RF Dipole Support System Analysis

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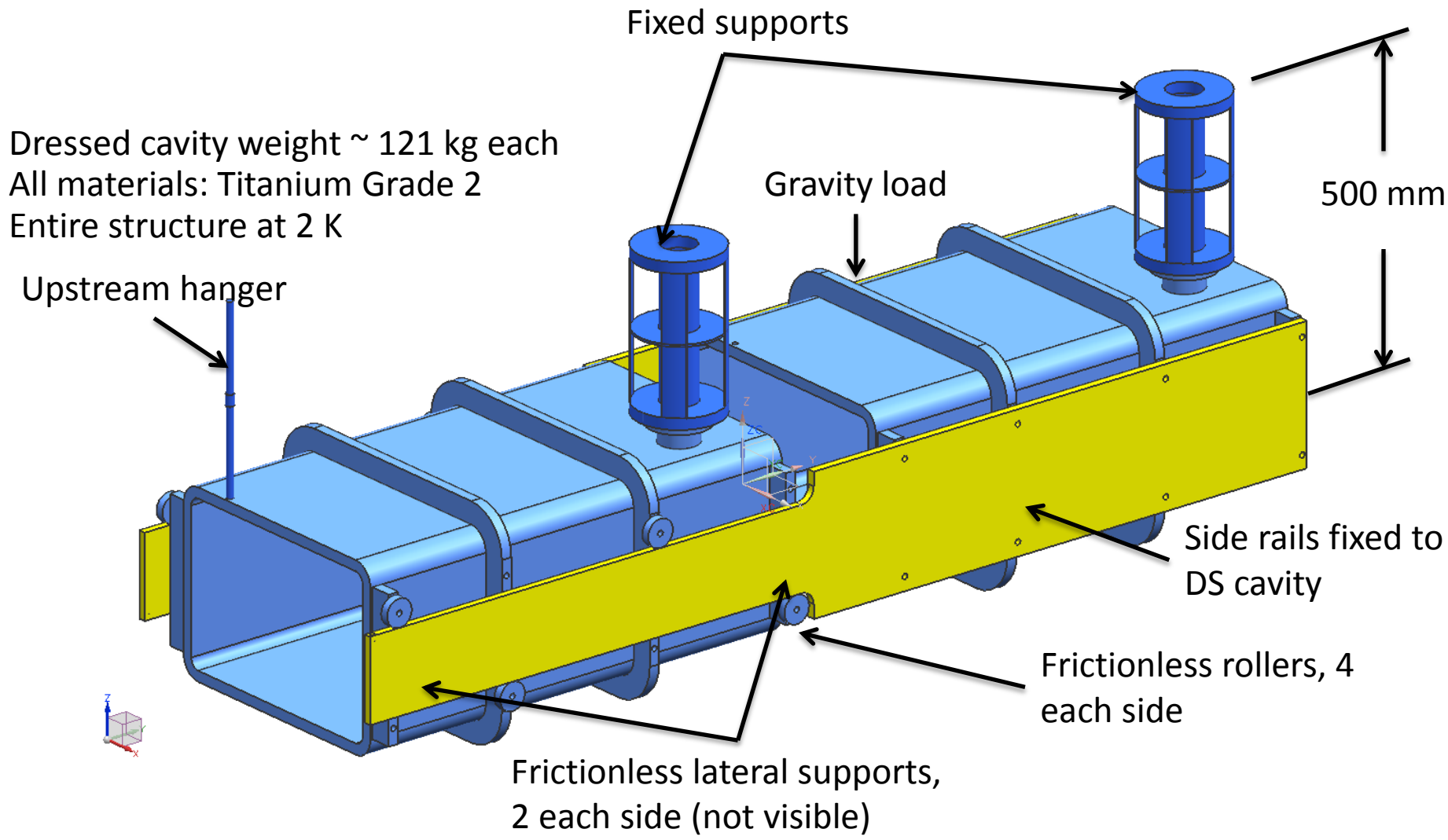
March 18, 2014

Case 10

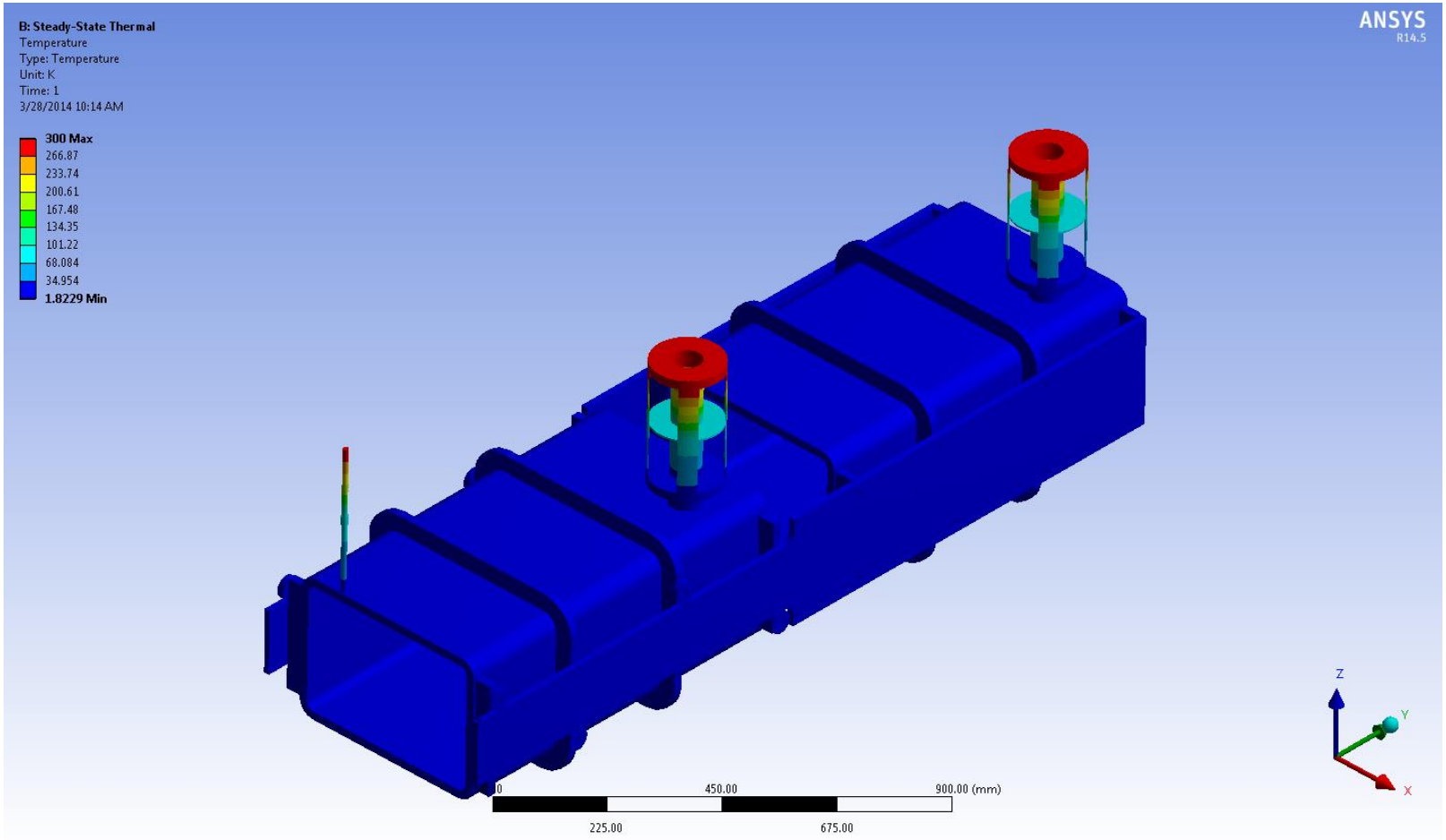
Case 10 - Model setup

- Modified the solid model to separate the coupler extensions from the main body of the cavity and defined these as stainless steel instead of titanium. Changed the support hanger material to stainless steel and reduced the diameter to 12 mm. Created surfaces on the hangers and couplers for 80 K intercepts. Re-created the ANSYS model to be a thermal-stress model to simulate the actual temperature distribution and thermal contractions.

