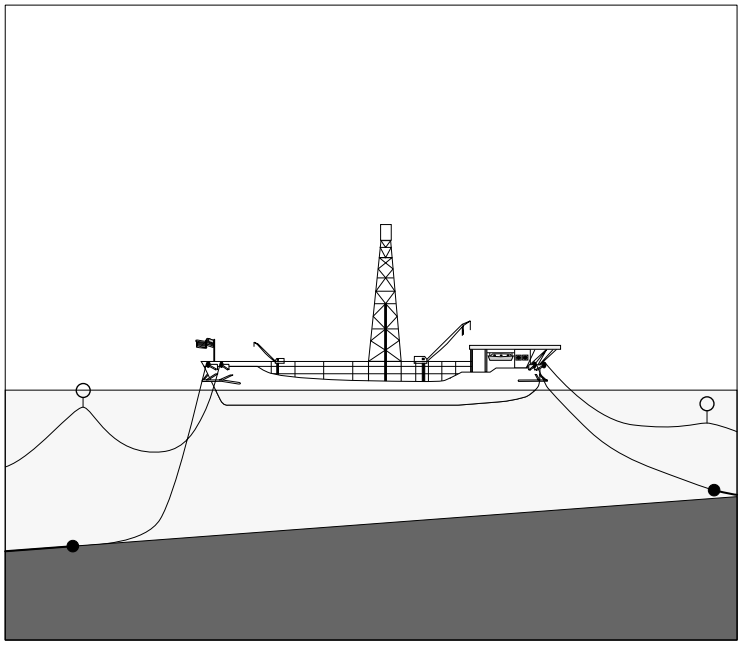
Statmoor™

A Mooring Statics Calculator

from

SeaSoft® Systems



User's Manual

December, 1998

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I. Introduction

Statmoor was created for the analysis of mooring line and mooring system response to static fairlead and vessel offsets; it shares this objective with a group of existing computer codes, some of which are rather well known in the offshore industry and a few of which enjoy widespread acceptance amongst naval architects and marine engineers. In this group we would mention Ultramarine's *OSCAR*, Exxon's *CALMS* and Ocean Engineering Consultants' *VESDYN*.

In developing **Statmoor**, special attention was given to a number of areas in which some widely-used codes are deficient. The most prominent common weakness in the analysis of mooring statics is the treatment of elasticity of mooring elements. Many modern mooring materials, in particular the synthetics (Kevlar, nylon, polyproplyene, etc.), are notable in that their gravitational response to imposed loads is small compared to their elastic response. In the analysis of materials of this type, special care must be taken to account properly for this dominant elastic response. In particular, the usual approximate methods employed to account for the small elastic distortion of chain or wire rope under static mooring conditions are inadequate in many conditions of physical interest, in particular when elastic response is significant. **Statmoor** incorporates an exact analytical expression for the combined elasto-gravitational static response of mooring line elements and thereby avoids altogether the problem of approximating the effects of either gravity or elasticity. Furthermore, the exact equations used in the code apply to arbitrary degrees of nonlinearity in the stress-strain relationship of the line elements, thereby rendering the analysis of highly nonlinear synthetic elements completely straightforward.

Capabilities of Statmoor

1. Up to sixteen individual mooring lines can be accommodated (twelve in some microcomputer versions).

2. Each mooring line may consist of up to three independent sublines. Each subline can have specifiable mass characteristics and nonlinear elastic characteristics (tension-strain relationship may include up to cubic terms).

3. A concentrated weight and/or line support buoy can be specified between appropriate sublines.

4. The ocean bottom may be uniformly sloping or anchor depths may be independently specified.

5. Fairlead tensions, fairlead vertical departure angles or fairlead-anchor distances may be used to define the pretension condition.

System and individual line characteristics (net restoring force, individual line tensions, suspended lengths, line declination angles, fairlead and anchor tensions) may be output for horizontal offsets of any magnitude in any direction and for yaw offsets both clockwise and counter-clockwise.

It should be noted that all offsets are by the "Hand of God" meaning that the vessel is not allowed to respond in any degree of freedom to the development of mooring forces as the offset is made. The totality of forces and moments acting on the vessel during offset are, however, output.

Scope of the User's Manual

This manual describes in brief those aspects of the program which are needed to use the code effectively. It is a user's manual, not an introduction to the physics of mooring systems. Input procedures will be covered and the options available for output will be explained. For the purpose of learning to run **Statmoor** effectively and quickly, the sample problem laid out in Section V should be thoroughly studied and understood.

Statmoor Description

Statmoor begins execution by preparing, for each physically distinct line type, interpolation tables of horizontal tension component versus several parameters of importance, including the horizontal anchor-fairlead separation distance. Each element of these tables is computed using an iterative procedure with an accuracy of better than one part per million. In simple cases where all lines are equivalent, only one table is prepared. In cases where more than one type of line is present, a different table is prepared for each distinct line. In particular, when the sloping bottom option is selected, all lines are physically distinct because of differences in anchor-fairlead vertical separation and a separate table is prepared for each line. After the tables have been prepared, the offset conditions requested can be processed using interpolation in the tables to obtain all quantities of interest. Normally the interpolation tables themselves are of only limited value to the user being, as they are, intermediate stages in the calculation of offset information. They may, however, be included in **Statmoor**'s output stream at the user's option.

II. Input Description And Discussion

Data Requirements

Before **Statmoor** can be exercised, all relevant physical data for the mooring system to be analyzed must be gathered. When available, manufacturers data for the specific materials to be used should be obtained.

The list of input parameters which should be prepared before attempting to execute **Statmoor** follow:

A. General Layout

1. Number of mooring lines.

2. Plan view layout of the lines with the fairlead-anchor direction for each. Every mooring line is assigned a unique number; the number serves to associate each line with its physical characteristics. Thus, the first fairlead-anchor direction to be specified is associated with Line Number 1, etc. Numbering should normally begin with the most forward line on the port side and progress in a counter-clockwise direction. See Figure 1 for a sample layout.

3. Spatial coordinates (x,y,z) of each fairlead. z is positive upwards; *zero at the keel*. x (forward) and y (port) coordinates measured from vessel center of gravity are required only if yaw restoring characteristics and pitch/roll moments are desired.

4. Depth of water beneath vessel.

5. Slope of ocean bottom, if uniform, or depth of each anchor.

6. Direction of maximum downwards slope (the "slope direction").

B. Details of Mooring Lines

1. Complete description of each type of mooring line to be used, including length, weight/unit length in water, nominal diameter and breaking strength of each subline component of a composite line. Each line can consist of at most three independent sublines which are numbered Subline 1 through Subline 3 beginning at the fairlead and proceeding towards the anchor . There are no restrictions on the composition of the sublines. A lumped weight or sinker can be specified between Sublines 1 and 2 of a two-element line or Sublines 2 and 3 of a three-element line. A mooring buoy can be specified between Sublines 1 and 2. See Figure 2 for specific examples.

Note: Default weight/unit length values and breaking strengths for a wide variety of mooring materials including chain, IWRC wire rope, Kevlar and nylon are available through the "*Help*" facility of the user interface described in Section IV.

2. Complete description of the elastic characteristics of each subline for each distinct line. For elements with approximately linear elasticity, such as chain and wire rope, the EA value for the specified line should be obtained. For elements with nonlinear elastic properties, manufacturers data for the elastic component of elongation versus line tension should be obtained. See the material in Appendix B for further description.

Default values for the elastic coefficients of many mooring material are also available through the "*Help*" facility of the user interface. (See Section IV).

3. Submerged weight of any lumped weights or sinkers to be employed.

4. Submerged buoyancy of any mooring buoys to be employed.

C. Zero-Offset Conditions; Establishing Pretension Values

Zero-offset line tensions at fairleads ("pretensions"), declination angles at fairleads (measured from the horizontal) or horizontal distances from fairlead to anchor. *Note* **Statmoor** does ***not*** permit specification of the declination angles at fairleads in the case that the ocean bottom is sloped or if anchor depths are specified.

D. Offset Specifications

1. Direction of each desired lateral offset sequence.

2. Actual lateral offset magnitudes from the zero-offset position. (Default offset increments are one percent (1%) of water depth).

3. Direction ("parity") of any desired yaw offset sequence. The possibilities are two: clockwise and counter-clockwise.

4. Actual yaw offsets magnitudes from the zero-offset conditions. (Default offset increments are 2.5 degrees).

Miscellaneous Notes

1. **Dimensions:** Either English or Metric units can be used in **Statmoor**. All lengths, depths, etc., should be input in feet (meters) *except* mooring line diameters, which should be input in inches (millimeters). All weights, forces or line tensions should be input in kips (metric tons) *except* line weights which should be input in pounds/foot (kilogram weight/meter). Elastic coefficient units should be inverse powers of line tension in kips (metric tons), see Appendix B. Bottom slope is dimensionless (feet/foot, meters/meter); all angular quantities are in degrees.

2. **Stability of Zero-Offset Point:** Unless, as is usually the case, the mooring layout possesses a high degree of symmetry and the ocean bottom is not sloping, the zero-offset fairlead tensions or declination angles selected by the user will not necessarily result in the zero-offset point being a point of lateral or yaw equilibrium. That is, under most asymmetric conditions a specified set of fairlead tensions at the zero-offset point, unless very cleverly chosen, will result in a net force or moment on the vessel. **Statmoor** does not correct such an imbalance but will simply report the net forces and moments on the vessel, if any, at the zero-offset position, as well as at the other offset positions requested. Provided that the *layout* of the mooring lines is sufficiently symmetric, as it normally will be, **Statmoor** provides one method of obtaining a condition of lateral and yaw equilibrium even though, for instance, the ocean bottom is sloping, thereby imposing a strong asymmetry on the mooring layout. This method will be invoked whenever the input option to "Equalize Horizontal Tensions" is selected. This option will override the requested fairlead tension or declination angle values and result in the selection of new values, reasonably near the requested ones, which will result in a condition of equilibrium. Note, however, that if the plan-view line layout is *not*

sufficiently symmetric, even this option will fail to generate a perfect equilibrium situation in the zero-offset condition. In this context, a "symmetric layout" is one for which the distribution of plan view line directions possesses at least two vertical planes of symmetry; a corresponding symmetry in the distribution of line *types* is not required.

3. **Selection of anchor depths:** Anchor depths may be selected independently, or a global slope to the ocean floor can be selected. In the former case, a slope to each anchor is ultimately calculated assuming a uniform slope between the vessel and anchor. This procedure can represent an undulatory bottom topography with, however, uniform slope along radial lines emanating from the vessel. If anchor depths are input *and* a bottom slope is specified, the anchor and line length information will take precedence and **Statmoor** will compute a slope to each anchor which will be used in lieu of the specified global bottom slope information.

4. **Slope Direction:** The bottom slope direction, when specified, is defined to be the direction of the maximum downwards slope of the sea floor when viewed from the vessel.

5. **Breaking Strengths:** These are used only for setting the maximum horizontal tension limits in the interpolation tables; the table limits can thus be manipulated, if desired, by setting the breaking strength to any (possibly unrealistic) value. Only the largest breaking strength input is used to set the maximum values for all tables.

6. **Horizontal Distance to Anchor Option:** The facility for specifying horizontal distances from anchor to fairlead is useful for exploring the effect of changes in water depth as might occur, for example, due to the action of tides. One must first execute **Statmoor** at the nominal water depth with the desired line tension or declination angle at the fairlead. The anchor distances for this nominal condition, as computed by **Statmoor** and displayed in the output file, are then used as input data for a second run with the same line lengths but a new water depth.

Input Data Files

Statmoor requires that an unformatted binary input file called SMORDAT be prepared with the necessary input data. An intermediate, *formatted* input file called STMDAT is also created which can be viewed if necessary with a suitable text editor; this may be useful, in extreme cases, for debugging a seriously misbehaving input data file. Section V contains a specific sample of the STMDAT file; Appendix G documents its record structure.

To aid in the construction of these files a user interface sub-program has been developed which can be used to create a new input file or to edit an existing file. The user interface is discussed in detail in Section IV and Appendix E.

III. Output Description And Discussion

Output Control Options

The output stream from **Statmoor** consists of two distinct output types: mandatory and elective. The mandatory output includes:

a) Tabular output of selected input parameters of importance.

b) Tabular output of the details of the zero-offset condition including distances to anchors, slope of bottom towards anchors, fairlead and anchor line tension components, and suspended line lengths.

c) Tabular output of the physical characteristics of the most exposed (most highly loaded) line during each requested offset sequence.

d) Tabular output of the total restoring characteristics of the mooring system for each requested offset sequence.

Elective output can be included or excluded as desired. The elective output includes, for every line and every specified offset condition:

a) A cross-coupling summary which gives all forces and moments induced by the rigid transport of the vessel as specified in the offset requirements.

b) Any or all tension components at the fairleads or anchors.

c) Suspended line lengths.

d) Declination angles at the fairleads.

Appendix H contains a complete sample output stream displaying all mandatory and elective output (with the exception of the horizontal line tension components at the anchors) for each line.

Output Data Files

Statmoor's output is broken into three files which roughly parallel the logical division into input data ("STATIN "), mandatory output data independent of the offsets chosen for evaluation ("PREOFFSETDAT") and data, comprising largely elective output, dependent on the offsets chosen for evaluation ("OFFSETDAT "). The STATIN file is optionally produced at the end of any editing session and contains only hardcopy of the editor screens, as discussed further in Appendix E.

IV. User Interface Description

A user-interface sub-program was created to provide a simplified environment for preparation and editing of the SMORDAT and STMDAT files required by **Statmoor**. Its use is largely self-explanatory. Printouts of the various console screen images which appear during execution of **Statmoor** are provided in Appendix E. The following special features should be noted.

Help Utilities

1. *Help* facility for effective weight/unit length and breaking strength of mooring lines: A built-in database provides approximate default values for breaking strengths and for effective weights of a wide variety of mooring materials in seawater, fresh water and air. Although variations in line properties between different manufacturers are generally small, it is recommended that manufacturer's data, when available, be used in lieu of the default values. Refer to Appendix E for a specific illustration of the *Help* facility.

2. *Help* facility for elastic coefficients of mooring lines: This provides two types of *Help*: (a) Default values for a wide variety of mooring materials from the built-in database and (b) a curve-fitting routine to compute the required coefficients from manufacturer-supplied curves or tables of elongation versus line tension.

Note that the default values supplied by **Statmoor** for synthetic materials, in particular nylon and Nystron, apply to wet, stabilized lines. See the discussion in Appendix B.

The following procedure should be followed in utilizing the curve fitting routine in **Statmoor**; refer to Appendix E for additional discussion.

i) At least eight {Tension, Elongation} data points should be entered (ten is preferable).

ii) The data points should span the range from T = 0 to T = 1.25 TB with equal tension spacing between points. Here T is line tension and TB is the line breaking strength. (The point T = 0 should not be included). Since manufacturer's data will never go beyond TB, the points with T greater than TB must be obtained by interpolation from manufacturer's data using the largest available values of T; linear interpolation is generally sufficient.

Note that uncertainties in manufacturers elastic response data for synthetic materials are typically rather large and that variations between different manufacturers are larger still. The curve-fitting procedure supplied with **Statmoor** will normally reproduce the supplied tension-elongation data with a precision of 15 percent or better which is sufficient given the large uncertainties in the available data. Somewhat larger curve-fitting errors may sometimes occur, in particular for very small line tension values (5 percent of breaking strength or less), but these will have no significant impact on the overall restoring characteristics of the mooring system, or on the tension results for the most heavily loaded mooring lines.

