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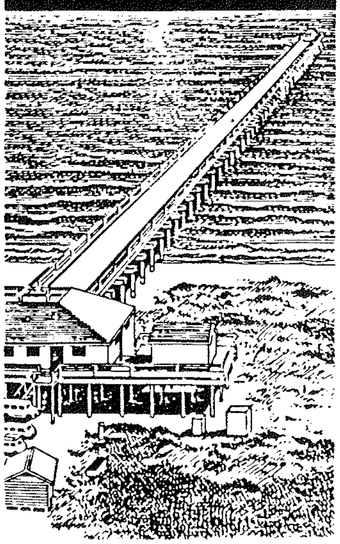

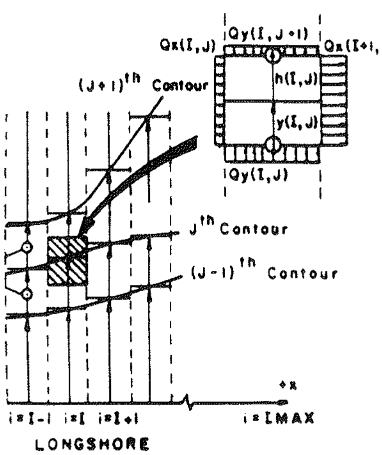

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A USER'S GUIDE TO THE N-LINE MODEL: A NUMERICAL MODEL TO SIMULATE SEDIMENT TRANSPORT IN THE VICINITY OF COASTAL STRUCTURES

by

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19. ABSTRACT (Continue on reverse if necessary and identify by block number)

A user's manual was developed for the N-line numerical sediment transport model by the Coastal Engineering Research Center (CERC). This report provides the necessary guidance, complete with multiple example applications which include model input and output, for using the N-line numerical model. Capabilities of the model include the simulation of (a) single or multiple shore-perpendicular structures, (b) single or multiple detached offshore breakwaters, and (c) disposal of material or dredging of material in the coastal zone. Model parameters are discussed in order to guide the potential user to a successful application of the model.

The N-line model is versatile, easy to use, and capable of producing dependable results when used for appropriate applications. The documentation presented in this manual is intended to cover only the breakwater subroutine. Since conceptual modifications were

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not made to the original model, the original documentation, presented in CERC's report MR 83-10, should be obtained by any potential user of the model.

The N-line model is useful in showing qualitative trends for a complex case such as Lakeview Park, Lorain, Ohio. Some of the drawbacks of the program when modeling Lakeview Park, such as the inability to reach an equilibrium shoreline, and the low sinuosity of the shoreline when influenced by breakwater segments, could possibly be successfully modeled by modifying the different input parameters, such as the ADEAN parameter and/or initial shoreline location and/or the model code. Perhaps then a quantitative verification of the model could be made. However, in this case, the model would have then been tailored to produce a previously known result.

A project cannot be successfully modeled without experimenting with different time-steps, space-steps, contour depths, shoreline locations, and structure configurations. A wave climate representative of the area being modeled is also very important. Finally, the response of the model to a particular setup must be interpreted with engineering judgment.

PREFACE

This study was authorized as a part of the Civil Works Research and Development Program by the Office, Chief of Engineers (OCE), US Army. The work was jointly performed under Work Unit C31551, Numerical Modeling of Shoreline Response to Coastal Structures, which is part of the Shore Protection and Restoration Program and Work Unit C31232, Evaluation of Navigation and Shore Protection Structures, which is part of the Coastal Structure, Evaluation, and Design Program. Messers. J. H. Lockhart, Jr., and J. Housley were OCE Technical Monitors.

This guide was developed to make the N-line model, developed for the Coastal Engineering Research Center (CERC) by Mr. Marc Perlin and Dr. Robert G. Dean, of the Coastal and Offshore Engineering and Research, Inc., Newark, Delaware, available in an easy-to-use-and-apply format. This has been accomplished by providing detailed examples demonstrating appropriate model applications. Each example includes a listing of the model input parameters and a complete output file for user comparison. The model includes an interactive input data generator for fast and easy application of the model. Program listings are provided in the appendix of this report. Magnetic tape copies of the code can be obtained by contacting the Engineering Computer Programs Library Section of the Technical Information Division, US Army Engineer Waterways Experiment Station (WES), Vicksburg, Mississippi.

This guide was prepared by Dr. Norman W. Scheffner of the Research Division, CERC, and Ms. Julie Dean Rosati of the Engineering Development Division, CERC. The report was prepared under the direction of Dr. James R. Houston, Chief, CERC, and Mr. Charles C. Calhoun, Jr., Assistant Chief, CERC.

COL Allen F. Grum, USA, was the previous Director of WES. COL Dwayne G. Lee, CE, is the present Commander and Director. Dr. Robert W. Whalin is Technical Director.

CONTENTS

CONVERSION FACTORS, NON-SI TO SI (METRIC) UNITS OF MEASUREMENT

Non-SI units of measurement used in this report can be converted to SI (metric) units as follows:

Multiply	By	To Obtain
cubic yards	0.7645549	cubic metres
degrees (angle)	0.01745329	radians
feet	0.3048	metres
inches	2.54	centimetres

A USER'S GUIDE TO THE N-LINE MODEL: A NUMERICAL MODEL TO SIMULATE SEDIMENT TRANSPORT IN THE VICINITY OF COASTAL STRUCTURES

PART I: INTRODUCTION

1. The US Army Engineer Waterways Experiment Station, Coastal Engineering Research Center (CERC), presently supports a general use numerical model for simulating sediment transport and bathymetric changes in the coastal zone. The original report, "A Numerical Model to Simulate Sediment Transport in the Vicinity of Coastal Structures" (Perlin and Dean 1983), detailed an N-line model developed to simulate the effects of single or multiple, equal length groins and/or offshore dredged material disposal on the shoreline location and the local bathymetry. These changes are the result of wave action from an offshore wave field of known period, height, and direction. Subsequent enhancements to the model include the effects of single or multiple detached breakwaters; the capability of handling multiple unequal length groins; the capability to specify an initial nonstraight shoreline; and the addition of a separate, user-friendly program to generate input data files for the N-line model.

2. The purpose of this report is to provide a user's guide for applying the model to specific cases of interest. Theory of the model, with the exception of the breakwater subroutine, is not covered in this report. Those details can be found in the program documentation (Perlin and Dean 1983). This report includes (a) a description of the capabilities and limitations of the model, (b) a brief documentation of the breakwater subroutine, and (c) details on how to apply the model to specific cases. Since the intent of this report is to provide a potential user with enough guidance to properly use the model, specific input and output listings for detailed applications of the model. This approach will allow the user to become familiar with generating data and running the model are given. The sample output is provided as a check to verify that the model is producing the correct results for a given input condition. This solution also is valuable for comparison when the model is run on different computer systems. Finally, a listing of the model and the data file generation program is provided. Appendix A provides example input and output, while Appendix B provides the program listing.

PART II: CAPABILITIES AND LIMITATIONS

3. The intent of the N-line model is to provide the user with a tool to adequately predict the effects of modifications to the coastal zone if certain criteria are met. For example, the model was developed for specific application to coastal areas that are predominately influenced by waves and that are not characterized by complex bathymetries such as offshore bars, barrier islands, or deep and/or irregular channels. Areas of this complexity require more sophisticated, expensive, and difficult-to-apply numerical models. Physical models may even be required in some cases. The N-line model may, however, provide adequate results even to relatively complex areas if the user is aware of the limitations of the model and interprets the results with these limitations in mind. Incorrectly used, this model, as with any model, can yield erroneous results that must be recognized as resulting from poor input data or from an application to a situation beyond the capabilities of the model. It is the modeler's responsibility to correctly use and interpret the results of the model.

4. The limitations of the N-line model that restrict its applicability are a result of the basic formulation of the model. Certain physical processes are not accounted for in the governing equations. For example, the model simulates refraction and diffraction, onshore/offshore and alongshore sediment transport, and conservation of mass resulting from a known wave field. The model does not simulate tidally induced velocities and water levels nor does it simulate wave-induced currents and setup/setdown. The assumption that these complex effects are minor in comparison to the wave field allows for a simplified set of governing equations that result in a model which can easily and economically be used as a design tool. Cases in which tidal and/or wave-induced effects are significant require the use of additional governing equations resulting in a highly complex numerical model which is both difficult and expensive to apply. The purpose of the N-line model is to provide the user with a tool for the prediction of changes in the primarily wave-dominated coastal zone.

5. The distinction between an appropriate and inappropriate application of the model is difficult to define since certain idealizations and simplifications can be made that might adequately represent the physical system. This will often result in qualitative results that are useful in determining trends

or rates of change. In order to make a decision as to whether or not the model can be applied to a given situation, the following list of major assumptions and limitations of the model must be consulted:

a. The model is based on an equilibrium beach-profile concept. This requires that the beach profile be assumed to monotonically increase in depth in the offshore direction. The relationship used in the model is

$$h = Ay^{2/3}$$

where

h = depth
A = Dean's equilibrium profile coefficient
y = distance offshore

The entire modeled area is assumed to have this profile.

b. The offshore boundary condition for the model is the specification of a single wave climate for the entire offshore boundary. Although this can be changed at each time-step, it must apply to the entire length of coastline being modeled.

c. Shore-connected structures, such as groins or jetties, must be perpendicular to the specified baseline. This requirement is a consequence of the computational grid employed by the model.

d. The model is based on mean sea level and has no provisions for deviations from a mean condition.

e. The addition of offshore dredged material disposal is made by advancing the appropriate depth contours offshore by an amount equivalent to the quantity of material added. Because of the limitations imposed by the monotonically increasing depth assumption, a berm or dredged material island cannot be modeled.

f. Limitations of the modeling of a breakwater will be covered in the next section.

6. Several of the above limitations could be modified. For example, a separate equilibrium profile could be specified for each location along the modeled area. This could be in the form of a spatially variable coefficient A, which could be determined from a series of shore-perpendicular profiles. Similarly, mean sea level changes could be incorporated in the model formulation. Assumptions such as the equilibrium profile concept with a monotonically increasing depth are, however, basic assumptions of the model and cannot be altered. If a particular application cannot be adequately represented with these assumptions, the N-line model should not be used.

PART III: DETACHED OFFSHORE BREAKWATERS

7. A subroutine was added to the original N-line model described in Perlin and Dean (1983) to extend the applicability of the model to include the effects of detached offshore breakwaters. This subroutine was developed to utilize the computational procedure of the existing model. Certain assumptions and simplifications were made in order to achieve compatibility with the basic model. The major simplification is that only the refractive, diffractive, and transmissive effects of the breakwater on the wave field are considered. The physical existence of the breakwater (e.g., a small island) was not possible due to the N-line model formulation of a monotonically increasing depth offshore. The consequences of this assumption will be discussed in paragraph 12.

8. The procedure used for the breakwater computations was to first calculate the entire wave-field distribution using the N-line model as if no breakwater existed. The effects of the breakwater on the wave field can then be determined by adding the diffracted and refracted wave energy vectors from each breakwater tip to the previously computed vector components at each grid point. If the grid point falls in the shadow zone of the breakwater, the N-line-computed contribution is multiplied by a user-supplied transmission coefficient.

9. A more comprehensive description of the computational procedure can be made by referring to Figure 1 and to the list of variables shown in Table 1. The sequence of events is as follows:

- a. Calculate the breakwater orientation angle (BRKANG).
- b. Calculate the depth (DEEPL, DEEPR), angle (THETAL, THETAR), wave height (HLFT, HRT), celerity (CLFT, CRT), and group velocity (CGLFT, CGRT) for the left and right tips of the breakwater based on a linear interpolation of N-line-computed values.
- c. Calculate the left and right X-coordinate for the shadow zone (XXL, XXR).
- d. Calculate the local contour line orientation (CONANG) and the X- and Y-components of the N-line-computed wave height based on the N-line-computed wave angle (THETA).
- e. Calculate the angle from the tip of the breakwater to the grid point (ANG). A separate computation is made for diffraction from the right and left tips of the breakwater.
- f. Calculate wave height at the local point using the diffraction subroutines included in the N-line model (HTEMPR, HTEMPL).

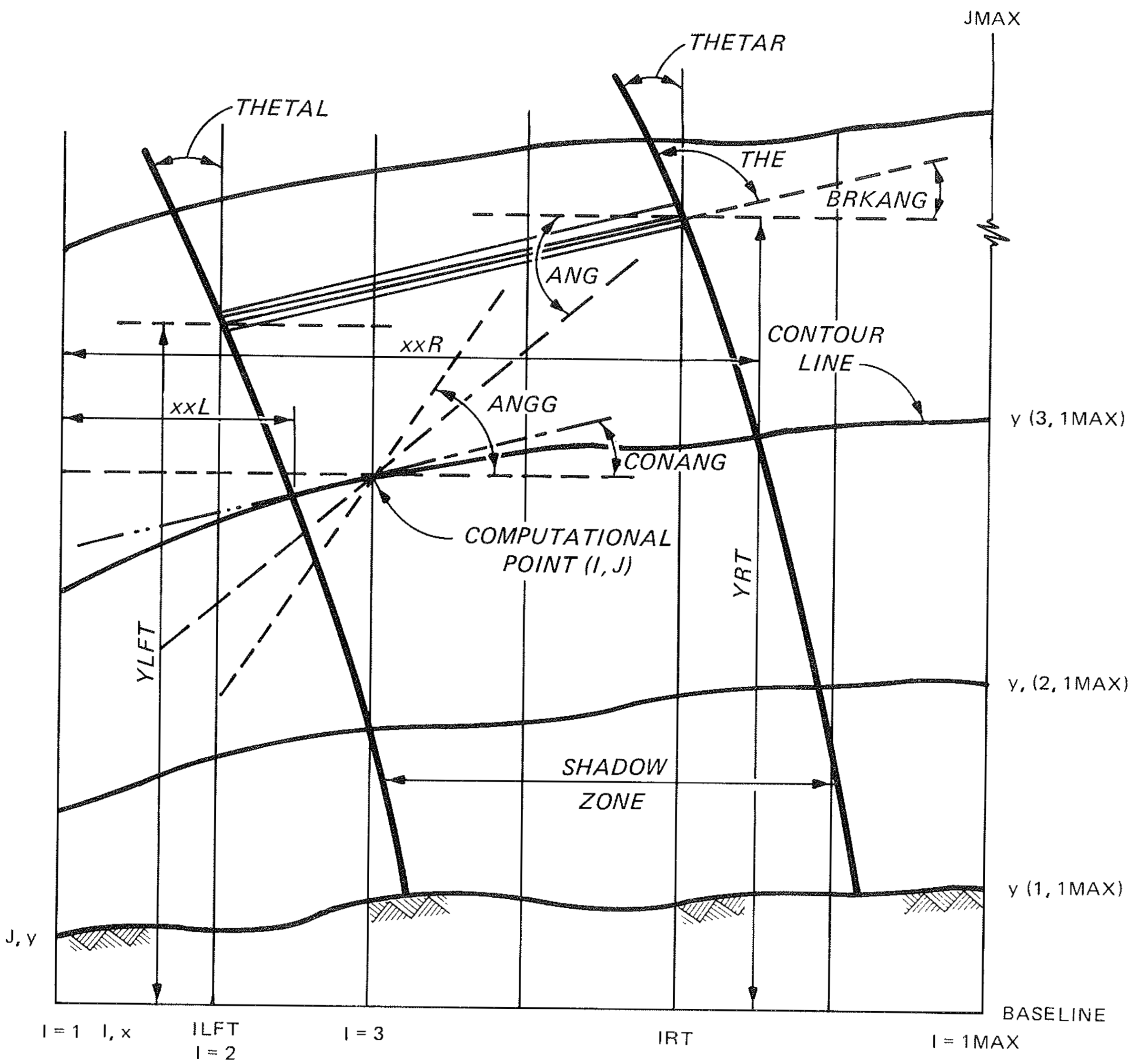


Figure 1. Schematic diagram of breakwater

Table 1

List of Variables

Parameter Name	Used For
ILFT(N)	I-location of left end of breakwater
IRT(N)	I-location of right end of breakwater
YLFT(N)	Distance offshore to left end of breakwater
YRT(N)	Distance offshore to right end of breakwater
NOBKS	Total number of breakwaters
DEEPR(N)	Depth at right end of breakwater
DEEPL(N)	Depth at left end of breakwater
HRT(N)	Wave height at right end of breakwater
HLFT(N)	Wave height at left end of breakwater
THETAL(N)	Wave angle at left end of breakwater
THETLL(N)	Wave angle used at left edge of shadow zone
THETAR(N)	Wave angle at right end of breakwater
THETRR(N)	Wave angle used at right edge of shadow zone
XXL(N)	X-location of left edge of shadow zone
XXR(N)	X-location of right edge of shadow zone
CLFT(N)	Wave celerity at left end of breakwater
CRT(N)	Wave celerity at right end of breakwater
HTEMPR(N)	Wave height contribution of diffraction from right end of breakwater
HTEMPL(N)	Wave height contribution of diffraction from left end of breakwater
HTXL(N)	X-component of HTEMPL
HTYL(N)	Y-component of HTEMPL
HTXR(N)	X-component of HTEMPR
HTYR(N)	Y-component of HTEMPR
YLLFT(N)	Y-location used to calculate left edge of shadow zone
YRRT(N)	Y-location used to calculate right edge of shadow zone
DXL(N)	X-distance used in calculation of left edge of shadow zone
DXR(N)	X-distance used in calculation of right edge of shadow zone
BRKANG(N)	Angle of the breakwater with respect to baseline
CGRT(N)	Group velocity at right end of breakwater
CGLFT(N)	Group velocity at left end of breakwater
XXDIST	X-distance to point (I,J)
HX	X-component of H (I,J)
HY	Y-component of H (I,J)
THETA(I,J)	Wave angle at I-,J-location
Y	Y-distance to I-,J-location
ANG	Diffraction angle from breakwater tip
ANGJET	Angle from breakwater tip to jetty tip
ANGG	Refracted value of ANG at point I,J
THE	Wave angle at breakwater adjusted for BRKANG(N)
AMP	Amplitude factor after diffraction
SHADOW	Zone in lee of breakwater
H(I,J)	Wave height at I-,J-location
HB(I,J)	Breaking wave height at I-,J-location
CONANG	Angle of local contour at I-,J-location

g. Calculate the refracted angle for the wave at the local point by using Snell's Law. For this computation, a shallow-water wave approximation is used for wave celerity. The computed angle is then adjusted to compensate for the local contour angle.

h. Compute the X- and Y-components of the diffracted wave from each tip by using the refracted wave angle (HTXR, HTYR, HTXL, HTYL).

i. Multiply the X- and Y-components of the N-line-computed wave heights by a shadow-zone factor. This coefficient is equal to unity when the point is not in the shadow zone behind the breakwater.

j. Sum all the contributing waves for each grid point, based on conservation of energy, and calculate an effective wave height and angle (H,THETA). For example:

$$XXX = \sum_{i=1}^{NOBKS} \left(HTXL_i * |HTXL_i| + HTXR_i * |HXTR_i| + HX * |HX| \right)$$

$$YYY = \sum_{i=1}^{NOBKS} \left(HTYL_i * |HTYL_i| + HTYR_i * |HTYR_i| + HY * |HY| \right)$$

$$H = \sqrt{|XXX| + |YYY|}$$

$$THETA = ATAN \left[\left(XXX/\sqrt{|XXX|} \right) / \left(YYY/\sqrt{|YYY|} \right) \right]$$

where NOBKS = the number of breakwaters in the modeled area.

10. The above formulation includes some simplifications that were not felt to be significant. These were considered to be justifiable since a rigorous treatment of the process of refraction and diffraction from a detached breakwater would require a total reformulation of the N-line model. In view of the original purpose of the model, reformulation was not considered appropriate.

11. The breakwater subroutine does not include a second diffraction and refraction of the breakwater-diffracted wave around groins or jetties. The program will compute a shadow zone behind each groin or jetty and will set the breakwater-diffracted wave components to zero for that area. Since it is unlikely that shore-perpendicular structures would be located directly behind a detached breakwater, this simplification appears adequate.

12. The unavoidable simplification of not recognizing the physical

presence of the breakwater in the surf zone was mentioned in paragraph 7. This approach introduces two physical processes which must be considered in the numerical model formulation. First, an actual breakwater causes the incoming waves to break, due in part to the decrease in depth in the vicinity of the structure. The exact location of the breaking point is primarily a function of both wave height and water depth. The model formulation assumes the breakwater can be considered as an abrupt barrier so that the wave height at the breakwater is equal to the wave height at the location computed by the N-line model. This value is used to diffract the wave around the breakwater tip. The breaking wave height and depth used in the N-line model for onshore/offshore sediment transport calculations are replaced by the height and depth at the breakwater location unless the wave would have broken seaward of the breakwater. Values between breakwater tips are calculated by linear interpolation of heights and depths at the ends of the breakwater.

13. The second process associated with a real breakwater is that depth contours do not cross the breakwater but tend to show a depth decrease shoreward of the breakwater and a depth increase offshore. This phenomenon cannot be correctly simulated by the N-line model without making alterations to the basic formulation. The solution adopted was to retain the N-line computations as if no breakwater existed. This will allow the contours to cross the breakwater; however, due to the decrease in wave energy inside the breakwater, the tendency is for the contours to behave in a qualitatively correct manner. This can be seen in the contour plots shown in Part IV.

14. The simplifications employed in the formulation and solution approach of the breakwater subroutine were made in order to achieve total compatibility with the existing N-line model. Consequently, very few changes have been made to the original model. Any questions concerning basic assumptions or numerical methods are referred to the program documentation (Perlin and Dean 1983).

PART IV: APPLICATION OF THE MODEL

15. The primary advantage of the N-line model over more complex numerical models is that, if applicable to the situation, the N-line model can be easily and economically used to simulate the physical problem and to provide a great deal of information on two-dimensional (2-D) changes in the modeled area. This simulation includes the capability to make predictions on the order of several months to several years. Simulations of this order of magnitude are not economically feasible with more complex sediment-transport models.

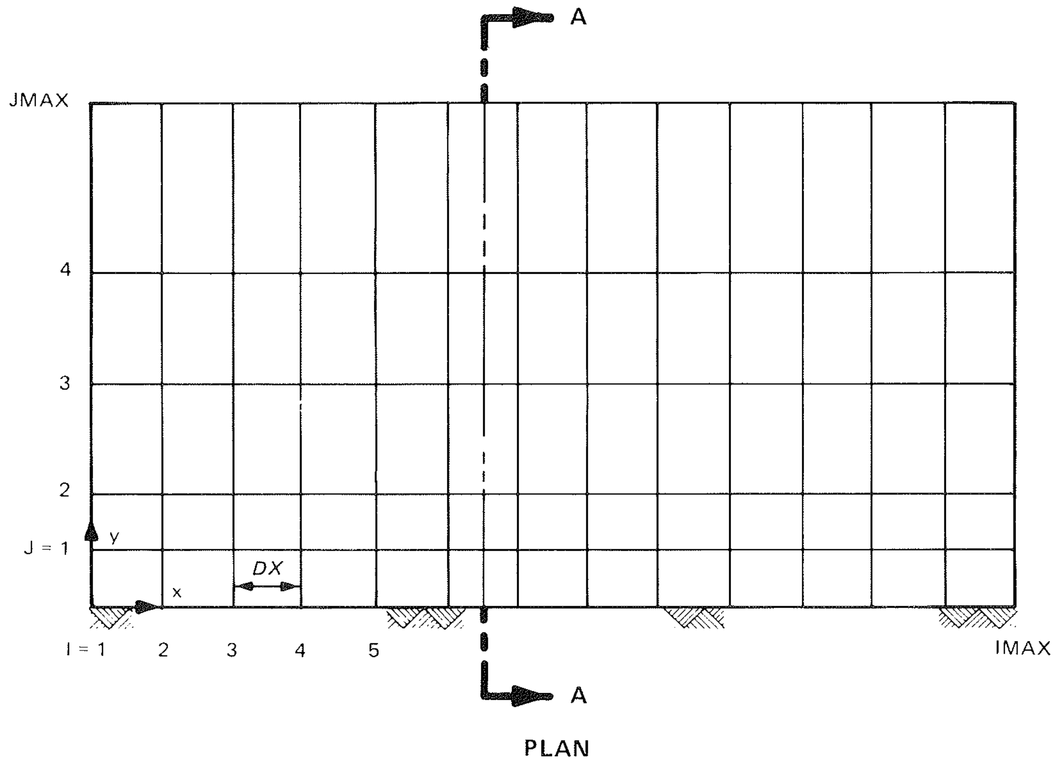
16. Application of the model to a specific or hypothetical situation is relatively easy. For example, there is no requirement for generating a complex computational grid, boundary conditions other than the offshore wave climate do not need to be specified, and a minimum of input data is required. The following list contains variables that are required. These can be classified as the basic model parameters that define the modeled area, and the time-dependent parameters that must be introduced at each time-step. A more complete description of a majority of the input variables can be found in Perlin and Dean (1983). Required variables include:

a. Basic parameters (see Figure 2 and Table 2):

(1) IMAX--The total number of alongshore grid cells used to adequately represent the modeled area. The examples in Perlin and Dean (1983) and in this report used 50. The specification of a total number much exceeding this will significantly increase the cost of running the model; therefore, some care should be exercised in selecting this number.

(2) JMAX--The total number of computational contour lines (Y-direction grid cells) used in the modeled area. Numbers in the vicinity of 8-10 were used in the examples. This number will have to adequately define the bathymetry in the modeled area by defining enough contour lines between the shoreline and the offshore depth defined by the variable WDEPTH. The parameter statements in the code (see Appendix B) must reflect NI = IMAX + 3 and NJ = JMAX + 3 for correct dimensioning.

(3) WDEPTH--The depth of water, defined in metres (as in the original publication), corresponding to the location of the input wave conditions. This depth represents the offshore boundary depth contour and is used as a constant computational boundary condition. A value of 10 m was used in all examples.



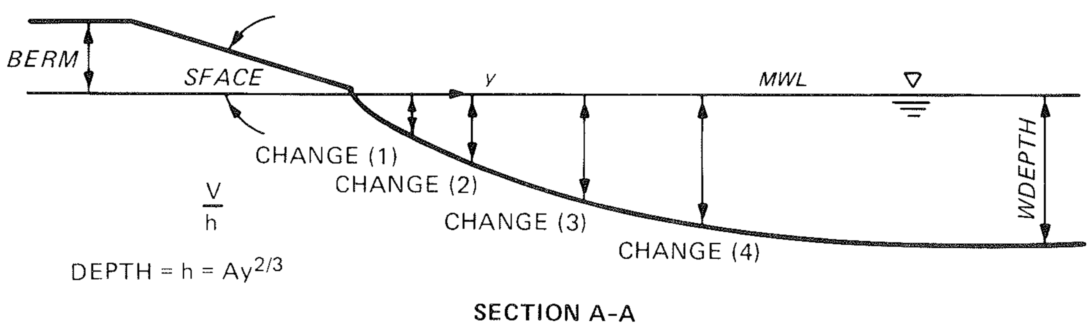


Figure 2. Schematic diagram of modeled area
(mwl = mean water level)

Table 2
Input Parameters

Card	Variables	Format	Comment
1	IMAX, JMAX	2I10	
2	WDEPTH	10X,F10.3	In metres
3	CHANGE(N), N = 1, JMAX + 1	10F8.3	
4	NWRITE	I10	
5	BERM, SFACE, DIAM	10X,F10.3,F10.4, F14.3	
6	MMAX	I3	If none exist, enter 1 and see next card
7	IJET, SJETTY	I3,F10.3	One card per structure. If none exist, enter any location and zero length
8	ADEAN	F10.4	
9	DX, DELT	2F10.3	
10	Y(I,1), I = 1, IMAX	10F8.2	
11	NOBKS	I5	If none, enter zero
12	ILFT, IRT, YLFT, YRT	10X,2I10,2F10.2	One card per structure. If none exist, omit card
13	HS, T, ALPWIS, IDDD	I5,5X,3F6.1, I5	This card is repeated for the desired number of time-steps in the total simulation. The simulation is terminated when HS > 50. If dredged material is to be added to any time increment (IDDD = 1), the IDREG, JDREG, and DREDGE cards must be inserted
14	IDREG, JDREG, DREDGE	2I5,F10.2	The dredged material simulation is terminated when IDREG = JMAX

(4) CHANGE--A one-dimensional array that specifies the numerical value of each contour line. For example: CHANGE(1) = 1.0, CHANGE(2) = 2.0, CHANGE(3) = 3.0, ...sets the J = 1,2,3,4, JMAX... + 1 contour lines to be the 1-ft,* 2-ft, 3-ft,... contour intervals. Note that JMAX + 1 values must be specified between a depth of 0 ft (shoreline) and WDEPTH (offshore boundary). The JMAX + 1 contour is merely a boundary condition used in conjunction with WDEPTH to define boundary derivatives. The 1 - JMAX contour lines represent the computational lines which will define the bathymetry of the modeled area.

(5) NWRITE--The desired frequency of printed output. The model provides a complete solution at each time-step. For a 1-month run at a 6-hr interval, 120 time-steps are computed. If, for example, only the weekly values are desired, enter NWRITE = 30 to print only every 30th output (i.e., 30, 60, 90, 120).

(6) BERM--A specified height of the berm (see Figure 2).

(7) SFACE--The slope of the beach face from the berm to the mwl (see Figure 2).

(8) DIAM--The mean diameter of the sediment particles in millimetres.

(9) ADEAN--The value of Dean's equilibrium constant. This value determines the distance offshore to a specified depth contour, $y = (h/A)^{1.5}$ ft; therefore, the values of CHANGE and A must produce the proper degree of resolution in the area of interest if reasonable results are to be expected. For a given A value, an improper selection of desired contour intervals (CHANGE) may result in contours located offshore of the area of interest. For example, a 3-ft contour with an A value of 0.15 will be 89 ft offshore. This contour will not provide much information about shoreline response to a groin that only extends 50 ft offshore.

(10) DX--The X-direction grid spacing in feet (see Figure 2). Exampls used for this report have varied from 50 to 100 ft.

(11) DELT--The time-step in hours. The examples used specify a value of 6 hr.

(12) Y(I,1)--Represents the initial shoreline location with respect to some reference line. A straight shoreline would be represented by Y(I,1) = 0.0 for IMAX values of I.

(13) MMAX--The number of shore-perpendicular structures (two groins, three groins, etc.).

(14) IJET--The I-grid location associated with each of the MMAX shore-perpendicular structures. The computations will consider the structure to be located to the right (increasing I) of the specified I-location.

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* A table of factors for converting non-SI units of measurement to SI (metric) units is presented on page 3.

(15) SJETTY--The length of each shore-perpendicular structure measured from the baseline.

(16) NOBKS--The number of detached breakwaters.

(17) ILFT,IRT--The I-grid location to be associated with the left and right end of each detached breakwater. Computationally, the I-value is assumed to be the exact location.

(18) YLFT,YRT--The exact Y-distance, measured from the baseline, offshore to the left and right tips of each detached breakwater.

b. Time-dependent parameters:

(1) HS--Offshore significant wave height (feet) specified at each time-step.

(2) T--Period of each wave in seconds.

(3) ALPWIS--The angle (-90 to +90 deg) of propagation of each wave with respect to the x-axis. Waves propagating onshore from the left of shore-perpendicular are positive (see Figure 2).

(4) IDREG,JDREG--The addition of dredged material, beach fill, or any other alteration to the existing bathymetry is simulated in the model by advancing a contour by an amount which yields the appropriate volume of material. The IDREG and JDREG parameters indicate the location of the contour line that will be moved.

(5) DREDGE--Indicates the amount of movement, in feet, the contours are to be moved to simulate dredging, fill, etc.

(6) IDDD--A dummy variable used to indicate whether or not the dredged material/fill option is used. This is specified at each time increment. When IDDD equals 1, the amount specified by DREDGE is read resulting in a movement of the (I,J) contour by the amount specified. The option is not exercised when 0 is entered.

17. The program can be submitted to the computer by either using cards (batch) or interactively using a remote terminal. If cards are used, the user will have to supply an input card deck. The required and optional cards are shown in Table 2.

18. An alternative to using a card deck is to use the interactive capability of a computer. To simplify the input data requirements, a user-friendly interactive program has been written to generate input data files for the N-line model. Since CERC is presently using CYBERNET services for computer support, the model and input generator are currently operational on the CYBER 176 computer. A detailed description of the steps necessary to generate an input file and execute the model will be presented for terminal entry batch processing for the CYBER 176. A similar procedure is available for any computer system with interactive capabilities.

19. The interactive generation of data and subsequent execution of the N-line model require the following user files:

BLDFIL	Input data file generation program
INPFIL	Input data generated by BLDFIL (excluding dredged material)
SPOOL	Dredged material data (generated by BLDFIL)
RUNLINE	Job control file to submit the N-line model for terminal entry batch processing
TRANSP	The N-line model

Examples will be presented which demonstrate how to create input files for the model using the program BLDFIL. Following the creation of appropriate input files, the N-line model can be submitted and executed in a variety of ways. The following examples use the program RUNLINE to submit the job for terminal entry batch processing:

```
GET,RUNLINE
SUBMIT,RUNLINE,T
```

where the job control file RUNLINE contains the following control entries:

```
/JOB
JOB,T1500,CM200000,P4.
/USER
/CHARGE
GET,TAPE1=INPFIL.
GET,TAPE20=SPOOL.
GET,TRANSP.
FTN5,I=TRANSP,L=OUTPUT,REW=I/L.
BEGIN,IMSL5,IMSLCCL.
$LIBRARY,IMSL5.
LGO.
/EOR
```

Following execution, the job output can be either routed to a remote job entry facility or retrieved at the user's terminal.

20. Before presenting example model applications, an explanation of the model output must be made so that model results can be properly interpreted. This can best be accomplished by reproducing the computational representation of Figure 2 of Perlin and Dean (1985), shown here as Figure 3. As in many numerical models, certain computations are made for midpoints between the I,J modes. For example, Figure 3 shows that the sediment transport values in the

onshore-offshore direction Q_y correspond to the contours specified by the user (CHANGE(1), CHANGE(2), etc.); however, the alongshore values Q_x correspond to a point halfway between the I grid points. Numerical differentiation of the continuity equation then yields a y value corresponding to an I grid location, but a midcontour location:

$$\frac{\partial y}{\partial t} + \frac{\partial Q_x}{\partial x} + \frac{\partial Q_y}{\partial y} = 0$$

For example, if a CHANGE(1) and CHANGE(2) contour was specified as 1.0 and 2.0, the Y(I,2)-distance would correspond to the 1.5-ft depth. In all cases, the Y(I,1)-location corresponds to a zero depth. The understanding of the computational representation of these variables is absolutely necessary if the user intends to compute or tabulate total transport quantities in, for example, cubic yards per year.

21. The results of any numerical model, especially one based on empirical relationships, must be carefully examined to determine whether or not the results are realistic. Empirically based models are generally site specific, requiring the adjustment of various parameters and coefficients to achieve model results that match prototype behavior. The selection of these values can have a substantial effect on the model results. Improper selection can lead to erroneous results or even to numerical instabilities resulting in the model "blowing up." The following list represents some of those parameters and coefficients that can be varied to achieve stability or to obtain better agreement between model and prototype:

a. DELT--The time increment used in the model has a substantial effect on the stability of the model. All example simulations shown in this report used a value of 6 hr.

b. DX--The alongshore grid also has a marked effect on the stability of the model. The selection of a reasonable value must be made based on the structures present, the length of coast being modeled, and the stability of the model. For example, a detached breakwater should be at least three grid spacings. The spacings used in the examples varied from 80 to 100 ft.

c. ADEAN--Dean's equilibrium profile coefficient determines the equilibrium profile for the entire modeled area. This coefficient should be determined by selecting a value that produces a beach profile which most closely matches the specific site being modeled. If no data are available to make this selection, the graph of ADEAN (signified by A in this figure) versus sediment diameter shown in Figure 4 (reproduced from Perlin and Dean 1983) can be used.

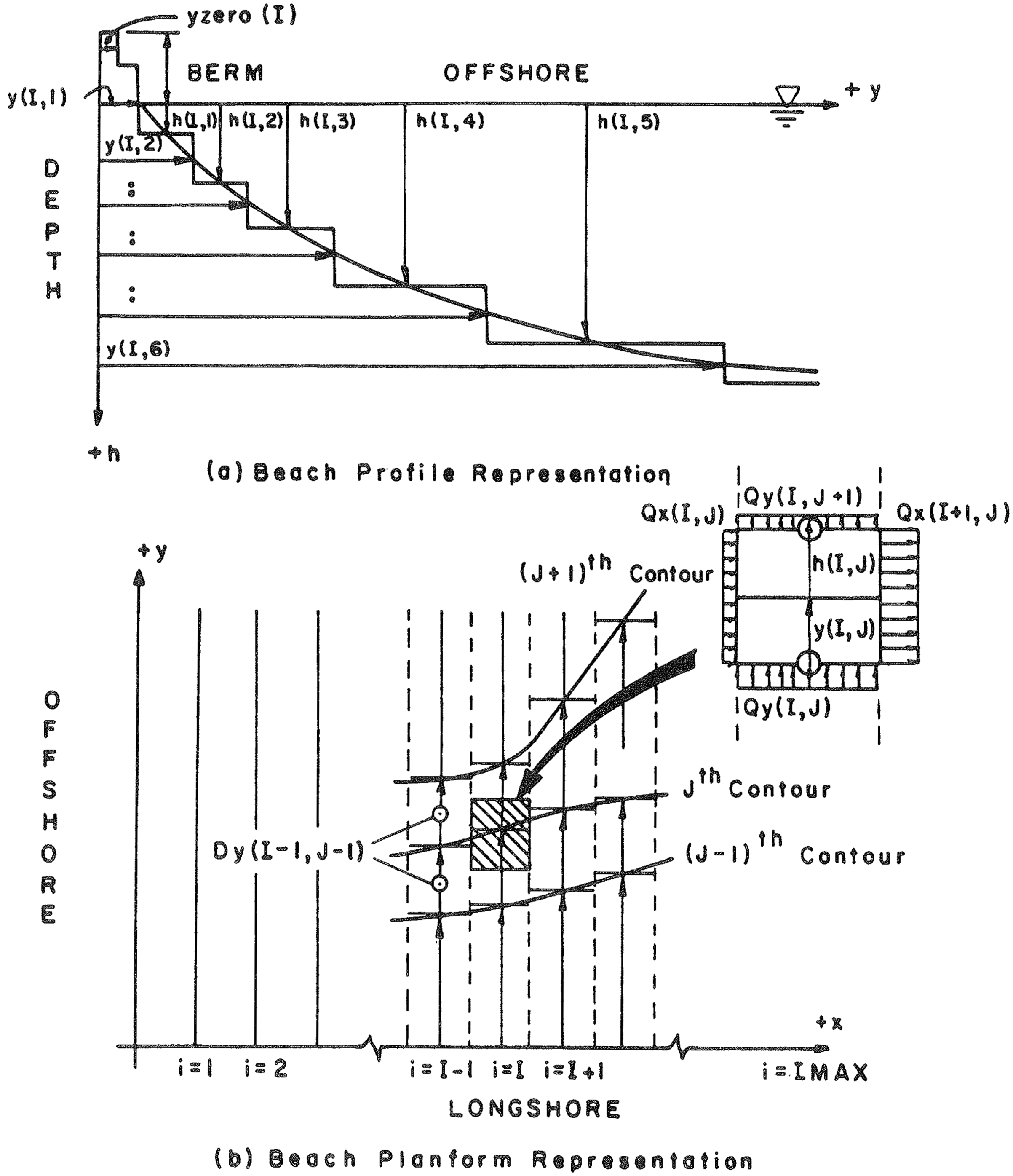

Figure 3. Definition sketch (from Perlin and Dean 1983)

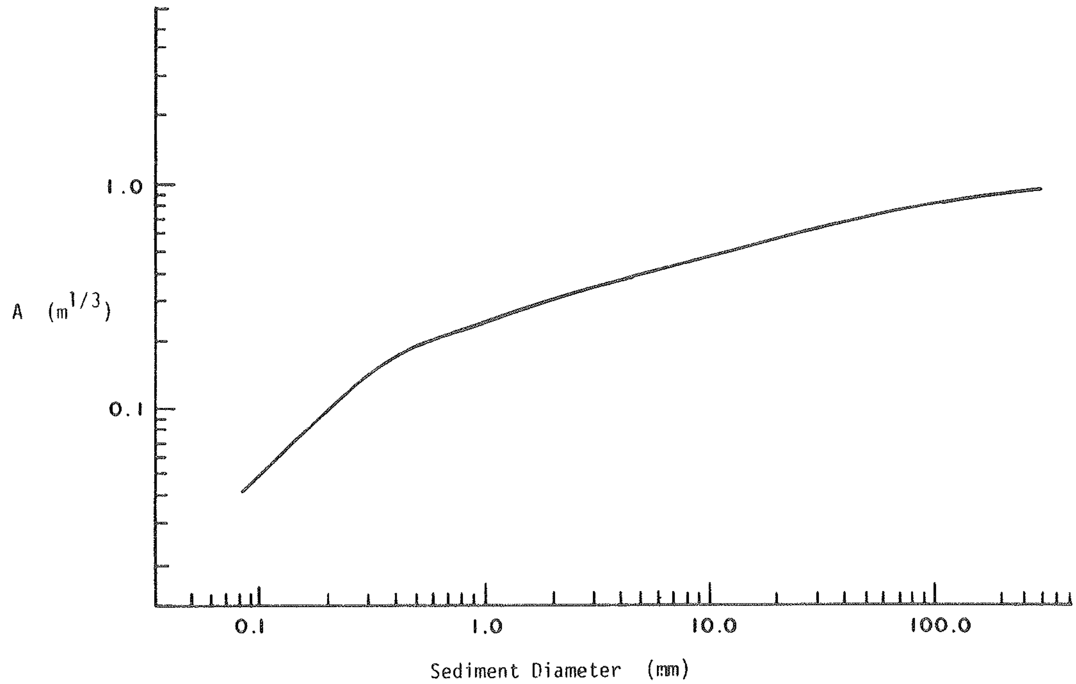

Figure 4. A versus sediment diameter (after Moore 1982)

d. COFF--The coefficient COFF linearly affects the magnitude of the onshore-offshore sediment transport. For example, doubling the COFF value will double Q_Y . The value used in Perlin and Dean (1983) and in all examples of this report is 0.00001. This program coefficient can be changed to achieve proper onshore-offshore sediment transport magnitudes.

e. CONST and CAPPA--These coefficients determine the value for the constant TKSI which linearly affects the magnitude of the total longshore transport. As in the COFF example, these coefficients can be altered to produce a desired total longshore sediment transport magnitude. The coefficients (lines 284 and 285 of the program) are currently set at 0.77 and 0.78.

f. An additional factor was introduced in the model to slow the shoreline response under certain design cases. This coefficient, Beach Response Factor, (BRF) is shown on lines 564, 565, and 566 of the program listing (Appendix B). The factor was set at 0.5 for the examples presented. This value can be replaced by 1.0, equivalent to the original listing, if the shoreline responds too slowly.

g. Additional constants such as density, beach slope, and porosity are defined in Perlin and Dean (1983) and can be located in the program listing.

22. Several examples are presented in this document to both demonstrate the capability of the model and allow the potential user the ability to verify that the model is operating correctly. Initially, five examples are

presented, three of which are taken from Perlin and Dean (1983). Complete input and output data are provided for each example in Appendix A. These cases are presented so that a user can become familiar with the model by applying known input data to reproduce known output data. This will also allow the user the opportunity of determining the model's response to varying certain of the model coefficients. A final example is presented which demonstrates the use of the interactive input data file generation program for the subsequent analysis of the Lakeview Park project in Lorain, Ohio. This actual example will show the simultaneous application of all of the N-line model capabilities. The five examples are:

a. Example 1--Single Jetty. The first example is for case 4.2a presented in Perlin and Dean (1983). Figure 5 is a reprint of the equilibrium planform along with input data. Sample input and output data after 30 iterations are shown in Appendix A.

b. Example 2--Multiple Jetties. Example 2 represents the multiple jetty example presented in Perlin and Dean (1983) as case 4.2c. Figure 6 shows the initial and final contours as presented by Perlin and Dean. Input and output data after 30 iterations are shown in Appendix A.

c. Example 3--Dredged Material Disposal. This simulation represents the single addition of dredged material disposal at the 7- and 11-ft contours according to the monthly incremental value used for case 2.c1 in Perlin and Dean (1983). Figure 7, reproduced from Perlin and Dean (1983), shows the equilibrium results for this case. Input and output data after 30 iterations are presented in Appendix A.

d. Example 4--Single Breakwater. This example, shown in Figure 8, shows a hypothetical case of a single detached offshore breakwater. Input variables for this case and a sample output after 30 iterations are shown in Appendix A.

e. Example 5--Double Breakwaters, Single Jetty. Figure 9 represents the fifth example which begins to demonstrate the use of multiple structures. This hypothetical case incorporates a single jetty, as in Example 1, with two detached breakwaters. Input and output data after 30 iterations are shown in Appendix A.

f. Example 6--Lakeview Park, Lorain, Ohio. A specific application of the model was made to the Lakeview Park project in Lorain, Ohio. This project incorporates all of the capabilities of the model in a single application. This design case, along with some of the problems associated with its computer simulation, is presented in Part V.

