FORWARD

This publication is Volume 3 of six volumes of the final report on Mathematical Ship Lofting and Numerical Control of Shipyard Fabricating Equipment. The work reported on herein was performed under Bureau of Ships Contract NObs-4427, Code 770, during the period from April 1961 to March 1963.

The volumes of this final report have the following titles:

Vol. 1. Project Summary Report (Technical Report 9.0.0)

Vol. 2. Mathematical Ship Lofting -
Part 1. - Theory (Technical Report 1.0.0-1)
Part 2. - Operating Manual (Technical Report 1.0.0-2)

Vol. 3. Mathematical Ship Lofting - Summary Report (Technical Report 1.5.0)

Vol. 4. Programming System for Numerically Controlled Flame Cutting of Ships Parts - Operating Manual (Technical Report 5.0.0)

Vol. 5. Development and Testing of Programming System for Numerically Controlled Flame Cutting of Ships' Parts - Summary Report (Technical Report 5.5.0)

Vol. 6. Numerically Controlled Shipyard Fabricating Equipment - Summary Report (Technical Report 3.0.0)

The work was accomplished by the Research & Development Group of the Los Angeles Division of Todd Shipyards Corporation, San Pedro, Calif. Mr. Thomas G. Smith was Project Manager for the work, and Dr. Henry A. Schade of the University of California, Berkeley, was Principal Consultant.

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ABSTRACT

The formulation for mathematically fairing curves and surfaces presented in Volume 3 of this Final Report has proved capable of economically fairing large areas of the molded form up to half the ship in size. In addition, perhaps for the first time, a satisfactory method has been developed for fairing mathematically the extreme ends where discontinuities occur. The joining of these several faired surfaces to form a single fair surface has not yet been successfully demonstrated.

The fairing method has been incorporated in a system of programs which provide loft data mathematically. Some of these programs have been used in production by Todd Shipyards Corporation and under contract to others for producing loft data.

Several elements of the fairing system require additional development work. These items are listed in the recommendations at the end of this report.

There is a need to reduce the size and density of the problem so that larger surfaces can be handled more efficiently.

Production use of the fairing method itself should be attempted only after the additional work recommended has been completed. Suggestions for the solution of these problems have been offered in this report. The effort still needed is small compared to that already expended in formulating the method itself and demonstrating the system presented.

CONTENTS

Section I

INTRODUCTION

Todd Shipyards Corporation, Los Angeles Division, under Contract NObs-4427 has developed and presented as Volume 3 of this final report a system for mathematically fairing and lofting ships. This system starts with the preliminary offsets produced by a naval architect and produces much of the loft data needed for construction.

The heart of this system is the mathematical fairing method presented as Part 1 - Theory, of Volume 3. This method was formulated, developed, and tested to the extent possible, within the time and funds provided.

Presented in the following sections are:

- A discussion of the mathematical fairing method employed
- The limitations of the system
- A comparison of the system with the criteria
- Recommendations and conclusions

Section II

DISCUSSION OF MATHEMATICAL FAIRING METHOD

The basic fairing method developed followed exhaustive state-of-the-art studies and comparison of the many previous approaches to the problem with the criteria established for this program. This criteria was established for the purpose of developing a method capable of meeting shipyard production requirements.

These requirements are somewhat different and definitely more restricting than the requirements for a mathematical hull definition to be used in hydrodynamic studies.

Linear programming, employing a notation for cubic equations developed by Dr. Feodor Theilheimer of the David W. Taylor Model Basin, was chosen as the best method capable of meeting the criteria.*

A. PLANE CURVE FAIRING

In applying linear programming to ship fairing, plane curves were developed first. Plane curves defined by five to twelve offsets have been faired many times. It is possible to fair curves defined by twenty or twenty-five offsets on an IBM-1620 computer using the formulation developed.

To fair a five to ten-point waterline requires only a few minutes on the 1620. Representative examples of curves and times for

*Todd Shipyards Corporation Technical Report 1.1.1, "Evaluation of Mathematical Lofting Methods in Current Use, and Comparison with Developed Criteria," R. A. Tapia, March 1, 1962

fairing are given in Appendix A.

The success of the linear programming/mathematical spline curve method for plane curves encouraged an extension of the method to three dimensions.

B. THREE-DIMENSIONAL FAIRING

The three-dimensional method used in some previous fairing schemes, and that which is most obvious because of the ease with which plane curves can be faired, is simply to fair each of the original, individual stations and waterlines independently, and iterate back and forth between waterlines and stations until at each point where a waterline and station are common, the offset from one is very nearly equal to the offset of the other.

This method was attempted but was dropped in favor of surface fairing for two reasons:

1. It had not been possible to demonstrate a set of waterlines and stations which have the same offsets at common points.
2. The surface area between stations and between waterlines is undefined. Data can only be obtained in this area by some interpolation scheme.

C. SURFACE FAIRING

The method uses surface equations rather than plane curve equations. It was first formulated under Contract NObs-4427.* The surface has the characteristics of a spline curve in the station direction and in the waterline direction.

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*Ibid.

Two types of fit have been used. The first is the minimax or lambda (λ) fit. To fit the equation to the offsets using this fit, the linear program seeks to minimize the absolute value of the greatest deviation of the equation from the offsets.

The second type is the sum-of-the-deviations fit. This fit minimizes the sum of the absolute values of the individual deviations.

The difference is that the lambda fit provides an even distribution of the deviation over all the offsets. The sum-of-the-deviations fit usually provides a surface that comes very close to the majority of offsets, but may build up a large deviation at one or two offsets near one end of the surface.

The lambda fit was first formulated for linear programming using the primal tableau. It was later restated with changes using the dual tableau.

1. Lambda Formulation - Primal

   The formulation required four constraints per offset. These were:

   a. The equation of the surface at each preliminary offset is equal to, or greater than, the value of the preliminary offset minus λ.

   b. The equation of the surface at each preliminary offset is equal to, or less than, the value of the preliminary offset plus λ.

   c. The value of the second difference in the waterline direction of the preliminary offset, times the value of the second derivative of the surface equation taken in the waterline direction at the preliminary offset is greater than or equal to zero.

d. The value of the second difference in the station direction of the preliminary offset, times the value of the second derivative of the surface equation in the station direction at the preliminary offset is greater than or equal to zero.

Constraints a and b are the deviation constraints; c and d are the curvature constraints.

The first surfaces faired with this method each contained offsets for five stations and five waterlines (twenty-five offsets). These required approximately seventeen minutes of 7090 computer time to fair.* A larger surface covering ten stations and eight waterlines (eighty offsets) was then successfully faired but required an excessive amount of IBM-7090 computer time (seven hours).

At this point, it became apparent that the technique was successful from a technical viewpoint but needed to reach a solution faster for two reasons: first, to be economically feasible; second, because the great number of calculations involved could adversely affect the accuracy of the numbers involved.

2. Sum of Deviations Formulation

Experience with linear programming problems indicates that execution time of a problem varies greatly with the number of

*An example of the result of this effort is given in Appendix A of Todd Shipyards Corporation Technical Report 1.2.3, "A Method for Defining and Fairing Ships' Form Using Linear Programming," by R. A. Tapia, June 11, 1962

constraints present and varies little with the number of variables. Initial work on reducing the running time concentrated on reducing the number of constraints per offset. A variation in the formulation was made which produced the "sum of the deviations fit" reported in Part 1 - Theory, of Volume 2, of the Final Report.

Here, a single deviation constraint replaced the two deviation constraints of the λ fit. Two dummy variables were used in each constraint defined by the following:

> The equation of the surface at each preliminary offset, plus the first dummy variable, minus the second dummy variable, equals the preliminary offset.

A different pair of dummy variables is used for each offset. Since these variables are linearly dependent, only one of each pair can be in the solution at a time. Therefore, the dummy variables that are in the solution are the set of deviations of the equation from the offsets. The linear program minimizes the sum of the absolute values of these deviations.

Obviously, this formulation decreases the constraints by twenty-five percent. This, plus an improvement in the manner of using the LP, produced a solution to the eighty-offset problem in sixty-two minutes instead of seven hours. The twenty-five offset problem required one minute.

3. Lambda Formulation - Dual

In an effort to retain the lambda fit but reduce the solution time, an alternate approach retaining the original four constraints was tried using a surface equation which is "double splined," as discussed in Part 1 - Theory, Volume 2, of the

Final Report. Double splining means that each cubic spans two intervals between offsets instead of one, as in previous formulations. This reduces the required number of terms in the surface equation and eliminates the curvature constraints at the offset in the center of each cubic interval. With this change, it became important to re-state the problem in the dual form. In this form the constraint matrix is transposed, and this, for the fairing formulation, presents an apparently reduced number of constraints in the problem.

The double spline formulation requires an odd number of offsets; therefore, the ten-station, eight-waterline-eighty-offset surface was replaced by an eleven-station, seven-waterline, seventy-seven offset surface. This problem, double splined in both the station and waterline directions, required seventeen minutes on the 7090. The twenty-five offset problem now required about fifteen seconds.

Because the lambda fit gives a better overall fit it has been used in the system as presented. Examples of surfaces using both fits are presented in Appendixes B and C. Deviations in all cases have been of a reasonable order compared to the unfairness one might expect in preliminary offsets - usually under one inch in surfaces and under three-eighths inch on curves.

Section III

SYSTEM LIMITATION

A. LINEAR PROGRAMMING - PROBLEM SIZE LIMITATIONS

Although there are linear programs in existence which can handle very large problems (up to 1,023 constraints), there are still practical limitations on the size, caused by two special circumstances in the ship problem:

1. The high density of the formulation, compared to other linear programming problems
2. The extreme range, from very small to very large, in number size which occurs in the matrix

The high density as well as large size of the problem matrix for a large surface requires a great many iterations and a great number of calculations per iteration. This creates long execution times for large surfaces; but more important, the excessive number of calculations, combined with the extreme range of number size, can cause a loss of accuracy. This loss can produce a surface with unacceptably large deviations from the offsets, or it can cause the program to fail to find a solution.

During the evolution of the formulation, the effects of these factors have been diminished, allowing larger and larger surfaces to be done with increased reliability. At present, the largest surface that can be faired with assurance is eleven stations by nine waterlines (ninety-nine offsets).

Several surfaces of approximately seven stations by eleven waterlines, each requiring about an hour of IBM-7090 time, must be joined to produce the complete ship molded form, for a total estimated fairing

time of four to six hours per ship. The considerations used reaching this time estimate were (1) the surfaces will be double-splined in one direction only, (2) additional time because of the uncertainty of exact solution times using linear programming. A satisfactory method of joining such surfaces has not yet been demonstrated.

There are many methods offering possibilities for increasing the size of individual surfaces defined which have not yet been tried. Examples are:

1. To normalize each constraint within itself, thus reducing the extreme number range that can now be present
2. To perform other basic matrix arithmetic operations to reduce the size or density of the matrix
3. To investigate the possibility of fairing only every second station on selected parts of the hull.

These changes are mechanical, that is, they require no reformulation of the basic method. Such changes, coupled with improvements in linear programming methods and programs, or possibly an LP code written specifically for this problem should eventually make it possible to fair the ship molded surface complete in one pass.

B. JOINING THE FAIRED SURFACES

The problem of joining the several faired surfaces to produce a complete molded form was not attempted until near the end of the Contract period. Consequently, only one method was tried - the simplest.

This consisted of (1) fairing the first surface, (2) solving for the faired offsets at the last station of this surface, (3) overlapping the last station interval with the second surface and requiring the second surface to go exactly through the offsets found in (2). It was found that the second surface did go exactly through these points when

faired, and that on the waterlines where this happened, the difference in first and second derivatives was negligible. However, in some intervals (not all intervals) between these waterlines, the surface formed a different shaped station, causing a line of discontinuity between the surfaces so that the method was judged unsatisfactory. Examples of other methods are:

1. Overlapping the surfaces and requiring the second surface to go through first-surface offsets of both overlapped stations

2. Overlapping the surfaces and requiring the second surface to have the same station equation as the first surface for one or both of the overlapped stations

3. Collapsing the first-surface equation into an equation for the final station interval for the first surface and requiring the second surface to have this equation in its first-station interval

4. Using decomposition programming or dyhamic programming to obtain an optimum solution to the entire hull surface in stages

These methods have not been tried. Methods 1. and 2. will not provide continuous first and second derivatives at the joint, but the discrepancies may be negligible. Methods 3. and 4. have the ability to require continuous first and second derivatives. Method 3. is the easiest to implement. Method 4. uses well-established mathematical programming concepts and would provide a continuous surface equation over the entire hull.

C. FLAT BOTTOM FORMS

This horizontal surface condition leads to infinite slope in the surface equation. There are two methods for solving this problem. The first is to use the same formulation in this area as was used for the end conditions. This would allow for infinite slope, but would require a modification of the problem formulation.

A second method, more convenient to use, would be simply to require the surface to have a very large but finite slope.

Section IV

COMPARISON OF SYSTEM WITH CRITERIA

A. SYSTEM CRITERIA

The criteria established at the beginning for use in developing the fairing system, and the extent to which the fairing system meets these criteria are given below:

1. "The system should accept as data the preliminary information developed by the naval architect"

   The input data required by the fairing system consists of the table of preliminary offsets, including centerplane profile data. The only additional requirement placed on the naval architect is that he extend the station lines to an imaginary waterline above the deck edge.

2. "It should include a method for eliminating gross errors in the input data"

   To locate offsets which are obviously the result of an error, a computer program has been included which scans the data prior to fairing, by investigating the consistency of the signs of the second differences, along each waterline and station. If a bad offset is found, the program adjusts the value and reports both the questionable value and adjusted value to the loftsman.

3. "It should, from the data, obtain a fully faired hull form from which the ship can be produced"

   The mathematical definition of fairness used in developing the method is presented later, along with a discussion on its application. Because the molded form is described by a surface equation it is possible to describe completely intersections of other prescribed forms with it (frames, decklines, etc.). A computer program is included in the system which does this automatically.

4. "The fairing process should operate with as little human intervention as possible"

   The fairing system, in its final form, should require manual effort in the initial data stages only. This effort is limited to selecting the stations which limit the extent of each surface, to preparing the input offsets, and to verifying that the smoothed offsets and second differences are consistent with the original intent. All fairing calculations from this point on are made automatically and require only the operating of the computer and someone to monitor results. However, the method has not yet been demonstrated to the extent necessary to insure its reliable application in all cases. It will therefore be necessary to evaluate surfaces produced and continue to provide the system with greater capability until such time as it can satisfactorily define all principal surfaces on all types of ships.

5. "The system should develop, as much as is practicable, complete loft information now provided by the manual loft"

   The system provides the following loft data:

   a. Complete set of offsets on any station, waterline, buttock or diagonal plane at any interval

   b. Offsets along any waterline or station at any interval, such that a straight line joining two consecutive offsets comes exactly at a given tolerance from the mathematical molded form

   c. Other data as required for numerical control programs, such as slopes, curvatures, and standard cubic equations for form plane curves

   d. Mathematically developed shell plate cutting pattern offsets

   e. Offsets for plate rolling and frame bending templates

   f. Data describing the inside edge of web frames

   g. Mathematically developed offsets for longitudinal cutting patterns

B. FAIRNESS CRITERIA

System Criterion No. 3. requires the surface to be fully fair. Mathematical criteria for fairness were established, and a comparison of the system capabilities with these criteria is presented below.

1. "The curve Y(X) (which represents the intersection of a plane with the surface) must be continuous; its first derivative must be continuous; its second derivative must be continuous"

   These requirements are inherently met by the spline curve representation of the surface. That is, the surface is made up of cubic equations which have continuous first and second derivatives; and these cubics are joined by a technique which guarantees these continuities across each joint.

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2. "The curve must be completely free of unwanted inflection points while possessing those inherent in the data"

   This requirement has been met by requiring the equation at each offset to have the same sign for its second derivative as the previously calculated second difference at that offset. For the surface equation, this requirement is imposed in both the station and waterline directions. This technique has been very successful in controlling inflection points wherever applied. Use of it enables the formulation to specify a choice of either one inflection point or no inflection points within each cubic interval.

3. "Deviation from scaled offsets must be as small as possible, subject to Conditions 1. and 2."

   This requirement is the basic reason for the selection of linear programming to fit the surfaces, and is inherently met by it.

4. "Curves should be aesthetically pleasing"

   When criteria 1 through 3 have been met by a mathematical curve or surface, experience has confirmed that Criterion 4 will also be met, provided that it was reasonably inherent in the original data.

Section V

CONCLUSIONS AND RECOMMENDATIONS

A. CONCLUSIONS

The mathematical lofting system described herein has adequately demonstrated the applicability of the mathematical theory employed. It has been demonstrated that the system itself is a practical, economical one, potentially capable of providing any shipyard with all of the general information provided by conventional lofts. It is not yet a "black box" system; that is, the method has not been implemented with sufficient computer programs to permit complete lofting without some manual intervention and decisions.

The system was tested by trying to fully define only one ship. This single test showed that the system was lacking in completeness. It did not satisfactorily join individually faired surfaces, nor was it reliable in defining flat bottoms. It is apparent there is a need for additional work before the system is complete and ready for use by production forces.

The method employed in meeting the established criteria has overcome the basic problems in mathematical lofting which heretofore appeared insurmountable. It offers to the shipbuilding industry a greater potential for economical use of numerically controlled fabrication processes. If used early in the design phase, it offers the architect the potential for employing automated drawing machines in his daily work.

B. RECOMMENDATIONS

Though the method employing linear programming to fit a fair surface to the naval architect's offsets has been demonstrated as practical and economically feasible, the only full ship test which time permitted to be made proved that the system had certain technical deficiencies which remain to be corrected to improve its reliability and to make it a workable production system.

It is recommended that work on at least the following elements of the system be continued:

1. Demonstrate a satisfactory method for joining faired surface areas
2. Impose restrictions on the signs of the curvatures at the terminations of stations and waterlines
3. Demonstrate a method for defining flat bottoms

These developments do not require any state-of-the-art breakthroughs, but are generally a matter of straightforward application of mathematics and computer programming. This work should be accomplished before the system is placed in full production usage. Efforts can then proceed on expanding the system capability for all cases and toward improving the economy of the system itself.

APPENDIX A

Contents

APPENDIX A

PLANE CURVES

This Appendix contains three examples of curves faired with the linear programming method:

Curve 1	Load Waterline - Forward
Curve 2	Load Waterline - Aft
Curve 3	Floor Frame Curve

A description of the procedure followed, a listing of the input data, a listing of the offsets of the faired curve, and a plot of the faired curve are presented in each case.

CURVE 1 LOAD WATERLINE - FORWARD

Project:

To fair the forward one-half of the load waterline of a 250' cargo ship to investigate the fairness quality of the faired line. In addition, it was desired to investigate the ability of the method to fit a straight section.

Data:

The preliminary offsets of Stations 1 through 8 and Station 10. Station 8 through 10 are all equal and within the parallel middle-body.

Procedure:

The second differences of the offsets were found to be consistent. The matrix was punched by hand using the lambda - primal formulation. In addition, the slope and curvature at Station 10 were required to be zero. The line was faired on the IBM-1620 in eight minutes. The offsets were solved from the equation using GOBACK 3 and were plotted as shown. In addition, the line was plotted at 1/4" = 1'0" for sight checking.

Results:

The greatest deviation (λ) was approximately 5/16". The line was found to satisfy both the mathematical and sight tests for fairness. The straight section was fit perfectly and the transition into the curve was fair.

Input Data - Curve 1 Load Waterline - Forward

LOAD	WATERLINE-FWD PRELIM. OFFSETS
0.0	19.5
25.0	19.5
37.5	19.49
50.0	19.17
62.5	18.17
75.0	16.44
87.5	13.58
100.0	9.72
112.5	4.78
125.0	.08

LOAD WATERLINE FWD HALF FAIRED OFFSETS

.00000000	1.00000000	19.50000000					001
.08000000	.40000000	25.00000000	11	9	0		002
1	.00000000						003
2	.00000000						004
3	.00000000						005
4	-.20687680						006
5	-.88831936						007
6	1.76826450						008
7	-1.90888100						009
8	2.00391950						010
9	-1.60101680						011
10	2.72024050						012
11	-.25504729						013
1	25.00000000						014
2	37.50000000						015
3	50.00000000						016
4	62.50000000						017
5	75.00000000						018
6	87.50000000						019
7	100.00000000						020
8	112.50000000						021
9	125.00000000						022

X	Y	FIRST DERIVAT.	SECOND DERIVAT.	
.00000000	19.50000000	.00000000	.00000000	023
1.00000000	19.50000000	.00000000	.00000000	024
2.00000000	19.50000000	.00000000	.00000000	025
3.00000000	19.50000000	.00000000	.00000000	026
4.00000000	19.50000000	.00000000	.00000000	027
5.00000000	19.50000000	.00000000	.00000000	028
6.00000000	19.50000000	.00000000	.00000000	029
7.00000000	19.50000000	.00000000	.00000000	030
8.00000000	19.50000000	.00000000	.00000000	031
9.00000000	19.50000000	.00000000	.00000000	032
10.00000000	19.50000000	.00000000	.00000000	033
11.00000000	19.50000000	.00000000	.00000000	034
12.00000000	19.50000000	.00000000	.00000000	035
13.00000000	19.50000000	.00000000	.00000000	036
14.00000000	19.50000000	.00000000	.00000000	037
15.00000000	19.50000000	.00000000	.00000000	038
16.00000000	19.50000000	.00000000	.00000000	039
				040

17.00000000	19.50000000	.00000000	.00000000	041
18.00000000	19.50000000	.00000000	.00000000	042
19.00000000	19.50000000	.00000000	.00000000	043
20.00000000	19.50000000	.00000000	.00000000	044
21.00000000	19.50000000	.00000000	.00000000	045
22.00000000	19.50000000	.00000000	.00000000	046
23.00000000	19.50000000	.00000000	.00000000	047
24.00000000	19.50000000	.00000000	.00000000	048
25.00000000	19.50000000	.00000000	.00000000	049
26.00000000	19.49998700	-.00003972	-.00007944	050
27.00000000	19.49989500	-.00015888	-.00015888	051
28.00000000	19.49964300	-.00035748	-.00023832	052
29.00000000	19.49915300	-.00063552	-.00031776	053
30.00000000	19.49834500	-.00099300	-.00039720	054
31.00000000	19.49714100	-.00142993	-.00047664	055
32.00000000	19.49545900	-.00194629	-.00055608	056
33.00000000	19.49322200	-.00254210	-.00063552	057
34.00000000	19.49034800	-.00321734	-.00071496	058
35.00000000	19.48676000	-.00397203	-.00079440	059
36.00000000	19.48237800	-.00480616	-.00087384	060
37.00000000	19.47712200	-.00571972	-.00095328	061
37.50000000	19.47414100	-.00620630	-.00099300	062
38.00000000	19.47090500	-.00675537	-.00120328	063
39.00000000	19.46347900	-.00816894	-.00162384	064
40.00000000	19.45442700	-.01000306	-.00204439	065
41.00000000	19.44333200	-.01225773	-.00246495	066
42.00000000	19.42977200	-.01493296	-.00288550	067
43.00000000	19.41332600	-.01802875	-.00330606	068
44.00000000	19.39357400	-.02154509	-.00372661	069
45.00000000	19.37009600	-.02548198	-.00414717	070
46.00000000	19.34247000	-.02983943	-.00456772	071
47.00000000	19.31027700	-.03461744	-.00498828	072
48.00000000	19.27309500	-.03981600	-.00540883	073
49.00000000	19.23050400	-.04543512	-.00582939	074
50.00000000	19.18208500	-.05147479	-.00624995	075
51.00000000	19.12752700	-.05759552	-.00599149	076
52.00000000	19.06697900	-.06345778	-.00573303	077
53.00000000	19.00009700	-.06906158	-.00547457	078
54.00000000	18.92894100	-.07440692	-.00521611	079
55.00000000	18.85197000	-.07949382	-.00495765	080
56.00000000	18.77004000	-.08432225	-.00469920	081

57.00000000	18.68341100	-.08889222	-.00444074	082
58.00000000	18.59234200	-.09320373	-.00418228	083
59.00000000	18.49709100	-.09725679	-.00392382	084
60.00000000	18.39791500	-.10105139	-.00366536	085
61.00000000	18.29507400	-.10458752	-.00340690	086
62.00000000	18.18882500	-.10786520	-.00314845	087
62.50000000	18.13450500	-.10940712	-.00301922	088
63.00000000	18.07941500	-.11097605	-.00325649	089
64.00000000	17.96673100	-.11446982	-.00373105	090
65.00000000	17.85031700	-.11843815	-.00420560	091
66.00000000	17.72969700	-.12288103	-.00468015	092
67.00000000	17.60439600	-.12779846	-.00515470	093
68.00000000	17.47394300	-.13319044	-.00562925	094
69.00000000	17.33785700	-.13905698	-.00610381	095
70.00000000	17.19567000	-.14539806	-.00657836	096
71.00000000	17.04690400	-.15221370	-.00705291	097
72.00000000	16.89108300	-.15950389	-.00752746	098
73.00000000	16.72773700	-.16726864	-.00800201	099
74.00000000	16.55638900	-.17550793	-.00847656	100
75.00000000	16.37656300	-.18422178	-.00895112	101
76.00000000	16.18791500	-.19302543	-.00865616	102
77.00000000	15.99061100	-.20153412	-.00836121	103
78.00000000	15.78494500	-.20974786	-.00806626	104
79.00000000	15.57121400	-.21766662	-.00777131	105
80.00000000	15.34970900	-.22529051	-.00747635	106
81.00000000	15.12073000	-.23261938	-.00718140	107
82.00000000	14.88457000	-.23965331	-.00688645	108
83.00000000	14.64152200	-.24639227	-.00659149	109
84.00000000	14.39188200	-.25283629	-.00629654	110
85.00000000	14.13594700	-.25898534	-.00600159	111
86.00000000	13.87401000	-.26483945	-.00570663	112
87.00000000	13.60636600	-.27039862	-.00541168	113
87.50000000	13.47049600	-.27306761	-.00526420	114
88.00000000	13.33330000	-.27573968	-.00542412	115
89.00000000	13.05479500	-.28132374	-.00574396	116
90.00000000	12.77054500	-.28722761	-.00606380	117
91.00000000	12.48023100	-.29345130	-.00638364	118
92.00000000	12.18353600	-.29999487	-.00670347	119
93.00000000	11.88013700	-.30685834	-.00702331	120
94.00000000	11.56971200	-.31404156	-.00734315	121
95.00000000	11.25194600	-.32154458	-.00766299	122

96.00000000	10.92651700	-.32936754	-.00798282	123
97.00000000	10.59310600	-.33751029	-.00830266	124
98.00000000	10.25139000	-.34597288	-.00862250	125
99.00000000	9.90105200	-.35475526	-.00894234	126
100.00000000	9.54177240	-.36385754	-.00926217	127
101.00000000	9.17340440	-.37275733	-.00853744	128
102.00000000	8.79649960	-.38093242	-.00781270	129
103.00000000	8.41178000	-.38838277	-.00708797	130
104.00000000	8.01997510	-.39510832	-.00636323	131
105.00000000	7.62180510	-.40110924	-.00563850	132
106.00000000	7.21799720	-.40638536	-.00491376	133
107.00000000	6.80927680	-.41093676	-.00418903	134
108.00000000	6.39636610	-.41476344	-.00346429	135
109.00000000	5.97999050	-.41786536	-.00273956	136
110.00000000	5.56087620	-.42024252	-.00201482	137
111.00000000	5.13974760	-.42189504	-.00129009	138
112.00000000	4.71732780	-.42282272	-.00056535	139
112.50000000	4.50586150	-.42301484	-.00020298	140
113.00000000	4.29434220	-.42303792	.00011040	141
114.00000000	3.87146320	-.42261416	.00073720	142
115.00000000	3.44932180	-.42156360	.00136400	143
116.00000000	3.02854580	-.41988612	.00199079	144
117.00000000	2.60975820	-.41758196	.00261759	145
118.00000000	2.19358940	-.41465096	.00324439	146
119.00000000	1.78066500	-.41109320	.00387118	147
120.00000000	1.37161200	-.40690860	.00449798	148
121.00000000	.96705713	-.40209720	.00512478	149
122.00000000	.56762635	-.39665909	.00575157	150
123.00000000	.17394746	-.39059408	.00637837	151
124.00000000	-.21335258	-.38390232	.00700517	152
125.00000000	-.59364811	-.37658373	.00763196	153

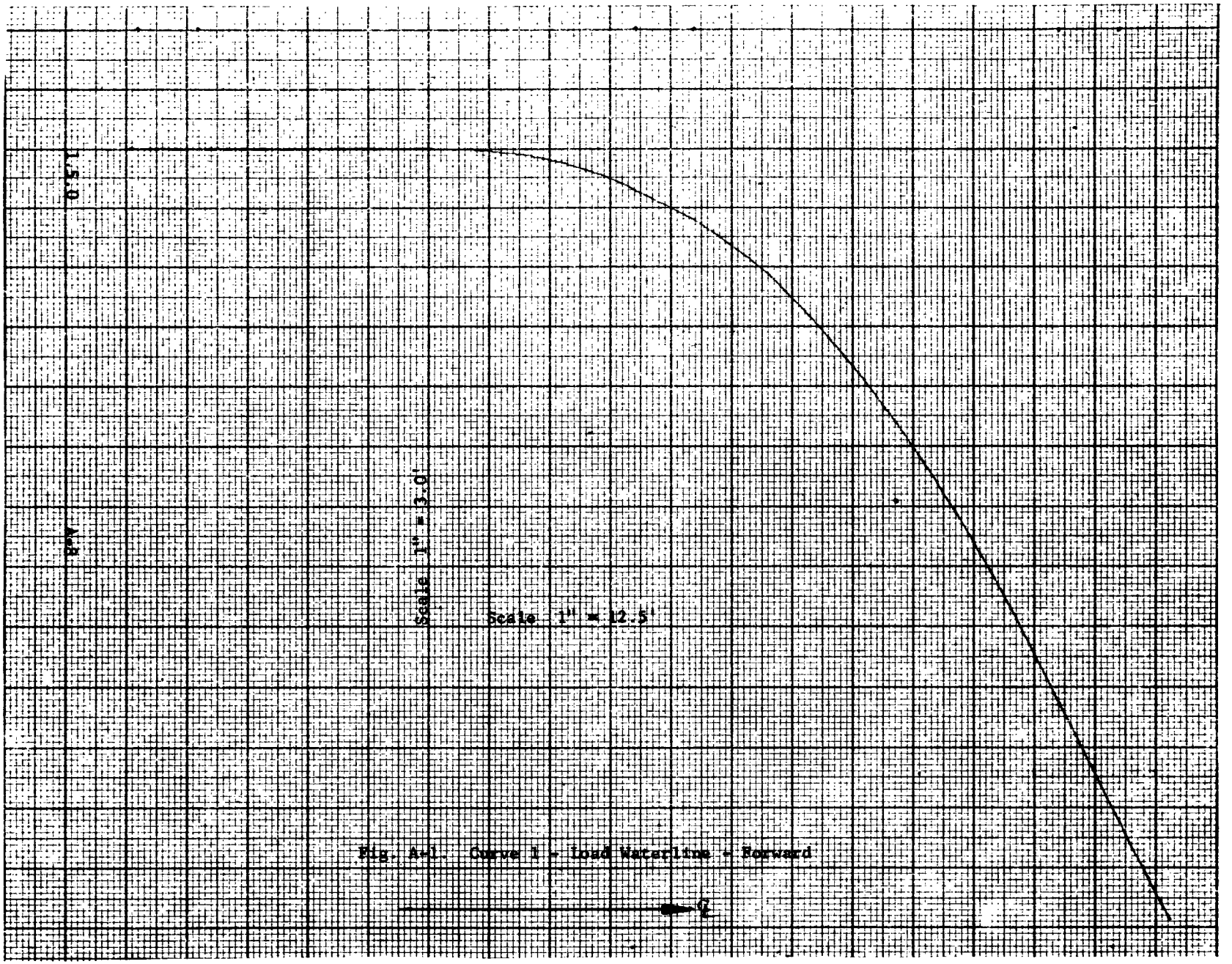

Fig. A-1. Curve 1 - Load Waterline - Forward

CURVE 2 LOAD WATERLINE - AFT

Project:

To fair the after one-half of the load waterline of a 250' cargo ship for investigating the fairness quality of the faired line and to determine the applicability of the fairing method.

Data:

The preliminary offsets of the eleven stations from Station 10 to Station 20, inclusive

Procedure:

The second differences of the offsets were found to be OK. The matrix was punched by hand using the lambda-primal formulation. The line was faired on the IBM-1620 computer in approximately ten minutes. Offsets were solved for using GOBACK 3 and were plotted as shown. Additionally, the line was plotted at a scale of 1/4" = 1'-0" to be checked for fairness.

Results:

On the larger scaled plot, the line was observed to contain a fairly flat section approximately fifty feet from amidships. The preliminary lines plan and offsets were reviewed and this confirmed that an intentional flat area exists in this portion of the hull. The curve was then found to meet the fairness criteria, both mathematically and by sight tests of a number of qualified individuals.

