TECHNICAL MEMORANDUM WHOI-8-74

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TECHNICAL MEMORANDUM NO. 8-74

DSRV ALVIN WEIGHT REPORT, 1974

Arnold G. Sharp

December 1974

*WHOI Tech.
Memo. 8-74
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WOODS HOLE, MASSACHUSETTS 02543

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Woods Hole, Massachusetts 02543

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DSRV ALVIN WEIGHT REPORT, 1974

prepared by

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Office of Naval Research Contract No.
N00014-73-C-0097; NR 265-107

ABSTRACT

Weight and stability computations are presented for the research submarine ALVIN for the year 1974. Longitudinal and vertical components of the BG distance are shown for the vehicle in its normal submerged condition, and for a number of emergency conditions. Calculations for pounds per inch immersion and moment to heel one degree also are included.

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I. Introduction

This report provides a summary of the weight and stability computations for the research submarine ALVIN for the year 1974. While the usual computer calculations were performed, none of the related dockside trials (inclining experiments or trim dive) were conducted after the 1973-74 overhaul, and therefore there are no new experimentally determined stability figures to report. The most recent values, obtained in 1973, are recorded in the weight report for that year (Ref. 1).

The weight and stability calculations are in the usual form, showing a tabulation of weights, displacements, moment arm values (both longitudinal and vertical), and first moments. Weight, displacement, and moment summations yield values which locate the center of gravity G and the center of buoyancy B of the vehicle. Finally, longitudinal and vertical components of the BG distance are computed. The computer printout sheets have been reproduced and are included in this report. The computations were performed using the W.H.O.I. Sigma-7 computer made by Xerox Data Systems, Inc.

Only minor changes have been made to the submarine since the 1973 weight report was issued. Since the elimination of the mercury-dump valves, the option to jettison trim mercury as an emergency measure no longer exists and this is reflected as a decrease in the number of emergency conditions computed. Certain modifications were made to the frame. Damaged welds were repaired, and a number of new diagonal braces were added aft in the area of the battery boxes. Stiffening gussets were placed near the base of each sphere-support pedestal. The syntactic foam in the portside space formerly occupied by the variable-ballast rubber bag was accurately weighed and found to be 197.60 pounds and not the 234 pounds previously reported. Miscellaneous small items, i.e. lights, cameras, transponders, etc., vary in number and configuration from year to year and these show minor changes in this instance. The air weight of the vehicle is approximately 68 pounds greater than it was in 1973.

II. Weight and Stability Computations

A. Explanation of Procedure In computing the weight and stability of ALVIN, two separate force systems were considered. The weights, acting downward, were summed to find the total weight, which acts at the center of gravity G. Similarly, the buoyancy forces, which act upward, were summed to find the total buoyant force or displacement, which acts at the center of buoyancy B. The locations of G and B were determined by summing the moments of weights and displacements with respect to the forward perpendicular and the base plane. Points G and B are assumed to lie in a vertical plane which passes through the longitudinal centerline of the submarine.

For the computer run, data were obtained for the separate components (or packages) and a data card was punched for each. The items were broken down into subgroups as follows (refer to computer printout sheets):

1. Pressure hull plus contents
2. Other forebody
3. Afterbody
4. Variable load
5. Entire vehicle

6. Released forebody

7. Emergency conditions

At the end of each sub-group the weight, displacement and moment summations were made, and the locations of G and B were determined. At the end of Section 4 (variable load) cumulative summations were made which yielded G and B values for the entire submarine in what is called the "normal submerged" condition. In this condition the main ballast tanks are flooded, the variable ballast tanks are three-quarters flooded, and the trim mercury is divided 50 percent forward and 50 percent aft.

B. Definition of Symbols The following symbols which appear on the computer printout sheets are defined here for convenience.

W - weight of item in air, lbs.

X - distance of center of gravity of item from forward perpendicular, feet (positive x means aft of F.P.; see Figure 1.)

Y - distance of center of gravity of item above base plane, feet (see Figure 1.)

MX - product of W times X, foot-lbs.

MY - product of W times Y, foot-lbs.

Figure 1. Longitudinal Section of ALVIN Showing Sample of Data Used in Computations

Figure 2. Longitudinal Section of ALVIN Showing Components of BG Distance

Figure 3. Transverse Section of ALVIN Showing Locations of Points K, G, B, B' and M

D - displacement of item, lbs. of seawater

XP - distance of center of buoyancy of item from forward perpendicular, feet (positive XP means aft of F.P.)

YP - distance of center of buoyancy of item above base plane, feet

MXP - product of D times XP, foot-lbs.

MYP - product of D times YP, foot-lbs.

BG longitudinal - distance between center of buoyancy B and center of gravity G, longitudinal component, feet (negative value indicates tendency for bow-up angle of trim; see Figure 2.)

BG vertical - distance between center of buoyancy B and center of gravity G, vertical component, feet (positive value indicates vertical stability of submerged vehicle; see Figure 2.)

The following additional terms and symbols appear in various places in this report:

Forward Perpendicular - vertical plane passing through foremost edge of front window cone of ALVIN (see Figure 1.)

Base Plane - horizontal plane passing through bottom of skids of ALVIN (see Figure 1.)

B' - new position of center of buoyancy B. Lateral shift occurs due to change of underwater form when vehicle is inclined on the surface (see Figure 3.)

Metacenter M - point found by extending line of action of vertical buoyancy force through B' to intersect with original vertical centerline of vehicle inclined on the surface (see Figure 3.)

GM - vertical distance from center of gravity G to metacenter M (M above G indicates positive stability of surfaced vehicle; (see Figure 3.)

C. Outline of Programmed Computations

1. Total weight = summation W
2. Total displacement = summation D
3. Distance to center of gravity, longitudinal
$$XW = (\text{summation } MX) / (\text{summation } W)$$
4. Distance to center of gravity, vertical
$$YW = (\text{summation } MY) / (\text{summation } W)$$
5. Distance to center of buoyancy, longitudinal
$$XPD = (\text{summation } MXP) / (\text{summation } D)$$
6. Distance to center of buoyancy, vertical
$$YPD = (\text{summation } MYP) / (\text{summation } D)$$

