12 METER MILLIMETER WAVE TELESCOPE

MEMO No. 180

THERMAL BEHAVIOR of 12M REFLECTOR STRUCTURE in Green Bank

----- ANALYTICAL RESULTS -----

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There were two questions on July 14, 1982:

(1) The astigmatism of the rim deflections due to temp. change.

(2) The "wrong" direction of the rim movement due to temp. increase.

By July 30, 1982, we all agree that the reflector is a well behaved structure (thermally). Some thermal conditions are simulated in the computer and results are given in this memo. for further reference.

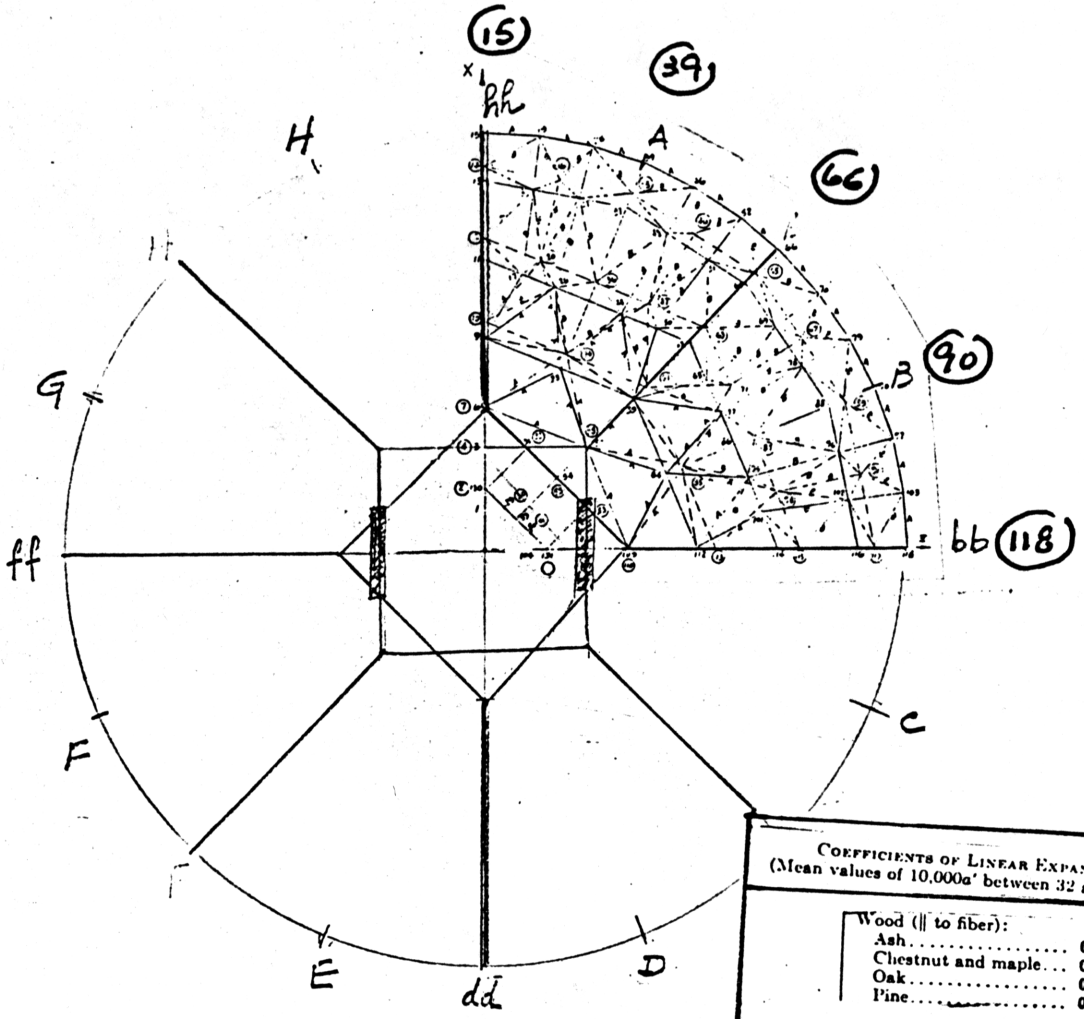
ASTIGMATISM (REF P.3) The supports are constrained at the interfaces with the concrete floor. A 2°C linear temp. distribution in Hub plus a 5°C uniform temp. increase for the entire structure. The result shows a ± 100 μm deflections on top of -48 μm average. The tests in July resulted -186 ± 50 μm. The discrepancy may be caused by some slipping at supports during the tests.