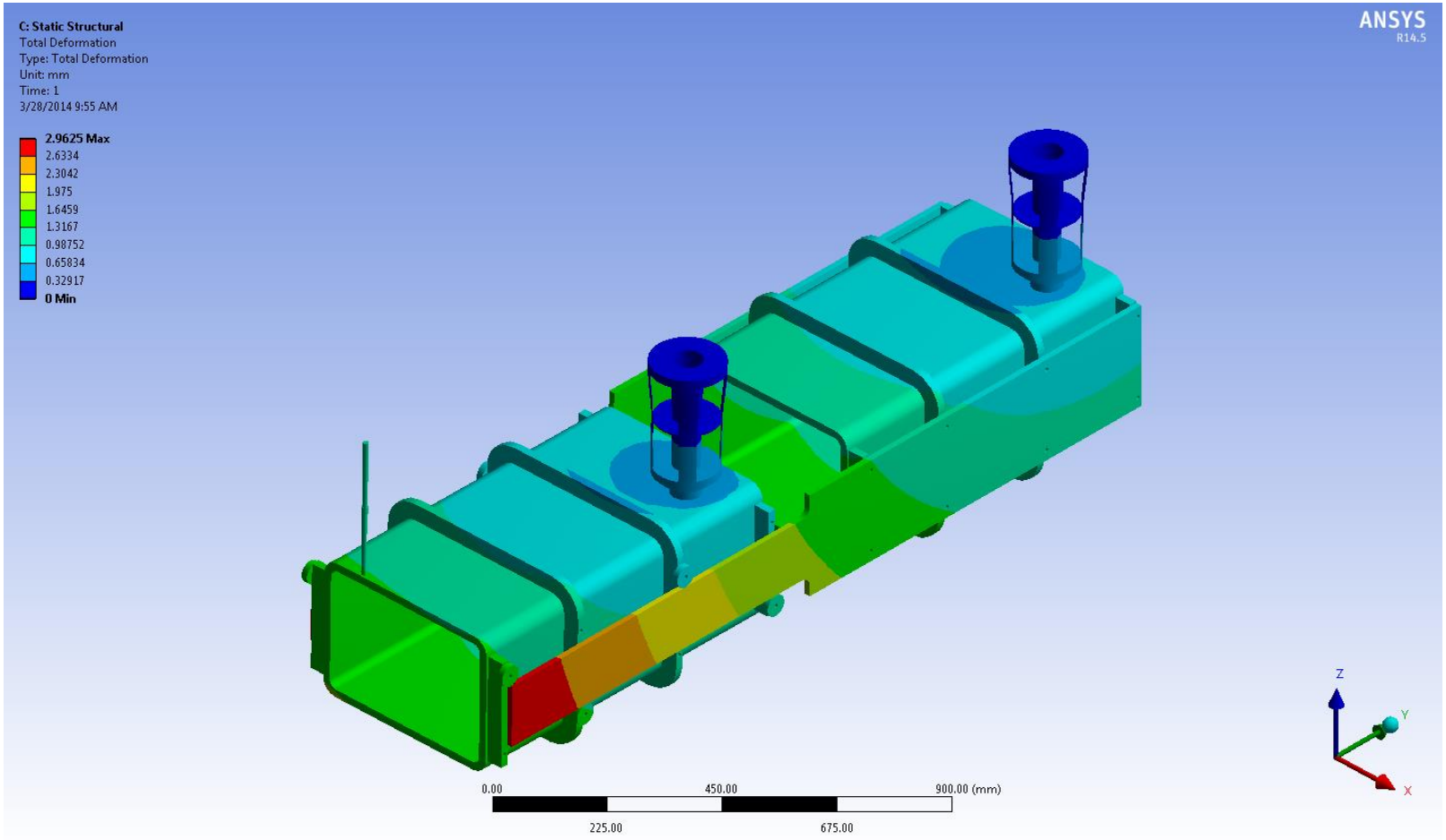
Analysis model – Case 10



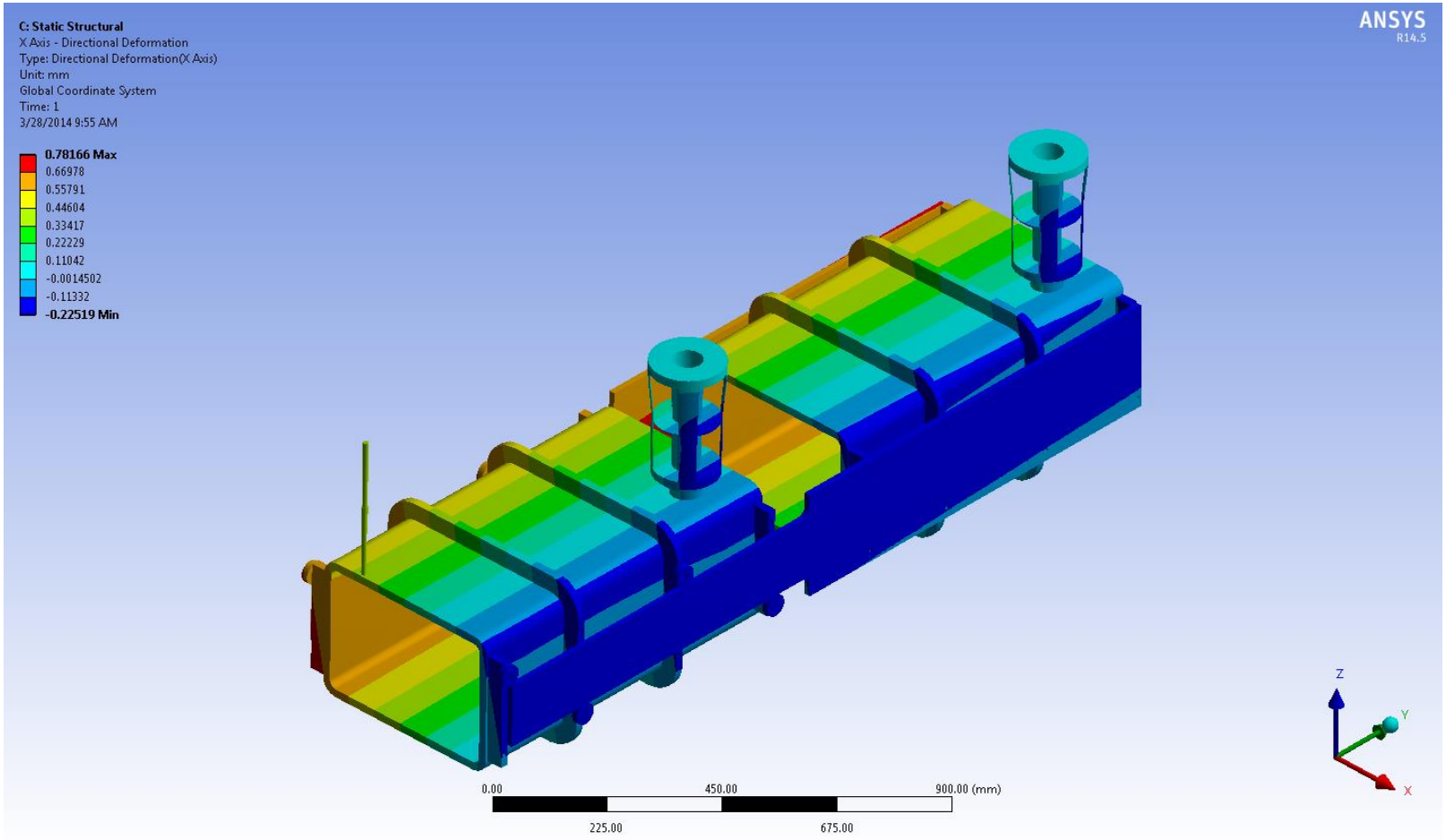
Temperature plot – Case 10



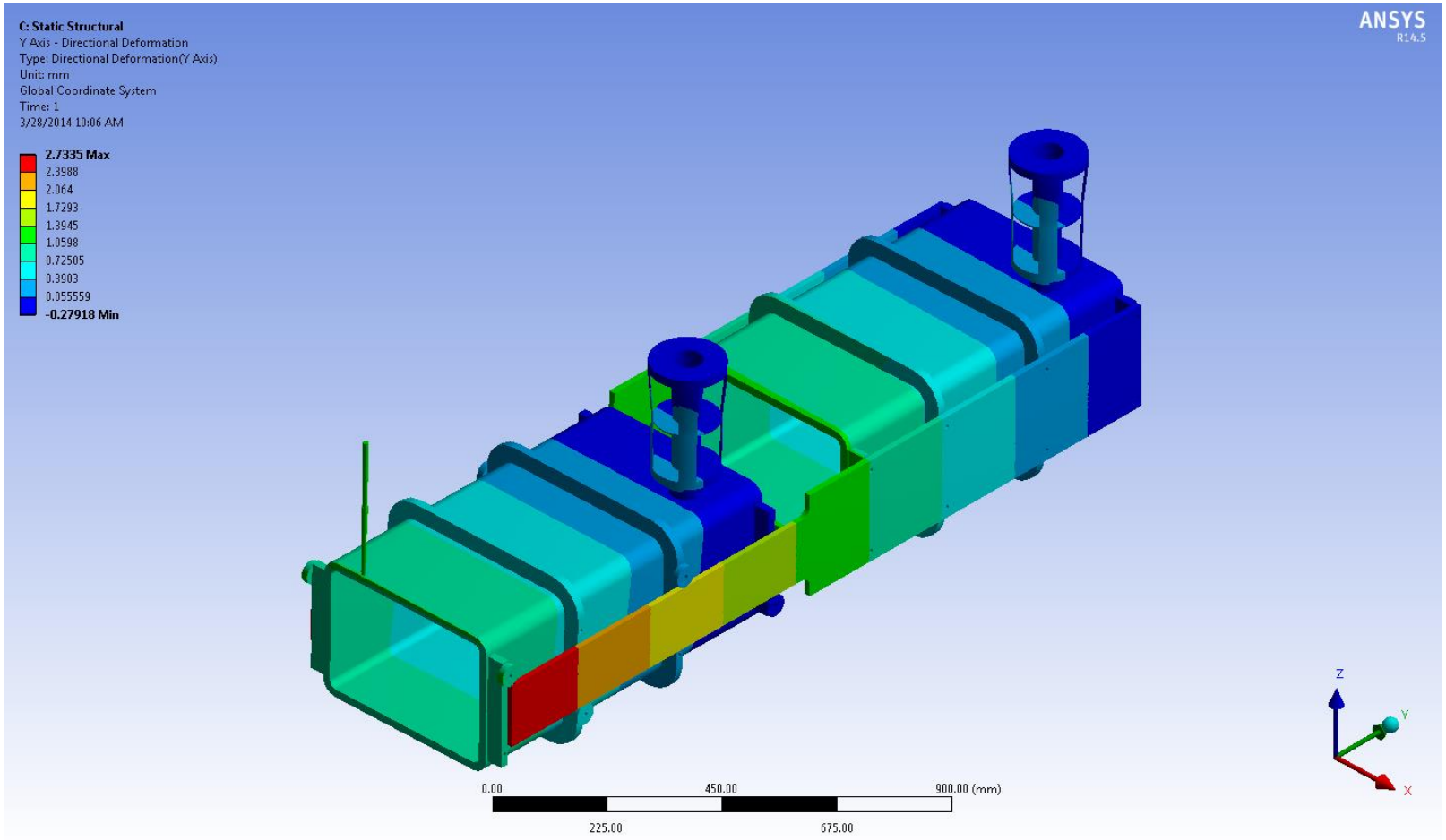
Total deformation – Case 10



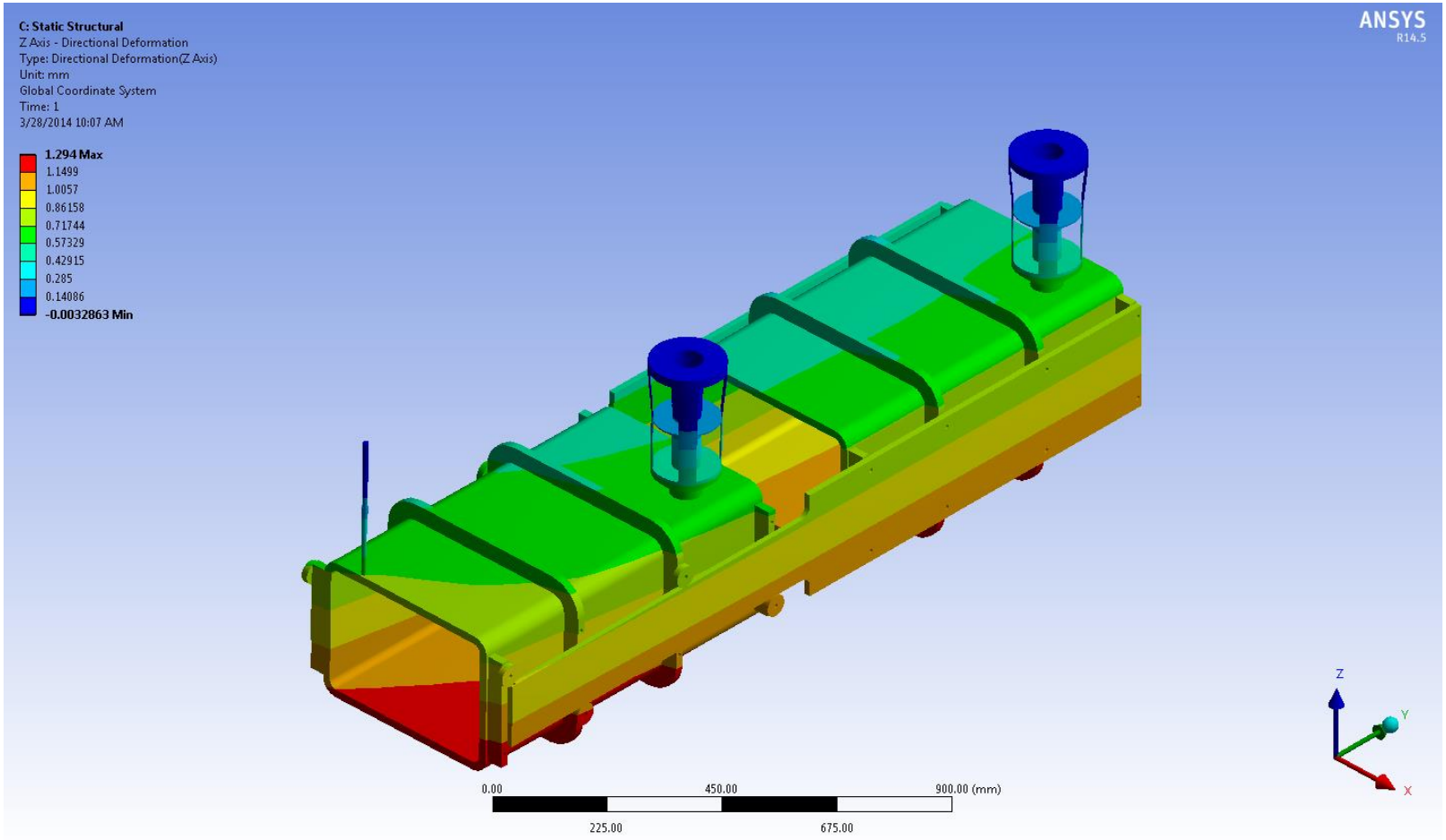
X deflection – Case 10



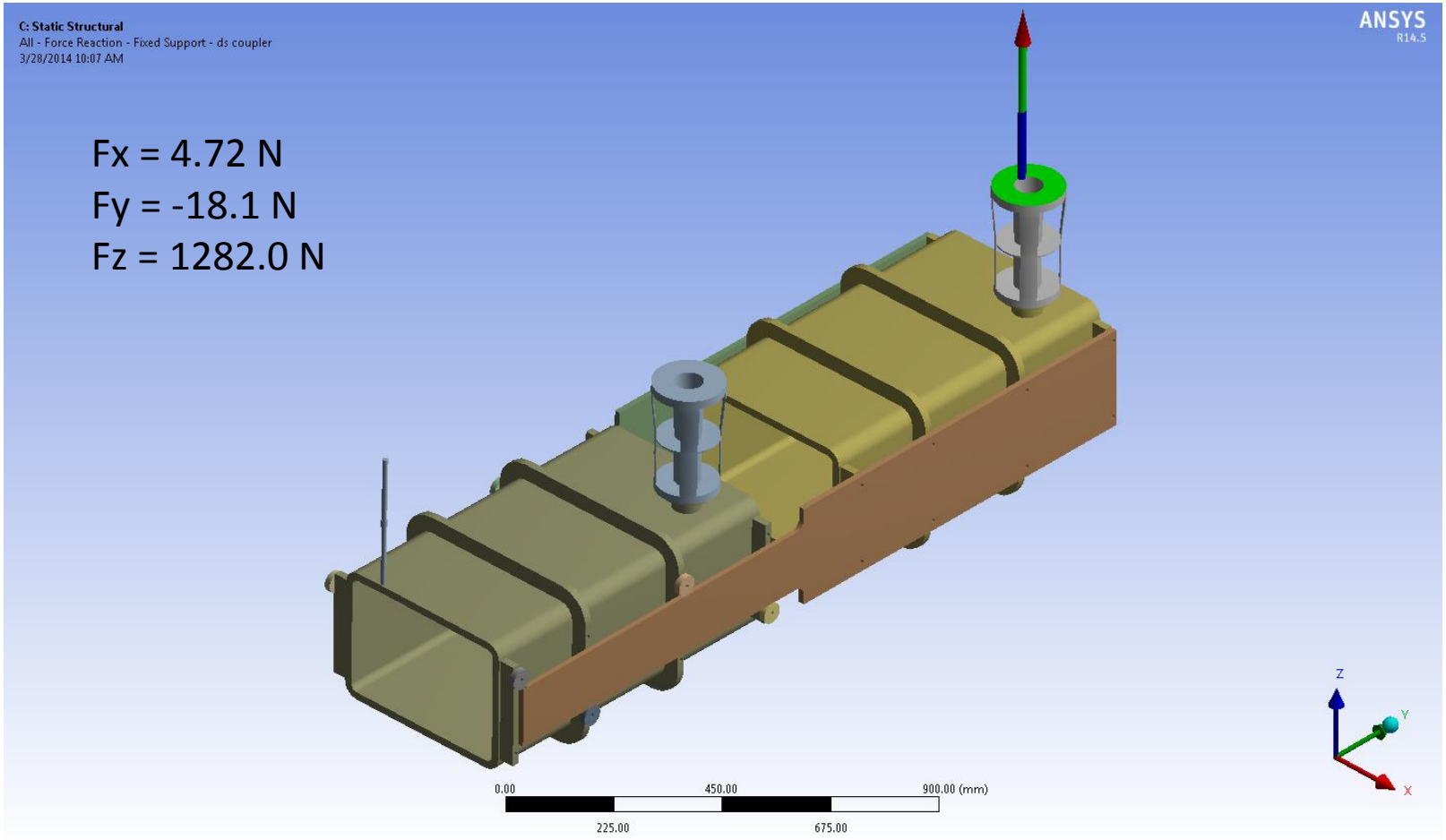
Y deflection – Case 10



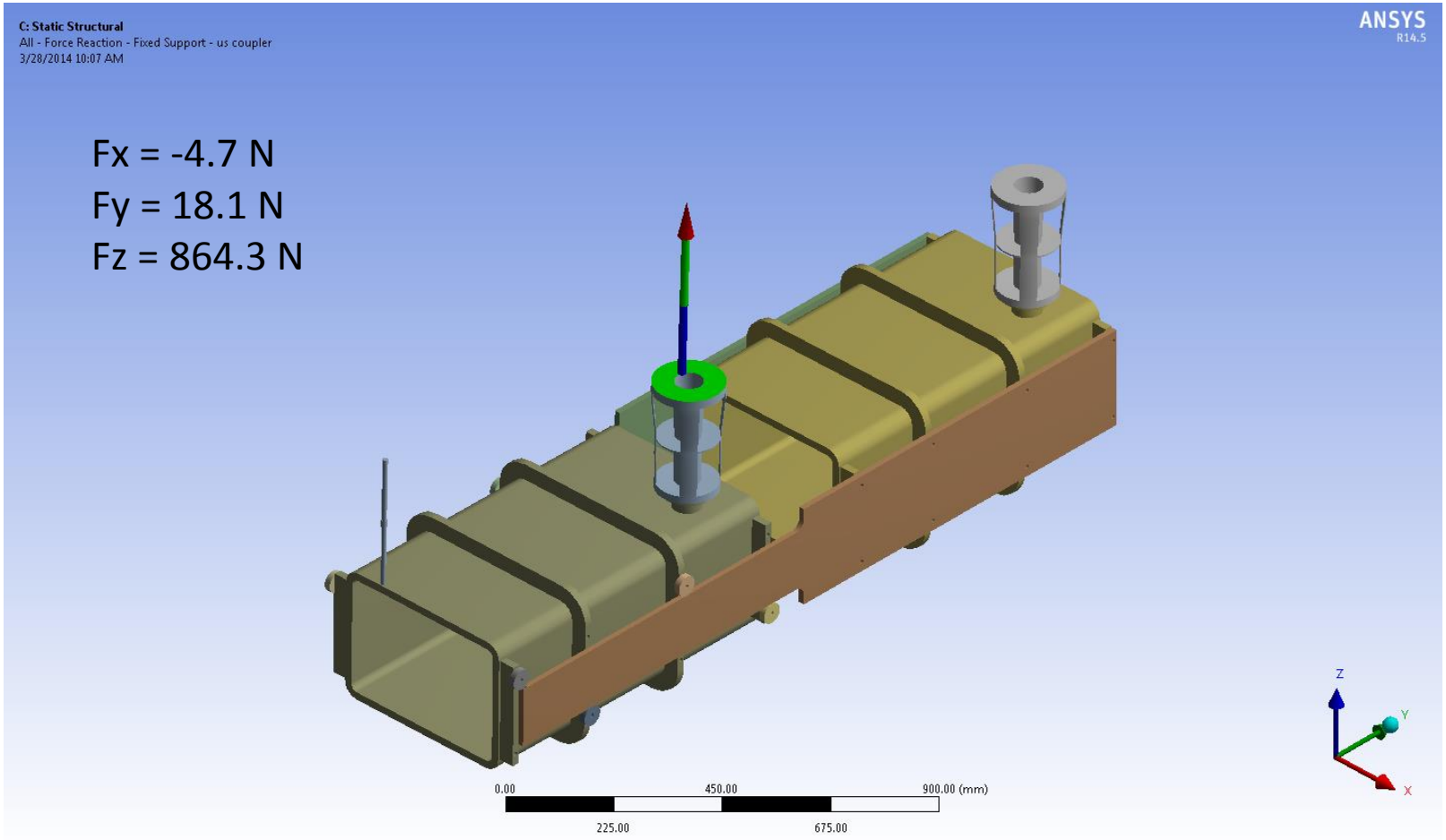
Z deflection – Case 10



