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EXTRACT A PROGRAM FOR EXTRACTING A SECTION OF A FINITE ELEMENT MODEL FOR TOP-DOWN-MODELLING

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EXTRACT A PROGRAM FOR EXTRACTING A SECTION OF A FINITE ELEMENT MODEL FOR TOP-DOWN-MODELLING

by
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CONTRACTOR REPORT

Prepared for

Defence Research Establishment Atlantic

Centre de Recherches pour la Défense Atlantique

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Abstract

EXTRACT is a computer program designed to extract a portion of a large finite element model to obtain more detailed displacements and stresses. In addition the program applies boundary conditions to the extracted region in the form of prescribed displacements obtained from a previous analysis of the large model. The extracted portion can be refined by the use of a special refining program or by hand modelling. Hydrostatic pressure on the portion, due to balance-on-a-wave loading, is applied by EXTRACT. The extracted model created, along with its associated boundary and load conditions, is in a form suitable for a finite element analysis to obtain displacements and stresses.

Résumé

EXTRACT est un logiciel conçu pour extraire une partie d'un modèle étendu à éléments finis afin de fournir plus de détails sur les déplacements et les contraintes. De plus, le programme applique des conditions limites à la région extraite, sous la forme des déplacements prescrits obtenus d'une analyse antérieure du modèle étendu. Il est possible de raffiner la partie extraite au moyen d'un programme spécial ou par modélisation manuelle. EXTRACT applique la pression hydrostatique à cette partie, en raison de l'effet de charge dû au balancement sur les vagues. Le modèle extrait qui est créé, dans les conditions pertinentes de limite et de charge, se présente dans une forme qui convient à l'analyse des éléments finis pour l'obtention des déplacements et des contraintes.

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1 Introduction

This report describes the program EXTRACT which has been developed to carry out the extraction of a portion of a finite element model as part of the procedure for top-down modelling. Top-down modelling of a ship structure is based on initially creating a coarse finite element model of a ship hull structure in the format of a finite element program such as VAST[1]. The model is placed under load to obtain the boundary conditions for a region of the ship where a detailed structural analysis is to be carried out. The region of interest is extracted and refined to the degree of detail required. Boundary displacements for the refined model are obtained from an analysis of the large model and they together with the load on the extracted region are applied to obtain stresses and displacements in the refined model. An illustration of this procedure is given in reference[2].

2 Program Organization

EXTRACT is an interactive program using PLOT10[3] or GKS[4] graphics through an interface program PLOTVX [5]. It has been organized as a suite of subroutines with which a portion of the finite element model of a ship hull, in VAST data format, can be extracted. The program also extracts the boundary displacements of the extracted model from a file generated by an analysis of the large ship hull model. These are applied to the extracted model as prescribed displacements. The hydrostatic pressure due to a balance-on-a-wave loading, which was applied to the full hull model in the region of the extraction, is reapplied by EXTRACT to the extracted model. The axis system for the models is a right handed system as shown in Figure 1. The Z axis is the longitudinal axis of the hull.

2.1 Subroutines

The main body of the program displays terminal prompts requesting a five character name to be assigned to the extracted portion. A second prompt requests the five character prefix name of the full ship model VAST finite element file. An option is provided to take the full crossection or the nearest or farthest half section from the hull centre line. The full model is then displayed on the screen along with the cursor crosshairs which are used to outline and enlarge the region to be extracted. This is followed by a display of the enlarged region on which the extracted portion is outlined by windowing.

SUBROUTINE DISPLACE is called from the main routine after outlining the region to be extracted. It expects to find a VAST results file of nodal displacements for the large ship model which has been converted from the binary file PREFX.T52 to a formated ASCII file PREFX.DISP. If the file PREFX.DISP does not exist a terminal prompt is displayed requesting the program DISPLCON be run to convert the VAST displacement file from binary to ASCII. The extracted model is then displayed on the screen and the boundaries, at which the nodal displacements from the large model are to be applied, are identified by windowing thereby creating the following files;

1. PREFX.GOM the extracted finite element model file
2. PREFX.SMD the constraints file
3. PREFX.EQUI which lists the renumbered nodes of the extracted model and their equivalence in the large model.
4. PREFX.DIS the prescribed displacement file

SUBROUTINE PLOTEX is called from DISPLACE and provides the ability to add additional boundary conditions to the extracted model when rotated 90 degrees about the longitudinal axis Z.

SUBROUTINE IDENT is called from the main routine, after the extracted model and its boundary conditions have been obtain, if loading of the model is required. It plots the model and is used to identify the parts of the model, such as the hull side, which are to be loaded. At this stage the extracted model plot can be rotated for easier viewing of its parts.

SUBROUTINE READV is called from IDENT. It reads in the extracted finite element model data from file PREFX.GOM. The data is then used for the identification of the model parts.

SUBROUTINE ESELECT is called from IDENT and is used to search the model data to find the element groups identified as parts to be loaded with hydrostatic pressures due to balance-on-a-wave. Self weight or element loads due to vertical acceleration can be accounted for as well.

SUBROUTINE PROFILE is called from ESELECT. It expects to find a file, PROFL.DAT, generated by the program POSBOW[6]. The file is the balance-on-a-wave profile from which the hydrostatic pressures on the model are determined. The subroutine creates the load file PREFX.LOD.

SUBROUTINE READC is called from PROFILE and is used to read the nodal coordinates from the extracted model finite element file PREFX.GOM.

SUBROUTINE SPLN1 is called from ESELECT. It is used to spline for intermediate points to obtain the hydrostatic head on the nodes of the extracted model which are under the wave profile.

SUBROUTINE LIMITS sets the screen window dimensions in raster units for plotting.

SUBROUTINE DDMAX determines the maximum and minimium values of the model's X,Y, and Z coordinates.

SUBROUTINE ROTAT rotates the model views as required.

The following subroutines are components of the plotting program PLOTVX;

1. PLOTLN plots model lines

2. PLTCS displays prompts on screen
3. POPPUP display prompts in pasteboard form
4. PLOTSY plots symbols
5. TERCTN is a series of terminal control functions
6. CURSOR is the cursor control of the window crosshairs

2.2 Include Statements

The following include statements, listed in Appendix A, are shared with the program SHPHUL[7] and are used throughout the program to allow for easy change of parameters.

1. SHPHUL.PAR are the sizes set for the arrays used in the program.
2. SHPHUL.GEN initializes plotting and terminal attributes etc.
3. SHPHUL.GOM sets nodal coordinate arrays.

3 Program Operation

Because EXTRACT has been designed to extract a region of a large model subjected to balance-on-a-wave loading, the large model must include the full length of the ship. A finite element model of half a ship hull, sectioned by the YZ plane at the centre line along the full length, may be used as shown in Figure 2. A region to be extracted from the half model is shown windowed on the half model in Figure 3. The extracted finite element model in VAST format model is shown in Figure 4. The nodal displacements resulting from a VAST analysis of the large model must be converted from binary to ASCII form by the use of the conversion program DISPLCON. A listing of the program is given in Appendix B. A profile of the wave loading on the model, if not available, is obtained by running the interactive version of the program POSBOW. The loading command for POSBOW and an example terminal session is given in Appendix C.

3.1 Terminal Session

A terminal session is provided as a guide in the program operation. The prompts are displayed in graphic form by the use of the subroutine POPUPP in the PLOTVX suite of graphic subroutines.