RIM MOVEMENTS The results of 4 cases of thermal loadings are given in the following table:

(REF P.4 & P.5)

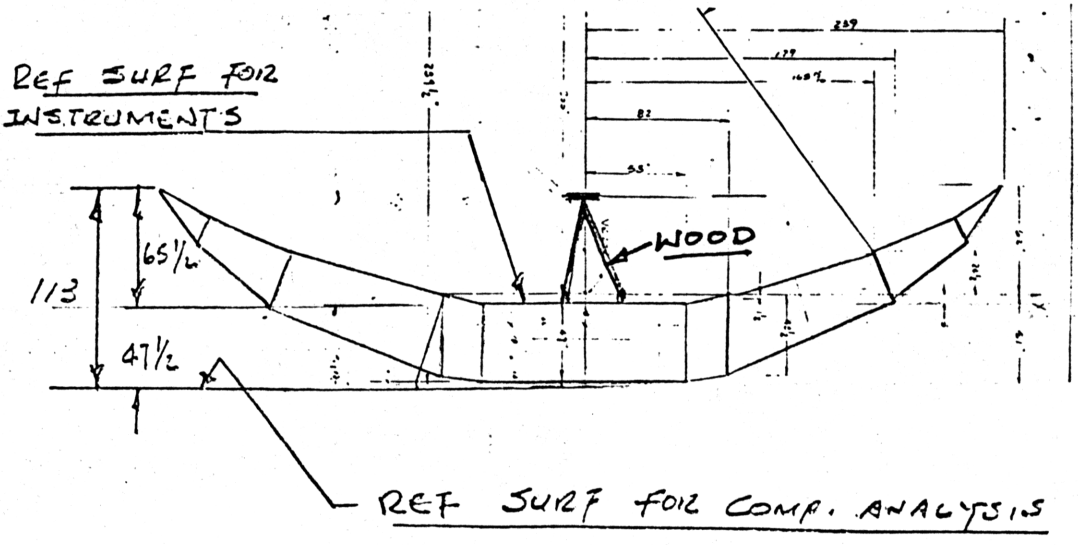
CASE	UNIF. TEMP. ΔT	LINEAR TEMP. IN HUB (TOP TO BOTTOM)	AVERAGE REFL. RIM DEFL (STR. ON CONC. FLOOR) SUPPORTS CONSTRAINED	SUPPORTS FREE
1	5°c	5°c – 5°c	+76 μm	+101 μm
2	5°c	5°c – 4°c	+15	+35
3	5°c	5°c – 3°c	-48	-33
4	5°c	5°c – 2°c	-111	-100

The July 8/9, 1982 tests showed a much higher average rim deflection of -186 μm. This may be due to the temperature dependency of the wooden (instrument) tripod.



