

JUNE 24, 1976

TO: G. PEERY

ENGINEERING MEMO # 116

FROM: L. J. KING

SUBJECT: MODIFICATION OF 36 FT BACKUP STRUCTURE

THE GOAL OF THIS MODIFICATION IS TO IMPROVE THE SURFACE ASTIGMATISM DUE TO THE AMBIENT TEMPERATURE CHANGE. THE PRESENT SURFACE PROVIDED BEST EFFICIENCY AT AROUND 11 DEGC, PRESUMABLY WAS THE AVERAGE TEMPERATURE DURING ELECTION OF THE ELEVATION STRUCTURE. FOR THE OPERATING TEMPERATURE RANGE FROM -5 TO 25 DEGC, THE DECREASE OF EFFICIENCY IS FOUND TO BE LINEARLY RELATED TO THE TEMPERATURE DIFFERENCE WRT THE REFERENCE TEMP. OF 11 DEGC.

THE COMPUTER STUDY (SEPTEMBER 1975) SHOWED A CONTOUR MAP OF THE SURFACE DEVIATIONS OF 5 DEGE (2.78 DEGC) UNIFORM TEMP. INCREASE OF THE ELEVATION STRUCTURE. THE DIFFERENCE OF FOCAL LENGTHS (DELTA F) BETWEEN THE ELEVATION HALF AND AZIMUTH HALF OF THE SURFACE IS 0.022 INCHES (0.57 MM). EXTERNAL FORCES, SUCH AS HYDRAULIC CYLINDERS AND/OR HEATERS APPLIED TO CERTAIN MEMBERS (SUGGESTED BY B. ULICH, JAN. 1976) HAD BEEN STUDIED TO CORRECT THIS ASTIGMATISM, BUT, WITH NOT MUCH SUCCESS. DURING THIS COURSE HOWEVER, THE TROUBLE AREAS CAUSING THE ASTIGMATISM BEGAN TO SHOW IN THE COMPUTER RESULTS\*. FURTHER STUDIES SHOWED THAT THE SURFACE COULD BE IMPROVED BY A PASSIVE METHOD: BY REMOVING THOSE TROUBLE MAKING MEMBERS AND STIFFERING THE BACKUP STRUCTURE WITH MEMBERS IN DIFFERENT ORIENTATIONS.

THE LATEST CONFIGURATION, 36M5\*\*, GIVEN ON PAGE 2, IS OBTAINED BY:

- (1) REMOVE MEMBER GROUPS A AND B
- (2) ADD MEMBER GROUP C (STEEL)
- (3) ADD 3/8 PLATE AND 4-1X3X5/16 ANGLES (AL.; VIEW D)

THE RESULTING SURFACE CONTOUR IS GIVEN ON PAGE 3. DELTA F DUE TO 5 DEGC (2.78 DEGC) TEMP INCREASE IS NOW REDUCED TO .002 INCHES (0.05 MM). THE PHYSICAL DEVIATIONS OF THE SURFACE AFTER THE MODIFICATION 36M5 IS SHOWN ON PAGE 4.