Input Data - Curve 2

LOAD WATERLINE-AFT PRELIM. OFFSETS

0.0	19.5
25.0	19.5
37.5	19.25
50.0	18.63
62.5	17.67
75.0	16.67
87.5	15.00
100.0	12.50
112.5	8.750
125.0	3.25

1.5.0

LOAD WATERLINE AFT FAIRED OFFSETS

.00000000	1.00000000	19.50000000				154
.08000000	.40000000	25.00000000	11	9	0	155
1	.00000000					156
2	.00000000					157
3	-.02698730					158
4	-.85554348					159
5	1.84188210					160
6	-1.46962800					161
7	.26551038					162
8	.00000000					163
9	-.46355964					164
10	.00000000					165
11	.00000000					166
1	25.00000000					167
2	37.50000000					168
3	50.00000000					169
4	62.50000000					170
5	75.00000000					171
6	87.50000000					172
7	100.00000000					173
8	112.50000000					174
9	125.00000000					175

X	Y	FIRST DERIVAT.	SECOND DERIVAT.	
.00000000	19.50000000	.00000000	.00000000	176
1.00000000	19.49999900	-.00000518	-.00001036	177
2.00000000	19.49998700	-.00002072	-.00002072	178
3.00000000	19.49995400	-.00004663	-.00003108	179
4.00000000	19.49989000	-.00008290	-.00004145	180
5.00000000	19.49978500	-.00012953	-.00005181	181
6.00000000	19.49962700	-.00018653	-.00006217	182
7.00000000	19.49940800	-.00025389	-.00007254	183
8.00000000	19.49911600	-.00033161	-.00008290	184
9.00000000	19.49874100	-.00041970	-.00009326	185
10.00000000	19.49827300	-.00051815	-.00010363	186
11.00000000	19.49770200	-.00062696	-.00011399	187
12.00000000	19.49701600	-.00074614	-.00012435	188
13.00000000	19.49620600	-.00087568	-.00013472	189
14.00000000	19.49526100	-.00101558	-.00014508	190
15.00000000	19.49417100	-.00116585	-.00015544	191
16.00000000	19.49292600	-.00132647	-.00016580	192
				193

1.5.0

17.00000000	19.49151500	-.00149747	-.00017617	194
18.00000000	19.48992800	-.00167882	-.00018653	195
19.00000000	19.48815400	-.00187054	-.00019689	196
20.00000000	19.48618300	-.00207262	-.00020726	197
21.00000000	19.48400500	-.00228506	-.00021762	198
22.00000000	19.48160900	-.00250787	-.00022798	199
23.00000000	19.47898600	-.00274104	-.00023835	200
24.00000000	19.47612400	-.00298457	-.00024871	201
25.00000000	19.47301300	-.00323847	-.00025907	202
26.00000000	19.46958900	-.00366699	-.00059796	203
27.00000000	19.46556600	-.00443441	-.00093686	204
28.00000000	19.46060700	-.00554072	-.00127575	205
29.00000000	19.45437200	-.00698592	-.00161464	206
30.00000000	19.44652200	-.00877001	-.00195353	207
31.00000000	19.43671900	-.01089299	-.00229242	208
32.00000000	19.42462400	-.01335487	-.00263132	209
33.00000000	19.40989700	-.01615563	-.00297021	210
34.00000000	19.39219900	-.01929529	-.00330910	211
35.00000000	19.37119300	-.02277384	-.00364799	212
36.00000000	19.34653900	-.02659129	-.00398688	213
37.00000000	19.31789700	-.03074762	-.00432577	214
37.50000000	19.30197600	-.03295287	-.00449522	215
38.00000000	19.28494400	-.03515443	-.00431103	216
39.00000000	19.24769500	-.03928127	-.00394263	217
40.00000000	19.20650500	-.04303972	-.00357424	218
41.00000000	19.16174000	-.04642977	-.00320585	219
42.00000000	19.11376800	-.04945143	-.00283746	220
43.00000000	19.06296000	-.05210470	-.00246907	221
44.00000000	19.00968100	-.05438958	-.00210068	222
45.00000000	18.95430300	-.05630607	-.00173229	223
46.00000000	18.89719200	-.05785417	-.00136390	224
47.00000000	18.83871800	-.05903388	-.00099551	225
48.00000000	18.77924700	-.05984519	-.00062712	226
49.00000000	18.71915000	-.06028812	-.00025873	227
50.00000000	18.65879400	-.06036265	.00010966	228
51.00000000	18.59845300	-.06035096	-.00008628	229
52.00000000	18.53802700	-.06053522	-.00028223	230
53.00000000	18.47731800	-.06091543	-.00047817	231
54.00000000	18.41613100	-.06149158	-.00067412	232
55.00000000	18.35426900	-.06226368	-.00087007	233
56.00000000	18.29153800	-.06323172	-.00106601	234

57.00000000	18.22774100	-.06439571	-.00126196	235
58.00000000	18.16268200	-.06575564	-.00145790	236
59.00000000	18.09616500	-.06731152	-.00165385	237
60.00000000	18.02799300	-.06906336	-.00184980	238
61.00000000	17.95797200	-.07101113	-.00204574	239
62.00000000	17.88590400	-.07315485	-.00224169	240
62.50000000	17.84904400	-.07430019	-.00233966	241
63.00000000	17.81160000	-.07548178	-.00238666	242
64.00000000	17.73490800	-.07791543	-.00248065	243
65.00000000	17.65573700	-.08044308	-.00257464	244
66.00000000	17.57399000	-.08306472	-.00266863	245
67.00000000	17.48957500	-.08578035	-.00276262	246
68.00000000	17.40239900	-.08858997	-.00285661	247
69.00000000	17.31236400	-.09149357	-.00295060	248
70.00000000	17.21938000	-.09449118	-.00304459	249
71.00000000	17.12335000	-.09758277	-.00313858	250
72.00000000	17.02418300	-.10076830	-.00323257	251
73.00000000	16.92178300	-.10404789	-.00332656	252
74.00000000	16.81605600	-.10742146	-.00342055	253
75.00000000	16.70690800	-.11088905	-.00351454	254
76.00000000	16.59424700	-.11445054	-.00360853	255
77.00000000	16.47797600	-.11810609	-.00370252	256
78.00000000	16.35800300	-.12185562	-.00379651	257
79.00000000	16.23423300	-.12569913	-.00389050	258
80.00000000	16.10657300	-.12963659	-.00398449	259
81.00000000	15.97492900	-.13366810	-.00407848	260
82.00000000	15.83920600	-.13779356	-.00417247	261
83.00000000	15.69930900	-.14201304	-.00426646	262
84.00000000	15.55514800	-.14632653	-.00436045	263
85.00000000	15.40662600	-.15073397	-.00445444	264
86.00000000	15.25364900	-.15523544	-.00454843	265
87.00000000	15.09612300	-.15983084	-.00464242	266
87.50000000	15.01562600	-.16216383	-.00468942	267
88.00000000	14.93395300	-.16454256	-.00482541	268
89.00000000	14.76695100	-.16950392	-.00509741	269
90.00000000	14.59485400	-.17473740	-.00536941	270
91.00000000	14.41738600	-.18024273	-.00564141	271
92.00000000	14.23427800	-.18602019	-.00591340	272
93.00000000	14.04525500	-.19206959	-.00618540	273
94.00000000	13.85004700	-.19839100	-.00645740	274
95.00000000	13.64838300	-.20498438	-.00672940	275

96.00000000	13.43998900	-.21184980	-.00700139	276
97.00000000	13.22459200	-.21898720	-.00727339	277
98.00000000	13.00192300	-.22639657	-.00754539	278
99.00000000	12.77170700	-.23407803	-.00781738	279
100.00000000	12.53367600	-.24203142	-.00808938	280
101.00000000	12.28755600	-.25025678	-.00836138	281
102.00000000	12.03307100	-.25875420	-.00863338	282
103.00000000	11.76995400	-.26752354	-.00890537	283
104.00000000	11.49793500	-.27656494	-.00917737	284
105.00000000	11.21673400	-.28587826	-.00944937	285
106.00000000	10.92608800	-.29546364	-.00972136	286
107.00000000	10.62571700	-.30532102	-.00999336	287
108.00000000	10.31535400	-.31545038	-.01026536	288
109.00000000	9.99472500	-.32585180	-.01053735	289
110.00000000	9.66356000	-.33652515	-.01080935	290
111.00000000	9.32158400	-.34747055	-.01108135	291
112.00000000	8.96852700	-.35868788	-.01135335	292
112.50000000	8.78775840	-.36439851	-.01148935	293
113.00000000	8.60411770	-.37017721	-.01162534	294
114.00000000	8.22808400	-.38193855	-.01189734	295
115.00000000	7.84014980	-.39397190	-.01216934	296
116.00000000	7.44004810	-.40627724	-.01244134	297
117.00000000	7.02750480	-.41885456	-.01271333	298
118.00000000	6.60224800	-.43170388	-.01298533	299
119.00000000	6.16400550	-.44482524	-.01325733	300
120.00000000	5.71250630	-.45821864	-.01352932	301
121.00000000	5.24747830	-.47188396	-.01380132	302
122.00000000	4.76864760	-.48582120	-.01407332	303
123.00000000	4.27574490	-.50003056	-.01434532	304
124.00000000	3.76849640	-.51451192	-.01461731	305
125.00000000	3.24662990	-.52926520	-.01488931	306

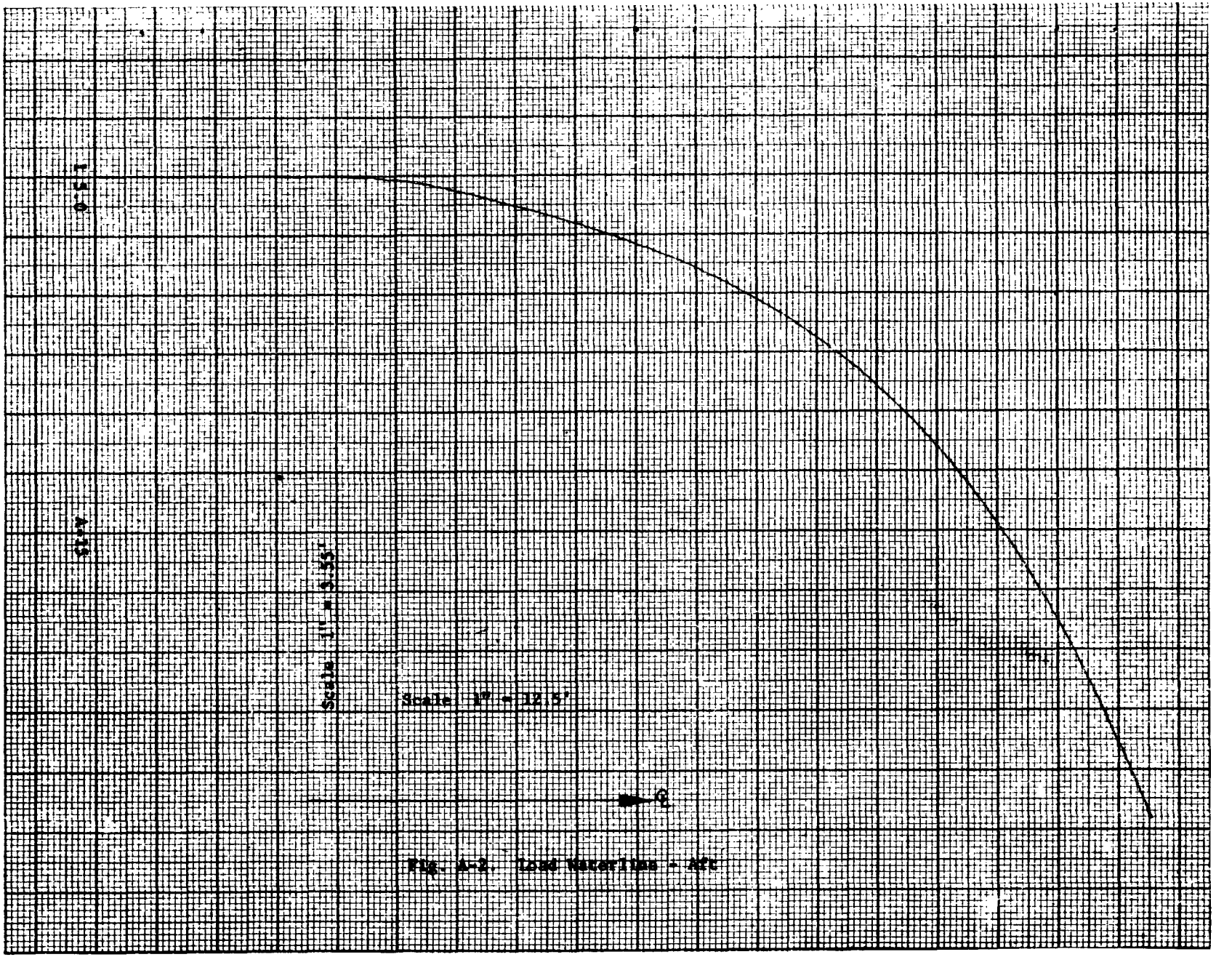

Fig. A-2. Load Waterline - Aft

CURVE 3 FLOOR FRAME CURVE

Project:

To fair a curve taken from a transverse section of a ship hull to determine the applicability of the fairing method.

Data:

The data was taken from previously faired offsets of a floor frame of the DLG-26. It contained seven offsets.

Procedure:

The matrix was punched by SMOG 4 in the sum of the deviations formulation. The curve was faired on the IBM-1620 and required two minutes to fair. The offsets were solved for using GOBACK 3. In addition, ten offsets from the curve were chosen at random and sent to the loft to be plotted at a scale of 1" - 1'-0" vertically.

Results:

The faired curve passed exactly through every data point. The offsets which were sent to the loft were fit with a batten and were found to be fair without changes.

Curve 3

FLOOR FRAME CURVE PRELIM. OFFSETS

1.0	6.44
2.0	8.13
3.0	10.32
4.0	13.14
5.0	6.68
6.0	21.08
7.0	26.36

DLC 26 FLOOR FRAME CURVE FAIRED OFFSETS

.00000000	.25000000	5.19000000					307
2.00000000	.50000000	1.00000000	9	7	0		308
1	1.15870760						309
2	.00000000						310
3	.09129244						311
4	-.10775472						312
5	.05101856						313
6	-.02631842						314
7	.01940595						315
8	-.02494013						316
9	.00000000						317
1	1.00000000						318
2	2.00000000						319
3	3.00000000						320
4	4.00000000						321
5	5.00000000						322
6	6.00000000						323
7	7.00000000						324

X	Y	FIRST DERIVAT.	SECOND DERIVAT.	
.00000000	5.19000000	1.15870760	.00000000	326
.25000000	5.48110330	1.17582490	.13693867	327
.50000000	5.78076530	1.22717690	.27387734	328
.75000000	6.09754470	1.31276360	.41081601	329
1.00000000	6.44000000	1.43258490	.54775468	330
1.25000000	6.81500640	1.56643690	.52306127	331
1.50000000	7.22270410	1.69411560	.49836786	332
1.75000000	7.66154970	1.81562090	.47367445	333
2.00000000	8.13000000	1.93095290	.44898110	334
2.25000000	8.62730880	2.04967730	.50081544	335
2.50000000	9.15591870	2.18136060	.55264999	336
2.75000000	9.71906940	2.32600240	.60448433	337
3.00000000	10.31999900	2.48360270	.65631877	338
3.25000000	10.96153900	2.64922700	.66867557	339
3.50000000	11.64487100	2.81794050	.68103238	340
3.75000000	12.37076600	2.98974310	.69338918	341
4.00000000	13.13999900	3.16463530	.70574588	342
4.25000000	13.95364400	3.34625480	.74721171	343
4.50000000	14.81399100	3.53824070	.78867746	344
4.75000000	15.72362900	3.74059370	.83014311	345
5.00000000	16.68515100	3.95331240	.87160885	346

5.25000000	17.70076000	4.17172160	.87566440	347
5.50000000	18.77109700	4.39114510	.87971994	348
5.75000000	19.89641500	4.61158220	.88377547	349
6.00000000	21.07697100	4.83303170	.88783120	350
6.25000000	22.31301500	5.05549740	.89188660	351
6.50000000	23.60480500	5.27897650	.89594210	352
6.75000000	24.95259000	5.50346760	.89999770	353
7.00000000	26.35662200	5.72897420	.90405330	354

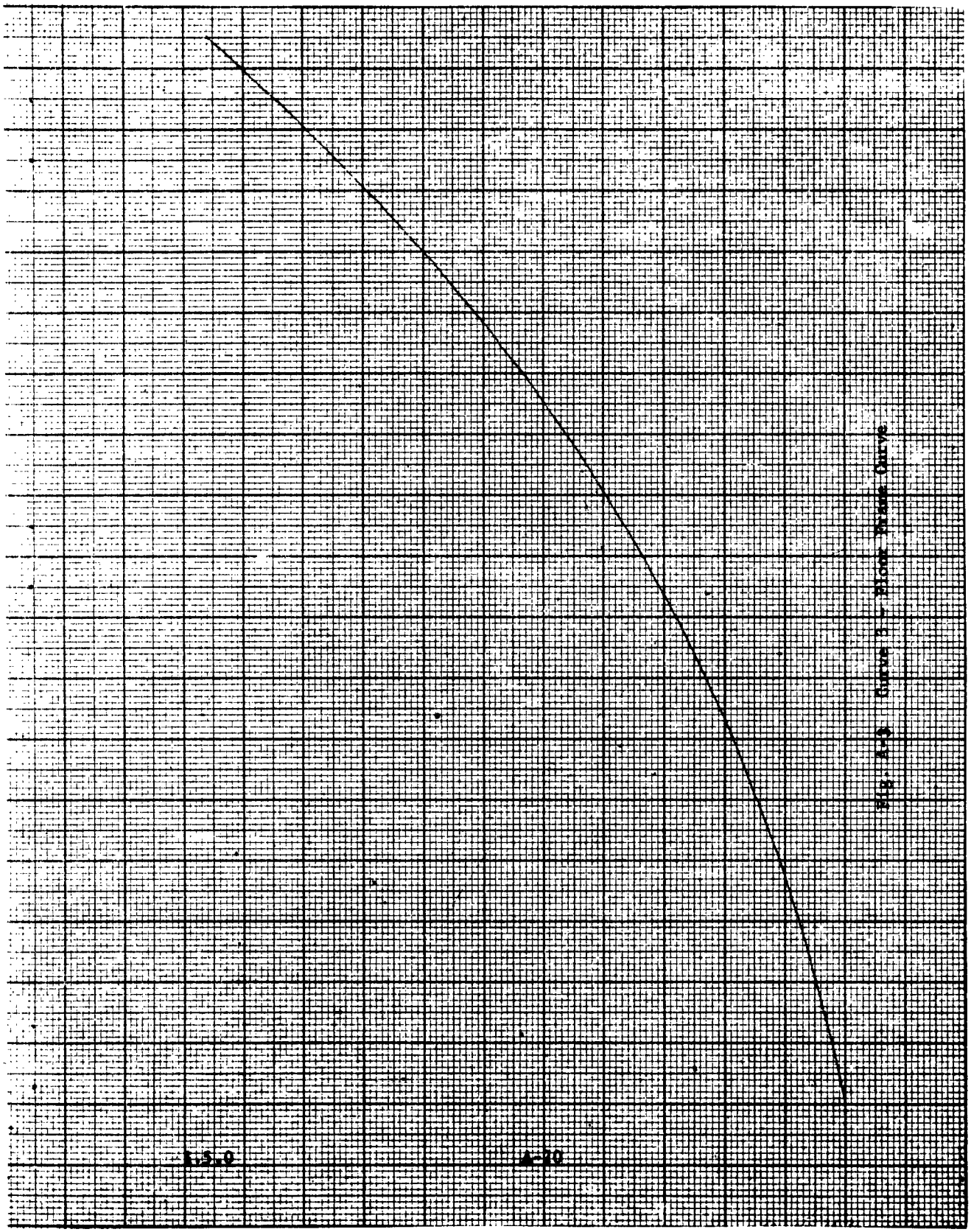

Fig. A-3 Curve 3 - Floor Drain Curve

APPENDIX B

Contents

Appendix B

SURFACES

Contained in this Appendix are several examples of surfaces faired as tests for the mathematical lofting system. Included are the preliminary data, final faired results, and a plot of the surfaces.

DOUBLE SPLINED 8 x 10 SURFACE

Project:

To fair a surface of DLG-26 containing eight waterlines and ten stations using the double spline concept to determine the applicability of the technique.

Data:

The data used were preliminary offsets taken from DLG-26 Drawing No. 2068017 on Stations 2 through 12 at Waterlines 4 through 32, at four-foot intervals.

Procedure:

The data was smoothed and then used with SMOG-3 to punch the matrix in the sum of the deviations-primal formulation, using the double spline in both waterline and station directions. The surface was then faired on the IBM-7090 using LP-90. Results were solved for using GOBACK 1.

Results:

The deviation between the surface and the offsets were reasonable in all cases and generally very small. The surface meets all the requirements for fairness, including sight tests.

DLG 26 8 x 10 PRELIMINARY OFFSETS - SURFACE

```
   8   10     .001000
  4.0000
    .0000   3.593749
  25.5000   7.833333
  51.0000   5.666666
  76.5000  10.031250
 102.0000  12.354166
 127.5000  14.645833
 153.0000  16.593749
 178.5000  18.020833
 204.0000  18.677082
 229.5000  18.437499
  8.0000
    .0000   4.729166
  25.5000   7.500000
  51.0000  10.322916
  76.5000  13.302083
 102.0000  16.250000
 127.5000  18.874999
 153.0000  21.000000
 178.5000  22.562500
 204.0000  23.458332
 229.5000  23.791666
  12.0000
    .0000   5.333333
  25.5000   8.427083
  51.0000  11.781250
  76.5000  15.166666
 102.0000  18.343749
 127.5000  21.072916
 153.0000  23.239582
 178.5000  24.770833
 204.0000  25.760416
 229.5000  26.156249
  16.0000
    .0000   5.812500
  25.5000   9.250000
  51.0000  12.916666
  76.5000  16.354166
 102.0000  19.666666
 127.5000  22.291666
 153.0000  24.364583
 178.5000  25.770833
 204.0000  26.708332
 229.5000  27.187499
```

```
 20.0000
    .0000   6.333333
  25.5000  10.124999
  51.0000  14.114583
  76.5000  17.697916
 102.0000  20.708332
 127.5000  23.104166
 153.0000  24.885416
 178.5000  26.114583
 204.0000  26.895833
 229.5000  27.291666
  24.0000
    .0000   7.166666
  25.5000  11.374999
  51.0000  15.468749
  76.5000  18.937499
 102.0000  21.635416
 127.5000  23.718749
 153.0000  25.208332
 178.5000  26.208332
 204.0000  26.895833
 229.5000  27.239582
  28.0000
    .0000   8.583333
  25.5000  13.093749
  51.0000  17.000000
  76.5000  20.229166
 102.0000  22.520833
 127.5000  24.229166
 153.0000  25.416666
 178.5000  26.229166
 204.0000  26.843749
 229.5000  27.187499
  32.0000
    .0000  10.750000
  25.5000  15.260416
  51.0000  18.916666
  76.5000  21.624999
 102.0000  23.395833
 127.5000  24.583333
 153.0000  25.510416
 178.5000  26.208332
 204.0000  26.739582
 229.5000  27.093749
```

0.97

	STATION	OFFSETS 5 X 6	DOUBLE INTERVAL		
FR	0.00	5.00000000	3.76376360	.17002366	0.00000000
FR	0.00	6.00000000	3.93378730	.17002366	0.00000000
FR	0.00	7.00000000	4.10381090	.17002366	0.00000000
FR	0.00	8.00000000	4.27383460	.17002366	0.00000000
FR	0.00	9.00000000	4.44385830	.17002366	0.00000000
FR	0.00	10.00000000	4.61388190	.17002366	0.00000000
FR	0.00	11.00000000	4.78390560	.17002366	0.00000000
FR	0.00	12.00000000	4.95392930	.17002366	0.00000000
FR	0.00	13.00000000	5.12399040	.17013627	.00022524
FR	0.00	14.00000000	5.29427690	.17047415	.00045049
FR	0.00	15.00000000	5.46501380	.17103727	.00067574
FR	0.00	16.00000000	5.63642650	.17182565	.00090099
FR	0.00	17.00000000	5.80874030	.17283927	.00112624
FR	0.00	18.00000000	5.98218010	.17407815	.00135149
FR	0.00	19.00000000	6.15697160	.17554227	.00157674
FR	0.00	20.00000000	6.33333990	.17723165	.00180199
FR	0.00	21.00000000	6.51143750	.17892865	.00159199
FR	0.00	22.00000000	6.69112720	.18041565	.00138199
FR	0.00	23.00000000	6.87219880	.18169263	.00117198
FR	0.00	24.00000000	7.05444240	.18275962	.00096198
FR	0.00	25.00000000	7.23764810	.18361660	.00075197
FR	0.00	26.00000000	7.42160560	.18426357	.00054197
FR	0.00	27.00000000	7.60610520	.18470055	.00033197
FR	0.00	28.00000000	7.79093680	.18492751	.00012196
FR	0.00	29.00000000	7.97592010	.18503423	.00009147
FR	0.00	30.00000000	8.16099500	.18511046	.00006098
FR	0.00	31.00000000	8.34613090	.18515618	.00003049
FR	0.00	32.00000000	8.53129730	.18517145	0.00000000
PEN UP		6000.00000000			
GO TO		4.00000000	8.53129730		
	5.66663990				
	5.14788460				
	-3.53675120				
	1.14926640				
	-.88459626				
	-.22791642				
	1.74118760				
IDENT.		Z	Y	FIRST DER.	SECOND DER.
FR	25.50	4.00000000	5.66663990	.64348557	-.11052347
PEN DOWN		5000.00000000			

FR	25.50	5.00000000	6.25710830	.53969607	-.09705550
FR	25.50	6.00000000	6.75052130	.44937455	-.08358754
FR	25.50	7.00000000	7.16034680	.37252098	-.07011957
FR	25.50	8.00000000	7.50005270	.30913540	-.05665161
FR	25.50	9.00000000	7.78310690	.25921776	-.04318364
FR	25.50	10.00000000	8.02297750	.22276810	-.02971568
FR	25.50	11.00000000	8.23313160	.19978640	-.01624771
FR	25.50	12.00000000	8.42703940	.19027267	-.00277975
FR	25.50	13.00000000	8.61644000	.18904372	.00032185
FR	25.50	14.00000000	8.80616110	.19091638	.00342345
FR	25.50	15.00000000	8.99930600	.19589063	.00652506
FR	25.50	16.00000000	9.19897560	.20396651	.00962666
FR	25.50	17.00000000	9.40827320	.21514393	.01272826
FR	25.50	18.00000000	9.63029700	.22942298	.01582987
FR	25.50	19.00000000	9.86815300	.24680363	.01893147
FR	25.50	20.00000000	10.12493900	.26728591	.02203307
FR	25.50	21.00000000	10.40331200	.28953440	.02246378
FR	25.50	22.00000000	10.70415100	.31221348	.02289449
FR	25.50	23.00000000	11.02788200	.33532332	.02332520
FR	25.50	24.00000000	11.37494100	.35886390	.02375591
FR	25.50	25.00000000	11.74575500	.38283531	.02418661
FR	25.50	26.00000000	12.14075500	.40723726	.02461733
FR	25.50	27.00000000	12.56037400	.43206993	.02504804
FR	25.50	28.00000000	13.00503900	.45733310	.02547874
FR	25.50	29.00000000	13.47858500	.49322937	.04631399
FR	25.50	30.00000000	13.99844300	.54996105	.06714923
FR	25.50	31.00000000	14.58545200	.62752801	.08798449
FR	25.50	32.00000000	15.26044500	.72593011	.10881974
PEN UP		6000.00000000			
GO TO		4.00000000	15.26044500		
	7.78364360				
	6.73399720				
	-3.88521860				
	1.14881730				
	-.82813290				
	-.41163256				
	1.84982390				
IDENT.		Z	Y	FIRST DER.	SECOND DER.
FR	51.00	4.00000000	7.78364360	.84174965	-.12141308
PEN DOWN		5000.00000000			
FR	51.00	5.00000000	8.56693040	.72706792	-.10795037

FR	51.00	6.00000000	9.24226700	.62584888	-.09448767
FR	51.00	7.00000000	9.82311610	.53809256	-.08102497
FR	51.00	8.00000000	10.32294000	.46379893	-.06756227
FR	51.00	9.00000000	10.75520000	.40296802	-.05409956
FR	51.00	10.00000000	11.13336300	.35559980	-.04063686
FR	51.00	11.00000000	11.47088800	.32169430	-.02717416
FR	51.00	12.00000000	11.78123900	.30125148	-.01371145
FR	51.00	13.00000000	12.07626200	.28941902	-.00995344
FR	51.00	14.00000000	12.36133000	.28134460	-.00619541
FR	51.00	15.00000000	12.64020300	.27702818	-.00243739
FR	51.00	16.00000000	12.91663900	.27646988	.00132061
FR	51.00	17.00000000	13.19439500	.27966946	.00507863
FR	51.00	18.00000000	13.47723100	.28662697	.00883665
FR	51.00	19.00000000	13.76890200	.29734278	.01259467
FR	51.00	20.00000000	14.07316900	.31181641	.01635269
FR	51.00	21.00000000	14.39298500	.32763621	.01528690
FR	51.00	22.00000000	14.72808600	.34239025	.01422110
FR	51.00	23.00000000	15.07741000	.35607842	.01315530
FR	51.00	24.00000000	15.43988800	.36870082	.01208950
FR	51.00	25.00000000	15.81445600	.38025752	.01102371
FR	51.00	26.00000000	16.20004800	.39074826	.00995791
FR	51.00	27.00000000	16.59559800	.40017332	.00889211
FR	51.00	28.00000000	17.00004100	.40853242	.00782632
FR	51.00	29.00000000	17.41591900	.42666477	.02843814
FR	51.00	30.00000000	17.86023900	.46540867	.04904996
FR	51.00	31.00000000	18.35361000	.52476465	.06966179
FR	51.00	32.00000000	18.91663900	.60473216	.09027361
PEN UP		6000.00000000			
GO TO		4.00000000	18.91663900		
	10.03124000				
	8.71790860				
	-5.12404990				
	1.48965640				
	-1.23285300				
	-.29524537				
	1.01719250				
IDENT.		Z	Y	FIRST DER.	SECOND DER.
FR	76.50	4.00000000	10.0312400C	1.08973850	-.16012654
PEN DOWN		5000.00000000			
FR	76.50	5.00000000	11.04382400	.93834048	-.14266964
FR	76.50	6.00000000	11.91373900	.80439930	-.12521273

FR	76.50	7.00000000	12.65844200	.68791502	-.10775582
FR	76.50	8.00000000	13.29538900	.58888767	-.09029890
FR	76.50	9.00000000	13.84203600	.50731722	-.07284200
FR	76.50	10.00000000	14.31584100	.44320368	-.05538509
FR	76.50	11.00000000	14.73426300	.39654706	-.03792817
FR	76.50	12.00000000	15.11475500	.36734727	-.02047126
FR	76.50	13.00000000	15.47236900	.34838076	-.01746185
FR	76.50	14.00000000	15.81252000	.33242367	-.01445242
FR	76.50	15.00000000	16.13821900	.31947587	-.01144301
FR	76.50	16.00000000	16.45247400	.30953753	-.00843360
FR	76.50	17.00000000	16.75829600	.30260867	-.00542419
FR	76.50	18.00000000	17.05869600	.29868920	-.00241477
FR	76.50	19.00000000	17.35667800	.29777910	.00059463
FR	76.50	20.00000000	17.65525700	.29987837	.00360404
FR	76.50	21.00000000	17.95686200	.30325721	.00315356
FR	76.50	22.00000000	18.26162000	.30618551	.00270306
FR	76.50	23.00000000	18.56908300	.30866316	.00225257
FR	76.50	24.00000000	18.87879900	.31069087	.00180209
FR	76.50	25.00000000	19.19031600	.31226767	.00135160
FR	76.50	26.00000000	19.50318200	.31339393	.00090110
FR	76.50	27.00000000	19.81695100	.31406978	.00045060
FR	76.50	28.00000000	20.13117100	.31429498	.00000012
FR	76.50	29.00000000	20.44738000	.32003001	.01146986
FR	76.50	30.00000000	20.77505300	.33723473	.02293958
FR	76.50	31.00000000	21.12567100	.36590940	.03440932
FR	76.50	32.00000000	21.51069700	.40605363	.04587905
PEN UP		6000.00000000			
GO TO		4.00000000	21.51069700		
	12.35413900				
	10.61081300				
	-6.58137000				
	1.88668800				
	-1.65251780				
	-.15863290				
	-.08074090				
IDENT.		X	Y	FIRST DER.	SECOND DER.
FR	102.00	4.00000000	12.35413900	1.32635160	-.20566781
PEN DOWN		5000.00000000			
FR	102.00	5.00000000	13.58134100	1.13173860	-.18355818
FR	102.00	6.00000000	14.62498600	.95923525	-.16144856
FR	102.00	7.00000000	15.50718100	.80884156	-.13933893

FR 102.00	8.00000000	16.25003900	.68055737	-.11722931
FR 102.00	9.00000000	16.87566700	.57438293	-.09511968
FR 102.00	10.00000000	17.40617400	.49031800	-.07301006
FR 102.00	11.00000000	17.86367200	.42836281	-.05090043
FR 102.00	12.00000000	18.27027000	.38851712	-.02879081
FR 102.00	13.00000000	18.64484900	.36109847	-.02604662
FR 102.00	14.00000000	18.99338200	.33642387	-.02330244
FR 102.00	15.00000000	19.31861100	.31449351	-.02055826
FR 102.00	16.00000000	19.62328400	.29530733	-.01781408
FR 102.00	17.00000000	19.91014200	.27886535	-.01506990
FR 102.00	18.00000000	20.18193000	.26516753	-.01232572
FR 102.00	19.00000000	20.44139200	.25421390	-.00958153
FR 102.00	20.00000000	20.69127200	.24600445	-.00683735
FR 102.00	21.00000000	20.93400500	.23960970	-.00595215
FR 102.00	22.00000000	21.17078800	.23410016	-.00506694
FR 102.00	23.00000000	21.40250100	.22947585	-.00418173
FR 102.00	24.00000000	21.63003300	.22573667	-.00329654
FR 102.00	25.00000000	21.85426900	.22288276	-.00241133
FR 102.00	26.00000000	22.07609400	.22091400	-.00152612
FR 102.00	27.00000000	22.29639200	.21983051	-.00064093
FR 102.00	28.00000000	22.51605000	.21963216	.00024427
FR 102.00	29.00000000	22.73579500	.21984588	.00018330
FR 102.00	30.00000000	22.95572300	.21999867	.00012231
FR 102.00	31.00000000	23.17577300	.22009057	.00006133
FR 102.00	32.00000000	23.39588200	.22012142	.00000034
PEN UP	6000.00000000			
GO TO	4.00000000	23.39588200		
14.62796200				
11.48635300				
-6.89130830				
1.81305540				
-1.43572700				
-.30270555				
-.86376103				
IDENT.	Z	Y	FIRST DER.	SECOND DER.
FR 127.50	4.00000000	14.62796200	1.43579410	-.21535337
PEN DOWN	5000.00000000			
FR 127.50	5.00000000	15.95962100	1.23106410	-.19410664
FR 127.50	6.00000000	17.09717200	1.04758080	-.17285989
FR 127.50	7.00000000	18.06186400	.88534433	-.15161315
FR 127.50	8.00000000	18.87494200	.74435456	-.13036640

