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STRUCTURAL SYNTHESIS DESIGN PROGRAM.(U)
DEC 77 R W WALZ, F M LEV, N S NAPPI
UNCLASSIFIED DTNSRDC-77-0032 NL

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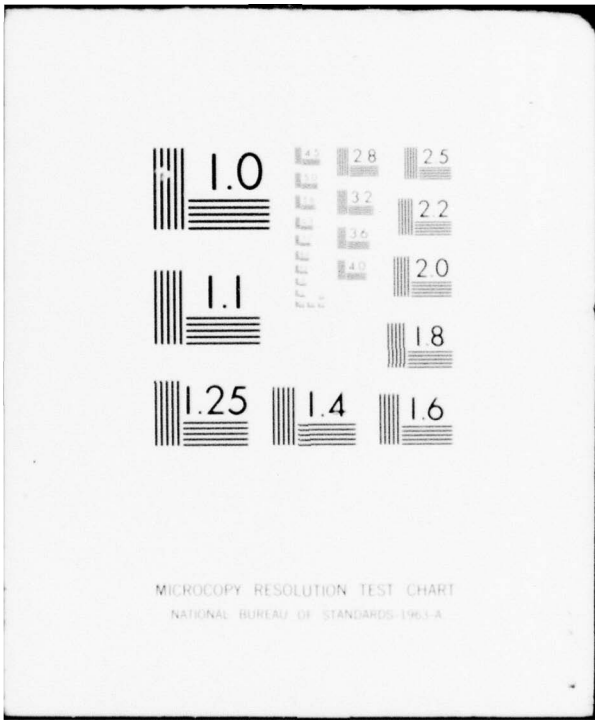
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STRUCTURAL SYNTHESIS DESIGN PROGRAM

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DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER

Bethesda, Md. 20084

STRUCTURAL SYNTHESIS DESIGN PROGRAM

by

Ronald W. Walz,
Frank M. Lev,
and
Natale S. Nappi

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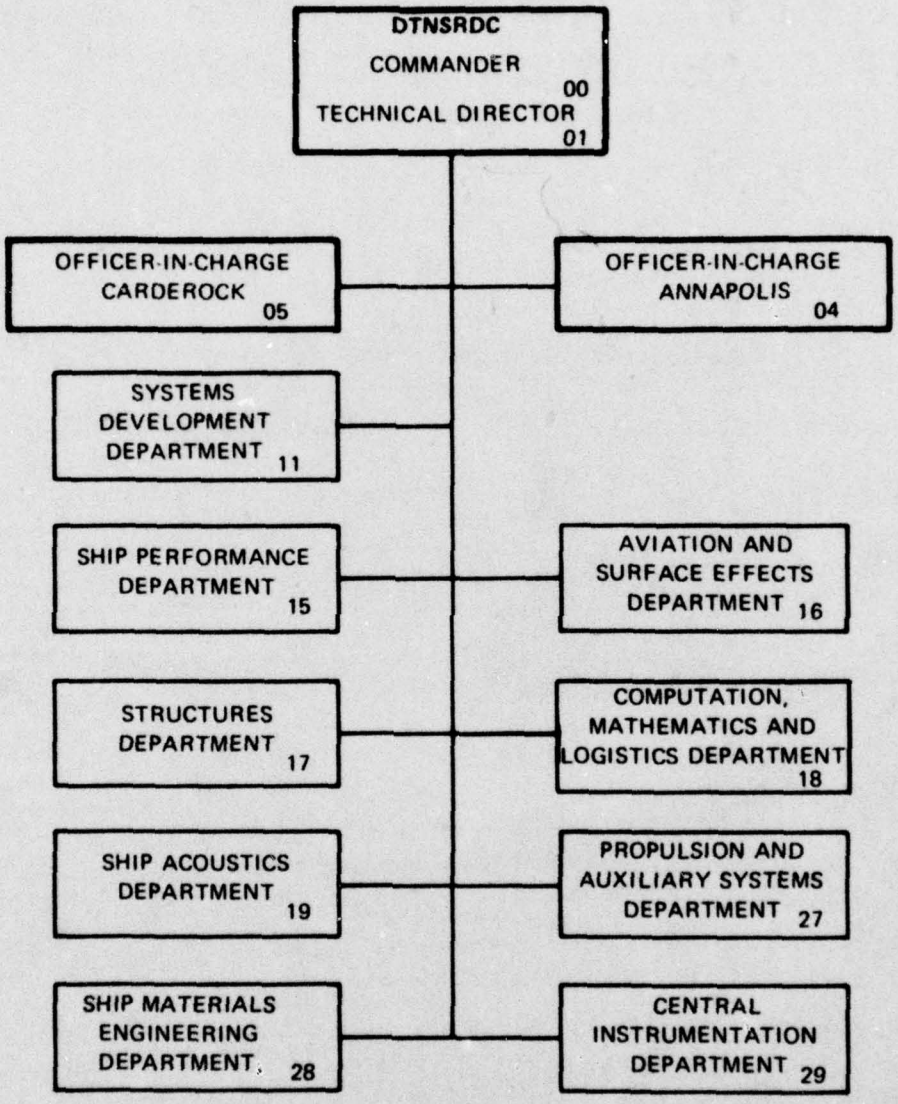

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GPO 928-108

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REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1. REPORT NUMBER: DTNSRDC-77-0032
2. GOVT ACCESSION NO.
3. RECIPIENT'S CATALOG NUMBER

(14) (9) Research and development rept.,

4. TITLE (and Subtitle)

(6) STRUCTURAL SYNTHESIS DESIGN PROGRAM.

5. TYPE OF REPORT & PERIOD COVERED

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)

(10) Ronald W. Walz, Frank M. Lev, and Natale S. Nappi

8. CONTRACT OR GRANT NUMBER(s)

(16) F43422

(17) SF43422536

9. PERFORMING ORGANIZATION NAME AND ADDRESS

David W. Taylor Naval Ship Research and Development Center
Bethesda, Maryland 20084

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

(See reverse side)

11. CONTROLLING OFFICE NAME AND ADDRESS

Naval Sea Systems Command (03511)
Washington, D.C. 20362

(11) 12. REPORT DATE

Dec[redacted]77

(12) 13. NUMBER OF PAGES

176

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)

15. SECURITY CLASS. (of this report)

UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

APPROVED FOR PUBLIC RELEASE: DISTRIBUTION UNLIMITED

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RECEIVED
JAN 9 1978
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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Ship Structural Design
Midship-Section Design
Minimum Weight Design
Computer Program

(AD 999 193L)

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

The Structural Synthesis Design Program (SSDP) described herein is an extension of the original MIDSHIP section program, developed at the Center. The SSDP may be used to design the longitudinal scantlings for a variety of ship cross sections, consisting of any practical combinations of decks, platforms, bulkheads, and materials--steels and/or aluminum. The final section design will have the lowest practical weight for the chosen geometric

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387682

(Block 10)

Element No. 62534N
Task Area SF 43 422 53B
Task 20445
Work Unit 1-1730-053

(Block 20 Continued)

configuration and imposed loadings. The scantlings developed by it will comply with design criteria defined by current U.S. Navy design practices. An additional feature of SSDP is that the program can also be used to perform a design validation of proposed section design.

The input data required for operating the program are no more comprehensive than those normally assembled to develop an efficient design of a cross section by manual methods. Four demonstration problems have been provided to aid the program user in preparing input data. These examples are of no specific existing ship type, but they are merely idealized examples intended to illustrate the design capabilities of the program.

The English unit system is used in the program. No attempt has been made to convert to metric units since at this time the majority of section designs are still done with English units.

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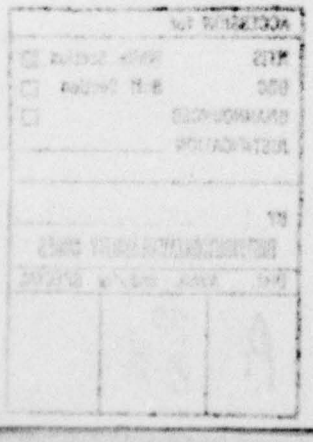

ABSTRACT

The Structural Synthesis Design Program (SSDP) described herein is an extension of the original MIDSHIP-section program developed at the Center. The SSDP may be used to design the longitudinal scantlings for a variety of ship cross sections, consisting of any practical combinations of decks, platforms, bulkheads, and materials—steels and/or aluminum. The final section design will have the lowest practical weight for the chosen geometric configuration and imposed loadings. The scantlings developed by it will comply with design criteria, defined by current U.S. Navy design practices. An additional feature of SSDP is that the program can also be used to perform a design validation of a proposed section design.

The input data required for operating the program are no more comprehensive than those normally assembled to develop an efficient design of a cross section by manual methods. Four demonstration problems have been provided to aid the program user in preparing input data. These examples are of no specific existing ship type. They are merely idealized examples intended to illustrate the design capabilities of the program.

The English unit system is used in the program. No attempt has been made to convert to metric units since at this time the majority of section designs are still done with English units.

ADMINISTRATIVE INFORMATION

This work was approved and funded by the Naval Sea Systems Command (03511) under Research, Development, Test, and Evaluation Element 62534N, Task Area SF 43 422, 53B Task 20445, Program Code 053, under work unit title Advanced Ship Structures. The work was accomplished in the Advanced Ship Division, Structures Department, of the David W. Taylor Naval Ship Research and Development Center.

The U.S. Government will incur no liability for loss arising from use of the computer program described herein.

SECTION 1. INTRODUCTION

The Structural Synthesis Design Program (SSDP) described herein is an extension of the original MIDSHIP-section design program.[1] Significant modifications were made to the original program to enlarge its design

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[1]Nappi, N. S. and F. M. Lev, "Midship Section Design for Naval Ships", NSRDC Report 3815 (1972). A complete listing of references is given on page 157.

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capabilities and to allow more flexibility in regard to cross sectional geometry, material of the cross section, and a design-validation capability.

The SSDP is designed to run on the DTNSRDC CDC 6000-series computer and is readily available through Naval Ship Engineering Center terminals. No user intervention is required when the program is being run since it operates by the batch mode.

The SSDP synthesizes a section design that will be in compliance with the strength criteria defined by current U.S. Navy design practices. To achieve this design, the program user simply puts in the basic geometry of the section, the assumed primary hull-girder stresses, the secondary loads, the type of plate and beam material, the ranges of beam spacings to be investigated, and other special data no more comprehensive than those normally assembled to permit efficient design of a section by manual methods.

With the input data supplied, the SSDP can be used to determine an initial set of minimum weight longitudinal scantlings for the section. The initial design will produce a minimum weight section that is capable of withstanding the constant secondary loadings and the assumed primary hull-girder stresses. Refinement of the scantlings will continue until actual and assumed primary stresses of the section are within the specified primary stress tolerance. Once a stress-consistent design is achieved, the program has the capability of checking for adequate hull-girder strength. If the calculated primary stress at either the upper deck or the keel exceeds the limiting primary stress, additional material will automatically be added at the proper location. After the material addition, the entire design process will be repeated until scantlings are determined that are of minimum weight and that are structurally adequate. Demonstration problems 1 and 4 illustrate this synthesis mode of SSDP operation.

An additional feature of SSDP is that the program can also be used to validate the design of a section by analysis of preselected scantlings. To select this mode of program operation, the program user simply puts in the given geometry, scantlings, and primary and secondary loadings of the proposed section design. Using this input, SSDP will perform an analysis of the section scantlings to determine whether the scantlings conform to the strength requirements as defined by current U.S. Navy design practices. Demonstration problem 2 illustrates this analysis mode of SSDP operation.

The final scantlings generated by SSDP can be used to develop typical section drawings, indicating material and longitudinal scantlings. This information will indicate the structural feasibility of a proposed design and will provide guidance in developing a longitudinal weight estimate.

SECTION 2. PROGRAM PROCEDURE

A simplified diagram showing the main program modules is given in Figure 1. Each module shown has an elaborate structure of its own. The following sequence of events occurs in the program when the program user requests synthesis of a section design.