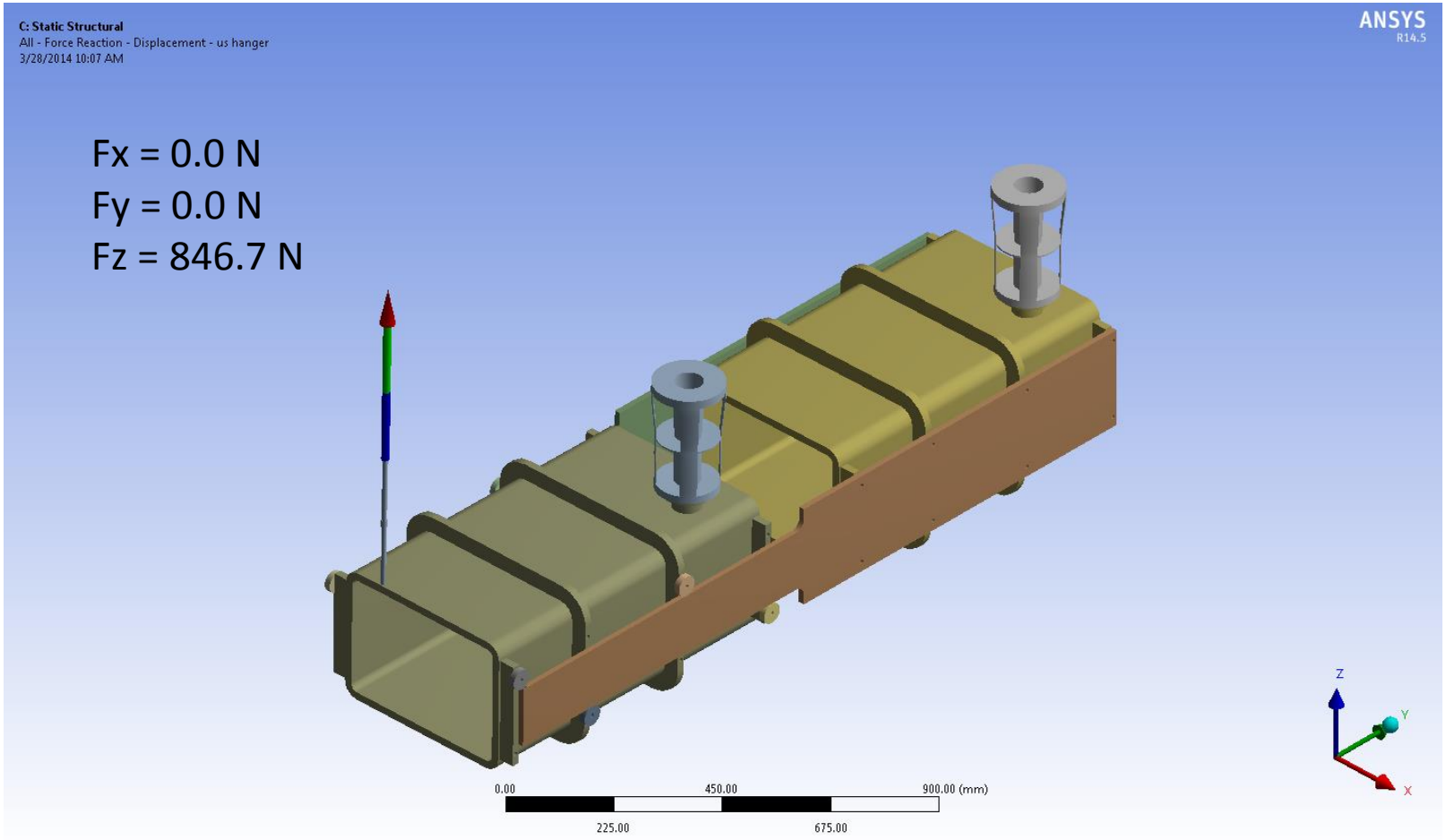
Downstream coupler reaction – Case 10



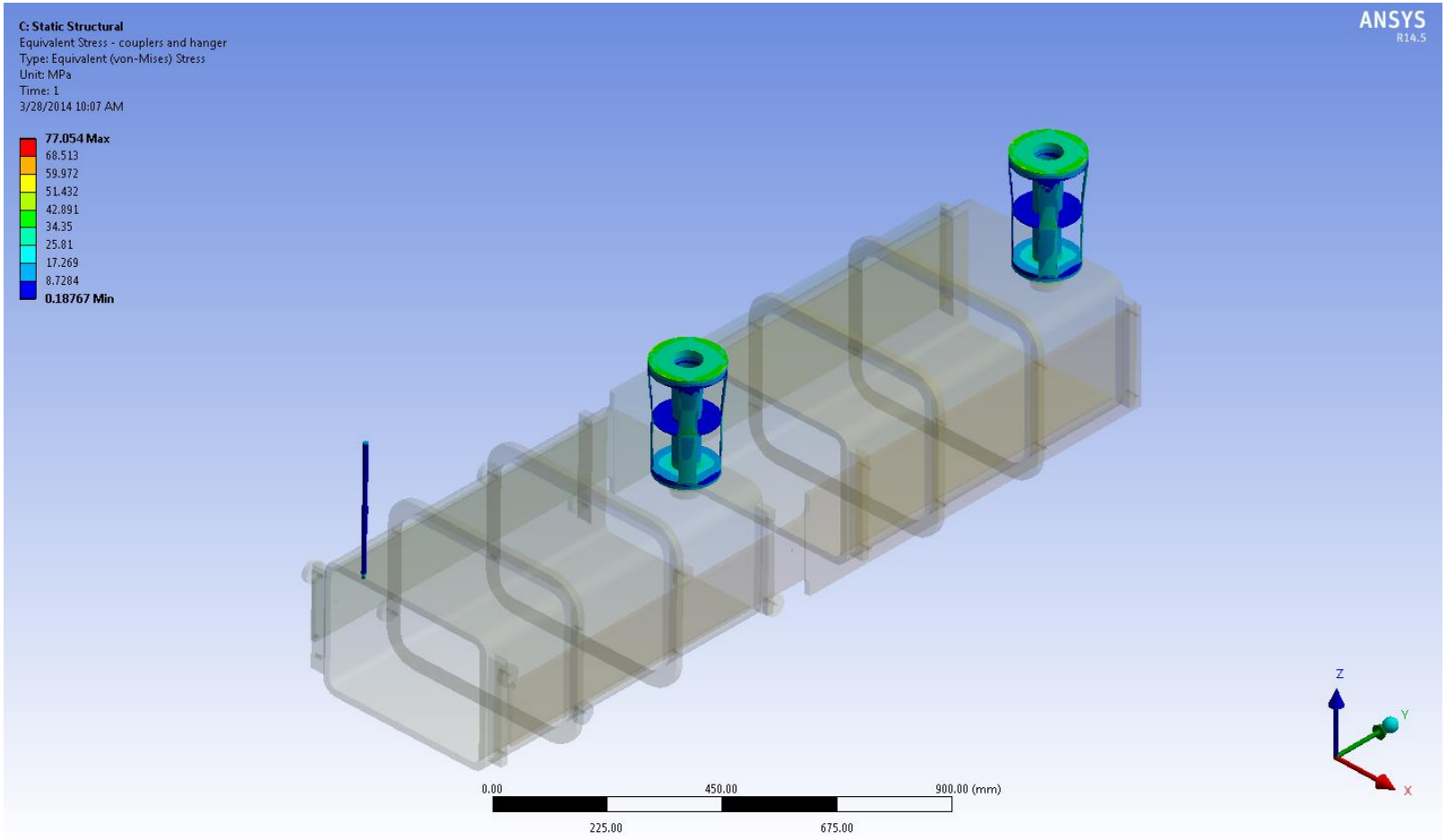
Upstream coupler reaction – Case 10



Upstream hanger reaction – Case 10



Coupler and hanger stress – Case 10

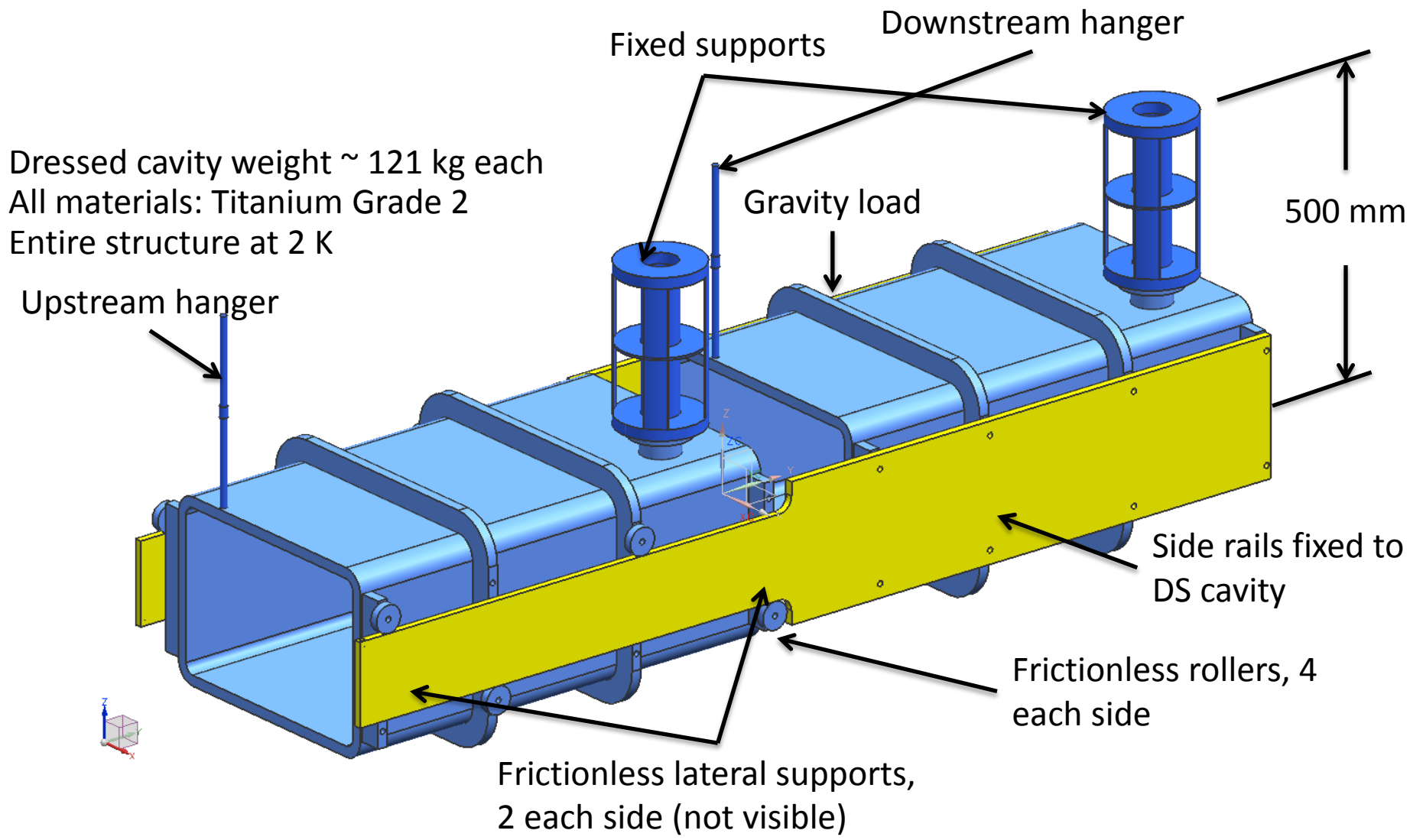


Case 11

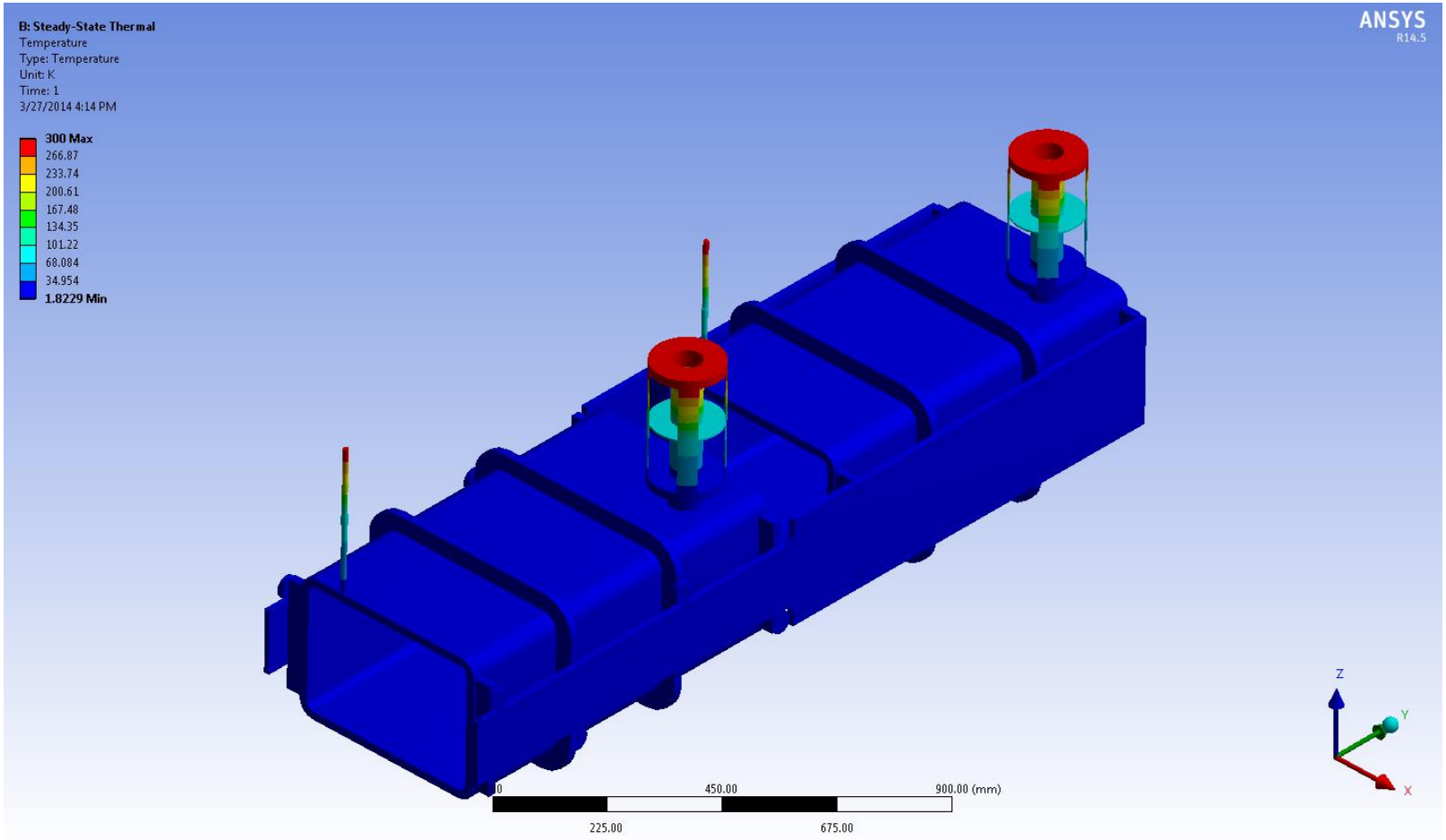
Case 11 - Model setup

- Same as case 10, but with an additional support hanger attached to the downstream cavity.

