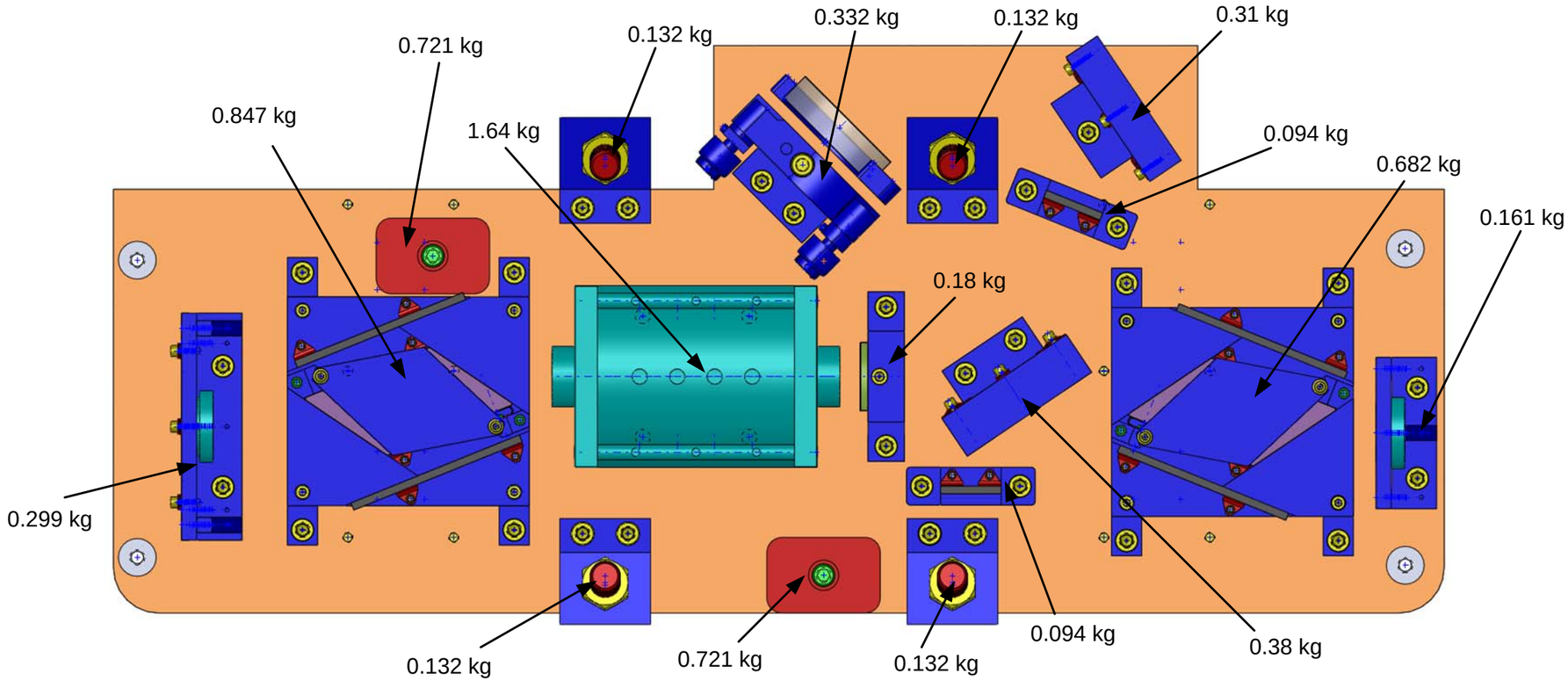
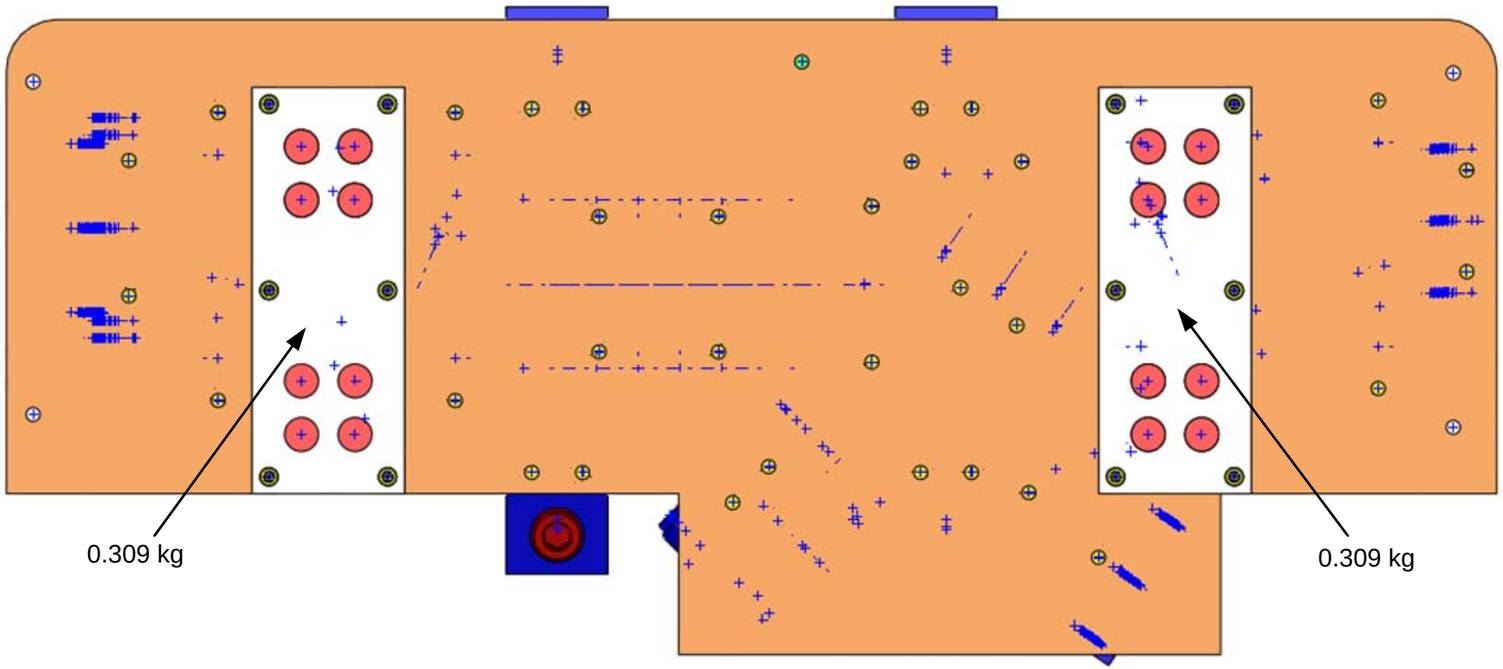
LIGO-T1000558- -v2

No changes data is as per data reported in v1





Total Mass of Payload Elements on the Table = 7.939 kg

Sum of mass break down = 7.607 (4% lower) due to not accounting for all fasteners

