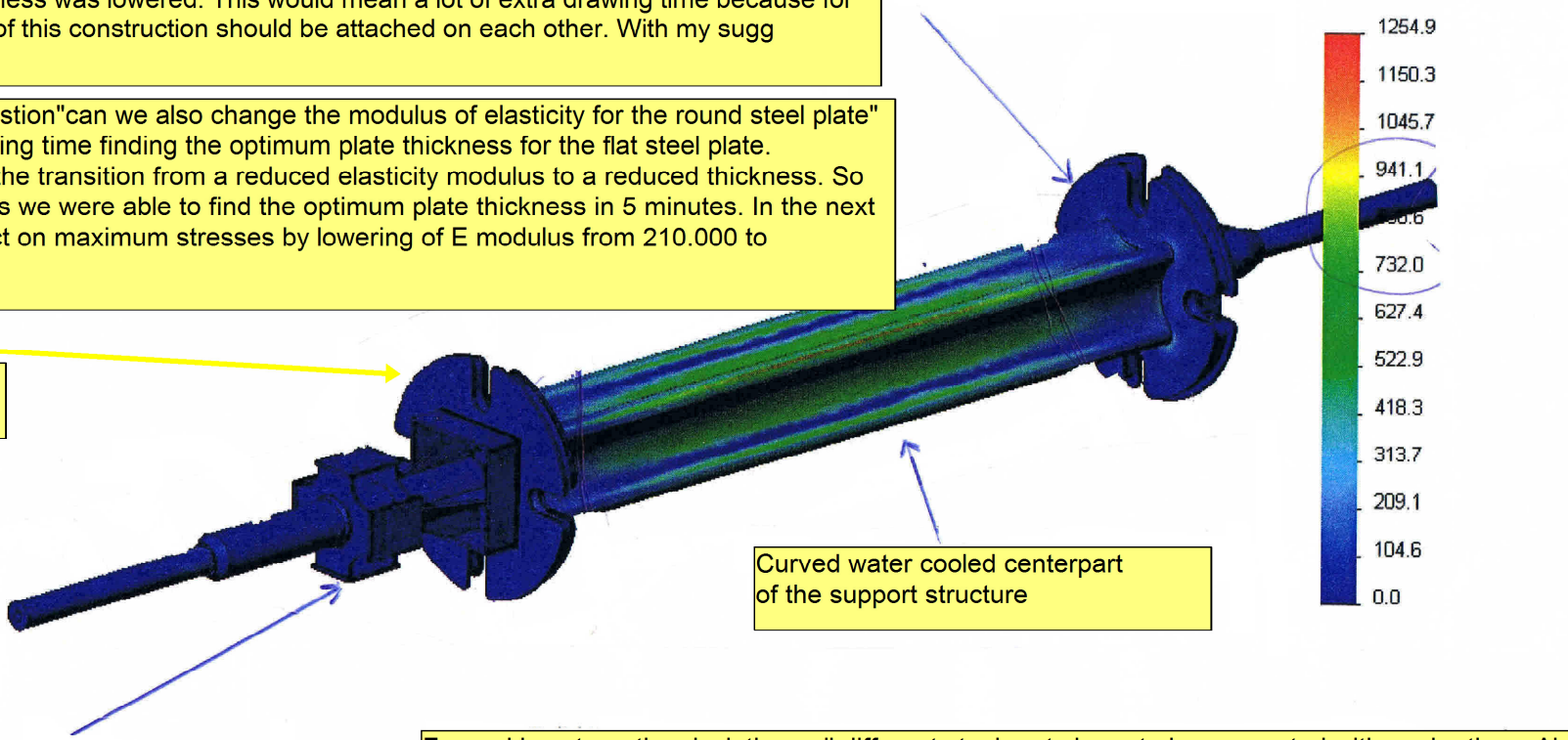
Support construction for stainless steel plate in furnace

