Adv LIGO BSC-ISI Stage 0

Design Review

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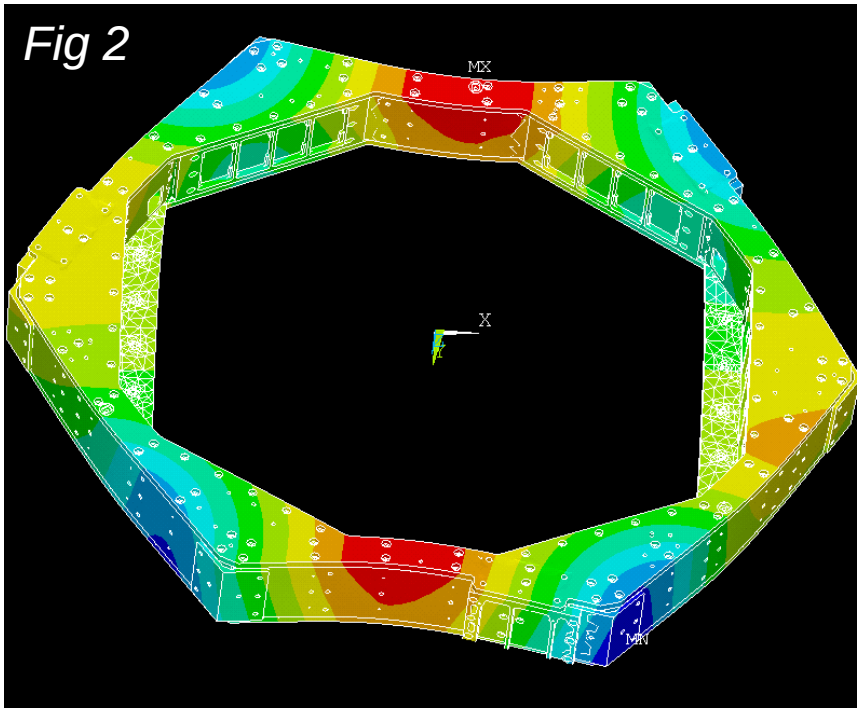
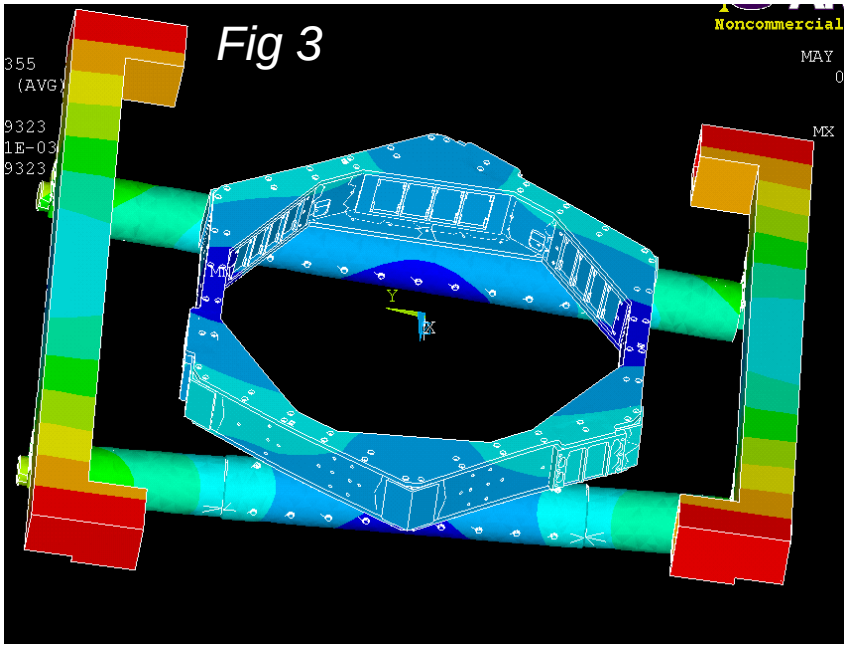
Overview

- LASTI prototype
- New design approach
- New design analysis
- Yet to be added…

LASTI Prototype

- 11 parts
- 1077 lbs (967+110)
- 1st natural frequency: 77 Hz
- 1st natural frequency Stage0+ support structure: 27 Hz





LASTI Prototype (2)

- FEA Static

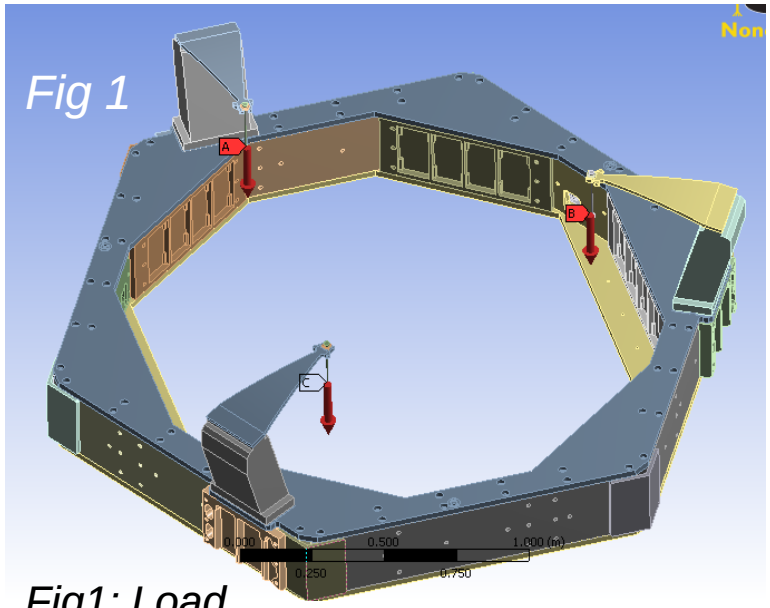
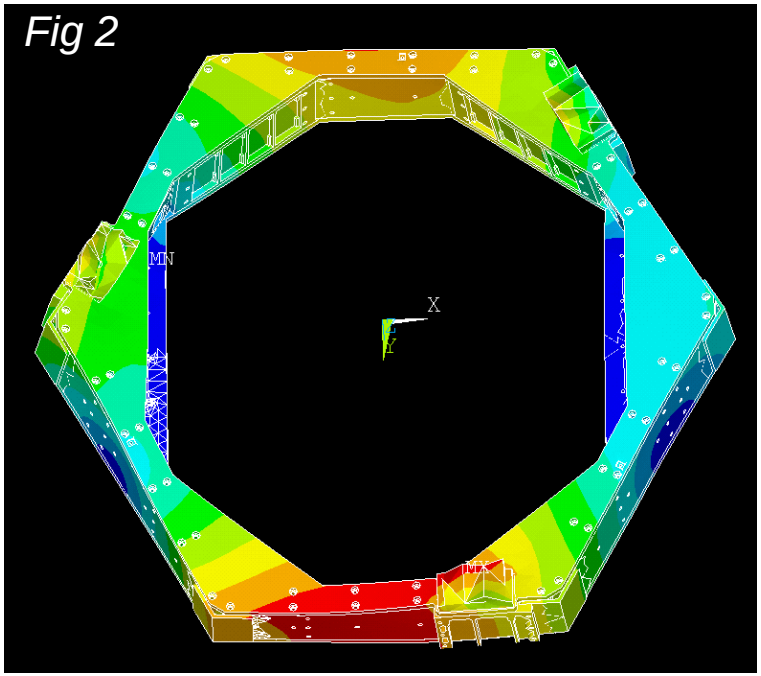