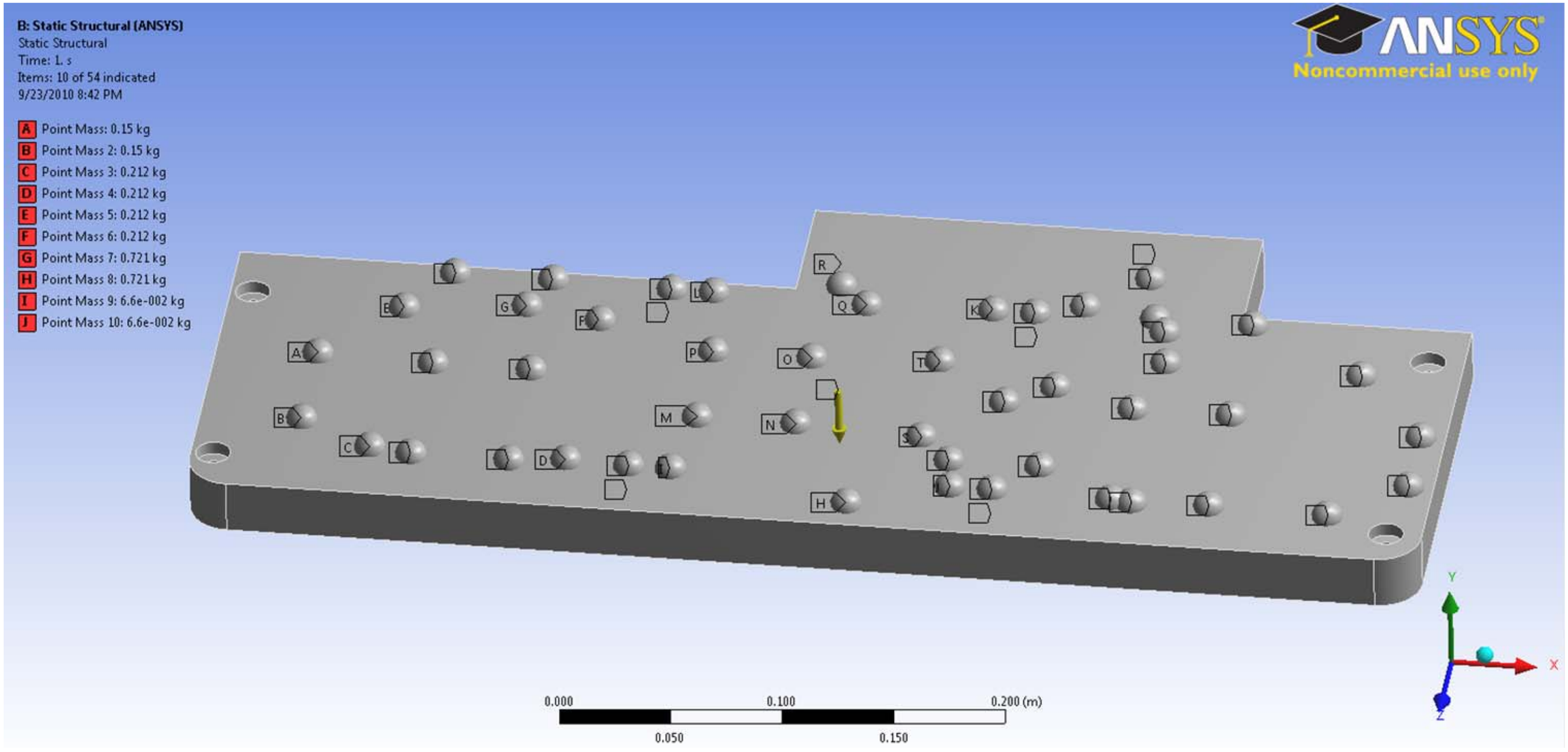
SYSTEM ENGINEERING

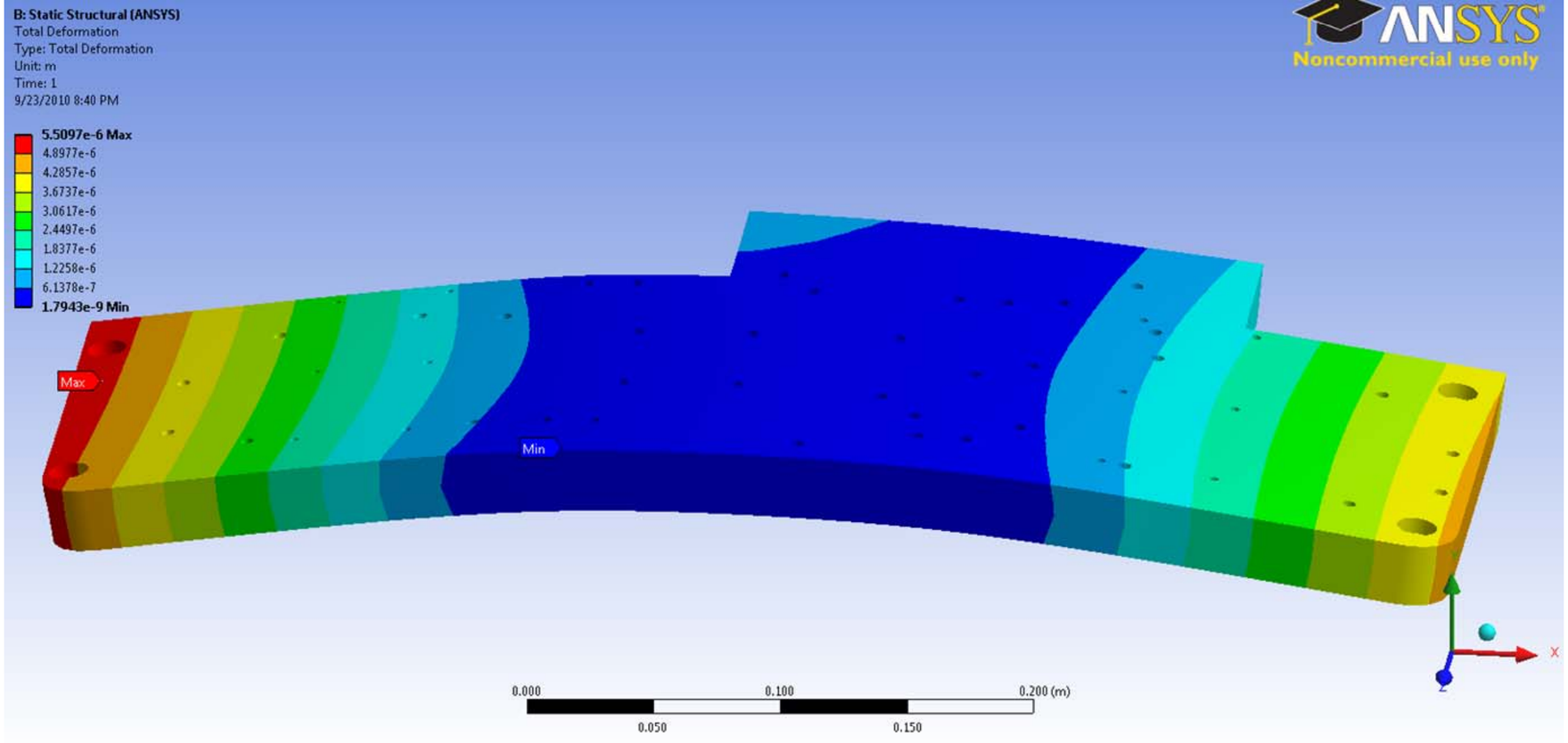
As a result of this change the work covered in v1 of LIGO-T1000558 (the original release of this document) is no longer valid.