To load the program on a VAX VMS system requires the following load command.

```
$FOR/NOOPT/CHECK EXTRACT.DRS
$LINK EXTRACT,-
PS_9:[SOURCE.LIB.V60]PLOTVX,PLOTV,MARLIB,PL4113,-
DREAGUI,PS_9:[SOURCE.LIB.OLD]PLOT10/LIB

RUN EXTRACT

WHAT IS THE LINE SPEED?
9600
```

The baud rate of the communication link with the terminal is requested.

```
IDENTIFY TERMINAL TYPE ACCORDING TO RESOLUTION,
CURSOR AND COLOUR CAPABILITY:
ENTER 0 FOR TEKTRONIX 4006 (LOW RES/NO CURS/NO COL)
      1 FOR TEKTRONIX 4010/12/13 (LOW RES/CURSORS/NO COL)
      2 FOR TEKTRONIX 4014/4015  (HI RES/CURSORS/NO COL)
      3 FOR TEKTRONIX 41XX/42XX OR 4014/4015-EGM (COLOUR)
1
```

The program has been designed to run on Tektronix terminals or terminals with Tektronix emulation packages. In this case a 4010 terminal is assumed.

```
IDENTIFY TERMINAL TYPE ACCORDING TO DIALOG CAPABILITY:
ENTER 0 NO DIALOG AREA
      1 DIALOG AREA

0
```

The terminal type chosen has no dialog display capability.

```
ENTER THE FIVE CHARACTER NAME OF THE SECTION TO BE EXTRACTED
FROM THE ASSEMBLED MODEL

SHPEX
```

The file on which the finite element model of the section to be extracted will be stored must be identified by any five character prefix. The prefix chosen in this case is SHPEX.

```
ENTER THE FIVE CHARACTER NAME OF THE ASSEMBLED SECTIONS
OF THE VAST GEOMETRY FILE FROM WHICH THE SECTION IS
TO BE EXTRACTED

SHPAS
```

The five character name of the large finite element model of the ship hull, in VAST format, is required.

```
CHOOSE FROM THE FOLLOWING
0 = THE FULL CROSSECTION SECTION TO IS BE EXTRACTED
1 = NEAREST HALF OF THE CROSSECTION IS TO BE EXTRACTED
2 = FARTHEST HALF OF THE CROSSECTION IS TO BE EXTRACTED

1
```

The section or portion extracted may be a full cross-section or half a section from either side of the longitudinal centre line. After the selection is made, the full hull model is displayed as shown in Figure 5. The region from which the extraction is to be made is windowed to produce an enlarged view for better vizualization. The window is formed with the terminal cursor by locating the lower left hand corner and the upper right hand corner and pressing the character P on the keyboard.

The enlarged view of the region prior to extraction is shown in Figure 6. Figure 7 shows the window used to locate the region to be extracted . The nodal points are marked with circles to indicate that the extraction has been made.

```
ENTER
0 TO STOP WITH NO FILES CREATED
1 TO CREATE A VAST GEOMETRY FILE OF THE EXTRACTED SECTION

1
```

A VAST finite element file of the extracted region can be created at this stage. The creation of the file is followed by the selection of the boundary conditions with windows formed by the use of the termimnal cursor, as shown in Figure 8. The boundary conditions are in the form of prescribed displacements obtained from the equivalent nodes from the analysis of the large model. A maximum of four windows can be used to identify the nodes on which the prescribed displacements are to be applied. Those windows not used are dumped by moving the crosshairs off the model and pressing P until the crosshairs disappear and the screen is erased.

```
ENTER
0 TO CONTINUE
1 TO ROTATE MODEL AND WINDOW TO DEFINE ADDITIONAL
  BOUNDARY CONDITIONS
```

```
1
```

The model can be rotated 90 degrees in the positive direction about the longitudinal axis if additional boundary conditions are required as in the case of an extracted half section. The boundary conditions are located by windowing the nodes as previously described and as shown in Figure 9. Again four windows are available.

```
THE PRESCRIBED DISPLACEMENT FILE SHPEX.DIS HAS BEEN CREATED
FOR EXTRACTED SECTION SHPEX.GOM
THE CONSTRAINTS FILE SHPEX.SMD HAS BEEN ADJUSTED
THE NODAL EQUIVALENCE FILE IS SHPEX.EQUI
 ENTER
  0 TO CONTINUE AND LOAD MODEL
  1 TO STOP
```

```
0
```

Once the boundary conditions have been defined the VAST analysis files, except for the load file, are created. The input at this stage can be ended if the extracted model has no load acting on it. It is also at this stage that the model can be refined by a program such as VASFEM[8]. In the case of VASFEM the boundary conditions are refined for three dimensional models, however, the node numbering of the unrefined extracted model is retained within the new node numbering. Provided the boundaries are chosen a suitable distance from the area of the detail, reasonable results can be obtained by applying the displacements from the unrefined model to the retained boundary nodes. If hydrostatic pressure covers the extracted region then the model can be loaded by continuing to the loading phase. EXTRACT can load the unrefined or the refined extracted model. In the following example only the unrefined model is loaded.

```
ENTER THE ANGLES OF ROTATION ABOUT X Y Z AXES
TO DISPLAY MODEL FOR IDENTIFICATION OF HULL PARTS
```

```
10 10 10
```

The parts of the model that are under load must be identified. To make the identification easier the model can be rotated to any convenient position as illustrated in Figure 10.

```
TO IDENTIFY HULL PARTS ENTER AFTER EACH PANEL DISPLAY
S = SIDE
D = DECK
B = BULKHEAD
 ENTER C TO CONTINUE/
---
C
```

The panels forming the model are displayed in sequence to identify their place in the structure until the full extracted model of Figure 10 is displayed.

```
SELECT GRAVITY AXIS AND DIRECTION
1 = X    2 = -X
3 = Y    4 = -Y
---
3
```

The axis of any acceleration such as that due to gravity is required at this point. It is required for selfweight or to smear non structural weight into the model elements.

```
ENTER G FORCE MULTIPLIER
      1 FOR SELF WEIGHT
---
1
```

For selfweight a G force multiplier of one is required. If during the analysis of the large model a G force multiplier was used to achieve a static balance, because the non structural weight was not distributed in lumped mass form, then the same multiplier must be entered at this time.

```
BALANCE ON A WAVE LOADING

ENTER
0 = WAVE PROFILE ESTIMATED FROM WAVE HEIGHT FORMULA
1 = WAVE PROFILE FROM POSBOW PROGRAM
---------------------------------------------------
1
```

Balance on a wave loading can be specified either by the wave height formula or from the wave profile generated by the program POSBOW. The POSBOW program is described in Appendix 3. It is generally more convenient to choose the POSBOW option.

```
        WAVE HEIGHT DATA IN IN.
ENTER  0  TO CONTINUE  S  TO STOP
---------------------------------
0
```

The units of the data supplied by POSBOW in the file PROFL.DAT are given to determine if they are compatible with those used in the model.

```
ENTER
0 = AUTOMATICALLY APPLY PRESSURE LOAD
1 = DEFINE PRESSURE LOAD WITH WITH CURSOR
-----------------------------------------
0
```

If the POSBOW option is chosen then the pressure load will automatically be applied otherwise it must be defined with the cursor. In the case of definition with the cursor, a horizontal line showing the peak pressure will be displayed for reference. In the case of the automatic application of the load, the wave profile, superimposed on a portion of the extracted model, is displayed as shown in Figure 11.

```
ENTER A TITLE FOR THE LOADING CASE (MAX 62 CHAR)
------------------------------------------------
TEST OF EXTRACT
```

After the acceptance of the wave load profile, a title for the load case is requested for inclusion in the load file SHPEX.LOD. This is the last entry of the program run.

3.2 Plots of the VAST Files Created by EXTRACT

The VAST finite element files created by EXTRACT are listed below with their associated figures plotted using VASTG[9].

1. SPHEX.GOM produces the finite element model shown in Figure 12.
2. SHPEX.SMD produces the boundary conditions shown in Figure 13.
3. SPHEX.LOD produces the loading shown in Figure 14.

4 Summary

The computer program EXTRACT has been described and its ability to extract a portion of a large model, to create a smaller model suitable for grid refinement, has been demonstrated. Also shown was the collection and application of the boundary conditions from those produced by a finite element analysis of a large model. Finally the ability of program to apply balance-on-a-wave hydrostatic pressure loading on the extracted model was demonstrated.