7. BG longitudinal = $XPD - XW$

8. BG vertical = $YPD - YW$

D. Computer Printout

ALVIN HEIGHT AND STABILITY COMPUTATIONS
SPHERE ONLY

PAGE 1

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MPX	MPY
P HULL MINUS INSERTS	50.81	4.97	4.89	252.55	248.87	1060.40	4.50	4.75	477.18	50369.38
HULL INSERT FWD	383.78	1.14	4.75	437.51	1822.95	14.77	1.14	4.75	16.84	70.16
HULL INSERT BBT	386.28	2.39	1.42	1436.96	548.52	14.77	3.72	1.42	54.94	20.97
HULL INSERT PORT	387.29	3.39	3.46	925.62	1340.02	14.77	2.39	3.46	35.30	51.10
HULL INSERT STBD	385.54	2.39	3.46	921.44	1333.97	14.77	2.39	3.46	35.30	51.10
HATCH INSERT	261.53	4.50	8.11	1176.88	2121.01	19.28	4.50	8.11	41.76	75.26
WINDOW FWD	9.02	1.14	4.75	10.28	42.84	3.48	1.14	4.75	3.97	16.53
WINDOW BBT	9.02	3.72	1.44	33.55	12.99	3.48	1.14	1.44	12.95	5.01
WINDOWS P,S	13.04	2.39	3.46	43.12	62.42	6.96	2.39	3.46	16.63	24.08
WINDOW RET RING FWD	4.80	1.14	4.75	5.47	22.80	1.09	1.14	4.75	1.24	5.18
WINDOW RET RING BBT	4.80	3.72	1.30	17.86	6.24	1.09	3.72	1.30	4.05	5.18
WIND RET RINGS P,S	9.60	2.39	3.46	17.86	33.22	2.18	2.39	3.46	5.21	7.54
SPHERE REL UPPER	48.50	4.50	1.33	22.94	64.50	5.49	4.50	1.21	24.70	6.64
HATCH	199.34	4.50	8.11	897.03	1616.65	11.37	4.50	8.11	51.16	92.21
HINGE ARMS	4.57	4.21	8.28	19.24	37.84	1.05	4.21	8.28	4.42	8.69
HINGE SHAFT	3.25	4.00	8.28	13.00	26.91	.75	4.00	8.28	3.00	6.21
INSIDE HANDLE	2.57	4.91	7.94	12.62	20.41	.00	4.91	8.08	.00	.00
OUTSIDE HANDLE	5.14	4.91	8.28	25.24	42.56	1.18	4.91	8.28	5.79	9.77
SPRING RETAINER	2.67	4.14	8.28	11.05	22.11	.61	4.14	8.28	2.53	5.05
INT SWING CLAMP	1.52	4.60	7.94	6.99	12.07	.00	4.60	8.00	.00	.00
HINGE SPRINGS	12.05	4.00	8.28	48.20	99.77	1.45	4.00	8.28	5.80	12.01
HATCH WINDOW	2.02	4.50	8.19	9.09	16.54	.94	4.50	8.19	4.23	4.05
HATCH WIND RET RING	2.16	3.92	8.10	25.72	17.50	.50	3.92	8.10	2.25	4.05
HINGE BLOCKS	6.16	3.92	4.75	38.88	174.23	4.48	3.92	4.75	4.75	12.16
PENETRATORS (7) FWD	36.68	1.06	1.42	112.40	37.20	3.20	1.06	1.42	13.73	21.28
PENETRATORS (5) BBT	26.20	4.29	4.25	28.82	44.54	1.28	4.29	4.25	3.52	4.44
PENETRATORS (2) P	10.48	2.75	3.52	23.16	36.89	1.28	2.75	3.52	2.83	4.51
PENETRATORS (2) S	10.48	2.21	2.70	21.45	231.66	4.24	2.21	2.70	105.80	114.05
CABLE 24 CAND 220 FT	83.80	2.50	2.70	53.46	58.68	1.23	2.50	2.70	3.65	4.01
BLANKING PLUGS (3) P	18.00	2.97	3.26	72.96	84.48	1.64	2.97	3.26	4.99	5.77
BLANKING PLUGS (4) S	24.00	3.04	3.52	45.90	83.33	2.35	3.04	3.52	10.57	19.20
LIFT PACS	10.20	4.50	1.09	236.25	57.22	5.25	4.50	1.09	23.63	5.72
CORNA HALVES UPPER	52.50	4.50	8.10	45.00	81.00	2.30	4.50	8.10	10.35	18.63
MISC OUTSIDE	10.00	4.50	5.53	93.90	165.90	.00	.00	.00	.00	.00
STRAZA MBD 100	30.00	3.13	5.96	129.28	190.72	.00	.00	.00	.00	.00
STRAZA MBD 200	32.00	4.04	6.67	174.80	266.80	.00	.00	.00	.00	.00
STRAZA MBD 300	40.00	4.37	6.50	18.26	9.00	.00	.00	.00	.00	.00
TAPE RECORDER	2.00	4.13	6.70	18.83	23.45	.00	.00	.00	.00	.00
O2 ANALYZER	3.50	5.38	6.70	18.83	23.45	.00	.00	.00	.00	.00
O2 BOTTLES (3)	105.00	6.71	3.79	704.55	397.95	.00	.00	.00	.00	.00

ALVIN WEIGHT AND STABILITY COMPUTATIONS
(CONTINUED)

SPHERE ONLY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
LIGH CANISTERS (3)	24.00	6.29	5.00	150.96	120.00	.00	.00	.00	.00	.00
CABIN LIGHT	1.00	5.67	6.79	5.67	6.79	.00	.00	.00	.00	.00
RATIONS	2.00	4.29	7.17	8.58	14.34	.00	.00	.00	.00	.00
EMERG BREATH APPAR 3	45.00	5.33	5.88	239.85	264.60	.00	.00	.00	.00	.00
VESTS (3)	6.00	5.33	5.88	31.98	35.28	.00	.00	.00	.00	.00
PILOTS CHAIR	9.31	2.88	2.88	26.81	26.81	.00	.00	.00	.00	.00
TRIM INDICATOR	.30	1.63	5.50	.49	1.65	.00	.00	.00	.00	.00
CABIN LIGHTS,P,S(2)	2.00	3.67	5.46	7.34	10.92	.00	.00	.00	.00	.00
MAP LIGHTS (4)	4.00	2.58	6.50	10.32	26.00	.00	.00	.00	.00	.00
FLOOR BOARDS	8.00	4.58	2.12	36.64	16.96	.00	.00	.00	.00	.00
MISC WIRING,HDWR	10.00	4.55	4.75	45.50	47.50	.00	.00	.00	.00	.00
PENETRATOR LEADS	80.00	4.50	4.75	360.00	380.00	.00	.00	.00	.00	.00
URINALS (3)	1.00	5.50	2.50	5.50	2.50	.00	.00	.00	.00	.00
CAMERAS	6.00	5.80	5.20	34.80	31.20	.00	.00	.00	.00	.00
TOOL KIT	4.00	5.50	2.40	22.00	9.60	.00	.00	.00	.00	.00
FLASHLIGHTS(6)	4.80	5.50	2.40	26.40	11.52	.00	.00	.00	.00	.00
SOUND PHONES(2)	6.00	4.30	7.00	25.80	42.00	.00	.00	.00	.00	.00
CUSHIONS	4.00	4.60	2.20	18.40	8.80	.00	.00	.00	.00	.00
RELEASE T-BAR	4.00	5.60	2.40	22.40	9.60	.00	.00	.00	.00	.00
RACK ASSEMBLIES	35.00	4.60	5.00	161.00	175.00	.00	.00	.00	.00	.00
EMERG WATER	5.00	6.00	2.80	30.00	14.00	.00	.00	.00	.00	.00
STBD DISTR PANEL	42.00	2.90	6.25	121.80	262.50	.00	2.90	6.25	.00	.00
PORT WING PANEL	12.50	2.90	6.25	36.25	78.12	.00	.00	.00	.00	.00
RADIO	11.25	4.58	5.96	51.52	67.05	.00	.00	.00	.00	.00
U G C	31.00	4.29	6.75	132.99	209.25	.00	.00	.00	.00	.00
INSTR PANEL	17.00	1.75	6.25	29.75	106.25	.00	.00	.00	.00	.00
LOWER SHELVES(3)	12.50	2.90	5.50	36.25	68.75	.00	.00	.00	.00	.00
GYRO COMP	17.00	3.50	5.75	59.50	97.75	.00	.00	.00	.00	.00
POWER SUPPLY 6V.	7.00	7.00	5.12	49.00	35.84	.00	.00	.00	.00	.00
INVERTER	27.00	7.67	6.54	207.09	176.58	.00	.00	.00	.00	.00
POWER PANEL	20.00	6.00	3.75	120.00	75.00	.00	6.00	3.75	.00	.00
SHELF UPPER STBD	2.00	4.35	6.75	8.70	13.50	.00	.00	.00	.00	.00
SHELF UPPER PORT	3.50	4.35	6.75	15.22	23.63	.00	.00	.00	.00	.00
SHELF OVER IND PANEL	1.50	1.70	6.60	2.55	9.90	.00	.00	.00	.00	.00
SHELF OVER LEAK DET.	2.00	2.88	7.04	5.76	14.08	.00	.00	.00	.00	.00
FATHOMETER SCOPE	7.00	3.83	6.29	26.81	44.03	.00	.00	.00	.00	.00
FATHOMETER XMTR (2)	14.00	3.00	5.50	42.00	77.00	.00	.00	.00	.00	.00
ALTIMETER	5.00	2.25	7.00	11.25	35.00	.00	.00	.00	.00	.00
R2 BOTTLE BRK (3)	8.00	6.71	3.79	53.68	30.32	.00	.00	.00	.00	.00
AIR RESEN UNIT	13.50	6.38	4.50	86.13	60.75	.00	.00	.00	.00	.00