In version of LIGO-T1000558-v2 we look again at both the modal and static analysis for this bench. This work is included in the following pages.

LIGO-T1000558-v2

No changes data is as per data reported in v1

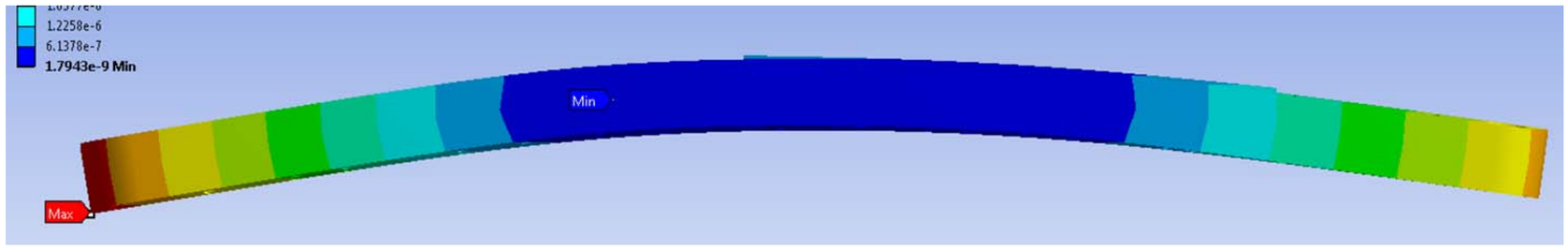




LIGO-T1000558- -v2

No changes data is as per data reported in v1

STATIC DEFLECTION UNDER GRAVITATIONAL LOAD WITH THE 4 WIRE SUPPORT POINTS PINNED. THE MAXIMUM DEFLECTION IS 6 MICRONS. FAR LESS THAN THE 1 MM ALIGNMENT TOLERANCE. ALIGNMENT ON A BENCH WILL NOT CHANGE SIGNIFICANTLY WHEN SUSPENDED DUE TO TRANSLATIONAL DEFLECTION.



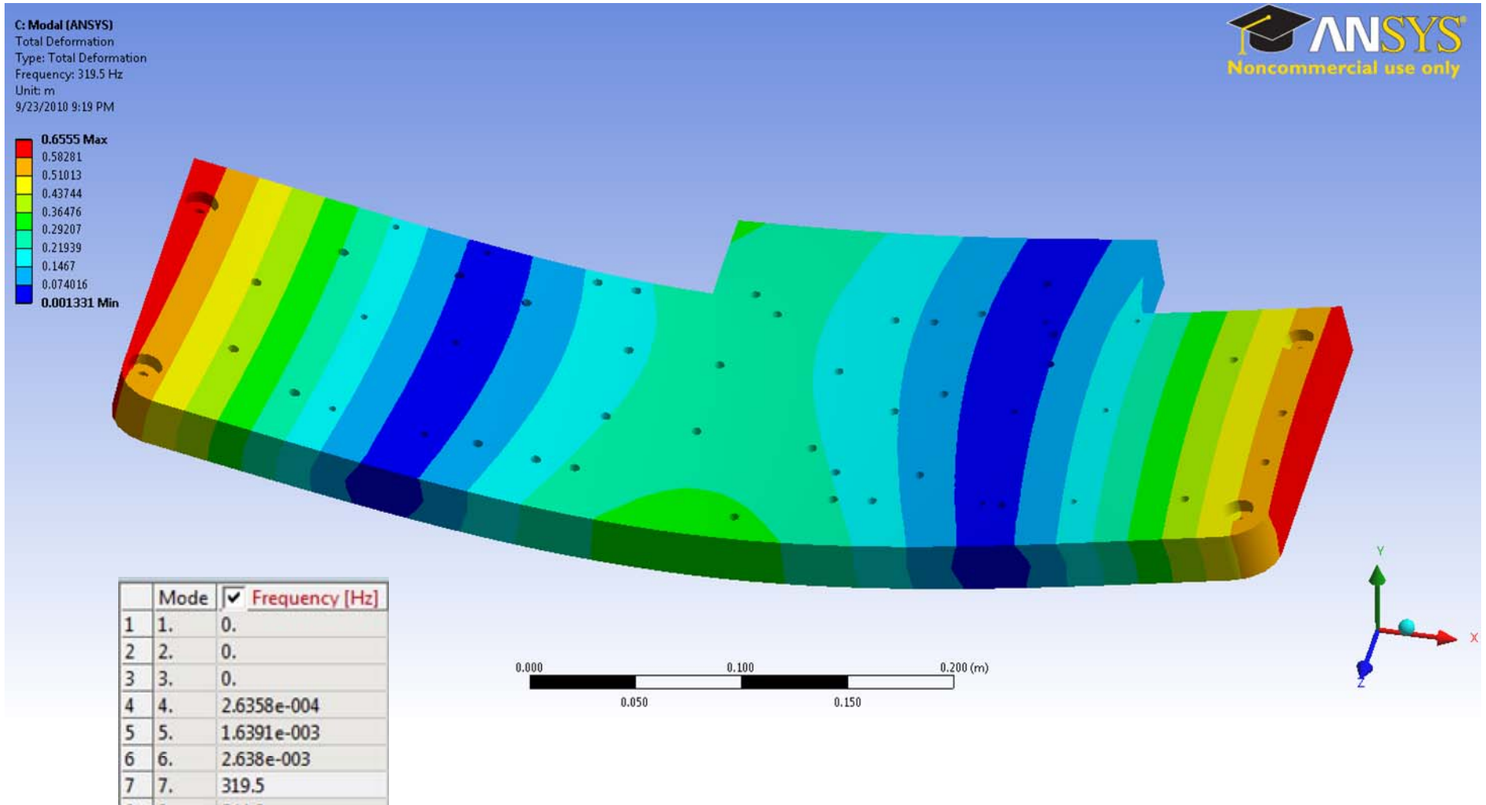
ANGULAR DEFLECTION (approximate, based on FEA deflection, assuming deflection of plate to an arc)					
	6.00E-06	deflection, d	m		
	6.51E+03	radius, r	m		
	8.59E-05	angle, Θ	rad		
	1.72E-04	reflected angle	rad		
	2	maximum lever arm	m		
	3.44E-04	maximum reflected beam shift	m		

SYSTEM ENGINEERING

As a result of this change the work covered in v1 of LIGO-T1000558 (the original release of this document) is no longer valid.