- User puts in section data, a printout is made for verification. Title page lists principal hull dimensions, general design criteria, and assumed primary hull-girder stresses. Additional pages include a listing of geometry and design criteria for structural elements of the section.
- Initial sets of longitudinal scantlings are determined for structural members of the section. The initial design will produce various sectional designs that are capable of withstanding the constant secondary, local lateral, loading and the assumed input primary hull-girder stresses.
- Minimum weight scantlings are selected for the section from among alternatives produced in the previous step. Under the program, the section modulus will then be computed and the actual primary hull-girder stresses, existing in the minimum weight section, will be determined.
- Comparison is made between actual and assumed input of hull-girder primary stresses. Only occasionally, after the initial design, will the stresses be within the specified primary stress tolerance; therefore, the section scantlings must usually be refined. A new primary stress schedule is then developed by the program for refining scantlings. The recycling continues until the actual primary stresses and the assumed primary stresses of the section are within the primary stress tolerance specified. This condition is defined as a stress-consistent design, one in which the design of the section structure has been optimized, using local criteria and computed primary stresses. However, no consideration has been given to the possible existence of a primary stress deficiency.
- Adequacy of hull girder strength is checked. After a stress-consistent section has been obtained, the hull girder is examined as a simple

SECTION 2. PROGRAM PROCEDURE

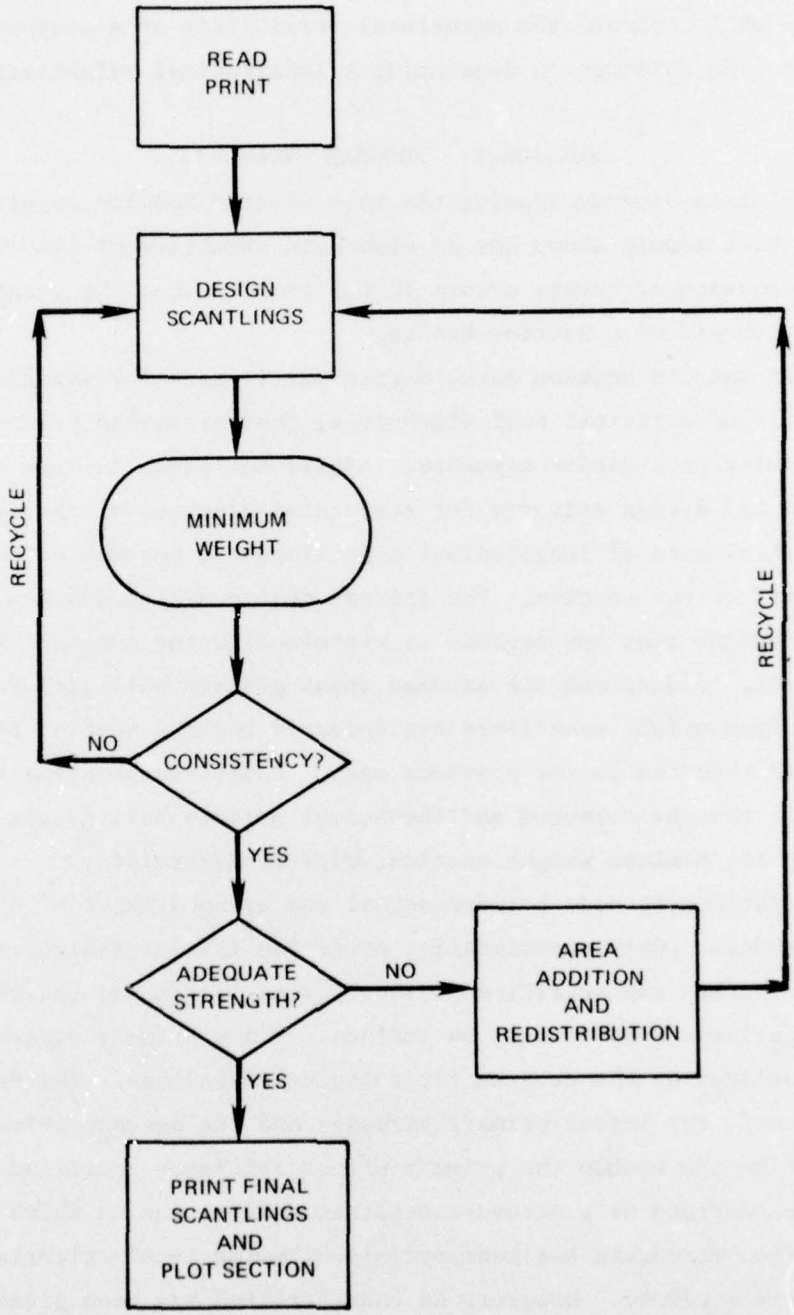

Figure 1 — Modular Structure of Program

beam in bending. The computed primary stresses, both hog and sag, are compared with the limiting primary stress. If the primary stresses are less than the limiting primary stress, the section scantlings are considered adequate. No further material increase or decrease will be required, and the section will have the lowest practical weight for the chosen geometric configuration, imposed loadings, and design criteria. However, if the computed primary stresses are greater than the limiting primary stress, then the section, as designed, is deficient, and the area addition module is used to optimally increase the thickness of plates, located in the critical stress regions.

- After material addition, the entire design process is repeated, i.e., a new section design is obtained that is stress consistent and has minimum weight, and the primary hull-girder stresses are again compared with the limiting primary stress. Cycling terminates when the limiting primary stress requirement is satisfied.

- A summary of the results will be printed at the end of each cycle, and a detailed printout of the final acceptable section will be produced at the termination of cycling. The following items are included in the detailed printout: (1) scantlings of the structural members along with their concomitant secondary loads, primary stresses, and factors of safety for each applicable loading condition; (2) a weight summation table for each structural element segment, listing the structural weights for the various schemes—spacing of beams.

The following sequence of events occurs in the program when the program user requests the analysis of a section design.

- Section data are read in and for verification are printed out. Title page lists the principal hull dimensions, general design criteria, and assumed hull-girder stresses. Additional pages include a listing of the geometry and design criteria for the structural elements of the section.

- A detailed printout is made of the given scantlings of the structural members along with their concomitant secondary loads, primary stresses, and factors of safety for each applicable loading condition.

The SSDP is intended to be used in an iterative design process. An initial sectional design will produce minimum acceptable scantlings for the loadings specified. During this initial design, no attempt is made to

integrate the various segments of the structure; therefore, certain inconsistencies may be produced, e.g., strakes of light plating surrounded by much heavier plating or heavy stiffeners adjacent to light ones. It is during subsequent executions of SSDP for the same section that these problems can be resolved, owing to interpolation by the designer to the program. In general, for subsequent runs, efforts should be made to standardize plate and stiffener sizes. It is suggested that a final run for a particular sectional design be made via the analysis mode of program operation. The final run would serve to validate the final design scantlings selected.

SECTION 3. SIGNIFICANT PROGRAM CAPABILITIES

The SSDP will accommodate a variety of ships cross sections, consisting of any combination of decks, platforms, and bulkheads. The program works best with conventional monohull cross-sections; however, it has been used for section configurations such as those of advanced high-performance ships, surface effect ship (SES),* small-waterplane-area, twin-hull ship (SWATH),[2,3] and the hydrofoil, small-waterplane-area ship (HYSWAS).**

The SSDP can handle ships with as many as 12 decks and 7 longitudinal bulkheads per side. The program has a builtin materials table, consisting of four different steels and four different aluminum alloys; see Table 4 in Section 9. The following significant program options are offered to the user:

- Ability to perform a design check, pure analysis of preselected scantlings. In particular, the program user takes a given cross section design and assumed loads and puts them into the program. The output then

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*Unpublished 1975 report by R. Walz and A. Furio.

**Unpublished 1975 report by N. S. Nappi and F. M. Lev.

[2]Aronne, E. L. et al., "Structural Weight Determination for SWATH Ships," American Institute of Aeronautics and Astronautics Paper 74-326, Advanced Marine Vehicles Conference, San Diego, Calif. (Feb 1974).

[3]Department of the Navy, "General Specifications for Ships of the United States Navy," Naval Ship Engineering Center Section 100, General Requirements for Hull Structure, (1 Jan 1972).

consists of a printout of the factors of safety for all the structural elements.

- Geometric configuration of the cross section can be varied, i.e., the number of decks and bulkheads, deck heights, half-breadth.

- Primary and secondary loads can be varied—in particular, bending moments, hydrostatic heads, slamming pressures, and deck loads.

- Selection of the type of material to be used for each structural member of the section, section can be homogeneous or hybrid. Material options offered are medium steel (MS), high tensile steel (HTS), HY 80 and HY 100 steels, and 5086-H 116, 5086-H 111, 5456-H 116, and 5456-H 111 aluminum alloys.

- Design of a simulated double bottom girder, the girder consists of an upper flange, inner bottom plate; a lower flange, shell plate; and a web, double bottom plate longitudinal. The girder is loaded by any combination of uniform internal live loads, an external hydrostatic load, and an external slamming-pressure load. The ends of the girder are considered fixed, and the girder span is specified by the program user.

- Design lengths of beams and panels can be varied for each structural segment of the section. In this manner, the framing can be specified as either uniform longitudinal or a mix of longitudinal and transverse.

- Nuclear airblast analysis can be requested of shell and upper-strength deck structure.

- Portions of structural segments can be treated as either ineffective material or as openings.

- Decks can be specified as continuous or intercostal—platforms are to be designated as intercostal decks.

- Cubic or quadratic representation can be obtained for curved shell and inner bottom segments. Girths are computed accordingly.

- Minimum plate-thickness requirements can be specified for segments of structural elements.

- Minimum and maximum permissible panel widths can be specified for each structural segment. The program will examine all justifiable spacings included within these precise bounds and will select the lightest configuration. Specification of zero for both panel-width limits will cause the program to design the structural segment without stiffeners.

SECTION 4. PROGRAM RESTRICTIONS

The program is written in FORTRAN IV extended language for operation under the SCOPE operating system on the CDC 6000-series computer system. The field length required to execute the program is 230,000 octal words. If an S-C 4020 plot of the section is desired, a tape assignment must be specified by the program user.

Every effort has been made to ensure the accuracy of the program. Hand calculations have been made continually during testing phases of program development, and results have compared satisfactorily with program results. Please notify the authors promptly of any difficulties encountered.

The major program restrictions are as follows.

- Beams must be of the same modulus of elasticity as the plate to which they are attached.
- The yield strength of the material specified for beams must not be greater than the yield strength of the plate material to which they are attached. For example, using HY 80 beams on HTS plate is prohibited.
- The double bottom girder consists of an upper flange, inner bottom plate; a lower flange, shell plate; and a web, double bottom-plate longitudinal. The flanges and web must be of the same modulus of elasticity, if a girder analysis is requested.
- The first 14 T-beams of the aluminum shape catalog are standard extruded shapes. The remaining T-beams are builtup plate beams and are proportioned in compliance with Navy design criteria. The material of the builtup T-beams is assumed to be the same as the material specified for the plates to which they are attached.
- When specifying minimum and maximum panel widths for deck segments within a particular deck region, the range specified must be the same for all deck segments for which a range investigation is desired.
- The program can handle a section in which the base and keel lines do not coincide. The program user must put in the offsets to geometry points and removal extremities relative to the baseline. Specification of all head loads are relative to the keel line, except the tank top head, which is relative to the lowest point of the structural segment.

SECTION 5. INPUT DATA PREPARATION

Before preparing input data forms, a sketch of the section should be made, preferably in the form of Figure 2, showing the arrangement and numbering of structural elements. All structural elements, element segments, and beginning, intermediate, and end points of segments must be numbered as follows.

- Point 1 must be at the intersection of the bottom shell with the center vertical keel plate or girder, and all additional points on the shell must be numbered consecutively, upward along the shell. Numbering of shell segments must follow the same pattern. The number of shell segments must be greater than the number of upper strength deck segments. Consideration should be given to the last shell-segment girth; it will be assumed to be the sheer strake.