V. Sample Problem

The following sample problem was used in the creation of the STMDAT input file displayed in Appendix F which in turn resulted in the displayed **Statmoor** output presented in Appendix H. Note that the sample problem presented here does not illustrate a realistic or well designed mooring system for a semi-submersible. The line characteristics were selected solely to demonstrate various capabilities of **Statmoor** in a single sample problem and the layout was made geometrically simple to facilitate understanding the results; no attempt to produce a practical mooring system design was made.

Vessel:	60,000 kip Semi-Submersible
Water Depth:	1000 ft
Bottom slope:	0.0 ft/ft (no slope)
Mooring System:	Eight mooring Lines deployed as in Figure 1
Types of Lines:	Two composite line types characterized by the following table (See also Figure 2)

Line Type A *(Mooring lines numbered 1, 4, 5 & 8)*

Subline Number	Material	Length (ft)	Nominal Diameter (in)	Weight/Length (In Water) (lbs/ft)	Alpha1 ($kips^{-1}$)	Alpha2 ($kips^{-2}$)	Alpha3 ($kips^{-3}$)
3	Chain	2000	3.00	78.20	.980E-5	0.00	0.00
2	Chain	1500	2.00	35.00	.220E-4	0.00	0.00
1	Wire	1000	2.50	9.60	.230E-4	0.00	0.00

Net buoyancy of mooring buoy (between sublines 1 and 2) = 120.0 kips

Line Type B *(Mooring lines numbered 2, 3, 6 & 7)*

Subline Number	Material	Length (ft)	Nominal Diameter (in)	Weight/Length (In Water) (lbs/ft)	Alpha1 ($kips^{-1}$)	Alpha2 ($kips^{-2}$)	Alpha3 ($kips^{-3}$)
2	Chain	2000	3.00	78.20	.980E-5	0.00	0.00
1	Nylon	2000	5.00	00.73	.667E-3	-.126E-5	.884E-9

Sinker weight (between sublines 1 and 2) = 100.0 kips in water

Miscellaneous Input Data

Pretension Required:	80.0 kips in all lines
Lateral Offsets Required:	Two offset sequences, one each at 0 and 90°, both with twenty-five offset increments of 1% of water depth (this is the default increment value)

Yaw Offsets Required:	One offset sequence, clockwise parity with offset increments of 5°
Fairlead Positions:	At the waterline on the four corners of the 300'x300' platform (50' draft)
Breaking Strengths:	3" Chain - 1080 kips; 2" Chain - 454 kips; 2.5" Wire - 584 kips; 5" nylon - 686 kips

Notes:

1. The user interface screens associated with the correctly completed sample problem appear in Appendix E.

2. The formatted STMDAT file associated with the correctly completed sample problem appears in Appendix F.

3. The record structure of STMDAT is documented in Appendix G.

4. The output stream associated with the correctly completed sample problem appears in Appendix H.

Appendix A: Output Files; Description and Terminology

The output of **Statmoor** is largely self explanatory; we will limit our comments to those items for which some confusion might arise. The sample output given in Appendix H should be consulted for specifics.

1. **Title Page:** Self Explanatory

2. **Interpolation Tables for Line Number J:** These are the tables, one for each physically distinct line, which are prepared prior to computing forces and moments due to a prescribed offset sequence. The output of these tables is *optional*; a separate table can be printed for each distinct line as prescribed by the user. A glossary of the abbreviated headings follows:

   INDEX = Table row label

   THTOP = Horizontal component of tension at fairlead

   TOPT = Total tension at fairlead if fairlead pretensions or anchor distances were specified for the zero offset condition. If fairlead angles were specified, this column is the fairlead angle in radians (measured from horizontal), labeled TOPANG.

   TZANC = Component of tension perpendicular to sea bottom at anchor

   THANC = Component of tension parallel to sea bottom at anchor

   XANC = Horizontal distance from anchor to fairlead

   SL = Total unstretched suspended line length (length along line from fairlead to touchdown point, less total amount of line stretch in the same line interval)

3. **Mooring Line Mass Characteristics Summary:** Self explanatory, mandatory output.

4. **Mooring Line elastic Characteristics Summary:** Self explanatory, mandatory output.

5. **Fairlead Summary:** Self explanatory, mandatory when fairlead positions are input.

6. **Ocean Bottom Summary:** Self explanatory, mandatory output.

7. **Zero Offset Summary:** Summarizes conditions in the zero offset condition. Line Dec. = line declination angles at fairlead, measured from the horizontal. Mandatory output.

8. **Lateral Offset Restoring Characteristics - Most Exposed Line Characteristics:** Summarizes for a given lateral offset sequence (i.e. direction and sequence of offsets) the characteristics of the most exposed line and the total restoring characteristics of the moor. Mandatory output for each offset sequence requested.

9. **Lateral Offset Restoring Characteristics - Total Restoring Characteristics and Cross-Coupling Summary:** Summarizes for a given lateral offset sequence the induced forces and moments experienced by a rigidly transported vessel. Elective output.

10. **Total Fairlead Line Tension:** Elective output.
11. **Horizontal Tension Components:** At fairlead. Elective output.
12. **Vertical Tension Components:** At fairlead. Elective output.
13. **Anchor Pull Parallel to Bottom:** Elective output.
14. **Anchor Pull Perpendicular to Bottom:** Elective output.
15. **Suspended Line Lengths:** Unstretched lengths. Elective output.
16. **Declination Angles at Fairleads:** Measured from the horizontal. Elective output.

Note: Normally, the vertical components of line tension at the fairlead are downwards (negative z direction). Under some circumstances however, such as with deeply submerged fairleads in conjunction with a mooring buoy, the line departure from the fairlead can be upwards. **Statmoor** will correctly report the magnitudes of fairlead angles and vertical tension components in such cases, but the direction (i.e. upwards or downwards) must be inferred from other information; for instance the occurrence in the output tables of a minimum value near zero in the vertical tensions or declination angles as the horizontal or total tension components increase monotonically.

Appendix B: Discussion of Elasticity

As discussed in the introduction, **Statmoor** utilizes an exact representation for the elasto-gravitational static response of each element of the mooring system. In order to accommodate nonlinear elastic elements, a cubic tension-elongation relationship of the form

$$\varepsilon = \text{Alpha1}*T + \text{Alpha2}*T^2 + \text{Alpha3}*T^3$$

has been adopted. Here T represents tension, ε is elongation. Although the analytical treatment of elasticity forming the basis of the calculations in **Statmoor** places no limit on the complexity of the tension-elongation relationship, a cubic relation is sufficient to adequately represent all materials of importance to the mooring problem.

From the form of the above equation, it can be seen that for linear materials (e.g., chain and wire rope) Alpha2 = Alpha3 = 0 and Alpha1 = l/EA, the usual elastic compliance per unit length of a linear material. For nonlinear materials, the three coefficients Alpha1, Alpha2 and Alpha3 must be estimated from tabular or graphical representations of the tension-elongation curve for the particular line material. These curves are generally available from rope manufacturers, and a sample from the *Samson* rope catalog is included as an example. Note that the dimensions of Alpha1, Alpha2 and Alpha3 are determined by the requirement that ε in the above equation be dimensionless. Thus, for example, the units of Alpha3 are $(\text{kips})^{-3}$ or $(\text{metric tons})^{-3}$ depending on the units of T. It should be mentioned that only the "recoverable" portion of the tension-elongation characteristic for a particular material is relevant to the mooring problem. That is, a new synthetic rope will, upon initial tensioning, undergo a significant amount of unrecoverable stretching. After this permanent "set", the resulting "stabilized" line will be longer and somewhat smaller in diameter than the unstretched new rope. It is the static tension-elongation characteristic of this "worked" rope that should be used. Note that the hysteresis characteristics of synthetic rope play the same role as bottom friction in the static mooring problem and, like bottom friction, can be ignored in a static analysis. See Appendix C for a discussion of this point.

For some of the synthetics, nylon in particular, the wet and dry characteristics are vastly different and, naturally, the wet characteristics would normally be required in mooring applications. Unfortunately, most published manufacturers data is given for dry rope. (See, for example, the *Samson* curves). Among other important synthetics, Kevlar, polyester and polyproplyene have approximately the same wet and dry characteristics. In all cases, the manufacturer should be consulted for the elastic characteristics of a synthetic material under the conditions of interest.

Appendix C: Treatment of Bottom Friction

Traditionally, bottom friction has been accommodated in static mooring programs by the specification of a friction coefficient and incorporation of a simple tension correction based on the assumption that the tension in each line under all conditions of offset has been reached by a uniform monotonic *increase* in tension from low values. This assumption is invalid since approximately half of the mooring lines, for any offset condition other than zero, have *lower* tension levels than they had at zero offset. Furthermore, under realistic conditions in a weakly dynamic environment, the tension in each line will oscillate somewhat about its mean value. It is a consequence of the irreversibility ("hysteresis") inherent in all dissipative processes such as friction that the recent tension history for each individual line must be considered in the determination of its instantaneous state. A careful analysis of the consequences of bottom friction for the calculation of static offset restoring characteristics shows that the complete neglect of bottom friction will most realistically reproduce the average static offset characteristics one would measure in a weakly dynamic environment. This approach has been adopted in **Statmoor**. The physical basis for this procedure is best understood by considering the friction-associated hysteresis curve for a single line, as depicted in a schematically exaggerated way in the accompanying figure. As a fairlead undergoes even infinitesimal horizontal oscillations about a particular point, for instance its zero offset point, the fairlead line tension jumps discontinuously between the two hysteresis branches due to the action of elastic elongation in the presence of friction. Since every environment is at least weakly dynamic, it is clear that the most reasonable single value of tension for a given fairlead-anchor distance is given by the average of the double-valued tension function, which average is adequately represented by the curve representing the case of zero friction. It must be stressed that these comments apply *only* to static offset calculations. When considering quasi-static or fully dynamic conditions, the energy loss due to frictional effects can play an important role and must be carefully accounted for.

Appendix D: Error Messages

Error messages generated either by **Statmoor** or by the Fortran run-time error trapping system are almost invariably due to errors in the input file. When **Statmoor** will not run, *carefully* go over the input file and check for errors. Misplaced decimal points, erroneous signs, physically impossible mooring systems (e.g. 500 foot total line length in 1000 feet of water) will generally cause **Statmoor** to give up early; in any event the results will normally be of little value in such circumstances. There is very little "dummy" insurance built into the code. When all else fails, carefully re-generate the input file from scratch and try again. The following error messages are generated by **Statmoor** and should be noted:

"ERROR ON INPUT FILE" - An unexpected end-of-file was encountered. Check the number of lateral plus yaw offset sequences.

"NO ITERATION CONVERGENCE FOR LINE NUMBER I, TABLE ENTRY J" - The iteration procedure failed to converge for the indicated line number and table entry. Check the input file for possible errors. A positively buoyant mooring line (e.g. polyproplyene) can give this error if it results in an upwards departure angle of the line at the fairlead. Although the program will continue after issuing this message, the interpolation table results for the flagged rows will normally be worthless; other rows in the same table should, however, be unaffected.

"TABLE RANGE EXCEEDED ON OFFSET X" - The requested offset sequence went too far; the last offset computed would have resulted in at least one line tension exceeding the interpolation table limits. This message does not halt program execution or cause any useable data to be lost.

Note: In very shallow water when metric units are selected (fairlead-to-bottom distances less than 50 meters) the default option to 1 percent of water depth for lateral offset values will sometimes cause offset increments of zero to be chosen. In such cases, input offset values directly rather than selecting the default option.

Appendix E: Sample Session with the User Interface

Statmoor has been designed to provide a simplified interface which should allow program utilization with a minimal amount of preparation. Although it cannot replace the user's manual, it has been made as self-contained as possible within the memory limitations of the computers it is required to run on. Although the user interface is reasonably comprehensive, it does no error checking for unphysical or impossible mooring systems (for instance, negative line lengths or line lengths less than the anchor-to-fairlead vertical distance). These and similar unphysical mooring systems will naturally cause **Statmoor** to fail, typically with little or no explanation of why failure occurred. It is the user's responsibility to enter a physically realizable mooring system and to carefully check the input file for inadvertent data entry errors.

User Interface Organization

The user interface is organized into logical blocks, each containing related mooring system information.

Printouts of console screen images which appear during a sample session are included at the end of this Appendix. These should be examined to obtain an overview of **Statmoor**'s logical organization.

Sample Session

This section is devoted to a description of the user interface. The interface comprises the editor program (the "Editor") which is used for creation of new data files and editing of existing files. The following pages contain images of most console screens produced by the Editor, along with comments regarding the meaning of selected items on the screen. Since all options for execution of **Statmoor** are represented by Editor selections, this chapter comprises an itemization of capabilities, input/output cross-reference and tutorial as well. All responses typed by the user at the console are in **bold** typeset, both on screen images and in the text of this chapter. User-typed carriage returns are indicated by **<c/r>**. Note that a carriage return ("**ENTER**" on some keyboards) is required as the last keystroke of *any* input to the console; thus, when we speak of "Entering the value 3", we in fact mean the keystroke combination "**3<c/r>**". (Quotation marks are included here and below only for readability; they are *never* to be used for data entry in the Editor.)

Screen Pages are numbered sequentially according to the order of their appearance; unnumbered Subpages that are actually part of the main Page but overlay it are designated by letter. Thus Subpage 3a would be the first Subpage of Screen Page 3.

General Editing Information

The editing session is largely self-explanatory; the editing alternatives consist of several simple, fundamental types:

1. The "toggle": Many editing items are configured as toggles between two possible values; selection of these items will require no further data input from the user. For example, selection of "units of measure" on Screen Page 1 below will cause the selected units to toggle between "English" and "metric". All items displaying a value of "yes" or "no" are of the toggle type.

2. Single datum input: Most of the selections in the Editor require input or modification of a single item on a Screen Page. To change a particular item, input the item number followed by a

carriage return (**<c/r>**) at the "Enter number..." prompt, and an appropriate prompt line requesting the new input value will appear at the screen bottom. It is not necessary to input decimal points for floating point numbers with no fractional parts (i.e. 10.0 can be input as 10). When more that one input value is required on an input line, the values should be separated by commas. A carriage return in response to a request for data will leave the current value of the data unchanged.

3. Expanded data input: For situations in which many numbers must be entered, or a choice more complicated than a simple datum input is involved, the Editor will produce a "Subpage" to the active Screen Page to accomplish the input operation.

The following mechanisms for paging through the Editor should be noted: To page forward to the next sequential Screen Page, press the carriage return at the "Enter selection number" prompt; to Page ***B***ackwards to the previous Screen Page, enter "**B<c/r>**"; the ***F***irst and ***L***ast input Pages can be accessed from any numbered Screen Page in the Editor by entering, respectively, "**F<c/r>**" or "**L<c/r>**"; one can ***S***kip a Page by entering "**S<c/r>**" or ***J***ump to Page "n" by entering "**Jn<c/r>**" (for example, **J5<c/r>** will produce a jump to Page 5 from any numbered Screen Page in the Editor).