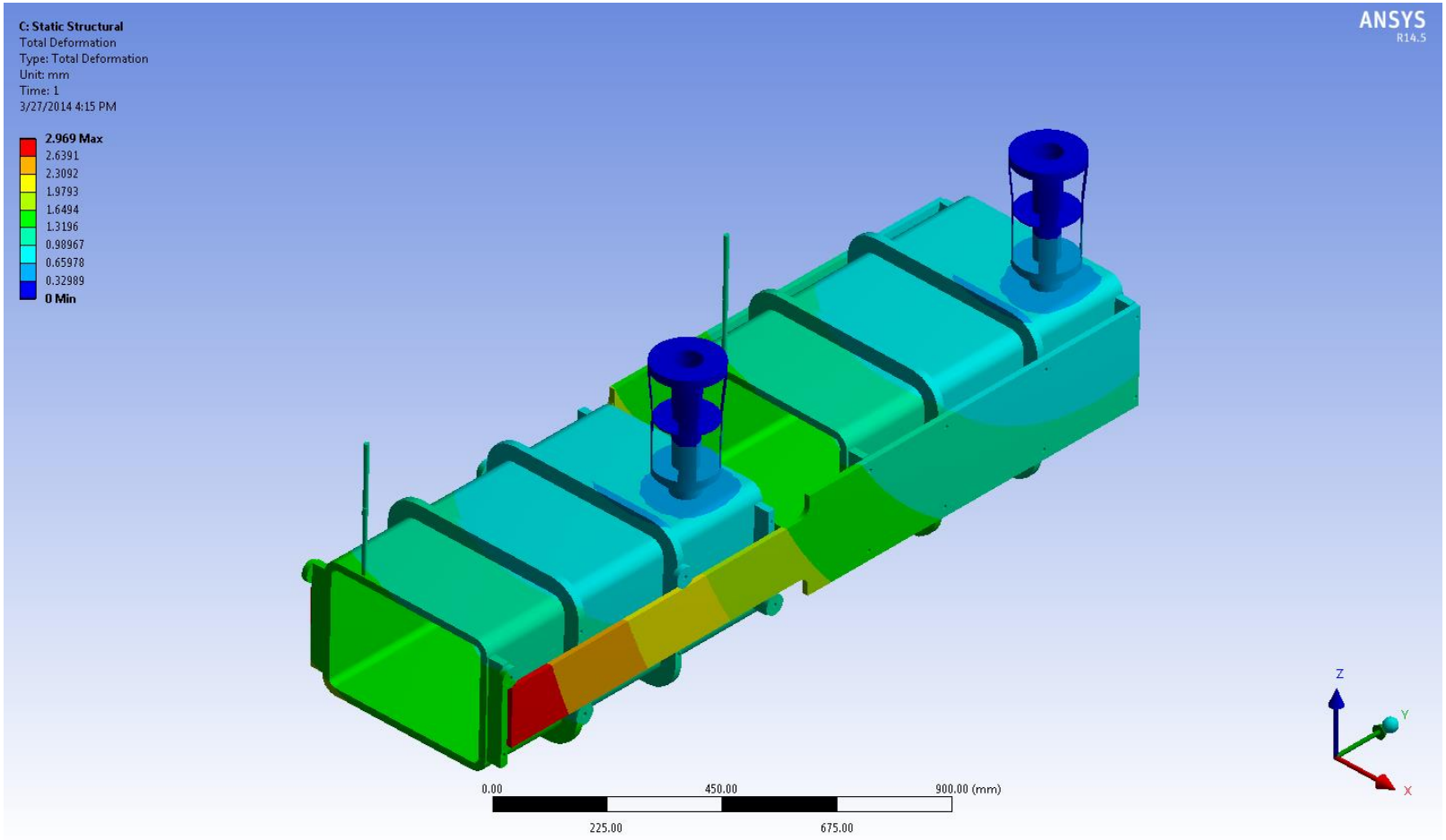
Analysis model – Case 11



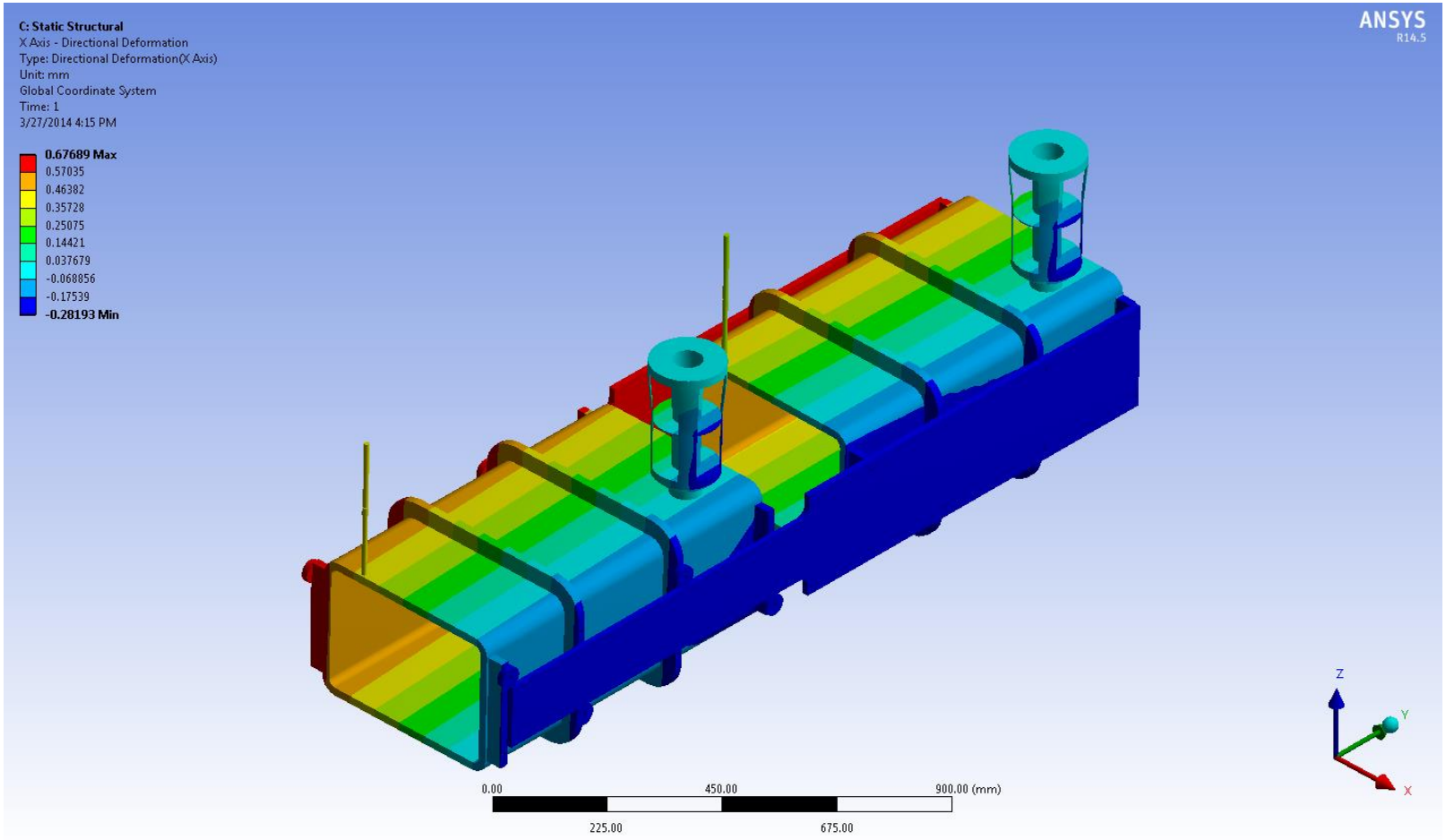
Temperature plot – Case 11



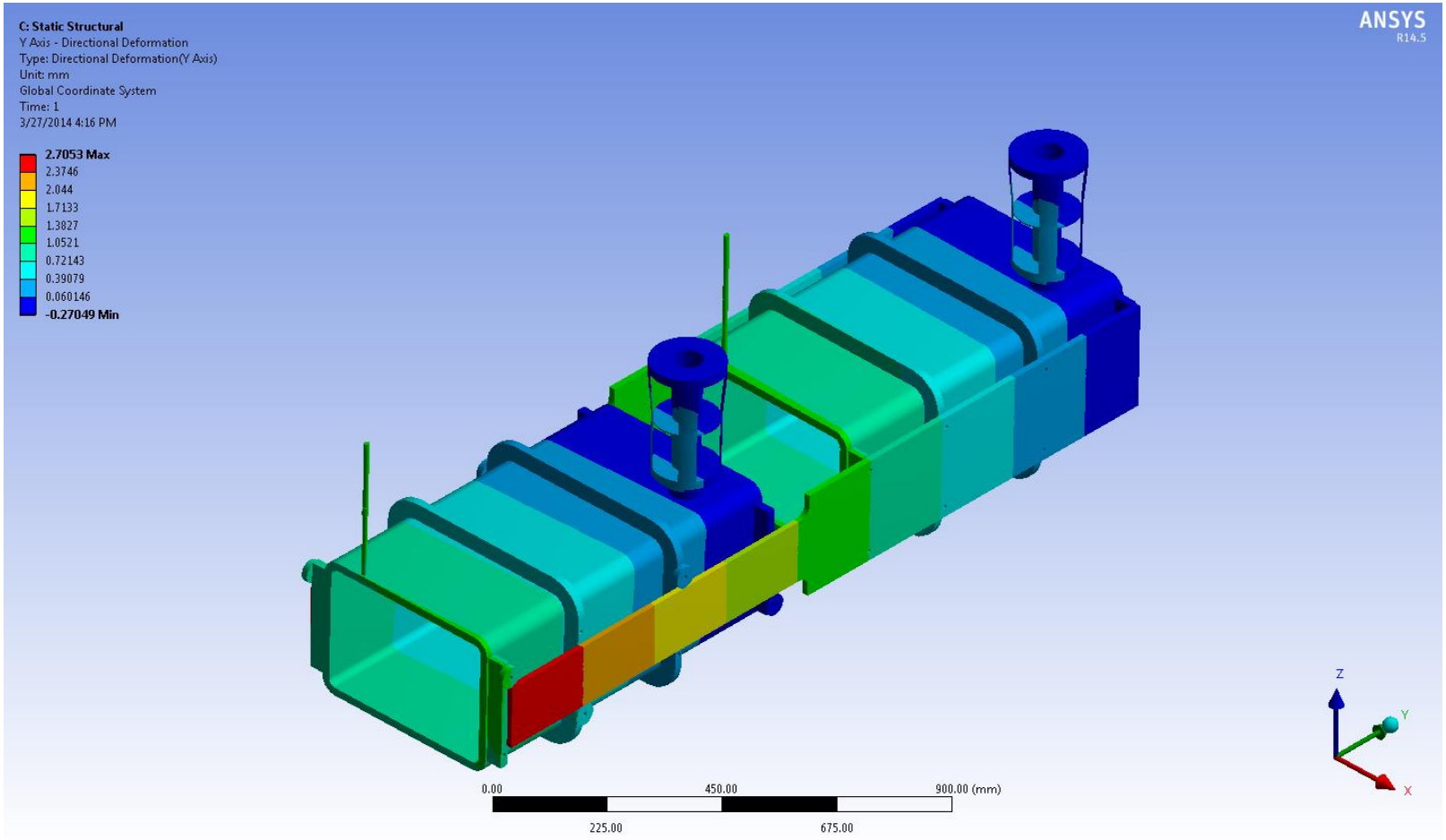
Total deformation – Case 11



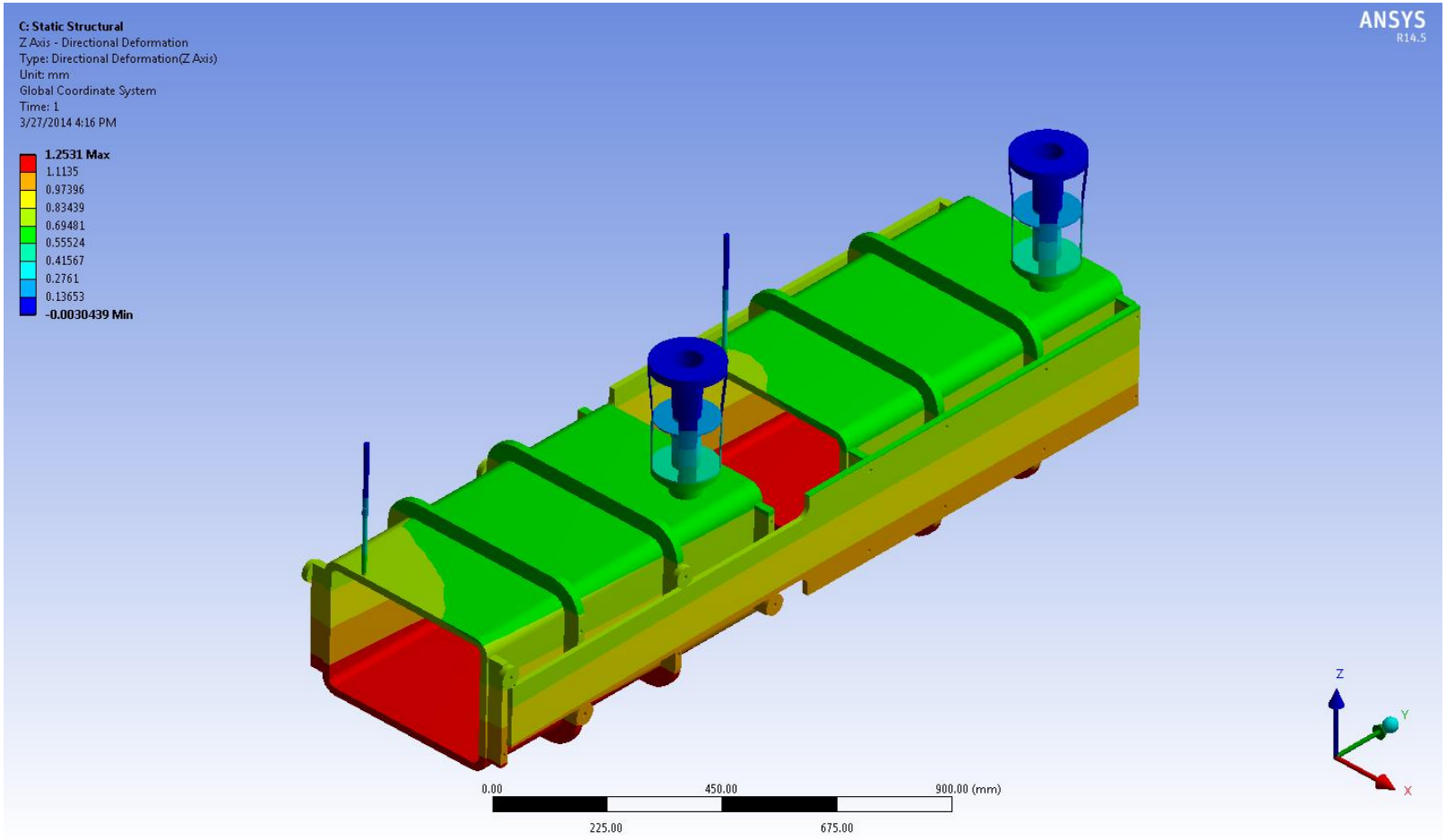
X deflection – Case 11



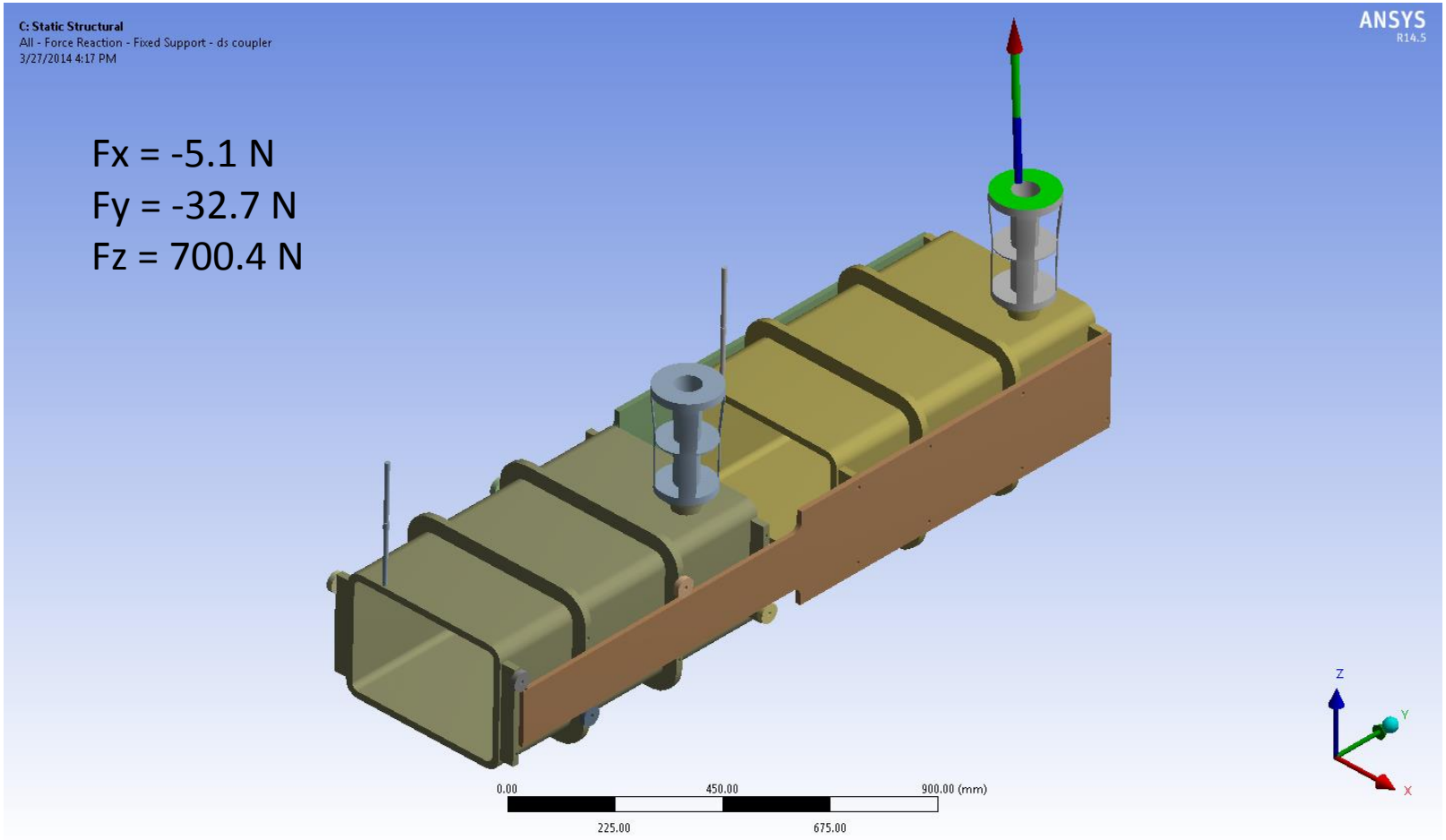
Y deflection – Case 11



