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Collider Accelerator Department

Brookhaven National Laboratory

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COORDINATES of the MAGNETS and SURVEY MONUMENTS for the AGS BOOSTER

AD

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ABSTRACT

Coordinates of the Booster elements and survey Monuments are generated in the Booster centered frame, AGS and BNL grids. Five possible schemes for the locations of the Survey points is given, and corresponding sets of coordinates for these Survey points with respect to the three frames are generated and tabulated. This updates the preliminary survey of the Booster coordinates.

TABLE OF CONTENTS

I. INTRODUCTION

Coordinates of the Booster MAGNETS are generated with BSGE02.FOR. The coordinates of the survey Monuments relative to a)Booster centered frame, b) AGS, and c) BNL grids are obtained and given in Tables I-(A,B,C) to V-(A,B,C) respectively. These survey points (Monuments) are to be placed in the Booster Tunnel, a perpendicular distance d from the upstream ends of QF Magnets (Tables I-V, corresponds to d=1.1m, 1.2m, 1.3m, 1.4m, 1.5m respectively). In Sections II, and III a discussion of the coordinates and the survey points (monuments and markers) is presented, and in Table VI, coordinates of the Apex of the dipoles and centers of the quadrupoles and sextupoles (in the Booster centered frame and AGS grid) are tabulated. Labeling convention for the magnets are the same as those we previously used for the Booster Design Manual.

Figure 1, is a layout of the AGS Booster showing the dipole Apex locations and relative position of the magnets. Figure 2, shows the a) top, b) bottom, c) side views of the AGS Booster half cell assembly and Figure 3, shows the Booster Tunnel Cross Section, from which the location of the 5 possible sets of the monuments (coordinates given in Tables I-V) can be deduced.

II. COORDINATES

The Booster centered frame East (as X) and North (as Y) axes with lengths measured in meters (m) were used in generating the survey coordinates for the AGS Booster. The values listed in this note (Tables) corresponds to the coordinates of an on - axis point of (down stream, center, or upstream end as defined) that element when viewed in a clockwise direction. With Alpha= o.1617647 (defined in Reference 1), the transformation equations given in [1] and the coordinates for the Booster center (Xc,Yc) given in the

AGS grid (in)	BNL grid (ft)
Xc ags = 1,148.88	Xc bnl = 98,517.19
Yc ags = 1,5459.36	Yc bnl = 102,438.28

In the present calculation we used the Iron lamination lengths of 2.3148 m and 0.42228 m for the dipoles (chord) and quadrupoles. (Assuming the magnets have sharp edges where the field becomes zero.).

The transformation from the Booster centered reference system to the AGS and BNL grids are reviewed in [1].

III. SURVEY POINTS

Tables I-V provides the coordinates for 5 different possible choices of (24)survey monuments. The choice of the location of the monuments (i.e. survey points to be placed in the Booster tunnel) is arbitrary as long as they don't interfere with wirings, pipes, etc. in the tunnel. Each monuments is placed a perpendicular distance d from the upstream end of each focusing quadrupole QF. (This is also chosen arbitrarily, for reference in surveying). The 5 possible scenarios of 24 survey monuments given in Tables I-V corresponds to d = 1.1m, 1.2m, 1.3m 1.4m,1.5m respectively. We do not recommend using d < 1.1 or d > 1.5 since it could lead to space problem. If the surveyors find no specific interference or problem, (theoretically, one can use any of the sets although), we recommend d = 1.2m or d=1.3 m since it provides a larger distance from both the tunnel walls and the quads (that may have to be aligned more (sensitive) than other elements).

Thus at the completion of construction, the surveyors are to determine the number and locations of the monuments around the ring, (to assure the location of these survey points (generated) would not interfere with the pipes, magnet installations etc. Then, if needed we will generate a new set of coordinates for the selected points.

Previously, (at ADD/AP meeting and e.g. in Ref. [1]) we recommended Possible schemes for the location of survey markers for the Booster elements (e.g similar to those used in AGS or that which was proposed for ISABEL, (i.e. the use of 3 markers per magnet). From the information and recent discussions with members of ADD and Booster Group, It seems that two markers (called Bushings, placed at the upstream and downstream ends of each magnet) per magnet may be sufficient.

In the case of sextupoles, only one marker (at the center) may be needed, since they have a rather small length (lamination length of 0.075 m and magnetic length of 0.1m). A set of coordinate for the markers are included in the Update for the Design Manual.

Note, that the final decision on the locations of the markers on the magnets should be made such that cables and equipments would not interfere with markers visibility.

IV. CONCLUSION

The coordinates of the Booster were generated using the lamination lengths of the magnets. The coordinates generated using the magnetic lengths of the Booster elements were given in Ref. [1]. The results obtained for (5) possible sets of (24) Monuments (that could be placed in the Booster tunnel for survey measurements) is given in Tables I-V (a,b,c). The coordinates are given in the Booster centered reference system, AGS and BNL grids. The coordinates of the apex of the dipoles and centers of the quadrupoles and sextupoles in these reference frames are also tabulated (Table VI), and can be used for reference in survey measurements and/or alignment of the elements in the Booster Tunnel. As discussed in section III, if no obstacles and/or interference with the magnet installations, pipes, wiring, etc, we recommend the use of our second or third schemes (Tables II (A,B,C) or Tables III (A,B,C)) for the location of the survey monuments in the Booster Tunnel.

V. REFERENCES

1. Z. Parsa, Booster Technical Note No. 100, Nov. 1987;

   Booster Design Manual.

2. Originally was designed for ISABEL (E. Courant). Modified for the Booster (BSGE02.FOR VAX version), with Courant, Dell. This program is being further modified in the hope of making it input (format) independent, and to run it on IBM (with E. Courant).

3. used tape 15 generated from Program SYNCH, A. Garren, Principle author, SSC Central Design Group, Berkeley, California. The program is available in the

   BNLDAG::DUA0:[PARSA1.SYNCH] DIRECTORY.

4. S. Turner, ed., Applied Geodesy, (Lecture Notes in Earth Sciences, Proc. CERN Acc.School, Geneva 1987), Springer-Verlag, 1987.