Editor Screen Page Images

Note that not all possible Screen Page images are displayed here; the images are intended only as aids to discussion and do not portray a realistic session in its entirety.

```
        +=======================================================+
        |                                                       |
        |                                                       |
        |                                                       |
        |              **   Welcome to Statmoor  **             |
        |                                                       |
        |                                                       |
        |                  Statmoor Version 4.10                |
        |                  Copyright (C) 1989 by                |
        |                 Richard J. Hartman, Ph.D.             |
        |                                                       |
        |                                                       |
        +=======================================================+




--------------------------------------------------------------------------------

(M) Modify existing data file, (C) Create a new file, (E) Execute simulation
Enter letter of selection: M<c/r>
```

Title Page: This Screen presents options to ***M***odify (**M**) an existing data file, ***C***reate (**C**) a wholly new one or ***E***xecute (**E**) **Statmoor** using an existing data file. No response but "**M**", "**m**", "**C**", "**c**", "**E**" or "**e**" will be accepted; that is, .letter case is irrelevant here (and elsewhere). If either (**M**) or (**C**) are entered, any first or second generation data files in the current directory will be copied to backup files to avoid inadvertent loss of data. Thus, the two most recent

generations of data files are automatically preserved. At the end of the Editor session, a data file with the new or modified data will be created in the current directory in addition to the two generations of backup files.

```
****  Page 1: Site conditions  ****


    Two-line Identification for this simulation:

1) [Statmoor Trial Run                                                  ]
2) [Deep Water Semi                                                     ]

3) Units of measure: English

4) Site water depth:         1000.00 feet
5) Water density:              64.00 lbs/cubic foot

Enter number of selection: H<c/r>
```

Screen Page 1: This Screen contains necessary site data and other miscellaneous information. The units of measure can be toggled between English and metric by selecting item 3. Input of new numerical data (e.g., item 4) or character string data (e.g., item 1) is accomplished by selecting the relevant numbered item and responding appropriately to the ensuing prompts. In this example, we have requested navigational "***H***elp" by entering "**H**" at the "Enter number of selection:" prompt; the screen response to this action follows:

```
(F)  First page
(L)  Last page
(S)  Skip ahead a page
(E)  Execute program
(B)  Back a page
(Jn) Jump to page n


Press <RETURN> to continue: <c/r>
```

Help Page: This Screen contains instructions for quick access to various editor Pages. The described actions are accomplished by entering the appropriate (uppercase or lowercase) letter at an "Enter number of selection:" prompt on any numbered Screen Page.

```
**** Page 2: Anchor Depth/Bottom Slope/Vessel Draft Information ****

 1) Equalize horizontal tension components ....... No
 2) Anchor depths determined by bottom slope
 3) Bottom slope (unsigned) .....                .000 feet  / feet
 4) Direction of maximum downwards slope .....   .000 degrees
 5) Vessel Draft ..............................  50.000 feet


Enter number of selection: <c/r>
```

Screen Page 2: This page contains bottom slope information and the "Equalize horizontal tension components" option discussed in Section II.

```
**** Page 3: General Mooring Information ****

 1) Fairlead layout characterization: Spread Moor
 2) Number of mooring legs (Max 12) .............   8
 3) Number of distinct mooring leg types (Max 12)   2
 4) Maximum horizontal load .....                   1000.00 kips
 5) Number of points in interpolation table(s) ...  30
 6) Mean line profile determined by ..... line tension
 7) Modify individual values of line tension


Enter number of selection: 7<c/r>
```

Screen Page 3: General mooring information, including pretension specification and maximum horizontal force value to be used in interpolation tables. The maximum horizontal force value is for documentation purposes only; the actual maximum value used by **Statmoor** is taken from the largest value of line breaking strength given on the line specification pages. Selection of item 7 produces the following screen response:

```
line tension

 1)   80.00
 2)   80.00
 3)   80.00
 4)   80.00
 5)   80.00
 6)   80.00
 7)   80.00
 8)   80.00

 9) Auto repeat

Enter number of selection: <c/r>
```

This Subpage, which accomplishes input values for pretension in the eight mooring lines, contains the Editor "auto repeat" feature, which is discussed in more detail below.

```
**** Page 4: More General Mooring Information ****

 1) Number of mooring legs associated with each type --
     4 in Type A    4 in Type B

 2) Number of sublines associated with each type (max  3) --
     3 in Type A    2 in Type B

 3) Edit fairlead positions
 4) Edit plan-view line departure angles


Enter number of selection: 1<c/r>
```

Screen Page 4: This page accomplishes line type specification, fairlead coordinate and plan-view line departure angle data input. The following four Subpages document respectively the results of entering "**1**", "**2**", "**3**" and "**4**" at the Page 4 "Enter number…" prompt.

```
--- Mooring line type multiplicity ---

 1)    4.00
 2)    4.00

 3) Auto repeat

Enter number of selection: <c/r>
```

```
--- Number of sublines for each distinct type ---

 1)    3.00
 2)    2.00

 3) Auto repeat

Enter number of selection: <c/r>
```

```
>>> Enter coordinates for     Fairleads
           x          y          z
 1)      150.00     150.00      50.00
 2)      150.00     150.00      50.00
 3)     -150.00     150.00      50.00
 4)     -150.00     150.00      50.00
 5)     -150.00    -150.00      50.00
 6)     -150.00    -150.00      50.00
 7)      150.00    -150.00      50.00
 8)      150.00    -150.00      50.00

Enter number of selection: <c/r>
```

```
Plan-view GLOBAL Angles (Zero forward; Positive C-clockwise)

 1)     .00
 2)   90.00
 3)   90.00
 4)  180.00
 5)  180.00
 6)  270.00
 7)  270.00
 8)  360.00

 9) Auto repeat

Enter number of selection: 9<c/r>
```

Subpages to Page 4. The last Subpage above demonstrates access to the Editor "auto repeat" feature applied to input of plan-view line pretension values. By selecting the "Auto repeat" item number, prompts will be issued to permit automatic input of values beginning with user-specified first value and separated by a fixed user-specified interval. The prompts for the required user input are self-explanatory. If equally spaced values are not desired, the values for each line can be entered individually.

```
**** Page 4A: Subline Specifics ****

---> Subline attached to fairlead

 1) Moor leg type A (of  2 type(s))
 2) Subline number:  1 of  3

 3) Subline composition ..........................      Wire
 4) Subline length ...............................    1000.00 feet
 5) Subline outside diameter .....................       2.50 inches
 6) Wt/unit length in water ......................       9.60 lbs/foot
 7) Breaking strength ............................     574.38 kips
10) Compliance coefficient #1  (alpha1) ..........  0.230E-04 (k.lbs)**-1
11) Compliance coefficient #2  (alpha2) ..........  0.000E+00 (k.lbs)**-2
12) Compliance coefficient #3  (alpha3) ..........  0.000E+00 (k.lbs)**-3
13) Buoyancy of spring buoy ......................     120.00 kips
15) Line numbers associated with type A:
     1, 4, 5, 8,

("?" for default physical data; "C", "D", "I" to Copy, Delete, Insert)

Enter number of selection: <c/r>
```

```
**** Page 4A: Subline Specifics ****


 1) Moor leg type A (of  2 type(s))
 2) Subline number:  2 of  3

 3) Subline composition ..........................      Chain
 4) Subline length ...............................    1500.00 feet
 5) Subline outside diameter .....................       2.00 inches
 6) Wt/unit length in water ......................      35.00 lbs/foot
 7) Breaking strength ............................     431.20 kips
10) Compliance coefficient #1  (alpha1) ..........  0.220E-04 (k.lbs)**-1
11) Compliance coefficient #2  (alpha2) ..........  0.000E+00 (k.lbs)**-2
12) Compliance coefficient #3  (alpha3) ..........  0.000E+00 (k.lbs)**-3

("?" for default physical data; "C", "D", "I" to Copy, Delete, Insert)


Enter number of selection: <c/r>
```

The above Subpages to Page 4 comprise the physical data for the first two sublines of line type "A". Estimates for items 6-12 can be obtained from the built-in *Help* facility by typing "**?**" at the "Enter number..." prompt. Also, line data can be automatically ***C***opied in a single step from other sublines belonging to the same or other line types by typing "**C**" at the "Enter number..." prompt. Data for the current subline can be ***D***eleted by typing "**D**", which causes all data on the current Subpage to be replaced with data associated with the next sequential subline of the

current type. In the present case, entering "**D**" would cause the data for the current Subpage to be lost and replaced by the data for subline 3 whose data would in turn be replaced by the data for subline 4, if it exists…, etc. That is, data for sublines with subline numbers greater than the current one "collapses" by one subline number due to the "**D**" command. The ***I***nsert ("**I**") command, conversely, causes data for sublines with subline numbers greater than or equal to the current one to "expand", thereby creating an additional empty subline "slot" at the current page location. In the present case, all subline data from the current Subpage and data for all sequentially larger numbered sublines will be bumped up one subline number to the next sequential subline and so forth; all data on the current page will become zero or blank. The "**D**" and "**I**" commands have no effect on data for other line *types*, or on data for sublines with smaller subline numbers than that of the current screen.

```
**** Page 4A: Subline Specifics ****

---> Subline attached to anchor

 1) Moor leg type A (of  2 type(s))
 2) Subline number:  3 of  3

 3) Subline composition ........................      Chain
 4) Subline length .............................    2000.00 feet
 5) Subline outside diameter ...................       3.00 inches
 6) Wt/unit length in water ....................      78.20 lbs/foot
 7) Breaking strength ..........................    1080.00 kips
10) Compliance coefficient #1  (alpha1) ........  0.980E-05 (k.lbs)**-1
11) Compliance coefficient #2  (alpha2) ........  0.000E+00 (k.lbs)**-2
12) Compliance coefficient #3  (alpha3) ........  0.000E+00 (k.lbs)**-3
13) Clump weight ..............................        .00 kips

("?" for default physical data; "C", "D", "I" to Copy, Delete, Insert)

Enter number of selection: ?<c/r>
```

The above Subpage demonstrates a request for *Help* from the built-in physical properties database. The "**?**" response at the "Enter number..." prompt elicits the following stream of Sub-subpages in which *Help* is obtained for the weight per unit length for the chain of subline "3", line type "A".

```
****  Simulation Help Facility  ****

 1) HELP with weight per unit length...
 2) HELP with breaking strength...
 3) HELP with compliance coefficients...
 4) Convert a "dry" weight to "submerged" weight...

Enter number of selection: 1<c/r>
```

```
***  Help for line weight/length  ***


 >>> Select submergence medium:

1) Air
2) Freshwater
3) Seawater



Enter number of selection: 3<c/r>
```

```
***  Help for line weight/length  ***


1) Stud-link chain (O.R.Q.)
2) I.W.R.C. wire rope (O.R.Q.)
3) Kevlar stranded rope (Samson)
4) Inextensible stud-link chain
5) Braided nylon rope (Samson "two-in-one")
6) Samson Nystron rope
7) Vermeire 100% polyester braided rope
8) 100% polyproplyene rope (Vermeire "Monogrip")



Enter number of selection: 1<c/r>
```

```
****  Simulation Help Facility  ****

 1) HELP with weight per unit length...
 2) HELP with breaking strength...
 3) HELP with compliance coefficients...
 4) Convert a "dry" weight to "submerged" weight...

Enter number of selection: <c/r>
```

Help for other physical properties leads to similar self-explanatory interaction stream. To exit the *Help* facility, enter a **<c/r>** at the top level of *Help* as demonstrated above.

```
**** Page 4B: Subline Specifics ****

---> Subline attached to fairlead

 1) Moor leg type B (of  2 type(s))
 2) Subline number:  1 of  2

 3) Subline composition ..........................      Nylon
 4) Subline length ...............................    2000.00 feet
 5) Subline outside diameter .....................       5.00 inches
 6) Wt/unit length in water ......................        .73 lbs/foot
 7) Breaking strength ............................     685.43 kips
10) Compliance coefficient #1  (alpha1) ..........  0.667E-03 (k.lbs)**-1
11) Compliance coefficient #2  (alpha2) .......... -0.126E-05 (k.lbs)**-2
12) Compliance coefficient #3  (alpha3) ..........  0.884E-09 (k.lbs)**-3
13) Buoyancy of spring buoy ......................        .00 kips
15) Line numbers associated with type B:
     2, 3, 6, 7,

("?" for default physical data; "C", "D", "I" to Copy, Delete, Insert)

Enter number of selection: ?<c/r>
```

The above Subpage demonstrates a request for *Help* from the built-in physical properties database. The "**?**" response at the "Enter number..." prompt elicits the following stream of Sub-subpages in which curve-fitting *Help* is obtained for the elastic properties of the Nylon of subline "1", line type "B", using manufacturers tension-elongation data.

```
****  Simulation Help Facility  ****

 1) HELP with weight per unit length...
 2) HELP with breaking strength...
 3) HELP with compliance coefficients...
 4) Convert a "dry" weight to "submerged" weight...

Enter number of selection: 3<c/r>
```

```
***  Help for line compliance coefficients  ***


1) User-specified stress/strain curve
2) Built-in compliance coefficients



Enter number of selection: 1<c/r>
```

```
Enter number of points (max 10, min 4):  10

-->> Array input for TENSION values


 1)      85.00
 2)     170.00
 3)     255.00
 4)     340.00
 5)     425.00
 6)     510.00
 7)     595.00
 8)     680.00
 9)     765.00
10)     850.00

Enter number of selection: <c/r>
```

```
-->> Array input for ELONGATION values


 1)        .0481
 2)        .0813
 3)        .1028
 4)        .1159
 5)        .1237
 6)        .1297
 7)        .1370
 8)        .1489
 9)        .1686
10)        .1995

Enter number of selection: <c/r>
```

The above Sub-subpages represent the outcome of an extended input procedure which would be difficult to display concisely in hardcopy form but is reasonably intuitive. At the end of the input procedure, the cubic fit to the tension-elongation curve represented by the Alpha1, Alpha2 and Alpha3 coefficients will be displayed on the screen data Subpage for line type "B", subline "1". ***Note:*** The tension-elongation point (.0,.0) is always included automatically and must not be included in the user-supplied values.

```
**** Page 4B: Subline Specifics ****

---> Subline attached to anchor

 1) Moor leg type B (of  2 type(s))
 2) Subline number:  2 of  2

 3) Subline composition ..........................      Chain
 4) Subline length ...............................    2000.00 feet
 5) Subline outside diameter .....................       3.00 inches
 6) Wt/unit length in water ......................      78.20 lbs/foot
 7) Breaking strength ............................    1080.00 kips
10) Compliance coefficient #1  (alpha1) ..........  0.980E-05 (k.lbs)**-1
11) Compliance coefficient #2  (alpha2) ..........  0.000E+00 (k.lbs)**-2
12) Compliance coefficient #3  (alpha3) ..........  0.000E+00 (k.lbs)**-3
13) Clump weight ................................     100.00 kips

("?" for default physical data; "C", "D", "I" to Copy, Delete, Insert)

Enter number of selection: <c/r>
```

This Subpage contains data for subline "2" of line type "B" and completes the mooring line specification for the sample problem.

```
****  Page 13: Static offset Specifications ****


 1) Number of <<lateral>> offset directions (Max  8) .............  2
 2) Number of lateral offsets per direction (Max 25) ............. 25
 3) Specify lateral offset DIRECTIONS
 4) Specify lateral offset VALUES

 5) Number of <<yaw>> offset directions (Max  2) .................  1
 6) Number of yaw offsets per direction (Max 25) ................. 25
 7) Specify yaw offset DIRECTIONS
 8) Specify yaw offset VALUES

Enter number of selection: <c/r>
```