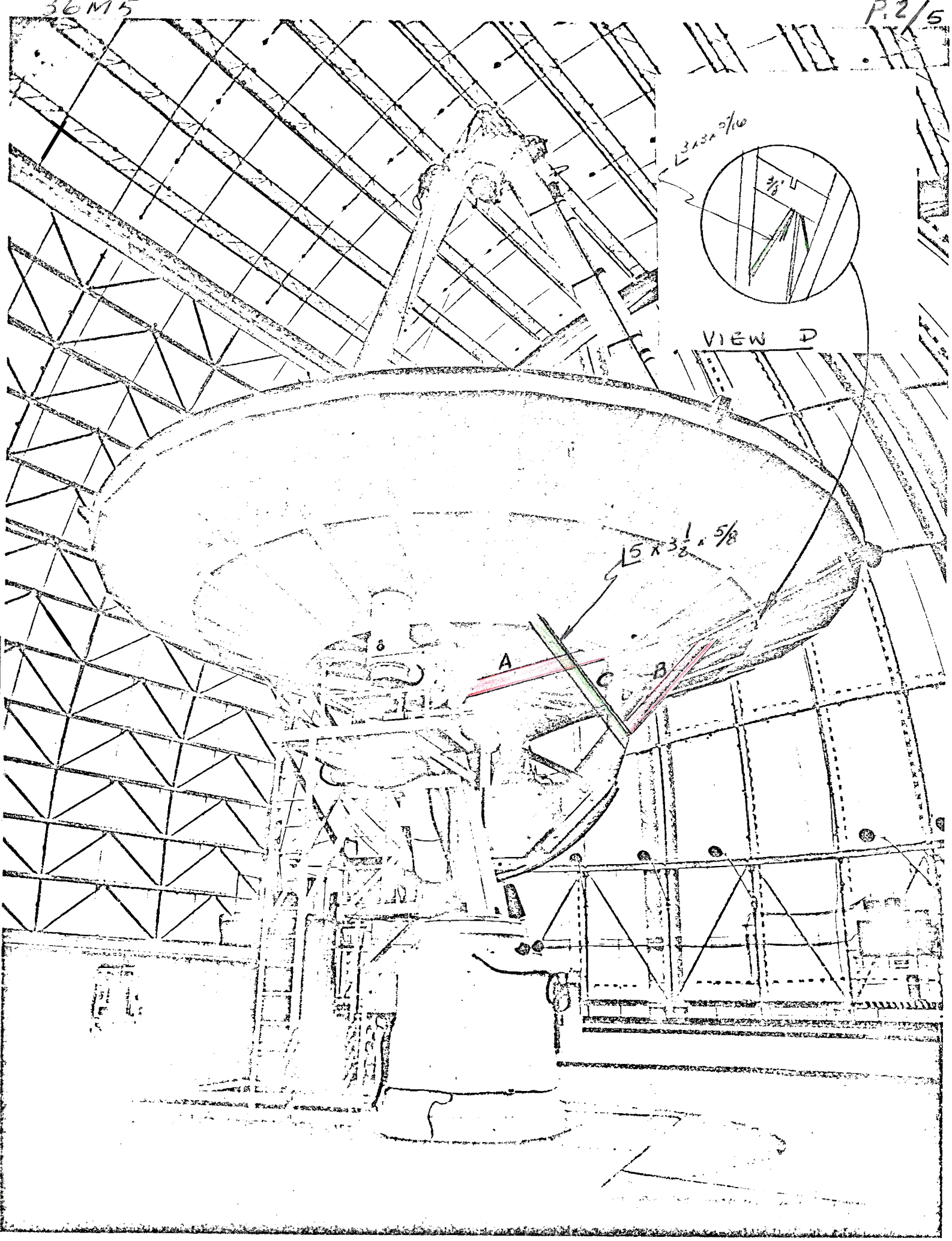
SOME RESULTS OF 36M5 VS THE PRESENT STRUCTURE ARE TABULATED ON PAGE 5. NOTE 36M5 IS NOT AS GOOD AS THE PRESENT STRUCTURE IN THE DEAD LOAD CASES 5 THRU 7, HOWEVER, IS MUCH BETTER FOR THE THERMAL DEFORMATIONS.

\* STRUCTURE MODIFICATION FIRST SUGGESTED IN MEMO TO ULICH (3-23-76).

\*\* DETAIL DRAWINGS WILL BE FORWARDED FOR YOUR REVIEW AFTER I VISIT TUCSON NEXT WEEK.