- For an inner bottom, the first numbered point must be at the intersection of the inner bottom with the center vertical keel plate and all additional points must be numbered consecutively, outward from the centerline. Numbering of inner bottom segments is consecutive, outward along the inner bottom.

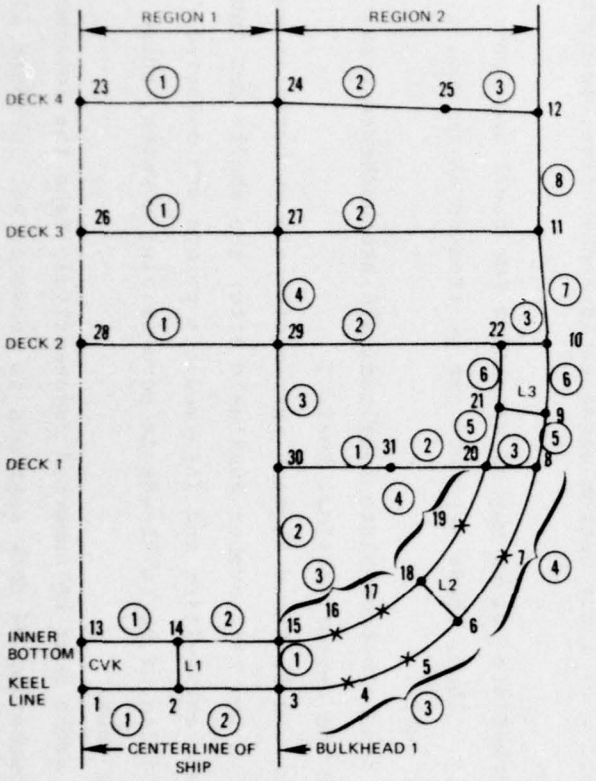
- Intermediate points may be specified for shell and inner bottom segments only. Thus, these segments can be treated as curved, i.e., quadratic or cubic.

- The double bottom-plate longitudinals are numbered consecutively, outward from the center vertical keel.

- Deck- and bulkhead-segment extremities are numbered in sequence, beginning with the next number available after the shell- and inner bottom-segment extremities and intermediate points are numbered. Note, the specification of no bulkheads is permissible; however, there must be at least one deck.

- All decks must be numbered consecutively from the lowermost deck (deck 1). Numbering of deck segments is consecutive, outboard along the deck. The upper strength deck must have a minimum of two segments. It is suggested that the upper strength deck be divided in such a manner as to result in segment girths which decrease outboard along the deck.

- The innermost bulkhead must be numbered bulkhead 1 (centerline bulkhead, if one exists) and all additional bulkheads must be numbered



LEGEND

(K) – DENOTES SEGMENT K OF STRUCTURAL ELEMENT

• – DENOTES SEGMENT EXTREMITY POINT

X – DENOTES INTERMEDIATE POINT ON SEGMENT
1. SEGMENTS HAVING *TWO* INTERMEDIATE POINTS ARE TREATED AS CURVED *CUBIC* SEGMENTS
2. SEGMENTS HAVING *ONE* INTERMEDIATE POINT ARE TREATED AS CURVED *QUADRATIC* SEGMENTS

CVK – CENTER VERTICAL KEEL; IF INNER BOTTOM OPTION IS SELECTED, THERE MUST BE A CVK

L1, L2, . . . DOUBLE BOTTOM PLATE LONGITUDINALS

REGION X – ATHWARTSHIP DISTANCE IN WHICH THERE WILL BE VERTICAL ALIGNMENT OF LONGITUDINALS THROUGH ALL DECKS

Figure 2 — Arrangement and Numbering of Structural Elements

consecutively, outboard of bulkhead 1. Numbering of bulkhead segments is consecutive, upward along the bulkhead. If the ship is to be designed with an inner bottom, and a double bottom-girder analysis is requested, the program prohibits the specifying a centerline bulkhead directly above the center vertical keel plate.

. Intersection of structural elements must be considered as segment extremely points.

. Segments defined by intersection of structural elements may be divided into smaller segments, provided they are stiffened segments.

Careful preparation of input data is vitally important. A comprehensive set of program-error messages (Section 7) has been coded into the program to facilitate recovery from conditions of invalid input.

The following chart shows the maximum allowable number of structural elements per side of a cross section. The program user is reminded that the maximum storage criteria of the program must not be violated.

Structural Element:	Maximum Number
Shell segments	30
Shell beams per segment	25
Longitudinal bulkheads, including centerline bulkhead, if any	7
Segments per longitudinal bulkhead	15
Bulkhead beams per segment	25
Decks and platforms combined	12
Segments per deck or platform	8
Inner bottom segments	18
Inner bottom beams per segment	15
Double bottom plate longitudinals, center vertical keel excluded	17
Shell removals	15
Deck removals	30
Bulkhead removals	15

SECTION 6. DESCRIPTION OF INPUT FORMS

The input data required for operating the program are no more comprehensive than those normally assembled to permit efficient design of a cross section by manual methods.

Several types of input forms are required for solution of a problem. The set of blank input forms may be removed and reproduced by the program user; see Section 10. A careful review of the following description of required input data and format type—I=integer, F=floating point, and A=alphanumeric—will provide the guidance needed for preparing input forms.

The input data values are a free-field type. This permits the user to put in data without regard to particular column placement and right or left justification. The program will accept one or more blanks or a comma as a delimiter between data values. However when a particular data value is zero, it must be put in as zero, corresponding to its format type—integer or floating point.

RUN IDENTIFICATION CARD 1		
NUMBER OF SECTIONS	OUTPUT INDICATOR	
1	2	

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	NSECT	I	NUMBER OF SECTIONS PER PROCESSING REQUEST; FOR MULTIPLE SECTIONS PER PROCESSING REQUEST, THIS CARD MUST ONLY BE SUBMITTED WITH FIRST SET OF SECTION DATA.
2	LOPUT	I	INDICATOR FOR LEVEL OF OUTPUT DESIRED.

SUBMIT LOPUT=	INPUT SUMMARY	PRINTER PLOT	EXECUTION	SUMMARY OF ALL CYCLES	DETAILS OF LAST CYCLE ONLY	DETAILS OF ALL CYCLES	PLATE AND BEAM CATALOGS
0	X	X	X	X	X		X
1	X	X					
2	X		X	X			X
3	X		X	X		X	

RUN IDENTIFICATION CARD 2
JOB IDENTIFICATION, USER'S NAME, PHONE NUMBER, DATE, ETC.

1

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	TITLE (12)	A	SECTION IDENTIFICATION AND PERTINENT USER INFORMATION; USE ONLY COLUMNS 1 THROUGH 72.

GENERAL INFORMATION CARD 1											
				OUTSIDE DOUBLE BOTTOM							
LENGTH BETWEEN PERPS. (feet)	DEPTH OF HULL (feet)	MAX. HALF-BREADTH (feet)	FULL LOAD DRAFT (feet)	BEAM DESIGN LENGTH (feet)	PANEL DESIGN LENGTH (feet)	LENGTH BETWEEN TRANSVERSE BULKHEADS (feet)	ANGLE OF HEEL (degrees)	SHELL DESIGN HEAD (feet)	MIN. SHELL DESIGN PRESSURE (psf)	WAVE HEIGHT COEF.	
1	2	3	4	5	6	7	8	9	10	11	

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	XL1BP	F	SHIP LENGTH BETWEEN PERPENDICULARS.
2	D1	F	DEPTH OF SECTION; SUBMIT VERTICAL DISTANCE FROM LOWERMOST POINT OF SHELL (ASSUMED KEEL LINE) TO UPPER STRENGTH DECK AT CENTERLINE.
3	B3MAX	F	SHIP MAXIMUM HALF-BREADTH.
4	H1DFL	F	SHIP FULL-LOAD DRAFT.
5	XL1WEB	F	UNIFORM DESIGN LENGTH FOR BEAMS OUTSIDE OF DOUBLE BOTTOM. FOR NONUNIFORM DESIGN LENGTH FOR BEAMS OUTSIDE OF DOUBLE BOTTOM, SUBMIT XL1WEB = 0.0; THEN SPECIFY ON DESIGN CRITERIA CARDS THE LENGTH OF BEAM DESIGN FOR EACH SEGMENT.
6	PNLXL1	F	UNIFORM DESIGN LENGTH FOR PLATE PANELS OUTSIDE OF DOUBLE BOTTOM. FOR NONUNIFORM DESIGN LENGTH FOR PANELS OUTSIDE OF DOUBLE BOTTOM, SUBMIT PNLXL1 = 0.0; THEN SPECIFY ON DESIGN CRITERIA CARDS THE LENGTH OF PANEL DESIGN FOR EACH SEGMENT.
7	XL1TBD	F	LENGTH BETWEEN TRANSVERSE BULKHEADS; USED TO COMPUTE NUMBER OF CONTINUOUS SPANS FOR BEAM DESIGN.
8	A3HEEL	F	ANGLE OF HEEL.

GENERAL INFORMATION CARD 1—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
9	H1DSHL	F	SHELL DESIGN HEAD OF WATER ABOVE KEEL LINE.
10	SHPRMN	F	MINIMUM SHELL DESIGN PRESSURE.
11	COEWH	F	WAVE HEIGHT COEFFICIENT IS 1/2 DESIGN-WAVE HEIGHT; COMMONLY USED VALUE IS 0.55 IN EXPRESSION COEWH * $\sqrt{XL1BP}$.

NOTE: HEADS DUE TO FOUR DESIGNED HYDROSTATIC LOADINGS—INPUT DATA 8 THROUGH 11—ARE COMPUTED FOR EACH SHELL PANEL AND BEAM, AND MAXIMUM HEAD IS USED FOR DESIGNING.

GENERAL INFORMATION CARD 2																							
							REMOVALS			INDICATORS						IF INNERBOTTOM INDICATOR = 0, THEN THESE DATA ITEMS ARE TO BE OMITTED							
																				WITHIN DOUBLE BOTTOM			
TOTAL NUMBER OF POINTS FOR ONE SIDE	NUMBER OF SHELL SEGMENTS FOR ONE SIDE	NUMBER OF DECKS	NUMBER OF BULKHEADS FOR ONE SIDE	NUMBER OF DECK REGIONS	AREA ADDITION BOTTOM SHELL SEG. NOS.		TOTAL NUMBER IN SHELL (ONE SIDE)	TOTAL NUMBER IN DECKS (ONE SIDE)	TOTAL NUMBER IN BULKHEADS (ONE SIDE)	TYPE OF MATERIAL	BEAM SPAN DESCRIPTION	NUCLEAR BLAST 0 = NO, 1 = YES	INNER BOTTOM 0 = NO, 1 = YES	BEAM I.L.S. 0 = NO, 1 = YES	SC 4020 PLOT 0 = NO, 1 = YES	NUMBER OF I.B. SEGMENTS (ONE SIDE)	NUMBER OF D.B. PLT. LONGLS. (ONE SIDE)	D.B. GIRDER ANALYSIS 0 = NO, 1 = YES	MAX. PERMISSIBLE DEPTH OF I.B. BEAMS (inches)	BEAM DESIGN LENGTH (feet)	PANEL DESIGN LENGTH (feet)	D.B. GIRDER DESIGN LENGTH (feet)	
					FROM	TO																	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	NPT	I	TOTAL NUMBER OF POINTS FOR HALF-SECTION (ONE SIDE).
2	NBELTS	I	NUMBER OF SHELL SEGMENTS FOR HALF-SECTION.
3	NDECKS	I	NUMBER OF DECKS; PLATFORMS ARE DESIGNATED AS INTERCOSTAL DECKS AND ARE TO BE INCLUDED IN THE NDECKS COUNT.
4	NBKHDS	I	NUMBER OF BULKHEADS FOR HALF-SECTION; CENTERLINE BULKHEAD, IF ANY, TO BE DESIGNATED BULKHEAD 1.
5	NREGS	I	NUMBER OF DECK REGIONS; A REGION IS DEFINED AS AN ATHWARTSHIP DISTANCE IN WHICH SPACING OF DECK LONGITUDINALS IS EITHER THE SAME FOR EVERY DECK OR AN INTEGER MULTIPLE OF A SPACING; THIS INSURES VERTICAL ALIGNMENT OF DECK LONGITUDINALS WITHIN REGIONS; A MAXIMUM OF EIGHT REGIONS FOR ONE SIDE IS PERMITTED.
6	NSTART	I	THE NUMBER OF THE SHELL SEGMENT TO BE CONSIDERED AS THE START OF THE BOTTOM FLANGE OF THE SECTION WHEN AREA ADDITION TO THE KEEL FIBER IS REQUIRED.
7	NEND	I	THE NUMBER OF THE SHELL SEGMENT TO BE CONSIDERED AS THE END OF THE BOTTOM FLANGE OF THE SECTION WHEN AREA ADDITION TO THE KEEL FIBER IS REQUIRED.
8	NSHLR	I	TOTAL NUMBER OF REMOVALS IN SHELL FOR ONE SIDE; REMOVALS ARE DEFINED AS OPENINGS IN SEGMENTS OR PORTIONS OF SEGMENTS WHICH ARE CONSIDERED TO BE INEFFECTIVE; MAXIMUM OF 15 REMOVALS IN SHELL ARE ALLOWED.