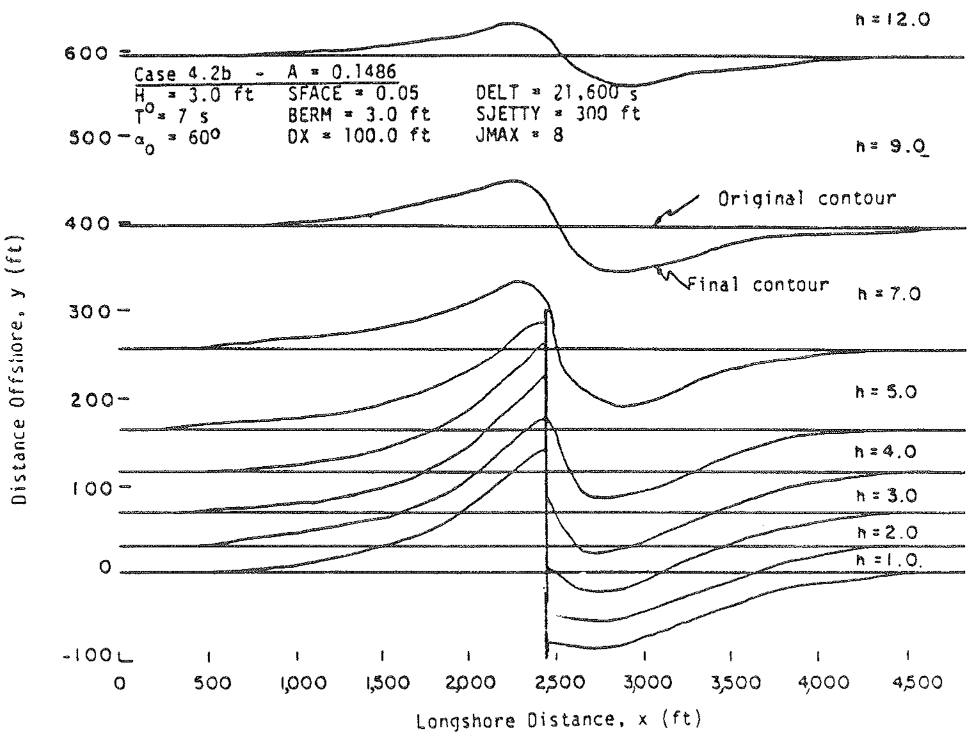

Figure 5. Single jetty (from Perlin and Dean 1983)

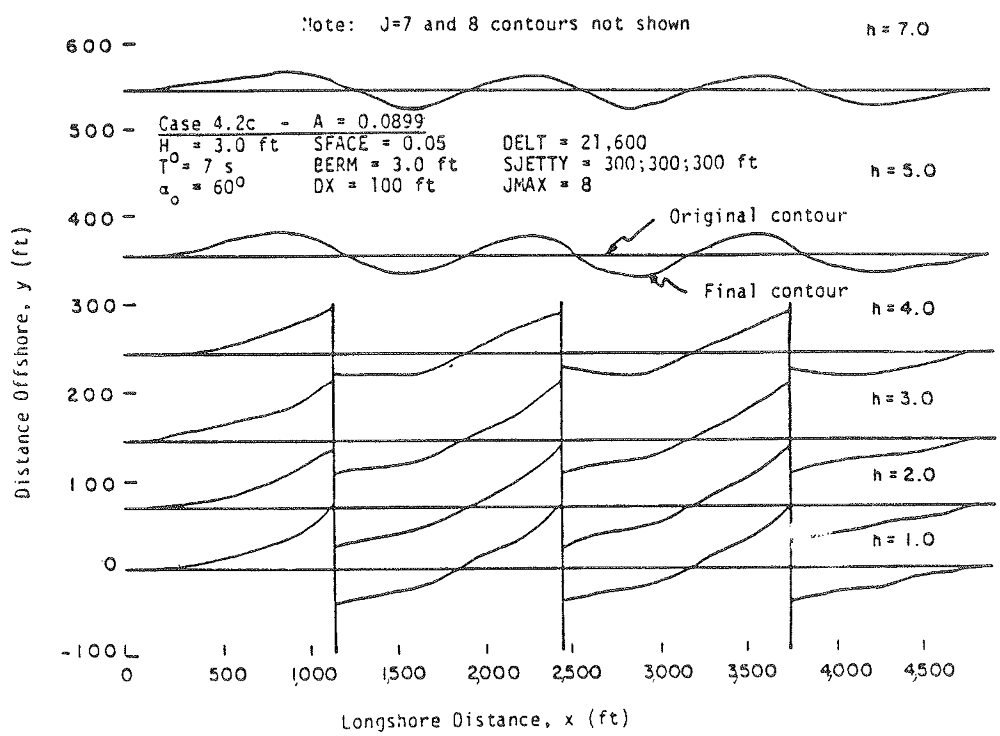

Figure 6. Multiple jetties (from Perlin and Dean 1983)

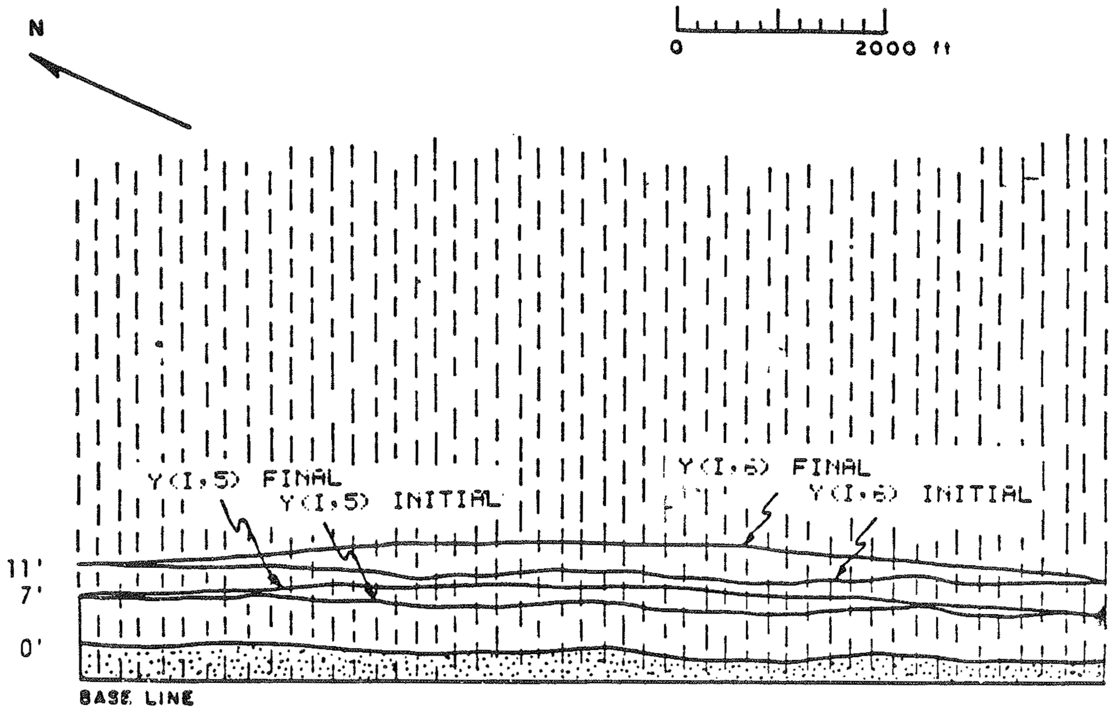

Figure 7. Dredged material disposal (from Perlin and Dean 1983)

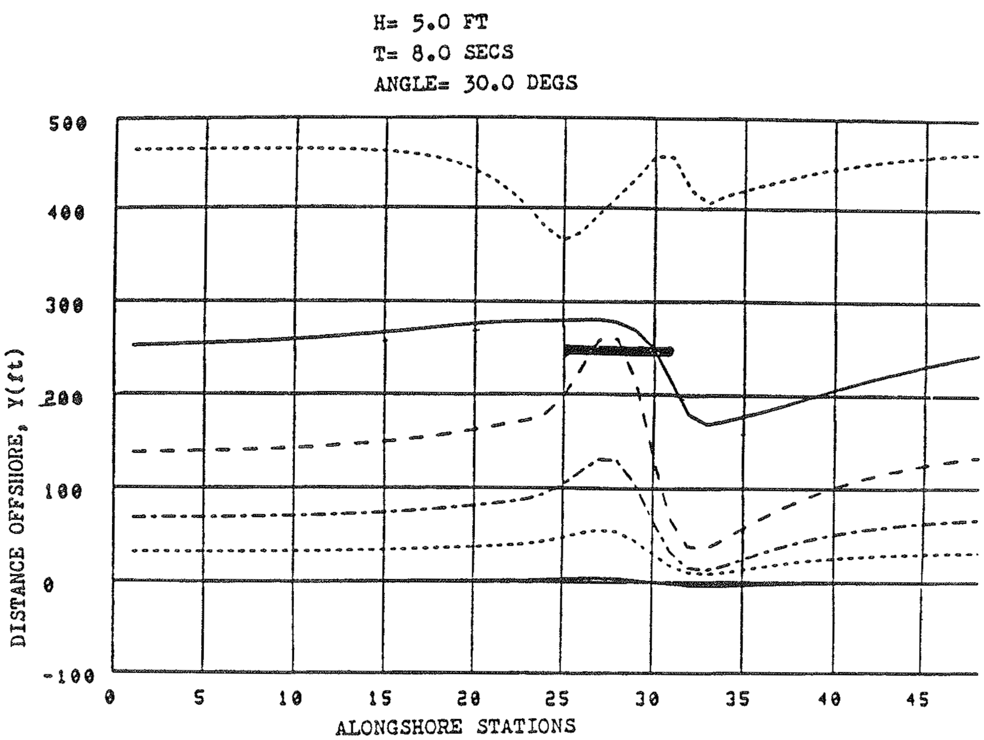

Figure 8. Single breakwater

H= 4.0 FT
T= 6.0 SECS
ANGLE= 25.0 DEGS

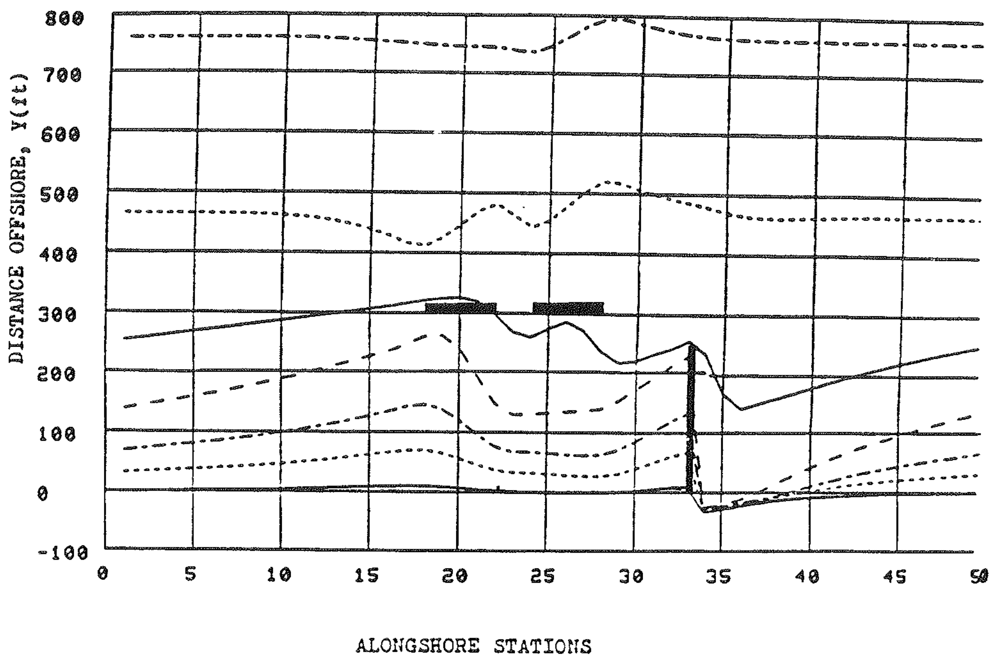

Figure 9. Double breakwaters, single jetty

PART V: MODELING LAKEVIEW PARK WITH THE N-LINE MODEL

23. When modeling an actual process, whether using an equation, a physical model, or a computer program, comparison of the model's output with a real-world result is necessary for verification of the model. This comparison can be in a qualitative and/or quantitative sense; if the modeling process is successful for one real situation, it is reasonable to expect successful results for other similar cases.

24. The N-line model has been verified in a qualitative sense, as presented in Figures 5-9 of this report. Lakeview Park, Lorain, Ohio, was modeled with the N-line program to compare the actual beach response of Lakeview Park with the model. This allows a quantitative evaluation of the model's adaptivity to specific conditions where a known response is expected.

Lakeview Park

25. Lakeview Park in Lorain, Ohio, is a project that has been monitored since its creation in 1977 by the Buffalo District and CERC. Lakeview Park has been a successful project, accreting approximately 3,000 cu yd of material per year (Pope and Rowen 1983). The site has a three-segmented detached breakwater, two groins, and placed fill, and, as such, utilizes most of the capabilities of the modified N-line model (see Figure 10). The beach fill was placed along 1,250 ft of shoreline, the two groins are 166 and 350 ft in length, and the detached breakwater has segments approximately 250 ft in length and 200 to 250 ft from the initial placed fill waterline.

26. The project has a large prototype data base, including bathymetric surveys for 1977-1982, aerial photographs from 1977-1982, hindcast and Littoral Environment Observation (LEO) wave data for the area, and data from a physical model study (Bottin 1982). The prototype aerial photographs of Lakeview Park were digitized, and a set of shorelines were plotted that represent the stabilized project shoreline, creating an envelope of shorelines that was compared with the model's output (see Figure 11). Thus, the prototype data from Lakeview Park were used to conduct verification tests of the N-line model. In this way the N-line model could be used for a situation where the beach response was well known.

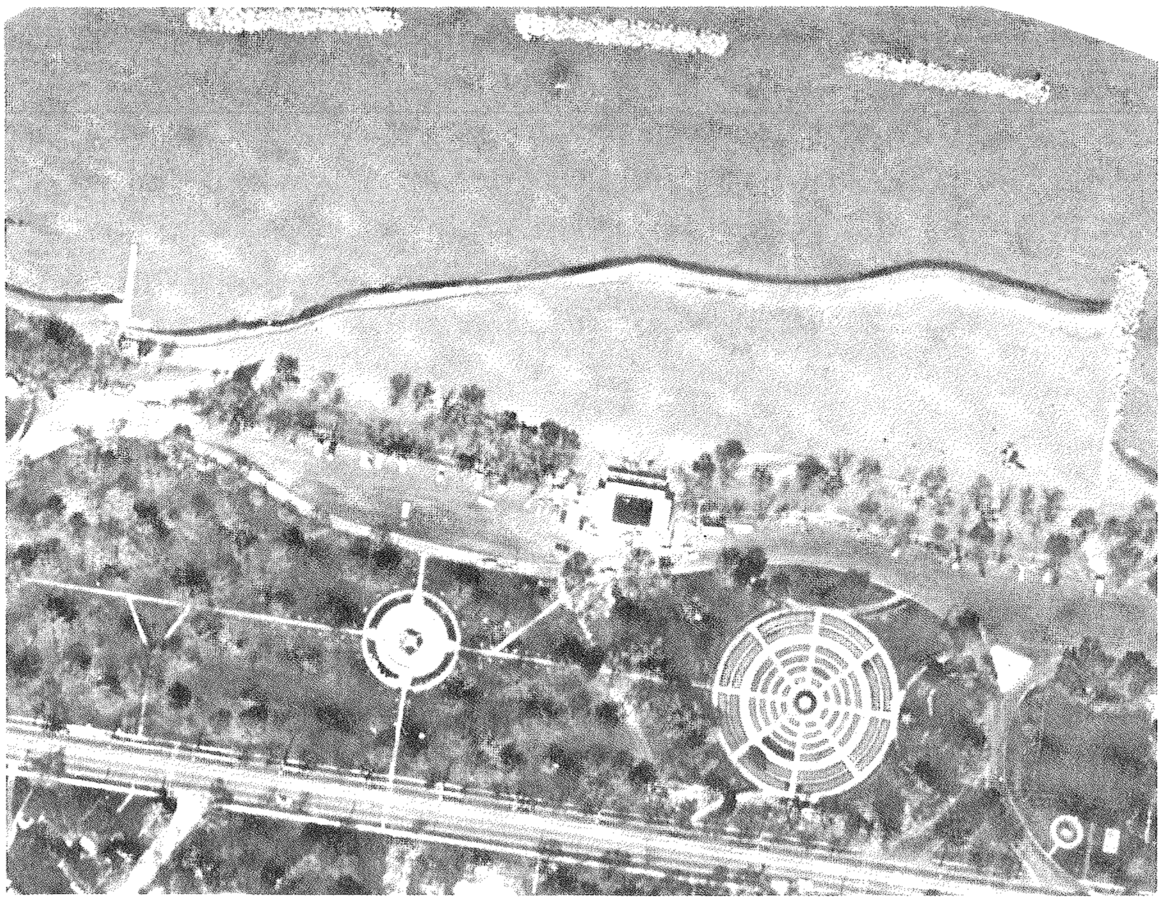

Figure 10. Aerial photograph of Lakeview Park, Lorain, Ohio, 8 Sep 1980. Scale: 1 in. = 4,800 ft

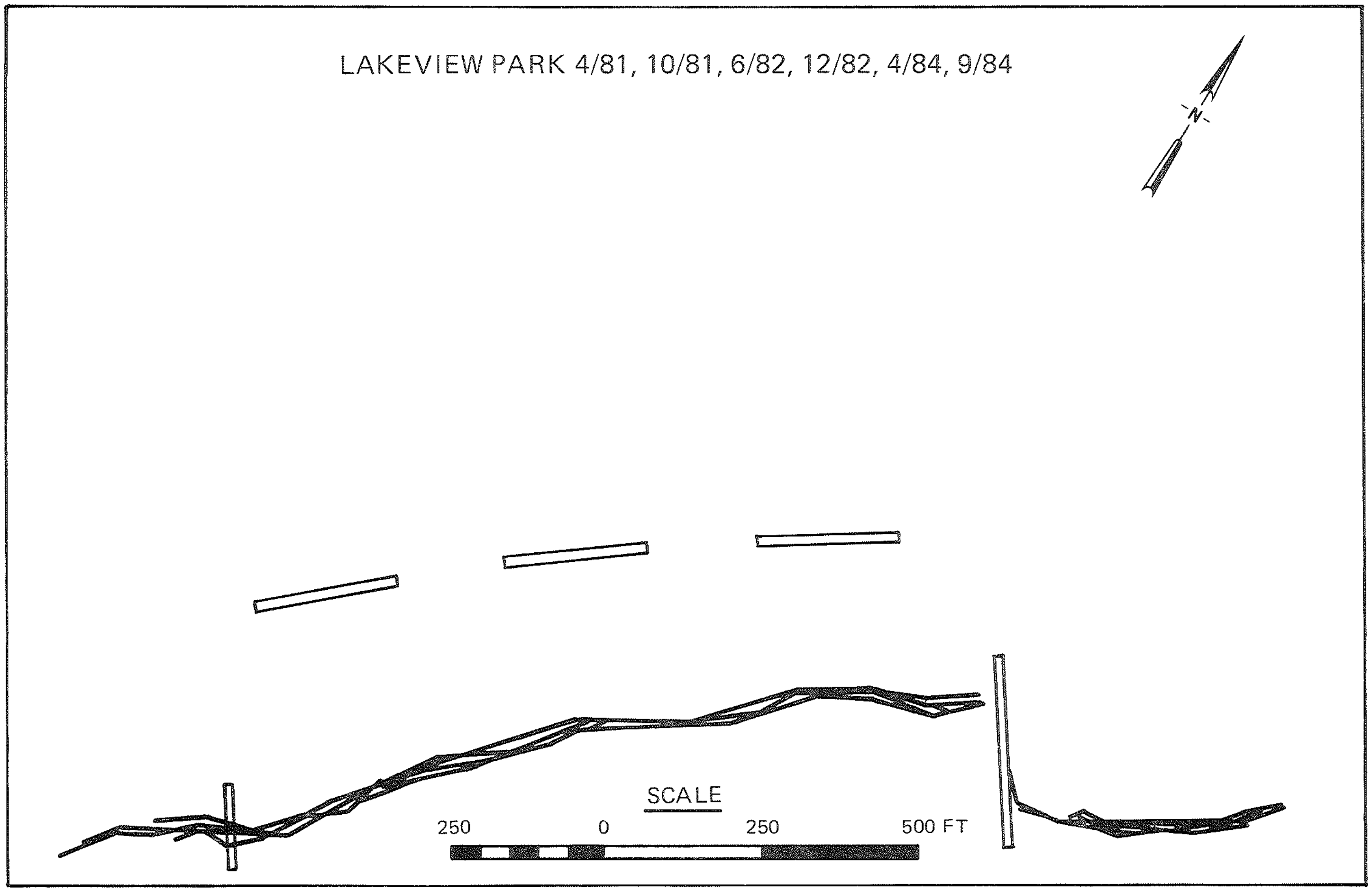

Figure 11. Stabilized project shoreline, 1981-1984 (digitized from aerial photographs)

Model Input Conditions

27. For the Lakeview Park example presented herein, hindcast wave data (Saville 1953) were reduced to obtain representative values of wave height, period, direction, and percentage of time from a particular direction. The 10 wave conditions that resulted agreed reasonably well with the LEO data. These 10 wave conditions were repeated and used in all the Lakeview Park cases presented. A single wave condition from a single direction is not a true prototype occurrence and could generate unrealistic responses in the model, or cause the model to "blow up."

28. The initial project contour locations that were used for each model run are presented in Figure 12. The initial shoreline was calculated by measuring the distance from the baseline to the approximate waterline based on the as-constructed condition. Since the model assumes equilibrium profiles at each I-grid shoreline point, the Lakeview Park fill area (on a linear slope) was simulated using the model's disposal option, creating a file called SPOOL that contains the I,J-location and the amount of fill to be added to the average of each two adjacent contours (see Figure 13). The model uses the average depth between adjacent contours in all calculations.

29. The value of ADEAN can be calculated using the equations presented in Figure 4, which gives ADEAN in metres$^{1/3}$. ADEAN as used in the model is in units of feet$^{1/3}$; the value of D_{50} = 0.22 mm (the grain size of the placed fill) was used, giving a value of ADEAN = 0.15 ft$^{1/3}$.

30. The selection of a time-step of 6 hr and a space-step of 50 ft was the result of an interactive analysis. A larger space-step would give ample distance for the contours to return to their boundary conditions (problems arise if the project ends are too close to the boundaries), but would not show much detail in the project area. A small space-step requires a small time-step and a large number of x-grid points, and therefore is costly to run. Several combinations of time-steps and space-steps were attempted, some resulting in unrealistic responses from the model, until the values presented here were selected. The interactive file generator is shown in Figure 14. The input files are presented in Figures 15 and 16.

31. Since the sediment transport from the west into the prototype area is small, the contours west of the smaller groin were modeled to move no sediment in the longshore direction by changing the N-line model code.

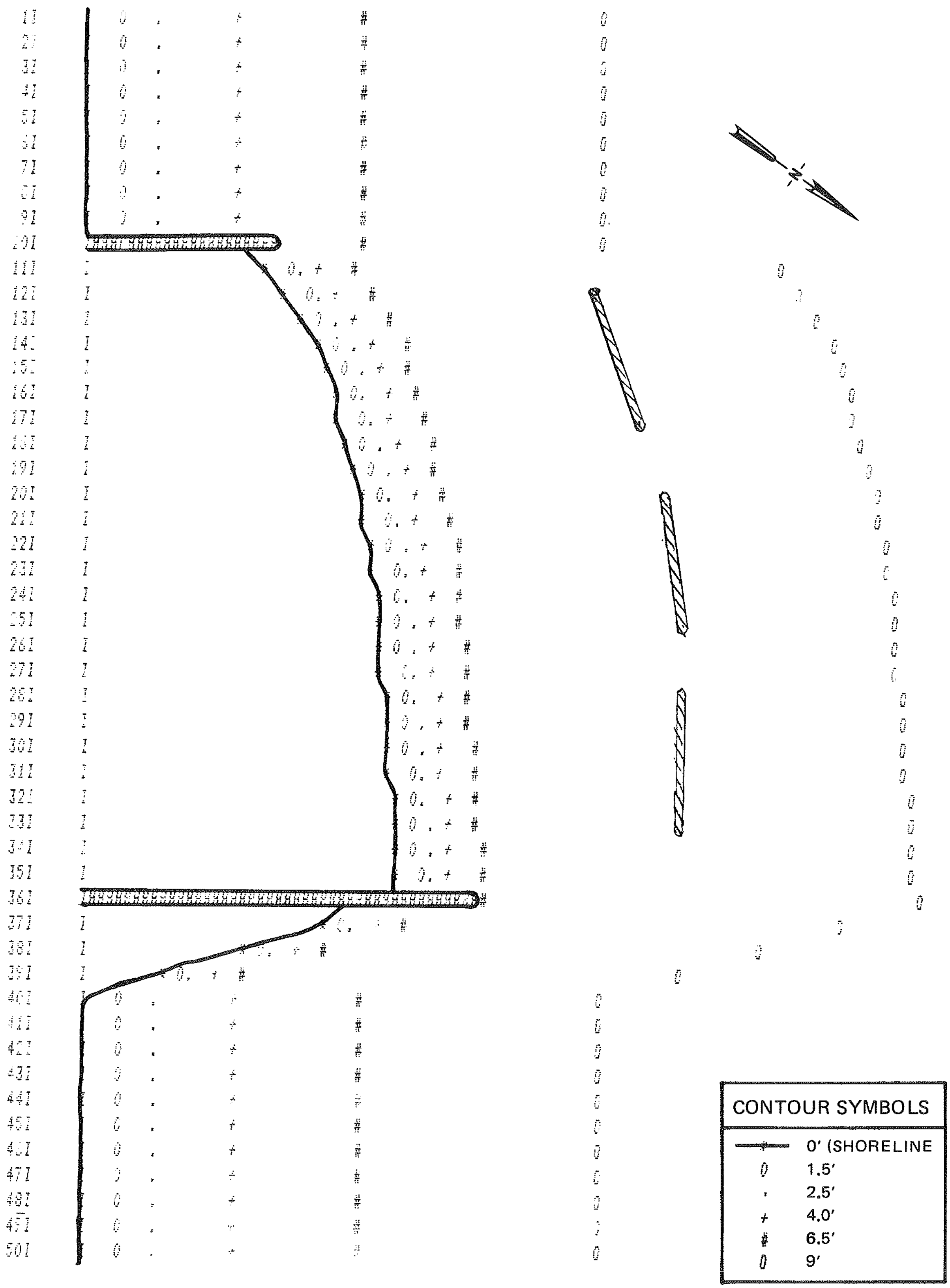

Figure 12. Initial project contour locations used for each model run, t = 0 days

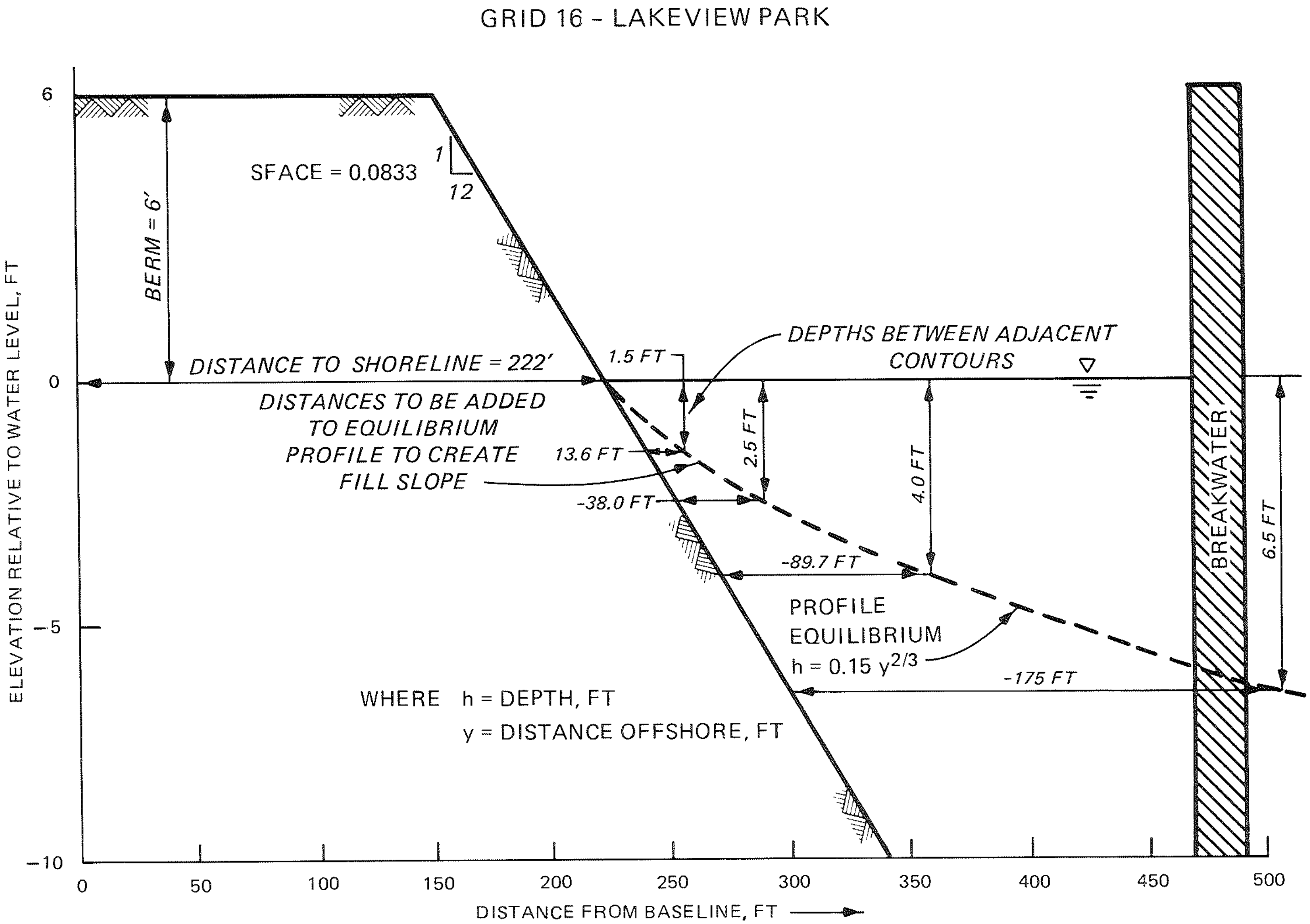

Figure 13. Example grid profile and distance to be added to equilibrium profile to get fill slope (creating file SPOOL)

```
OLD,BLDFIL
/FTN5,I=BLDFIL,L=0,REW
      0.889 CP SECONDS COMPILATION TIME.
/LGO
 ENTER IMAX
? 50
 ENTER JMAX
? 8
 ENTER THE OFFSHORE BOUNDARY CONTOUR DEPTH IN METERS(WDEPTH)
? 10
 ENTER THE DESIRED CONTOUR DEPTHS IN FEET(1ST,2ND,3RD,...JMAX+1)
? 1.,2.,3.,5.,7.,11.,14.,17.,25.
 ENTER THE DESIRED FREQUENCY OF PRINTED OUTPUT
(EXAMPLE-EVERY NTH WAVE)
? 20
 ENTER BERM(FT)
? 6
 ENTER SPACE
? 0.0833
 ENTER DIAM(MM)
? .22
 ENTER NUMBER OF GROINS(MMAX),0,1,2,ETC.
? 2
 ENTER I LOCATION,LENGTH OF NO. 1 GROIN(FT)
? 10,166.
 ENTER I LOCATION,LENGTH OF NO. 2 GROIN(FT)
? 36,350
 ENTER ADEAN (FT**1/3)
? 0.15
 ENTER DX(FT),DELT(HRS)
? 50.,6.
 SHORELINE IS INITIALLY STRAIGHT(Y(I,1)=0.0)
ENTER CHANGES BY ENTERING I LOCATION, DISTANCE IN FEET
IF NO CHANGES OR TO TERMINATE CHANGES, ENTER IMAX VALUE,0.
? 11,165
? 12,180
? 13,195
? 14,210
? 15,216
? 16,222
? 17,228
? 18,234
?
     .
     .
     .
     .
     .
36,286
? 37,214.5
? 38,143
? 50,0
 ENTER THE NUMBER OF BREAKWATERS
?
```

Figure 14. Interactive file generator (Continued)

```
3
 ENTER NO. 1 BREAKWATER LEFT,RIGHT I LOCATION, LEFT,RIGHT DISTANCE OFFSHORE(FT)
? 12,17,460,500
 ENTER NO. 2 BREAKWATER LEFT,RIGHT I LOCATION, LEFT,RIGHT DISTANCE OFFSHORE(FT)
? 20,25,520,540
 ENTER NO. 3 BREAKWATER LEFT,RIGHT I LOCATION, LEFT,RIGHT DISTANCE OFFSHORE(FT)
? 28,33,540,540
 DO YOU WISH TO ADJUST THE LOCATIONS OF ANY
 CONTOURS?  ENTER Ø FOR NO OR 1 FOR YES
? 1
 AT WHAT TIME INTERVAL WILL THE CONTOURS BE ADJUSTED?
? 1
 ENTER I,J VALUE, INCREMENTAL VALUE TO BE ADDED
 TO THE AVERAGE OF EACH ADJACENT CONTOUR(FT). ENTER IMAX,JMAX
 VALUES,Ø. WHEN COMPLETE
? 11,2,-13.6
? 12,2,-13.6
?
      .
      .
      .
      .
37,5,-175
? 38,5,-175
? 39,5,-175
? 50,8,Ø
 ENTER WAVE HEIGHT(FT), PERIOD(SECS), ANGLE(DEGS)
AND NUMBER OF REPETITIONS OF THAT WAVE FIELD. WHEN COMPLETED,
ENTER 99.,99.,99.,Ø
? 1.5,3.1,38
? 2.5,4.2,60
? 2.5,4.2,38
? 3.5,5.1,38
? 4.5,5.7,38
?
      .
      .
      .
      .
99.,99.,99.,Ø

     Ø.377 CP SECONDS EXECUTION TIME.
/REPLACE,ZINPUT

/REPLACE,SPOOL
/
```

Figure 14. (Concluded)

```
  50      8   IMAX, JMAX
       10.000   WDEPTH (meter)
 1.000   2.000   3.000   5.000   7.000  11.000  14.000  17.000  25.000  32.808 } Contour Depths (feet)
  .000    .000    .000    .000    .000    .000    .000    .000    .000    .000 }
    20 ← Number of Iterations between printouts
        6.000    .0833    .220   Berm height (ft), slope, grain diameter (mm)
2 ← Number of Groins
10   166.000 } I-location, length of groin (ft)
16   350.000 }
  .1500   ADEAN, ft^1/3
 50.000 21600.000   space step (ft), time step (sec)
   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00 } Initial shoreline:
165.00  180.00  195.00  210.00  216.00  222.00  228.00  234.00  240.00  246.00 }   Distances from baseline (ft)
252.00  258.00  260.00  262.00  264.00  266.00  268.00  270.00  272.00  274.00 }
276.00  278.00  280.00  282.00  284.00  286.00  214.50  143.00   71.50     .00 }
   .00     .00     .00     .00     .00     .00     .00     .00     .00     .00 }
  3  ← Number of Breakwaters
           12      17    460.00    500.00 } Breakwaters:
           20      25    520.00    540.00 }  Right location, left location, distance offshore right side,
           28      33    540.00    540.00 }        distance offshore left side
  1     1.5   3.1   38.0 }  1 ← Code meaning fill added at this time-step
  2     2.5   4.2   60.0 }  0
  3     2.5   4.2   38.0 }  0
  4     3.5   5.1   38.0 }  0
  5     4.5   5.7   38.0 }  0
  6     2.5   4.0   15.0 }  0
  7     1.5   2.9   -8.0 }  0 ↓ Fill not added
  8     1.5   2.9   15.0 }  0
  9     2.5   4.0   -8.0 }  0
 10     1.5   2.9  -30.0 }  0
 11     2.5   3.1   38.0 }  0
 12     2.5   4.2   60.0 }  0
 13     2.5   4.2   38.0 }  0
 14     2.5   5.1   38.0 }  0
 15     2.5   5.7   38.0 }  0
 16     2.5   4.0   15.0 }  0
 17     1.5   2.9   -8.0 }  0
 18     1.5   2.9   15.0 }  0
 19     1.5   4.0   -8.0 }  0
 20     1.5   2.9  -30.0 }  0
              •
              •             Wave Conditions:
              •               wave height (ft), period (sec), angle (deg)
              •
112     2.5   4.2   60.0 }  0
113     2.5   4.2   38.0 }  0
114     2.5   5.1   38.0 }  0    (Ten Wave Conditions Repeated)
115     2.5   5.7   38.0 }  0
116     2.5   4.0   15.0 }  0
117     1.5   2.9   -8.0 }  0
118     1.5   2.9   15.0 }  0
119     1.5   4.0   -8.0 }  0
120     1.5   2.9  -30.0 }  0
121    99.0  99.0   99.0 }  0
```

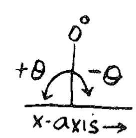

Figure 15. INPUT file (this file generated Figure 7)

11	2	-13.60
12	2	-13.60
13	2	-13.60
14	2	-13.60
15	2	-13.60
16	2	-13.60
17	2	-13.60
18	2	-13.60
19	2	-13.60
20	2	-13.60
21	2	-13.60
22	2	-13.60
23	2	-13.60
24	2	-13.60
25	2	-13.60
26	2	-13.60
27	2	-13.60
28	2	-13.60
29	2	-13.60
30	2	-13.60
31	2	-13.60
32	2	-13.60
33	2	-13.60
34	2	-13.60
35	2	-13.60
36	2	-13.60
37	2	-13.60
38	2	-13.60
39	2	-13.60
11	3	-38.00
12	3	-38.00
13	3	-38.00
14	3	-38.00
15	3	-38.00
16	3	-38.00
17	3	-38.00
18	3	-38.00
19	3	-38.00
20	3	-38.00
21	3	-38.00
22	3	-38.00
23	3	-38.00
24	3	-38.00
25	3	-38.00
26	3	-38.00
27	3	-38.00
28	3	-38.00
29	3	-38.00
30	3	-38.00
31	3	-38.00
32	3	-38.00
33	3	-38.00
34	3	-38.00
35	3	-38.00
36	3	-38.00
37	3	-38.00
38	3	-38.00
39	3	-38.00
11	4	-89.70
12	4	-89.70
13	4	-89.70
14	4	-89.70
15	4	-89.70
16	4	-89.70
17	4	-89.70
18	4	-89.70
19	4	-89.70
20	4	-89.70
21	4	-89.70
22	4	-89.70
23	4	-89.70
24	4	-89.70
25	4	-89.70
26	4	-89.70
27	4	-89.70
28	4	-89.70
29	4	-89.70
30	4	-89.70
31	4	-89.70
32	4	-89.70
33	4	-89.70
34	4	-89.70
35	4	-89.70
36	4	-89.70
37	4	-89.70
38	4	-89.70
39	4	-89.70
11	5	-175.00
12	5	-175.00
13	5	-175.00
14	5	-175.00
15	5	-175.00
16	5	-175.00
17	5	-175.00
18	5	-175.00
19	5	-175.00
20	5	-175.00
21	5	-175.00
22	5	-175.00
23	5	-175.00
24	5	-175.00
25	5	-175.00
26	5	-175.00
27	5	-175.00
28	5	-175.00
29	5	-175.00
30	5	-175.00
31	5	-175.00
32	5	-175.00
33	5	-175.00
34	5	-175.00
35	5	-175.00
36	5	-175.00
37	5	-175.00
38	5	-175.00
39	5	-175.00
50	9	.00

I-GRID Point

Contour Level to add fill
'2' = average of 1 and 2 contour depths
'3' = average of 2 and 3 contour depths
'4' = " " 3 and 4 " "
'5' = " " 4 and 5 " "
etc.

Distance to be added to contour level

Figure 16. SPOOL file (used in all model runs except Figure 18)

32. The parameter in the N-line model code that controls the rate of shoreline movement, the BRF, was set at 1.0 (BRF = 1.0).

Model Output

33. The model was run using the input configuration described for a period of 360 days; printouts are included at 30 days (Figure 17), 180 days (Figure 18), and 360 days (Figure 19). Notice that the model never reaches the equilibrium shoreline as shown in Figure 11; the shoreline keeps eroding. The outer contours show a greater sinuosity than the inner contours; this is because of the small slope of the equilibrium profile as distance offshore increases. As in the prototype, the model's shoreline on the west end erodes more quickly than the east end. However, since the sinuosity of the model's shoreline is much less than in the prototype, it is difficult to see the influence of the individual breakwater segments which was obvious in the prototype.

34. After the model was run for the original configuration of structures at Lakeview Park, eight different configurations were run for 30 days. Each of these runs can be compared with Figure 17 to see how different structure configurations influence the project area; except for the change in structures, all model input parameters have been held constant. These runs are presented in Figures 20-27.

Discussion

35. In Figure 22, the run with four short-length breakwater segments and two groins, the model acts unrealistically, eroding the project severely at the east end. Figure 23 shows a run with four longer length break-water segments which appear to respond more realistically when performing as a long, single breakwater (compare with Figure 24). Therefore, the number of breakwater segments does not cause unrealistic response in the model. In comparing Figure 22 (short-length breakwater segments and two groins) with Figure 20 (two groins, no breakwater), one can see that the addition of the breakwater causes more erosion than the run without the breakwater. Apparently, the reflected waves around each segment in the four short-breakwater segment case interact and create a focusing of wave energy on the shoreline.