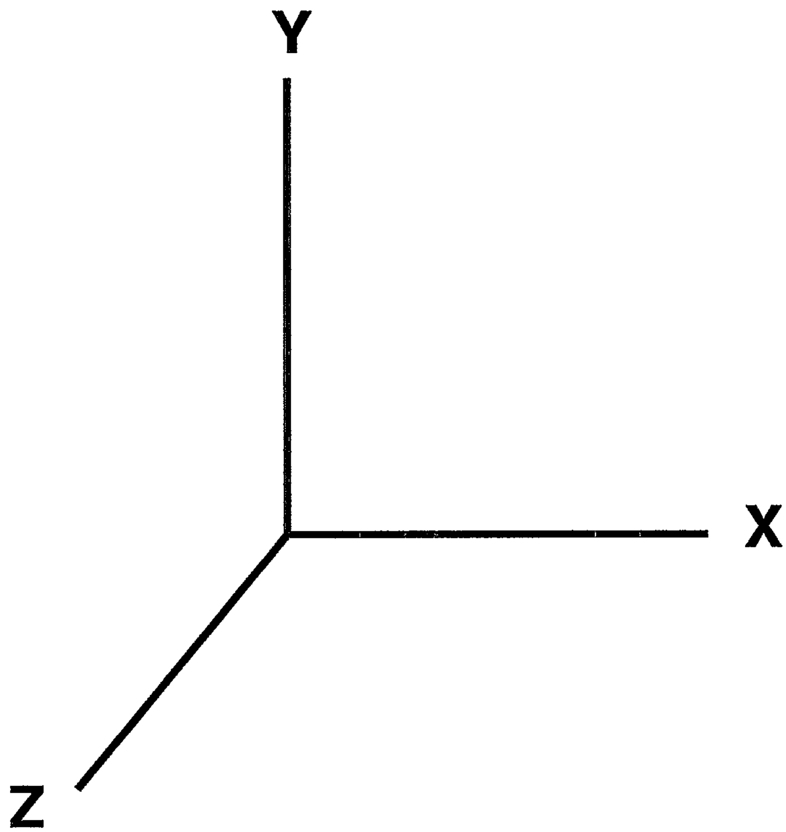

Figure 1: The Coordinate Axis System For EXTRACT

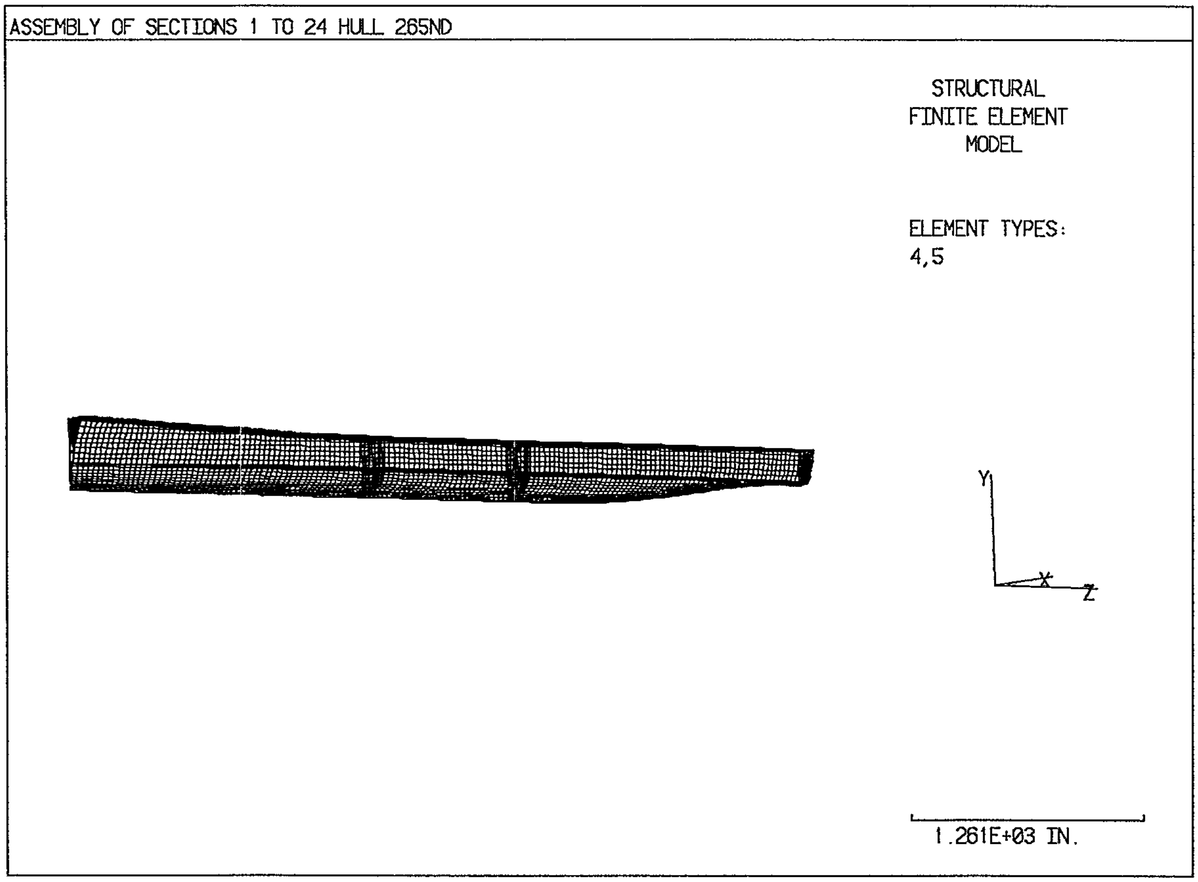

Figure 2: The Finite Element Model of the Half Hull

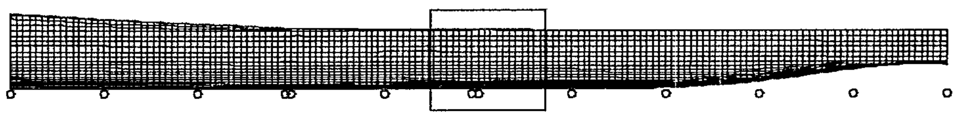

Figure 3: A Window on the Region to be Extracted from the Half Hull Model

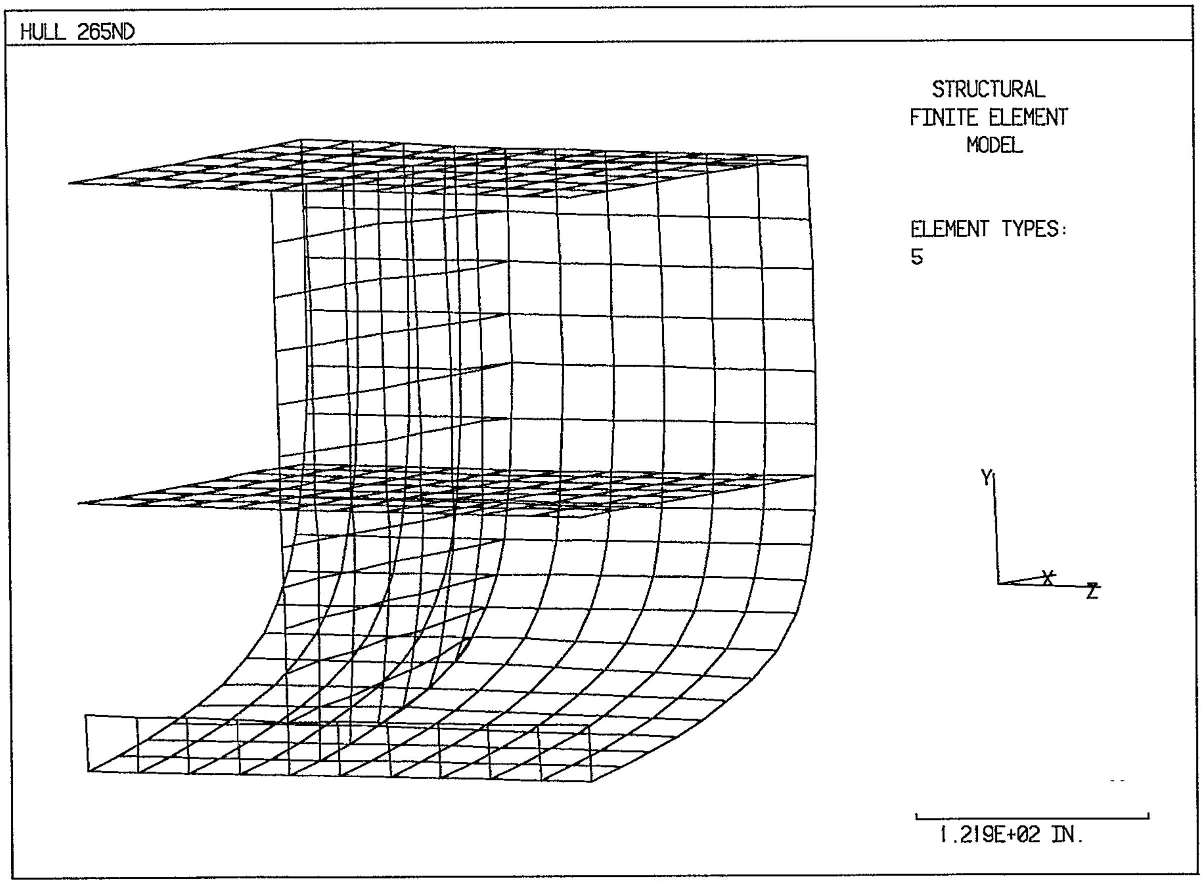

Figure 4: A Plot of the VAST Formatted Finite Element Model of the Region Extracted