Fig1: Load

Post #	z Displacement bottom flexure rod		% between Z displacement
	mm	mil	
1	0.770	30.3	7.85
2	0.757	29.8	
3	0.710	27.9	

Stage 0 is asymmetrically deformed under load



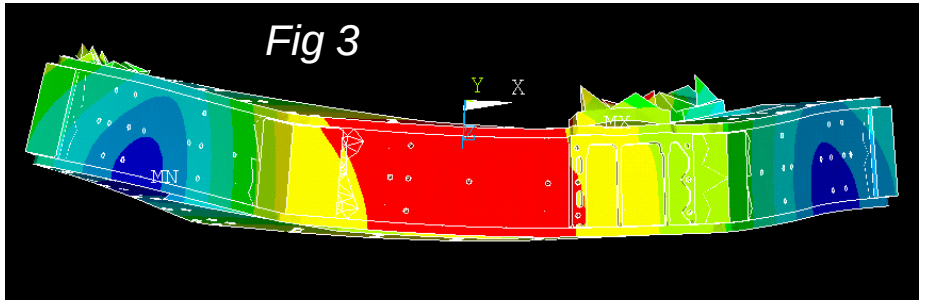
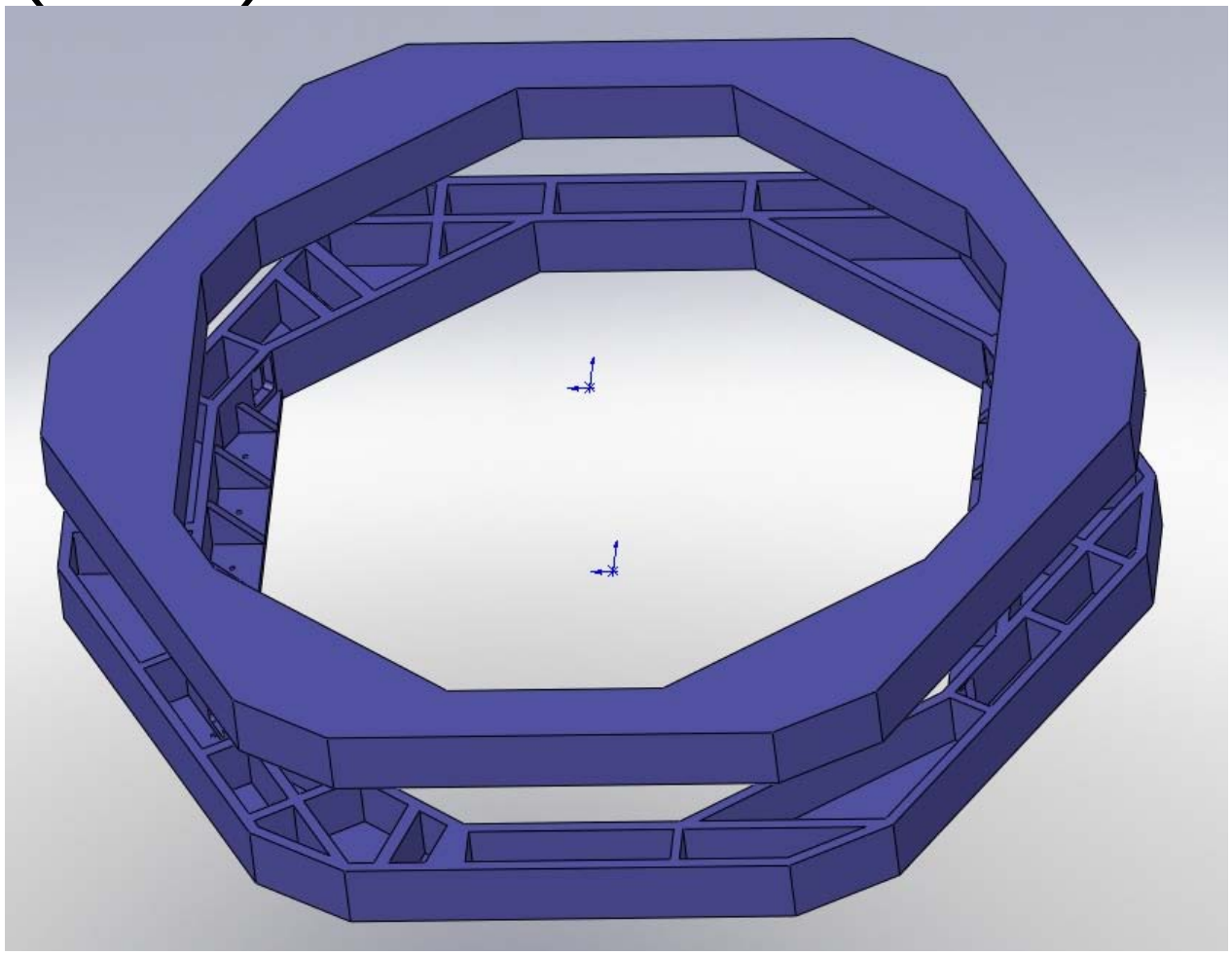