This Page provides input for characteristics of the static offsets desired. Selection of items 3, 4, 7 and 8 produce the following stream of Subpages to accomplish the required data input:

```
lateral Offset Directions (degrees)

 1)     .00
 2)   90.00

 3) Auto repeat

Enter number of selection: <c/r>
```

```
lateral Offset Values ( feet  )

 1)     .00      16)  150.00
 2)   10.00      17)  160.00
 3)   20.00      18)  170.00
 4)   30.00      19)  180.00
 5)   40.00      20)  190.00
 6)   50.00      21)  200.00
 7)   60.00      22)  210.00
 8)   70.00      23)  220.00
 9)   80.00      24)  230.00
10)   90.00      25)  240.00
11)  100.00
12)  110.00
13)  120.00
14)  130.00
15)  140.00

26) Auto repeat

Enter number of selection: <c/r>
```

```
yaw Offset Parity (+1 = clockwise, -1 = counter-clockwise)

 1)    1.00

 2) Auto repeat

Enter number of selection: <c/r>
```

```
yaw Offset Values (degrees)

 1)     .00      16)   75.00
 2)    5.00      17)   80.00
 3)   10.00      18)   85.00
 4)   15.00      19)   90.00
 5)   20.00      20)   95.00
 6)   25.00      21)  100.00
 7)   30.00      22)  105.00
 8)   35.00      23)  110.00
 9)   40.00      24)  115.00
10)   45.00      25)  120.00
11)   50.00
12)   55.00
13)   60.00
14)   65.00
15)   70.00

26) Auto repeat

Enter number of selection: <c/r>
```

```
****  Page 14: Interpolation Table Data ****


 1) Number of interpolation tables (Max 12):  2
 2) Number of elements in interpolation table (Max 30): 30

 3) Table #  1 is for line #  1
 4) Table #  2 is for line #  2

Enter number of selection: <c/r>
```

```
****  Page 15: Output options 1 ****


----- Printout Control -----

 1) Total tension at fairlead ................ Yes
 2) Horizontal tension component at fairlead   Yes
 3) Vertical tension component at fairlead ... Yes
 4) Horizontal tension component at anchor ... No
 5) Vertical tension component at anchor ..... Yes
 6) Total suspended line length .............. Yes
 7) Declination angles at fairlead ........... Yes
 8) Cross-coupling summary ................... Yes
 9) Plots for selected outputs ............... No

12) Debug option is on ....................... No
13) Output goes to Disk, on logged drive

Enter number of selection: 13<c/r>
```

This Screen Page controls the kind and amount of printout produced and its destination. If a large number of offsets have been specified, the amount of output produced can be prodigious since every option above produces output for each mooring line and each offset type and direction specified. The "debug" option is sometimes useful in conjunction with **SeaSoft** support services in tracking down program execution problems; it will normally be deselected since it severely slows program execution. Selection of the output destination option produces the following Subpage:

```
>>> Output Device Selection: <<<

1) Console
2) Printer
3) Disk

Enter number of selection: <c/r>
```

This Subpage permits selection of the device to receive output from **Statmoor**. The normal choice will be the disk, since at the end of execution, the output disk files produced can be viewed at leisure, inspected for errors and omissions and later sent to the printer if it appears to be a good run. Output vectored to the screen will be lost once it scrolls by and output vectored to the printer will often generate unnecessarily wasted paper.

```
****  Page 16: End of Session  ****


1) Exit to operating system
2) Produce hardcopy of input data
3) Produce diskfile of input data
4) Execute simulation now

 (Press <RETURN> to review data.)

Enter number of selection:1<c/r>
```

This is the final Screen Page of the Editor.

• Item 1 allows direct exit to the operating system, which will result in saving of prepared data to a data file in the current directory which can later be reaccessed for further modification by the Editor or for executing **Statmoor** at a later time.

• Item 2 produces a printout of all Editor data screens for documentation purposes.

• Item 3 produces a disk file (file name "P") of all Editor data screens which can be used for future reference. It is strongly recommended that an STATIN file be made and archived, along with the appropriate SMORDAT file, for any final execution runs.

• Item 4 allows **Statmoor** to be executed immediately. In this case, as always, a copy of the input data file will be left on the disk for later use. There is no functional difference between using item 4 or the "**E**" command from any numbered Editor page to execute the main program.

• Pressing <RETURN> at the "Enter number..." prompt allows reinspection of Editor screens before any disk-writing activity is undertaken.

Appendix F: Sample Problem STMDAT Input File

```
Statmoor Trial Run      Deep Water Semi
    8    0    1    0    0    0    1    2    1    0   30    1    0    0    0
    1    1    1    1    1    1    1    0    0    0    0    0    2
    1    2
      .000      .000      .000
  1000.000      .000      .000
    80.000    80.000    80.000    80.000    80.000    80.000    80.000    80.000
      .000    90.000    90.000   180.000   180.000   270.000   270.000   360.000
    2    3    2
    4    1    4    5    8
Chain       2000.000     3.000    78.200
0.9800E-050.0000E+000.0000E+000.1080E+04
Chain       1500.000     2.000    35.000      .000
0.2200E-040.0000E+000.0000E+000.4312E+03
Wire        1000.000     2.500     9.600   120.000
0.2300E-040.0000E+000.0000E+000.5744E+03
    4    2    3    6    7
Chain       2000.000     3.000    78.200
0.9800E-050.0000E+000.0000E+000.1080E+04
Nylon       2000.000     5.000      .731   100.000
0.6670E-03-.1260E-050.8840E-090.6854E+03
   150.000   150.000      .000
   150.000   150.000      .000
  -150.000   150.000      .000
  -150.000   150.000      .000
  -150.000  -150.000      .000
  -150.000  -150.000      .000
   150.000  -150.000      .000
   150.000  -150.000      .000
   25      .000
      .000    10.000    20.000    30.000    40.000    50.000    60.000    70.000
    80.000    90.000   100.000   110.000   120.000   130.000   140.000   150.000
   160.000   170.000   180.000   190.000   200.000   210.000   220.000   230.000
   240.000
   25    90.000
      .000    10.000    20.000    30.000    40.000    50.000    60.000    70.000
    80.000    90.000   100.000   110.000   120.000   130.000   140.000   150.000
   160.000   170.000   180.000   190.000   200.000   210.000   220.000   230.000
   240.000
   25     1.000
      .000     5.000    10.000    15.000    20.000    25.000    30.000    35.000
    40.000    45.000    50.000    55.000    60.000    65.000    70.000    75.000
    80.000    85.000    90.000    95.000   100.000   105.000   110.000   115.000
   120.000
```

Appendix G: STMDAT Input File Structure

It is assumed that the user interface will preclude the necessity of a detailed knowledge of the input file structure for **Statmoor**; the following descriptions are presented for documentation purposes only and need not be studied by the user before running Statmoor. The following material may, however, be of some use in debugging troublesome input files. Many simple errors can be quickly found on even a cursory inspection of the input file. A knowledge of Fortran FORMAT descriptors is required for a detailed understanding of the following material.

Record 1 --(6A8)-- Two 24 Character Identification Fields

Record 2 --(16I5)-- Miscellaneous Integer Input Variables and Flags:

Entry	Column	
1	4-5	Number of Mooring Lines
2	10 =	1 To Equalize Horizontal Line Tensions; Otherwise 0
3	15 =	1 If Lateral Offsets Input; = 0 If Calculated
4	20 =	1 If anchor depths are to be Read; =0 If Calculated
5	25	Units Flag = 0 English; = 1 Metric
6	30	Offset Type Flag = 0 For Lateral+Yaw; = 1 For Lateral Only;=2 For Yaw Only
7	35 =	1 If Yaw Offsets Input; = 0 If Calculated
8	40 =	Number of Lateral Offset Directions
9	45 =	Number of Yaw Offset Directions (2 MAX; CW & CCW)
10	50	A Debugging Parameter
11	54-55	Number of Elements in the Interpolation Tables
12-16		Available for Expansion

Record 3 --(16I5)-- Integer Flags:

Entry	Column			
1	5	NTO	=	1 for output of total fairlead tensions
2	10	NHO	=	1 for output of horizontal fairlead tensions
3	15	NVO	=	1 for output of vertical fairlead tensions
4	20	NHA	=	1 for output of anchor tensions parallel to bottom
5	25	NVA	=	1 for output of anchor tensions perpendicular to bottom
6	30	NSL	=	1 for output of suspended line lengths
7	35	NDA	=	1 for output of line declination angles at fairleads
8	40	NFL	=	1 to suppress fairlead input read and output summary (*Note*: Fairlead locations are set to zero if NFL = 1; no yaw computations will be meaningful)
9	45	NELAS	=	1 To suppress elastic output summary
10	50	NVES	=	1 To suppress vessel input and output
11	55	NANG	=	0, 1 or 2 to specify tension, angle or anchor distance
12	60	NCRS	=	1 To Suppress Cross-Coupling Summary on Output
13	65	NTAB	=	Number of lines for which interpolation table output is desired
14-16				Available for expansion

Record 4 --(16I5)-- (Optional depending on flag NTAB): The line numbers for which output of interpolation tables is required

Record 5 --(3F10.0)-- (Optional depending on flag NVES): vessel displacement, longitudinal and transverse gm's

Record 6 --(3F10.0)-- :

Column

1-10 Water depth at vessel (feet or meters)
11-20 Maximum sea floor slope (feet/foot or meters/meter)
21-30 Direction of maximum downward slope (degrees)

Records 7a-7b --(8F10.0)-- (Optional depending on entry 4 of record 2): Anchor depths

Column

1-10 Anchor depth for line 1
11-20 Anchor depth for line 2
.
.
.
etc.

Records 8a-8b --(8F10.0)-- Total pretension, fairlead departure angles from horizontal, or horizontal distances to anchors according to flag NANG

Column

1-10 pretension, angle or anchor distance for line 1
11-20 Pretension, angle or anchor distance for line 2
.
.
.
etc.

Records 9a-9b --(8F10.0)-- Plan view line departure angles

Column

1-10 Departure angle for line 1
11-20 Departure angle for line 2
.
.
.
etc.

Record 10 --(16I5)--:

Column

4-5 Number of line types
9-10 Number of sublines in first line type
14-15 Number of sublines in second line type
.
.
.
etc.

Record 11 --(16I5)-- (Not present if only one line type):

Column

4- 5 Total number of lines of current line type
9-10 Line number of first line of current type
14-15 Line number of second line of current type
.
.
etc.

Record 12-I --(A8,2X,4F10.0)-- Composition, length, weight in medium of anchor-attached subline of current type

Record 13-I --(4E10.3)-- Three elastic coefficients (alpha1, alpha2, alpha3) and breaking strength of anchor-attached subline of current type

Record 12-II --(A8,2X,4F10.0)-- Duplicate record 12-I for subline 2 of current type, if present - also, last entry is submerged weight of sinker at fairlead end of anchor-attached subline of current type, if any

Record 13-II --(4E10.3)-- Duplicate record 13-I above for subline 2 of current type, if present

Record 12-III --(A8,2X,4F10.0)-- Duplicate record 12-I for fairlead-attached subline of current type;- also, last entry is submerged buoyancy of buoy between sublines 1 and 2, if any

Record 13-III --(4E10.3)-- Duplicate record 13-I above for fairlead-attached subline of current type

Notes:

1) There are only as many sets 12-13 above as there are sublines for the current type (three maximum, as shown above). That is, for two sublines in a type, only 12-13 I and II would be present.

2) Records 11 through 13-III above are repeated as a block for each distinct line type in the mooring system.

Records 14 a-l --(3F10.0)-- (Optional depending on flag NFL): Fairlead locations (x,y,z); one record for each fairlead - positive directions are x forward, y port, z upwards

Record 15 --(I5,F10.0)-- Number of lateral offset increments and direction (degrees); or number of yaw offsets and parity (+1 or -1 for clockwise or counter-clockwise rotation direction)

Records 16 a-l --(8F10.0)-- (Optional depending on entries 3 and 7 of record 2): requested offset values (lateral or yaw)

Records 15 and 16 a-l are repeated a total of NLAT+NYAW times (see Record 2); Lateral offsets are exhausted first, then yaw offsets.

Appendix H: Sample Problem Output

SeaSoft Systems Simulation Library

Volume 7

Catenary Mooring Statics Calculator

Statmoor Version 4.60

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By Richard J. Hartman, Ph.D.

Statmoor Trial Run
Deep Water Semi

Executed at 10:42 on 9/8/93

***** INTERPOLATION TABLES FOR LINE NUMBER 1 *****

INDEX	THTOP	TOPT	TZANC	THANC	XANC	SL
1	.078	4.801	.000	.078	2591.719	2001.845
2	7.483	8.890	.000	7.483	3765.668	2194.271
3	15.590	16.312	.000	15.590	3933.556	2374.312
4	24.464	24.930	.000	24.464	4020.668	2521.720
5	34.178	34.513	.000	34.178	4073.284	2605.083
6	44.812	45.068	.000	44.812	4109.604	2693.624
7	56.453	56.657	.000	56.453	4137.911	2785.780
8	69.196	69.363	.000	69.196	4161.581	2881.068
9	83.147	83.285	.000	83.147	4182.236	2979.449
10	98.418	98.535	.000	98.418	4200.779	3081.057
11	115.135	115.235	.000	115.135	4217.754	3186.110
12	133.436	133.522	.000	133.436	4233.521	3294.860
13	153.469	153.797	.000	153.469	4262.283	3368.846
14	175.399	176.141	.000	175.399	4286.140	3446.882
15	199.406	200.702	.000	199.406	4305.658	3531.607
16	225.686	227.661	.000	225.686	4322.051	3623.050
17	254.455	257.219	.000	254.455	4336.191	3721.294
18	285.948	289.598	.000	285.948	4348.714	3826.462
19	320.424	325.044	.000	320.424	4360.087	3938.712
20	358.164	363.829	.000	358.164	4370.659	4058.233
21	399.478	406.253	.000	399.478	4380.694	4185.240
22	444.703	452.646	.000	444.703	4390.398	4319.970
23	494.212	503.370	.000	494.212	4399.933	4462.680
24	548.409	558.847	9.009	548.409	4409.231	4500.000
25	607.738	619.581	22.064	607.738	4417.992	4500.000
26	672.685	686.069	36.357	672.685	4426.426	4500.000
27	743.782	758.854	51.996	743.782	4434.729	4500.000
28	821.611	838.531	69.098	821.611	4443.069	4500.000
29	906.811	925.748	87.789	906.811	4451.591	4500.000
30	1000.078	1021.217	108.208	1000.078	4460.429	4500.000

***** INTERPOLATION TABLES FOR LINE NUMBER 2 *****

INDEX	THTOP	TOPT	TZANC	THANC	XANC	SL
1	.078	.809	.000	.078	3222.459	1101.499
2	7.483	9.019	.000	7.483	3743.198	2000.000
3	15.590	18.310	.000	15.590	3758.530	2000.000
4	24.464	28.455	.000	24.464	3773.233	2000.000
5	34.178	39.525	.000	34.178	3788.385	2000.000
6	44.812	51.601	.000	44.812	3804.081	2000.000
7	56.453	64.776	.000	56.453	3820.292	2000.000
8	69.196	79.151	.000	69.196	3836.951	2000.000
9	83.147	94.839	.000	83.147	3853.962	2000.000
10	98.418	111.963	.000	98.418	3871.202	2000.000
11	115.135	130.659	.000	115.135	3888.525	2000.000
12	133.436	151.076	.000	133.436	3905.758	2000.000
13	153.469	173.382	.000	153.469	3922.701	2000.000
14	175.399	197.759	.000	175.399	3939.135	2000.000
15	199.406	224.406	.000	199.406	3954.859	2018.823
16	225.686	253.230	.000	225.686	3971.869	2171.232
17	254.455	284.301	.000	254.455	3990.173	2324.088
18	285.948	317.910	.000	285.948	4008.569	2479.080
19	320.424	354.355	.000	320.424	4026.393	2637.500
20	358.164	393.944	.000	358.164	4043.373	2800.297
21	399.478	437.002	.000	399.478	4059.601	2968.093
22	444.703	483.867	.000	444.703	4075.573	3141.145
23	494.212	534.900	.000	494.212	4092.306	3319.256
24	548.409	590.479	.000	548.409	4111.517	3501.633
25	607.738	651.001	.000	607.738	4135.879	3686.686
26	672.685	716.886	.000	672.685	4169.375	3871.758
27	743.782	788.584	4.157	743.782	4217.758	4000.000
28	821.611	866.686	18.001	821.611	4288.803	4000.000
29	906.811	951.660	30.844	906.811	4394.146	4000.000
30	1000.078	1043.945	41.578	1000.078	4549.715	4000.000