GENERAL INFORMATION CARD 2—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
9	NDKR	I	TOTAL NUMBER OF REMOVALS IN DECKS FOR ONE SIDE. MAXIMUM OF 30 REMOVALS IN DECKS ARE ALLOWED.
10	NBHDR	I	TOTAL NUMBER OF REMOVALS IN BULKHEADS FOR ONE SIDE. MAXIMUM OF 15 REMOVALS IN BULKHEADS ARE ALLOWED.
11	I1MATL	I	INDICATOR FOR TYPE OF MATERIAL FOR SECTION; 11 FIXED COMBINATIONS FOR PLATE-BEAM MATERIAL ARE PROVIDED AS OUTLINED:

I1 MATL	MATERIAL FOR		I1 MATL	MATERIAL FOR	
	PLATE	BEAM		PLATE	BEAM
1	MS	MS	6	HY 80	HTS
2	HTS	HTS	7	HY 100	HTS
3	HY 80	HY 80	8	5086-H 116	5086-H 111
4	HY 100	HY 100	9	5086-H 116	5456-H 111
5	HTS	MS	10	5456-H 116	5086-H 111
			11	5456-H 116	5456-H 111

FOR TYPE OF MATERIAL COMBINATIONS DIFFERENT FROM THOSE LISTED PREVIOUSLY, SUBMIT I1MATL=0; THEN SPECIFY ON DESIGN CRITERIA CARDS PLATE-BEAM MATERIAL FOR EACH SEGMENT. THIS OPTION IS PROVIDED TO SPECIFY A HYBRID MIX OF MATERIALS FOR THE SECTION—STEELS AND ALUMINUM.

GENERAL INFORMATION CARD 2—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
12	I1SPL	I	INDICATOR FOR DESCRIPTION OF BEAM SPANS BETWEEN TRANSVERSE BULKHEADS: SUBMIT EITHER I1SPL=1 FOR NO SHORT SPANS–EQUAL SPANS OR =2 WHEN SHORT SPANS ARE THREE-FOURTHS OF THE LENGTH OF AVERAGE SPAN OR =3 FOR WHERE SHORT SPANS ARE TWO-THIRDS OF THE LENGTH OF AVERAGE SPAN.
13	NUB	I	INDICATOR FOR NUCLEAR AIRBLAST ANALYSIS OF DECK AND SHELL STRUCTURE: SUBMIT EITHER NUB=0 FOR ANALYSIS NOT REQUIRED OR =1 FOR EXECUTION OF ANALYSIS.
14	IB	I	INDICATOR FOR PRESENCE OF AN INNER BOTTOM STRUCTURE: SUBMIT EITHER IB=0 FOR NO INNER BOTTOM STRUCTURE OR =1 FOR AN INNER BOTTOM STRUCTURE; A CENTER VERTICAL KEEL PLATE (CVK) IS ASSUMED AND MUST BE PUT IN.
15	ILS	I	INDICATOR FOR PRESENCE OF BEAM INTERMEDIATE LATERAL SUPPORTS: SUBMIT EITHER ILS=0 FOR NO LATERAL SUPPORTS; PROGRAM WILL DESIGN BEAMS THAT HAVE ADEQUATE LATERAL STABILITY FOR SPAN SPECIFIED. OR =1 FOR LATERAL SUPPORTS; PROGRAM WILL FIRST DESIGN BEAMS WITHOUT CHECKING LATERAL STABILITY CRITERIA AND THEN DESIGN THE LATERAL SUPPORTS NEEDED TO INSURE THAT THE BEAM SELECTED WILL NOT TRIP.
16	I1DRW	I	INDICATOR FOR SC 4020 PLOT OF SECTION: SUBMIT I1DRW=0 FOR NO PLOT REQUIRED OR =1 FOR PLOT REQUIRED. FOR MULTIPLE SECTIONS PER PROCESSING REQUEST, AN SC 4020 PLOT CAN BE REQUESTED ONLY FOR FIRST SECTION SUBMITTED.
17	NSSIB	I	NUMBER OF INNER BOTTOM SEGMENTS FOR ONE SIDE; THIS MUST EQUAL NUMBER OF SHELL SEGMENTS ALONG THE FULL GIRTH OF THE DOUBLE BOTTOM (ONE SIDE).

GENERAL INFORMATION CARD 2—Continued

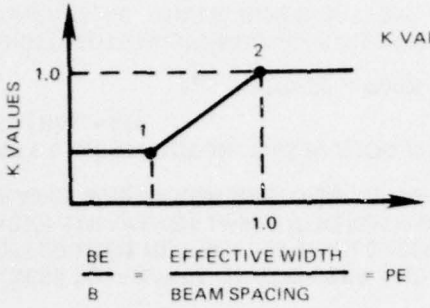
INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
18	NDBL	I	NUMBER OF DOUBLE BOTTOM PLATE LONGITUDINALS FOR ONE SIDE; DO NOT INCLUDE CVK IN THIS COUNT.
19	IBTH1	I	INDICATOR FOR DOUBLE BOTTOM GIRDER ANALYSIS: SUBMIT EITHER IBTH1=0 FOR NO ANALYSIS REQUIRED OR =1 FOR ANALYSIS REQUIRED.
20	DIBSTR	F	MAXIMUM PERMISSIBLE DEPTH OF INNER BOTTOM BEAMS.
21	XL1FLR	F	UNIFORM DESIGN LENGTH FOR BEAMS WITHIN DOUBLE BOTTOM. FOR NONUNIFORM DESIGN LENGTH FOR BEAMS WITHIN DOUBLE BOTTOM, SUBMIT XL1FLR=0.0; THEN SPECIFY ON DESIGN CRITERIA CARDS LENGTH OF BEAM DESIGN FOR EACH SEGMENT.
22	PNLXL	F	UNIFORM DESIGN LENGTH FOR PLATE PANELS WITHIN THE DOUBLE BOTTOM. FOR NONUNIFORM DESIGN LENGTH FOR PANELS WITHIN DOUBLE BOTTOM, SUBMIT PNLXL=0.0; THEN SPECIFY ON DESIGN CRITERIA CARDS LENGTH OF PANEL DESIGN FOR EACH SEGMENT.
23	XL1GDR	F	DESIGN LENGTH OF DOUBLE BOTTOM GIRDER; ENDS OF GIRDER ARE CONSIDERED FIXED, AND GIRDER SPAN IS USUALLY TAKEN AS DISTANCE BETWEEN MAIN TRANSVERSE WATERTIGHT BULKHEADS; TO ALLOW FOR STIFFNESS CONTRIBUTION, GRILLAGE EFFECT, OF TRANSVERSE FLOORS, AN EFFECTIVE GIRDER-DESIGN LENGTH SHOULD BE PUT IN.

GENERAL INFORMATION CARD 3									
DESIGN MARGINAL STRESS (psi)	PRIMARY STRESS TOLERANCE (psi)	STRINGER - SHEERSTRAKE TOLERANCE (inches)	PRIMARY STRESS FACTOR	COMBINE PRIMARY STRESS WITH SLAM STRESS 0 = NO, 1 = YES	USE K vs. PE CURVE 0 = NO, 1 = YES	INPUT VALUES - K vs. PE CURVE			
						K FOR POINT 1	PE FOR POINT 1	PE FOR POINT 2	
1	2	3	4	5	6	7	8	9	

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	DELST1	F	DESIGN MARGINAL STRESS; THIS STRESS IS ADDED TO CALCULATED EXTREME FIBER STRESSES TO GIVE EXTREME FIBER-DESIGN STRESSES.
2	EPLST1	F	PRIMARY STRESS TOLERANCE; REFINEMENT OF SECTION SCANTLINGS CONTINUES UNTIL OUTPUT (ACTUAL) AND INPUT (ASSUMED) PRIMARY STRESSES OF SECTION ARE WITHIN TOLERANCE SPECIFIED; PRIMARY STRESS TOLERANCE SHOULD NOT BE LESS THAN 100 PSI.
3	STOL1	F	THICKNESS TOLERANCE OF STRINGER AND SHEER STRAKES; TOLERANCE SUBMITTED MUST NOT BE LESS THAN 0.0625; THICKNESSES OF SHEER AND STRINGER STRAKES OF UPPER STRENGTH DECK ARE HELD WITHIN THIS SPECIFIED TOLERANCE WHEN AREA ADDITION TO THE DECK FIBER IS REQUIRED.
4	STRESF	F	PRIMARY STRESS FACTOR; THIS FACTOR IS USED TO COMPUTE PRIMARY STRESS AT NEUTRAL AXIS σ_{NA} = STRESF X (MAX OF σ_{DK} OR σ_{KEEL}) THIS DISTRIBUTION OF PRIMARY STRESS IS USED ONLY FOR HULL-ENVELOPE COMPONENTS; I.E., SHELL, INNER BOTTOM, AND MAIN DECK; A COMMONLY USED VALUE IS 0.50.
5	ICBPRI	I	INDICATOR FOR COMBINING PRIMARY STRESS WITH SLAMMING STRESS FOR DESIGN OF SHELL PLATE-BEAM MEMBERS: SUBMIT EITHER ICBPRI=0 FOR NONCOMBINING STRESSES OR=1 FOR COMBINING STRESSES.

GENERAL INFORMATION CARD 3—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
6	ISIG2	I	INDICATOR FOR THE USE OF K VERSUS PERCENT EFFECTIVE (PE) CURVE:



THE FACTOR K IS USED TO LIMIT THE AMOUNT OF SECONDARY STRESS TO BE COMBINED WITH PRIMARY STRESS WHEN CHECKING CRITICAL BUCKLING AND ULTIMATE COMPRESSIVE STRENGTH OF PLATE PANELS, THAT IS, THE FOLLOWING RELATIONS MUST BE SATISFIED

$$\sigma 1 + K\sigma 2 \leqslant \sigma cri \text{ (SHORT EDGE LOADED)}$$
$$\sigma 1 + K\sigma 2 \leqslant 0.8\,\sigma cri \text{ (LONG EDGE LOADED)}$$
$$\sigma 1 + K\sigma 2 \leqslant 0.8\,\sigma ULT.\,\frac{Fc}{\sigma y} \text{ (SHORT EDGE LOADED)}$$

SUBMIT ISIG2=0 TO INDICATE THAT CURVE SHOULD NOT BE USED; PROGRAM WILL THEN USE K=1.0 FOR SHORT EDGE LOADED AND K=0.0 FOR LONG EDGE LOADED, REGARDLESS OF VALUE OF PE—THIS AGREES WITH CURRENT STANDARD NAVY PRACTICES.

