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STRUCTURAL DESIGN OF 65-METER HOMOLOGY TELESCOPE

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I. INTRODUCTION

The first stage of a fully-steerable telescope with a reflector diameter of 65 meters (213 feet) is being finished. Figures 1 and 2 show the line drawings of the complete telescope with its tower and foundation in y and x direction respectively.

A general description of the telescope is given in the report by Findlay (1). The following report will stress the engineering aspects, such as the physical shape of the dish structure, weight, locations of joints, length and cross-sectional areas of connections, design criterions, loading conditions and magnitudes. The homologous improvement procedure is based on the paper by von Hoerner (2). A computer program is prepared in the observatory to accomplish the tasks of stress analysis and homologous improvements.

The goal is to design a dish structure in which observations at short wavelengths are feasible, plus the sustentation of survival conditions. Each member in the structure can withstand the survival loads without inducing a permanent deformation. The configuration of the structure should be realistic for construction. All clearance and angles between bars are investigated carefully to insure the absence of interference problems.

The basic configuration is similar to the 300 ft. design (3), except the arrangement of surface panels. The new radial pattern will not provide a uniform distribution of surface points; however, the reductions in construction cost and the effort of surface point adjustment will be considerable. Market-available single pipes are used as much as possible. Some members with large cross-sectional areas will be designed especially. Except the feed-support legs, no built-up member is used. Some exceedingly long members have been eliminated to avoid high cost of construction, or to avoid the possible blocking of the optical platform, but without undermining the stability of the structure.

II. DESCRIPTION OF THE REFLECTOR

The following are statistics for the entire dish structure:

a. The telescope will be an altitude-azimuth instrument 65 meters in diameter (213.254').

b. Focus length = 90.0', f/D = 0.42

c. Total weight of the reflector = 780 tons.

d. Total surface area = 38,586.6 sf.

e. Number of surface pts = 60; total structural pts = 172

f. Pipes selected from manual = 447, special design* = 134

g. Total panel structures = 44

h. Code name for the structure = EH112

III. WEIGHTS AND LOADINGS

Dead load:	surface plates (3.8 #/s.f.)	73 tons
	panel structures	135 tons
	back-up structure	214 tons
	cone member	39 tons
	wheel	72 tons
	suspension member	128 tons
	counter-weight	87 tons
	feed legs	9 tons
	instrument @ prime focus	10 tons
	instrument @ vertex	13 tons
**Live load:	wind load during observ.	1.29 #/s.f.
	survival snow or ice	20.0 #/s.f.
	survival wind load @ 100 mph	15.0 #/s.f.

All the structural members are joined together by spherical joints whose stiffness and weight will have some contribution structurally to the dish structure. Corrections are thus included: 3.2% increase in density for the extra weight; 5% lower in stiffness to include the "softness" of the joints. Consequently, all the densities are higher by 3.2% and the modulus of elasticity is 5% lower.

Six loading conditions are being investigated and are listed as following:

Loading Condition	Loads	Directions
1	dead load only	Z
2	dead load only	X
3	wind load during obs.	Z***
4	dead load and survival snow	Z
5	survival wind	X***
6	survival wind	Y***

Loading conditions 1 and 2 are for the surface deformation studies; No. 3 is for the study of behavior under wind while the survival conditions are based

*Includes special ordered pipes and members with special function.
**Live load applies on surface only.
***Apply on surface only.

on the following relation:

$$Sm = \text{Max.}\ \{S_4,\ |S_1| + \sqrt{S_5^2 + S_6^2}\}$$

Survival check is computed for each member demanding that the stress ratio, the quotient between the actual stress of the member to the allowable stress, is less than 1. (4)

It would be most ideal if the stress ratio of each member is close to 1. At this stage, however, great effort has not been applied to the optimization of weight. Several experiments have been done without significant improvement.

IV. DESIGN PARAMETER AND APPROACH

a. The design concept is based on elastic theory. The dish is analyzed as a truss.

b. All dimensions are in inches, loadings in pounds, area in square inches.

c. Young's modulus of elasticity, E, is 29,000,000 psi.*

d. Specified yield stress, F_Y, is 50 ksi for COR-TEN steel.

e. Density of steel = 0.283 #/cu. in. (For the correction of weight, density is 3.2% higher.)

f. Coefficients for members:

Type	Area	k_i	K
1	$A \leq 4$	0.830	0.8
2	$4 < A \leq 16$	0.703	0.8
3	$A > 16$	1.000	1.0
6	special design	-----	---

in which,

$$\Lambda = \frac{\ell}{K_i \times A^{2/3}}$$

K = effective length factor

V. PANEL STRUCTURE AND ITS EQUIVALENCE

Figure 3 shows the arrangement of surface panels, which are supported by the surface points (homologous points) of the reflector. There are four types of panel design: A, B, C, and D. The demands on the panels are similar to those on the reflector; accuracy over the surface area for short wavelength observations, and stability for survival conditions. Due to the number of panels and their own number of connections, it is not possible to include all the panel bars in the reflector design. Since all the supports are approximately on a surface, we can, by finding out the stiffness between supports, replace a panel by imaginary bars between the supports. From the weight of the panel, we can assign an equivalent density for each bar.

VI. POINTS

a. The dish structure is symmetrical according to two planes. Incidents of

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*(For the correction of stiffness, E is 5% lower.)

all members are defined in only one quadrant of a right-handed orthogonal Cartesian coordinate system. The origin is located at the vertex of the paraboloid of revolution. X-Y plane and Y-Z plane are planes of symmetry.

b. Corrections of coordinates for surface points are included. It is necessary because each panel has a certain thickness. Since the depths of the panels are not the same, the surface points of the dish are no longer subscribed to the paraboloid of revolution.

c. Since only one quadrant of the telescope is analyzed, weight factors are introduced for the analysis to maintain its completeness.

mu = 0 Fictitious point, when a member crosses perpendicularly the plane of symmetry with one incident in one quadrant. This fictitious point will be the center point of that member.

mu = 1 The point is located on the Z-axis. It does not have a counter part.

mu = 2 The point is located either on X-Z plane or Y-Z plane. It has one counter part.

mu = 4 It is a normal point and has three counter parts.

d. Constraints are also required, in conjunction with weight factors, to simulate the complete structure. Each point has three degrees of freedom; 0 means it is free to deform, while 1 means the point is held in that direction.

e. Direction of a point load is always identical with the direction of gravity.

f. Table 1 contains the data for points. One could also find the location of points in Figure 4.

g. Optical platform will be located at pt. 56.

h. Total points used in one quadrant for structural analysis = 65.

VII. MEMBERS

a. Weight factors are also required for members.

nu = 1 The member is located along the Z-axis. The true area should be larger by a factor of 4.

nu = 2 The member is perpendicular to either plane of symmetry. The true length should be longer by a factor of 2.

nu = 3 The member is located along either plane of symmetry. The true area of the member should be larger by a factor of 2.

nu = 4 Normal bar, it will have 3 counter parts.

b. If the member is selected from the steel manual, radius of gyration (R), diameter (DIA), and wall thickness (T) are listed in Table 2.

c. If the member is specified as a "special order" member, it means either a panel design or a special design. Members 1 through 61 in Table 2 are panel structures. Table 3 lists all the members of special design with special functions in which the true physical shape is not defined until the detailed structural design for that member is completed. The rest of the members requiring special order are those with a large cross-sectional area, without a bar in the steel manual close enough to the area required. The cross-sectional area will be circular.

d. Total members used in the quadrant for the structural analysis is 229.

REFERENCES

(1) J. Findlay: Radio Astronomy with the 65-meter millimeter wave antenna. (Second draft: 10/20/70)

(2) S. von Hoerner: Homologous deformations of tiltable telescopes.

(3) S. von Hoerner: Report 21: Final data for telescope design

(4) A.S.C.E.: Manual of steel construction, 6th edition under "Specification for design", Section 1.5 and 1.6