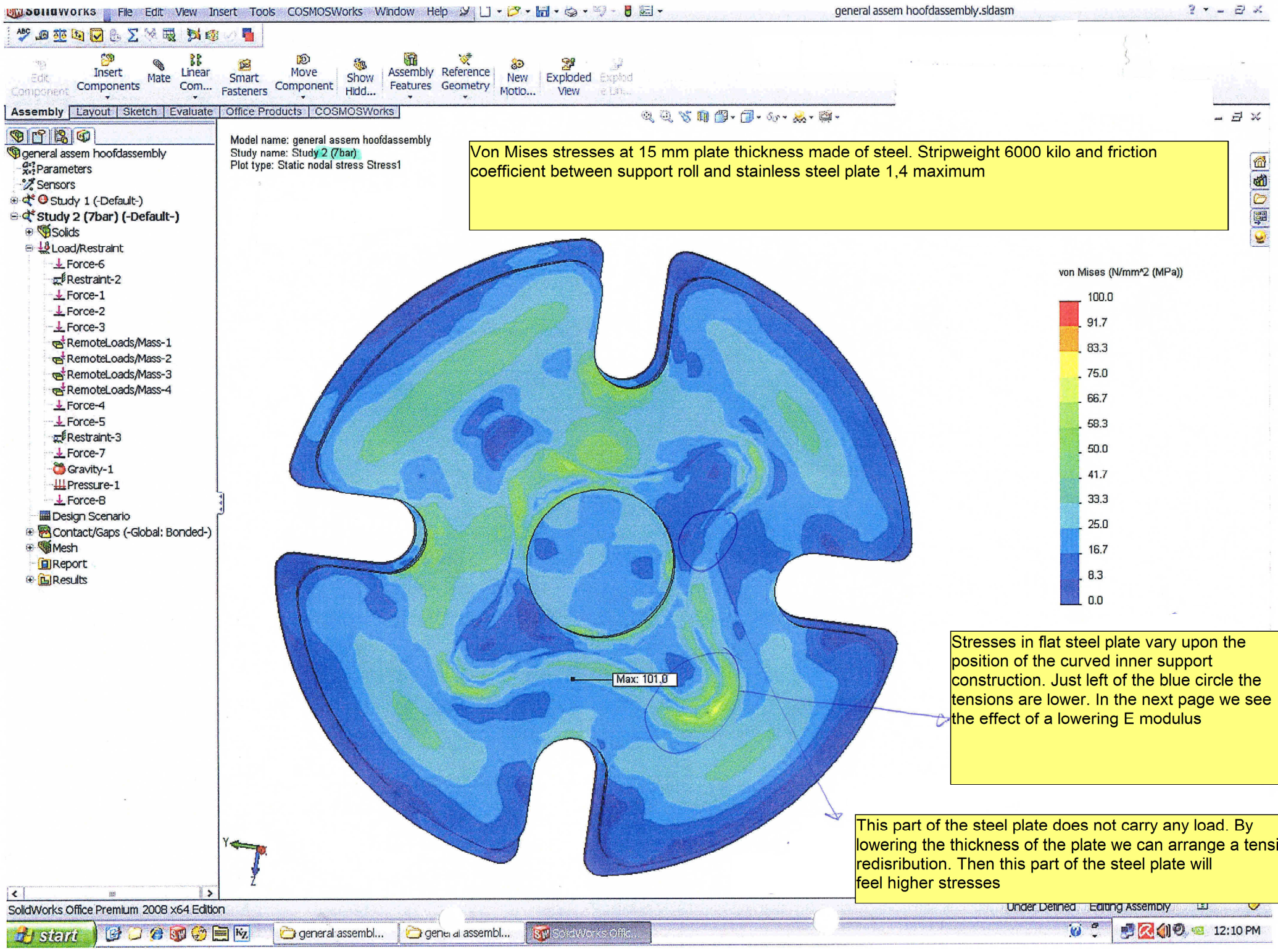
Underneath you see the support structure for a stainless steel plate in a furnace. In this furnace the plate gets its heat treatment. Not drawn are the 4 motor driven rolls that carry the load of the weight of the steel plate. The axis of the support rolls are placed in the recesses of the end plates. This is called a carrousel. When 1 of the 4 not drawn rolls is damaged the production process can continue just by rotating the carrousel by 90 degree. A new not damaged roll will come on top. For strength calculations this construction was drawn is Solid Works. The strength of the transition between the curved middle part of the support structure and the flat round plates at each end was a problem. The round plates are now 15 mm thick steel and Practical Solution suggested that a redistribution of stresses would occur if the plate thinckness was lowered. This would mean a lot of extra drawing time because for strength calculations all parts of this construction should be attached on each other. With my sugg