SUBMIT ISIG2=1 TO INDICATE THAT CURVE SHOULD BE USED; THEN SUBMIT INPUT DATA 7 THROUGH 9 ON THIS CARD.

GENERAL INFORMATION CARD 3—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
7	P1S2K	F	K VALUE FOR POINT 1.
8	P1PE	F	PERCENT EFFECTIVE FOR POINT 1.
9	P2PE	F	PERCENT EFFECTIVE FOR POINT 2.

NUCLEAR BLAST CARD		NOTE: IF SHIP IS **NOT** TO BE DESIGNED FOR NUCLEAR BLAST, THIS CARD **MUST BE OMITTED.**			
PEAK OVER PRESSURE (psi)	HEIGHT OF SUPER-STRUCTURE ABOVE WEATHER DECK (feet)	DUCTILITY FACTORS: RATIO OF MAXIMUM PLASTIC DEFL. TO ELASTIC DEFL.		WEAPON YIELD (megatons)	
		SHELL	DECK		
1	2	3	4	5	

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	PSO	F	PEAK INCIDENT OVERPRESSURE BEHIND SHOCK FRONT.
2	HO	F	HEIGHT OF SUPERSTRUCTURE ABOVE WEATHER DECK: SUBMIT HO=0.0, IF SHIP DOES NOT HAVE A SUPERSTRUCTURE.
3	XMUS	F	DUCTILITY FACTORS: RATIO OF MAXIMUM PLASTIC DEFLECTION TO MAXIMUM ELASTIC DEFLECTION.
4	XMUD	F	
5	WYLD	F	ENERGY YIELD OF EXPLOSION IN MEGATONS.

PRIMARY STRESS CARD							
BENDING MOMENT SAG (ft-tons)	BENDING MOMENT HOG (ft-tons)	ASSUMED CALCULATED PRIMARY STRESSES (psi)				DESIGN LIMITING PRIMARY STRESS	
		DECK FIBER		KEEL FIBER		DECK FIBER (psi)	KEEL FIBER (psi)
		SAGGING	HOGGING	SAGGING	HOGGING		
		+	-	-	+		
1	2	3	4	5	6	7	8

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	BMSAG	F	BENDING MOMENT DUE TO SHIP SAGGING.
2	BMHOG	F	BENDING MOMENT DUE TO SHIP HOGGING.
3	ST1D(1)	F	ASSUMED PRIMARY COMPRESSIVE STRESS AT UPPER DECK DUE TO SHIP SAGGING.
4	ST1D(2)	F	ASSUMED PRIMARY TENSILE STRESS AT UPPER DECK DUE TO SHIP HOGGING.
5	ST1K(2)	F	ASSUMED PRIMARY TENSILE STRESS AT KEEL DUE TO SHIP SAGGING.
6	ST1K(1)	F	ASSUMED PRIMARY COMPRESSIVE STRESS AT KEEL DUE TO SHIP HOGGING.
7	STSLT	F	DESIGN LIMITING PRIMARY STRESS FOR UPPER DECK FIBER; THIS IS A PRESCRIBED PRIMARY STRESS LIMIT, BASED ON MATERIAL SPECIFIED FOR UPPER DECK; FOR MILD STEEL, A VALUE OF 19,040 PSI (8.5 TSI) IS COMMONLY USED. THIS LIMIT USUALLY INCLUDES A MARGIN STRESS OF BETWEEN 0.5 AND 1.0 TSI.
8	STSLIM	F	DESIGN-LIMITING PRIMARY STRESS FOR KEEL FIBER; THIS IS A PRESCRIBED PRIMARY-STRESS LIMIT, BASED ON MATERIAL SPECIFIED FOR KEEL FIBER.

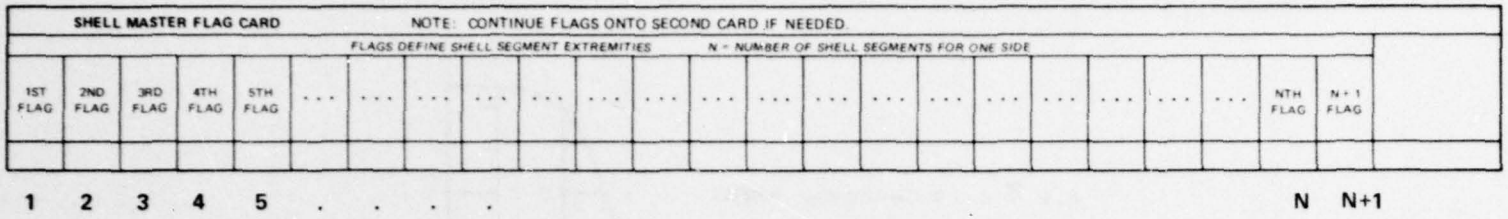
NOTE: SIGN CONVENTION USED IN PROGRAM IS: COMPRESSION (+), TENSION (-); INPUT DATA 4 AND 5 MUST CONTAIN A NEGATIVE SIGN.

GEOMETRY COORDINATE CARDS						NOTE: HEIGHTS ARE ABOVE BASELINE				
FIRST COORDINATE SET OF CARD		SECOND COORDINATE SET OF CARD		THIRD COORDINATE SET OF CARD		FOURTH COORDINATE SET OF CARD		FIFTH COORDINATE SET OF CARD		
HEIGHT Z (feet)	HALF BREADTH Y (feet)	HEIGHT Z (feet)	HALF BREADTH Y (feet)	HEIGHT Z (feet)	HALF BREADTH Y (feet)	HEIGHT Z (feet)	HALF BREADTH Y (feet)	HEIGHT Z (feet)	HALF BREADTH Y (feet)	
1	2	3	4	5	6	7	8	9	10	

THIS IS FIRST GEOMETRY-COORDINATE CARD.

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	COFILE(1,1)	F	HEIGHT ABOVE BASELINE TO POINT 1 OF SECTION.
2	COFILE(1,2)	F	HALF-BREADTH TO POINT 1 OF SECTION.
.	.	.	. . . . .
9	COFILE(5,1)	F	HEIGHT ABOVE BASELINE TO POINT 5 OF SECTION.
10	COFILE(5,2)	F	HALF-BREADTH TO POINT 5 OF SECTION.

NOTE: FIVE COORDINATE SETS ARE CONTAINED ON EACH GEOMETRY COORDINATE CARD; NUMBER OF CARDS DEPENDS ON NUMBER OF POINTS SPECIFIED; INFORMATION REQUIRED ON ADDITIONAL CARDS IS SIMILAR TO ITEMS SHOWN ON FIRST GEOMETRY COORDINATE CARD



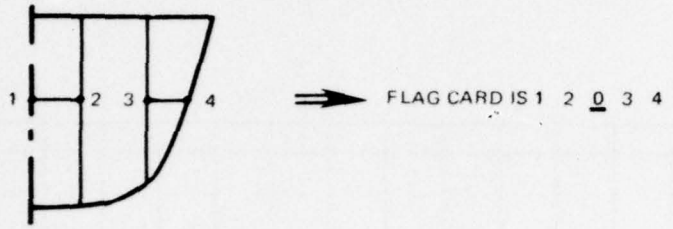
INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITIONS AND INSTRUCTIONS
1	MFLSHL(1)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF SHELL SEGMENT 1.
2	MFLSHL(2)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF SHELL SEGMENT 2.
.	.	.	. . . .
N	MFLSHL(N)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF SHELL SEGMENT N.
N+1	MFLSHL(N+1)	I	NUMBER (FLAG) ASSIGNED TO TERMINAL EXTREMITY POINT OF SHELL SEGMENT N.

DECK NUMBER DO NOT INPUT	DECK MASTER FLAG CARDS																			
	FLAGS DEFINE DECK SEGMENT EXTREMITIES N = NUMBER OF SEGMENTS FOR DECK																			
	1ST FLAG	2ND FLAG	3RD FLAG	4TH FLAG	5TH FLAG	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	NTH FLAG	N + 1 FLAG
1																				

1 2 . . . . N N+1

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	MFLDEK(1,1)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF DECK 1, SEGMENT 1.
2	MFLDEK(1,2)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF DECK 1, SEGMENT 2.
.	.	.	. . . .
N	MFLDEK(1,N)	I	NUMBER (FLAG) ASSIGNED TO THE INITIAL EXTREMITY POINT OF DECK 1, SEGMENT N.
N+1	MFLDEK(1,N+1)	I	NUMBER (FLAG) ASSIGNED TO THE TERMINAL EXTREMITY POINT OF DECK 1, SEGMENT N.

NOTE: PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EACH DECK; NUMBER OF CARDS DEPENDS ON NUMBER OF DECK SPECIFIED; FOR DECKS CONTAINING A BREAK, FLAG CARD MUST CONTAIN A ZERO FLAG TO INDICATE INTERRUPTION, EXAMPLE

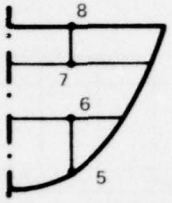


BULKHEAD NO DO NOT INPUT	BULKHEAD MASTER FLAG CARDS — NOTE: IF NO BULKHEADS ARE SPECIFIED, THESE CARDS MUST BE OMITTED.																			
	FLAGS DEFINE BULKHEAD SEGMENT EXTREMITIES — N = NUMBER OF SEGMENTS FOR BULKHEAD																			
	1ST FLAG	2ND FLAG	3RD FLAG	4TH FLAG	5TH FLAG	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	NTH FLAG	N+1 FLAG
1																				

1 2 . . . . N N+1

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	MFLBHD(1,1)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF BULKHEAD 1, SEGMENT 1.
2	MFLBHD(1,2)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF BULKHEAD 1, SEGMENT 2.
.	.	.	. . . .
N	MFLBHD(1,N)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF BULKHEAD 1, SEGMENT N.
N+1	MFLBHD(1,N+1)	I	NUMBER (FLAG) ASSIGNED TO TERMINAL EXTREMITY POINT OF BULKHEAD 1, SEGMENT N.

NOTE: PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EACH BULKHEAD; NUMBER OF CARDS DEPENDS ON NUMBER OF BULKHEADS SPECIFIED; FOR BULKHEADS CONTAINING A BREAK, FLAG CARD MUST CONTAIN A ZERO FLAG TO INDICATE INTERRUPTION, EXAMPLE



⟹ FLAG CARD IS 5 6 0 7 8

INNERBOTTOM MASTER FLAG CARD NOTE: IF THERE IS NO INNERBOTTOM, THIS CARD MUST BE OMITTED.

FLAGS DEFINE INNERBOTTOM SEGMENT EXTREMITIES. N = NUMBER OF INNERBOTTOM SEGMENTS FOR ONE SIDE.

1ST FLAG	2ND FLAG	3RD FLAG	4TH FLAG	5TH FLAG	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	...	NTH FLAG	N+1 FLAG	

1 2 . . . . N N+1

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	MFLIB(1)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF INNER BOTTOM SEGMENT 1.
2	MFLIB(2)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF INNER BOTTOM SEGMENT 2.
.	.	.	. . . .
N	MFLIB(N)	I	NUMBER (FLAG) ASSIGNED TO INITIAL EXTREMITY POINT OF INNER BOTTOM SEGMENT N.
N+1	MFLIB(N+1)	I	NUMBER (FLAG) ASSIGNED TO TERMINAL EXTREMITY POINT OF INNER BOTTOM SEGMENT N.

CVK AND DOUBLE BOTTOM PLATE LONGITUDINAL MASTER FLAG CARD NOTE: CONTINUE FLAGS ONTO SECOND CARD IF NEEDED.

NOTE: IF THERE IS **NO** INNERBOTTOM, THIS CARD **MUST BE OMITTED**.