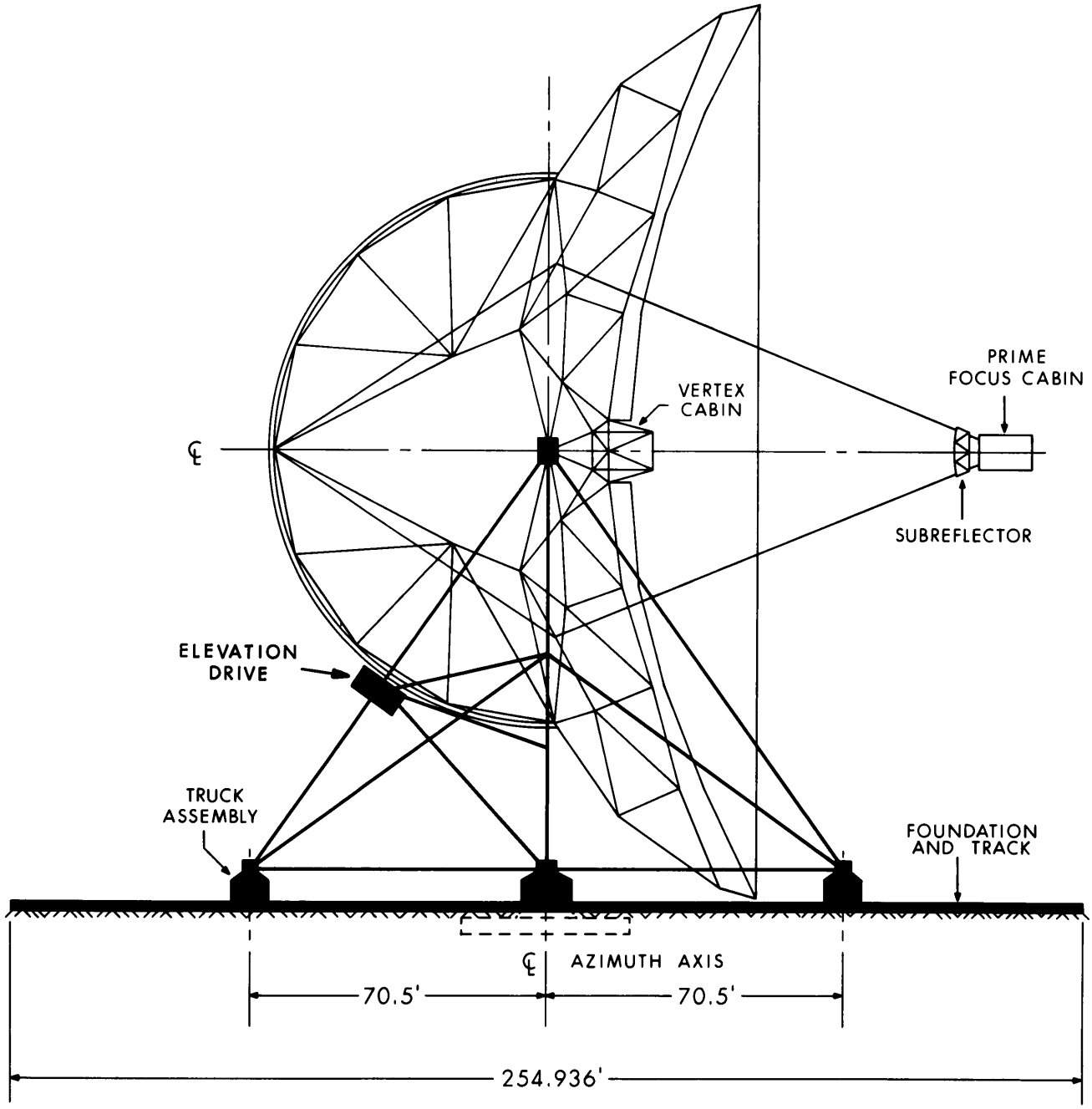

Figure 1: Outline Drawing of the 65-meter Telescope

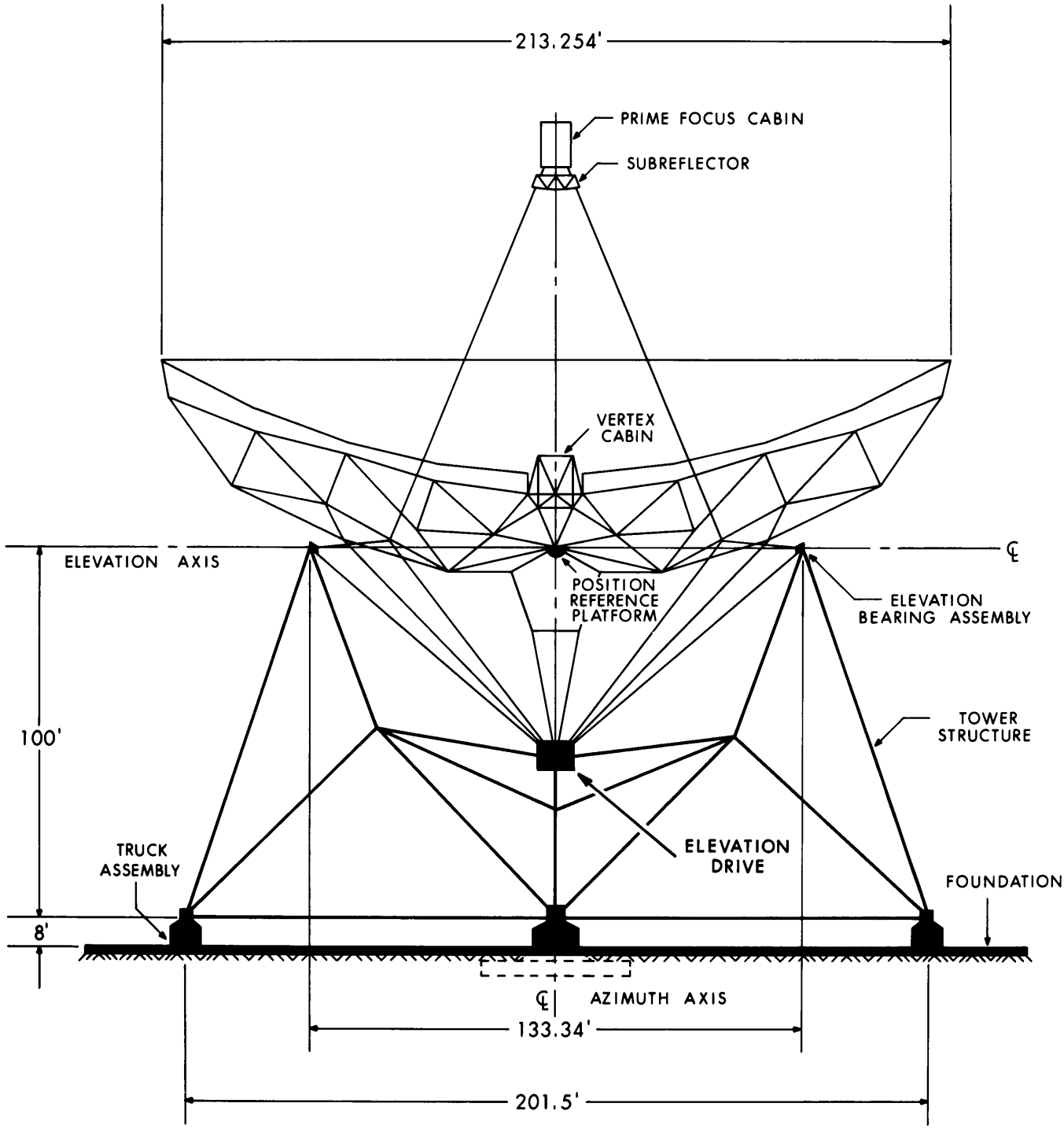

Figure 2: Outline Drawing of the 65-meter Telescope

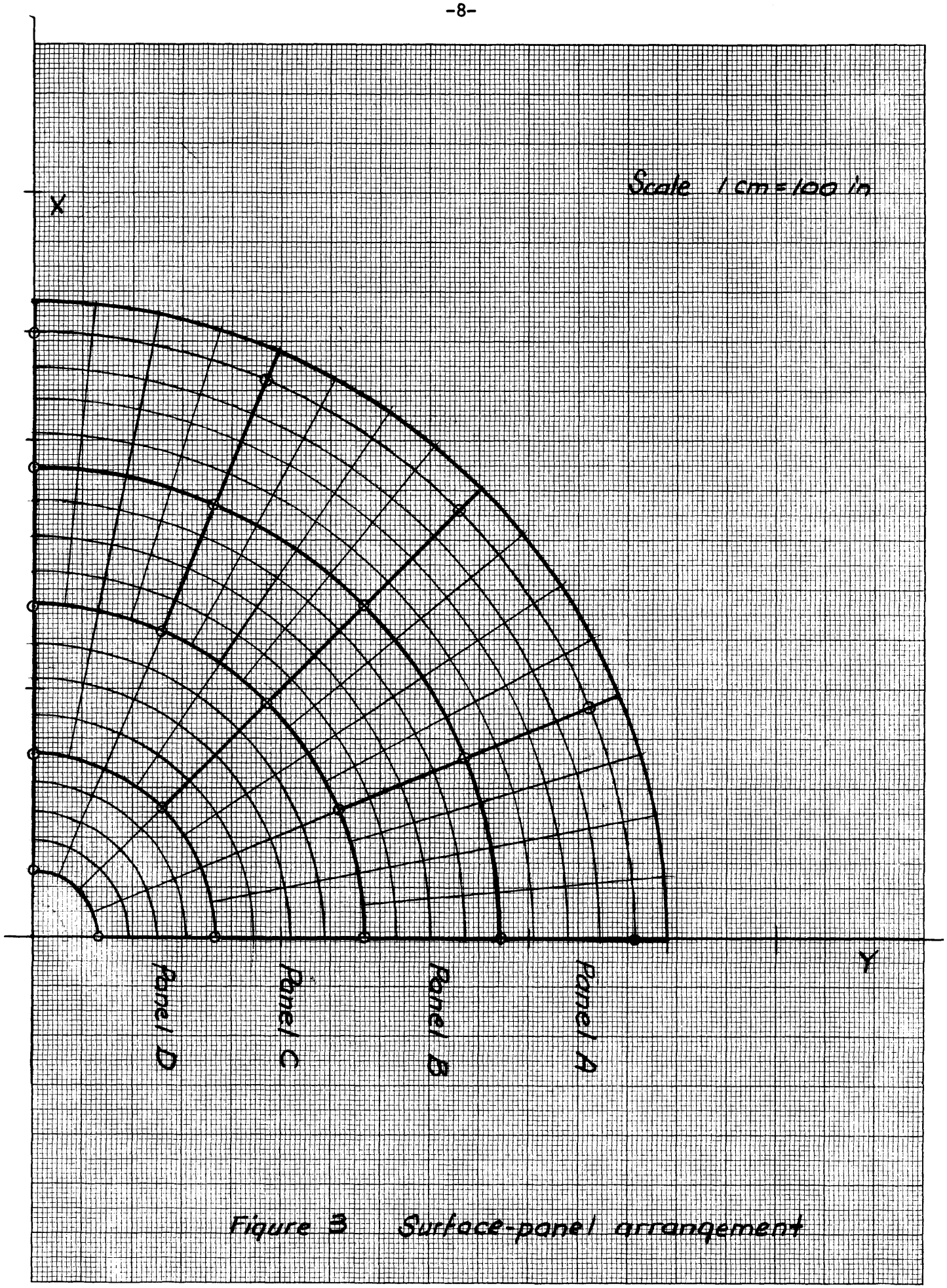

Figure 3 Surface-panel arrangement

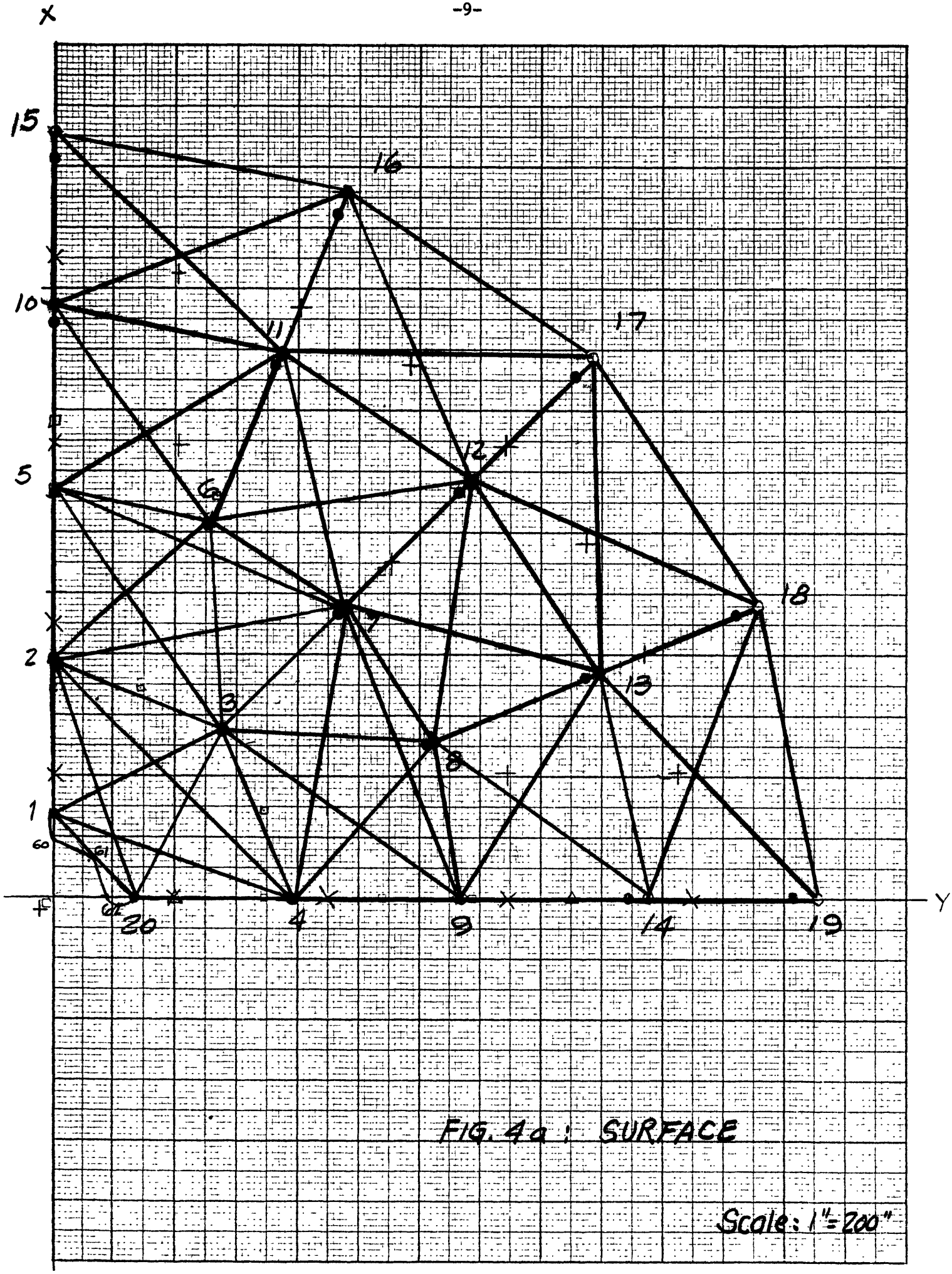

