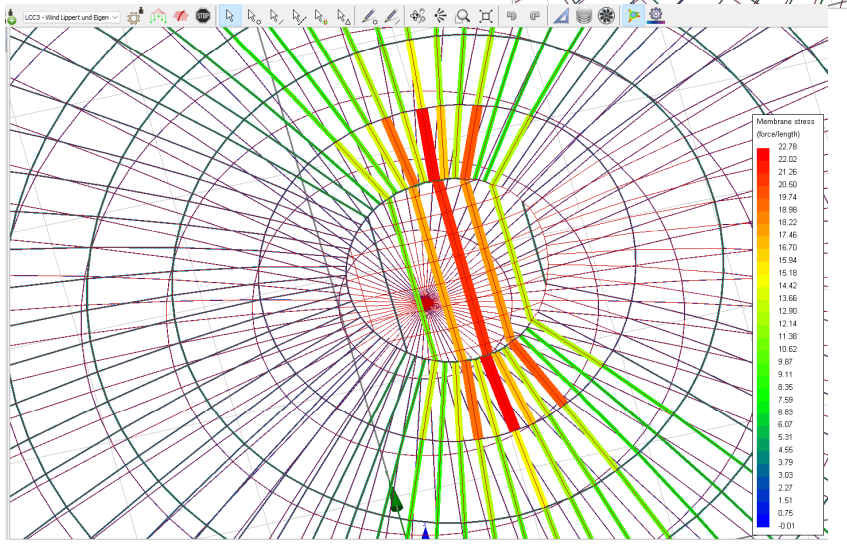
DIN EN – stress: 17,67 → 16%



Zuranski – stress: 24,35 →60%



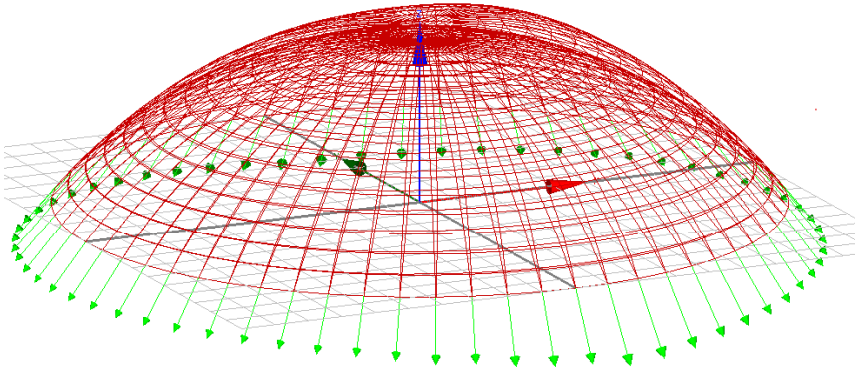
Lippert – stress: 22,76
→ 49%



results – ¼ calotte resulting forces

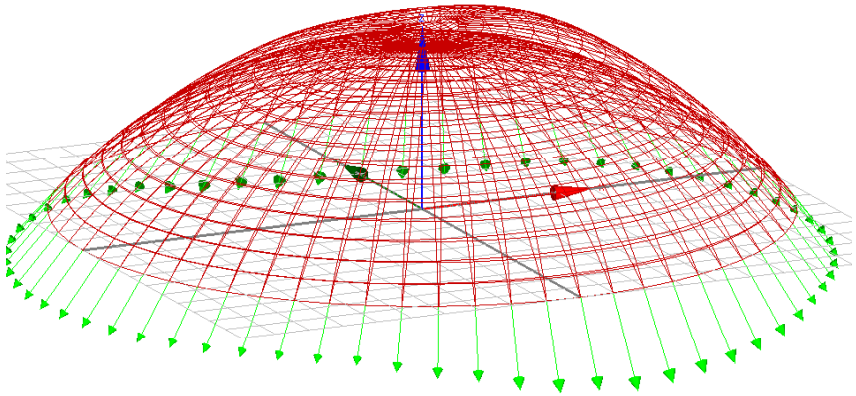
- wind and selfweight
- DIN 4134 → 10,61