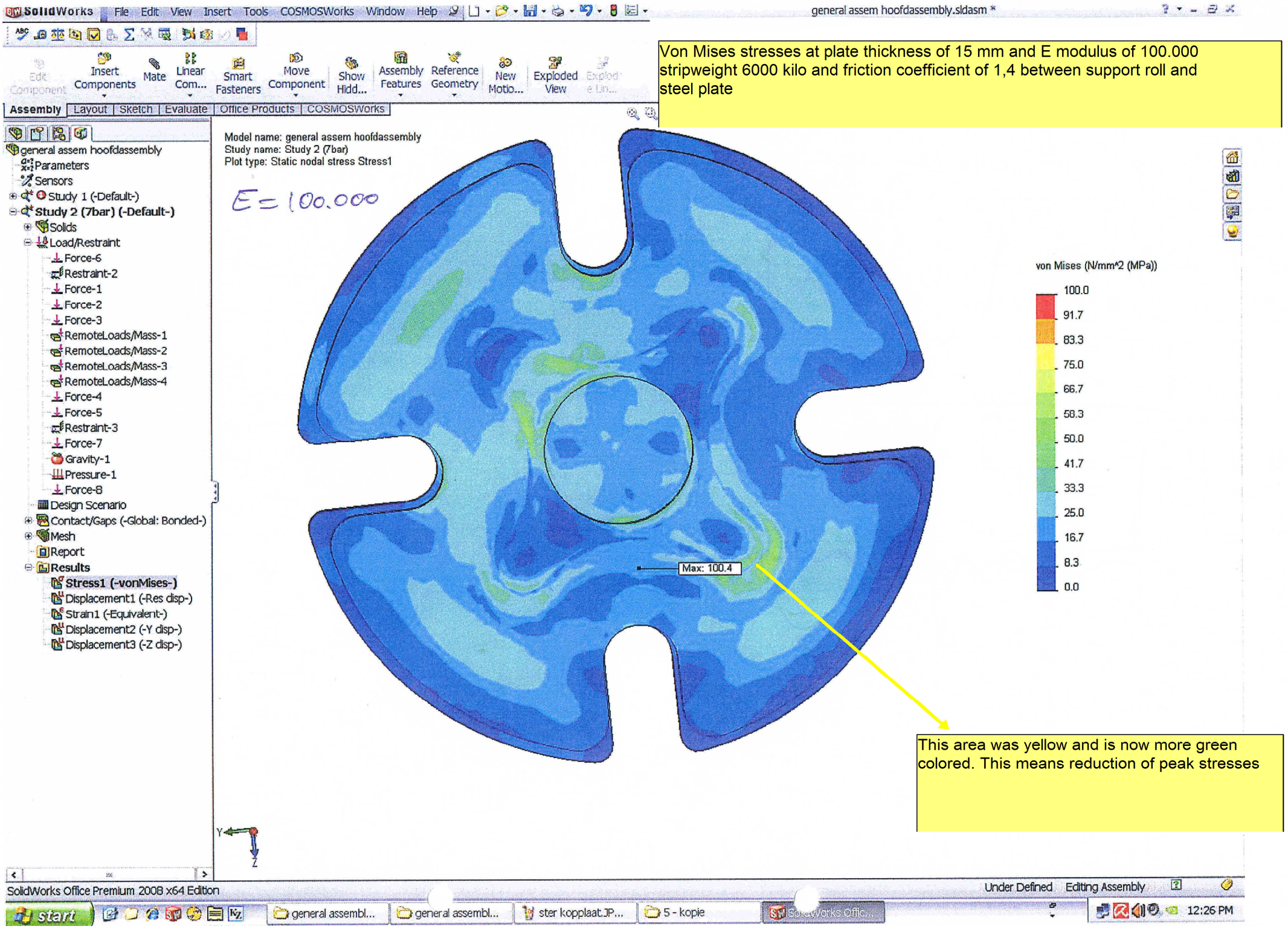
to each other. With my suggestion"can we also change the modulus of elasticity for the round steel plate" we could save 3 days of drawing time finding the optimum plate thickness for the flat steel plate.
A mechanics formula makes the transition from a reduced elasticity modulus to a reduced thickness. So just by lowering the E modulus we were able to find the optimum plate thickness in 5 minutes. In the next three pages you see the effect on maximum stresses by lowering of E modulus from 210.000 to 30.000 N/mm*mm