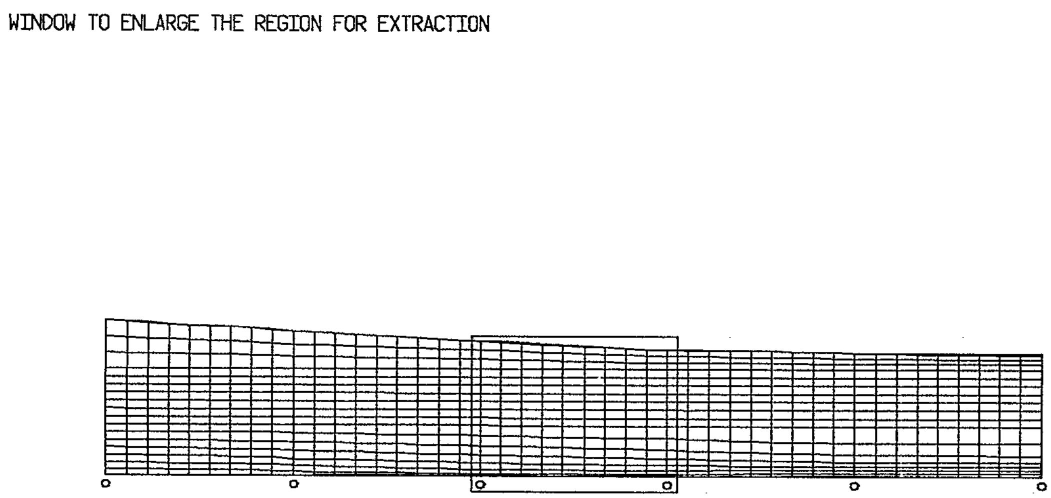

Figure 5: The Window on the Hull Model to Enlarge the Region for Extraction

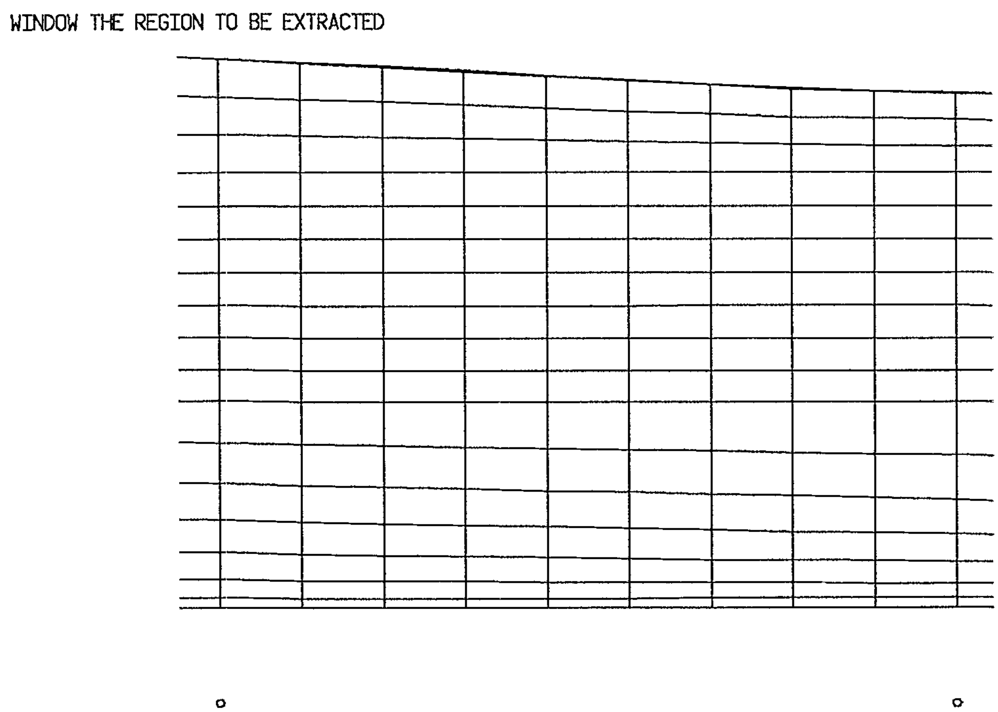

Figure 6: An Enlargement of the Region to be Extracted from the Hull Model

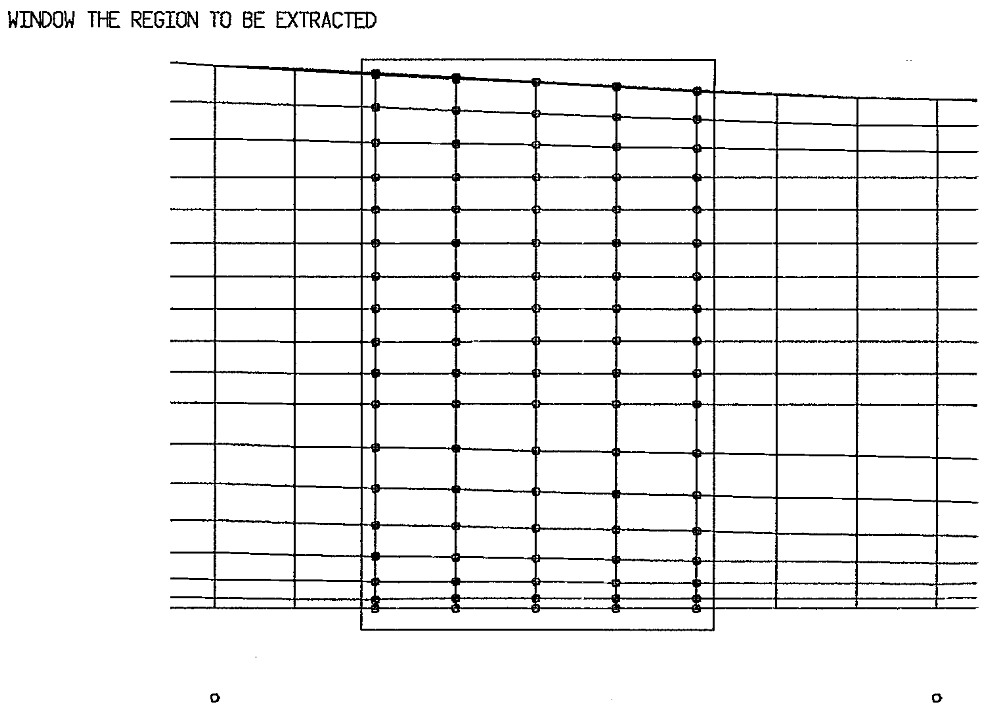

Figure 7: The Window of the Region to be Extracted from the Hull Model

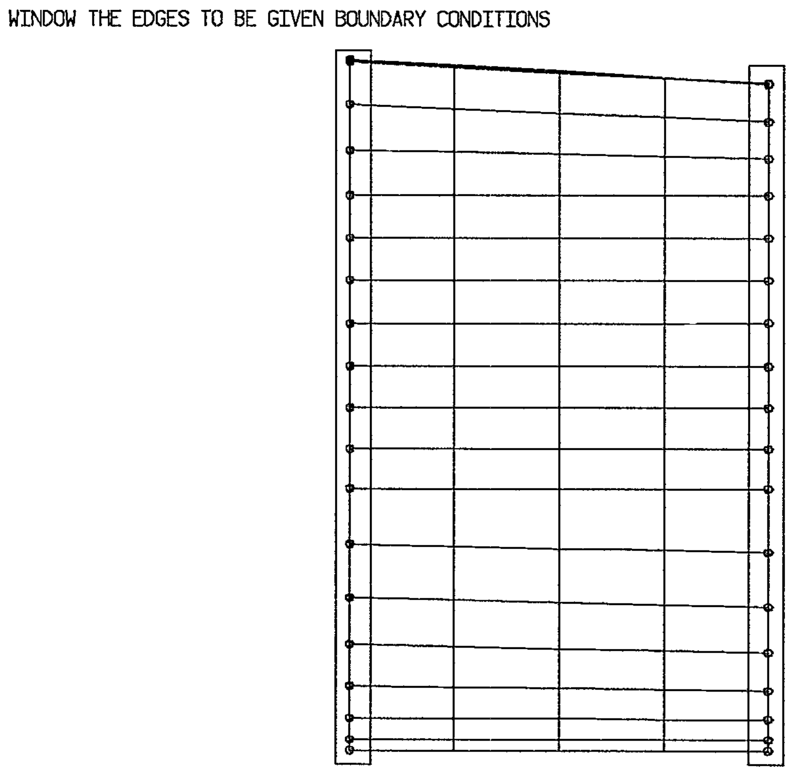

Figure 8: The Region Extracted from the Hull Model with the Boundary Conditions Identified

