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U.S. DEPARTMENT OF THE NAVY
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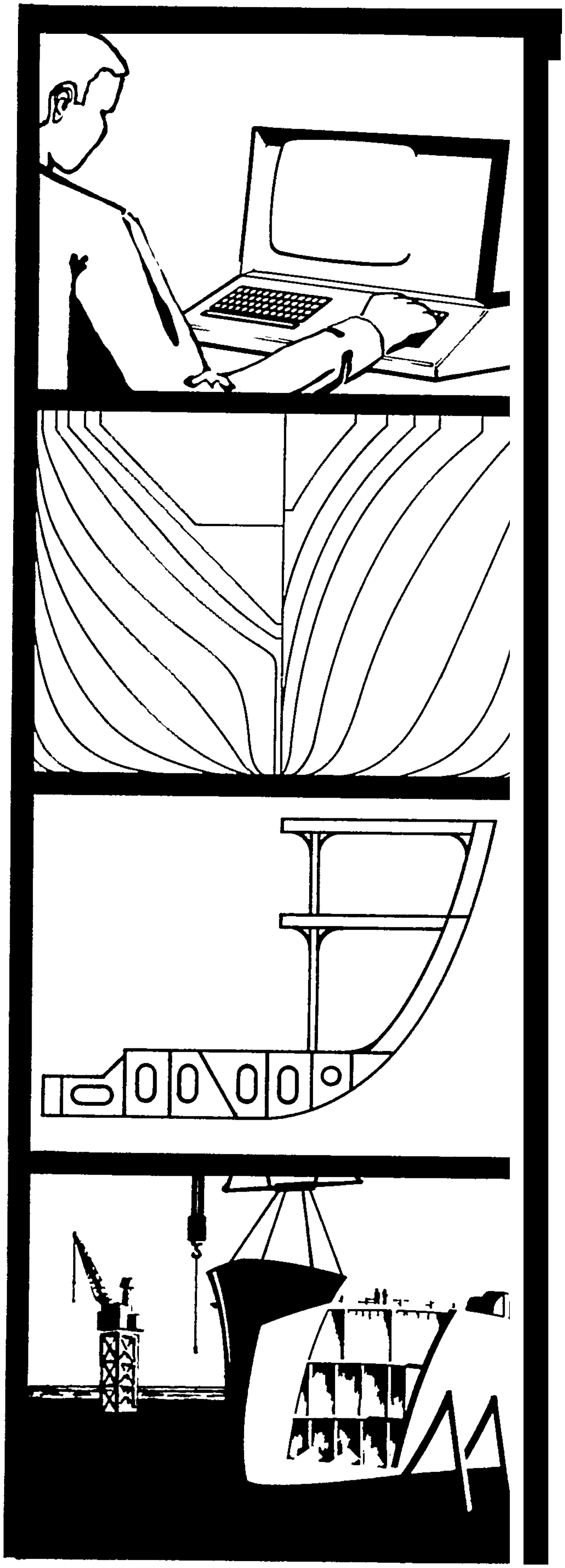

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IN
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Proceedings of the

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DISCLAIMER

USERS EXPERIENCE WITH THE HULDEF PROGRAM

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Mr. Pleasant is Mold Loft Supervisor, responsible for training, development and use of Newport News computer aided lofting systems. Mr. Pleasant has been with the Newport News Mold Loft for 15 years. He has been a supervisor for the past 6 years, specializing in the implementation and development of AUTOKON and other computer aided systems.

I. OVERVIEW OF THE HULDEF PROJECT

HULDEF is a computer aided program for defining a ship's surface. In addition HULDEF generates ship's lines and offsets and provides the ability to store frames in a database with the use of AUTOKON's TRABO module. HULDEF has modules or job options that allow the application of most manual fairing techniques.

I-1 GENERAL INFORMATION

The purpose for undertaking the project was to determine if HULDEF is a better and/or more efficient means of obtaining faired lines than the current computer aided methods used at Newport News Shipbuilding. To determine this, several vessels of various types were used, varying from small hard chined boats to large merchant ships with and without a-bulbous bow.

The scope of the project included the following items:

- Convert the HULDEF program to make it compatible with our computer system.
- Familiarize Mold Loft personnel with the capabilities and use of the program.
- Select and attempt the fairing of several types of vessels using HULDEF.
- Store the faired lines in a database using AUTOKON'S TRABO .
- Run other AUTOKON modules such as LANSKI, SHELL, AND TEMPLATE against the stored faired lines.
- Determine if HULDEF is a better and/or more efficient means of obtaining faired lines than the current computer aided methods used at Newport News Shipbuilding.

- Make any suggestions as to possible program enhancements and identify any program bugs.
- Report on the HULDEF project.
- Host a workshop in the use of HULDEF for all REAPS shipyards.

Our evaluation in no way covers all environments or aspects of the program. We merely tried to simulate production in our Loft, since this is where all final fairings are done as opposed to a design environment. The methods used in no way suggest the only or most appropriate for the vessels used in the examples. The methods were selected after examining the HULDEF User’s Manual and meeting with M.E. Aughey (Naval Ship Engineering Center) and J.R. Vander Schaaf (IITRI) to resolve problems discovered during the course of the project and to discuss fairing techniques related to HULDEF .

I-2 PROJECT DEVELOPMENTS

Upon receipt of the HULDEF program by Newport News Shipbuilding, our computer support department began making modifications to make it compatible with our computer system. The modifications are listed in the Appendix.

After a period of familiarization of the program by the participants several vessels were selected and subsequent fairings were attempted. The fairing exercises continued until bugs and deficiencies discovered proved detrimental to successful completion of the project.

The bugs discovered were as follows:

- Inaccurate plot output
- Inability of DIF12 module to.plot output correctly on the C.R.T.
- Inability to load half stations to a database using TRABO

The deficiencies discovered were as follows:

- Incorrect and unclear program documentation
- Extraneous pen moves before plotting
- Inability of DIF12 module-to give differences at data input points
- The limiting of the user to only ten (10) 206 cards used to slice frames

As stated earlier, Newport News participants met with M.E. Aughey and J.R. Vander Schaaf as a result of the program bugs and deficiencies discovered. Each bug and deficiency was addressed individually and acceptable solutions were identified. The bugs related to plotting were said to be an internal conversion problem. Mr. Aughey assured us that this problem would definitely be looked into along with the other bugs.

The project was suspended for several months at Newport News Shipbuilding until the fixes were made. As a result of the problems found with the program a new version with additional features and capabilities was sent to Newport News Shipbuildirlg for testing.

Further testing resumed .and at the conclusion of the project only two problems were outstanding. The WIND option does not work properly and the program does not generate stations correctly in way of both the bulb and stem in the example of the ship with the bulbous bow. The examples in the Appendix show the graphic results of the testing during the course of the project.

After conferring with Mr. Vander Schaaf concerning the aforementioned problems we concluded that the WIND option works properly in accordance with the way the HULDEF program is written. It was also found out-that the program does generate stations correctly in way of both the bulb and stem if the centerline profile is defined in a specific manner not detailed in the current documentation.

I-3 NEWPORT NEWS CONCLUSIONS

It was decided by the participants that HULDEF is a better and more efficient means of obtaining faired lines than the current computer aided methods used at Newport News Shipbuilding for some of the following reasons:

- The program is a surface definition rather than fairing program allowing the use of most manual fairing techniques.
- The program's use of the parametric spline (a mathematical model of the draftmants spline) for curve fitting ensures that input data points do not move as they do in other computer aided fairing programs.
- There are several auxiliary modules that allow the application of most manual fairing techniques.
- A number of views may be requested and plotted at four place decimal accuracy.
- The program has the ability to calculate preliminary hydrostatic values of the hull form at the specified waterline at any point during the fairing.

Newport News Shipbuilding participants are basically pleased with the features, capabilities and most of all, the ease of use o-f HULDEF; consequently, this program will be used in future fairings.

II-1 NEWPORT NEWS SHIPBUILDING PARTICIPANTS

1.	R.C. Moore	N.C. Coordinator and Project Leader
2.	J.D. Snyder, III	Computer System Support
3.	K.W. Rayhorn	N.C. Programmer and Hull Definition User
4.	P.A. Fitzhorn	Mold Loftsman and Hull Definition User
5.	G.M. Branch	N.C. Programmer and Hull Definition User

APPENDIX

FAIRING EXAMPLE 1 (FORWARD BODY OF A TANKER WITH BULBOUS BOW)

An attempt was made to fair the forward end of a tanker with a bulbous bow. This type vessel was decided upon to determine how HULDEF would handle the bulb and adjacent regions. Also, the bulbous bow has been known to be a problem area in fairing ships; so this was thought to be an excellent test example. The attempted fairing was with the bulb attached.