********** MOORING LINE MASS CHARACTERISTICS SUMMARY **********

LINE NO.	LINE HEADING (DEG)	SUBLINE INDEX	SUBLINE LENGTH (FT)	SUBLINE COMP.	NOMINAL DIAMETER (IN)	EFFECTIVE WEIGHT (LBS/FT)	SINKER WEIGHT (K.LBS)	MOORING BUOY-NET BUOYANCY (K.LBS)
1	.0	SUBLN 3	2000.0	Chain	3.00	78.20		
		SUBLN 2	1500.0	Chain	2.00	35.00	.00	
		SUBLN 1	1000.0	Wire	2.50	9.60		120.00
2	90.0	SUBLN 2	2000.0	Chain	3.00	78.20		
		SUBLN 1	2000.0	Nylon	5.00	.73	100.00	
3	90.0	SUBLN 2	2000.0	Chain	3.00	78.20		
		SUBLN 1	2000.0	Nylon	5.00	.73	100.00	
4	180.0	SUBLN 3	2000.0	Chain	3.00	78.20		
		SUBLN 2	1500.0	Chain	2.00	35.00	.00	
		SUBLN 1	1000.0	Wire	2.50	9.60		120.00
5	180.0	SUBLN 3	2000.0	Chain	3.00	78.20		
		SUBLN 2	1500.0	Chain	2.00	35.00	.00	
		SUBLN 1	1000.0	Wire	2.50	9.60		120.00
6	270.0	SUBLN 2	2000.0	Chain	3.00	78.20		
		SUBLN 1	2000.0	Nylon	5.00	.73	100.00	
7	270.0	SUBLN 2	2000.0	Chain	3.00	78.20		
		SUBLN 1	2000.0	Nylon	5.00	.73	100.00	
8	360.0	SUBLN 3	2000.0	Chain	3.00	78.20		
		SUBLN 2	1500.0	Chain	2.00	35.00	.00	
		SUBLN 1	1000.0	Wire	2.50	9.60		120.00

******** MOORING LINE ELASTIC CHARACTERISTICS SUMMARY *********

LINE NO.	LINE HEADING (DEG)	SUBLINE INDEX	SUBLINE LENGTH	SUBLINE COMP.	ELASTIC COEFFICIENTS ALPHA1 (K.LBS**-1)	ALPHA2 (K.LBS**-2)	ALPHA3 (K.LBS**-3)
1	.0	SUBLN 3	2000.0	Chain	0.980E-05	0.000E+00	0.000E+00
		SUBLN 2	1500.0	Chain	0.220E-04	0.000E+00	0.000E+00
		SUBLN 1	1000.0	Wire	0.230E-04	0.000E+00	0.000E+00
2	90.0	SUBLN 2	2000.0	Chain	0.980E-05	0.000E+00	0.000E+00
		SUBLN 1	2000.0	Nylon	0.667E-03	-0.126E-05	0.884E-09
3	90.0	SUBLN 2	2000.0	Chain	0.980E-05	0.000E+00	0.000E+00
		SUBLN 1	2000.0	Nylon	0.667E-03	-0.126E-05	0.884E-09
4	180.0	SUBLN 3	2000.0	Chain	0.980E-05	0.000E+00	0.000E+00
		SUBLN 2	1500.0	Chain	0.220E-04	0.000E+00	0.000E+00
		SUBLN 1	1000.0	Wire	0.230E-04	0.000E+00	0.000E+00
5	180.0	SUBLN 3	2000.0	Chain	0.980E-05	0.000E+00	0.000E+00
		SUBLN 2	1500.0	Chain	0.220E-04	0.000E+00	0.000E+00
		SUBLN 1	1000.0	Wire	0.230E-04	0.000E+00	0.000E+00
6	270.0	SUBLN 2	2000.0	Chain	0.980E-05	0.000E+00	0.000E+00
		SUBLN 1	2000.0	Nylon	0.667E-03	-0.126E-05	0.884E-09
7	270.0	SUBLN 2	2000.0	Chain	0.980E-05	0.000E+00	0.000E+00
		SUBLN 1	2000.0	Nylon	0.667E-03	-0.126E-05	0.884E-09
8	360.0	SUBLN 3	2000.0	Chain	0.980E-05	0.000E+00	0.000E+00
		SUBLN 2	1500.0	Chain	0.220E-04	0.000E+00	0.000E+00
		SUBLN 1	1000.0	Wire	0.230E-04	0.000E+00	0.000E+00

********** FAIRLEAD SUMMARY **********

FAIRLEAD NUMBER	LINE DIRECTION (DEG)	FAIRLEAD COORDINATES (FROM WATERLINE) X (FT)	Y (FT)	Z (FT)
1	.0	150.00	150.00	.00
2	90.0	150.00	150.00	.00
3	90.0	-150.00	150.00	.00
4	180.0	-150.00	150.00	.00
5	180.0	-150.00	-150.00	.00
6	270.0	-150.00	-150.00	.00
7	270.0	150.00	-150.00	.00
8	360.0	150.00	-150.00	.00

********** ZERO-OFFSET CONDITION SUMMARY **********

LINE NO.	ANCHOR-TO-FRLD HEIGHT (FT)	MEAN SLOPE TO ANCHOR (FT/FT)	FAIRLEAD-ANCHOR DISTANCE (FT)	UNSTRETCHED SUSPENDED LENGTH (FT)	ZERO-OFFSET FAIRLEAD TENSIONS --- TOTAL (K.LBS)	HORIZ. (K.LBS)	VERT. (K.LBS)	LINE DEC. (DEG)
1	1000.0	.000	4177.7	2957.8	80.00	79.85	-4.81	3.5
2	1000.0	.000	3837.9	2000.0	80.00	69.95	-38.82	29.0
3	1000.0	.000	3837.9	2000.0	80.00	69.95	-38.82	29.0
4	1000.0	.000	4177.7	2957.8	80.00	79.85	-4.81	3.5
5	1000.0	.000	4177.7	2957.8	80.00	79.85	-4.81	3.5
6	1000.0	.000	3837.9	2000.0	80.00	69.95	-38.82	29.0
7	1000.0	.000	3837.9	2000.0	80.00	69.95	-38.82	29.0
8	1000.0	.000	4177.7	2957.8	80.00	79.85	-4.81	3.5

********** OCEAN BOTTOM SUMMARY **********

BOTTOM:	DEPTH AT VESSEL	1000.00	FT
	BOTTOM SLOPE	.000	FT/FT
	SLOPE DIRECTION	.0	DEGREES
	FRICTION COEFFICIENT	.000	

********** LATERAL OFFSET RESTORING CHARACTERISTICS **********

OFFSET DIRECTION = .00 DEG

---- MOST EXPOSED LINE CHARACTERISTICS ----

OFFSET (FT)	LINE NO.	-- FAIRLEAD TENSIONS -- TOTAL (K.LBS)	HORIZ. (K.LBS)	VERT. (K.LBS)	UNSTRETCHED SUSPENDED LENGTH (FT)	ANCHOR FORCES REL. TO BOTTOM PARALLEL (K.LBS)	PERP. (K.LBS)	TOTAL RESTORING FORCE (K.LBS)
.0	8	80.00	79.85	-4.81	2957.8	79.85	.00	.00
10.0	5	87.76	87.63	-4.81	3009.3	87.63	.00	-29.36
20.0	5	95.99	95.87	-4.81	3064.1	95.87	.00	-59.00
30.0	5	105.33	105.22	-4.81	3123.8	105.22	.00	-89.20
40.0	5	115.17	115.07	-4.80	3185.7	115.07	.00	-120.34
50.0	5	126.75	126.66	-4.81	3254.6	126.66	.00	-152.49
60.0	5	136.46	136.33	-5.75	3305.6	136.33	.00	-180.80
70.0	5	143.51	143.30	-7.68	3331.3	143.30	.00	-203.24
80.0	5	150.55	150.26	-9.33	3357.0	150.26	.00	-223.78
90.0	5	158.85	158.43	-11.57	3386.5	158.43	.00	-246.72
100.0	5	168.22	167.63	-14.14	3419.2	167.63	.00	-271.72
110.0	5	178.08	177.30	-16.71	3453.6	177.30	.00	-296.47
120.0	5	190.67	189.60	-20.17	3497.0	189.60	.00	-325.54
130.0	5	204.03	202.65	-23.69	3542.9	202.65	.00	-356.12
140.0	5	220.48	218.68	-28.07	3598.7	218.68	.00	-392.67
150.0	5	239.43	237.15	-33.03	3662.2	237.15	.00	-434.08
160.0	5	261.08	258.21	-38.60	3733.8	258.21	.00	-480.21
170.0	5	286.93	283.36	-45.16	3817.8	283.36	.00	-533.36
180.0	5	317.55	313.14	-52.77	3915.0	313.14	.00	-595.79
190.0	5	352.91	347.54	-61.34	4024.6	347.54	.00	-667.48
200.0	5	393.52	387.08	-70.91	4147.1	387.08	.00	-749.45
210.0	5	439.67	432.05	-81.48	4282.3	432.05	.00	-842.29
220.0	5	491.40	482.53	-92.95	4429.0	482.53	.00	-946.16
230.0	5	549.61	539.39	-105.52	4500.0	539.39	.00	-1062.81
240.0	5	617.44	605.64	-120.10	4500.0	605.64	21.60	-1198.27

********** LATERAL OFFSET RESTORING CHARACTERISTICS **********

OFFSET DIRECTION = .00 DEG

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TOTAL RESTORING CHARACTERISTICS
AND CROSS-COUPLING SUMMARY

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OFFSET (FT)	TOTAL RESTORING FORCE (K.LBS)	INDUCED MOMENTS (ABOUT WATERLINE) ROLL (K.LBS*FT)	PITCH	YAW	ORTHOGONAL INDUCED FORCES TO OFFSET (K.LBS)	SURGE	SWAY	HEAVE
.0	.00	0.00E+00	0.00E+00	0.00E+00	.00	.00	.00	-174.53
10.0	-29.36	0.00E+00	0.00E+00	0.00E+00	.00	-29.36	.00	-174.61
20.0	-59.00	0.00E+00	0.12E+01	0.00E+00	.00	-59.00	.00	-174.66
30.0	-89.20	0.00E+00	0.30E+01	0.00E+00	.00	-89.20	.00	-174.80
40.0	-120.34	0.00E+00	0.00E+00	0.00E+00	.00	-120.34	.00	-174.88
50.0	-152.49	0.00E+00	0.52E+01	0.00E+00	.00	-152.49	.00	-175.16
60.0	-180.80	0.00E+00	-0.28E+03	0.00E+00	.00	-180.80	.00	-177.27
70.0	-203.24	0.00E+00	-0.86E+03	0.00E+00	.00	-203.24	.00	-181.37
80.0	-223.78	0.00E+00	-0.13E+04	0.00E+00	.00	-223.78	.00	-185.08
90.0	-246.72	0.00E+00	-0.20E+04	0.00E+00	.00	-246.72	.00	-189.93
100.0	-271.72	0.00E+00	-0.28E+04	0.00E+00	.00	-271.72	.00	-195.44
110.0	-296.47	0.00E+00	-0.36E+04	0.00E+00	.00	-296.47	.00	-201.05
120.0	-325.54	0.00E+00	-0.46E+04	0.00E+00	.00	-325.54	.00	-208.54
130.0	-356.12	0.00E+00	-0.56E+04	0.00E+00	.00	-356.12	.00	-216.16
140.0	-392.67	0.00E+00	-0.70E+04	0.00E+00	.00	-392.67	.00	-225.49
150.0	-434.08	0.00E+00	-0.85E+04	0.00E+00	.00	-434.08	.00	-236.00
160.0	-480.21	0.00E+00	-0.10E+05	0.00E+00	.00	-480.21	.00	-247.79
170.0	-533.36	0.00E+00	-0.12E+05	0.00E+00	.00	-533.36	.00	-261.73
180.0	-595.79	0.00E+00	-0.14E+05	0.00E+00	.00	-595.79	.00	-277.77
190.0	-667.48	0.00E+00	-0.17E+05	0.00E+00	.00	-667.48	.00	-295.76
200.0	-749.45	0.00E+00	-0.20E+05	0.00E+00	.00	-749.45	.00	-315.79
210.0	-842.29	0.00E+00	-0.23E+05	0.00E+00	.00	-842.29	.00	-337.81
220.0	-946.16	0.00E+00	-0.26E+05	0.00E+00	.00	-946.16	.00	-361.66
230.0	-1062.81	0.00E+00	-0.30E+05	0.00E+00	.00	-1062.81	.00	-387.74
240.0	-1198.27	0.00E+00	-0.35E+05	0.00E+00	.00	-1198.27	.00	-417.85

********** TOTAL FAIRLEAD LINE TENSION **********
(K.LBS)

OFFSET DIRECTION = .00 DEG

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (FT)								
.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
10.00	73.48	80.04	80.04	87.76	87.76	80.04	80.04	73.48
20.00	67.27	80.08	80.08	95.99	95.99	80.08	80.08	67.27
30.00	61.90	80.14	80.14	105.33	105.33	80.14	80.14	61.90
40.00	56.56	80.22	80.22	115.17	115.17	80.22	80.22	56.56
50.00	52.47	80.33	80.33	126.75	126.75	80.33	80.33	52.47
60.00	48.38	80.46	80.46	136.46	136.46	80.46	80.46	48.38
70.00	44.51	80.62	80.62	143.51	143.51	80.62	80.62	44.51
80.00	41.60	80.80	80.80	150.55	150.55	80.80	80.80	41.60
90.00	38.70	81.00	81.00	158.85	158.85	81.00	81.00	38.70
100.00	35.79	81.23	81.23	168.22	168.22	81.23	81.23	35.79
110.00	33.49	81.48	81.48	178.08	178.08	81.48	81.48	33.49
120.00	31.67	81.76	81.76	190.67	190.67	81.76	81.76	31.67
130.00	29.85	82.06	82.06	204.03	204.03	82.06	82.06	29.85
140.00	28.03	82.38	82.38	220.48	220.48	82.38	82.38	28.03
150.00	26.21	82.73	82.73	239.43	239.43	82.73	82.73	26.21
160.00	24.63	83.10	83.10	261.08	261.08	83.10	83.10	24.63
170.00	23.65	83.50	83.50	286.93	286.93	83.50	83.50	23.65
180.00	22.66	83.92	83.92	317.55	317.55	83.92	83.92	22.66
190.00	21.67	84.36	84.36	352.91	352.91	84.36	84.36	21.67
200.00	20.68	84.83	84.83	393.52	393.52	84.83	84.83	20.68
210.00	19.69	85.32	85.32	439.67	439.67	85.32	85.32	19.69
220.00	18.70	85.84	85.84	491.40	491.40	85.84	85.84	18.70
230.00	17.71	86.38	86.38	549.61	549.61	86.38	86.38	17.71
240.00	16.72	86.94	86.94	617.44	617.44	86.94	86.94	16.72