5. S. Krinsky, Data Analysis for the Preliminary Survey of the X-Ray Ring's Primary Monuments, 1981.

VI. ACKNOWLEDGEMENT

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TABLE I-A

COORDINATES OF THE SURVEY "MONUMENTS" IN BOOSTER CENTERED FRAME. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.1 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

MONUMENTS COORDINATES IN THE BOOSTER FRAME

NUM	QUAD	X(m)	Y(m)
1	MQA1	31.32855	-10.35657
2	MQA3	27.35469	-17.90774
3	MQA5	21.65937	-24.39327
4	MQA7	14.87025	-29.54067
5	MQB1	6.69520	-32.30964
6	MQB3	-1.83124	-32.64376
7	MQB5	-10.29552	-30.95423
8	MQB7	-18.14787	-27.64838
9	MQC1	-24.63339	-21.95306
10	MQC3	-29.18597	-14.73601
11	MQC5	-31.95494	-6.56096
12	MQC7	-33.01815	1.89230
13	MQD1	-31.32863	10.35659
14	MQD3	-27.35476	17.90776
15	MQD5	-21.65945	24.39328
16	MQD7	-14.87032	29.54068
17	MQE1	-6.69527	32.30965
18	MQE3	1.83117	32.64377
19	MQE5	10.29545	30.95424
20	MQE7	18.14780	27.64839
21	MQF1	24.63332	21.95307
22	MQF3	29.18589	14.73602
23	MQF5	31.95486	6.56097
24	MQF7	33.01808	-1.89229

TABLE I-B

COORDINATES OF THE SURVEY "MONUMENTS" IN THE AGS GRID. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.1 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

	MONUMENTS COORDINATES IN THE AGS GRID		
NUM	QUAD	N(in)	E(in)
1	MQA1	15051.621	2382.288
2	MQA3	14754.331	2225.836
3	MQA5	14498.995	2001.611
4	MQA7	14296.342	1734.323
5	MQB1	14187.327	1412.470
6	MQB3	14174.173	1076.784
7	MQB5	14240.690	743.544
8	MQB7	14370.841	434.397
9	MQC1	14595.066	179.061
10	MQC3	14879.202	-0.174
11	MQC5	15201.055	-109.188
12	MQC7	15533.860	-151.047
13	MQD1	15867.100	-84.530
14	MQD3	16164.390	71.921
15	MQD5	16419.725	296.146
16	MQD7	16622.379	563.434
17	MQE1	16731.393	885.287
18	MQE3	16744.548	1220.973
19	MQE5	16678.031	1554.213
20	MQE7	16547.879	1863.360
21	MQF1	16323.654	2118.696
22	MQF3	16039.518	2297.931
23	MQF5	15717.666	2406.945
24	MQF7	15384.861	2448.804

TABLE I-C

COORDINATES OF THE SURVEY "MONUMENTS" IN THE BNL GRID. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.1 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

	MONUMENTS COORDINATES IN THE BNL GRID		
NUM	QUAD	N(ft)	E(ft)
1	MQA1	102404.302	98619.974
2	MQA3	102379.528	98606.936
3	MQA5	102358.250	98588.251
4	MQA7	102341.362	98565.977
5	MQB1	102332.277	98539.156
6	MQB3	102331.181	98511.182
7	MQB5	102336.724	98483.412
8	MQB7	102347.570	98457.650
9	MQC1	102366.256	98436.372
10	MQC3	102389.934	98421.436
11	MQC5	102416.755	98412.351
12	MQC7	102444.488	98408.863
13	MQD1	102472.258	98414.406
14	MQD3	102497.032	98427.443
15	MQD5	102518.310	98446.129
16	MQD7	102535.198	98468.403
17	MQE1	102544.283	98495.224
18	MQE3	102545.379	98523.198
19	MQE5	102539.836	98550.968
20	MQE7	102528.990	98576.730
21	MQF1	102510.305	98598.008
22	MQF3	102486.627	98612.944
23	MQF5	102459.805	98622.029
24	MQF7	102432.072	98625.517

TABLE II-A

COORDINATES OF THE SURVEY "MONUMENTS" IN BOOSTER CENTERED FRAME. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.2 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

MONUMENTS COORDINATES IN THE BOOSTER FRAME

NUM	QUAD	X(m)	Y(m)
1	MQA1	31.37197	-10.44666
2	MQA3	27.38181	-18.00400
3	MQA5	21.65193	-24.49299
4	MQA7	14.84560	-29.63758
5	MQB1	6.63889	-32.39228
6	MQB3	-1.90104	-32.71537
7	MQB5	-10.38561	-30.99765
8	MQB7	-18.24412	-27.67549
9	MQC1	-24.73311	-21.94562
10	MQC3	-29.28288	-14.71136
11	MQC5	-32.03758	-6.50465
12	MQC7	-33.08976	1.96210
13	MQD1	-31.37204	10.44667
14	MQD3	-27.38188	18.00401
15	MQD5	-21.65200	24.49300
16	MQD7	-14.84568	29.63760
17	MQE1	-6.63896	32.39229
18	MQE3	1.90097	32.71538
19	MQE5	10.38554	30.99766
20	MQE7	18.24405	27.67550
21	MQF1	24.73304	21.94563
22	MQF3	29.28281	14.71137
23	MQF5	32.03750	6.50466
24	MQF7	33.08969	-1.96209

TABLE II-B

COORDINATES OF THE SURVEY "MONUMENTS" IN THE AGS GRID. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.2 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

NUM	QUAD	MONUMENTS COORDINATES IN THE AGS GRID N(in)	E(in)
1	MQA1	15048.074	2383.997
2	MQA3	14750.541	2226.904
3	MQA5	14495.069	2001.318
4	MQA7	14292.526	1733.353
5	MQB1	14184.073	1410.254
6	MQB3	14171.353	1074.036
7	MQB5	14238.980	739.998
8	MQB7	14369.774	430.607
9	MQC1	14595.359	175.135
10	MQC3	14880.172	-3.989
11	MQC5	15203.271	-112.442
12	MQC7	15536.608	-153.867
13	MQD1	15870.646	-86.240
14	MQD3	16168.179	70.853
15	MQD5	16423.651	296.439
16	MQD7	16626.194	564.405
17	MQE1	16734.647	887.504
18	MQE3	16747.367	1223.721
19	MQE5	16679.740	1557.759
20	MQE7	16548.947	1867.150
21	MQF1	16323.361	2122.622
22	MQF3	16038.548	2301.746
23	MQF5	15715.449	2410.199
24	MQF7	15382.112	2451.624