In version of LIGO-T1000558-v2 we look again at both the modal and static analysis for this bench. This work is included in the following pages.

No changes data is as per data reported in v1



	Mode	Frequency [Hz]
1	1.	0.
2	2.	0.
3	3.	0.
4	4.	2.6358e-004
5	5.	1.6391e-003
6	6.	2.638e-003
7	7.	319.5
8	8.	544.2
9	9.	865.56
10	10.	1076.7
11	11.	1480.5
12	12.	1661.7

Finite Element modal analysis result is 319 Hz for the first frequency. This is close to simple analytical calculations for the first frequency assuming uniform distribution of the mass on a beam (280 Hz) and a rectangular plate (292 Hz).

Analytical formulas are from R. Blevins, Formulas for Natural Frequency and Mode Shape, Krieger Pub., cr 1979.

OUTPUT FARADAY ISOLATOR TABLE

RECTANGULAR PLATE (all edges free)			
22	0.5588	plate length, a	in, m
7	0.1778	plate width, b	in, m
	3.142857143	plate aspect ratio, a/b	--
	22	approx. eigenvalue λ^2 for a/b=3	--
1	0.0254	plate thickness, h	in, m
	0.33	Poisson's ratio, ν	--
	6.89E+10	elastic modulus, E	Pa
	7.56	plate mass	kg
	7.94	payload mass	kg
	15.5	total mass	kg
	156.0068055	areal density, γ	kg/m^2
	292	**1st frequency**	**Hz**
BEAM (free-free boundary conditions)			
	2.42802E-07	moment of inertia, I=bh^3/12	m^4
	27.73801002	lineal density, m	kg/m
	4.73	eigenvalue, λ	--
	280	**1st frequency**	**Hz**

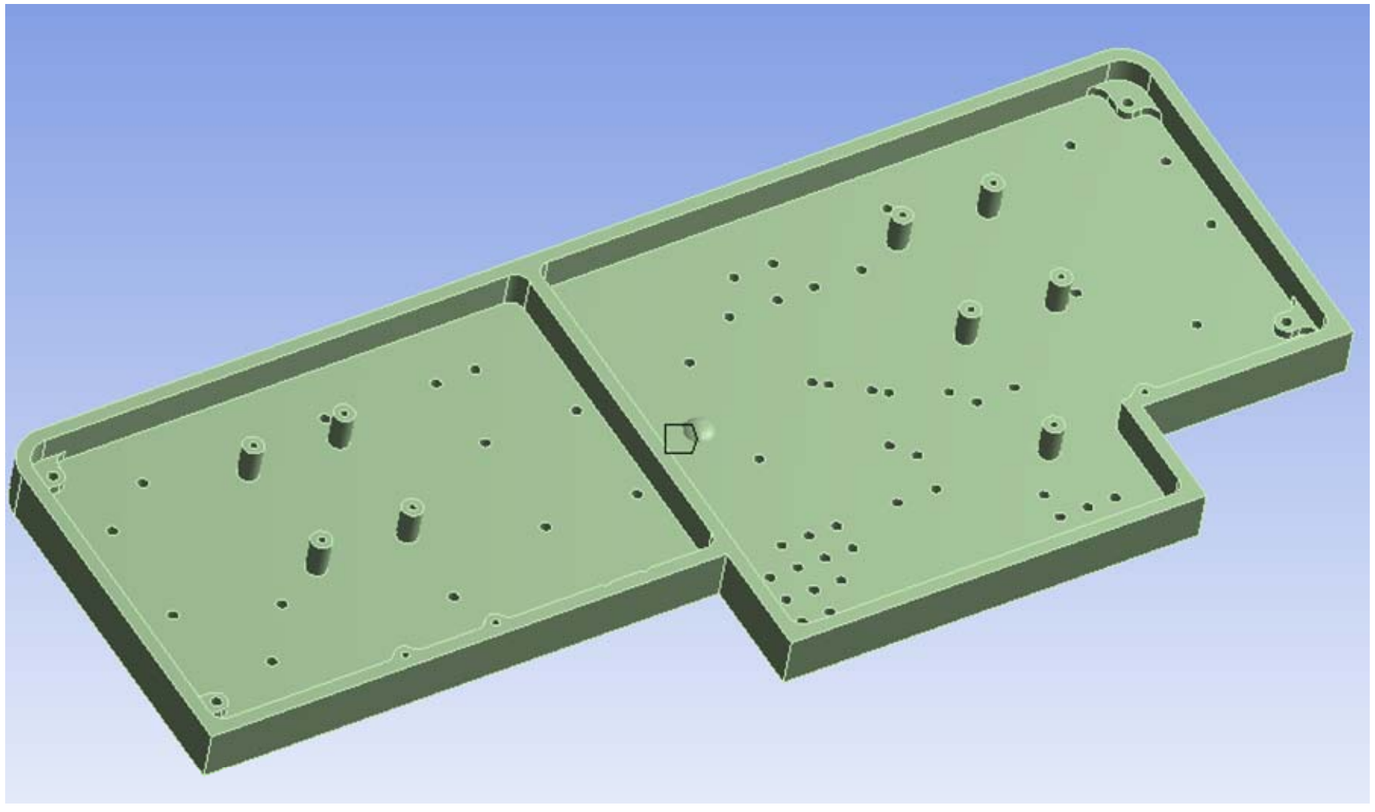
SYSTEM ENGINEERING

As a result of this change the work covered in v1 of LIGO-T1000558 (the original release of this document) is no longer valid.

In version of LIGO-T1000558-v2 we look again at both the modal and static analysis for this bench. This work is included in the following pages.

As per LIGO-D0900015-v4 the bench as become a lightweight version of its former self i.e. LIGO-D0900015-v3.
This change occurred with no ECR or DCN to go along with it.

