

## DUCT STIFFENER DEFLECTION MEASUREMENTS – PRACTICAL VS. THEORETICAL

By: Radu Munteanu/Constantin Popescu/Mircea Dinulescu - July 2012



Fig. 1 The duct

### 1. Introduction

The theme of the project was to compare how a duct will behave when is inflated with air at different pressures from the practical point of view and the theoretical point of view. The duct was manufactured as a fully welded structure from 6mm thick S235JR steel sheet. The dimensions of the duct are 8000x1500x112 and a welded stiffener (8000x80x8mm) was welded on both sides.

Inside the duct the following pressures were applied: 2500, 5000, 7500, 10000, 12500, 15000, 20000 Pa. In the practical measurements both, the deflection during inflating and deflating were measured.

For the simulation Dlubal RFEM 4.xx and Graitec ADVANCE DESIGN 2012 software were used.

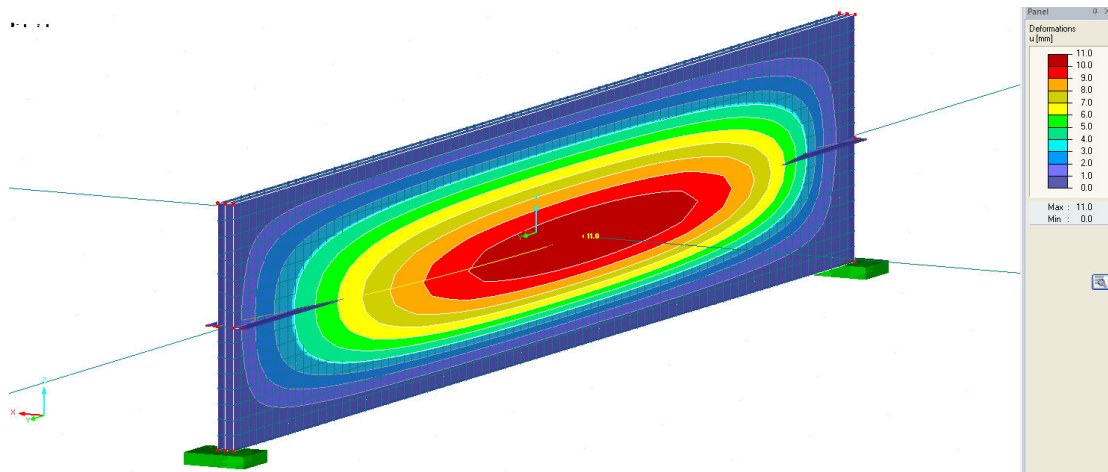


Fig. 2 Displacements in Dlubal RFEM 4.xx simulation at 2500 Pa

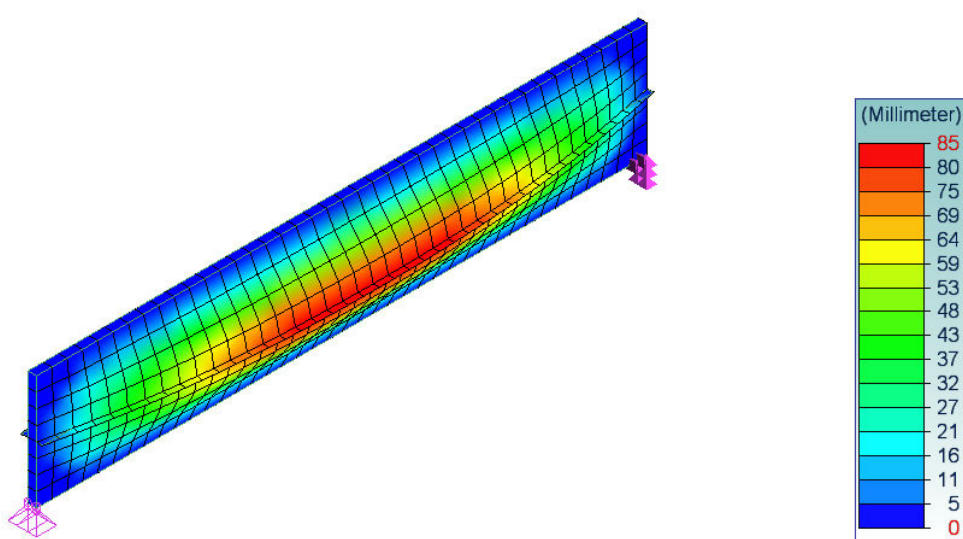


Fig. 3 Displacements in Graitec ADVANCE DESIGN 2012 at 20000 Pa

2. Comparative values measured vs. simulated:

In the next table the following data was introduced:

- The deflection of the duct during inflating at the specified pressures (and deflating for the practical test).
- For the simulated values of the deflection also the stress on the plate surface was calculated (8000x15000x6mm plates) in order to see at what pressure the plate goes into plastic deformation.

No.	Pressure value (Pa)	Deflection value (mm) " Loading"	Deflection value (mm) " Unloading"	Simulated values Dlubal RFEM 4.xx Displacement / Stress mm / MPa		Simulated values Advance Design 2012 Displacement/Stress mm / MPa	
1	2500	11	15	11	51	10.7	51.2
2	5000	22	27	22	102	21	111
3	7500	32	38	32.9	153	32	166.5
4	10000	41	47	43.9	204	43	221.5
5	12500	49	54	54.9	255	53	299
6	15000	60	66	65.9	306	64	333
7	20000	76	76	87.8	409	85	443.9

### 3. Conclusions

Comparing the results collected from the practical measurements with the results obtained with the simulation software we can conclude that the duct behaves similarly in all cases. For the practical cases we can observe that while the material is below the yield strength the measurements are very close to the simulated values. After the pressure increases and the stress goes over yield strength of the material in practice the plate deforms slower than the simulated values.

The conclusion is that in the elastic range the simulations made with two different FEM software packages are very close to each other and to the measured values. In the plastic range, however, the deviations are somewhat larger, but still small enough up to a stress of about twice the yield stress.