TABLE II-C

COORDINATES OF THE SURVEY "MONUMENTS" IN THE BNL GRID. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.2 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

		MONUMENTS COORDINATES IN THE BNL GRID	
NUM	QUAD	N(ft)	E(ft)
1	MQA1	102404.006	98620.116
2	MQA3	102379.212	98607.025
3	MQA5	102357.922	98588.227
4	MQA7	102341.044	98565.896
5	MQB1	102332.006	98538.971
6	MQB3	102330.946	98510.953
7	MQB5	102336.582	98483.116
8	MQB7	102347.481	98457.334
9	MQC1	102366.280	98436.045
10	MQC3	102390.014	98421.118
11	MQC5	102416.939	98412.080
12	MQC7	102444.717	98408.628
13	MQD1	102472.554	98414.263
14	MQD3	102497.348	98427.354
15	MQD5	102518.638	98446.153
16	MQD7	102535.516	98468.484
17	MQE1	102544.554	98495.409
18	MQE3	102545.614	98523.427
19	MQE5	102539.978	98551.263
20	MQE7	102529.079	98577.046
21	MQF1	102510.280	98598.335
22	MQF3	102486.546	98613.262
23	MQF5	102459.621	98622.300
24	MQF7	102431.843	98625.752

TABLE III-A

COORDINATES OF THE SURVEY "MONUMENTS" IN BOOSTER CENTERED FRAME. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.3 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

MONUMENTS COORDINATES IN THE BOOSTER FRAME

NUM	QUAD	X(m)	Y(m)
1	MQA1	31.41538	-10.53674
2	MQA3	27.40892	-18.10025
3	MQA5	21.64449	-24.59271
4	MQA7	14.82096	-29.73450
5	MQB1	6.58258	-32.47492
6	MQB3	-1.97084	-32.78697
7	MQB5	-10.47569	-31.04106
8	MQB7	-18.34038	-27.70260
9	MQC1	-24.83284	-21.93817
10	MQC3	-29.37980	-14.68672
11	MQC5	-32.12022	-6.44834
12	MQC7	-33.16137	2.03190
13	MQD1	-31.41546	10.53675
14	MQD3	-27.40899	18.10026
15	MQD5	-21.64456	24.59272
16	MQD7	-14.82103	29.73451
17	MQE1	-6.58266	32.47493
18	MQE3	1.97077	32.78699
19	MQE5	10.47562	31.04107
20	MQE7	18.34030	27.70261
21	MQF1	24.83276	21.93818
22	MQF3	29.37972	14.68673
23	MQF5	32.12014	6.44836
24	MQF7	33.16130	-2.03189

TABLE III-B

COORDINATES OF THE SURVEY "MONUMENTS" IN THE AGS GRID. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.3 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

		MONUMENTS COORDINATES IN THE AGS GRID	
NUM	QUAD	N(in)	E(in)
1	MQA1	15044.528	2385.706
2	MQA3	14746.752	2227.971
3	MQA5	14491.143	2001.025
4	MQA7	14288.710	1732.382
5	MQB1	14180.820	1408.037
6	MQB3	14168.534	1071.288
7	MQB5	14237.271	736.451
8	MQB7	14368.706	426.818
9	MQC1	14595.652	171.209
10	MQC3	14881.143	-7.805
11	MQC5	15205.488	-115.695
12	MQC7	15539.356	-156.686
13	MQD1	15874.193	-87.949
14	MQD3	16171.969	69.786
15	MQD5	16427.577	296.732
16	MQD7	16630.010	565.375
17	MQE1	16737.901	889.720
18	MQE3	16750.186	1226.469
19	MQE5	16681.449	1561.306
20	MQE7	16550.014	1870.939
21	MQF1	16323.068	2126.548
22	MQF3	16037.578	2305.562
23	MQF5	15713.232	2413.453
24	MQF7	15379.364	2454.443

TABLE III-C

COORDINATES OF THE SURVEY "MONUMENTS" IN THE BNL GRID. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.3 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

		MONUMENTS COORDINATES IN THE BNL GRID	
NUM	QUAD	N(ft)	E(ft)
1	MQA1	102403.711	98620.259
2	MQA3	102378.896	98607.114
3	MQA5	102357.595	98588.202
4	MQA7	102340.726	98565.815
5	MQB1	102331.735	98538.786
6	MQB3	102330.711	98510.724
7	MQB5	102336.439	98482.821
8	MQB7	102347.392	98457.018
9	MQC1	102366.304	98435.717
10	MQC3	102390.095	98420.800
11	MQC5	102417.124	98411.809
12	MQC7	102444.946	98408.393
13	MQD1	102472.849	98414.121
14	MQD3	102497.664	98427.265
15	MQD5	102518.965	98446.178
16	MQD7	102535.834	98468.565
17	MQE1	102544.825	98495.593
18	MQE3	102545.849	98523.656
19	MQE5	102540.121	98551.559
20	MQE7	102529.168	98577.362
21	MQF1	102510.256	98598.662
22	MQF3	102486.465	98613.580
23	MQF5	102459.436	98622.571
24	MQF7	102431.614	98625.987

TABLE IV-A

COORDINATES OF THE SURVEY "MONUMENTS" IN BOOSTER CENTERED FRAME. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.4 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