FR 127.50	9.00000000	19.55765500	.62461152	-.10911967
FR 127.50	10.00000000	20.13124800	.52611523	-.08787292
FR 127.50	11.00000000	20.61696800	.44886570	-.06662618
FR 127.50	12.00000000	21.03606200	.39286290	-.04537943
FR 127.50	13.00000000	21.40697200	.34969436	-.04095762
FR 127.50	14.00000000	21.73692400	.31094766	-.03653580
FR 127.50	15.00000000	22.03034100	.27662271	-.03211399
FR 127.50	16.00000000	22.29164400	.24671960	-.02769217
FR 127.50	17.00000000	22.52525600	.22123843	-.02327036
FR 127.50	18.00000000	22.73559500	.20017896	-.01884853
FR 127.50	19.00000000	22.92708600	.18354120	-.01442672
FR 127.50	20.00000000	23.10415200	.17132550	-.01000490
FR 127.50	21.00000000	23.27062100	.16175785	-.00913042
FR 127.50	22.00000000	23.42796100	.15306443	-.00825592
FR 127.50	23.00000000	23.57704100	.14524588	-.00738144
FR 127.50	24.00000000	23.71874300	.13830173	-.00650696
FR 127.50	25.00000000	23.85393600	.13223212	-.00563248
FR 127.50	26.00000000	23.98350000	.12703705	-.00475798
FR 127.50	27.00000000	24.10830000	.12271590	-.00388350
FR 127.50	28.00000000	24.22922300	.11926980	-.00300902
FR 127.50	29.00000000	24.34544600	.11163701	-.01225673
FR 127.50	30.00000000	24.44941700	.09475657	-.02150443
FR 127.50	31.00000000	24.53187800	.06862797	-.03075215
FR 127.50	32.00000000	24.58358600	.03325198	-.03999987
PEN UP	6000.00000000			
GO TO	4.00000000	24.58358600		
	16.59374100			
	11.75612400			
	-6.66254610			
	1.55097370			
	-.97815060			
	-.53958440			
	-1.13466530			
IDENT.	Z	Y	FIRST DER.	SECOND DER.
FR 153.00	4.00000000	16.59374100	1.46951550	-.20820456
PEN DOWN	5000.00000000			
FR 153.00	5.00000000	17.96218300	1.27039860	-.19002909
FR 153.00	6.00000000	19.14059600	1.08945730	-.17185362
FR 153.00	7.00000000	20.14715600	.92669150	-.15367815
FR 153.00	8.00000000	21.00003800	.78210102	-.13550267
FR 153.00	9.00000000	21.71741600	.65568615	-.11732720

FR 153.00	10.00000000	22.31746900	.54744663	-.09915173
FR 153.00	11.00000000	22.81836900	.45738270	-.08097626
FR 153.00	12.00000000	23.23829200	.38549413	-.06280078
FR 153.00	13.00000000	23.59350500	.32604980	-.05608801
FR 153.00	14.00000000	23.89263000	.27331811	-.04937524
FR 153.00	15.00000000	24.14237800	.22729933	-.04266246
FR 153.00	16.00000000	24.34946700	.18799313	-.03594970
FR 153.00	17.00000000	24.52060300	.15539985	-.02923693
FR 153.00	18.00000000	24.66250400	.12951923	-.02252416
FR 153.00	19.00000000	24.78188100	.11035155	-.01581138
FR 153.00	20.00000000	24.88544400	.09789652	-.00909861
FR 153.00	21.00000000	24.97885800	.08899268	-.00870910
FR 153.00	22.00000000	25.06356000	.08047825	-.00831959
FR 153.00	23.00000000	25.13994500	.07235336	-.00793006
FR 153.00	24.00000000	25.20839700	.06461802	-.00754055
FR 153.00	25.00000000	25.26930900	.05727223	-.00715103
FR 153.00	26.00000000	25.32307400	.05031617	-.00676151
FR 153.00	27.00000000	25.37007000	.04374938	-.00637200
FR 153.00	28.00000000	25.41070000	.03757210	-.00598249
FR 153.00	29.00000000	25.44313000	.02513600	-.01888983
FR 153.00	30.00000000	25.45667300	-.00020769	-.03179717
FR 153.00	31.00000000	25.43841300	-.03845851	-.04470451
FR 153.00	32.00000000	25.37545100	-.08961683	-.05761186
PEN UP	6000.00000000			
GO TO	4.00000000	25.37545100		
17.98964900				
12.08811800				
-6.79092030				
1.48398990				
-.79268605				
-.63973679				
-.87731016				

IDENT.	Z	Y	FIRST DER.	SECOND DER.
FR 178.50	4.00000000	17.98964900	1.51101470	-.21221625
PEN DOWN	5000.00000000			
FR 178.50	5.00000000	19.39745300	1.30749370	-.19482575
FR 178.50	6.00000000	20.61043300	1.12136320	-.17743525
FR 178.50	7.00000000	21.64597700	.95262327	-.16004473
FR 178.50	8.00000000	22.52147600	.80127380	-.14265423
FR 178.50	9.00000000	23.25432100	.66731482	-.12526371
FR 178.50	10.00000000	23.86190300	.55074636	-.10787321

FR 178.50	11.00000000	24.36161100	.45156840	-.09048271
FR 178.50	12.00000000	24.77083600	.36978096	-.07309220
FR 178.50	13.00000000	25.10542100	.30073937	-.06499099
FR 178.50	14.00000000	25.37501600	.23979900	-.05688976
FR 178.50	15.00000000	25.58772000	.18695983	-.04878855
FR 178.50	16.00000000	25.75163600	.14222181	-.04068732
FR 178.50	17.00000000	25.87486400	.10558513	-.03258611
FR 178.50	18.00000000	25.96550700	.07704967	-.02448490
FR 178.50	19.00000000	26.03166400	.05661528	-.01638368
FR 178.50	20.00000000	26.08143800	.04428223	-.00828247
FR 178.50	21.00000000	26.12168000	.03630195	-.00767816
FR 178.50	22.00000000	26.15424500	.02892570	-.00707386
FR 178.50	23.00000000	26.17973200	.02215425	-.00646955
FR 178.50	24.00000000	26.19875400	.01598684	-.00586526
FR 178.50	25.00000000	26.21190800	.01042361	-.00526096
FR 178.50	26.00000000	26.21980400	.00546480	-.00465664
FR 178.50	27.00000000	26.22303900	.00111015	-.00405236
FR 178.50	28.00000000	26.22222600	-.00263966	-.00344804
FR 178.50	29.00000000	26.21624900	-.01092617	-.01312473
FR 178.50	30.00000000	26.19714900	-.02888933	-.02280139
FR 178.50	31.00000000	26.15524300	-.05652913	-.03247808
FR 178.50	32.00000000	26.08086200	-.09384571	-.04215475
PEN UP	6000.00000000			
GO TO	4.00000000	26.08086200		
	18.67703900			
	12.83775500			
	-7.34626030			
	1.59190880			
	-.81413440			
	-.69582357			
	-.41680171			
IDENT.	Z	Y	FIRST DER.	SECOND DER.
FR 204.00	4.00000000	18.67703900	1.60471930	-.22957062
PEN DOWN	5000.00000000			
FR 204.00	5.00000000	20.17008200	1.38447620	-.21091545
FR 204.00	6.00000000	21.45220900	1.18288840	-.19226026
FR 204.00	7.00000000	22.54207800	.99995581	-.17360509
FR 204.00	8.00000000	23.45833900	.83567832	-.15494990
FR 204.00	9.00000000	24.21965200	.69005601	-.13629471
FR 204.00	10.00000000	24.84467000	.56308888	-.11763954
FR 204.00	11.00000000	25.35204800	.45477693	-.09898435

FR 204.00	12.00000000	25.76044200	.36512017	-.08032918
FR 204.00	13.00000000	26.08691700	.28934827	-.07121463
FR 204.00	14.00000000	26.34217700	.22269091	-.06210008
FR 204.00	15.00000000	26.53533800	.16514810	-.05298555
FR 204.00	16.00000000	26.67551200	.11671977	-.04387100
FR 204.00	17.00000000	26.77181500	.07740603	-.03475646
FR 204.00	18.00000000	26.83336300	.04720690	-.02564191
FR 204.00	19.00000000	26.86926600	.02612226	-.01652736
FR 204.00	20.00000000	26.88864500	.01415210	-.00741283
FR 204.00	21.00000000	26.89925000	.00721934	-.00645246
FR 204.00	22.00000000	26.90340400	.00124713	-.00549211
FR 204.00	23.00000000	26.90206400	-.00376475	-.00453174
FR 204.00	24.00000000	26.89619600	-.00781623	-.00357137
FR 204.00	25.00000000	26.88675100	-.01090776	-.00261102
FR 204.00	26.00000000	26.87470100	-.01303850	-.00165065
FR 204.00	27.00000000	26.86099400	-.01420883	-.00069030
FR 204.00	28.00000000	26.84660300	-.01441883	.00027007
FR 204.00	29.00000000	26.83166400	-.01611070	-.00365395
FR 204.00	30.00000000	26.81307400	-.02172715	-.00757800
FR 204.00	31.00000000	26.78690300	-.03126705	-.01150203
FR 204.00	32.00000000	26.74922800	-.04473103	-.01542608
PEN UP	6000.00000000			
GO TO	4.00000000	26.74922800		
	18.43744000			
	14.12029500			
	-8.16632210			
	1.76482910			
	-.86815168			
	-.83042874			
	-.06060179			
IDENT.	Z	Y	FIRST DER.	SECOND DER.
FR 229.50	4.00000000	18.43744000	1.76503680	-.25519756
PEN DOWN	5000.00000000			
FR 229.50	5.00000000	20.07832400	1.52018010	-.23451598
FR 229.50	6.00000000	21.48469300	1.29600480	-.21383439
FR 229.50	7.00000000	22.67722800	1.09251140	-.19315279
FR 229.50	8.00000000	23.67661000	.90969935	-.17247120
FR 229.50	9.00000000	24.50352100	.74756900	-.15178962
FR 229.50	10.00000000	25.17864200	.60612012	-.13110803
FR 229.50	11.00000000	25.72265500	.48535296	-.11042643
FR 229.50	12.00000000	26.15624200	.38526728	-.08974484

FR 229.50	13.00000000	26.49838800	.30077647	-.07923691
FR 229.50	14.00000000	26.76129800	.22679348	-.06872897
FR 229.50	15.00000000	26.95547900	.16331857	-.05822103
FR 229.50	16.00000000	27.09143800	.11035141	-.04771309
FR 229.50	17.00000000	27.17968400	.06789235	-.03720516
FR 229.50	18.00000000	27.23072500	.03594113	-.02669722
FR 229.50	19.00000000	27.25507000	.01449790	-.01618928
FR 229.50	20.00000000	27.26322300	.00356250	-.00568134
FR 229.50	21.00000000	27.26407600	-.00173058	-.00490500
FR 229.50	22.00000000	27.26002200	-.00624741	-.00412865
FR 229.50	23.00000000	27.25183900	-.00998785	-.00335229
FR 229.50	24.00000000	27.24030500	-.01295190	-.00257594
FR 229.50	25.00000000	27.22619400	-.01513957	-.00179958
FR 229.50	26.00000000	27.21028600	-.01655097	-.00102323
FR 229.50	27.00000000	27.19334900	-.01718636	-.00024688
FR 229.50	28.00000000	27.17617100	-.01704502	.00052946
FR 229.50	29.00000000	27.15940300	-.01648233	.00059563
FR 229.50	30.00000000	27.14323000	-.01585367	.00066180
FR 229.50	31.00000000	27.12771600	-.01515853	.00072798
FR 229.50	32.00000000	27.11293600	-.01439753	.00079415
PEN UP	6000.00000000			
GO TO	4.00000000	27.11293600		

WATERLINE OFFSETS 5 X 6 DOUBLE INTERVAL

3.59374000
4.18298540
-.15566008
.16257823
-.28355646
-.26917620
.24634675
-.88494458

IDENT.		X	Y	FIRST DER.	SECOND DER.
WL	4.00	0.00000000	3.59374000	.08201932	-.00011969
PEN DOWN		5000.00000000			
WL	4.00	5.10000000	4.01064440	.08150452	-.00008218
WL	4.00	10.20000000	4.42541120	.08118099	-.00004468
WL	4.00	15.30000000	4.83901580	.08104873	-.00000718
WL	4.00	20.40000000	5.25243350	.08110774	.00003032
WL	4.00	25.50000000	5.66663990	.08135801	.00006782
WL	4.00	30.60000000	6.08261040	.08179956	.00010532
WL	4.00	35.70000000	6.50132060	.08243237	.00014283
WL	4.00	40.80000000	6.92374590	.08325646	.00018033
WL	4.00	45.90000000	7.35086170	.08427180	.00021784
WL	4.00	51.00000000	7.78364360	.08547842	.00025534
WL	4.00	56.10000000	8.22278340	.08670952	.00022743
WL	4.00	61.20000000	8.66783860	.08779828	.00019952
WL	4.00	66.30000000	9.11808380	.08874471	.00017162
WL	4.00	71.40000000	9.57279280	.08954882	.00014371
WL	4.00	76.50000000	10.03124000	.09021060	.00011580
WL	4.00	81.60000000	10.49269900	.09073006	.00008789
WL	4.00	86.70000000	10.95644500	.09110718	.00005999
WL	4.00	91.80000000	11.42175100	.09134198	.00003208
WL	4.00	96.90000000	11.88789200	.09143445	.00000417
WL	4.00	102.00000000	12.35413900	.09138459	-.00002372
WL	4.00	107.10000000	12.81950300	.09103407	-.00011373
WL	4.00	112.20000000	13.28190700	.09022454	-.00020373
WL	4.00	117.30000000	13.73901400	.08895601	-.00029373
WL	4.00	122.40000000	14.18847800	.08722847	-.00038373
WL	4.00	127.50000000	14.62796200	.08504193	-.00047373
WL	4.00	132.60000000	15.05512500	.08239638	-.00056373
WL	4.00	137.70000000	15.46762700	.07929182	-.00065373
WL	4.00	142.80000000	15.86312200	.07572827	-.00074373
WL	4.00	147.90000000	16.23927400	.07170570	-.00083373

WL	4.00	153.00000000	16.59374100	.06722413	-.00092373
WL	4.00	158.10000000	16.92442600	.06242847	-.00095691
WL	4.00	163.20000000	17.23022200	.05746362	-.00099008
WL	4.00	168.30000000	17.51026600	.05232958	-.00102326
WL	4.00	173.40000000	17.76369700	.04702636	-.00105643
WL	4.00	178.50000000	17.98964900	.04155395	-.00108960
WL	4.00	183.60000000	18.18725900	.03591235	-.00112278
WL	4.00	188.70000000	18.35566700	.03010158	-.00115595
WL	4.00	193.80000000	18.49400800	.02412162	-.00118912
WL	4.00	198.90000000	18.60142100	.01797247	-.00122230
WL	4.00	204.00000000	18.67703900	.01165413	-.00125547
WL	4.00	209.10000000	18.71912200	.00464606	-.00149278
WL	4.00	214.20000000	18.72237200	-.00357231	-.00173010
WL	4.00	219.30000000	18.68062600	-.01300098	-.00196741
WL	4.00	224.40000000	18.58770400	-.02363994	-.00220472
WL	4.00	229.50000000	18.43744000	-.03548918	-.00244204
PEN UP		6000.00000000			
GO TO		0.00000000	18.43744000		
	4.27383460				
	7.34440450				
	-2.27257420				
	.97727477				
	-1.44050510				
	.28378276				
	.24586891				
	-1.47065720				
IDENT.		X	Y	FIRST DER.	SECOND DER.
WL	8.00	0.00000000	4.27383460	.14400793	-.00174746
PEN DOWN		5000.00000000			
WL	8.00	5.10000000	4.98652650	.13567074	-.00152202
WL	8.00	10.20000000	5.65963070	.12848329	-.00129658
WL	8.00	15.30000000	6.29901070	.12244557	-.00107114
WL	8.00	20.40000000	6.91053010	.11755758	-.00084570
WL	8.00	25.50000000	7.50005260	.11381933	-.00062027
WL	8.00	30.60000000	8.07344190	.11123082	-.00039483
WL	8.00	35.70000000	8.63656160	.10979205	-.00016939
WL	8.00	40.80000000	9.19527560	.10950300	.00005604
WL	8.00	45.90000000	9.75544630	.11036369	.00028148
WL	8.00	51.00000000	10.32293900	.11237412	.00050692
WL	8.00	56.10000000	10.90217700	.11468693	.00040006
WL	8.00	61.20000000	11.49182000	.11645476	.00029320

WL	8.00	66.30000000	12.08908900	.11767761	.00018634
WL	8.00	71.40000000	12.69120400	.11835549	.00007948
WL	8.00	76.50000000	13.29538800	.11848838	-.00002737
WL	8.00	81.60000000	13.89886000	.11807630	-.00013422
WL	8.00	86.70000000	14.49883900	.11711925	-.00024108
WL	8.00	91.80000000	15.09255000	.11561722	-.00034794
WL	8.00	96.90000000	15.67720900	.11357020	-.00045480
WL	8.00	102.00000000	16.25004000	.11097822	-.00056166
WL	8.00	107.10000000	16.80854300	.10800820	-.00060305
WL	8.00	112.20000000	17.35136300	.10482705	-.00064445
WL	8.00	117.30000000	17.87742200	.10143479	-.00068584
WL	8.00	122.40000000	18.38564000	.09783140	-.00072724
WL	8.00	127.50000000	18.87494300	.09401690	-.00076863
WL	8.00	132.60000000	19.34425400	.08999131	-.00081003
WL	8.00	137.70000000	19.79249600	.08575460	-.00085142
WL	8.00	142.80000000	20.21859100	.08130676	-.00089282
WL	8.00	147.90000000	20.62146600	.07664780	-.00093421
WL	8.00	153.00000000	21.00004000	.07177772	-.00097561
WL	8.00	158.10000000	21.35348300	.06684118	-.00096029
WL	8.00	163.20000000	21.68195200	.06198277	-.00094496
WL	8.00	168.30000000	21.98584200	.05720253	-.00092964
WL	8.00	173.40000000	22.26555100	.05250038	-.00091432
WL	8.00	178.50000000	22.52147800	.04787641	-.00089900
WL	8.00	183.60000000	22.75402400	.04333054	-.00088367
WL	8.00	188.70000000	22.96358400	.03886281	-.00086835
WL	8.00	193.80000000	23.15055900	.03447332	-.00085303
WL	8.00	198.90000000	23.31534500	.03016187	-.00083771
WL	8.00	204.00000000	23.45834300	.02592866	-.00082239
WL	8.00	209.10000000	23.57848000	.02090837	-.00114632
WL	8.00	214.20000000	23.66880000	.01423618	-.00147025
WL	8.00	219.30000000	23.72088100	.00591184	-.00179418
WL	8.00	224.40000000	23.72629300	-.00406451	-.00211811
WL	8.00	229.50000000	23.67661800	-.01569286	-.00244204
PEN UP		6000.00000000			
GO TO		0.00000000	23.67661800		

4.95392930
7.17320510
-.56204280
.21614780
-.51108100
.07579290

.46576080
-1.88656440

IDENT.		X	Y	FIRST DER.	SECOND DER.
WL	12.00	0.00000000	4.95392930	.14065108	-.00043217
PEN	DOWN	5000.00000000			
WL	12.00	5.10000000	5.66584550	.13857413	-.00038231
WL	12.00	10.20000000	6.36781770	.13675148	-.00033245
WL	12.00	15.30000000	7.06114290	.13518312	-.00028259
WL	12.00	20.40000000	7.74711790	.13386905	-.00023273
WL	12.00	25.50000000	8.42703950	.13280927	-.00018286
WL	12.00	30.60000000	9.10220480	.13200379	-.00013300
WL	12.00	35.70000000	9.77391050	.13145259	-.00008314
WL	12.00	40.80000000	10.44345300	.13115569	-.00003328
WL	12.00	45.90000000	11.11213000	.13111308	.00001657
WL	12.00	51.00000000	11.78123900	.13132476	.00006643
WL	12.00	56.10000000	12.45156400	.13149010	-.00000159
WL	12.00	61.20000000	13.12184900	.13130845	-.00006963
WL	12.00	66.30000000	13.79032000	.13077983	-.00013766
WL	12.00	71.40000000	14.45521300	.12990422	-.00020570
WL	12.00	76.50000000	15.11475300	.12868163	-.00027374
WL	12.00	81.60000000	15.76717600	.12711207	-.00034177
WL	12.00	86.70000000	16.41070800	.12519552	-.00040981
WL	12.00	91.80000000	17.04358000	.12293200	-.00047784
WL	12.00	96.90000000	17.66402300	.12032149	-.00054588
WL	12.00	102.00000000	18.27026900	.11736400	-.00061391
WL	12.00	107.10000000	18.86062200	.11410412	-.00066446
WL	12.00	112.20000000	19.43369300	.11058642	-.00071501
WL	12.00	117.30000000	19.98816600	.10681092	-.00076557
WL	12.00	122.40000000	20.52272600	.10277760	-.00081612
WL	12.00	127.50000000	21.03605900	.09848647	-.00086667
WL	12.00	132.60000000	21.52685000	.09393753	-.00091722
WL	12.00	137.70000000	21.99378400	.08913077	-.00096777
WL	12.00	142.80000000	22.43554500	.08406620	-.00101832
WL	12.00	147.90000000	22.85082100	.07874382	-.00106887
WL	12.00	153.00000000	23.23829300	.07316363	-.00111943
WL	12.00	158.10000000	23.59711600	.06759960	-.00106254
WL	12.00	163.20000000	23.92830400	.06232571	-.00100564
WL	12.00	168.30000000	24.23333300	.05734198	-.00094875
WL	12.00	173.40000000	24.51368500	.05264837	-.00089186
WL	12.00	178.50000000	24.77083900	.04824493	-.00083497
WL	12.00	183.60000000	25.00627600	.04413160	-.00077808

WL	12.00	188.70000000	25.22147400	.04030842	-.00072119
WL	12.00	193.80000000	25.41791600	.03677538	-.00066430
WL	12.00	198.90000000	25.59707700	.03353250	-.00060741
WL	12.00	204.00000000	25.76044000	.03057972	-.00055052
WL	12.00	209.10000000	25.90759700	.02680738	-.00092882
WL	12.00	214.20000000	26.03059600	.02110568	-.00130713
WL	12.00	219.30000000	26.11959600	.01347465	-.00168543
WL	12.00	224.40000000	26.16475800	.00391423	-.00206373
WL	12.00	229.50000000	26.15624200	-.00757549	-.00244204
PEN UP		6000.00000000			
GO TO		0.00000000	26.15624200		
		5.63642650			
		6.71973260			
		1.06098500			
		-.50050526			
		.30749127			
		.05869193			
		.44494005			
		-2.10074160			

IDENT.		X	Y	FIRST DER.	SECOND DER.
WL	16.00	0.00000000	5.63642650	.13175946	.00081582
PEN DOWN		5000.00000000			
WL	16.00	5.10000000	6.31850900	.13562577	.00070037
WL	16.00	10.20000000	7.01880840	.13890325	.00058491
WL	16.00	15.30000000	7.73432120	.14159190	.00046945
WL	16.00	20.40000000	8.46204480	.14369172	.00035400
WL	16.00	25.50000000	9.19897590	.14520271	.00023854
WL	16.00	30.60000000	9.94211100	.14612488	.00012308
WL	16.00	35.70000000	10.68844800	.14645821	.00000763
WL	16.00	40.80000000	11.43498400	.14620271	-.00010782
WL	16.00	45.90000000	12.17871400	.14535839	-.00022328
WL	16.00	51.00000000	12.91663900	.14392523	-.00033873
WL	16.00	56.10000000	13.64605800	.14208412	-.00038326
WL	16.00	61.20000000	14.36550900	.14001594	-.00042778
WL	16.00	66.30000000	15.07383400	.13772068	-.00047231
WL	16.00	71.40000000	15.76987500	.13519834	-.00051683
WL	16.00	76.50000000	16.45247100	.13244893	-.00056136
WL	16.00	81.60000000	17.12046800	.12947244	-.00060588
WL	16.00	86.70000000	17.77270400	.12626888	-.00065041
WL	16.00	91.80000000	18.40802400	.12283825	-.00069493
WL	16.00	96.90000000	19.02526800	.11918054	-.00073946

WL	16.00	102.00000000	19.62328000	.11529576	-.00078398
WL	16.00	107.10000000	20.20095600	.11121841	-.00081497
WL	16.00	112.20000000	20.75743700	.10698306	-.00084595
WL	16.00	117.30000000	21.29191500	.10258965	-.00087694
WL	16.00	122.40000000	21.80358500	.09803824	-.00090792
WL	16.00	127.50000000	22.29163800	.09332880	-.00093891
WL	16.00	132.60000000	22.75526900	.08846133	-.00096989
WL	16.00	137.70000000	23.19367400	.08343585	-.00100088
WL	16.00	142.80000000	23.60604700	.07825234	-.00103186
WL	16.00	147.90000000	23.99157900	.07291079	-.00106285
WL	16.00	153.00000000	24.34946700	.06741121	-.00109383
WL	16.00	158.10000000	24.67934800	.06201536	-.00102218
WL	16.00	163.20000000	24.98264500	.05698492	-.00095053
WL	16.00	168.30000000	25.26121700	.05231992	-.00087887
WL	16.00	173.40000000	25.51692900	.04802034	-.00080722
WL	16.00	178.50000000	25.75164600	.04408621	-.00073557
WL	16.00	183.60000000	25.96723000	.04051751	-.00066391
WL	16.00	188.70000000	26.16554500	.03731425	-.00059226
WL	16.00	193.80000000	26.34845600	.03447641	-.00052061
WL	16.00	198.90000000	26.51782500	.03200400	-.00044895
WL	16.00	204.00000000	26.67551900	.02989702	-.00037730
WL	16.00	209.10000000	26.82129500	.02691977	-.00079025
WL	16.00	214.20000000	26.94651900	.02183646	-.00120319
WL	16.00	219.30000000	27.04044700	.01464712	-.00161614
WL	16.00	224.40000000	27.09233900	.00535180	-.00202909
WL	16.00	229.50000000	27.09145600	-.00604957	-.00244203
PEN UP		6000.00000000			
GO TO		0.00000000	27.09145600		
		6.33333990			
		7.02091200			
		1.53023220			
		-.81131490			
		.68568920			
		.13724840			
		.30044840			
		-2.22299730			

IDENT.		X	Y	FIRST DER.	SECOND DER.
WL	20.00	0.00000000	6.33333990	.13766494	.00117664
PEN DOWN		5000.00000000			
WL	20.00	5.10000000	7.04992210	.14318860	.00098949
WL	20.00	10.20000000	7.79224100	.14775778	.00080234

WL	20.00	15.30000000	8.55542880	.15137247	.00061518
WL	20.00	20.40000000	9.33461770	.15403267	.00042803
WL	20.00	25.50000000	10.12493900	.15573839	.00024087
WL	20.00	30.60000000	10.92152600	.15648961	.00005372
WL	20.00	35.70000000	11.71951000	.15628635	-.00013343
WL	20.00	40.80000000	12.51402400	.15512860	-.00032058
WL	20.00	45.90000000	13.30020000	.15301636	-.00050774
WL	20.00	51.00000000	14.07316900	.14994964	-.00069489
WL	20.00	56.10000000	14.82874800	.14633175	-.00072387
WL	20.00	61.20000000	15.56550100	.14256611	-.00075285
WL	20.00	66.30000000	16.28267200	.13865264	-.00078183
WL	20.00	71.40000000	16.97950700	.13459140	-.00081081
WL	20.00	76.50000000	17.65525300	.13038235	-.00083979
WL	20.00	81.60000000	18.30915500	.12602551	-.00086877
WL	20.00	86.70000000	18.94046000	.12152086	-.00089775
WL	20.00	91.80000000	19.54841600	.11686843	-.00092673
WL	20.00	96.90000000	20.13226800	.11206820	-.00095571
WL	20.00	102.00000000	20.69126100	.10712018	-.00098469
WL	20.00	107.10000000	21.22477900	.10210511	-.00098200
WL	20.00	112.20000000	21.73275400	.09710368	-.00097932
WL	20.00	117.30000000	22.21526000	.09211596	-.00097664
WL	20.00	122.40000000	22.67236100	.08714189	-.00097396
WL	20.00	127.50000000	23.10413200	.08218151	-.00097128
WL	20.00	132.60000000	23.51063600	.07723478	-.00096860
WL	20.00	137.70000000	23.89194900	.07230175	-.00096592
WL	20.00	142.80000000	24.24813800	.06738239	-.00096324
WL	20.00	147.90000000	24.57927200	.06247669	-.00096056
WL	20.00	153.00000000	24.88542300	.05758467	-.00095787
WL	20.00	158.10000000	25.16695900	.05288306	-.00086589
WL	20.00	163.20000000	25.42545400	.04854860	-.00081390
WL	20.00	168.30000000	25.66277900	.04458126	-.00074191
WL	20.00	173.40000000	25.88080600	.04098107	-.00066992
WL	20.00	178.50000000	26.08141100	.03774803	-.00059793
WL	20.00	183.60000000	26.26646200	.03488211	-.00052594
WL	20.00	188.70000000	26.43783200	.03238338	-.00045395
WL	20.00	193.80000000	26.59739500	.03025175	-.00038196
WL	20.00	198.90000000	26.74702300	.02848730	-.00030998
WL	20.00	204.00000000	26.88859200	.02708996	-.00023799
WL	20.00	209.10000000	27.02174400	.02475213	-.00067880
WL	20.00	214.20000000	27.13724000	.02016621	-.00111961
WL	20.00	219.30000000	27.22361800	.01333204	-.00156043

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WL	20.00	224.40000000	27.26940600	.00424980	-.00200124
WL	20.00	229.50000000	27.26314400	-.00708066	-.00244205
PEN UP		6000.00000000			
GO TO		0.00000000	27.26314400		
		7.05444240			
		8.59809330			
		.38428388			
		-.59693068			
		.61769343			
		.07666455			
		.21331101			
		-2.34795840			

IDENT.		X	Y	FIRST DER.	SECOND DER.
WL	24.00	0.00000000	7.05444240	.16859006	.00029548
PEN DOWN		5000.00000000			
WL	24.00	5.10000000	7.91749760	.16974592	.00015778
WL	24.00	10.20000000	8.78465690	.17019951	.00002008
WL	24.00	15.30000000	9.65233870	.16995083	-.00011761
WL	24.00	20.40000000	10.51696100	.16899987	-.00025531
WL	24.00	25.50000000	11.37494300	.16734664	-.00039301
WL	24.00	30.60000000	12.22270300	.16499115	-.00053071
WL	24.00	35.70000000	13.05665900	.16193338	-.00066841
WL	24.00	40.80000000	13.87323000	.15817334	-.00080611
WL	24.00	45.90000000	14.66883300	.15371103	-.00094381
WL	24.00	51.00000000	15.43988800	.14854645	-.00108151
WL	24.00	56.10000000	16.18343100	.14304294	-.00107672
WL	24.00	61.20000000	16.89896600	.13756397	-.00107193
WL	24.00	66.30000000	17.58662300	.13210921	-.00106714
WL	24.00	71.40000000	18.24652300	.12667899	-.00106235
WL	24.00	76.50000000	18.87878900	.12127319	-.00105756
WL	24.00	81.60000000	19.48355000	.11589182	-.00105277
WL	24.00	86.70000000	20.06092800	.11053487	-.00104798
WL	24.00	91.80000000	20.61104800	.10520236	-.00104319
WL	24.00	96.90000000	21.13403400	.09989427	-.00103840
WL	24.00	102.00000000	21.63001100	.09461059	-.00103361
WL	24.00	107.10000000	22.09917800	.08939646	-.00101114
WL	24.00	112.20000000	22.54205000	.08429694	-.00098866
WL	24.00	117.30000000	22.95920300	.07931205	-.00096619
WL	24.00	122.40000000	23.35122700	.07444176	-.00094371
WL	24.00	127.50000000	23.71870600	.06968609	-.00092124
WL	24.00	132.60000000	24.06222100	.06504507	-.00089877

WL	24.00	137.70000000	24.38235800	.06051865	-.00087629
WL	24.00	142.80000000	24.67970600	.05610685	-.00085382
WL	24.00	147.90000000	24.95484400	.05180967	-.00083134
WL	24.00	153.00000000	25.20835800	.04762710	-.00080887
WL	24.00	158.10000000	25.44104900	.04368465	-.00073719
WL	24.00	163.20000000	25.65456300	.04010776	-.00066550
WL	24.00	168.30000000	25.85076900	.03689645	-.00059382
WL	24.00	173.40000000	26.03152800	.03405070	-.00052214
WL	24.00	178.50000000	26.19870700	.03157054	-.00045046
WL	24.00	183.60000000	26.35416900	.02945597	-.00037878
WL	24.00	188.70000000	26.49978000	.02770695	-.00030710
WL	24.00	193.80000000	26.63740300	.02632350	-.00023542
WL	24.00	198.90000000	26.76890100	.02530564	-.00016374
WL	24.00	204.00000000	26.89614300	.02465334	-.00009205
WL	24.00	209.10000000	27.01863900	.02298549	-.00056200
WL	24.00	214.20000000	27.12652000	.01892089	-.00103195
WL	24.00	219.30000000	27.20755900	.01245955	-.00150190
WL	24.00	224.40000000	27.24953200	.00360151	-.00197184
WL	24.00	229.50000000	27.24021900	-.00765327	-.00244179
PEN UP		6000.00000000			
GO TO		0.00000000	27.24021900		

7.79093680
11.92372400
-3.26748000
.55285218
-.47524960
.13092940
.04237003
-2.36779030

IDENT.		X	Y	FIRST DER.	SECOND DER.
WL	28.00	0.00000000	7.79093680	.23379850	-.00251247
PEN DOWN		5000.00000000			
WL	28.00	5.10000000	8.95118720	.22131005	-.00238494
WL	28.00	10.20000000	10.04940400	.20947203	-.00225741
WL	28.00	15.30000000	11.08890800	.19828443	-.00212988
WL	28.00	20.40000000	12.07301200	.18774723	-.00200235
WL	28.00	25.50000000	13.00503400	.17786045	-.00187481
WL	28.00	30.60000000	13.88829500	.16862408	-.00174728
WL	28.00	35.70000000	14.72610600	.16003812	-.00161975
WL	28.00	40.80000000	15.52178900	.15210259	-.00149222
WL	28.00	45.90000000	16.27865800	.14481746	-.00136468