FIG. 4a : SURFACE

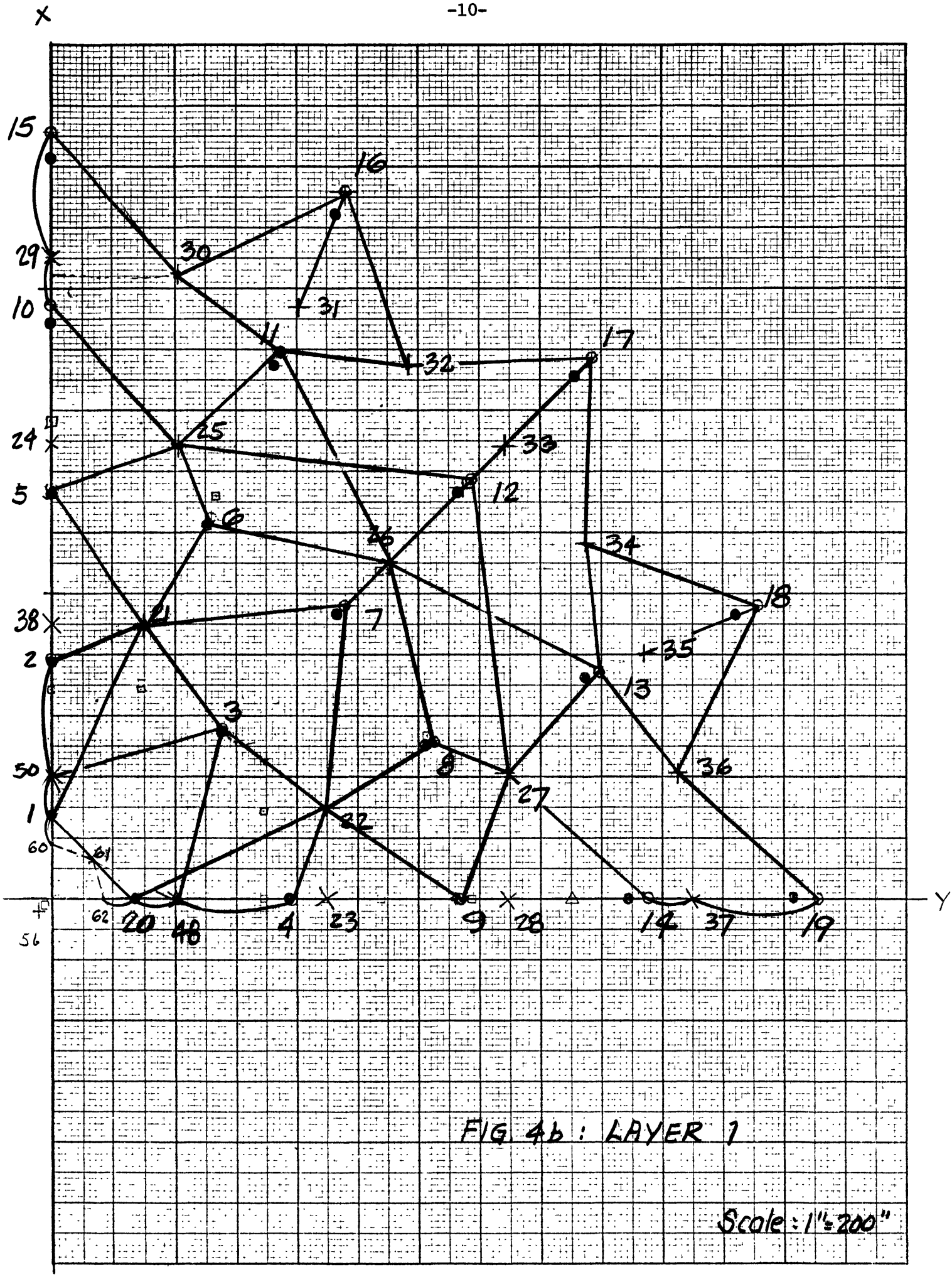

FIG 4b : LAYER 1

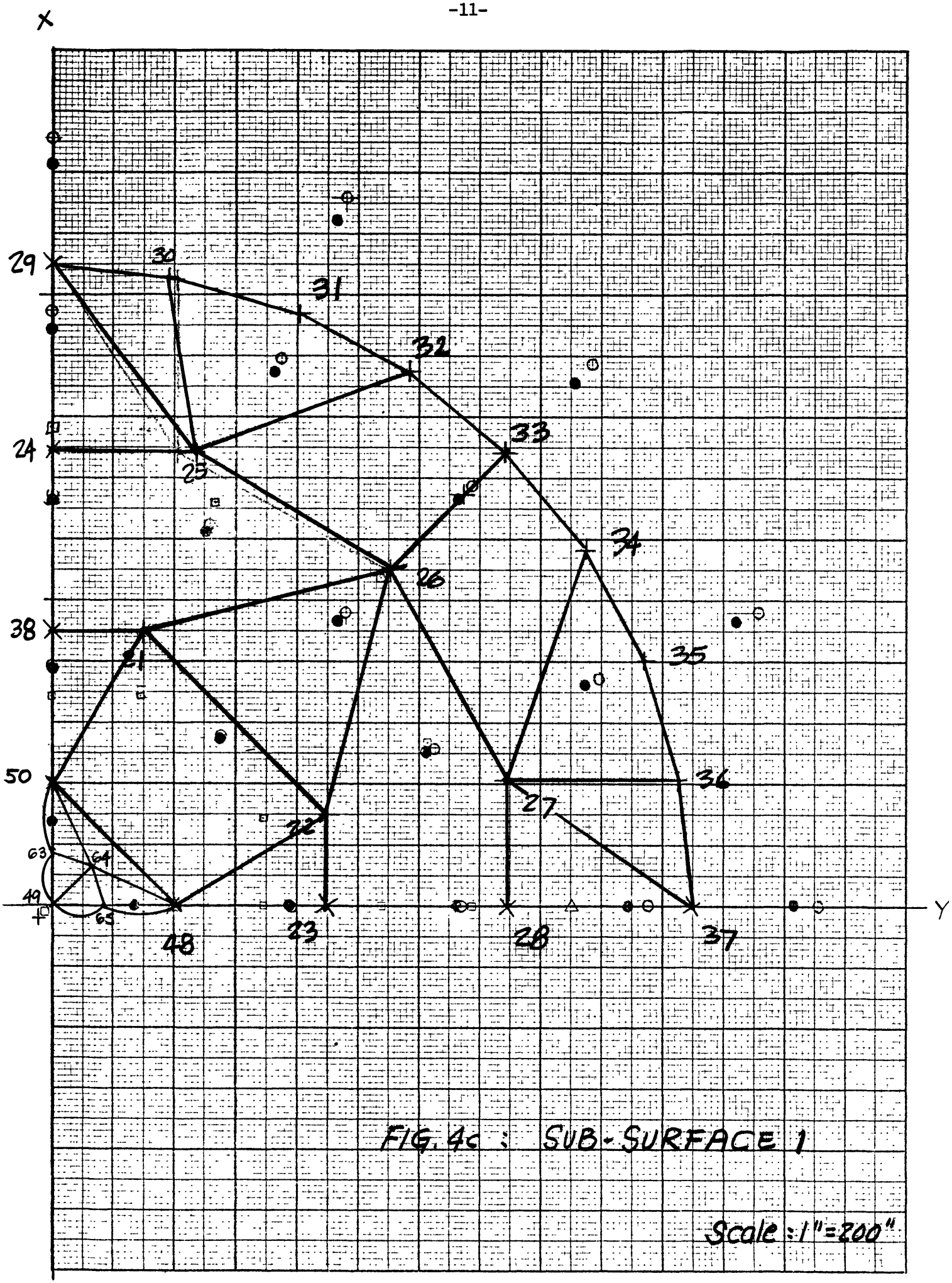

FIG. 4c : SUB-SURFACE 1

Scale : 1" = 200"

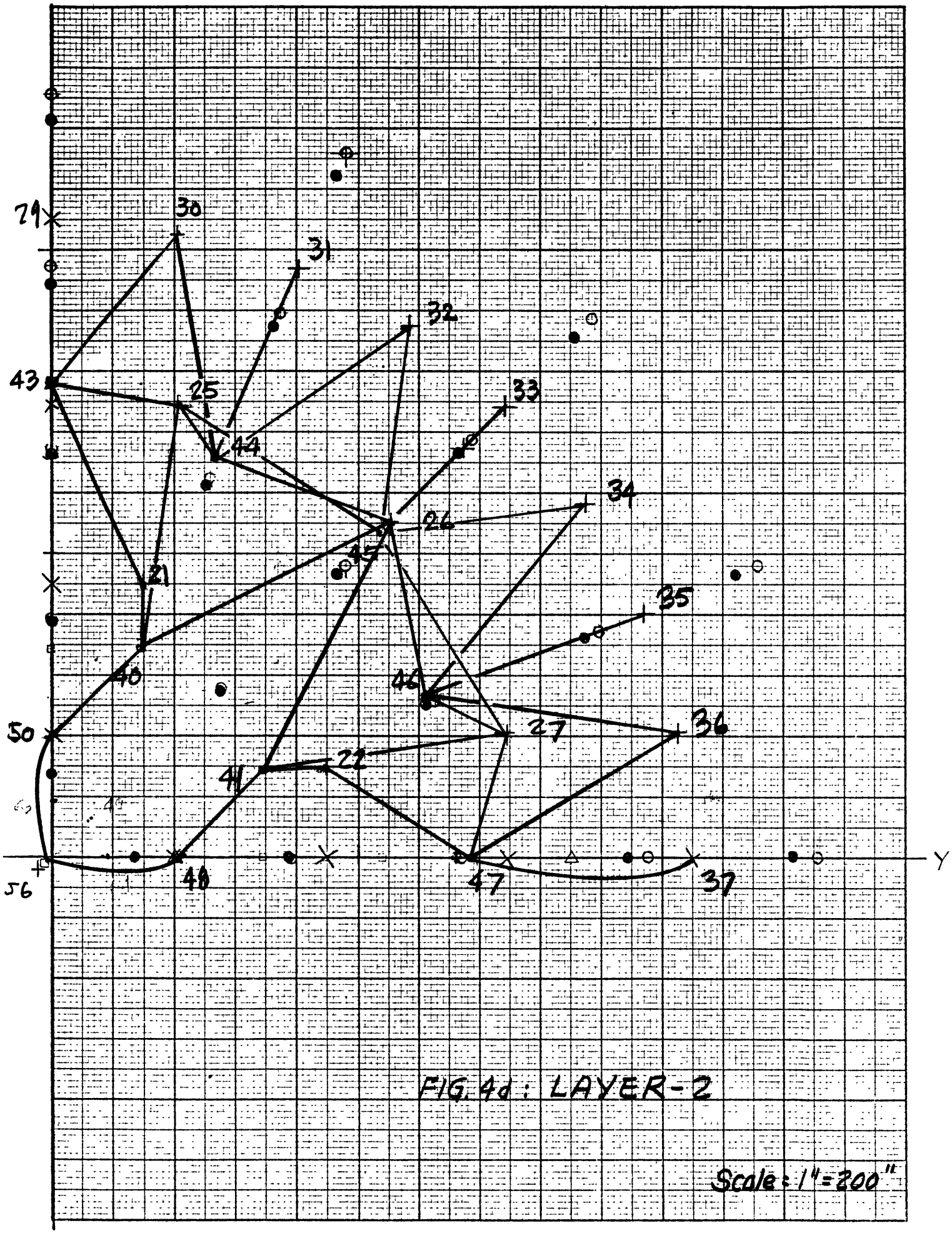

FIG. 4d: LAYER-2

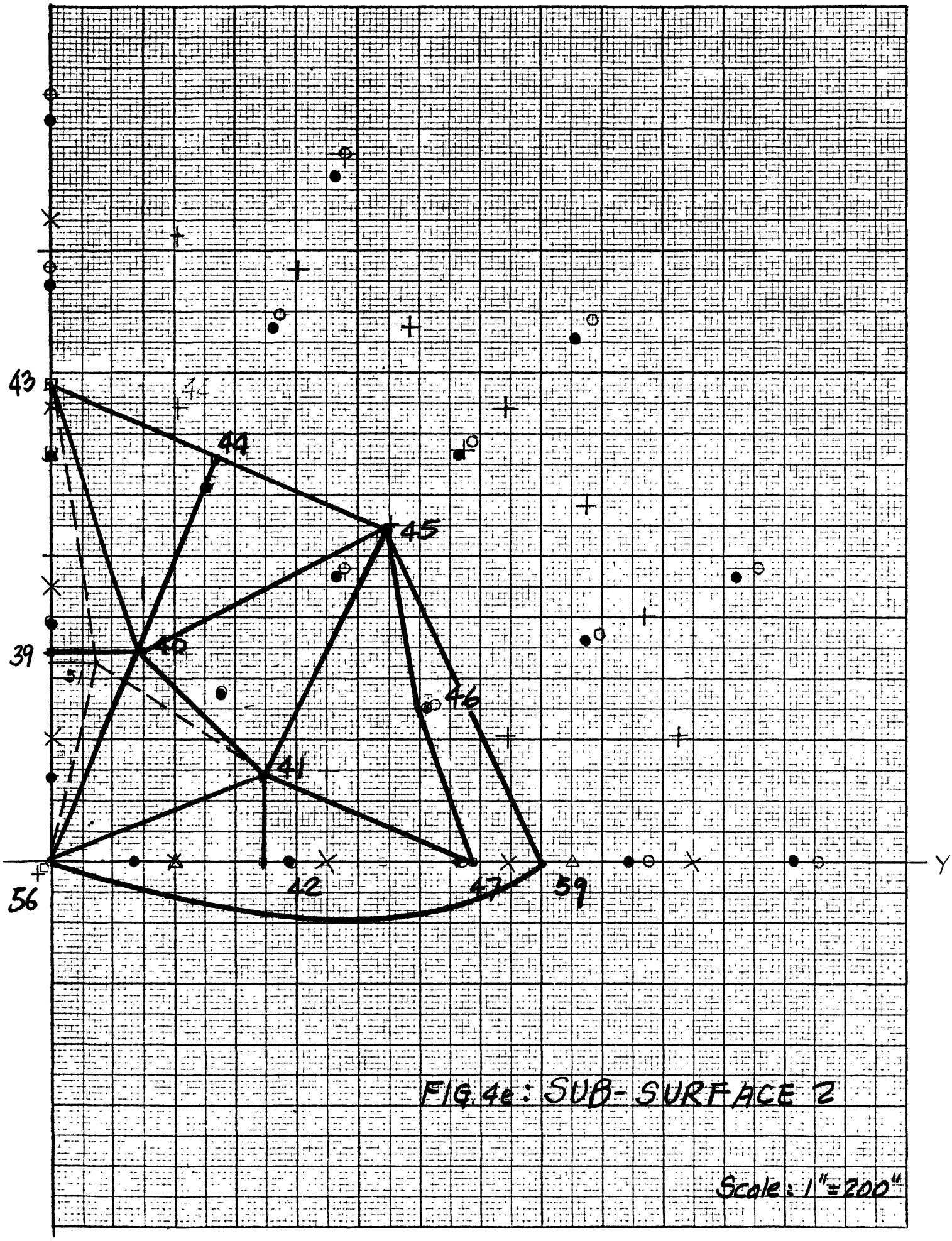

FIG. 4e: SUB-SURFACE 2

Scale: 1" = 200"