Fig 2 & 3: Nodal displacement contours on deformed structure (max 0.220 mm)

New Design Approach

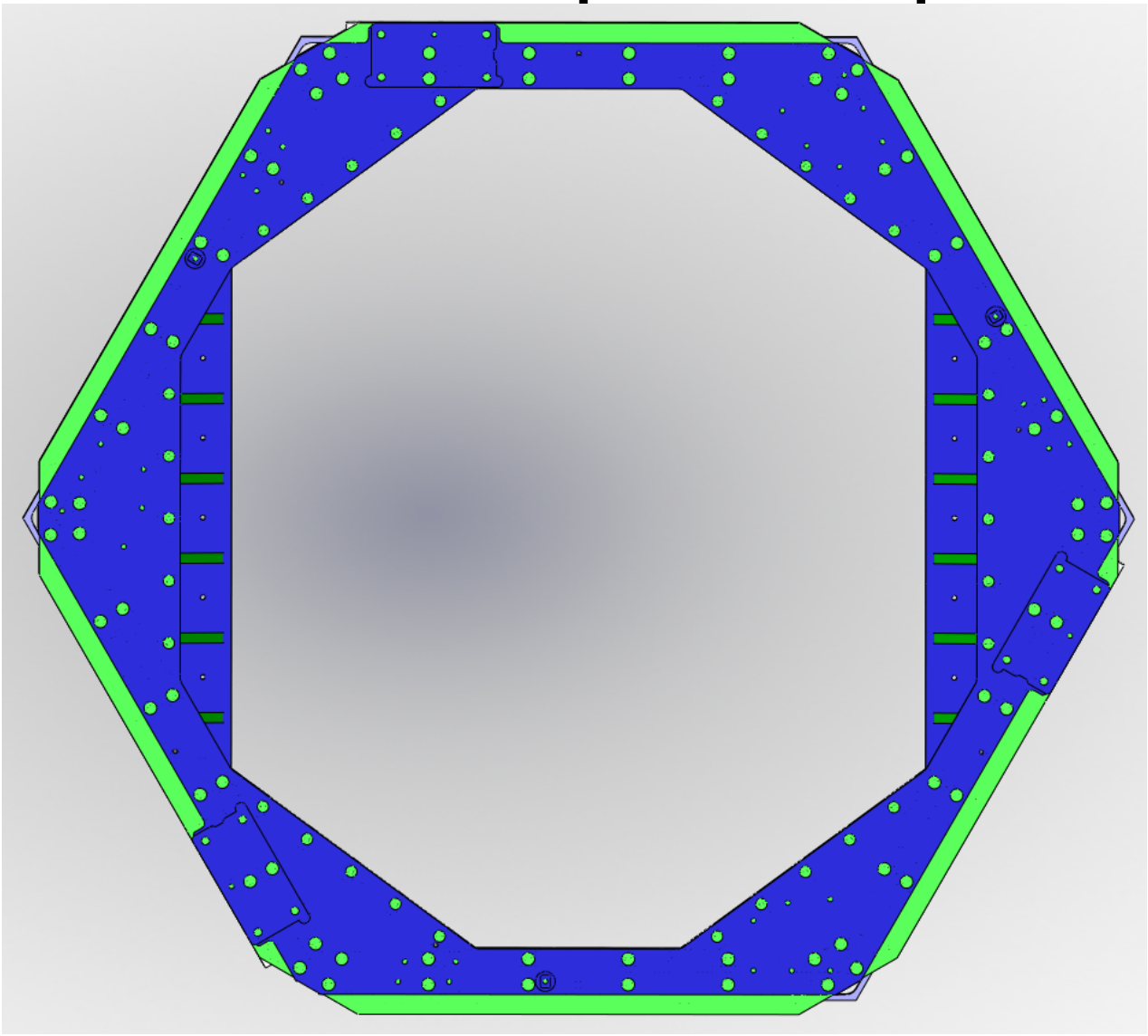
- Monolithic (6”+6”)
  - 2 parts
  - 1195 lbs