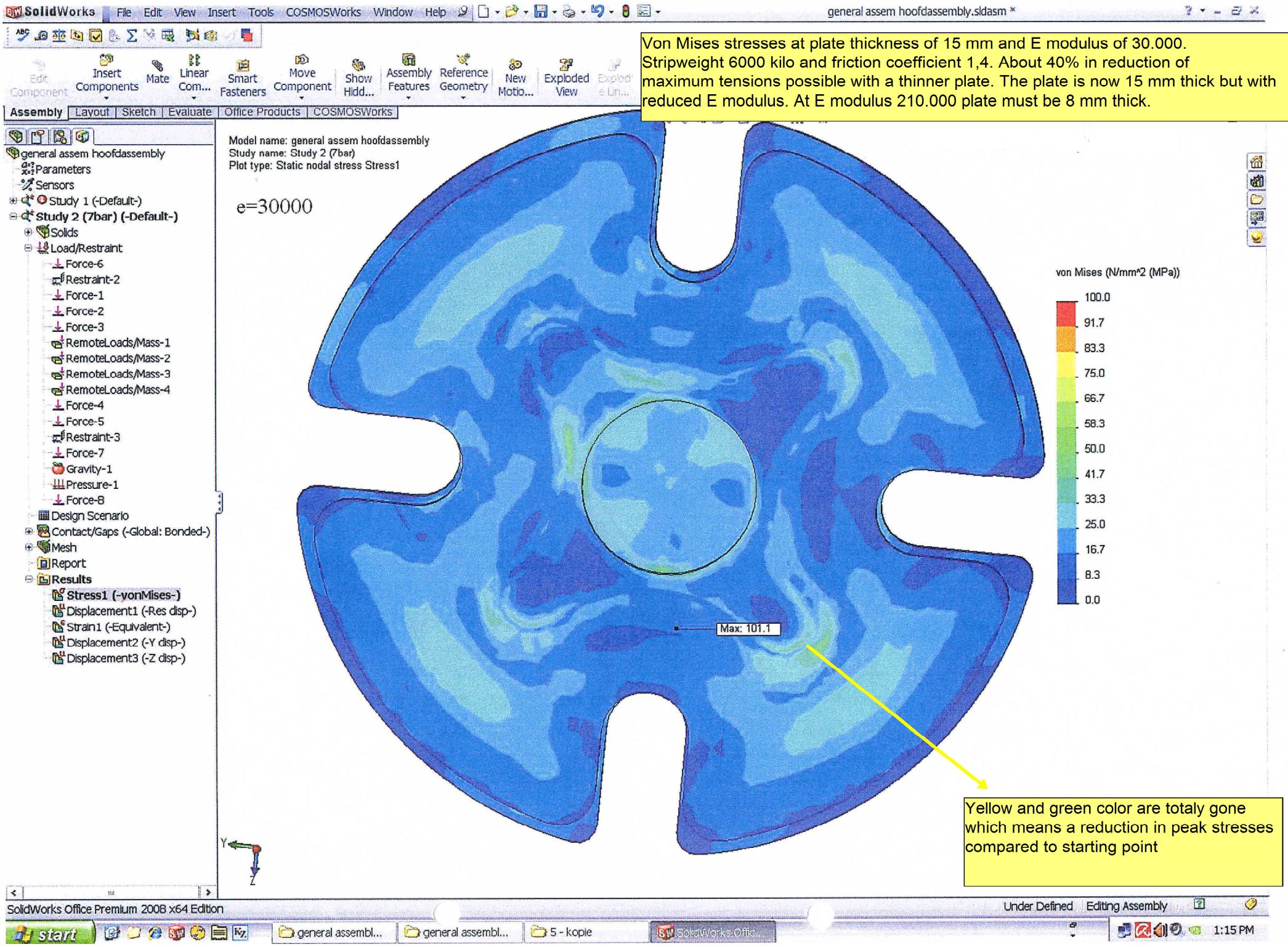


For making strength calculations all different steel parts have to be connected with each other. Also the kind of connection (thickness of the weld) must be in the drawing. High stresses arise at the transition from curved center part to the flat end plates. Practical Solution suggested a lowering of the thickness of the flat steel plate. Changing the thickness of the steel plate will cost 1/2 a day of drawing time. In Solid Works it is also possible to lower the elasticity modulus of the flat steel plate. When we find the optimum elasticity (around 30.000 see page 4) we can devide this optimum elasticity with the e modulus we started with. This ratio of E moduli equals the third root of the optimum thickness devided by starting thickness. A reduction of E modulus from 210.000 to 30.000 gives an optimum plate thickness of 7 or 8 mm. Finding this optimum thickness without using this trick would take 2,5 untill 3 days drawing time. Now it only costs 5 minutes of calculation. In the next drawing you see the vo