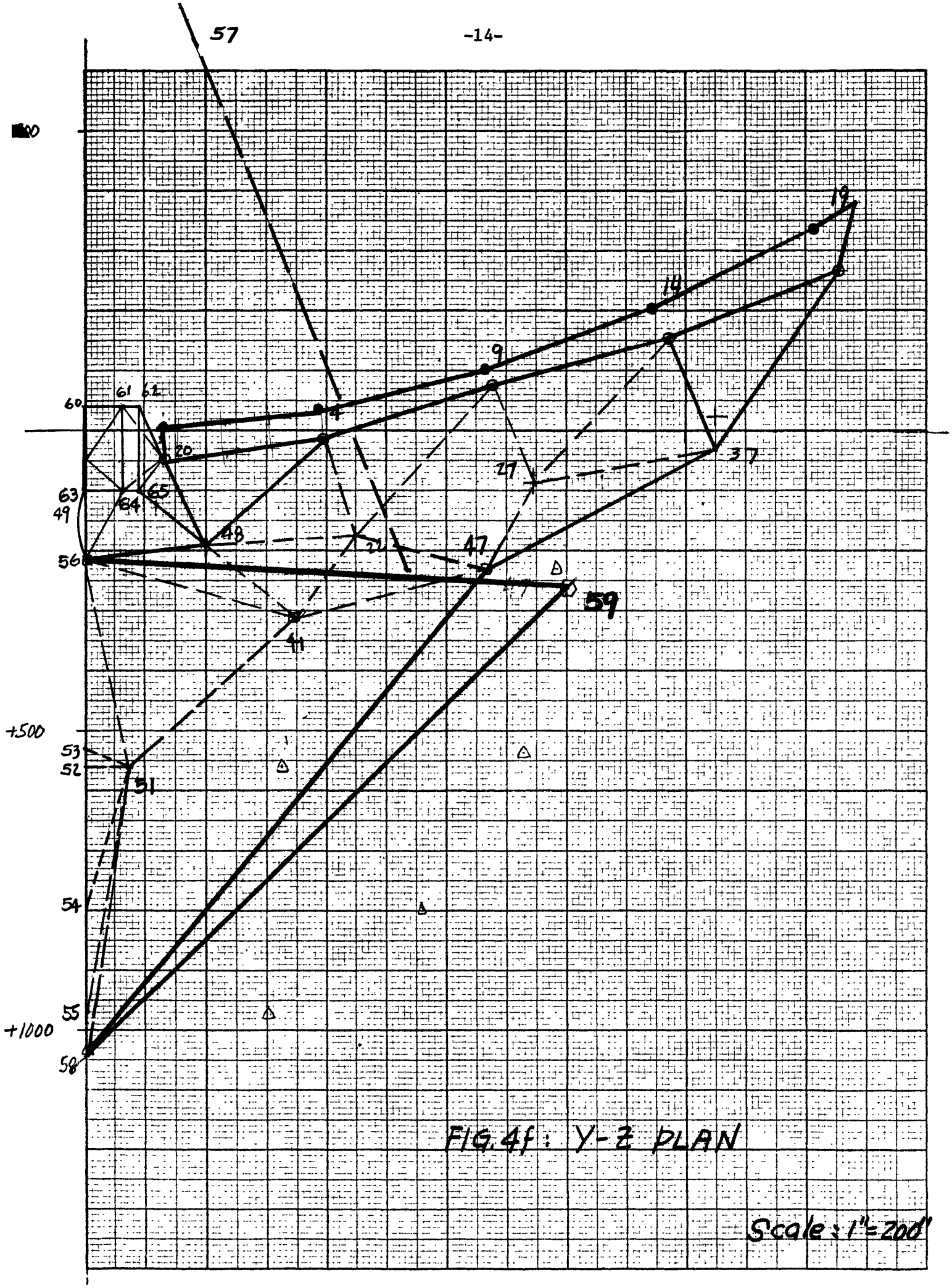

FIG. 4f: Y-Z PLAN

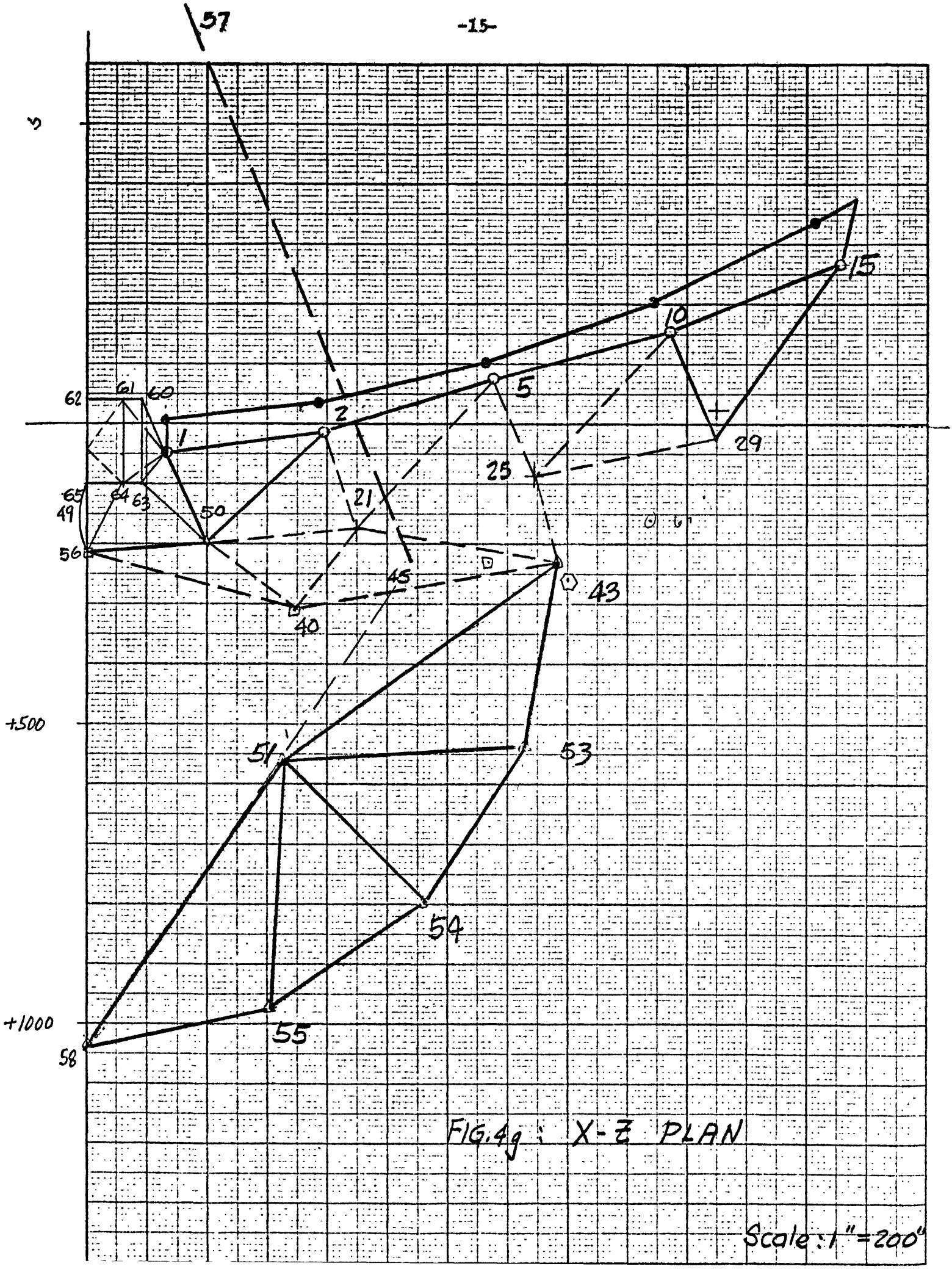

FIG. 4g : X-Z PLAN

POINT	COORDINATES X	COORDINATES Y	COORDINATES Z	RESTRAINTS OMEGA=1 X	OMEGA=1 Y	OMEGA=1 Z	OMEGA=2 X	OMEGA=2 Y	OMEGA=2 Z	OMEGA=6 X	OMEGA=6 Y	OMEGA=6 Z	POINT LOADS	MU
1	133.153	0.0	49.033	0	1	0	0	1	0	1	0	1	452.40	2
2	388.746	0.0	14.104	0	1	0	0	1	0	1	0	1	1151.20	2
3	274.884	274.884	14.104	0	0	0	0	0	0	0	0	0	2302.30	4
4	0.0	388.746	14.104	1	0	0	0	1	1	1	0	0	1151.20	2
5	678.407	0.0	-74.082	0	1	0	0	1	0	1	0	1	1019.60	2
6	626.766	259.615	-74.082	0	0	0	0	0	0	0	0	0	2039.20	4
7	479.706	479.706	-74.082	0	0	0	0	0	0	0	0	0	2039.20	4
8	259.615	626.766	-74.082	0	0	0	0	0	0	0	0	0	2039.20	4
9	0.0	678.407	-74.082	1	0	0	0	1	1	1	0	0	1019.60	2
10	972.368	0.0	-151.143	0	1	0	0	1	0	1	0	1	1454.20	2
11	898.352	372.109	-151.143	0	0	0	0	0	0	0	0	0	2908.40	4
12	687.568	687.568	-151.143	0	0	0	0	0	0	0	0	0	2908.40	4
13	372.109	898.352	-151.143	0	0	0	0	0	0	0	0	0	2908.40	4
14	0.0	972.368	-151.143	1	0	0	0	1	1	1	0	0	1454.20	2
15	1256.277	0.0	-264.031	0	1	0	0	1	0	1	0	1	1361.10	2
16	1160.649	480.757	-264.031	0	0	0	0	0	0	0	0	0	2722.20	4
17	888.322	888.322	-264.031	0	0	0	0	0	0	0	0	0	2722.20	4
18	480.757	1160.649	-264.031	0	0	0	0	0	0	0	0	0	2722.20	4
19	0.0	1256.277	-264.031	1	0	0	0	1	1	1	0	0	1361.10	2
20	0.0	133.153	49.033	1	0	0	0	1	1	1	0	0	452.40	2
21	450.000	150.000	184.600	0	0	0	0	0	0	0	0	0	0.0	4
22	150.000	450.000	184.600	0	0	0	0	0	0	0	0	0	0.0	4
23	0.0	450.000	184.600	1	1	1	0	1	1	1	1	1	0.0	0
24	746.410	0.0	87.806	1	1	1	1	1	1	1	0	1	0.0	0
25	746.410	235.000	87.806	0	0	0	0	0	0	0	0	0	0.0	4
26	551.000	551.000	100.000	0	0	0	0	0	0	0	0	0	0.0	4
27	207.055	746.410	87.806	0	0	0	0	0	0	0	0	0	0.0	4
28	0.0	746.410	87.806	1	1	1	0	1	1	1	1	1	0.0	0
29	1050.000	0.0	24.885	0	1	0	0	1	0	1	0	1	0.0	2
30	1030.000	190.000	-46.114	0	0	0	0	0	0	0	0	0	0.0	4

Table 1: Points

31	970.074	401.818	24.885	0 0 0	0 0 0	0 0 0	0.0	4
32	873.043	583.349	-46.114	0 0 0	0 0 0	0 0 0	0.0	4
33	742.462	742.462	24.885	0 0 0	0 0 0	0 0 0	0.0	4
34	583.349	873.043	-46.114	0 0 0	0 0 0	0 0 0	0.0	4
35	401.818	970.074	35.000	0 0 0	0 0 0	0 0 0	0.0	4
36	204.845	1029.825	-46.114	0 0 0	0 0 0	0 0 0	0.0	4
37	0.0	1050.000	24.885	1 0 0	0 1 1	1 0 0	0.0	2
38	450.000	0.0	184.600	1 1 1	1 1 1	1 0 1	0.0	0
39	346.455	0.0	310.000	1 1 1	1 1 1	1 0 1	0.0	0
40	346.455	143.506	310.000	0 0 0	0 0 0	0 0 0	0.0	4
41	143.506	346.455	310.000	0 0 0	0 0 0	0 0 0	0.0	4
42	0.0	346.455	310.000	1 1 1	0 1 1	1 1 1	0.0	0
43	780.685	0.0	230.000	0 1 0	0 1 0	1 0 1	0.0	2
44	659.394	269.051	230.000	0 0 0	0 0 0	0 0 0	0.0	4
45	538.102	538.102	230.000	0 0 0	0 0 0	0 0 0	0.0	4
46	250.000	600.000	245.000	0 0 0	0 0 0	0 0 0	0.0	4
47	0.0	688.700	230.000	1 0 0	0 1 1	1 0 0	0.0	2
48	0.0	200.000	200.000	1 0 0	0 1 1	1 0 0	0.0	2
49	0.0	0.0	90.000	1 1 0	0 1 1	1 0 1	2250.00	1
50	200.000	0.0	200.000	0 1 0	0 1 0	1 0 1	0.0	2
51	325.000	75.000	560.000	0 0 0	0 0 0	0 0 0	0.0	4
52	325.000	0.0	560.000	1 1 1	1 1 1	1 0 1	0.0	0
53	727.758	0.0	535.624	0 1 0	0 1 0	1 0 1	0.0	2
54	560.045	0.0	796.545	0 1 0	0 1 0	1 0 1	0.0	2
55	303.997	0.0	971.608	0 1 0	0 1 0	1 0 1	0.0	2
56	0.0	0.0	217.200	1 1 0	0 1 1	1 0 1	500.00	1
57	0.0	0.0	-1090.560	1 1 0	0 1 1	1 0 1	5000.00	1
58	0.0	0.0	1033.200	1 1 0	1 1 1	1 1 1	41000.00	1
59	0.0	800.000	252.200	1 0 1	1 1 1	1 1 1	0.0	2
60	91.924	0.0	-40.000	0 1 0	0 1 0	1 0 1	1125.00	2
61	65.000	65.000	-40.000	0 0 0	0 0 0	0 0 0	2250.00	4
62	0.0	91.924	-40.000	1 0 0	0 1 1	1 0 0	1125.00	2
63	91.924	0.0	90.000	0 1 0	0 1 0	1 0 1	0.0	2
64	65.000	65.000	90.000	0 0 0	0 0 0	0 0 0	0.0	4
65	0.0	91.924	90.000	1 0 0	0 1 1	1 0 0	0.0	2

Table 1: Points (Cont.)