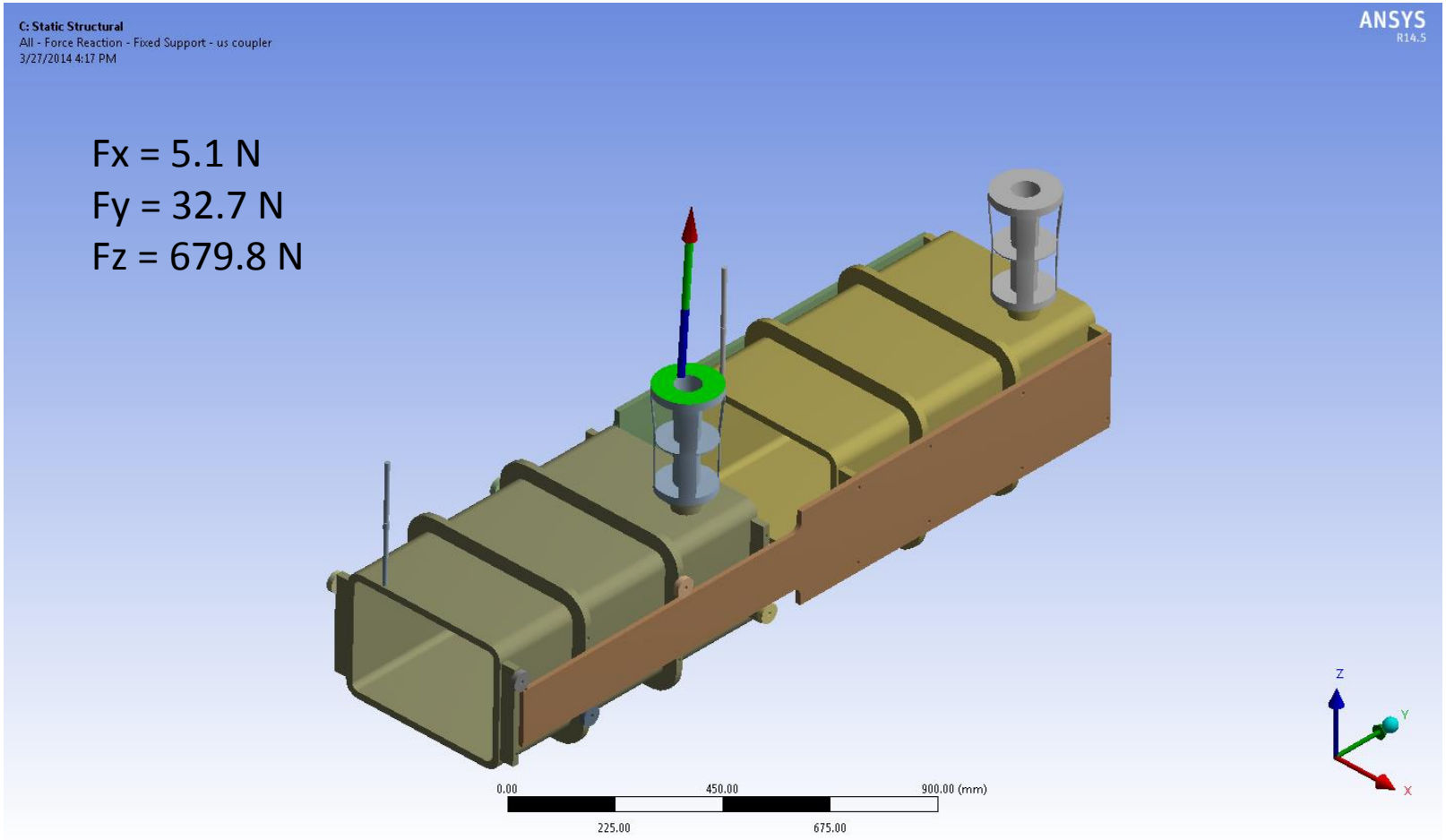
Z deflection – Case 11



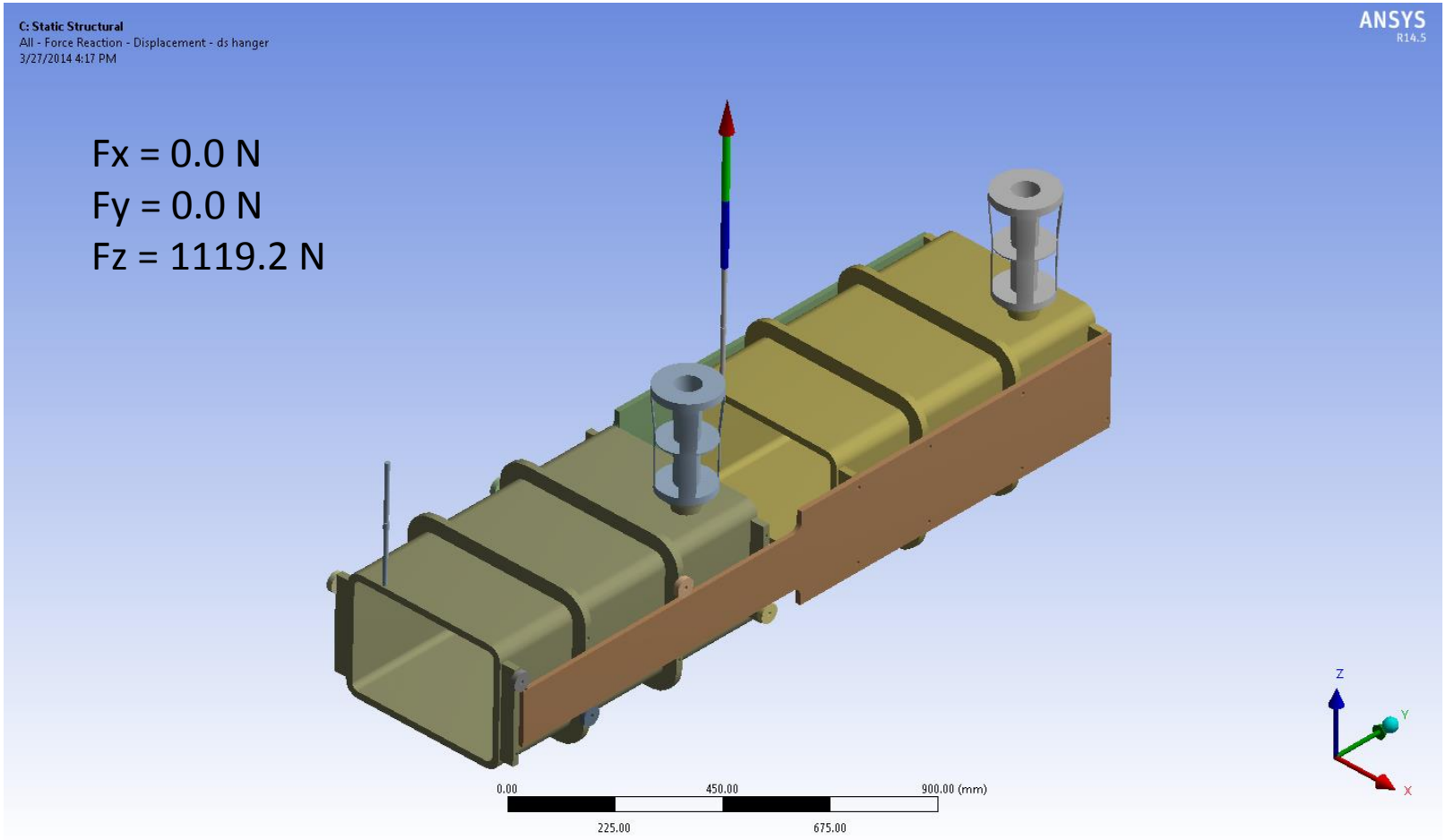
Downstream coupler reaction – Case 11



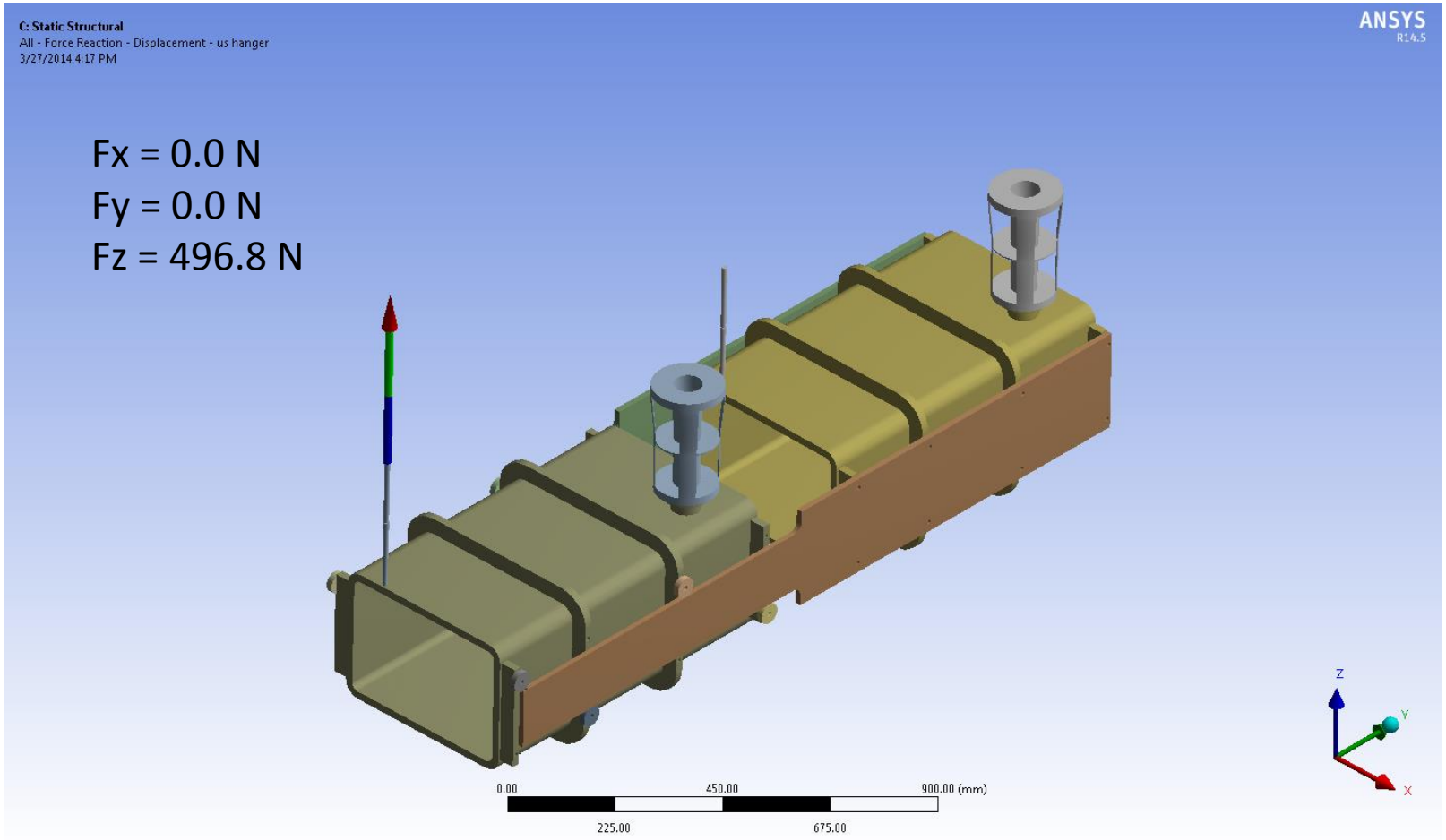
Upstream coupler reaction – Case 11



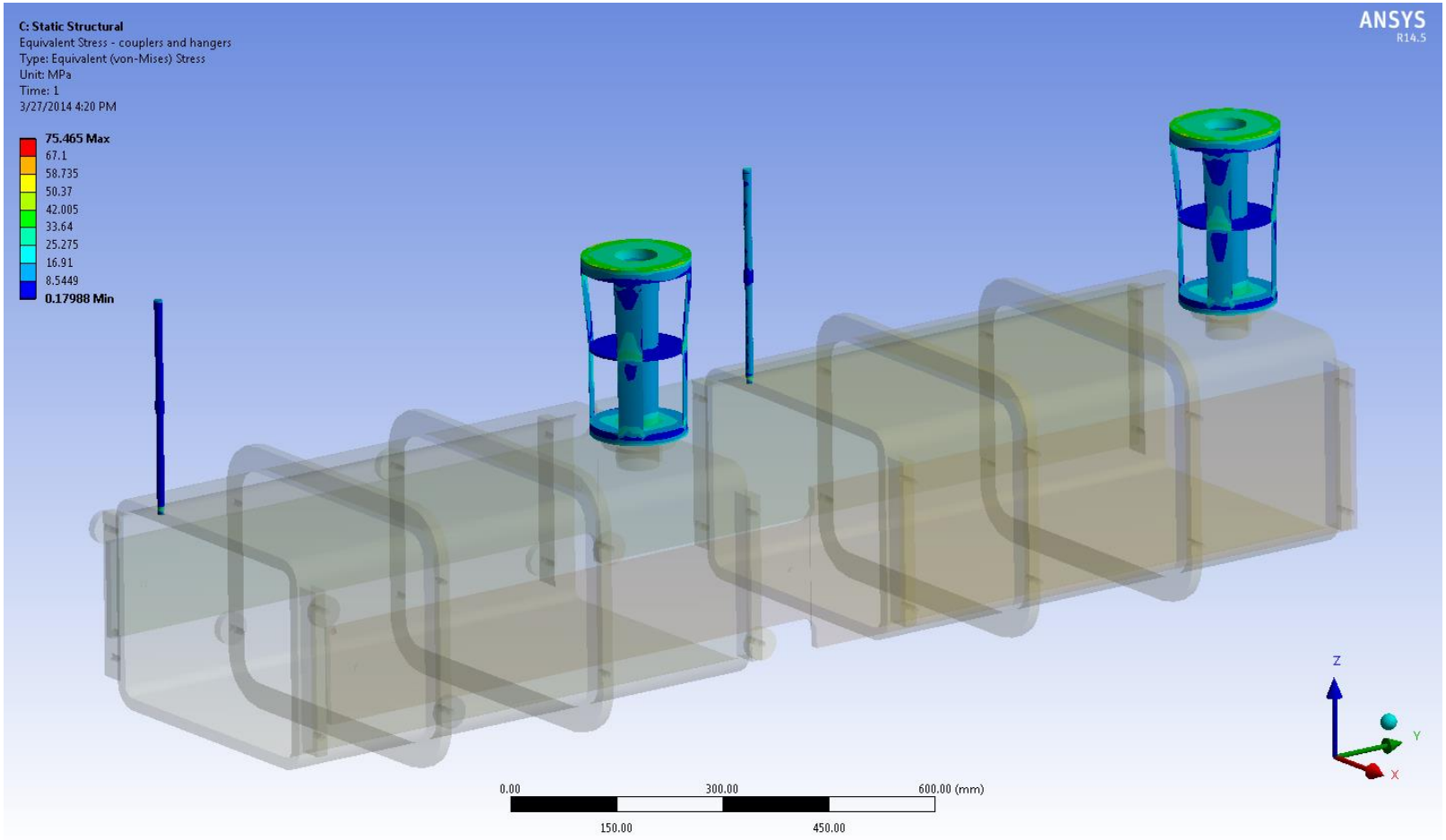
Downstream hanger reaction – Case 11



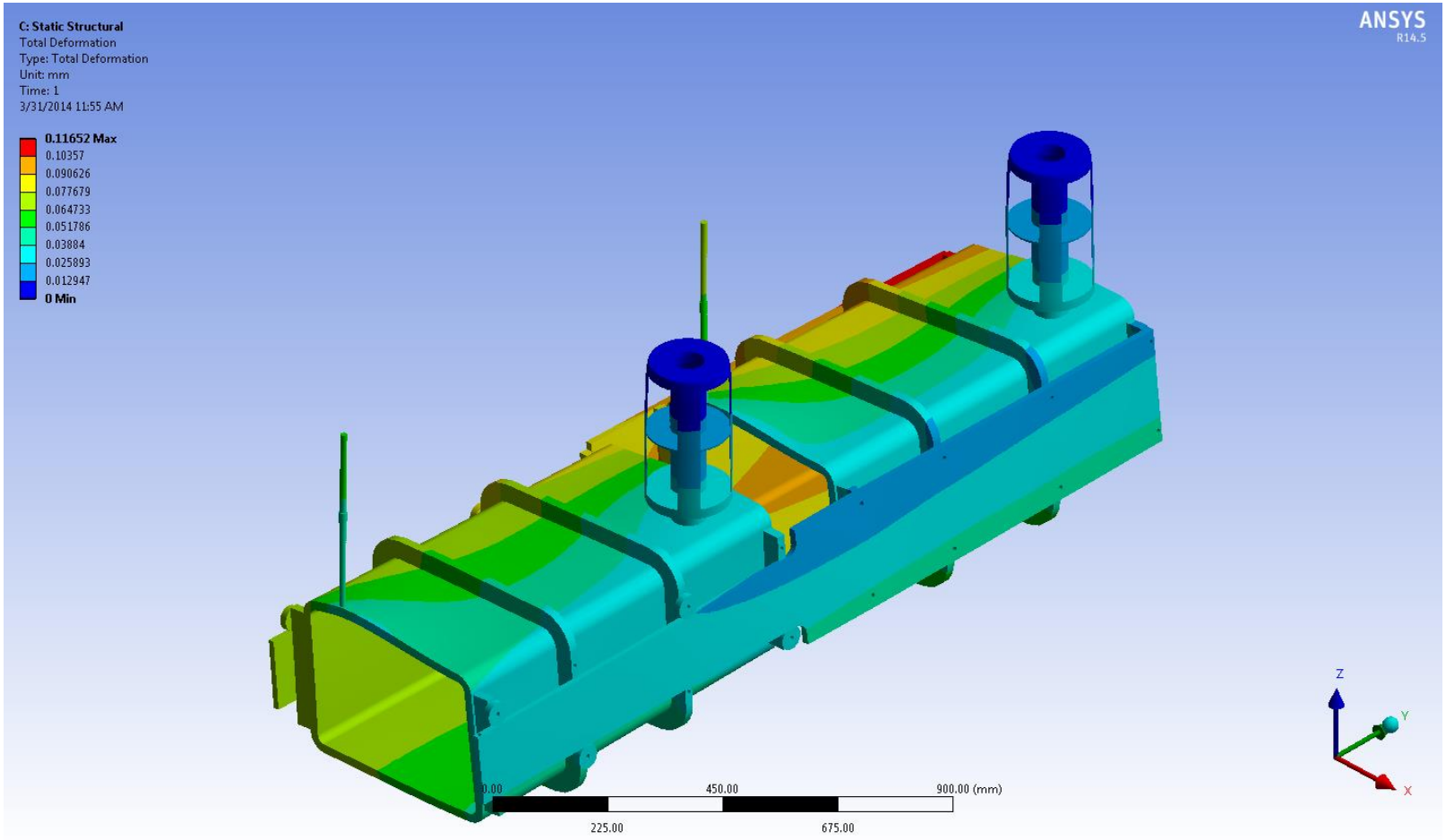
Upstream hanger reaction – Case 11