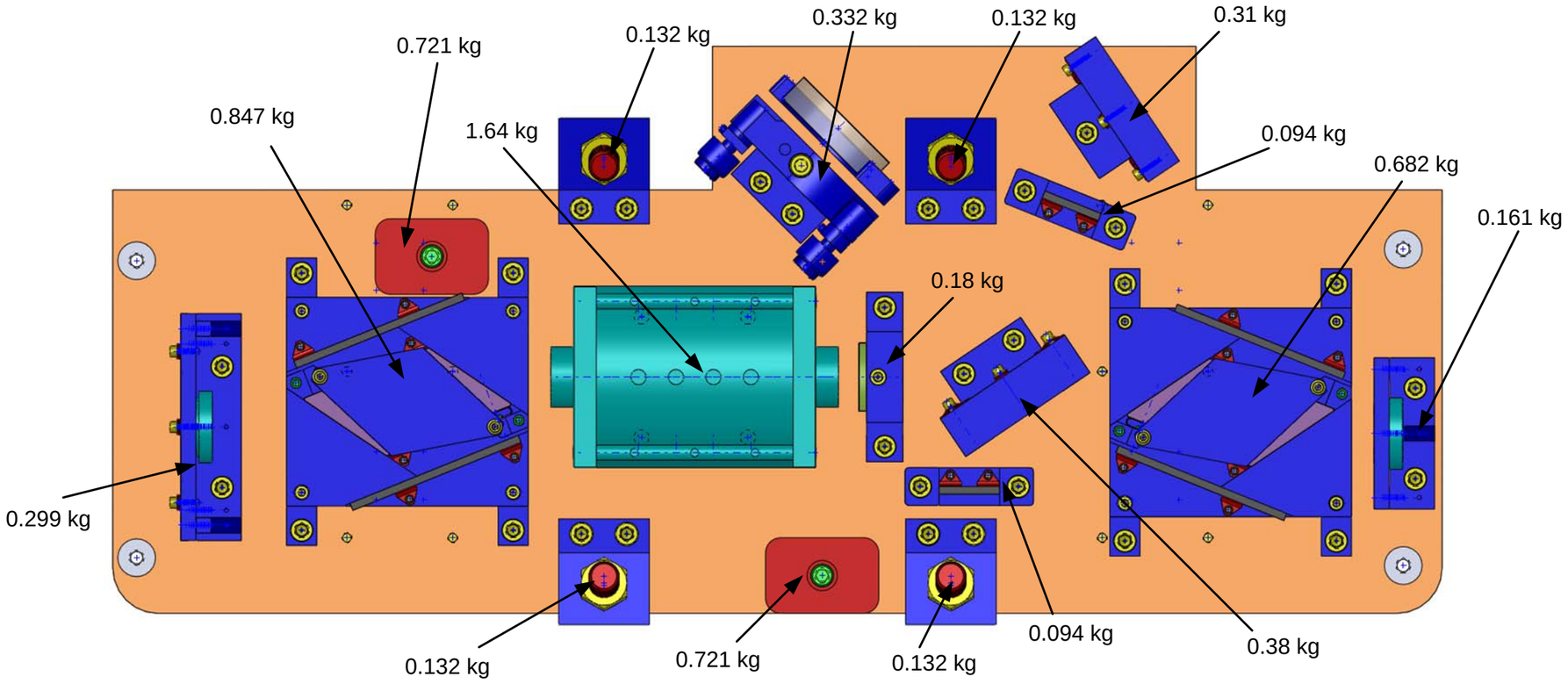
New bench layout is shown below

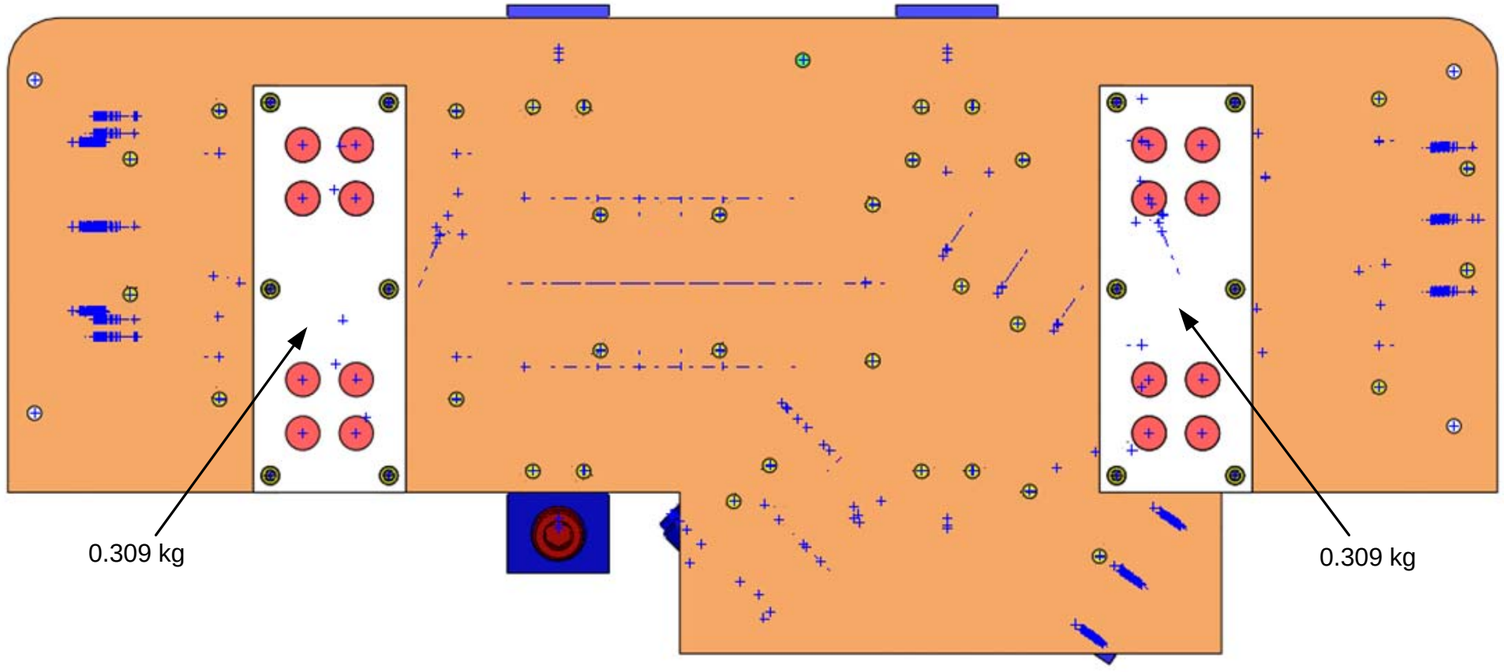


LIGO-D0900015-v4 (shown upside down with cut-out pockets shown.)
LIGO-D0900015-v4 now weighs 2.8 kg cf. LIGO-D0900015-v3 which weighed 7.7 kg.

As stated above no ECR or DCN goes along with LIGO-D0900015-v4. The only statement on the DCC is as follows “Reduced table plate weight by machining pockets from bottom surface. TQ. Nguyen, 02 Nov 2012.”

SYSTEM ENGINEERING
As a result of this change the work covered in v1 of LIGO-T1000558 (the original release of this document) is no longer valid.
In version of LIGO-T1000558-v2 we look again at both the modal and sttic analysis for this bench. This work is included in the following pages.