DIN EN – resulting forces



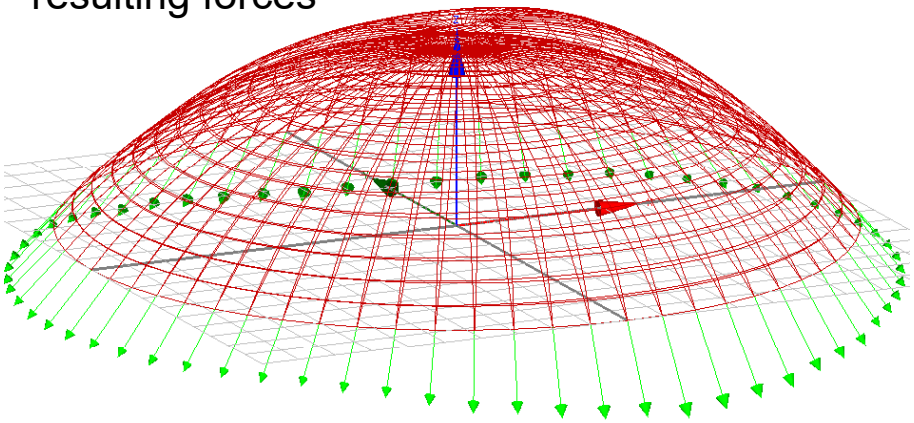
6 → -43%

Zuranski – resulting forces



7 → -34%

Lippert –
resulting forces

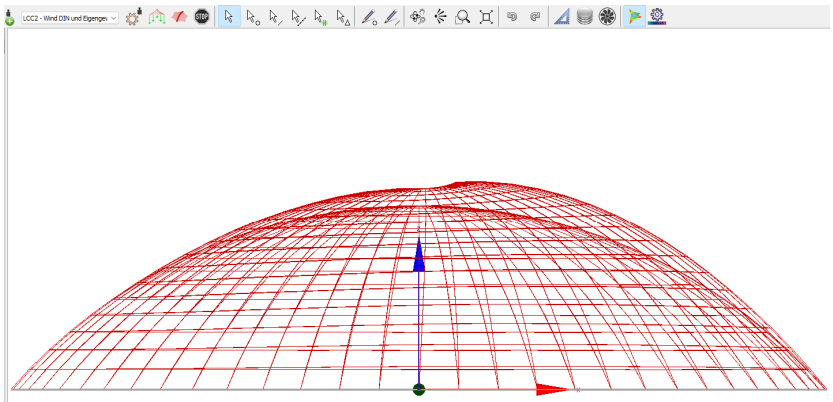


6,8 → -36%

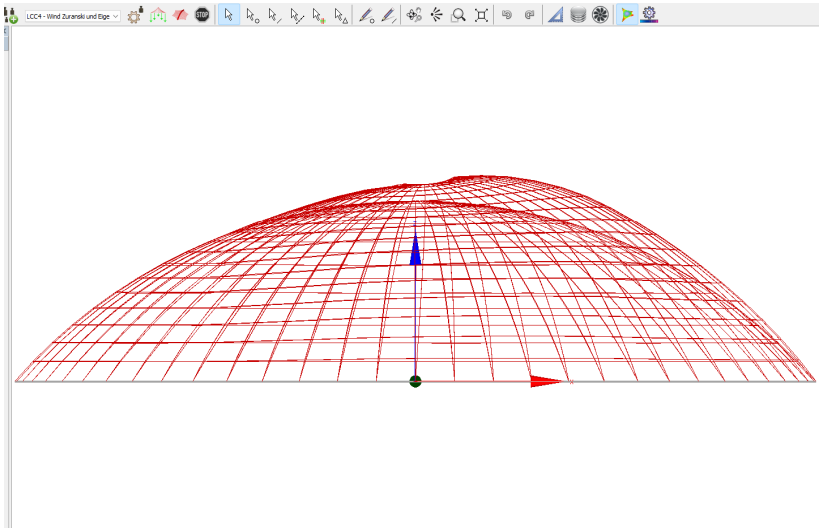
results – ¼ calotte deformation

- wind x1,5 and selfweight x1,35