ALVIN WEIGHT AND STABILITY COMPUTATIONS

(CONTINUED)

SPHERE ONLY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
SPHERE STEP HDWR	6.00	5.00	6.50	30.00	39.00	.00	.00	.00	.00	.00
BATTERY SHELF	3.00	5.63	7.33	16.89	21.99	.00	.00	.00	.00	.00
FIRE EXTING	10.50	5.57	4.50	58.48	47.25	.00	.00	.00	.00	.00
EMERG LIGHT BATT	5.00	6.50	4.50	32.50	22.50	.00	.00	.00	.00	.00
MISC SHEET METAL	5.00	4.50	4.50	22.50	22.50	.00	.00	.00	.00	.00
GYRO REPEATER	2.00	1.54	4.83	3.08	9.66	.00	.00	.00	.00	.00
FLARE BOX FLARES	6.00	5.38	5.87	32.28	35.22	.00	.00	.00	.00	.00
PILOTS CNTR BOX	7.00	2.00	7.00	14.00	49.00	.00	.00	.00	.00	.00
CLINOMETERS(2)	1.00	3.50	6.25	3.50	6.25	.00	.00	.00	.00	.00
FIRST AID KIT	1.00	6.20	2.79	6.20	2.79	.00	.00	.00	.00	.00
EMERG BATTERIES (3)	27.00	4.50	6.00	121.50	162.00	.00	.00	.00	.00	.00
ALNAV CLOCK	14.00	5.75	5.50	80.50	77.00	.00	.00	.00	.00	.00

SPHERE ONLY

SUMMARY	NO. ITEMS	SUM W	S	MXW	S	MYW	S	MX	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	SUM MXP	SUM MYP
92		8331.11		4.37		4.73		36372.21		39404.13	10780.82		4.47		4.74	48239.98	51065.38

BG LONGITUDINAL .11

BG VERTICAL .01

ALVIN WEIGHT AND STABILITY COMPUTATIONS

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OTHER FOREBODY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
SAIL,ETC	221.85	4.64	7.02	1029.38	1557.39	135.00	4.64	7.02	626.40	947.70
SPLASH GUARD	20.00	4.50	8.50	90.00	170.00	12.06	4.50	8.50	54.27	102.51
LITTON UP FB DY SYNT	1904.50	4.64	7.00	8836.88	13331.50	2201.65	4.64	7.00	10215.66	15411.55
3M UPPER FOREBODY	863.00	.38	7.00	327.94	6041.00	1434.60	.38	7.00	545.15	10042.20
LOWER SYNT RING	1052.00	4.42	3.43	4649.84	3608.36	1212.98	4.42	3.43	5361.37	4160.52
FRT WINDOW CONE	36.00	.75	4.75	27.00	171.00	21.70	.75	4.75	16.27	103.07
MAIN BALLAST WATER	1346.00	4.50	6.00	6057.00	8076.00	1346.00	4.50	6.00	6057.00	8076.00
MAIN BALLAST TANKS	173.00	4.50	6.00	801.00	1068.00	107.50	4.50	6.00	483.75	645.00
VELOCIMETER	20.00	2.20	9.50	44.00	190.00	10.00	2.20	9.50	22.00	95.00
SAIL CENTRAL BOX	30.00	3.40	12.00	102.00	360.00	20.00	3.40	12.00	68.00	240.00
SAIL J BOX	107.00	7.00	19.00	749.00	963.00	72.00	7.00	19.00	504.00	648.00
FIBERGLASS CLAMP	4.00	2.39	3.46	9.56	13.84	2.22	2.39	3.46	5.31	7.68
SONAR UNIT	92.00	.50	8.00	46.00	736.00	30.00	.50	8.00	15.00	240.00
MAGNETIC COMPASS	9.00	7.00	10.13	63.49	91.88	8.33	7.00	10.13	58.31	84.38
EXTERIOR LIGHTS	24.00	2.50	5.40	60.00	129.60	8.00	2.50	5.40	20.00	43.20
CURRENT METER,ETC	18.08	3.50	13.20	63.28	238.66	4.00	3.50	13.20	14.00	52.80
PREC DEPTH XDCR	3.50	5.75	10.00	20.12	35.00	1.25	5.75	10.00	7.19	12.50
UGC XDUCER	27.00	6.50	12.50	175.50	337.50	4.00	6.50	12.50	26.00	50.00
EGG CAMERAS (2)	104.00	.00	7.06	.00	734.24	30.00	.00	7.06	.00	211.80
STROBE PWR UNITS	48.00	7.50	7.25	360.00	348.00	32.00	7.50	7.25	240.00	232.00
FWD STROBE	54.00	.00	6.50	.00	351.00	16.00	.00	6.50	.00	104.00
BAR RADIO TRANS	1.70	7.50	12.00	12.75	20.40	.84	7.50	12.00	6.30	10.08
BAR FLASH LIGHT	1.70	7.50	12.00	12.75	20.40	.84	7.50	12.00	6.30	10.08
TV CAMERA	30.00	-1.50	7.75	-45.00	232.50	6.40	-1.50	7.75	-9.60	49.60
RESCUE SLING,SHCKLS	33.00	4.50	9.00	148.50	297.00	4.20	4.50	9.00	18.90	37.80

OTHER FOREBODY

SUMMARY	NO. ITEMS	SUM W	S MXW	S MYW	SUM MX	SUM MY	SUM D	S MXP	S MYP	SUM MXP	SUM MYP
	25	6228.40	3.80	6.28	23641.00	39122.26	6721.57	3.62	6.19	24361.57	41617.48