Total Mass of Payload Elements on the Table = 7.939 kg

Sum of mass break down = 7.607 (4% lower) due to not accounting for all fasteners

SYSTEM ENGINEERING

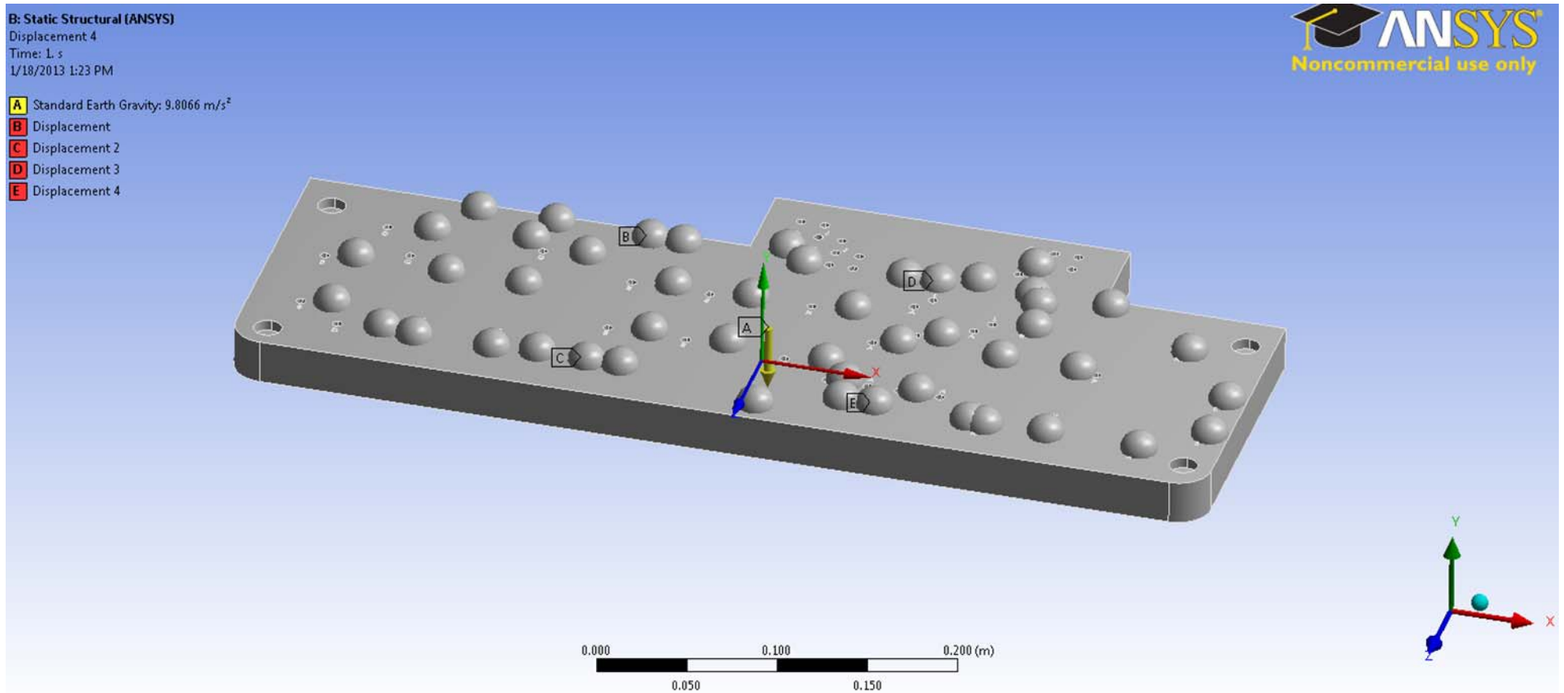
As a result of this change the work covered in v1 of LIGO-T1000558 (the original release of this document) is no longer valid.

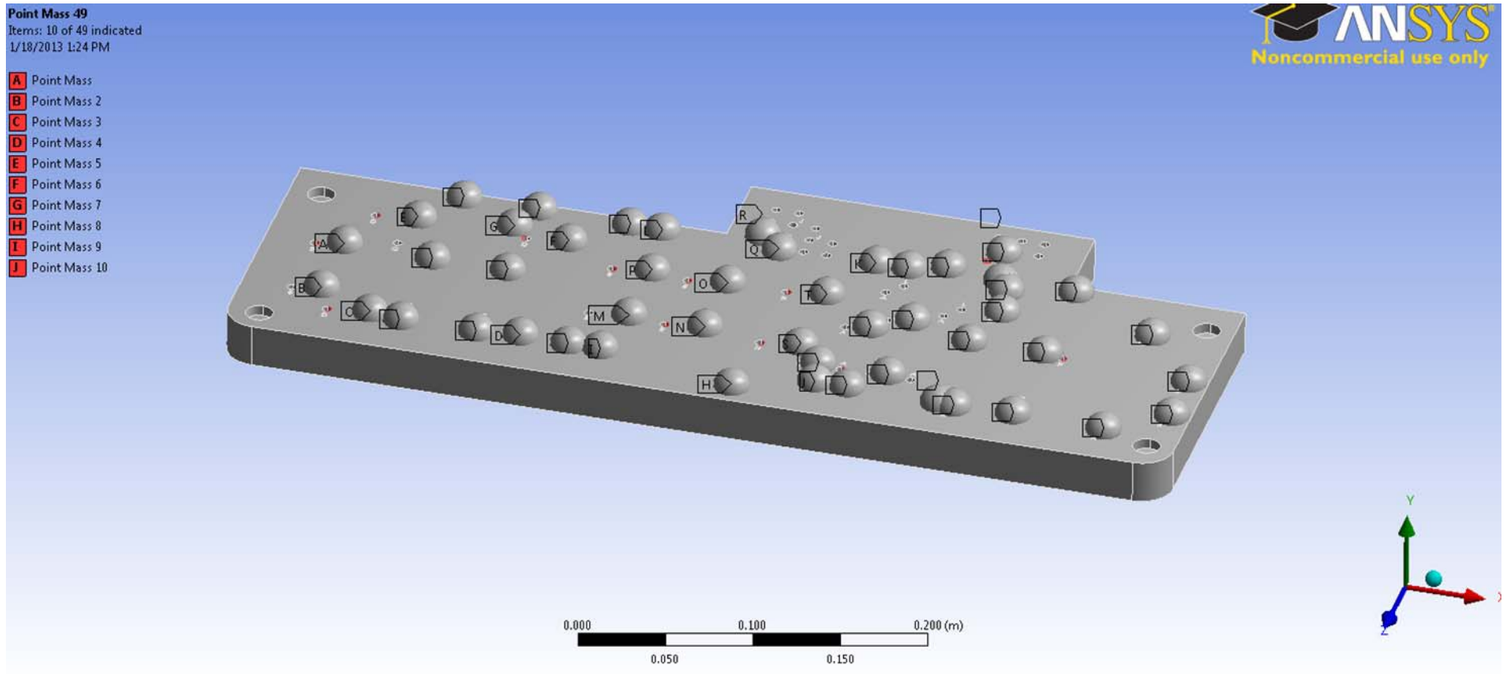
In version of LIGO-T1000558-v2 we look again at both the modal and static analysis for this bench. This work is included in the following pages.