CVK-SHL FLAG	CVK-IB FLAG	1ST DBL-SHL FLAG	1ST DBL-IB FLAG	2ND DBL-SHL FLAG	2ND DBL-IB FLAG	3RD DBL-SHL FLAG	3RD DBL-IB FLAG	4TH DBL-SHL FLAG	4TH DBL-IB FLAG	5TH DBL-SHL FLAG	5TH DBL-IB FLAG	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	NTH DBL-SHL FLAG	NTH DBL-IB FLAG	

1 2 3 4 . . . . 2N+1 2N+2

N=NUMBER OF PLATE LONGITUDINALS FOR ONE SIDE.

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	MFLCVK(1)	I	NUMBER (FLAG) ASSIGNED TO INTERSECTION OF BOTTOM SHELL WITH CENTER VERTICAL KEEL PLATE.
2	MFLCVK(2)	I	NUMBER (FLAG) ASSIGNED TO INTERSECTION OF INNER BOTTOM WITH CENTER VERTICAL KEEL PLATE.
3	MFLDBL(1,1)	I	NUMBER (FLAG) ASSIGNED TO INTERSECTION OF SHELL WITH PLATE LONGITUDINAL 1.
4	MFLDBL(1,2)	I	NUMBER (FLAG) ASSIGNED TO INTERSECTION OF INNER BOTTOM WITH PLATE LONGITUDINAL 1.
.	.	.	. . . .
(2xN)+1	MFLDBL(N,1)	I	NUMBER (FLAG) ASSIGNED TO INTERSECTION OF SHELL WITH PLATE LONGITUDINAL N.
(2xN)+2	MFLDBL(N,2)	I	NUMBER (FLAG) ASSIGNED TO INTERSECTION OF INNER BOTTOM WITH PLATE LONGITUDINAL N.

DECK IDENTIFICATION CARD												
1 = CONTINUOUS DECK, 0 = INTERCOSTAL DECK												
1ST DK.	2ND DK.	3RD DK.	4TH DK.	5TH DK.	6TH DK.	7TH DK.	8TH DK.	9TH DK.	10TH DK.	11TH DK.	12TH DK.	

1 . . . . . N

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	LSTRD(1)	I	INDICATOR FOR CONTINUITY OF DECK 1: SUBMIT EITHER LSTRD(1)=0 FOR INTERCOSTAL DECK (PLATFORM) OR =1 FOR CONTINUOUS DECK.
.	.	.	. . . .
N	LSTRD(N)	I	INDICATOR FOR CONTINUITY OF DECK N.

NOTE: N=NUMBER OF DECKS.

BETWEEN DECK CLEARANCE CARD												
BETWEEN DECK #1 AND BOTTOM STRUCTURE (feet)	BETWEEN DECK #2 AND DECK #1 (feet)	BETWEEN DECK #3 AND DECK #2 (feet)	BETWEEN DECK #4 AND DECK #3 (feet)	BETWEEN DECK #5 AND DECK #4 (feet)	BETWEEN DECK #6 AND DECK #5 (feet)	BETWEEN DECK #7 AND DECK #6 (feet)	BETWEEN DECK #8 AND DECK #7 (feet)	BETWEEN DECK #9 AND DECK #8 (feet)	BETWEEN DECK #10 AND DECK #9 (feet)	BETWEEN DECK #11 AND DECK #10 (feet)	BETWEEN DECK #12 AND DECK #11 (feet)	

1 . . . . N

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	DKCL(1)	F	MINIMUM HEADROOM CLEARANCE REQUIRED BETWEEN DECK 1 AND BOTTOM STRUCTURE; INNER BOTTOM PLATING FOR SHIPS WITH A DOUBLE BOTTOM.
.	.	.	. . . .
N	DKCL(N)	F	MINIMUM HEADROOM CLEARANCE REQUIRED BETWEEN DECKS N AND N-1.

NOTE: N=NUMBER OF DECKS.

REGION NO. (DO NOT INPUT)	DECK REGION DESCRIPTION CARDS													
	WIDTH OF REGION (feet)	NUMBER OF SEGMENTS PER DECK PER REGION												
		1ST DK.	2ND DK.	3RD DK.	4TH DK.	5TH DK.	6TH DK.	7TH DK.	8TH DK.	9TH DK.	10TH DK.	11TH DK.	12TH DK.	
1														
	1	2	3	.	.	.	.						1+N	

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	W5REG(1)	F	ATHWARTSHIP WIDTH OF REGION 1; REGIONS ARE NUMBERED CONSECUTIVELY, OUTBOARD FROM THE CENTERLINE.
2	NSEGRG(1,1)	I	NUMBER OF DECK 1 SEGMENTS CONTAINED WITHIN REGION 1.
3	NSEGRG(1,2)	I	NUMBER OF DECK 2 SEGMENTS CONTAINED WITHIN REGION 1.
.	.	.	. . . .
1+N	NSEGRG(1,N)	I	NUMBER OF DECK N SEGMENTS CONTAINED WITHIN REGION 1.

NOTES: 1. PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EACH DECK REGION; NUMBER OF CARDS DEPENDS ON NUMBER OF DECK REGIONS SPECIFIED.

2. N=NUMBER OF DECKS.

SHELL SEGMENT NO. DO NOT INPUT	SHELL DESIGN CRITERIA CARDS																
	TANK OVERFLOW HEAD (feet)	TANK TOP HEAD (feet)	SLAM PRESSURE (psi)		LIMITS FOR WIDTH OF SHELL PANEL (inches)		DESIGN LENGTH (feet)		MIN. PLT. THICK (CATALOG NO.)	MIN. TEE BEAM (CATALOG NO.)	PLT. DEFORMATION FOR SLAM ONLY	END BRACKETS 0 = NO, 1 = YES	REASON FOR MIN. PLT. THICK	TYPE OF MATERIAL		
			PLATE	BEAM	MINIMUM	MAXIMUM	PANEL	BEAM						PLATE	BEAM	
J																
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

J DENOTES SHELL-SEGMENT NUMBER.

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	TOFSHL(J)	F	TANK-OVERFLOW HEAD, ABOVE KEEL.
2	TTHSHL(J)	F	TANK-TOP HEAD, ABOVE LOWEST POINT OF SHELL SEGMENT J.
3	PLSLAM(J)	F	SLAM PRESSURE FOR PANELS OF SHELL SEGMENT J.
4	BMSLAM(J)	F	SLAM PRESSURE FOR BEAMS OF SHELL SEGMENT J.
5	W5MINS(J)	F	MINIMUM ALLOWABLE PANEL WIDTH FOR SHELL SEGMENT J.*
6	W5MAXS(J)	F	MAXIMUM ALLOWABLE PANEL WIDTH FOR SHELL SEGMENT J.*
7	SPLLTH(J)	F	PANEL-DESIGN LENGTH FOR SHELL SEGMENT J: FOR SHELL SEGMENTS OUTSIDE OF DOUBLE BOTTOM, PUT IN ONLY IF PNLXL1=0.0 ON GENERAL INFORMATION CARD 1; FOR SHELL SEGMENTS WITHIN DOUBLE BOTTOM, PUT IN ONLY IF PNLXL=0.0 ON GENERAL INFORMATION CARD 2; OTHERWISE, SUBMIT SPLLTH(J)=0.0.
8	SBMLTH(J)	F	BEAM-DESIGN LENGTH FOR SHELL SEGMENT J: FOR SHELL SEGMENTS OUTSIDE OF DOUBLE BOTTOM, PUT IN ONLY IF XL1WEB=0.0 ON GENERAL INFORMATION CARD 1; FOR SHELL SEGMENTS WITHIN DOUBLE BOTTOM, PUT IN ONLY IF XL1FLR=0.0 ON GENERAL INFORMATION CARD 2; OTHERWISE, SUBMIT SBMLTH(J)=0.0.

*PROGRAM WILL EXAMINE ALL JUSTIFIABLE SPACINGS INCLUDED WITHIN THESE PRECISE BOUNDS; SPECIFICATION OF W5MINS(J) =W5MAXS(J) WILL GIVE SHELL SEGMENT J PANEL WIDTHS APPROXIMATELY EQUAL TO NOMINAL VALUE SPECIFIED; SPECIFICATION OF W5MINS(J)=W5MAXS(J)=0.0 WILL CAUSE SHELL SEGMENT J TO BE DESIGNED WITHOUT LONGITUDINAL BEAMS.

SHELL-DESIGN CRITERIA CARDS—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
9	MTSHL(J)	I	MINIMUM PLATE-THICKNESS CODE NUMBER FOR SHELL SEGMENT J; REFER TO SECTION 11 FOR PLATE THICKNESS CODE NUMBERS; IF THERE IS NO MINIMUM THICKNESS REQUIREMENT FOR SEGMENT, SUBMIT MTSHL(J)=1; SPECIFICATION OF MTSHL(J)=*NEGATIVE* CODE NUMBER WILL CAUSE THICKNESS OF SHELL SEGMENT J TO BE HELD *FIXED* AT THICKNESS CORRESPONDING TO CODE NUMBER SPECIFIED.
10	MKSHL(J)	I	MINIMUM T-BEAM CODE NUMBER FOR SHELL SEGMENT J; REFER TO SECTION 11 FOR T-BEAM CODE NUMBERS. IF THERE IS NO MINIMUM T-BEAM REQUIREMENT FOR THE SEGMENT, SUBMIT MKSHL(J)=1; SPECIFICATION OF MKSHL(J)=*NEGATIVE* CODE NUMBER WILL CAUSE BEAMS OF SHELL SEGMENT J TO BE HELD *FIXED* AT SIZE CORRESPONDING TO CODE NUMBER SPECIFIED.
11	IDEFOR(J)	I	INDICATOR FOR AMOUNT OF DEFORMATION TO BE ALLOWED FOR PANELS OF *SHELL SEGMENT J WHEN DESIGNING FOR SLAM ONLY*: SUBMIT EITHER IDEFOR(J)=1 FOR NO SET OR =2 FOR SOME SET OR =3 FOR CONSIDERABLE SET THESE COMPARE TO THE THREE-PLATE-RESPONSE CATEGORIES LISTED IN THE GENERAL SPECIFICATIONS.[3]
12	LBKTSH(J)	I	INDICATOR FOR PRESENCE OF END BRACKETS IN DESIGN OF SHELL SEGMENT J LONGITUDINAL BEAMS: SUBMIT EITHER LBKTSH(J)=0 FOR END BRACKETS NOT REQUIRED OR =1 FOR END BRACKETS REQUIRED.
13	MPRS(J)	I	INDICATOR TO IDENTIFY REASON FOR SPECIFYING MINIMUM PLATE THICKNESS FOR SHELL SEGMENT J: SUBMIT EITHER MPRS(J)=0 FOR NO MINIMUM THICKNESS SPECIFIED OR =1 FOR BALLISTIC REQUIREMENT OR =2 FOR HELICOPTER/AIRCRAFT HANDLING AREA OR =3 FOR SPECIAL HANDLING REQUIREMENTS OR =4 FOR RUGGEDNESS REQUIREMENT.

SHELL-DESIGN CRITERIA CARDS—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
14	MPLS(J)	I	INDICATOR FOR TYPE OF PLATE MATERIAL FOR SHELL SEGMENT J; PUT IN ONLY IF I1MATL=0 ON GENERAL INFORMATION CARD 2: SUBMIT EITHER MPLS(J)=1 FOR MS OR =2 FOR HTS OR =3 FOR HY 80 OR =4 FOR HY 100 OR =5 FOR AL 5086-H 116 OR =7 FOR AL 5456-H 116.
15	MBMS(J)	I	INDICATOR FOR TYPE OF BEAM MATERIAL FOR SHELL SEGMENT J; PUT IN ONLY IF I1MATL=0 ON GENERAL INFORMATION CARD 2: SUBMIT EITHER MBMS(J)=1 FOR MS OR =2 FOR HTS OR =3 FOR HY 80 OR =4 FOR HY 100 OR =6 FOR AL 5086-H 111 OR =8 FOR AL 5456-H 111.