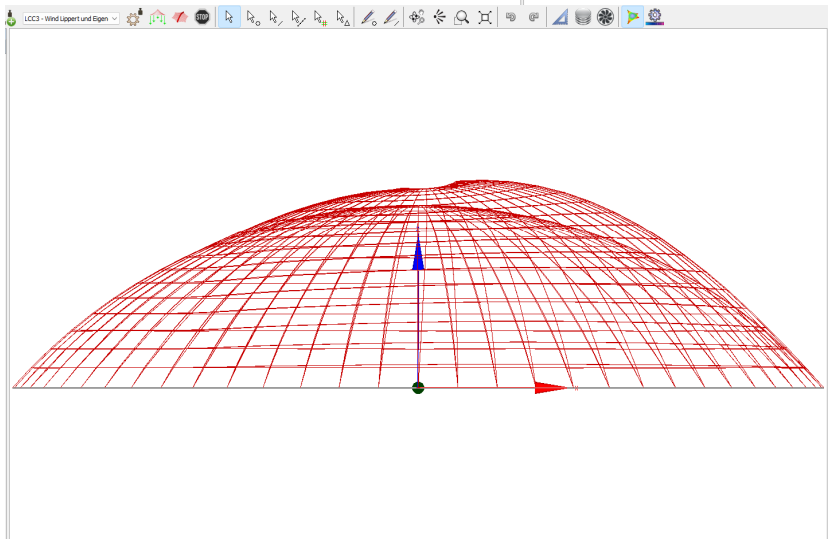
DIN EN – deformation x1



Zuranski – deformation x1



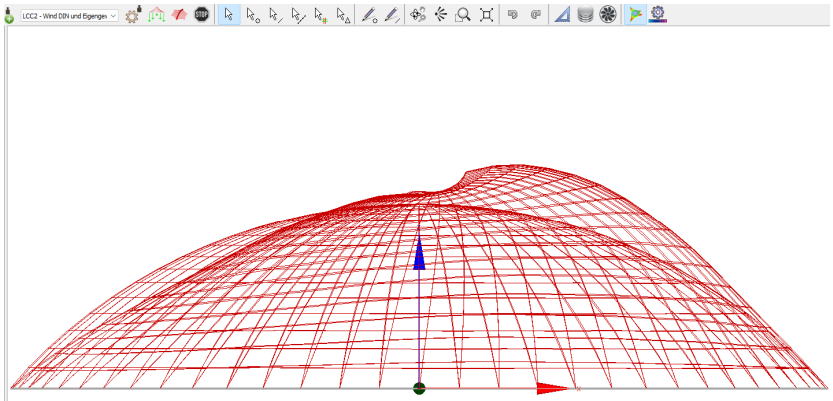
Lippert – deformation x1



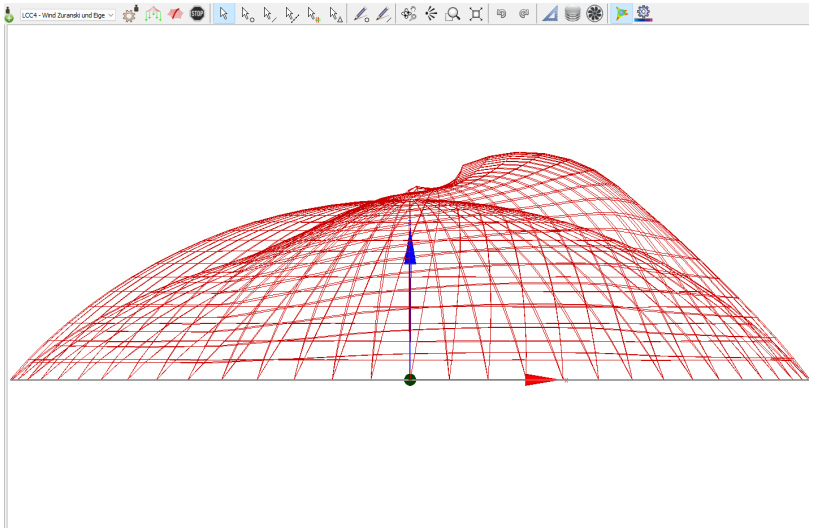
results – ¼ calotte deformation

- wind x1,5 and selfweight x1,35

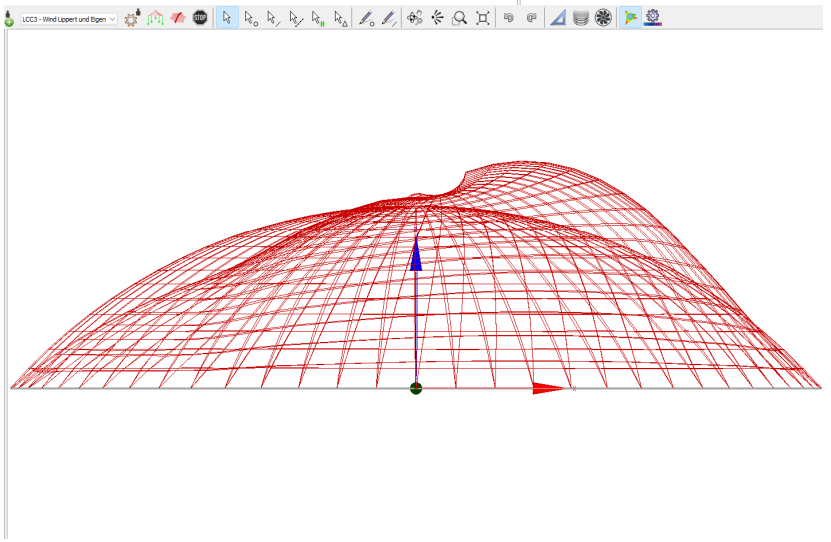