Assembly checked in the vault D0900896

Exploded view

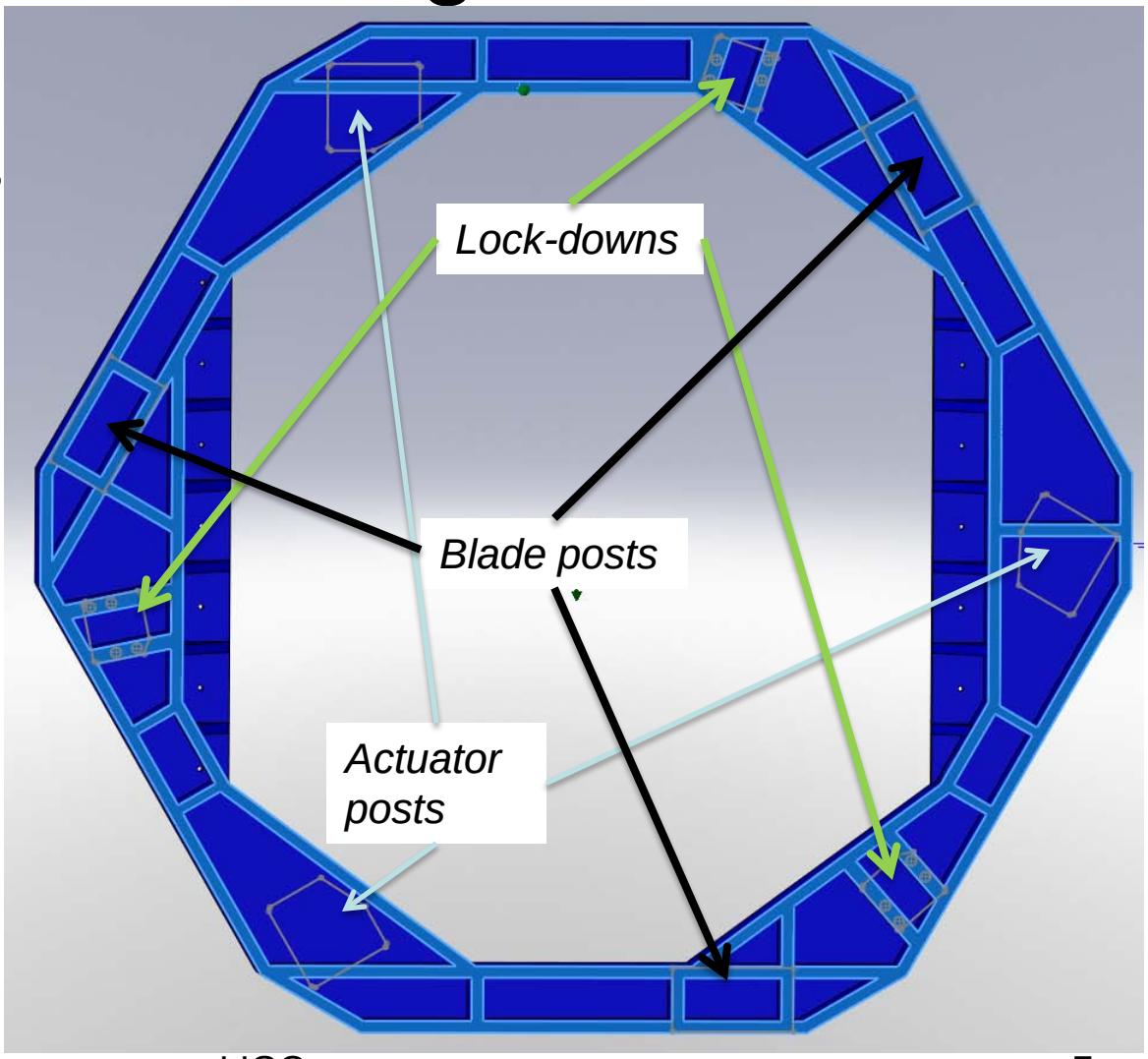
New Design Approach (2)
Shape Comparison



- Blue: old design
- Green : new design
- Same height
- Same interior shape
- 1.75” larger on all sides

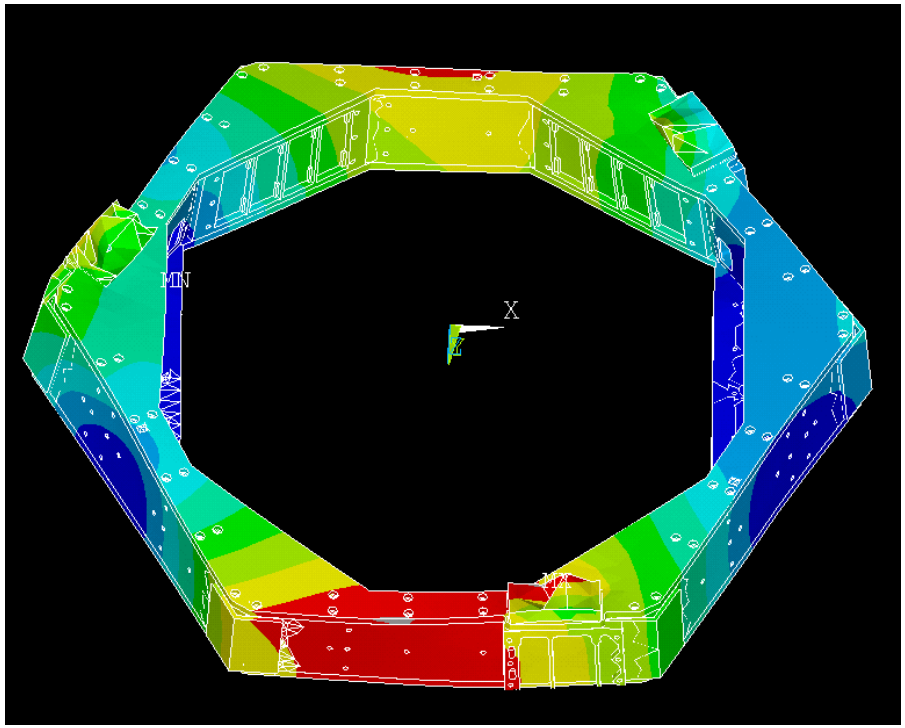
New Design Approach (3)
Webbing

- Allow sufficient bolting of the 2 parts
- Allow bolting & support of blade posts and lock-downs
- Maximize 'horizontal' webbing to oppose static deformation