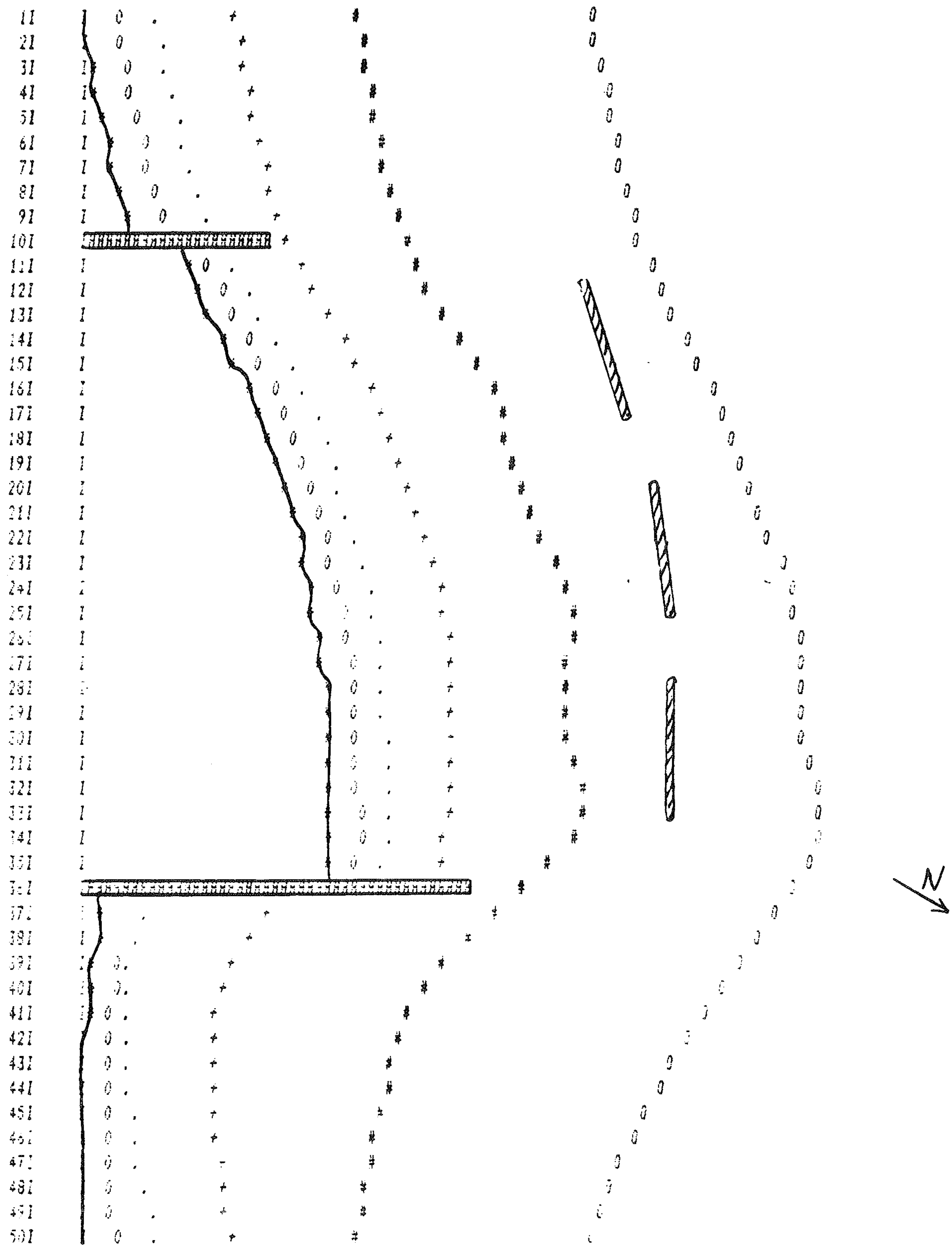

Figure 17. Prototype configuration at t = 30 days

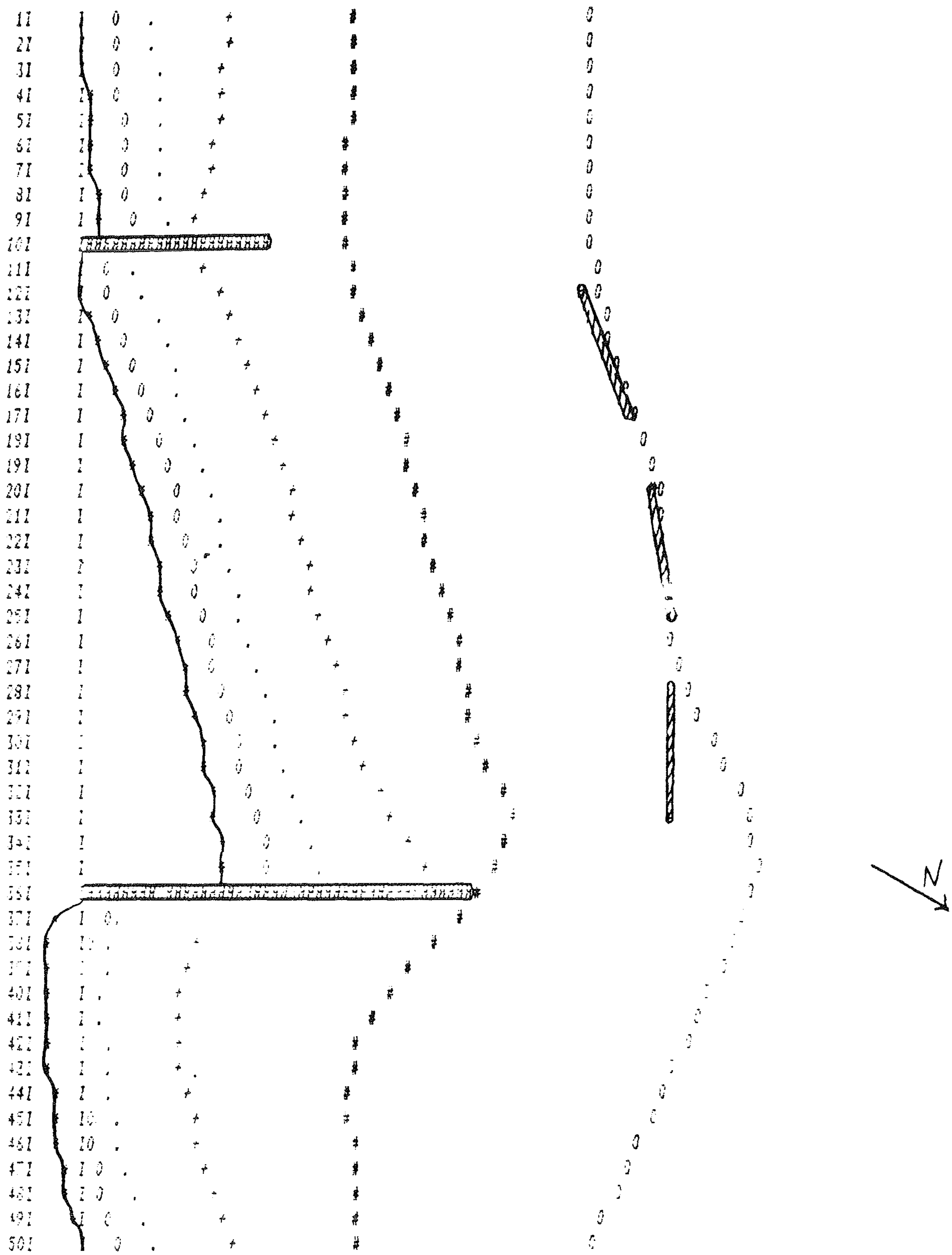

Figure 18. Prototype configuration at t = 180 days

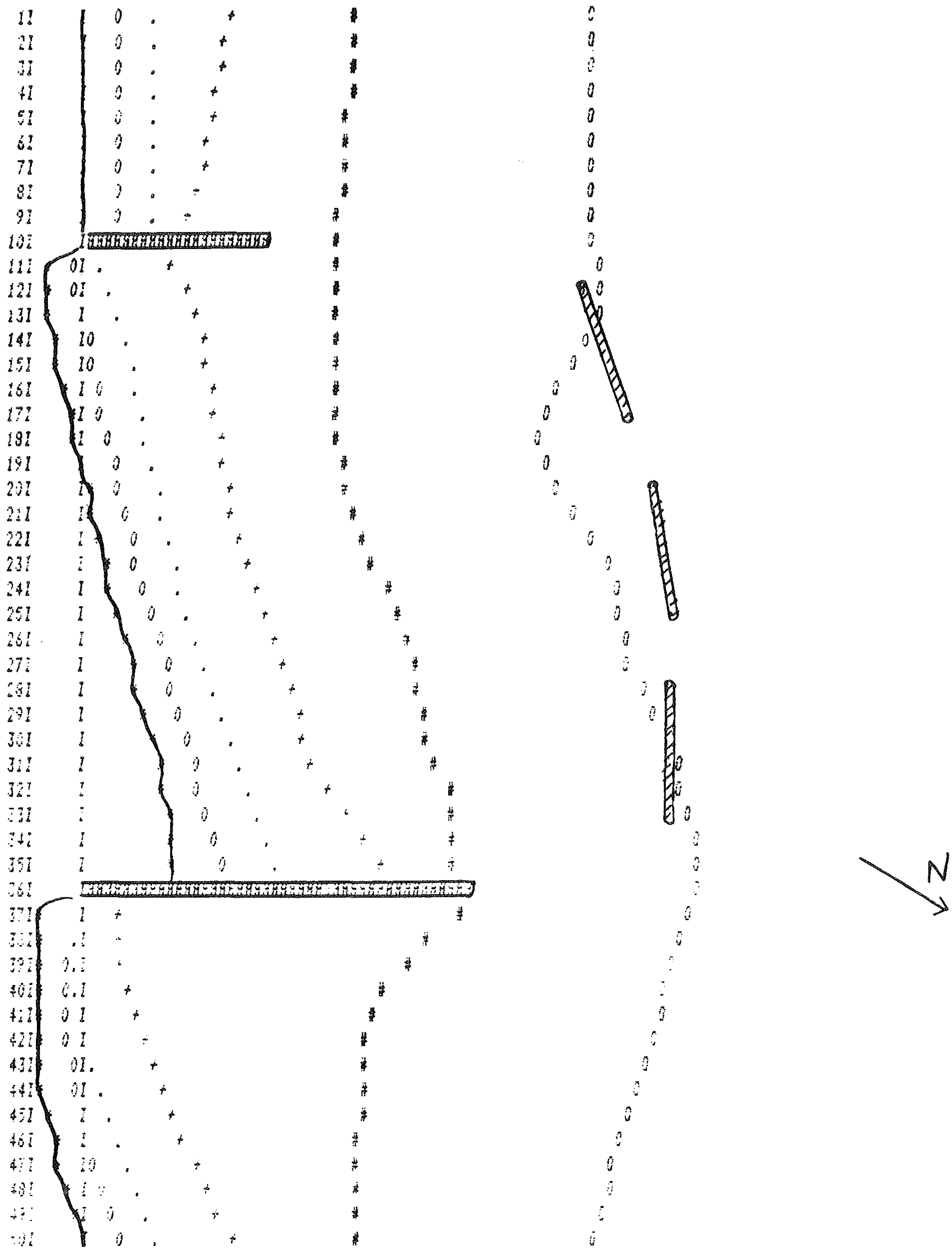

Figure 19. Prototype configuration at t = 360 days

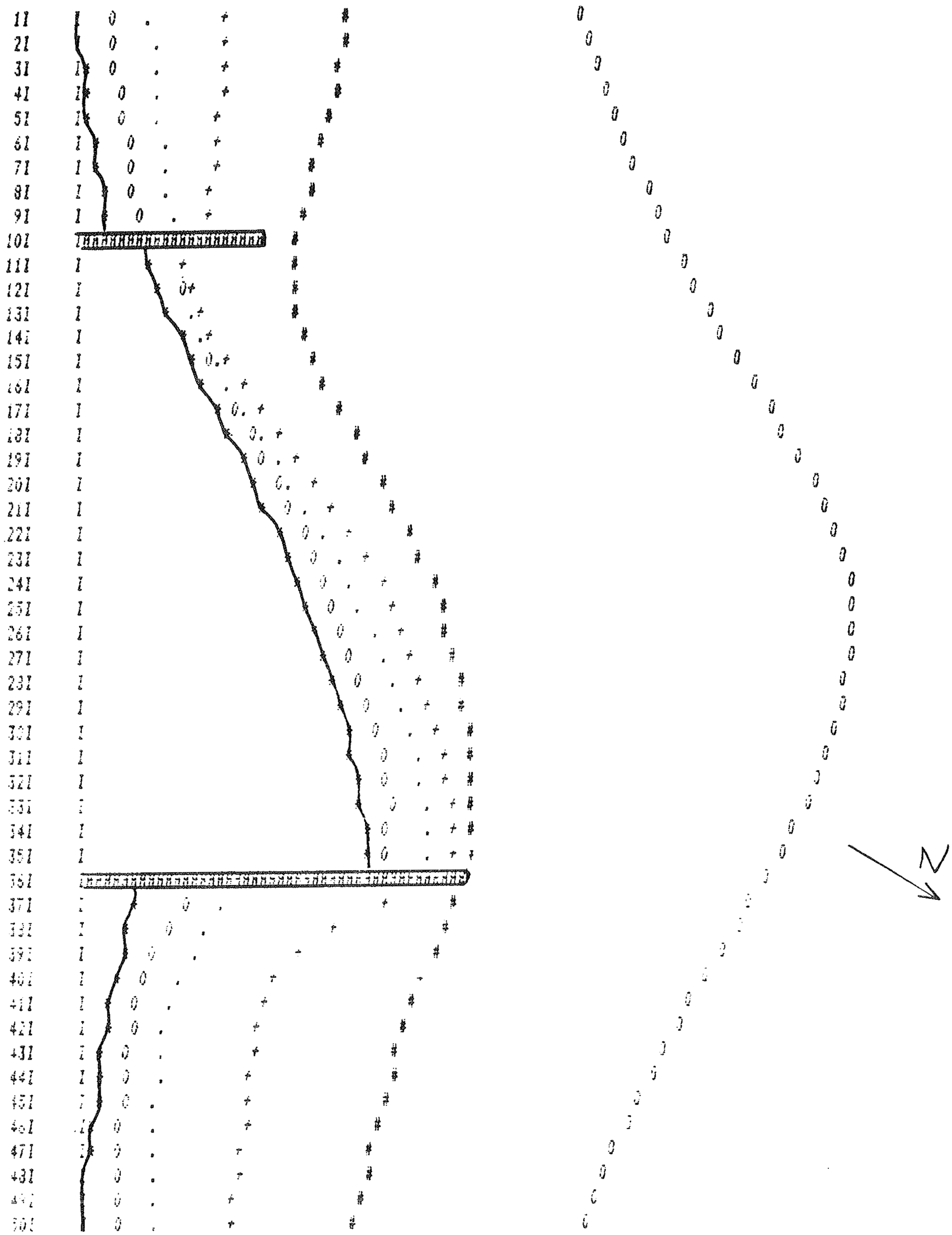

Figure 20. Two groins, no breakwater, t = 30 days

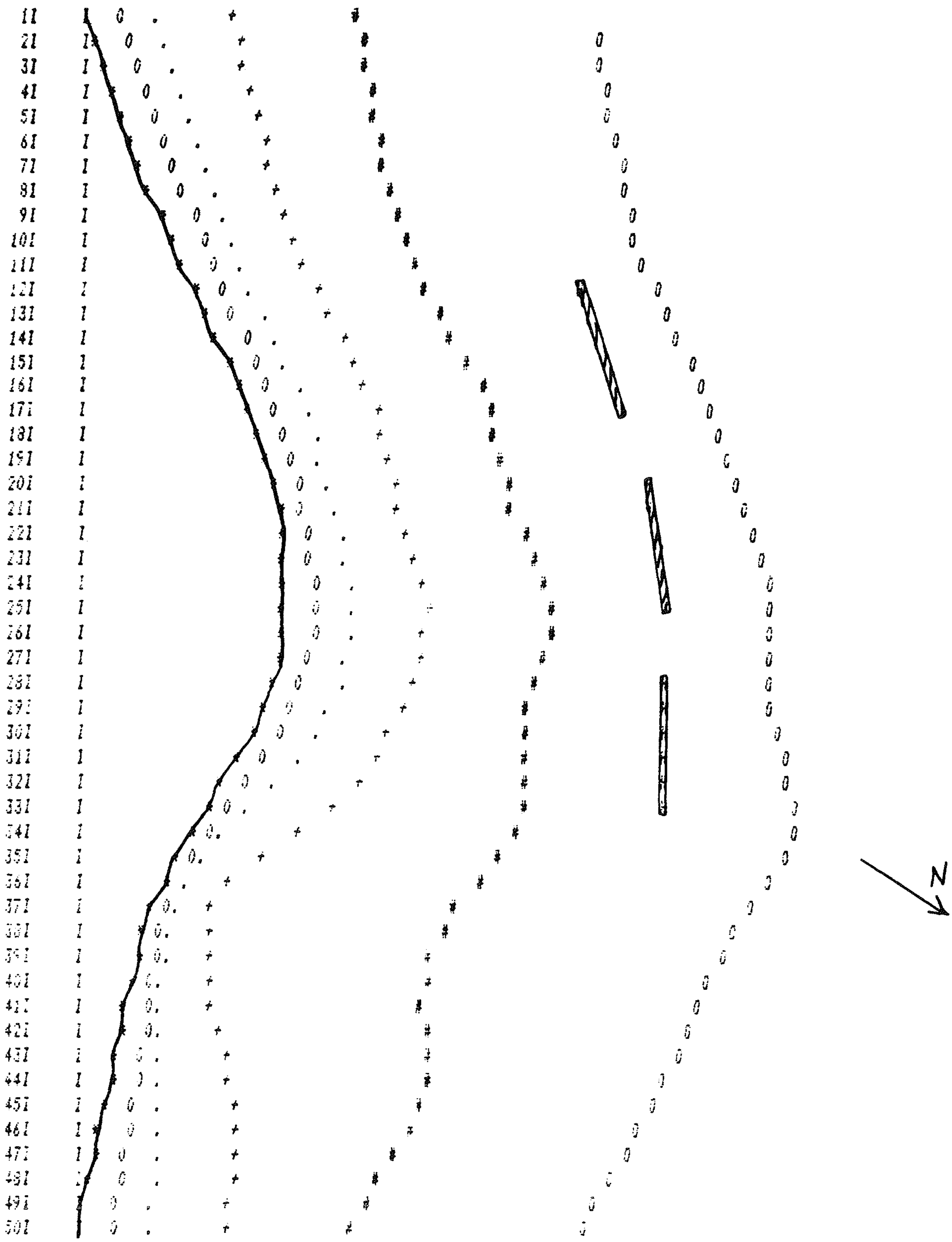

Figure 21. Three segment breakwater, no groins, t = 30 days

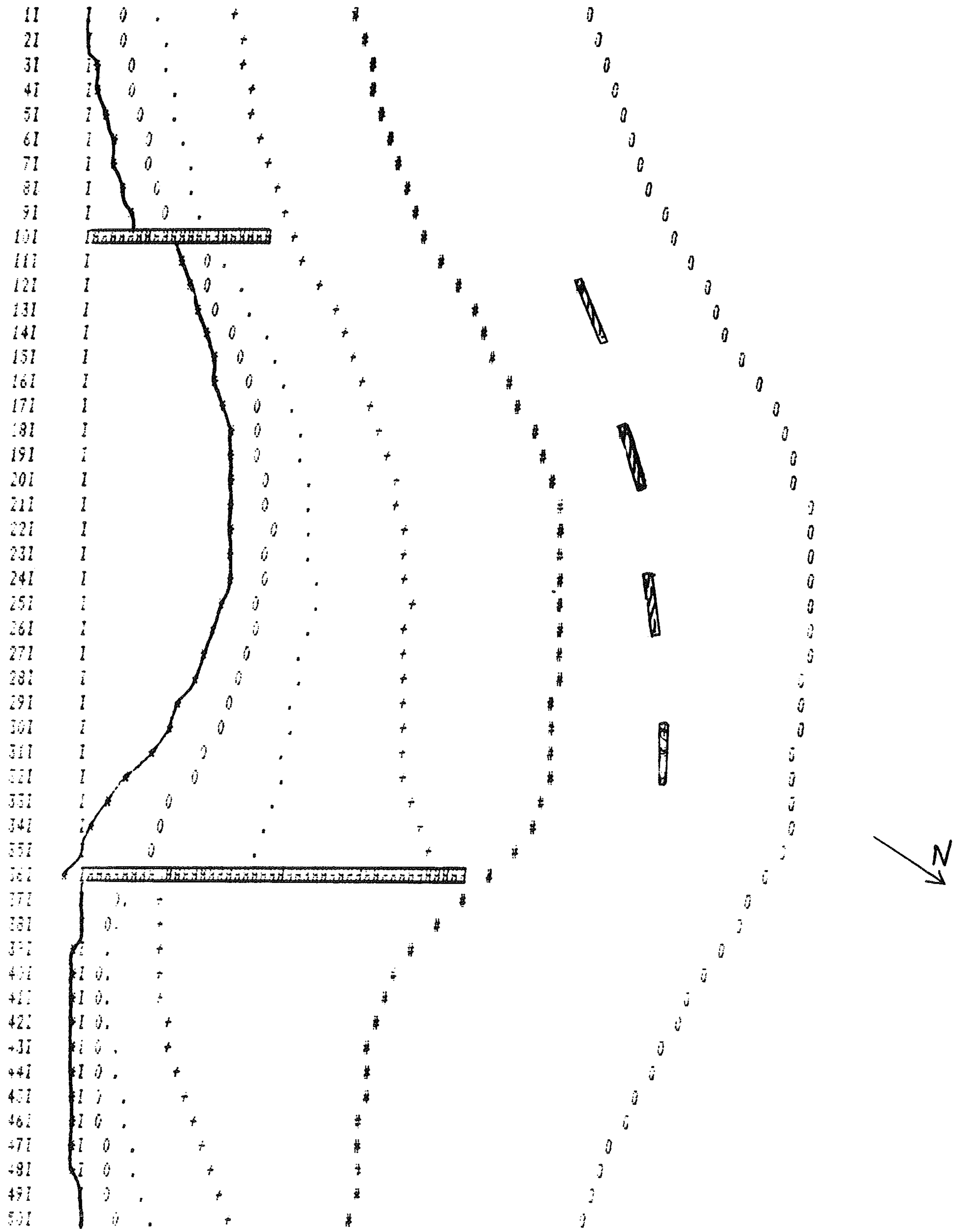

Figure 22. Four short-length breakwater segments, two groins, t = 30 days

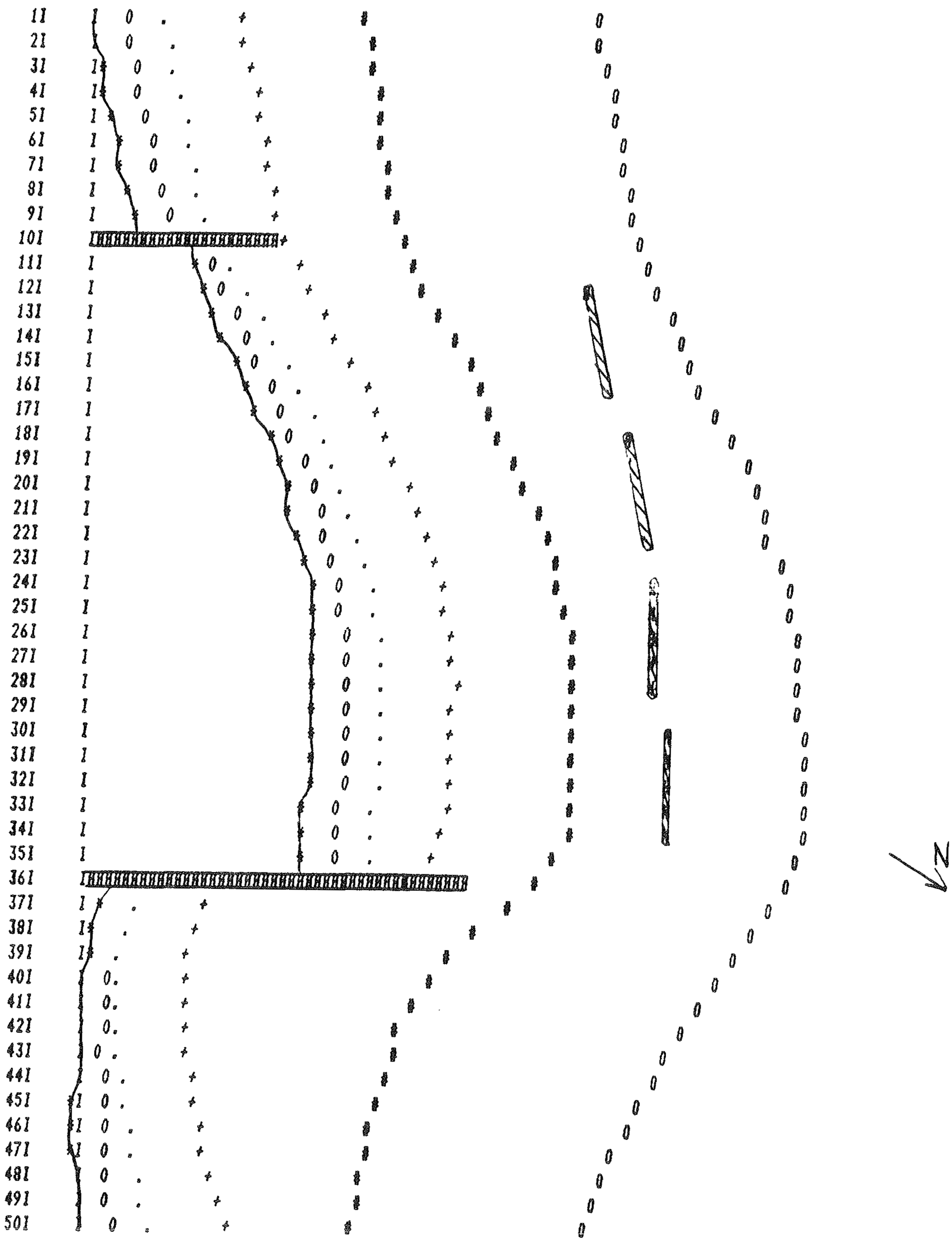

Figure 23. Four longer length breakwater segments, two groins, t = 30 days

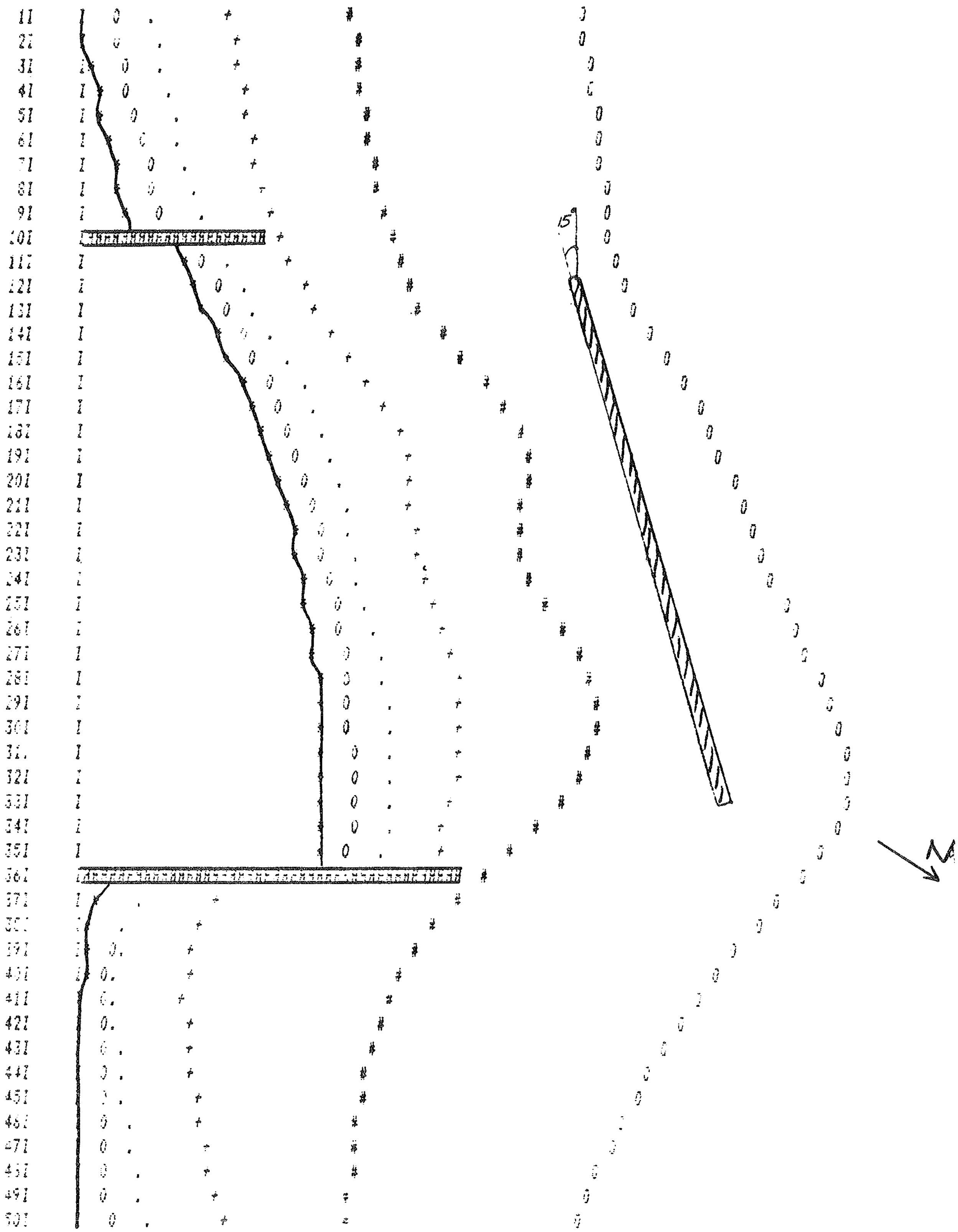

Figure 24. One breakwater, 15 deg offshore from baseline, two groins, t = 30 days

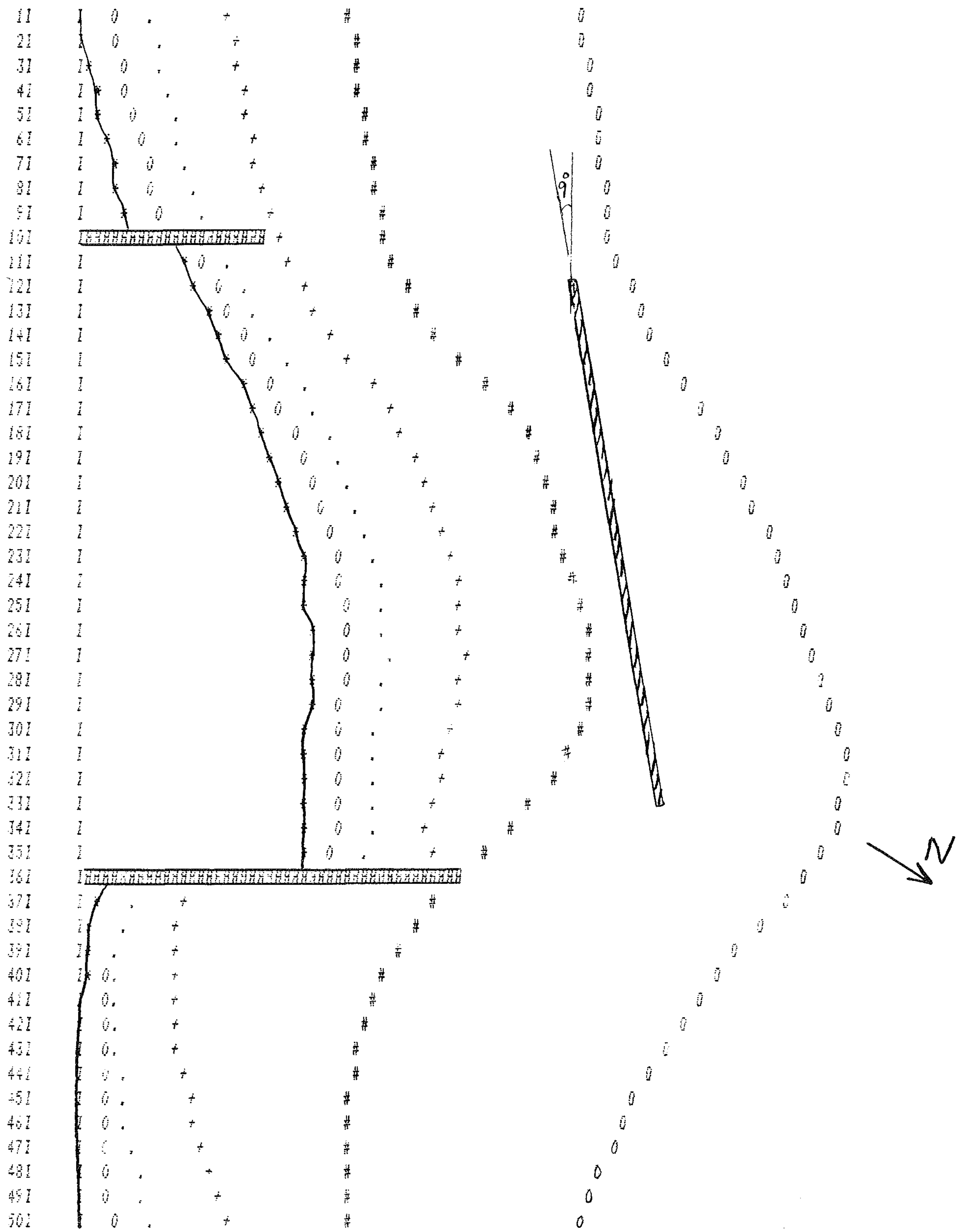

Figure 25. One breakwater, 9 deg offshore from baseline, two groins, t = 30 days

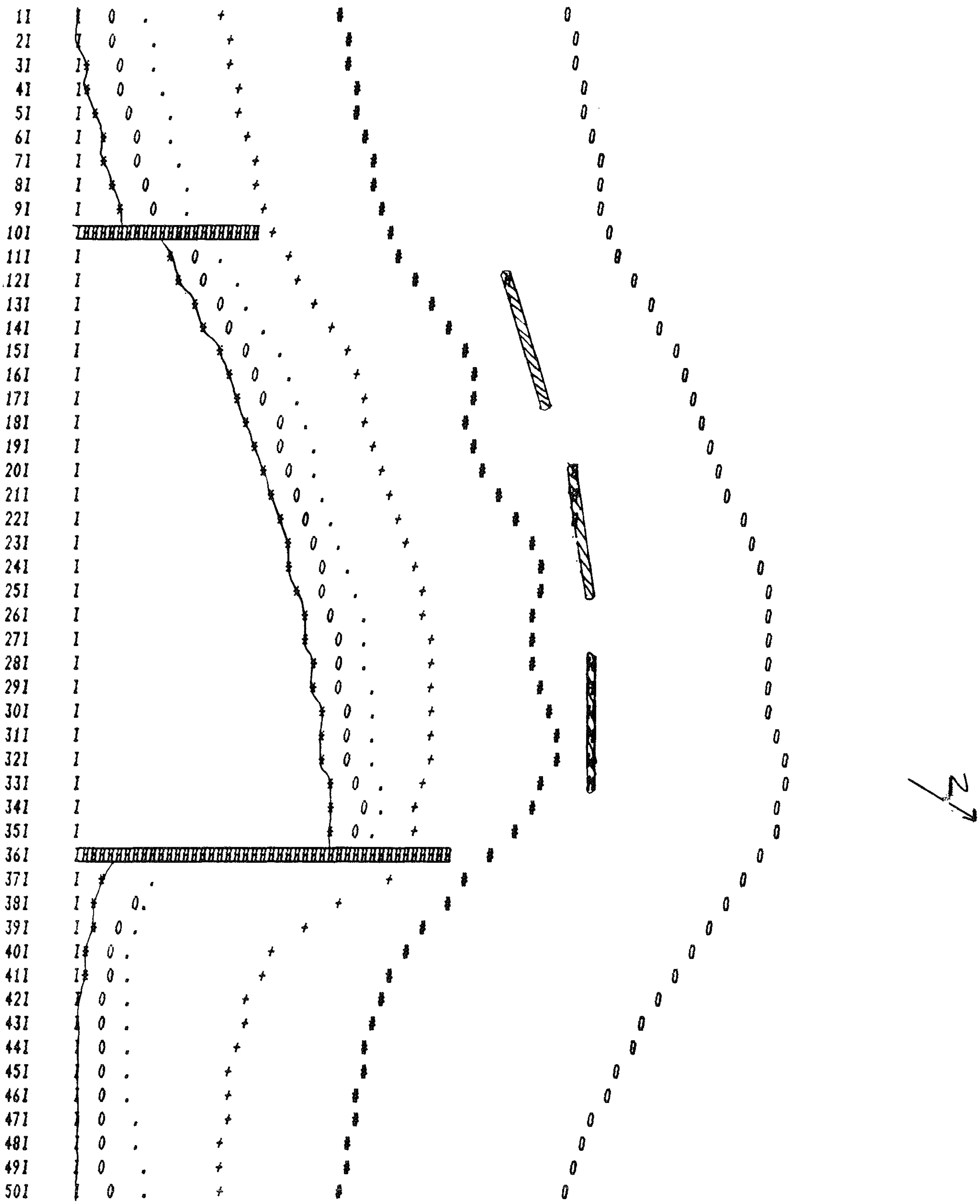

Figure 26. Three breakwater segments, 50 ft closer to shoreline, two groins, t = 30 days

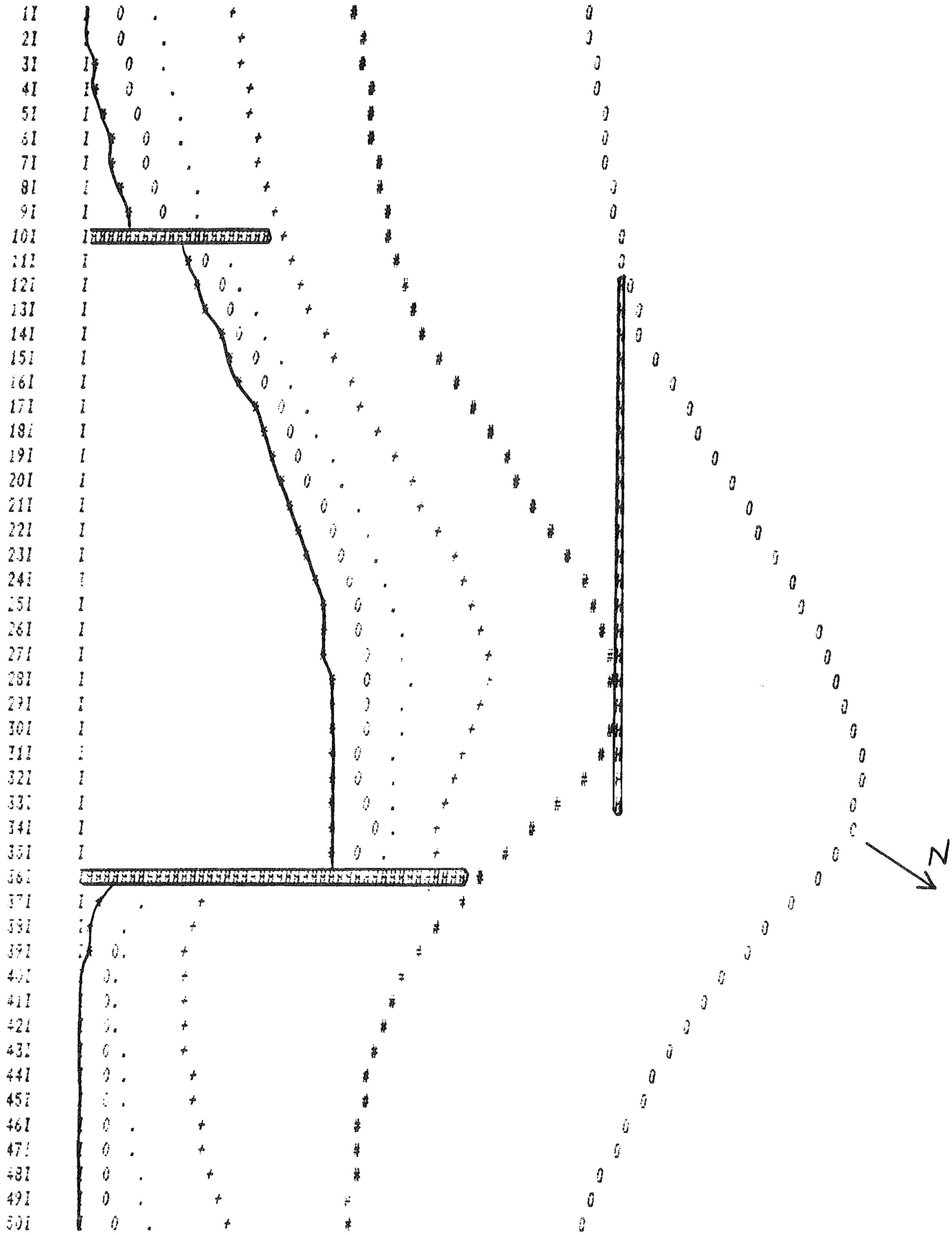

Figure 27. One breakwater parallel to baseline, two groins, t = 30 days

36. In Figure 26, the breakwater segments were moved 50 ft closer to shore. In comparing Figures 26 and 17, it is apparent that the contours did not change at all when the breakwater segments were moved closer to shore.

37. The two model responses described above are not logical and indicate that the program can only realistically model certain simple configurations. The user should be wary of accepting the model's output at face value, and should experiment with different configurations as was done here to determine the model's sensitivity to the user's particular setup. The breakwater addition to the model was written for use with structures that are located shore-parallel or near-parallel. Angled structures alone or connected to shore-parallel structures are not intended for use with the N-line model.

38. The choice of the initial shoreline position may appear arbitrary to the model user; however, the initial beach conditions greatly influence the model's output. A run was made using an initial shoreline on the baseline ((I,J) = 0.0). Fill was then added to create the same initial configuration as presented in Figure 12. However, after 30 days the model gave an entirely different result than when using an initial shoreline defined at the waterline (compare Figures 26 and 28). This discrepancy results because the model's rate of erosion is calculated from the difference between the waterline location after the fill has been added, and the initial shoreline location before the fill is added; the larger this distance, the faster the erosion rate.

39. In experimenting further with the model, two conditions used in simulating Lakeview Park, the BRF and the restriction of longshore transport across the west groin, were adjusted in the model code. Both of these conditions were observed as greatly influencing the model's output.

40. Figure 28 was a run made for 360 days with the BRF changed to 0.5 while continuing to restrict transport across the west groin. The amount of beach at 360 days is much greater with BRF = 0.5 than when BRF = 1.0 (compare Figures 29 and 19). This factor controls the rate of transport.

41. Figure 30 was a run for 360 days with the BRF kept at 0.5, but longshore transport was allowed across the west groin. Note that this run did reach an equilibrium point (compare with Figure 31, the same run at 300 days). However, the beach planform is not sinuous at all, and the cutback at the west groin is not apparent as it is in the prototype.

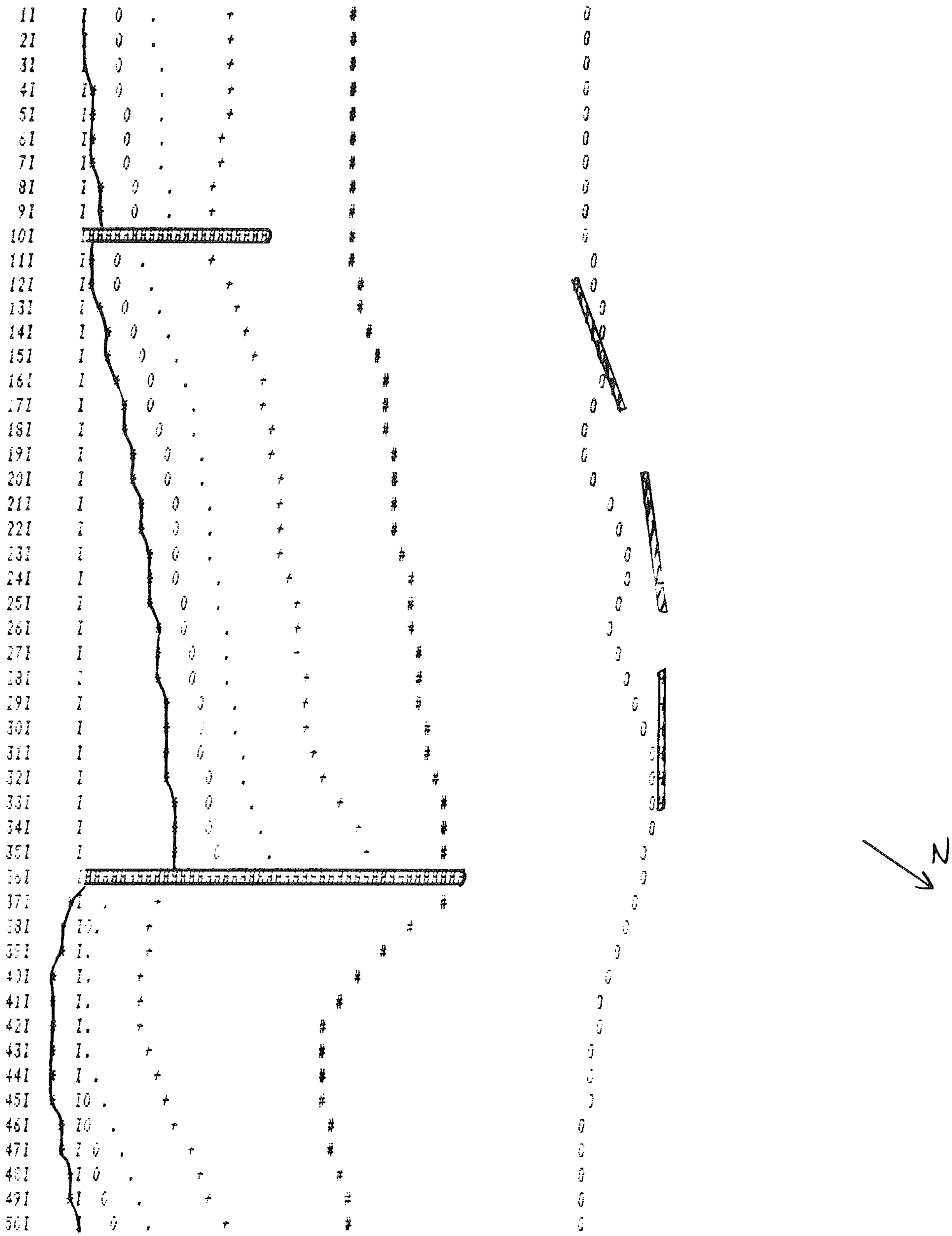

Figure 28. Model at t = 30 days; initial shoreline = 0.0; fill added to create initial contour locations as in Figure 1