WL	28.00	51.00000000	17.00003200	.13818275	-.00123715
WL	28.00	56.10000000	17.68875300	.13191890	-.00121925
WL	28.00	61.20000000	18.34576000	.12574634	-.00120135
WL	28.00	66.30000000	18.97152100	.11966508	-.00118345
WL	28.00	71.40000000	19.56650000	.11367511	-.00116555
WL	28.00	76.50000000	20.13116200	.10777644	-.00114765
WL	28.00	81.60000000	20.66597500	.10196908	-.00112974
WL	28.00	86.70000000	21.17140100	.09625300	-.00111184
WL	28.00	91.80000000	21.64791000	.09062823	-.00109394
WL	28.00	96.90000000	22.09596600	.08509475	-.00107604
WL	28.00	102.00000000	22.51603200	.07965257	-.00105814
WL	28.00	107.10000000	22.90870700	.07437870	-.00101003
WL	28.00	112.20000000	23.27511100	.06935017	-.00096193
WL	28.00	117.30000000	23.61649600	.06456696	-.00091383
WL	28.00	122.40000000	23.93411200	.06002909	-.00086572
WL	28.00	127.50000000	24.22921000	.05573655	-.00081762
WL	28.00	132.60000000	24.50304100	.05168932	-.00076951
WL	28.00	137.70000000	24.75685700	.04788745	-.00072141
WL	28.00	142.80000000	24.99191100	.04433090	-.00067330
WL	28.00	147.90000000	25.20945000	.04101971	-.00062520
WL	28.00	153.00000000	25.41072900	.03795382	-.00057710
WL	28.00	158.10000000	25.59704000	.03515818	-.00051922
WL	28.00	163.20000000	25.76984400	.03265775	-.00046134
WL	28.00	168.30000000	25.93064900	.03045248	-.00040346
WL	28.00	173.40000000	26.08096200	.02854240	-.00034558
WL	28.00	178.50000000	26.22228400	.02692746	-.00028771
WL	28.00	183.60000000	26.35612400	.02560775	-.00022983
WL	28.00	188.70000000	26.48398500	.02458320	-.00017195
WL	28.00	193.80000000	26.60737400	.02385382	-.00011407
WL	28.00	198.90000000	26.72779600	.02341963	-.00005619
WL	28.00	204.00000000	26.84675700	.02328062	.00000168
WL	28.00	209.10000000	26.96339500	.02204396	-.00048664
WL	28.00	214.20000000	27.06737200	.01831685	-.00097496
WL	28.00	219.30000000	27.14599200	.01209927	-.00146329
WL	28.00	224.40000000	27.18655200	.00339124	-.00195161
WL	28.00	229.50000000	27.17634800	-.00780723	-.00243994
PEN UP		6000.00000000			
GO TO		0.00000000	27.17634800		
	8.53129730				
	18.14805900				
	-10.99630700				

3.23360700
-3.31511150
.58047877
-.51939716
-2.02109770

IDENT.		X	Y	FIRST DER.	SECOND DER.
WL	32.00	0.00000000	8.53129730	.35584429	-.00845544
PEN	DOWN	5000.00000000			
WL	32.00	5.10000000	10.23937300	.31462364	-.00770951
WL	32.00	10.20000000	11.74692500	.27720723	-.00696358
WL	32.00	15.30000000	13.07335500	.24359505	-.00621765
WL	32.00	20.40000000	14.23806100	.21378715	-.00547172
WL	32.00	25.50000000	15.26045000	.18778347	-.00472579
WL	32.00	30.60000000	16.15992100	.16558404	-.00397986
WL	32.00	35.70000000	16.95587500	.14718886	-.00323393
WL	32.00	40.80000000	17.66771400	.13259790	-.00248800
WL	32.00	45.90000000	18.31484100	.12181121	-.00174207
WL	32.00	51.00000000	18.91665600	.11482874	-.00099614
WL	32.00	56.10000000	19.48924600	.10970046	-.00101494
WL	32.00	61.20000000	20.03543800	.10447630	-.00103374
WL	32.00	66.30000000	20.55474100	.09915623	-.00105254
WL	32.00	71.40000000	21.04666900	.09374028	-.00107135
WL	32.00	76.50000000	21.51073000	.08822843	-.00109015
WL	32.00	81.60000000	21.94643600	.08262071	-.00110895
WL	32.00	86.70000000	22.35330000	.07691711	-.00112775
WL	32.00	91.80000000	22.73082900	.07111760	-.00114655
WL	32.00	96.90000000	23.07853600	.06522225	-.00116535
WL	32.00	102.00000000	23.39593200	.05923100	-.00118415
WL	32.00	107.10000000	23.68310900	.05348530	-.00106905
WL	32.00	112.20000000	23.94247900	.04832663	-.00095395
WL	32.00	117.30000000	24.17703800	.04375496	-.00083884
WL	32.00	122.40000000	24.38978000	.03977036	-.00072374
WL	32.00	127.50000000	24.58369400	.03637276	-.00060864
WL	32.00	132.60000000	24.76177900	.03356219	-.00049353
WL	32.00	137.70000000	24.92702900	.03133868	-.00037843
WL	32.00	142.80000000	25.08243200	.02970216	-.00026333
WL	32.00	147.90000000	25.23098800	.02865269	-.00014822
WL	32.00	153.00000000	25.37568600	.02819028	-.00003312
WL	32.00	158.10000000	25.51900700	.02800933	-.00003783
WL	32.00	163.20000000	25.66133500	.02780438	-.00004254
WL	32.00	168.30000000	25.80256700	.02757531	-.00004725

WL	32.00	173.40000000	25.94256100	.02732232	-.00005196
WL	32.00	178.50000000	26.08122400	.02704517	-.00005667
WL	32.00	183.60000000	26.21838300	.02674405	-.00006139
WL	32.00	188.70000000	26.35397000	.02641900	-.00006610
WL	32.00	193.80000000	26.48782400	.02606998	-.00007081
WL	32.00	198.90000000	26.61984300	.02569680	-.00007552
WL	32.00	204.00000000	26.74988300	.02529968	-.00008023
WL	32.00	209.10000000	26.87583500	.02368971	-.00055117
WL	32.00	214.20000000	26.98744100	.01967792	-.00102211
WL	32.00	219.30000000	27.07247100	.01326388	-.00149305
WL	32.00	224.40000000	27.11864300	.00444864	-.00196399
WL	32.00	229.50000000	27.11375800	-.00676858	-.00243492
PEN UP		6000.00000000			
GO TO		0.00000000	27.11375800		
		3.59374000			
		1.36018930			
		0.00000000			
		0.00000000			
		.01922132			
		-.03714167			
		.01531844			
IDENT.		Z	Y	FIRST DER.	SECOND DER.
FR	0.00	4.00000000	3.59374000	.17002366	0.00000000
PEN DOWN		5000.00000000			

13.26

1.3.6
2.27

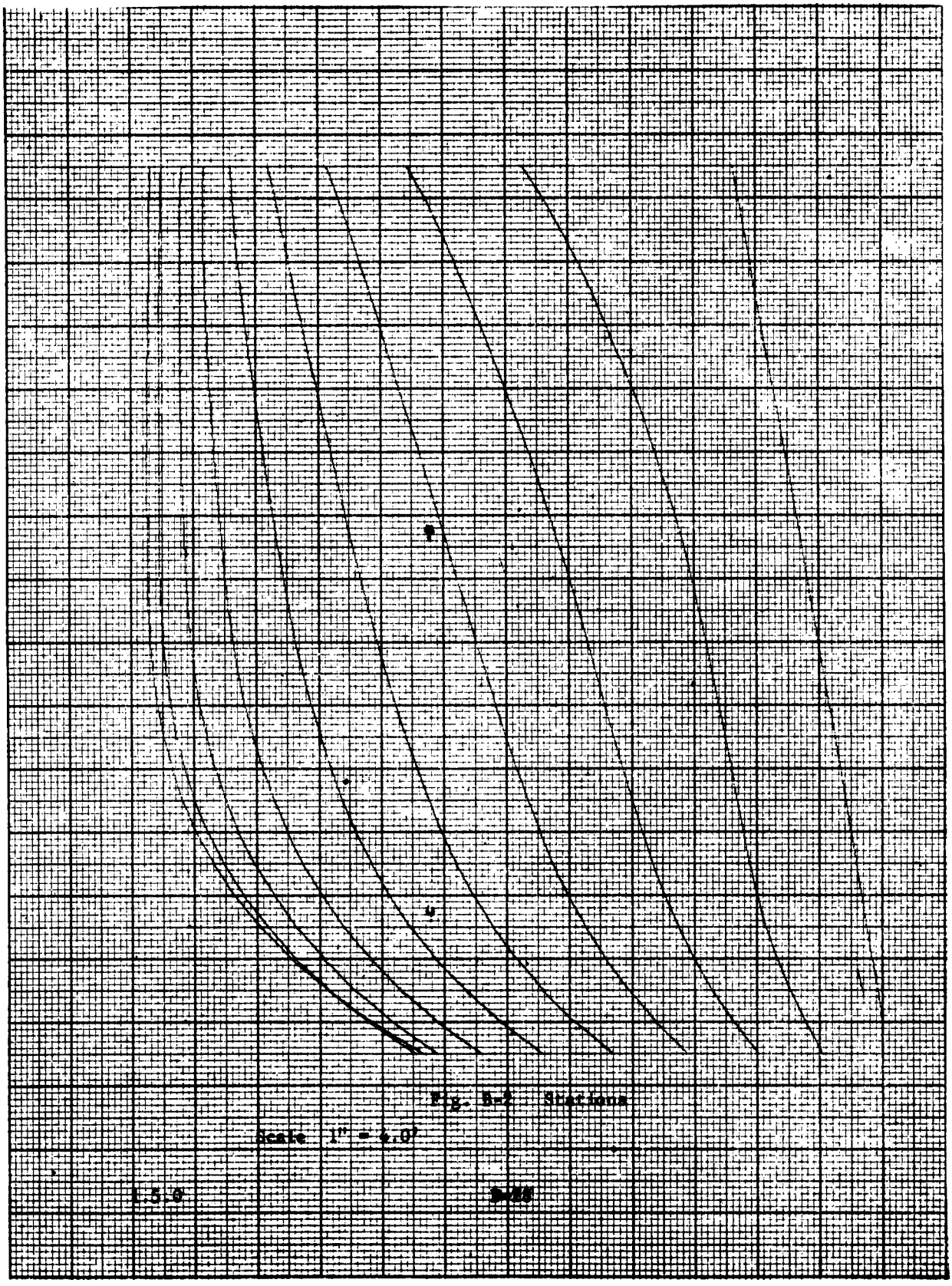

Fig. 5-2 Stations

Scale 1" = 4.0'

1.5.0

3-28

UPPER BOW SECTION OF DLG-26

Project:

To fair the extreme forward section of the DLG-26, including the end profile above Waterline 16, for the purpose of testing the ability of the end profile fairing formulation

Data:

The data was the preliminary offsets of DLG-26 on Stations 0, 1/2, 1, 1-1/2, 2, at Waterlines 16, 20, 24, 28, 32, 36, and 40. The surface was re-faired slightly to eliminate the knuckle. In addition, the offsets which describe the bow profile in this area were used.

Procedure:

The profile of the bow above the sixteen-foot waterline was determined to be a straight line and its equation was found. The equation and the preliminary offsets were entered into SMOG-2. This program punched the LP matrix in the end profile formulation using the χ fit and dual tableau on the IBM-1620. The surface was faired on the IBM-7090 using LP-90 in approximately fifteen minutes. The results were then solved for on the 1620 using GOBACK 2 and plotted as shown.

Results:

The faired surface went exactly through the profile equation. The surface seems to be completely fair but shows a slight hook at the extreme ends of the waterlines. This may require some adjustment of the profile turn.

```
   DLG  26     BOW     PRELIMINARY  OFFSETS
2.0
     .0000    .000000
    1.0000   1.239583
    2.0000   2.697916
    3.0000   4.197916
    4.0000   5.812500
2.5
     .0000    .078000
    1.0000   1.479166
    2.0000   2.979166
    3.0000   4.583333
    4.0000   6.333333
3.0
     .0000    .343749
    1.0000   1.791666
    2.0000   3.447916
    3.0000   5.250000
    4.0000   7.166666
3.5
     .0000    .708333
    1.0000   2.416666
    2.0000   4.322916
    3.0000   6.416666
    4.0000   8.583333
4.0
     .0000   1.343749
    1.0000   3.531250
    2.0000   5.864583
    3.0000   8.250000
    4.0000  10.750000
4.5
     .0000   2.312500
    1.0000   5.145833
    2.0000   8.000000
    3.0000  10.802083
    4.0000  13.510416
5.0
     .0000   3.697916
    1.0000   7.135416
    2.0000  10.52063
    3.0000  13.9
    4.0000  16.68749
  1.0        1.0        0.0        0.0
```

DLG 26 BOW PROFILE 7 X 5 STATION OFFSETS

-.90204234
.90531677
-.64695722
.24262574
-.05059105
-.18186510

IDENT.		Z	Y	1ST DER.	2ND DER.
FR	-.50	29.00781250	0.00000000	0.00000000	0.00000000
PN DOWN		5000.00000000			
FR	-.50	30.00781250	-.01241726	.06133707	.02999484
FR	-.50	31.00781250	.06838928	.09488421	.02510153
FR	-.50	32.00000000	.18265904	.12337569	.02508706
FR	-.50	32.00781250	.18367777	.12359445	.02507798
FR	-.50	33.00781250	.32827435	.15043581	.02404715
FR	-.50	34.00781250	.49886258	.17528991	.02311983
FR	-.50	35.00781250	.69267447	.19844057	.02224496
FR	-.50	36.00781250	.90746497	.22014958	.02148276
FR	-.50	37.00781250	1.14158602	.24079723	.02094894
FR	-.50	38.00781250	1.39423076	.26096504	.02079921
FR	-.50	39.00781250	1.66578873	.28149525	.02121887
FR	-.50	40.00000000	1.95559456	.30272257	.02148540
PN UP		6000.00000000			
GO TO		16.00000000	1.95559456		

-.19857018
.86080928
-.63872110
.30943566
-.12540561
-.31318475

IDENT.		Z	Y	1ST DER.	2ND DER.
FR	0.00	18.80468750	0.00000000	0.00000000	0.00000000
PN DOWN		5000.00000000			
FR	0.00	19.80468750	.06412827	.04685365	.00326694
FR	0.00	20.80468750	.12146806	.04995185	.00150935
FR	0.00	21.80468750	.17999151	.05250239	.00293430
FR	0.00	22.80468750	.24064737	.05682068	.00555439
FR	0.00	23.80468750	.30579310	.06386893	.00870399
FR	0.00	24.00000000	.31929059	.06560569	.00935178
FR	0.00	24.80468750	.37829853	.07360382	.01091786
FR	0.00	25.80468750	.46038739	.08522280	.01289397

FR	0.00	26.80468750	.55399413	.09877085	.01491106
FR	0.00	27.80468750	.66123297	.11438730	.01702527
FR	0.00	28.80468750	.78457756	.13234689	.01934179
FR	0.00	29.80468750	.92697687	.15282182	.02156796
FR	0.00	30.80468750	1.09094210	.17546808	.02372456
FR	0.00	31.80468750	1.27863190	.20027094	.02588116
FR	0.00	32.00000000	1.31824365	.20536699	.02630237
FR	0.00	32.80468750	1.49188414	.22604216	.02508445
FR	0.00	33.80468750	1.73021628	.25036985	.02357092
FR	0.00	34.80468750	1.99211935	.27318401	.02205739
FR	0.00	35.80468750	2.27607980	.29448464	.02054386
FR	0.00	36.80468750	2.58058412	.31427173	.01903032
FR	0.00	37.80468750	2.90411877	.33254530	.01751679
FR	0.00	38.80468750	3.24517021	.34930533	.01600326
FR	0.00	39.80468750	3.60222492	.36455183	.01448973
FR	0.00	40.00000000	3.67370095	.36735299	.01419412
PN UP		6000.00000000			
GO TO		16.00000000	3.67370095		
	1.21408366				
	.77772376				
	-.61082310				
	.43533247				
	-.26726459				
	-.55579327				
IDENT.		Z	Y	1ST DER.	2ND DER.
FR	1.00	16.00000000	1.21408366	.09721547	-.01908822
PN DOWN		5000.00000000			
FR	1.00	17.00000000	1.30260527	.08067802	-.01398666
FR	1.00	18.00000000	1.37714022	.06924213	-.00888511
FR	1.00	19.00000000	1.44279005	.06290779	-.00378356
FR	1.00	20.00000000	1.50465632	.06167500	.00131798
FR	1.00	21.00000000	1.56784057	.06554376	.00641954
FR	1.00	22.00000000	1.63744437	.07451408	.01152109
FR	1.00	23.00000000	1.71856925	.08858595	.01662264
FR	1.00	24.00000000	1.81631679	.10775937	.02172419
FR	1.00	25.00000000	1.93526651	.13046834	.02369374
FR	1.00	26.00000000	2.07790998	.15514685	.02566328
FR	1.00	27.00000000	2.24621674	.18179491	.02763283
FR	1.00	28.00000000	2.44215633	.21041252	.02960237
FR	1.00	29.00000000	2.66769830	.24099967	.03157192
FR	1.00	30.00000000	2.92481220	.27355637	.03354147

FR	1.00	31.00000000	3.21546756	.30808261	.03551101
FR	1.00	32.00000000	3.54163395	.34457840	.03748056
FR	1.00	33.00000000	3.90419535	.37978713	.03293690
FR	1.00	34.00000000	4.29969367	.41045221	.02839324
FR	1.00	35.00000000	4.72358522	.43657363	.02384959
FR	1.00	36.00000000	5.17132637	.45815139	.01930593
FR	1.00	37.00000000	5.63837346	.47518549	.01476227
FR	1.00	38.00000000	6.12018282	.48767594	.01021861
FR	1.00	39.00000000	6.61221079	.49562273	.00567496
FR	1.00	40.00000000	7.10991374	.49902587	.00113130
PN UP		6000.00000000			
GO TO		16.00000000	7.10991374		
	2.67241364				
	.74207394				
	-.49151906				
	.49944512				
	-.34696249				
	-.63815559				
IDENT.		Z	Y	1ST DER.	2ND DER.
FR	2.00	16.00000000	2.67241364	.09275924	-.01535997
PN DOWN		5000.00000000			
FR	2.00	17.00000000	2.75846837	.08032570	-.00950709
FR	2.00	18.00000000	2.83501601	.07374504	-.00365422
FR	2.00	19.00000000	2.90790942	.07301725	.00219864
FR	2.00	20.00000000	2.98300148	.07814234	.00805151
FR	2.00	21.00000000	3.06614506	.08912029	.01390439
FR	2.00	22.00000000	3.16319303	.10595112	.01975726
FR	2.00	23.00000000	3.27999826	.12863482	.02561013
FR	2.00	24.00000000	3.42241364	.15717139	.03146300
FR	2.00	25.00000000	3.59561435	.18952785	.03324991
FR	2.00	26.00000000	3.80206499	.22367122	.03503682
FR	2.00	27.00000000	4.04355245	.25960150	.03682372
FR	2.00	28.00000000	4.32186363	.29731868	.03861063
FR	2.00	29.00000000	4.63878544	.33682276	.04039753
FR	2.00	30.00000000	4.99610480	.37811375	.04218444
FR	2.00	31.00000000	5.39560860	.42119165	.04397135
FR	2.00	32.00000000	5.83908375	.46605645	.04575825
FR	2.00	33.00000000	6.32707075	.50896897	.04006677
FR	2.00	34.00000000	6.85512453	.54619001	.03437529
FR	2.00	35.00000000	7.41755361	.57771956	.02868381
FR	2.00	36.00000000	8.00866651	.60355764	.02299233

```
FR    2.00    37.00000000        8.62277174      .62370423      .01730085
FR    2.00    38.00000000        9.25417782      .63815935      .01160937
FR    2.00    39.00000000        9.89719329      .64692299      .00591789
FR    2.00    40.00000000       10.54612665      .64999514      .00022641
 PN UP      6000.00000000
GO TO         16.00000000       10.54612665
     4.20687052
      .82954215
     -.29917699
      .49583100
     -.37592884
     -.49514040
 IDENT.            Z                   Y          1ST DER.       2ND DER.
FR    3.00    16.00000000        4.20687052      .10369276      -.00934928
 PN DOWN    5000.00000000
FR    3.00    17.00000000        4.30685706      .09724874      -.00353876
FR    3.00    18.00000000        4.40330485      .09661524       .00227175
FR    3.00    19.00000000        4.50202439      .10179226       .00808227
FR    3.00    20.00000000        4.60882622      .11277980       .01389279
FR    3.00    21.00000000        4.72952084      .12957785       .01970331
FR    3.00    22.00000000        4.86991877      .15218643       .02551383
FR    3.00    23.00000000        5.03583055      .18060553       .03132435
FR    3.00    24.00000000        5.23306668      .21483514       .03713487
FR    3.00    25.00000000        5.46670344      .25267257       .03853997
FR    3.00    27.00000000        6.05100202      .33256273       .04135018
FR    3.00    28.00000000        6.40447403      .37461547       .04275528
FR    3.00    29.00000000        6.80070134      .41807331       .04416039
FR    3.00    30.00000000        7.24108903      .46293626       .04556549
FR    3.00    31.00000000        7.72704222      .50920430       .04697059
FR    3.00    32.00000000        8.25996602      .55687745       .04837570
FR    3.00    33.00000000        8.84029844      .60305450       .04397837
FR    3.00    34.00000000        9.46460924      .64483421       .03958105
FR    3.00    35.00000000       10.12850110      .68221661       .03518373
FR    3.00    36.00000000       10.82757669      .71520168       .03078641
FR    3.00    37.00000000       11.55743870      .74378943       .02638908
FR    3.00    38.00000000       12.31368979      .76797985       .02199176
FR    3.00    39.00000000       13.09193264      .78777296       .01759444
FR    3.00    40.00000000       13.88776994      .80316874       .01319711
 PN UP      6000.00000000
GO TO         16.00000000       13.88776994
FR    3.00    26.00000000        5.73888019      .29191510       .03994508
```

DLG 26 BOW PROFILE 7 X 5 WATERLINE OFFSETS

-.19857018
1.40504115
0.00000000
.00761269
-.01522538

IDENT.		X	Y	1ST DER.	2ND DER.
WL	16.00	.13733000	0.00000000	0.00000000	0.00000000
PN	DOWN	5000.00000000			
WL	16.00	.28733000	.17849315	1.35621694	1.25689116
WL	16.00	.43733000	.40745055	1.44832611	.11882215
WL	16.00	.58733000	.62798552	1.41873430	-.07075341
WL	16.00	.73733000	.84046038	1.41745719	.03367838
WL	16.00	.88733000	1.05348353	1.42302280	.04052980
WL	16.00	1.03733000	1.26741861	1.42961613	.04738123
WL	16.00	1.18733000	1.48241976	1.43723717	.05423265
WL	16.00	1.33733000	1.69864115	1.44588593	.06108407
WL	16.00	1.48733000	1.91623692	1.45556239	.06793549
WL	16.00	1.63733000	2.13536125	1.46626657	.07478691
WL	16.00	1.78733000	2.35616828	1.47799847	.08163833
WL	16.00	1.93733000	2.57881218	1.49075807	.08848975
WL	16.00	2.00000000	2.67241364	1.49639343	.09135228
WL	16.00	2.08733000	2.80343695	1.50419704	.08736338
WL	16.00	2.23733000	3.03002366	1.51678770	.08051196
WL	16.00	2.38733000	3.25842188	1.52835063	.07366054
WL	16.00	2.53733000	3.48847746	1.53888586	.06680911
WL	16.00	2.68733000	3.72003625	1.54839337	.05995769
WL	16.00	2.83733000	3.95294409	1.55687317	.05310627
WL	16.00	2.98733000	4.18704682	1.56432525	.04625485
WL	16.00	3.13733000	4.42219028	1.57074962	.03940343
WL	16.00	3.28733000	4.65822032	1.57614628	.03255201
WL	16.00	3.43733000	4.89498278	1.58051523	.02570059
WL	16.00	3.58733000	5.13232350	1.58385646	.01884917
WL	16.00	3.73733000	5.37008833	1.58616998	.01199775
WL	16.00	3.88733000	5.60812311	1.58745579	.00514633
WL	16.00	4.00000000	5.78700354	1.58774571	0.00000000
PN	UP	6000.00000000			
GO	TO	0.00000000	5.78700354		

.11083364
1.37973560
0.00000000

.01408708
-.02156538

IDENT.		X	Y	1ST DER.	2ND DER.
WL	20.00-	.05867000	0.00000000	0.00000000	0.00000000
PN	DOWN	5000.00000000			
WL	20.00	.09133000	.20590749	1.35333122	1.12847537
WL	20.00	.24133000	.43432158	1.42630062	.08559769
WL	20.00	.39133000	.65139250	1.39226567	-.06973164
WL	20.00	.54133000	.85996055	1.39211975	.04575455
WL	20.00	.69133000	1.06934080	1.39993381	.05843292
WL	20.00	.84133000	1.28003578	1.40964963	.07111129
WL	20.00	.99133000	1.49233077	1.42126720	.08378967
WL	20.00	1.14133000	1.70651103	1.43478653	.09646804
WL	20.00	1.29133000	1.92286182	1.45020762	.10914641
WL	20.00	1.44133000	2.14166841	1.46753046	.12182478
WL	20.00	1.59133000	2.36321605	1.48675505	.13450315
WL	20.00	1.74133000	2.58779001	1.50788140	.14718153
WL	20.00	1.89133000	2.81567556	1.53090951	.15985990
WL	20.00	2.00000000	2.98300148	1.54878056	.16904496
WL	20.00	2.04133000	3.04715643	1.55572886	.16719049
WL	20.00	2.19133000	3.28237142	1.58030265	.16046001
WL	20.00	2.34133000	3.52119675	1.60386687	.15372954
WL	20.00	2.49133000	3.76348100	1.62642151	.14699907
WL	20.00	2.64133000	4.00907273	1.64796659	.14026859
WL	20.00	2.79133000	4.25782050	1.66850209	.13353812
WL	20.00	2.94133000	4.50957288	1.68802802	.12680764
WL	20.00	3.09133000	4.76417843	1.70654439	.12007717
WL	20.00	3.24133000	5.02148572	1.72405118	.11334670
WL	20.00	3.39133000	5.28134330	1.74054840	.10661622
WL	20.00	3.54133000	5.54359976	1.75603605	.09988575
WL	20.00	3.69133000	5.80810364	1.77051412	.09315528
WL	20.00	3.84133000	6.07470352	1.78398263	.08642480
WL	20.00	3.99133000	6.34324795	1.79644157	.07969433
WL	20.00	4.00000000	6.35882609	1.79713083	.07930531
PN	UP	6000.00000000			
GO	TO	0.00000000	6.35882609		

.33295366
1.46290751
0.00000000
.02045562
-.04091125

IDENT.	X	Y	1ST DER.	2ND DER.
WL 24.00-	.25467000	0.00000000	0.00000000	0.00000000
PN DOWN	5000.00000000			
WL 24.00-	.10467000	.15631356	1.38892585	1.37971448
WL 24.00	.04533000	.39056295	1.49789454	.13807856
WL 24.00	.19533000	.61864947	1.47095299	-.07068761
WL 24.00	.34533000	.83898190	1.47022568	.04238363
WL 24.00	.49533000	1.06006161	1.47796398	.06079369
WL 24.00	.64533000	1.28250917	1.48846378	.07920375
WL 24.00	.79533000	1.50673882	1.50172510	.09761380
WL 24.00	.94533000	1.73316478	1.51774793	.11602386
WL 24.00	1.09533000	1.96220127	1.53653226	.13443392
WL 24.00	1.24533000	2.19426253	1.55807810	.15284398
WL 24.00	1.39533000	2.42976278	1.58238546	.17125404
WL 24.00	1.54533000	2.66911625	1.60945432	.18966409
WL 24.00	1.69533000	2.91273715	1.63928469	.20807415
WL 24.00	1.84533000	3.16103973	1.67187656	.22648421
WL 24.00	1.99533000	3.41443820	1.70722995	.24489427
WL 24.00	2.00000000	3.42241364	1.70837495	.24546744
WL 24.00	2.14533000	3.67322121	1.74275261	.22763053
WL 24.00	2.29533000	3.93712591	1.77551644	.20922047
WL 24.00	2.44533000	4.20573807	1.80551875	.19081040
WL 24.00	2.59533000	4.47864346	1.83275956	.17240033
WL 24.00	2.74533000	4.75542786	1.85723885	.15399027
WL 24.00	2.89533000	5.03567705	1.87895664	.13558020
WL 24.00	3.04533000	5.31897678	1.89791291	.11717013
WL 24.00	3.19533000	5.60491285	1.91410768	.09876007
WL 24.00	3.34533000	5.89307101	1.92754094	.08035000
WL 24.00	3.49533000	6.18303705	1.93821268	.06193993
WL 24.00	3.64533000	6.47439674	1.94612292	.04352986
WL 24.00	3.79533000	6.76673585	1.95127164	.02511980
WL 24.00	3.94533000	7.05964016	1.95365886	.00670973
WL 24.00	4.00000000	7.16645338	1.95384227	-.00000012
PN UP	6000.00000000			
GO TO	0.00000000	7.16645338		

.68419091
1.73767510
0.00000000
.02029031
-.04058064

IDENT.	X	Y	1ST DER.	2ND DER.

IDENT.	X	Y	1ST DER.	2ND DER.
WL 28.00-	.45067000	0.00000000	0.00000000	0.00000000
PN DOWN	5000.00000000			
WL 28.00-	.30067000	.14011342	1.61990873	1.77416727
WL 28.00-	.15067000	.41309747	1.77175117	.18642552
WL 28.00-	.00067000	.68279892	1.74393054	-.10213816
WL 28.00	.14933000	.94374550	1.73903249	.01817971
WL 28.00	.29933000	1.20487338	1.74312905	.03644099
WL 28.00	.44933000	1.46682118	1.74996479	.05470227
WL 28.00	.59933000	1.72999978	1.75953973	.07296355
WL 28.00	.74933000	1.99482006	1.77185386	.09122483
WL 28.00	.89933000	2.26169289	1.78690718	.10948612
WL 28.00	1.04933000	2.53102917	1.80469969	.12774740
WL 28.00	1.19933000	2.80323976	1.82523140	.14600868
WL 28.00	1.34933000	3.07873555	1.84850230	.16426996
WL 28.00	1.49933000	3.35792741	1.87451239	.18253124
WL 28.00	1.64933000	3.64122623	1.90326167	.20079252
WL 28.00	1.79933000	3.92904288	1.93475015	.21905380
WL 28.00	1.94933000	4.22178824	1.96897782	.23731508
WL 28.00	2.00000000	4.32186363	1.98115885	.24348375
WL 28.00	2.09933000	4.51983341	2.00474351	.23139111
WL 28.00	2.24933000	4.82307961	2.03808258	.21312982
WL 28.00	2.39933000	5.13112123	2.06868246	.19486852
WL 28.00	2.54933000	5.44354739	2.09654314	.17660722
WL 28.00	2.69933000	5.75994721	2.12166463	.15834593
WL 28.00	2.84933000	6.07990982	2.14404692	.14008463
WL 28.00	2.99933000	6.40302433	2.16369002	.12182333
WL 28.00	3.14933000	6.72887987	2.18059392	.10356204
WL 28.00	3.29933000	7.05706555	2.19475863	.08530074
WL 28.00	3.44933000	7.38717050	2.20618415	.06703944
WL 28.00	3.59933000	7.71878384	2.21487047	.04877814
WL 28.00	3.74933000	8.05149468	2.22081759	.03051685
WL 28.00	3.89933000	8.38489216	2.22402552	.01225555
WL 28.00	4.00000000	8.60882621	2.22464239	-.00000021
PN UP	6000.00000000			
GO TO	0.00000000	8.60882621		
	1.31824365			
	2.21104705			
	0.00000000			
	.01234325			
	-.02468653			

```
WL   32.00-     .64667000          0.00000000      0.00000000      0.00000000
 PN DOWN  5000.00000000
WL   32.00-     .49667000           .19001166      2.07180071      2.23071720
WL   32.00-     .34667000           .53920604      2.25935956       .22343280
WL   32.00-     .19667000           .88300859      2.22058051      -.14723676
WL   32.00-     .04667000          1.21505282      2.21112770      -.00345635
WL   32.00      .10333000          1.54672475      2.21144241       .00765256
WL   32.00      .25333000          1.87856887      2.21342347       .01876149
WL   32.00      .40333000          2.21083511      2.21707086       .02987041
WL   32.00      .55333000          2.54377344      2.22238459       .04097934
WL   32.00      .70333000          2.87763381      2.22936467       .05208826
WL   32.00      .85333000          3.21266616      2.23801108       .06319719
WL   32.00     1.00333000          3.54912045      2.24832382       .07430611
WL   32.00     1.15333000          3.88724663      2.26030291       .08541504
WL   32.00     1.30333000          4.22729464      2.27394834       .09652396
WL   32.00     1.45333000          4.56951445      2.28926010       .10763289
WL   32.00     1.60333000          4.91415599      2.30623820       .11874181
WL   32.00     1.75333000          5.26146923      2.32488265       .12985074
WL   32.00     1.90333000          5.61170410      2.34519343       .14095966
WL   32.00     2.00000000          5.83908375      2.35916605       .14811900
WL   32.00     2.05333000          5.96510683      2.36695992       .14416939
WL   32.00     2.20333000          6.32173107      2.38775215       .13306044
WL   32.00     2.35333000          6.68134916      2.40687805       .12195149
WL   32.00     2.50333000          7.04371116      2.42433760       .11084254
WL   32.00     2.65333000          7.40856713      2.44013081       .09973358
WL   32.00     2.80333000          7.77566709      2.45425768       .08862463
WL   32.00     2.95333000          8.14476111      2.46671820       .07751568
WL   32.00     3.10333000          8.51559924      2.47751238       .06640673
WL   32.00     3.25333000          8.88793151      2.48664022       .05529778
WL   32.00     3.40333000          9.26150799      2.49410172       .04418882
WL   32.00     3.55333000          9.63607871      2.49989687       .03307987
WL   32.00     3.70333000         10.01139373      2.50402568       .02197092
WL   32.00     3.85333000         10.38720310      2.50648815       .01086197
WL   32.00     4.00000000         10.75490761      2.50728469      -.00000036
 PN UP    6000.00000000
GO TO        0.00000000         10.75490761
     2.33398630
     2.83734006
     0.00000000
      .00000001
     -.01843006
```

IDENT.	X	Y	1ST DER.	2ND DER.
WL 36.00-	.84267000	0.00000000	0.00000000	0.00000000
PN DOWN	5000.00000000			
WL 36.00-	.69267000	.32047778	2.70562329	2.63983062
WL 36.00-	.54267000	.77692813	2.90827910	.23943323
WL 36.00-	.39267000	1.21944122	2.84860059	-.18759211
WL 36.00-	.24267000	1.64544899	2.83734006	-.00000001
WL 36.00-	.09267000	2.07105000	2.83734006	0.00000000
WL 36.00	.05733000	2.49665101	2.83734006	0.00000000
WL 36.00	.20733000	2.92225202	2.83734006	.00000001
WL 36.00	.35733000	3.34785303	2.83734006	.00000002
WL 36.00	.50733000	3.77345404	2.83734007	.00000003
WL 36.00	.65733000	4.19905505	2.83734007	.00000003
WL 36.00	.80733000	4.62465606	2.83734008	.00000004
WL 36.00	.95733000	5.05025707	2.83734009	.00000005
WL 36.00	1.10733000	5.47585809	2.83734010	.00000006
WL 36.00	1.25733000	5.90145910	2.83734011	.00000007
WL 36.00	1.40733000	6.32706012	2.83734012	.00000008
WL 36.00	1.55733000	6.75266114	2.83734013	.00000009
WL 36.00	1.70733000	7.17826216	2.83734015	.00000010
WL 36.00	1.85733000	7.60386318	2.83734016	.00000011
WL 36.00	2.00000000	8.00866651	2.83734018	.00000012
WL 36.00	2.00733000	8.02946420	2.83733721	-.00081043
WL 36.00	2.15733000	8.45499347	2.83597161	-.01739748
WL 36.00	2.30733000	8.88013129	2.83211796	-.03398453
WL 36.00	2.45733000	9.30450445	2.82577625	-.05057159
WL 36.00	2.60733000	9.72773976	2.81694649	-.06715864
WL 36.00	2.75733000	10.14946400	2.80562866	-.08374569
WL 36.00	2.90733000	10.56930396	2.79182278	-.10033275
WL 36.00	3.05733000	10.98688643	2.77552883	-.11691980
WL 36.00	3.20733000	11.40183821	2.75674683	-.13350685
WL 36.00	3.35733000	11.81378608	2.73547678	-.15009390
WL 36.00	3.50733000	12.22235684	2.71171866	-.16668096
WL 36.00	3.65733000	12.62717728	2.68547249	-.18326801
WL 36.00	3.80733000	13.02787418	2.65673826	-.19985506
WL 36.00	3.95733000	13.42407435	2.62551597	-.21644212
WL 36.00	4.00000000	13.53590665	2.61617971	-.22116058
PN UP	6000.00000000			
GO TO	0.00000000	13.53590665		
	3.67370095			
	3.43621277			