days of drawing time. At the next pages we can see the effect of a lowered E modulus from 210.000 to 100.000 to 30.0000. Looking at the three drawings shows that a reduction in E modulus of th eflat steel plate is resulting in lower tensions in the steel plate. All the yellow colors and most of the green are now gone which means a lowering in maximum tensions in the steel plate. Optimum plate thickness is around 7 or 8 mm.


general assem hoofdassembly.sldasm
Assembly
Layout
Sketch
Evaluate
Office Products
COSMOSWorks
Model name: general assem hoofdassembly
Study name: Study 2 (7bar)
Plot type: Static nodal stress Stress1
Von Mises stresses at 15 mm plate thickness made of steel. Stripweight 6000 kilo and friction coefficient between support roll and stainless steel plate 1,4 maximum
von Mises (N/mm^2 (MPa))
100.0
91.7
83.3
75.0
66.7
58.3
50.0
41.7
33.3
25.0
16.7
8.3
0.0
Max: 101.0
Stresses in flat steel plate vary upon the position of the curved inner support construction. Just left of the blue circle the tensions are lower. In the next page we see the effect of a lowering E modulus
This part of the steel plate does not carry any load. By lowering the thickness of the plate we can arrange a tension redisribution. Then this part of the steel plate will feel higher stresses
general assem hoofdassembly
Parameters
Sensors
Study 1 (-Default-)
Study 2 (7bar) (-Default-)
Solids
Load/Restraint
Force-6
Restraint-2
Force-1
Force-2
Force-3
RemoteLoads/Mass-1
RemoteLoads/Mass-2
RemoteLoads/Mass-3
RemoteLoads/Mass-4
Force-4
Force-5
Restraint-3
Force-7
Gravity-1
Pressure-1
Force-8
Design Scenario
Contact/Gaps (-Global: Bonded-)
Mesh
Report
Results
SolidWorks Office Premium 2008 x64 Edition
Under Defined
Editing Assembly
start
12:10 PM


general assem hoofdassembly.sldasm *
Von Mises stresses at plate thickness of 15 mm and E modulus of 100.000 stripweight 6000 kilo and friction coefficient of 1,4 between support roll and steel plate
Model name: general assem hoofdassembly
Study name: Study 2 (7bar)
Plot type: Static nodal stress Stress1
E=100.000
von Mises (N/mm^2 (MPa))
100.0
91.7
83.3
75.0
66.7
58.3
50.0
41.7
33.3
25.0
16.7
8.3
0.0
Max: 100.4
This area was yellow and is now more green colored. This means reduction of peak stresses
general assem hoofdassembly
Parameters
Sensors
Study 1 (-Default-)
Study 2 (7bar) (-Default-)
Solids
Load/Restraint
Force-6
Restraint-2
Force-1
Force-2
Force-3
RemoteLoads/Mass-1
RemoteLoads/Mass-2
RemoteLoads/Mass-3
RemoteLoads/Mass-4
Force-4
Force-5
Restraint-3
Force-7
Gravity-1
Pressure-1
Force-8
Design Scenario
Contact/Gaps (-Global: Bonded-)
Mesh
Report
Results
Stress1 (-vonMises-)
Displacement1 (-Res disp-)
Strain1 (-Equivalent-)
Displacement2 (-Y disp-)
Displacement3 (-Z disp-)
SolidWorks Office Premium 2008 x64 Edition
Under Defined
Editing Assembly
12:26 PM



Von Mises stresses at plate thickness of 15 mm and E modulus of 30.000. Stripweight 6000 kilo and friction coefficient 1,4. About 40% in reduction of maximum tensions possible with a thinner plate. The plate is now 15 mm thick but with reduced E modulus. At E modulus 210.000 plate must be 8 mm thick.

Yellow and green color are totaly gone which means a reduction in peak stresses compared to starting point