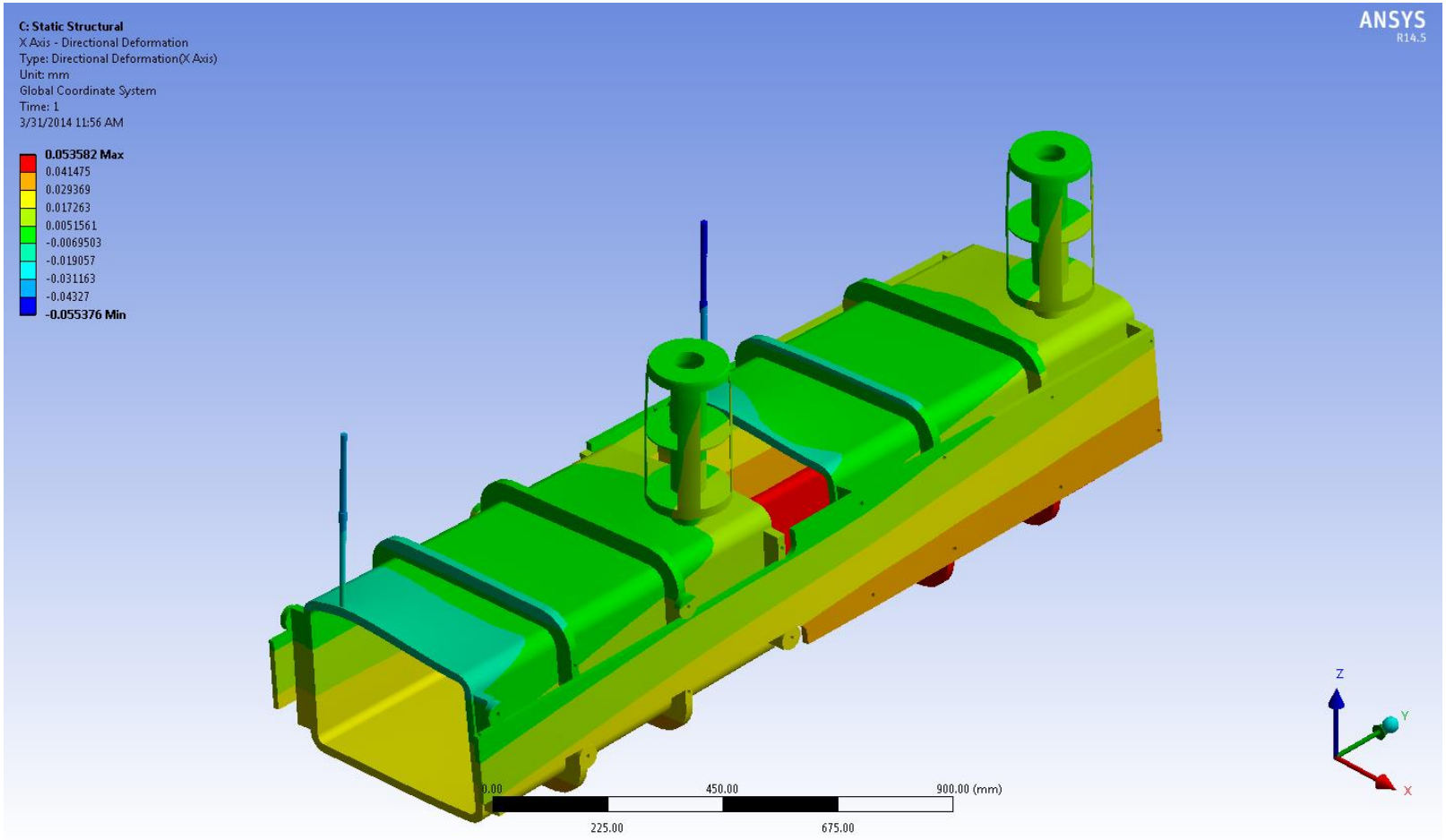
Coupler and hanger stress – Case 11



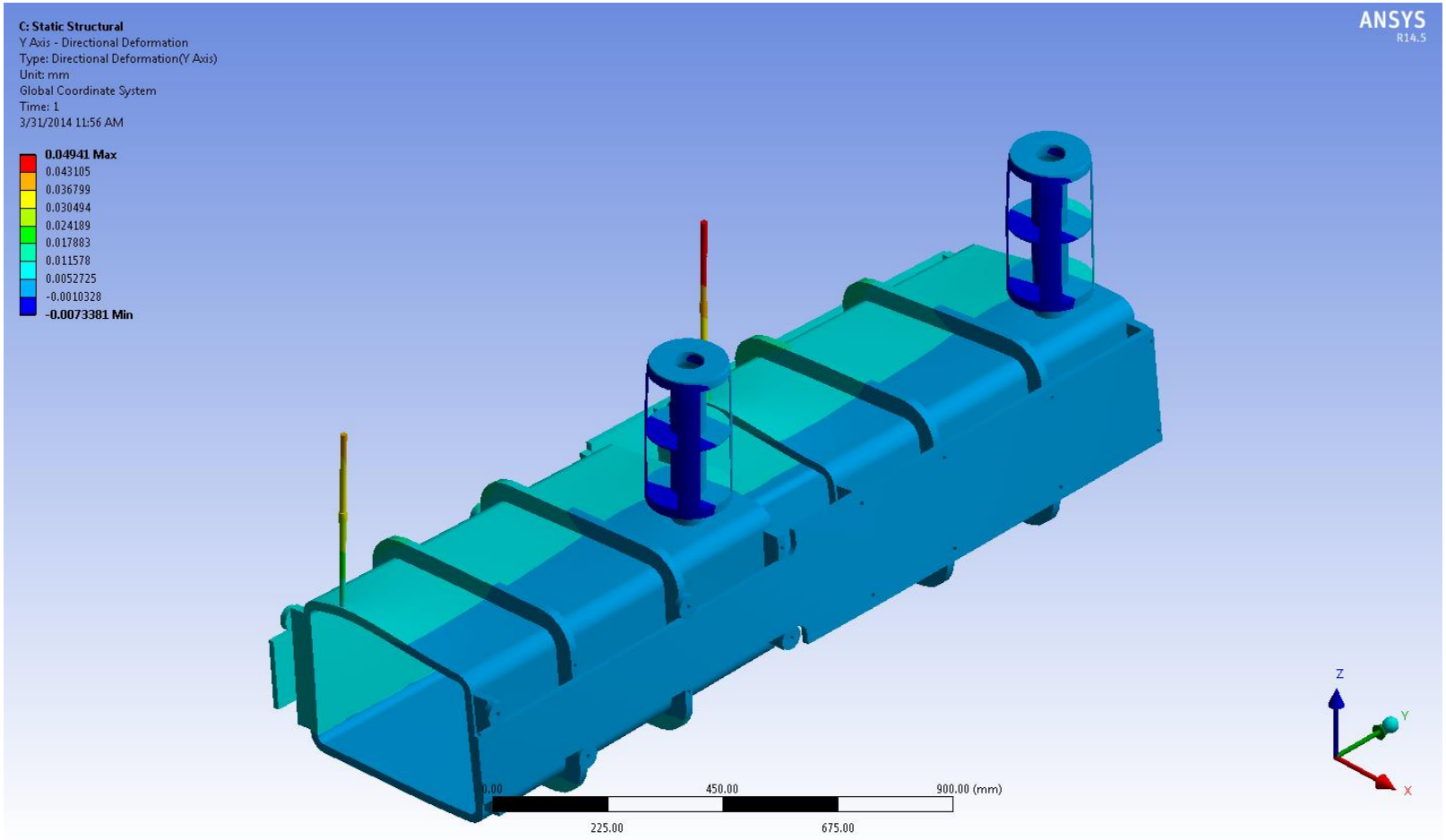
Total deformation – Case 11a (no thermal load)



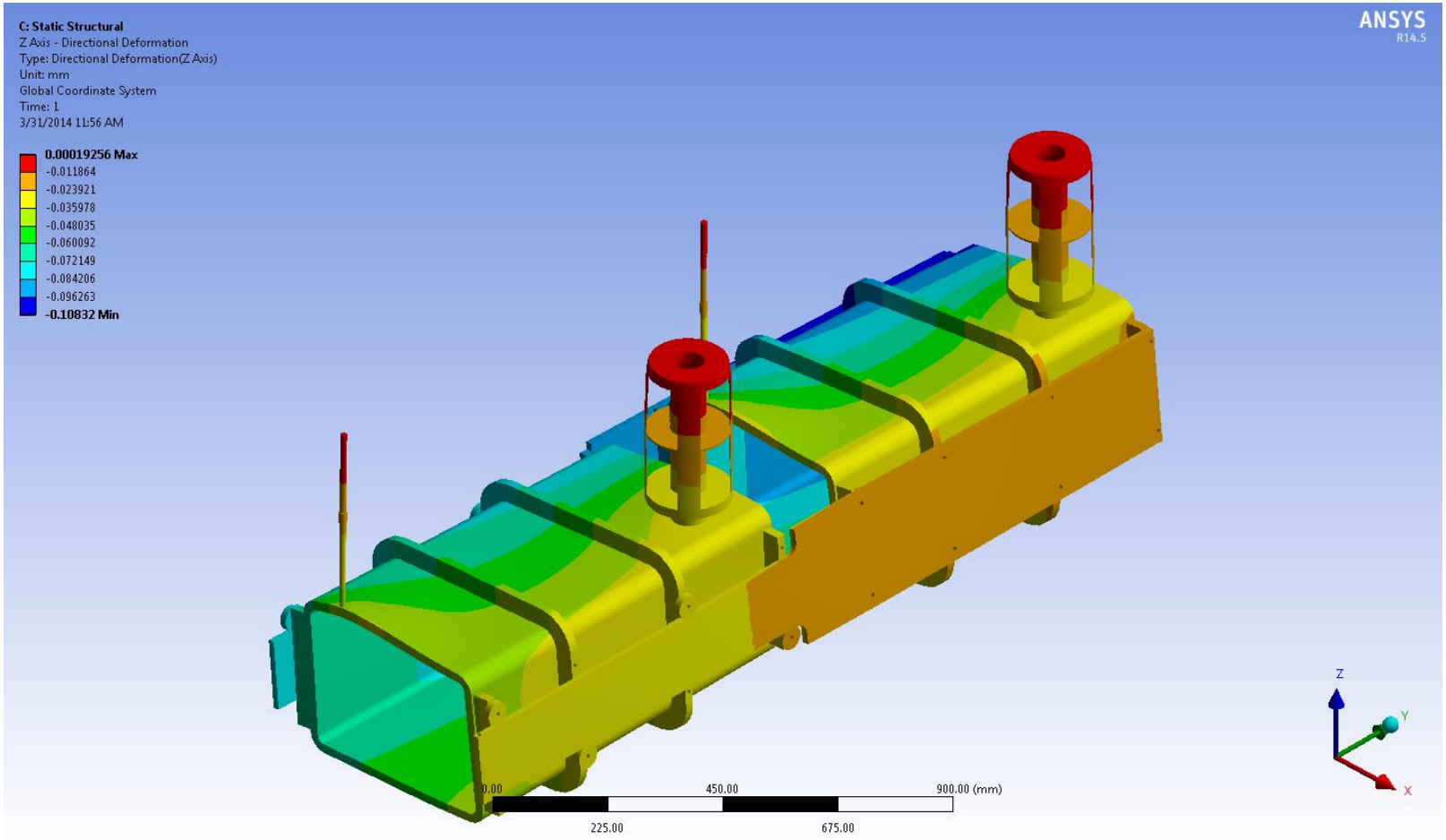
X deflection – Case 11a (no thermal load)



Y deflection – Case 11a (no thermal load)



Z deflection – Case 11a (no thermal load)