********** HORIZONTAL TENSION COMPONENTS **********
(K.LBS)

OFFSET DIRECTION = .00 DEG

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (FT)								
.00	79.85	69.95	69.95	79.85	79.85	69.95	69.95	79.85
10.00	73.32	69.99	69.99	87.63	87.63	69.99	69.99	73.32
20.00	67.10	70.02	70.02	95.87	95.87	70.02	70.02	67.10
30.00	61.71	70.07	70.07	105.22	105.22	70.07	70.07	61.71
40.00	56.36	70.15	70.15	115.07	115.07	70.15	70.15	56.36
50.00	52.25	70.24	70.24	126.66	126.66	70.24	70.24	52.25
60.00	48.13	70.36	70.36	136.33	136.33	70.36	70.36	48.13
70.00	44.25	70.50	70.50	143.30	143.30	70.50	70.50	44.25
80.00	41.32	70.66	70.66	150.26	150.26	70.66	70.66	41.32
90.00	38.39	70.84	70.84	158.43	158.43	70.84	70.84	38.39
100.00	35.47	71.04	71.04	167.63	167.63	71.04	71.04	35.47
110.00	33.14	71.27	71.27	177.30	177.30	71.27	71.27	33.14
120.00	31.30	71.51	71.51	189.60	189.60	71.51	71.51	31.30
130.00	29.45	71.78	71.78	202.65	202.65	71.78	71.78	29.45
140.00	27.60	72.07	72.07	218.68	218.68	72.07	72.07	27.60
150.00	25.76	72.38	72.38	237.15	237.15	72.38	72.38	25.76
160.00	24.16	72.71	72.71	258.21	258.21	72.71	72.71	24.16
170.00	23.14	73.06	73.06	283.36	283.36	73.06	73.06	23.14
180.00	22.12	73.44	73.44	313.14	313.14	73.44	73.44	22.12
190.00	21.10	73.83	73.83	347.54	347.54	73.83	73.83	21.10
200.00	20.08	74.25	74.25	387.08	387.08	74.25	74.25	20.08
210.00	19.07	74.68	74.68	432.05	432.05	74.68	74.68	19.07
220.00	18.05	75.14	75.14	482.53	482.53	75.14	75.14	18.05
230.00	17.03	75.62	75.62	539.39	539.39	75.62	75.62	17.03
240.00	16.01	76.12	76.12	605.64	605.64	76.12	76.12	16.01

********** VERTICAL TENSION COMPONENTS **********
(K.LBS)

OFFSET DIRECTION = .00 DEG

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (FT)								
.00	-4.81	-38.82	-38.82	-4.81	-4.81	-38.82	-38.82	-4.81
10.00	-4.82	-38.84	-38.84	-4.81	-4.81	-38.84	-38.84	-4.82
20.00	-4.81	-38.85	-38.85	-4.81	-4.81	-38.85	-38.85	-4.81
30.00	-4.82	-38.88	-38.88	-4.81	-4.81	-38.88	-38.88	-4.82
40.00	-4.80	-38.92	-38.92	-4.80	-4.80	-38.92	-38.92	-4.80
50.00	-4.83	-38.97	-38.97	-4.81	-4.81	-38.97	-38.97	-4.83
60.00	-4.83	-39.03	-39.03	-5.75	-5.75	-39.03	-39.03	-4.83
70.00	-4.81	-39.10	-39.10	-7.68	-7.68	-39.10	-39.10	-4.81
80.00	-4.84	-39.18	-39.18	-9.33	-9.33	-39.18	-39.18	-4.84
90.00	-4.84	-39.28	-39.28	-11.57	-11.57	-39.28	-39.28	-4.84
100.00	-4.82	-39.38	-39.38	-14.14	-14.14	-39.38	-39.38	-4.82
110.00	-4.82	-39.50	-39.50	-16.71	-16.71	-39.50	-39.50	-4.82
120.00	-4.85	-39.62	-39.62	-20.17	-20.17	-39.62	-39.62	-4.85
130.00	-4.87	-39.76	-39.76	-23.69	-23.69	-39.76	-39.76	-4.87
140.00	-4.86	-39.91	-39.91	-28.07	-28.07	-39.91	-39.91	-4.86
150.00	-4.83	-40.07	-40.07	-33.03	-33.03	-40.07	-40.07	-4.83
160.00	-4.82	-40.24	-40.24	-38.60	-38.60	-40.24	-40.24	-4.82
170.00	-4.86	-40.42	-40.42	-45.16	-45.16	-40.42	-40.42	-4.86
180.00	-4.89	-40.61	-40.61	-52.77	-52.77	-40.61	-40.61	-4.89
190.00	-4.91	-40.82	-40.82	-61.34	-61.34	-40.82	-40.82	-4.91
200.00	-4.92	-41.03	-41.03	-70.91	-70.91	-41.03	-41.03	-4.92
210.00	-4.91	-41.26	-41.26	-81.48	-81.48	-41.26	-41.26	-4.91
220.00	-4.89	-41.49	-41.49	-92.95	-92.95	-41.49	-41.49	-4.89
230.00	-4.86	-41.74	-41.74	-105.52	-105.52	-41.74	-41.74	-4.86
240.00	-4.82	-42.00	-42.00	-120.10	-120.10	-42.00	-42.00	-4.82

********** ANCHOR PULL PERPENDICULAR TO BOTTOM **********
(K.LBS)

OFFSET DIRECTION = .00 DEG

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (FT)								
.00	.00	.00	.00	.00	.00	.00	.00	.00
10.00	.00	.00	.00	.00	.00	.00	.00	.00
20.00	.00	.00	.00	.00	.00	.00	.00	.00
30.00	.00	.00	.00	.00	.00	.00	.00	.00
40.00	.00	.00	.00	.00	.00	.00	.00	.00
50.00	.00	.00	.00	.00	.00	.00	.00	.00
60.00	.00	.00	.00	.00	.00	.00	.00	.00
70.00	.00	.00	.00	.00	.00	.00	.00	.00
80.00	.00	.00	.00	.00	.00	.00	.00	.00
90.00	.00	.00	.00	.00	.00	.00	.00	.00
100.00	.00	.00	.00	.00	.00	.00	.00	.00
110.00	.00	.00	.00	.00	.00	.00	.00	.00
120.00	.00	.00	.00	.00	.00	.00	.00	.00
130.00	.00	.00	.00	.00	.00	.00	.00	.00
140.00	.00	.00	.00	.00	.00	.00	.00	.00
150.00	.00	.00	.00	.00	.00	.00	.00	.00
160.00	.00	.00	.00	.00	.00	.00	.00	.00
170.00	.00	.00	.00	.00	.00	.00	.00	.00
180.00	.00	.00	.00	.00	.00	.00	.00	.00
190.00	.00	.00	.00	.00	.00	.00	.00	.00
200.00	.00	.00	.00	.00	.00	.00	.00	.00
210.00	.00	.00	.00	.00	.00	.00	.00	.00
220.00	.00	.00	.00	.00	.00	.00	.00	.00
230.00	.00	.00	.00	.00	.00	.00	.00	.00
240.00	.00	.00	.00	21.60	21.60	.00	.00	.00

********** SUSPENDED LINE LENGTHS **********
(FT)

OFFSET DIRECTION = .00 DEG

LINE NO. OFFSET (FT)	1	2	3	4	5	6	7	8
.00	2957.76	2000.00	2000.00	2957.76	2957.76	2000.00	2000.00	2957.76
10.00	2910.13	2000.00	2000.00	3009.30	3009.30	2000.00	2000.00	2910.13
20.00	2865.38	2000.00	2000.00	3064.09	3064.09	2000.00	2000.00	2865.38
30.00	2825.12	2000.00	2000.00	3123.79	3123.79	2000.00	2000.00	2825.12
40.00	2785.04	2000.00	2000.00	3185.67	3185.67	2000.00	2000.00	2785.04
50.00	2752.48	2000.00	2000.00	3254.59	3254.59	2000.00	2000.00	2752.48
60.00	2719.93	2000.00	2000.00	3305.57	3305.57	2000.00	2000.00	2719.93
70.00	2688.94	2000.00	2000.00	3331.29	3331.29	2000.00	2000.00	2688.94
80.00	2664.56	2000.00	2000.00	3357.01	3357.01	2000.00	2000.00	2664.56
90.00	2640.18	2000.00	2000.00	3386.51	3386.51	2000.00	2000.00	2640.18
100.00	2615.81	2000.00	2000.00	3419.22	3419.22	2000.00	2000.00	2615.81
110.00	2596.21	2000.00	2000.00	3453.58	3453.58	2000.00	2000.00	2596.21
120.00	2580.37	2000.00	2000.00	3496.99	3496.99	2000.00	2000.00	2580.37
130.00	2564.52	2000.00	2000.00	3542.90	3542.90	2000.00	2000.00	2564.52
140.00	2548.68	2000.00	2000.00	3598.69	3598.69	2000.00	2000.00	2548.68
150.00	2532.83	2000.00	2000.00	3662.18	3662.18	2000.00	2000.00	2532.83
160.00	2516.67	2000.00	2000.00	3733.83	3733.83	2000.00	2000.00	2516.67
170.00	2499.75	2000.00	2000.00	3817.81	3817.81	2000.00	2000.00	2499.75
180.00	2482.83	2000.00	2000.00	3914.99	3914.99	2000.00	2000.00	2482.83
190.00	2465.90	2000.00	2000.00	4024.59	4024.59	2000.00	2000.00	2465.90
200.00	2448.98	2000.00	2000.00	4147.14	4147.14	2000.00	2000.00	2448.98
210.00	2432.06	2000.00	2000.00	4282.27	4282.27	2000.00	2000.00	2432.06
220.00	2415.14	2000.00	2000.00	4429.00	4429.00	2000.00	2000.00	2415.14
230.00	2398.22	2000.00	2000.00	4500.00	4500.00	2000.00	2000.00	2398.22
240.00	2381.30	2000.00	2000.00	4500.00	4500.00	2000.00	2000.00	2381.30

********** DECLINATION ANGLES AT FAIRLEAD **********
(DEG)

OFFSET DIRECTION = .00 DEG

LINE NO. OFFSET (FT)	1	2	3	4	5	6	7	8
.00	3.45	29.03	29.03	3.45	3.45	29.03	29.03	3.45
10.00	3.76	29.03	29.03	3.14	3.14	29.03	29.03	3.76
20.00	4.10	29.03	29.03	2.87	2.87	29.03	29.03	4.10
30.00	4.47	29.02	29.02	2.62	2.62	29.02	29.02	4.47
40.00	4.87	29.02	29.02	2.39	2.39	29.02	29.02	4.87
50.00	5.28	29.02	29.02	2.18	2.18	29.02	29.02	5.28
60.00	5.73	29.02	29.02	2.42	2.42	29.02	29.02	5.73
70.00	6.20	29.01	29.01	3.07	3.07	29.01	29.01	6.20
80.00	6.68	29.01	29.01	3.55	3.55	29.01	29.01	6.68
90.00	7.19	29.01	29.01	4.18	4.18	29.01	29.01	7.19
100.00	7.74	29.00	29.00	4.82	4.82	29.00	29.00	7.74
110.00	8.28	29.00	29.00	5.38	5.38	29.00	29.00	8.28
120.00	8.82	28.99	28.99	6.07	6.07	28.99	28.99	8.82
130.00	9.38	28.98	28.98	6.67	6.67	28.98	28.98	9.38
140.00	9.98	28.98	28.98	7.31	7.31	28.98	28.98	9.98
150.00	10.62	28.97	28.97	7.93	7.93	28.97	28.97	10.62
160.00	11.27	28.96	28.96	8.50	8.50	28.96	28.96	11.27
170.00	11.86	28.95	28.95	9.06	9.06	28.95	28.95	11.86
180.00	12.46	28.95	28.95	9.57	9.57	28.95	28.95	12.46
190.00	13.09	28.94	28.94	10.01	10.01	28.94	28.94	13.09
200.00	13.75	28.93	28.93	10.38	10.38	28.93	28.93	13.75
210.00	14.44	28.92	28.92	10.68	10.68	28.92	28.92	14.44
220.00	15.17	28.91	28.91	10.90	10.90	28.91	28.91	15.17
230.00	15.94	28.90	28.90	11.07	11.07	28.90	28.90	15.94
240.00	16.76	28.89	28.89	11.22	11.22	28.89	28.89	16.76

********** LATERAL OFFSET RESTORING CHARACTERISTICS **********

OFFSET DIRECTION = 90.00 DEG

---- MOST EXPOSED LINE CHARACTERISTICS ----

OFFSET (FT)	LINE NO.	-- FAIRLEAD TENSIONS -- TOTAL (K.LBS)	HORIZ. (K.LBS)	VERT. (K.LBS)	UNSTRETCHED SUSPENDED LENGTH (FT)	ANCHOR FORCES REL. TO BOTTOM PARALLEL (K.LBS)	PERP. (K.LBS)	TOTAL RESTORING FORCE (K.LBS)
.0	8	80.00	79.85	-4.81	2957.8	79.85	.00	.00
10.0	7	89.25	78.18	-43.06	2000.0	78.18	.00	-32.57
20.0	7	98.75	86.64	-47.39	2000.0	86.64	.00	-65.33
30.0	7	108.68	95.49	-51.90	2000.0	95.49	.00	-98.18
40.0	7	119.19	104.88	-56.63	2000.0	104.88	.00	-131.59
50.0	7	129.99	114.53	-61.47	2000.0	114.53	.00	-165.17
60.0	7	141.77	125.09	-66.71	2000.0	125.09	.00	-199.89
70.0	7	153.90	135.97	-72.09	2000.0	135.97	.00	-234.84
80.0	7	167.06	147.79	-77.89	2000.0	147.79	.00	-271.25
90.0	7	181.10	160.41	-84.05	2000.0	160.41	.00	-307.83
100.0	7	195.93	173.75	-90.54	2000.0	173.75	.00	-340.43
110.0	7	212.62	188.78	-97.81	2010.5	188.78	.00	-371.57
120.0	7	229.56	204.11	-105.07	2046.1	204.11	.00	-403.30
130.0	7	246.51	219.56	-112.07	2135.7	219.56	.00	-435.28
140.0	7	263.47	235.17	-118.80	2221.6	235.17	.00	-467.60
150.0	7	280.45	250.89	-125.32	2305.1	250.89	.00	-500.13
160.0	7	298.42	267.69	-131.91	2389.2	267.69	.00	-534.84
170.0	7	316.69	284.81	-138.49	2473.5	284.81	.00	-570.19
180.0	7	336.99	304.00	-145.42	2562.0	304.00	.00	-609.70
190.0	7	357.87	323.78	-152.45	2652.0	323.78	.00	-650.38
200.0	7	381.19	346.00	-159.96	2747.8	346.00	.00	-695.97
210.0	7	405.96	369.69	-167.72	2847.1	369.69	.00	-744.51
220.0	7	432.49	395.15	-175.80	2950.5	395.15	.00	-796.60
230.0	7	461.36	422.98	-184.22	3058.0	422.98	.00	-853.44
240.0	7	490.97	451.59	-192.65	3165.9	451.59	.00	-911.87