WINDOW THE EDGES TO BE GIVEN BOUNDARY CONDITIONS

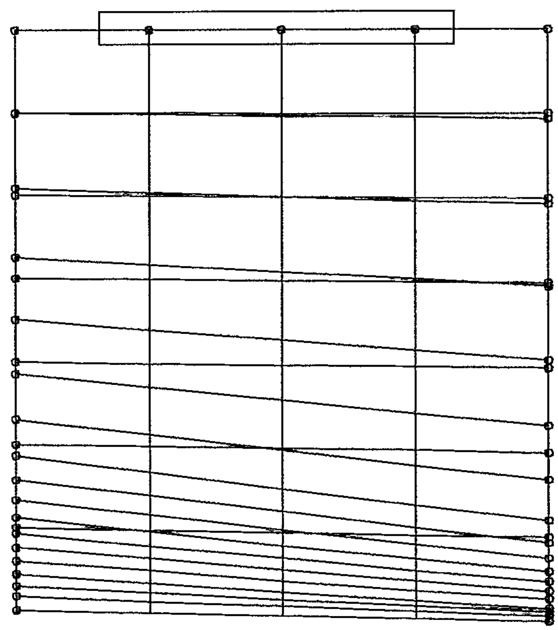

Figure 9: The Extracted Section Rotated and Additional Boundary Conditions Identified