36 M 5

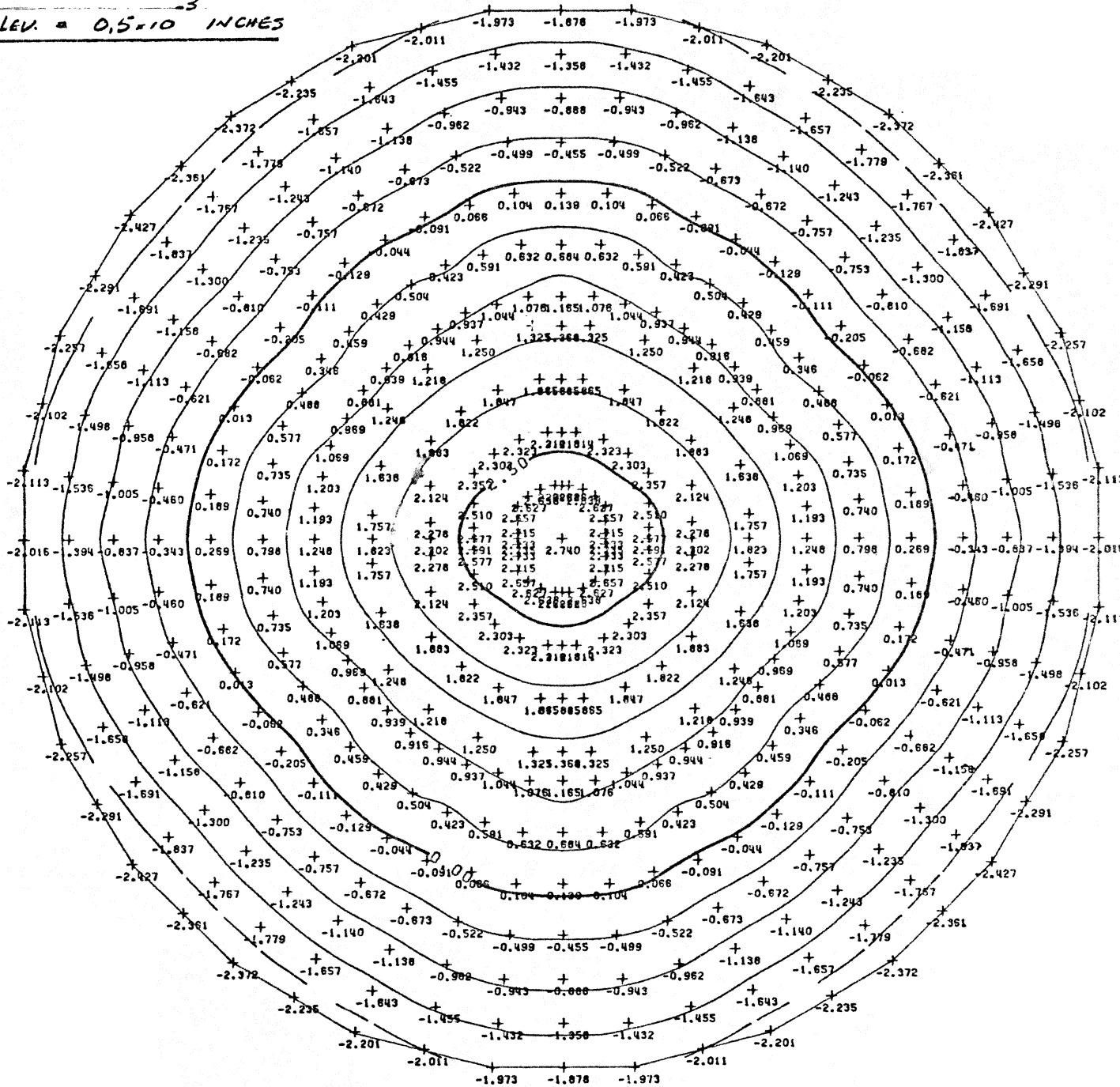
P. 2 / 5



MODIFIED 36' ELEV. STRU. — Y5

SURFACE DEV. DUE TO 5°F UNIF TEMP. INCREASE

BLEV. = 0.5 × 10<sup>-3</sup> INCHES



BEST FIT PARABOLOID WITH MINIMUM PATH LENGTH IN LEAST SQUARES SENSE

36.91 ELEVATION STR --- MODIFIED STR Y5 DELT=5F (36M5)

ORIGINAL FOCAL LENGTH = 345.6000 ( 8778.238 MM )  
 NO. POINTS IN ANALYSIS = 450

ASSIGNED OFF-SET OF VERTEX Y COORDINATE = 0.0 ( 0.0 MM)  
 ASSIGNED ROTATION ABOUT X-AXIS = 0.0

MINIMIZATION OF RMS WITH RESPECT TO RIGID BODY MOTION

RMS OF 1/2 LAMBDA WEIGHTED BY AREAS = 0.001287 ( 0.03268 MM)  
 DEVIATION OF THE MEAN - 1/2 LAMBDA = -0.00003 ( -0.0008 MM)  
 SUM-UNIT AREA\*1/2 LAMBDA = -0.60036610D 01 (-0.98382298D 05 MM\*\*3)  
 SUM-UNIT AREAS = 0.91743955D 05 ( 0.59189500D 08 MM\*\*2)  
 X COORDINATE OF VERTEX = 0.0 ( 0.0 MM)  
 Y COORDINATE OF VERTEX = 0.0 ( 0.0 MM)  
 Z COORDINATE OF VERTEX = 0.00028 ( 0.0071 MM)  
 ROTATION ABOUT X AXIS = 0.0  
 ROTATION ABOUT Y AXIS = 0.0