BG LONGITUDINAL .17

BG VERTICAL .09

ALVIN HEIGHT AND STABILITY COMPUTATIONS

PAGE 5

AFTERBODY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
FRAME	447.50	9.18	2.77	4108.05	1239.57	169.00	9.18	2.77	1551.42	468.13
ADDN TO FRAME P	12.00	10.25	1.65	123.00	19.80	4.42	10.25	1.65	45.30	7.29
ADDN TO FRAME S	2.50	10.25	1.65	87.13	14.02	3.13	10.25	1.65	32.08	5.16
ADDN TO FRAME S	.60	6.00	2.75	3.60	1.65	.22	6.00	2.75	1.32	.60
LG BUBY PKG AFT	2310.00	14.16	5.05	32709.60	11665.50	4082.56	14.16	5.05	5789.05	20616.93
PINGER	87.00	14.00	6.75	1218.00	587.25	55.00	14.00	6.75	770.00	371.25
SM BUBYANCY PK CTR	516.00	10.25	6.33	5289.00	3266.28	946.00	10.25	6.33	9696.50	5988.18
SIDE BUBY PKG (2)	433.00	10.40	6.75	4503.20	2922.75	692.00	10.40	6.75	7196.80	4671.00
V/B PKG UPPER P	1062.88	10.18	5.70	10820.12	6058.42	1314.00	10.18	5.70	13376.52	7489.80
V/B PKG UPPER S	1062.88	10.18	5.70	10820.12	6058.42	1314.00	10.18	5.70	13376.52	7489.80
V/B SPHERE LOWER P	300.80	6.78	1.42	2039.42	427.14	265.00	6.78	1.42	1796.70	376.30
V/B SPHERE LOWER S	300.80	6.78	1.42	2039.42	427.14	265.00	6.78	1.42	1796.70	376.30
V/B SPHERES PLUMBING	25.00	9.16	4.31	229.00	107.75	3.24	9.16	4.31	29.68	13.96
V/B PUMP	86.00	5.15	1.00	442.90	86.00	14.72	5.15	1.00	75.81	14.72
V/B PUMP MOTOR	150.00	5.15	1.00	772.50	150.00	88.96	5.15	1.00	458.14	88.96
SHUT OFF VALVE	11.70	9.00	1.75	105.30	20.47	2.18	9.00	1.75	19.62	3.81
FLOAT SWITCH	18.00	5.15	1.00	92.70	18.00	1.92	5.15	1.00	9.89	1.92
TANK RELIEF VALVE	1.50	9.00	1.75	13.50	2.63	.00	.00	.00	.00	.00
VALVE FRAME, PIPING	20.00	9.83	3.38	196.60	67.60	.00	.00	.00	.00	.00
4-WAY VALVE	5.00	11.33	4.42	56.65	22.10	.00	.00	.00	.00	.00
BY-PASS VALVE	11.70	10.17	3.04	118.99	35.57	2.18	10.17	3.04	22.17	6.63
PB VALVE	5.40	10.17	4.46	54.70	24.08	.00	10.13	4.46	.00	.00
FLOW METER	21.00	10.96	2.88	230.16	60.48	2.96	10.96	2.88	32.44	8.52
PUMP RELIEF VALVE	1.50	10.25	3.96	15.37	5.94	.00	.00	.00	.00	.00
CHECK VALVE	1.90	10.58	4.44	20.10	8.44	.00	.00	.00	.00	.00
HYDR CONTROL BOX	195.00	9.04	4.52	1762.80	881.40	142.22	9.04	4.52	1285.67	642.83
MOTOR PUMP FRAME	15.00	5.15	1.00	77.25	15.00	.00	.00	.00	.00	.00
HG SPHERES FWD (2)	26.00	1.79	1.90	46.54	49.40	41.70	1.79	1.90	74.64	79.23
HG FRAME FWD	12.00	1.79	1.90	21.48	22.80	4.54	1.79	1.90	8.13	8.63
HG FRAME SYNT FWD	5.00	1.79	1.90	8.95	9.50	8.00	1.79	1.90	14.32	15.20
HG SPHERES AFT (2)	26.00	17.50	3.92	455.00	101.92	41.70	17.50	3.92	729.75	163.46
HG FRAME AFT	10.00	17.50	3.92	175.00	39.20	3.78	17.50	3.92	66.15	14.82
HG FWD	245.25	1.79	1.90	4291.87	961.38	.00	1.79	1.90	.00	.00
HG AFT	245.25	17.50	3.92	4291.87	961.38	.00	17.50	3.92	.00	.00
HG SYSTEM PLUMBING	25.00	11.00	2.00	275.00	50.00	.00	11.00	2.00	.00	.00
SKIDS & BOLTS (2 STS)	46.50	8.67	.25	403.15	11.62	5.00	8.67	.25	55.00	10.00
CONTROL CENTER	262.00	10.21	4.63	2675.02	1213.06	17.60	10.21	4.63	152.59	4.40
SPHERE REL. GUIDES (2)	19.00	4.50	1.20	85.50	22.80	2.50	4.50	1.20	11.25	3.00
SPHERES REL DGS, ET	33.00	4.50	1.20	148.50	39.60	4.36	4.50	1.20	19.62	5.23
SPHERE PDSTLS & PADS	13.50	4.50	2.00	60.75	27.00	5.10	4.50	2.00	22.95	10.20

ALVIN WEIGHT AND STABILITY COMPUTATIONS

(CONTINUED)

