SPACE SYSTEMS

University of California Lick Observatory

Level 2 Temporary Support Structure

DESIGN NOTES

STRUCTURAL ENGINEERING

CI No. DN-500803

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FIGURES

1. SCOPE

The scope is to design a mock assembly structure to partially support level 2 quadrants in addition to the bogies attached. This specification documents the design of this mock structure for assembly process at LICK site, as depicted in Figure 1.

Figure 1: LICK - mock structure

2. PERFORMANCE REQUIREMENTS

The mock structure requires to partially support the dead weight of each quadrant of level 2 with dynamic factor of 1.2.

3. MATERIAL

The steel grade is AS1163 grade 350LO with yield strength of 350MPa and ultimate design strength of 430MPa.

4. LOAD

The location of the supports for each quadrant is depicted in figures 2 to 5. There are at least four bogies attached to the quadrants, underneath azimuth support beam as designated as "b", whilst location of the support on the mock structure is designated as bold "**s**". There is a vertical gap of 200mm between the mock structure and bottom surface of level 2 quadrants. A "pancake jack" is placed between this gap to adjust the clearance as required on site. Hence, part of the dead load of each quadrant will be transferred through to the mock structure as point load @ "s" whilst remainder of load is transferred directly via attached bogies "b" to the ring beam.

bending stress of 120MPa for 100x50x6 RHS. Assuming two third of the point load shared either at point B or C with L2=3.40m, which will give design moment of 5.2kNm. Using 100x50x6 produces bending stress of 152MPa. At the location C, the span L3 is 3.40m and the design moment is 6.5kNm. This produces 190MPa bending stress.

Given vertical load as 1.2 tonne, the normal stress in vertical member 100x4 SHS is 8MPa. 100x6 lateral bracing is needed to resist the sideway movement. The design is considered satisfactory with factor of safety of 1.84 based on 350MPa yield strength. The weld for bracing 100x6 flat bar on 100x4 SHS must be a 4mm fillet with minimum length of 50mm on both sides (100mm total). Note: Please refer appendix for the hand calculation.

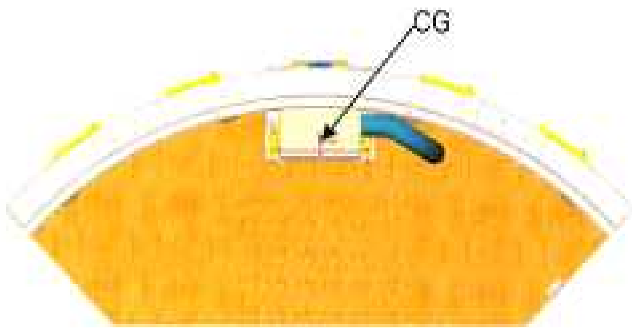


Figure 6: CG Location

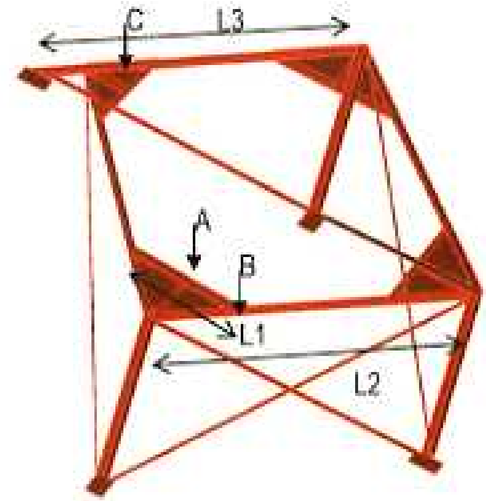
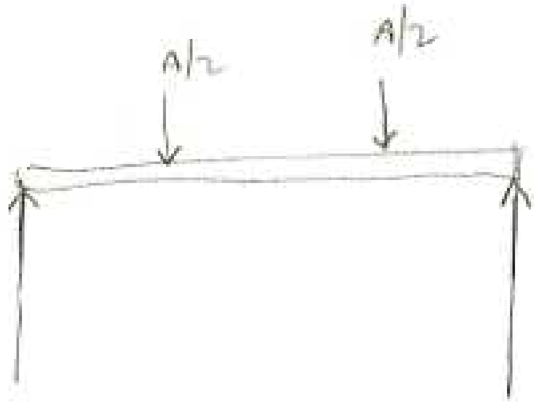


Figure 7: Load Location

6. CONCLUSION

The design of the mock structure is satisfactory to withstand the load specified with factor safety of 1.84 based on 350MPa yield strength.