MINIMIZATION OF RMS WITH RESPECT TO FOCAL LENGTH CHANGE

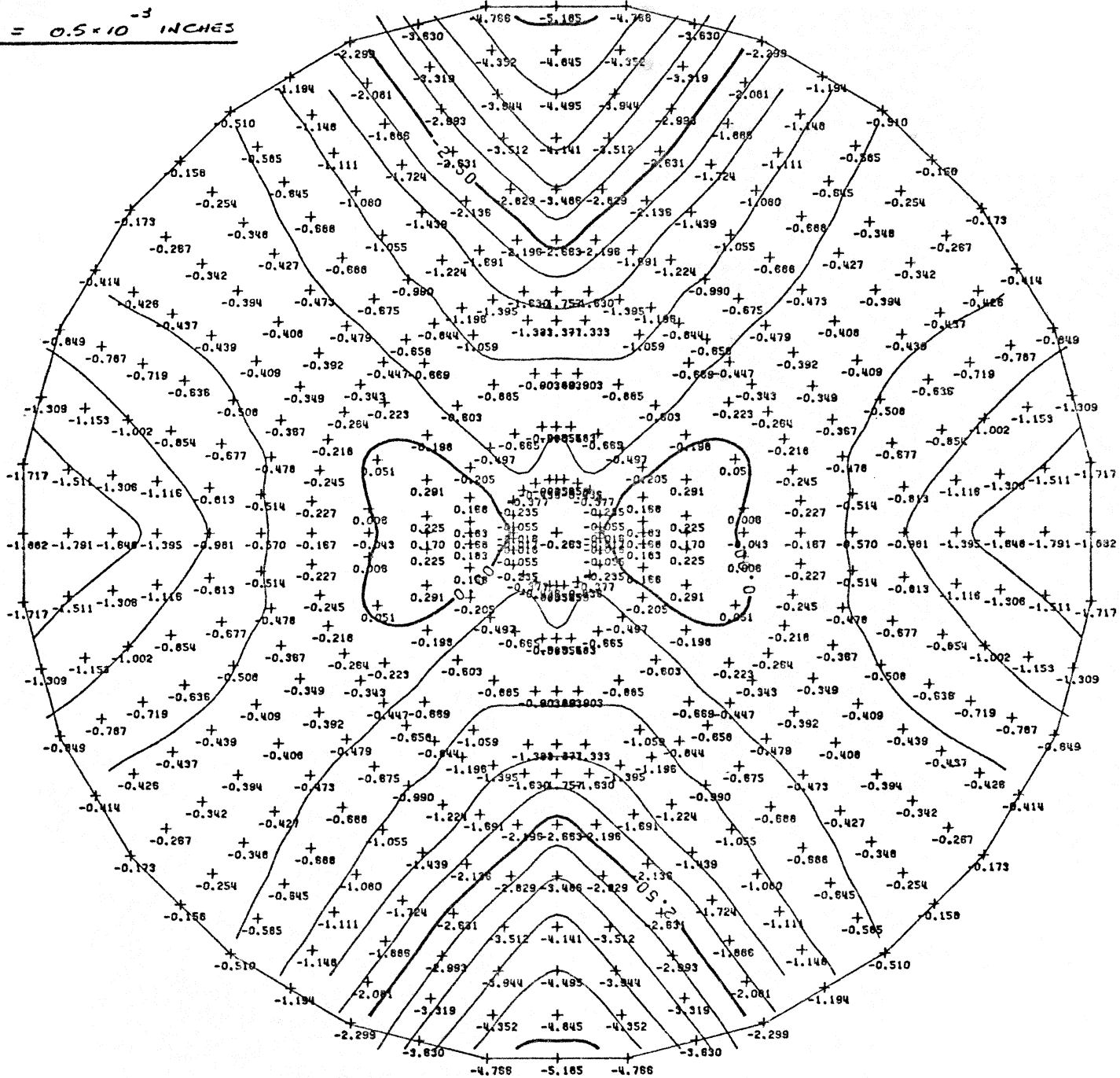
RMS OF 1/2 LAMBDA WEIGHTED BY AREAS = 0.000226 ( 0.00574 MM)  
 NEW FOCAL LENGTH = 345.6490 ( 8779.483 MM)  
 DEVIATION OF THE MEAN - 1/2 LAMBDA = 0.00000 ( 0.0000 MM)  
 SUM-UNIT AREA\*1/2 LAMBDA = 0.16558421D-11 ( 0.27134369D-07 MM\*\*3)  
 SUM-UNIT AREAS = 0.91743955D 05 ( 0.59189500D 08 MM\*\*2)  
 X COORDINATE OF VERTEX = 0.0 ( 0.0 MM)  
 Y COORDINATE OF VERTEX = 0.0 ( 0.0 MM)  
 Z COORDINATE OF VERTEX = 0.00219 ( 0.0556 MM)  
 ROTATION ABOUT X AXIS = 0.0  
 ROTATION ABOUT Y AXIS = 0.0