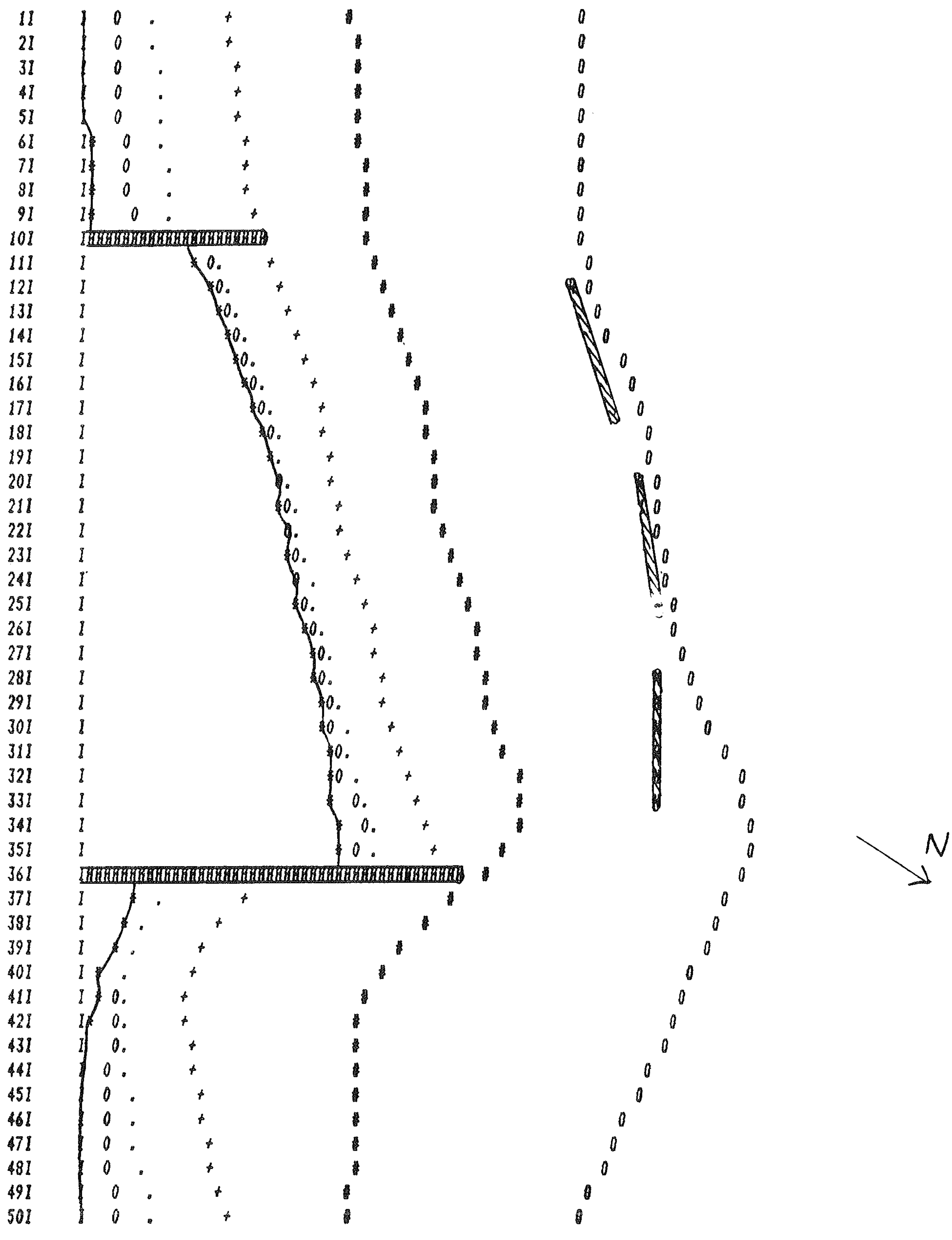

Figure 29. Three breakwater segments, two groins, BRF = 0.5, t = 360 days

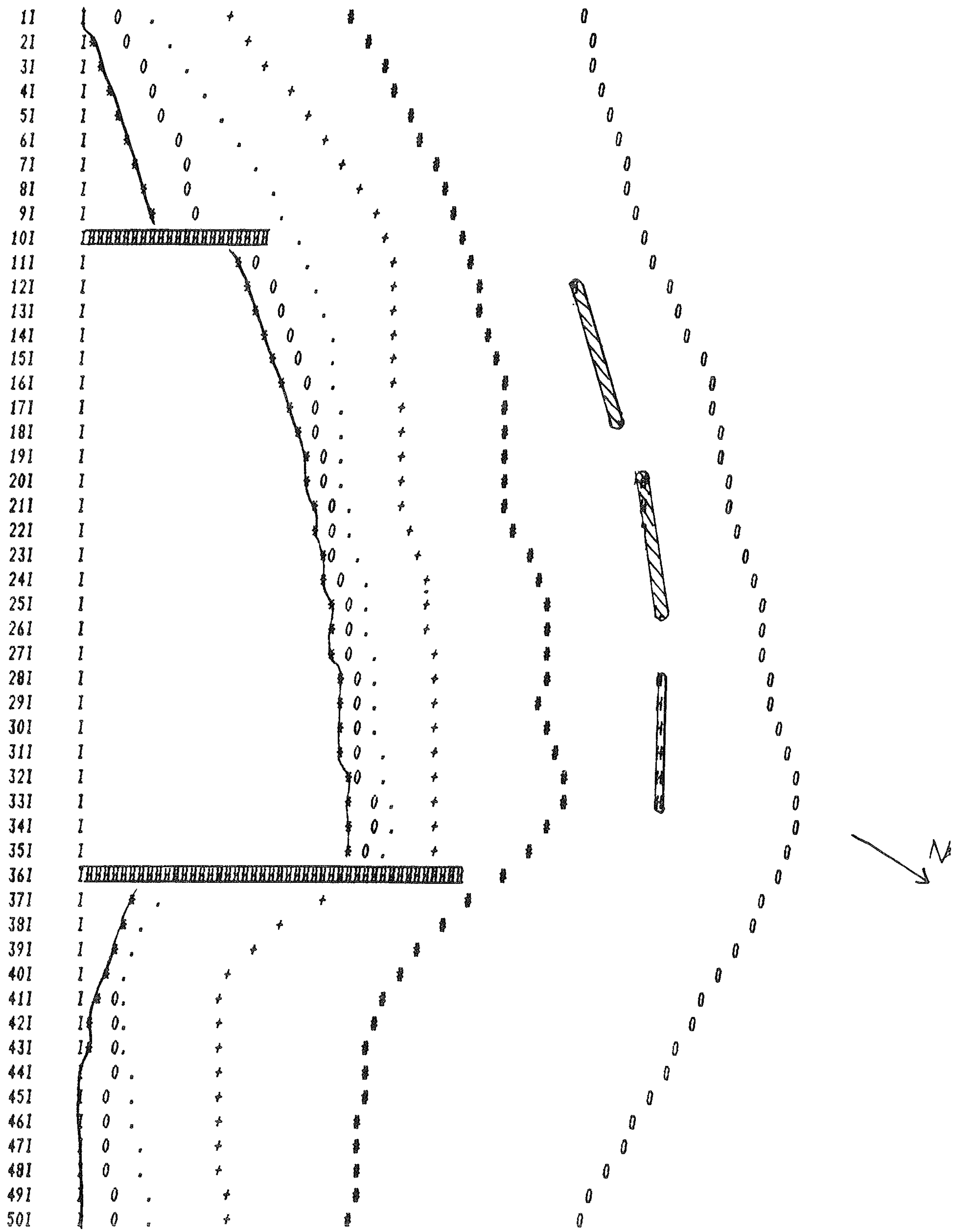

Figure 30. Three breakwater segments, two groins, BRF = 0.5, transport allowed across west groin, t = 360 days

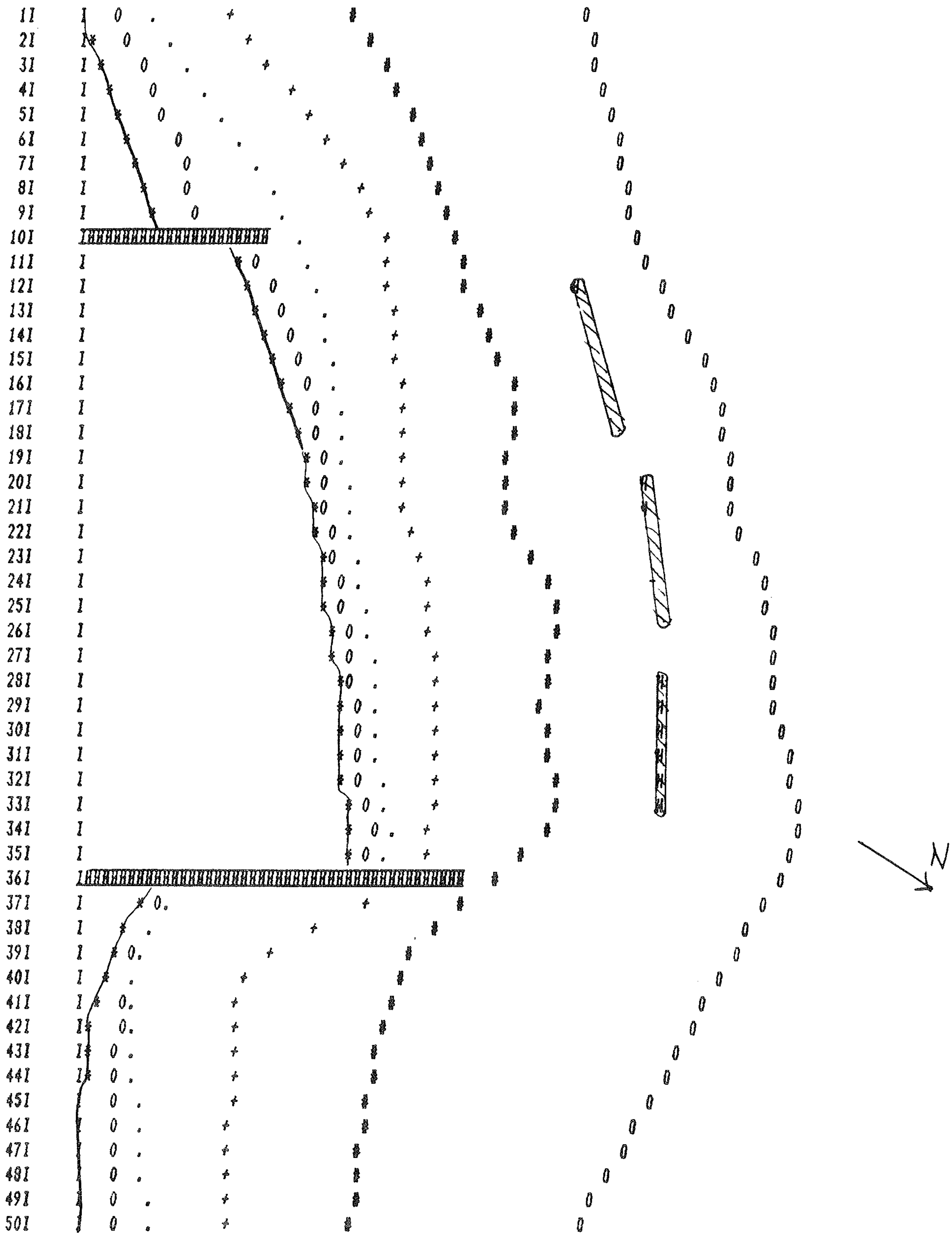

Figure 31. Three breakwater segments, two groins, BRF = 0.5, transport allowed across west groin, t = 300 days

PART VI: CONCLUSIONS

42. The N-line model presented in this report is versatile, easy to use, and capable of producing dependable results when used for appropriate applications. The documentation presented in this report is intended to cover only the breakwater subroutine. Since conceptual modifications were not made to the original model, the original documentation presented in Perlin and Dean (1983) should be obtained by any potential user of the model.

43. The N-line model is useful in showing qualitative trends for a complex case such as Lakeview Park. Some of the drawbacks of the program when modeling Lakeview Park, such as the inability to reach an equilibrium shoreline and the low sinuosity of the shoreline when influenced by breakwater segments, could possibly be successfully modeled by modifying the different input parameters (such as the ADEAN parameter, the initial shoreline location, and/or the model code). Perhaps then a quantitative verification of the model could be made. However, in this case, the model would have then been tailored to produce a previously known result.

44. A project cannot be successfully modeled without experimenting with different time-steps, space-steps, contour depths, shoreline locations, and structure configurations. A wave climate representative of the area being modeled is also very important. Finally, the response of the model to a particular setup must be interpreted with engineering judgment.

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Bottin, R. R. 1982. "Lakeview Park Beach Erosion Study, Ohio," unpublished Letter Report, 30 September, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Moore, B. 1982. "Beach Profile Evolution in Response to Changes in Water Level and Wave Height," M.S. Thesis, University of Delaware, Newark, Del.

Perlin, M., and Dean, R. G. 1983 (May). "A Numerical Model to Simulate Sediment Transport in the Vicinity of Coastal Structures," MR 83-10, Coastal Engineering Research Center, US Army Engineer Waterways Experiment Station, Vicksburg, Miss.

Pope, J., and Rowen, D. D. 1983. "Breakwaters for Beach Protection at Lorain, OH," Coastal Structures '83, American Society of Civil Engineers, New York.

Saville, T., Jr. 1953. "Wave and Lake Level Statistics for Lake Erie," Technical Memorandum No. 37, Beach Erosion Board.

APPENDIX A: EXAMPLES OF INPUT AND OUTPUT DATA

EXAMPLE 1 - INPUT

```
       50           8
             10.000
  1.000    2.000    3.000     4.000    5.000     7.000     9.000   12.000   18.000   32.808
   .000     .000     .000      .000     .000      .000      .000     .000     .000     .000
       30
              3.000      .0500       .220
 1
25    300.000
    .1486
  100.000 21600.000
    .00      .00      .00       .00      .00       .00       .00      .00      .00      .00
    .00      .00      .00       .00      .00       .00       .00      .00      .00      .00
    .00      .00      .00       .00      .00       .00       .00      .00      .00      .00
    .00      .00      .00       .00      .00       .00       .00      .00      .00      .00
    .00      .00      .00       .00      .00       .00       .00      .00      .00      .00
    0
    1         3.0    7.0  60.0     0
    2         3.0    7.0  60.0     0
    3         3.0    7.0  60.0     0
    4         3.0    7.0  60.0     0
    5         3.0    7.0  60.0     0
    6         3.0    7.0  60.0     0
    7         3.0    7.0  60.0     0
    8         3.0    7.0  60.0     0
    9         3.0    7.0  60.0     0
   10         3.0    7.0  60.0     0
   11         3.0    7.0  60.0     0
   12         3.0    7.0  60.0     0
   13         3.0    7.0  60.0     0
   14         3.0    7.0  60.0     0
   15         3.0    7.0  60.0     0
   16         3.0    7.0  60.0     0
   17         3.0    7.0  60.0     0
   18         3.0    7.0  60.0     0
   19         3.0    7.0  60.0     0
   20         3.0    7.0  60.0     0
   21         3.0    7.0  60.0     0
   22         3.0    7.0  60.0     0
   23         3.0    7.0  60.0     0
   24         3.0    7.0  60.0     0
   25         3.0    7.0  60.0     0
   26         3.0    7.0  60.0     0
   27         3.0    7.0  60.0     0
   28         3.0    7.0  60.0     0
   29         3.0    7.0  60.0     0
   30         3.0    7.0  60.0     0
   31        99.0   99.0  99.0     0
```

EXAMPLE 1 - SPOOL: NONE

EXAMPLE 1 - OUTPUT

```
*****************************************************
  THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH=      32.808
*****************************************************
  THE HEIGHT OF THE BERM, BERM=      3.000
  THE SLOPE OF THE BEACH FACE, SFACE=      .0500
  THE SEDIMENT DIAMETER, DIAM=       .220
*****************************************************
  THE LENGTH OF THE STRUCTURE, SJETTY=    300.000
  THE NUMBER    1 GROIN IS LOCATED AT GRID   25
*****************************************************
  THE VALUE OF ADEAN=      .1486  IN THE EQ. H=AY**2/3
*****************************************************
  THE VALUE OF THE LONGSHORE SPACE-STEP, DX=    100.000
  THE TIME-STEP IN SECONDS, DELT=  21600.000
*****************************************************
   THE INITIAL SHORELINE COORDINATES :
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
*****************************************************
  THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS

     .00   32.07   69.01  114.31  166.64  256.57  395.01  593.96 1014.17 2235.24
     .00   32.07   69.01  114.31  166.64  256.57  395.01  593.96 1014.17 2235.24
*****************************************************
  THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS
    1.00    2.00    3.00    4.00    5.00    7.00    9.00   12.00   18.00   32.81
*****************************************************
    1         3.0   7.0  60.0     0
    2         3.0   7.0  60.0     0
    3         3.0   7.0  60.0     0
    4         3.0   7.0  60.0     0
    5         3.0   7.0  60.0     0
    6         3.0   7.0  60.0     0
    7         3.0   7.0  60.0     0
    8         3.0   7.0  60.0     0
    9         3.0   7.0  60.0     0
   10         3.0   7.0  60.0     0
   11         3.0   7.0  60.0     0
   12         3.0   7.0  60.0     0
   13         3.0   7.0  60.0     0
   14         3.0   7.0  60.0     0
   15         3.0   7.0  60.0     0
   16         3.0   7.0  60.0     0
   17         3.0   7.0  60.0     0
   18         3.0   7.0  60.0     0
   19         3.0   7.0  60.0     0
   20         3.0   7.0  60.0     0
   21         3.0   7.0  60.0     0
   22         3.0   7.0  60.0     0
   23         3.0   7.0  60.0     0
   24         3.0   7.0  60.0     0
   25         3.0   7.0  60.0     0
```

26	3.0	7.0	60.0	0
27	3.0	7.0	60.0	0
28	3.0	7.0	60.0	0
29	3.0	7.0	60.0	0
30	3.0	7.0	60.0	0

THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV= 30

LONGSHORE STATION 1

Y	.000	32.071	69.005	114.307	166.644	256.566	395.009	593.958	1014.165
QX	.005	.113	.527	.725	.232	.008	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000

LONGSHORE STATION 2

Y	.003	32.129	69.330	115.697	166.584	256.565	395.009	593.958	1014.165
QX	.005	.113	.527	.725	.232	.008	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000

LONGSHORE STATION 3

Y	.010	32.200	69.552	116.999	166.494	256.562	395.009	593.958	1014.165
QX	.005	.114	.525	.722	.232	.008	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000

LONGSHORE STATION 4

Y	.021	32.280	69.746	118.314	166.354	256.554	395.009	593.958	1014.165
QX	.005	.113	.524	.721	.232	.008	.000	.000	.000
QY	.000	.000	-.001	.000	.000	.000	.000	.000	.000

LONGSHORE STATION 5

Y	.038	32.380	70.013	119.772	166.188	256.543	395.009	593.958	1014.165
QX	.005	.113	.523	.718	.232	.008	.000	.000	.000
QY	.000	.000	-.001	.000	.000	.000	.000	.000	.000

LONGSHORE STATION 6

Y	.068	32.529	70.405	121.447	166.025	256.532	395.009	593.958	1014.165
QX	.005	.113	.522	.715	.232	.008	.000	.000	.000
QY	.000	.000	-.001	.000	.000	.000	.000	.000	.000

LONGSHORE STATION 7

Y	.116	32.757	70.966	123.394	165.878	256.519	395.009	593.958	1014.165
QX	.005	.113	.520	.710	.233	.008	.000	.000	.000
QY	.000	-.001	-.001	.000	.000	.000	.000	.000	.000

LONGSHORE STATION 8

Y	.195	33.092	71.748	125.671	165.767	256.502	395.009	593.958	1014.165
QX	.005	.113	.517	.705	.233	.009	.000	.000	.000
QY	.000	-.001	-.002	.000	.000	.000	.000	.000	.000

LONGSHORE STATION 9

Y	.315	33.573	72.818	128.340	165.731	256.482	395.009	593.958	1014.165
QX	.005	.113	.514	.699	.234	.008	.000	.000	.000
QY	.000	-.001	-.002	-.001	.000	.000	.000	.000	.000

LONGSHORE STATION 10

Y	.497	34.250	74.261	131.464	165.826	256.454	395.009	593.958	1014.165
QX	.005	.113	.510	.692	.234	.009	.000	.000	.000
QY	-.001	-.002	-.003	-.001	.000	.000	.000	.000	.000

LONGSHORE STATION 11

Y	.765	35.188	76.180	135.113	166.141	256.418	395.009	593.958	1014.165
QX	.005	.113	.505	.685	.234	.009	.000	.000	.000
QY	-.001	-.002	-.004	-.001	.000	.000	.000	.000	.000

LONGSHORE STATION 12

Y	1.155	36.470	78.705	139.363	166.797	256.369	395.008	593.958	1014.165
QX	.005	.112	.498	.676	.234	.009	.000	.000	.000
QY	-.001	-.003	-.005	-.001	.000	.000	.000	.000	.000

```
LONGSHORE STATION   13
Y        1.715  38.201  81.992 144.295 167.951 256.305 395.008 593.9581014.165
QX        .005    .112    .489    .666    .234    .009    .000    .000    .000
QY       -.001   -.004   -.007   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION   14
Y        2.507  40.508  86.225 149.993 169.796 256.223 395.008 593.9581014.165
QX        .005    .111    .478    .656    .233    .009    .000    .000    .000
QY       -.002   -.006   -.009   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION   15
Y        3.614  43.545  91.616 156.543 172.556 256.125 395.008 593.9581014.165
QX        .005    .109    .465    .644    .232    .009    .000    .000    .000
QY       -.002   -.008   -.011   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION   16
Y        5.137  47.488  98.409 164.032 176.469 256.030 395.008 593.9581014.165
QX        .006    .108    .448    .632    .229    .010    .000    .000    .000
QY       -.003   -.010   -.014   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION   17
Y        7.193  52.541 106.880 172.562 181.785 255.992 395.008 593.9581014.165
QX        .006    .106    .428    .619    .226    .010    .000    .000    .000
QY       -.004   -.013   -.017   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION   18
Y        9.909  58.950 117.433 182.161 188.556 256.119 395.008 593.9581014.165
QX        .006    .103    .404    .607    .223    .011    .000    .000    .000
QY       -.005   -.017   -.021   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION   19
Y       13.397  66.888 130.254 193.314 197.600 256.787 395.011 593.9581014.165
QX        .006    .101    .380    .587    .213    .011    .000    .000    .000
QY       -.006   -.021   -.026   -.018    .001    .000    .000    .000    .000
LONGSHORE STATION   20
Y       17.727  76.474 145.228 206.779 209.943 258.518 395.015 593.9581014.165
QX        .006    .097    .358    .569    .221    .015    .000    .000    .000
QY       -.007   -.026   -.032   -.016    .001    .000    .000    .000    .000
LONGSHORE STATION   21
Y       22.898  87.925 162.495 222.303 224.825 261.578 395.022 593.9581014.165
QX        .006    .094    .334    .539    .211    .015    .000    .000    .000
QY       -.008   -.033   -.038   -.015    .001    .001    .000    .000    .000
LONGSHORE STATION   22
Y       28.759 101.343 182.290 239.479 241.472 266.262 395.031 593.9581014.165
QX        .006    .090    .302    .511    .205    .016    .000    .000    .000
QY       -.009   -.040   -.044   -.012    .001    .001    .000    .000    .000
LONGSHORE STATION   23
Y       34.905 116.411 204.252 257.607 259.404 272.674 395.041 593.9581014.165
QX        .006    .084    .268    .504    .203    .016    .000    .000    .000
QY       -.009   -.049   -.051   -.008    .001    .001    .000    .000    .000
LONGSHORE STATION   24
Y       40.605 133.477 229.672 277.517 279.336 281.688 395.047 593.9581014.165
QX        .006    .072    .202    .407    .181    .014    .000    .000    .000
QY       -.009   -.061   -.059   -.005    .022    .022    .000    .000    .000
LONGSHORE STATION   25
Y       44.358 147.813 251.841 266.914 268.733 284.306 395.044 593.9581014.165
QX        .007    .080    .239    .940    .285    .010    .000    .000    .000
QY       -.010   -.071   -.067    .001    .022    .001    .000    .000    .000
LONGSHORE STATION   26
Y      -49.295 -46.269 -44.450 177.726 191.930 257.721 395.033 593.9581014.165
QX        .000    .000    .000    .000    .000    .009    .000    .000    .000
```

```
QY        .010      .014      .001      .000      .000      .000      .000      .000      .000
LONGSHORE STATION    27
Y      -51.222 -48.249 -46.430  48.840 116.942 256.328 395.021 593.9581014.165
QX        .017      .028      .000      .000      .000      .000      .000      .000      .000
QY        .009      .053      .019      .000      .000      .000      .000      .000      .000
LONGSHORE STATION    28
Y      -51.352 -48.415 -46.596 -35.806  75.695 254.699 395.013 593.9581014.165
QX        .009      .114      .030      .000      .000      .000      .000      .000      .000
QY        .010      .056      .076      .001     -.001     -.001      .000      .000      .000
LONGSHORE STATION    29
Y      -47.975 -44.934 -43.251 -41.432  68.367 253.722 395.008 593.9581014.165
QX        .003      .070      .269      .699      .180      .004      .000      .000      .000
QY        .010      .064      .089      .033     -.001     -.001      .000      .000      .000
LONGSHORE STATION    30
Y      -37.328 -34.371 -32.552 -27.836  79.830 253.510 395.005 593.9581014.165
QX        .002      .064      .307      .383      .164      .008      .000      .000      .000
QY        .010      .037      .044      .002     -.001     -.001      .000      .000      .000
LONGSHORE STATION    31
Y      -27.621 -24.580 -20.612  -9.508  93.796 254.012 395.005 593.9581014.165
QX        .003      .077      .375      .426      .178      .010      .000      .000      .000
QY        .009      .029      .033      .034     -.001     -.001      .000      .000      .000
LONGSHORE STATION    32
Y      -20.452 -14.400  -6.957   8.750 109.649 255.101 395.007 593.9581014.165
QX        .004      .086      .388      .480      .204      .016      .000      .000      .000
QY        .008      .026      .029      .030     -.001     -.001      .000      .000      .000
LONGSHORE STATION    33
Y      -15.024  -4.827   6.165  25.718 125.137 256.289 395.008 593.9581014.165
QX        .004      .097      .403      .519      .210      .016      .000      .000      .000
QY        .007      .022      .026      .026     -.001      .000      .000      .000      .000
LONGSHORE STATION    34
Y      -10.880   3.541  18.248  40.763 138.989 257.222 395.010 593.9581014.165
QX        .005      .102      .415      .556      .220      .016      .000      .000      .000
QY        .006      .017      .022      .023     -.001      .000      .000      .000      .000
LONGSHORE STATION    35
Y       -7.732  10.472  29.090  53.406 150.143 257.719 395.011 593.9581014.165
QX        .006      .105      .424      .595      .233      .015      .000      .000      .000
QY        .004      .014      .018      .021     -.001      .000      .000      .000      .000
LONGSHORE STATION    36
Y       -5.379  16.104  38.503  63.480 157.587 257.702 395.011 593.9581014.165
QX        .006      .109      .436      .614      .224      .011      .000      .000      .000
QY        .003      .010      .014      .001     -.001      .000      .000      .000      .000
LONGSHORE STATION    37
Y       -3.669  20.490  46.067  71.804 162.424 257.467 395.011 593.9581014.165
QX        .006      .110      .452      .635      .234      .011      .000      .000      .000
QY        .003      .008      .011      .001     -.001      .000      .000      .000      .000
LONGSHORE STATION    38
Y       -2.460  23.758  51.853  78.916 165.653 257.244 395.010 593.9581014.165
QX        .006      .111      .468      .645      .236      .010      .000      .000      .000
QY        .002      .006      .009      .001     -.001      .000      .000      .000      .000
LONGSHORE STATION    39
Y       -1.623  26.161  56.272  84.908 167.510 257.053 395.010 593.9581014.165
QX        .005      .112      .481      .657      .237      .010      .000      .000      .000
QY        .001      .004      .007      .001     -.001      .000      .000      .000      .000
LONGSHORE STATION    40
Y       -1.054  27.907  59.614  89.976 168.433 256.906 395.010 593.9581014.165
```

QX	.005	.113	.492	.668	.238	.009	.000	.000	.000
QY	.001	.003	.005	.001	-.001	.000	.000	.000	.000
LONGSHORE STATION 41									
Y	-.674	29.164	62.125	94.265	168.750	256.801	395.009	593.958	1014.165
QX	.005	.113	.500	.677	.238	.009	.000	.000	.000
QY	.001	.002	.004	.001	.000	.000	.000	.000	.000
LONGSHORE STATION 42									
Y	-.423	30.062	63.998	97.904	168.711	256.728	395.009	593.958	1014.165
QX	.005	.113	.506	.686	.237	.009	.000	.000	.000
QY	.001	.002	.003	.001	.000	.000	.000	.000	.000
LONGSHORE STATION 43									
Y	-.259	30.696	65.384	101.000	168.487	256.678	395.009	593.958	1014.165
QX	.005	.113	.511	.693	.236	.009	.000	.000	.000
QY	.000	.001	.002	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 44									
Y	-.155	31.140	66.402	103.645	168.188	256.645	395.009	593.958	1014.165
QX	.005	.113	.515	.700	.235	.008	.000	.000	.000
QY	.000	.001	.002	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 45									
Y	-.089	31.446	67.142	105.921	167.878	256.621	395.009	593.958	1014.165
QX	.005	.114	.518	.705	.234	.008	.000	.000	.000
QY	.000	.000	.001	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 46									
Y	-.050	31.653	67.673	107.896	167.588	256.605	395.009	593.958	1014.165
QX	.005	.114	.520	.710	.234	.008	.000	.000	.000
QY	.000	.000	.001	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 47									
Y	-.027	31.793	68.046	109.634	167.330	256.593	395.009	593.958	1014.165
QX	.005	.114	.522	.714	.233	.008	.000	.000	.000
QY	.000	.000	.001	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 48									
Y	-.012	31.899	68.313	111.194	167.093	256.583	395.009	593.958	1014.165
QX	.005	.114	.523	.717	.233	.008	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 49									
Y	-.004	31.992	68.598	112.708	166.861	256.573	395.009	593.958	1014.165
QX	.005	.114	.524	.718	.232	.008	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 50									
Y	.000	32.071	69.005	114.307	166.644	256.568	395.009	593.958	1014.165
QX	.005	.113	.526	.721	.232	.008	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000

```
 1I     I   0   .     +      #          0
 2I     I   0   .     +      #          0
 3I     I   0   .     +      #          0
 4I     I   0   .      +     #          0
 5I     I   0    .     +     #          0
 6I     I   0    .     +     #          0
 7I     I   0    .     +    #           0
 8I     I   0    .     +    #           0
 9I     I   0    .      +   #           0
10I     I   0    .      +   #           0
11I     I   0    .       +   #          0
12I     I   0     .      +   #          0
13I     I    0    .       +  #          0
14I     I    0     .      +  #          0
15I     I    0     .       + #          0
16I     I     0     .       + #         0
17I     I*    0      .       +#         0
18I     I*     0      .        #        0
19I     I*      0       .       #       0
20I     I *      0        .       #     0
21I     I  *       0        .       #   0
22I     I  *        0          .      #  0
23I     I   *         0          .      # 0
24I     I    *          0           .     +0
25I     IHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHHH
26I.    I                     + #       0
27I.    I     +       #                 0
28I+    I        #                      0
29I+    I       #                      0
30I0+   I         #                    0
31I *. +I          #                    0
32I  *0.I+           #                  0
33I   *0I. +           #                0
34I   * I .  +           #              0
35I    *I0 .  +            #            0
36I    *I 0  .  +          #            0
37I    *I 0   .  +          #           0
38I    *I  0  .   +         #           0
39I     I  0   .  +          #          0
40I     I  0   .   +         #          0
41I     I  0    .   +        #          0
42I     I   0   .   +        #          0
43I     I   0   .   +        #          0
44I     I   0   .    +       #          0
45I     I   0   .    +       #          0
46I     I   0   .    +       #          0
47I     I   0   .    +       #          0
48I     I   0   .     +      #          0
49I     I   0   .     +      #          0
50I     I   0   .     +      #          0
 31       99.0  99.0  99.0    0
```

EXAMPLE 2 – INPUT

```
      50          8
              10.000
  1.000    2.000    3.000    4.000    5.000    7.000   10.000   15.000   25.000   32.808
   .000     .000     .000     .000     .000     .000     .000     .000     .000     .000
      30
               3.000      .0500       .220
 3
12   300.000
25   300.000
38   300.000
    .0899
  100.000 21600.000
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
   0
   1         3.0   7.0  60.0     0
   2         3.0   7.0  60.0     0
   3         3.0   7.0  60.0     0
   4         3.0   7.0  60.0     0
   5         3.0   7.0  60.0     0
   6         3.0   7.0  60.0     0
   7         3.0   7.0  60.0     0
   8         3.0   7.0  60.0     0
   9         3.0   7.0  60.0     0
  10         3.0   7.0  60.0     0
  11         3.0   7.0  60.0     0
  12         3.0   7.0  60.0     0
  13         3.0   7.0  60.0     0
  14         3.0   7.0  60.0     0
  15         3.0   7.0  60.0     0
  16         3.0   7.0  60.0     0
  17         3.0   7.0  60.0     0
  18         3.0   7.0  60.0     0
  19         3.0   7.0  60.0     0
  20         3.0   7.0  60.0     0
  21         3.0   7.0  60.0     0
  22         3.0   7.0  60.0     0
  23         3.0   7.0  60.0     0
  24         3.0   7.0  60.0     0
  25         3.0   7.0  60.0     0
  26         3.0   7.0  60.0     0
  27         3.0   7.0  60.0     0
  28         3.0   7.0  60.0     0
  29         3.0   7.0  60.0     0
  30         3.0   7.0  60.0     0
  31        99.0  99.0  99.0     0
```

EXAMPLE 2 – SPOOL: NONE

EXAMPLE 2 - OUTPUT

```
*******************************************************
  THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH=     32.808
*******************************************************
  THE HEIGHT OF THE BERM, BERM=       3.000
  THE SLOPE OF THE BEACH FACE, SFACE=       .0500
  THE SEDIMENT DIAMETER, DIAM=       .220
*******************************************************
  THE LENGTH OF THE STRUCTURE, SJETTY=    300.000
  THE LENGTH OF THE STRUCTURE, SJETTY=    300.000
  THE LENGTH OF THE STRUCTURE, SJETTY=    300.000
  THE NUMBER    1 GROIN IS LOCATED AT GRID   12
  THE NUMBER    2 GROIN IS LOCATED AT GRID   25
  THE NUMBER    3 GROIN IS LOCATED AT GRID   38
*******************************************************
  THE VALUE OF ADEAN=       .0899  IN THE EQ. H=AY**2/3
*******************************************************
  THE VALUE OF THE LONGSHORE SPACE-STEP, DX=    100.000
  THE TIME-STEP IN SECONDS, DELT=  21600.000
*******************************************************
   THE INITIAL SHORELINE COORDINATES :
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
*******************************************************
  THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS

     .00    68.15  146.65  242.92  354.14  545.24  819.37 1639.55 3318.22 5764.97
     .00    68.15  146.65  242.92  354.14  545.24  819.37 1639.55 3318.22 5764.97
*******************************************************
  THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS
    1.00    2.00    3.00    4.00    5.00    7.00   10.00   15.00   25.00   32.81
*******************************************************
    1        3.0   7.0  60.0     0
    2        3.0   7.0  60.0     0
    3        3.0   7.0  60.0     0
    4        3.0   7.0  60.0     0
    5        3.0   7.0  60.0     0
    6        3.0   7.0  60.0     0
    7        3.0   7.0  60.0     0
    8        3.0   7.0  60.0     0
    9        3.0   7.0  60.0     0
   10        3.0   7.0  60.0     0
   11        3.0   7.0  60.0     0
   12        3.0   7.0  60.0     0
   13        3.0   7.0  60.0     0
   14        3.0   7.0  60.0     0
   15        3.0   7.0  60.0     0
   16        3.0   7.0  60.0     0
   17        3.0   7.0  60.0     0
   18        3.0   7.0  60.0     0
   19        3.0   7.0  60.0     0
   20        3.0   7.0  60.0     0
   21        3.0   7.0  60.0     0
```

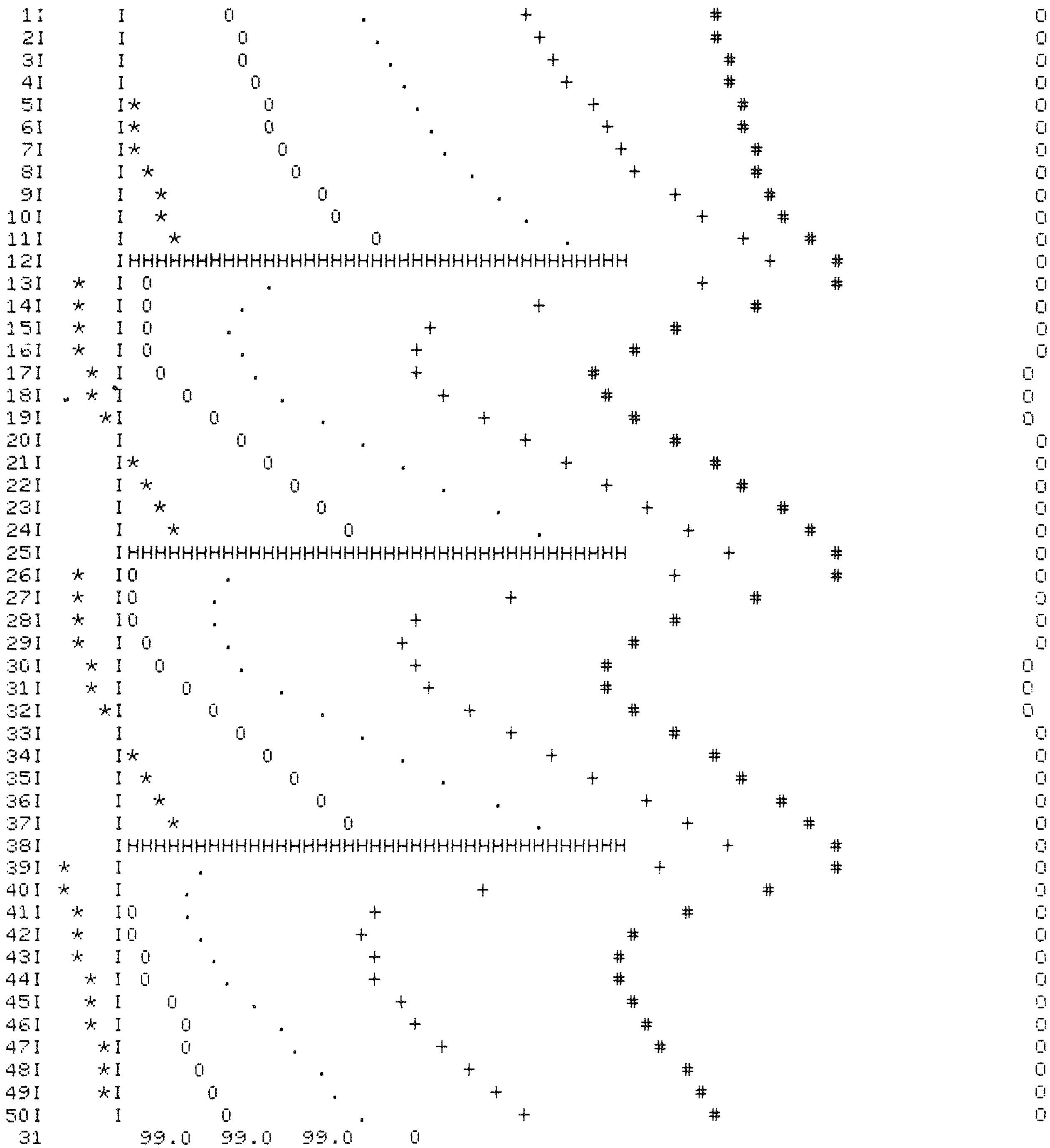
```
  22         3.0   7.0  60.0    0
  23         3.0   7.0  60.0    0
  24         3.0   7.0  60.0    0
  25         3.0   7.0  60.0    0
  26         3.0   7.0  60.0    0
  27         3.0   7.0  60.0    0
  28         3.0   7.0  60.0    0
  29         3.0   7.0  60.0    0
  30         3.0   7.0  60.0    0
 THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV=    30

LONGSHORE STATION    1
Y          .000  68.155 146.646 242.920 354.143 545.240 919.3671639.5533318.222
QX         .004    .106    .472    .659    .262    .012    .000    .000    .000
QY         .000    .000    .000    .000    .000    .000    .000    .000    .000
LONGSHORE STATION    2
Y         1.656  72.780 155.034 252.783 357.283 545.350 919.3671639.5533318.222
QX         .004    .106    .472    .659    .262    .012    .000    .000    .000
QY        -.001   -.003   -.004   -.001    .000    .000    .000    .000    .000
LONGSHORE STATION    3
Y         3.376  77.162 162.277 261.592 360.279 545.417 919.3671639.5533318.222
QX         .005    .104    .455    .644    .260    .012    .000    .000    .000
QY        -.001   -.006   -.007    .000    .001    .000    .000    .000    .000
LONGSHORE STATION    4
Y         5.254  81.491 169.080 269.782 363.081 545.410 919.3671639.5533318.222
QX         .005    .102    .448    .640    .255    .011    .000    .000    .000
QY        -.002   -.008   -.009    .000    .001    .000    .000    .000    .000
LONGSHORE STATION    5
Y         7.434  86.192 176.448 278.114 366.225 545.374 919.3671639.5533318.222
QX         .005    .100    .438    .635    .251    .011    .000    .000    .000
QY        -.003   -.011   -.012   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION    6
Y        10.097  91.704 184.892 286.967 370.225 545.344 919.3671639.5533318.222
QX         .005    .098    .423    .627    .249    .011    .000    .000    .000
QY        -.004   -.013   -.015   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION    7
Y        13.427  98.553 195.077 297.063 374.787 545.255 919.3671639.5533318.222
QX         .005    .096    .406    .616    .243    .011    .000    .000    .000
QY        -.005   -.017   -.018   -.001    .001    .000    .000    .000    .000
LONGSHORE STATION    8
Y        17.568 107.361 207.982 309.919 379.891 545.096 919.3671639.5533318.222
QX         .005    .095    .388    .610    .232    .010    .000    .000    .000
QY        -.005   -.022   -.022   -.001    .002    .001    .000    .000    .000
LONGSHORE STATION    9
Y        22.529 118.749 224.587 326.422 386.258 544.995 919.3681639.5533318.222
QX         .005    .093    .368    .616    .229    .011    .000    .000    .000
QY        -.006   -.028   -.027   -.001    .002    .001    .000    .000    .000
LONGSHORE STATION   10
Y        28.049 132.903 244.774 347.258 395.998 545.513 919.3701639.5533318.222
QX         .005    .091    .349    .593    .218    .012    .000    .000    .000
QY        -.007   -.037   -.033   -.006    .003    .001    .000    .000    .000
LONGSHORE STATION   11
Y        33.438 150.595 269.309 369.740 410.457 547.117 919.3721639.5533318.222
QX         .005    .081    .301    .632    .241    .021    .000    .000    .000
QY        -.007   -.049   -.040   -.004    .003    .001    .000    .000    .000
```

LONGSHORE STATION 12									
Y	37.105	166.364	291.059	388.628	427.770	548.818	919.373	1639.553	3318.222
QX	.006	.091	.353	.524	.221	.022	.000	.000	.000
QY	-.008	-.061	-.046	-.001	.003	.001	.000	.000	.000
LONGSHORE STATION 13									
Y	-24.708	15.548	86.456	349.719	423.818	548.919	919.373	1639.553	3318.222
QX	.000	.000	.162	1.076	.286	.012	.000	.000	.000
QY	.004	.028	.000	-.006	.001	.001	.000	.000	.000
LONGSHORE STATION 14									
Y	-23.991	15.392	72.875	246.700	380.615	547.224	919.370	1639.553	3318.222
QX	.002	.031	.057	.003	.000	.000	.000	.000	.000
QY	.004	.029	.022	-.004	-.001	.000	.000	.000	.000
LONGSHORE STATION 15									
Y	-22.565	15.505	66.466	184.606	331.924	544.968	919.366	1639.553	3318.222
QX	.001	.028	.213	.598	.041	.000	.000	.000	.000
QY	.004	.030	.028	-.001	-.001	.000	.000	.000	.000
LONGSHORE STATION 16									
Y	-20.043	18.437	70.508	177.230	302.357	542.853	919.361	1639.553	3318.222
QX	.002	.043	.200	.467	.102	.001	.000	.000	.000
QY	.004	.030	.027	-.001	.000	-.001	.000	.000	.000
LONGSHORE STATION 17									
Y	-16.048	26.500	81.464	179.219	285.548	540.893	919.358	1639.553	3318.222
QX	.003	.063	.236	.435	.104	.001	.000	.000	.000
QY	.003	.026	.024	.000	.000	-.001	.000	.000	.000
LONGSHORE STATION 18									
Y	-10.675	39.438	100.262	192.637	286.281	540.175	919.357	1639.553	3319.222
QX	.005	.084	.294	.484	.153	.003	.000	.000	.000
QY	.002	.018	.018	.004	.001	-.001	.000	.000	.000
LONGSHORE STATION 19									
Y	-4.340	55.032	124.160	215.565	305.461	541.537	919.359	1639.553	3318.222
QX	.005	.091	.324	.548	.264	.024	.000	.000	.000
QY	.001	.009	.009	.005	.001	-.001	.000	.000	.000
LONGSHORE STATION 20									
Y	2.519	71.143	148.696	240.136	329.887	543.600	919.363	1639.553	3318.222
QX	.005	.093	.319	.511	.233	.022	.000	.000	.000
QY	.000	-.001	.001	.005	.001	.000	.000	.000	.000
LONGSHORE STATION 21									
Y	9.614	87.018	172.311	263.303	352.628	545.152	919.367	1639.553	3318.222
QX	.005	.089	.308	.512	.247	.022	.000	.000	.000
QY	-.002	-.009	-.007	.005	.001	.000	.000	.000	.000
LONGSHORE STATION 22									
Y	16.804	103.272	196.441	286.699	373.608	546.229	919.370	1639.553	3318.222
QX	.005	.087	.297	.511	.242	.021	.000	.000	.000
QY	-.003	-.018	-.015	.006	.001	.000	.000	.000	.000
LONGSHORE STATION 23									
Y	23.899	120.845	222.471	313.278	392.820	547.278	919.373	1639.553	3318.222
QX	.005	.085	.287	.516	.238	.022	.000	.000	.000
QY	-.004	-.029	-.023	.006	.001	.001	.000	.000	.000
LONGSHORE STATION 24									
Y	30.344	141.357	252.918	341.154	411.091	548.702	919.375	1639.553	3318.222
QX	.006	.079	.245	.577	.235	.025	.000	.000	.000
QY	-.005	-.043	-.033	.008	.002	.001	.000	.000	.000
LONGSHORE STATION 25									
Y	34.575	159.146	279.718	364.405	429.139	549.863	919.376	1639.553	3319.222
QX	.006	.093	.311	.487	.224	.024	.000	.000	.000