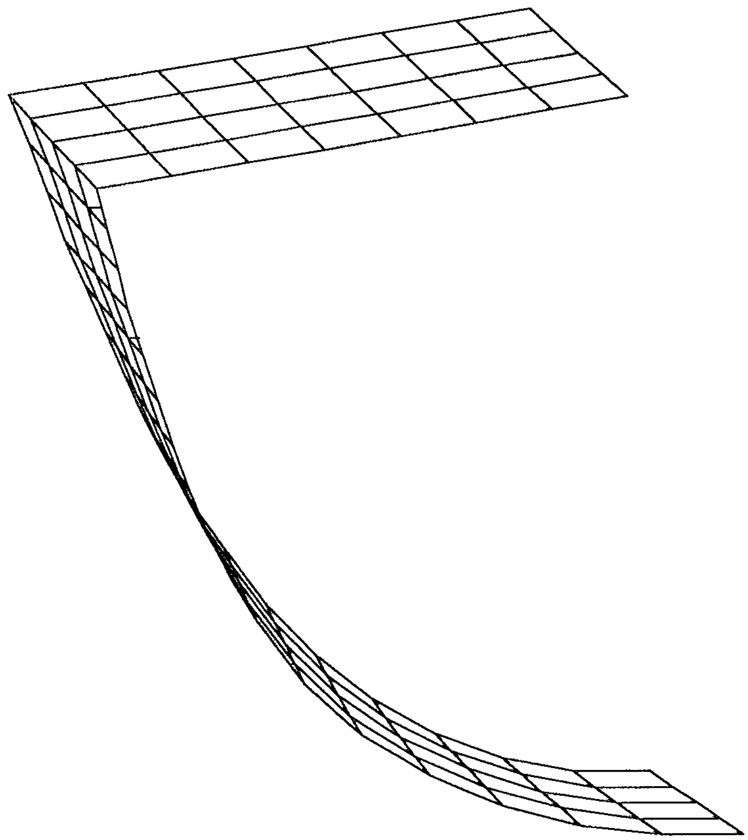

Figure 10: The Extracted Section on which the Loading will be Applied

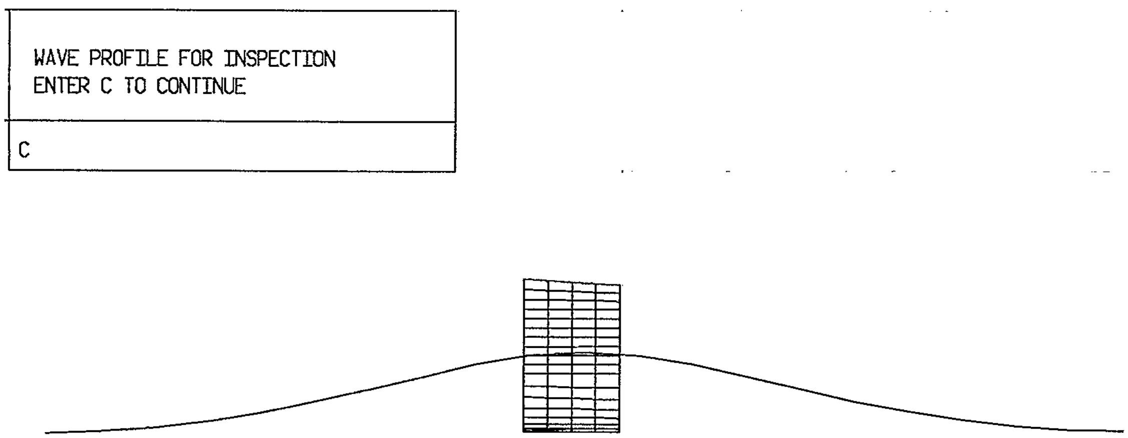

Figure 11: The Wave Profile Superimposed on the Extracted Section

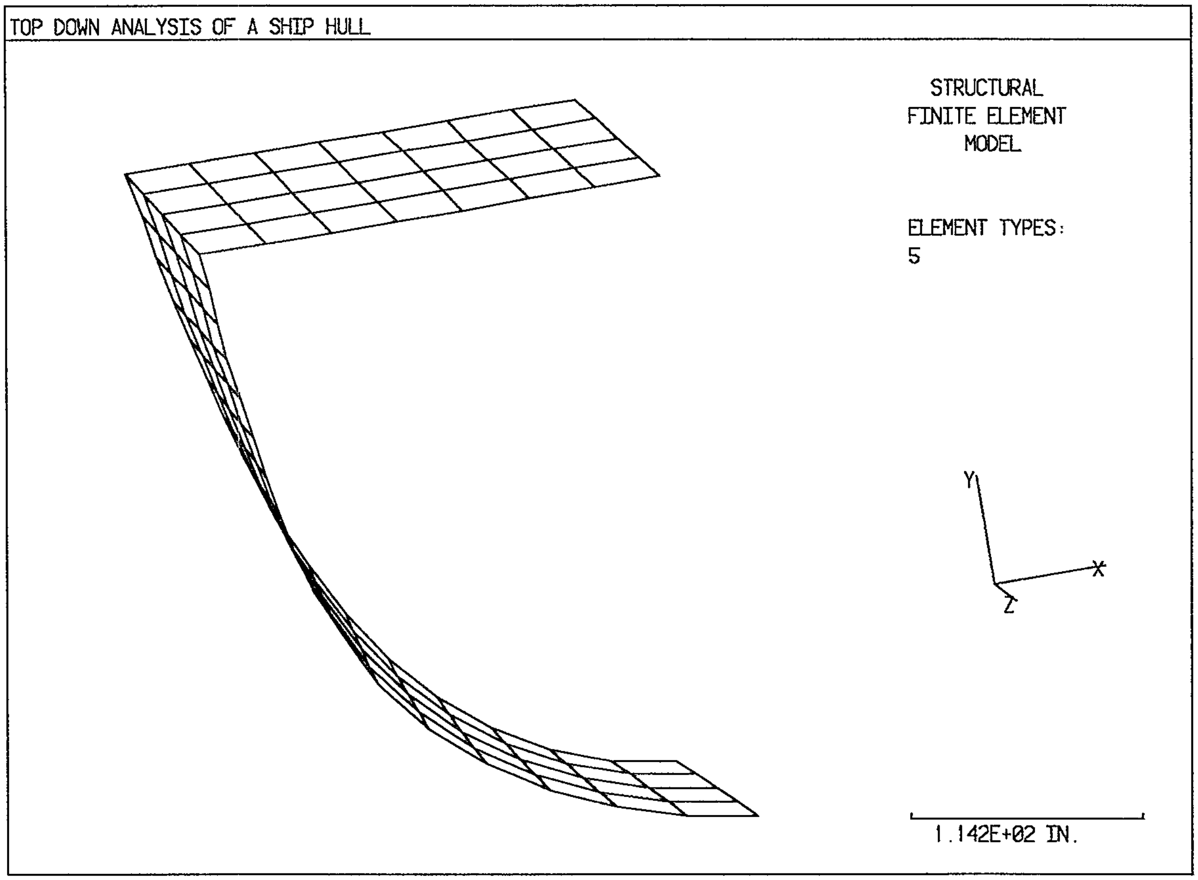

Figure 12: Plot of the Extracted Finite Element Model File SHPEX.GOM

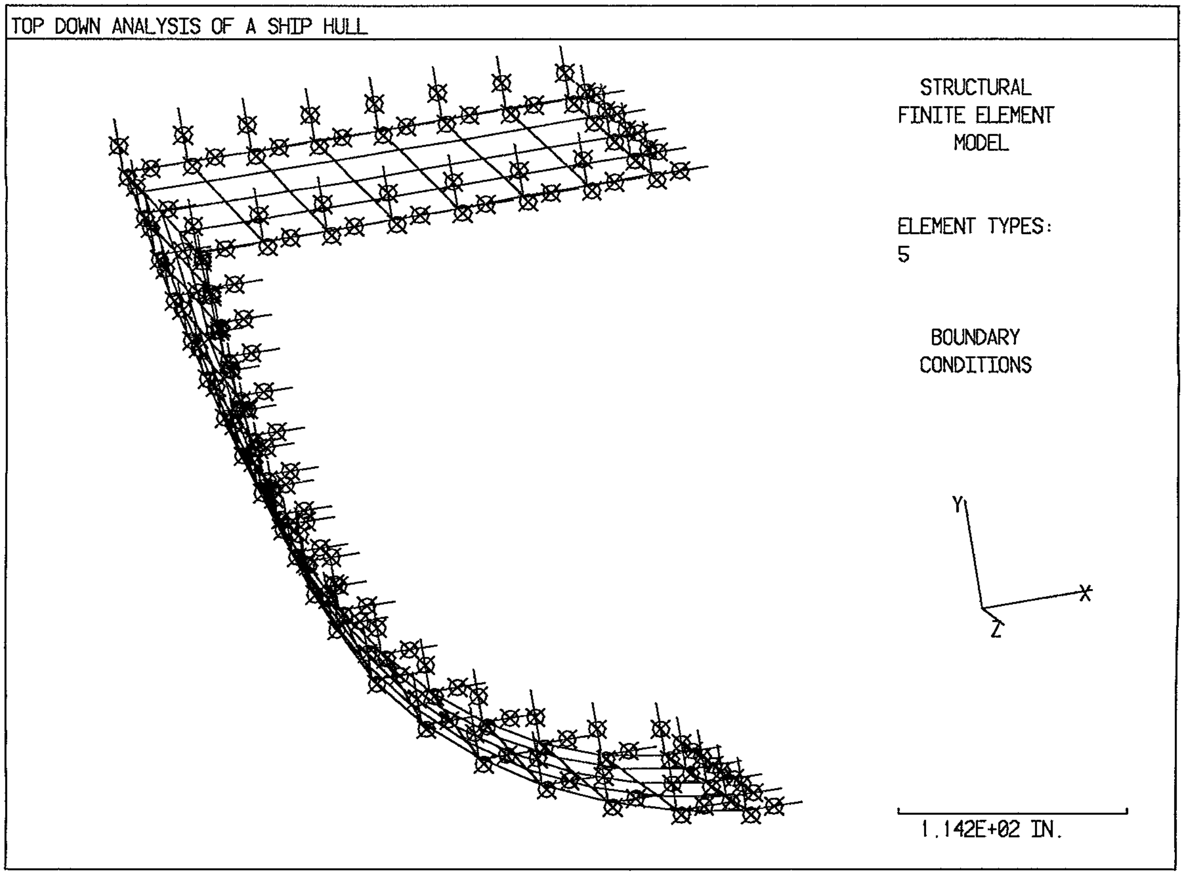

Figure 13: Plot of the Extracted Finite Element Model Boundary Conditions File SHPEX.SMD