The ship chosen was a Liquid Natural Gas Carrier with principal particulars as being:

Length	OA	- 948.5′
Length	BP	- 906.0′
Beam	MLD	- 135.0′
Draft		- 36.0′

In defining the vessel, the centerline profile, flat-of-side, flat-of-bottom, 95 ft. waterline and station 7 were defined as control lines. An offset line was generated using the OFFSET module at .01' away from the flat-of-side and flat-of-bottom to ensure a smooth transition into these flat regions. See figure II-1. At this point the stations were input as display lines as shown in figure II-2. Next, the centerline profile, stations, flat-of-side and station 7 were intersected at desired heights using the INTLP module. The intersections were used to create waterlines and a preliminary body plot. See figure 11-3. The waterlines were then intersected with diagonals in the stem region again with the INTLP module. Diagonals were selected′ in way of the bulb and their intersections with the stations were used to create the bulb diagonals as shown in figure 11-4 along with corresponding body plot. The time involved in achieving this body plot was approximately 80 hours.

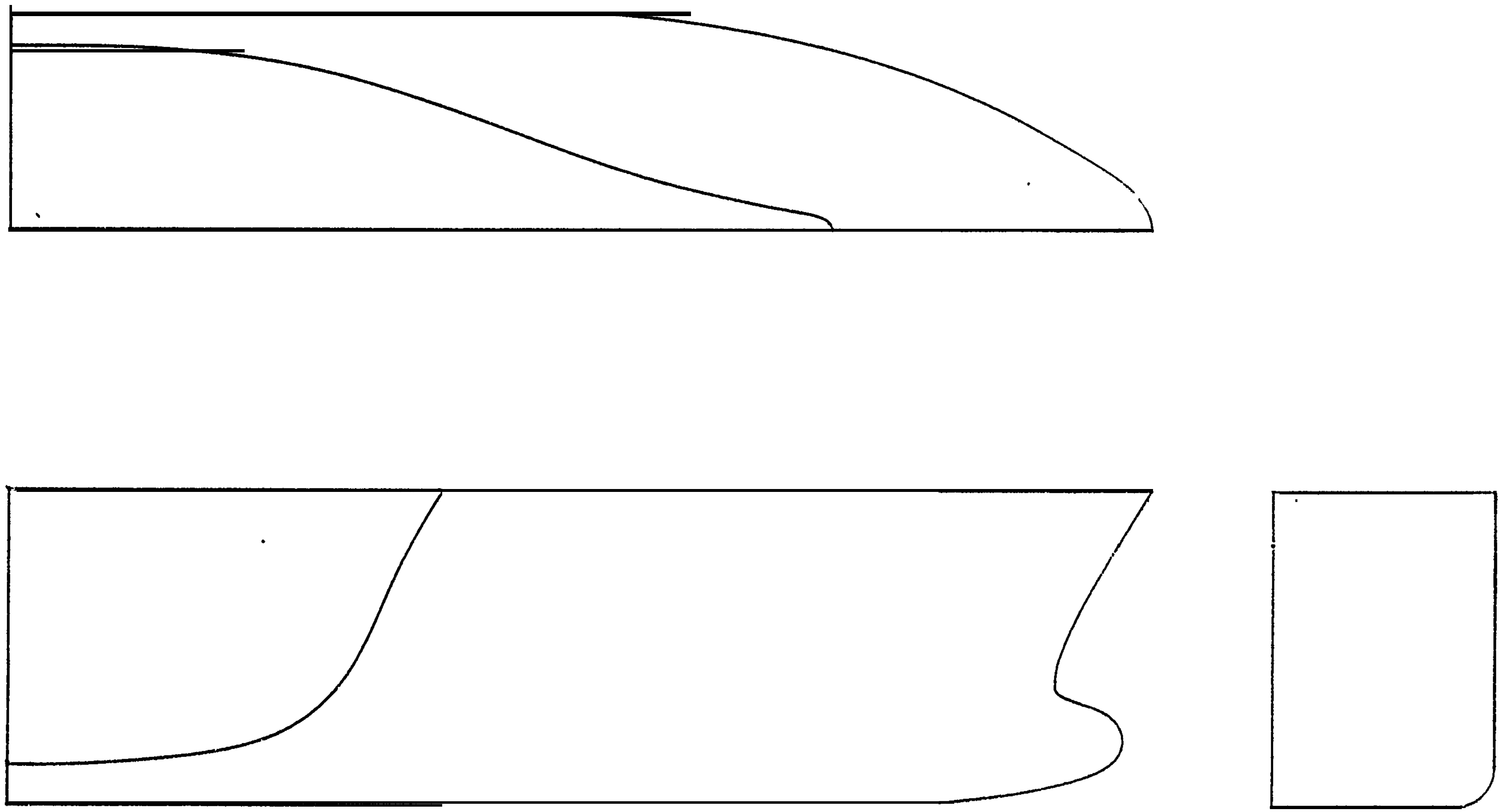

Figure I Conventional views Control lines

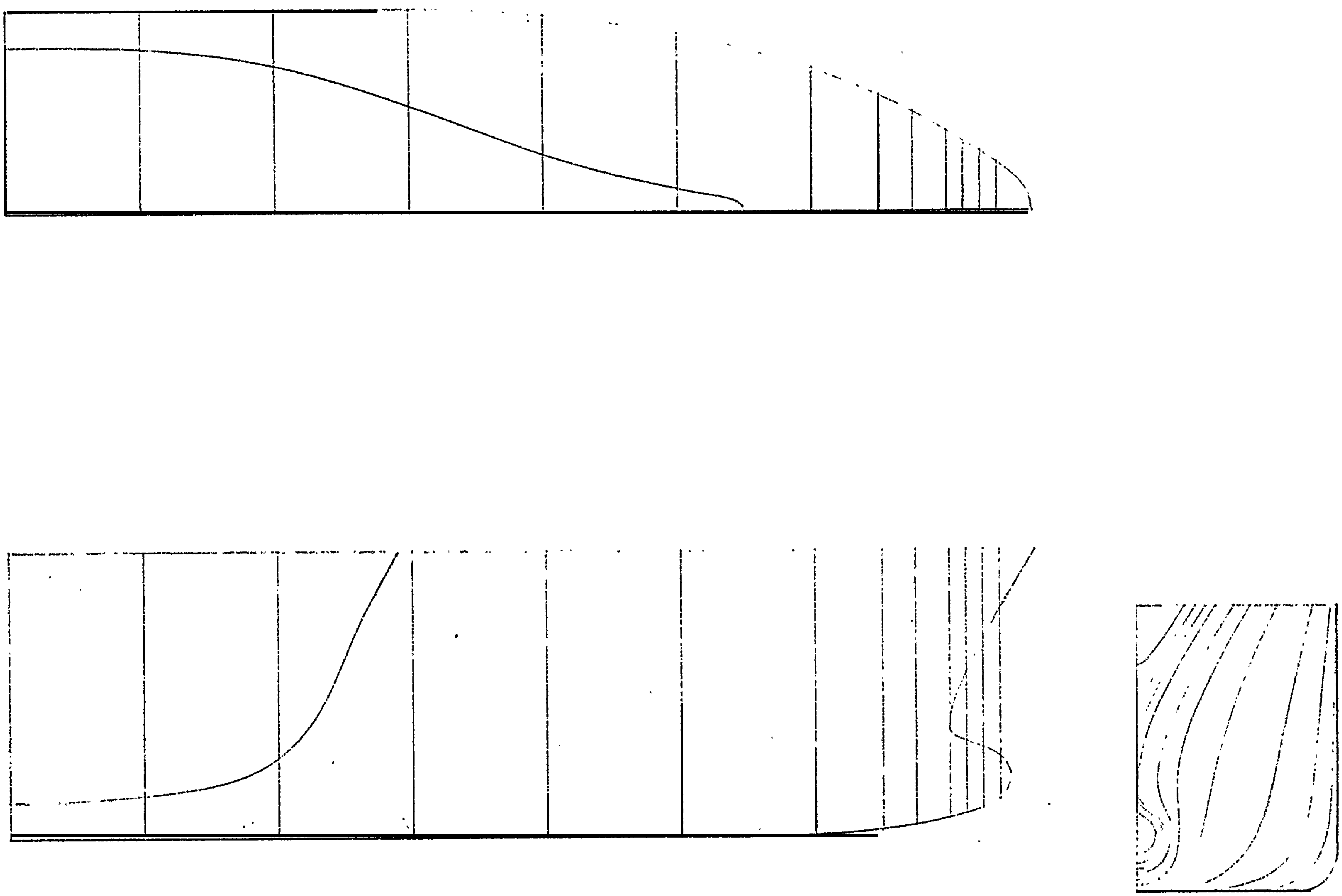

Figure II-2 Conventional three views of Control lines and Stations

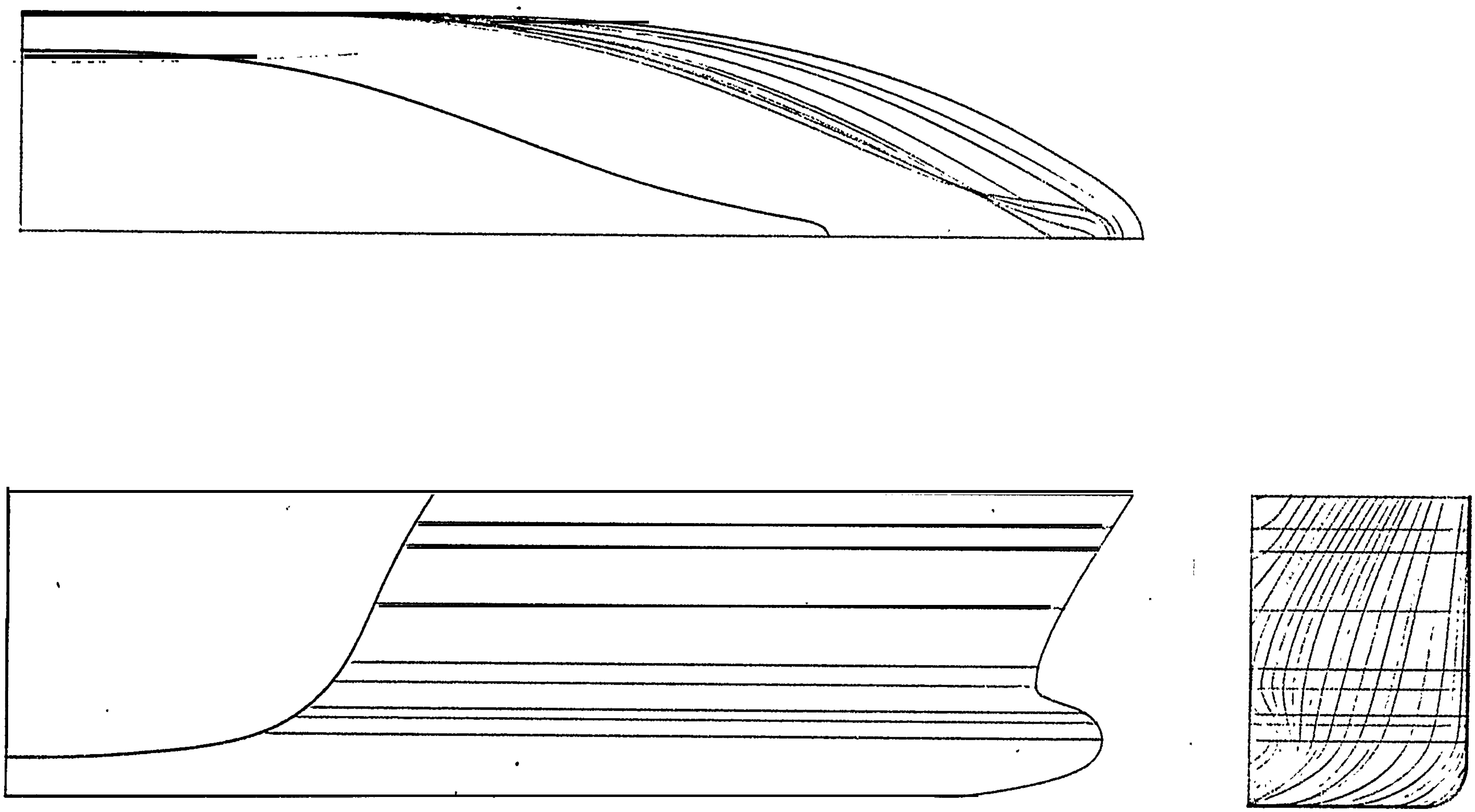

Figure II-3 Elevation and plan views of reference lines and corresponding body plot

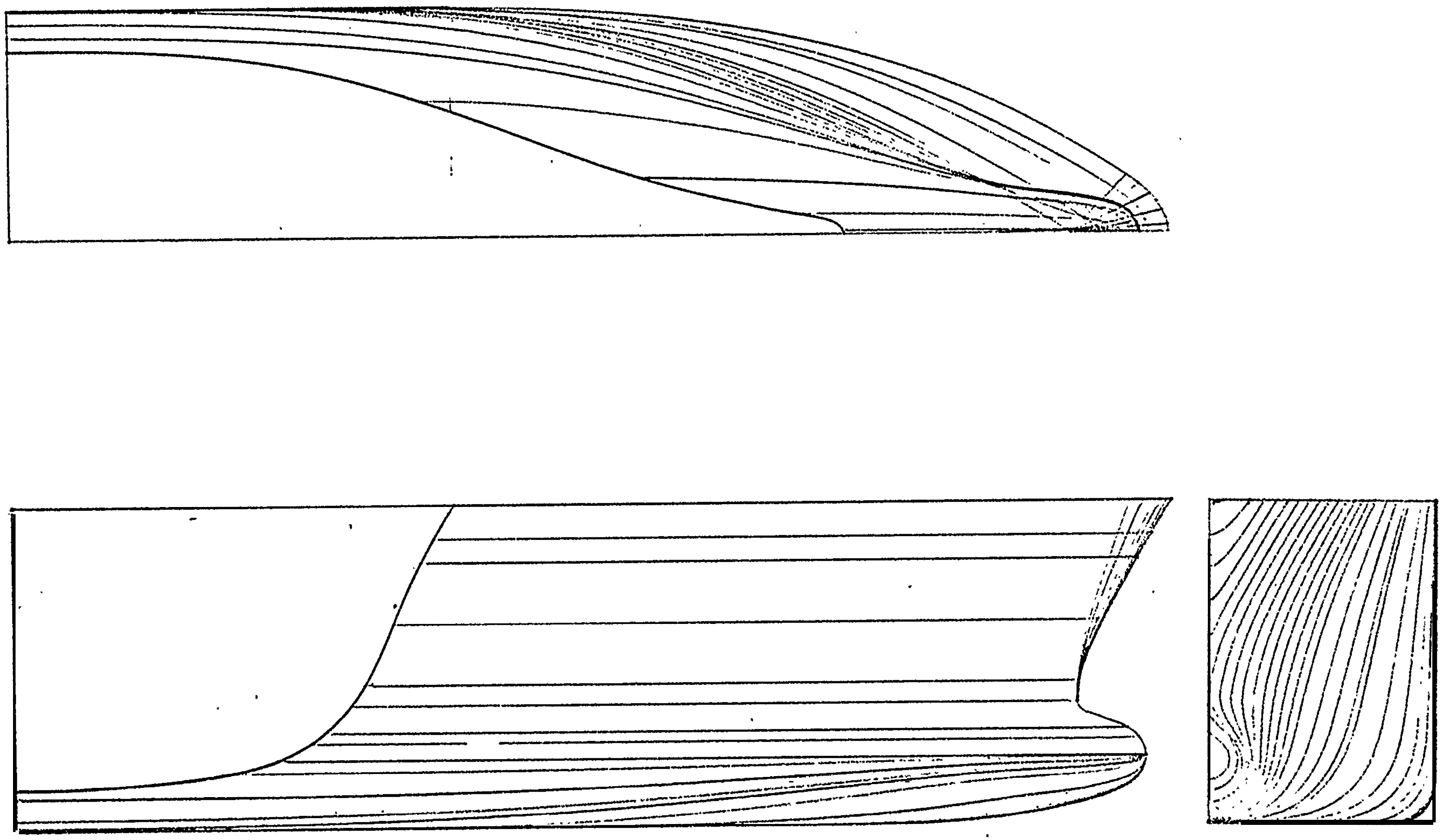

Figure I-4 Elevation and plan views of final reference lines and corresponding body plot

FAIRING EXAMPLE 2 (FORWARD SECTION OF AN OCEAN' LINER)

A. The Ship used for this example is the T.S.S. Carnivale, an ocean liner of principal dimensions:

Length OA - 635'
Length BP - 616'
Beam MLD - 85'
Draft 28.9'
Deadrise 6" in 42.5' Half Breadth
Bilge Radius 11.25'

The example, although used to test the program, was in this shipyard for overhaul and repair of some damaged framing and shell plating. Consequently, only the forward half (containing the damaged area) was defined. Figure 11-5 is the completed traditional three view lines drawing of the example.

B. This example is similar to the Series 60 Merchant Type hull fully developed in the HULDEF documentation. The user attempted to utilize the documentation to reproduce those results for this example. Two other methods of definition not outlined in the documentation were also attempted as additional tests for the program.

c. First, a data file was created using the station ordinates, flat-of-side data, flat-of-bottom data, deck and centerline profile from the design offsets. Figure II-6 is the graphic output of that file. Approximately 40 hours were used to create the file.

D. The first method used to develop the hull. surface, as explained in the HULDEF documentation, took the longest time of the three methods used. It required approximately 100 hours to 'complete this file.

1. First," fractional girths were generated from the stations, along with the beginning and ending tangents at each station input point.

2. Diagonals were then. generated, starting at the intersection of the stera and deck, and running through the intersection of the girths and a convenient station. The beginning and end tangents at each station were also found.

3. The girths and diagonals were joined at their intersections along with the proper beginning and end tangents to maintain continuity.