QY	-.006	-.056	-.042	.012	.002	.001	.000	.000	.000
LONGSHORE STATION 26									
Y	-25.599	11.801	67.545	330.446	424.795	549.448	919.374	1639.553	3318.222
QX	.000	.000	.088	1.046	.288	.012	.000	.000	.000
QY	.005	.031	.001	-.006	.001	.001	.000	.000	.000
LONGSHORE STATION 27									
Y	-24.763	12.010	59.613	234.257	380.862	547.419	919.371	1639.553	3318.222
QX	.003	.037	.030	.002	.000	.000	.000	.000	.000
QY	.005	.032	.031	-.004	-.001	.000	.000	.000	.000
LONGSHORE STATION 28									
Y	-23.172	12.716	57.587	177.587	332.281	545.033	919.366	1639.553	3318.222
QX	.001	.031	.154	.607	.045	.000	.000	.000	.000
QY	.005	.032	.034	-.002	-.001	.000	.000	.000	.000
LONGSHORE STATION 29									
Y	-20.480	16.268	63.861	172.436	303.300	542.891	919.361	1639.553	3318.222
QX	.002	.044	.170	.446	.107	.001	.000	.000	.000
QY	.004	.031	.031	-.001	-.001	-.001	.000	.000	.000
LONGSHORE STATION 30									
Y	-16.335	24.877	76.556	175.336	286.555	540.932	919.358	1639.553	3318.222
QX	.004	.063	.211	.424	.105	.001	.000	.000	.000
QY	.004	.027	.027	.000	.000	-.001	.000	.000	.000
LONGSHORE STATION 31									
Y	-10.842	38.297	96.727	189.353	286.948	540.218	919.357	1639.553	3318.222
QX	.005	.084	.276	.473	.154	.003	.000	.000	.000
QY	.003	.019	.020	.004	.001	-.001	.000	.000	.000
LONGSHORE STATION 32									
Y	-4.423	54.294	121.729	212.637	305.806	541.581	919.359	1639.553	3318.222
QX	.005	.091	.311	.539	.266	.024	.000	.000	.000
QY	.001	.009	.011	.005	.001	.001	.000	.000	.000
LONGSHORE STATION 33									
Y	2.488	70.697	147.074	237.407	329.913	543.334	919.363	1639.553	3318.222
QX	.005	.093	.308	.505	.234	.022	.000	.000	.000
QY	.000	.000	.002	.006	.001	.000	.000	.000	.000
LONGSHORE STATION 34									
Y	9.610	86.777	171.300	260.626	352.297	545.166	919.367	1639.553	3318.222
QX	.005	.089	.298	.508	.248	.022	.000	.000	.000
QY	-.001	-.009	-.006	.007	.001	.000	.000	.000	.000
LONGSHORE STATION 35									
Y	16.810	103.198	195.997	283.927	372.963	546.218	919.370	1639.553	3318.222
QX	.005	.087	.287	.511	.243	.021	.000	.000	.000
QY	-.003	-.018	-.014	.008	.001	.000	.000	.000	.000
LONGSHORE STATION 36									
Y	23.906	120.930	222.648	310.243	391.982	547.235	919.373	1639.553	3318.222
QX	.005	.085	.276	.519	.238	.022	.000	.000	.000
QY	-.004	-.029	-.023	.009	.001	.001	.000	.000	.000
LONGSHORE STATION 37									
Y	30.349	141.588	253.952	337.641	410.204	548.627	919.375	1639.553	3318.222
QX	.006	.078	.230	.583	.235	.025	.000	.000	.000
QY	-.005	-.043	-.034	.013	.002	.001	.000	.000	.000
LONGSHORE STATION 38									
Y	34.579	159.473	281.630	360.057	428.410	549.800	919.376	1639.553	3318.222
QX	.006	.092	.295	.497	.222	.024	.000	.000	.000
QY	-.006	-.057	-.044	.018	.002	.001	.000	.000	.000
LONGSHORE STATION 39									
Y	-27.671	3.956	47.585	323.412	425.058	549.501	919.375	1639.553	3318.222

QX	.000	.000	.056	1.066	.283	.012	.000	.000	.000
QY	.006	.037	.001	-.006	.000	.001	.000	.000	.000
LONGSHORE STATION 40									
Y	-26.828	5.847	43.269	221.134	382.807	547.727	919.372	1639.553	3318.222
QX	.003	.066	.035	.001	.000	.000	.000	.000	.000
QY	.006	.036	.041	-.004	-.001	.000	.000	.000	.000
LONGSHORE STATION 41									
Y	-25.508	6.692	42.831	157.931	335.079	545.761	919.368	1639.553	3318.222
QX	.002	.030	.123	.571	.035	.000	.000	.000	.000
QY	.006	.036	.043	-.001	-.002	.000	.000	.000	.000
LONGSHORE STATION 42									
Y	-23.608	8.959	48.609	149.889	308.920	544.299	919.365	1639.553	3318.222
QX	.002	.051	.186	.467	.087	.000	.000	.000	.000
QY	.006	.036	.039	.000	-.002	-.001	.000	.000	.000
LONGSHORE STATION 43									
Y	-20.978	14.498	58.170	150.824	298.616	543.352	919.362	1639.553	3318.222
QX	.003	.066	.237	.465	.117	.001	.000	.000	.000
QY	.006	.033	.035	.000	-.001	-.001	.000	.000	.000
LONGSHORE STATION 44									
Y	-17.827	21.892	69.821	157.075	297.735	542.894	919.361	1639.553	3318.222
QX	.004	.076	.283	.486	.141	.003	.000	.000	.000
QY	.006	.028	.031	.001	-.001	-.001	.000	.000	.000
LONGSHORE STATION 45									
Y	-14.473	30.015	82.445	167.071	302.534	542.863	919.361	1639.553	3318.222
QX	.004	.085	.324	.498	.159	.004	.000	.000	.000
QY	.005	.024	.026	.001	-.001	-.001	.000	.000	.000
LONGSHORE STATION 46									
Y	-11.178	38.179	95.317	179.720	311.133	543.199	919.362	1639.553	3318.222
QX	.005	.093	.358	.513	.178	.006	.000	.000	.000
QY	.004	.019	.021	.001	-.001	-.001	.000	.000	.000
LONGSHORE STATION 47									
Y	-8.094	45.946	107.906	194.321	322.548	543.343	919.364	1639.553	3318.222
QX	.005	.098	.388	.529	.199	.008	.000	.000	.000
QY	.004	.014	.016	.001	-.001	-.001	.000	.000	.000
LONGSHORE STATION 48									
Y	-5.249	53.266	119.949	209.648	334.622	544.542	919.365	1639.553	3318.222
QX	.005	.101	.409	.544	.220	.011	.000	.000	.000
QY	.002	.010	.012	.007	-.001	.000	.000	.000	.000
LONGSHORE STATION 49									
Y	-2.578	60.564	132.496	225.519	345.066	544.993	919.366	1639.553	3318.222
QX	.005	.105	.417	.542	.220	.010	.000	.000	.000
QY	.001	.005	.006	.000	.000	.000	.000	.000	.000
LONGSHORE STATION 50									
Y	.000	68.155	146.646	242.920	354.143	545.240	919.367	1639.553	3318.222
QX	.005	.108	.446	.574	.225	.010	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000



EXAMPLE 3 - INPUT

```
      50          8
              10.000
  1.000    2.000    3.000    5.000    7.000   11.000   14.000   17.000   25.000   32.808
   .000     .000     .000     .000     .000     .000     .000     .000     .000     .000
      30
               5.000      .0500       .220
1
3       .000
    .1500
  200.000 21600.000
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
   0
   1          3.0    7.0     .0     0
   2          3.0    7.0     .0     0
   3          3.0    7.0     .0     0
   4          3.0    7.0     .0     0
   5          3.0    7.0     .0     1
   6          3.0    7.0     .0     0
   7          3.0    7.0     .0     0
   8          3.0    7.0     .0     0
   9          3.0    7.0     .0     0
  10          3.0    7.0     .0     0
  11          3.0    7.0     .0     0
  12          3.0    7.0     .0     0
  13          3.0    7.0     .0     0
  14          3.0    7.0     .0     0
  15          3.0    7.0     .0     0
  16          3.0    7.0     .0     0
  17          3.0    7.0     .0     0
  18          3.0    7.0     .0     0
  19          3.0    7.0     .0     0
  20          3.0    7.0     .0     0
  21          3.0    7.0     .0     0
  22          3.0    7.0     .0     0
  23          3.0    7.0     .0     0
  24          3.0    7.0     .0     0
  25          3.0    7.0     .0     0
  26          3.0    7.0     .0     0
  27          3.0    7.0     .0     0
  28          3.0    7.0     .0     0
  29          3.0    7.0     .0     0
  30          3.0    7.0     .0     0
  31         99.0   99.0   99.0     0
```

EXAMPLE 3 - SPOOL

13	5	10.40
14	5	20.80
15	5	31.20
16	5	41.70
17	5	52.10
18	5	62.50
19	5	72.90
20	5	83.30
21	5	93.70
22	5	104.10
23	5	114.60
24	5	125.00
25	5	135.40
26	5	145.80
27	5	135.40
28	5	125.00
29	5	114.60
30	5	104.10
31	5	93.70
32	5	83.30
33	5	72.90
34	5	62.50
35	5	52.10
36	5	41.70
37	5	31.20
38	5	20.80
39	5	10.40
13	6	13.90
14	6	27.80
15	6	41.70
16	6	55.50
17	6	69.40
18	6	83.30
19	6	97.20
20	6	111.10
21	6	125.00
22	6	138.90
23	6	152.70
24	6	166.60
25	6	180.50
26	6	194.40
27	6	180.50
28	6	166.60
29	6	152.70
30	6	138.90
31	6	125.00
32	6	111.10
33	6	97.20
34	6	83.30
35	6	69.40
36	6	55.50
37	6	41.70
38	6	27.80
39	6	13.90
50	8	.00

EXAMPLE 3 – OUTPUT

```
*****************************************************
  THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH=      32.808
*****************************************************
  THE HEIGHT OF THE BERM, BERM=       5.000
  THE SLOPE OF THE BEACH FACE, SFACE=       .0500
  THE SEDIMENT DIAMETER, DIAM=        .220
*****************************************************
  THE LENGTH OF THE STRUCTURE, SJETTY=       .000
  THE NUMBER    1 GROIN IS LOCATED AT GRID    3
*****************************************************
  THE VALUE OF ADEAN=      .1500  IN THE EQ. H=AY**2/3
*****************************************************
  THE VALUE OF THE LONGSHORE SPACE-STEP, DX=    200.000
  THE TIME-STEP IN SECONDS, DELT=  21600.000
*****************************************************
   THE INITIAL SHORELINE COORDINATES :
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
*****************************************************
  THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS

     .00   31.62   68.04  137.71  252.98  464.76  760.73 1050.41 1656.50 2674.85
     .00   31.62   68.04  137.71  252.98  464.76  760.73 1050.41 1656.50 2674.85
*****************************************************
  THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS
   1.00    2.00    3.00    5.00    7.00   11.00   14.00   17.00   25.00   32.81
*****************************************************
    1        3.0   7.0   .0    0
    2        3.0   7.0   .0    0
    3        3.0   7.0   .0    0
    4        3.0   7.0   .0    0
    5        3.0   7.0   .0    1
 DREDGED MATERIAL ADDED AT TIME      5
 CONTOURS AFTER MATERIAL ADDITION AT TIME     SARE:
    1       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
    2       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
    3       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
    4       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
    5       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
    6       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
    7       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
    8       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
    9       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
   10       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
   11       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
   12       .000    31.623    68.041   137.706   252.982   464.758   760.726 1050.414
   13       .000    31.623    68.041   137.706   263.382   478.658   760.726 1050.414
   14       .000    31.623    68.041   137.706   273.782   492.558   760.726 1050.414
   15       .000    31.623    68.041   137.706   284.182   506.458   760.726 1050.414
   16       .000    31.623    68.041   137.706   294.682   520.258   760.726 1050.414
   17       .000    31.623    68.041   137.706   305.082   534.158   760.726 1050.414
   18       .000    31.623    68.041   137.706   315.482   548.058   760.726 1050.414
```

19	.000	31.623	68.041	137.706	325.882	561.958	760.726	1050.414
20	.000	31.623	68.041	137.706	336.282	575.858	760.726	1050.414
21	.000	31.623	68.041	137.706	346.682	589.758	760.726	1050.414
22	.000	31.623	68.041	137.706	357.082	603.658	760.726	1050.414
23	.000	31.623	68.041	137.706	367.582	617.458	760.726	1050.414
24	.000	31.623	68.041	137.706	377.982	631.358	760.726	1050.414
25	.000	31.623	68.041	137.706	388.382	645.258	760.726	1050.414
26	.000	31.623	68.041	137.706	398.782	659.158	760.726	1050.414
27	.000	31.623	68.041	137.706	388.382	645.258	760.726	1050.414
28	.000	31.623	68.041	137.706	377.982	631.358	760.726	1050.414
29	.000	31.623	68.041	137.706	367.582	617.458	760.726	1050.414
30	.000	31.623	68.041	137.706	357.082	603.658	760.726	1050.414
31	.000	31.623	68.041	137.706	346.682	589.758	760.726	1050.414
32	.000	31.623	68.041	137.706	336.282	575.858	760.726	1050.414
33	.000	31.623	68.041	137.706	325.882	561.958	760.726	1050.414
34	.000	31.623	68.041	137.706	315.482	548.058	760.726	1050.414
35	.000	31.623	68.041	137.706	305.082	534.158	760.726	1050.414
36	.000	31.623	68.041	137.706	294.682	520.258	760.726	1050.414
37	.000	31.623	68.041	137.706	284.182	506.458	760.726	1050.414
38	.000	31.623	68.041	137.706	273.782	492.558	760.726	1050.414
39	.000	31.623	68.041	137.706	263.382	478.658	760.726	1050.414
40	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
41	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
42	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
43	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
44	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
45	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
46	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
47	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
48	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
49	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414
50	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414

6	3.0	7.0	.0	0
7	3.0	7.0	.0	0
8	3.0	7.0	.0	0
9	3.0	7.0	.0	0
10	3.0	7.0	.0	0
11	3.0	7.0	.0	0
12	3.0	7.0	.0	0
13	3.0	7.0	.0	0
14	3.0	7.0	.0	0
15	3.0	7.0	.0	0
16	3.0	7.0	.0	0
17	3.0	7.0	.0	0
18	3.0	7.0	.0	0
19	3.0	7.0	.0	0
20	3.0	7.0	.0	0
21	3.0	7.0	.0	0
22	3.0	7.0	.0	0
23	3.0	7.0	.0	0
24	3.0	7.0	.0	0
25	3.0	7.0	.0	0
26	3.0	7.0	.0	0
27	3.0	7.0	.0	0
28	3.0	7.0	.0	0

```
  29         3.0   7.0    .0     0
  30         3.0   7.0    .0     0
 THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV=    30

LONGSHORE STATION    1
Y          .000  31.623  68.041 137.706 252.982 464.758 760.7261050.4141656.502
QX         .000    .000    .000    .012   -.001    .000    .000    .000    .000
QY         .000    .000    .000    .000    .000    .000    .000    .000    .000
LONGSHORE STATION    2
Y         -.021  31.523  67.799 137.283 253.156 464.789 760.7261050.4141656.502
QX         .000    .000    .000    .012   -.001    .000    .000    .000    .000
QY         .000    .000    .000    .000    .000    .000    .000    .000    .000
LONGSHORE STATION    3
Y         -.044  31.417  67.559 136.861 253.377 464.847 760.7261050.4141656.502
QX         .000    .000    .001    .014   -.002    .000    .000    .000    .000
QY         .000    .000    .001    .001    .000    .000    .000    .000    .000
LONGSHORE STATION    4
Y         -.071  31.302  67.308 136.428 253.703 464.970 760.7261050.4141656.502
QX         .000    .000    .001    .015   -.002    .000    .000    .000    .000
QY         .000    .000    .001    .001    .000    .000    .000    .000    .000
LONGSHORE STATION    5
Y         -.102  31.175  67.036 135.975 254.202 465.225 760.7271050.4141656.502
QX         .000    .000    .001    .018   -.003    .000    .000    .000    .000
QY         .000    .001    .001    .001    .000    .000    .000    .000    .000
LONGSHORE STATION    6
Y         -.138  31.036  66.749 135.512 254.959 465.715 760.7271050.4141656.502
QX         .000    .000    .002    .021   -.005    .000    .000    .000    .000
QY         .000    .001    .001    .002    .000    .000    .000    .000    .000
LONGSHORE STATION    7
Y         -.177  30.891  66.458 135.060 256.075 466.594 760.7291050.4141656.502
QX         .000    .000    .002    .025   -.007    .000    .000    .000    .000
QY         .000    .001    .002    .002    .000    .000    .000    .000    .000
LONGSHORE STATION    8
Y         -.216  30.750  66.185 134.651 257.666 468.063 760.7311050.4141656.502
QX         .000    .000    .003    .030   -.010    .000    .000    .000    .000
QY         .000    .001    .002    .002    .000    .000    .000    .000    .000
LONGSHORE STATION    9
Y         -.252  30.629  65.958 134.327 259.855 470.365 760.7351050.4141656.502
QX         .000    .000    .003    .035   -.013    .000    .000    .000    .000
QY         .000    .001    .002    .003    .000    .000    .000    .000    .000
LONGSHORE STATION   10
Y         -.278  30.542  65.806 134.132 262.759 473.751 760.7411050.4141656.502
QX         .000    .000    .004    .040   -.017    .000    .000    .000    .000
QY         .000    .002    .002    .003   -.001    .000    .000    .000    .000
LONGSHORE STATION   11
Y         -.292  30.505  65.758 134.109 266.475 478.447 760.7491050.4141656.502
QX         .000    .000    .005    .046   -.021    .000    .000    .000    .000
QY         .000    .002    .002    .003   -.001    .000    .000    .000    .000
LONGSHORE STATION   12
Y         -.290  30.531  65.837 134.292 271.065 484.609 760.7591050.4141656.502
QX         .000    .000    .005    .051   -.026    .000    .000    .000    .000
QY         .000    .002    .002    .002   -.001    .000    .000    .000    .000
LONGSHORE STATION   13
Y         -.269  30.625  66.057 134.702 276.542 492.292 760.7721050.4141656.502
QX         .000    .001    .006    .056   -.030    .000    .000    .000    .000
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N-1
 QY        .000     .001     .002     .002    -.001     .000     .000     .000     .000
 LONGSHORE STATION   14
 Y        -.229   30.791   66.421  135.343  282.868  501.438  760.7871050.4141656.502
 QX        .000     .001     .007     .060    -.034     .000     .000     .000     .000
 QY        .000     .001     .002     .002    -.002     .000     .000     .000     .000
 LONGSHORE STATION   15
 Y        -.171   31.024   66.924  136.206  289.952  511.883  760.8051050.4141656.502
 QX        .000     .001     .007     .064    -.038     .000     .000     .000     .000
 QY        .000     .001     .001     .001    -.002     .000     .000     .000     .000
 LONGSHORE STATION   16
 Y        -.098   31.317   67.551  137.267  297.654  523.385  760.8241050.4141656.502
 QX        .000     .001     .008     .066    -.041     .000     .000     .000     .000
 QY        .000     .000     .000     .000    -.002     .000     .000     .000     .000
 LONGSHORE STATION   17
 Y        -.013   31.663   68.286  138.496  305.796  535.654  760.8451050.4141656.502
 QX        .000     .001     .008     .067    -.044     .000     .000     .000     .000
 QY        .000     .000     .000    -.001    -.003     .000     .000     .000     .000
 LONGSHORE STATION   18
 Y         .084   32.050   69.104  139.855  314.168  548.378  760.8661050.4141656.502
 QX        .000     .001     .008     .067    -.045     .000     .000     .000     .000
 QY        .000    -.001    -.001    -.002    -.003     .000     .000     .000     .000
 LONGSHORE STATION   19
 Y         .189   32.467   69.981  141.298  322.534  561.226  760.8881050.4141656.502
 QX        .000     .001     .008     .064    -.045     .000     .000     .000     .000
 QY        .000    -.001    -.002    -.003    -.003     .000     .000     .000     .000
 LONGSHORE STATION   20
 Y         .299   32.901   70.884  142.774  330.633  573.339  760.9091050.4141656.502
 QX        .000     .001     .007     .060    -.043     .000     .000     .000     .000
 QY       -.001    -.002    -.003    -.004    -.004    -.001     .000     .000     .000
 LONGSHORE STATION   21
 Y         .411   33.334   71.776  144.220  338.189  585.807  760.9291050.4141656.502
 QX        .000     .001     .007     .055    -.040     .000     .000     .000     .000
 QY       -.001    -.003    -.004    -.006    -.004    -.001     .000     .000     .000
 LONGSHORE STATION   22
 Y         .519   33.742   72.611  145.561  344.910  596.661  760.9481050.4141656.502
 QX        .000     .001     .006     .047    -.035     .000     .000     .000     .000
 QY       -.001    -.003    -.005    -.007    -.004    -.001     .000     .000     .000
 LONGSHORE STATION   23
 Y         .615   34.100   73.336  146.718  350.512  605.882  760.9631050.4141656.502
 QX        .000     .001     .005     .038    -.029     .000     .000     .000     .000
 QY       -.001    -.004    -.006    -.007    -.004    -.001     .001     .000     .000
 LONGSHORE STATION   24
 Y         .691   34.381   73.899  147.611  354.731  612.949  760.9751050.4141656.502
 QX        .000     .001     .004     .028    -.022     .000     .000     .000     .000
 QY       -.001    -.004    -.006    -.008    -.005    -.001     .001     .000     .000
 LONGSHORE STATION   25
 Y         .740   34.559   74.254  148.171  357.355  617.401  760.9831050.4141656.502
 QX        .000     .000     .002     .017    -.014     .000     .000     .000     .000
 QY       -.001    -.004    -.007    -.009    -.005    -.001     .001     .000     .000
 LONGSHORE STATION   26
 Y         .756   34.618   74.371  148.354  358.244  618.923  760.9851050.4141656.502
 QX        .000     .000     .001     .005    -.005     .000     .000     .000     .000
 QY       -.001    -.004    -.007    -.009    -.005    -.001     .001     .000     .000
 LONGSHORE STATION   27
 Y         .738   34.552   74.238  148.143  357.349  617.401  760.9831050.4141656.502
```
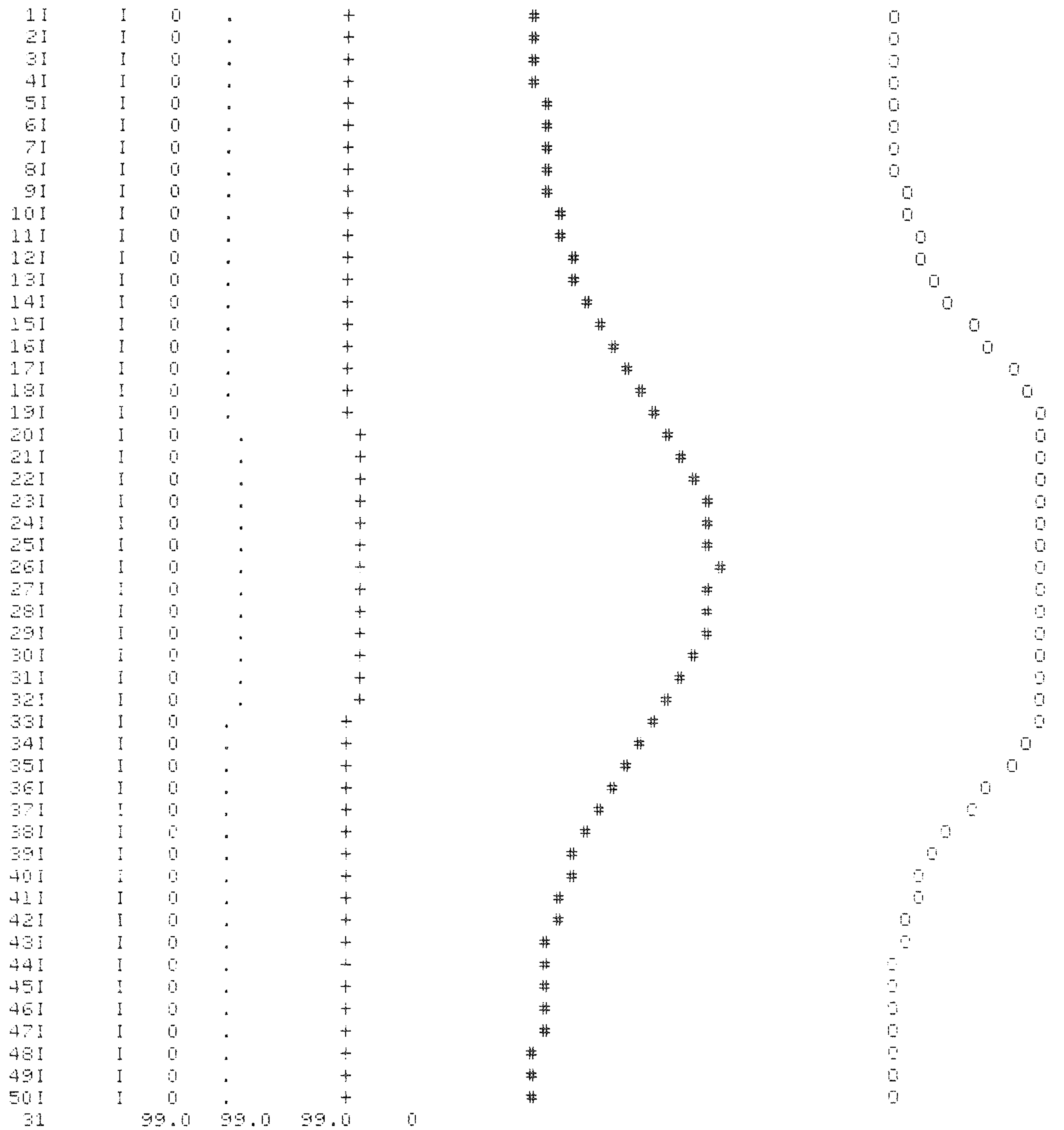

QX	.000	.000	-.001	-.007	.004	.000	.000	.000	.000
QY	-.001	-.004	-.007	-.008	-.005	-.001	.001	.000	.000
LONGSHORE STATION 28									
Y	.688	34.368	73.868	147.556	354.720	612.949	760.975	1050.414	1656.502
QX	.000	.000	-.002	-.018	.013	.000	.000	.000	.000
QY	-.001	-.004	-.006	-.008	-.005	-.001	.001	.000	.000
LONGSHORE STATION 29									
Y	.610	34.082	73.293	146.642	350.497	605.882	760.963	1050.414	1656.502
QX	.000	.000	-.004	-.029	.022	.000	.000	.000	.000
QY	-.001	-.004	-.006	-.007	-.004	-.001	.001	.000	.000
LONGSHORE STATION 30									
Y	.514	33.720	72.559	145.470	344.893	596.661	760.948	1050.414	1656.502
QX	.000	-.001	-.005	-.039	.029	.000	.000	.000	.000
QY	-.001	-.003	-.005	-.006	-.004	-.001	.000	.000	.000
LONGSHORE STATION 31									
Y	.406	33.309	71.719	144.120	338.170	585.807	760.929	1050.414	1656.502
QX	.000	-.001	-.006	-.048	.035	.000	.000	.000	.000
QY	-.001	-.003	-.004	-.005	-.004	-.001	.000	.000	.000
LONGSHORE STATION 32									
Y	.294	32.875	70.824	142.671	330.614	573.839	760.909	1050.414	1656.502
QX	.000	-.001	-.007	-.055	.040	.000	.000	.000	.000
QY	-.001	-.002	-.003	-.004	-.004	-.001	.000	.000	.000
LONGSHORE STATION 33									
Y	.183	32.442	69.921	141.196	322.514	561.226	760.888	1050.414	1656.502
QX	.000	-.001	-.007	-.061	.043	.000	.000	.000	.000
QY	.000	-.001	-.002	-.003	-.003	.000	.000	.000	.000
LONGSHORE STATION 34									
Y	.078	32.025	69.047	139.757	314.149	548.379	760.866	1050.414	1656.502
QX	.000	-.001	-.008	-.065	.044	.000	.000	.000	.000
QY	.000	-.001	-.001	-.002	-.003	.000	.000	.000	.000
LONGSHORE STATION 35									
Y	-.018	31.640	68.232	138.406	305.777	535.653	760.845	1050.414	1656.502
QX	.000	-.001	-.008	-.067	.045	.000	.000	.000	.000
QY	.000	.000	.000	-.001	-.003	.000	.000	.000	.000
LONGSHORE STATION 36									
Y	-.103	31.296	67.504	137.188	297.636	523.384	760.824	1050.414	1656.502
QX	.000	-.001	-.008	-.067	.044	.000	.000	.000	.000
QY	.000	.000	.000	.000	-.002	.000	.000	.000	.000
LONGSHORE STATION 37									
Y	-.175	31.006	66.883	136.141	289.335	511.993	760.805	1050.414	1656.502
QX	.000	-.001	-.008	-.066	.041	.000	.000	.000	.000
QY	.000	.001	.001	.001	-.002	.000	.000	.000	.000
LONGSHORE STATION 38									
Y	-.232	30.777	66.390	135.296	282.854	501.438	760.787	1050.414	1656.502
QX	.000	-.001	-.007	-.064	.038	.000	.000	.000	.000
QY	.000	.001	.002	.002	-.002	.000	.000	.000	.000
LONGSHORE STATION 39									
Y	-.271	30.616	66.037	134.675	276.531	492.292	760.772	1050.414	1656.502
QX	.000	-.001	-.007	-.060	.034	.000	.000	.000	.000
QY	.000	.001	.002	.002	-.001	.000	.000	.000	.000
LONGSHORE STATION 40									
Y	-.291	30.527	65.829	134.287	271.058	484.609	760.759	1050.414	1656.502
QX	.000	-.001	-.006	-.056	.030	.000	.000	.000	.000
QY	.000	.002	.002	.002	-.001	.000	.000	.000	.000
LONGSHORE STATION 41									

Y	-.292	30.506	65.763	134.127	266.472	478.447	760.749	1050.414	1656.502
QX	.000	-.001	-.005	-.051	.026	.000	.000	.000	.000
QY	.000	.002	.002	.003	-.001	.000	.000	.000	.000
LONGSHORE STATION		42							
Y	-.277	30.548	65.824	134.173	262.760	473.751	760.741	1050.414	1656.502
QX	.000	.000	-.005	-.045	.021	.000	.000	.000	.000
QY	.000	.002	.002	.003	-.001	.000	.000	.000	.000
LONGSHORE STATION		43							
Y	-.249	30.640	65.989	134.393	259.858	470.365	760.735	1050.414	1656.502
QX	.000	.000	-.004	-.040	.017	.000	.000	.000	.000
QY	.000	.001	.002	.003	.000	.000	.000	.000	.000
LONGSHORE STATION		44							
Y	-.213	30.767	66.230	134.744	257.670	468.063	760.731	1050.414	1656.502
QX	.000	.000	-.003	-.035	.013	.000	.000	.000	.000
QY	.000	.001	.002	.002	.000	.000	.000	.000	.000
LONGSHORE STATION		45							
Y	-.173	30.914	66.519	135.183	256.076	466.594	760.729	1050.414	1656.502
QX	.000	.000	-.003	-.030	.010	.000	.000	.000	.000
QY	.000	.001	.002	.002	.000	.000	.000	.000	.000
LONGSHORE STATION		46							
Y	-.132	31.066	66.830	135.673	254.952	465.715	760.727	1050.414	1656.502
QX	.000	.000	-.002	-.026	.007	.000	.000	.000	.000
QY	.000	.001	.001	.002	.000	.000	.000	.000	.000
LONGSHORE STATION		47							
Y	-.094	31.216	67.144	136.183	254.180	465.224	760.727	1050.414	1656.502
QX	.000	.000	-.002	-.022	.005	.000	.000	.000	.000
QY	.000	.001	.001	.001	.000	.000	.000	.000	.000
LONGSHORE STATION		48							
Y	-.060	31.359	67.452	136.695	253.654	464.966	760.726	1050.414	1656.502
QX	.000	.000	-.001	-.020	.004	.000	.000	.000	.000
QY	.000	.000	.001	.001	.000	.000	.000	.000	.000
LONGSHORE STATION		49							
Y	-.029	31.493	67.750	137.202	253.281	464.835	760.726	1050.414	1656.502
QX	.000	.000	-.001	-.018	.003	.000	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000
LONGSHORE STATION		50							
Y	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414	1656.502
QX	.000	.000	-.001	-.017	.002	.000	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000



EXAMPLE 4 - INPUT

```
      50         8
            10.000
  1.000    2.000    3.000    5.000    7.000   11.000   14.000   17.000   25.000   32.808
   .000     .000     .000     .000     .000     .000     .000     .000     .000     .000
      30
              5.000      .0500       .220
1
3        .000
   .1500
 100.000 21600.000
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
    .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
   1
                   25          31     250.00      250.00
   1        5.0    8.0   30.0     0
   2        5.0    8.0   30.0     0
   3        5.0    8.0   30.0     0
   4        5.0    8.0   30.0     0
   5        5.0    8.0   30.0     0
   6        5.0    8.0   30.0     0
   7        5.0    8.0   30.0     0
   8        5.0    8.0   30.0     0
   9        5.0    8.0   30.0     0
  10        5.0    8.0   30.0     0
  11        5.0    8.0   30.0     0
  12        5.0    8.0   30.0     0
  13        5.0    8.0   30.0     0
  14        5.0    8.0   30.0     0
  15        5.0    8.0   30.0     0
  16        5.0    8.0   30.0     0
  17        5.0    8.0   30.0     0
  18        5.0    8.0   30.0     0
  19        5.0    8.0   30.0     0
  20        5.0    8.0   30.0     0
  21        5.0    8.0   30.0     0
  22        5.0    8.0   30.0     0
  23        5.0    8.0   30.0     0
  24        5.0    8.0   30.0     0
  25        5.0    8.0   30.0     0
  26        5.0    8.0   30.0     0
  27        5.0    8.0   30.0     0
  28        5.0    8.0   30.0     0
  29        5.0    8.0   30.0     0
  30        5.0    8.0   30.0     0
  31       99.0   99.0   99.0     0
```

EXAMPLE 4 - SPOOL: NONE

EXAMPLE 4 - OUTPUT

```
*******************************************************
  THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH=      32.808
*******************************************************
  THE HEIGHT OF THE BERM, BERM=        5.000
  THE SLOPE OF THE BEACH FACE, SFACE=        .0500
  THE SEDIMENT DIAMETER, DIAM=        .220
*******************************************************
  THE LENGTH OF THE STRUCTURE, SJETTY=        .000
  THE NUMBER    1 GROIN IS LOCATED AT GRID    3
*******************************************************
  THE VALUE OF ADEAN=      .1500  IN THE EQ. H=AY**2/3
*******************************************************
  THE VALUE OF THE LONGSHORE SPACE-STEP, DX=     100.000
  THE TIME-STEP IN SECONDS, DELT=  21600.000
*******************************************************
   THE INITIAL SHORELINE COORDINATES :
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
     .00      .00      .00      .00      .00      .00      .00      .00      .00      .00
*******************************************************
  THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS

     .00    31.62    68.04   137.71   252.98   464.76   760.73 1050.41 1656.50 2674.85
     .00    31.62    68.04   137.71   252.98   464.76   760.73 1050.41 1656.50 2674.85
*******************************************************
  THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS
    1.00     2.00     3.00     5.00     7.00    11.00    14.00    17.00    25.00    32.81
*******************************************************
*******************************************************
 BREAKWATER  LEFT LOC  RIGHT LOC  LEFT Y VALUE  RIGHT Y VALUE
     1          25        31          250.00        250.00
*******************************************************
    1         5.0   8.0   30.0     0
    2         5.0   8.0   30.0     0
    3         5.0   8.0   30.0     0
    4         5.0   8.0   30.0     0
    5         5.0   8.0   30.0     0
    6         5.0   8.0   30.0     0
    7         5.0   8.0   30.0     0
    8         5.0   8.0   30.0     0
    9         5.0   8.0   30.0     0
   10         5.0   8.0   30.0     0
   11         5.0   8.0   30.0     0
   12         5.0   8.0   30.0     0
   13         5.0   8.0   30.0     0
   14         5.0   8.0   30.0     0
   15         5.0   8.0   30.0     0
   16         5.0   8.0   30.0     0
   17         5.0   8.0   30.0     0
   18         5.0   8.0   30.0     0
   19         5.0   8.0   30.0     0
   20         5.0   8.0   30.0     0
   21         5.0   8.0   30.0     0
```

```
   22         5.0    8.0   30.0     0
   23         5.0    8.0   30.0     0
   24         5.0    8.0   30.0     0
   25         5.0    8.0   30.0     0
   26         5.0    8.0   30.0     0
   27         5.0    8.0   30.0     0
   28         5.0    8.0   30.0     0
   29         5.0    8.0   30.0     0
   30         5.0    8.0   30.0     0
 THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV=     30

LONGSHORE STATION     1
Y          .000  31.623   68.041 137.706 252.982 464.758 760.7261050.4141656.502
QX         .001    .025     .146   1.443   2.257    .518    .000    .000    .000
QY         .000    .000     .000    .000    .000    .000    .000    .000    .000
LONGSHORE STATION     2
Y          .106  32.027   68.786 138.894 254.313 464.803 760.7261050.4141656.502
QX         .001    .025     .146   1.443   2.257    .518    .000    .000    .000
QY         .000    .000     .000    .000    .000    .000    .000    .000    .000
LONGSHORE STATION     3
Y          .181  32.279   69.317 139.853 255.564 464.826 760.7261050.4141656.502
QX         .001    .024     .144   1.432   2.251    .517    .000    .000    .000
QY         .000    .000    -.001   -.001    .000    .000    .000    .000    .000
LONGSHORE STATION     4
Y          .230  32.431   69.714 140.692 256.782 464.833 760.7261050.4141656.502
QX         .001    .024     .144   1.431   2.250    .517    .000    .000    .000
QY         .000   -.001    -.001   -.001    .000    .000    .000    .000    .000
LONGSHORE STATION     5
Y          .268  32.576   70.112 141.561 258.028 464.829 760.7261050.4141656.502
QX         .001    .024     .144   1.427   2.247    .517    .000    .000    .000
QY         .000   -.001    -.001   -.002    .000    .000    .000    .000    .000
LONGSHORE STATION     6
Y          .306  32.742   70.555 142.511 259.323 464.805 760.7261050.4141656.502
QX         .001    .024     .143   1.422   2.243    .517    .000    .000    .000
QY         .000   -.001    -.001   -.002    .000    .000    .000    .000    .000
LONGSHORE STATION     7
Y          .349  32.941   71.067 143.569 260.680 464.751 760.7261050.4141656.502
QX         .001    .024     .142   1.415   2.237    .518    .000    .000    .000
QY         .000   -.001    -.002   -.003    .000    .000    .000    .000    .000
LONGSHORE STATION     8
Y          .402  33.181   71.665 144.759 262.111 464.647 760.7261050.4141656.502
QX         .001    .023     .142   1.406   2.231    .518    .000    .000    .000
QY         .000   -.001    -.002   -.003    .000    .000    .000    .000    .000
LONGSHORE STATION     9
Y          .468  33.471   72.364 146.106 263.625 464.466 760.7251050.4141656.502
QX         .001    .023     .141   1.396   2.224    .519    .000    .000    .000
QY         .000   -.001    -.002   -.004    .000    .000    .000    .000    .000
LONGSHORE STATION    10
Y          .550  33.820   73.181 147.629 265.228 464.165 760.7241050.4141656.502
QX         .001    .023     .140   1.384   2.215    .521    .000    .000    .000
QY        -.001   -.002    -.003   -.005    .000    .000    .000    .000    .000
LONGSHORE STATION    11
Y          .652  34.238   74.134 149.348 266.925 463.687 760.7211050.4141656.502
QX         .000    .023     .139   1.370   2.206    .523    .000    .000    .000
QY        -.001   -.002    -.003   -.005    .000    .001    .000    .000    .000
```

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LONGSHORE STATION   12
Y         .777  34.735  75.240 151.279 268.717 462.951 760.7151050.4141656.502
QX        .000    .023    .138   1.355   2.196    .526    .000    .000    .000
QY       -.001   -.002   -.004   -.006    .000    .001    .000    .000    .000
LONGSHORE STATION   13
Y         .928  35.321  76.513 153.435 270.600 461.850 760.7031050.4141656.502
QX        .000    .023    .136   1.338   2.184    .531    .000    .000    .000
QY       -.001   -.003   -.005   -.007    .000    .001    .000    .000    .000
LONGSHORE STATION   14
Y        1.107  36.007  77.968 155.819 272.564 460.244 760.6771050.4141656.502
QX        .000    .022    .135   1.319   2.172    .537    .000    .000    .000
QY       -.001   -.003   -.005   -.008    .000    .001    .000    .000    .000
LONGSHORE STATION   15
Y        1.314  36.800  79.614 158.431 274.589 457.956 760.6261050.4141656.502
QX        .000    .022    .133   1.298   2.159    .546    .000    .000    .000
QY       -.001   -.004   -.006   -.009    .000    .001    .000    .000    .000
LONGSHORE STATION   16
Y        1.552  37.710  81.458 161.259 276.641 454.765 760.5271050.4141656.502
QX        .000    .022    .130   1.276   2.146    .557    .000    .000    .000
QY       -.001   -.004   -.007   -.010    .000    .001    .000    .000    .000
LONGSHORE STATION   17
Y        1.826  38.739  83.497 164.281 278.669 450.407 760.3471050.4131656.502
QX        .000    .021    .128   1.252   2.132    .572    .000    .000    .000
QY       -.002   -.005   -.008   -.011    .000    .001    .000    .000    .000
LONGSHORE STATION   18
Y        2.144  39.889  85.722 167.463 280.598 444.563 760.0381050.4121656.502
QX       -.001    .021    .124   1.226   2.119    .590    .000    .000    .000
QY       -.002   -.006   -.009   -.012    .000    .002    .000    .000    .000
LONGSHORE STATION   19
Y        2.508  41.151  88.107 170.756 282.325 436.359 759.5371050.4101656.502
QX       -.001    .020    .120   1.198   2.108    .612    .000    .000    .000
QY       -.002   -.007   -.010   -.013    .000    .002    .000    .000    .000
LONGSHORE STATION   20
Y        2.926  42.512  90.620 174.093 283.737 426.874 758.7741050.4081656.502
QX       -.001    .019    .116   1.168   2.100    .638    .000    .000    .000
QY       -.003   -.008   -.012   -.014    .000    .002    .000    .000    .000
LONGSHORE STATION   21
Y        3.416  43.974  93.230 177.367 284.748 414.217 757.6821050.4041656.502
QX       -.001    .018    .111   1.136   2.098    .667    .000    .000    .000
QY       -.003   -.009   -.013   -.014    .000    .003    .000    .000    .000
LONGSHORE STATION   22
Y        4.015  45.637  96.037 180.581 285.335 398.718 756.2171050.3991656.502
QX       -.001    .017    .104   1.094   2.101    .696    .000    .000    .000
QY       -.002   -.010   -.014   -.015    .001    .004   -.001    .000    .000
LONGSHORE STATION   23
Y        4.768  47.842  99.405 183.502 285.625 380.537 754.3681050.3931656.502
QX       -.001    .016    .098   1.077   2.101    .720    .000    .000    .000
QY       -.004   -.011   -.015   -.014    .001    .004   -.001    .000    .000
LONGSHORE STATION   24
Y        5.691  51.416 105.304 199.464 286.199 359.090 752.1451050.3861656.502
QX       -.001    .016    .085    .888   2.091    .748    .000    .000    .000
QY       -.004   -.014   -.017   -.014    .001    .005   -.001    .000    .000
LONGSHORE STATION   25
Y        6.683  56.566 116.475 207.211 288.663 345.993 749.6121050.3791656.502
QX       -.001    .020    .099   1.026   2.058    .667    .000    .000    .000
```

QY	-.004	-.018	-.023	-.021	.035	.005	-.001	.000	.000
LONGSHORE STATION 26									
Y	7.413	61.916	132.515	239.425	295.163	353.884	747.046	1050.371	1656.502
QX	.000	.016	.098	1.099	2.071	1.686	.002	.000	.000
QY	-.004	-.023	-.034	-.038	.064	.005	-.001	.000	.000
LONGSHORE STATION 27									
Y	7.339	64.567	144.727	268.898	307.970	371.959	745.337	1050.362	1656.502
QX	.001	.017	.104	1.058	1.930	1.286	.010	.000	.000
QY	-.004	-.025	-.044	-.055	.089	.005	-.001	.000	.000
LONGSHORE STATION 28									
Y	5.944	60.276	137.822	267.488	321.795	390.866	746.433	1050.353	1656.502
QX	.001	.012	.048	.680	1.900	1.464	.029	.000	.000
QY	-.003	-.023	-.041	-.060	.084	.005	-.001	.000	.000
LONGSHORE STATION 29									
Y	3.142	47.249	106.166	217.554	309.133	410.420	752.741	1050.358	1656.502
QX	.001	.002	-.016	.289	1.264	1.642	.064	.000	.000
QY	-.001	-.012	-.022	-.042	.043	.090	.000	.000	.000
LONGSHORE STATION 30									
Y	-.513	29.080	61.607	131.945	245.105	434.627	766.212	1050.406	1656.502
QX	.000	-.002	-.026	-.103	-.589	1.281	.106	.000	.000
QY	.000	.002	.004	-.001	.000	.024	.000	.000	.000
LONGSHORE STATION 31									
Y	-4.065	12.297	23.150	56.465	164.924	435.037	779.138	1050.477	1656.502
QX	.000	.001	-.001	-.001	-.817	4.485	.202	.001	.000
QY	.002	.015	.025	.036	-.015	-.037	.000	.000	.000
LONGSHORE STATION 32									
Y	-6.652	1.648	3.467	22.570	128.338	401.543	780.608	1050.502	1656.502
QX	.001	.013	.053	.467	.969	.474	.000	.000	.000
QY	.003	.023	.037	.050	-.011	-.002	-.001	.000	.000
LONGSHORE STATION 33									
Y	-7.940	-1.650	.169	20.441	134.104	389.172	775.221	1050.484	1656.502
QX	.002	.024	.099	.767	2.518	1.075	.001	.000	.000
QY	.004	.025	.038	.049	-.010	-.001	-.001	.000	.000
LONGSHORE STATION 34									
Y	-8.135	.364	3.653	29.657	147.888	398.639	770.472	1050.461	1656.502
QX	.002	.025	.106	.741	2.138	1.669	.001	.000	.000
QY	.005	.023	.033	.044	-.008	-.001	-.001	.000	.000
LONGSHORE STATION 35									
Y	-7.624	3.338	9.982	40.649	157.946	404.660	766.888	1050.444	1656.502
QX	.002	.025	.106	.770	2.288	1.964	.001	.000	.000
QY	.005	.020	.030	.039	-.004	-.001	-.001	.000	.000
LONGSHORE STATION 36									
Y	-6.772	6.760	16.755	51.416	165.954	411.187	764.388	1050.432	1656.502
QX	.002	.026	.108	.835	2.393	1.933	.001	.000	.000
QY	.005	.018	.026	.035	.000	-.001	.000	.000	.000
LONGSHORE STATION 37									
Y	-5.775	10.186	23.347	61.550	173.190	417.395	762.747	1050.424	1656.502
QX	.002	.025	.110	.883	2.444	2.042	.001	.000	.000
QY	.005	.015	.023	.032	.004	-.001	.000	.000	.000
LONGSHORE STATION 38									
Y	-4.788	13.398	29.458	70.887	180.111	423.202	761.742	1050.420	1656.502
QX	.002	.025	.112	.928	2.466	2.083	.001	.000	.000
QY	.004	.013	.020	.028	.007	-.001	.000	.000	.000
LONGSHORE STATION 39									
Y	-3.886	16.303	35.005	79.450	186.849	428.619	761.172	1050.417	1656.502

QX	.002	.025	.114	.969	2.475	2.123	.001	.000	.000
QY	.004	.011	.018	.025	.009	-.001	.000	.000	.000
LONGSHORE STATION 40									
Y	-3.103	18.873	39.981	87.288	193.457	433.634	760.877	1050.416	1656.502
QX	.002	.025	.116	1.007	2.482	2.161	.001	.000	.000
QY	.003	.009	.015	.022	.010	-.001	.000	.000	.000
LONGSHORE STATION 41									
Y	-2.443	21.115	44.412	94.443	199.963	438.240	760.740	1050.415	1656.502
QX	.002	.025	.117	1.041	2.493	2.198	.001	.000	.000
QY	.003	.008	.013	.019	.010	-.001	.000	.000	.000
LONGSHORE STATION 42									
Y	-1.898	23.055	48.343	100.957	206.366	442.428	760.686	1050.415	1656.502
QX	.002	.025	.119	1.071	2.508	2.231	.001	.000	.000
QY	.002	.007	.011	.017	.010	-.001	.000	.000	.000
LONGSHORE STATION 43									
Y	-1.454	24.728	51.828	106.886	212.644	446.208	760.673	1050.414	1656.502
QX	.002	.025	.120	1.095	2.528	2.261	.001	.000	.000
QY	.002	.005	.009	.014	.010	-.001	.000	.000	.000
LONGSHORE STATION 44									
Y	-1.092	26.171	54.925	112.297	218.771	449.608	760.676	1050.414	1656.502
QX	.002	.024	.120	1.116	2.549	2.287	.001	.000	.000
QY	.002	.004	.008	.012	.009	-.001	.000	.000	.000
LONGSHORE STATION 45									
Y	-.739	27.419	57.690	117.265	224.735	452.665	760.684	1050.414	1656.502
QX	.002	.024	.121	1.133	2.569	2.308	.001	.000	.000
QY	.001	.003	.006	.010	.008	-.001	.000	.000	.000
LONGSHORE STATION 46									
Y	-.562	28.509	60.182	121.862	230.537	455.428	760.693	1050.414	1656.502
QX	.002	.024	.121	1.146	2.589	2.326	.001	.000	.000
QY	.001	.002	.005	.008	.007	.000	.000	.000	.000
LONGSHORE STATION 47									
Y	-.370	29.472	62.456	126.165	236.194	457.946	760.702	1050.414	1656.502
QX	.002	.024	.121	1.156	2.605	2.341	.001	.000	.000
QY	.001	.002	.003	.006	.005	.000	.000	.000	.000
LONGSHORE STATION 48									
Y	-.217	30.329	64.555	130.241	241.740	460.272	760.709	1050.414	1656.502
QX	.002	.024	.122	1.163	2.618	2.352	.001	.000	.000
QY	.000	.001	.002	.004	.004	.000	.000	.000	.000
LONGSHORE STATION 49									
Y	-.098	31.049	66.426	134.087	247.300	462.505	760.717	1050.414	1656.502
QX	.002	.024	.122	1.169	2.624	2.357	.001	.000	.000
QY	.000	.000	.001	.002	.002	.000	.000	.000	.000
LONGSHORE STATION 50									
Y	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414	1656.502
QX	.002	.023	.120	1.166	2.639	2.365	.001	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000