AFTERBODY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
SPHERE RELEASE SHIMS	2.50	4.50	.50	11.25	1.25	.95	4.50	.50	4.27	.47
PROPULSION BOX & OIL	849.00	13.50	2.30	11461.50	1952.70	510.00	13.50	2.30	6885.00	1173.00
PROP BOX P/B M/D	12.00	13.50	2.30	162.00	27.60	.00	.00	.00	.00	.00
PROP BOX SUPPRTS	8.00	13.50	2.30	108.00	18.40	2.00	13.50	2.30	27.00	4.60
PROP BOX FRAME SUPP	3.00	13.50	2.30	40.50	6.90	1.00	13.50	2.30	13.50	2.30
FRAME REAR SPT STS	35.50	15.75	2.42	559.13	85.91	12.00	15.75	2.42	189.00	29.04
CONN HALVES LOWER	35.00	4.50	2.00	157.50	70.00	14.22	4.50	2.00	63.99	28.44
LIFT PRPF UNITS, P/B	382.00	9.00	7.75	3438.00	2960.50	232.00	9.00	7.75	2088.00	1798.00
LIFT PRPF BOX OIL	127.00	20.20	4.63	1143.00	984.25	.00	.00	.00	.00	.00
STERN PRPF ASSEMBLY	950.00	20.20	4.63	19190.00	4398.50	458.00	20.20	4.63	9251.60	2120.54
STERN PRPF OIL	82.68	20.20	4.63	1670.14	382.81	.00	20.20	4.63	.00	.00
BATTERY & BOX FWD	1470.00	8.68	2.80	12759.60	4116.00	929.00	8.68	2.80	8063.72	2601.20
BATTERY & BOX MID	1470.00	10.00	2.80	14700.00	4116.00	929.00	10.00	2.80	9290.00	2601.20
BATTERY & BOX AFT	1470.00	11.40	2.80	16758.00	4116.00	929.00	11.40	2.80	10590.60	2601.20
BATTERY DRPS(2) FWD	56.00	8.68	3.03	486.08	169.68	7.15	8.68	3.25	62.06	23.24
BATTERY DRPS(2) MID	56.00	10.00	3.03	560.00	169.68	7.15	10.00	3.25	71.50	23.24
BATTERY DRPS(2) AFT	56.00	11.40	3.03	638.40	169.68	7.15	11.40	3.25	81.51	23.24
SPHERE SUP SYNTAC(2)	3.00	4.30	2.00	12.90	6.00	4.80	4.30	2.00	20.64	9.60
FRAME SYNTACTIC(9)	17.00	9.00	3.50	153.00	59.50	27.20	9.00	3.50	244.80	95.20
V/B BOX BRKT	1.50	17.50	5.00	26.25	7.50	.56	17.50	5.00	9.80	2.80
LWR BASKET HINGE (2)	4.50	4.00	.30	18.00	1.35	1.70	4.00	.30	6.80	.51
WT & BSKT REL BRKT 3	2.00	4.62	2.75	9.24	5.50	.76	4.62	2.75	3.51	2.09
V/B SPHERE BRAC (2)	2.00	6.78	1.42	13.56	2.84	.76	6.78	1.42	5.15	1.08
CTR V/B PKG BRAC 2	4.00	10.50	5.00	42.00	20.00	1.52	10.50	5.00	15.96	7.60
BUZY PKG HLD DOWNS 6	3.00	15.00	5.00	45.00	15.00	1.13	15.00	5.00	16.95	5.65
HASTING PIN	2.50	12.50	7.44	31.25	18.60	.95	12.50	7.44	11.87	7.07
FWD FRAME SIDE BDS(2)	22.50	7.00	1.50	157.50	33.75	11.90	7.00	1.50	83.30	17.85
FRAME SIDE BD SKIN(2)	11.50	7.00	1.50	80.50	17.25	6.10	7.00	1.50	42.70	9.15
TIE DOWNS (4)	20.00	13.50	4.67	270.00	93.40	7.40	13.50	4.67	99.90	34.56
HANDLING PADS(6)	15.00	8.00	6.50	120.00	97.50	1.98	8.00	6.50	15.84	12.87
BATTERY CHG CABLE TR	10.00	10.70	7.83	107.00	78.30	3.70	10.70	7.83	39.59	28.97
BATTERY CHG CABLES	14.50	10.70	7.67	155.15	111.21	7.25	10.70	7.67	77.57	55.61
MARSH MARINE CABLES	62.50	9.35	4.67	584.37	291.87	31.25	9.35	4.67	292.19	145.94
INSTRUMENT CASE	17.00	6.30	.83	107.10	14.11	3.34	6.30	.83	21.04	2.77
BOTTOM WINDOW CONE	12.50	3.50	1.00	43.75	12.50	6.95	3.50	1.00	24.32	6.95
FWD WT CRP, SOL	10.50	4.50	3.00	2.63	31.50	3.50	4.50	3.00	15.30	10.50
PORT WT CRP, SOL FWD	10.10	4.50	3.00	45.45	30.30	3.40	4.50	3.00	15.30	10.20
STBC WT CRP, SOL FWD	10.10	4.50	3.00	45.45	30.30	3.40	4.50	3.00	15.30	10.20
PORT WT CRP, SOL AFT	10.10	6.00	3.00	60.60	30.30	3.40	6.00	3.00	20.40	10.20
STBD WT CRP, SOL AFT	10.10	6.00	3.00	60.60	30.30	3.40	6.00	3.00	20.40	10.20

ALVIN HEIGHT AND STABILITY COMPUTATIONS

(CONTINUED)

AFTERBODY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
BATTERY RESERVOIR 88	182.00	7.00	1.40	1274.00	254.80	215.10	7.00	1.40	1505.70	301.14
BATTERY RES BOX BAG	32.00	7.00	1.40	224.00	44.80	17.80	7.00	1.40	124.60	24.92
BATTERY RES BOX BRKT	1.40	7.00	1.40	9.80	1.96	.37	7.00	1.40	2.59	.52
RUBBER GASKETS (3)	10.00	4.50	2.60	45.00	26.00	8.33	4.50	2.60	37.48	21.66
MISC PLUMBING	24.00	10.10	3.67	242.40	88.08	3.14	10.10	3.67	31.71	11.52
FATHOMETER	31.50	5.50	2.25	173.25	70.87	15.50	5.50	2.25	85.25	34.87
SYNT FWD SKIDS	22.00	6.50	.25	143.00	5.50	39.00	6.50	.25	253.50	9.75
V/B BAG SYNT P	197.60	10.40	3.20	632.32	351.29	351.29	10.40	3.20	3653.42	1124.13
SMALL BUSH PKGS AFT	103.00	17.28	5.38	554.14	183.11	183.11	17.28	5.38	3164.14	985.13
SYNT AFT SKIDS	21.93	10.50	.25	230.26	5.48	38.98	10.50	.25	409.29	9.74
AMF XPDR CASE	80.00	9.83	4.12	786.40	329.60	45.00	9.83	4.12	442.35	185.40
AMF XPDR HEAD	3.00	17.12	5.12	136.96	40.96	5.82	17.12	5.12	99.64	29.80
AUX BATT BOX BRKT	23.50	15.87	1.96	372.94	46.06	8.88	15.87	1.96	140.93	17.40
SS INSERTS, BBLTS	4.00	16.03	3.17	64.12	12.68	.50	16.03	3.17	18.01	1.58
BASKET ELECT DISC	15.00	.67	2.00	10.05	30.00	4.87	.67	2.00	3.26	9.74

AFTERBODY

SUMMARY	NO. ITEMS	SUM W	S	MXW	S	MYW	S	MX	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	SUM MXP	SUM MYP
	95	16175.67		11.17		3.96		180611.17		64135.66	14824.65		11.50		4.47	170416.74	66218.54
BG LONGITUDINAL			.33					BG VERTICAL			.50						

ALVIN WEIGHT AND STABILITY COMPUTATIONS

VARIABLE LOAD(NORMAL)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
MECHANICAL ARM	438.55	-0.30	2.70	-131.56	1184.08	143.00	.00	2.70	.00	386.10
MECH ARM REL	96.50	.80	3.00	77.20	289.50	30.50	.80	3.00	24.40	91.50
MECH ARM CNTR BRX	10.00	1.00	7.00	10.00	70.00	.00	1.00	7.00	.00	.00
ARM OFFSET BRKTS	13.00	1.00	3.00	13.00	39.00	3.00	1.00	3.00	3.00	9.00
SAMPLE TRAY, T96LS	150.00	-2.50	1.40	-375.00	210.00	45.00	-2.50	1.40	-112.50	63.00
PERSONNEL (3)	500.00	5.86	4.13	2930.00	2065.00	.00	.00	.00	.00	.00
ASCENT WEIGHT	500.00	4.50	2.60	2250.00	1300.00	45.00	4.50	2.60	202.50	117.00
ADD LEAD BR PAYLOAD	145.00	4.00	3.00	580.00	435.00	.00	.00	.00	.00	.00