NO	INC	NU	DENS	APFA	LENGTH	R	DIA	T	TABLE
1	1-20	4	0.479	0.609	188.306				SPECIAL ORDER
2	1- 4	4	0.164	3.144	412.398				SPECIAL ORDER
3	2-20	4	0.164	3.144	412.398				SPECIAL ORDER
4	1- 3	4	9.594	0.476	311.238				SPECIAL ORDER
5	3-20	4	9.594	0.476	311.238				SPECIAL ORDER
6	2- 3	4	0.517	4.613	297.532				SPECIAL ORDER
7	3- 4	4	0.517	4.613	297.532				SPECIAL ORDER
8	1- 2	3	0.164	1.337	257.969				SPECIAL ORDER
9	4-20	3	0.164	1.337	257.969				SPECIAL ORDER
10	2- 4	4	0.479	4.206	549.769				SPECIAL ORDER
11	2- 7	4	0.708	2.279	496.153				SPECIAL ORDER
12	3- 5	4	0.708	2.279	496.154				SPECIAL ORDER
13	3- 9	4	0.708	2.279	496.154				SPECIAL ORDER
14	4- 7	4	0.708	2.279	496.153				SPECIAL ORDER
15	2- 6	4	4.943	0.649	363.085				SPECIAL ORDER
16	3- 6	4	4.943	0.649	363.085				SPECIAL ORDER
17	3- 8	4	4.943	0.649	363.085				SPECIAL ORDER
18	4- 8	4	4.943	0.649	363.085				SPECIAL ORDER
19	5- 6	4	0.683	4.683	264.701				SPECIAL ORDER
20	6- 7	4	0.683	4.683	264.701				SPECIAL ORDER
21	7- 8	4	0.683	4.683	264.701				SPECIAL ORDER
22	8- 9	4	0.683	4.683	264.701				SPECIAL ORDER
23	2- 5	3	0.708	1.887	302.788				SPECIAL ORDER
24	3- 7	4	0.708	3.774	302.788				SPECIAL ORDER
25	4- 9	3	0.708	1.887	302.788				SPECIAL ORDER
26	5- 7	4	0.641	2.747	519.230				SPECIAL ORDER
27	7- 9	4	0.641	2.747	519.230				SPECIAL ORDER
28	5-11	4	1.221	2.537	439.066				SPECIAL ORDER
29	6-10	4	1.221	2.537	439.066				SPECIAL ORDER
30	6-12	4	1.221	2.537	439.065				SPECIAL ORDER
31	7-11	4	1.221	2.537	439.066				SPECIAL ORDER
32	7-13	4	1.221	2.537	439.066				SPECIAL ORDER
33	8-12	4	1.221	2.537	439.065				SPECIAL ORDER
34	8-14	4	1.221	2.537	439.066				SPECIAL ORDER

Table 2: Members

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
35	9-13	4	1.221	2.537	439.066				SPECIAL ORDER
36	5-10	3	0.747	1.478	303.894				SPECIAL ORDER
37	6-11	4	0.747	2.956	303.894				SPECIAL ORDER
38	7-12	4	0.747	2.956	303.894				SPECIAL ORDER
39	8-13	4	0.747	2.956	303.894				SPECIAL ORDER
40	9-14	3	0.747	1.478	303.894				SPECIAL ORDER
41	10-11	4	1.168	5.917	379.399				SPECIAL ORDER
42	11-12	4	1.168	5.917	379.400				SPECIAL ORDER
43	12-13	4	1.168	5.917	379.400				SPECIAL ORDER
44	13-14	4	1.168	5.917	379.399				SPECIAL ORDER
45	10-16	4	0.092	2.697	528.508				SPECIAL ORDER
46	11-15	4	0.092	2.697	528.506				SPECIAL ORDER
47	11-17	4	0.092	2.697	528.507				SPECIAL ORDER
48	12-16	4	0.092	2.697	528.507				SPECIAL ORDER
49	12-18	4	0.092	2.697	528.507				SPECIAL ORDER
50	13-17	4	0.092	2.697	528.507				SPECIAL ORDER
51	13-19	4	0.092	2.697	528.506				SPECIAL ORDER
52	14-18	4	0.092	2.697	528.508				SPECIAL ORDER
53	10-15	3	1.761	1.665	305.528				SPECIAL ORDER
54	11-16	4	1.761	3.329	305.528				SPECIAL ORDER
55	12-17	4	1.761	3.329	305.528				SPECIAL ORDER
56	13-18	4	1.761	3.329	305.528				SPECIAL ORDER
57	14-19	3	1.761	1.665	305.528				SPECIAL ORDER
58	15-16	4	1.761	4.691	490.175				SPECIAL ORDER
59	16-17	4	1.761	4.691	490.174				SPECIAL ORDER
60	17-18	4	1.761	4.691	490.174				SPECIAL ORDER
61	18-19	4	1.761	4.691	490.175				SPECIAL ORDER
62	1-21	4	0.292	4.387	375.860	1.760	5.250	0.281	D-442
63	1-50	3	0.292	8.705	165.105				SPECIAL ORDER
64	2-21	4	0.292	2.129	235.204	1.537	4.500	0.156	D-283
65	2-50	3	0.292	5.817	264.919	3.494	10.250	0.375	D-585
66	3-21	4	0.292	14.565	274.463				SPECIAL ORDER
67	3-22	4	0.292	4.418	274.463	1.332	4.125	0.375	D-443
68	3-48	4	0.292	2.945	340.186	1.515	4.500	0.219	D-356
69	3-50	4	0.292	3.829	340.186	1.726	5.125	0.250	D-413

Table 2: Members (Cont.)

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
70	4-22	4	0.292	2.101	235.204	1.765	5.125	0.134	D-280
71	4-48	3	0.292	1.421	264.919	1.142	3.500	0.281	D-348
72	5-21	4	0.292	4.387	376.279	1.760	5.250	0.281	D-442
73	5-25	4	0.292	2.916	293.355	1.747	5.125	0.188	D-355
74	6-21	4	0.292	3.232	331.931	2.332	6.750	0.156	D-376
75	6-25	4	0.292	4.712	202.801	1.420	4.375	0.375	D-456
76	6-26	4	0.292	5.600	347.779	2.245	6.625	0.281	D-490
77	7-21	4	0.292	16.770	420.125				SPECIAL ORDER
78	7-22	4	0.292	12.223	420.125	3.670	10.750	0.375	D-587
79	7-26	4	0.292	1.655	201.172	0.854	2.625	0.219	D-235
80	8-22	4	0.292	3.232	331.931	2.332	6.750	0.156	D-376
81	8-26	4	0.292	9.771	347.779	3.515	10.250	0.313	D-571
82	8-27	4	0.292	1.981	208.051	1.858	5.375	0.120	D-269
83	9-22	4	0.292	16.202	376.279				SPECIAL ORDER
84	9-27	4	0.292	9.355	271.485	3.063	9.000	0.344	D-567
85	10-25	4	0.292	6.112	404.201	2.003	6.000	0.344	D-503
86	10-29	3	0.292	0.785	192.386	0.810	2.500	0.219	D-225
87	11-25	4	0.292	4.665	314.614	2.399	7.000	0.219	D-455
88	11-26	4	0.292	6.084	464.465	2.190	6.500	0.313	D-501
89	11-30	4	0.292	14.213	248.044				SPECIAL ORDER
90	11-32	4	0.292	1.823	237.263	1.316	3.875	0.156	D-253
91	12-25	4	0.292	7.035	515.147	2.819	8.250	0.281	D-522
92	12-26	4	0.292	14.938	316.819				SPECIAL ORDER
93	12-27	4	0.292	8.983	539.862	2.699	8.000	0.375	D-560
94	12-33	4	0.292	1.741	192.386	0.898	2.750	0.219	D-245
95	13-26	4	0.292	6.283	464.465	2.830	8.250	0.250	D-506
96	13-27	4	0.292	14.298	327.759				SPECIAL ORDER
97	13-34	4	0.292	2.206	237.263	1.854	5.375	0.134	D-292
98	13-36	4	0.292	2.251	237.263	1.349	4.000	0.188	D-294
99	14-27	4	0.292	5.890	388.620	1.773	5.375	0.375	D-497
100	14-37	3	0.292	3.461	192.386	2.268	6.750	0.344	D-521
101	15-29	3	0.292	31.067	354.996				SPECIAL ORDER
102	15-30	4	0.292	6.653	367.135	2.180	6.500	0.344	D-515
103	16-30	4	0.292	7.035	386.130	2.819	8.250	0.281	D-522
104	16-31	4	0.292	4.025	354.996	1.814	5.375	0.250	D-424

Table 2: Members (Cont.)

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
105	16-32	4	0.292	6.152	375.140	2.466	7.250	0.281	D-504
106	17-32	4	0.292	4.516	375.139	2.035	6.000	0.250	D-449
107	17-33	4	0.292	6.283	354.996	2.830	8.250	0.250	D-506
108	17-34	4	0.292	4.387	375.139	1.760	5.250	0.281	D-442
109	18-34	4	0.292	8.099	375.140	2.434	7.250	0.375	D-546
110	18-35	4	0.292	4.171	363.276	2.498	7.250	0.188	D-432
111	18-36	4	0.292	6.152	375.139	2.466	7.250	0.281	D-504
112	19-36	4	0.292	6.627	375.139	1.993	6.000	0.375	D-514
113	19-37	3	0.292	13.571	354.996				SPECIAL ORDER
114	20-22	4	0.292	4.387	375.860	1.760	5.250	0.281	D-442
115	20-48	3	0.292	0.867	165.105	1.040	3.125	0.188	D-243
116	21-22	4	0.292	20.199	424.264				SPECIAL ORDER
117	21-26	4	0.292	5.269	422.089	2.113	6.250	0.281	D-476
118	21-38	2	0.292	34.891	150.000				SPECIAL ORDER
119	21-40	4	0.292	2.273	162.754	0.825	2.625	0.313	D-298
120	21-43	4	0.292	5.437	365.942	1.783	5.375	0.344	D-482
121	21-50	4	0.292	5.838	291.954	2.102	6.250	0.313	D-495
122	22-23	2	0.292	3.354	150.000	2.420	7.000	0.156	D-384
123	22-26	4	0.292	22.851	422.089				SPECIAL ORDER
124	22-41	4	0.292	2.496	162.754	1.802	5.250	0.156	D-318
125	22-47	4	0.292	2.842	285.550	1.142	3.500	0.281	D-348
126	22-48	4	0.292	3.547	291.954	1.825	5.375	0.219	D-398
127	24-25	2	0.292	73.045	235.000				SPECIAL ORDER
128	25-26	4	0.292	5.838	371.739	2.102	6.250	0.313	D-495
129	25-29	4	0.292	27.535	389.038				SPECIAL ORDER
130	25-30	4	0.292	32.860	316.833				SPECIAL ORDER
131	25-32	4	0.292	6.921	394.103	2.081	6.250	0.375	D-520
132	25-40	4	0.292	7.476	466.589	2.996	8.750	0.281	D-533
133	25-43	4	0.292	5.154	276.801	1.552	4.750	0.375	D-473
134	25-44	4	0.292	2.765	170.148	1.000	3.125	0.313	D-343
135	25-45	4	0.292	7.313	394.312	2.632	7.750	0.313	D-529
136	26-27	4	0.292	6.084	395.767	2.190	6.500	0.313	D-501
137	26-33	4	0.292	4.321	280.994	2.222	6.500	0.219	D-439
138	26-40	4	0.292	6.814	501.986	2.731	8.000	0.281	D-517
139	26-41	4	0.292	7.805	501.986	2.808	8.250	0.313	D-539

Table 2: Members (Cont.)