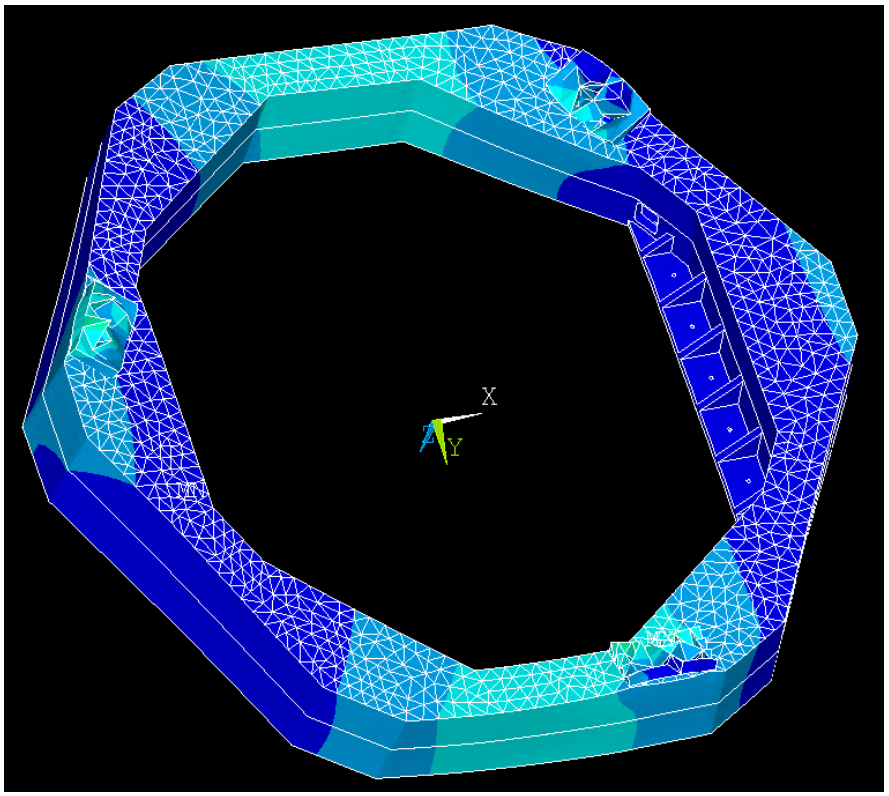


FEA: Nodal Displacement Comparison

LASTI Prototype



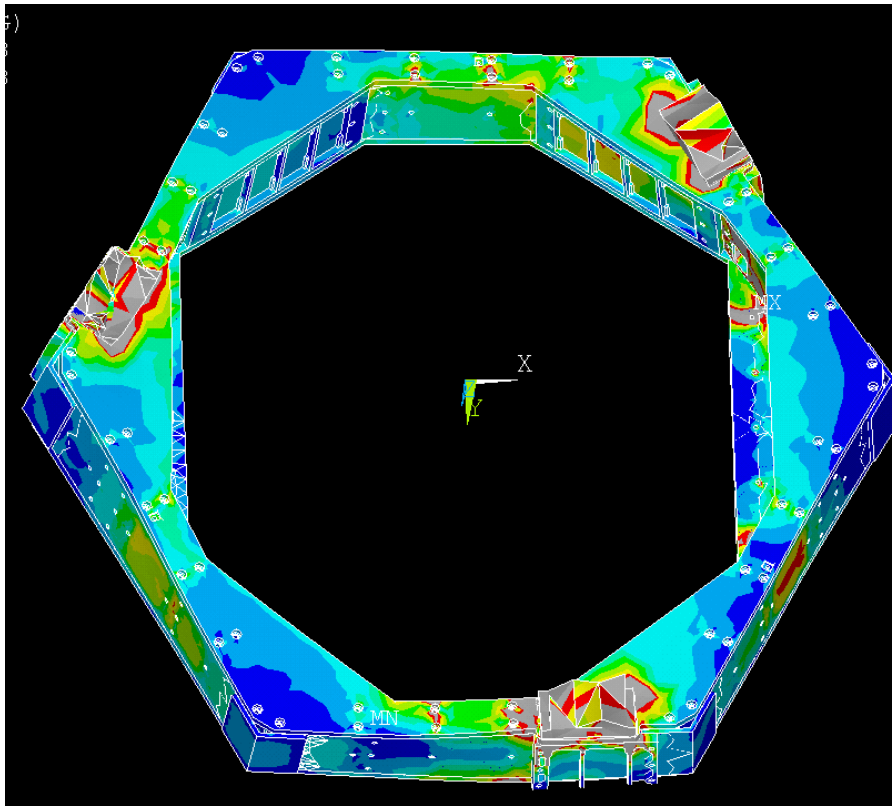
Monolithic



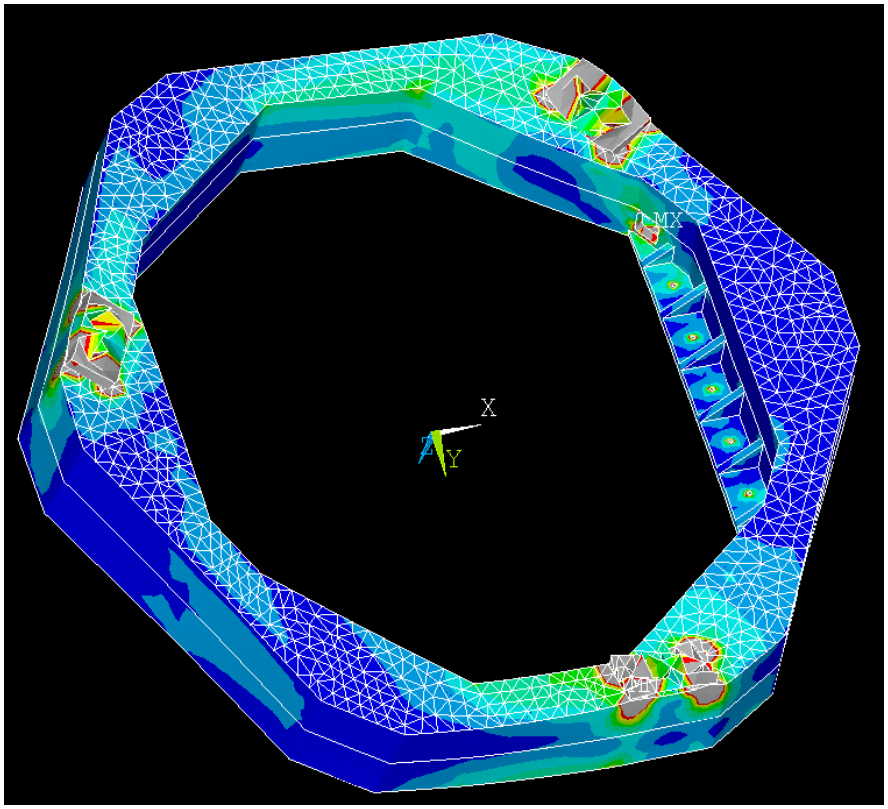
Same scale

FEA (2): Elastic Strain Comparison

LASTI Prototype



Monolithic



Same scale

FEA (3): Bottom Flexure Rod Displacement

	Post #	X Displacement		y Displacement		x-y displacement		z Displacement		% between Z displacement
		mm	mil	mm	mil	mm	mil	mm	mil	
LASTI Prototype	1	-0.059	**-2.339**	-0.117	**-4.624**	0.132	**5.182**	0.770	**30.316**	**7.85**
	2	-0.229	**-9.019**	0.035	**1.370**	0.232	**9.123**	0.757	**29.813**	
	3	0.277	**10.913**	0.073	**2.868**	0.287	**11.283**	0.710	**27.937**	
Monolithic	1	-0.037	**-1.444**	-0.111	**-4.370**	0.117	**4.602**	0.735	**28.918**	**6.36**