0.00000000
.00000002
-.09456986

IDENT.		X	Y	1ST DER.	2ND DER.
WL	40.00-	1.03867000	0.00000000	0.00000000	0.00000000
PN	DOWN	5000.00000000			
WL	40.00-	.88867000	.53902558	3.38924194	2.70757343
WL	40.00-	.73867000	1.11071425	3.55115066	.13491740
WL	40.00-	.58867000	1.65035508	3.45158707	-.26196210
WL	40.00-	.43867000	2.16633749	3.43621278	-.00000005
WL	40.00-	.28867000	2.68176940	3.43621277	-.00000003
WL	40.00-	.13867000	3.19720132	3.43621277	-.00000001
WL	40.00	.01133000	3.71263324	3.43621277	0.00000000
WL	40.00	.16133000	4.22806515	3.43621277	.00000001
WL	40.00	.31133000	4.74349707	3.43621277	.00000003
WL	40.00	.46133000	5.25892898	3.43621278	.00000005
WL	40.00	.61133000	5.77436090	3.43621279	.00000007
WL	40.00	.76133000	6.28979282	3.43621280	.00000009
WL	40.00	.91133000	6.80522474	3.43621281	.00000010
WL	40.00	1.06133000	7.32065667	3.43621283	.00000012
WL	40.00	1.21133000	7.83608860	3.43621285	.00000014
WL	40.00	1.36133000	8.35152053	3.43621288	.00000016
WL	40.00	1.51133000	8.86695246	3.43621290	.00000018
WL	40.00	1.66133000	9.38238440	3.43621293	.00000019
WL	40.00	1.81133000	9.89781634	3.43621296	.00000021
WL	40.00	1.96133000	10.41324829	3.43621300	.00000023
WL	40.00	2.00000000	10.54612665	3.43621301	.00000024
WL	40.00	2.11133000	10.92854975	3.43269663	-.06317052
WL	40.00	2.26133000	11.44242440	3.41683759	-.14828337
WL	40.00	2.41133000	11.95296268	3.38821162	-.23339623
WL	40.00	2.56133000	12.45824954	3.34681872	-.31850908
WL	40.00	2.71133000	12.95636995	3.29265889	-.40362194
WL	40.00	2.86133000	13.44540886	3.22573213	-.48873480
WL	40.00	3.01133000	13.92345125	3.14603845	-.57384765
WL	40.00	3.16133000	14.38858205	3.05357784	-.65896051
WL	40.00	3.31133000	14.83888625	2.94835030	-.74407336
WL	40.00	3.46133000	15.27244880	2.83035583	-.82918622
WL	40.00	3.61133000	15.68735465	2.69959443	-.91429908
WL	40.00	3.76133000	16.08168878	2.55606610	-.99941193
WL	40.00	3.91133000	16.45353614	2.39977085	-1.08452479
WL	40.00	4.00000000	16.66199443	2.30137541	-1.13483784

```
                                                    16.661994443
                                    6000.00000000
                                       0.00000000
                PN UP
                GO TO
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1.5.0

13.42

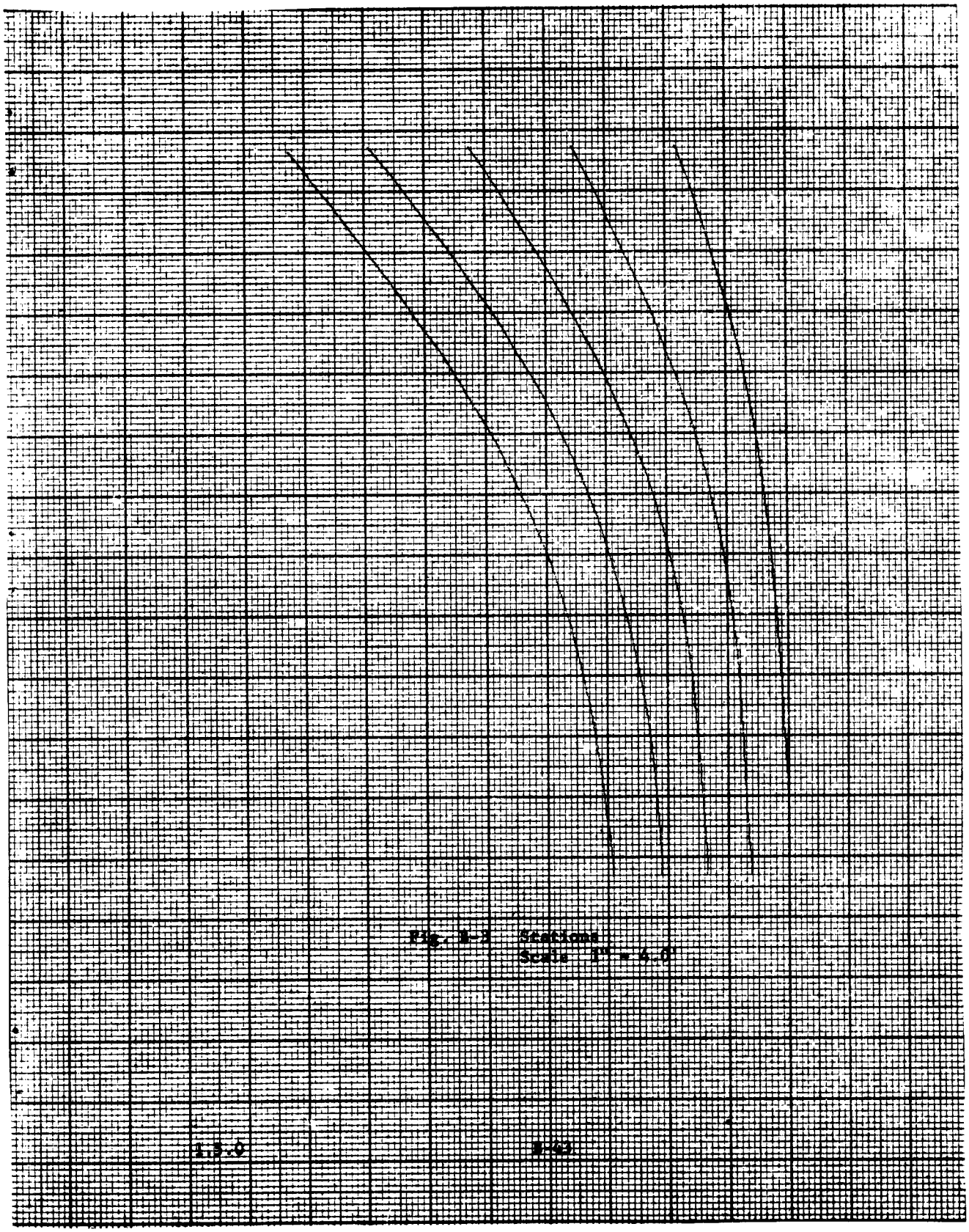

Fig. 3-3 Sections
Scale 1" = 6.0'

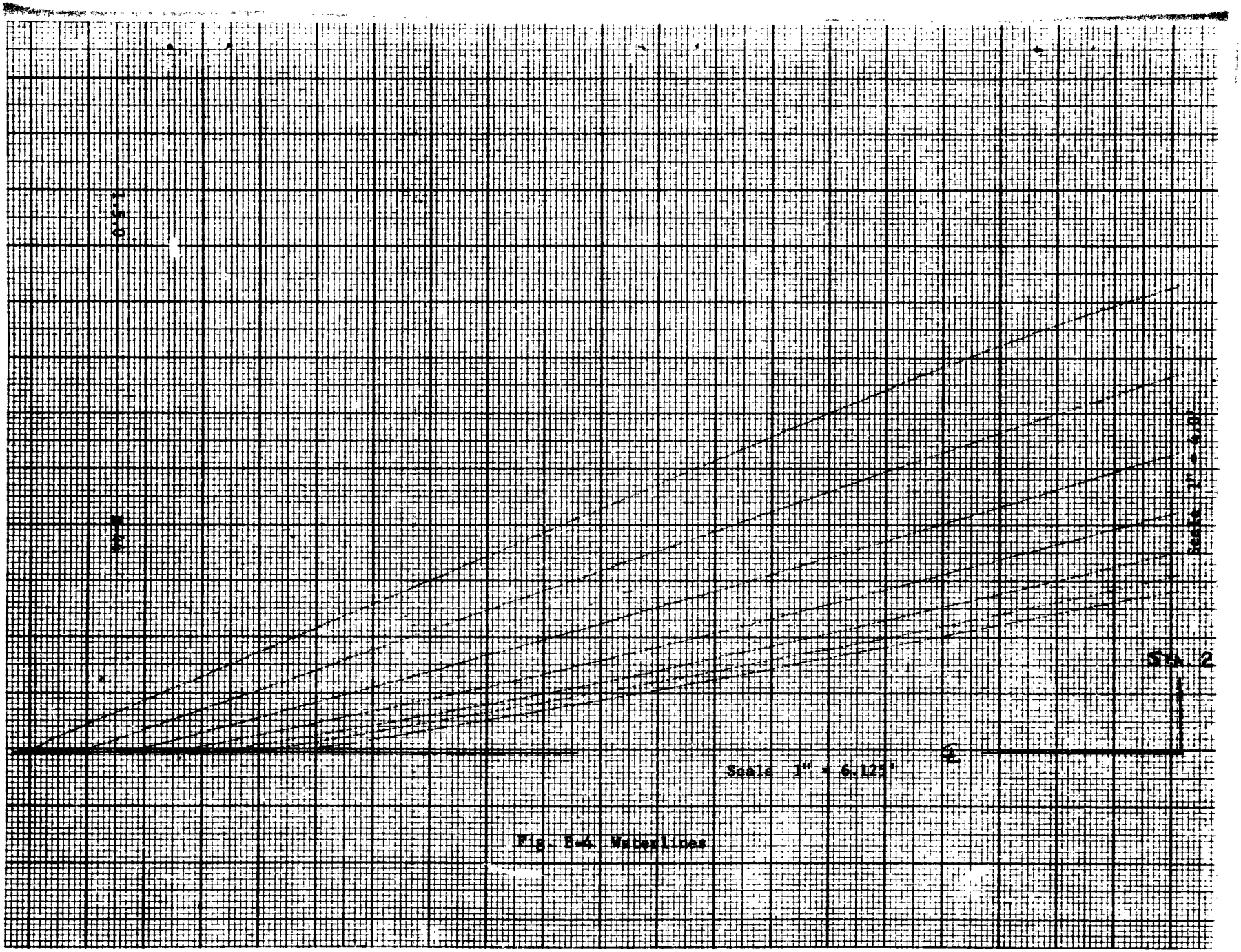

Fig. 5-4 Waterlines

Appendix C

CONTENTS

Appendix C

DLG-26 HULL SURFACES

The surfaces contained in this Appendix are a set of surfaces which extend from the baseline to above the sheer line on the DLG-26 class frigate. These surfaces result from an attempt to more completely fair a ship's hull in order to determine the capabilities and problems associated with the fairing method. The surfaces presented cover representative sections of the ship's hull. The extent of the hull which each covers is shown in the figure.

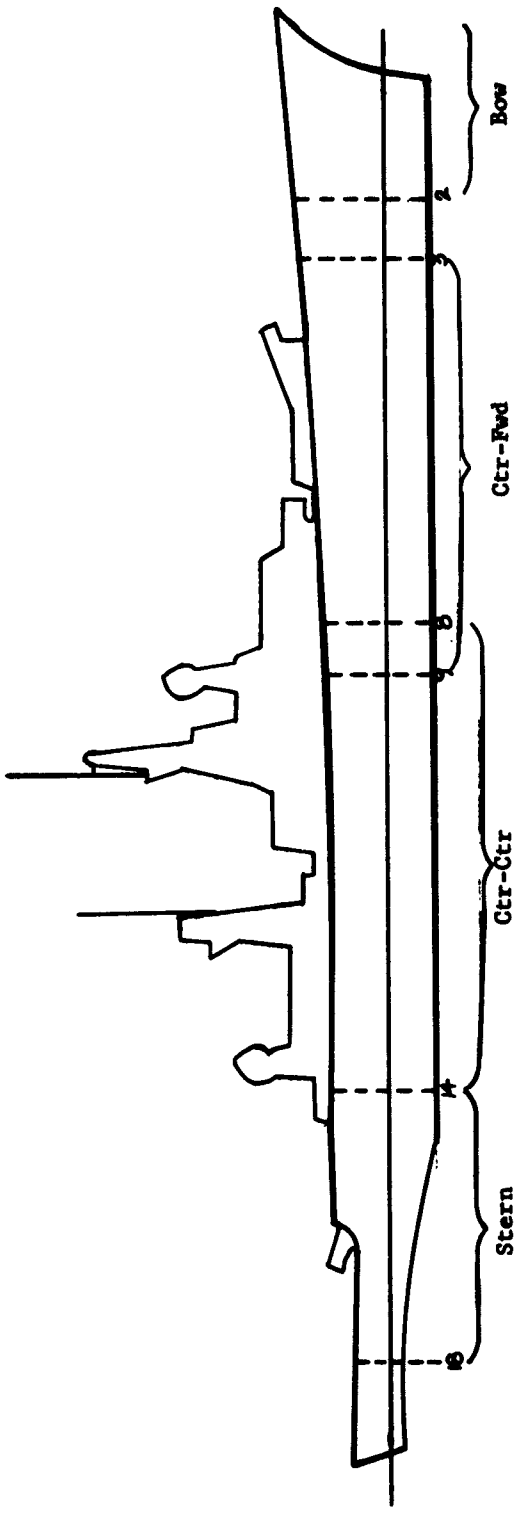

Fig. C-1 Extent of Faired Surfaces, DLG-26

UPPER BOW SECTION OF DLG-26

Project:

To fair the extreme forward section of the DLG-26 including the end profile above Waterline 16, for the purpose of testing the ability of the end profile fairing formulation.

Data:

The data was the preliminary offsets of DLG-26 on Stations 0, 1/2, 1, 1-1/2, 2, at Waterlines 16, 20, 24, 28, 32, 36, and 40. The surface was re-faired slightly to eliminate the knuckle. In addition the offsets which describe the bow profile in this area were used.

Procedure:

The profile of the bow above the sixteen-foot waterline was determined to be a straight line, and its equation was found. The equation and the preliminary offsets were entered into SMOG-2. This program punched the LP matrix in the end profile formulation using the fit and dual tableau on the IBM-1620. The surface was faired on the IBM-7090 using LP-90 in approximately fifteen minutes. The results were then solved for on the 1620 using GOBACK-2 and plotted as shown.

Results:

The faired surface went exactly through the profile equation. The surface is completely fair but shows a slight hook at the extreme ends of the waterlines. This may require some adjustment of the profile turn.

```
*       BOW PROFILE DLG 11X5
    0   -1     .2          3.0
   11    5    0.0        .0001        3.      .33333333
 .8562
 -.26795
 0.0
 -.0786
 .1531
 -.0704
 -.0041
 0.0
 0.0
 0.0
0.0
 0.0
 0.0
      .0000
       .0000    .000000
     1.0000   4.062500
     2.0000   7.500000
     3.0000   4.374999
     4.0000   1.906249
       .5000
       .0000    .000000
     1.0000   1.052083
     2.0000   3.302083
     3.0000   2.958333
     4.0000   3.593749
     1.0000
       .0000    .000000
     1.0000    .916666
     2.0000   2.354166
     3.0000   3.437499
     4.0000   4.729166
     1.5000
       .0000    .000000
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     2.0000   2.458333
     3.0000   3.874999
     4.0000   5.333333
 2.0
       .0000    .000000
     1.0000   1.239583
     2.0000   2.697916
     3.0000   4.197916
     4.0000   5.812500
 2.5
       .0000    .078000
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Profile equations

Preliminary offsets

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    2.0000  2.979166
    3.0000  4.583333
    4.0000  6.333333
3.0
     .0000   .343749
    1.0000  1.791666
    2.0000  3.447916
    3.0000  5.250000
    4.0000  7.166666
3.5
     .0000   .708333
    1.0000  2.416666
    2.0000  4.322916
    3.0000  6.416666
    4.0000  8.583333
4.0
     .0000  1.343749
    1.0000  3.531250
    2.0000  5.864583
    3.0000  8.250000
    4.0000 10.750000
4.5
     .0000  2.312500
    1.0000  5.145833
    2.0000  8.000000
    3.0000 10.802083
    4.0000 13.510416
5.0
     .0000  3.697916
    1.0000  7.135416
    2.0000 10.52063
    3.0000 13.9
    4.0000 16.68749
 1.0        1.0        0.0        0.0
```

BOW DLG 26 STATIONS

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2.89710319
-2.33844915
3.81770188
-1.54632108
.34638152
-.44640127

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3.59267113

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.18523556
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-.13945750
-.29674426

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FR	15.30	12.00000000	3.83647253	.08493223	-.00893989
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FR	20.40	32.00000000	10.80274454	.62121937	.03864115
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PEN UP
GO TO
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1.5.0

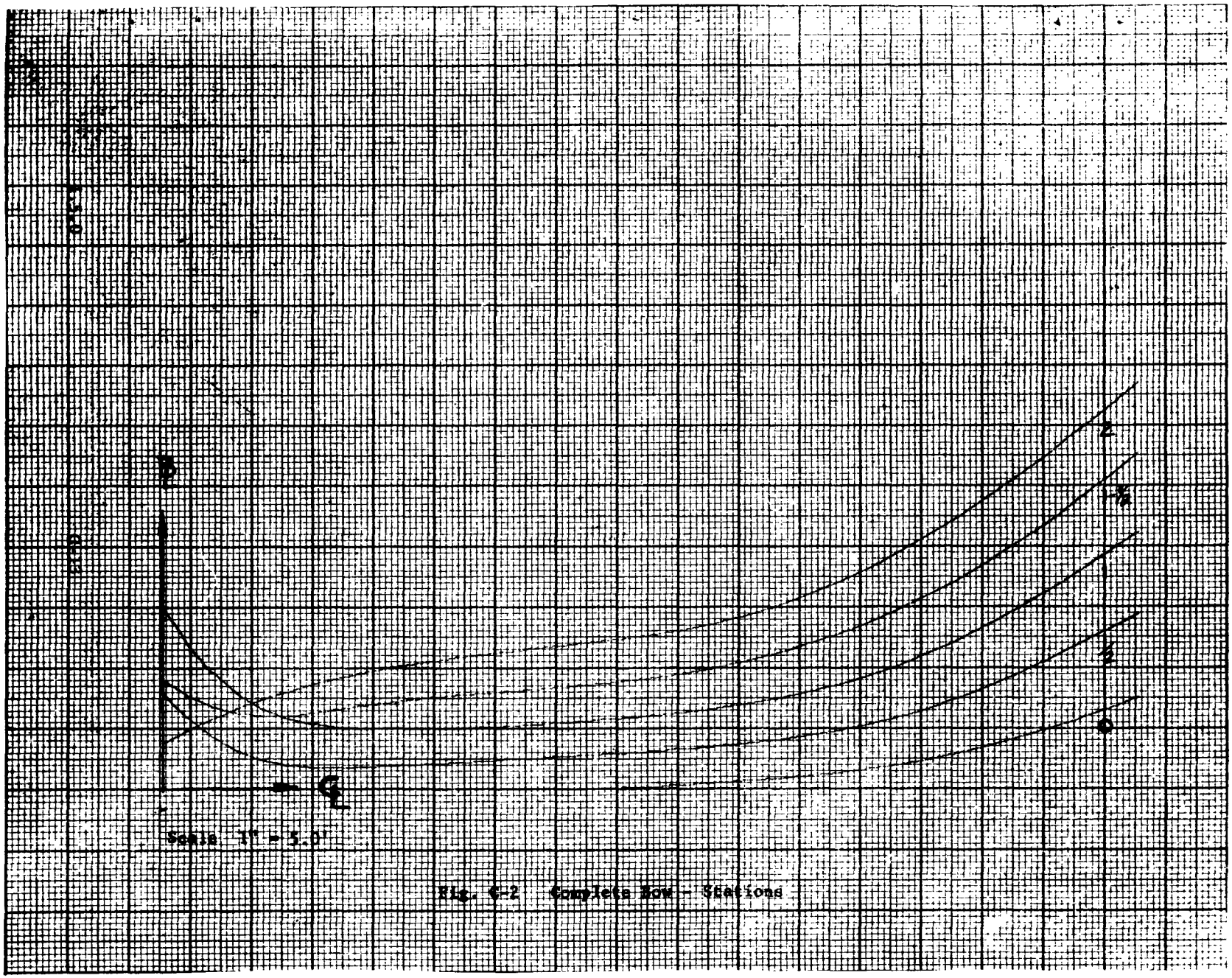

Fig. C-2 Complete Bow - Stations

CENTER - FORWARD SURFACE OF DLG-26

Project:

To fair a section of the DLG-26, extending from Station 3 to Station 9, for the purpose of testing the method on surfaces containing large slopes.

Data:

The data consisted of preliminary offsets for DLG-26 on Stations 4 through 10 at Waterlines from the baseline to the 36 at four-foot intervals.

Procedure:

The data was smoothed and then used with SMOG-1 to punch the LP matrix for the $\wedge$- dual formulation double splined in the X direction only. The surface was faired on the IBM-7090 in fifty minutes. The results were then calculated using GOBACK-1.

Results:

The surface is fair everywhere except in the area influenced by the first cubic interval above the baseline. Because no sign on the second derivative in the vertical direction was required on the baseline, a line of inflection is apparent in part of the surface. This is caused by the high slopes at the baseline and points out a need for curvature control at the first point.

```
*              DLG 26  CENTER SECT  11X7  DUAL NO Z     12-20
    0     0
   11     7    0.      0.0001
    7    11
   0.
  25.5000   1.000000
  51.0000   1.000000
  76.5000   1.000000
 102.0000   1.000000
 127.5000   1.000000
 153.0000   1.000000
 178.5000   1.000000
   2.0000
  25.5000   4.031250
  51.0000   5.562500
  76.5000   7.114583
 102.0000   8.833333
 127.5000  10.666667
 153.0000  12.427083
 178.5000  13.739583
   4.0000
  25.5000   5.666667
  51.0000   7.833333
  76.5000  10.031250
 102.0000  12.354167
 127.5000  14.645833
 153.0000  16.593750
 178.5000  18.020833
   8.0000
  25.5000   7.500000
  51.0000  10.322917
  76.5000  13.302083
 102.0000  16.250000
 127.5000  18.875000
 153.0000  21.000000
 178.5000  22.562500
  12.0000
  25.5000   8.427083
  51.0000  11.781250
  76.5000  15.166667
 102.0000  18.343750
 127.5000  21.072917
 153.0000  23.239583
 178.5000  24.770833
  16.0000
  25.5000   9.250000
  51.0000  12.916667
```

```
 76.5000 16.454167
102.0000 19.666667
127.5000 22.291667
153.0000 24.364583
178.5000 25.770833
 20.0000
 25.5000 10.125000
 51.0000 14.114583
 76.5000 17.697917
102.0000 20.708333
127.5000 23.104167
153.0000 24.885417
178.5000 26.114583
 24.0000
 25.5000 11.375000
 51.0000 15.468750
 76.5000 18.937500
102.0000 21.635417
127.5000 23.718750
153.0000 25.208333
178.5000 26.208333
 28.0000
 25.5000 13.093750
 51.0000 17.000000
 76.5000 20.229167
102.0000 22.520833
127.5000 24.229167
153.0000 25.416667
178.5000 26.229167
 32.0000
 25.5000 15.260417
 51.0000 18.916667
 76.5000 21.625000
102.0000 23.354167
127.5000 24.572917
153.0000 25.510417
178.5000 26.208333
  36.00000
 25.5     18.10416
 51.000   21.18749
 76.5     23.03125
 102.0    24.16666
127.5     25.01041
153.0     25.69791
178.5     26.22916
 51.0     6.0        25.50        0.0
```

```
*            DLG 26  CENTER SECT  11X7  STATIONS
     1.00000000                                                          453
    17.35508300                                                          454
   -36.87489300                                                          455
    36.87526200                                                          456
   -39.49271000                                                          457
     3.44852000                                                          458
     -.35360598                                                          459
     -.47687956                                                          460
      .30977842                                                          461
     -.45391099                                                          462
      .28177280                                                          463
     -.02369321                                                          464
     -.53470284                                                          465
 IDENT.          Z                    Y          FIRST DER.    SECOND DER.  466
FR    3.00      .00000000          1.00000000    2.89251380   -2.04860510  467
PEN DOWN  5000.00000000                                                  468
FR    3.00      .50000000          2.21152110    1.99625030   -1.53644870  469
FR    3.00      .99999996          3.03892990    1.35606500   -1.02429230  470
FR    3.00     1.49999990          3.61026580     .97195803    -.51213600  471
FR    3.00     1.99999990          4.05356750     .84392933     .00002038  472
FR    3.00     2.00000000          4.05356770     .84392916     .00002047  473
FR    3.00     2.49999990          4.47402020     .83485125    -.03633300  474
FR    3.00     2.99999990          4.88538950     .80759625    -.07268627  475
FR    3.00     3.49999990          5.27858760     .76216500    -.10903972  476
FR    3.00     3.99999980          5.64452430     .69855666    -.14539316  477
FR    3.00     4.00000000          5.64452410     .69855650    -.14539302  478
FR    3.00     4.49999980          5.97610890     .62874585    -.13385054  479
FR    3.00     4.99999980          6.27423230     .56470608    -.12230779  480
FR    3.00     5.49999980          6.54177710     .50643788    -.11076529  481
FR    3.00     5.99999980          6.78162990     .45394256    -.09922252  482
FR    3.00     6.49999920          6.99667480     .40721560    -.08768005  483
FR    3.00     6.99999900          7.18980670     .36626100    -.07613755  484
FR    3.00     7.49999880          7.36389970     .33107991    -.06459480  485
FR    3.00     7.99999860          7.52184690     .30166905    -.05305202  486
FR    3.00     7.99999980          7.52184390     .30166618    -.05305191  487
FR    3.00     8.49999840          7.66632460     .27679795    -.04642045  488
FR    3.00     8.99999820          7.79920360     .25524428    -.03978917  489
FR    3.00     9.49999800          7.92211320     .23700636    -.03315761  490
FR    3.00     9.99999780          8.03675050     .22208926    -.02652603  491
FR    3.00    10.49999800          8.14474690     .21048293    -.01989475  492
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FR	3.00	10.99999700	8.24778640	.20219400	-.01326347	493
FR	3.00	11.49999700	8.34749520	.19721913	-.00663161	494
FR	3.00	11.99999700	8.44553960	.19556001	-.00000033	495
FR	3.00	12.00000000	8.44555900	.19556240	-.00000036	496
FR	3.00	12.49999700	8.54333030	.19556433	.00000766	497
FR	3.00	12.99999700	8.64110260	.19557105	.00001620	498
FR	3.00	13.49999600	8.73890880	.19558200	.00002415	499
FR	3.00	13.99999600	8.83667660	.19559186	.00003211	500
FR	3.00	14.49999600	8.93449860	.19561598	.00004065	501
FR	3.00	14.99999600	9.03230420	.19563750	.00004860	502
FR	3.00	15.49999600	9.13012450	.19565975	.00005656	503
FR	3.00	15.99999500	9.22796890	.19569278	.00006482	504
FR	3.00	16.00000000	9.22798540	.19569371	.00006483	505
FR	3.00	16.49999500	9.32599730	.19680213	.00437549	506
FR	3.00	16.99999500	9.42512500	.20007030	.00868592	507
FR	3.00	17.49999500	9.52642360	.20549211	.01299663	508
FR	3.00	17.99999500	9.63094210	.21306608	.01730737	509
FR	3.00	18.49999400	9.73990960	.22280018	.02161780	510
FR	3.00	18.99999400	9.85426400	.23468126	.02592851	511
FR	3.00	19.49999400	9.97494720	.24873786	.03023897	512
FR	3.00	19.99999400	10.10324900	.26493160	.03454968	513
FR	3.00	20.00000000	10.10321900	.26492295	.03454990	514
FR	3.00	20.49999400	10.24005100	.28171443	.03255615	515
FR	3.00	20.99999300	10.38475500	.29749375	.03056229	516
FR	3.00	21.49999300	10.53725400	.31226978	.02856896	517
FR	3.00	21.99999300	10.69683300	.32605896	.02657508	518
FR	3.00	22.49999300	10.86319000	.33884455	.02458123	519
FR	3.00	22.99999300	11.03549900	.35064336	.02258761	520
FR	3.00	23.49999200	11.21356700	.36142096	.02059401	521
FR	3.00	23.99999200	11.39688000	.37124713	.01860012	522
FR	3.00	24.00000000	11.39682400	.37122805	.01860013	523
FR	3.00	24.49999200	11.58477900	.38103006	.02051999	524
FR	3.00	24.99999200	11.77809400	.39176818	.02243991	525
FR	3.00	25.49999200	11.97666900	.40345661	.02435954	526
FR	3.00	25.99999100	12.18147800	.41610023	.02627946	527
FR	3.00	26.49999100	12.39290700	.42974755	.02819909	528
FR	3.00	26.99999100	12.61149100	.44433003	.03011898	529
FR	3.00	27.49999100	12.83732200	.45986613	.03204364	530
FR	3.00	27.99999100	13.07157200	.47635728	.03396131	531
FR	3.00	28.00000000	13.07129200	.47637406	.03395923	532
FR	3.00	28.49999000	13.31398900	.49373496	.03555271	533

FR	3.00	28.99999000	13.56306100	.51188330	.03714134	534
FR	3.00	29.49999000	13.82598200	.53087071	.03873550	535
FR	3.00	29.99999000	14.09615900	.55064881	.04032411	536
FR	3.00	30.49999000	14.37673700	.57119768	.04191552	537
FR	3.00	30.99998900	14.66753200	.59256871	.04350415	538
FR	3.00	31.49998900	14.96842800	.61471236	.04509553	539
FR	3.00	31.99998900	15.28027900	.63765978	.04668692	540
FR	3.00	32.00000000	15.28223700	.63763513	.04668775	541
FR	3.00	32.49998900	15.60681000	.65954185	.04085206	542
FR	3.00	32.99998900	15.93125200	.67849386	.03501420	543
FR	3.00	33.49998800	16.28489200	.69454770	.02917918	544
FR	3.00	33.99998800	16.65521900	.70767031	.02334416	545
FR	3.00	34.49998800	16.99188000	.71788713	.01750913	546
FR	3.00	34.99998800	17.35250900	.72519673	.01167136	547
FR	3.00	35.49998800	17.71640600	.72957971	.00583634	548
FR	3.00	35.99998700	18.08130400	.73102258	.00000131	549
FR	3.00	36.00000000	18.08281300	.73102054	.00000200	550
PEN UP		5000.00000000				551
GO TO		.00000000	18.08281300			552
	1.00000000					553
	4.39872100					554
	45.92569600					555
	-72.43547000					556
	98.94140000					557
	-27.25251900					558
	1.28852000					559
	-.17099304					560
	-.54481860					561
	.35757905					562
	-.13868668					563
	-.16955630					564
	1.19735640					565
IDENT.		Z	Y	FIRST DER.	SECOND DER.	566
FR	4.00	.00000000	1.00000000	1.05979680	* 2.55141640	567
PEN DOWN		5000.00000000				568
FR	4.00	.50000000	1.80690290	2.08399000	1.54539600	569
FR	4.00	.99999996	3.00015480	2.60513280	.53937569	570
FR	4.00	1.49999990	4.32825080	2.62336560	-.46664472	571
FR	4.00	1.99999990	5.53968540	2.13853810	-1.47266500	572
FR	4.00	2.00000000	5.53968550	2.13953810	-1.47266520	573
FR	4.00	2.49999990	6.44021070	1.49424690	-1.10449960	574

FR	4.00	2.99999990	7.06461190	1.03403860	-.73633388	575
FR	4.00	3.49999990	7.50493000	.75791300	-.36816805	576
FR	4.00	3.99999980	7.85320670	.66587116	-.00000250	577
FR	4.00	4.00000000	7.85320620	.66587033	-.00000250	578
FR	4.00	4.49999980	8.18570980	.66328271	-.01034819	579
FR	4.00	4.99999980	8.51562660	.65552225	-.02069400	580
FR	4.00	5.49999980	8.84037090	.64258961	-.03103952	581
FR	4.00	5.99999980	9.15735400	.62448150	-.04138502	582
FR	4.00	6.49999920	9.46400000	.60120633	-.05173069	583
FR	4.00	6.99999900	9.75769700	.57275400	-.06207636	584
FR	4.00	7.49999880	10.03587600	.53912950	-.07242200	585
FR	4.00	7.99999860	10.29595800	.50033100	-.08276777	586
FR	4.00	7.99999980	10.29596000	.50033233	-.08276777	587
FR	4.00	8.49999840	10.53609100	.46083363	-.07522005	588
FR	4.00	8.99999820	10.75741000	.42511243	-.06767228	589
FR	4.00	9.49999800	10.96184700	.39316406	-.06012478	590
FR	4.00	9.99999780	11.15122100	.36498851	-.05257701	591
FR	4.00	10.49999800	11.32745300	.34058563	-.04502924	592
FR	4.00	10.99999700	11.49244200	.31995640	-.03748175	593
FR	4.00	11.49999700	11.64804400	.30310466	-.02993398	594
FR	4.00	11.99999700	11.79615300	.29002460	-.02238648	595
FR	4.00	12.00000000	11.79615800	.29002170	-.02238638	596
FR	4.00	12.49999700	11.93860300	.28012746	-.01721221	597
FR	4.00	12.99999700	12.07675300	.27279788	-.01203823	598
FR	4.00	13.49999600	12.21181100	.26808250	-.00686453	599
FR	4.00	13.99999600	12.34525400	.26593133	-.00169888	600
FR	4.00	14.49999600	12.47807300	.26638266	.00347508	601
FR	4.00	14.99999600	12.61201700	.26941996	.00864878	602
FR	4.00	15.49999600	12.74800400	.27502808	.01381999	603
FR	4.00	15.99999500	12.88740600	.28322371	.01899368	604
FR	4.00	16.00000000	12.88748100	.28321985	.01899355	605
FR	4.00	16.49999500	13.03133600	.29213191	.01659803	606
FR	4.00	16.99999500	13.17950700	.29984248	.01420510	607
FR	4.00	17.49999500	13.33102800	.30634048	.01181189	608
FR	4.00	17.99999500	13.48550500	.31165758	.00941614	609
FR	4.00	18.49999400	13.64247700	.31576210	.00702320	610
FR	4.00	18.99999400	13.80110300	.31868736	.00462721	611
FR	4.00	19.49999400	13.96094800	.32038338	.00223428	612
FR	4.00	19.99999400	14.12137300	.32091515	-.00016173	613
FR	4.00	20.00000000	14.12138700	.32091040	-.00016051	614
FR	4.00	20.49999400	14.28183800	.32140611	.00213317	615