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
140	26-44	4	0.292	7.559	328.853	2.720	8.000	0.313	D-535
141	26-46	4	0.292	4.466	337.679	2.674	7.750	0.188	D-444
142	27-28	2	0.292	15.222	207.055				SPECIAL ORDER
143	27-34	4	0.292	6.283	419.008	2.830	8.250	0.250	D-506
144	27-36	4	0.292	4.240	313.470	1.528	4.625	0.313	D-434
145	27-37	4	0.292	4.466	372.824	2.674	7.750	0.188	D-444
146	27-41	4	0.292	9.572	461.923	2.876	8.500	0.375	D-569
147	27-45	4	0.292	14.264	416.177				SPECIAL ORDER
148	27-46	4	0.292	2.945	219.066	1.515	4.500	0.219	D-356
149	27-47	4	0.292	21.506	257.723				SPECIAL ORDER
150	29-30	4	0.292	2.452	203.816	2.300	6.625	0.120	D-314
151	30-31	4	0.292	1.661	231.298	0.996	3.000	0.188	D-237
152	30-43	4	0.292	13.544	417.728				SPECIAL ORDER
153	30-44	4	0.292	7.256	468.867	2.908	8.500	0.281	D-527
154	31-32	4	0.292	1.639	217.737	1.184	3.500	0.156	D-233
155	31-44	4	0.292	4.732	395.249	1.705	5.125	0.313	D-458
156	32-33	4	0.292	2.206	217.737	1.854	5.375	0.134	D-292
157	32-44	4	0.292	6.575	469.753	2.367	7.000	0.313	D-512
158	32-45	4	0.292	7.658	436.430	3.448	10.000	0.250	D-536
159	33-34	4	0.292	2.206	217.737	1.854	5.375	0.134	D-292
160	33-45	4	0.292	6.593	354.398	2.643	7.750	0.281	D-513
161	34-35	4	0.292	3.276	221.242	1.078	3.375	0.344	D-380
162	34-45	4	0.292	8.580	436.430	3.438	10.000	0.281	D-555
163	34-46	4	0.292	8.394	520.020	2.523	7.500	0.375	D-552
164	35-36	4	0.292	3.005	221.242	0.991	3.125	0.344	D-360
165	35-46	4	0.292	5.838	451.778	2.102	6.250	0.313	D-495
166	36-37	4	0.292	2.101	217.737	1.765	5.125	0.134	D-280
167	36-46	4	0.292	8.050	521.091	2.897	8.500	0.313	D-545
168	36-47	4	0.292	6.383	484.321	2.092	6.250	0.344	D-510
169	37-47	3	0.292	4.271	415.463	3.073	9.000	0.313	D-553
170	39-40	2	0.292	26.477	143.506				SPECIAL ORDER
171	40-44	4	0.292	3.977	346.543	2.045	6.000	0.219	D-421
172	40-41	4	0.292	31.413	287.013				SPECIAL ORDER
173	40-43	4	0.292	8.814	464.273	2.886	8.500	0.344	D-559
174	40-45	4	0.292	7.035	445.908	2.819	8.250	0.281	D-522

Table 2: Members (COnt.)

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
175	41-51	4	0.292	7.256	411.251	2.908	8.500	0.281	D-527
176	40-56	4	0.292	6.207	386.312	2.234	6.625	0.313	D-505
177	40-50	4	0.292	8.688	232.686	2.611	7.750	0.375	D-556
178	41-42	2	0.292	21.923	143.506				SPECIAL ORDER
179	41-45	4	0.292	13.438	445.908				SPECIAL ORDER
180	41-47	4	0.292	5.931	379.639	2.378	7.000	0.281	D-499
181	41-48	4	0.292	6.921	232.686	2.081	6.250	0.375	D-520
182	41-56	4	0.292	8.099	386.312	2.434	7.250	0.375	D-546
183	43-44	4	0.292	4.828	295.127	1.936	5.750	0.281	D-460
184	44-45	4	0.292	14.941	295.127				SPECIAL ORDER
185	45-46	4	0.292	15.572	295.058				SPECIAL ORDER
186	45-57	4	0.423	7.035	1524.134				SPECIAL ORDER
187	46-47	4	0.292	8.983	265.693	2.699	8.000	0.375	D-560
188	48-56	3	0.292	2.635	200.738	2.113	6.250	0.281	D-476
189	48-50	4	0.292	13.880	282.843				SPECIAL ORDER
190	51-52	2	0.292	4.828	75.000	1.936	5.750	0.281	D-460
191	56-50	3	0.292	1.043	200.738	1.074	3.250	0.219	D-279
192	43-51	4	0.292	55.264	567.604				SPECIAL ORDER
193	43-53	3	0.310	38.231	310.195				SPECIAL ORDER
194	53-54	3	0.310	38.233	310.166				SPECIAL ORDER
195	54-55	3	0.310	38.228	310.166				SPECIAL ORDER
196	55-58	3	0.310	38.236	310.165				SPECIAL ORDER
197	51-58	4	0.292	55.283	578.937				SPECIAL ORDER
198	51-53	4	0.292	12.749	410.396				SPECIAL ORDER
199	51-54	4	0.292	6.814	341.795	2.731	8.000	0.281	D-517
200	51-55	4	0.292	6.814	418.914	2.731	8.000	0.281	D-517
201	45-58	4	0.292	40.853	1106.452				SPECIAL ORDER
202	47-58	3	0.292	20.061	1058.034				SPECIAL ORDER
203	45-59	4	0.310	51.203	598.863				SPECIAL ORDER
204	56-59	3	0.310	72.446	800.765				SPECIAL ORDER
205	58-59	3	0.310	104.924	1118.016				SPECIAL ORDER
206	1-64	4	0.292	4.271	102.704	1.288	4.000	0.375	D-435
207	1-60	3	0.292	1.035	98.115	0.835	2.625	0.281	D-278
208	1-61	4	0.292	0.922	129.602	0.556	1.750	0.188	D-143
209	1-63	3	0.292	0.720	58.121	0.864	2.625	0.188	D-211

Table 2: Members (Cont.)

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
210	20-64	4	0.292	1.669	102.704	0.756	2.375	0.250	D-238
211	20-61	4	0.292	3.142	129.602	1.417	4.250	0.250	D-372
212	20-62	3	0.292	0.991	98.115	1.858	5.375	0.120	D-269
213	20-65	3	0.292	0.962	58.121	0.641	2.125	0.344	D-264
214	48-64	4	0.292	7.918	185.876	3.173	9.250	0.281	D-542
215	48-65	3	0.292	2.307	154.209	2.763	8.000	0.188	D-453
216	64-50	4	0.292	1.292	185.876	0.776	2.375	0.188	D-194
217	64-56	4	0.292	2.680	156.939	2.251	6.500	0.134	D-335
218	64-61	4	0.292	1.463	130.000	0.594	1.938	0.281	D-214
219	64-63	4	0.292	1.718	70.355	1.774	5.125	0.109	D-241
220	64-65	4	0.292	0.873	70.355	0.632	1.938	0.156	D-134
221	50-63	3	0.292	0.933	154.209	0.844	2.625	0.250	D-257
222	60-61	4	0.413	1.041	70.355				SPECIAL ORDER
223	60-63	3	0.292	0.574	130.000	0.831	2.500	0.156	D-176
224	61-62	4	0.413	0.955	70.355				SPECIAL ORDER
225	62-65	3	0.292	1.347	130.000	1.614	4.750	0.188	D-337
226	49-63	3	0.292	0.941	91.924	1.129	3.375	0.188	D-258
227	49-64	4	0.292	1.887	91.924	1.770	5.125	0.120	D-260
228	49-65	3	0.292	1.252	91.924	0.763	2.500	0.375	D-319
229	49-56	1	0.292	0.245	127.200	0.343	1.250	0.344	D-151

Table 2: Members (Cont.)

NO.	Member	Equiv. density	Area	Nu	Function
186	45-57	0.42	7.04	4	Feed support
193	43-53			3	
194	53-54	0.31	38.23	3	Gear on elev. wheel
195	54-55			3	
196	55-58			3	
201	45-58	0.29	40.85	4	Cone members
202	47-58		20.06	3	
203	45-59		51.20	4	
204	56-59	0.31	72.45	3	Suspensions
205	58-59		104.92	3	
222	60-61	0.41	1.04	4	Curve beam for vertex cabin
224	61-62		0.95	4	

Table 3

Members to be design specially

REPORT #34A
MARCH 1, 1971

REVISION - STRUCTURAL DESIGN OF 65-METER HOMOLOGY TELESCOPE

Woon-Yin Wong; NRAO, Charlottesville, Virginia

The design of the 65 meter telescope has been updated due to the following changes or requirements:

A. To overcome the low dynamic behavior of the declination wheel, a cable has been added between point 54 and point 45. The dynamic frequency of the wheel about its long axis (43-58) has been increased to 3.5 cps by introducing this cable with a cross-sectional area of 2.00 in^2 (Figure 1).

B. Point 48 has been lifted by 5 inches. This enables a bigger depth for the long member 56-59, this will in turn increase the dynamical frequency of the member.

C. The thickness of panel A,B, and C, which is the distance from the surface to the supporting points, has been increased by 5 inches. This will require the adjustment of point coordinates of points no. 5 to 14.

D. All members of the telescope structure are divided in 4 types: (Report #35)

Type		Number in one quadrant
1	Normal	139
2	Special order	17
3	Special design	12
4	Fictitious	61
5	Cable	1

Please note that 12 "Special order" has been eliminated and 12 "Normal" has been added. This is due to the fact that the table from which the selections are based on is not just one COR-TEN pipe, but also the PLATN END pipes.

The list of coordinates and member tables in this report will supersede those in Report #34.

The code name of the structure is EK031, dated 03/01/71.

POINT	COORDINATES X	COORDINATES Y	COORDINATES Z	RESTRAINTS OMEGA=1 X Y Z	RESTRAINTS OMEGA=2 X Y Z	RESTRAINTS OMEGA=6 X Y Z	POINT LOADS	MU
1	133.153	0.0	49.033	0 1 0	0 1 0	1 0 1	452.40	2
2	388.746	0.0	14.104	0 1 0	0 1 0	1 0 1	1151.20	2
3	274.884	274.884	14.104	0 0 0	0 0 0	0 0 0	2302.30	4
4	0.0	388.746	14.104	1 0 0	0 1 1	1 0 0	1151.20	2
5	679.875	0.0	-69.302	0 1 0	0 1 0	1 0 1	1019.60	2
6	628.122	260.177	-69.302	0 0 0	0 0 0	0 0 0	2039.20	4
7	480.744	480.744	-69.302	0 0 0	0 0 0	0 0 0	2039.20	4
8	260.177	628.122	-69.302	0 0 0	0 0 0	0 0 0	2039.20	4
9	0.0	679.875	-69.302	1 0 0	0 1 1	1 0 0	1019.60	2
10	974.352	0.0	-146.557	0 1 0	0 1 0	1 0 1	1454.20	2
11	900.193	372.872	-146.558	0 0 0	0 0 0	0 0 0	2908.40	4
12	688.978	688.978	-146.557	0 0 0	0 0 0	0 0 0	2908.40	4
13	372.872	900.193	-146.558	0 0 0	0 0 0	0 0 0	2908.40	4
14	0.0	974.352	-146.557	1 0 0	0 1 1	1 0 0	1454.20	2
15	1256.277	0.0	-264.031	0 1 0	0 1 0	1 0 1	1361.10	2
16	1160.649	480.757	-264.031	0 0 0	0 0 0	0 0 0	2722.20	4
17	888.322	888.322	-264.031	0 0 0	0 0 0	0 0 0	2722.20	4
18	480.757	1160.649	-264.031	0 0 0	0 0 0	0 0 0	2722.20	4
19	0.0	1256.277	-264.031	1 0 0	0 1 1	1 0 0	1361.10	2
20	0.0	133.153	49.033	1 0 0	0 1 1	1 0 0	452.40	2
21	450.000	150.000	184.600	0 0 0	0 0 0	0 0 0	0.0	4
22	150.000	450.000	184.600	0 0 0	0 0 0	0 0 0	0.0	4
23	0.0	450.000	184.600	1 1 1	0 1 1	1 1 1	0.0	0
24	746.410	0.0	87.806	1 1 1	1 1 1	1 0 1	0.0	0
25	746.410	235.000	87.806	0 0 0	0 0 0	0 0 0	0.0	4
26	551.000	551.000	100.000	0 0 0	0 0 0	0 0 0	0.0	4
27	207.055	746.410	87.806	0 0 0	0 0 0	0 0 0	0.0	4
28	0.0	746.410	87.806	1 1 1	0 1 1	1 1 1	0.0	0
29	1050.000	0.0	24.885	0 1 0	0 1 0	1 0 1	0.0	2
30	1030.000	190.000	-46.114	0 0 0	0 0 0	0 0 0	0.0	4

Table 1: Points

31	970.074	401.818	24.885	0 0 0	0 0 0	0 0 0	0.0	4
32	873.043	583.349	-46.114	0 0 0	0 0 0	0 0 0	0.0	4
33	742.462	742.462	24.885	0 0 0	0 0 0	0 0 0	0.0	4
34	583.349	873.043	-46.114	0 0 0	0 0 0	0 0 0	0.0	4
35	401.818	970.074	35.000	0 0 0	0 0 0	0 0 0	0.0	4
36	204.845	1029.825	-46.114	0 0 0	0 0 0	0 0 0	0.0	4
37	0.0	1050.000	24.885	1 0 0	0 1 1	1 0 0	0.0	2
38	450.000	0.0	184.600	1 1 1	1 1 1	1 0 1	0.0	0
39	346.455	0.0	310.000	1 1 1	1 1 1	1 0 1	0.0	0
40	346.455	143.506	310.000	0 0 0	0 0 0	0 0 0	0.0	4
41	143.506	346.455	310.000	0 0 0	0 0 0	0 0 0	0.0	4
42	0.0	346.455	310.000	1 1 1	0 1 1	1 1 1	0.0	0
43	780.685	0.0	230.000	0 1 0	0 1 0	1 0 1	0.0	2
44	659.394	259.051	230.000	0 0 0	0 0 0	0 0 0	0.0	4
45	538.102	538.102	230.000	0 0 0	0 0 0	0 0 0	0.0	4
46	250.000	600.000	245.000	0 0 0	0 0 0	0 0 0	0.0	4
47	0.0	688.700	230.000	1 0 0	0 1 1	1 0 0	0.0	2
48	0.0	200.000	195.000	1 0 0	0 1 1	1 0 0	0.0	2
49	0.0	0.0	90.000	1 1 0	0 1 1	1 0 1	2250.00	1
50	200.000	0.0	200.000	0 1 0	0 1 0	1 0 1	0.0	2
51	325.000	75.000	560.000	0 0 0	0 0 0	0 0 0	0.0	4
52	325.000	0.0	560.000	1 1 1	1 1 1	1 0 1	0.0	0
53	727.758	0.0	535.624	0 1 0	0 1 0	1 0 1	0.0	2
54	560.045	0.0	796.545	0 1 0	0 1 0	1 0 1	500.00	2
55	303.997	0.0	971.608	0 1 0	0 1 0	1 0 1	5000.00	2
56	0.0	0.0	217.200	1 1 0	0 1 1	1 0 1	41000.00	1
57	0.0	0.0	-1090.560	1 1 0	0 1 1	1 0 1	0.0	1
58	0.0	0.0	1033.200	1 1 0	1 1 1	1 1 1	1125.00	1
59	0.0	800.000	252.200	1 0 1	1 1 1	1 1 1	2250.00	2
60	91.924	0.0	-40.000	0 1 0	0 1 0	1 0 1	1125.00	2
61	65.000	65.000	-40.000	0 0 0	0 0 0	0 0 0	0.0	4
62	0.0	91.924	-40.000	1 0 0	0 1 1	1 0 0	0.0	2
63	91.924	0.0	90.000	0 1 0	0 1 0	1 0 1	0.0	2
64	65.000	65.000	90.000	0 0 0	0 0 0	0 0 0	0.0	4
65	0.0	91.924	90.000	1 0 0	0 1 1	1 0 0	0.0	2

Table 1: Points (cont.)