DIN EN – deformation x3



Zuranski – deformation x3



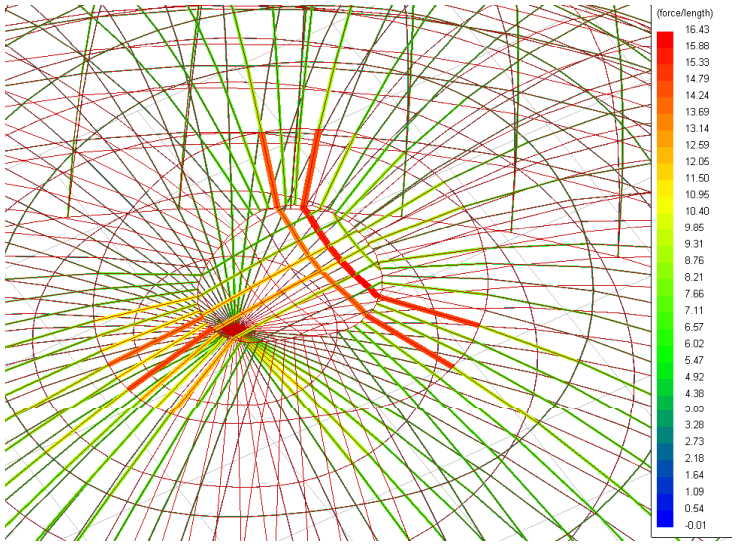
Lippert – deformation x3



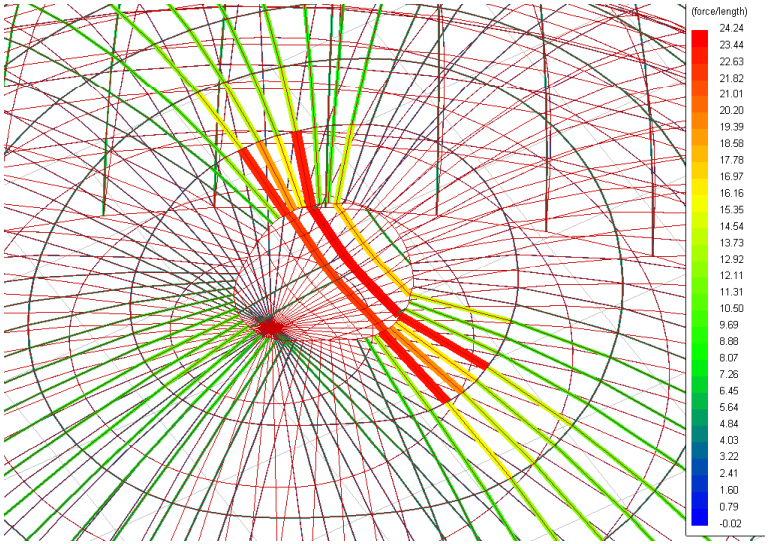
results – hemisphere stress

- wind x1,5 and selfweight x1,35
- DIN 4134 -> stress: 12,19

Lippert – stress: 16,43 → 35%