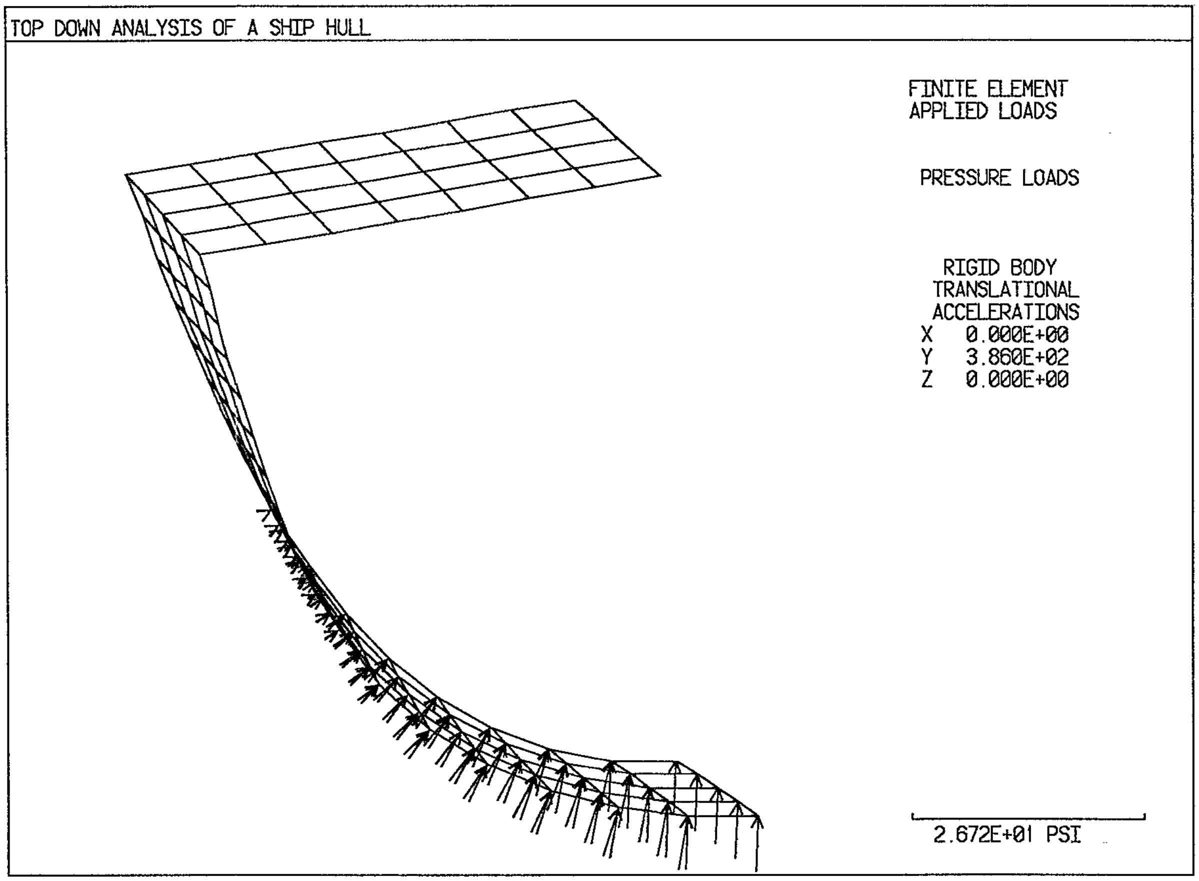

Figure 14: Plot of the Extracted Finite Element Model Loading File SHPEX.LOD

A Include Statements

```
C       FILE SHPHUL.PAR
      PARAMETER (NSMAX=60,NPMAX=30,NBMAX=40,NFMAX=40,NPAMAX=50
     #,NBPMAX=NSMAX*NPAMAX,NPPMAX=NPMAX*12,NPNMAX=NBMAX*NFMAX
     #,NBTMAX=40,NSBMAX=500,NODMAX=NPNMAX*NPMAX,NDMAX=400,NOD=NODMAX/2)
C
C     NSMAX = NUMBER OF BODY PLAN SECTION LINES
C     NPMAX = NUMBER OF PANELS IN ONE SECTION ARROUND THE HULL
C             INCLUDES DECKS, HULL SIDE, AND LONGITUDINAL BULKHEADS.
C     NDMAX = NUMBER OF ELEMENT GROUPS FOR ASSEMBLED MODELS
C     NBMAX = NUMBER OF LONGITUDINAL BEAMS IN A PANEL
C     NFMAX = NUMBER OF TRANSVERSE FRAMES IN A PANEL
C     NPAMAX = NUMBER OF ARRAY POINTS DESCRIBING EACH CURVE
C     NBPMAX = NUMBER OF BODY PLAN COORDINATES, NSMAX LINES WITH 30 POINTS
C              EACH IS ASUMED AS A MAXIMUM.
C     NPPMAX = NUMBER OF POINTS DEFINING THE PANELS IN ONE SECTION
C              PANELS ARE DEFINED BY 4 OR 12 POINTS FOR EACH PANEL.
C     NPNMAX = NUMBER OF NODES GENERATED ON A PANEL, DEFINED BY THE BEAM
C              FRAME GRID.
C     NBTMAX = NUMBER OF BEAM TYPES USED TO DEFINE ALL BEAMS IN THE SHIP.
C     NSBMAX = NUMBER OF SELECTED BODY PLAN LINES POINTS (PBODY)
C     NODMAX = TOTAL NUMBER OF GENERATED NODES IN ASSEMBLED MODEL
C        NOD = NUMBER OF NODES IN A SECTION


C       FILE SHPHUL.GEN
      CHARACTER*3 UNITL,UNITF
      CHARACTER*72 STRING
      CHARACTER*20 RES
      COMMON /PLTM/ ITERM,ISCAL,ISX,ISY,IPE,ICUR,ISPEE,IPEX,ICOLR,IDIA
      COMMON /DEVN/ ITTY,ICDR,ILPT,IDAT,IOUT
      COMMON /HEDC/ UNITL,UNITF
      COMMON /UNT/ IUL,IUF
      COMMON /CHAN99/ IOUT99
      COMMON /TERLI/ NTLI
      COMMON /WND1/ MINX,MAXX,MINY,MAXY
      COMMON /WND2/ XMIN,XMAX,YMIN,YMAX,ZMIN,ZMAX,IZCHK
      COMMON /WND3/ IXM,IXX,IYM,IYX
      COMMON /WND4/ DXM,DXX,DYM,DYX,RUX,RUY,IX1,IY1,IY2
      COMMON /PMO/ STRING(24)

C     /PLTM/ TERMINAL AND PLOTTING INFORMATION
C     /DEVN/ TERMINAL INPUT AND OUTPUT UNITS
C     /HEDC/ MEASUREMENT UNITS FLAGS (CHARACTER FORM)
C     /UNT/  MEASUREMENT UNIT FLAGS (INTEGER FORM)
C     /CHAN99/ PLOT RECORDING FLAG
C     /TERLI/ TERMINAL LINE HANDLING COUNTER
```

```
C     /WND1/ RASTER MAX AND MIN FOR TOTAL SCREEN
C     /WND2/ REAL MAX AND MIN FOR TOTAL SCREEN
C     /WND3/ RASTER DATA RANGE
C     /WND4/ REAL DATA RANGE, RUX RUY ARE CONVERSIONS RASTER TO REAL
C     /PMO/ STRING IS A CHARACTER STRING USED FOR SCREEN PROMPTS


C       FILE SHPHUL.GOM
      COMMON/NODE/ X(NODMAX),Y(NODMAX),Z(NODMAX),N1(NOD),N2(NOD)
     #,N3(NOD),N4(NOD)
C    X Y Z NODE NUMBERS ARE SET FOR AN ASSEMBLED MODEL
C    N1 N2 N3 N4 ARE SET FOR A SINGLE SECTION
```

B Program DISPLCON

```
      PROGRAM DISPLCON
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C        THE SUBROUTINE GENERATES A PRESCRIBED DISPLACEMENT FILE
C       FROM THE DISPLACEMENT RESULTS OF A VAST STATIC ANALYSIS
C       STORED ON THE PREFX.T52 FILE
C       FILCN IS THE CONVERTED DISPLACEMENT FILE
      INCLUDE 'SHPHUL.PAR'
      INCLUDE 'SHPHUL.GEN'
      INCLUDE 'SHPHUL.GOM'
      CHARACTER*10 FILD,FILCN
      CHARACTER*5 PREFX
      real*8       DIS(72000)
      dimension ICOL(2)
      COMMON /PLTFIL/IPLSC !PLOTVX
      COMMON /PROMPT/ IQ          !PLOTVX
      COMMON /NAM/ PREFX,ICURC   !PLOTVX
      NT29=36
      NT30=37
CIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
      IQ=1
      MAXX=ISX
      MAXY=ISY
      MINX=0
      MINY=0
      XMIN=0.0
      XMAX=10.2
      YMAX=7.8
      YMIN=0.0
      IOUT=5
      IDAT=5
      IKB=5
      ICDR=5
      IPLSC=1
      INITIAL=1
      ICOL(1)=0
      ICOL(2)=0
      CALL FACLTY
      CALL TERCTN(1,INITIAL)
      IX1=10*ISX/1024
      IY1=700*ISY/780
      IY2=722*ISY/780
CIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIIII
      FILD='SHPXX.T52 '
      FILCN='SHPXX.DISP'
      NLI=1
      WRITE(STRING,10)
```

```
10    FORMAT(' ENTER THE FIVE CHARACTER PREFX OF THE VAST DISPLACEMENT
     #FILE')
        CALL POPUPP(IX1,IY1,ICOL,STRING,NLI,PREFX)
      CALL TERCTN(6,IERASE)
      FILD(1:5)=PREFX
      FILCN(1:5)=PREFX
      OPEN(UNIT=NT29,FORM='UNFORMATTED',STATUS='UNKNOWN',FILE=FILD)
      OPEN(UNIT=NT30,CARRIAGECONTROL='LIST',STATUS=
     #'UNKNOWN',FILE=FILCN)
      READ(NT29)ICODE,ILOADS
      READ(NT29)NGN,NDF,NS
      WRITE(NT30,20)
20    FORMAT(' STATIC DISPLACEMENTS')
C     Read column of displacements and rewrite in formated form
      READ(NT29)(DIS(I),I=1,NS)
      WRITE(NT30,40)(I,DIS(I),I=1,NS)
40    FORMAT(I5,6E12.5)
      NLI=2
      WRITE(STRING,50)FILCN
50    FORMAT(' FORMATED DISPLACEMENTS ARE STORED ON 'A/
     #' ENTER 0 TO CONTINUE')
        CALL POPUPP(IX1,IY1,ICOL,STRING,NLI,RES)
      READ(RES,*)IC
      CALL TERCTN(6,IERASE)
      CLOSE(UNIT=NT29)
      CLOSE(UNIT=NT30)
      STOP
      END
```

C Program POSBOW

```
C       THE PROGRAM TO COMPUTE "P"RESSURES "O"N "S"HIP "B"ALANCED "O"N
C       "W"AVE.  THE HULL IS POISED STATICALLY ON A TROCHOIDAL WAVE.
C       A1 (BONJEAN CURVES) AND A10 (BALANCING SHIP ON WAVE) PROGRAMS
C       IN CASDOP (CANADIAN ADOPTED SHIP DESIGN ORIENTED PROGRAMS)
C       COMPUTER PROGRAMS ARE INTEGRATED AS SUBROUTINES IN POSBOW.
C
C       PROGRAMED BY  S. ANDO          D.R. SMITH VERSION
C       DATE 8 JULY 1983               MODIFIED OCT. 2 1992
C                                      TO CREATE FILE PROFL.DAT
C                                      FOR PROGRAM SHPHUL
C
```