NC	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
1	1-20	4	0.479	0.609	188.306				SPECIAL DESIGN
2	1- 4	4	0.164	3.144	412.398				SPECIAL DESIGN
3	2-20	4	0.164	3.144	412.398				SPECIAL DESIGN
4	1- 3	4	9.594	0.476	311.238				SPECIAL DESIGN
5	3-20	4	9.594	0.476	311.238				SPECIAL DESIGN
6	2- 3	4	0.517	4.613	297.532				SPECIAL DESIGN
7	3- 4	4	0.517	4.613	297.532				SPECIAL DESIGN
8	1- 2	3	0.164	1.337	257.969				SPECIAL DESIGN
9	4-20	3	0.164	1.337	257.969				SPECIAL DESIGN
10	2- 4	4	0.479	4.206	549.769				SPECIAL DESIGN
11	2- 7	4	0.708	2.279	496.153				SPECIAL DESIGN
12	3- 5	4	0.708	2.279	496.154				SPECIAL DESIGN
13	3- 9	4	0.708	2.279	496.154				SPECIAL DESIGN
14	4- 7	4	0.708	2.279	496.153				SPECIAL DESIGN
15	2- 6	4	4.943	0.649	363.085				SPECIAL DESIGN
16	3- 6	4	4.943	0.649	363.085				SPECIAL DESIGN
17	3- 8	4	4.943	0.649	363.085				SPECIAL DESIGN
18	4- 8	4	4.943	0.649	363.085				SPECIAL DESIGN
19	5- 6	4	0.683	4.683	264.701				SPECIAL DESIGN
20	6- 7	4	0.683	4.683	264.701				SPECIAL DESIGN
21	7- 8	4	0.683	4.683	264.701				SPECIAL DESIGN
22	8- 9	4	0.683	4.683	264.701				SPECIAL DESIGN
23	2- 5	3	0.708	1.887	302.788				SPECIAL DESIGN
24	3- 7	4	0.708	3.774	302.788				SPECIAL DESIGN
25	4- 9	3	0.708	1.887	302.788				SPECIAL DESIGN
26	5- 7	4	0.641	2.747	519.230				SPECIAL DESIGN
27	7- 9	4	0.641	2.747	519.230				SPECIAL DESIGN
28	5-11	4	1.221	2.537	439.066				SPECIAL DESIGN
29	6-10	4	1.221	2.537	439.066				SPECIAL DESIGN
30	6-12	4	1.221	2.537	439.065				SPECIAL DESIGN
31	7-11	4	1.221	2.537	439.066				SPECIAL DESIGN
32	7-13	4	1.221	2.537	439.066				SPECIAL DESIGN
33	8-12	4	1.221	2.537	439.065				SPECIAL DESIGN
34	8-14	4	1.221	2.537	439.066				SPECIAL DESIGN

Table 2: Members

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
35	9-13	4	1.221	2.537	439.066				SPECIAL DESIGN
36	5-10	3	0.747	1.478	303.894				SPECIAL DESIGN
37	6-11	4	0.747	2.956	303.894				SPECIAL DESIGN
38	7-12	4	0.747	2.956	303.894				SPECIAL DESIGN
39	8-13	4	0.747	2.956	303.894				SPECIAL DESIGN
40	9-14	3	0.747	1.478	303.894				SPECIAL DESIGN
41	10-11	4	1.168	5.917	379.399				SPECIAL DESIGN
42	11-12	4	1.168	5.917	379.400				SPECIAL DESIGN
43	12-13	4	1.168	5.917	379.400				SPECIAL DESIGN
44	13-14	4	1.168	5.917	379.399				SPECIAL DESIGN
45	10-15	4	0.092	2.697	528.508				SPECIAL DESIGN
46	11-15	4	0.092	2.697	528.506				SPECIAL DESIGN
47	11-17	4	0.092	2.697	528.507				SPECIAL DESIGN
48	12-16	4	0.092	2.697	528.507				SPECIAL DESIGN
49	12-18	4	0.092	2.697	528.507				SPECIAL DESIGN
50	13-17	4	0.092	2.697	528.507				SPECIAL DESIGN
51	13-19	4	0.092	2.697	528.506				SPECIAL DESIGN
52	14-18	4	0.092	2.697	528.508				SPECIAL DESIGN
53	10-15	3	1.761	1.665	305.528				SPECIAL DESIGN
54	11-16	4	1.761	3.329	305.528				SPECIAL DESIGN
55	12-17	4	1.761	3.329	305.528				SPECIAL DESIGN
56	13-18	4	1.761	3.329	305.528				SPECIAL DESIGN
57	14-19	3	1.761	1.665	305.528				SPECIAL DESIGN
58	15-16	4	1.761	4.691	490.175				SPECIAL DESIGN
59	16-17	4	1.761	4.691	490.174				SPECIAL DESIGN
60	17-18	4	1.761	4.691	490.174				SPECIAL DESIGN
61	18-19	4	1.761	4.691	490.175				SPECIAL DESIGN
62	1-21	4	0.292	4.337	375.860	1.856	5.250	0.281	D-420
63	1-50	3	0.292	8.705	165.105				SPECIAL ORDER
64	2-21	4	0.292	2.129	235.204	1.591	4.500	0.156	D-365
65	2-50	3	0.292	5.817	264.919	3.624	10.250	0.375	D-579
66	3-21	4	0.292	14.579	274.463	4.508	12.750	0.375	A- 74
67	3-22	4	0.292	4.418	274.463	1.458	4.125	0.375	D-348
68	3-49	4	0.292	2.945	337.479	1.591	4.500	0.219	D-367
69	3-50	4	0.292	3.829	340.186	1.812	5.125	0.250	D-411

Table 2: Members (cont.)

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
70	4-22	4	0.292	2.101	235.204	1.812	5.125	0.134	D-407
71	4-48	3	0.292	1.421	261.435	1.237	3.500	0.281	D-307
72	5-21	4	0.292	4.387	376.279	1.856	5.250	0.281	D-420
73	5-25	4	0.292	2.916	293.355	1.812	5.125	0.188	D-409
74	6-21	4	0.292	3.232	331.931	2.386	6.750	0.156	D-487
75	6-25	4	0.292	4.712	202.801	2.210	6.250	0.250	D-465
76	6-26	4	0.292	5.600	347.779	2.342	6.625	0.281	D-484
77	7-21	4	0.292	16.770	420.125				SPECIAL ORDER
78	7-22	4	0.292	12.223	420.125	3.801	10.750	0.375	D-587
79	7-26	4	0.292	1.655	201.172	0.928	2.625	0.219	D-250
80	8-22	4	0.292	3.232	331.931	2.386	6.750	0.156	D-487
81	8-26	4	0.292	9.771	347.779	3.624	10.250	0.313	D-577
82	8-27	4	0.292	1.981	208.051	1.900	5.375	0.120	D-425
83	9-22	4	0.292	16.202	376.279				SPECIAL ORDER
84	9-27	4	0.292	9.355	271.485	3.182	9.000	0.344	D-553
85	10-25	4	0.292	6.112	404.201	2.121	6.000	0.344	D-457
86	10-29	3	0.292	0.785	192.386	0.884	2.500	0.219	D-242
87	11-25	4	0.292	4.665	314.614	2.475	7.000	0.219	D-497
88	11-26	4	0.292	6.084	464.465	2.298	6.500	0.313	D-478
89	11-30	4	0.292	14.579	248.044	4.508	12.750	0.375	A- 74
90	11-32	4	0.292	1.823	237.263	1.370	3.875	0.156	D-327
91	12-25	4	0.292	7.035	515.147	2.917	8.250	0.281	D-533
92	12-26	4	0.292	14.579	316.819	4.508	12.750	0.375	A- 74
93	12-27	4	0.292	8.983	539.862	2.828	8.000	0.375	D-530
94	12-33	4	0.292	1.741	192.386	0.972	2.750	0.219	D-258
95	13-26	4	0.292	6.283	464.465	2.917	8.250	0.250	D-532
96	13-27	4	0.292	14.579	327.759	4.508	12.750	0.375	A- 74
97	13-34	4	0.292	2.206	237.263	1.900	5.375	0.134	D-426
98	13-36	4	0.292	2.251	237.263	1.414	4.000	0.188	A- 31
99	14-27	4	0.292	5.890	388.620	2.740	7.750	0.250	D-519
100	14-37	3	0.292	3.461	192.386	2.386	6.750	0.344	D-493
101	15-29	3	0.292	31.067	354.996				SPECIAL ORDER
102	15-30	4	0.292	6.653	367.135	2.298	6.500	0.344	D-479
103	16-30	4	0.292	7.035	386.130	2.917	8.250	0.281	D-533
104	16-31	4	0.292	4.025	354.996	1.900	5.375	0.250	D-430

Table 2: Members (cont.)

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
105	16-32	4	0.292	6.152	375.140	2.563	7.250	0.281	D-506
106	17-32	4	0.292	4.516	375.139	2.121	6.000	0.250	D-454
107	17-33	4	0.292	6.283	354.996	2.917	8.250	0.250	D-532
108	17-34	4	0.292	4.387	375.139	1.856	5.250	0.281	D-420
109	18-34	4	0.292	8.099	375.140	2.563	7.250	0.375	D-509
110	18-35	4	0.292	4.171	363.276	2.563	7.250	0.188	D-503
111	18-36	4	0.292	6.152	375.139	2.563	7.250	0.281	D-506
112	19-36	4	0.292	6.627	375.139	2.121	6.000	0.375	D-458
113	19-37	3	0.292	13.571	354.996				SPECIAL ORDER
114	20-22	4	0.292	4.387	375.860	1.856	5.250	0.281	D-420
115	20-48	3	0.292	0.867	160.546	1.105	3.125	0.188	D-280
116	21-22	4	0.292	20.199	424.264				SPECIAL ORDER
117	21-26	4	0.292	5.269	422.089	2.210	6.250	0.281	D-466
118	21-38	2	0.292	34.891	150.000				SPECIAL ORDER
119	21-40	4	0.292	2.273	162.754	0.928	2.625	0.313	D-253
120	21-43	4	0.292	5.437	365.942	1.900	5.375	0.344	D-433
121	21-50	4	0.292	5.838	291.954	2.210	6.250	0.313	D-467
122	22-23	2	0.292	3.354	150.000	2.475	7.000	0.156	D-495
123	22-26	4	0.292	22.851	422.089				SPECIAL ORDER
124	22-41	4	0.292	2.503	162.754	0.884	2.500	0.375	D-247
125	22-47	4	0.292	2.842	285.550	1.237	3.500	0.281	D-307
126	22-48	4	0.292	3.547	291.733	1.900	5.375	0.219	D-429
127	24-25	2	0.292	73.045	235.000				SPECIAL ORDER
128	25-26	4	0.292	5.838	371.739	2.210	6.250	0.313	D-467
129	25-29	4	0.292	27.535	389.038				SPECIAL ORDER
130	25-30	4	0.292	32.860	316.833				SPECIAL ORDER
131	25-32	4	0.292	6.921	394.103	2.210	6.250	0.375	D-469
132	25-40	4	0.292	7.476	466.589	3.094	8.750	0.281	D-546
133	25-43	4	0.292	5.154	276.801	1.679	4.750	0.375	D-388
134	25-44	4	0.292	2.765	170.148	1.105	3.125	0.313	D-284
135	25-45	4	0.292	7.313	394.312	2.740	7.750	0.313	D-521
136	26-27	4	0.292	6.084	395.767	2.298	6.500	0.313	D-478
137	26-33	4	0.292	4.321	280.994	2.298	6.500	0.219	D-475
138	26-40	4	0.292	6.814	501.986	2.828	8.000	0.281	D-527
139	26-41	4	0.292	7.805	501.986	2.917	8.250	0.313	D-534

Table 2: Members (cont.)