```
 1I     I   0   .        +             #                          0
 2I     I   0   .        +              #                         0
 3I     I   0   .        +              #                         0
 4I     I   0   .        +              #                         0
 5I     I   0    .       +              #                         0
 6I     I   0    .        +             #                         0
 7I     I   0    .        +             #                         0
 8I     I   0    .        +              #                        0
 9I     I   0    .        +              #                        0
10I     I   0    .        +              #                        0
11I     I   0    .        +              #                        0
12I     I   0    .         +             #                        0
13I     I   0    .         +              #                      0
14I     I   0    .         +              #                      0
15I     I   0     .         +             #                      0
16I     I   0     .         +             #                      0
17I     I    0    .         +              #                    0
18I     I    0    .          +             #                   0
19I     I    0     .         +             #                  0
20I     I    0     .          +            #                 0
21I     I    0     .          +            #                0
22I     I    0      .         +            #              0
23I     I     0     .          +           #           0
24I     I     0      .         +            #        0
25I     I*     0      .           +    H    #      0
26I     I*     0        .             +H     #      0
27I     I*      0         .            H +    #       0
28I     I      0         .             H +      =        0
29I     I     0      .             +   H      #            0
30I     I  0   .        +             #H                      0
31I    *I0 .   +            #          H                      0
32I    *I  +            #                                 0
33I    *I +              #                              0
34I    *I  +              #                               0
35I    *I.   +             #                              0
36I    *I0.   +             #                              0
37I    *I0 .   +             #                              0
38I    *I0 .     +            #                              0
39I    *I 0 .     +            #                             0
40I    *I 0  .     +            #                             0
41I    *I 0  .      +            #                             0
42I     I  0  .     +             #                            0
43I     I  0  .      +            #                             0
44I     I  0   .      +            #                            0
45I     I  0   .      +             #                           0
46I     I  0   .       +             #                           0
47I     I  0    .       +            #                           0
48I     I   0   .       +             #                          0
49I     I   0   .        +             #                          0
50I     I   0   .        +             #                          0
 31       99.0  99.0  99.0    0
```

EXAMPLE 5 - INPUT

```
       50          8
              10.000
   1.000   2.000   3.000   5.000   7.000  11.000  14.000  17.000  25.000  32.808
    .000    .000    .000    .000    .000    .000    .000    .000    .000    .000
       30
               5.000      .0500      .220
 1
33   250.000
   .1500
  100.000 21600.000
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
   2
                 18        22   300.00    300.00
                 24        28   300.00    300.00
   1        4.0   6.0  25.0    0
   2        4.0   6.0  25.0    0
   3        4.0   6.0  25.0    0
   4        4.0   6.0  25.0    0
   5        4.0   6.0  25.0    0
   6        4.0   6.0  25.0    0
   7        4.0   6.0  25.0    0
   8        4.0   6.0  25.0    0
   9        4.0   6.0  25.0    0
  10        4.0   6.0  25.0    0
  11        4.0   6.0  25.0    0
  12        4.0   6.0  25.0    0
  13        4.0   6.0  25.0    0
  14        4.0   6.0  25.0    0
  15        4.0   6.0  25.0    0
  16        4.0   6.0  25.0    0
  17        4.0   6.0  25.0    0
  18        4.0   6.0  25.0    0
  19        4.0   6.0  25.0    0
  20        4.0   6.0  25.0    0
  21        4.0   6.0  25.0    0
  22        4.0   6.0  25.0    0
  23        4.0   6.0  25.0    0
  24        4.0   6.0  25.0    0
  25        4.0   6.0  25.0    0
  26        4.0   6.0  25.0    0
  27        4.0   6.0  25.0    0
  28        4.0   6.0  25.0    0
  29        4.0   6.0  25.0    0
  30        4.0   6.0  25.0    0
  31       99.0  99.0  99.0    0
```

EXAMPLE 5 - SPOOL: NONE

EXAMPLE 5 - OUTPUT

```
*******************************************************
  THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH=     32.808
*******************************************************
  THE HEIGHT OF THE BERM, BERM=      5.000
  THE SLOPE OF THE BEACH FACE, SFACE=       .0500
  THE SEDIMENT DIAMETER, DIAM=       .220
*******************************************************
  THE LENGTH OF THE STRUCTURE, SJETTY=    250.000
  THE NUMBER    1 GROIN IS LOCATED AT GRID   33
*******************************************************
  THE VALUE OF ADEAN=       .1500  IN THE EQ. H=AY**2/3
*******************************************************
  THE VALUE OF THE LONGSHORE SPACE-STEP, DX=    100.000
  THE TIME-STEP IN SECONDS, DELT=  21600.000
*******************************************************
   THE INITIAL SHORELINE COORDINATES :
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
     .00     .00     .00     .00     .00     .00     .00     .00     .00     .00
*******************************************************
  THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS

     .00   31.62   68.04  137.71  252.98  464.76  760.73 1050.41 1656.50 2674.85
     .00   31.62   68.04  137.71  252.98  464.76  760.73 1050.41 1656.50 2674.85
*******************************************************
  THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS
    1.00    2.00    3.00    5.00    7.00   11.00   14.00   17.00   25.00   32.81
*******************************************************
*******************************************************
 BREAKWATER  LEFT LOC  RIGHT LOC  LEFT Y VALUE  RIGHT Y VALUE
      1         18        22          300.00         300.00
      2         24        28          300.00         300.00
*******************************************************
    1         4.0   6.0  25.0     0
    2         4.0   6.0  25.0     0
    3         4.0   6.0  25.0     0
    4         4.0   6.0  25.0     0
    5         4.0   6.0  25.0     0
    6         4.0   6.0  25.0     0
    7         4.0   6.0  25.0     0
    8         4.0   6.0  25.0     0
    9         4.0   6.0  25.0     0
   10         4.0   6.0  25.0     0
   11         4.0   6.0  25.0     0
   12         4.0   6.0  25.0     0
   13         4.0   6.0  25.0     0
   14         4.0   6.0  25.0     0
   15         4.0   6.0  25.0     0
   16         4.0   6.0  25.0     0
   17         4.0   6.0  25.0     0
   18         4.0   6.0  25.0     0
   19         4.0   6.0  25.0     0
   20         4.0   6.0  25.0     0
```

```
   21         4.0    6.0   25.0      0
   22         4.0    6.0   25.0      0
   23         4.0    6.0   25.0      0
   24         4.0    6.0   25.0      0
   25         4.0    6.0   25.0      0
   26         4.0    6.0   25.0      0
   27         4.0    6.0   25.0      0
   28         4.0    6.0   25.0      0
   29         4.0    6.0   25.0      0
   30         4.0    6.0   25.0      0
 THE TOTAL ELAPSED NUMBER OF TIME-STEPS, NUNIV=     30