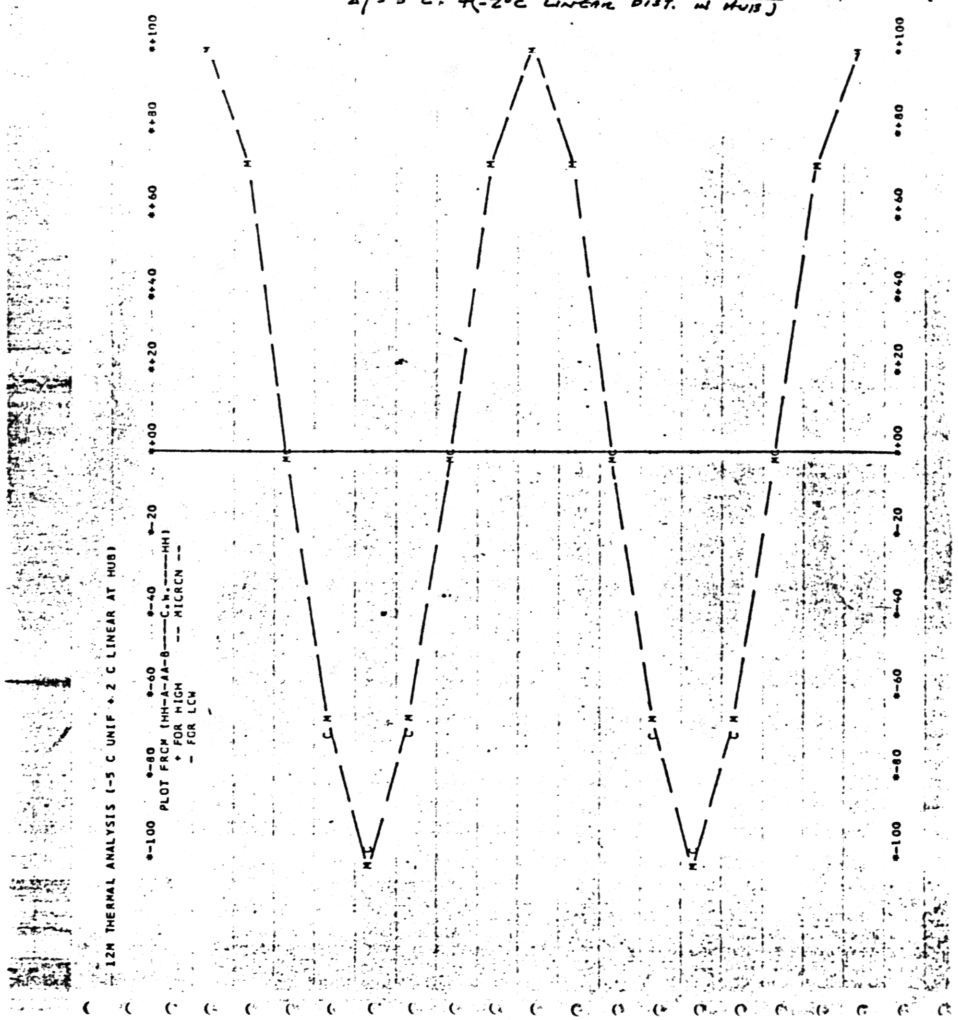
COEFFICIENTS OF LINEAR EXPANSION
(Mean values of 10,000α' between 32 and 212 F)

Wood (‖ to fiber):	
Ash	0.053
Chestnut and maple	0.036
Oak	0.027
Pine	0.030
Steel:	
Bessemer, rolled hard	0.056
Bessemer, rolled soft	0.063
Nickel (10% Ni)	0.073