********** LATERAL OFFSET RESTORING CHARACTERISTICS **********

OFFSET DIRECTION = 90.00 DEG

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TOTAL RESTORING CHARACTERISTICS
AND CROSS-COUPLING SUMMARY

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OFFSET (FT)	TOTAL RESTORING FORCE (K.LBS)	INDUCED MOMENTS (ABOUT WATERLINE) ROLL (K.LBS*FT)	PITCH	YAW	ORTHOGONAL TO OFFSET	INDUCED FORCES SURGE (K.LBS)	SWAY	HEAVE
.0	.00	0.00E+00	0.00E+00	0.00E+00	-.00	.00	.00	-174.53
10.0	-32.57	0.25E+04	0.00E+00	0.00E+00	0.00	.00	-32.57	-174.99
20.0	-65.33	0.50E+04	0.00E+00	0.00E+00	0.00	.00	-65.33	-175.75
30.0	-98.18	0.75E+04	0.00E+00	0.00E+00	0.00	.00	-98.18	-177.13
40.0	-131.59	0.10E+05	0.00E+00	0.00E+00	0.00	.00	-131.59	-179.16
50.0	-165.17	0.13E+05	0.00E+00	0.00E+00	0.00	.00	-165.17	-181.55
60.0	-199.89	0.15E+05	0.00E+00	0.00E+00	0.00	.00	-199.89	-185.01
70.0	-234.84	0.18E+05	0.00E+00	0.00E+00	0.00	.00	-234.84	-188.92
80.0	-271.25	0.21E+05	0.00E+00	0.00E+00	0.00	.00	-271.25	-193.86
90.0	-307.83	0.23E+05	0.00E+00	0.00E+00	0.00	.00	-307.83	-200.23
100.0	-340.43	0.26E+05	0.00E+00	0.00E+00	0.00	.00	-340.43	-210.33
110.0	-371.57	0.28E+05	0.00E+00	0.00E+00	0.00	.00	-371.57	-224.71
120.0	-403.30	0.30E+05	0.00E+00	0.00E+00	0.00	.00	-403.30	-239.08
130.0	-435.28	0.32E+05	0.00E+00	0.00E+00	0.00	.00	-435.28	-252.95
140.0	-467.60	0.34E+05	0.00E+00	0.00E+00	0.00	.00	-467.60	-266.25
150.0	-500.13	0.36E+05	0.00E+00	0.00E+00	0.00	.00	-500.13	-279.16
160.0	-534.84	0.38E+05	0.00E+00	0.00E+00	0.00	.00	-534.84	-292.17
170.0	-570.19	0.40E+05	0.00E+00	0.00E+00	0.00	.00	-570.19	-305.18
180.0	-609.70	0.42E+05	0.00E+00	0.00E+00	0.00	.00	-609.70	-318.91
190.0	-650.38	0.44E+05	0.00E+00	0.00E+00	0.00	.00	-650.38	-332.81
200.0	-695.97	0.47E+05	0.00E+00	0.00E+00	0.00	.00	-695.97	-347.68
210.0	-744.51	0.49E+05	0.00E+00	0.00E+00	0.00	.00	-744.51	-363.07
220.0	-796.60	0.51E+05	0.00E+00	0.00E+00	0.00	.00	-796.60	-379.09
230.0	-853.44	0.54E+05	0.00E+00	0.00E+00	0.00	.00	-853.44	-395.79
240.0	-911.87	0.57E+05	0.00E+00	0.00E+00	0.00	.00	-911.87	-412.51

********** TOTAL FAIRLEAD LINE TENSION (K.LBS) **********

OFFSET DIRECTION = 90.00 DEG

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (FT)								
.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
10.00	80.22	71.34	71.34	80.22	80.22	89.25	89.25	80.22
20.00	80.25	62.83	62.83	80.25	80.25	98.75	98.75	80.25
30.00	80.29	54.71	54.71	80.29	80.29	108.68	108.68	80.29
40.00	80.35	46.85	46.85	80.35	80.35	119.19	119.19	80.35
50.00	80.42	39.17	39.17	80.42	80.42	129.99	129.99	80.42
60.00	80.51	31.87	31.87	80.51	80.51	141.77	141.77	80.51
70.00	80.61	24.78	24.78	80.61	80.61	153.90	153.90	80.61
80.00	80.73	17.93	17.93	80.73	80.73	167.06	167.06	80.73
90.00	80.87	11.87	11.87	80.87	80.87	181.10	181.10	80.87
100.00	81.02	8.94	8.94	81.02	81.02	195.93	195.93	81.02
110.00	81.19	8.78	8.78	81.19	81.19	212.62	212.62	81.19
120.00	81.38	8.62	8.62	81.38	81.38	229.56	229.56	81.38
130.00	81.58	8.46	8.46	81.58	81.58	246.51	246.51	81.58
140.00	81.80	8.30	8.30	81.80	81.80	263.47	263.47	81.80
150.00	82.03	8.15	8.15	82.03	82.03	280.45	280.45	82.03
160.00	82.28	7.99	7.99	82.28	82.28	298.42	298.42	82.28
170.00	82.55	7.83	7.83	82.55	82.55	316.69	316.69	82.55
180.00	82.83	7.67	7.67	82.83	82.83	336.99	336.99	82.83
190.00	83.13	7.52	7.52	83.13	83.13	357.87	357.87	83.13
200.00	83.48	7.36	7.36	83.48	83.48	381.19	381.19	83.48
210.00	83.88	7.20	7.20	83.88	83.88	405.96	405.96	83.88
220.00	84.30	7.04	7.04	84.30	84.30	432.49	432.49	84.30
230.00	84.74	6.89	6.89	84.74	84.74	461.36	461.36	84.74
240.00	85.21	6.73	6.73	85.21	85.21	490.97	490.97	85.21

********** HORIZONTAL TENSION COMPONENTS (K.LBS) **********

OFFSET DIRECTION = 90.00 DEG

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (FT)								
.00	79.85	69.95	69.95	79.85	79.85	69.95	69.95	79.85
10.00	80.08	62.27	62.27	80.08	80.08	78.18	78.18	80.08
20.00	80.10	54.74	54.74	80.10	80.10	86.64	86.64	80.10
30.00	80.14	47.56	47.56	80.14	80.14	95.49	95.49	80.14
40.00	80.20	40.63	40.63	80.20	80.20	104.88	104.88	80.20
50.00	80.27	33.87	33.87	80.27	80.27	114.53	114.53	80.27
60.00	80.36	27.46	27.46	80.36	80.36	125.09	125.09	80.36
70.00	80.47	21.25	21.25	80.47	80.47	135.97	135.97	80.47
80.00	80.59	15.26	15.26	80.59	80.59	147.79	147.79	80.59
90.00	80.73	9.97	9.97	80.73	80.73	160.41	160.41	80.73
100.00	80.88	7.41	7.41	80.88	80.88	173.75	173.75	80.88
110.00	81.05	7.27	7.27	81.05	81.05	188.78	188.78	81.05
120.00	81.24	7.12	7.12	81.24	81.24	204.11	204.11	81.24
130.00	81.44	6.98	6.98	81.44	81.44	219.56	219.56	81.44
140.00	81.66	6.84	6.84	81.66	81.66	235.17	235.17	81.66
150.00	81.89	6.70	6.70	81.89	81.89	250.89	250.89	81.89
160.00	82.14	6.55	6.55	82.14	82.14	267.69	267.69	82.14
170.00	82.41	6.41	6.41	82.41	82.41	284.81	284.81	82.41
180.00	82.69	6.27	6.27	82.69	82.69	304.00	304.00	82.69
190.00	82.99	6.13	6.13	82.99	82.99	323.78	323.78	82.99
200.00	83.34	5.99	5.99	83.34	83.34	346.00	346.00	83.34
210.00	83.74	5.84	5.84	83.74	83.74	369.69	369.69	83.74
220.00	84.16	5.70	5.70	84.16	84.16	395.15	395.15	84.16
230.00	84.61	5.56	5.56	84.61	84.61	422.98	422.98	84.61
240.00	85.07	5.42	5.42	85.07	85.07	451.59	451.59	85.07

********** VERTICAL TENSION COMPONENTS **********
(K.LBS)

OFFSET DIRECTION = 90.00 DEG

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (FT)								
.00	-4.81	-38.82	-38.82	-4.81	-4.81	-38.82	-38.82	-4.81
10.00	-4.81	-34.81	-34.81	-4.81	-4.81	-43.06	-43.06	-4.81
20.00	-4.81	-30.85	-30.85	-4.81	-4.81	-47.39	-47.39	-4.81
30.00	-4.81	-27.04	-27.04	-4.81	-4.81	-51.90	-51.90	-4.81
40.00	-4.81	-23.33	-23.33	-4.81	-4.81	-56.63	-56.63	-4.81
50.00	-4.81	-19.68	-19.68	-4.81	-4.81	-61.47	-61.47	-4.81
60.00	-4.81	-16.17	-16.17	-4.81	-4.81	-66.71	-66.71	-4.81
70.00	-4.81	-12.75	-12.75	-4.81	-4.81	-72.09	-72.09	-4.81
80.00	-4.81	-9.42	-9.42	-4.81	-4.81	-77.89	-77.89	-4.81
90.00	-4.81	-6.44	-6.44	-4.81	-4.81	-84.05	-84.05	-4.81
100.00	-4.81	-5.00	-5.00	-4.81	-4.81	-90.54	-90.54	-4.81
110.00	-4.81	-4.93	-4.93	-4.81	-4.81	-97.81	-97.81	-4.81
120.00	-4.81	-4.85	-4.85	-4.81	-4.81	-105.07	-105.07	-4.81
130.00	-4.81	-4.78	-4.78	-4.81	-4.81	-112.07	-112.07	-4.81
140.00	-4.81	-4.71	-4.71	-4.81	-4.81	-118.80	-118.80	-4.81
150.00	-4.81	-4.64	-4.64	-4.81	-4.81	-125.32	-125.32	-4.81
160.00	-4.81	-4.57	-4.57	-4.81	-4.81	-131.91	-131.91	-4.81
170.00	-4.80	-4.50	-4.50	-4.80	-4.80	-138.49	-138.49	-4.80
180.00	-4.80	-4.42	-4.42	-4.80	-4.80	-145.42	-145.42	-4.80
190.00	-4.80	-4.35	-4.35	-4.80	-4.80	-152.45	-152.45	-4.80
200.00	-4.80	-4.28	-4.28	-4.80	-4.80	-159.96	-159.96	-4.80
210.00	-4.80	-4.21	-4.21	-4.80	-4.80	-167.72	-167.72	-4.80
220.00	-4.80	-4.14	-4.14	-4.80	-4.80	-175.80	-175.80	-4.80
230.00	-4.81	-4.06	-4.06	-4.81	-4.81	-184.22	-184.22	-4.81
240.00	-4.81	-3.99	-3.99	-4.81	-4.81	-192.65	-192.65	-4.81

********** ANCHOR PULL PERPENDICULAR TO BOTTOM **********
(K.LBS)

OFFSET DIRECTION = 90.00 DEG

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (FT)								
.00	.00	.00	.00	.00	.00	.00	.00	.00
10.00	.00	.00	.00	.00	.00	.00	.00	.00
20.00	.00	.00	.00	.00	.00	.00	.00	.00
30.00	.00	.00	.00	.00	.00	.00	.00	.00
40.00	.00	.00	.00	.00	.00	.00	.00	.00
50.00	.00	.00	.00	.00	.00	.00	.00	.00
60.00	.00	.00	.00	.00	.00	.00	.00	.00
70.00	.00	.00	.00	.00	.00	.00	.00	.00
80.00	.00	.00	.00	.00	.00	.00	.00	.00
90.00	.00	.00	.00	.00	.00	.00	.00	.00
100.00	.00	.00	.00	.00	.00	.00	.00	.00
110.00	.00	.00	.00	.00	.00	.00	.00	.00
120.00	.00	.00	.00	.00	.00	.00	.00	.00
130.00	.00	.00	.00	.00	.00	.00	.00	.00
140.00	.00	.00	.00	.00	.00	.00	.00	.00
150.00	.00	.00	.00	.00	.00	.00	.00	.00
160.00	.00	.00	.00	.00	.00	.00	.00	.00
170.00	.00	.00	.00	.00	.00	.00	.00	.00
180.00	.00	.00	.00	.00	.00	.00	.00	.00
190.00	.00	.00	.00	.00	.00	.00	.00	.00
200.00	.00	.00	.00	.00	.00	.00	.00	.00
210.00	.00	.00	.00	.00	.00	.00	.00	.00
220.00	.00	.00	.00	.00	.00	.00	.00	.00
230.00	.00	.00	.00	.00	.00	.00	.00	.00
240.00	.00	.00	.00	.00	.00	.00	.00	.00

********** SUSPENDED LINE LENGTHS (FT) **********

OFFSET DIRECTION = 90.00 DEG

LINE NO. OFFSET (FT)	1	2	3	4	5	6	7	8
.00	2957.76	2000.00	2000.00	2957.76	2957.76	2000.00	2000.00	2957.76
10.00	2957.82	2000.00	2000.00	2957.82	2957.82	2000.00	2000.00	2957.82
20.00	2957.99	2000.00	2000.00	2957.99	2957.99	2000.00	2000.00	2957.99
30.00	2958.28	2000.00	2000.00	2958.28	2958.28	2000.00	2000.00	2958.28
40.00	2958.67	2000.00	2000.00	2958.67	2958.67	2000.00	2000.00	2958.67
50.00	2959.19	2000.00	2000.00	2959.19	2959.19	2000.00	2000.00	2959.19
60.00	2959.81	2000.00	2000.00	2959.81	2959.81	2000.00	2000.00	2959.81
70.00	2960.56	2000.00	2000.00	2960.56	2960.56	2000.00	2000.00	2960.56
80.00	2961.41	2000.00	2000.00	2961.41	2961.41	2000.00	2000.00	2961.41
90.00	2962.38	2000.00	2000.00	2962.38	2962.38	2000.00	2000.00	2962.38
100.00	2963.46	1990.86	1990.86	2963.46	2963.46	2000.00	2000.00	2963.46
110.00	2964.66	1973.61	1973.61	2964.66	2964.66	2010.49	2010.49	2964.66
120.00	2965.97	1956.35	1956.35	2965.97	2965.97	2046.08	2046.08	2965.97
130.00	2967.39	1939.10	1939.10	2967.39	2967.39	2135.68	2135.68	2967.39
140.00	2968.93	1921.84	1921.84	2968.93	2968.93	2221.61	2221.61	2968.93
150.00	2970.58	1904.59	1904.59	2970.58	2970.58	2305.12	2305.12	2970.58
160.00	2972.35	1887.33	1887.33	2972.35	2972.35	2389.20	2389.20	2972.35
170.00	2974.23	1870.08	1870.08	2974.23	2974.23	2473.46	2473.46	2974.23
180.00	2976.22	1852.83	1852.83	2976.22	2976.22	2562.03	2562.03	2976.22
190.00	2978.33	1835.57	1835.57	2978.33	2978.33	2651.97	2651.97	2978.33
200.00	2980.72	1818.32	1818.32	2980.72	2980.72	2747.84	2747.84	2980.72
210.00	2983.40	1801.06	1801.06	2983.40	2983.40	2847.12	2847.12	2983.40
220.00	2986.22	1783.81	1783.81	2986.22	2986.22	2950.52	2950.52	2986.22
230.00	2989.17	1766.55	1766.55	2989.17	2989.17	3058.02	3058.02	2989.17
240.00	2992.24	1749.30	1749.30	2992.24	2992.24	3165.93	3165.93	2992.24

********** DECLINATION ANGLES AT FAIRLEAD (DEG) **********

OFFSET DIRECTION = 90.00 DEG

LINE NO. OFFSET (FT)	1	2	3	4	5	6	7	8
.00	3.45	29.03	29.03	3.45	3.45	29.03	29.03	3.45
10.00	3.44	29.20	29.20	3.44	3.44	28.85	28.85	3.44
20.00	3.44	29.41	29.41	3.44	3.44	28.68	28.68	3.44
30.00	3.44	29.62	29.62	3.44	3.44	28.52	28.52	3.44
40.00	3.43	29.87	29.87	3.43	3.43	28.36	28.36	3.43
50.00	3.43	30.16	30.16	3.43	3.43	28.22	28.22	3.43
60.00	3.43	30.50	30.50	3.43	3.43	28.07	28.07	3.43
70.00	3.42	30.96	30.96	3.42	3.42	27.93	27.93	3.42
80.00	3.42	31.68	31.68	3.42	3.42	27.79	27.79	3.42
90.00	3.41	32.86	32.86	3.41	3.41	27.65	27.65	3.41
100.00	3.40	34.00	34.00	3.40	3.40	27.52	27.52	3.40
110.00	3.40	34.13	34.13	3.40	3.40	27.39	27.39	3.40
120.00	3.39	34.27	34.27	3.39	3.39	27.24	27.24	3.39
130.00	3.38	34.42	34.42	3.38	3.38	27.04	27.04	3.38
140.00	3.37	34.56	34.56	3.37	3.37	26.80	26.80	3.37
150.00	3.36	34.72	34.72	3.36	3.36	26.54	26.54	3.36
160.00	3.35	34.87	34.87	3.35	3.35	26.23	26.23	3.35
170.00	3.34	35.04	35.04	3.34	3.34	25.93	25.93	3.34
180.00	3.32	35.21	35.21	3.32	3.32	25.57	25.57	3.32
190.00	3.31	35.39	35.39	3.31	3.31	25.21	25.21	3.31
200.00	3.30	35.57	35.57	3.30	3.30	24.81	24.81	3.30
210.00	3.28	35.76	35.76	3.28	3.28	24.40	24.40	3.28
220.00	3.27	35.96	35.96	3.27	3.27	23.98	23.98	3.27
230.00	3.25	36.16	36.16	3.25	3.25	23.53	23.53	3.25
240.00	3.23	36.38	36.38	3.23	3.23	23.10	23.10	3.23