MONUMENTS COORDINATES IN THE BOOSTER FRAME

NUM	QUAD	X(m)	Y(m)
1	MQA1	31.45880	-10.62682
2	MQA3	27.43603	-18.19651
3	MQA5	21.63705	-24.69243
4	MQA7	14.79631	-29.83141
5	MQB1	6.52628	-32.55756
6	MQB3	-2.04064	-32.85858
7	MQB5	-10.56578	-31.08448
8	MQB7	-18.43663	-27.72972
9	MQC1	-24.93256	-21.93073
10	MQC3	-29.47671	-14.66207
11	MQC5	-32.20286	-6.39204
12	MQC7	-33.23298	2.10170
13	MQD1	-31.45887	10.62684
14	MQD3	-27.43610	18.19652
15	MQD5	-21.63712	24.69245
16	MQD7	-14.79638	29.83143
17	MQE1	-6.52635	32.55757
18	MQE3	2.04057	32.85859
19	MQE5	10.56570	31.08449
20	MQE7	18.43656	27.72973
21	MQF1	24.93249	21.93074
22	MQF3	29.47664	14.66208
23	MQF5	32.20279	6.39205
24	MQF7	33.23290	-2.10169

TABLE IV-B

COORDINATES OF THE SURVEY "MONUMENTS" IN THE AGS GRID. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.4 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

		MONUMENTS COORDINATES IN THE AGS GRID	
NUM	QUAD	N(in)	E(in)
1	MQA1	15040.981	2387.415
2	MQA3	14742.962	2229.039
3	MQA5	14487.217	2000.732
4	MQA7	14284.895	1731.412
5	MQB1	14177.566	1405.820
6	MQB3	14165.715	1068.540
7	MQB5	14235.562	732.905
8	MQB7	14367.639	423.028
9	MQC1	14595.945	167.283
10	MQC3	14882.113	-11.620
11	MQC5	15207.705	-118.949
12	MQC7	15542.104	-159.505
13	MQD1	15877.739	-89.658
14	MQD3	16175.758	68.718
15	MQD5	16431.504	297.025
16	MQD7	16633.826	566.345
17	MQE1	16741.154	891.937
18	MQE3	16753.005	1229.217
19	MQE5	16683.159	1564.853
20	MQE7	16551.082	1874.729
21	MQF1	16322.775	2130.474
22	MQF3	16036.607	2309.378
23	MQF5	15711.015	2416.706
24	MQF7	15376.616	2457.262

TABLE IV-C

COORDINATES OF THE SURVEY "MONUMENTS" IN THE BNL GRID. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.4 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

		MONUMENTS COORDINATES IN THE BNL GRID	
NUM	QUAD	N(ft)	E(ft)
1	MQA1	102403.415	98620.401
2	MQA3	102378.580	98607.203
3	MQA5	102357.268	98588.178
4	MQA7	102340.408	98565.734
5	MQB1	102331.464	98538.602
6	MQB3	102330.476	98510.495
7	MQB5	102336.297	98482.525
8	MQB7	102347.303	98456.702
9	MQC1	102366.329	98435.390
10	MQC3	102390.176	98420.482
11	MQC5	102417.309	98411.538
12	MQC7	102445.175	98408.158
13	MQD1	102473.145	98413.978
14	MQD3	102497.980	98427.177
15	MQD5	102519.292	98446.202
16	MQD7	102536.152	98468.645
17	MQE1	102545.096	98495.778
18	MQE3	102546.084	98523.885
19	MQE5	102540.263	98551.854
20	MQE7	102529.257	98577.677
21	MQF1	102510.231	98598.989
22	MQF3	102486.384	98613.898
23	MQF5	102459.251	98622.842
24	MQF7	102431.385	98626.222

TABLE V-A

COORDINATES OF THE SURVEY "MONUMENTS" IN BOOSTER CENTERED FRAME. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.5 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

MONUMENTS COORDINATES IN THE BOOSTER FRAME

NUM	QUAD	X(m)	Y(m)
1	MQA1	31.50222	-10.71691
2	MQA3	27.46314	-18.29276
3	MQA5	21.62960	-24.79216
4	MQA7	14.77166	-29.92833
5	MQB1	6.46997	-32.64020
6	MQB3	-2.11045	-32.93019
7	MQB5	-10.65586	-31.12789
8	MQB7	-18.53289	-27.75683
9	MQC1	-25.03228	-21.92329
10	MQC3	-29.57363	-14.63742
11	MQC5	-32.28550	-6.33573
12	MQC7	-33.30458	2.17151
13	MQD1	-31.50229	10.71692
14	MQD3	-27.46322	18.29277
15	MQD5	-21.62968	24.79217
16	MQD7	-14.77174	29.92834
17	MQE1	-6.47004	32.64021
18	MQE3	2.11037	32.93020
19	MQE5	10.65579	31.12790
20	MQE7	18.53281	27.75684
21	MQF1	25.03221	21.92330
22	MQF3	29.57355	14.63743
23	MQF5	32.28543	6.33574
24	MQF7	33.30451	-2.17150

TABLE V-B

COORDINATES OF THE SURVEY "MONUMENTS" IN THE AGS GRID. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.5 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

		MONUMENTS COORDINATES IN THE AGS GRID	
NUM	QUAD	N(in)	E(in)
1	MQA1	15037.434	2389.125
2	MQA3	14739.173	2230.106
3	MQA5	14483.291	2000.439
4	MQA7	14281.079	1730.442
5	MQB1	14174.313	1403.603
6	MQB3	14162.896	1065.792
7	MQB5	14233.852	729.358
8	MQB7	14366.571	419.239
9	MQC1	14596.238	163.357
10	MQC3	14883.084	-15.436
11	MQC5	15209.922	-122.203
12	MQC7	15544.852	-162.324
13	MQD1	15881.286	-91.368
14	MQD3	16179.548	67.651
15	MQD5	16435.430	297.318
16	MQD7	16637.641	567.316
17	MQE1	16744.408	894.154
18	MQE3	16755.825	1231.966
19	MQE5	16684.868	1568.399
20	MQE7	16552.149	1878.518
21	MQF1	16322.482	2134.400
22	MQF3	16035.637	2313.193
23	MQF5	15708.799	2419.960
24	MQF7	15373.868	2460.081

TABLE V-C

COORDINATES OF THE SURVEY "MONUMENTS" IN THE BNL GRID. THESE ARE THE SURVEY POINTS IN THE BOOSTER TUNNEL (PERPENDICULAR) DISTANCE OF "1.5 m" AWAY FROM THE MARKER #1 (I.E. THE UPSTREAM END) OF THE FOCUSING QUAD QF.