The program POSBOW.DRS is a modified version of the program POSBOW.FOR. It is interactive and will read a bodyplan file in the format required by the program BODYPLAN or POSBOW.DAT. The file must be the original unmodified data consisting of a title on one line and the overall length on the second line followed by 21 stations. Less than 21 stations can be used but not more than 21. It is important that the units be identified and located on the line giving the overall length. They must be in the abreviated form (in.,ft., mm.,or MM.) and consist of a space and three characters as shown below.

```
            356.00 ft.
```

A sample file in the format for BODYPLAN is shown at the end of this Appendix listing. The format for POSBOW.DAT can be found in the following report The program has been converted to run with graphics interface program PLOTVX developed for DREA by MARTEC LTD. so the program can be used with PLOT10 and GKS graphics.

```
 cccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccccc
C
C     TYPICAL POSBOW INPUT FILE
C
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
   265 HULL OFFSETS       Title
     356.00 FT.            Overall length F10.2 format
  1 12  1                1=Station  12=Number of offsets  1=Unused number
   0.0  0.46  1.19  1.82  2.33  2.57  2.84  3.50  4.50  6.55  9.25 12.79 x
   0.0  0.00  2.77  6.60  9.93 11.21 12.61 15.53 18.84 23.84 28.78 34.01 y
  2 12  1
   0.0  0.49  1.60  2.76  3.61  4.49  5.04  6.56  8.32 11.19 13.65 15.57
   0.0  0.0  1.44  3.62  5.96  8.70 10.56 15.05 19.40 25.42 29.81 32.65
  3 12  1
   0.0  0.49  3.07  4.55  5.77  6.90  8.24  9.58 11.19 13.40 15.19 17.16
```

```
 0.0  0.0  2.01  3.69  6.06  8.49 11.76 14.97 18.87 23.68 27.30 31.40
4 12  1
 0.0  0.49  3.79  6.43  8.75 10.19 11.53 12.72 14.00 15.38 16.92 18.09
 0.0  0.0  1.54  3.86  7.13  9.97 12.77 15.58 18.86 22.32 26.88 30.34
5 12  1
 0.0  0.55  4.59  8.68 11.01 12.75 14.52 16.01 16.37 17.33 17.92 18.93
 0.0  0.0  1.30  4.18  6.86  9.76 13.47 17.34 18.82 22.12 25.01 29.30
6 12  1
 0.0  0.52  7.18 11.60 14.70 15.80 16.62 17.90 18.25 18.81 19.24 19.65
 0.0  0.0  1.93  4.94  8.78 10.59 12.55 16.66 18.65 21.67 25.21 28.14
7 12  0
 0.0  0.52  8.78 12.59 15.29 17.10 18.14 19.11 19.64 20.06 20.22 20.27
 0.0  0.0  2.10  4.01  6.39  9.04 11.22 14.52 18.60 23.83 26.69 27.53
8 12  0
 0.0  0.49  8.87 13.40 16.23 18.61 19.71 20.40 20.47 20.65 20.66 20.74
 0.0  0.0  1.91  3.46  5.27  8.46 11.66 15.12 18.49 22.64 25.47 27.16
9 12  3
 0.0  0.49  8.90 14.66 17.43 19.36 20.39 20.84 20.99 20.94 20.92 20.94
 0.0  0.0  1.91  3.49  5.16  7.53 10.58 13.75 19.04 22.18 24.92 26.75
10 12  3
 0.0  0.46 12.67 16.51 18.66 19.73 20.51 20.87 21.00 20.97 20.92 20.94
 0.0  0.0  2.65  4.16  5.98  7.69 10.03 12.98 16.12 20.72 24.06 26.50
11 12  3
 0.0  0.43 12.67 16.39 18.53 19.54 20.36 20.77 20.97 20.94 20.92 20.94
 0.0  0.0  2.71  4.32  6.16  7.66 10.15 13.01 16.12 20.72 24.06 26.50
12 12  3
 0.0  0.43  9.90 14.33 17.40 18.87 20.08 20.62 20.91 20.91 20.92 20.91
 0.0  0.0  2.14  3.65  5.66  7.28  9.90 12.95 16.12 20.72 24.06 26.5
13 12  3
 0.0  0.43 11.53 14.72 16.69 18.74 19.68 20.41 20.81 20.85 20.86 20.85
 0.0  0.0  2.99  4.34  5.66  7.90  9.87 12.64 16.12 20.72 24.09 26.50
14 12  3
 0.0  0.40  9.56 13.95 17.48 18.76 19.68 20.28 20.60 20.76 20.77 20.75
 0.22  0.22  2.82  4.74  7.34  9.05 11.14 13.63 16.12 20.72 24.03 26.50
15 12  2
 0.0  0.40  8.36 14.56 16.95 18.51 19.39 20.02 20.26 20.48 20.46 20.45
 0.96  0.96  3.40  6.17  7.99 10.14 12.41 14.93 16.15 20.72 24.06 26.5
16 12  2
 0.0  0.51  8.41 11.21 14.58 16.45 17.89 19.16 19.40 19.68 19.75 19.80
 2.70  2.70  4.93  5.97  7.66  9.26 11.35 15.27 16.08 20.71 24.05 26.5
17 12  2
 0.00  0.46  7.66 12.55 14.85 16.35 17.02 17.41 18.10 18.60 18.77 18.84
 5.41  5.41  7.06  8.55  9.99 11.56 12.86 13.86 16.08 20.64 24.02 26.5
18 12  2
 0.0  0.38 10.20 12.26 13.55 14.62 15.38 15.78 16.32 17.00 17.38 17.64
 8.48  8.48 10.06 10.73 11.48 12.42 13.63 14.69 16.10 20.66 24.01 26.5
19 12  0
 0.0  6.56  8.93 10.22 11.33 11.97 12.61 13.25 13.82 14.88 15.59 16.10
 10.66 10.75 10.89 11.37 12.02 12.65 13.59 14.83 16.08 20.65 24.00 26.5
```

```
 20 12  0
   0.00  4.74  6.25  7.23  8.15  8.80  9.65 10.17 10.78 12.20 13.29 14.13
  10.66 10.81 10.97 11.32 11.85 12.45 13.63 14.75 16.06 20.63 24.0 26.5

CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC


CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
C
C         LOADING COMMAND FOR A VAX VMS COMPUTER
C
 $FOR/NOOPT POSBOW.DRS/CHECK
 $LINK POSBOW,PS_9:[SOURCE.LIB.V60]PLOTVX,PLOTV,MARLIB,PL4113,-
 DREAGUI,PS_9:[SOURCE.LIB.OLD]PLOT10/LIB
CCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCCC
```

TERMINAL SESSION FOR POSBOW

```
 RUN POSBOW

WHAT IS THE LINE SPEED?
9600

IDENTIFY TERMINAL TYPE ACCORDING TO RESOLUTION,
CURSOR AND COLOUR CAPABILITY:
ENTER 0 FOR TEKTRONIX 4006 (LOW RES/NO CURS/NO COL)
      1 FOR TEKTRONIX 4010/12/13 (LOW RES/CURSORS/NO COL)
      2 FOR TEKTRONIX 4014/4015  (HI RES/CURSORS/NO COL)
      3 FOR TEKTRONIX 41XX/42XX OR 4014/4015-EGM (COLOUR)
1

IDENTIFY TERMINAL TYPE ACCORDING TO DIALOG CAPABILITY:
ENTER 0 NO DIALOG AREA
      1 DIALOG AREA
0
```

```
CHOOSE THE BODYPLAN FILE FORMAT AVAILABLE
 0 = BODYPLAN FORMAT
 1 = POSBOW.DAT FORMAT

0
```

ENTER THE PREFIX OF THE BODYPLAN FILE NAME
265NO

SHIP NAME
265 HULL OFFSETS

DISTANCE BETWEEN PERPENDICULARS 380.00 ft ENTER 0 TO CONTINUE 1 TO STOP
0

ENTER CG DISTANCE FROM BOW IN ft
180

ENTER DISPLACEMENT IN LONG TONS OR TONNES
2400

ENTER DRAFT IN ft
10

ENTER THE LOADING CONDITION 1 = SAGGING 2 = HOGGING
2

UNITS FOR THE WAVE PROFILE ARE ft. DO YOU WISH TO CHANGE THEM ? 0 = YES 1 = NO
1

OUTPUT FILES POSBOW.OUT PROFL.DAT = WATER LINE OFFSETS IN SHPHUL FORMAT 265NO.DIN = BODYPLAN FILE CREATED IN POSBOW FORMAT ENTER 0 TO STOP
0

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