VARIABLE LOAD(NORMAL)

SUMMARY	NO. ITEMS	SUM W	S	MXW	S	MYW	S	MX	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	SUM MXP	SUM MYP
	8	1853.05		2.89		3.02		5353.63		5592.58	266.50		.44		2.50	117.40	666.60

BG LONGITUDINAL -2.45

BG VERTICAL .52

ALVIN WEIGHT AND STABILITY COMPUTATIONS

ENTIRE VEHICLE(NORMAL)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
SPHERE ONLY	8331.11	4.37	4.73	36406.95	39406.15	10780.82	4.47	4.74	48190.27	51101.09
OTHER FOREBODY	6228.40	3.80	6.28	23667.92	39114.35	6721.57	3.62	6.19	24332.08	41608.52
AFTERBODY	16175.67	11.17	3.96	180682.23	64055.65	14824.65	11.50	4.47	170483.47	66266.19
VARIABLE LOAD	1853.05	2.39	3.01	5355.31	5577.68	266.50	.44	2.50	117.26	666.25

ENTIRE VEHICLE(NORMAL)

SUMMARY	NO. ITEMS	SUM W	S MXW	S MYW	SUM MX	SUM MY	SUM D	S MXP	S MYP	SUM MXP	SUM MYP
	4	32588.23	7.55	4.55	246112.42	148153.84	32593.54	7.46	4.90	243123.08	159640.04

BG LONGITUDINAL

.09

BG VERTICAL

.35

ALVIN HEIGHT AND STABILITY COMPUTATIONS

RELEASED FOREBODY

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
SPHERE ONLY	8331.11	4.37	4.73	36406.95	39406.15	10780.82	4.47	4.74	48190.27	51101.09
OTHER FOREBODY	6223.40	3.80	6.28	23667.92	39114.35	6721.57	3.62	6.19	24332.08	41606.52
PERSONNEL (3)	500.00	5.86	4.13	2930.00	2065.00	.00	.00	.00	.00	.00
MECH ARM CONTR BOX	10.00	1.00	7.00	10.00	70.00	.00	.00	.00	.00	.00

RELEASED FOREBODY

SUMMARY	NO. ITEMS	SUM W	S	MXW	S	MYW	S	MX	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	S	MXP	SUM MXP	MYP	SUM MYP
	4	15069.51		4.18		5.35		63014.87		80655.50	17502.39		4.14		5.30		72522.35		92707.61	

BG LONGITUDINAL --.04

BG VERTICAL --.06

ALVIN WEIGHT AND STABILITY COMPUTATIONS

EMERGENCY CONDITIONS (1)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
IN NORMAL CONDITION	3258.23	7.55	4.55	246041.14	148276.45	32593.54	7.46	4.90	243147.81	159708.35
BLW MAIN BALLAST	-1346.00	4.50	6.00	-6057.00	-8076.00	.00	.00	.00	.00	.00

EMERGENCY CONDITIONS (1)

SUMMARY	NO. ITEMS	SUM W	S	MXW	S	MYW	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	SUM MXP	SUM MYP
	2	31242.23		7.62		4.49	23984.14	14020.45	32593.54		7.46		4.90	243147.81	139708.35
BG LONGITUDINAL		0.22					BG VERTICAL	0.41							

ALVIN *EIGHT AND STABILITY COMPUTATIONS

EMERGENCY CONDITIONS (2)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
IN NORMAL CONDITION	32588.23	7.55	4.55	246041.14	148276.45	32593.54	7.46	4.90	243147.81	159708.35
DROP MID BATTERY	-1470.00	10.00	2.80	-14700.00	-4116.00	-929.00	10.00	2.80	-9290.00	-2601.20

EMERGENCY CONDITIONS (2)

SUMMARY	NB. ITEMS	SUM W	S	MXW	S	MYW	S	MX	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	SUM MXP	SUM MYP
	2	31118.23		7.43		4.63		231341.14		144160.45	31664.54		7.39		4.96	233857.81	157107.15

BG LONGITUDINAL -0.05

BG VERTICAL .33

ALVIN WEIGHT AND STABILITY COMPUTATIONS

EMERGENCY CONDITIONS (4)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
IN NORMAL CONDITION	32588.23	7.55	4.55	246041.14	148276.45	32593.54	7.46	4.90	243147.81	159708.35
DROP FWD BATTERY	-1470.00	8.68	2.80	-12759.60	-4116.00	-929.00	8.68	2.80	-8063.72	-2601.20
DROP MID BATTERY	-1470.00	10.00	2.80	-14700.00	-4116.00	-929.00	10.00	2.80	-9290.00	-2601.20
DROP AFT BATTERY	-1470.00	11.40	2.80	-16758.00	-4116.00	-929.00	11.40	2.80	-10590.60	-2601.20

EMERGENCY CONDITIONS (4)

SUMMARY	NO. ITEMS	SUM W	S	MXW	S	MYW	S	MX	SUM MX	MY	SUM MY	S	MXPD	S	MYPD	SUM MXP	SUM MYP
4		28178.23		7.16		4.82		201823.54		135928.45			7.22		5.10	215203.49	151904.75
BG LONGITUDINAL			.06					BG VERTICAL			.27						

ALVIN HEIGHT AND STABILITY COMPUTATIONS

EMERGENCY CONDITIONS (5)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
IN NORMAL CONDITION	32588.23	7.55	4.55	246041.14	148276.45	32593.54	7.46	4.90	243147.81	159708.35
DRBP FWD BATTERY	-1470.00	8.68	2.80	-12759.60	-4116.00	-929.00	8.68	2.80	-8063.72	-2601.20
DRBP MID BATTERY	-1470.00	10.00	2.80	-14700.00	-4116.00	-929.00	10.00	2.80	-9290.00	-2601.20
DRBP AFT BATTERY	-1470.00	11.40	2.80	-16758.00	-4116.00	-929.00	11.40	2.80	-10590.60	-2601.20
DRBP ARM	-438.55	-0.30	2.70	131.56	-1184.08	-143.00	.00	2.70	.00	-386.10

EMERGENCY CONDITIONS (5)

SUMMARY	NO. ITEMS	SUM W	S	MXW	S	MYW	S	MX	SUM MX	SUM MY	SUM D	S	MXPD	S	MYPD	SUM MXP	SUM MYP
5	5	27739.68		7.28		4.86		201955.10	134744.36	29663.54		7.25	5.11			215203.49	151518.65

BG LONGITUDINAL -0.03

BG VERTICAL .25

ALVIN WEIGHT AND STABILITY COMPUTATIONS

EMERGENCY CONDITIONS (6)