		MONUMENTS COORDINATES IN THE BNL GRID	
NUM	QUAD	N(ft)	E(ft)
1	MQA1	102403.120	98620.544
2	MQA3	102378.264	98607.292
3	MQA5	102356.941	98588.153
4	MQA7	102340.090	98565.653
5	MQB1	102331.193	98538.417
6	MQB3	102330.241	98510.266
7	MQB5	102336.154	98482.230
8	MQB7	102347.214	98456.387
9	MQC1	102366.353	98435.063
10	MQC3	102390.257	98420.164
11	MQC5	102417.493	98411.266
12	MQC7	102445.404	98407.923
13	MQD1	102473.441	98413.836
14	MQD3	102498.296	98427.088
15	MQD5	102519.619	98446.226
16	MQD7	102536.470	98468.726
17	MQE1	102545.367	98495.963
18	MQE3	102546.319	98524.114
19	MQE5	102540.406	98552.150
20	MQE7	102529.346	98577.993
21	MQF1	102510.207	98599.317
22	MQF3	102486.303	98614.216
23	MQF5	102459.067	98623.113
24	MQF7	102431.156	98626.457

TABLE VI. THE COORDINATES OF THE APEX OF THE DIPOLES AND CENTERS OF QUADRUPOLES AND SEXTUPOLES IN THE BOOSTERR CENTERED FRAME AND THE AGS GRID RESPECTIVELY.

No	NAME	BOOSTER FRAME X(M)	BOOSTER FRAME Y(M)	AGS GRID N(IN)	AGS GRID E(IN)
1	MDA1	31.57798	-7.28601	15172.509	2392.107
2	MSFA1	30.94998	-9.08246	15101.783	2367.383
3	MQA1	30.76787	-9.60342	15081.273	2360.213
4	MDA2	30.18875	-11.26004	15016.051	2337.413
5	MSDA2	29.25834	-12.92015	14950.693	2300.783
6	MQA2	28.98853	-13.40157	14931.739	2290.161
7	MQA3	26.93331	-17.06867	14787.365	2209.246
8	MDA4	26.07532	-18.59956	14727.094	2175.467
9	MSDA4	24.87077	-20.07289	14669.089	2128.044
10	MQA4	24.52146	-20.50014	14652.268	2114.292
11	MDA5	23.41067	-21.85879	14598.778	2070.560
12	MQA5	21.55038	-23.46067	14535.712	1997.320
13	MQA6	18.36489	-26.20368	14427.719	1871.907
14	MDA7	17.03504	-27.34880	14382.635	1819.551
15	MSFA7	15.39923	-28.32130	14344.348	1755.149
16	MQA7	14.92486	-28.60331	14333.245	1736.473
17	MDA8	13.41637	-29.50011	14297.938	1677.084
18	MQA8	11.12040	-30.36913	14263.725	1586.691
19	MDB1	9.47910	-30.99036	14239.267	1522.073
20	MSFB1	7.60933	-31.34473	14225.316	1448.460
21	MQB1	7.06711	-31.44749	14221.270	1427.113
22	MDB2	5.34287	-31.77427	14208.404	1359.229
23	MSDB2	3.43997	-31.79857	14207.448	1284.312
24	MQB2	2.88814	-31.80562	14207.170	1262.586
25	MQB3	-1.31527	-31.85929	14205.057	1097.098
26	MDB4	-3.07006	-31.88170	14204.175	1028.012
27	MSDB4	-4.94827	-31.57519	14216.242	954.066
28	MQB4	-5.49294	-31.48630	14219.742	932.623
29	MDB5	-7.22496	-31.20366	14230.870	864.433
30	MQB5	-9.54237	-30.39354	14262.764	773.196
31	MQB6	-13.51064	-29.00633	14317.379	616.965
32	MDB7	-15.16726	-28.42721	14340.178	551.744
33	MSFB7	-16.82737	-27.49680	14376.809	486.385
34	MQB7	-17.30879	-27.22699	14387.431	467.431
35	MDB8	-18.83969	-26.36900	14421.210	407.160
36	MQB8	-20.74027	-24.81514	14482.386	332.334

TABLE VI (CONTD.)

THE COORDINATES OF THE APEX OF THE DIPOLES AND CENTERS OF QUADRUPOLES AND SEXTUPOLES IN THE BOOSTERR CENTERED FRAME AND THE AGS GRID RESPECTIVELY.

No	NAME	BOOSTER FRAME X(M)	BOOSTER FRAME Y(M)	AGS GRID N(IN)	AGS GRID E(IN)
37	MDC1	-22.09891	-23.70435	14526.118	278.844
38	MSFC1	-23.34069	-22.26226	14582.893	229.955
39	MQC1	-23.70080	-21.84407	14599.357	215.778
40	MDC2	-24.84592	-20.51422	14651.713	170.694
41	MSDC2	-25.81841	-18.87841	14716.115	132.407
42	MQC2	-26.10043	-18.40404	14734.792	121.304
43	MQC3	-28.24861	-14.79062	14877.052	36.730
44	MDC4	-29.14541	-13.28213	14936.442	1.423
45	MSDC4	-29.81907	-11.50230	15006.514	-25.099
46	MQC4	-30.01443	-10.98616	15026.834	-32.791
47	MDC5	-30.63566	-9.34486	15091.452	-57.248
48	MQC5	-31.09279	-6.93287	15186.413	-75.245
49	MQC6	-31.87556	-2.80264	15349.020	-106.063
50	MDC7	-32.20234	-1.07840	15416.903	-118.929
51	MSFC7	-32.22664	0.82450	15491.821	-119.885
52	MQC7	-32.23368	1.37633	15513.546	-120.163
53	MDC8	-32.25609	3.13112	15582.632	-121.045
54	MQC8	-31.86070	5.55400	15678.021	-105.478
55	MDD1	-31.57805	7.28602	15746.211	-94.350
56	MSFD1	-30.95005	9.08247	15816.938	-69.626
57	MQD1	-30.76794	9.60343	15837.448	-62.456
58	MDD2	-30.18882	11.26005	15902.669	-39.656
59	MSDD2	-29.25841	12.92016	15968.028	-3.026
60	MQD2	-28.98860	13.40158	15986.981	7.597
61	MQD3	-26.93338	17.06868	16131.355	88.511
62	MDD4	-26.07539	18.59957	16191.627	122.290
63	MSDD4	-24.87084	20.07290	16249.632	169.713
64	MQD4	-24.52153	20.50015	16266.453	183.465
65	MDD5	-23.41074	21.85880	16319.943	227.197
66	MQD5	-21.55045	23.46068	16383.009	300.437
67	MQD6	-18.36496	26.20370	16491.002	425.850
68	MDD7	-17.03512	27.34882	16536.085	478.206
69	MSDF7	-15.39930	28.32131	16574.372	542.608
70	MQD7	-14.92493	28.60333	16585.475	561.284
71	MDD8	-13.41644	29.50012	16620.782	620.674
72	MQD8	-11.12047	30.36915	16654.996	711.066

