ANALYSIS OF ADDITIONAL CFT SUPPORT AT Z=0 FOR THE SILICON HALF TROUGH

D-ZERO ENGINEERING NOTE # 3823.112 EN-523

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Summary:

The D-Zero silicon trough is segmented into two half troughs. Loading to the Central Fiber Tracker Barrel 1 is at both ends and near $Z=0$. The loading near $Z=0$ is thought to be 4 lbs at 4 points. The point locations are at ± 45 degrees for each half trough on each side of $Z=0$. An additional support at $Z=0$ is required to prevent beam sag and out of round distortions to the CFT Barrel 1. An additional joining washer will be attached between barrels 1 and 2 at $Z=0$. Also a support ring will be attached to the inner diameter of barrel 1 to further help in out of round distortions. Details of the washer and loading are modeled using ANSYS.

Analysis:

The inner support ring is a double I-beam structure. The flanges are 0.040 inch thick and the web is 0.020 inch thick. The lower and upper flanges are 1.56 inches wide. The webs are located at ± 0.39 inch in Z . The total radial thickness of the ring is 0.304 inch. The ring is continuous around the circumference.

The support ring that attaches the outer diameter of barrel 1 to the inner diameter of barrel 2 is a single I-beam structure. The flanges and web are 0.020 inch thick. The web location is at $Z=0$. The flange width is 0.78 inch. The ring is continuous around the circumference.

ANSYS input parameters are:

- Loading: 8 lbs per point (a safety factor of 2 on the estimated loading) near $Z=0$
- 1 point at $+45$ degrees and $Z= -0.39$ inch
- 1 point at -45 degrees and $Z= 0.39$ inch
- 1 point at $+45$ degrees and $Z= 0.39$ inch
- 1 point at -45 degrees and $Z= -0.39$ inch
- loading direction: vertical on the inner diameter of CFT barrel 1.

A total load of 125 lbs distributed over 4 points was also added to the CFT barrel 1 at the end ring ($Z=33$ inches) for beam pipe and silicon trough loading. The one point in the quadrant modeled was at 45 degrees from the bottom and located over the CFT barrel 1 end ring. This load is thought to be a circumferential line load but was modeled as a point load.

Stiffening ring material: carbon fiber with a composite modulus of 12 mpsi

All 8 barrels were modeled. The barrel composite consisted of an inner layer of carbon fiber (0.010 inch 105 Mpsi fiber for barrels 3 and 4, the remaining barrels are 0.015 inch with 55 Mpsi fiber), a layer of Rohacell (0.250 inch), another layer of carbon fiber, a layer of glue (0.020 inch), and a layer of ribbons (0.105 inch).

Symmetry planes were used, only a quarter of the full tracker was modeled.

ANSYS results,

Plots are given showing distortions and stresses for barrels 1 and 2 only.

Plot 1 is distortions in the vertical direction with units of inch. The radial out of round distortion is 0.0005 inch. The beam sag distortion is 0.0007 inch.

Plot 2 shows the Von Mises Stresses in the ribbon material on barrels 1 and 2. The highest magnitude is 27 psi near the location of the loading.

Plot 3 is a general picture of the added support structure near at $Z=0$. The entire structure is not shown due to the symmetry planes.

Conclusions:

The addition of a support structure to CFT barrels 1 and 2 is required to prevent distortions due to the loading of the silicon half troughs at $Z=0$. A support ring is attached to the inner diameter of barrel 1 to distribute the point loads from the silicon supports. An additional ring is used to attach barrels 1 and 2. The system was modeled using ANSYS. Results showed an out of round distortion of 0.0005 inches and a beam sag distortion of 0.0007 inches. The stress magnitude in the barrel 1 ribbons was found to be 27 psi. The distortions and stresses as modeled are at an acceptable level.

ANSYS 5.5.1S
MAR 9 2000
13:54:59
PLOT NO. 1
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
UY
TOP
RSYS=0
DMX =.003059
SMN =-.003057
SMX =-.001701

fiber traker_D0,15 mils Ef=55 mpsi,/except 3,4__20 mils,Ef=105 mpsi

PLOT 1

ANSYS 5.5.1S
MAR 9 2000
14:11:56
PLOT NO. 4
NODAL SOLUTION
STEP=1
SUB =1
TIME=1
SINT (AVG)
TOP
DMX =.002942
SMN =.350701
SMX =27.461
3.363
6.375
9.387
12.4
15.412
18.424
21.436
24.449
27.461

fiber traker_D0,15 mils Ef=55 mpsi,/except 3,4__20 mils,Ef=105 mpsi

PLOT 2

fiber traker_D0,15 mils Ef=55 mpsi,/except 3,4_20 mils,Ef=105 mpsi

PLOT 3