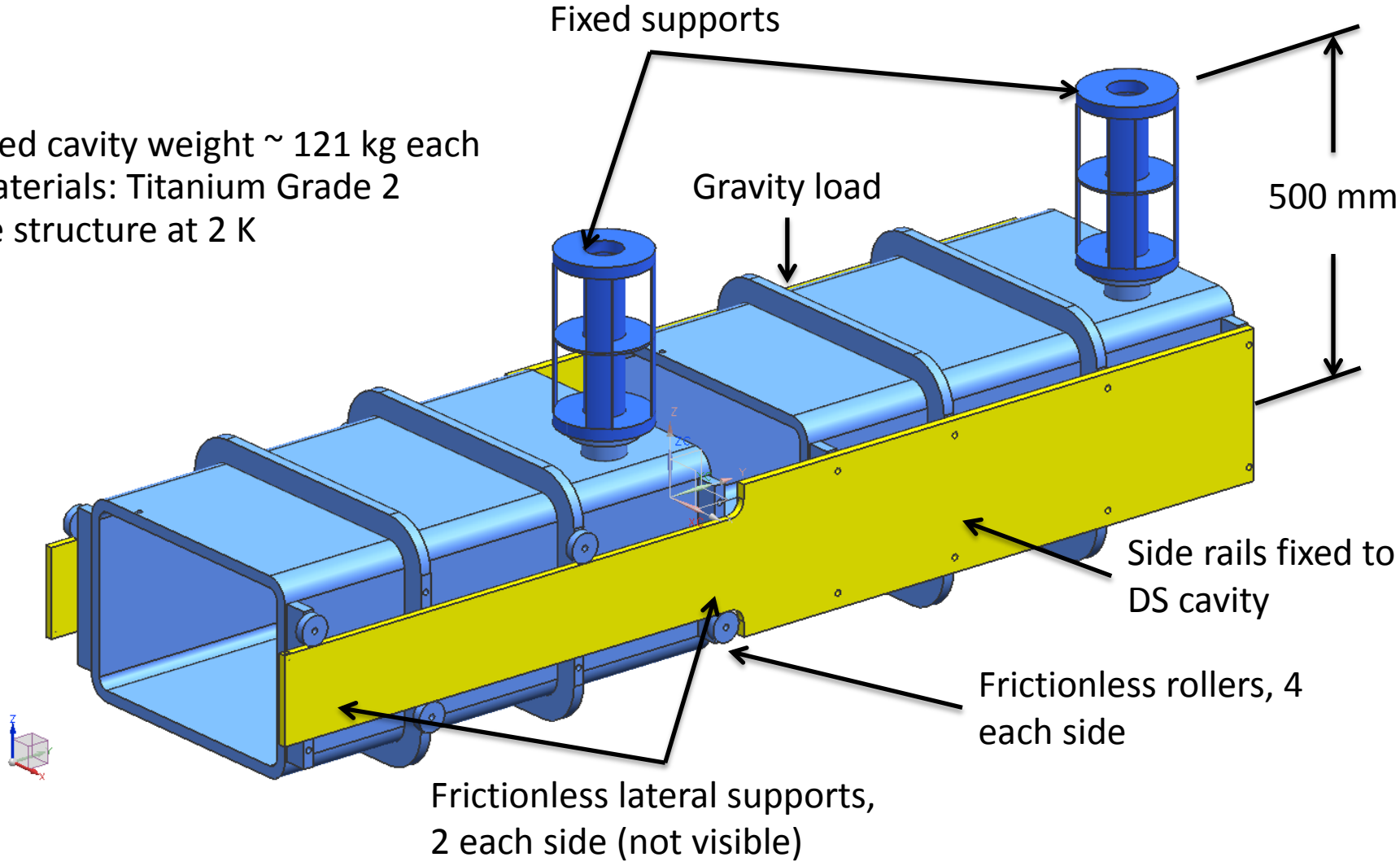
Case 12

Case 12 - Model setup

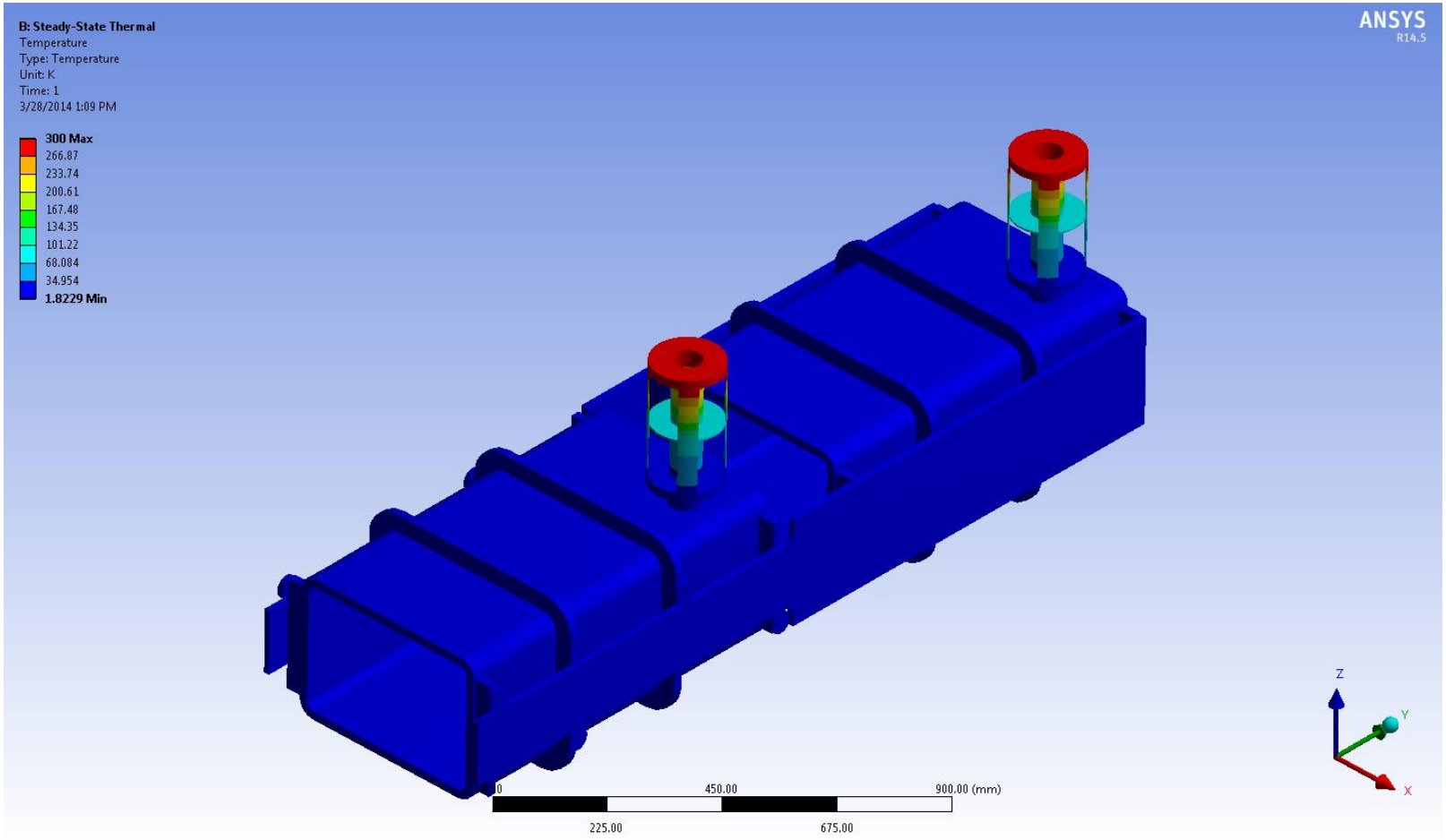
- Same as case 10, but with no support hangers.

Analysis model – Case 12

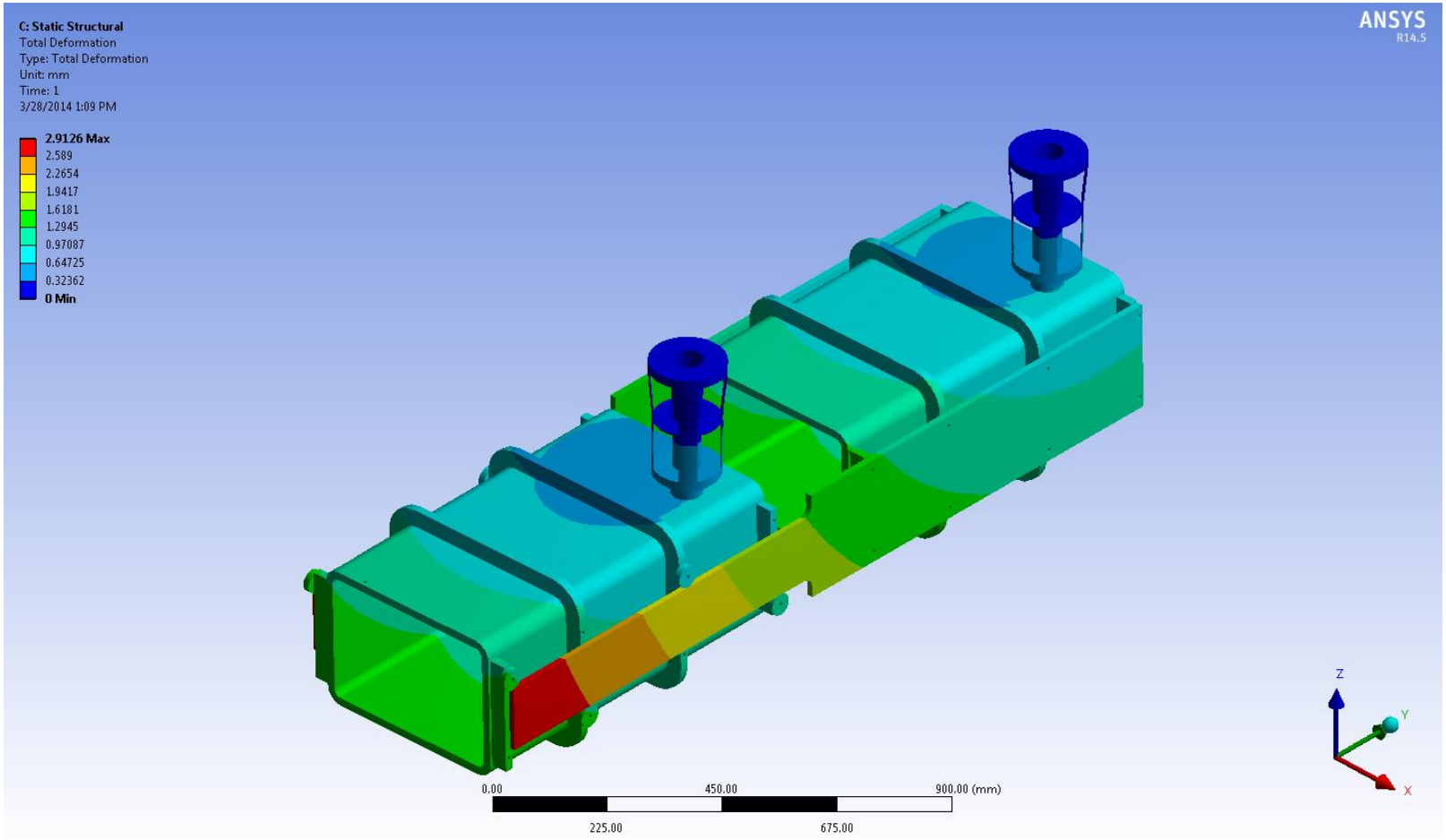
Dressed cavity weight ~ 121 kg each
All materials: Titanium Grade 2
Entire structure at 2 K