TABLE VI (CONTD.)

THE COORDINATES OF THE APEX OF THE DIPOLES AND CENTERS OF QUADRUPOLES AND SEXTUPOLES IN THE BOOSTERR CENTERED FRAME AND THE AGS GRID RESPECTIVELY.

No	NAME	BOOSTER FRAME X(M)	BOOSTER FRAME Y(M)	AGS GRID N(IN)	AGS GRID E(IN)
73	MDE1	-9.47917	30.99037	16679.453	775.684
74	MSFE1	-7.60940	31.34474	16693.405	849.297
75	MQE1	-7.06718	31.44750	16697.451	870.645
76	MDE2	-5.34294	31.77428	16710.316	938.528
77	MSDE2	-3.44004	31.79858	16711.273	1013.445
78	MQE2	-2.88821	31.80563	16711.550	1035.171
79	MQE3	1.31520	31.85930	16713.663	1200.659
80	MDE4	3.06998	31.88171	16714.545	1269.746
81	MSDE4	4.94819	31.57520	16702.478	1343.691
82	MQE4	5.49286	31.48632	16698.979	1365.135
83	MDE5	7.22488	31.20367	16687.851	1433.324
84	MQE5	9.54230	30.39355	16655.957	1524.561
85	MQE6	13.51056	29.00634	16601.342	1680.792
86	MDE7	15.16719	28.42722	16578.542	1746.013
87	MSFE7	16.82730	27.49682	16541.912	1811.372
88	MQE7	17.30872	27.22700	16531.289	1830.326
89	MDE8	18.83961	26.36901	16497.510	1890.597
90	MQE8	20.74019	24.81515	16436.335	1965.423
91	MDF1	22.09884	23.70436	16392.603	2018.913
92	MSFF1	23.34062	22.26228	16335.828	2067.802
93	MQF1	23.70072	21.84408	16319.363	2081.979
94	MDF2	24.84584	20.51424	16267.007	2127.063
95	MSDF2	25.81834	18.87842	16202.605	2165.350
96	MQF2	26.10035	18.40405	16183.929	2176.453
97	MQF3	28.24854	14.79063	16041.668	2261.027
98	MDF4	29.14534	13.28214	15982.279	2296.334
99	MSDF4	29.81900	11.50231	15912.207	2322.856
100	MQF4	30.01436	10.98617	15891.886	2330.548
101	MDF5	30.63559	9.34487	15827.268	2355.005
102	MQF5	31.09271	6.93288	15732.308	2373.003
103	MQF6	31.87549	2.80265	15569.701	2403.820
104	MDF7	32.20227	1.07841	15501.817	2416.686
105	MSFF7	32.22657	-0.82449	15426.900	2417.642
106	MQF7	32.23361	-1.37632	15405.174	2417.920
107	MDF8	32.25602	-3.13111	15336.088	2418.802
108	MQF8	31.86063	-5.55399	15240.699	2403.235