LONGSHORE STATION     1
Y          .000  31.623  68.041 137.706 252.982 464.758 760.7261050.4141656.502
QX         .001    .029    .154   1.173   1.178    .089    .000    .000    .000
QY         .000    .000    .000    .000    .000    .000    .000    .000    .000
LONGSHORE STATION     2
Y          .365  33.172  71.497 143.456 257.058 464.852 760.7251050.4141656.502
QX         .001    .029    .154   1.173   1.178    .089    .000    .000    .000
QY         .000   -.001   -.002   -.002    .000    .000    .000    .000    .000
LONGSHORE STATION     3
Y          .704  34.570  74.537 148.621 260.890 464.894 760.7241050.4141656.502
QX         .001    .028    .150   1.144   1.170    .088    .000    .000    .000
QY        -.001   -.002   -.003   -.004    .000    .000    .000    .000    .000
LONGSHORE STATION     4
Y         1.027  35.871  77.355 153.501 264.551 464.853 760.7221050.4141656.502
QX         .001    .027    .148   1.140   1.166    .087    .000    .000    .000
QY        -.001   -.003   -.005   -.006    .000    .000    .000    .000    .000
LONGSHORE STATION     5
Y         1.361  37.203  80.256 158.493 268.204 464.740 760.7141050.4141656.502
QX         .001    .027    .146   1.127   1.162    .087    .000    .000    .000
QY        -.001   -.004   -.007   -.009    .000    .000    .000    .000    .000
LONGSHORE STATION     6
Y         1.730  38.654  83.365 163.713 271.920 464.553 760.6961050.4141656.502
QX         .001    .027    .144   1.108   1.155    .087    .000    .000    .000
QY        -.002   -.005   -.008   -.011    .000    .000    .000    .000    .000
LONGSHORE STATION     7
Y         2.158  40.280  86.749 169.224 275.722 464.250 760.6541050.4141656.502
QX         .001    .026    .141   1.086   1.147    .088    .000    .000    .000
QY        -.002   -.006   -.010   -.013    .000    .000    .000    .000    .000
LONGSHORE STATION     8
Y         2.664  42.119  90.455 175.068 279.613 463.751 760.5681050.4131656.502
QX         .001    .026    .138   1.060   1.139    .088    .000    .000    .000
QY        -.003   -.008   -.012   -.015    .000    .000    .000    .000    .000
LONGSHORE STATION     9
Y         3.266  44.196  94.512 181.269 283.570 462.938 760.4031050.4111656.502
QX         .001    .025    .135   1.030   1.129    .089    .000    .000    .000
QY        -.003   -.009   -.014   -.017    .001    .000    .000    .000    .000
LONGSHORE STATION    10
Y         3.976  46.528  98.934 187.828 287.549 461.644 760.1111050.4071656.502
QX         .001    .025    .130    .997   1.118    .091    .000    .000    .000
QY        -.004   -.011   -.016   -.019    .001    .000    .000    .000    .000
LONGSHORE STATION    11
Y         4.801  49.118 103.725 194.728 291.478 459.644 759.6331050.4021656.502
QX         .001    .024    .126    .960   1.106    .093    .000    .000    .000
```

QY	-.004	-.012	-.018	-.021	.001	.001	.000	.000	.000
LONGSHORE STATION 12									
Y	5.735	51.962	108.889	201.942	295.305	456.657	758.904	1050.394	1656.502
QX	.000	.023	.120	.921	1.092	.096	.000	.000	.000
QY	-.005	-.014	-.020	-.023	.001	.001	.000	.000	.000
LONGSHORE STATION 13									
Y	6.753	55.044	114.432	209.441	299.136	452.370	757.868	1050.382	1656.502
QX	.000	.023	.114	.878	1.077	.099	.000	.000	.000
QY	-.005	-.016	-.023	-.025	.001	.001	.000	.000	.000
LONGSHORE STATION 14									
Y	7.798	58.341	120.377	217.175	303.170	446.464	756.494	1050.364	1656.502
QX	.000	.022	.108	.835	1.069	.103	.000	.000	.000
QY	-.005	-.019	-.025	-.027	.001	.001	.000	.000	.000
LONGSHORE STATION 15									
Y	8.779	61.831	126.808	225.173	307.402	438.645	754.784	1050.338	1656.502
QX	.000	.021	.100	.784	1.060	.107	.000	.000	.000
QY	-.006	-.021	-.028	-.029	.001	.001	.000	.000	.000
LONGSHORE STATION 16									
Y	9.545	65.417	133.962	233.187	311.671	428.661	752.782	1050.299	1656.502
QX	-.001	.020	.091	.755	1.044	.110	.000	.000	.000
QY	-.006	-.024	-.032	-.030	.001	.001	.000	.000	.000
LONGSHORE STATION 17									
Y	9.861	68.520	141.773	244.203	316.401	416.289	750.574	1050.238	1656.502
QX	-.001	.019	.083	.561	1.018	.112	.000	.000	.000
QY	-.006	-.027	-.037	-.033	.002	.001	.000	.000	.000
LONGSHORE STATION 18									
Y	9.469	68.799	145.363	257.194	321.232	412.130	748.458	1050.146	1656.502
QX	-.001	.017	.087	.955	1.063	.094	.000	.000	.000
QY	-.006	-.027	-.040	-.042	.051	.002	.000	.000	.000
LONGSHORE STATION 19									
Y	8.248	64.018	137.809	259.368	324.837	426.288	746.846	1050.015	1656.502
QX	.000	.002	.011	.502	1.028	.749	.006	.000	.000
QY	-.005	-.024	-.037	-.052	.049	.002	.000	.000	.000
LONGSHORE STATION 20									
Y	6.343	55.264	119.345	237.038	325.574	447.954	745.892	1049.841	1656.502
QX	.000	.000	-.007	.307	1.121	.449	.012	.000	.000
QY	-.004	-.017	-.027	-.048	.026	.001	.000	.000	.000
LONGSHORE STATION 21									
Y	4.152	45.145	95.621	191.412	319.149	470.835	745.663	1049.636	1656.502
QX	.000	-.001	-.013	-.075	1.067	.430	.023	.000	.000
QY	-.003	-.009	-.014	-.026	-.013	.001	.000	.000	.000
LONGSHORE STATION 22									
Y	2.165	36.568	75.054	146.890	297.041	482.043	744.106	1049.430	1656.502
QX	.000	.001	-.003	-.071	1.024	1.138	.042	.000	.000
QY	-.002	-.003	-.002	-.002	-.035	.026	.000	.000	.000
LONGSHORE STATION 23									
Y	.727	32.439	66.252	128.144	268.771	462.810	738.545	1049.270	1656.502
QX	.001	.009	.022	.126	.546	.024	.000	.000	.000
QY	-.001	.000	.003	.008	-.001	.000	.000	.000	.000
LONGSHORE STATION 24									
Y	-.220	31.361	65.974	129.304	260.637	444.072	737.305	1049.355	1656.502
QX	.001	.018	.078	.567	1.022	.048	.000	.000	.000
QY	-.001	.000	.002	.006	-.015	.027	.000	.000	.000
LONGSHORE STATION 25									
Y	-.936	29.681	64.483	131.703	275.104	455.825	748.894	1049.848	1656.502

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QX          .000     .002     .013     .180     .882    1.219     .228     .004     .000
QY          .000     .001     .002     .003    -.026     .029     .000     .000     .000
LONGSHORE STATION    26
Y         -1.442   27.681   62.014  133.384  287.194  479.465  766.1021050.5431656.502
QX          .000     .003     .018     .256     .864     .516     .171     .004     .000
QY          .000     .003     .002    -.001    -.038     .018     .000     .000     .000
LONGSHORE STATION    27
Y         -1.570   26.533   60.798  135.107  272.003  503.462  783.4091051.2051656.502
QX          .000     .003     .021     .272     .380     .560     .170     .004     .000
QY         -.001     .004     .002    -.004    -.023    -.019     .000     .000     .000
LONGSHORE STATION    28
Y         -1.095   26.643   61.803  138.627  238.260  520.237  795.1041051.6231656.502
QX          .000     .003     .019     .228     .234    1.027     .226     .004     .000
QY         -.001     .004     .001    -.007     .014    -.069     .000     .000     .000
LONGSHORE STATION    29
Y           .267   30.422   69.785  151.360  219.091  517.534  793.5391051.6351656.502
QX          .001     .009     .043     .323     .518     .092     .000     .000     .000
QY         -.002     .002    -.003    -.012     .002    -.001     .000     .000     .000
LONGSHORE STATION    30
Y          2.542   38.747   84.591  170.321  223.152  506.532  785.3851051.4131656.502
QX          .003     .030     .080     .311    1.088     .136     .000     .000     .000
QY         -.002    -.004    -.009    -.016     .003    -.001     .000     .000     .000
LONGSHORE STATION    31
Y          5.269   48.821  101.128  189.398  234.207  497.825  778.2011051.1561656.502
QX          .003     .028     .061     .206     .698     .121     .000     .000     .000
QY         -.003    -.012    -.016    -.018     .003    -.001     .000     .000     .000
LONGSHORE STATION    32
Y          7.806   58.975  118.130  209.319  243.452  490.357  772.3921050.9191656.502
QX          .003     .027     .056     .145     .793     .107     .000     .000     .000
QY         -.003    -.019    -.023    -.021     .003     .000     .000     .000     .000
LONGSHORE STATION    33
Y          9.423   66.781  131.815  225.751  256.820  484.381  768.0531050.7301656.502
QX          .003     .030     .084     .387     .574     .096     .000     .000     .000
QY         -.003    -.026    -.028    -.024     .003     .000     .000     .000     .000
LONGSHORE STATION    34
Y        -33.165  -29.559  -27.740  -25.209  234.217  477.793  765.0511050.5961656.502
QX          .000     .000     .000     .000    2.109     .096     .000     .000     .000
QY          .017     .064     .074     .029    -.006     .000     .000     .000     .000
LONGSHORE STATION    35
Y        -28.683  -25.071  -23.252  -20.718  169.807  469.739  763.1201050.5121656.502
QX          .001     .025     .114     .119     .001     .000     .000     .000     .000
QY          .018     .051     .062     .082    -.003    -.001     .000     .000     .000
LONGSHORE STATION    36
Y        -22.896  -19.181  -17.362  -12.182  144.147  464.135  761.9681050.4631656.502
QX          .000     .011     .072     .316    2.005     .058     .000     .000     .000
QY          .017     .041     .050     .063    -.002    -.001     .000     .000     .000
LONGSHORE STATION    37
Y        -17.720  -13.891  -12.072     .343  154.328  461.974  761.3281050.4371656.502
QX          .001     .018     .104     .366     .606     .065     .000     .000     .000
QY          .016     .037     .045     .056    -.002    -.001     .000     .000     .000
LONGSHORE STATION    38
Y        -13.146   -7.977   -6.364   13.997  162.035  461.522  760.9981050.4241656.502
QX          .001     .023     .121     .486     .875     .079     .000     .000     .000
QY          .012     .026     .035     .049    -.001    -.001     .000     .000     .000
LONGSHORE STATION    39
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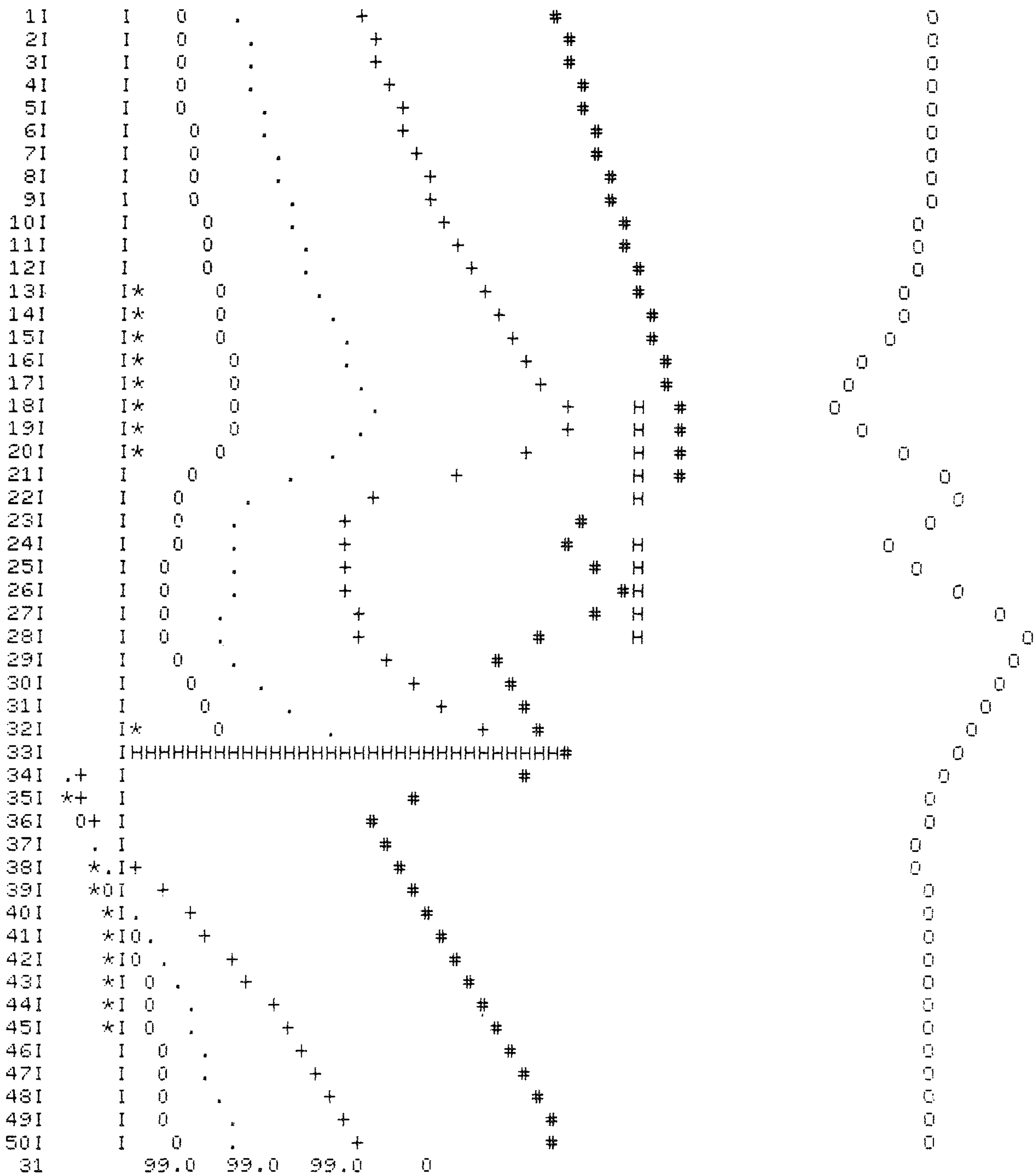
Y	-10.234	-2.362	1.900	27.924	171.244	462.052	760.840	1050.418	1656.502
QX	.001	.026	.119	.558	.859	.086	.000	.000	.000
QY	.009	.024	.032	.044	-.001	-.001	.000	.000	.000
LONGSHORE STATION 40									
Y	-8.165	2.765	10.135	41.304	180.374	462.858	760.770	1050.416	1656.502
QX	.002	.028	.123	.628	.890	.089	.000	.000	.000
QY	.007	.020	.029	.038	-.001	-.001	.000	.000	.000
LONGSHORE STATION 41									
Y	-6.549	7.345	18.054	53.869	189.244	463.606	760.741	1050.415	1656.502
QX	.002	.029	.126	.693	.912	.091	.000	.000	.000
QY	.006	.017	.026	.034	-.001	-.001	.000	.000	.000
LONGSHORE STATION 42									
Y	-5.231	11.400	25.430	65.555	197.752	464.183	760.731	1050.415	1656.502
QX	.002	.030	.129	.752	.934	.091	.000	.000	.000
QY	.005	.015	.022	.029	-.001	-.001	.000	.000	.000
LONGSHORE STATION 43									
Y	-4.145	14.963	32.205	76.388	205.916	464.575	760.727	1050.414	1656.502
QX	.002	.030	.133	.805	.959	.091	.000	.000	.000
QY	.004	.012	.019	.025	-.001	-.001	.000	.000	.000
LONGSHORE STATION 44									
Y	-3.249	18.088	38.384	86.432	213.676	464.815	760.726	1050.414	1656.502
QX	.002	.030	.137	.852	.984	.091	.000	.000	.000
QY	.003	.010	.016	.022	.000	-.001	.000	.000	.000
LONGSHORE STATION 45									
Y	-2.505	20.836	44.011	95.770	220.947	464.944	760.726	1050.414	1656.502
QX	.002	.031	.140	.892	1.004	.091	.000	.000	.000
QY	.003	.008	.013	.018	.000	.000	.000	.000	.000
LONGSHORE STATION 46									
Y	-1.880	23.272	49.153	104.509	227.767	465.004	760.726	1050.414	1656.502
QX	.002	.031	.143	.927	1.021	.091	.000	.000	.000
QY	.002	.006	.010	.014	.000	.000	.000	.000	.000
LONGSHORE STATION 47									
Y	-1.343	25.476	53.891	112.751	234.257	465.046	760.726	1050.414	1656.502
QX	.002	.031	.145	.955	1.036	.090	.000	.000	.000
QY	.002	.005	.008	.011	.000	.000	.000	.000	.000
LONGSHORE STATION 48									
Y	-.863	27.562	58.374	120.624	240.465	465.040	760.726	1050.414	1656.502
QX	.002	.031	.147	.975	1.049	.090	.000	.000	.000
QY	.001	.003	.006	.007	.000	.000	.000	.000	.000
LONGSHORE STATION 49									
Y	-.420	29.609	62.996	128.749	246.597	464.922	760.726	1050.414	1656.502
QX	.002	.031	.148	.977	1.046	.087	.000	.000	.000
QY	.001	.002	.003	.004	.000	.000	.000	.000	.000
LONGSHORE STATION 50									
Y	.000	31.623	68.041	137.706	252.982	464.758	760.726	1050.414	1656.502
QX	.002	.030	.153	1.024	1.066	.087	.000	.000	.000
QY	.000	.000	.000	.000	.000	.000	.000	.000	.000



APPENDIX B: PROGRAM LISTING

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LIST
      PROGRAM SEDTRAN(INPUT,OUTPUT,TAPE1,TAPE20,TAPE2=OUTPUT)
      PARAMETER (NI=53,NJ=11)
C*THIS PROGRAM IS SET-UP TO HANDLE MULTIPLE GROINS(M)=10).
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
      COMMON/BB/WEQ(NI,NJ)
      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
      COMMON/F/ADEAN,REPOSE,DIAM
      COMMON/AAA/DELT,NTIMES
      COMMON/COUNT/NUNIV,NWRITE
      COMMON/EXPL/QYEXP(NI,NJ),YIMP(NI,NJ)
      COMMON/NWS/ILFT(5),IRT(5),YLFT(5),YRT(5),NOBKS
     1,DEEPR(5),DEEPL(5),HRT(5),HLFT(5)
      DIMENSION CHANGE(20),HC(10),TC(10)
      DIMENSION YORIG(NI,NJ),YZEROO(NI),SANGLE(NJ)
      READ(1,60) IMAX,JMAX
   60 FORMAT(2I10)
      JUSE=JMAX+2
      PI=3.141592654
      TWOPI=PI*2.
      PIO2=PI/2.0
      REPOSE=32.*TWOPI/360.
      NUNIV=0
      WRITE(2,732)
  732 FORMAT("************************************************************")
C*WDEPTH MUST BE A DEPTH BEYOND THE END OF THE STRUCT, PREFERABLY AT
C**DEEP(JMAX) OR GREATER(OR ELSE SNELL\S LAW OR SHOAL COULD BLOWUP IN
C***DEEPER WATER. IT\S IN METERS HERE?
      READ(1,770)   WDEPTH
  770 FORMAT(10X,F10.3)
      WDEPTH=WDEPTH*3.28084
      WRITE(2,762)   WDEPTH
  762 FORMAT(2X,"THE DEPTH (IN FT) WAVES TRANSFORMED TO, WDEPTH= ",
     *  F10.3)
C******READ IN THE DESIRED CONTOUR DEPTHS**
      READ(1,61) (CHANGE(N),N=1,20)
   61 FORMAT(10F8.3)
C******READ IN THE DESIRED OUTPUT INTERVAL
      READ(1,62) NWRITE
   62 FORMAT(I10)
      WRITE(2,732)
C     WRITE(2,777)
  777 FORMAT(2X,"ITS TIME FOR         BERM, SFACE, AND DIAM",/)
C*SJETTY MUST BE MUCH LESS THAN Y(I,JMAX).
      READ(1,776)   BERM,SFACE,DIAM
  776 FORMAT(10X,F10.3,F10.4,F10.3)
  761 FORMAT(2X,"THE LENGTH OF THE STRUCTURE, SJETTY= ",F10.3)
      WRITE(2,740)   BERM
  740 FORMAT(2X,"THE HEIGHT OF THE BERM, BERM= ",F10.3)
      WRITE(2,739)SFACE
  739 FORMAT(2X,"THE SLOPE OF THE BEACH FACE, SFACE= ",F10.4)
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      WRITE(2,738)   DIAM
  738 FORMAT(2X,"THE SEDIMENT DIAMETER, DIAM= ",F10.3)
      WRITE(2,732)
  780 FORMAT(2X,"SUPPLY MMAX( THE NO. OF GROINS) AND THEIR I-LOC",/)
      UCRIT=16.3*SQRT(DIAM*0.00328)
C*THE NO. OF MULTIPLE GROINS,MMAX MUST BE GIVEN THEIR X LOCATIONS.
      READ(1,779)   MMAX
  779 FORMAT(I3)
      DO 760 M=1,MMAX
C*IJET REPS LESSER I-VALUE ADJACENT TO STRUCTURE.
      READ(1,778)   IJET(M),SJETTY(M)
  760 WRITE(2,761) SJETTY(M)
  778 FORMAT(I3,F10.3)
      WRITE(2,759)  (M,IJET(M),M=1,MMAX)
  759 FORMAT(2X,"THE NUMBER",I5," GROIN IS LOCATED AT GRID",I5)
      WRITE(2,732)
C*CONVERT TO RADIANS.
C*FIRST MUST GIVE Y COORS POSITIONS AND DEPTHS.
C*FIRST, MUST SET UP ALL OF THE DEEP-VALUES.
C****READ THE VALUE OF ADEAN
      READ(1,774)ADEAN
  774 FORMAT(F10.4)
      WRITE(2,749)   ADEAN
  749 FORMAT(2X,"THE VALUE OF ADEAN= ",F10.4,"  IN THE EQ. H=AY**2/3")
      WRITE(2,732)
      READ(1,775)   DX,DELT
  775 FORMAT(2(F10.3))
      WRITE(2,737)   DX
  737 FORMAT(2X,"THE VALUE OF THE LONGSHORE SPACE-STEP, DX= ",F10.3)
      WRITE(2,736)   DELT
  736 FORMAT(2X,"THE TIME-STEP IN SECONDS, DELT= ",F10.3)
       DO 220 J=1,JMAX+3
      DO 220 I=1,IMAX+1
  220 DEEP(I,J)=CHANGE(J)
      DATA(HC(I),I=1,8)/1.87,0.5,0.35,.25,.21,.20,.19,.19/
      DATA(TC(I),I=1,8)/2.,3.,4.,6.,8.,10.,12.,14./
*************DEFINE INITIAL COASTLINE*******
      READ(1,63) (Y(I,1),I=1,IMAX)
   63 FORMAT(10F8.2)
**********************************************
      DO 200 J=1,JMAX+2
      DO 200 I=1,IMAX
  200 Y(I,J+1)=(0.5*(DEEP(I,J+1)+DEEP(I,J))/ADEAN)**1.5+Y(I,1)
      WRITE(2,732)
      WRITE(2,772)
  772 FORMAT(3X,35HTHE INITIAL SHORELINE COORDINATES :)
      WRITE(2,9993) (Y(I,1),I=1,IMAX)
 9993 FORMAT(10F8.2)
      WRITE(2,732)
C***************************
C*WE WILL ALWAYS REQUIRE Y(I,JM) TO COMPUTE DY AND YBAR.
C*WE WILL ALWAYS REQUIRE DEEP(I,JM) TO COMP SEDIMENT TRANSPORT.
C***************************
      WRITE(2,734)
  734 FORMAT(2X,"THE BOUNDARY Y-VALUES, I=1,IMAX ARE AS FOLLOWS",/)
```

```
      WRITE(2,801)   (Y(1,J),J=1,JMAX+2)
      WRITE(2,801)   (Y(IMAX,J),J=1,JMAX+2)
      WRITE(2,732)
      WRITE(2,735)
  735 FORMAT(2X,"THE DEPTHS BETWEEN CONTOURS ARE AS FOLLOWS",)
      WRITE(2,801)   (DEEP(1,J),J=1,JMAX+2)
      WRITE(2,732)
  801 FORMAT(10F8.2)
      DO 2 I=1,IMAX
  2   YZERO(I)=Y(I,1)-(BERM/SFACE)
C*WILL COMPUTE THE EQUIL WIDTH BETWEEN CONTOURS, HERE.
      DO 1 I=1,IMAX
      WEQ(I,1)=Y(I,1)-YZERO(I)
      DO 1 J=1,JMAX
      IF(J.NE.1)   GO TO 32
      YTEMP1=0.0
      GO TO 33
  32  YTEMP1=((0.5*(DEEP(I,J-1)+DEEP(I,J)))/ADEAN)**1.5
  33  YTEMP2=((0.5*(DEEP(I,J)+DEEP(I,J+1)))/ADEAN)**1.5
      WEQ(I,J+1)=YTEMP2-YTEMP1
   1  CONTINUE
C*LET\S STORE THE ORIG VALUES TO COMPUTE VOL CHANGES OVER CONTOURS,LATER
      DO 796 I=1,IMAX+1
      YZEROO(I)=YZERO(I)
       DO 796 J=1,JMAX+2
  796 YORIG(I,J)=Y(I,J)
C*****************************************************************************
C READ IN THE BREAKWATER INFORMATION
C*****************************************************************************
      READ(1,800) NOBKS
  800 FORMAT(I5)
      IF(NOBKS.EQ.0) GO TO 899
      DO 805 N=1,NOBKS
  805 READ(1,807) ILFT(N),IRT(N),YLFT(N),YRT(N)
  807 FORMAT(10X,2I10,2F10.2)
      WRITE(2,732)
      WRITE(2,810)
  810 FORMAT(1X,45HBREAKWATER  LEFT LOC  RIGHT LOC  LEFT Y VALUE,2X,
     113HRIGHT Y VALUE)
      DO 820 N=1,NOBKS
  820 WRITE(2,830) N,ILFT(N),IRT(N),YLFT(N),YRT(N)
  830 FORMAT(4X,I3,8X,I3,7X,I3,7X,F9.2,5X,F9.2)
      WRITE(2,732)
  899 CONTINUE
C******************************************************************************
C*READ THE DISK FILE AND TRANSFORM PARAMETERS INTO MY UNITS.
C*******************??????????????????????????????????*********************
C*ALL ADJUSTMENTS TO WAVE ANGLE,HEIGHT,CELERITY,GROUP VEL, WILL BE MADE
C**HERE, AND THRUOUT THE REST  OF THE PROG, THEY WILL BE AS IF OCCURRED
C***AT WDEPTH?
C****SELECT DREDGED DISPOSAL OPTION
  798 READ(1,799) IJKLMN,HS,T,ALPWIS,IDDD
      WRITE(2,799) IJKLMN,HS,T,ALPWIS,IDDD
C     IF(EOF(5) .EQ. 1) GO TO 1000
      IF(HS.GT.50.) GO TO 1000
```

```
C***********************************
  799 FORMAT(I5,5X,3F6.1,I5)
      NTIMES=1
      NCHECK=NUNIV+NTIMES
      HGEN=0.707107*HS
      SIGMA=TWOPI/T
      G=32.17
      CO=G*T/TWOPI
      ELO=CO*T
      IF(T.LE.2.0)   GO TO 797
      HCC=0.23
      DO 444 I=2,7
      T2=TC(I)
      IF(T.GT.T2)   GO TO 444
      T1=TC(I-1)
      DELTAT=T2-T1
      DT=(T-T1)/DELTAT
      DTT=(T2-T)/DELT
      HCC=HC(I)*DT+HC(I-1)*DTT
      GO TO 446
  444 CONTINUE
  446 CONTINUE
      IF(HGEN.LT.HCC)   GO TO 797
      ANGGEN=ALPWIS*TWOPI/360.
C***********************************************************************
      CALL WVNUM(WDEPTH,T,DUMKK)
C*ANGGEN,HGEN,CGEN,CGGEN REPRESENT THE WAVE ANGLE,HEIGHT,CELERITY AND
C**GROUP VEL(RESPECT.) OF THE SPECIFIED WAVE INPUT AT A DEPTH, WDEPTH
      CALL WVNUM(11.0,T,DUMKKK)
      C11=TWOPI/(T*DUMKKK)
      CG11=0.5*C11*(1.+(2.*DUMKKK*11.0/SINH(2.*DUMKKK*11.0)))
      CGEN=TWOPI/(T*DUMKK)
      CGGEN=0.5*CGEN*(1.+(2.*DUMKK*WDEPTH/SINH(2.*DUMKK*WDEPTH)))
      IF(IDDD.EQ.0) GO TO 8002
      WRITE(2,67) NCHECK
   67 FORMAT(1X,31HDREDGED MATERIAL ADDED AT TIME ,I5)
      WRITE(2,294) NCHECK
  294 FORMAT(1X,40HCONTOURS AFTER MATERIAL ADDITION AT TIME,I5,4HARE:)
   66 READ(20,65) IDREG,JDREG,DREDGE
   65 FORMAT(2I5,F10.2)
      IF(IDREG.EQ.IMAX.AND.JDREG.EQ.JMAX) GO TO 795
      Y(IDREG,JDREG)=Y(IDREG,JDREG)+DREDGE
      GO TO 66
  795 CONTINUE
      DO 8001 I=1,IMAX
 8001 WRITE(2,8000) I,(Y(I,J),J=1,JMAX)
 8000 FORMAT(I5,8F9.3)
 8002 CONTINUE
      IF(NUNIV.EQ.0) CALL PLOTNS(IMAX,JMAX,Y,YLFT,YRT,ILFT
     1,IRT,SJETTY,IJET,NOBKS,MMAX)
      REWIND 20
      CALL TRANS
  797 IF(NCHECK.NE.NUNIV)  NUNIV=NCHECK
  709 GO TO 798
 1000 CONTINUE
```

```
      STOP
      END
      SUBROUTINE TRANS
      PARAMETER (NI=53,NJ=11)
C************************************************************************
C*THIS SUBROUTINE WILL COMPUTE SEDIMENT TRANSPORT
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
      COMMON/BB/WEQ(NI,NJ)
      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
      COMMON/E/RHO,RHOS,POROS,CONST,TKSI
      COMMON/F/ADEAN,REPOSE,DIAM
      COMMON/G/IBREAK(NI),HNONBR(NJ)
      COMMON/P/HBQ(NI),DEEPB(NI)
      COMMON/ZZZ/NTIME
      COMMON/AAA/DELT,NTIMES
      COMMON/COUNT/NUNIV,NWRITE
      COMMON/NWS/ILFT(5),IRT(5),YLFT(5),YRT(5),NOBKS
     1,DEEPR(5),DEEPL(5),HRT(5),HLFT(5)
      DIMENSION YOLD(NI,NJ),R(NI,NJ),S(NI,NJ),HC(NI,NJ),QY(NI,NJ),YDISS(
     *   60,20)
      DIMENSION RHS1(NI,NJ),S3(NI,NJ),THETAB(NI,NJ),ANGLOC(NI,NJ)
       DIMENSION DISTR(NI,NJ),AWARE(NI,NJ),
     *BMATRX((NJ-3)*(NI-5)),ABAND((NJ-3)*(NI-5),2*(NJ-3)+1),QX(NI,NJ),
     1XL((NJ-3)*(NI-5),NJ-2),CONST6(NI,NJ)
C************************************************************************
C************************************************************************
C***************  NOTE   00000SIZE OF ABAND AND XL HAVE TO BE CHANGED
C***************           ACCORDING TO JMAX+1+JMAX AND JMAX+1,RESPECT.
C***************           CHANGE REQ\D AT 7040 AND 18650
C************************************************************************
      COMMON/MP/ RKB(NI),HBI(NI),DEEPBI(NI)
      COMMON/EXPL/QYEXP(NI,NJ),YIMP(NI,NJ)
      DIMENSION SANGLE(NJ)
      DO 199 J=1,JMAX+3
      SANGLE(J)=0.
      DO 199 I=1,IMAX+3
      YOLD(I,J)=0.
      R(I,J)=0.
      QY(I,J)=0.
      YDISS(I,J)=0.
      RHS1(I,J)=0.
      S3(I,J)=0.
      THETAB(I,J)=0.
      ANGLOC(I,J)=0.
      DISTR(I,J)=0.
      AWARE(I,J)=0.
      QX(I,J)=0.
      CONST6(I,J)=0.
      QYEXP(I,J)=0.
  199 CONTINUE
```

```
      DO 200 I=1,IMAX+3
      DEEPB(I)=0.
      HBQ(I)=0.
      DEEPBI(I)=0.
  200 HBI(I)=0.
      RHO=1.99
      RHOS=5.14
      POROS=0.40
      CONST=0.77
      CAPPA=0.78
      TAU=0.25
      TKSI=(CONST*RHO*SQRT(G))/((RHOS-RHO)*(1.0-POROS)*16.0*SQRT(CAPPA))
C*  QX(I,J) IS THE TRANSPORT BETWEEN THE (I,J+1) AND (I,J) CONTOURS.
C*THE \DO 1 LOOP\ SIMULATES TIME---TIME=DELT*NTIMES.
      COFF=0.00001
      GAMMA=RHO*G
      DO 1 NTIME=1,NTIMES
      NUNIV=NUNIV+1
C*THE MATRICES ABAND AND BMATRX  MUST BE \ZEROED OUT\
      K=0
        DO 26 I=2,IMAX-1
      DO 26 J=1,JMAX
      K=K+1
      BMATRX(K)=0.0
        DO 26 L=1,JMAX+1+JMAX
   26 ABAND(K,L)=0.0
      XNTIME=1.0*(NTIME)
      CALL PREDIF
      IF(NOBKS.EQ.0) GO TO 10
      CALL BRKH2O(IMAX,JMAX,MMAX,Y,THETA,H,C,IJET,SJETTY,T,DX
     1,DEEP,HB,CG)
   10 CONTINUE
C*SMOOTHING OF THE WAVE ANGLE,THETA, IS RE\D TO ACCT FOR DIFF EFFECTS.
      CALL SMOOTH(THETA,IMAX,JMAX,IJET,SJETTY,MMAX,Y)
      CALL QTRAN
      IF(NOBKS.EQ.0) GO TO 9990
      DO 9999 N=1,NOBKS
      XDD=ILFT(N)-IRT(N)
      DO 9998 NN=ILFT(N),IRT(N)-1
      XLT=ILFT(N)-NN+.5
      DEEPDM=DEEPL(N)-(DEEPL(N)-DEEPR(N))*XLT/XDD
      IF(DEEPB(NN+1).GE.DEEPDM) GO TO 9998
      DEEPB(NN+1)=DEEPDM
      HBQ(NN+1)=HLFT(N)-(HLFT(N)-HRT(N))*XLT/XDD
 9998 CONTINUE
      DEEPB(ILFT(N))=.5*(DEEPB(ILFT(N))+DEEPB(ILFT(N)-1))
      HBQ(ILFT(N))=.5*(HBQ(ILFT(N))+HBQ(ILFT(N)-1))
      DEEPB(IRT(N)+1)=.5*(DEEPB(IRT(N))+DEEPB(IRT(N)+1))
      HBQ(IRT(N)+1)=.5*(HBQ(IRT(N))+HBQ(IRT(N)+1))
 9999 CONTINUE
 9990 CONTINUE
C*FIRST THE LONGSHORE SEDIMENT TRANSPORT WILL BE DISTRIBUTED
C****ACROSS THE SURF ZONE....
      CC=1.25
C***QX(I,J) WILL BE DETERMINED BY SUBTRACTING FROM THE INTEGRAL
```

```
C**OF QX FROM DEEP(I,J-1) TO INFINITY, THE INTEGRAL OF QX FROM DEEP(I,J)
C***TO INFINITY. IN THIS WAY THE SEDIMENT TRANS FROM JMAX OUT GETS
C***INCLUDED IN QX(I,JMAX). TO INCLUDE THE SWASH TRANS, WHEN J=1
C*WE WILL SUBTRACT FROM 2 TO INFINITY FROM 1.0
C*LOOP FOR VALUES WHICH ARE HELD CONST AND STORED.
      THETAB(1,1)=0.5*(THETA(1,1)+0.0)
      R(1,1)=0.5/(DX*(DEEP(1,1)+BERM/2.))
      DO 290 I=2,IMAX
      R(I,1)=0.5/(DX*(DEEP(I,1)+BERM/2.))
C*    THETAB(I,1)=0.25*(THETA(I,1)+THETA(I-1,1)+0.+0.)
      THETAB(I,1)=0.5*(THETA(I,1)+THETA(I-1,1))
C*NO NEED TO COMPUTE PROP ANGLE AT STRUCTS BECAUSE QX =0.0 AT IJET(M)+1
      ANGLOC(I,1)=ATAN((Y(I,1)-Y(I-1,1))/DX)
C*HBQ(IJET(M)+1) IS PROPERLY SET IN THE SUBROUTINE QTRAN.
      ARG0=((DEEP(I,1)**1.5+HBQ(I)*ADEAN**1.5)/(CC*DEEPB(I)**1.5
     1))**3
      IF(ARG0.GT.50.) ARG0=50.
      DISTR(I,1)=1.0-EXP(-ARG0)
      DISTR(I,1)=DISTR(I,1)*TKSI*HBQ(I)**2.5
      DO 290 J=2,JMAX
      R(I,J)=0.5/(DX*(DEEP(I,J)-DEEP(I,J-1)))
      THETAB(I,J)=0.5*(THETA(I,J)+THETA(I-1,J))
      ANGLOC(I,J)=ATAN((Y(I,J)-Y(I-1,J))/DX)
      ARG1=((DEEP(I,J-1)**1.5+HBQ(I)*ADEAN**1.5)/(CC*DEEPB(I)**1.5
     1))**3
      ARG2=((DEEP(I,J)**1.5+HBQ(I)*ADEAN**1.5)/(CC*DEEPB(I)**1.5
     1))**3
      IF(ARG1.GT.50.) ARG1=50.
      IF(ARG2.GT.50.) ARG2=50.
      DISTR(I,J)=EXP(-ARG1)-EXP(-ARG2)
      DISTR(I,J)=DISTR(I,J)*TKSI*HBQ(I)**2.5
  290 CONTINUE
      DO 301 J=1,JMAX
      DO 301 I=2,IMAX
      AWARE(I,J)=DELT*R(I,J)*(QX(I,J)-QX(I+1,J)+QY(I,J)-QY(I,J+1))+Y(I,J
     *    )
      S1=2.*SIN(THETAB(I,J))*COS(THETAB(I,J))*(-1.+2.*(COS(
     *   ANGLOC(I,J)))**2)
      S2=COS(2.*THETAB(I,J))*COS(ANGLOC(I,J))/(SQRT(DX**2+
     *    (Y(I,J)-Y(I-1,J))**2))
      S3(I,J)=S2*DISTR(I,J)
      DO 325 M=1,MMAX
      IF(SJETTY(M).EQ.0.0) GO TO 302
      IF(I.NE.IJET(M)+1)   GO TO 325
      IF(THETAO(M).GE.0.0)   ISIDE=IJET(M)
       IF(THETAO(M).LT.0.0)  ISIDE=IJET(M)+1
      YSEA=0.5*(Y(ISIDE,J)+Y(ISIDE,J+1))
      IF(J.EQ.1) DUMYY=YZERO(ISIDE)
      IF(J.GT.1) DUMYY=Y(ISIDE,J-1)
      YSHORE=0.5*(Y(ISIDE,J)+DUMYY)
      IF(YSEA.GT.SJETTY(M).AND.YSHORE.GT.SJETTY(M))   GO TO 302
      IF(YSEA.GT.SJETTY(M).AND.YSHORE.LE.SJETTY(M))   GO TO 298
C*BECAUSE A NO FLOW B.C. IS USED ALONG THE STRUCT, NO ATTN WAS PAID
C**TO GETTING PROPER VALUES OF ANGLOC, THETAB,DISTR,ETC.
      S3(I,J)=0.0
```

```
      DISTR(I,J)=0.0
      GO TO 302
  325 CONTINUE
      GO TO 302
C***ABOVE, ALL PARAMETERS(I.E.,S1,S2,S3,THETAB,DISTR,ANGLOC)
C***ARE COMPUTED AS IF THE STRUCT IS NOT THERE. THE B.C. AT THE
C***STRUCT TIP ASSUMES QX COMPUTED AS IF NO STRUCT PRESENT AND THEN
C***BYPASSES ACCORDING TO \RATIO\.
  298 RATIO=(YSEA-SJETTY(M))/(YSEA-YSHORE)
      S3(I,J)=S3(I,J)*RATIO
      DISTR(I,J)=DISTR(I,J)*RATIO
  302 RHS1(I,J)=DISTR(I,J)*S1-S3(I,J)*(Y(I,J)-Y(I-1,J))
 301  CONTINUE
      CALL BREAK(IMAX,JMAX)
      IF(NOBKS.EQ.0) GO TO 9991
      DO 9996 N=1,NOBKS
      XDD=ILFT(N)-IRT(N)
      DO 9996 NN=ILFT(N),IRT(N)
      XLT=ILFT(N)-NN
      DEEPDM=DEEPL(N)-(DEEPL(N)-DEEPR(N))*XLT/XDD
      IF(DEEPBI(NN).GE.DEEPDM) GO TO 9996
      DEEPBI(NN)=DEEPDM
      HBI(NN)=HLFT(N)-(HLFT(N)-HRT(N))*XLT/XDD
 9996 CONTINUE
 9991 CONTINUE
C*TO DETERMINE DECAY OF CONST6(I,J),NEED WAVE NO. AT BREAKING.
        DO 754 I=1,IMAX+1
  754 CALL WVNUM(DEEPBI(I),T,RKB(I))
C*USING SHIELD\S DIAG,Y AXIS=0.05 + (TAU0=RHO*C*U**2),GET UCRIT(FT/SEC)
      UCRIT=16.3*SQRT(DIAM*.00328)
      DO 748 J=1,JMAX+2
  748 H(IMAX+1,J)=H(IMAX,J)
      DO 750 I=1,IMAX+1
      CONST6(I,1)=COFF*DX
        DO 750 J=2,JMAX+2
C*CONST6(I,J) GOES W/ QY(I,J) WHICH IS ASSOC W/ DEEP(I,J-1)
      IF(DEEP(I,J-1).LE.DEEPBI(I))   GO TO 751
C*HERE, MUST CAUSE COFF TO DECAY (WE\RE BEYOND SURF ZONE)
      UMAXB=HBI(I)*G*T*RKB(I)/(2.*TWOPI*COSH(RKB(I)*DEEPBI(I)))
      UMAX=H(I,J-1)*G*T*RK(I,J-1)/(2.*TWOPI*COSH(RK(I,J-1)*DEEP(I,J-1)))
      IF(UCRIT.LT.UMAX.AND.UCRIT.LT.UMAXB)   GO TO 749
      CONST6(I,J)=0.0
      GO TO 750
  749 TOP=0.01*H(I,J-1)**3*SIGMA**3/(SINH(RK(I,J-1)*DEEP(I,J-1))**3)
      BOT=DEEP(I,J-1)*(0.625*TWOPI*G**1.5*0.78**2*ADEAN**1.5+
     *(0.01*HBI(I)**3*SIGMA**3/(DEEPBI(I)*(SINH(RKB(I)*DEEPBI(I)))**3)))
      CONST6(I,J)=DX*COFF*TOP/BOT
      GO TO 750
  751 CONST6(I,J)=COFF*DX
  750 CONTINUE
      K=0
C**PUT INTO BANDED FORM USING THE ALGORITHM  A(M,N)-;B(M,NN) WHERE
C***NN=KB+1-M+N(KB IS THE NUMBER OF LOWER CODIAGONALS(=JMAX,HERE)).
        DO 304 I=2,IMAX-1
      DO 304 J=1,JMAX
```

```
      K=K+1
      AWARE(I,J)=AWARE(I,J)+DELT*RHS1(I,J)*R(I,J)-DELT*R(I,J)*RHS1(I+1,J
     *   )+DELT*R(I,J)*CONST6(I,J)*WEQ(I,J)-DELT*R(I,J)*CONST6(I,J+1)*
     *   WEQ(I,J+1)
      YDUM=YZERO(I)
      IF(J.NE.1)   YDUM=Y(I,J-1)
      AWARE(I,J)=AWARE(I,J)+DELT*R(I,J)*CONST6(I,J)*0.5*(YDUM-Y(I,J))
     *   -DELT*R(I,J)*CONST6(I,J+1)*0.5*(Y(I,J)-Y(I,J+1))
      U=DELT*R(I,J)*S3(I,J)
      V=DELT*R(I,J)*S3(I+1,J)
      Z1=DELT*R(I,J)*CONST6(I,J)*0.5
      Z2=DELT*R(I,J)*CONST6(I,J+1)*0.5
C*NOW WILL SET UP THE MATRICES ABAND AND BMATRX.
      ABAND(K,JMAX+1)=1.0+U+V+Z1+Z2
      IF(I.NE.2)   GO TO 305
      AWARE(I,J)=AWARE(I,J)+U*Y(I-1,J)
      GO TO 310
  305 ABAND(K,1)=-U
  310 IF(I.NE.IMAX-1)   GO TO 306
      AWARE(I,J)=AWARE(I,J)+V*Y(IMAX,J)
      GO TO 311
  306 ABAND(K,JMAX+1+JMAX)=-V
  311 IF(J.NE.1)   GO TO 307
      ABAND(K,JMAX+1)=ABAND(K,JMAX+1)-Z1
      AWARE(I,1)=AWARE(I,1)+Z1*(YZERO(I)-Y(I,1))
      GO TO 312
  307 ABAND(K,JMAX)=-Z1
  312 IF(J.NE.JMAX)   GO TO 308
      AWARE(I,J)=AWARE(I,J)+Z2*Y(I,JMAX+1)
      GO TO 309
  308 ABAND(K,JMAX+2)=-Z2
  309 BMATRX(K)=AWARE(I,J)
  304 CONTINUE
      KMAX=K
C**CALL IMSL ROUTINE LEQT1B TO SOLVE THE BANDED MATRIX.
      ISIZE=(NJ-3)*(NI-5)
      CALL LEQT1B(ABAND,KMAX,JMAX,JMAX,ISIZE,BMATRX,1,ISIZE,0,XL,IER)
C*NOW, GIVE Y\S THEIR NEW VALUES STORING OLD VALUES IN YOLD.
      K=0
        DO 315 I=2,IMAX-1
      YOLD(I,JMAX+1)=Y(I,JMAX+1)
      DO 315 J= 1,JMAX
      K=K+1
      YOLD(I,J)=Y(I,J)
      Y(I,J)=BMATRX(K)
  315 CONTINUE
      DO 320 J=1,JMAX+3
      YOLD(1,J)=Y(1,J)
  320 YOLD(IMAX,J)=Y(IMAX,J)
C*WILL USE ABBOTT\S DISSIPATIVE INTERFACE TO RID HIGH FREQ OSCILLATIONS
      DO 650 J=1,JMAX
      DO 650 I=2,IMAX-1
      YDISS(I,J)=TAU*Y(I-1,J)+(1.-2.*TAU)*Y(I,J)+TAU*Y(I+1,J)
      DO 649 M=1,MMAX
      IF(SJETTY(M).EQ.0.) GO TO 650
```

```
      IF(I.NE.IJET(M).AND.I.NE.IJET(M)+1)   GO TO 649
      IF(Y(IJET(M),J).GT.SJETTY(M).OR.Y(IJET(M)+1,J).GT.SJETTY(M))GO
     1 TO 649
      IF(I.EQ.IJET(M))YDISS(I,J)=TAU*Y(I-1,J)+(1.-TAU)*Y(I,J)
      IF(I.EQ.(IJET(M)+1))YDISS(I,J)=TAU*Y(I+1,J)+(1.-TAU)*Y(I,J)
  649 CONTINUE
  650 CONTINUE
      DO 651 J=1,JMAX
      DO 651 I=2,IMAX-1
  651 Y(I,J)=YDISS(I,J)
C*THIS LOOP WILL STORE THE IMPLICIT Y VALUES REQ\D TO COMP QY+QX
      DO 40 I=1,IMAX+1
      DO 40 J=1,JMAX+3
   40 YIMP(I,J)=Y(I,J)
C*THIS LOOP WILL EXPLICITLY MOVE CONTOURS SEAWARD IF REPOSE EXCEEDED.
      KOUNT=0
      SLOPEM=TAN(0.9*REPOSE)
      DO 48 I=1,IMAX
   43 KOUNT=KOUNT+1
      IF(KOUNT.GT.50000)   GO TO 41
C*LET US COMPUTE ALL THE SLOPES(PSLOP) FOR EACH CHANGE IN DEPTH.
      DO 47 J=1,JMAX+1
      DUM=-BERM/2.0
      IF(J.NE.1)   DUM=DEEP(I,J-1)
      DELH=0.5*(DEEP(I,J+1)+DEEP(I,J))-0.5*(DEEP(I,J)+DUM)
      PSLOP=DELH/(Y(I,J+1)-Y(I,J))
   47 SANGLE(J)=ATAN(PSLOP)
C*FIND THE MIN NEG SLOPE ANGLE OR THEN THE POS SLOPE;REPOSE OR FORGET IT
      ASLOPM=-1.0E50
      ASLOPP=0.0
      DO 46 J=1,JMAX+1
      IF(SANGLE(J).GT.0.0)   GO TO 45
      IF(SANGLE(J).GT.ASLOPM)ASLOPM=SANGLE(J)
      IF(ASLOPM.EQ.SANGLE(J))   JM=J
      GO TO 46
   45 IF(SANGLE(J).GT.REPOSE.AND.SANGLE(J).GT.ASLOPP)ASLOPP=SANGLE(J)
      IF(ASLOPP.EQ.SANGLE(J))   JP=J
   46 CONTINUE
      IF(ASLOPM.EQ.-1.0E50.AND.ASLOPP.EQ.0.0)   GO TO 42
      IF(ASLOPM.EQ.-1.0E50)   GO TO 44
      DUM=-BERM/2.
      IF(JM.NE.1)   DUM=DEEP(I,JM-1)
      ALTER=((0.5/SLOPEM*(DEEP(I,JM+1)-DUM))-(Y(I,JM+1)-Y(I,JM)))/
     *   (1.0+((DEEP(I,JM+1)-DEEP(I,JM))/(DEEP(I,JM)-DUM)))
      Y(I,JM+1)=Y(I,JM+1)+ALTER
      Y(I,JM)=Y(I,JM)-(ALTER*(DEEP(I,JM+1)-DEEP(I,JM))/(DEEP(I,JM)-DUM))
      QYEXP(I,JM+1)=QYEXP(I,JM+1)+DX/DELT*ALTER*(DEEP(I,JM+1)-DEEP(I,JM)
     *   )
      GO TO 43
   44 CONTINUE
      DUM=-BERM/2.
      IF(JP.NE.1)   DUM=DEEP(I,JP-1)
      ALTER=((0.5/SLOPEM*(DEEP(I,JP+1)-DUM))-(Y(I,JP+1)-Y(I,JP)))/
```

```
     *   (1.0+((DEEP(I,JP+1)-DEEP(I,JP))/(DEEP(I,JP)-DUM)))
      Y(I,JP+1)=Y(I,JP+1)+ALTER
      Y(I,JP)=Y(I,JP)-(ALTER*(DEEP(I,JP+1)-DEEP(I,JP))/(DEEP(I,JP)-DUM))
      QYEXP(I,JP+1)=QYEXP(I,JP+1)+DX/DELT*ALTER*(DEEP(I,JP+1)-DEEP(I,JP)
     *   )
      GO TO 43
   42 WEQ(I,JMAX+1)=Y(I,JMAX+1)-Y(I,JMAX)
   48 CONTINUE
C*IF WE GET SENT HERE, LOOP 444 WILL CATCH THE CROSSED CONTOURS.
   41 CONTINUE
C*NOW WE CAN COMPUTE QX\S AND QY\S?
      DO 318 I=2,IMAX
C*ALL IMPLIC AND EXPLIC MOVEMENT OF YZERO WILL BE TAKEN CARE OF HERE
      BRF=.5
      QY(I,1)=-BRF*BERM*DX*(Y(I,1)-YOLD(I,1))/DELT
      YZERO(I)=YZERO(I)+BRF*(Y(I,1)-YOLD(I,1))
  319 DO 318 J=1,JMAX
      QX(I,J)=RHS1(I,J)-S3(I,J)*YIMP(I,J)+S3(I,J)*YIMP(I-1,J)
  318 QY(I,J+1)=CONST6(I,J+1)*(0.5*(YIMP(I,J)+YOLD(I,J)-YIMP(I,J+1)
     *   -YOLD(I,J+1))+WEQ(I,J+1))
      DO 323 J=1,JMAX
      QX(1,J)=QX(2,J)
  323 QX(IMAX+1,J)=QX(IMAX,J)
C*TOTAL QYS WILL BE COMP FROM IMPLIC AND EXPLIC VALUES.THEN ZERO QYEXP
      DO 39 I=1,IMAX+1
      DO 39 J=1,JMAX+3
       QY(I,J)=QY(I,J)+QYEXP(I,J)
   39 QYEXP(I,J)=0.0
C*THIS CHECK WILL BOMB THINGS OUT IF CONTOURS HAVE CROSSED.
      DO 444 I=1,IMAX
      DO 444 J=1,JMAX
C*IF CONTOURS CROSS AT ANY TIME WANT PROGRAM TO STOP?
      IF(Y(I,J).LT.Y(I,J+1))   GO TO 444
      WRITE(2,103)
 9265 FORMAT(" */ REPLACEMENT ",I5)
       WRITE(2,9265) NUNIV
COMMENT WRITE(2,*/) NUNIV
  103 FORMAT(2X,"THE CONTOURS HAVE CROSSED AND SOMETHING IS WRONG",/)
COMMENT I AND J HAVE BEEN CHANGED TO II AND JJ HERE
      DO 150 JJ=1,JMAX
  150   WRITE(2,100)   (QX(II,JJ),II=1,IMAX)
      DO 151 JJ=1,JMAX
  151   WRITE(2,101)   (QY(II,JJ),II=1,IMAX)
      DO 152 JJ=1,JMAX
  152   WRITE(2,100)   (Y(II,JJ),II=1,IMAX)
      DO 19 JJ=1,JMAX
   19 WRITE(2,100) (YOLD(II,JJ),II=1,IMAX)
COMMENT I AND J WERE CHANGED DOWN TO HERE
      GO TO 445
  444 CONTINUE
C     WRITE(2,9265) NUNIV
COMMENT WRITE(2,9265) NUNIV
C*THE FOLLOWING STATEMENT DETERMINES AT WHAT FREQ EVERYTHING IS WRITTEN?
      IF(MOD(NUNIV,NWRITE).NE.0)   GO TO 1
C*LET\S WRITE ALL OF IT OUT.
```

```
      WRITE(2,926)   NUNIV
  926 FORMAT(2X,"THE TOTAL ELAPSED NUMBER OF TIME-STEPS. NUNIV= ",I5,/)
 800  FORMAT(2X,14(F8.4))
C*     DO 900 I=1,IMAX
C*900  WRITE(2,800)   (THETA(I,J),J=1,JMAX)
C*     DO 903 J=1,JMAX+1
C*903  WRITE(2,801)   DEEP(1,J)
C*     DO 906 I=1,IMAX
C*906  WRITE(2,800)   (H(I,J),J=1,JMAX)
C*    DO 755 J=1,JMAX
C*755 WRITE(2,800) (CONST6(I,J),I=1,IMAX)
 801  FORMAT(2X,14(F8.2))
C     WRITE(2,107)
C 107 FORMAT(/,2X,"THE LONGSHORE TRANSPORTS,QX, FOLLOW")
C     DO 15 J=1,JMAX
C 15   WRITE(2,100)   (QX(I,J),I=1,IMAX)
C     WRITE(2,108)
C 108 FORMAT(/,2X,"THE ON-OFFSHORE TRANSPORTS, QY, FOLLOW")
C     DO 17 J=1,JMAX
C 17   WRITE(2,101)   (QY(I,J),I=1,IMAX)
C     WRITE(2,109)
C 109 FORMAT(/,2X,"THE NEW CONTOUR VALUES, Y, FOLLOW")
C     DO 18 J=1,JMAX
C 18   WRITE(2,100)   (Y(I,J),I=1,IMAX)
      DO 15 I=1,IMAX
      WRITE(2,17) I
      WRITE(2,1801) (H(I,J),J=1,JMAX+1)
 1801 FORMAT(1X,5HH    ,9F8.3)
      WRITE(2,1802) (THETA(I,J),J=1,JMAX+1)
 1802 FORMAT(1X,5HTHETA,9F8.3)
      WRITE(2,1803) (Y(I,J),J=1,JMAX+1)
 1803 FORMAT(1X,5HY    ,9F8.2)
      WRITE(2,1804) (QX(I,J),J=1,JMAX+1)
 1804 FORMAT(1X,5HQX   ,9F8.3)
   15 WRITE(2,1805) (QY(I,J),J=1,JMAX+1)
 1805 FORMAT(1X,5HQY   ,9F8.3)
   17 FORMAT(1X,17HLONGSHORE STATION,I5)
  100  FORMAT(2X,13(F9.3))
  101 FORMAT(2X,13(F9.4))
      CALL PLOTNS(IMAX,JMAX,Y,YLFT,YRT,ILFT,IRT,SJETTY,IJET,NOBKS,MMAX)
  1   CONTINUE
      RETURN
  445 STOP
  446 CONTINUE
      END
      SUBROUTINE QTRAN
      PARAMETER (NI=53,NJ=11)
C*THIS SUBROUTINE CALCS THE BREAKER HEIGHT  FOR EACH
C*************************************************************************
C*OF THE I GRID LINES. METHOD--FINDS Y-LOCATIONS BEFORE AND AFTER
C*BREAKING HAS OCCURRED BY \REFRAC\, THEN USES SHOALING TO GET THE
C*HBQ.SNELL\S LAW IS USED FOR REFRACTION OVER THE SHORT DIST TO BREAKING
C* QX(I,J) IS THE TRANS BETWEEN(I-1,J) AND (I,J) AT THE BLOCKCENT
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
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      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
      COMMON/G/IBREAK(NI),HNONBR(NJ)
      COMMON/E/RHO,RHOS,POROS,CONST,TKSI
      COMMON/P/HBQ(NI),DEEPB(NI)
      CAPPA=0.78
      DO 1 I=2,IMAX
      DO 2 JJ=1,JMAX
      J=JMAX-JJ+1
      HDUM=(H(I,J)+H(I-1,J))*0.5
      HBDUM=(HB(I,J)+HB(I-1,J))*0.5
C*CAN ONLY USE COND ON ONE SIDE OF STRUCT. CAN\T AVG HERE?
      DO 4 M=1,MMAX
      IF(SJETTY(M).EQ.0.) GO TO 74
      IF(I.NE.IJET(M)+1)   GO TO 4
      IF(THETAO(M).GE.0.0)   ISIDE=IJET(M)
      IF(THETAO(M).LT.0.0)   ISIDE=IJET(M)+1
      YSEA=.5*(Y(ISIDE,J)+Y(ISIDE,J+1))
      IF(YSEA.GT.SJETTY(M))   GO TO 3
      HDUM=H(ISIDE,J)
      HBDUM=HB(ISIDE,J)
      GO TO 3
    4 CONTINUE
   74 CONTINUE
    3 IF(HDUM.LT.HBDUM)   GO TO 2
      DEEPB(I)=((0.5*(H(I,J+1)+H(I-1,J+1)))*(0.5*(DEEP(I,J+1)
     *   +DEEP(I-1,J+1)))**0.25)/CAPPA)**0.8
      HBQ(I)=CAPPA*DEEPB(I)
C*HBQ(I) AND DEEPB(I) WILL BE COMPUTED ACCORDING TO THE WAVE DIR.
C** AT THE STRUCTURE TIP,THETAO.
      DO 6 M=1,MMAX
      IF(SJETTY(M).EQ.0.) GO TO 1
      IF(I.NE.IJET(M)+1)   GO TO 6
C**THE TRANSPORTING WAVES WILL BE COMPUTED USING THE WAVE TO PROP SIDE.
      IF(THETAO(M).GE.0.0)   GO TO 11
      DEEPB(I)=(H(IJET(M)+1,J+1)*DEEP(IJET(M)+1,J+1)**0.25/CAPPA)**0.8
      IBREAK(I)=IBREAK(IJET(M)+1)
      GO TO 12
   11 DEEPB(I)=(H(IJET(M),J+1)*DEEP(IJET(M),J+1)**0.25/CAPPA)**0.8
      IBREAK(I)=IBREAK(IJET(M))
   12 HBQ(I)=DEEPB(I)*CAPPA
      GO TO 1
    6 CONTINUE
      GO TO 1
    2 CONTINUE
    1 CONTINUE
C*IF THE OFFSHORE WAVE HT IS ZERO, NEVER GET TO HERE.
C*HOWEVER IF THE H IS SUCH THAT IT WOULD BREAK INSHORE OF Y(I,2)
      DO 20 I=2,IMAX
      IF(DEEPB(I).GT.0.0)   GO TO 20
      DEEPB(I)=(H(I,1)*DEEP(I,1)**0.25/CAPPA)**0.8
      HBQ(I)=CAPPA*DEEPB(I)