	2	-0.179	**-7.028**	0.037	**1.458**	0.182	**7.178**	0.729	**28.710**	
	3	0.194	**7.624**	0.063	**2.464**	0.204	**8.012**	0.688	**27.079**	

Yet to be added…

- ¾ inch fillets inside
- Screws locations
  - Larger webbing around screws
  - Thinner webbing in between
- Deep counterbores & partial threads
- No blind tapped holes
- Vented pockets for vacuum AND cleaning
- *Thicker “top plate” below critical parts (such as blade posts) ?*

Yet to be added… (2) Hardware

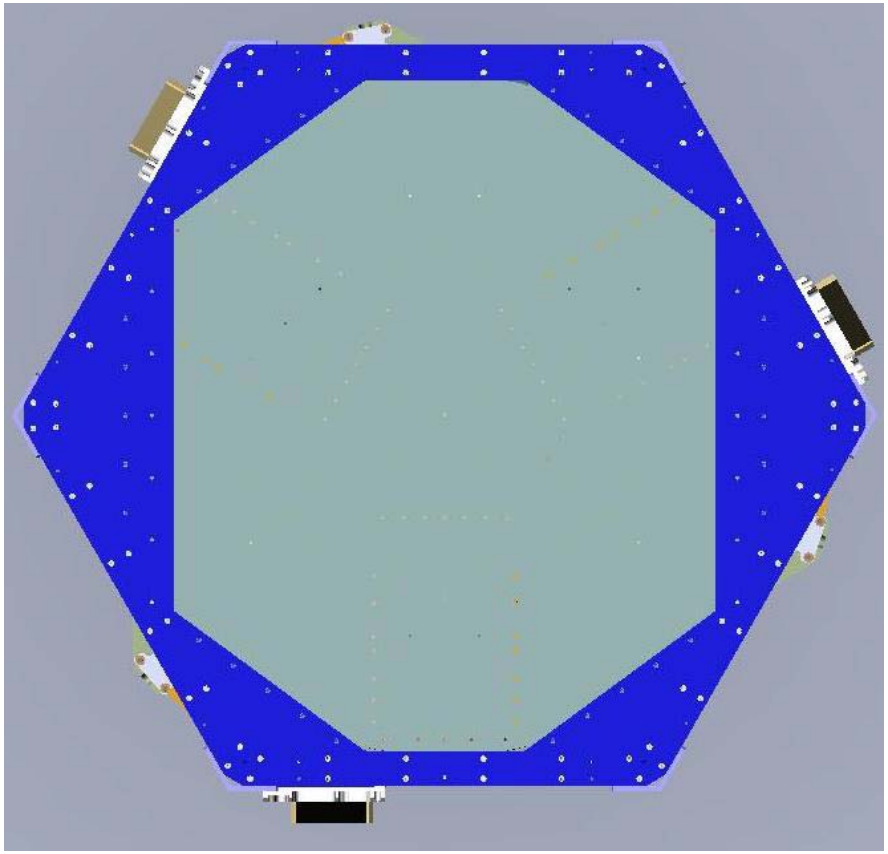
- Alignment pins
  - Taper or ‘multi-stage’
  - Offset from center (to avoid 180 deg rotation)
- Eyebolts to move assembly
- *Nitronic heli-coil?*

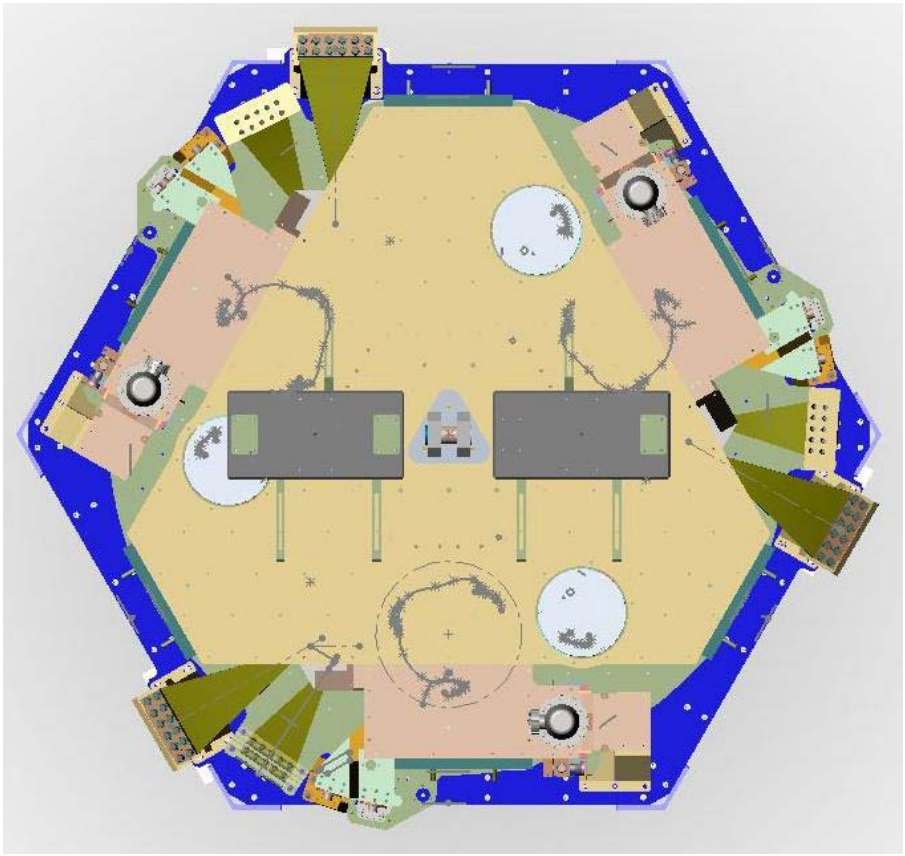
Questions?
Comments?
Suggestions?