4. This information was used to create a new data file.

Comments

The length of time required to complete the first method of hull definition was needed due to the need to determine two different families of lines, (i.e. girths, diagonals), then find the required tangents, delete any portion of the lines extending past the intersection and piece the information together to form the file. Several areas, notably at the stem, are void of any control and would still. need additional definition.

E. The second method used was to entirely eliminate the diagonals; defining the ship with fractional girths only. This was made possible by editing the original HULDEF data file containing the stations. A “dummy” station was created at the intersection of the stem and the deck (straight line from stem to baseline),- and extensions of the next two stations from the centerline, to the baseline, figure II-7, This continuity of stations from the deck edge to the baseline created a family of girths able to define the surface by themselves. The approximate time required to complete this file *was* 60 hours.

1. Fractional girths were generated from the altered. HULDEF, data file as in paragraph D-1 above.

2. The intersection of each girth with the centerline at the bow was generated and inserted in the new data file. All girth data forward of the centerline was then deleted.

Comments

Using girths alone saved a large amount of time over the' previous method. It also provided better definition of the area near the forefoot and at the stem, as the girths end on the stem and not at the intersection of the stem and deck.

F. The last method attempted utilized waterlines as the family of lines for surface definition. This was done as a test to determine if waterlines could adequately define the hull surface in a shorter time period than the other methods. As the total hull surface of the example could be defined by a family of waterlines,"hull continuity could still be maintained. The results showed that in a significantly shorter time, the example could be adequately defined by waterlines. However, the hull of the example is quite different from most ships faired at larger shipyards. Bulbous bows, no deadrise, knuckles, etc. would render definition with waterlines virtually useless. It is included here only to show that the HULDEF user has a number of techniques available which, when used alone or in combination with other methods, should optimize the definition of a hull form. The approximate time required to complete the file was 30 hours, which represents a large savings. of time over the other two methods.

1. A HULDEF auxiliary module, INTLP, which intersects lines and plans was used to determine the intersection of the waterline planes with the stations in the original HULDEF data file. One

further advantage of the INTLP module is the ability to locate the intersections of the centerline with the waterline planes at the same time.

Therefore, at the bow of the ship, no extraneous data was generated which had to be deleted at a later time, as in the other methods.

2. When the waterline information.was used to create a new HULDEF data file, Figure 11-9. resulted.

Comments

One interesting sideline occurred with an input station which was known to be producing inflections in the waterlines. After that station was deleted and new waterline intersections found and plotted, they came out smooth through that region, producing a fair station.