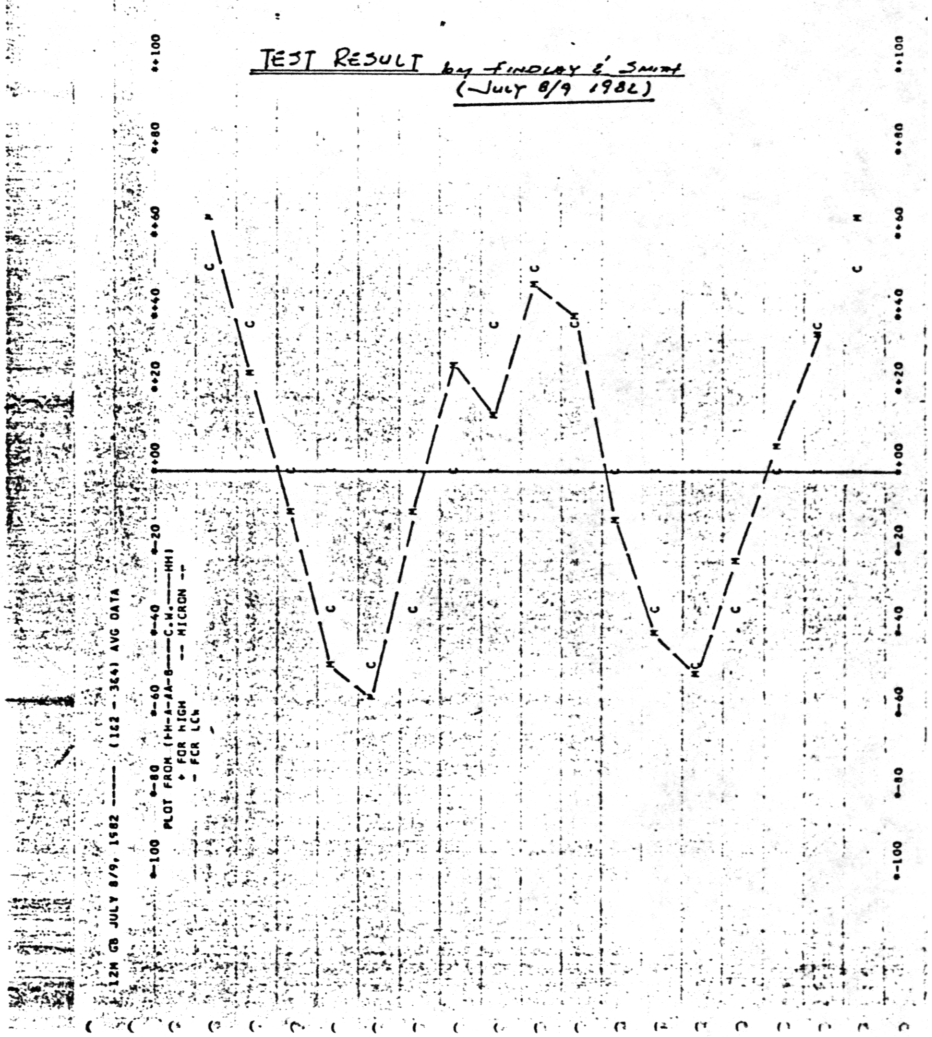


ANALYTICAL RESULT

ΔT = 5°C, +(-2°C LINEAR DIST. IN HUB)



TEST RESULT by FINDLAY & SMART (JULY 8/9 1982)



LABEL # UNIF TEMP INCREASE OF -5 DEG C SUPPORT FREE

REPCASE 4

DISPLACEMENTS
REAL OUTPUT
SUBCASE ID # 4

δ(Avg @ ctr. Ring) = -.00252"

15	G	-1.441226E-02	-6.513696E-03	0.0
-CONT-		0.0	0.0	-6.721422E-08
39	G	-1.331395E-02	-6.514113E-03	-5.514804E-03
-CONT-		3.330451E-08	2.967318E-09	-7.764237E-08
66	G	-1.019060E-02	-6.513651E-03	-1.019076E-02
-CONT-		4.692894E-08	-1.729793E-09	-5.411200E-08
90	G	-5.514830E-03	-6.513350E-03	-1.331433E-02
-CONT-		6.881629E-08	-2.517274E-09	-3.260083E-08
118	G	0.0	-6.512962E-03	-1.441243E-02
-CONT-		6.443082E-08	0.0	0.0

LABEL # DELT -5 DEGC PLUS &2 DEGC LINEAR %TOP TO BOTTOM< @ HUB

REPCASE 8

DISPLACEMENTS
REAL OUTPUT
SUBCASE ID # 8

δ = .00255"

15	G	-1.533724E-02	-1.097132E-03	0.0
-CONT-		0.0	0.0	1.469956E-05
39	G	-1.415553E-02	-1.229357E-03	-5.850635E-03
-CONT-		-5.658945E-06	-1.035477E-08	1.420349E-05
66	G	-1.084755E-02	-1.139264E-03	-1.081323E-02
-CONT-		-9.623409E-06	-1.696297E-07	1.098764E-05
90	G	-5.862027E-03	-1.418810E-03	-1.409429E-02
-CONT-		-1.213508E-05	3.052315E-07	6.479270E-06
118	G	0.0	-1.357295E-03	-1.527425E-02
-CONT-		-1.287978E-05	0.0	0.0

LABEL # DELT -5 DEGC PLUS &1 DEGC LINEAR %TOP TO BOTTOM< @ HUB

REPCASE 6

DISPLACEMENTS
REAL OUTPUT
SUBCASE ID # 6

δ = -.00255"

15	G	-1.487474E-02	-3.805426E-03	0.0
-CONT-		0.0	0.0	7.316074E-06
39	G	-1.373474E-02	-3.871742E-03	-5.682722E-03
-CONT-		-2.832905E-06	-3.741597E-09	7.062831E-06
66	G	-1.051908E-02	-3.826451E-03	-1.050200E-02
-CONT-		-4.788329E-06	8.391635E-08	5.466711E-06
90	G	-5.688429E-03	-3.966063E-03	-1.370431E-02
-CONT-		-6.033214E-06	1.513422E-07	3.223314E-06
118	G	0.0	-3.935110E-03	-1.484335E-02
-CONT-		-6.407763E-06	0.0	0.0

LABEL # DELT -5 DEGC PLUS &3 DEGC LINEAR %TOP TO BOTTOM< @ HUB

REPCASE 8

DISPLACEMENTS
REAL OUTPUT
SUBCASE ID # 8

δ = -.00256"