Vertical Asymmetry measured at LASTI

- Blade vertical stiffness: 2700pds/in
- Loading asymmetry: 80pds
- Virtual Tip Blades height asymmetry: 80/2700~30mils
- (stop allows only +-12 mils deviation)

Bottom/Top views





AL alloys properties

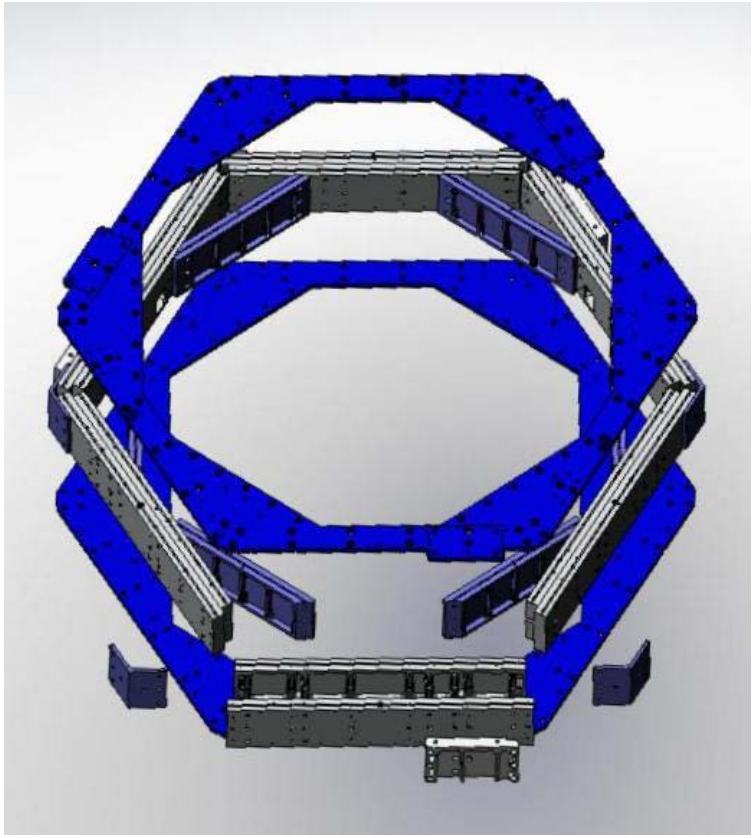
AL	Density (lb/in^3)	Tensile Strength (ksi)	Young Modulus (ksi)
6061-T6	0.0975	45	10.0e3
7075-T6	0.1015	83	10.4e3
2024-T4	0.1012	68	10.6e3

Source: Mechanical Engineer's Handbook-Materials and Mechanical Design (3rd Ed.), Myer Kutz, Ed John Wiley & Sons