IDENTIFICATION	W	X	Y	MX	MY	D	XP	YP	MXP	MYP
IN NORMAL CONDITION	32588.23	7.55	4.55	246041.14	148276.45	32593.54	7.46	4.90	243147.81	159708.35
FL00D V/B SPHERES	1062.00	9.05	4.27	9611.10	4534.74	.00	.00	.00	.00	.00
DR0P FWD BATTERY	-1470.00	8.68	2.80	-12759.60	-4116.00	-929.00	8.68	2.80	-8063.72	-2601.20
DR0P MID BATTERY	-1470.00	10.00	2.80	-14700.00	-4116.00	-929.00	10.00	2.80	-9290.00	-2601.20
DR0P AFT BATTERY	-1470.00	11.40	2.80	-16758.00	-4116.00	-929.00	11.40	2.80	-10590.60	-2601.20
DR0P ARM	-438.55	11.30	2.70	131.56	-1184.08	-143.00	.00	2.70	.00	-386.10

EMERGENCY CONDITIONS (6)

SUMMARY	NO. ITEMS	SUM W	S MXW	S MYW	SUM MX	SUM MY	SUM D	S MXP	S MYP	SUM MXP	SUM MYP
	6	28801.68	7.35	4.84	211566.20	139279.10	29663.54	7.25	5.11	215203.49	151518.65
BG LONGITUDINAL		.09			BG VERTICAL	.27					

E. Other Calculations

1. Pounds per Inch Immersion - This is the weight of a layer of sea water one inch thick at the vehicle's waterplane, and is used to obtain the change in draft for a given change in weight. The increase or decrease in draft is equal to the vehicle weight change divided by the pounds per inch immersion. The waterplane area used is based on draft readings taken at the time of the 1973 surface inclining experiment. Thus, the pounds per inch immersion

$$\begin{aligned} \text{PPI} &= A_{wp} \times \frac{1}{12} \times 64 \\ &= 73.96 \times \frac{1}{12} \times 64 \\ &= 394 \text{ lbs. per inch} \end{aligned}$$

2. Moment to Heel One Degree (submerged) - This is the moment required to produce an inclination of 1 degree about the vehicle's longitudinal axis. It is found for the submerged vehicle by

$$\begin{aligned} \text{MHD} &= W(\text{BG}) \sin 1^\circ \\ &= 32,520(.36) (.0175) \\ &= 205 \text{ ft.-lbs.} \end{aligned}$$

3. Moment to Heel One Degree (on surface) - This is the moment required to produce an inclination of 1 degree

about the longitudinal axis of the vehicle on the surface. It is given by

$$\begin{aligned} \text{MHD} &= W(\text{GM}) \sin 1^\circ \\ &= 31,136(.47) (.0175) \\ &= 256 \text{ ft.-lbs.} \end{aligned}$$

III. Discussion of Results

Since no inclining experiments or trim dives were run for the submersible during 1974, there are no experimentally determined BG or GM values reported here. The reader is referred to the 1973 ALVIN weight report (Ref. 1) for the most recent values.

The computed values of BG longitudinal and BG vertical, for the normal submerged vehicle, the released forebody, and the emergency conditions, are shown in the computer printout and they are summarized here briefly for convenience. The entire vehicle (normal, submerged) shows a value of BG vertical of 0.35 ft., about 3 percent less than the 1973 value of 0.36 ft. The new value of BG longitudinal is -0.09 ft., slightly greater than the -0.08 ft. found in 1973. The negative sign indicates a slight bow-up tendency; the mercury trim system is normally used to correct for this discrepancy. The released forebody has a BG vertical value of -0.06 ft., somewhat greater than the 1973 value of -0.04 ft. The negative value here indicates a tendency for the forebody to invert. However, even if the sign were positive, the magnitude of the number would be quite small, and the

forebody would likely invert due to hydrodynamic drag acting on the conning tower as it moves upward through the water.

The computed results for the various emergency conditions differ only to a small degree, if at all, from those of previous computations.

The forebody on the surface has been observed to have stability in the upright condition for roll angles up to 30 or 40 degrees. The overall shape of the forebody leads one to suspect that it may be stable also in the inverted position although this has not been established through calculation. In the event of an emergency release, it is fairly certain that the forebody would travel to the surface in an inverted condition. The assumption is made that upon reaching the surface, the forebody might be in equilibrium either upright or inverted. The inverted forebody on the surface would not present unusual difficulties. Inflatable bags might be attached for righting the forebody; or, the sphere could be internally pressurized by the occupants, and the hatch could be opened against the slight sea pressure.

IV. References

1. DSRV ALVIN Weight Report, 1973, by Arnold G. Sharp and Kenneth W. Doherty, WHOI Technical Memorandum No. 6-73, December, 1973.

V. Appendix

Computer Program

Name: ALVINSTA

Type: Main Program

Purpose: To compute total weight and total displacement of the DSV ALVIN in its normal and various emergency conditions; weight and displacement of various subassemblies (sphere, forebody, etc.); location of center of gravity and center of buoyancy for the vehicle and for subassemblies; BG distance for the vehicle and for subassemblies expressed in longitudinal and vertical components. The program has an optional plot tape output to give graphic representation of submersibles attitude under the various conditions.

MACHINE: XDS Sigma 7

SOURCE LANGUAGE: XDS Fortran IV

PROGRAM CATEGORY: Data Processing

DESCRIPTION:

A full description and an example of the input/output data may be found in W.H.O.I. Technical Memorandum DS-26, WEIGHT, BUOYANCY AND STABILITY OF DSRV ALVIN, 1967, Arnold G. Sharp, January 1968.

INPUT: Punched cards. For each section of data there is one set of data cards of the following form:

Card 1 28 character alphanumeric title

Succeeding Data cards of the following format:
cards (up
to 500)

Columns		
1-20	20	Char. Alphanumeric Identifier
22-29	W	Item air weight
31-35	X	CG X Distance
37-41	Y	CG Y Distance
43-50	D	Displacement of Item
52-56	XP	B X Distance
58-62	YP	B Y Distance
64	C	Control Integer

Last Card !EOD (After each data section)

OUTPUT: On the line printer. Please see Technical Memorandum DS-26 for format and example program output. On calcomp plotter. Graphic representation of ALVIN in the attitude calculated by the program for a given data section.

USAGE: The deck is set up

```
!JOB ---, ---
!MESSAGE PLOT TAPE (if needed)
!ASSIGN F:PLOT, (DEVICE, 7T), (BIN),
      (OUTSN, PLTL), (OUT), (UNPACK)
!FORTRAN LS, GO,X*
      (Fortran deck of ALVINSTA)
! DATA
!   (Permanent data deck)
      (Data cards as described above)
      *Use "X" option only if plot is
        desired
```

RESTRICTIONS:

1. Column 64 contains 0 (zero) on all but the last data card in each section (before !EOD card)
2. A (2) in column 64 of the last data card causes plot output for that section.
3. A (3) in column 64 of the last data card indicates last section and terminates program. Plot will be output for last section unless "X" option was not specified on !FORTRAN card.

STORAGE REQUIREMENTS: About 5000₁₀ words

SUBPROGRAMS REQUIRED: AXDRAW, PLOT, SYMBOL

OPERATIONAL ENVIRONMENT:

<u>Device</u>	<u>Function</u>	<u>Special requirements</u>
card reader	input	F:105 DCB
line printer	output	F:108 DCB
7 track tape	output	F:PLOT DCB

OPERATIONAL CHARACTERISTICS:

Reads a data section then prints and writes tape (if called for).