NOTE: PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EACH SHELL SEGMENT; NUMBER OF CARDS DEPENDS ON NUMBER OF SHELL SEGMENTS SPECIFIED; PROGRAM REQUIRES THAT *ZERO* BE SUBMITTED FOR *LOADS* THAT DO NOT APPLY FOR A SHELL SEGMENT.

REMOVAL NO. DO NOT INPUT	SHELL REMOVAL CARDS — NOTE: IF THERE ARE NO REMOVALS IN THE SHELL, THESE CARDS MUST BE OMITTED.					
	SEGMENT NO. CONTAINING REMOVAL	TYPE OF REMOVAL 1 = OPENING 2 = INEFFECTIVE AREA	IS REMOVAL SYMMETRIC 0 = NO, 1 = YES	HEIGHT ABOVE BASELINE TO EXTREMITY POINTS OF REMOVAL (feet)		
				LOWER	UPPER	
1						
	1	2	3	4	5	

J DENOTES NUMBER OF SHELL REMOVAL.

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	NSSR(J)	I	SHELL-SEGMENT NUMBER CONTAINING REMOVAL.
2	ITRS(J)	I	INDICATOR FOR TYPE OF REMOVAL: SUBMIT EITHER ITRS(J)=1 FOR AN OPENING OR =2 FOR AN INEFFECTIVE AREA.
3	ISYMS(J)	I	INDICATOR FOR SYMMETRY OF REMOVAL: SUBMIT EITHER ISYMS(J)=0 FOR UNSYMMETRICAL REMOVAL OR =1 FOR SYMMETRICAL REMOVAL.
4	ZLSR(J)	F	HEIGHT ABOVE BASELINE TO LOWER EXTREMITY POINT OF REMOVAL.*
5	ZUSR(J)	F	HEIGHT ABOVE BASELINE TO UPPER EXTREMITY POINT OF REMOVAL.*

*IF ABSOLUTE DIFFERENCE IN HEIGHT BETWEEN SEGMENT EXTREMITY POINTS IS LESS THAN OR EQUAL TO *0.50 FEET*, SUBMIT *HALF-BREADTHS* TO EXTREMITY POINTS OF REMOVAL.

NOTE: THE PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EACH REMOVAL IN THE SHELL. THE NUMBER OF CARDS IS DEPENDENT ON THE NUMBER OF SHELL REMOVALS SPECIFIED. REMOVALS EXTENDING OVER TWO ADJACENT SHELL SEGMENTS MUST BE TREATED AS TWO SEPARATE REMOVALS, ONE FOR EACH SEGMENT.

DO NOT INPUT	DECK DESIGN CRITERIA CARDS															
DECK NO	SEGMENT NO	LIVE LOAD (psf)	VITAL/ NORMAL DAMAGE HEAD (feet)	TANK OVERFLOW HEAD (feet)	TANK TOP HEAD (feet)	LIMITS FOR WIDTH OF DECK PANEL (inches)		DESIGN LENGTH (feet)		MIN. PLT. THICK. (CATALOG NO.)	MIN. TEE BEAM (CATALOG NO.)	TYPE OF SPACE I.D.	END BRACKETS 0 - NO, 1 - YES	REASON FOR MIN. PLT. THICK.	TYPE OF MATERIAL		
						MINIMUM	MAXIMUM	PANEL	BEAM						PLATE	BEAM	
1	1																
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	

N DENOTES DECK NUMBER, AND J DENOTES SEGMENT NUMBER.

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	XLL(N,J)	F	LIVE LOAD FOR DECK N, SEGMENT J.
2	VNDHDD(N,J)	F	VITAL/NORMAL SPACE, DESIGN DAMAGE HEAD ABOVE KEEL FOR DECK N, SEGMENT J.
3	TOFDK(N,J)	F	TANK-OVERFLOW HEAD ABOVE KEEL FOR DECK N, SEGMENT J.
4	TTHDDK(N,J)	F	TANK-TOP HEAD ABOVE DECK FOR DECK N, SEGMENT J.
5	W5MIND(N,J)	F	MINIMUM ALLOWABLE PANEL WIDTH FOR DECK N, SEGMENT J.*
6	W5MAXD(N,J)	F	MAXIMUM ALLOWABLE PANEL WIDTH FOR DECK N, SEGMENT J.*
7	DPPLLTH(N,J)	F	PANEL DESIGN LENGTH FOR DECK N, SEGMENT J. PUT IN ONLY IF PNLXL1=0.0 ON GENERAL INFORMATION CARD 1, OTHERWISE SUBMIT DPLLTH(N,J)=0.0.

*PROGRAM WILL EXAMINE ALL JUSTIFIABLE SPACINGS INCLUDED WITHIN THESE PRECISE BOUNDS: SPECIFICATION OF W5MIND(N,J)=W5MAXD(N,J) WILL GIVE DECK N, SEGMENT J, PANEL WIDTHS APPROXIMATELY EQUAL TO NOMINAL VALUE SPECIFIED; SPECIFICATION OF W5MIND(N,J)=W5MAXD(N,J)=0.0 WILL CAUSE DECK N, SEGMENT J, TO BE DESIGNED WITHOUT BEAMS.

DECK-DESIGN CRITERIA CARDS—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
8	DBMLTH(N,J)	F	BEAM-DESIGN LENGTH FOR DECK N, SEGMENT J; PUT IN ONLY IF XL1WEB=0.0 ON GENERAL INFORMATION CARD 1, OTHERWISE SUBMIT DBMLTH(N,J)=0.0.
9	MTDK(N,J)	I	MINIMUM PLATE-THICKNESS CODE NUMBER FOR DECK N, SEGMENT J; REFER TO SECTION 11 FOR PLATE-THICKNESS CODE NUMBERS; IF THERE IS NO MINIMUM THICKNESS REQUIREMENT FOR SEGMENT, SUBMIT MTDK(N,J)=1; SPECIFICATION OF MTDK(N,J)=*NEGATIVE* CODE NUMBER WILL CAUSE THICKNESS OF DECK N, SEGMENT J, TO BE HELD *FIXED* AT THICKNESS CORRESPONDING TO CODE NUMBER SPECIFIED.
10	MKDK(N,J)	I	MINIMUM T-BEAM CODE NUMBER FOR DECK N, SEGMENT J; REFER TO SECTION 11 FOR T-BEAM CODE NUMBERS; IF THERE IS NO MINIMUM T-BEAM REQUIREMENT FOR THE SEGMENT, SUBMIT MKDK(N,J)=1; SPECIFICATION OF MKDK(N,J)=*NEGATIVE* CODE NUMBER WILL CAUSE BEAMS OF DECK N, SEGMENT J, TO BE HELD *FIXED* AT SIZE CORRESPONDING TO CODE NUMBER SPECIFIED.
11	MDSP(N,J)	I	TYPE OF SPACE IDENTIFIER FOR DECK N, SEGMENT J; DESIGN-LOADING CONDITIONS FOR A GIVEN DECK SEGMENT DEPEND ON TYPE OF SPACE ABOVE AND BELOW THE SEGMENT; 10 COMBINATIONS BOUNDING A DECK SEGMENT ARE POSSIBLE AS SHOWN:

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS

11 (Con.)

SUBMIT MDSP(N,J)=	COMBINATIONS
1	N/N, N/V, V/N, V/V
2	T/T
3	N/T, V/T
4	W.D.
5	T/N, T/V

N IS A NORMAL SPACE
V IS A VITAL SPACE
T IS A TANK
WD IS A WEATHER DECK.

PROGRAM WILL SELECT APPROPRIATE LOADINGS (TABLE 1) TO IMPOSE ON DECK SEGMENT, BASED ON VALUE SPECIFIED FOR MDSP(N,J).

12 LBKTDK(N,J) I

INDICATOR FOR PRESENCE OF END BRACKETS IN DESIGN OF DECK N, SEGMENT J, BEAMS:
SUBMIT EITHER LBKTDK(N,J)=0 FOR END BRACKETS NOT REQUIRED
OR =1 FOR END BRACKETS REQUIRED.

13 MPRD(N,J) I

INDICATOR TO IDENTIFY REASON FOR SPECIFYING MINIMUM PLATE THICKNESS FOR DECK N, SEGMENT J:
SUBMIT EITHER MPRD(N,J)=0 FOR NO MINIMUM THICKNESS SPECIFIED
OR =1 FOR BALLISTIC REQUIREMENT
OR =2 FOR HELICOPTER/AIRCRAFT HANDLING AREA
OR =3 FOR SPECIAL HANDLING REQUIREMENTS
OR =4 FOR RUGGEDNESS REQUIREMENT.

TABLE 1 — DECK-SEGMENT LOADINGS

Type of Space Identifier MDSP(N,J)	Plate* Deformation	Loadings To Be Combined						
		Primary Stresses	Live Load	Dead Load	Tank-Top Head	Tank-Overflow Head	Vital or Normal Damage Head	Nuclear Airblast
1	No set	x	x	x				
	Considerable set			x			x	
2	Some set	x		x	x			
	Some set			x		x		
3	No set	x	x	x				
	Some set			x		x		
	Considerable set			x			x	
4	No set	x	x	x				
	XMUD**							x
5	Some set	x		x	x			
	Some set			x		x		
	Considerable set			x			x	

*These compare to three plate-response cateogires listed in General Specifications.[3]

**Ductility factor for deck structure; this condition applies only to ships without a superstructure.

DECK-DESIGN CRITERIA CARDS—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
14	MPLD(N,J)	I	INDICATOR FOR TYPE OF PLATE MATERIAL FOR DECK N, SEGMENT J; PUT IN ONLY IF I1MATL=0 ON GENERAL INFORMATION CARD 2: SUBMIT EITHER MPLD(N,J)=1 FOR MS OR =2 FOR HTS OR =3 FOR HY 80 OR =4 FOR HY 100 OR =5 FOR AL 5086-H 116 OR =7 FOR AL 5456-H 116.
15	MBMD(N,J)	I	INDICATOR FOR TYPE OF BEAM MATERIAL FOR DECK N, SEGMENT J; PUT IN ONLY IF I1MATL=0 ON GENERAL INFORMATION CARD 2: SUBMIT EITHER MBMD(N,J)=1 FOR MS OR =2 FOR HTS OR =3 FOR HY 80 OR =4 FOR HY 100 OR =6 FOR AL 5086-H 111 OR =8 FOR AL 5456-H 111.

NOTES: 1. PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EVERY SEGMENT OF EACH DECK. THE PROGRAM REQUIRES THAT ZERO BE SUBMITTED FOR *LOADS* THAT DO NOT APPLY FOR A DECK SEGMENT.

2. DECK-DESIGN CRITERIA CARDS MUST BE IN THE FOLLOWING SEQUENCE:
   CARD 1–DECK 1, SEGMENT 1
   CARD 2–DECK 1, SEGMENT 2
   CARD 3–DECK 1, LAST SEGMENT OF DECK 1
   CARD 4–DECK 2, SEGMENT 1
   ETC.

REMOVAL NO DO NOT INPUT	DECK REMOVAL CARDS — NOTE: IF THERE ARE NO REMOVALS IN DECKS, THESE CARDS MUST BE OMITTED.						
	DECK NO CONTAINING REMOVAL	DECK SEGMENT NO CONTAINING REMOVAL	TYPE OF REMOVAL 1 = OPENING 2 = INEFFECTIVE AREA	IS REMOVAL SYMMETRIC 0 = NO, 1 = YES	HALF BREADTH TO EXTREMITY POINTS OF REMOVAL (feet)		
					INNER	OUTER	
1							
	1	2	3	4	5	6	

J DENOTES NUMBER OF DECK REMOVAL.