15	G	-1.579973E-02	1.611139E-03	0.0
-CONT-		0.0	0.0	2.208292E-05
39	G	-1.457632E-02	1.413008E-03	-6.018549E-03
-CONT-		-8.565045E-06	-1.698559E-08	2.134404E-05
66	G	-1.117602E-02	1.547916E-03	-1.112445E-02
-CONT-		-1.445859E-05	2.553066E-07	1.650846E-05
90	G	-6.035626E-03	1.128452E-03	-1.448426E-02
-CONT-		-1.823707E-05	4.590984E-07	9.735161E-06
118	G	0.0	1.220534E-03	-1.570515E-02
-CONT-		-1.935191E-05	0.0	0.0

Δ

LABEL # UNIF TEMP INCREASE OF -5 DEG C — SUPPORT FIXED

REPCASE 4

Hub δ = -.00286"

DISPLACEMENTS
REAL OUTPUT
SUBCASE ID # 4

15	G	-1.409332E-02	-1.002704E-02	0.0
-CONT-		0.0	0.0	-2.615033E-05
39	G	-1.282401E-02	-8.790024E-03	-5.757224E-03
-CONT-		-1.406680E-05	-2.455055E-06	-2.539835E-05
66	G	-9.826768E-03	-5.988229E-03	-1.069894E-02
-CONT-		-2.384212E-05	-6.640125E-06	-2.305250E-05
90	G	-5.332436E-03	-2.972153E-03	-1.404261E-02
-CONT-		-2.958422E-05	-3.506525E-06	-1.621737E-05
118	G	0.0	-1.393963E-03	-1.504182E-02
-CONT-		-3.208894E-05	0.0	0.0

LABEL # DELT -5 DEGC PLUS &1 DEGC LINEAR %TCP TO BOTTOM< @ HUB

REPCASE 6

δ = -.00289"

DISPLACEMENTS
REAL OUTPUT
SUBCASE ID # 6

15	G	-1.431450E-02	-7.453226E-03	0.0
-CONT-		0.0	0.0	-1.849257E-05
39	G	-1.309181E-02	-6.285794E-03	-5.913343E-03
-CONT-		-1.692363E-05	-3.398512E-06	-1.801412E-05
66	G	-1.010232E-02	-3.487530E-03	-1.103656E-02
-CONT-		-2.778375E-05	-6.872217E-06	-1.671551E-05
90	G	-5.507238E-03	-7.180299E-04	-1.453508E-02
-CONT-		-3.451506E-05	-3.968799E-06	-1.231054E-05
118	G	0.0	8.040241E-04	-1.564453E-02
-CONT-		-3.702124E-05	0.0	0.0

LABEL # DELT -5 DEGC PLUS &2 DEGC LINEAR %TCP TO BOTTOM< @ HUB

REPCASE 8

δ = -.00292"

DISPLACEMENTS
REAL OUTPUT
SUBCASE ID # 8

15	G	-1.453568E-02	-4.879411E-03	0.0
-CONT-		0.0	0.0	-1.083477E-05
39	G	-1.335960E-02	-3.781572E-03	-6.069459E-03
-CONT-		-1.978037E-05	-4.341914E-06	-1.062985E-05
66	G	-1.037787E-02	-9.868473E-04	-1.137418E-02
-CONT-		-3.172531E-05	-7.104286E-06	-1.037852E-05
90	G	-5.682044E-03	1.536076E-03	-1.502754E-02
-CONT-		-3.944586E-05	-4.430678E-06	-8.403718E-06
118	G	0.0	3.001995E-03	-1.624723E-02
-CONT-		-4.195349E-05	0.0	0.0

LABEL # DELT -5 DEGC PLUS &3 DEGC LINEAR %TCP TO BOTTOM< @ HUB

REPCASE 8

δ = -.00295"

DISPLACEMENTS
REAL OUTPUT
SUBCASE ID # 8

15	G	-1.475686E-02	-2.305600E-03	0.0
-CONT-		0.0	0.0	-3.176934E-06
39	G	-1.362740E-02	-1.277353E-03	-6.225571E-03
-CONT-		-2.263710E-05	-5.285299E-06	-3.245543E-06
66	G	-1.065342E-02	1.513830E-03	-1.171180E-02
-CONT-		-3.566686E-05	-7.336349E-06	-4.041510E-06
90	G	-5.856846E-03	3.790176E-03	-1.552000E-02
-CONT-		-4.437666E-05	-4.892549E-06	-4.496854E-06
118	G	0.0	5.199958E-03	-1.684993E-02
-CONT-		-4.688570E-05	0.0	0.0