TIMING: About 2 1/2 min. for typical large job w/plot

PROGRAMMER: Andy Eliason

ORIGINATOR: Arnold Sharp

DATE: July, 1971

REFERENCE: Technical Memorandum DS-26


```

1. C ALVIN WEIGHT AND STABILITY PROGRAM
2. C
3. C JUNE 1971
4. C PROGRAMMER: ANDREW H. ELIASON
5. C USE X OPTION FOR CALCULATION WITH PLOT
6. C
7. C IMPLICIT DOUBLE PRECISION (A-H, O-Z)
8. C REAL X2,Y2
9. C COMMON IRUF(1000)
10. C COMMON ARRAY1(500)
11. C COMMON ARRAY2(500)
12. C COMMON ARRAY3(500)
13. C COMMON ARRAY4(500)
14. C SCALE= 500.0
15. C COMMON IDEN(300,5),ID(7)
16. C DIMENSION X(300),Y(300),W(300),D(300),XP(300),YP(300),C(300)
17. C FORMAT(5A4,1X,F8.2,2(1X,F5.2),1X,F8.2,2(1X,F5.2),1X,I1)
18. C FORMAT(46X,ALVIN WEIGHT AND STABILITY COMPUTATIONS',35X,'PAGE ',I
19. C 11/)
20. C FORMAT(46X,7A4/)
21. C FORMAT(46X,7A4,1 (CONTINUED),/,/)
22. C FORMAT(3X,IDENTIFICATION',11X,'W',9X,'X',8X,'Y',9X,'MX',10X,'MY',
23. C 11X,'D',9X,'XP',7X,'YP',8X,'MPI',9X,'MYP',/)
24. C FORMAT(1X,5A4,4X,F8.2,2(1X,F5.2),3(1X,F9.2),2(4X,F5.2),2(3X,F9.2))
25. C FORMAT(/, SUMMARY N6. ITEMS,16X,SUM W,4X,S MXW,4X,S MYW,
26. C 16X,SUM MX,16X,SUM MY,7X,SUM D,5X,S MXP,3X,S MYP,4X,S SUM
27. C 1 MXP,5X,SUM MYP)
28. C FORMAT(14X,13,8X,F8.2,2(4X,F5.2),3(3X,F9.2),2(4X,F5.2),2(3X,F9.2))
29. C FORMAT(/,10X,'BG LONGITUDINAL',5X,F5.2,20X,'BG VERTICAL',5X,F5.2)
30. C FORMAT('1')
31. C FORMAT(7A4)
32. C FORMAT(/,1X,7A4)
33. C CALL PLOTS(1BUF,-1000)
34. C *****
35. C READ ALVIN PICTURE DATA
36. C M=1
37. C 15 M1=M+3
38. C READ(105,105,END=55)(ARRAY1(I),ARRAY2(I),I=M,M1)
39. C 105 FORMAT(4(5X,16,2X,16,1X))
40. C M=M+4
41. C GO TO 15
42. C 55 CONTINUE
43. C M=M+4
44. C *****
45. C READ SECTION TITLE AND DATA
46. C IPAGE = 1
47. C N=1
48. C READ(105,900)ID
49. C 10 READ(105,100,END=20)(IDEN(N,J),J=1,5),W(N),X(N),Y(N),D(N),XP(N),
50. C 1YP(N),C(N)
51. C N=N+1
52. C GO TO 10

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```

53. 20 N=N-1;WRITE(108,200)IPAGE,WRITE(108,250)ID,WRITE(108,300)
54. ITEM = 1
55. SW=0.0;SRXW=0.0;SRYW=0.0;SRX=0.0;SRY=0.0;SD=0.0;SRXPD=0.0;SRYPD=0.0
56. SRXP=0.0;SRYP=0.0
57. CALCULATE RESULTS
58. DO 30 I=1,N
59. RX=W(I)*X(I),RY=W(I)*Y(I)
60. RXP=D(I)*XP(I),RYP=D(I)*YP(I)
61. SW=W(I)*SW,SD=D(I)*SD
62. SRX=SRX+RX;SRY=SRY+RY;SRXP=SRXP+RXP;SRYP=SRYP+RYP
63. SRXW=SRX/SW;SRYW=SRY/SW
64. SRXPD=SRXP/SD;SRYPD=SRYP/SD
65. BGL=SRXPD-SRXW*BGL;BGV=SRYPD-SRYW
66. WRITE(108,400)(IDEN(I),J),J=1,5),W(I),X(I),Y(I),RX,RY,D(I),XP(I),
67. YP(I),RXP,RYP
68. 1 IF(ITEM.EQ.40.8R,ITEM.EQ.80.8R,ITEM.EQ.120)IPAGE=IPAGE+1;WRITE(108
69. 1,800);WRITE(108,200)IPAGE,WRITE(108,260)ID;WRITE(108,300)
70. ITEM=ITEM+1
71. 30 CONTINUE
72. C
73. PRINT RESULTS
74. WRITE(108,950)ID
75. WRITE(108,500)
76. WRITE(108,600)N,SW,SRXW,SRYW,SRX,SRY,SD,SRXPD,SRYPD,SRXP,
77. 1SRYP;WRITE(108,700)BGL,BGV;WRITE(108,800);IPAGE=IPAGE+1
78. C*****
79. CALCULATE PICTURE ROTATION DATA
80. IF(C(N).LT.2) GO TO 80
81. THETA=ATAN2(SRXPD-SRXW,SRYPD-SRYW)
82. DO 25 I=1,M
83. IF(ARRAY2(I).GT.3000) ARRAY4(I)=10500; GO TO 25
84. X1=ARRAY1(I)
85. Y1=ARRAY2(I)
86. GAMMA=ATAN2(Y1,X1)
87. R=DSQRT(X1**2+Y1**2)
88. A=GAMMA+THETA
89. X1=R*DCOS(A)
90. Y1=R*DSIN(A)
91. ARRAY3(I)=X1
92. ARRAY4(I)=Y1
93. 25 CONTINUE
94. C*****
95. PLOT ALVIN PICTURE
96. CALL PLST(10.0,10.0,-3)
97. CALL AXDRAW(-6.0,0.0,'X',1,16.0,0.0,-6.0,1.0,1.0,-1)
98. CALL AXDRAW(0.0,-4.0,'Y',1,10.0,90.0,-4.0,1.0,1.0,-1)
99. CALL SYMBOL (-7.9,-9.21,ID,0.28)
100. DO 75 I=1,M
101. IPEN=2
102. IF(1.EQ.1.8R,IFLAG.EQ.1) IPEN=3;GO TO 65
103. IF(ARRAY4(I).GT.10000)IFLAG=1;GO TO 75
104. 65 X2=ARRAY3(I)/SCALE
105. Y2=ARRAY4(I)/SCALE
CALL PLST(X2,Y2,IPEN)

```



```
106. X IFLAG=0
107. X 75 CONTINUE
108. X CALL PLAT (0.0,0.0,999)
109. C *****
110. 80 CONTINUE
111. C CHECK FOR LAST CARD
112. IF(C(N).EQ.3)GO TO 40
113. GO TO 5
114. 40 CALL EXIT
115. END
```