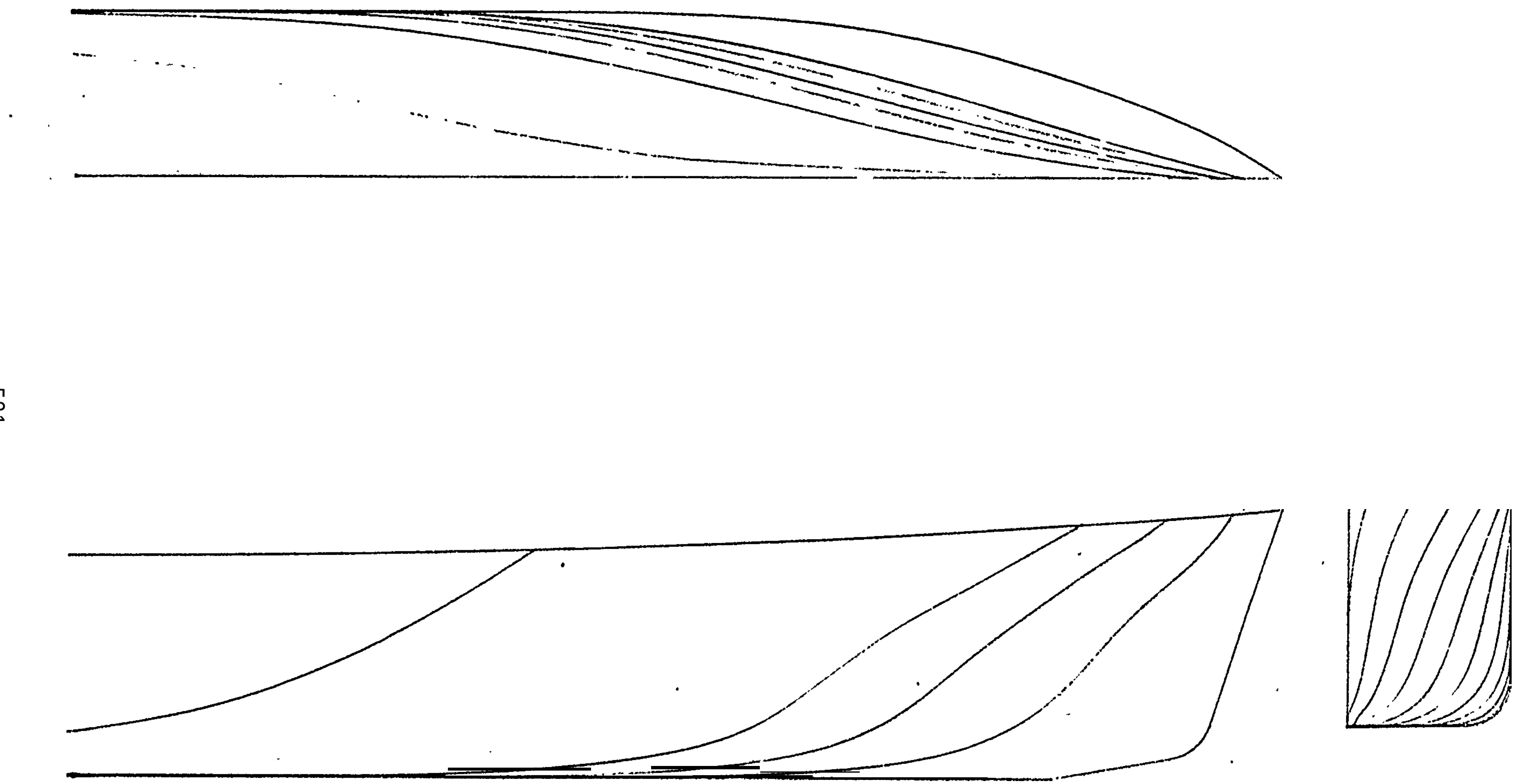

Figure II-5 Traditional three views of Buttocks, Waterlines, and Stations

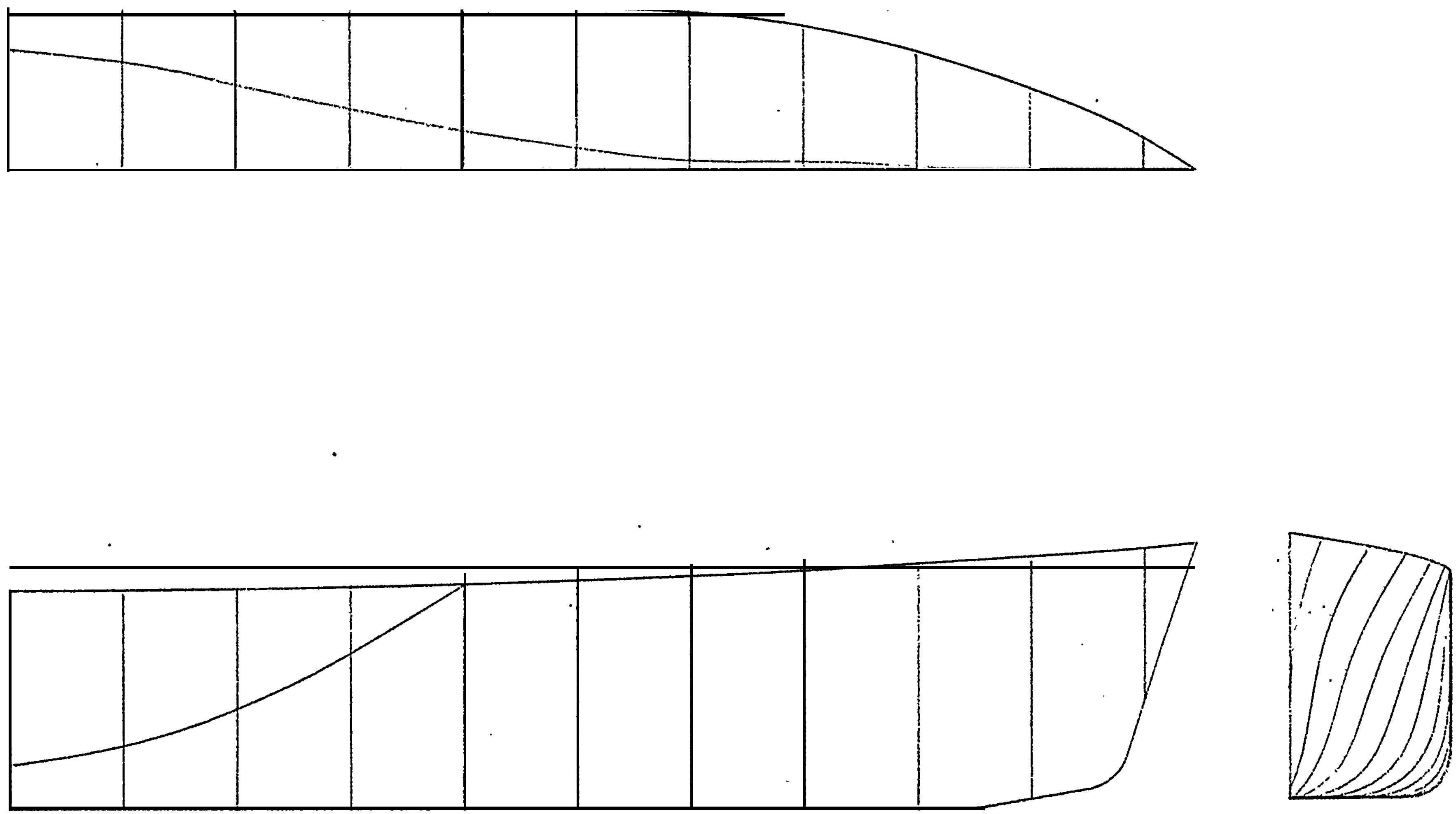

Figure II-6 Conventional three views of Control lines and Stations

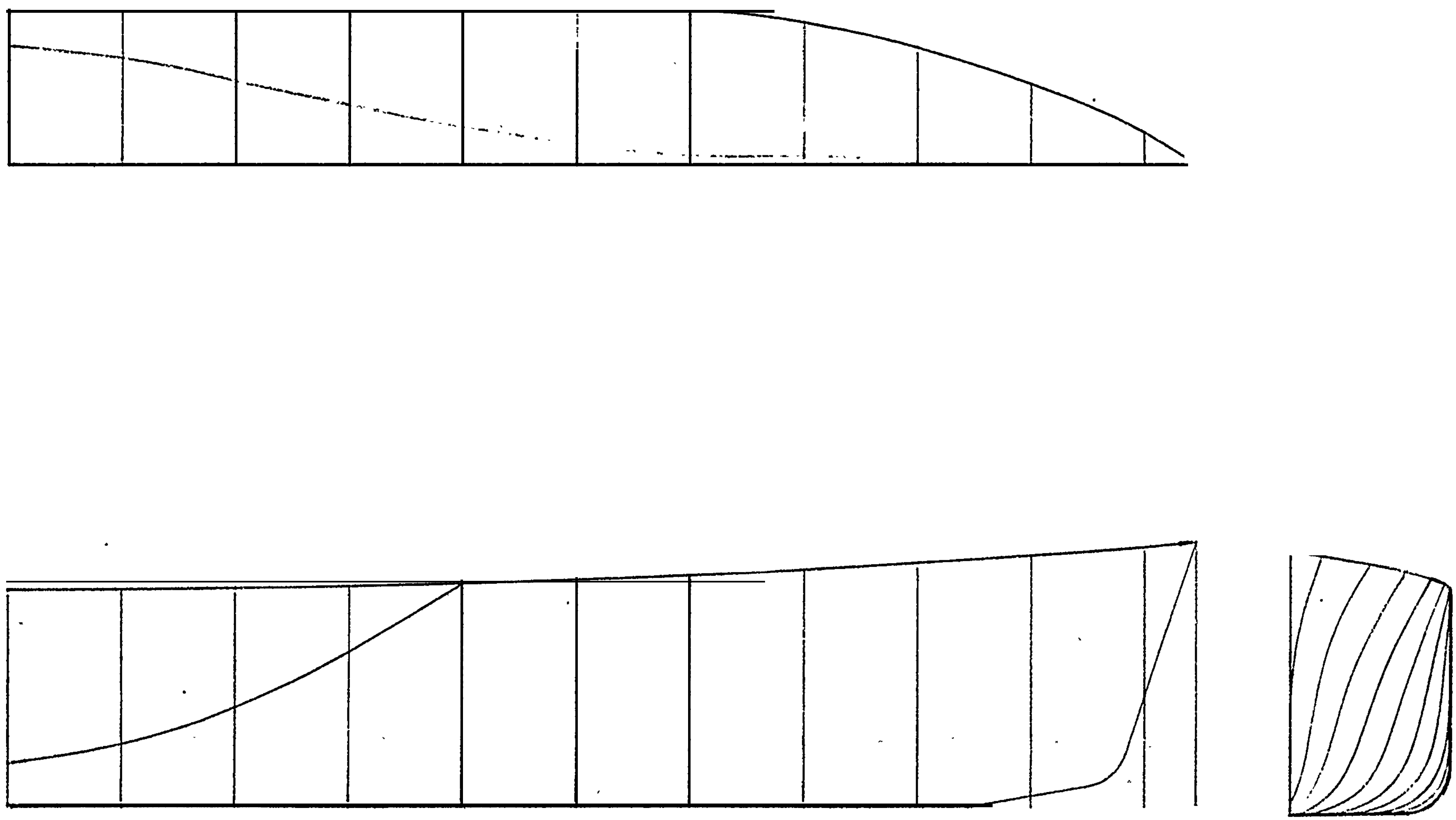

Figure [illegible] * [illegible]e views of Control lines and extended forward Stations