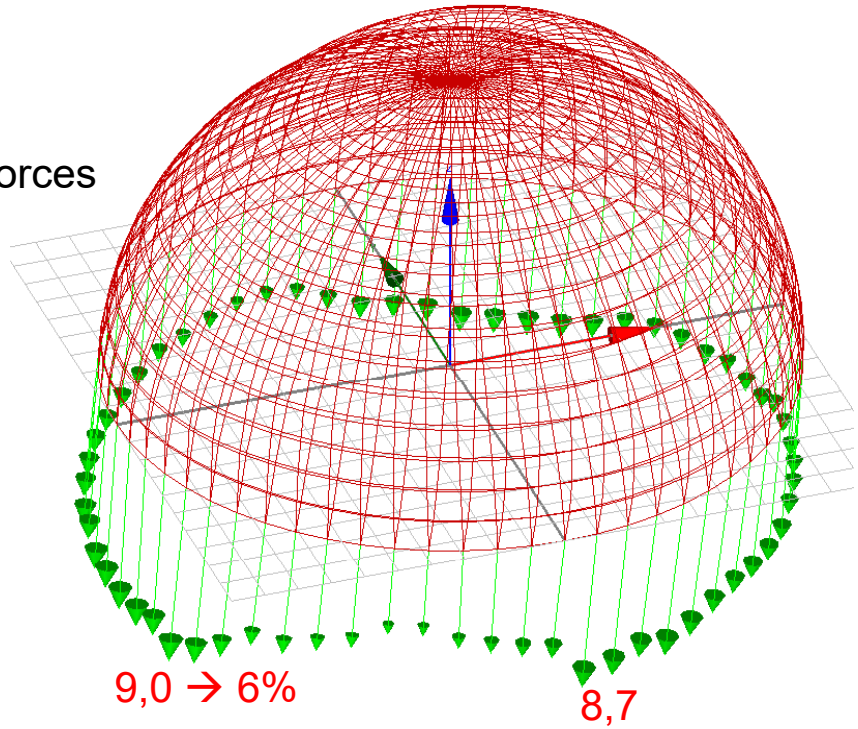
DIN EN – stress: 24,24 → 99%



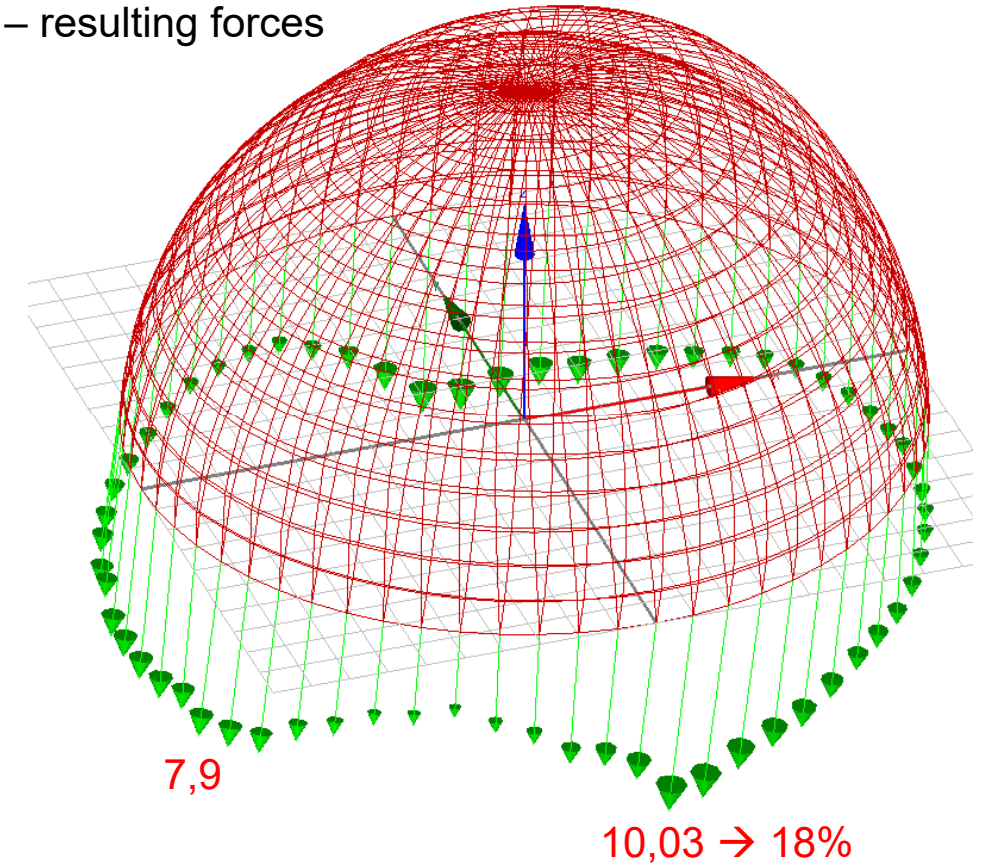
results – hemisphere resulting forces

- wind and selfweight
- DIN 4134 → 8,5

Lippert – resulting forces



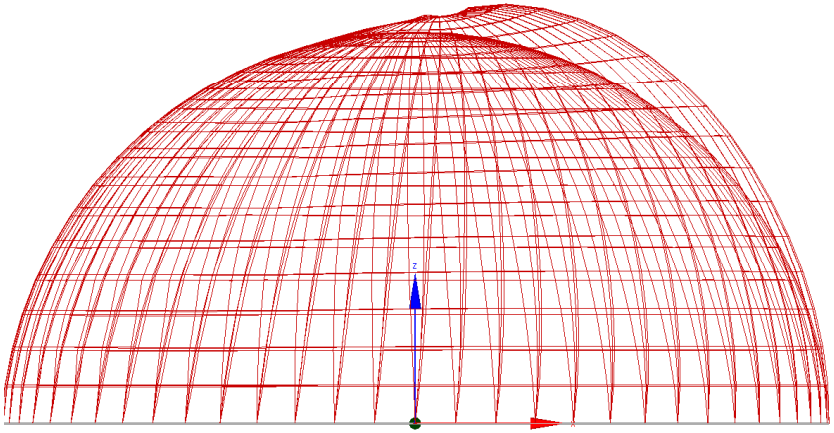
DIN EN – resulting forces



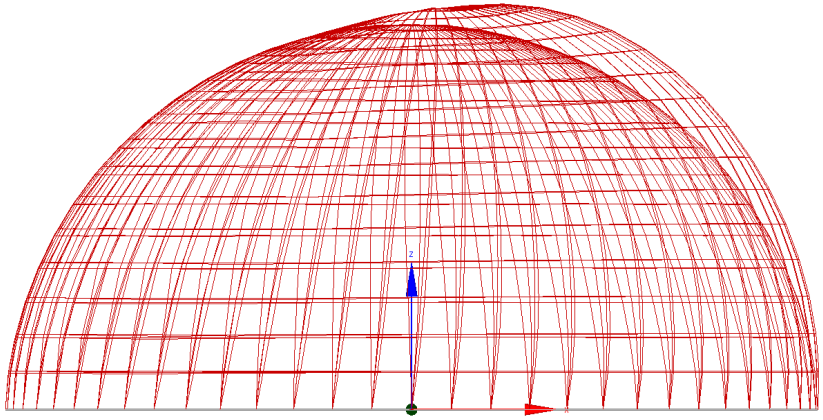