ALL LENGTH UNITS ARE INCHES EXCEPT AS NOTED

ROTATION UNITS ARE RADIAN

DEV. OF D.L. DEFL OF MODAYS W.R.T. PRESENT SURFACE

BLEV. =  $0.5 \times 10^{-3}$  INCHES



DEV. OF D.L. DEFL. OF MODAYS WRT. PRESENT SURFACE

ORIGINAL FOCAL LENGTH = 345.6000 ( 8778.238 MM )  
-- NO. POINTS IN ANALYSIS = 450

(36M5)

ASSIGNED OFF-SET OF VERTEX Y COORDINATE = 0.0 ( 0.0 MM)

ASSIGNED ROTATION ABOUT X-AXIS = 0.0

MINIMIZATION OF RMS WITH RESPECT TO RIGID BODY MOTION

RMS OF 1/2 LAMBDA WEIGHTED BY AREAS = 0.000931 ( 0.02365 MM)

DEVIATION OF THE MEAN - 1/2 LAMBDA = -0.00001 ( -0.0003 MM)

SUM-UNIT AREA\*1/2 LAMBDA = -0.19404418D 01 (-0.31798119D 05 MM\*\*3)

SUM-UNIT AREAS = 0.91743955D 05 ( 0.59189500D 08 MM\*\*2)

X COORDINATE OF VERTEX = 0.0 ( 0.0 MM)

Y COORDINATE OF VERTEX = 0.0 ( 0.0 MM)

Z COORDINATE OF VERTEX = -0.00095 ( -0.0241 MM)

ROTATION ABOUT X AXIS = 0.0

ROTATION ABOUT Y AXIS = 0.0

MINIMIZATION OF RMS WITH RESPECT TO FOCAL LENGTH CHANGE

RMS OF 1/2 LAMBDA WEIGHTED BY AREAS = 0.000836 ( 0.02124 MM)

NEW FOCAL LENGTH = 345.6158 ( 8778.640 MM)

DEVIATION OF THE MEAN - 1/2 LAMBDA = 0.00000 ( 0.0000 MM)

SUM-UNIT AREA\*1/2 LAMBDA = 0.79364293D-12 ( 0.13005467D-07 MM\*\*3)

SUM-UNIT AREAS = 0.91743955D 05 ( 0.59189500D 08 MM\*\*2)

X COORDINATE OF VERTEX = 0.0 ( 0.0 MM)

Y COORDINATE OF VERTEX = 0.0 ( 0.0 MM)

Z COORDINATE OF VERTEX = -0.00032 ( -0.0084 MM)

ROTATION ABOUT X AXIS = 0.0

ROTATION ABOUT Y AXIS = 0.0

ALL LENGTH UNITS ARE INCHES EXCEPT AS NOTED

ROTATION UNITS ARE RADIAN

SUMMARY OF RMS CALCULATIONS FOR 36 FT SURFACE \*

PRESENT SURFACE MODIFIED (36MS)