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
140	26-44	4	0.292	7.559	328.853	2.828	8.000	0.313	D-528
141	26-46	4	0.292	4.466	337.679	2.740	7.750	0.188	D-517
142	27-28	2	0.292	15.377	207.055	5.657	16.000	0.312	A- 95
143	27-34	4	0.292	6.283	419.008	2.917	8.250	0.250	D-532
144	27-36	4	0.292	4.240	313.470	1.635	4.625	0.313	D-378
145	27-37	4	0.292	4.466	372.824	2.740	7.750	0.188	D-517
146	27-41	4	0.292	9.572	461.923	3.005	8.500	0.375	D-542
147	27-45	4	0.292	14.579	416.177	4.508	12.750	0.375	A- 74
148	27-46	4	0.292	2.945	219.066	1.591	4.500	0.219	D-367
149	27-47	4	0.292	21.506	257.723				SPECIAL ORDER
150	29-30	4	0.292	2.452	203.816	2.342	6.625	0.120	D-481
151	30-31	4	0.292	1.661	231.298	1.061	3.000	0.188	D-272
152	30-43	4	0.292	13.417	417.728	4.950	14.000	0.312	A- 84
153	30-44	4	0.292	7.256	468.867	3.005	8.500	0.281	D-539
154	31-32	4	0.292	1.639	217.737	1.237	3.500	0.156	D-303
155	31-44	4	0.292	4.732	395.249	1.812	5.125	0.313	D-413
156	32-33	4	0.292	2.206	217.737	1.900	5.375	0.134	D-426
157	32-44	4	0.292	6.575	469.753	2.475	7.000	0.313	D-500
158	32-45	4	0.292	7.658	436.430	3.536	10.000	0.250	D-570
159	33-34	4	0.292	2.206	217.737	1.900	5.375	0.134	D-426
160	33-45	4	0.292	6.594	354.398	2.740	7.750	0.281	D-520
161	34-35	4	0.292	3.276	221.242	1.193	3.375	0.344	D-301
162	34-45	4	0.292	8.580	436.430	3.536	10.000	0.281	D-571
163	34-46	4	0.292	8.394	520.020	2.652	7.500	0.375	D-516
164	35-36	4	0.292	3.005	221.242	1.105	3.125	0.344	D-285
165	35-46	4	0.292	5.838	451.778	2.210	6.250	0.313	D-467
166	36-37	4	0.292	2.101	217.737	1.812	5.125	0.134	D-407
167	36-46	4	0.292	8.050	521.091	3.005	8.500	0.313	D-540
168	36-47	4	0.292	6.383	484.321	2.210	6.250	0.344	D-468
169	37-47	3	0.292	4.271	415.463	3.182	9.000	0.313	D-552
170	39-40	2	0.292	26.477	143.506				SPECIAL ORDER
171	40-44	4	0.292	3.977	346.543	2.121	6.000	0.219	D-453
172	40-41	4	0.292	31.413	287.013				SPECIAL ORDER
173	40-43	4	0.292	8.814	464.273	3.005	8.500	0.344	D-541
174	40-45	4	0.292	7.035	445.908	2.917	8.250	0.281	D-533

Table 2: Members (cont.)

NO	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
175	41-51	4	0.292	7.256	411.251	3.005	8.500	0.281	D-539
176	40-56	4	0.292	6.207	386.312	2.342	6.625	0.313	D-485
177	40-50	4	0.292	8.688	232.686	2.740	7.750	0.375	D-523
178	41-42	2	0.292	21.923	143.506				SPECIAL ORDER
179	41-45	4	0.292	13.417	445.308	4.950	14.000	0.312	A- 84
180	41-47	4	0.292	5.931	379.639	2.475	7.000	0.281	D-499
181	41-48	4	0.292	6.921	235.091	2.210	6.250	0.375	D-469
182	41-56	4	0.292	8.099	386.312	2.563	7.250	0.375	D-509
183	43-44	4	0.292	4.828	295.127	2.033	5.750	0.281	D-447
184	44-45	4	0.292	14.579	295.127	4.508	12.750	0.375	A- 74
185	45-46	4	0.292	15.377	295.058	5.657	16.000	0.312	A- 95
186	45-57	4	0.423	7.035	1524.134				SPECIAL DESIGN
187	46-47	4	0.292	8.983	265.693	2.828	8.000	0.375	D-530
188	48-56	3	0.292	2.635	201.228	2.210	6.250	0.281	D-466
189	48-50	4	0.292	13.417	282.887	4.950	14.000	0.312	A- 84
190	51-52	2	0.292	4.828	75.000	2.033	5.750	0.281	D-447
191	56-50	3	0.292	1.043	200.738	1.149	3.250	0.219	D-289
192	43-51	4	0.292	55.264	567.604				SPECIAL ORDER
193	43-53	3	0.310	38.231	310.195				SPECIAL DESIGN
194	53-54	3	0.310	38.233	310.166				SPECIAL DESIGN
195	54-55	3	0.310	38.228	310.166				SPECIAL DESIGN
196	55-58	3	0.310	38.236	310.165				SPECIAL DESIGN
197	51-58	4	0.292	55.283	578.937				SPECIAL ORDER
198	51-53	4	0.292	12.876	410.396	4.508	12.750	0.330	A- 73
199	51-54	4	0.292	6.814	341.795	2.828	8.000	0.281	D-527
200	51-55	4	0.292	6.814	418.914	2.828	8.000	0.281	D-527
201	45-58	4	0.292	40.853	1106.452				SPECIAL DESIGN
202	47-58	3	0.292	20.061	1058.034				SPECIAL DESIGN
203	45-59	4	0.310	51.203	598.863				SPECIAL DESIGN
204	56-59	3	0.310	72.446	800.765				SPECIAL DESIGN
205	58-59	3	0.310	104.924	1118.016				SPECIAL DESIGN
206	1-64	4	0.292	4.271	102.704	1.414	4.000	0.375	D-340
207	1-60	3	0.292	1.035	98.115	0.928	2.625	0.281	D-252
208	1-61	4	0.292	0.923	129.602	0.619	1.750	0.188	D-171
209	1-63	3	0.292	0.720	58.121	0.928	2.625	0.188	D-249

Table 2: Members (cont.)

NC	INC	NU	DENS	AREA	LENGTH	R	DIA	T	TABLE
210	20-64	4	0.292	1.669	102.704	0.840	2.375	0.250	D-235
211	20-61	4	0.292	3.142	129.602	1.503	4.250	0.250	D-352
212	20-62	3	0.292	0.991	98.115	1.900	5.375	0.120	D-425
213	20-65	3	0.292	0.962	58.121	0.751	2.125	0.344	D-222
214	48-64	4	0.292	7.918	182.962	3.270	9.250	0.281	D-556
215	48-65	3	0.292	2.307	150.683	2.828	8.000	0.188	D-524
216	64-50	4	0.292	1.292	185.876	0.840	2.375	0.188	D-233
217	64-56	4	0.292	2.680	156.939	2.298	6.500	0.134	D-472
218	64-61	4	0.292	1.463	130.000	0.685	1.938	0.281	D-204
219	64-63	4	0.413	1.718	70.355	1.812	5.125	0.109	D-405
220	64-65	4	0.413	0.873	70.355	0.685	1.938	0.156	D-200
221	50-63	3	0.292	0.933	154.209	0.928	2.625	0.250	D-251
222	60-61	4	0.413	1.041	70.355				SPECIAL DESIGN
223	60-63	3	0.292	0.574	130.000	0.884	2.500	0.156	D-240
224	61-62	4	0.413	0.955	70.355				SPECIAL DESIGN
225	62-65	3	0.292	1.344	130.000	1.458	4.125	0.219	D-343
226	49-63	3	0.292	0.941	91.924	1.193	3.375	0.188	D-296
227	49-64	4	0.292	1.887	91.924	1.812	5.125	0.120	D-406
228	49-65	3	0.292	1.252	91.924	0.884	2.500	0.375	D-247
229	49-56	1	0.292	0.245	127.200	0.530	1.500	0.250	D-135
230	45-54	4	0.292	2.000	781.677				SPECIAL DESIGN

Table 2: Members (cont.)

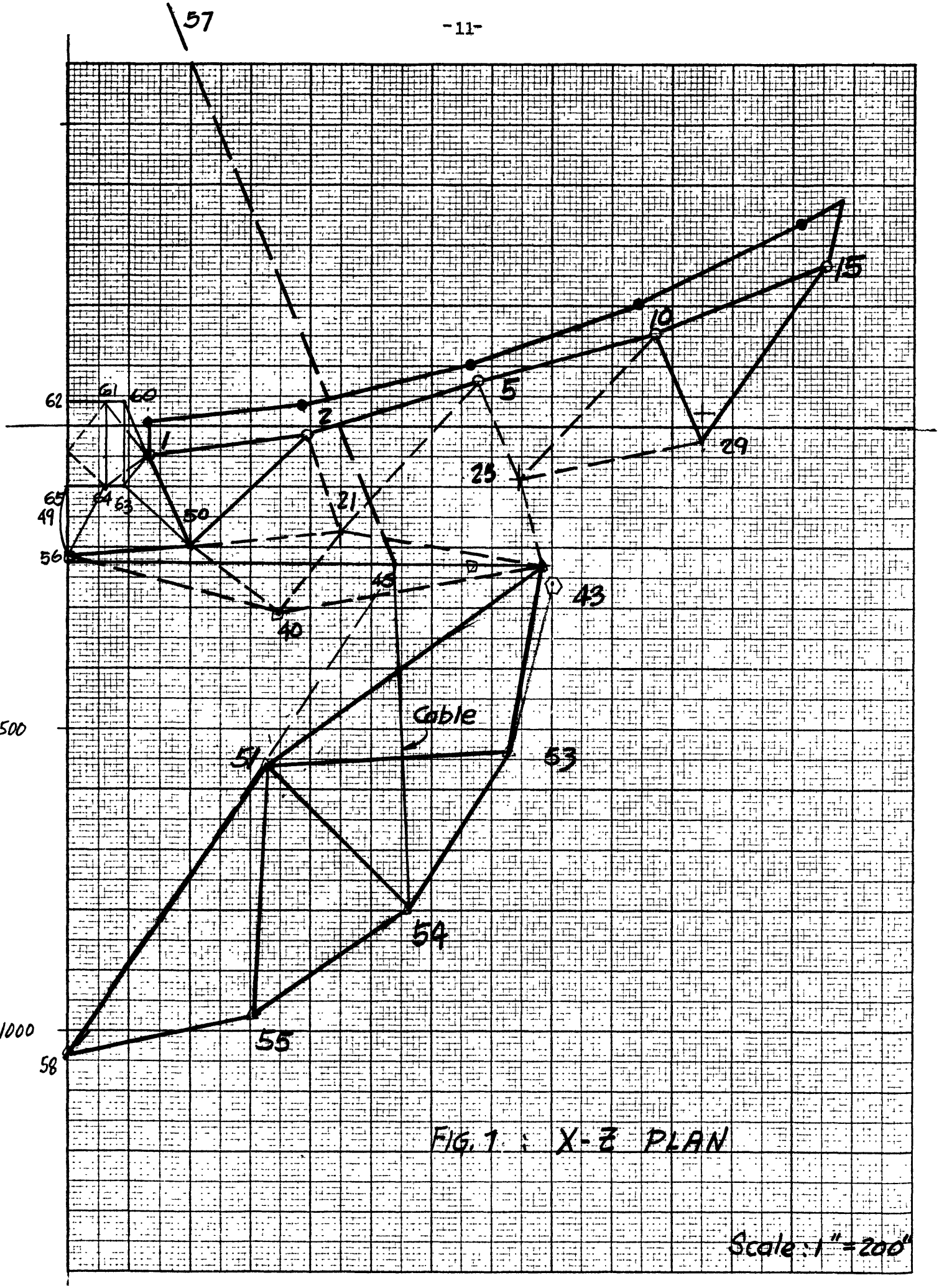
57
15
10
5
2
1
29
25
21
62
61
60
65
64
63
49
50
56
46
43
40
Cable
+500
51
53
54
+1000
55
58
Scale: 1" = 200'

FIG. 1 : X-Z PLAN

NATIONAL RADIO ASTRONOMY OBSERVATORY

Charlottesville, Virginia

December 30, 1970

TO: 65 Meter Homology Telescope Design Group

FROM: W. Y. Wong

SUBJECT: Correction on Report No. 34

Enclosed please find replacement pages (18-24) to be inserted in Report No. 34. Table 2 of the original report was found to be erroneous. Under the "Density" column, whenever the density reads 0.283, the adjustment due to spherical joints is not being included. The correct figure should be 0.292. This is only a typographical error, however, and does not effect the results of the telescope.

WYW;sw

Corrected pages filed; incorrect pages discarded