********** YAW OFFSET RESTORING CHARACTERISTICS **********

OFFSET PARITY = -1. (C-WISE)

---- MOST EXPOSED LINE CHARACTERISTICS ----

OFFSET (DEG)	LINE NO.	-- FAIRLEAD TENSIONS -- TOTAL (K.LBS)	HORIZ. (K.LBS)	VERT. (K.LBS)	UNSTRETCHED SUSPENDED LENGTH (FT)	ANCHOR FORCES REL. TO BOTTOM PARALLEL (K.LBS)	PERP. (K.LBS)	TOTAL YAW RESTORING MOMENT (K.LBS*FT)
.0	8	80.00	79.85	-4.81	2957.8	79.85	.00	0.000E+00
5.0	6	92.63	81.18	-44.61	2000.0	81.18	.00	0.201E+05
10.0	6	107.09	94.08	-51.18	2000.0	94.08	.00	0.408E+05
15.0	6	123.60	108.82	-58.60	2000.0	108.82	.00	0.626E+05
20.0	6	142.45	125.71	-67.01	2000.0	125.71	.00	0.849E+05
25.0	6	164.11	145.14	-76.59	2000.0	145.14	.00	0.106E+06
30.0	6	189.22	167.72	-87.61	2000.0	167.72	.00	0.128E+06
35.0	6	218.72	194.28	-100.46	2014.8	194.28	.00	0.153E+06
40.0	6	249.87	222.62	-113.46	2153.5	222.62	.00	0.180E+06
45.0	6	281.27	251.65	-125.64	2309.2	251.65	.00	0.209E+06
50.0	6	314.79	283.02	-137.80	2464.7	283.02	.00	0.242E+06
55.0	6	351.85	318.06	-150.47	2626.6	318.06	.00	0.281E+06
60.0	8	416.95	409.90	-76.32	4216.3	409.90	.00	0.325E+06
65.0	8	506.83	497.59	-96.33	4471.4	497.59	.00	0.373E+06
70.0	8	616.42	604.65	-119.88	4500.0	604.65	21.38	0.425E+06
75.0	8	751.39	736.49	-148.89	4500.0	736.49	50.39	0.479E+06
80.0	8	903.53	885.11	-181.53	4500.0	885.11	83.03	0.529E+06

TABLE RANGE EXCEEDED ON OFFSET = 85.0

********** YAW OFFSET RESTORING CHARACTERISTICS **********

OFFSET PARITY = -1. (C-WISE)

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TOTAL RESTORING CHARACTERISTICS
AND CROSS-COUPLING SUMMARY

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OFFSET (DEG)	TOTAL YAW RESTORING MOMENT (K.LBS*FT)	---- INDUCED MOMENTS ---- (ABOUT WATERLINE) ROLL (K.LBS*FT)	PITCH	YAW	--- INDUCED FORCES --- SURGE (K.LBS)	SWAY	HEAVE
.0	0.000E+00	0.00E+00	0.00E+00	0.00E+00	.00	.00	-174.53
5.0	0.201E+05	0.00E+00	0.00E+00	0.20E+05	.00	.00	-176.11
10.0	0.408E+05	0.00E+00	0.00E+00	0.41E+05	.00	.00	-180.53
15.0	0.626E+05	0.00E+00	0.00E+00	0.63E+05	.00	.00	-187.91
20.0	0.849E+05	0.00E+00	0.00E+00	0.85E+05	.00	.00	-200.74
25.0	0.106E+06	0.00E+00	0.00E+00	0.11E+06	.00	.00	-221.19
30.0	0.128E+06	0.00E+00	0.00E+00	0.13E+06	.00	.00	-247.65
35.0	0.153E+06	0.00E+00	0.00E+00	0.15E+06	.00	.00	-280.83
40.0	0.180E+06	0.00E+00	0.00E+00	0.18E+06	.00	.00	-318.73
45.0	0.209E+06	0.00E+00	0.00E+00	0.21E+06	.00	.00	-360.42
50.0	0.242E+06	0.00E+00	0.00E+00	0.24E+06	.00	.00	-408.24
55.0	0.281E+06	0.00E+00	0.00E+00	0.28E+06	.00	.00	-464.73
60.0	0.325E+06	0.00E+00	0.00E+00	0.32E+06	.00	.00	-529.91
65.0	0.373E+06	0.00E+00	0.00E+00	0.37E+06	.00	.00	-603.19
70.0	0.425E+06	0.00E+00	0.00E+00	0.42E+06	.00	.00	-685.01
75.0	0.479E+06	0.00E+00	0.00E+00	0.48E+06	.00	.00	-777.20
80.0	0.529E+06	0.00E+00	0.00E+00	0.53E+06	.00	.00	-874.02

********** TOTAL FAIRLEAD LINE TENSION **********
(K.LBS)

OFFSET PARITY = -1. (C-WISE)

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (DEG)								
.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00	80.00
5.00	71.80	92.63	69.20	90.78	71.80	92.63	69.20	90.78
10.00	65.30	107.09	59.86	103.75	65.30	107.09	59.86	103.75
15.00	60.03	123.60	51.90	119.87	60.03	123.60	51.90	119.87
20.00	55.82	142.45	45.48	136.85	55.82	142.45	45.48	136.85
25.00	53.04	164.11	40.27	148.96	53.04	164.11	40.27	148.96
30.00	50.91	189.22	36.46	163.96	50.91	189.22	36.46	163.96
35.00	49.46	218.72	33.90	182.57	49.46	218.72	33.90	182.57
40.00	48.69	249.87	32.57	207.24	48.69	249.87	32.57	207.24
45.00	48.62	281.27	32.48	240.37	48.62	281.27	32.48	240.37
50.00	49.24	314.79	33.64	284.14	49.24	314.79	33.64	284.14
55.00	50.56	351.85	36.03	342.76	50.56	351.85	36.03	342.76
60.00	52.55	393.49	39.65	416.95	52.55	393.49	39.65	416.95
65.00	55.19	440.39	44.69	506.83	55.19	440.39	44.69	506.83
70.00	59.05	490.57	50.92	616.42	59.05	490.57	50.92	616.42
75.00	64.15	540.11	58.69	751.39	64.15	540.11	58.69	751.39
80.00	70.18	585.06	67.80	903.53	70.18	585.06	67.80	903.53

********** HORIZONTAL TENSION COMPONENTS **********
(K.LBS)

OFFSET PARITY = -1. (C-WISE)

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (DEG)								
.00	79.85	69.95	69.95	79.85	79.85	69.95	69.95	79.85
5.00	71.64	81.18	60.38	90.65	71.64	81.18	60.38	90.65
10.00	65.12	94.08	52.11	103.63	65.12	94.08	52.11	103.63
15.00	59.84	108.82	45.07	119.78	59.84	108.82	45.07	119.78
20.00	55.61	125.71	39.42	136.72	55.61	125.71	39.42	136.72
25.00	52.82	145.14	34.83	148.69	52.82	145.14	34.83	148.69
30.00	50.68	167.72	31.49	163.44	50.68	167.72	31.49	163.44
35.00	49.22	194.28	29.24	181.69	49.22	194.28	29.24	181.69
40.00	48.45	222.62	28.07	205.78	48.45	222.62	28.07	205.78
45.00	48.38	251.65	28.00	238.05	48.38	251.65	28.00	238.05
50.00	49.01	283.02	29.02	280.64	49.01	283.02	29.02	280.64
55.00	50.32	318.06	31.12	337.67	50.32	318.06	31.12	337.67
60.00	52.32	357.73	34.28	409.90	52.32	357.73	34.28	409.90
65.00	54.98	402.74	38.72	497.59	54.98	402.74	38.72	497.59
70.00	58.85	451.21	44.22	604.65	58.85	451.21	44.22	604.65
75.00	63.97	499.29	51.07	736.49	63.97	499.29	51.07	736.49
80.00	70.01	543.12	59.13	885.11	70.01	543.12	59.13	885.11

********** VERTICAL TENSION COMPONENTS **********
(K.LBS)

OFFSET PARITY = -1. (C-WISE)

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (DEG)								
.00	-4.81	-38.82	-38.82	-4.81	-4.81	-38.82	-38.82	-4.81
5.00	-4.81	-44.61	-33.82	-4.82	-4.81	-44.61	-33.82	-4.82
10.00	-4.82	-51.18	-29.46	-4.81	-4.82	-51.18	-29.46	-4.81
15.00	-4.82	-58.60	-25.72	-4.81	-4.82	-58.60	-25.72	-4.81
20.00	-4.81	-67.01	-22.68	-5.87	-4.81	-67.01	-22.68	-5.87
25.00	-4.83	-76.59	-20.21	-8.97	-4.83	-76.59	-20.21	-8.97
30.00	-4.83	-87.61	-18.38	-13.00	-4.83	-87.61	-18.38	-13.00
35.00	-4.83	-100.46	-17.15	-17.97	-4.83	-100.46	-17.15	-17.97
40.00	-4.83	-113.46	-16.51	-24.56	-4.83	-113.46	-16.51	-24.56
45.00	-4.83	-125.64	-16.47	-33.27	-4.83	-125.64	-16.47	-33.27
50.00	-4.83	-137.80	-17.03	-44.46	-4.83	-137.80	-17.03	-44.46
55.00	-4.83	-150.47	-18.18	-58.89	-4.83	-150.47	-18.18	-58.89
60.00	-4.83	-163.90	-19.91	-76.32	-4.83	-163.90	-19.91	-76.32
65.00	-4.81	-178.15	-22.30	-96.33	-4.81	-178.15	-22.30	-96.33
70.00	-4.82	-192.54	-25.26	-119.88	-4.82	-192.54	-25.26	-119.88
75.00	-4.82	-205.97	-28.91	-148.89	-4.82	-205.97	-28.91	-148.89
80.00	-4.80	-217.51	-33.17	-181.53	-4.80	-217.51	-33.17	-181.53

********** ANCHOR PULL PERPENDICULAR TO BOTTOM **********
(K.LBS)

OFFSET PARITY = -1. (C-WISE)

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (DEG)								
.00	.00	.00	.00	.00	.00	.00	.00	.00
5.00	.00	.00	.00	.00	.00	.00	.00	.00
10.00	.00	.00	.00	.00	.00	.00	.00	.00
15.00	.00	.00	.00	.00	.00	.00	.00	.00
20.00	.00	.00	.00	.00	.00	.00	.00	.00
25.00	.00	.00	.00	.00	.00	.00	.00	.00
30.00	.00	.00	.00	.00	.00	.00	.00	.00
35.00	.00	.00	.00	.00	.00	.00	.00	.00
40.00	.00	.00	.00	.00	.00	.00	.00	.00
45.00	.00	.00	.00	.00	.00	.00	.00	.00
50.00	.00	.00	.00	.00	.00	.00	.00	.00
55.00	.00	.00	.00	.00	.00	.00	.00	.00
60.00	.00	.00	.00	.00	.00	.00	.00	.00
65.00	.00	.00	.00	.00	.00	.00	.00	.00
70.00	.00	.00	.00	21.38	.00	.00	.00	21.38
75.00	.00	.00	.00	50.39	.00	.00	.00	50.39
80.00	.00	.00	.00	83.03	.00	.00	.00	83.03

********** SUSPENDED LINE LENGTHS (FT) **********

OFFSET PARITY = -1. (C-WISE)

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (DEG)								
.00	2957.76	2000.00	2000.00	2957.76	2957.76	2000.00	2000.00	2957.76
5.00	2898.32	2000.00	2000.00	3029.37	2898.32	2000.00	2000.00	3029.37
10.00	2850.60	2000.00	2000.00	3113.84	2850.60	2000.00	2000.00	3113.84
15.00	2811.11	2000.00	2000.00	3213.69	2811.11	2000.00	2000.00	3213.69
20.00	2779.12	2000.00	2000.00	3307.01	2779.12	2000.00	2000.00	3307.01
25.00	2757.00	2000.00	2000.00	3351.18	2757.00	2000.00	2000.00	3351.18
30.00	2740.09	2000.00	2000.00	3404.33	2740.09	2000.00	2000.00	3404.33
35.00	2728.54	2014.81	2000.00	3469.07	2728.54	2014.81	2000.00	3469.07
40.00	2722.45	2153.47	2000.00	3553.77	2722.45	2153.47	2000.00	3553.77
45.00	2721.88	2309.16	2000.00	3665.28	2721.88	2309.16	2000.00	3665.28
50.00	2726.83	2464.68	2000.00	3808.74	2726.83	2464.68	2000.00	3808.74
55.00	2737.27	2626.62	2000.00	3993.32	2737.27	2626.62	2000.00	3993.32
60.00	2753.08	2798.42	2000.00	4216.29	2753.08	2798.42	2000.00	4216.29
65.00	2774.15	2980.59	2000.00	4471.36	2774.15	2980.59	2000.00	4471.36
70.00	2803.71	3164.54	2000.00	4500.00	2803.71	3164.54	2000.00	4500.00
75.00	2842.00	3336.34	2000.00	4500.00	2842.00	3336.34	2000.00	4500.00
80.00	2886.82	3483.85	2000.00	4500.00	2886.82	3483.85	2000.00	4500.00

********** DECLINATION ANGLES AT FAIRLEAD (DEG) **********

OFFSET PARITY = -1. (C-WISE)

LINE NO.	1	2	3	4	5	6	7	8
OFFSET (DEG)								
.00	3.45	29.03	29.03	3.45	3.45	29.03	29.03	3.45
5.00	3.84	28.79	29.25	3.04	3.84	28.79	29.25	3.04
10.00	4.23	28.55	29.48	2.66	4.23	28.55	29.48	2.66
15.00	4.60	28.30	29.71	2.30	4.60	28.30	29.71	2.30
20.00	4.94	28.06	29.91	2.46	4.94	28.06	29.91	2.46
25.00	5.22	27.82	30.12	3.45	5.22	27.82	30.12	3.45
30.00	5.45	27.58	30.27	4.55	5.45	27.58	30.27	4.55
35.00	5.60	27.34	30.39	5.65	5.60	27.34	30.39	5.65
40.00	5.69	27.01	30.46	6.81	5.69	27.01	30.46	6.81
45.00	5.70	26.53	30.47	7.96	5.70	26.53	30.47	7.96
50.00	5.63	25.96	30.40	9.00	5.63	25.96	30.40	9.00
55.00	5.48	25.32	30.29	9.89	5.48	25.32	30.29	9.89
60.00	5.27	24.62	30.14	10.55	5.27	24.62	30.14	10.55
65.00	5.00	23.86	29.94	10.96	5.00	23.86	29.94	10.96
70.00	4.68	23.11	29.74	11.21	4.68	23.11	29.74	11.21
75.00	4.31	22.42	29.51	11.43	4.31	22.42	29.51	11.3
80.00	3.93	21.83	29.29	11.59	3.93	21.83	29.29	11.59

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