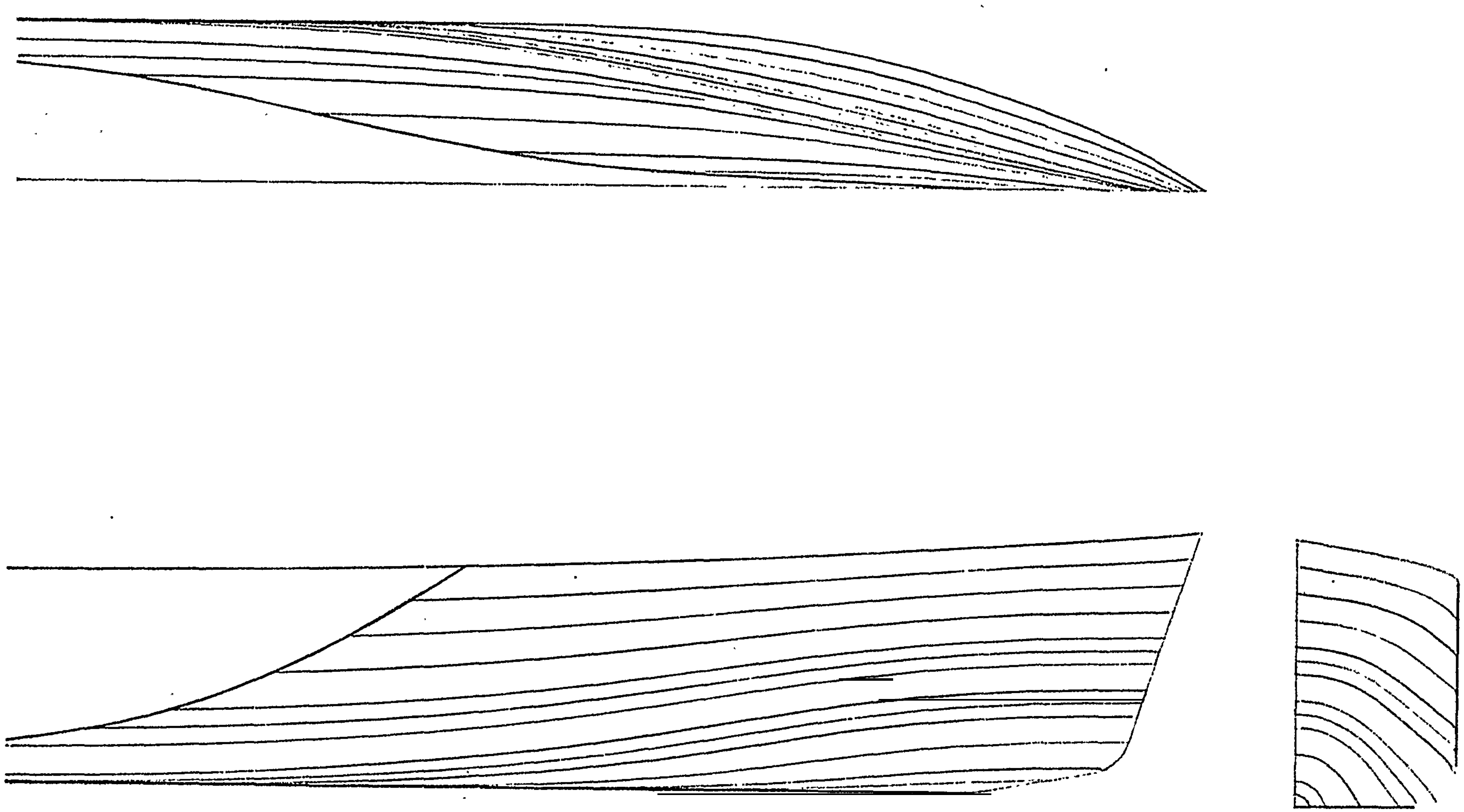

Figure II-8 Three views of Control lines and Iso-girth lines

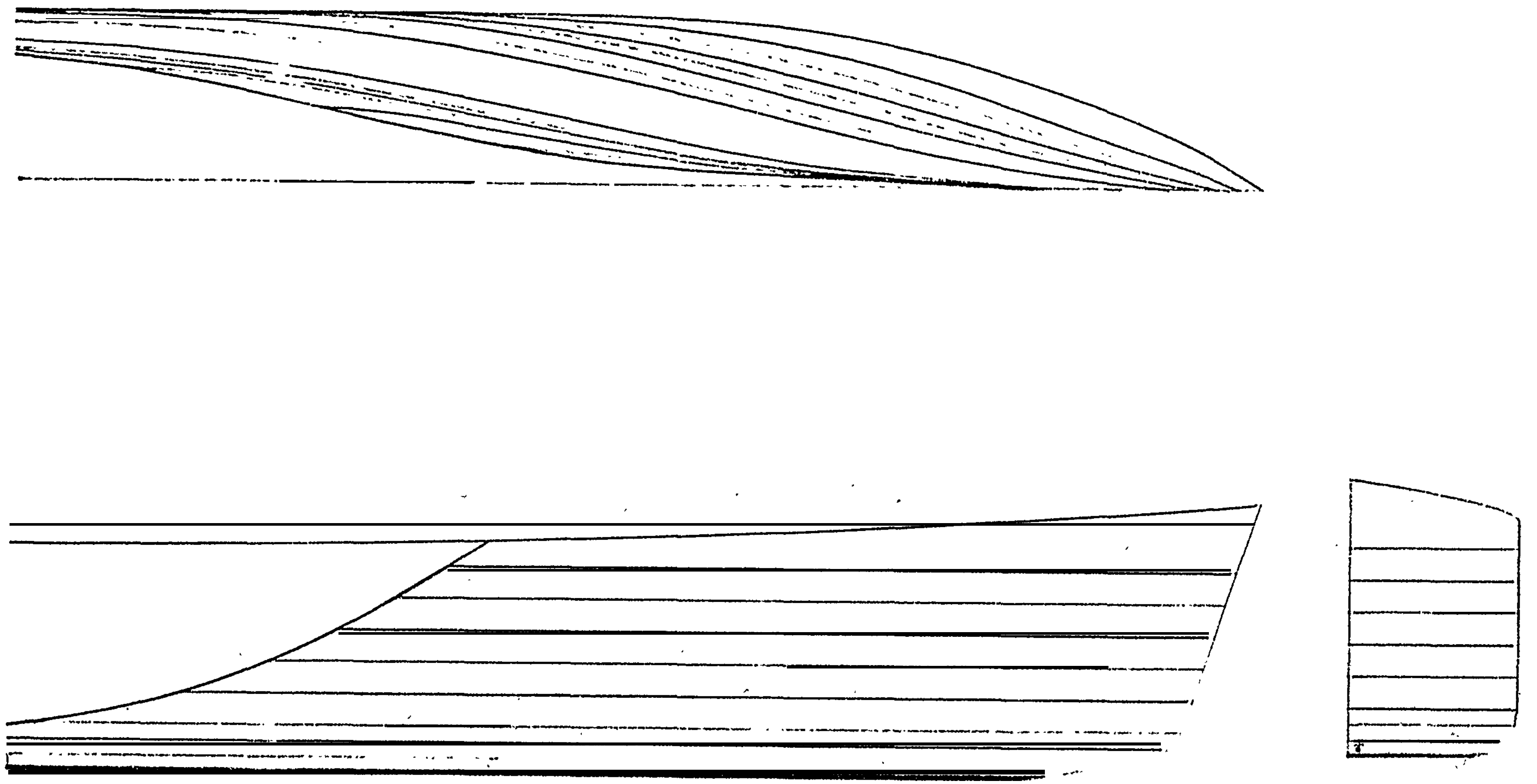

Figure II-9 Three views of Control lines and Water lines

FAIRING EXAMPLE 3, (A HARD CHINED, BOAT)

The definition of a small boat (36 feet overall) was done using hand written offsets as original data. There was no flat-of-side or flat-of-bottom on the vessel and was originally intended to have, ’distinct chines.

The initial attempt was made using as little data as possible, namely the deck line, sheer line, centerline, and a tangency line (inboard of which the stations were straight) as the only data. This resulted in Figure II-10 and proved to have too little control. After using the DIF12 module to determine minor adjustments needed, and adding the five foot design waterline, Figure II-11 resulted.

After changing a few more data points, these five lines met the users criteria of fair, so the FRACG module was used to get several additional data points for station definition. Figure II-12 was the result of using girths of 5, 10, 25, 40, 50, 60, 75, and 90 percent.

The output from FRACG was then used with the INTLP module to get station intersections at these girths. Selected points were then combined with the original five lines to get a “fair” ship. The resulting plots looked similar to Figure 11-11. The PRBO option was used and the printed book of offsets were compared to the hand written offsets. The comparison was favorable for test purposes (less than 1/8” difference in all cases) and ready to transfer to test database.

At this point it was decided to add a skeg to the ship. To do so, several more control lines were needed to get into the skeg and down to the baseline.

The EFIL option was now used (along with REVR to reverse the coordinate system to the AP) to set up a file to be transferred by the Autokon Program TRABO. Since HULDEF automatically numbers transverse sections from 101 on, and TRABO interprets these numbers as 1.01, 1.02, l.03--- etc., several runs were needed due to users errors to get the desired frame numbers (O, .5, 1, 1.5, 2, --- etc.) stored in the database.

The transferred contour matrices were listed and appeared to be in the proper format for other Autokon modules, so the LANSKI Program was used to define several longitudinal curves. The ship was treated as a whole, as well as a forward section and an aft section. All the plots and printouts generated by LANSKI compared favorably with the original offsets and the HULDEF plots.

A total of 120-160 manhours was used to do this portion of testing of the HULDEF Program.