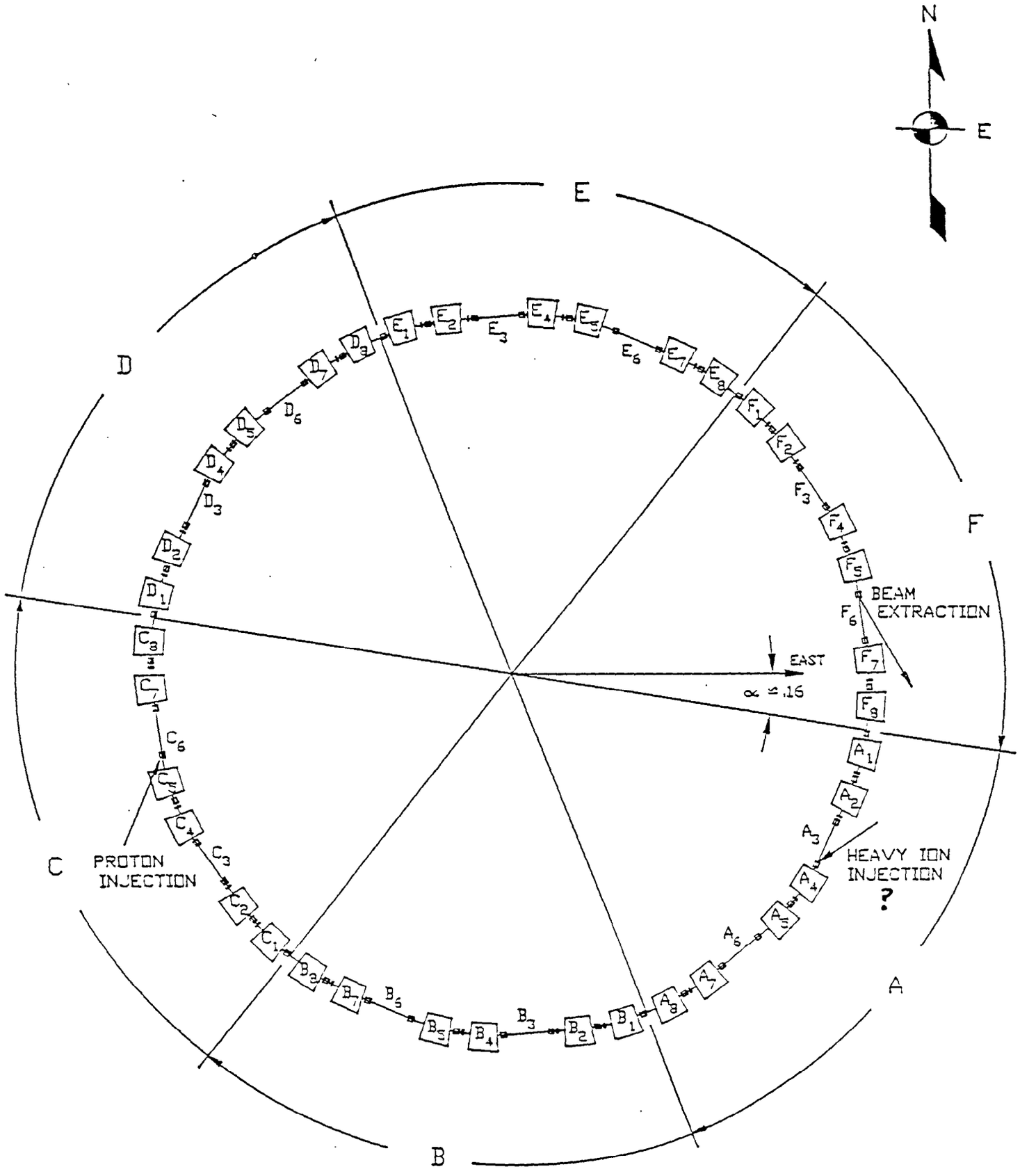


Fig. 1 Layout of the AGS Booster showing the relative position of magnets (e.g. Dipole Apex locations) and labling convention of the Booster Superperiods. (A to F, with the Beam in the Clockwise direction).

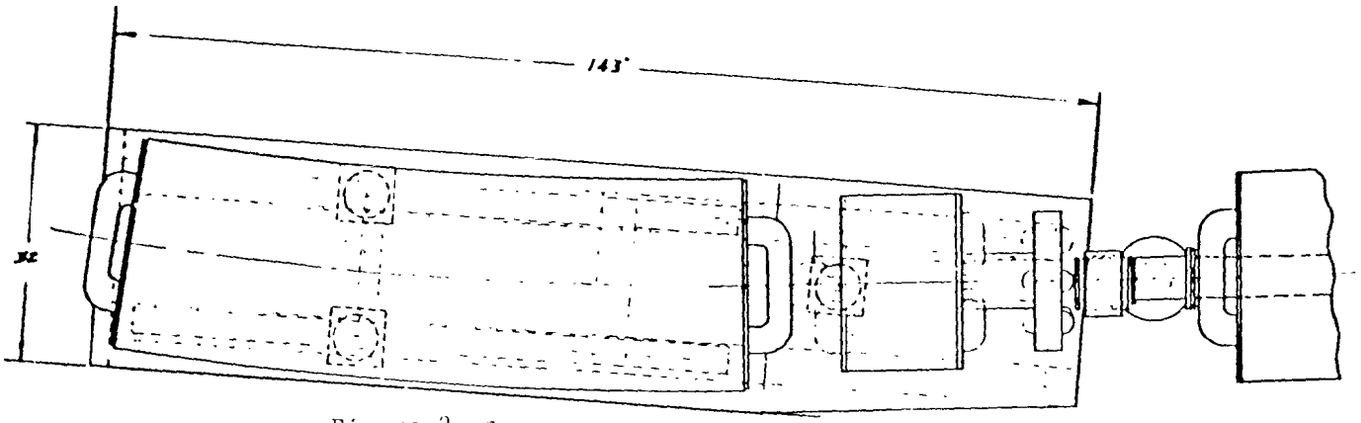


Figure 2 -a

Figures 2 -(a,b,c) shows a) the top, b) end and c) side views of the AGS Booster Strongback (Halfcell) assembly consisting of a dipole, a quadrupole and a sextupole magnets mounted on a rigid platform for ease in installation and alignment.