results – hemisphere deformation

- wind x1,5 and selfweight x1,35

DIN EN – deformation x1



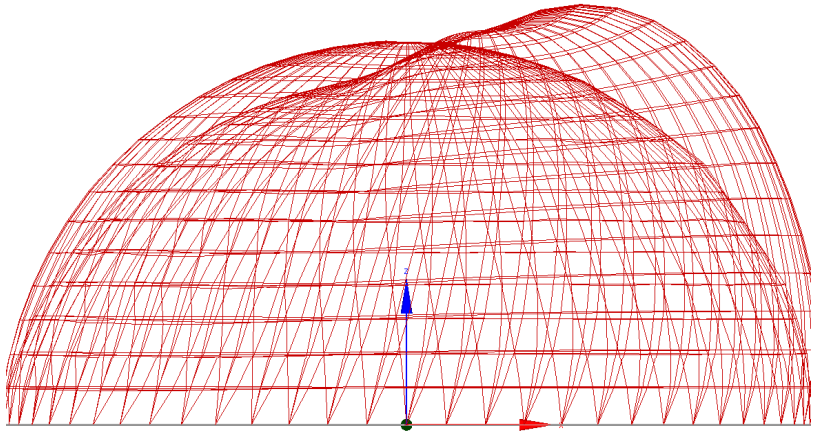
Lippert – deformation x1



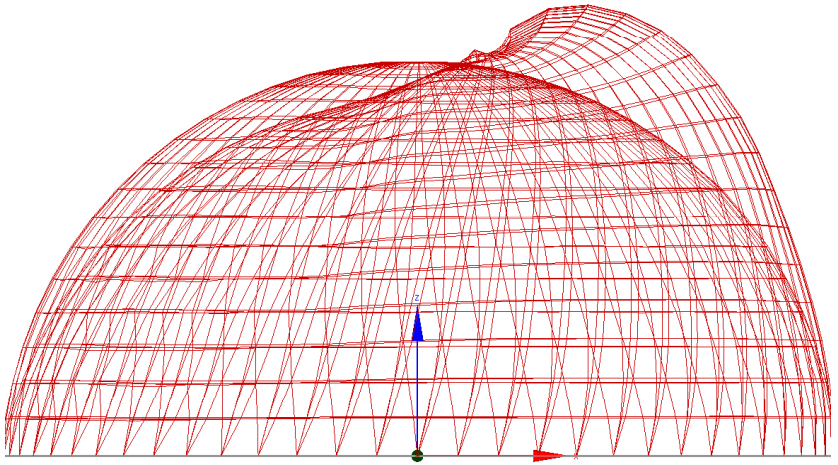
results – hemisphere deformation

- wind x1,5 and selfweight x1,35

Lippert – deformation x3



DIN EN – deformation x3



results – what is missing

- temperatur differences
- fluctuating pressure/volume
- different filling level of biogas
- design resistance values of material

conclusion

- more precise statical analysis for biogas storages
- compare results with practical expirence

Questions?