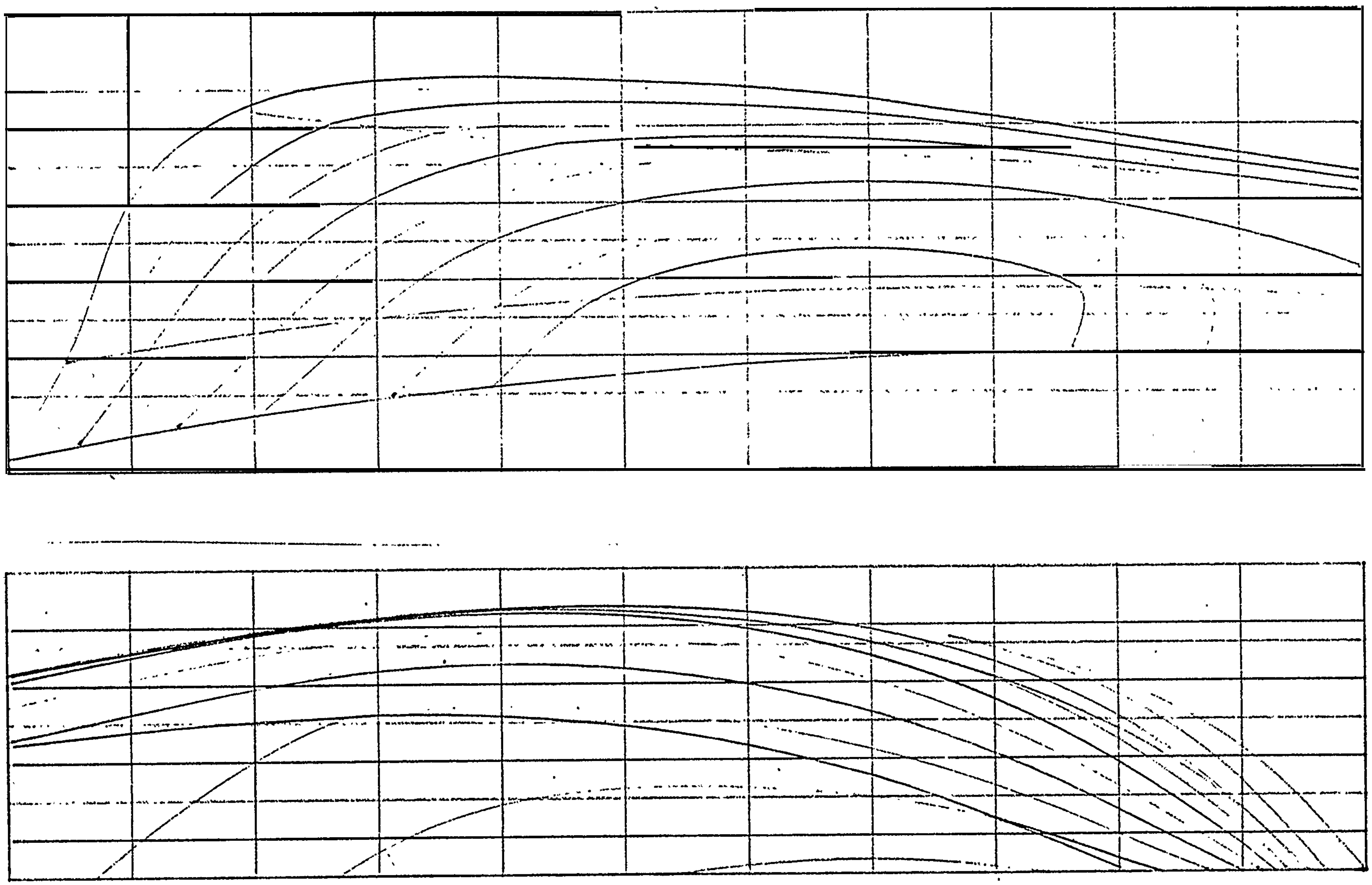

Figure II-10 Traditional three views of Buttocks, Waterlines, and Stations

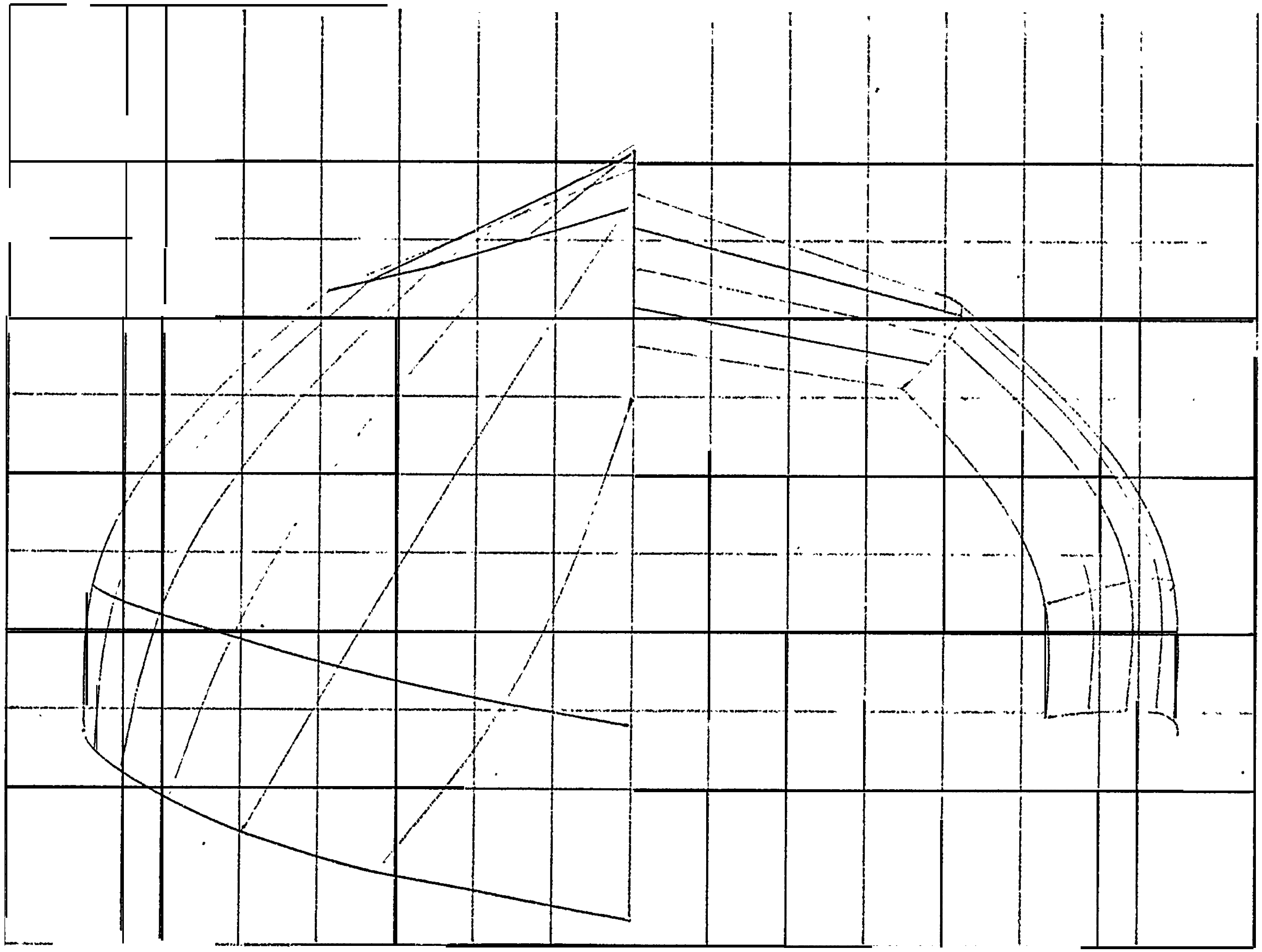

Figure II-10 (concluded)