FR	4.00	20.99999300	14.44297000	.32302863	.00442814	616
FR	4.00	21.49999300	14.60508800	.32583085	.00672002	617
FR	4.00	21.99999300	14.76906300	.32979778	.00901499	618
FR	4.00	22.49999300	14.93508400	.33484425	.01130718	619
FR	4.00	22.99999300	15.10427000	.34109558	.01360186	620
FR	4.00	23.49999200	15.27633100	.34846813	.01589680	621
FR	4.00	23.99999200	15.45257900	.35697056	.01818899	622
FR	4.00	24.00000000	15.45270800	.35696895	.01818863	623
FR	4.00	24.49999200	15.63344100	.36615115	.01855751	624
FR	4.00	24.99999200	15.81868500	.37551153	.01892349	625
FR	4.00	25.49999200	16.00899300	.38509681	.01929195	626
FR	4.00	25.99999100	16.20434000	.39483893	.01966072	627
FR	4.00	26.49999100	16.40590500	.40473741	.02002670	628
FR	4.00	26.99999100	16.60866700	.41485886	.02039519	629
FR	4.00	27.49999100	16.81890600	.42513746	.02076115	630
FR	4.00	27.99999100	17.03359600	.43563946	.02112991	631
FR	4.00	28.00000000	17.03414800	.43556086	.02113150	632
FR	4.00	28.49999000	17.25421900	.44570868	.01914349	633
FR	4.00	28.99999000	17.47996800	.45475776	.01715731	634
FR	4.00	29.49999000	17.70862200	.46285215	.01516804	635
FR	4.00	29.99999000	17.94247800	.46990908	.01317908	636
FR	4.00	30.49999000	18.17882400	.47607845	.01119289	637
FR	4.00	30.99998900	18.41775100	.48112686	.00920643	638
FR	4.00	31.49998900	18.65884900	.48522151	.00722022	639
FR	4.00	31.99998900	18.90260100	.48839525	.00523128	640
FR	4.00	32.00000000	18.90338600	.48836793	.00523146	641
FR	4.00	32.49998900	19.14779200	.49460461	.01987164	642
FR	4.00	32.99998900	19.39958600	.50827573	.03451544	643
FR	4.00	33.49998800	19.65771700	.52914018	.04915891	644
FR	4.00	33.99998800	19.92952900	.55734898	.06380270	645
FR	4.00	34.49998800	20.21619700	.59295196	.07844369	646
FR	4.00	34.99998800	20.52453000	.63581568	.09308444	647
FR	4.00	35.49998800	20.85280100	.68605705	.10772820	648
FR	4.00	35.99998700	21.21143900	.74357511	.12237200	649
FR	4.00	36.00000000	21.20957500	.74350213	.12237123	650
PEN UP		6000.00000000				651
GO TO		.00000000	21.20957500			652
	1.00000000					653
	36.06414000					654
	-79.14455000					655
	78.27756000					656

		-82.39828000				657
		6.04407000				658
		-1.62188600				659
		-.03267765				660
		-.31832840				661
		.17062610				662
		-.12237409				663
		-.06873381				664
		.06958540				665
IDENT.		Z	Y	FIRST DER.	SECOND DER.	666
FR	5.00	.00000000	1.00000000	6.01069000	-4.39691940	667
PEN DOWN		5000.00000000				668
FR	5.00	.50000000	3.50102960	4.08402730	-3.30973110	669
FR	5.00	.99999996	5.17462620	2.70095880	-2.22254300	670
FR	5.00	1.49999990	6.29258670	1.86148460	-1.13535440	671
FR	5.00	1.99999990	7.12671050	1.56560450	-.04816638	672
FR	5.00	2.00000000	7.12671080	1.56560430	-.04816611	673
FR	5.00	2.49999990	7.90110650	1.52721330	-.10539841	674
FR	5.00	2.99999990	8.64915380	1.46020660	-.16263061	675
FR	5.00	3.49999990	9.35654500	1.36458210	-.21986277	676
FR	5.00	3.99999980	10.00896700	1.24034310	-.27709500	677
FR	5.00	4.00000000	10.00896800	1.24034280	-.27709500	678
FR	5.00	4.49999980	10.59561500	1.10847360	-.25038183	679
FR	5.00	4.99999980	11.11966700	.98996155	-.22366891	680
FR	5.00	5.49999980	11.58780200	.88480531	-.19695547	681
FR	5.00	5.99999980	12.00669900	.79300660	-.17024225	682
FR	5.00	6.49999920	12.38302400	.71456203	-.14352936	683
FR	5.00	6.99999900	12.72347200	.64947511	-.11681622	684
FR	5.00	7.49999880	13.03472700	.59774588	-.09010305	685
FR	5.00	7.99999860	13.32345300	.55937265	-.06338988	686
FR	5.00	7.99999980	13.32345500	.55937180	-.06338997	687
FR	5.00	8.49999840	13.59539200	.52872565	-.05920285	688
FR	5.00	8.99999820	13.85252400	.50016988	-.05501587	689
FR	5.00	9.49999800	14.09589700	.47370518	-.05082891	690
FR	5.00	9.99999780	14.32657500	.44933858	-.04664193	691
FR	5.00	10.49999800	14.54560300	.42706820	-.04245495	692
FR	5.00	10.99999700	14.75398500	.40688756	-.03826769	693
FR	5.00	11.49999700	14.95282700	.38879620	-.03408102	694
FR	5.00	11.99999700	15.14315300	.37280623	-.02989376	695
FR	5.00	12.00000000	15.14314900	.37280485	-.02989395	696
FR	5.00	12.49999700	15.32596000	.35878738	-.02616063	697

FR	5.00	12.99999700	15.50223600	.34665783	-.02242806	698
FR	5.00	13.49999600	15.67294500	.33637113	-.01869382	699
FR	5.00	13.99999600	15.83887400	.32796688	-.01496239	700
FR	5.00	14.49999600	16.00118000	.32140868	-.01122872	701
FR	5.00	14.99999600	16.16072100	.31672151	-.00749393	702
FR	5.00	15.49999600	16.31815900	.31391705	-.00376190	703
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FR	5.00	23.49999200	18.75826300	.30307101	.00623988	721
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FR	8.00	6.99999900	20.05051000	1.01222280	-.13830194	984

FR	8.00	7.49999880	20.53837400	.93731550	-.16131694	985
FR	8.00	7.99999860	20.98590800	.85090500	-.18433250	986
FR	8.00	7.99999980	20.98591000	.85090333	-.18433250	987
FR	8.00	8.49999840	21.38897800	.76270833	-.16844564	988
FR	8.00	8.99999820	21.74994400	.68245876	-.15255842	989
FR	8.00	9.49999800	22.07277600	.61015315	-.13667148	990
FR	8.00	9.99999780	22.36141300	.54578696	-.12078481	991
FR	8.00	10.49999800	22.61987300	.48936190	-.10489788	992
FR	8.00	10.99999700	22.85210900	.44088791	-.08901066	993
FR	8.00	11.49999700	23.06208600	.40035505	-.07312400	994
FR	8.00	11.99999700	23.25378200	.36775995	-.05723702	995
FR	8.00	12.00000000	23.25378400	.36776088	-.05723680	996
FR	8.00	12.49999700	23.43065600	.33995310	-.05401468	997
FR	8.00	12.99999700	23.59402200	.31374820	-.05079268	998
FR	8.00	13.49999600	23.74465200	.28915191	-.04757041	999
FR	8.00	13.99999600	23.88345300	.26618428	-.04434759	000
FR	8.00	14.49999600	24.01110600	.24480190	-.04112726	001
FR	8.00	14.99999600	24.12853100	.22506005	-.03790444	002
FR	8.00	15.49999600	24.23638600	.20690985	-.03468133	003
FR	8.00	15.99999500	24.33574000	.19036998	-.03146101	004
FR	8.00	16.00000000	24.33574000	.19037056	-.03145828	005
FR	8.00	16.49999500	24.42710000	.17511876	-.02951918	006
FR	8.00	16.99999500	24.51108800	.16083537	-.02757708	007
FR	8.00	17.49999500	24.58787200	.14752019	-.02563805	008
FR	8.00	17.99999500	24.65869300	.13518818	-.02369595	009
FR	8.00	18.49999400	24.72343900	.12384437	-.02175413	010
FR	8.00	18.99999400	24.78263800	.11343357	-.01981482	011
FR	8.00	19.49999400	24.83708200	.10400916	-.01787300	012
FR	8.00	19.99999400	24.88687800	.09556475	-.01593091	013
FR	8.00	20.00000000	24.88682700	.09555229	-.01593310	014
FR	8.00	20.49999400	24.93281000	.08805162	-.01413190	015
FR	8.00	20.99999300	24.97506500	.08141302	-.01233040	016
FR	8.00	21.49999300	25.01432100	.07573259	-.01052861	017
FR	8.00	21.99999300	25.05108000	.07092674	-.00872989	018
FR	8.00	22.49999300	25.08544700	.06697875	-.00692811	019
FR	8.00	22.99999300	25.11832700	.06400544	-.00512660	020
FR	8.00	23.49999200	25.14961700	.06187335	-.00332758	021
FR	8.00	23.99999200	25.18012900	.06064954	-.00152582	022
FR	8.00	24.00000000	25.18029300	.06065670	-.00152515	023
FR	8.00	24.49999200	25.21021900	.05943421	-.00332399	024
FR	8.00	24.99999200	25.23932800	.05731131	-.00511944	025

FR	8.00	25.49999200	25.26737300	.05431432	-.00691489	026
FR	8.00	25.99999100	25.29385700	.05042657	-.00871593	027
FR	8.00	26.49999100	25.31748300	.04554790	-.01051137	028
FR	8.00	26.99999100	25.33904900	.03991130	-.01230680	029
FR	8.00	27.49999100	25.35737300	.03326812	-.01410505	030
FR	8.00	27.99999100	25.37185100	.02578438	-.01590051	031
FR	8.00	28.00000000	25.37225900	.02576082	-.01590290	032
FR	8.00	28.49999000	25.38314000	.01828278	-.01406630	033
FR	8.00	28.99999000	25.39100300	.01173977	-.01223480	034
FR	8.00	29.49999000	25.39484900	.00602005	-.01040333	035
FR	8.00	29.99999000	25.39688100	.00129177	-.00856906	036
FR	8.00	30.49999000	25.39652700	-.00251374	-.00674035	037
FR	8.00	30.99998900	25.39510300	-.00546130	-.00490607	038
FR	8.00	31.49998900	25.39141000	-.00743374	-.00307183	039
FR	8.00	31.99998900	25.38855700	-.00848226	-.00124033	040
FR	8.00	32.00000000	25.38783600	-.00851838	-.00123980	041
FR	8.00	32.49998900	25.38353900	-.00577570	.01218674	042
FR	8.00	32.99998900	25.38329200	.00366801	.02561127	043
FR	8.00	33.49998800	25.38871600	.01983183	.03903582	044
FR	8.00	33.99998800	25.40502600	.04271666	.05246316	045
FR	8.00	34.49998800	25.43264400	.07227243	.06589049	046
FR	8.00	34.99998800	25.47736600	.10861453	.07931502	047
FR	8.00	35.49998800	25.54240500	.15157756	.09274235	048
FR	8.00	35.99998700	25.63076200	.20134560	.10616968	049
FR	8.00	36.00000000	25.63024900	.20131470	.10616780	050
PEN UP		6000.00000000				051
GO TO		.00000000	25.63024900			052
	1.00000000					053
	87.68152700					054
	-222.34281000					055
	222.35564000					056
	-230.44186000					057
	11.22215000					058
	-2.81541000					059
	-.21233630					060
	.30957680					061
	-.36421070					062
	-.12318330					063
	.13419310					064
	.03699559					065
IDENT.		Z	Y	FIRST DER.	SECOND DER.	066

FR	9.00	.00000000	1.00000000	14.61358700	-12.35237800	067
PEN	DOWN	5000.00000000				068
FR	9.00	.50000000	6.89142470	9.20946680	-9.26410550	069
FR	9.00	.99999996	10.46682300	5.34948260	-6.17583330	070
FR	9.00	1.49999990	12.49826300	3.03363300	-3.08756050	071
FR	9.00	1.99999990	13.75781200	2.26192160	.00071194	072
FR	9.00	2.00000000	13.75781200	2.26192100	.00071222	073
FR	9.00	2.49999990	14.88418400	2.23420000	-.11159638	074
FR	9.00	2.99999990	15.98265700	2.15032600	-.22390527	075
FR	9.00	3.49999990	17.02515000	2.01029630	-.33621388	076
FR	9.00	3.99999980	17.98359600	1.81411060	-.44852277	077
FR	9.00	4.00000000	17.98359300	1.81411110	-.44852305	078
FR	9.00	4.49999980	18.83639700	1.60073910	-.40496825	079
FR	9.00	4.99999980	19.58795600	1.40914480	-.36141422	080
FR	9.00	5.49999980	20.24918100	1.23932710	-.31786019	081
FR	9.00	5.99999980	20.83091600	1.09128600	-.27430616	082
FR	9.00	6.49999920	21.34405700	.96501801	-.23075358	083
FR	9.00	6.99999900	21.79955800	.86053318	-.18719602	084
FR	9.00	7.49999880	22.20825300	.77782150	-.14364122	085
FR	9.00	7.99999860	22.58102800	.71689316	-.10008641	086
FR	9.00	7.99999980	22.58102200	.71689800	-.10008883	087
FR	9.00	8.49999840	22.92714100	.66796400	-.09563719	088
FR	9.00	8.99999820	23.24935000	.62127321	-.09118531	089
FR	9.00	9.49999800	23.54874500	.57679415	-.08673341	090
FR	9.00	9.99999780	23.82651600	.53454365	-.08228428	091
FR	9.00	10.49999800	24.08362400	.49448986	-.07783238	092
FR	9.00	10.99999700	24.32135700	.45669965	-.07337772	093
FR	9.00	11.49999700	24.54074600	.42112231	-.06892582	094
FR	9.00	11.99999700	24.74293200	.38777538	-.06447669	095
FR	9.00	12.00000000	24.74296200	.38776560	-.06447602	096
FR	9.00	12.49999700	24.92879300	.35592140	-.06297390	097
FR	9.00	12.99999700	25.09885000	.32480625	-.06147101	098
FR	9.00	13.49999600	25.25366300	.29444676	-.05997107	099
FR	9.00	13.99999600	25.39337700	.26484260	-.05846838	100
FR	9.00	14.49999600	25.51855000	.23597693	-.05696566	101
FR	9.00	14.99999600	25.62953300	.20785055	-.05545991	102
FR	9.00	15.49999600	25.72657900	.18049676	-.05395997	103
FR	9.00	15.99999500	25.81023900	.15391543	-.05245728	104
FR	9.00	16.00000000	25.81042200	.15392766	-.05245900	105
FR	9.00	16.49999500	25.88095000	.12914611	-.04665464	106
FR	9.00	16.99999500	25.93985100	.10728407	-.04085225	107

FR	9.00	17.49999500	25.98868500	.08830914	-.03505266	108
FR	9.00	17.99999500	26.02855500	.07224133	-.02925026	109
FR	9.00	18.49999400	26.06111300	.05902746	-.02344762	110
FR	9.00	18.99999400	26.08848100	.04875238	-.01764522	111
FR	9.00	19.49999400	26.11078200	.04139958	-.01184285	112
FR	9.00	19.99999400	26.12994600	.03693556	-.00604046	113
FR	9.00	20.00000000	26.13006100	.03695981	-.00604175	114
FR	9.00	20.49999400	26.14798500	.03411240	-.00529623	115
FR	9.00	20.99999300	26.16417700	.03166561	-.00455509	116
FR	9.00	21.49999300	26.18040000	.02956151	-.00381118	117
FR	9.00	21.99999300	26.19427800	.02783381	-.00306701	118
FR	9.00	22.49999300	26.20722300	.02649933	-.00232588	119
FR	9.00	22.99999300	26.22093900	.02545403	-.00157921	120
FR	9.00	23.49999200	26.23414800	.02493862	-.00083530	121
FR	9.00	23.99999200	26.24648900	.02483257	-.00009113	122
FR	9.00	24.00000000	26.24591900	.02472409	-.00009236	123
FR	9.00	24.49999200	26.25793500	.02450522	-.00106085	124
FR	9.00	24.99999200	26.27044700	.02375379	-.00202781	125
FR	9.00	25.49999200	26.28178200	.02248463	-.00299452	126
FR	9.00	25.99999100	26.29083900	.02072139	-.00396148	127
FR	9.00	26.49999100	26.30246400	.01863393	-.00493125	128
FR	9.00	26.99999100	26.31139400	.01570641	-.00589544	129
FR	9.00	27.49999100	26.31765000	.01262365	-.00686215	130
FR	9.00	27.99999100	26.32477100	.00887816	-.00783189	131
FR	9.00	28.00000000	26.32343700	.00893005	-.00783268	132
FR	9.00	28.49999000	26.32796000	.00527089	-.00693512	133
FR	9.00	28.99999000	26.32726900	.00209361	-.00603829	134
FR	9.00	29.49999000	26.32908100	-.00064784	-.00514119	135
FR	9.00	29.99999000	26.32672600	-.00294512	-.00424716	136
FR	9.00	30.49999000	26.32540500	-.00497993	-.00334756	137
FR	9.00	30.99998900	26.32348900	-.00657558	-.00245048	138
FR	9.00	31.49998900	26.32120200	-.00757196	-.00155643	139
FR	9.00	31.99998900	26.31488200	-.00796763	-.00065963	140
FR	9.00	32.00000000	26.31503100	-.00806053	-.00065998	141
FR	9.00	32.49998900	26.31199400	-.00795890	.00075101	142
FR	9.00	32.99998900	26.30776200	-.00726425	.00216194	143
FR	9.00	33.49998800	26.30358300	-.00570174	.00356980	144
FR	9.00	33.99998800	26.30018900	-.00361985	.00498045	145
FR	9.00	34.49998800	26.30156500	-.00051021	.00639386	146
FR	9.00	34.99998800	26.29954800	.00262544	.00780479	147
FR	9.00	35.49998800	26.30334200	.00695561	.00921265	148

	FR	9.00	35.99998700	26.30649000	.01181346	.01062330	149
	FR	9.00	36.00000000	26.30907400	.01207516	.01062334	150
	PEN UP		6000.00000000				151
	GO TO		.00000000	26.30907400			152

1.5.0

```
*              DLG 26  CENTER SECT  11X7  WATERLINES
     1.00000000                                                          002
      .00000000                                                          003
      .00000000                                                          004
      .00000000                                                          005
      .00000000                                                          006
      .00000000                                                          007
 IDENT.          X                Y          FIRST DER.    SECOND DER.  008
WL     .00    3.00000000      1.00000000      .00000000     .00000000    009
PEN DOWN   5000.00000000                                                 010
WL     .00    3.20000000      1.00000000      .00000000     .00000000    011
WL     .00    3.40000000      1.00000000      .00000000     .00000000    012
WL     .00    3.60000000      1.00000000      .00000000     .00000000    013
WL     .00    3.80000000      1.00000000      .00000000     .00000000    014
WL     .00    4.00000000      1.00000000      .00000000     .00000000    015
WL     .00    4.20000000      1.00000000      .00000000     .00000000    016
WL     .00    4.40000000      1.00000000      .00000000     .00000000    017
WL     .00    4.60000000      1.00000000      .00000000     .00000000    018
WL     .00    4.80000000      1.00000000      .00000000     .00000000    019
WL     .00    5.00000000      1.00000000      .00000000     .00000000    020
WL     .00    5.20000000      1.00000000      .00000000     .00000000    021
WL     .00    5.40000000      1.00000000      .00000000     .00000000    022
WL     .00    5.60000000      1.00000000      .00000000     .00000000    023
WL     .00    5.80000000      1.00000000      .00000000     .00000000    024
WL     .00    6.00000000      1.00000000      .00000000     .00000000    025
WL     .00    6.20000000      1.00000000      .00000000     .00000000    026
WL     .00    6.40000000      1.00000000      .00000000     .00000000    027
WL     .00    6.60000000      1.00000000      .00000000     .00000000    028
WL     .00    6.80000000      1.00000000      .00000000     .00000000    029
WL     .00    7.00000000      1.00000000      .00000000     .00000000    030
WL     .00    7.20000000      1.00000000      .00000000     .00000000    031
WL     .00    7.40000000      1.00000000      .00000000     .00000000    032
WL     .00    7.60000000      1.00000000      .00000000     .00000000    033
WL     .00    7.80000000      1.00000000      .00000000     .00000000    034
WL     .00    8.00000000      1.00000000      .00000000     .00000000    035
WL     .00    8.20000000      1.00000000      .00000000     .00000000    036
WL     .00    8.40000000      1.00000000      .00000000     .00000000    037
WL     .00    8.60000000      1.00000000      .00000000     .00000000    038
WL     .00    8.80000000      1.00000000      .00000000     .00000000    039
WL     .00    9.00000000      1.00000000      .00000000     .00000000    040
PEN UP     6000.00000000                                                 041
```

C-35

1.5.0

GO TO 3.00000000 1.00000000 042
4.05356770 043
2.91016700 044
.08526700 045
.07770300 046
-.18201400 047
-.43579200 048

IDENT.	X	Y	FIRST DER.	SECOND DER.	
WL 2.00	3.00000000	4.05356770	1.45508350	.04263350	049
PEN DOWN	5000.00000000				050
WL 2.00	3.20000000	4.34551470	1.46477570	.05428895	051
WL 2.00	3.40000000	4.63963330	1.47679900	.06594440	052
WL 2.00	3.60000000	4.93638970	1.49115350	.07759985	053
WL 2.00	3.80000000	5.23625010	1.50783900	.08925530	054
WL 2.00	4.00000000	5.53968070	1.52685560	.10091075	055
WL 2.00	4.20000000	5.84714780	1.54820330	.11256620	056
WL 2.00	4.40000000	6.15911750	1.57188210	.12422165	057
WL 2.00	4.60000000	6.47605600	1.59789190	.13587710	058
WL 2.00	4.80000000	6.79842960	1.62623290	.14753255	059
WL 2.00	5.00000000	7.12670470	1.65690500	.15918800	060
WL 2.00	5.20000000	7.46116500	1.68717790	.14354135	061
WL 2.00	5.40000000	7.80136710	1.71432150	.12789470	062
WL 2.00	5.60000000	8.14668510	1.73833580	.11224805	063
WL 2.00	5.80000000	8.49649300	1.75922070	.09660140	064
WL 2.00	6.00000000	8.85016480	1.77697630	.08095475	065
WL 2.00	6.20000000	9.20707480	1.79160260	.06530810	066
WL 2.00	6.40000000	9.56659720	1.80309960	.04966145	067
WL 2.00	6.60000000	9.92810600	1.81146720	.03401480	068
WL 2.00	6.80000000	10.29097500	1.81670550	.01836815	069
WL 2.00	7.00000000	10.65457900	1.81881450	.00272150	070
WL 2.00	7.20000000	11.01785700	1.81125730	-.07829395	071
WL 2.00	7.40000000	11.37800200	1.78749700	-.15930940	072
WL 2.00	7.60000000	11.73177500	1.74753350	-.24032485	073
WL 2.00	7.80000000	12.07593500	1.69136700	-.32134030	074
WL 2.00	8.00000000	12.40724100	1.61899740	-.40235575	075
WL 2.00	8.20000000	12.72245200	1.53042470	-.48337120	076
WL 2.00	8.40000000	13.01833200	1.42564890	-.56438665	077
WL 2.00	8.60000000	13.29163400	1.30467000	-.64540210	078
WL 2.00	8.80000000	13.53911900	1.16748800	-.72641755	079
WL 2.00	9.00000000	13.75754800	1.01410300	-.80743300	080
PEN UP	6000.00000000				081