```

```
   20 CONTINUE
      HBQ(1)=HBQ(2)
      HBQ(IMAX+1)=HBQ(IMAX)
      DEEPB(1)=DEEPB(2)
      DEEPB(IMAX+1)=DEEPB(IMAX)
      RETURN
      END
      SUBROUTINE BREAK(IMAX,JMAX)
      PARAMETER(NI=53,NJ=11)
C*****************************************************************************
C*ROUTINE WILL DETERMINE HB AND DEEPB ON THE GRID LINES RATHER
C*  THAN BETWEEN THEM. REQ\D FOR COFF BEYOND SURF ZONE.
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/MP/ RKB(NI),HBI(NI),DEEPBI(NI)
      CAPPA=0.78
      DO 1 I=2,IMAX
      DO 2 JJ=1,JMAX
      J=JMAX-JJ+1
      IF(H(I,J).LT.HB(I,J))   GO TO 2
      DEEPBI(I)=((H(I,J+1)*DEEP(I,J+1)**0.25)/CAPPA)**0.8
      HBI(I)=CAPPA*DEEPBI(I)
C***ONCE THE HEIGHT + DEPTH AT BREAKING ARE FOUND, GO TO NEXT GRID-LINE.
      GO TO 1
    2 CONTINUE
    1 CONTINUE
      DO 20 I=2,IMAX
      IF(DEEPBI(I).GT.0.0)   GO TO 20
      DEEPBI(I)=(H(I,1)*DEEP(I,1)**0.25/CAPPA)**0.8
      HBI(I)=CAPPA*DEEPBI(I)
   20 CONTINUE
      DEEPBI(1)=DEEPBI(2)
      DEEPBI(IMAX+1)=DEEPBI(IMAX)
      HBI(1)=HBI(2)
      HBI(IMAX+1)=HBI(IMAX)
      RETURN
      END
      SUBROUTINE REFRAC(JBEGIN,JEND,NPTS,IBEGIN,IEND,ISTART,M)
      PARAMETER(NI=53,NJ=11)
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
      COMMON/G/IBREAK(NI),HNONBR(NJ)
      COMMON/ZZZ/NTIME
      DIMENSION JBEGIN(NI),JEND(NI)
C****************                        THIS SUBROUTINE WILL DETERMINE H AND
C****************                        THETA AT THE MID PT OF Y VALUES.
C***TAU IS THE FACTOR WHICH RECOUPLES THE REFRACTION EQS.SEE ABBOTT
      TAU=0.25
C*MUST PRESCRIBE THE WAVE ANGLE AT THE OUTERMOSTCONTOUR BOX
C*SNELL\S LAW WILL BE USED TO START THINGS OFF.
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C*THETA(I,J) WILL BE AT AREA\S CENTER AND WILL USE Y(I,J) IN NEG Y-DIR
C*WILL INITIALIZE ALL THETA\S USING SNELL\S LAW.
      DO 206 I=IBEGIN,IEND
C*INITIALIZE TWO J-VALUES BEYOND JMAX,IF IN REGION 1.
      IF(JEND(I).EQ.JMAX)   JINIT=2
      IF(JEND(I).NE.JMAX)   JINIT=0
      DO 206 J= JBEGIN(I),JEND(I)+JINIT
C*MUST CORRECT FOR THE CONTOUR ORIENTATION, ALPHAS.
      IF(I.NE.IBEGIN)   GO TO 960
      ALPHAS(I,J)=ATAN((0.5*(Y(I+1,J)+Y(I+1,J+1))-0.5*(Y(I,J)
     *  +Y(I,J+1)))/DX)
      GO TO 962
  960  IF(I.NE.IEND)   GO TO 961
      ALPHAS(I,J)=ATAN((0.5*(Y(I,J)+Y(I,J+1))-0.5*(Y(I-1,J)
     *  +Y(I-1,J+1)))/DX)
      GO TO 962
  961  ALPHAS(I,J)=ATAN((0.5*(Y(I+1,J)+Y(I+1,J+1))-0.5*
     *  (Y(I-1,J)+Y(I-1,J+1)))/(2.*DX))
  962  DALPHA=ANGGEN-ALPHAS(I,J)
      ARG=(C(I,J )/CGEN)*SIN(DALPHA)
      IF(ARG.GT.1.) ARG=1.
      THETA(I,J)=ASIN(ARG)
C*MUST GET THETA WRT THE X-AXIS.
      THETA(I,J)=THETA(I,J)+ALPHAS(I,J)
  206  CONTINUE
C*NOW, WE MUST COMP THE BOUN WAVE HTS SO THE HTS CAN BE COMPUTED.
C*WILL USE THE EQ. ******   DEL DOT   (E*CG)=0.0
C*NOW WE WILL CORRECT THE HT FOR SHOALING AND REFRACTION TO THE B.C.
C*WILL ALSO INITIALIZE H\S WITH THESE EQUATIONS FOR ENTIRE ARRAY.
      DO 500 I=IBEGIN,IEND
C*INITIALIZE TWO J-VALUES BEYOND JMAX IF IN REGION 1.
      IF(JEND(I).EQ.JMAX)   JINIT=2
      IF(JEND(I).NE.JMAX)   JINIT=0
      DO 500 J=JBEGIN(I),JEND(I)+JINIT
      H(I,J)=HGEN*SQRT(CGGEN/CG(I,J))*SQRT(COS(ANGGEN)/COS(THETA(I,
     *  J)))
      IF(HB(I,J).LT.H(I,J))   H(I,J)=HB(I,J)
 500  CONTINUE
C*----------------------------------------------------------------------
C***********************************************************************
C*LET\S FILL THE DY ARRAY.
C*DY WILL BE INDEXED AS THE THETA TO WHICH WE ARE GOING.
      DO 209 I=IBEGIN,IEND
      DO 209 J=JBEGIN(I)+1,JEND(I)
      DY(I,J-1)=0.5*(Y(I,J-1)+Y(I,J))-0.5*(Y(I,J)+Y(I,J+1))
 209  CONTINUE
      NITERS=100
      DO 100 NITER=1,NITERS
      SUMANG=0.0
C*DO \60 LOOP\ GOES FROM 2 TO IMAX IF ISTART =IBEGIN
C*DO \60 LOOP\  GOES FROM IMAX-1 TO 1 IF ISTART=IEND
      DO 60 II=IBEGIN,IEND
CMUST HAVE IT SET UP SO THAT THE KNOWN BOUNDARIES
        IF(ISTART .EQ. IBEGIN) I=II
COMMENT LINE WITH UNKNOWN CHARACTERS REMOVED HERE.
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      IF(ISTART.EQ.IBEGIN  .AND.  I.EQ.IBEGIN)   GO TO 60
      IF(ISTART.EQ.IEND)   I=IEND-II+IBEGIN
      IF(ISTART.EQ.IEND  .AND.  I.EQ.IEND)   GO TO 60
C*ADX EQUALS ACTUAL DELTA X ACROSS SPACE STEP.
C*ONLY ON BOUNDARIES WHERE FORWARD OR BACKWARD DIFFERENCING.
      IF(I.NE.IBEGIN)   GO TO 6
      ADX=DX
      IP=I+1
      IM=I
      GO TO 12
 6    IF(I.NE.IEND)   GO TO 10
      ADX=DX
      IP=I
      IM=I-1
      GO TO 12
 10   ADX=2.0*DX
      IP=I+1
      IM=I-1
 12    CONTINUE
      DO 40 J=JBEGIN(I),JEND(I)-1
C*WILL GO FROM (JMAX-1) TO 1 BECAUSE THAT\S THE DIR WAVE COMES IN FROM.
      JJ=JEND(I)-1-J+JBEGIN(I)
      OLDANG(I,JJ)=THETA(I,JJ)
C*LOCATE MIDPOINT BETWEEN TWO ADJACENT BLOCK CENTERS
C*BECAUSE THETA\S JJ-VALUE IS THE SAME AS THE FIRST SHOREWARD Y VALUE
C*MUST USE JJ, JJ+1, AND JJ+2 TO COMPUTE YBAR.
      YBAR=0.25*(Y(I,JJ)+2.0*Y(I,JJ+1)+Y(I,JJ+2))
C*LOCATE APPROPRIATE INDICES ON IP AND IM GRID LINES.
      IMINUS=-1
      IPLUS=+1
      CALL LOC(IM,JJ,JOIM,JSIM,YBAR,IMINUS)
      CALL LOC(IP,JJ,JOIP,JSIP,YBAR,IPLUS)
C*NOW USE THE CONSERVATION OF WAVES EQUATION.............
      PART1C=RK(I,JJ+1)*SIN(THETA(I,JJ+1))
      PART2=-DY(I,JJ)/ADX
C*WILL LINEARLY INTERPOLATE TO DETERMINE RK*COS(THETA) AT I+1 AND I-1.
C*IF NO ADJ SHOREWARD PT EXISTS, PUT IN ZERO FOR TERMS IN GOV. EQ.
      IF(JSIM.NE.0)   GO TO 301
      PART3B=0.0
      GO TO 302
  301 TOPIM=RK(IM,JOIM-1)*COS(THETA(IM,JOIM-1))
      BOTIM=RK(IM,JSIM)*COS(THETA(IM,JSIM))
      TOTALB=0.5*(Y(IM,JOIM)+Y(IM,JOIM-1))-0.5*(Y(IM,JSIM+1)+Y(IM,JSIM))
      DUMB=0.5*(Y(IM,JOIM)+Y(IM,JOIM-1))-YBAR
      PART3B=((TOTALB-DUMB)*(TOPIM-BOTIM)/TOTALB)+BOTIM
  302 IF(JSIP.NE.0)   GO TO 303
      PART3A=0.0
      GO TO 304
  303 TOPIP=RK(IP,JOIP-1)*COS(THETA(IP,JOIP-1))
      BOTIP=RK(IP,JSIP)*COS(THETA(IP,JSIP))
      TOTALA=0.5*(Y(IP,JOIP)+Y(IP,JOIP-1))-0.5*(Y(IP,JSIP+1)+Y(IP,JSIP))
      DUMA=0.5*(Y(IP,JOIP)+Y(IP,JOIP-1))-YBAR
      PART3A=((TOTALA-DUMA)*(TOPIP-BOTIP)/TOTALA)+BOTIP
  304 PART3=PART3A-PART3B
C*NOW MUST FIND RK*SIN(THETA) FOR I+1 AND I-1 AT J+1
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      YBARP=0.25*(Y(I,JJ+1)+2.*Y(I,JJ+2)+Y(I,JJ+3))
      CALL LOC(IM,JJ+1,JPOIM,JPSIM,YBARP,IMINUS)
      CALL LOC(IP,JJ+1,JPOIP,JPSIP,YBARP,IPLUS)
      IF(JPSIM.NE.0)   GO TO 305
      PART1B=0.0
      GO TO 306
  305 TOPM=RK(IM,JPOIM-1)*SIN(THETA(IM,JPOIM-1))
      BOTM=RK(IM,JPSIM)*SIN(THETA(IM,JPSIM))
      TOTB=0.5*(Y(IM,JPOIM)+Y(IM,JPOIM-1))-0.5*(Y(IM,JPSIM+1)+
     *   Y(IM,JPSIM))
      DUMPB=0.5*(Y(IM,JPOIM)+Y(IM,JPOIM-1))-YBARP
      PART1B=((TOTB-DUMPB)*(TOPM-BOTM)/TOTB)+BOTM
  306 IF(JPSIP.NE.0)   GO TO 307
      PART1A=0.0
      GO TO 308
  307 TOPP=RK(IP,JPOIP-1)*SIN(THETA(IP,JPOIP-1))
      BOTP=RK(IP,JPSIP)*SIN(THETA(IP,JPSIP))
      TOTA=0.5*(Y(IP,JPOIP)+Y(IP,JPOIP-1))-0.5*(Y(IP,JPSIP+1)+Y(IP,JPSIP
     *   ))
      DUMPA=0.5*(Y(IP,JPOIP)+Y(IP,JPOIP-1))-YBARP
      PART1A=((TOTA-DUMPA)*(TOPP-BOTP)/TOTA)+BOTP
  308 PART1=TAU*PART1B+(1.-2.*TAU)*PART1C+TAU*PART1A
      IF(JPSIM.EQ.0)PART1=(1.-TAU)*PART1C+TAU*PART1A
      IF(JPSIP.EQ.0)PART1=TAU*PART1B+(1.-TAU)*PART1C
      ARG=((PART1+PART2*PART3)/RK(I,JJ))
C*IF THE ROUTINE IS TO BLOWUP,USE SNELLS LAW.
      IF(ABS(ARG).LE.1.0)   GO TO 41
      ARG=(C(I,JJ)/C(I,JJ+1))*SIN(THETA(I,JJ+1))
      IF(ARG.GT.1.0)   ARG=1.0
      THETA(I,JJ)=ASIN(ARG)
      GO TO 42
   41 THETA(I,JJ)=ASIN(ARG)
   42 THETA(I,JJ)=0.5*(THETA(I,JJ)+OLDANG(I,JJ))
      SUMANG=SUMANG+(ABS(THETA(I,JJ)-OLDANG(I,JJ)))
   40 CONTINUE
   60 CONTINUE
C*MUST EJECT IF WE HAVE REACHED AN ACCEPTABLE ITERATION ERROR
C*IF THE SUM OF THE ABSOLUTE VALUE OF ANGLE CHANGES DURING AN ITERATION
C*       AVERAGES LESS THAN 0.02 DEGREES PER GRID ITS CLOSE ENOUGH.
      IF(SUMANG.LT.(NPTS*0.0035))  GO TO 215
      IF(NITER.GE.50)   GO TO 215
  100 CONTINUE
      WRITE(2,803)
  215 CONTINUE
C*ITERATION LOOP FOR THE WAVE HEIGHT.
      DO 501 NITER=1,NITERS
      SUMH=0.0
      DO 510  II=IBEGIN,IEND
C*MUST HAVE IT SET UP SO THAT  THE KNOWN BOUNDARIES HTS. AREN\T RECOMP
      IF(ISTART.EQ.IBEGIN)   I=II
      IF(ISTART.EQ.IBEGIN  .AND.  I.EQ.IBEGIN)  GO TO 510
      IF(ISTART.EQ.IEND)   I=IEND-II+IBEGIN
      IF(ISTART.EQ.IEND  .AND.  I.EQ.IEND)   GO TO 510
C*ADX EQUALS ACTUAL DELTA X ACROSS SPACE STEP.
C*ONLY ON BOUNDARIES WHERE FORWARD OR BACKWARD DIFFERENCING.
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      IF(I.NE.IBEGIN)   GO TO 503
      ADX=DX
      IP=I+1
      IM=I
      GO TO 505
503     IF(I.NE.IEND)   GO TO 504
      ADX=DX
      IP=I
      IM=I-1
      GO TO 505
504    ADX=2.0*DX
      IP=I+1
      IM=I-1
505     CONTINUE
      HNONBR(JMAX)=H(I,JMAX)
      DO 502 J=JBEGIN(I),JEND(I)-1
      JJ=JEND(I)-1-J+JBEGIN(I)
      HOLD(I,JJ)=H(I,JJ)
      YBAR=0.25*(Y(I,JJ)+2.0*Y(I,JJ+1)+Y(I,JJ+2))
      CALL LOC(IM,JJ,JOIM,JSIM,YBAR,IMINUS)
      CALL LOC(IP,JJ,JOIP,JSIP,YBAR,IPLUS)
      PART13=(H(I,JJ+1)**2.)*CG(I,JJ+1)*COS(THETA(I,JJ+1))
      PART2=DY(I,JJ)/ADX
      IF(JSIM.NE.0)   GO TO 311
      PART4B=0.0
      GO TO 312
  311 TOPIMH=(H(IM,JOIM-1)**2.)*CG(IM,JOIM-1)*(SIN(THETA(IM,JOIM-1)))
      BOTIMH=(H(IM,JSIM)**2.)*CG(IM,JSIM)*SIN(THETA(IM,JSIM))
      TOTALB=0.5*(Y(IM,JOIM)+Y(IM,JOIM-1))-0.5*(Y(IM,JSIM+1)+Y(IM,JSIM))
      DUMB=0.5*(Y(IM,JOIM)+Y(IM,JOIM-1))-YBAR
      PART4B=((TOTALB-DUMB)*(TOPIMH-BOTIMH)/TOTALB)+BOTIMH
  312 IF(JSIP.NE.0)   GO TO 313
      PART4A=0.0
      GO TO 314
  313 TOPIPH=(H(IP,JOIP-1)**2.)*CG(IP,JOIP-1)*SIN(THETA(IP,JOIP-1))
      BOTIPH=(H(IP,JSIP)**2.)*CG(IP,JSIP)*SIN(THETA(IP,JSIP))
      TOTALA=0.5*(Y(IP,JOIP)+Y(IP,JOIP-1))-0.5*(Y(IP,JSIP+1)+Y(IP,JSIP))
      DUMA=0.5*(Y(IP,JOIP)+Y(IP,JOIP-1))-YBAR
      PART4A=((TOTALA-DUMA)*(TOPIPH-BOTIPH)/TOTALA)+BOTIPH
  314 PART4=PART4A-PART4B
      YBARP=0.25*(Y(I,JJ+1)+2.*Y(I,JJ+2)+Y(I,JJ+3))
      CALL LOC(IM,JJ+1,JPOIM,JPSIM,YBARP,IMINUS)
      CALL LOC(IP,JJ+1,JPOIP,JPSIP,YBARP,IPLUS)
      IF(JPSIM.NE.0)   GO TO 315
      PART12=0.0
      GO TO 316
  315 TOPMH=(H(IM,JPOIM-1)**2)*CG(IM,JPOIM-1)*COS(THETA(IM,JPOIM-1))
      BOTMH=(H(IM,JPSIM)**2)*CG(IM,JPSIM)*COS(THETA(IM,JPSIM))
      TOTB=.5*(Y(IM,JPOIM)+Y(IM,JPOIM-1))-.5*(Y(IM,JPSIM+1)+Y(IM,JPSIM))
      DUMPB=0.5*(Y(IM,JPOIM)+Y(IM,JPOIM-1))-YBARP
      PART12=((TOTB-DUMPB)*(TOPMH-BOTMH)/TOTB)+BOTMH
  316 IF(JPSIP.NE.0)   GO TO 317
      PART11=0.0
      GO TO 318
  317 TOPPH=(H(IP,JPOIP-1)**2)*CG(IP,JPOIP-1)*COS(THETA(IP,JPOIP-1))
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      BOTPH=(H(IP,JPSIP)**2)*CG(IP,JPSIP)*COS(THETA(IP,JPSIP))
      TOTA=.5*(Y(IP,JPOIP)+Y(IP,JPOIP-1))-.5*(Y(IP,JPSIP+1)+Y(IP,JPSIP))
      DUMPA=0.5*(Y(IP,JPOIP)+Y(IP,JPOIP-1))-YBARP
      PART11=((TOTA-DUMPA)*(TOPPH-BOTPH)/TOTA)+BOTPH
  318 PART1H=TAU*PART12+(1.-2.*TAU)*PART13+TAU*PART11
      IF(JPSIM.EQ.0)PART1H=(1.-TAU)*PART13+TAU*PART11
      IF(JPSIP.EQ.0)PART1H=TAU*PART12+(1.-TAU)*PART13
      ARG=((PART1H+PART2*PART4)/(CG(I,JJ)*COS(THETA(I,JJ))))
C*IF THERE IS TO BE AN INVALID SQRT,USE LINEAR SHOALING.
      IF(ARG.GE.0.)   GO TO 44
      ARG=(CG(I,JJ+1)*COS(THETA(I,JJ+1)))/(CG(I,JJ)*COS(THETA(I,JJ)))
      IF(ARG.LT.0.0)   ARG=0.0
      H(I,JJ)=H(I,JJ+1)*SQRT(ARG)
      GO TO 45
   44 H(I,JJ)=SQRT(ARG)
   45 H(I,JJ)=0.5*(H(I,JJ)+HOLD(I,JJ))
      HNONBR(JJ)=H(I,JJ)
C*IBREAK(I)=JJ, THEREFORE JJ WILL BE LEEWARD SIDE OF GRID AT INIT BREAK
      IF(HB(I,JJ) .LT. H(I,JJ) .AND. HB(I,JJ+1).GE.HNONBR(JJ+1))
     *       IBREAK(I)=JJ
      IF(HB(I,JJ).LT.H(I,JJ))    H(I,JJ)=HB(I,JJ)
      SUMH=SUMH+ABS(H(I,JJ)-HOLD(I,JJ))
  502 CONTINUE
  510 CONTINUE
      IBREAK(IEND)=IBREAK(IEND-1)
      IBREAK(IBEGIN)=IBREAK(IBEGIN+1)
      IF(SUMH.LT.(NPTS*0.01))    GO TO 507
      IF(NITER.GE.50)    GO TO 507
  501 CONTINUE
      WRITE(2,803)
  507 CONTINUE
  802 FORMAT(2X,4(F15.5),////)
  803 FORMAT(2X,"AFTER NITERS ITERATIONS, CONVERGENCE WAS NOT REACHED")
  804 FORMAT(2X,"THE WAVE HT. ROUTINE CONVERGED IN, NITER= ",I5,//)
  805 FORMAT(2X,"THIS IS MY CHECKING WRITE STATEMENT")
  806  FORMAT(2X,"THE WAVE ANGLE ROUTINE CONVERGED IN, NITER= ",I5,//)
      RETURN
      END
      SUBROUTINE DIFF(RHOND,THETAO,ANGLE,AMP)
C****DIFFRACTION ABOUT SEMI INFINITE BREAKWATER (PENNEY-PRICE)
      PI=3.14159265
      ABSS=SIN(0.5*(ANGLE-THETAO))
      ABSP=SIN(0.5*(ANGLE+THETAO))
      ABC=COS(ANGLE-THETAO)
      ABC1=COS(ANGLE+THETAO)
      XX=RHOND*ABC
      XXC=COS(XX)
      XXS=SIN(XX)
      XX1=RHOND*ABC1
      XXC1=COS(XX1)
      XXS1=SIN(XX1)
      AL=SQRT(RHOND/PI)
      SIG=2.0*AL*ABSS
      SIGP=-2.0*AL*ABSP
      CALL FRES(SIG,C,S,FR,FI)
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      CALL FRES(SIGP,CP,SP,FRP,FIP)
      SUM1=XXC*FR+XXS*FI+XXC1*FRP+XXS1*FIP
      SUM2=XXC*FI-XXS*FR+XXC1*FIP-XXS1*FRP
      AMP=SQRT(SUM1**2+SUM2**2)
      RETURN
      END
      SUBROUTINE FRES(A,C,S,FR,FI)
C*FRESNEL INTEGRAL SUBROUTINE****AFTER ABROMOWITZ AND STEGUN.
      Z=ABS(A)
      PO2=1.5707963
      FZ=(1.0+0.926*Z)/(2.0+1.792*Z+3.104*Z*Z)
      GZ=1.0/(2.0+4.142*Z+3.492*Z*Z+6.670*Z*Z*Z)
      XX=PO2*Z*Z
      CZ=COS(XX)
      SZ=SIN(XX)
      C=0.5-GZ*CZ+FZ*SZ
      S=0.5-FZ*CZ-GZ*SZ
      IF(A.GT.0.0)   GO TO 50
      C=-C
      S=-S
   50 FR=0.5*(1.0+C+S)
      FI=-0.5*(S-C)
      RETURN
      END
      SUBROUTINE PREDIF
      PARAMETER(NI=53,NJ=11)
C***********************************************************************
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
      COMMON/G/IBREAK(NI),HNONBR(NJ)
      DIMENSION J1(NI),J2(NI),J1REF(NI),J3REF(NI)
      DO 99 J=1,IMAX+3
      J1(J)=0
      J2(J)=0
      J1REF(J)=0
   99 CONTINUE
C*THIS SUB CALCS WHERE DIFFRACTION GOVERNS AND WHERE REFRACT GOVERNS.
C*IT WILL CALL REFRAC FOR OFFSHORE AREA(OFF TIP OF STRUCTURE).
C*THEN IT WILL DO THE SHADOW ZONE USING DIFF(IF THETAO .NE.0.0)
C* IT WILL THEN FINISH THE  OTHERS USING REFRAC AGAIN.
C*NOW, LETS FIND C,CG,RK,HB, AND WVNUM.
      DO 202 I=1,IMAX+1
      DO 202 J=1,JMAX+2
      DEPTH=DEEP(I,J)
      CALL WVNUM(DEPTH,T,DUMK)
      RK(I,J)=DUMK
      C(I,J)=CO*TANH(RK(I,J)*DEEP(I,J))
      EN=0.5*(1.0+((2.*RK(I,J)*DEEP(I,J))/SINH(2.*RK(I,J)*DEEP(I,J))))
      CG(I,J)=EN*C(I,J)
      HB(I,J)=0.78*DEEP(I,J)
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      H(I,J)=HB(I,J)
  202 CONTINUE
C*WILL ATTRIB AN EQUAL REACH TO EACH SIDE OF EACH M-GROIN.
      DO 200 M=1,MMAX
      IDUML=1
      IF(M.NE.1) IDUML=(IJET(M)+IJET(M-1))/2
      IDUMR=IMAX
      IF(M.NE.MMAX) IDUMR=(IJET(M)+IJET(M+1))/2
      NPTS=0
      DO 1 I=IDUML,IDUMR
      DO 2 J=1,JMAX
      IF(Y(I,J).LT.SJETTY(M))   GO TO 14
      J1(I)=J
      J2(I)=JMAX
      GO TO 15
   14 CONTINUE
    2 CONTINUE
   15 CONTINUE
C*IF NO STRUCT IS PRESENT(SJETTY=0.0), DO REFRAC THRUOUT GRID SYSTEM
      IF(SJETTY(M).EQ.0.0)   J1(I)=1
    1 CONTINUE
      DO 16 I=IDUML,IDUMR
C*  \REFRAC\ STARTS ON THE NEXT TO LAST J-CONTOUR,NOT THE LAST?
      DO 16 J=J1(I),J2(I)-1
   16 NPTS=NPTS+1
C*WILL NOW DO THE REFRACT FOR THE REGION 1 AREA.
C*ISTART REPRESENTS THE DIRECTION THE SWEEPS WILL BEGIN FROM.
C*WILL USE DUMMY IMAX,IJET,IJET+1 IN CALL STTS SO IBEGIN,IEND, AND
C***ISTART  WON\T CHANGE THEM.MUST RESET AFTER EACH CALL REFRAC.
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
      IF(ANGGEN.GE.0.0) CALL REFRAC(J1,J2,NPTS,IDUMLL,IMAXT,IDUMLL,M)
      IF(ANGGEN.LT.0.0) CALL REFRAC(J1,J2,NPTS,IDUMLL,IMAXT,IMAXT,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
      JDUMN=J1(IJET(M))
      JDUMS=J1(IJET(M)+1)
      XDISTN=(IJET(M)-1.0)*DX+DX/2.
      ELTIP=T*0.5*(C(IJET(M),JDUMN)+C(IJET(M)+1,JDUMS))
C*NOW MUST CHECK THE ANGLE AT THE STRUCTURE\S TIP TO SEE WHERE SHAD ZONE
C*IF NO STRUCT PRESENT(SJETTY(M)=0.0), FUTHER REFRAC/DIFF UNNECESSARY.
      IF(SJETTY(M).EQ.0.0)   GO TO 13
      THETA0(M)=0.5*(THETA(IJET(M),JDUMN)+THETA(IJET(M)+1,JDUMS))
      HINC=0.5*(H(IJET(M),JDUMN)+H(IJET(M)+1,JDUMS))
      IF(THETA0(M))10,11,12
C*THIS SECTION HANDLES REFRAC/DIFF IF THETA0)0.0.
   10 CONTINUE
C*FIRST ALL OF REGION 2 WILL GET REFRACTED.
      NPTS=0
      DO 100 I=IJET(M)+1,IDUMR
      J2(I)=J1(I)
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  100 J1(I)=1
       DO 101 I=IJET(M)+1,IDUMR
       DO 101 J=J1(I),J2(I)-1
  101 NPTS=NPTS+1
      IMAXT=IDUMR
      IDUMLL=IDUML
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1,J2,NPTS,IJETP1,IMAXT,IMAXT,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
C*NOW MUST DO REGION 3 OF NEG THETAO CASE-SHADOW ZONE.
      DO 102 I=IDUML,IJET(M)
      J2(I)=J1(I)
  102 J1(I)=1
      DO 103 I=IDUML,IJET(M)
      J1REF(I)=1
      DO 104 J=J1(I),J2(I)+1
      XCOOR=(I-1.0)*DX
      YCOOR=0.5*(Y(I,J)+Y(I,J+1))
      ANGLE=ATAN((XDISTN-XCOOR)/(SJETTY(M)-YCOOR))
      IF(YCOOR.GT.SJETTY(M))   ANGLE=PI+ANGLE
C*IF MOST SHOREWARD PT OUT OF SHAD ZONE, SO ARE THE OTHERS FOR THAT I.
      IF(ABS(ANGLE).GT.ABS(THETAO(M)))   GO TO 105
      RAD=SQRT((XDISTN-XCOOR)**2+(SJETTY(M)-YCOOR)**2)
      RHOND=RAD*TWOPI/ELTIP
C*DIFFRACTION TREATS THE POS THETAO CASE.
      THE=ABS(THETAO(M))
      CALL DIFF(RHOND,THE,ANGLE,AMP)
      H(I,J)=AMP*HINC
      ANGRAD=-ANGLE
C*WILL NOW REFRACT DIFF WAVES IN THE SHAD ZONE USING SNELL\S.
      CTIP=ELTIP/T
       ALPHAS(I,J)=ATAN((0.5*(Y(I+1,J)+Y(I+1,J+1))-0.5*
     *  (Y(I-1,J)+Y(I-1,J+1)))/(2.*DX))
      IF(I.EQ.IJET(M))ALPHAS(I,J)=ATAN((0.5*(Y(I,J)+Y(I,J+1))-0.5*(Y(I-1
     *    ,J)+Y(I-1,J+1)))/DX)
      DALPHA=ANGRAD-ALPHAS(I,J)
      ARG=(C(I,J)/CTIP)*SIN(DALPHA)
      IF(ARG.GT.1.) ARG=1.
      THETA(I,J)=ASIN(ARG)
      THETA(I,J)=THETA(I,J)+ALPHAS(I,J)
C*MUST CHECK TO SEE IF WAVE WOULD HAVE BROKEN.
      IF(HB(I,J).LE.H(I,J).AND.HB(I,J+1).GT.H(I,J+1))IBREAK(I)=J
      IF(HB(I,J).LT.H(I,J))   H(I,J)=HB(I,J)
  104 CONTINUE
      GO TO 103
  105 J1REF(I)=J
  103 CONTINUE
C*NOW MUST DO REFRACTION FOR REGION 4.
      NPTS=0
       DO 106 I=IDUML,IJET(M)
      DO 106 J=J1REF(I),J2(I)-1
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  106 NPTS=NPTS+1
      IDUMLL=IDUML
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1REF,J2,NPTS,IDUMLL,IJETT,IDUMLL,M)
      IDUMLL=IDUML
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      GO TO 13
C*THIS HANDLES REFRAC/DIFF IF THETAO IS 0.0.
C*FOR THIS CASE, ONLY THREE REGIONS EXIST.
   11 CONTINUE
      NPTS=0
      DO 120 I=IDUML,IJET(M)
      J2(I)=J1(I)
  120 J1(I)=1
      DO 121 I=IDUML,IJET(M)
      DO 121 J=J1(I),J2(I)-1
  121 NPTS=NPTS+1
      IMAXT=IDUMR
      IDUMLL=IDUML
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1,J2,NPTS,IDUMLL,IJETT,IDUMLL,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
      DO 122 I=IJET(M)+1,IDUMR
      J2(I)=J1(I)
  122 J1(I)=1
      NPTS=0
      DO 123 I=IJET(M)+1,IDUMR
      DO 123 J=J1(I),J2(I)-1
  123 NPTS=NPTS+1
      IMAXT=IDUMR
      IDUMLL=IDUML
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1,J2,NPTS,IJETP1,IMAXT,IMAXT,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
      GO TO 13
C*THIS SECTION HANDLES REFRACT/DIFF IF THETAO;0.0
   12 CONTINUE
C*FIRST, REGION 2- ALL REFRACTION.
      NPTS=0
      DO 110 I=IDUML,IJET(M)
      J2(I)=J1(I)
  110 J1(I)=1
      DO 111 I=IDUML,IJET(M)
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      DO 111 J= J1(I),J2(I)-1
  111 NPTS=NPTS+1
      IMAXT=IDUMR
      IDUMLL=IDUML
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1,J2,NPTS,IDUMLL,IJETT,IDUMLL,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
C*NOW WILL DO REGION 3 OF THE POS THETAO CASE.
      DO 112 I=IJET(M)+1,IDUMR
      J2(I)=J1(I)
  112 J1(I)=1
      DO 113 I=IJET(M)+1,IDUMR
      J1REF(I)=1
C*WILL GO ONE PT. BEYOND J2(I) TO MAKE SURE OUTOF DIFF ZONE.
      DO 114 J=J1(I),J2(I)+1
      XCOOR=(I-1.0)*DX
      YCOOR=0.5*(Y(I,J)+Y(I,J+1))
      ANGLE=ATAN((XCOOR-XDISTN)/(SJETTY(M)-YCOOR))
      IF(YCOOR.GT.SJETTY(M))   ANGLE=PI+ANGLE
C*IF LEAST J-VALUE IS OUT OF SHAD ZONE,SO ARE OTHER J\S.(FOR EACH I)
      IF(ANGLE.GT.ABS(THETAO(M)))   GO TO 115
      RAD=SQRT((XCOOR-XDISTN)**2+(SJETTY(M)-YCOOR)**2)
      RHOND=RAD*TWOPI/ELTIP
      THE=THETAO(M)
      CALL DIFF(RHOND,THE,ANGLE,AMP)
      ANGRAD=ANGLE
C*WILL NOW REFRACT DIFFRACTED WAVES IN SHAD ZONE USING SNELL\S.
      CTIP=ELTIP/T
      ALPHAS(I,J)=ATAN((0.5*(Y(I+1,J)+Y(I+1,J+1))-0.5*
     *  (Y(I-1,J)+Y(I-1,J+1)))/(2.*DX))
      IF(I.EQ.IJET(M)+1)ALPHAS(I,J)=ATAN((0.5*(Y(I+1,J)+Y(I+1,J+1))-0.5*
     *   (Y(I,J)+Y(I,J+1)))/DX)
      DALPHA=ANGRAD-ALPHAS(I,J)
      ARG=(C(I,J)/CTIP)*SIN(DALPHA)
      IF(ARG.GT.1.) ARG=1.
      THETA(I,J)=ASIN(ARG)
      THETA(I,J)=THETA(I,J)+ALPHAS(I,J)
      H(I,J)=HINC*AMP
C*MUST CHECK TO SEE IF WAVE WOULD HAVE BROKEN.
      IF(HB(I,J).LE.H(I,J).AND.HB(I,J+1).GT.H(I,J+1))IBREAK(I)=J
      IF(HB(I,J).LT.H(I,J))   H(I,J)=HB(I,J)
  114 CONTINUE
      GO TO 113
  115 J1REF(I)=J
  113 CONTINUE
C*NOW MUST DO REFRAC FOR REGION 4.
      NPTS=0
      DO 116 I=IJET(M)+1,IDUMR
      DO 116 J=J1REF(I),J2(I)-1
  116 NPTS=NPTS+1
      IMAXT=IDUMR
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      IDUMLL=IDUML
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      CALL REFRAC(J1REF,J2,NPTS,IJETP1,IMAXT,IMAXT,M)
      IMAXT=IDUMR
      IJETT=IJET(M)
      IJETP1=IJET(M)+1
      IDUMLL=IDUML
   13 CONTINUE
  200 CONTINUE
      RETURN
      END
      SUBROUTINE LOC(IM,JJ,JOIM,JSIM,YBAR,IDUM)
      PARAMETER(NI=53,NJ=11)
C*************************************************************************
      COMMON/A/ C(NI,NJ),RK(NI,NJ),Y(NI,NJ),DEEP(NI,NJ),ALPHAS(NI,NJ)
      COMMON/AA/YZERO(NI),WDEPTH
      COMMON/B/ THETA(NI,NJ),QXTOT(NI), OLDANG(NI,NJ), DY(NI,NJ)
      COMMON/C/ H(NI,NJ),CG(NI,NJ),HOLD(NI,NJ),HB(NI,NJ),YB(NI)
      COMMON/N USED/JUSE,T,CO,CGEN,CGGEN,ANGGEN,DX,BERM,THETAO(10),MMAX
      COMMON/D/SIGMA,G,ELO,JMAX,IMAX,PI,TWOPI,PIO2,HGEN,IJET(10)
     1,SJETTY(10)
C*SUBROUTINE LOC FINDS J-VALUES WHICH ARE GREATER AND LESS THAN YBAR.
      JOIM=2
 2    AA=0.5*(Y(IM,JOIM)+Y(IM,JOIM-1))
      IF(AA.GT.YBAR)   GO TO 4
      JOIM=JOIM+1
C*THE FOLLOWING IS REQ\D SO THAT DY/DX;0.5
C*WILL DTERMINE K SIN THETA ON IM-LINE AT A DIST YBAR.
C*WILL CALL THIS POINT    JUSE+1.
      IF(JOIM.LE.JUSE)   GO TO 2
      JOIM=JUSE+1
      Y(IM,JOIM)=YBAR
C* DEPTH AT THIS POINT WILL BE COMP ASSUMING CONST BEACH SLOPE ON I=IM
      DEL=.5*(Y(IM,JOIM-1)+Y(IM,JOIM-2))-.5*(Y(IM,JOIM-2)+Y(IM,JOIM-3))
      BSLOPE=(DEEP(IM,JOIM-2)-DEEP(IM,JOIM-3))/DEL
      DEEP(IM,JOIM-1)=DEEP(IM,JOIM-2)+BSLOPE*(Y(IM,JOIM)-Y(IM,JOIM-1))
      IF(DEEP(IM,JOIM-1).GT.WDEPTH) DEEP(IM,JOIM-1)=WDEPTH
      DEPTH=DEEP(IM,JOIM-1)
      CALL WVNUM(DEPTH,T,DUMK)
      RK(IM,JOIM-1)=DUMK
      C(IM,JOIM-1)=CO*TANH(RK(IM,JOIM-1)*DEEP(IM,JOIM-1))
      EN=0.5*(1.0+((2.0*RK(IM,JOIM-1)*DEEP(IM,JOIM-1))/SINH(
     *   2.*RK(IM,JOIM-1)*DEEP(IM,JOIM-1))))
      CG(IM,JOIM-1)=C(IM,JOIM-1)*EN
C*WILL USE SNELL\S LAW TO  DETERMINE THE WAVE ANGLE HERE
C*ANGLE OF CONTOUR WILL BE ASSUME TO BE THE SAME AS THE JMAX+1 CONTOUR
      IF(IDUM.EQ.1)ALPH=ATAN((Y(IM,JOIM-1)-Y(IM-1,JOIM-1))/DX)
      IF(IDUM.EQ.-1)ALPH=ATAN((Y(IM+1,JOIM-1)-Y(IM,JOIM-1))/DX)
      DALPHA=ANGGEN-ALPH
      ARG=(C(IM,JOIM-1)/CGEN)*SIN(DALPHA)
      IF(ARG.GT.1.) ARG=1.
      THETA(IM,JOIM-1)=ASIN(ARG)
      THETA(IM,JOIM-1)=THETA(IM,JOIM-1)+ALPH
 4     JSIM=JMAX-1
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 6    AA=0.5*(Y(IM,JSIM)+(Y(IM,JSIM+1)))
      IF(AA.LT.YBAR)   GO TO 8
      JSIM=JSIM-1
C*IF JSIM=0,THERE IS NO ADJ PT, SUB REFRAC CAN HANDLE IT.
      IF(JSIM.EQ.0)   GO TO 8
      GO TO 6
 8    RETURN
      END
      SUBROUTINE WVNUM(DEPTH,T,RK)
C***************************************************************************
      G=32.17
      EPS=0.001
      TWOPI=6.283185307
      SIGMA=TWOPI/T
      RK=TWOPI/(T*SQRT(G*DEPTH))
      DO 100 IT=1,20
      ARG=RK*DEPTH
      EK=(G*RK*TANH(ARG))-(SIGMA**2)
      EKPR=G*(ARG*((SECH(ARG))**2)+TANH(ARG))
      RKNEW=RK-EK/EKPR
      IF(ABS(RKNEW-RK).LE.ABS(EPS*RKNEW))   GO TO 120
      RK=RKNEW
 100  CONTINUE
      WRITE(2,1000)   IT,DEPTH,RK
 1000 FORMAT(///,10X,"ITERATION FOR K FAILED TO CONVERGE AFTER"
     *  ,3X,I3,"ITERATION",/,"OUTPUT00000DEPTH, RK",3X,2F13.5)
      CALL EXIT
 120  RK=RKNEW
      IF(RK.GT.0.0)   GO TO 140
      WRITE(2,1020)   DEPTH,RK
 1020 FORMAT(///,10X," RK IS NEG",/," OUTPUT DEPTH,RK",3X,2F13.5)
      CALL EXIT
 140  RETURN
      END
      SUBROUTINE SMOOTH(THETA,IMAX,JMAX,IJET,SJETTY,MMAX,Y)
      PARAMETER(NI=53,NJ=11)
C***************************************************************************
C*THIS WILL SMOOTH THE WAVE ANGLE FIELD TO ACCT FOR DIFF(ARTIFICIALLY)
      DIMENSION TEMP(NI,NJ),Y(NI,NJ),THETA(NI,NJ),IJET(10),SJETTY(10)
C*(MMAX+1) IS REQ\D BECAUSE M-GROINS HAVE M+1 REACHES OF SHORELINE.
      SJETTY(MMAX+1)=0.
       DO 10 M=1,MMAX+1
      IF(M.NE.1)   GO TO 3
      ILEFT=2
      IRIGHT=IJET(1)
      GO TO 5
   3  IF(M.NE.MMAX+1)   GO TO 4
      ILEFT=IJET(MMAX)+1
      IRIGHT=IMAX-1
      GO TO 5
   4  ILEFT=IJET(M-1)+1
      IRIGHT=IJET(M)
   5  CONTINUE
      DO 1 J=1,JMAX-1
      DO 1 I=ILEFT,IRIGHT
```

```
      IF(I.NE.ILEFT.AND.I.NE.IRIGHT)   GO TO 15
C*TO GET HERE, MUST BE ON BOUN OR ADJ TO A STRUCTURE.
      IF(I.EQ.2.OR.I.EQ.IMAX-1)   GO TO 15
C*TO GET HERE,ADJ TO A STRUCT AND CAN BE ILEFT OR IRIGHT.
      IF(Y(I,J).GE.SJETTY(M))   GO TO 15
C*IF HERE, WITHIN JETTY AND ADJ TO EITHER SIDE.
      IF(I.EQ.ILEFT)TEMP(I,J)=0.5*(THETA(I,J)+THETA(I+1,J))
      IF(I.EQ.IRIGHT)TEMP(I,J)=0.5*(THETA(I,J)+THETA(I-1,J))
      GO TO 1
   15 TEMP(I,J)=0.25*THETA(I-1,J)+0.50*THETA(I,J)+0.25*THETA(I+1,J)
    1 CONTINUE
   10 CONTINUE
       DO 2 J=1,JMAX-1
      DO 2 I=2,IMAX-1
    2 THETA(I,J)=TEMP(I,J)
      RETURN
      END
      FUNCTION SECH(A)
C***********************************************************************
      SECH=1.0/COSH(A)
      RETURN
C****HERE IS WHERE THE IMSL ROUTINES MUST GO
        END
      SUBROUTINE BRKH2O(IMAX,JMAX,MMAX,Y,THETA,H,C
     1,IJET,SJETTY,T,DX,DEEP,HB,CG)
      PARAMETER(NI=53,NJ=11)
      COMMON/NWS/ILFT(5),IRT(5),YLFT(5),YRT(5),NOBKS
     1,DEEPR(5),DEEPL(5),HRT(5),HLFT(5)
      DIMENSION THETAL(5),THETLL(5),THETAR(5),THETRR(5)
     1,XXL(5),XXR(5),CLFT(5),CRT(5),HTEMPR(5)
     1,HTEMPL(5),HTXL(5),HTYL(5),HTXR(5),HTYR(5)
     1,YLLFT(5),YRRT(5),DXL(5),DXR(5),BKANG(5)
     1,CGRT(5),CGLFT(5)
      DIMENSION Y(NI,NJ),THETA(NI,NJ),H(NI,NJ),C(NI,NJ)
     1,IJET(10),SJETTY(10),DEEP(NI,NJ),HB(NI,NJ),CG(NI,NJ)
      PI=3.14159
      TWOPI=2.*PI
      DO 500 N=1,NOBKS
      XXDIST=DX*(IRT(N)-ILFT(N))
      BKANG(N)=ATAN((YRT(N)-YLFT(N))/XXDIST)
      DXL(N)=0.0
      DXR(N)=0.0
      DO 300 J=1,JMAX
      JJ=JMAX-J+2
      IF(YLFT(N).LT.Y(ILFT(N),JJ).AND.YLFT(N).GE.Y(ILFT(N)
     1,JJ-1)) GO TO 350
      GO TO 300
  350 FACT=(Y(ILFT(N),JJ)-YLFT(N))/(Y(ILFT(N),JJ)-Y(ILFT(N),
     1JJ-1))
      DEEPL(N)=DEEP(ILFT(N),JJ)-(DEEP(ILFT(N),JJ)-DEEP
     1(ILFT(N),JJ-1))*FACT
      THETAL(N)=THETA(ILFT(N),JJ)-(THETA(ILFT(N),JJ)-THETA
     1(ILFT(N),JJ-1))*FACT
      HLFT(N)=H(ILFT(N),JJ)-(H(ILFT(N),JJ)-H(ILFT(N),JJ-1))
     1*FACT
```

```
      CLFT(N)=C(ILFT(N),JJ)-(C(ILFT(N),JJ)-C(ILFT(N),JJ-1))
     1*FACT
      CGLFT(N)=CG(ILFT(N),JJ)-(CG(ILFT(N),JJ)-CG(ILFT(N),JJ-1))
     1*FACT
  300 CONTINUE
      DO 400 J=1,JMAX
      JJ=JMAX-J+2
      IF(YRT(N).LT.Y(IRT(N),JJ).AND.YRT(N).GE.Y(IRT(N),JJ-1)
     1) GO TO 450
      GO TO 400
  450 FACT=(Y(IRT(N),JJ)-YRT(N))/(Y(IRT(N),JJ)-Y(IRT(N),JJ-1))
      DEEPR(N)=DEEP(IRT(N),JJ)-(DEEP(IRT(N),JJ)-DEEP(IRT(N)
     1,JJ-1))*FACT
      THETAR(N)=THETA(IRT(N),JJ)-(THETA(IRT(N),JJ)-THETA(IRT(N)
     1,JJ-1))*FACT
      HRT(N)=H(IRT(N),JJ)-(H(IRT(N),JJ)-H(IRT(N),JJ-1))*FACT
      CRT(N)=C(IRT(N),JJ)-(C(IRT(N),JJ)-C(IRT(N),JJ-1))*FACT
      CGRT(N)=CG(IRT(N),JJ)-(CG(IRT(N),JJ)-CG(IRT(N),JJ-1))*FACT
  400 CONTINUE
      YLLFT(N)=YLFT(N)
      YRRT(N)=YRT(N)
      THETLL(N)=THETAL(N)
      THETRR(N)=THETAR(N)
C     WRITE(2,501) N,BKANG(N),DEEPL(N),THETAL(N),HLFT(N),CLFT(N)
C    1,CGLFT(N),DEEPR(N),THETAR(N),HRT(N),CRT(N),CGRT(N),YLLFT(N)
C    1,YRRT(N),THETLL(N),THETRR(N)
  501 FORMAT((I5,7F10.4)/(8F10.4))
  500 CONTINUE
      IDIST=DX
      DO 1000 J=1,JMAX+1
      JJ=JMAX-J+2
      DO 1100 N=1,NOBKS
      XXL(N)=(YLLFT(N)-Y(ILFT(N),JJ))*TAN(THETLL(N))+DX*(
     1ILFT(N)-1)+DXL(N)
      XXR(N)=(YRRT(N)-Y(IRT(N),JJ))*TAN(THETRR(N))+DX*(IRT(N)-1)
     1+DXR(N)
 1100 CONTINUE
      DO 2000 I=2,IMAX
      CONANG=ATAN((Y(I+1,JJ)-Y(I-1,JJ))/(2.*DX))
      XDUM=(I-1)*DX
      HX=H(I,JJ)*SIN(THETA(I,JJ))
      HY=H(I,JJ)*COS(THETA(I,JJ))
      OUT=0.0
      DO 1800 N=1,NOBKS
      HTEMPR(N)=0.
      HTEMPL(N)=0.
      HTXL(N)=0.
      HTYL(N)=0.
      HTXR(N)=0.
      HTYR(N)=0.
C
      IF(Y(I,JJ).GT.YRT(N)) GO TO 1600
      IF(XDUM.GT.XXR(N)) GO TO 1600
      DELY=YRT(N)-Y(I,JJ)
      DELX=(IRT(N)-I)*DX+.0000001
```

```
      ANG=ATAN(DELY/DELX)
      IF(ANG.LE.BKANG(N)) GO TO 1600
      JSHAD=0
      DO 1400 JTY=1,MMAX
      IF(Y(I,JJ).GT.SJETTY(JTY)) GO TO 1400
      IF(I.GE.IJET(JTY).AND.IJET(JTY).LE.IRT(N)) GO TO 1400
      IF(I.LE.IJET(JTY).AND.IJET(JTY).GE.IRT(N)) GO TO 1400
      ANGJET=ATAN((YRT(N)-SJETTY(JTY))/((IRT(N)-IJET(JTY))*DX))
      IF(ABS(ANGJET).LT.ABS(ANG)) JSHAD=1
 1400 CONTINUE
      IF(JSHAD.EQ.1) GO TO 1600
      DUMANG=SQRT(DEEP(I,JJ)/DEEPR(N))*SIN(PI/2.-ANG)
      IF(DUMANG.GT.1.0) DUMANG=1.0
      ANGG=PI/2.-ASIN(DUMANG)+CONANG
      IF(ANG.LT.0.0) ANGG=-ANGG
      IF(ANG.LT.0.0) ANG=ANG+PI
      IF(ANGG.LT.0.0) ANGG=ANGG+PI
      ANG=ANG-BKANG(N)
      RHOND=(TWOPI/(T*CRT(N)))*SQRT(DELX*DELX+DELY*DELY)
      THE=THETAR(N)+PI/2.-BKANG(N)
      CALL DIFF(RHOND,THE,ANG,AMP)
      HTEMPR(N)=HRT(N)*AMP
      HTXR(N)=-HTEMPR(N)*COS(ANGG)
      HTYR(N)=HTEMPR(N)*SIN(ANGG)
      OUT=OUT+1.0
 1600 CONTINUE
C
      IF(Y(I,JJ).GT.YLFT(N)) GO TO 1800
      IF(XDUM.LT.XXL(N)) GO TO 1800
      DELY=YLFT(N)-Y(I,JJ)
      DELX=(I-ILFT(N))*DX+.0000001
      ANG=ATAN(DELY/DELX)
      IF(ANG.LE.BKANG(N)) GO TO 1800
      JSHAD=0
      DO 1700 JTY=1,MMAX
      IF(Y(I,JJ).GT.SJETTY(JTY)) GO TO 1700
      IF(I.LE.IJET(JTY).AND.IJET(JTY).GE.ILFT(N)) GO TO 1700
      IF(I.GE.IJET(JTY).AND.IJET(JTY).LE.ILFT(N)) GO TO 1700
      ANGJET=ATAN((YLFT(N)-SJETTY(JTY))/((IJET(JTY)-ILFT(N))*DX))
      IF(ABS(ANGJET).LT.ABS(ANG)) JSHAD=1
 1700 CONTINUE
      IF(JSHAD.EQ.1) GO TO 1800
      DUMANG=SQRT(DEEP(I,JJ)/DEEPL(N))*SIN(PI/2.-ANG)
      IF(DUMANG.GT.1.0) DUMANG=1.0
      ANGG=PI/2.-ASIN(DUMANG)-CONANG
      IF(ANG.LT.0.0) ANGG=-ANGG
      IF(ANG.LT.0.0) ANG=ANG+PI
      IF(ANGG.LT.0.0) ANGG=ANGG+PI
      ANG=ANG+BKANG(N)
      RHOND=(TWOPI/(T*CLFT(N)))*SQRT(DELY*DELY+DELX*DELX)
      THE=PI/2.-THETAL(N)+BKANG(N)
      CALL DIFF(RHOND,THE,ANG,AMP)
      HTEMPL(N)=HLFT(N)*AMP
      HTXL(N)=HTEMPL(N)*COS(ANGG)
      HTYL(N)=HTEMPL(N)*SIN(ANGG)
```

```
      OUT=OUT+1.
 1800 CONTINUE
      SHADOW=1.0
      IF(OUT.LT..5) GO TO 2000
      DO 1801 N=1,NOBKS
      DD=YLFT(N)+(XDUM-DX*(ILFT(N)-1))*TAN(BKANG(N))
      IF(XDUM.GT.XXL(N).AND.XDUM.LT.XXR(N).AND.Y(I,JJ).LT.DD) SHADOW=0.0
      HX=HX*SHADOW
      HY=HY*SHADOW
C
C

 1801 CONTINUE
      HXT=0.0000001
      HYT=0.0000001
      DO 1900 N=1,NOBKS
      HXT=HXT+HTXL(N)*ABS(HTXL(N))+HTXR(N)*ABS(HTXR(N))
      HYT=HYT+HTYL(N)*ABS(HTYL(N))+HTYR(N)*ABS(HTYR(N))
 1900 CONTINUE
      XXX=ABS(HX)*HX+HXT
      YYY=ABS(HY)*HY+HYT
      H(I,JJ)=SQRT(ABS(XXX)+ABS(YYY))
      IF(H(I,JJ).GT.HB(I,JJ)) H(I,JJ)=HB(I,JJ)
      THETA(I,JJ)=ATAN((XXX/SQRT(ABS(XXX)))/(YYY/SQRT(ABS(YYY))))
 2000 CONTINUE
      DO 1950 N=1,NOBKS
      IF(Y(ILFT(N),JJ).GT.YLFT(N)) GO TO 1960
      YLLFT(N)=Y(ILFT(N),JJ)
      IIXL=XXL(N)
      III=IIXL/IDIST+1
      THETLL(N)=THETA(III,JJ)
      DXL(N)=XXL(N)-DX*(ILFT(N)-1)
 1960 CONTINUE
      IF(Y(IRT(N),JJ).GT.YRT(N)) GO TO 1970
      YRRT(N)=Y(IRT(N),JJ)
      IIXR=XXR(N)
      III=IIXR/IDIST+2
      THETRR(N)=THETA(III,JJ)
      DXR(N)=XXR(N)-DX*(IRT(N)-1)
 1970 CONTINUE
 1950 CONTINUE
 1000 CONTINUE
      RETURN
      END
      SUBROUTINE PLOTNS(IMAX,JMAX,Y,YLFT,YRT,ILFT,IRT,SJETTY,IJET,
     1NOBKS,MMAX)
      PARAMETER(NI=53,NJ=11)
      DIMENSION Y(NI,NJ),YLFT(5),YRT(5),ILFT(5),IRT(5),SJETTY(5)
     1,IJET(5)
      DIMENSION ICHAR(200),IY(6),NN(7)
      DATA NN/1H*,1H0,1H.,1H+,1H#,1H0,1HH/
      DATA NIL/1H /
      IWIDTH=127
C     IWIDTH=75
      YMIN=-50.
```

```
      DO 1 I=1,IMAX
      IF(Y(I,1).GT.YMIN) GO TO 1
      YMIN=Y(I,1)
    1 CONTINUE
      YMAX=Y(1,6)
      DO 2 I=1,IMAX
      IF(Y(I,6).LT.YMAX) GO TO 2
      YMAX=Y(I,6)
    2 CONTINUE
      IF(YMIN.GE.0.) GO TO 3
      SCALE=(YMAX-YMIN)/IWIDTH
      IZERO=-YMIN/SCALE
      GO TO 4
    3 SCALE=YMAX/IWIDTH
      IZERO=50./SCALE
    4 CONTINUE
      DO 500 I=1,IMAX
      DO 10 N=1,127
   10 ICHAR(N)=NIL
      ICHAR(IZERO)=1HI
      DO 20 J=1,6
      IY(J)=Y(I,J)/SCALE+IZERO
      IF(IY(J).LT.1) IY(J)=1
      IF(IY(J).GT.IWIDTH) IY(J)=IWIDTH
   20 ICHAR(IY(J))=NN(J)
      DO 200 N=1,MMAX
      IF(I.EQ.IJET(N)) GO TO 150
      GO TO 200
  150 ILNG=SJETTY(N)/SCALE+IZERO
      IF(ILNG.GT.IWIDTH) ILNG=IWIDTH
      DO 175 M=IZERO,ILNG
  175 ICHAR(M)=NN(7)
  200 CONTINUE
      IF(NOBKS.LT.1) GO TO 301
      DO 300 N=1,NOBKS
      IF(I.GE.ILFT(N).AND.I.LE.IRT(N)) GO TO 250
      GO TO 300
  250 ILNG=YLFT(N)/SCALE+IZERO
      IF(ILNG.GT.IWIDTH) ILNG=IWIDTH
      ICHAR(ILNG)=NN(7)
  300 CONTINUE
  301 CONTINUE
      WRITE(2,30) I,(ICHAR(N),N=1,IWIDTH)
   30 FORMAT(1X,I3,1HI,127A1)
C  30 FORMAT(1X,I3,75A1)
  500 CONTINUE
      RETURN
      END
```

```
/LIST
      PROGRAM DATA(INPUT,OUTPUT,INPUT,SPOOL,TAPE6=OUTPUT,TAPE5=INPUT
     1,TAPE10=INPUT,TAPE20=SPOIL)
      DIMENSION IJET(20),SJETTY(20),ILFT(20),IRT(20),YLFT(20),YRT(20)
     1,Y(100,1),CHANGE(20)
C  THIS PROGRAM ALLOWS THE USER TO CREATE AN  INPUT' FILE CONTAINING
C    THE PROJECT PARAMETERS AND WAVE CONDITIONS,AND A  SPOOL  FILE
C    TO ADJUST THE CONTOUR LOCATIONS.
      DO 1 N=1,20
    1 CHANGE(N)=0.0
      WRITE(6,10)
   10 FORMAT(1X,10HENTER IMAX)
      READ(5,*) IMAX
      WRITE(6,12)
   12 FORMAT(1X,10HENTER JMAX)
      READ(5,*) JMAX
      WRITE(10,14) IMAX,JMAX
   14 FORMAT(2I10)
      WRITE(6,2)
    2 FORMAT(1X,51HENTER THE OFFSHORE BOUNDARY CONTOUR DEPTH IN METERS,
     18H(WDEPTH))
      READ(5,*) WDEPTH
      WRITE(10,7) WDEPTH
    7 FORMAT(10X,F10.3)
      WRITE(6,3)
    3 FORMAT(1X,40HENTER THE DESIRED CONTOUR DEPTHS IN FEET,
     123H(1ST,2ND,3RD,...JMAX+1))
      READ(5,*) (CHANGE(J),J=1,JMAX+1)
      CHANGE(JMAX+2)=WDEPTH*3.28084
      WRITE(10,4) (CHANGE(J),J=1,20)
    4 FORMAT(10F8.3)
      WRITE(6,5)
    5 FORMAT(1X,45HENTER THE DESIRED FREQUENC  OF FRINTED OUTPUT,
     124H(EXAMPLE-EVERY NTH WAVE))
      READ(5,*) NOUTPT
      WRITE(10,6) NOUTPT
    6 FORMAT(I10)
      WRITE(6,17)
   17 FORMAT(1X,14HENTER BERM(FT))
      READ(5,*) BERM
      WRITE(6,18)
   18 FORMAT(1X,11HENTER SFACE)
      READ(5,*) SFACE
      WRITE(6,20)
   20 FORMAT(1X,15HENTER DIAM(MM))
      READ(5,*) DIAM
      WRITE(10,22) BERM,SFACE,DIAM
   22 FORMAT(10X,F10.3,F10.4,F10.3)
      WRITE(6,24)
   24 FORMAT(1X,39HENTER NUMBER OF GROINS(MMAX),0,1,2,ETC.)
      READ(5,*) MMAX
      IF(MMAX.EQ.0) GO TO 30
      DO 26 M=1,MMAX
      WRITE(6,28) M
   28 FORMAT(1X,30HENTER I LOCATION,LENGTH OF NO.,I2,10H GROIN(FT))
   26 READ(5,*) IJET(M),SJETTY(M)
```

```
      GO TO 32
   30 MMAX=1
      IJET(1)=3
      SJETTY(1)=0.00
   32 WRITE(10,29) MMAX
   29 FORMAT(I3)
      DO 36 M=1,MMAX
   36 WRITE(10,34) IJET(M),SJETTY(M)
   34 FORMAT(I3,F10.3)
      WRITE(6,40)
   40 FORMAT(1X,21HENTER ADEAN (FT**1/3))
      READ(5,*) ADEAN
      WRITE(10,42) ADEAN
   42 FORMAT(F10.4)
      WRITE(5,44)
   44 FORMAT(1X,22HENTER DX(FT),DELT(HRS))
      READ(5,*) DX,DELT
      DELT=DELT*3600.
      WRITE(10,46) DX,DELT
   46 FORMAT(2F10.3)
      DELT=DELT*3600.
      DO 61 I=1,IMAX
   61 Y(I,1)=0.0
      WRITE(6,62)
   62 FORMAT(1X,43HSHORELINE IS INITIALLY STRAIGHT(Y(I,1)=0.0)/,
     154HENTER CHANGES BY ENTERING I LOCATION, DISTANCE IN FEET/,
     158HIF NO CHANGES OR TO TERMINATE CHANGES, ENTER IMAX VALUE,0.)
   65 READ(5,*) I,Y(I,1)
      IF(I.EQ.IMAX) GO TO 68
      GO TO 65
   68 WRITE(10,69) (Y(I,1),I=1,IMAX)
   69 FORMAT(10F8.2)
      WRITE(6,48)
   48 FORMAT(1X,31HENTER THE NUMBER OF BREAKWATERS)
      READ(5,*) NOBKS
      WRITE(10,50) NOBKS
   50 FORMAT(I5)
      IF(NOBKS.EQ.0) GO TO 60
      DO 52 N=1,NOBKS
      WRITE(6,54) N
   54 FORMAT(1X,9HENTER NO.,I2,12H BREAKWATER ,
     155HLEFT,RIGHT I LOCATION, LEFT,RIGHT DISTANCE OFFSHORE(FT
      READ(5,*) ILFT(N),IRT(N),YLFT(N),YRT(N)
   52 WRITE(10,56) ILFT(N),IRT(N),YLFT(N),YRT
   56 FORMAT(10X,2I10,2F10.2)
   60 CONTINUE
      WRITE(6,100)
  100 FORMAT(1X,42HDO YOU WISH TO ADJUST THE LOCATIONS OF -
     139H CONTOURS?  ENTER 0 FOR NO OR 1 FOR YES)
      READ(5,*) IDR
      IF(IDR.EQ.0) GO TO 500
      WRITE(6,115)
  115 FORMAT(1X,52HAT WHAT TIME INTERVAL WILL THE CONTOURS BE ADJUSTED?)
      READ(5,*) IDTIME
      WRITE(6,107)
```

```
107 FORMAT(1X,47HENTER I,J VALUE, INCREMENTAL VALUE TO BE ADDED /,
   161H TO THE AVERAGE OF EACH ADJACENT CONTOUR(FT). ENTER IMAX,JMAX /
   124H VALUES,0. WHEN COMPLETE)
108 READ(5,*) I,J,DREDGE
    IF(I.EQ.IMAX.AND.J.EQ.JMAX) GO TO 499
    WRITE(20,112) I,J,DREDGE
112 FORMAT(2I5,F10.2)
    GO TO 108
499 WRITE(20,112) I,J,DREDGE
500 CONTINUE
    ITIME=1
    WRITE(6,80)
 80 FORMAT(1X,49HENTER WAVE HEIGHT(FT), PERIOD(SECS), ANGLE(DEGS) /,
   162HAND NUMBER OF REPETITIONS OF THAT WAVE FIELD. WHEN COMPLETED,
   1/,19HENTER 99.,99.,99.,0)
 82 CONTINUE
    NREP=0
    READ(5,*) H,T,A,NREPIT
 87 IDD=0
    IF(ITIME.EQ.IDTIME) IDD=1
    WRITE(10,85) ITIME,H,T,A,IDD
 85 FORMAT(1X,I4,5X,3F8.1,I5)
    ITIME=ITIME+1
    NREP=NREP+1
    IF(H.GT.50.) GO TO 90
    IF(NREP.LT.NREPIT) GO TO 87
    GO TO 82
 90 CONTINUE
    STOP
    END
```