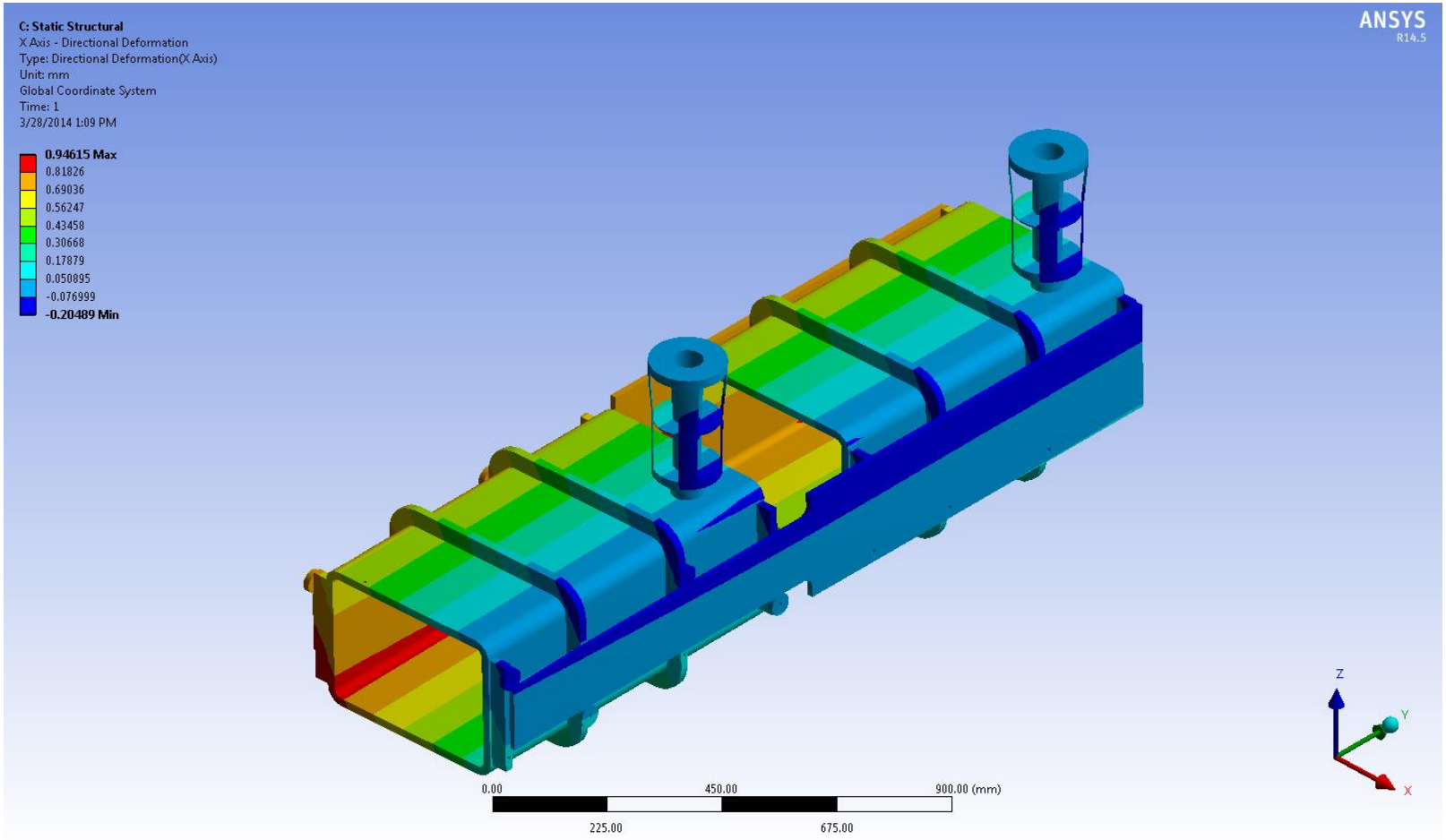
Temperature plot – Case 12



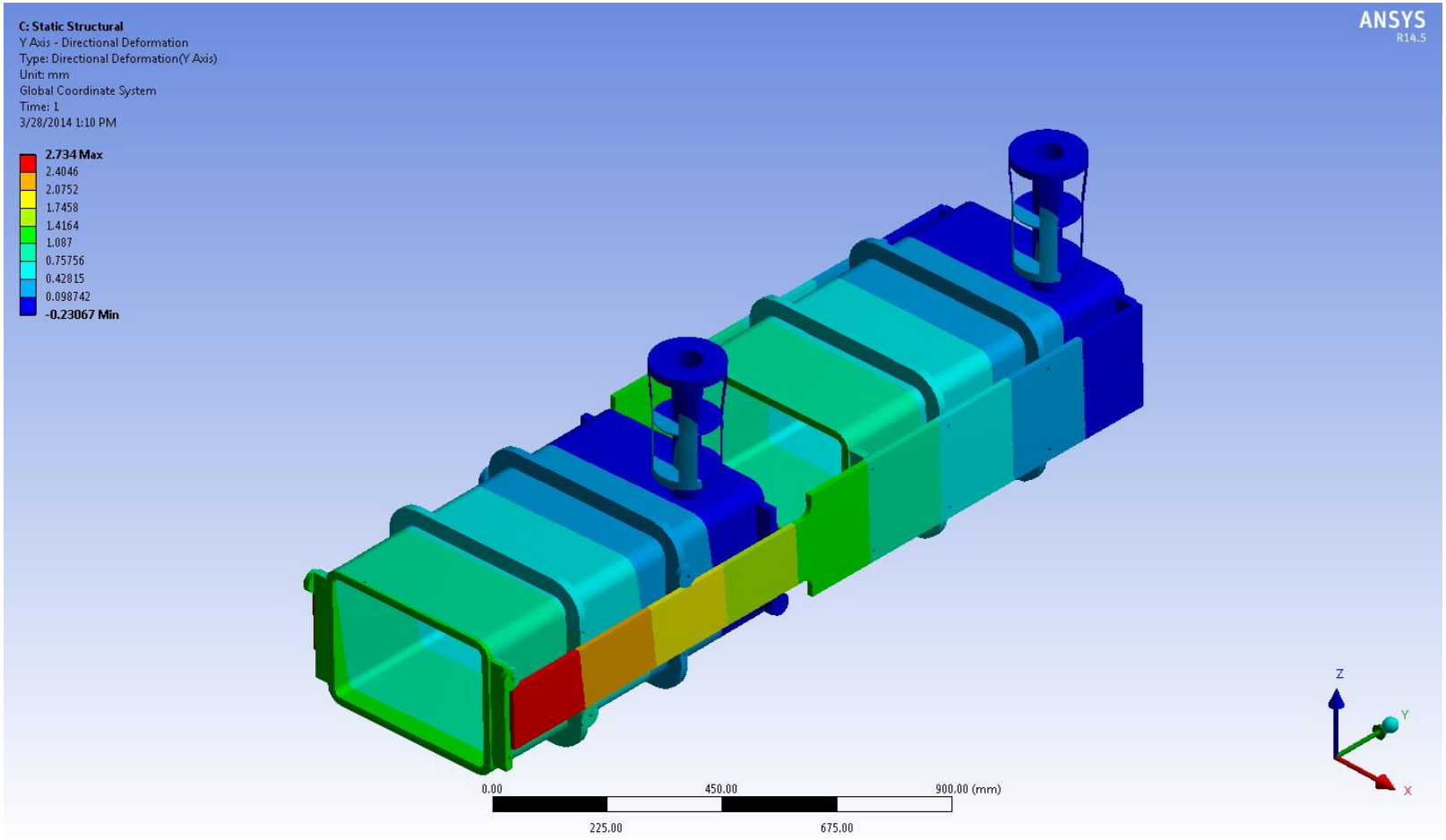
Total deformation – Case 12



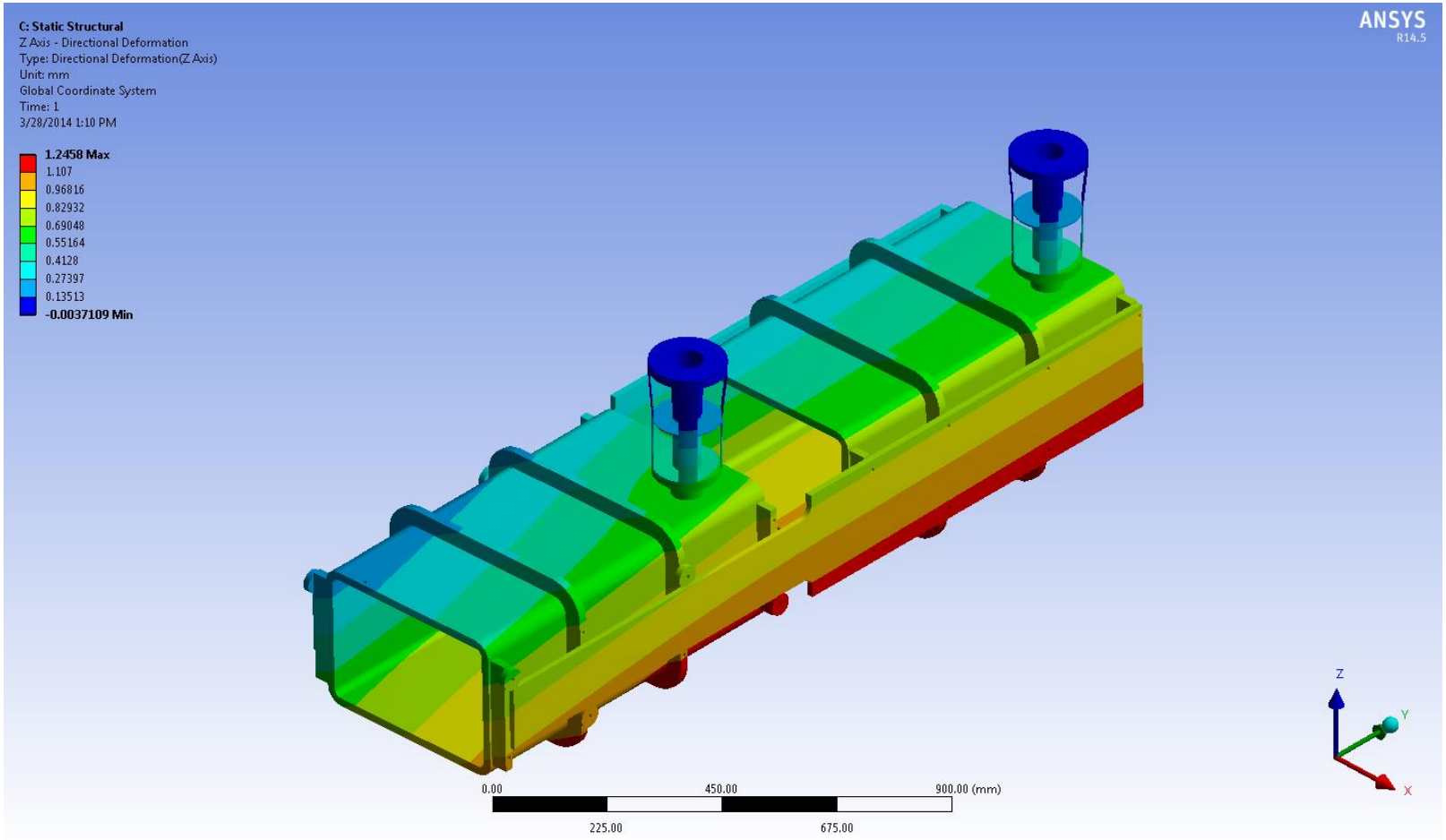
X deflection – Case 12



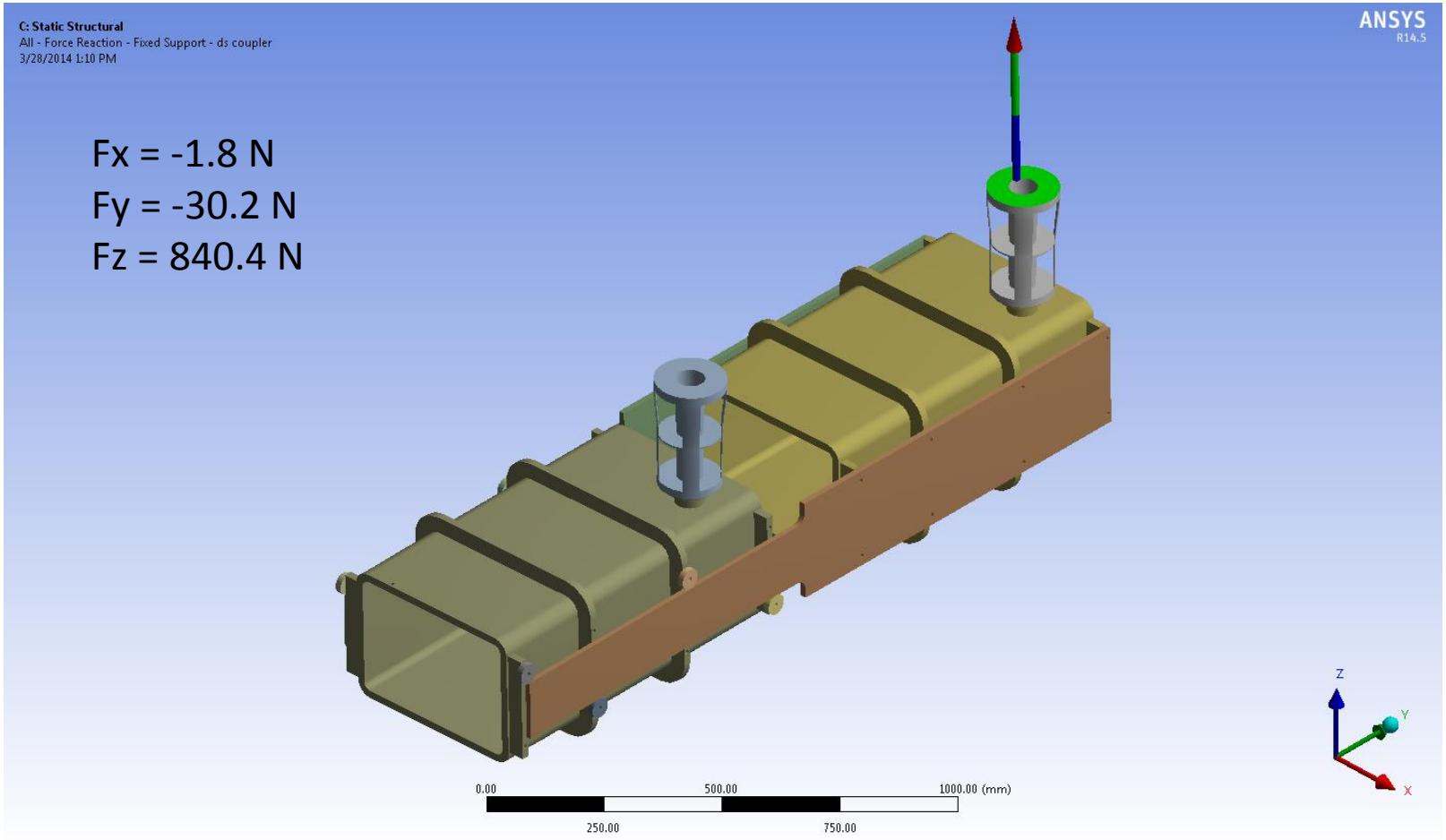
Y deflection – Case 12



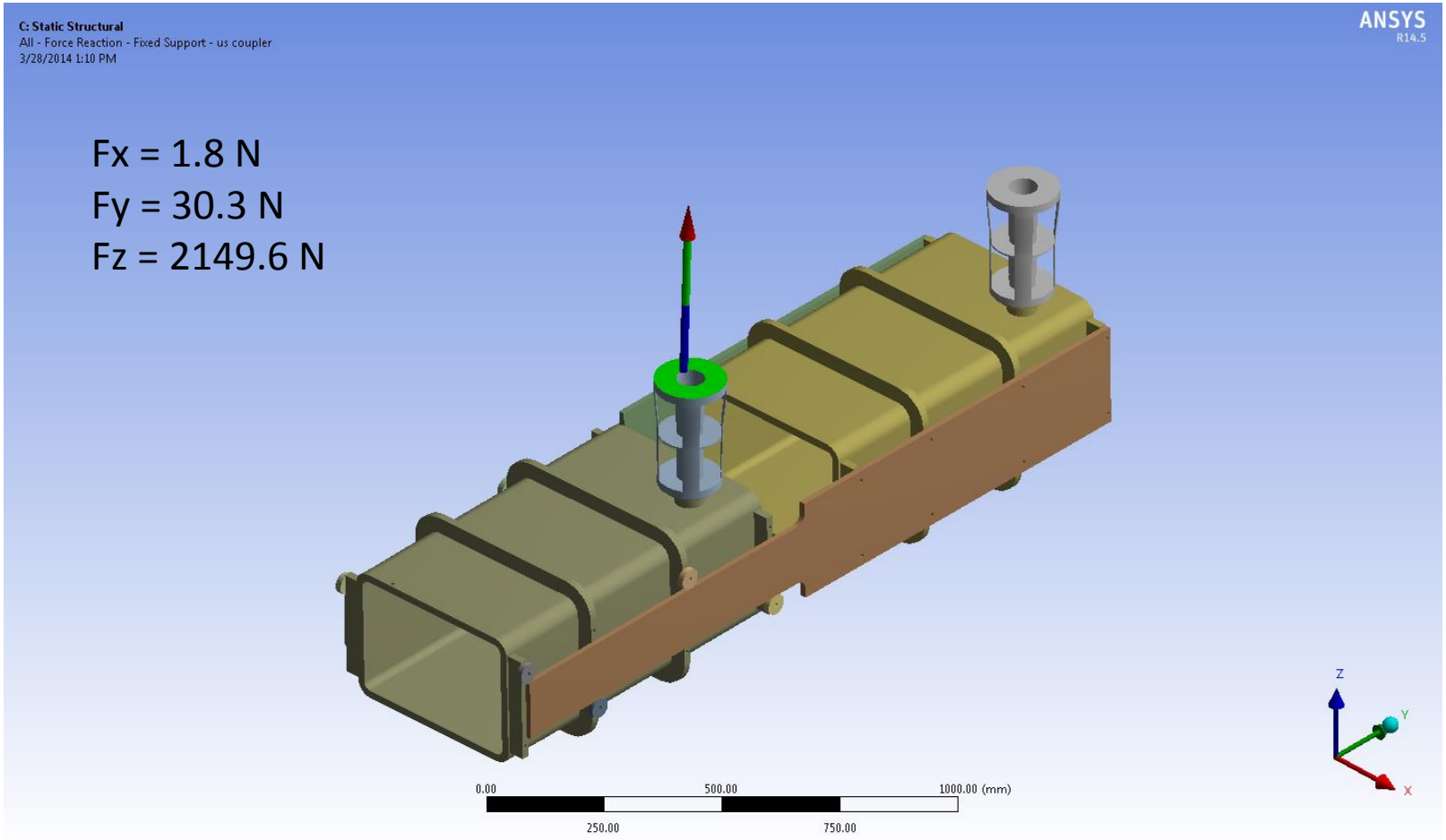
Z deflection – Case 12



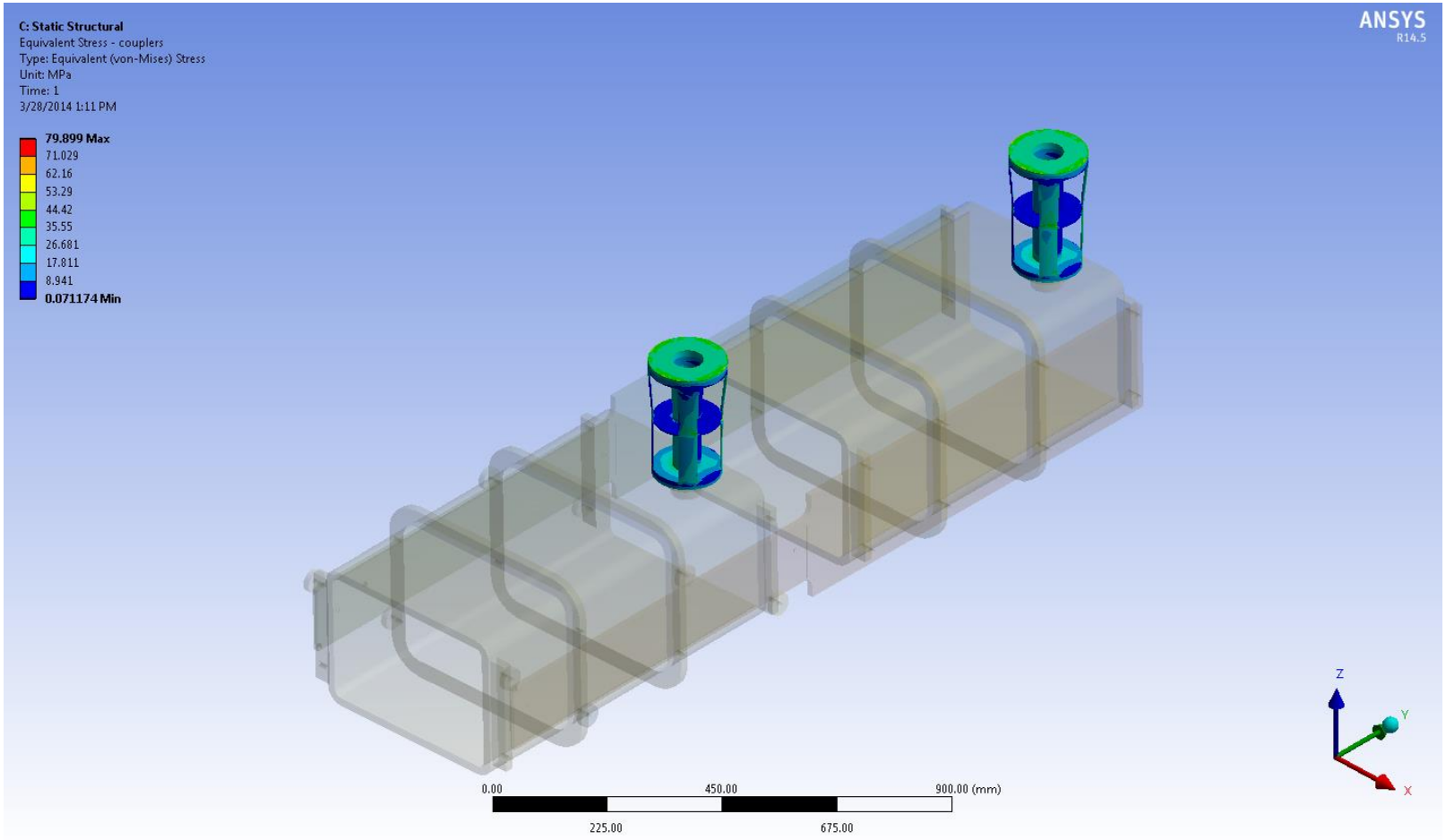
Downstream coupler reaction – Case 12



Upstream coupler reaction – Case 12



Coupler and hanger stress – Case 12



Summary – Cases 10 thru 12

- Vertical supports on the upstream end of the dressed cavities (opposite corner from the input coupler) reduce the load on the coupler extension and distribute the load between the two couplers more uniformly.
- They also give much more uniform displacements of both cavities along the length of the cavity string.
- Each support hanger adds ~0.25 W to the 2 K heat load.
- For one hanger per cavity in addition to the coupler extension, the static heat loads due to the couplers and hangers only are 23.2 W to 80 K and 3.3 W to 2 K.
- Case 11a is the same as 11, but with no thermal load, i.e. gravity load only.
- Summary of all results on next slide.

Summary of results – All cases

Summary of RF dipold support analysis cases - March 2014

	Total defl (mm)		ux (mm)		uy (mm)		uz (mm)		Fz (N)				Heat load (W)		
	min	max	min	max	min	max	min	max	US coupler	DS coupler	US hanger	DS hanger	300 K	80 K	2 K
Case 1	0	2.81	-0.25	1.07	-0.33	2.73	-0.52	0.80	1929	935					
Case 2	0	2.78	-0.22	0.90	-0.22	2.65	-0.35	0.81	2040	828					
Case 3	0	2.94	-0.17	1.12	-0.40	2.79	0.00	1.13	2162	778					
Case 4	0	3.09	-0.15	1.09	-0.35	2.86	0.00	1.13	2738	741					
Case 5	0	2.90	-0.17	1.10	-0.33	2.75	0.00	1.13	2140	792					
Case 6	0	0.70	0.00	0.44	0.00	0.11	-0.61	0.14	2125	806					
Case 7	0	2.97	-0.19	1.03	-0.38	2.82	0.00	1.16	1074	1371	496				
Case 8	0	2.99	-0.22	0.94	-0.42	2.84	0.00	1.17	1101	1268	572				
Case 9	0	2.99	-0.43	2.84	-0.43	2.84	0.00	1.17	1113	1231	602				
Case 10	0	2.96	-0.23	0.78	-0.28	2.73	0.00	1.29	864	1282	847		24.68	-21.58	-3.10
Case 11	0	2.97	-0.28	0.68	-0.27	2.71	0.00	1.25	680	700	497	1119	26.52	-23.18	-3.34
Case 12	0	2.91	-0.20	0.95	-0.23	2.73	0.00	1.25	2150	840			22.85	-19.98	-2.87
Case 11a	0	0.12	-0.06	0.05	-0.01	0.05	-0.11	0.00	842	873	532	749			