082

C.36

GO TO		3.00000000	13.75754800			083
	5.64452410					084
	4.68439100					085
	-.74822800					086
	.42832200					087
	-.82304900					088
	.03928900					089
IDENT.		X	Y	FIRST DER.	SECOND DER.	090
WL	4.00	3.00000000	5.64452410	2.34219550	-.37411400	091
PEN DOWN		5000.00000000				092
WL	4.00	3.20000000	6.10590930	2.27379750	-.30986570	093
WL	4.00	3.40000000	6.55489970	2.21824920	-.24561740	094
WL	4.00	3.60000000	6.99406550	2.17555050	-.18136910	095
WL	4.00	3.80000000	7.42597670	2.14570150	-.11712080	096
WL	4.00	4.00000000	7.85320280	2.12870220	-.05287250	097
WL	4.00	4.20000000	8.27831420	2.12455250	.01137580	098
WL	4.00	4.40000000	8.70388050	2.13325250	.07562410	099
WL	4.00	4.60000000	9.13247180	2.15480220	.13987240	100
WL	4.00	4.80000000	9.56665810	2.18920150	.20412070	101
WL	4.00	5.00000000	10.00900900	2.23645050	.26836900	102
WL	4.00	5.20000000	10.46127200	2.28420340	.20915995	103
WL	4.00	5.40000000	10.92190100	2.32011450	.14995090	104
WL	4.00	5.60000000	11.38852800	2.34418370	.09074185	105
WL	4.00	5.80000000	11.85878500	2.35641120	.03153280	106
WL	4.00	6.00000000	12.33030200	2.35679690	-.02767625	107
WL	4.00	6.20000000	12.80071400	2.34534070	-.08688530	108
WL	4.00	6.40000000	13.26765100	2.32204270	-.14609435	109
WL	4.00	6.60000000	13.72874100	2.28690290	-.20530340	110
WL	4.00	6.80000000	14.18162200	2.23992140	-.26451245	111
WL	4.00	7.00000000	14.62392100	2.18109800	-.32372150	112
WL	4.00	7.20000000	15.05331100	2.11102210	-.37703720	113
WL	4.00	7.40000000	15.46761900	2.03028300	-.43035290	114
WL	4.00	7.60000000	15.86471200	1.93888090	-.48366860	115
WL	4.00	7.80000000	16.24246000	1.83681570	-.53698430	116
WL	4.00	8.00000000	16.59872900	1.72408720	-.59030000	117
WL	4.00	8.20000000	16.93139500	1.60069570	-.64361570	118
WL	4.00	8.40000000	17.23829600	1.46664090	-.69693140	119
WL	4.00	8.60000000	17.51733000	1.32192200	-.75024710	120
WL	4.00	8.80000000	17.76635400	1.16654210	-.80356280	121
WL	4.00	9.00000000	17.98323600	1.00049800	-.85687850	122
PEN UP		6000.00000000				123

```
GO TO          3.00000000      17.98323600                                    124
     7.52184390                                                               125
     5.05787700                                                               126
     1.21735000                                                               127
     -.47362700                                                               128
      .16680100                                                               129
      .37652400                                                               130
 IDENT.              X                Y          FIRST DER.     SECOND DER.   131
WL    8.00      3.00000000       7.52184390      2.52893850       .60867500   132
PEN DOWN     5000.00000000                                                    133
WL    8.00      3.20000000       8.03933150      2.64356910       .53763095   134
WL    8.00      3.40000000       8.57832430      2.74399090       .46658690   135
WL    8.00      3.60000000       9.13598060      2.83020390       .39554285   136
WL    8.00      3.80000000       9.70945860      2.90220800       .32449880   137
WL    8.00      4.00000000      10.29591600      2.96000340       .25345475   138
WL    8.00      4.20000000      10.89251300      3.00358990       .18241070   139
WL    8.00      4.40000000      11.49640400      3.03296770       .11136665   140
WL    8.00      4.60000000      12.10475200      3.04813660       .04032260   141
WL    8.00      4.80000000      12.71471200      3.04909670      -.03072145   142
WL    8.00      5.00000000      13.32344300      3.03584800      -.10176550   143
WL    8.00      5.20000000      13.92827000      3.01089250      -.14778940   144
WL    8.00      5.40000000      14.52718700      2.97673220      -.19381330   145
WL    8.00      5.60000000      15.11835000      2.93336710      -.23983720   146
WL    8.00      5.80000000      15.69992000      2.88079730      -.28586110   147
WL    8.00      6.00000000      16.27005500      2.81902270      -.33188500   148
WL    8.00      6.20000000      16.82691600      2.74804330      -.37790890   149
WL    8.00      6.40000000      17.36865800      2.66785910      -.42393280   150
WL    8.00      6.60000000      17.89344600      2.57847020      -.46995670   151
WL    8.00      6.80000000      18.39943300      2.47987650      -.51598060   152
WL    8.00      7.00000000      18.88478200      2.37207800      -.56200450   153
WL    8.00      7.20000000      19.34802700      2.26072260      -.55154980   154
WL    8.00      7.40000000      19.78921000      2.15145800      -.54109510   155
WL    8.00      7.60000000      20.20874900      2.04428470      -.53064040   156
WL    8.00      7.80000000      20.60706300      1.93920210      -.52018570   157
WL    8.00      8.00000000      20.98457000      1.83621040      -.50973100   158
WL    8.00      8.20000000      21.34168600      1.73530980      -.49927630   159
WL    8.00      8.40000000      21.67883200      1.63649990      -.48882160   160
WL    8.00      8.60000000      21.99642600      1.53978080      -.47836690   161
WL    8.00      8.80000000      22.29488500      1.44515300      -.46791220   162
WL    8.00      9.00000000      22.57462700      1.35261600      -.45745750   163
PEN UP       6000.00000000                                                    164
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GO TO        3.00000000      22.57462700                                    165
     8.44555900                                                             166
     6.59258210                                                             167
      .32863440                                                             168
     -.22329350                                                             169
     -.07733570                                                             170
      .19862320                                                             171
 IDENT.          X                Y          FIRST DER.     SECOND DER.    172
WL  12.00    3.00000000       8.44555900     3.29629100      .16431720     173
PEN DOWN  5000.00000000                                                     174
WL  12.00    3.20000000       9.10788030     3.32580500      .13082317     175
WL  12.00    3.40000000       9.77543440     3.34862030      .09732915     176
WL  12.00    3.60000000      10.44688200     3.36473670      .06383512     177
WL  12.00    3.80000000      11.12088200     3.37415440      .03034110     178
WL  12.00    4.00000000      11.79609700     3.37687320     -.00315292     179
WL  12.00    4.20000000      12.47118500     3.37289320     -.03664695     180
WL  12.00    4.40000000      13.14480700     3.36221440     -.07014097     181
WL  12.00    4.60000000      13.81562400     3.34483680     -.10363500     182
WL  12.00    4.80000000      14.48229500     3.32076040     -.13712902     183
WL  12.00    5.00000000      15.14348200     3.28998520     -.17062305     184
WL  12.00    5.20000000      15.79776600     3.25135110     -.21571743     185
WL  12.00    5.40000000      16.44342100     3.20369820     -.26081180     186
WL  12.00    5.60000000      17.07864400     3.14702640     -.30590617     187
WL  12.00    5.80000000      17.70163000     3.08133570     -.35100055     188
WL  12.00    6.00000000      18.31057800     3.00662620     -.39609495     189
WL  12.00    6.20000000      18.90368000     2.92289780     -.44118932     190
WL  12.00    6.40000000      19.47913500     2.83015050     -.48628370     191
WL  12.00    6.60000000      20.03514000     2.72838430     -.53137807     192
WL  12.00    6.80000000      20.56988800     2.61759920     -.57647245     193
WL  12.00    7.00000000      21.08157700     2.49779530     -.62156685     194
WL  12.00    7.20000000      21.56860200     2.37195180     -.63686775     195
WL  12.00    7.40000000      22.03015300     2.24304820     -.65216865     196
WL  12.00    7.60000000      22.46561800     2.11108420     -.66746955     197
WL  12.00    7.80000000      22.87438300     1.97606030     -.68277045     198
WL  12.00    8.00000000      23.25583900     1.83797610     -.69807135     199
WL  12.00    8.20000000      23.60936900     1.69683180     -.71337225     200
WL  12.00    8.40000000      23.93436600     1.55262720     -.72867315     201
WL  12.00    8.60000000      24.23021800     1.40536250     -.74397405     202
WL  12.00    8.80000000      24.49630800     1.25503750     -.75927492     203
WL  12.00    9.00000000      24.73202800     1.10165260     -.77457585     204
PEN UP    6000.00000000                                                     205
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GO TO          3.00000000        24.73202800                                  206
      9.22798540                                                               207
      7.14345760                                                               208
       .59605475                                                               209
      -.49219207                                                               210
       .35397352                                                               211
       .22964735                                                               212
 IDENT.              X                    Y          FIRST DER.    SECOND DER.  213
WL   16.00      3.00000000         9.22798540      3.57172880      .29802737    214
PEN DOWN     5000.00000000                                                      215
WL   16.00      3.20000000         9.94779950      3.62395140      .22419857    216
WL   16.00      3.40000000        10.67658100      3.66140820      .15036977    217
WL   16.00      3.60000000        11.41137700      3.68409930      .07654095    218
WL   16.00      3.80000000        12.14923600      3.69202460      .00271212    219
WL   16.00      4.00000000        12.88720300      3.68518410     -.07111667    220
WL   16.00      4.20000000        13.62232600      3.66357790     -.14494547    221
WL   16.00      4.40000000        14.35165000      3.62720590     -.21877430    222
WL   16.00      4.60000000        15.07222400      3.57606820     -.29260310    223
WL   16.00      4.80000000        15.78109300      3.51016470     -.36643192    224
WL   16.00      5.00000000        16.47530500      3.42949540     -.44026072    225
WL   16.00      5.20000000        17.15226000      3.33937000     -.46099350    226
WL   16.00      5.40000000        17.81077600      3.24509800     -.48172630    227
WL   16.00      5.60000000        18.45002300      3.14667950     -.50245907    228
WL   16.00      5.80000000        19.06917200      3.04411440     -.52319187    229
WL   16.00      6.00000000        19.66739200      2.93740270     -.54392462    230
WL   16.00      6.20000000        20.24385700      2.82654460     -.56465740    231
WL   16.00      6.40000000        20.79773400      2.71153980     -.58539020    232
WL   16.00      6.60000000        21.32819600      2.59238840     -.60612297    233
WL   16.00      6.80000000        21.83441200      2.46909060     -.62685577    234
WL   16.00      7.00000000        22.31555600      2.34164620     -.64758855    235
WL   16.00      7.20000000        22.77102400      2.21349990     -.63387422    236
WL   16.00      7.40000000        23.20113900      2.08809650     -.62015992    237
WL   16.00      7.60000000        23.60644500      1.96543590     -.60644560    238
WL   16.00      7.80000000        23.98749500      1.84551800     -.59273130    239
WL   16.00      8.00000000        24.34483500      1.72834340     -.57901695    240
WL   16.00      8.20000000        24.67901600      1.61391140     -.56530262    241
WL   16.00      8.40000000        24.99058400      1.50222250     -.55158832    242
WL   16.00      8.60000000        25.28008700      1.39327580     -.53787397    243
WL   16.00      8.80000000        25.54807600      1.28707270     -.52415967    244
WL   16.00      9.00000000        25.79509900      1.18361220     -.51044535    245
PEN UP       6000.00000000                                                      246
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GO TO          3.00000000      25.79509900                                  247
     10.10321900                                                            248
      8.30684060                                                            249
      -.38831670                                                            250
      -.30955471                                                            251
       .38878396                                                            252
      -.20733644                                                            253
 IDENT.            X                    Y          FIRST DER.    SECOND DER.  254
WL   20.00     3.00000000      10.10321900      4.15342030     -.19415835    255
PEN DOWN   5000.00000000                                                    256
WL   20.00     3.20000000      10.92971100      4.10994530     -.24059155    257
WL   20.00     3.40000000      11.74657900      4.05718370     -.28702475    258
WL   20.00     3.60000000      12.55196600      3.99513540     -.33345795    259
WL   20.00     3.80000000      13.34401400      3.92380050     -.37989117    260
WL   20.00     4.00000000      14.12086600      3.84317890     -.42632437    261
WL   20.00     4.20000000      14.88066600      3.75327080     -.47275760    262
WL   20.00     4.40000000      15.62155500      3.65407590     -.51919080    263
WL   20.00     4.60000000      16.34167700      3.54559440     -.56562400    264
WL   20.00     4.80000000      17.03917400      3.42782630     -.61205722    265
WL   20.00     5.00000000      17.71218900      3.30077150     -.65849042    266
WL   20.00     5.20000000      18.35925100      3.17026190     -.64660605    267
WL   20.00     5.40000000      18.98045100      3.04212910     -.63472167    268
WL   20.00     5.60000000      19.57626300      2.91637320     -.62283727    269
WL   20.00     5.80000000      20.14716000      2.79299420     -.61095287    270
WL   20.00     6.00000000      20.69361800      2.67199200     -.59906850    271
WL   20.00     6.20000000      21.21611500      2.55336680     -.58718410    272
WL   20.00     6.40000000      21.71512300      2.43711840     -.57529970    273
WL   20.00     6.60000000      22.19112000      2.32324700     -.56341532    274
WL   20.00     6.80000000      22.64458100      2.21175230     -.55153095    275
WL   20.00     7.00000000      23.07598000      2.10263450     -.53964655    276
WL   20.00     7.20000000      23.48558600      1.99278370     -.55886260    277
WL   20.00     7.40000000      23.87283800      1.87908950     -.57807870    278
WL   20.00     7.60000000      24.23696500      1.76155220     -.59729477    279
WL   20.00     7.80000000      24.57720200      1.64017160     -.61651085    280
WL   20.00     8.00000000      24.89277800      1.51494790     -.63572695    281
WL   20.00     8.20000000      25.18292700      1.38588100     -.65494300    282
WL   20.00     8.40000000      25.44687500      1.25297060     -.67415907    283
WL   20.00     8.60000000      25.68385700      1.11621720     -.69337515    284
WL   20.00     8.80000000      25.89310600       .97562060     -.71259125    285
WL   20.00     9.00000000      26.07384900       .83118075     -.73180732    286
PEN UP     6000.00000000                                                    287
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GO TO          3.00000000      26.07384900                                  288
     11.39682400                                                            289
      8.57899370                                                            290
      -.81249200                                                            291
      -.25244503                                                            292
       .41435178                                                            293
      -.15279513                                                            294
 IDENT.              X                Y          FIRST DER.    SECOND DER.  295
WL   24.00      3.00000000      11.39682400      4.28949680     -.40624600   296
PEN  DOWN    5000.00000000                                                  297
WL   24.00      3.20000000      12.24634700      4.20446100     -.44411275   298
WL   24.00      3.40000000      13.07810400      4.11185170     -.48197950   299
WL   24.00      3.60000000      13.89058200      4.01166920     -.51984625   300
WL   24.00      3.80000000      14.68226700      3.90391320     -.55771300   301
WL   24.00      4.00000000      15.45164200      3.78858400     -.59557977   302
WL   24.00      4.20000000      16.19719500      3.66568130     -.63344652   303
WL   24.00      4.40000000      16.91741000      3.53520540     -.67131327   304
WL   24.00      4.60000000      17.61077400      3.39715600     -.70918005   305
WL   24.00      4.80000000      18.27576800      3.25153330     -.74704680   306
WL   24.00      5.00000000      18.91088000      3.09833730     -.78491355   307
WL   24.00      5.20000000      19.51501200      2.94378320     -.76062755   308
WL   24.00      5.40000000      20.08871700      2.79408630     -.73634152   309
WL   24.00      5.60000000      20.63297100      2.64924650     -.71205552   310
WL   24.00      5.80000000      21.14874000      2.50926410     -.68776952   311
WL   24.00      6.00000000      21.63700000      2.37413880     -.66348347   312
WL   24.00      6.20000000      22.09872000      2.24387070     -.63919747   313
WL   24.00      6.40000000      22.53487200      2.11845970     -.61491145   314
WL   24.00      6.60000000      22.94642800      1.99790600     -.59062545   315
WL   24.00      6.80000000      23.33435800      1.88220960     -.56633945   316
WL   24.00      7.00000000      23.69963400      1.77137030     -.54205342   317
WL   24.00      7.20000000      24.04307900      1.66309630     -.54068665   318
WL   24.00      7.40000000      24.36489200      1.55509560     -.53931992   319
WL   24.00      7.60000000      24.66513500      1.44736840     -.53795320   320
WL   24.00      7.80000000      24.94385900      1.33991440     -.53658645   321
WL   24.00      8.00000000      25.20111800      1.23273370     -.53521967   322
WL   24.00      8.20000000      25.43697100      1.12582650     -.53385295   323
WL   24.00      8.40000000      25.65146800      1.01919260     -.53248620   324
WL   24.00      8.60000000      25.84466400       .91283195     -.53111947   325
WL   24.00      8.80000000      26.01661900       .80674470     -.52975275   326
WL   24.00      9.00000000      26.16738100       .70093085     -.52838597   327
PEN  UP      6000.00000000                                                  328
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GO TO          3.00000000      26.16738100                                    329
     13.07129200                                                              330
      8.63354940                                                              331
     -1.32652980                                                              332
      -.16522285                                                              333
       .52109964                                                              334
      -.42319729                                                              335
 IDENT.              X                    Y          FIRST DER.    SECOND DER. 336
WL   28.00      3.00000000      13.07129200      4.31677470     -.66326490     337
PEN DOWN     5000.00000000                                                    338
WL   28.00      3.20000000      13.92121600      4.18164340     -.68804832     339
WL   28.00      3.40000000      14.74361900      4.04155540     -.71283175     340
WL   28.00      3.60000000      15.53750800      3.89651070     -.73761517     341
WL   28.00      3.80000000      16.30189300      3.74650930     -.76239860     342
WL   28.00      4.00000000      17.03578200      3.59155120     -.78718202     343
WL   28.00      4.20000000      17.73818300      3.43163650     -.81196545     344
WL   28.00      4.40000000      18.40810600      3.26676510     -.83674887     345
WL   28.00      4.60000000      19.04455800      3.09693690     -.86153230     346
WL   28.00      4.80000000      19.64655000      2.92215210     -.88631572     347
WL   28.00      5.00000000      20.21309000      2.74241060     -.91109917     348
WL   28.00      5.20000000      20.74370500      2.56552890     -.85771767     349
WL   28.00      5.40000000      21.24001100      2.39932350     -.80433615     350
WL   28.00      5.60000000      21.70414600      2.24379450     -.75095462     351
WL   28.00      5.80000000      22.13824200      2.09894170     -.69757310     352
WL   28.00      6.00000000      22.54443400      1.96476520     -.64419160     353
WL   28.00      6.20000000      22.92486000      1.84126500     -.59081007     354
WL   28.00      6.40000000      23.28165300      1.72844120     -.53742855     355
WL   28.00      6.60000000      23.61694900      1.62629360     -.48404705     356
WL   28.00      6.80000000      23.93288200      1.53482240     -.43066552     357
WL   28.00      7.00000000      24.23158900      1.45402740     -.37728400     358
WL   28.00      7.20000000      24.51478200      1.37756080     -.38738205     359
WL   28.00      7.40000000      24.78248000      1.29907460     -.39748012     360
WL   28.00      7.60000000      25.03427700      1.21856870     -.40757822     361
WL   28.00      7.80000000      25.26977300      1.13604330     -.41767630     362
WL   28.00      8.00000000      25.48856000      1.05149820     -.42777440     363
WL   28.00      8.20000000      25.69023700       .96493365     -.43787245     364
WL   28.00      8.40000000      25.87439800       .87634925     -.44797052     365
WL   28.00      8.60000000      26.04064000       .78574540     -.45806862     366
WL   28.00      8.80000000      26.18856100       .69312185     -.46816667     367
WL   28.00      9.00000000      26.31775500       .59847860     -.47826475     368
PEN UP       6000.00000000                                                    369
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GO TO          3.00000000      26.31775500                                  370
     15.28223700                                                            371
      8.09861500                                                            372
     -1.67710880                                                            373
      -.11039778                                                            374
       .65590317                                                            375
      -.59285533                                                            376
 IDENT.              X                Y          FIRST DER.    SECOND DER.  377
WL   32.00      3.00000000      15.28223700     4.04930750     -.83855440   378
PEN DOWN    5000.00000000                                                   379
WL   32.00      3.20000000      16.07521700     3.87994070     -.85511405   380
WL   32.00      3.40000000      16.83399300     3.70726190     -.87167372   381
WL   32.00      3.60000000      17.55790200     3.53127110     -.88823340   382
WL   32.00      3.80000000      18.24628100     3.35196850     -.90479305   383
WL   32.00      4.00000000      18.89846800     3.16935390     -.92135272   384
WL   32.00      4.20000000      19.51380200     2.98342740     -.93791240   385
WL   32.00      4.40000000      20.09161800     2.79418900     -.95447205   386
WL   32.00      4.60000000      20.63125700     2.60163860     -.97103172   387
WL   32.00      4.80000000      21.13205300     2.40577630     -.98759140   388
WL   32.00      5.00000000      21.59334700     2.20660200    -1.00415100   389
WL   32.00      5.20000000      22.01512800     2.01395430     -.92232525   390
WL   32.00      5.40000000      22.40001900     1.83767190     -.84049945   391
WL   32.00      5.60000000      22.75129000     1.67775460     -.75867362   392
WL   32.00      5.80000000      23.07221100     1.53420250     -.67684782   393
WL   32.00      6.00000000      23.36606100     1.40701540     -.59502202   394
WL   32.00      6.20000000      23.63610900     1.29619360     -.51319622   395
WL   32.00      6.40000000      23.88562900     1.20173700     -.43137042   396
WL   32.00      6.60000000      24.11789500     1.12364550     -.34954460   397
WL   32.00      6.80000000      24.33617900     1.06191910     -.26771880   398
WL   32.00      7.00000000      24.54375300     1.01655790     -.18589300   399
WL   32.00      7.20000000      24.74330200      .97866915     -.19299547   400
WL   32.00      7.40000000      24.93512700      .93935980     -.20009797   401
WL   32.00      7.60000000      25.11895000      .89862995     -.20720047   402
WL   32.00      7.80000000      25.29448500      .85647965     -.21430295   403
WL   32.00      8.00000000      25.46144700      .81290875     -.22140545   404
WL   32.00      8.20000000      25.61955200      .76791740     -.22850795   405
WL   32.00      8.40000000      25.76851900      .72150560     -.23561042   406
WL   32.00      8.60000000      25.90806000      .67367325     -.24271292   407
WL   32.00      8.80000000      26.03789300      .62442040     -.24981542   408
WL   32.00      9.00000000      26.15773300      .57374695     -.25691790   409
PEN UP      6000.00000000                                                   410
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GO TO          3.00000000      26.15773300                                  411
     18.08201300                                                            412
      8.07523430                                                            413
     -4.16930640                                                            414
      1.01104600                                                            415
      -.68482970                                                            416
      -.71760280                                                            417
 IDENT.              X                    Y          FIRST DER.    SECOND DER.  418
WL   36.00     3.00000000      18.08201300      4.03761710    -2.08465320      419
PEN DOWN    5000.00000000                                                     420
WL   36.00     3.20000000      18.84885400      3.63585220    -1.93299630      421
WL   36.00     3.40000000      19.53837500      3.26441860    -1.78133940      422
WL   36.00     3.60000000      20.15664400      2.92331640    -1.62968250      423
WL   36.00     3.80000000      20.70972300      2.61254560    -1.47802560      424
WL   36.00     4.00000000      21.20368400      2.33210620    -1.32636870      425
WL   36.00     4.20000000      21.64458800      2.08199810    -1.17471180      426
WL   36.00     4.40000000      22.03850500      1.86222140    -1.02305490      427
WL   36.00     4.60000000      22.39149900      1.67277620     -.87139800      428
WL   36.00     4.80000000      22.70963700      1.51366230     -.71974110      429
WL   36.00     5.00000000      22.99898700      1.38487970     -.56808420      430
WL   36.00     5.20000000      23.26492800      1.27615620     -.51915175      431
WL   36.00     5.40000000      23.51010200      1.17721910     -.47021930      432
WL   36.00     5.60000000      23.73646900      1.08806810     -.42128687      433
WL   36.00     5.80000000      23.94598200      1.00870410     -.37235442      434
WL   36.00     6.00000000      24.14060200       .93912665     -.32342197      435
WL   36.00     6.20000000      24.32228500       .87933565     -.27448952      436
WL   36.00     6.40000000      24.49298800       .82933055     -.22555692      437
WL   36.00     6.60000000      24.65467000       .78911255     -.17662440      438
WL   36.00     6.80000000      24.80928600       .75868090     -.12769210      439
WL   36.00     7.00000000      24.95879500       .73803545     -.07875955      440
WL   36.00     7.20000000      25.10443600       .71641310     -.13746742      441
WL   36.00     7.40000000      25.24457800       .68304870     -.19617554      442
WL   36.00     7.60000000      25.37687300       .63794285     -.25488342      443
WL   36.00     7.80000000      25.49897300       .58109505     -.31359155      444
WL   36.00     8.00000000      25.60852800       .51250620     -.37229942      445
WL   36.00     8.20000000      25.70319000       .43217545     -.43100730      446
WL   36.00     8.40000000      25.78061600       .34010270     -.48971542      447
WL   36.00     8.60000000      25.83845100       .23628895     -.54842330      448
WL   36.00     8.80000000      25.87434700       .12073375     -.60713142      449
WL   36.00     9.00000000      25.88596200      -.00656320     -.66583930      450
PEN UP      6000.00000000                                                     451
GO TO          3.00000000      25.88596200                                  452
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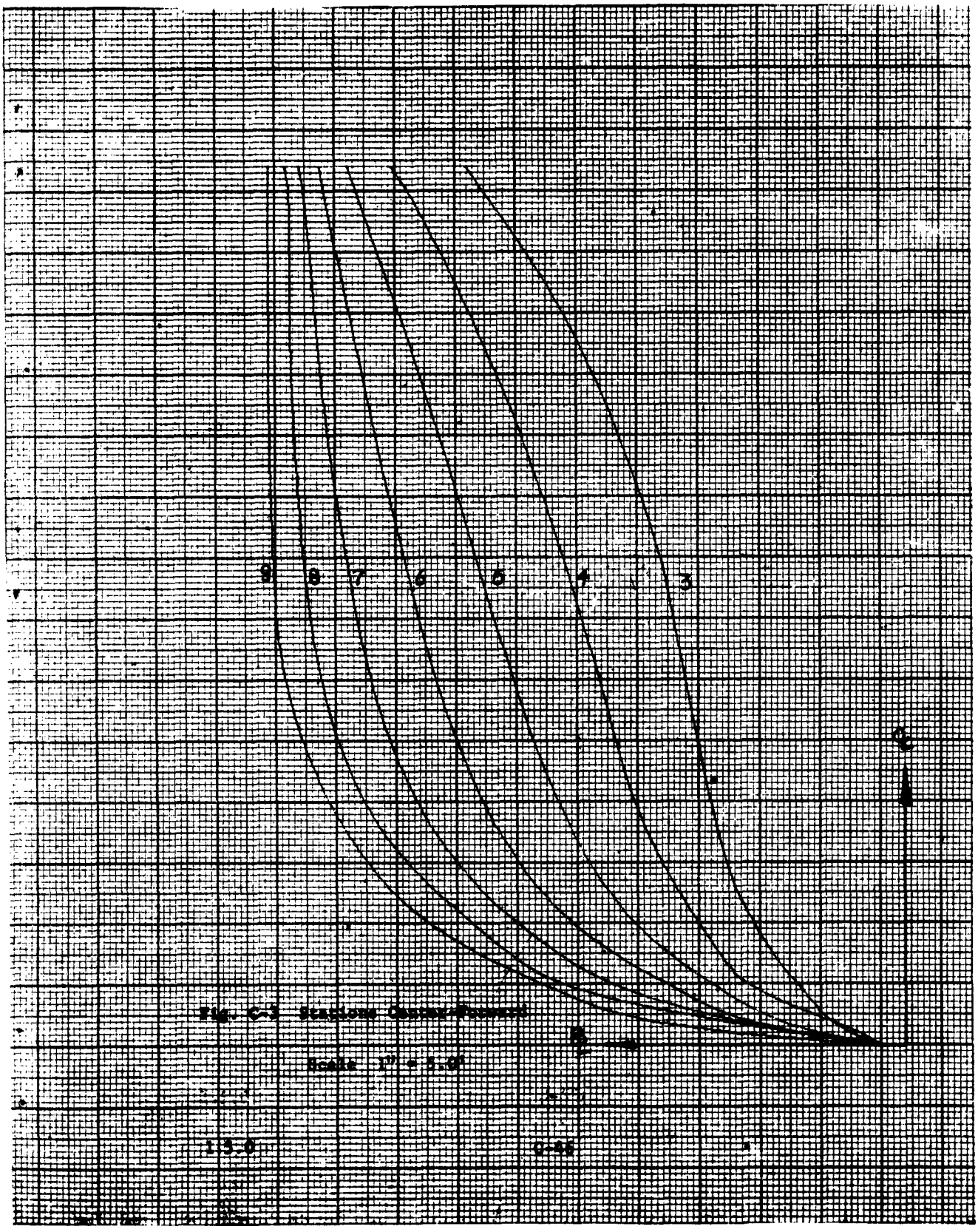

Fig. C-3 Stations Centerline

Scale 1" = 5.0'

13.0

C-45

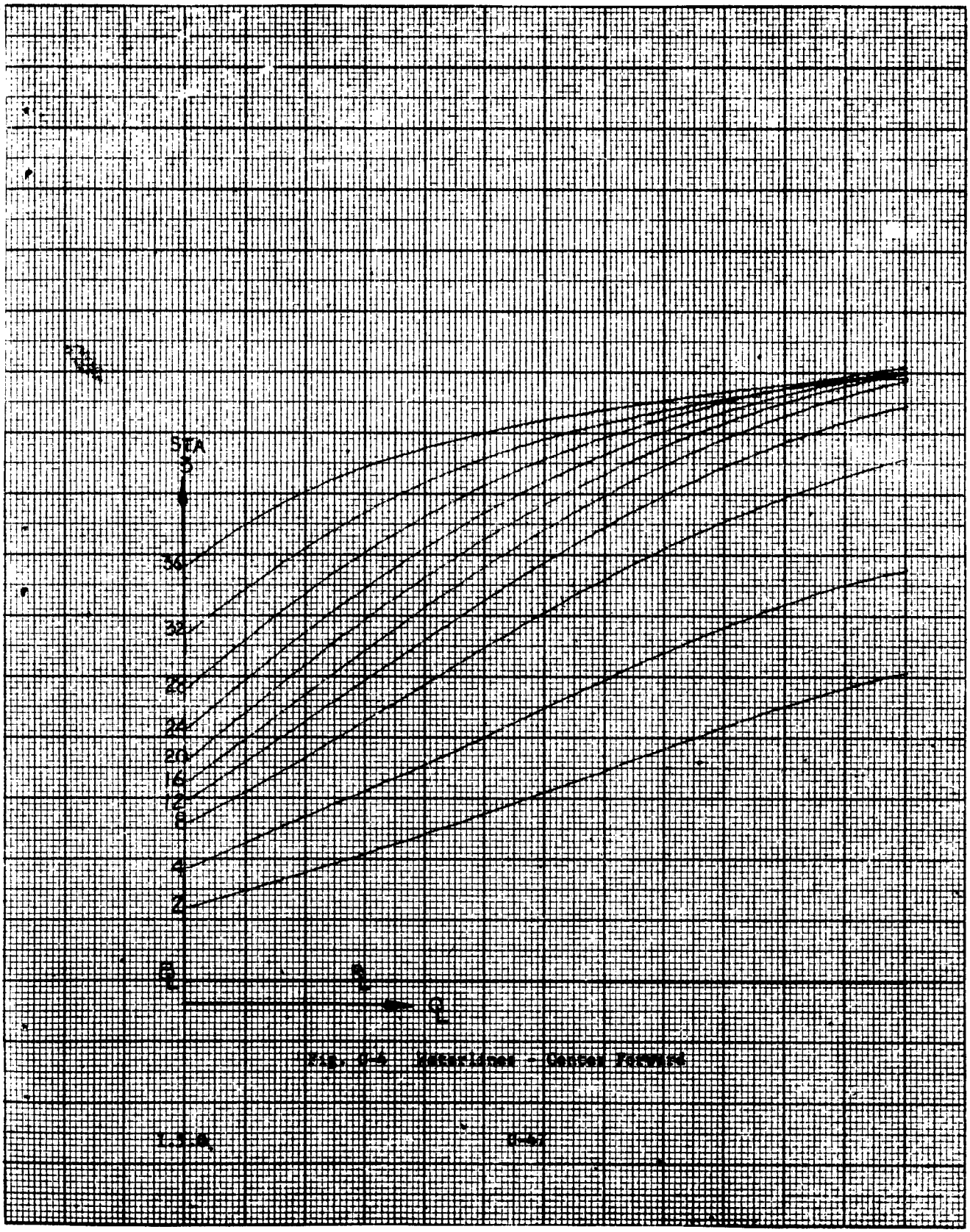

Fig. 9-6 Waterlines - Canted Forward

CENTER CENTER SURFACE OF DLG-26

Project Description:

To fair a surface of nine waterlines and eleven stations taken from the preliminary offsets for the hull of DLG-26. The object was to investigate more fully the problem of large slopes at the keel line and to try a very simple overlapping procedure between this surface and the next surface forward.

Data Used:

The offsets to be used were taken from Station 8 through Station 14 of the hull at Waterlines 0 to 32 at four-foot intervals of the offsets, except those of Station 9 which were taken from the preliminary offsets. The Station 9 offsets were taken from the forward surface.

Procedure:

The matrix was punched using SMOG-1 in the dual lambda formulation with double spline in the X direction only, then the entry for the lambda row in the deviation constraints of the offsets from Station 9 were removed. This required the surface to go exactly through these offsets. A basic feasible solution was included with the matrix. This problem was run on the IBM-7090 using LP-90 and required fifty-four minutes. The surface equation was solved with GOBACK-1 on the IBM-1620.

Results:

The surface fit the offsets to a deviation of $\geq$ .03'. The surface did go exactly through the given offsets of Station 9. Station 9, however, has a different shape on this surface than on the forward surface, causing a line of discontinuity between the surfaces at the intersections.

Recommendations:

More sophisticated means for joining surfaces should be investigated. In addition, it seems that a better surface would result from requiring a specific sign on the curvature in the Z direction at the baseline.

```
*            DLG  26  7X9  CTR  CTR

  10     7  0.       0.0001
   0.
 153.0000   1.000000
 178.5000   1.000000
 204.0000   1.000000
 239.5000   1.000000
 265.0000   1.000000
 290.5000   1.000000
 316.0000   1.000000
   2.0000
 153.0000  12.427083
 178.5      13.7578
 204.0000  14.250000
 239.5000  13.593750
 265.0000  11.531250
 290.5000   8.041667
 316.0000   3.520833
   4.0000
 153.0000  16.593750
 178.5      17.98359
 204.0000  18.677083
 239.5000  18.437500
 265.0000  17.291667
 290.5000  14.625000
 316.0000  10.197917
   8.0000
 153.0000  21.000000
 178.5      22.5810
 204.0000  23.458333
 239.5000  23.791667
 265.0000  23.468750
 290.5000  22.375000
 316.0000  20.281250
  12.0000
 153.0000  23.239583
 178.5      24.74296
 204.0000  25.760417
 239.5000  26.156250
 265.0000  26.062500
 290.5000  25.583333
 316.0000  24.718750
  16.0000
 153.0000  24.364583
 178.5      25.81042
```

```
204.0000 26.708333
239.5000 27.187500
265.0000 27.125000
290.5000 26.864583
316.0000 26.354167
 20.0000
153.0000 24.885417
178.5     26.130061
204.0000 26.895833
239.5000 27.291667
265.0000 27.375000
290.5000 27.166667
316.0000 26.760417
 24.0000
153.0000 25.208333
178.5     26.24592
204.0000 26.895833
239.5000 27.249583
265.0000 27.364583
290.5000 27.229167
316.0000 26.822917
 28.0000
153.0000 25.416667
178.5     26.32344
204.0000 26.843750
239.5000 27.187500
265.0000 27.291667
290.5000 27.250000
316.0000 26.822917
 32.0000
153.0000 25.510417
178.5     26.31503
204.0000 26.739583
239.5000 27.093750
265.0000 27.208333
290.5000 27.166667
316.0000 26.791667
 51.0       8.0        153.0
```

```
        DLG  CTR CTR STATIONS                                                339
PEN UP    6000.00000000                                                      419
GO TO          .00000000       26.30897600                                 420
     1.00000000                                                             421
    91.87558100                                                             422
  -205.35714000                                                             423
   201.32830000                                                             424
  -135.48370000                                                             425
   -66.08434000                                                             426
     1.97790700                                                             427
     -.83343120                                                             428
     -.12777800                                                             429
     -.63787830                                                             430
     -.13893454                                                             431
    -1.05766330                                                             432
 IDENT.          Z                Y          FIRST DER.    SECOND DER.      433
FR  51.00      .00000000        1.00000000   11.48444700   -6.41741060      434
PEN DOWN  5000.00000000                                                     435
FR  51.00      .50000000        5.98919990    8.57065670   -5.23775260      436
FR  51.00     1.00000000        9.66896230    6.24669500   -4.05809450      437
FR  51.00     1.50000000       12.33419900    4.51256210   -2.87843650      438
FR  51.00     2.00000000       14.27982800    3.36825850   -1.69877850      439
FR  51.00     2.50000000       15.76768600    2.61532130   -1.31297040      440
FR  51.00     3.00000000       16.92730100    2.05528750    -.92716218      441
FR  51.00     3.50000000       17.85512500    1.68815800    -.54135390      442
FR  51.00     4.00000000       18.64761200    1.51393450    -.15554578      443
FR  51.00     4.50000000       19.38507800    1.43581060    -.15695059      444
FR  51.00     5.00000000       20.08330700    1.35698260    -.15835523      445
FR  51.00     5.50000000       20.74194500    1.27745460    -.15975989      446
FR  51.00     6.00000000       21.36062700    1.19722320    -.16116468      447
FR  51.00     6.50000000       21.93904800    1.11629050    -.16256953      448
FR  51.00     7.00000000       22.47680800    1.03465360    -.16397265      449
FR  51.00     7.50000000       22.97357500     .95231537    -.16537734      450
FR  51.00     8.00000000       23.42901200     .86927562    -.16678234      451
FR  51.00     8.50000000       23.84322900     .78843043    -.15659804      452
FR  51.00     9.00000000       24.21829100     .71267603    -.14641375      453
FR  51.00     9.50000000       24.55676300     .64201478    -.13622898      454
FR  51.00    10.00000000       24.86115300     .57644718    -.12604328      455
FR  51.00    10.50000000       25.13405300     .51597311    -.11585757      456
FR  51.00    11.00000000       25.37796800     .46059868    -.10567343      457
FR  51.00    11.50000000       25.59549200     .41029391    -.09548914      458
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FR	51.00	12.00000000	25.78910800	.36509628	-.08530654	459
FR	51.00	12.50000000	25.96123100	.32377121	-.08000422	460
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FR	51.00	13.50000000	26.24675000	.24905742	-.06940256	462
FR	51.00	14.00000000	26.36293700	.21570122	-.06410024	463
FR	51.00	14.50000000	26.46287900	.18496296	-.05879949	464
FR	51.00	15.00000000	26.54835300	.15688517	-.05349872	465
FR	51.00	15.50000000	26.62024400	.13145283	-.04819781	466
FR	51.00	16.00000000	26.68012900	.10869345	-.04289705	467
FR	51.00	16.50000000	26.72931300	.08837988	-.03834343	468
FR	51.00	17.00000000	26.76894600	.07035236	-.03379138	469
FR	51.00	17.50000000	26.80004900	.05459476	-.02923917	470
FR	51.00	18.00000000	26.82384000	.04109944	-.02468553	471
FR	51.00	18.50000000	26.84137800	.02991033	-.02013348	472
FR	51.00	19.00000000	26.85396400	.02095967	-.01558142	473
FR	51.00	19.50000000	26.86287500	.01430272	-.01102921	474
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FR	51.00	20.50000000	26.87289100	.00688654	-.00566110	476
FR	51.00	21.00000000	26.87591700	.00428343	-.00484662	477
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FR	51.00	22.50000000	26.87764300	-.00119803	-.00240142	480
FR	51.00	23.00000000	26.87682700	-.00217182	-.00158693	481
FR	51.00	23.50000000	26.87545600	-.00277321	-.00077229	482
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FR	51.00	24.50000000	26.87251400	-.00291272	.00004464	484
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FR	51.00	26.50000000	26.86657500	-.00283864	.00004820	488
FR	51.00	27.00000000	26.86526400	-.00282243	.00004752	489
FR	51.00	27.50000000	26.86410700	-.00276602	.00004842	490
FR	51.00	28.00000000	26.86265400	-.00274441	.00004930	491
FR	51.00	28.50000000	26.86089600	-.00428178	-.00614549	492
FR	51.00	29.00000000	26.85799800	-.00890242	-.01234342	493
FR	51.00	29.50000000	26.85216000	-.01661900	-.01853978	494
FR	51.00	30.00000000	26.84107900	-.02744372	-.02473455	495
FR	51.00	30.50000000	26.82456500	-.04136438	-.03093248	496
FR	51.00	31.00000000	26.79861500	-.05838094	-.03712884	497
FR	51.00	31.50000000	26.76523400	-.07850568	-.04332519	498
FR	51.00	32.00000000	26.72062200	-.10171395	-.04952156	499

PEN UP	6000.00000000					500
GO TO	.00000000	26.72062200				501
	1.00000000					502
	107.46967000					503
	-326.23935000					504
	415.94720000					505
	-414.82464000					506
	5.07482400					507
	-5.36778600					508
	.00301490					509
	.19537250					510
	-.96097500					511
	-.04598987					512
	-1.03740100					513
IDENT.	Z	Y	FIRST DER.	SECOND DER.		514
FR 76.50	.00000000	1.00000000	13.43370800	-10.19497900		515
PEN DOWN	5000.00000000					516
FR 76.50	.50000000	6.54403160	8.94551760	-7.75778900		517
FR 76.50	1.00000000	10.14861600	5.67592060	-5.32059840		518
FR 76.50	1.50000000	12.42305000	3.62491760	-2.88340780		519
FR 76.50	2.00000000	13.97663300	2.79251120	-.44621718		520
FR 76.50	2.50000000	15.31738500	2.57104800	-.43963968		521
FR 76.50	3.00000000	16.54822800	2.35287310	-.43306218		522
FR 76.50	3.50000000	17.67080500	2.13798550	-.42648453		523
FR 76.50	4.00000000	18.68676000	1.92638760	-.41990703		524
FR 76.50	4.50000000	19.59897200	1.72551250	-.38359423		525
FR 76.50	5.00000000	20.41530300	1.54279400	-.34728143		526
FR 76.50	5.50000000	21.14479000	1.37823060	-.31096910		527
FR 76.50	6.00000000	21.79656400	1.23182360	-.27465568		528
FR 76.50	6.50000000	22.37964600	1.10357560	-.23834226		529
FR 76.50	7.00000000	22.90315700	.99348267	-.20203040		530
FR 76.50	7.50000000	23.37616600	.90154863	-.16571698		531
FR 76.50	8.00000000	23.80772300	.82776850	-.12940512		532
FR 76.50	8.50000000	24.20562900	.76428680	-.12454357		533
FR 76.50	9.00000000	24.57239700	.70322681	-.11968202		534
FR 76.50	9.50000000	24.90927700	.64460102	-.11482203		535
FR 76.50	10.00000000	25.21741000	.58840070	-.10996048		536
FR 76.50	10.50000000	25.49807700	.53462955	-.10509893		537
FR 76.50	11.00000000	25.75258900	.48330016	-.10023895		538
FR 76.50	11.50000000	25.98182700	.43440007	-.09537739		539
FR 76.50	12.00000000	26.18727100	.38792906	-.09051740		540