For the analysis on the next pages the same masses used as per T1000558-v1 i.e. as shown here on this page were used.

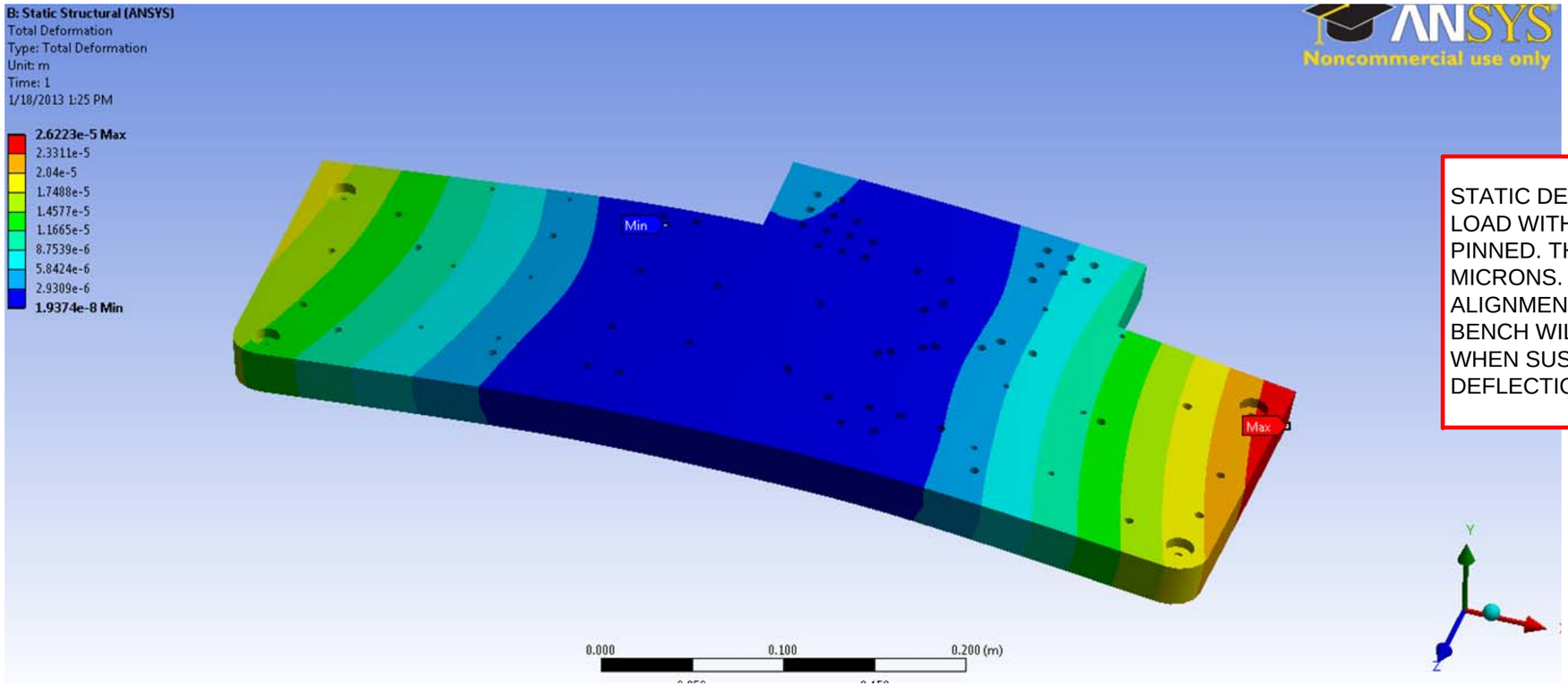
T1000558-v2

New bench layout is shown below

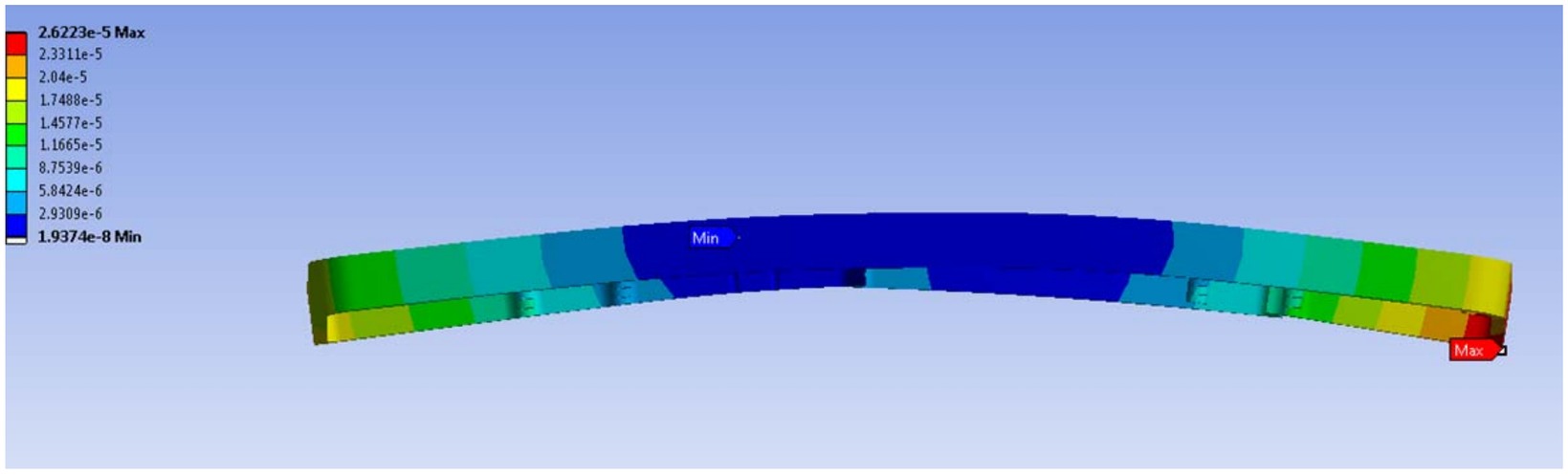




New bench layout is shown below

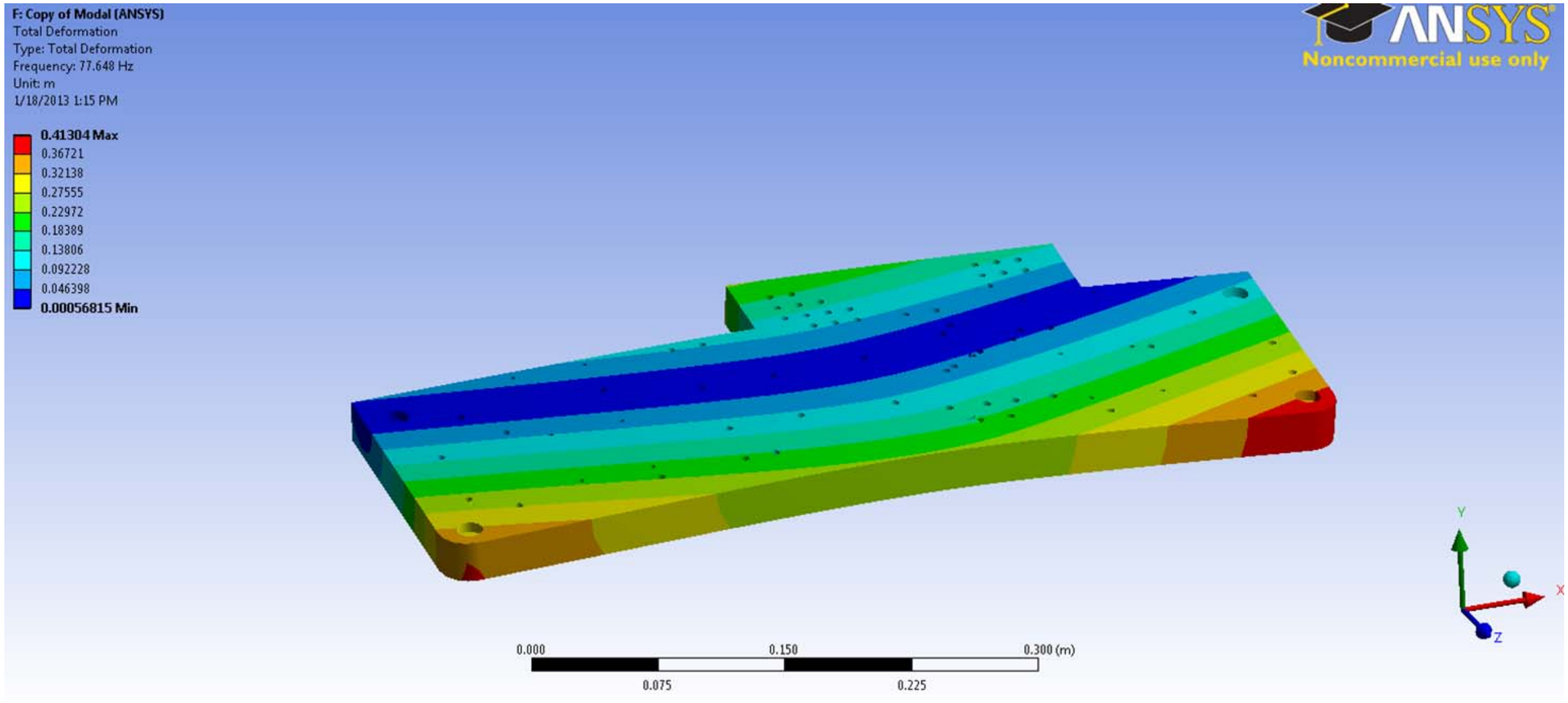


STATIC DEFLECTION UNDER GRAVITATIONAL LOAD WITH THE 4 WIRE SUPPORT POINTS PINNED. THE MAXIMUM DEFLECTION IS 2 MICRONS. FAR LESS THAN THE 1 MM ALIGNMENT TOLERANCE. ALIGNMENT ON A BENCH WILL NOT CHANGE SIGNIFICANTLY WHEN SUSPENDED DUE TO TRANSLATIONAL DEFLECTION.



(Refer to page 3 for original work on static.)

New bench layout is shown below



(Refer to page 4 for original work on modal.)

Finite Element modal analysis result is 77 Hz for the first frequency cf. 318 Hz with the original model using LIGO-D090015-v3.
(Refer to page 4 for original work on modal.)

Mode Number *	Mode Frequency (Hz) *	
1.	77.648	(shown)
2.	116.6	
3.	128.34	
4.	134.57	