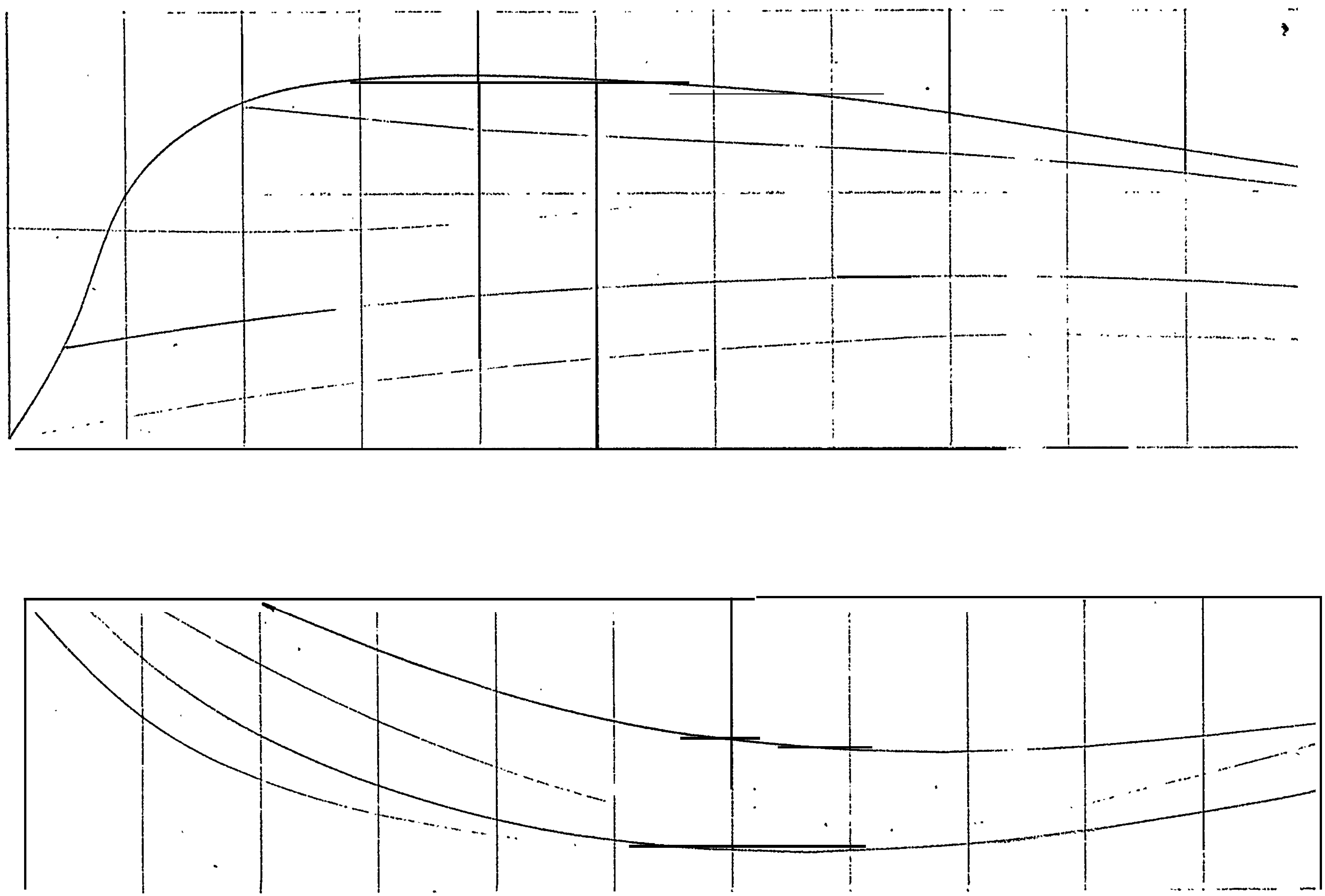

Figure II-11 Conventional three views of Stations and Reference lines

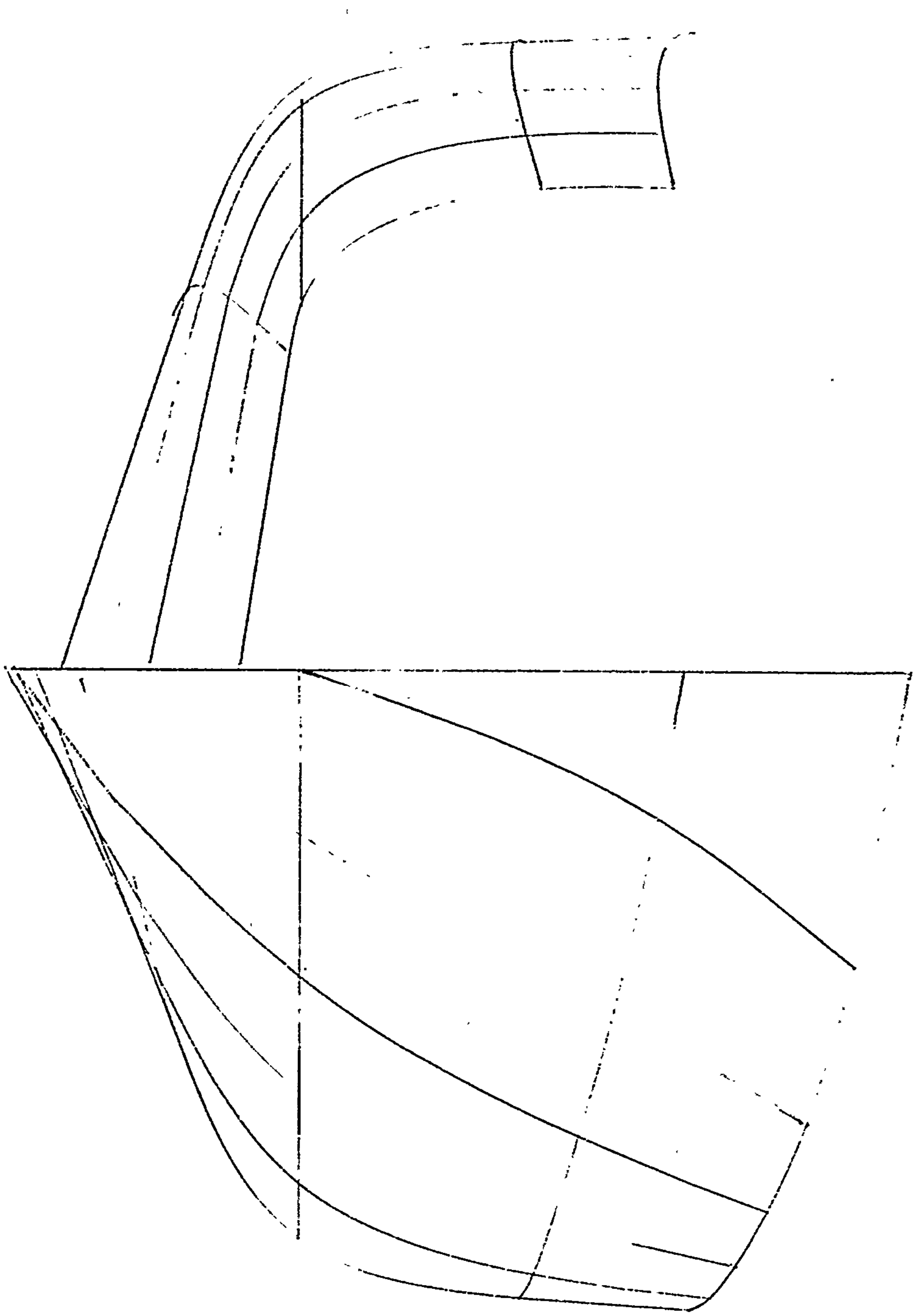

Figure II-11 (concluded)

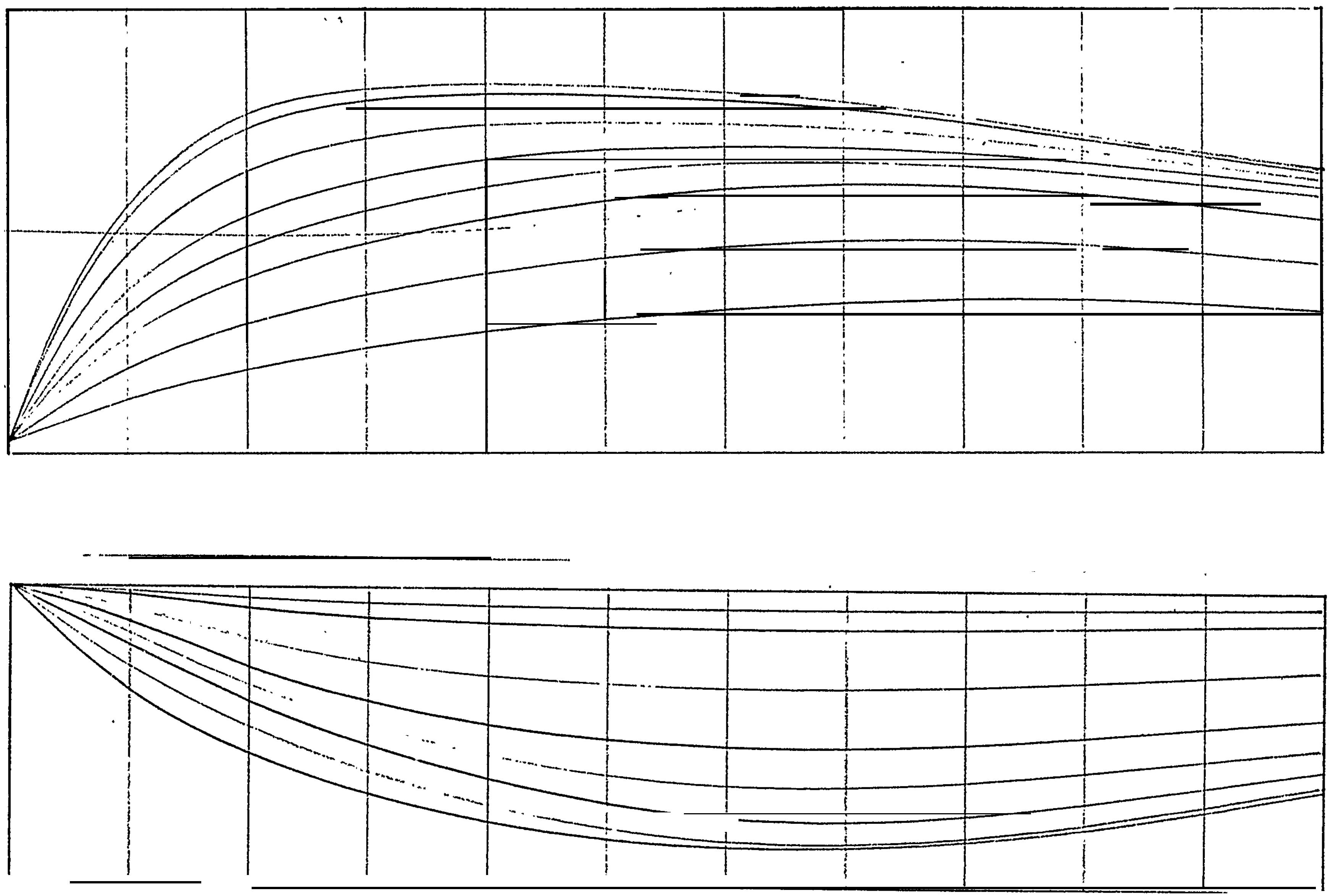

Figure II-12 Conventional three views of Stations and Iso-girth lines

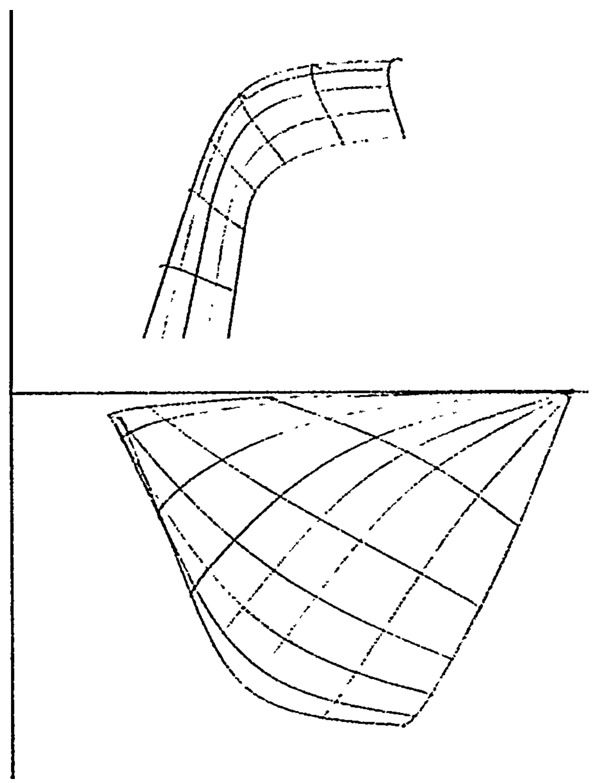

Figure 11-12 (concluded)

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