FR	76.50	12.50000000	26.37014300	.34386677	-.08563819	541
FR	76.50	13.00000000	26.53158800	.30226738	-.08075898	542
FR	76.50	13.50000000	26.67285100	.26310626	-.07588131	543
FR	76.50	14.00000000	26.79507800	.22639565	-.07100210	544
FR	76.50	14.50000000	26.89964400	.19211052	-.06612289	545
FR	76.50	15.00000000	26.98762100	.16026323	-.06124524	546
FR	76.50	15.50000000	27.06029000	.13086677	-.05636601	547
FR	76.50	16.00000000	27.11882100	.10390814	-.05148836	548
FR	76.50	16.50000000	27.16444000	.07966141	-.04546439	549
FR	76.50	17.00000000	27.19886200	.05843752	-.03944042	550
FR	76.50	17.50000000	27.22334500	.04021159	-.03341799	551
FR	76.50	18.00000000	27.23975100	.02502112	-.02739402	552
FR	76.50	18.50000000	27.24894500	.01281599	-.02137004	553
FR	76.50	19.00000000	27.25288300	.00364632	-.01534763	554
FR	76.50	19.50000000	27.25353200	-.00251287	-.00932364	555
FR	76.50	20.00000000	27.25094900	-.00567424	-.00330123	556
FR	76.50	20.50000000	27.24786500	-.00723282	-.00290797	557
FR	76.50	21.00000000	27.24406500	-.00858379	-.00251471	558
FR	76.50	21.50000000	27.23920100	-.00975216	-.00212300	559
FR	76.50	22.00000000	27.23403400	-.01070042	-.00172974	560
FR	76.50	22.50000000	27.22881200	-.01147870	-.00133648	561
FR	76.50	23.00000000	27.22258900	-.01192449	-.00094478	562
FR	76.50	23.50000000	27.21702200	-.01237506	-.00055150	563
FR	76.50	24.00000000	27.21006300	-.01258064	-.00015981	564
FR	76.50	24.50000000	27.20425300	-.01264598	-.00003602	565
FR	76.50	25.00000000	27.19789200	-.01265072	.00008776	566
FR	76.50	25.50000000	27.19146700	-.01252057	.00021000	567
FR	76.50	26.00000000	27.18565700	-.01236756	.00033379	568
FR	76.50	26.50000000	27.17956400	-.01219204	.00045758	569
FR	76.50	27.00000000	27.17355300	-.01186742	.00057980	570
FR	76.50	27.50000000	27.16802300	-.01152153	.00070361	571
FR	76.50	28.00000000	27.16137800	-.01115177	.00082583	572
FR	76.50	28.50000000	27.15571600	-.01215342	-.00512889	573
FR	76.50	29.00000000	27.14918000	-.01629820	-.01108362	574
FR	76.50	29.50000000	27.13861200	-.02333362	-.01703990	575
FR	76.50	30.00000000	27.12592100	-.03325842	-.02299464	576
FR	76.50	30.50000000	27.10493200	-.04632887	-.02894932	577
FR	76.50	31.00000000	27.07754000	-.06228745	-.03490561	578
FR	76.50	31.50000000	27.04261200	-.08126418	-.04086018	579
FR	76.50	32.00000000	26.99599300	-.10313029	-.04681662	580
PEN	UP	6000.00000000				581

```
GO TO          .00000000      26.99599300                                    582
     1.00000000                                                              583
    91.34176000                                                              584
  -270.60870000                                                              585
   358.35720000                                                              586
  -379.53930000                                                              587
    29.63921000                                                              588
    -6.63397300                                                              589
    -1.69904480                                                              590
     1.22533900                                                              591
    -1.28635190                                                              592
     -.11087661                                                              593
     -.16218130                                                              594
 IDENT.          Z              Y          FIRST DER.     SECOND DER.        595
FR 102.00      .00000000      1.00000000   11.41772000    -8.45652180        596
PEN DOWN   5000.00000000                                                     597
FR 102.00      .50000000      5.73928420    7.71439620    -6.35677260        598
FR 102.00     1.00000000      8.88937540    5.06094730    -4.25702340        599
FR 102.00     1.50000000     10.97521000    3.45737330    -2.15727420        600
FR 102.00     2.00000000     12.52172700    2.90367310     -.05752500        601
FR 102.00     2.50000000     13.96120300    2.84388170     -.18163890        602
FR 102.00     3.00000000     15.35526800    2.72203310     -.30575281        603
FR 102.00     3.50000000     16.67289200    2.53813050     -.42986656        604
FR 102.00     4.00000000     17.88305400    2.29216760     -.55398046        605
FR 102.00     4.50000000     18.96195800    2.02756670     -.50442634        606
FR 102.00     5.00000000     19.91474400    1.78773970     -.45487378        607
FR 102.00     5.50000000     20.75382500    1.57269250     -.40531951        608
FR 102.00     6.00000000     21.49155900    1.38242010     -.35576695        609
FR 102.00     6.50000000     22.14036300    1.21692520     -.30621220        610
FR 102.00     7.00000000     22.71263500    1.07620520     -.25666057        611
FR 102.00     7.50000000     23.22070400     .96026250     -.20710584        612
FR 102.00     8.00000000     23.67702100     .86910475     -.15755421        613
FR 102.00     8.50000000     24.09233300     .79300402     -.14687046        614
FR 102.00     9.00000000     24.47088900     .72224395     -.13618812        615
FR 102.00     9.50000000     24.81545700     .65679965     -.12550593        616
FR 102.00    10.00000000     25.12859700     .59673713     -.11482358        617
FR 102.00    10.50000000     25.41307700     .54198527     -.10413982        618
FR 102.00    11.00000000     25.67149700     .49259407     -.09345920        619
FR 102.00    11.50000000     25.90656700     .44851366     -.08277529        620
FR 102.00    12.00000000     26.12096400     .40980627     -.07209467        621
FR 102.00    12.50000000     26.31681500     .37394597     -.07136626        622
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FR	102.00	13.00000000	26.49487000	.33844378	-.07063925	623
FR	102.00	13.50000000	26.65533700	.30328723	-.06991241	624
FR	102.00	14.00000000	26.79832800	.26853751	-.06918541	625
FR	102.00	14.50000000	26.92399100	.23412212	-.06845698	626
FR	102.00	15.00000000	27.03242800	.20007481	-.06773170	627
FR	102.00	15.50000000	27.12405800	.16637571	-.06700313	628
FR	102.00	16.00000000	27.19887700	.13305842	-.06627785	629
FR	102.00	16.50000000	27.25741200	.10189403	-.05836972	630
FR	102.00	17.00000000	27.30136100	.07469045	-.05046299	631
FR	102.00	17.50000000	27.33263100	.05140957	-.04255642	632
FR	102.00	18.00000000	27.35342200	.03212562	-.03464970	633
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FR	102.00	19.00000000	27.37080100	.00540254	-.01883655	635
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FR	102.00	21.00000000	27.36287400	-.00818116	-.00228285	639
FR	102.00	21.50000000	27.35820600	-.00927484	-.00191349	640
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FR	102.00	22.50000000	27.34836100	-.01079012	-.00117306	642
FR	102.00	23.00000000	27.34259200	-.01127161	-.00080528	643
FR	102.00	23.50000000	27.33682700	-.01159913	-.00043421	644
FR	102.00	24.00000000	27.33104600	-.01172311	-.00006643	645
FR	102.00	24.50000000	27.32534900	-.01172935	-.00034517	646
FR	102.00	25.00000000	27.31954400	-.01199536	-.00062533	647
FR	102.00	25.50000000	27.31367000	-.01241741	-.00090556	648
FR	102.00	26.00000000	27.30787100	-.01282319	-.00118573	649
FR	102.00	26.50000000	27.30054200	-.01358778	-.00146449	650
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FR	102.00	28.50000000	27.26981600	-.01783874	-.00353588	654
FR	102.00	29.00000000	27.25981000	-.01998109	-.00476633	655
FR	102.00	29.50000000	27.24953500	-.02255979	-.00599692	656
FR	102.00	30.00000000	27.23774300	-.02593984	-.00722735	657
FR	102.00	30.50000000	27.22309700	-.02976016	-.00845639	658
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FR	102.00	31.50000000	27.18721300	-.03957099	-.01091745	660
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GO	TO	.00000000	27.16738200			663

0.9.1

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140.97314000					667
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1.18010480					672
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FR 127.50	6.00000000	20.16674000	1.69302510	-.40397054	690
FR 127.50	6.50000000	20.96464600	1.50237680	-.35862282	691
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FR 127.50	7.50000000	22.30283900	1.18910220	-.26792781	693
FR 127.50	8.00000000	22.86577300	1.06647470	-.22258000	694
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FR 127.50	10.00000000	24.60146200	.69318771	-.15070550	698
FR 127.50	10.50000000	24.92999800	.62232186	-.13273848	699
FR 127.50	11.00000000	25.22532300	.56044700	-.11476990	700
FR 127.50	11.50000000	25.49194400	.50755175	-.09680271	701
FR 127.50	12.00000000	25.73435400	.46364483	-.07883414	702
FR 127.50	12.50000000	25.95635300	.42447681	-.07782055	703
FR 127.50	13.00000000	26.15890700	.38582773	-.07680836	704

L9-D

FR 127.50	13.50000000	26.34226200	.34767015	-.07579478	705
FR 127.50	14.00000000	26.50666000	.31003538	-.07478105	706
FR 127.50	14.50000000	26.65239000	.27289702	-.07376901	707
FR 127.50	15.00000000	26.77966500	.23625377	-.07275543	708
FR 127.50	15.50000000	26.88871200	.20013215	-.07174168	709
FR 127.50	16.00000000	26.97985900	.16451816	-.07072966	710
FR 127.50	16.50000000	27.05370000	.13114183	-.06280140	711
FR 127.50	17.00000000	27.11163800	.10171811	-.05487453	712
FR 127.50	17.50000000	27.15589000	.07626072	-.04694472	713
FR 127.50	18.00000000	27.18862700	.05476841	-.03901787	714
FR 127.50	18.50000000	27.21146400	.03724359	-.03109116	715
FR 127.50	19.00000000	27.22647100	.02367021	-.02316289	716
FR 127.50	19.50000000	27.23584900	.01407555	-.01523446	717
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FR 127.50	20.50000000	27.24454000	.00500384	-.00639993	719
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FR 127.50	22.50000000	27.24434000	-.00413961	-.00277132	723
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FR 127.50	23.50000000	27.23899900	-.00602785	-.00095546	725
FR 127.50	24.00000000	27.23591800	-.00625816	-.00004918	726
FR 127.50	24.50000000	27.23269300	-.00646064	-.00065314	727
FR 127.50	25.00000000	27.22925400	-.00692531	-.00125694	728
FR 127.50	25.50000000	27.22552100	-.00769108	-.00186092	729
FR 127.50	26.00000000	27.22157300	-.00879392	-.00246630	730
FR 127.50	26.50000000	27.21658600	-.01017313	-.00307025	731
FR 127.50	27.00000000	27.21126600	-.01187629	-.00367421	732
FR 127.50	27.50000000	27.20500500	-.01383017	-.00427957	733
FR 127.50	28.00000000	27.19745800	-.01612386	-.00488503	734
FR 127.50	28.50000000	27.18898700	-.01811821	-.00304948	735
FR 127.50	29.00000000	27.17953400	-.01919723	-.00121691	736
FR 127.50	29.50000000	27.16971800	-.01932489	.00061707	737
FR 127.50	30.00000000	27.16011300	-.01857980	.00245120	738
FR 127.50	30.50000000	27.15122600	-.01687966	.00428365	739
FR 127.50	31.00000000	27.14341500	-.01427424	.00611761	740
FR 127.50	31.50000000	27.13717100	-.01077489	.00795019	741
FR 127.50	32.00000000	27.13291700	-.00634651	.00978401	742
PEN UP	6000.00000000				743
GO TO	.00000000	27.13291700			744
	1.00000000				340

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	205.08031000					343
	-145.77143000					344
	-59.42452700					345
	2.86080240					346
	-2.95156410					347
	1.23759060					348
	-.88271215					349
	-.27129843					350
	.01462191					351
IDENT.		Z	Y	FIRST DER.	SECOND DER.	352
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PEN	DOWN	5000.00000000				354
FR	25.50	.50000000	5.82494010	8.25878110	-5.16384890	355
FR	25.50	1.00000000	9.35891840	5.97726730	-3.96220620	356
FR	25.50	1.50000000	11.90234400	4.29657470	-2.76056370	357
FR	25.50	2.00000000	13.75562900	3.21670350	-1.55892120	358
FR	25.50	2.50000000	15.18359700	2.52412050	-1.21140830	359
FR	25.50	3.00000000	16.30871100	2.00529510	-.86389531	360
FR	25.50	3.50000000	17.21785100	1.66022480	-.51638234	361
FR	25.50	4.00000000	17.99789600	1.48891330	-.16886937	362
FR	25.50	4.50000000	18.72121700	1.40430680	-.16954684	363
FR	25.50	5.00000000	19.40214500	1.31936550	-.17022445	364
FR	25.50	5.50000000	20.04052100	1.23408270	-.17090192	365
FR	25.50	6.00000000	20.63616900	1.14846380	-.17157953	366
FR	25.50	6.50000000	21.18892500	1.06250380	-.17225734	367
FR	25.50	7.00000000	21.69861600	.97620475	-.17293359	368
FR	25.50	7.50000000	22.16508000	.88956787	-.17361140	369
FR	25.50	8.00000000	22.58813300	.80259187	-.17428937	370
FR	25.50	8.50000000	22.96830900	.71946750	-.15820468	371
FR	25.50	9.00000000	23.30893600	.64438788	-.14212014	372
FR	25.50	9.50000000	23.61403700	.57734665	-.12603231	373
FR	25.50	10.00000000	23.88762800	.51835005	-.10994792	374
FR	25.50	10.50000000	24.13374700	.46739321	-.09386353	375
FR	25.50	11.00000000	24.35636100	.42448637	-.07777914	376
FR	25.50	11.50000000	24.55957300	.38962080	-.06169459	377
FR	25.50	12.00000000	24.74733300	.36279272	-.04560864	378
FR	25.50	12.50000000	24.92295600	.33966858	-.04681858	379
FR	25.50	13.00000000	25.08688400	.31598103	-.04802850	380
FR	25.50	13.50000000	25.23882500	.29165258	-.04923827	381

FR	25.50	14.00000000	25.37847300	.26673948	-.05044820	382
FR	25.50	14.50000000	25.50556400	.24120047	-.05165815	383
FR	25.50	15.00000000	25.61962600	.21506555	-.05286495	384
FR	25.50	15.50000000	25.72048400	.18834223	-.05407473	385
FR	25.50	16.00000000	25.80787700	.16100926	-.05528466	386
FR	25.50	16.50000000	25.88173300	.13485207	-.04924308	387
FR	25.50	17.00000000	25.94324100	.11176085	-.04320151	388
FR	25.50	17.50000000	25.99382000	.09164467	-.03715821	389
FR	25.50	18.00000000	26.03523000	.07458185	-.03111664	390
FR	25.50	18.50000000	26.06887300	.06055785	-.02507350	391
FR	25.50	19.00000000	26.09620400	.04952484	-.01903193	392
FR	25.50	19.50000000	26.11903900	.04151541	-.01299019	393
FR	25.50	20.00000000	26.13822200	.03651208	-.00694706	394
FR	25.50	20.50000000	26.15576300	.03325187	-.00607763	395
FR	25.50	21.00000000	26.17183100	.03042417	-.00520819	396
FR	25.50	21.50000000	26.18626200	.02804653	-.00433860	397
FR	25.50	22.00000000	26.19975600	.02611132	-.00346916	398
FR	25.50	22.50000000	26.21259800	.02456630	-.00259818	399
FR	25.50	23.00000000	26.22432500	.02350233	-.00172718	400
FR	25.50	23.50000000	26.23591400	.02282105	-.00085759	401
FR	25.50	24.00000000	26.24731200	.02263858	.00001182	402
FR	25.50	24.50000000	26.25862100	.02243241	-.00070836	403
FR	25.50	25.00000000	26.26978400	.02191779	-.00142857	404
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FR	25.50	26.00000000	26.29072400	.01977520	-.00286570	406
FR	25.50	26.50000000	26.29978100	.01817248	-.00358606	407
FR	25.50	27.00000000	26.30868100	.01616108	-.00430628	408
FR	25.50	27.50000000	26.31641500	.01386620	-.00502647	409
FR	25.50	28.00000000	26.32256900	.01118778	-.00574512	410
FR	25.50	28.50000000	26.32743800	.00812228	-.00637965	411
FR	25.50	29.00000000	26.33083300	.00479096	-.00701418	412
FR	25.50	29.50000000	26.33266000	.00111888	-.00764714	413
FR	25.50	30.00000000	26.33232900	-.00288122	-.00828167	414
FR	25.50	30.50000000	26.32905700	-.00718453	-.00891621	415
FR	25.50	31.00000000	26.32445100	-.01179113	-.00954918	416
FR	25.50	31.50000000	26.31771600	-.01668842	-.01018371	417
FR	25.50	32.00000000	26.30897600	-.02200137	-.01081825	418

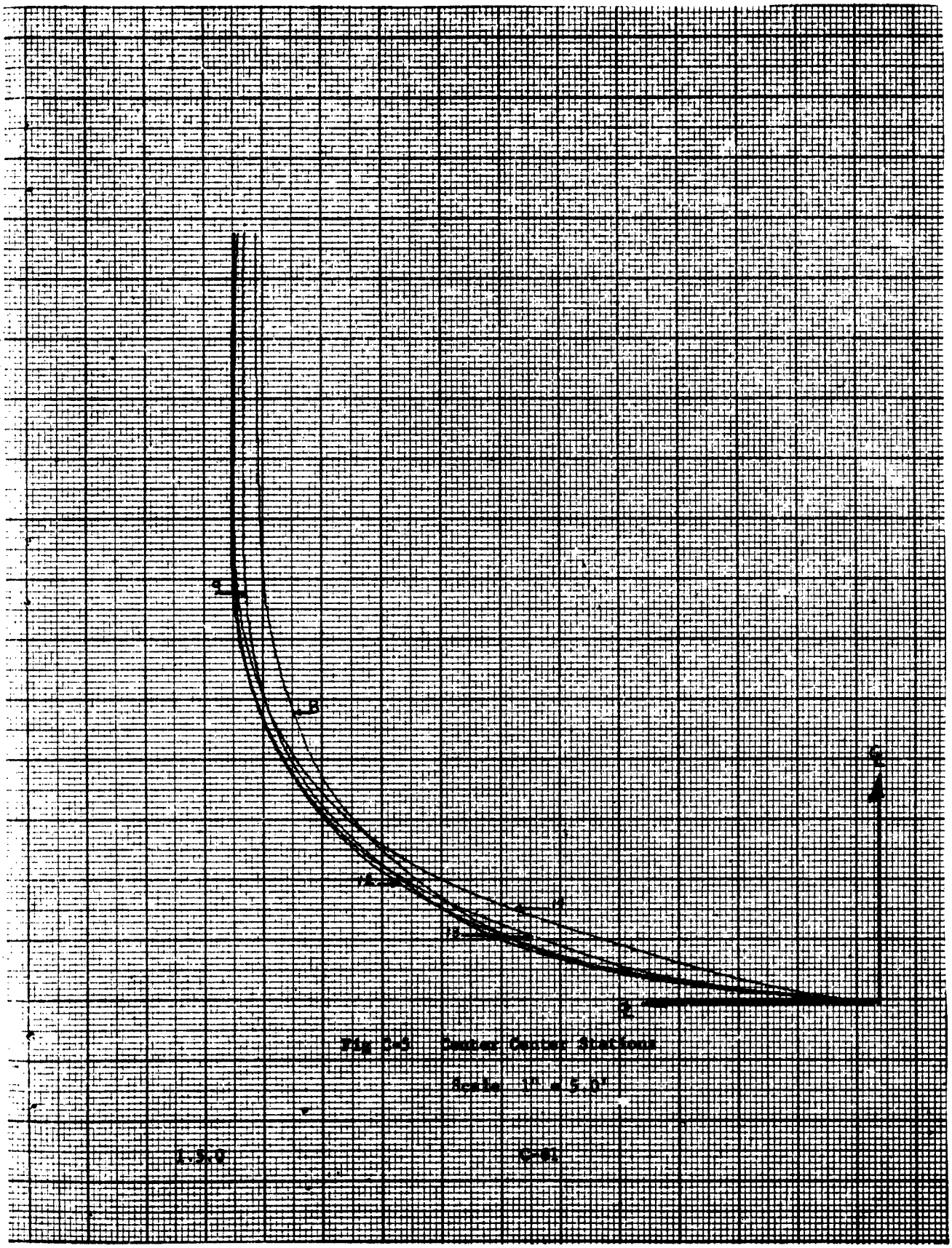


Fig 2-5 Center Center Stations

Scale: 1" = 5.0'

1-5.0 C-61

STERN SURFACE OF DLG-26

Project:

To fair a portion of the stern of the DLG-26, including the stern provile. This surface extends from Station 14 to Station 18 and is extremely complex. The surface includes the transition from the middlebody to the area encompassing the stern profile.

Data:

The preliminary offsets of Stations 14 through 18 on waterlines at four-foot intervals beginning at the baseline and extending to the thirty-two-foot waterline. Also, a set of offsets describing the profile of the stern runup which was scaled from the preliminary lines plans.

Procedure:

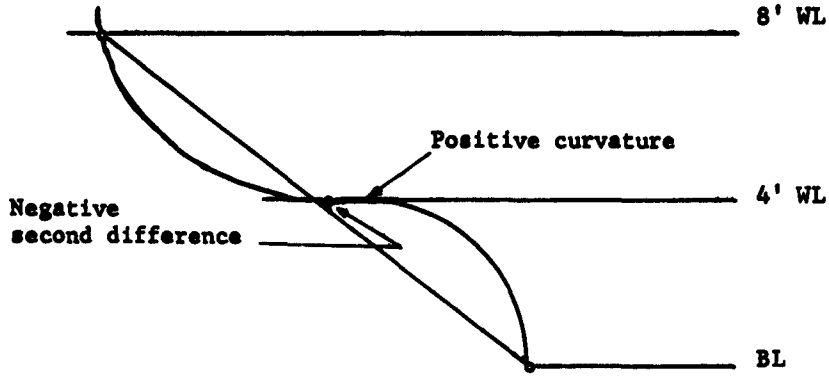
The first step was to fair the two-dimensional stern profile and obtain its faired equation on the IBM-1620. This equation, along with the preliminary offsets, were entered into SMOG-2 which punched the LP matrix on the IBM-1620 in the dual-lambda formulation using double spline in the X direction only. The results were solved for using GOBACK-2 and the offsets plotted as shown.

Results:

The upper portion of the surface faired quite well. However, the lower section which represents the largest portion of the surface appears to be quite unfair. In analyzing the results, two predominant reasons for this result were found:

1. The equation for the profile was found to contain an inflection point in the first interval and therefore did not accurately represent the profile.

2. A condition was found where the sign of the second difference at a given offset as calculated from the neighboring offsets was opposite in sign from the desired curvature. This is illustrated below.



The signs, however, were consistent with neighboring signs and therefore were not detected by the smoothing routine.

The surface meets all of the conditions which were required, including those in error, and λ equaled .02'.

Recommendations:

It is recommended that the surface be re-faired incorporating the following improvements:

1. Re-fair the profile to obtain an accurate equation
2. Manually set the erroneous signs of the second differences to their proper values
3. Include the two-foot waterline in the data to help define this portion of the surface

With these changes, a satisfactory surface should result.

```
   DLG 26     STERN          5 STA  14  TO  18
  -1     1    .25          30.
  10     5    0.001      1000.           3.        .33333333
1.5294
.5060
-2.1136
.4784
 0.0
0.0
-.2528
0.0
0.0
0.0
0.0
0.0
     .0000
    1.0000    .000000
    1.5000    .000000
    2.0000   1.000000
    2.5000   1.000000
    3.0000   1.000000
    0.25
    1.000    0.0
    1.5      0.0
    2.0      1.000
  2.5        1.2396
  3.0        3.5208
     .5000
    1.0000    .000000
    1.5000    .000000
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    1.0000
    1.0000    .000000
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    3.0000  20.281250
    1.5000
    1.0000   7.729166
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    3.0000  24.718749
    2.0000
    1.0000  19.000000
```

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 2.0000 24.208332
 2.5000 25.510416
 3.0000 26.354166
 2.5000
 1.0000 20.28161
 1.5000 22.979166
 2.0000 24.843749
 2.5000 26.031250
 3.0000 26.760416
 3.0000
 1.0000 20.647778
 1.5000 23.177082
 2.0000 24.968749
 2.5000 26.124999
 3.0000 26.822916
 3.5000
 1.0000 20.834333
 1.5000 23.312500
 2.0000 25.052083
 2.5000 26.177082
 3.0000 26.822916
 4.0000
1.0      20.92268
1.5      23.36458
2.0      25.11458
 2.5000 26.208332
 3.0000 26.791666
0.5          1.0      1.0        0.0
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DLG 26 FIRED OFFSETS STERN STATIONS 14 TO 18

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-1000.00000000
581.83551945
-322.22542225
-483.26606720
264.84603999
-33.50312000
-7.90164000
.42938000
-1.36372000

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FR	0.00	10.33789062	- 3.60785926	6.30046328	2.06522583
FR	0.00	11.33789062	3.28838887	7.05520492	-.55574256
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FR	0.00	14.00000000	15.99795231	2.49591257	-1.32571804
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FR	0.00	16.00000000	18.98193621	.80986874	-.36032578
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FR	0.00	18.00000000	20.00113073	.26938006	-.18016289
FR	0.00	19.00000000	20.19544294	.13425789	-.09008144
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-1.24476003

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FR	1.00	14.00000000	20.12284973	1.42576806	-.54019273
FR	1.00	15.00000000	21.30012949	.95039947	-.41054444
FR	1.00	16.00000000	22.06686478	.60467917	-.28089615
FR	1.00	17.00000000	22.54279990	.35889503	-.21067211
FR	1.00	18.00000000	22.80806289	.18333493	-.14044808
FR	1.00	19.00000000	22.93287779	.07799887	-.07022404
FR	1.00	20.00000000	22.98746863	.04288684	0.00000000
FR	1.00	21.00000000	23.03035552	.04288685	0.00000000
FR	1.00	22.00000000	23.07324235	.04288685	0.00000000
FR	1.00	23.00000000	23.11612916	.04288685	0.00000000
FR	1.00	24.00000000	23.15901602	.04288683	0.00000000
FR	1.00	25.00000000	23.20190289	.04288684	0.00000000
FR	1.00	26.00000000	23.24478987	.04288685	0.00000000
FR	1.00	27.00000000	23.28767656	.04288683	0.00000000
FR	1.00	28.00000000	23.33056343	.04288683	0.00000000
FR	1.00	29.00000000	23.37101918	.03559333	-.01458703
FR	1.00	30.00000000	23.39688765	.01371275	-.02917406
FR	1.00	31.00000000	23.39358238	-.02275480	-.04376109
FR	1.00	32.00000000	23.34651573	-.07380942	-.05834812
PN	UP	6000.00000000			

GO TO 5.65478515 23.34651573

.98193625
12.40774233
-55.50853650
63.59176373
-90.17783653
12.87245998
25.36495657
-10.04310612
-1.15420630
-.45403130
-.53987434

IDENT.		Z	Y	1ST DER.	2ND DER.
FR	2.00	0.00000000	.98193625	1.55096779	-1.73464176
PN	DOWN	5000.00000000			
FR	2.00	1.00000000	1.78978582	.18893401	-.98942578
FR	2.00	2.00000000	1.60820960	-.42788377	-.24420980
FR	2.00	3.00000000	1.18242359	-.29948559	.50100617
FR	2.00	4.00000000	1.25764375	.57412857	1.24622215
FR	2.00	5.00000000	2.40295749	1.66457296	.93466661
FR	2.00	6.00000000	4.48293784	2.44346181	.62311107
FR	2.00	7.00000000	7.18602927	2.91079512	.31155553
FR	2.00	8.00000000	10.20067624	3.06657289	0.00000000
FR	2.00	9.00000000	13.24046473	2.98621968	-.16070640
FR	2.00	10.00000000	16.11954681	2.74516008	-.32141280
FR	2.00	11.00000000	18.67721609	2.34339407	-.48211920
FR	2.00	12.00000000	20.75276617	1.78092167	-.64282560
FR	2.00	13.00000000	22.23503158	1.20636566	-.50628641
FR	2.00	14.00000000	23.21101056	.76834883	-.36974723
FR	2.00	15.00000000	23.81724231	.46687119	-.23320805
FR	2.00	16.00000000	24.19026601	.30193273	-.09666886
FR	2.00	17.00000000	24.44700540	.21468713	-.07782233
FR	2.00	18.00000000	24.62592246	.14628807	-.05897579
FR	2.00	19.00000000	24.74586373	.09673554	-.04012926
FR	2.00	20.00000000	24.82567572	.06602954	-.02128272
FR	2.00	21.00000000	24.88195069	.04740716	-.01596204
FR	2.00	22.00000000	24.92226361	.03410545	-.01064136
FR	2.00	23.00000000	24.95193517	.02612442	-.00532068
FR	2.00	24.00000000	24.97628602	.02346407	0.00000000
FR	2.00	25.00000000	24.99975011	.02346407	0.00000000
FR	2.00	26.00000000	25.02321418	.02346406	0.00000000

FR	2.00	27.00000000	25.04667824	.02346405	0.00000000
FR	2.00	28.00000000	25.07014226	.02346404	0.00000000
FR	2.00	29.00000000	25.09255188	.02030071	-.00632665
FR	2.00	30.00000000	25.10863482	.01081072	-.01265331
FR	2.00	31.00000000	25.11206446	-.00500590	-.01897996
FR	2.00	32.00000000	25.09651413	-.02714919	-.02530661
PN UP		6000.00000000			
GO TO		0.00000000	25.09651413		

1.01806375
-31.48543984
114.73951458
-76.49300981
68.28910003
9.51247788
3.83294821
-3.68263027
-1.16394716
-.43257891
.27528031

IDENT.		Z		Y	1ST DER.	2ND DER.
FR	3.00	0.00000000		1.01806375	-3.93567998	3.58560983
PN DOWN		5000.00000000				
FR	3.00	1.00000000	-	1.27421172	-.79827137	2.68920737
FR	3.00	2.00000000	-	.87727982	1.44273476	1.79280491
FR	3.00	3.00000000		1.31245698	2.78733844	.89640245
FR	3.00	4.00000000		4.39859624	3.23553967	0.00000000
FR	3.00	5.00000000		7.61811265	3.18746988	-.09613957
FR	3.00	6.00000000		10.74148949	3.04326052	-.19227913
FR	3.00	7.00000000		13.67258719	2.80291160	-.28841870
FR	3.00	8.00000000		16.31526618	2.46642311	-.38455827
FR	3.00	9.00000000		18.59196595	2.08953223	-.36922349
FR	3.00	10.00000000		20.49944223	1.72797612	-.35388871
FR	3.00	11.00000000		22.05302980	1.38175480	-.33855392
FR	3.00	12.00000000		23.26806345	1.05086827	-.32321914
FR	3.00	13.00000000		24.16736417	.75777519	-.26296700
FR	3.00	14.00000000		24.80369789	.52493427	-.20271485
FR	3.00	15.00000000		25.23731676	.35234548	-.14246271
FR	3.00	16.00000000		25.52847291	.24000884	-.08221056
FR	3.00	17.00000000		25.73022586	.16634643	-.06511424
FR	3.00	18.00000000		25.86686456	.10978035	-.04801792
FR	3.00	19.00000000		25.95548533	.07031058	-.03092160

FR	3.00	20.00000000	26.01318450	.04793713	-.01382528
FR	3.00	21.00000000	26.05478504	.03584000	-.01036897
FR	3.00	22.00000000	26.08601662	.02719919	-.00691265
FR	3.00	23.00000000	26.11033554	.02201469	-.00345634
FR	3.00	24.00000000	26.13119812	.02028651	-.00000002
FR	3.00	25.00000000	26.15121578	.01948000	-.00161299
FR	3.00	26.00000000	26.16962048	.01706052	-.00322596
FR	3.00	27.00000000	26.18479919	.01302807	-.00483893
FR	3.00	28.00000000	26.19513899	.00738266	-.00645190
FR	3.00	29.00000000	26.19956451	.00173724	-.00483892
FR	3.00	30.00000000	26.19915114	-.00229519	-.00322595
FR	3.00	31.00000000	26.19551178	-.00471466	-.00161298
FR	3.00	32.00000000	26.19025945	-.00552116	-.00000001
PN UP		6000.00000000			
GO TO		0.00000000	26.19025945		

.98193625
67.22258729
-172.85596836
150.69388729
-206.23405160
75.62375268
-22.41655973
4.45348728
-1.90806060
-.21245508
-.68279180

IDENT.		Z	Y	1ST DER.	2ND DER.
FR	4.00	0.00000000	.98193625	8.40282341	-5.40174901
PN DOWN		5000.00000000			
FR	4.00	1.00000000	6.97820915	3.88404639	-3.63580501
FR	4.00	2.00000000	9.33867703	1.13121337	-1.86986102
FR	4.00	3.00000000	9.82928389	.14432434	-.10391703
FR	4.00	4.00000000	10.21597371	.92337929	1.66202695
FR	4.00	5.00000000	11.86188961	2.25997560	1.01116565
FR	4.00	6.00000000	14.51897115	2.94571060	.36030435
FR	4.00	7.00000000	17.53635706	2.98058431	-.29055694
FR	4.00	8.00000000	20.26318602	2.36459671	-.94141824
FR	4.00	9.00000000	22.19629937	1.54085574	-.70606369
FR	4.00	10.00000000	23.42334903	.95246932	-.47070914
FR	4.00	11.00000000	24.17968954	.59943745	-.23535459
FR	4.00	12.00000000	24.70067546	.48176014	-.00000004

FR	4.00	13.00000000	25.17787899	.46809034	-.02733954
FR	4.00	14.00000000	25.62774298	.42708104	-.05467905
FR	4.00	15.00000000	26.02292791	.35873223	-.08201856
FR	4.00	16.00000000	26.33609427	.26304390	-.10935807
FR	4.00	17.00000000	26.54860077	.16611073	-.08450827
FR	4.00	18.00000000	26.67659900	.09402735	-.05965848
FR	4.00	19.00000000	26.74493875	.04679376	-.03480868
FR	4.00	20.00000000	26.77846979	.02440997	-.00995889
FR	4.00	21.00000000	26.79831528	.01569594	-.00746917
FR	4.00	22.00000000	26.81069160	.00947161	-.00497946
FR	4.00	23.00000000	26.81808844	.00573700	-.00248975
FR	4.00	24.00000000	26.82299551	.00449210	-.00000004
FR	4.00	25.00000000	26.82748761	.00449205	-.00000004
FR	4.00	26.00000000	26.83197964	.00449201	-.00000004
FR	4.00	27.00000000	26.83647163	.00449197	-.00000003
FR	4.00	28.00000000	26.84096356	.00449193	-.00000003
FR	4.00	29.00000000	26.84412193	.00049116	-.00800149
FR	4.00	30.00000000	26.83927876	-.01151106	-.01600296
FR	4.00	31.00000000	26.81843265	-.03151476	-.02400442
FR	4.00	32.00000000	26.77358210	-.05951991	-.03200589
PN UP		6000.00000000			
GO TO		0.00000000	26.77358210