B= A/2



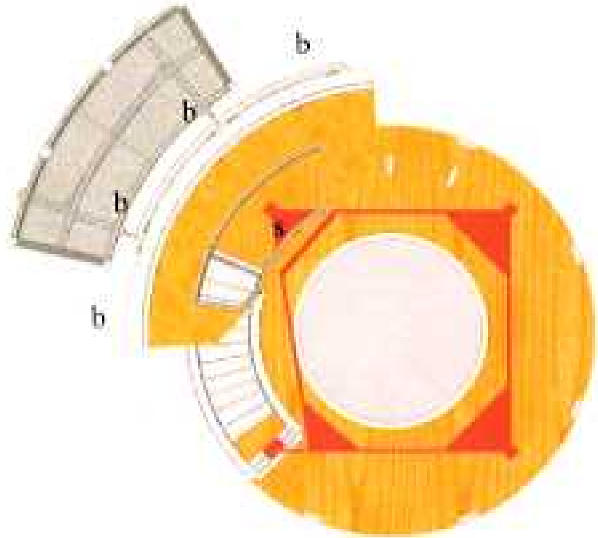


Figure 2: Dead Load 1

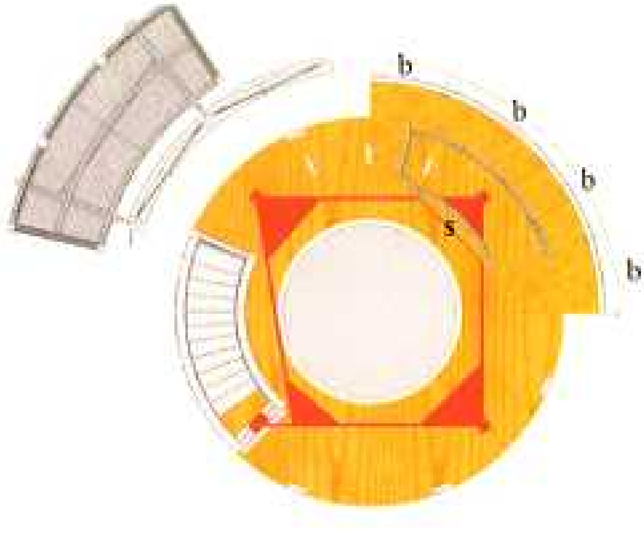


Figure 4 Dead Load 3

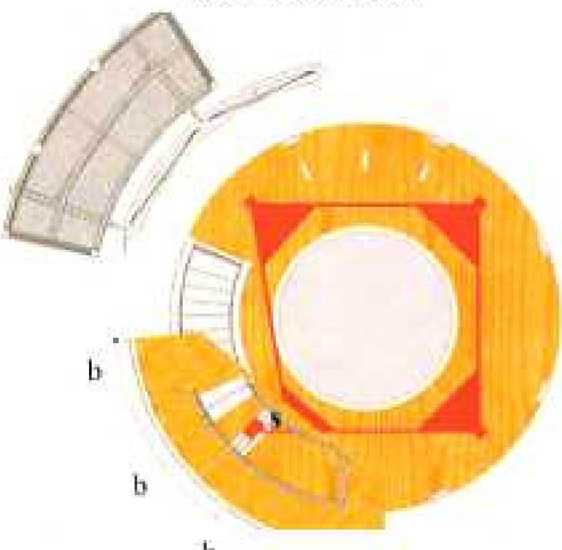


Figure 3 Dead Load 2

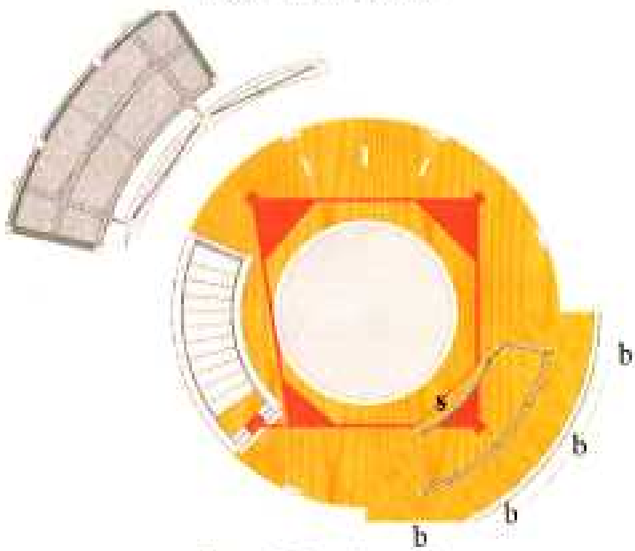


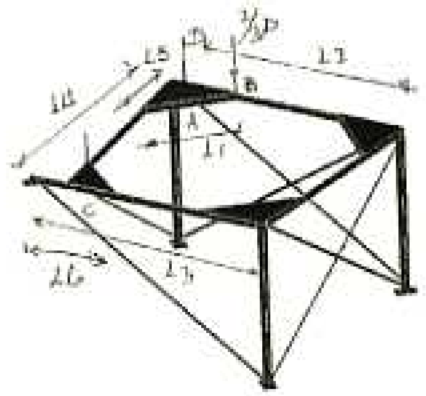
Figure 5 Dead Load 4

Each quadrant has a different weight and it is assumed that the drive quadrants are the heaviest amongst other. Solidwork gives weight 2.35 tonnes for drive quadrant. Also from Figure 6, the location of the centre of gravity is towards the bogies, which indicates most of the dead load will transfer directly to the ring beam via bogies, whilst only partial load will be supported via "pancake jack". For design purposes, 1 tonne is used as the point load via "pancake jack". It is also the design intention that the mock structure is "weaker" than the permanent dome structure to avoid any damage done to the permanent structure.

5. CALCULATION