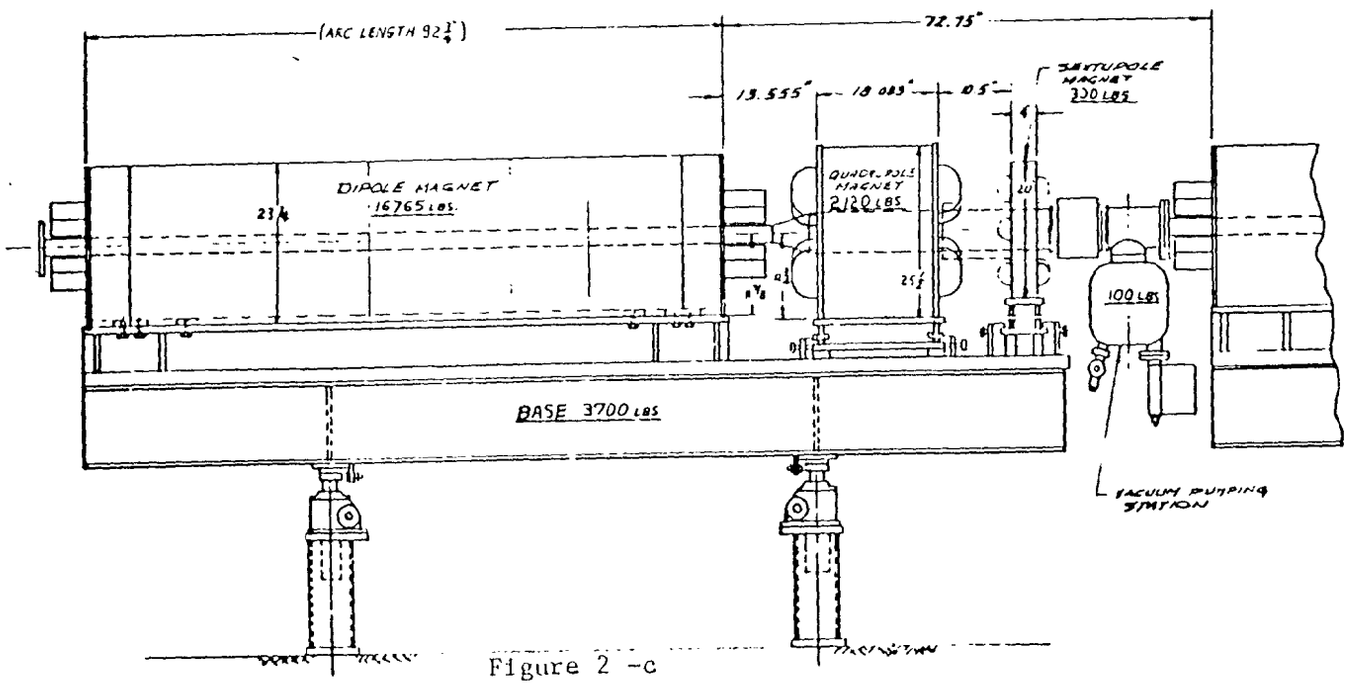


Figure 2 -c

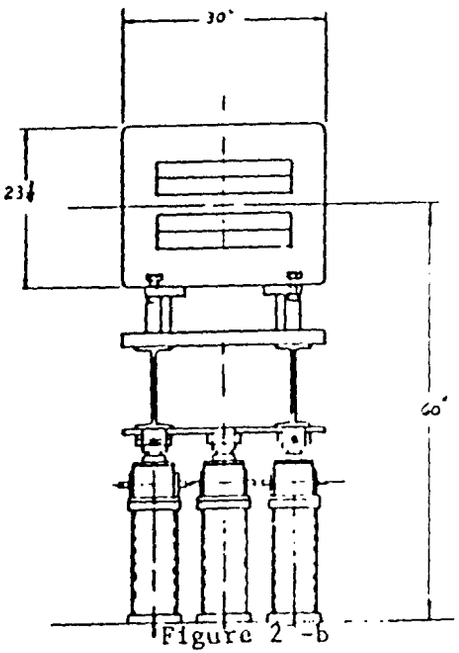
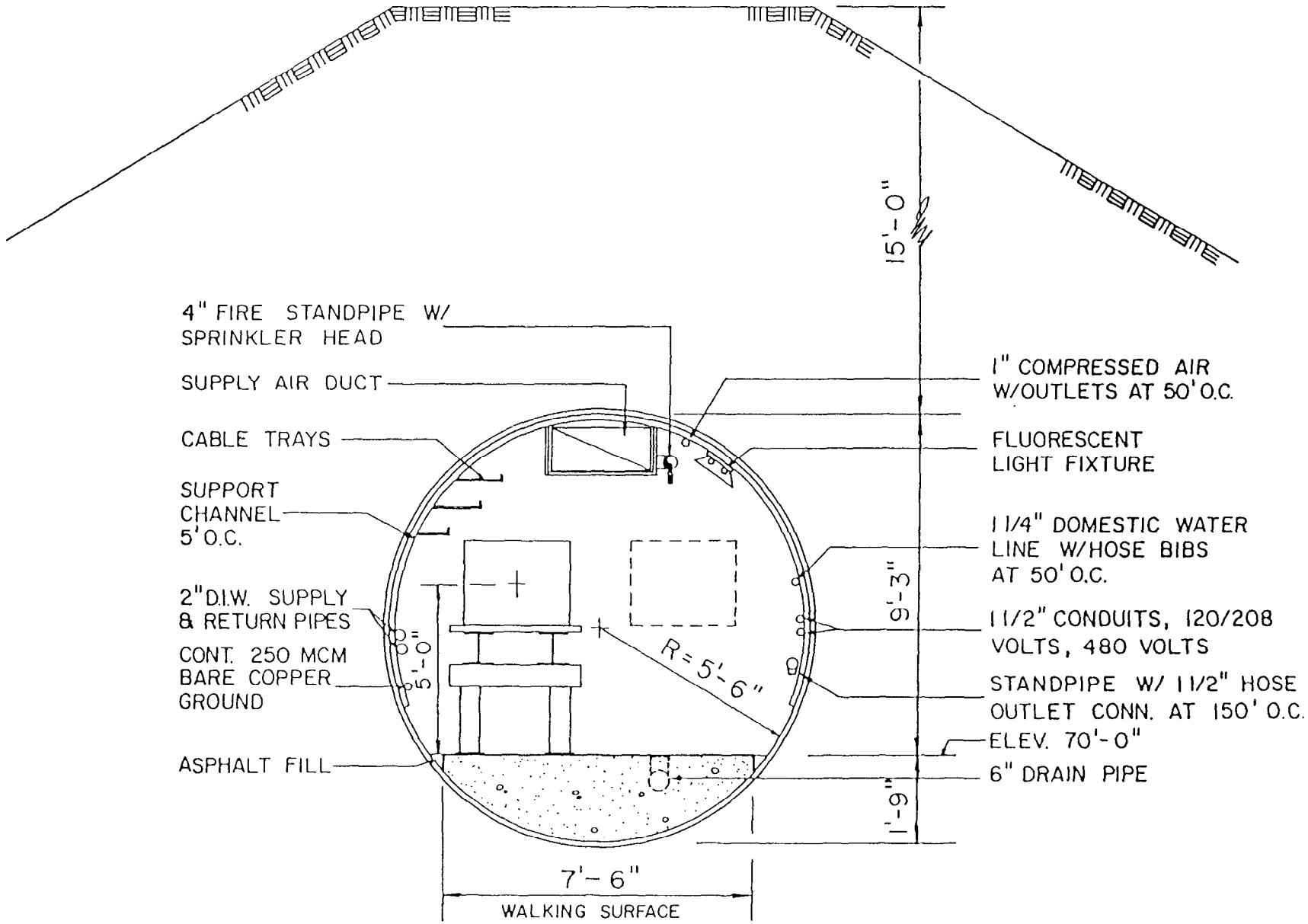


Figure 2 -b



TUNNEL CROSS SECTION

Figure 3