5.	159.83	
6.	189.67	

* Search range limited to > 1 Hz to avoid computing rigid body modes.

CONCLUSIONS

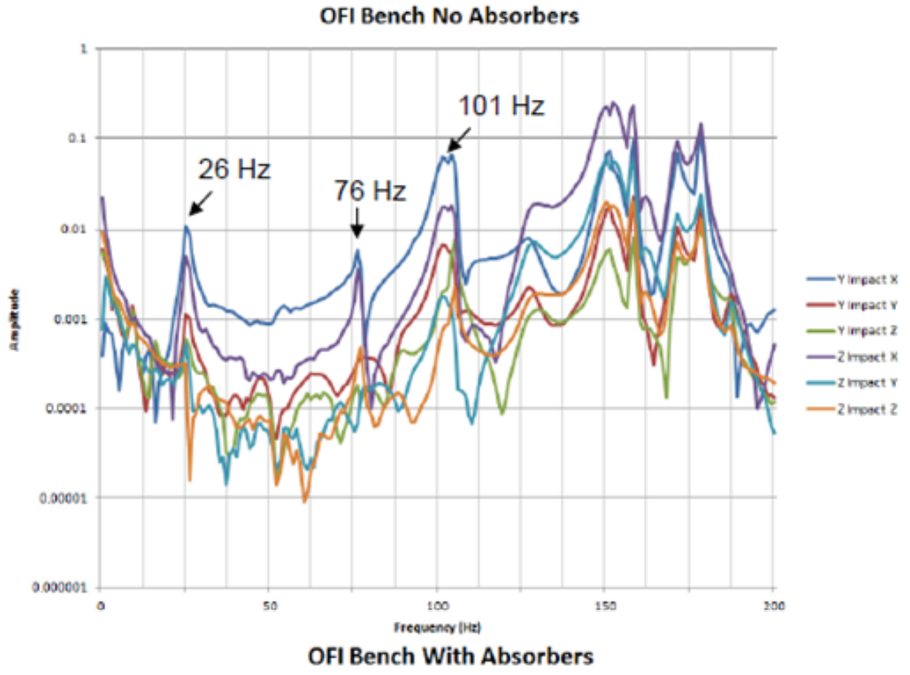
As per page 8 the updated Finite Element modal analysis result is 77 Hz for the first frequency cf. 318 Hz with the original model using LIGO-D090015-v3. (Refer to page 4 for original work on modal.)

How this could affect the performance of the bench is still an open question??

For reference the B&K Modal analysis work carried out on a suspended bench should be referenced, see LIGO-T1300042.

The B&K measurements in T1300042 indicate a bench resonance of 26 Hz. This could be the resonance the updated FEA measured at 77 Hz. The reason for the large discrepancy between this updated FEA and the experiment could be down to inaccuracy in the model caused by the fact we are modeling a thin plate with a large number of discrete mass distributed at specific points

Bench Data:



Extract from LIGO T1300042 page 4 of 6 (upper graph)