From section 4 above, the point load is 1 tonne at support by "pancake jack". Hence with dynamic factor of 1.2, the total load considered is 1.2 tonne at point A as shown in Figure 7, which takes account of the work in the assembly process; for instance lifting, swinging and placement. The design moment is 4.0kNm at point A with L1=1.30m, which produces

7. APPENDIX



$L1 = 1.3\,m$ $\quad L6 = 1.4\,m$

$L2 = 3.8\,m$

$L3 = 3.4\,m$

$L4 = 3.4\,m$

$L5 = 0.9\,m$

From section 6, D = 1.2 tonne.

Design moment at midspan @ A $= \frac{WL}{4} = \frac{1.2 \times 9.81 \times 1.3}{4}$

$= 3.83\,kNm \approx 4\,kNm$

Bending stress for 100x50x6 RHS, $\sigma_A = \frac{My}{I} = \frac{4.0\,kNm \times 50 \times 1 \times 10^6}{1.71 \times 10^6\,mm^4}$

$= 117\,MPa \ll 170\,MPa$

Design moment at @ B $= \frac{Wab}{L}$, assuming $\frac{2}{3}D$

$= \frac{1.2 \times \frac{2}{3} \times 9.81 \times 0.9 \times (3.4 - 0.9)}{3.4}$

$= 5.2\,kNm$

Bending stress for 100x50x6, $\sigma_B = \frac{My}{I} = \frac{5.2\,kNm \times 50 \times 1 \times 10^6}{1.71 \times 10^6\,mm^4}$