NC.	CASE	REFL DEAD LOAD AT REFLECTOR		TEMPERATURE INCREASE (DEGF)	FIXED FCCLS F=345.6000 RMS (IN.)		BEST FITTED FOCAL LENGTH (IN.)		FIXED FCCLS F=345.6000 RMS (IN.)		BEST FITTED FOCAL LENGTH (IN.)	
		ANGLE (DEG)	REF ANGLE (DEG)		RMS	FOCAL LENGTH	RMS	FOCAL LENGTH	RMS	FOCAL LENGTH		
1	1	15.00	90.00	5.00	0.001555	345.6042	0.001551	345.6042	0.001363	0.001316	345.5864	345.5864
1	AZ HALF	15.00	90.00	5.00	0.000417	345.5914	0.000352	345.5914	0.000573	0.000506	345.5896	345.5896
1	EL HALF	15.00	90.00	5.00	0.001482	345.6171	0.001415	345.6171	0.001492	0.001427	345.5831	345.5831
2	1	45.00	90.00	5.00	0.001614	345.6346	0.001344	345.6346	0.000979	0.000751	345.6243	345.6243
2	AZ HALF	45.00	90.00	5.00	0.000656	345.6227	0.000291	345.6227	0.000745	0.000314	345.6261	345.6261
2	EL HALF	45.00	90.00	5.00	0.001701	345.6465	0.001205	345.6465	0.001070	0.000899	345.6224	345.6224
3	1	60.00	90.00	5.00	0.001676	345.6453	0.001198	345.6453	0.001101	0.000511	345.6377	345.6377
3	AZ HALF	60.00	90.00	5.00	0.000919	345.6338	0.000282	345.6338	0.001043	0.000260	345.6391	345.6391
3	EL HALF	60.00	90.00	5.00	0.001808	345.6569	0.001053	345.6569	0.001130	0.000626	345.6364	345.6364
4	1	90.00	90.00	5.00	0.001742	345.6544	0.001028	345.6544	0.001288	0.000227	345.6490	345.6490
4	AZ HALF	90.00	90.00	5.00	0.001151	345.6432	0.000279	345.6432	0.001312	0.000227	345.6500	345.6500
4	EL HALF	90.00	90.00	5.00	0.001907	345.6657	0.000671	345.6657	0.001262	0.000222	345.6481	345.6481
5	1	15.00	90.00	0.0	0.001942	345.5498	0.001446	345.5498	0.002081	0.001305	345.5373	345.5373
5	AZ HALF	15.00	90.00	0.0	0.001400	345.5482	0.000410	345.5482	0.001644	0.000516	345.5397	345.5397
5	EL HALF	15.00	90.00	0.0	0.001777	345.5515	0.001258	345.5515	0.002175	0.001383	345.5351	345.5351
6	1	45.00	90.00	0.0	0.001142	345.5802	0.001021	345.5802	0.000965	0.000721	345.5752	345.5752
6	AZ HALF	45.00	90.00	0.0	0.000579	345.5795	0.000235	345.5795	0.000672	0.000267	345.5762	345.5762
6	EL HALF	45.00	90.00	0.0	0.001036	345.5808	0.000909	345.5808	0.001081	0.000854	345.5743	345.5743
7	1	60.00	90.00	0.0	0.000753	345.5909	0.000715	345.5909	0.000547	0.000462	345.5887	345.5887
7	AZ HALF	60.00	90.00	0.0	0.000286	345.5906	0.000152	345.5906	0.000327	0.000165	345.5891	345.5891
7	EL HALF	60.00	90.00	0.0	0.000680	345.5912	0.000641	345.5912	0.000649	0.000574	345.5883	345.5883
8	1	90.00	90.00	0.0	0.0	345.6000	0.0	345.6000	0.0	0.0	345.6000	345.6000
8	AZ HALF	90.00	90.00	0.0	0.0	345.6000	0.0	345.6000	0.0	0.0	345.6000	345.6000
8	EL HALF	90.00	90.00	0.0	0.0	345.6000	0.0	345.6000	0.0	0.0	345.6000	345.6000

\* BASED ON A PERFECT PARABOLOID w/ F = 345.600" ( 8778.438 mm )