Vacuum capable

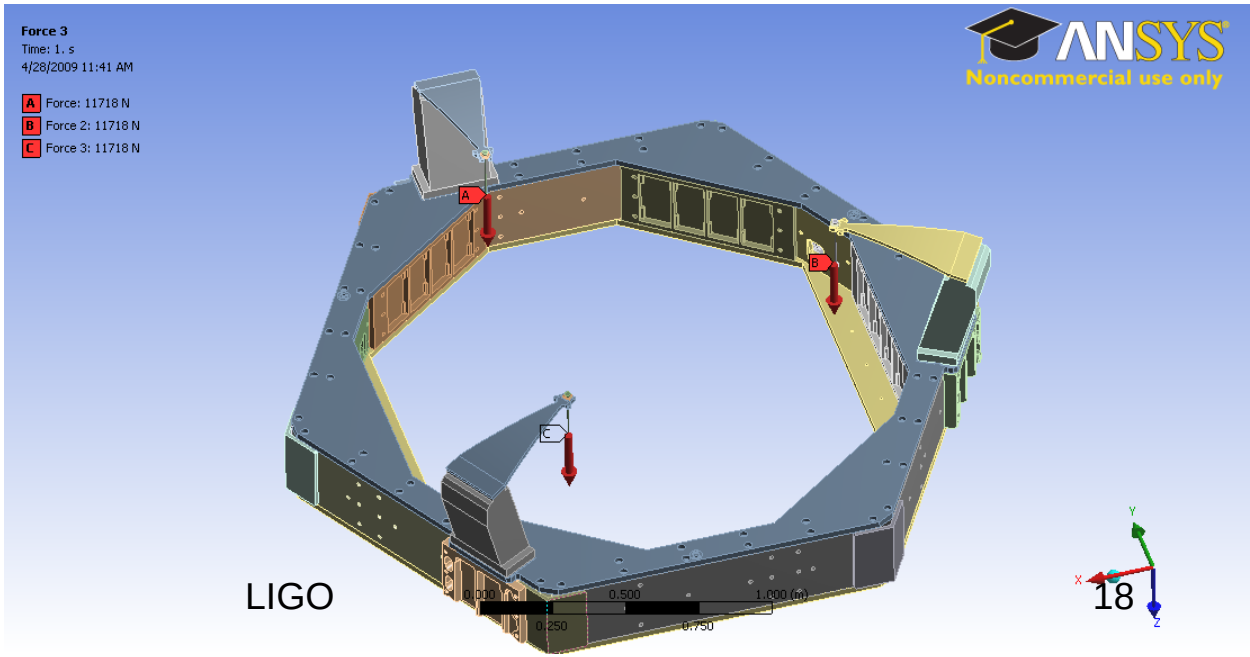
Goals

- Address known problems
  - Wrong materials, etc...
- Simplify assembly
  - Reduce parts number
  - Reduce parts with small differences
  - Simplify alignment
  - Reduce tolerances on cutouts
- Increase stiffness



LASTI Prototype
BSC-Stage 0 (2)

- FEA Static
  - Curved blades w/ infinite Young Modulus
  - Stage 0 fixed at the



Static Analysis

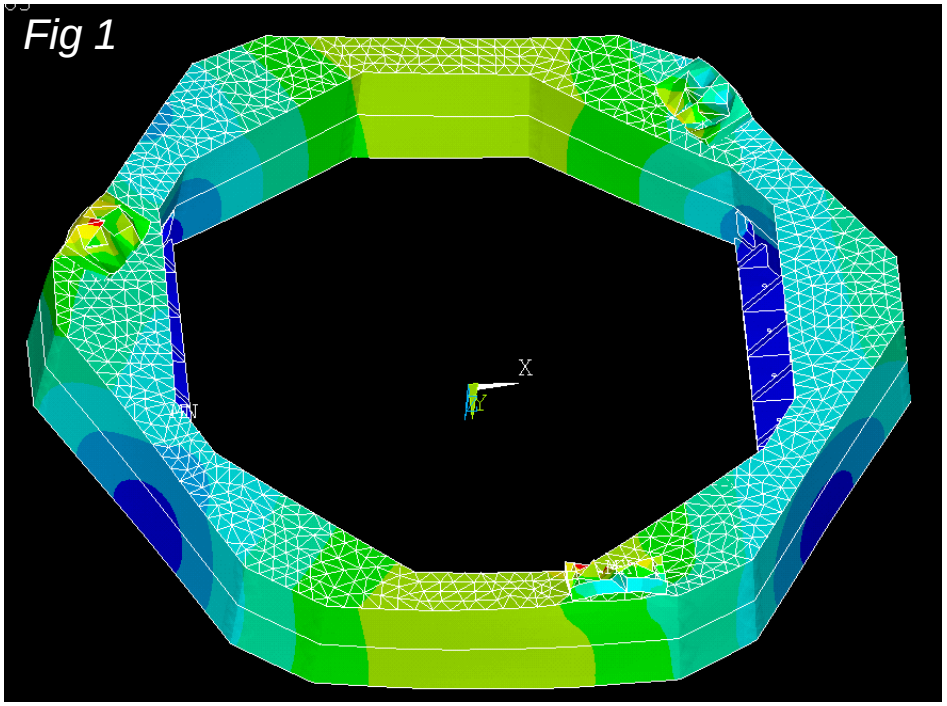


Fig 1: Nodal displacement contours on deformed structure (max 0.120 mm)

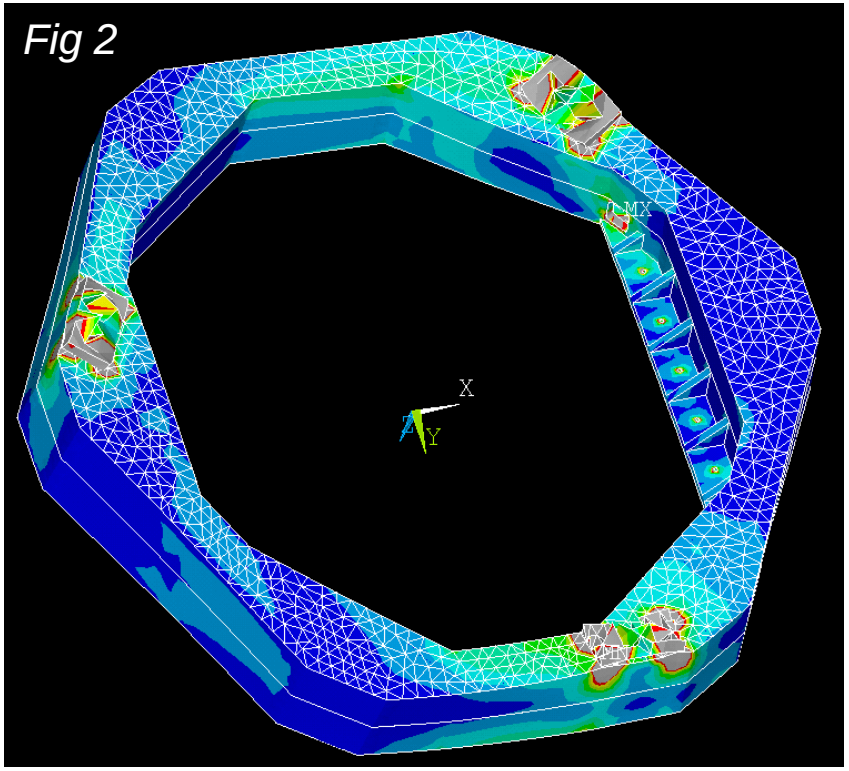


Fig 2: Elastic strain contours on deformed structure (max 0.856 mm)

Post #	z Displacement bottom flexure rod		% between Z displacement
	mm	mil	
1	0.735	**28.90**	6.36
2	0.729	**28.71**	
3	0.688	**271.1**	