$= 152\,MPa$

Design moment @ C $= \frac{Wab}{L}$, assuming $\frac{2}{3}D$

$= \frac{1.2 \times \frac{2}{3} \times 9.81 \times 1.4 \times (3.4 - 1.4)}{3.4}$

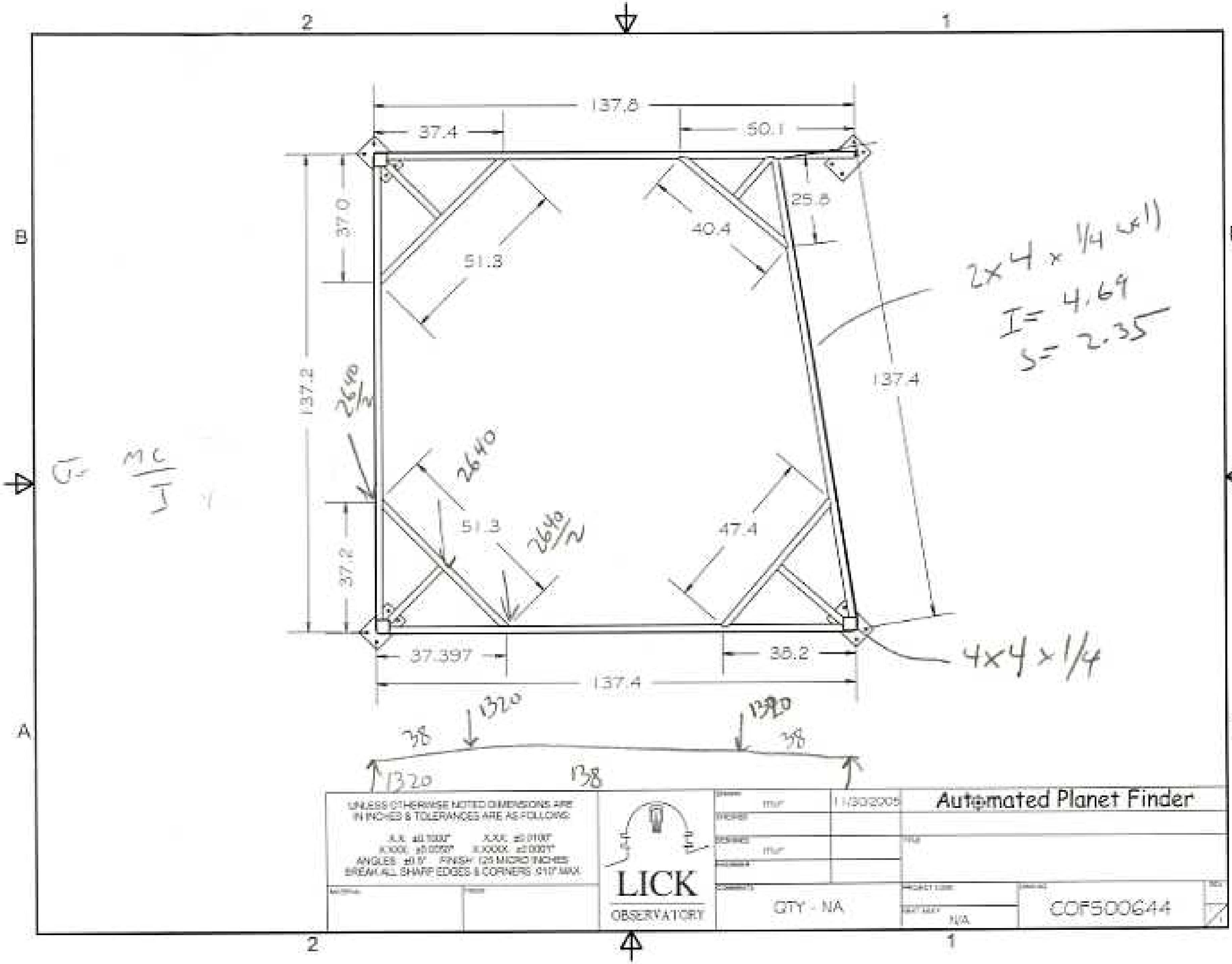
$= 6.5\,kNm$

Bending stress for 100x50x6, $\sigma_C = \frac{My}{I} = \frac{6.5\,kNm \times 50 \times 1 \times 10^6}{1.71 \times 10^6\,mm^4}$

$= 190\,MPa$

Normal stress in 100x4 SHS, assuming 1.2 tonne load

$\sigma = \frac{1.2 \times 10^3 \times 9.81}{1480} = 7.96\,MPa \approx 8\,MPa$



137.8
37.4
50.1
25.8
40.4
51.3
37.0
137.2
2640/2
2640
51.3
2640/2
37.2
47.4
137.4
37.397
38.2
137.4
2x4 x 1/4 wall
I= 4.69
S= 2.35
4x4 x 1/4
σ = MC/I
1320
38
1320
38
1320
138
UNLESS OTHERWISE NOTED DIMENSIONS ARE IN INCHES & TOLERANCES ARE AS FOLLOWS:
ANGLES ±0.5° FINISH 125 MICRO INCHES
BREAK ALL SHARP EDGES & CORNERS .010" MAX
LICK OBSERVATORY
11/30/2005
Automated Planet Finder
QTY - NA
N/A
COF500644