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	NDR(J)	I	DECK NUMBER CONTAINING REMOVAL.
2	NDSGR(J)	I	DECK-SEGMENT NUMBER CONTAINING REMOVAL.
3	ITRD(J)	I	INDICATOR FOR TYPE OF REMOVAL: SUBMIT EITHER ITRD(J)=1 FOR AN OPENING OR =2 FOR AN INEFFECTIVE AREA.
4	ISYMD(J)	I	INDICATOR FOR SYMMETRY OF REMOVAL: SUBMIT EITHER ISYMD(J)=0 FOR UNSYMMETRICAL REMOVAL OR =1 FOR SYMMETRICAL REMOVAL.
5	YIDR(J)	F	HALF-BREADTH TO INNER-EXTREMITY POINT OF REMOVAL.
6	YODR(J)	F	HALF-BREADTH TO OUTER-EXTREMITY POINT OF REMOVAL.

NOTE: PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EACH REMOVAL IN DECKS; NUMBER OF CARDS DEPENDS ON NUMBER OF DECK REMOVALS SPECIFIED; REMOVALS EXTENDING OVER TWO ADJACENT DECK SEGMENTS MUST BE TREATED AS TWO SEPARATE REMOVALS, ONE FOR EACH SEGMENT.

DO NOT INPUT	BULKHEAD DESIGN CRITERIA CARDS — NOTE: IF THERE ARE NO BULKHEADS, THESE CARDS MUST BE OMITTED.														
BULKHEAD NO.	SEGMENT NO.	VITAL/ NORMAL DAMAGE HEAD (feet)	TANK OVERFLOW HEAD (feet)	TANK TOP HEAD (feet)	LIMITS FOR WIDTH OF BULKHEAD PANEL (inches)		DESIGN LENGTH (feet)		MIN PLT THICK (CATALOG NO.)	MIN TEE BEAM (CATALOG NO.)	TYPE OF SPACE I.D.	END BRACKETS 0 - NO, 1 - YES	REASON FOR MIN PLT THICK	TYPE OF MATERIAL	
					MINIMUM	MAXIMUM	PANEL	BEAM						PLATE	BEAM
1	1														
		1	2	3	4	5	6	7	8	9	10	11	12	13	14

N DENOTES BULKHEAD NUMBER, AND J DENOTES SEGMENT NUMBER.

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	VNDHD(N,J)	F	VITAL/NORMAL SPACE-DESIGN DAMAGE HEAD ABOVE KEEL FOR BULKHEAD N, SEGMENT J.
2	TKDHD(N,J)	F	TANK-OVERFLOW HEAD ABOVE KEEL FOR BULKHEAD N, SEGMENT J.
3	TKTHD(N,J)	F	TANK-TOP HEAD ABOVE LOWEST POINT OF BULKHEAD N, SEGMENT J.
4	W5MINB(N,J)	F	MINIMUM ALLOWABLE PANEL WIDTH FOR BULKHEAD N, SEGMENT J.*
5	W5MAXB(N,J)	F	MAXIMUM ALLOWABLE PANEL WIDTH FOR BULKHEAD N, SEGMENT J.*
6	BPLLTH(N,J)	F	PANEL DESIGN LENGTH FOR BULKHEAD N, SEGMENT J: FOR BULKHEAD SEGMENTS OUTSIDE OF DOUBLE BOTTOM, PUT IN ONLY IF PNLXL1=0.0 ON GENERAL INFORMATION CARD 1; FOR BULKHEAD SEGMENTS WITHIN THE DOUBLE BOTTOM, PUT IN ONLY IF PNLXL=0.0 ON GENERAL INFORMATION CARD 2; OTHERWISE, SUBMIT BPLLTH(N,J)=0.0.

*PROGRAM WILL EXAMINE ALL JUSTIFIABLE SPACINGS INCLUDED WITHIN THESE PRECISE BOUNDS: SPECIFICATION OF W5MINB(N,J)=W5MAXB(N,J) WILL GIVE BULKHEAD N, SEGMENT J, PANEL WIDTHS APPROXIMATELY EQUAL TO NOMINAL VALUE SPECIFIED; SPECIFICATION OF W5MINB(N,J)=W5MAXB(N,J)=0.0 WILL CAUSE BULKHEAD N, SEGMENT J TO BE DESIGNED WITHOUT BEAMS.

BULKHEAD-DESIGN CRITERIA CARDS—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
7	BBMLTH(N,J)	F	BEAM DESIGN LENGTH FOR BULKHEAD N, SEGMENT J: FOR BULKHEAD SEGMENTS OUTSIDE OF DOUBLE BOTTOM, PUT IN ONLY IF XL1WEB=0.0 ON GENERAL INFORMATION CARD 1; FOR BULKHEAD SEGMENTS WITHIN DOUBLE BOTTOM, PUT IN ONLY IF XL1FLR=0.0 ON GENERAL INFORMATION CARD 2; OTHERWISE, SUBMIT BBMLTH(N,J)=0.0.
8	MTBHD(N,J)	I	MINIMUM PLATE-THICKNESS CODE NUMBER FOR BULKHEAD N, SEGMENT J: REFER TO SECTION 11 FOR PLATE-THICKNESS CODE NUMBERS; IF THERE IS NO MINIMUM THICKNESS REQUIREMENT FOR SEGMENT, SUBMIT MTBHD(N,J)=1; SPECIFICATION OF MTBHD(N,J)=*NEGATIVE* CODE NUMBER WILL CAUSE THICKNESS OF BULKHEAD N, SEGMENT J, TO BE HELD *FIXED* AT THICKNESS CORRESPONDING TO CODE NUMBER SPECIFIED.
9	MKBH(N,J)	I	MINIMUM T-BEAM CODE NUMBER FOR BULKHEAD N, SEGMENT J: REFER TO SECTION 11 FOR T-BEAM CODE NUMBERS; IF THERE IS NO MINIMUM T-BEAM REQUIREMENT FOR SEGMENT, SUBMIT MKBH(N,J)=1; SPECIFICATION OF MKBH(N,J)= *NEGATIVE* CODE NUMBER WILL CAUSE BEAMS OF BULKHEAD N, SEGMENT J, TO BE HELD *FIXED* AT SIZE CORRESPONDING TO CODE NUMBER SPECIFIED.
10	MBSP(N,J)	I	TYPE-OF-SPACE IDENTIFIER FOR BULKHEAD N, SEGMENT J: DESIGN-LOADING CONDITIONS FOR A GIVEN BULKHEAD SEGMENT DEPEND ON TYPE OF SPACE OUTBOARD AND INBOARD OF THE SEGMENT; NINE COMBINATIONS BOUNDING A BULKHEAD SEGMENT ARE POSSIBLE AS SHOWN:

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS

10 (Con.)

SUBMIT MBSP(N,J)=	COMBINATIONS
1	N N, N V, V V, V N
2	N T, V T, T N, T V
3	T T

N IS A NORMAL SPACE
V IS A VITAL SPACE
T IS A TANK

PROGRAM WILL SELECT APPROPRIATE LOADINGS (TABLE 2) TO IMPOSE ON BULKHEAD SEGMENT, BASED ON VALUE SPECIFIED FOR MBSP(N,J).

11 LBKTBD(N,J) I

INDICATOR FOR PRESENCE OF END BRACKETS IN DESIGN OF BULKHEAD N, SEGMENT J, BEAMS:
SUBMIT EITHER LBKTBD(N,J)=0 FOR END BRACKETS NOT REQUIRED
OR =1 FOR END BRACKETS REQUIRED.

12 MPRB(N,J) I

INDICATOR TO IDENTIFY REASON FOR SPECIFYING MINIMUM PLATE THICKNESS FOR BULKHEAD N, SEGMENT J:
SUBMIT EITHER MPRB(N,J)=0 FOR NO MINIMUM THICKNESS SPECIFIED
OR =1 FOR BALLISTIC REQUIREMENT
OR =2 FOR HELICOPTER/AIRCRAFT HANDLING AREA
OR =3 FOR SPECIAL HANDLING REQUIREMENTS
OR =4 FOR RUGGEDNESS REQUIREMENT.

TABLE 2 — BULKHEAD-SEGMENT LOADINGS

Type of Space Identifier MBSP(N,J)	Plate Deformation*	Loadings To Be Combined				
		Primary Stress	Dead Load	Tank-Top Head	Tank-Overflow Head	Vital or Normal Damage Head
1	No set	x	x			
	Considerable set		x			x
2	Some set	x	x	x		
	Some set		x		x	
	Considerable set		x			x
3	Some set	x	x	x		
	Some set		x		x	

*These compare to three plate-response categories listed in General Specifications.[3]

BULKHEAD-DESIGN CRITERIA CARDS—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
13	MPLB(N,J)	I	INDICATOR FOR TYPE OF PLATE MATERIAL FOR BULKHEAD N, SEGMENT J; PUT IN ONLY IF I1MATL=0 ON GENERAL INFORMATION CARD 2: SUBMIT EITHER MPLB(N,J)=1 FOR MS OR =2 FOR HTS OR =3 FOR HY 80 OR =4 FOR HY 100 OR =5 FOR AL 5086-H 116 OR =7 FOR AL 5456-H 116.
14	MBMB(N,J)	I	INDICATOR FOR TYPE OF BEAM MATERIAL FOR BULKHEAD N, SEGMENT J; PUT IN ONLY IF I1MATL=0 ON GENERAL INFORMATION CARD 2: SUBMIT EITHER MBMB(N,J)=1 FOR MS OR =2 FOR HTS OR =3 FOR HY 80 OR =4 FOR HY 100 OR =6 FOR AL 5086-H 111 OR =8 FOR AL 5456-H 111.

NOTES: 1. PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EVERY SEGMENT OF EACH BULKHEAD; PROGRAM REQUIRES THAT *ZERO* BE SUBMITTED FOR *LOADS* THAT DO NOT APPLY FOR A BULKHEAD SEGMENT.

2. BULKHEAD-DESIGN CRITERIA CARDS MUST BE IN THE FOLLOWING SEQUENCE:
   CARD 1—BULKHEAD 1, SEGMENT 1
   CARD 2—BULKHEAD 1, SEGMENT 2
   CARD 3—BULKHEAD 1, LAST SEGMENT OF BULKHEAD 1
   CARD 4—BULKHEAD 2, SEGMENT 1
   ETC.

BULKHEAD REMOVAL CARDS — NOTE: IF THERE ARE NO REMOVALS IN BULKHEADS, THESE CARDS MUST BE OMITTED.							
REMOVAL NO. DO NOT INPUT	BULKHEAD NO. CONTAINING REMOVAL	SEGMENT NO. CONTAINING REMOVAL	TYPE OF REMOVAL 1 = OPENING 2 = INEFFECTIVE AREA	IS REMOVAL SYMMETRIC 0 = NO, 1 = YES	HEIGHT ABOVE BASELINE TO EXTREMITY POINTS OF REMOVAL (feet)		
					LOWER	UPPER	
1							
	1	2	3	4	5	6	

J DENOTES NUMBER OF BULKHEAD REMOVAL.

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	NBR(J)	I	BULKHEAD NUMBER CONTAINING REMOVAL.
2	NBSGR(J)	I	BULKHEAD SEGMENT NUMBER CONTAINING REMOVAL.
3	ITRB(J)	I	INDICATOR FOR TYPE OF REMOVAL: SUBMIT EITHER ITRB(J)=1 FOR AN OPENING OR =2 FOR AN INEFFECTIVE AREA.
4	ISYMB(J)	I	INDICATOR FOR SYMMETRY OF REMOVAL: SUBMIT EITHER ISYMB(J)=0 FOR UNSYMMETRICAL REMOVAL OR =1 FOR SYMMETRICAL REMOVAL.
5	ZLBR(J)	F	HEIGHT ABOVE BASELINE TO LOWER-EXTREMITY POINT OF REMOVAL.
6	ZUBR(J)	F	HEIGHT ABOVE BASELINE TO UPPER-EXTREMITY POINT OF REMOVAL.

NOTE: PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EACH REMOVAL IN BULKHEADS; NUMBER OF CARDS DEPENDS ON NUMBER OF BULKHEAD REMOVALS SPECIFIED; REMOVALS EXTENDING OVER TWO ADJACENT BULKHEAD SEGMENTS MUST BE TREATED AS TWO SEPARATE REMOVALS, ONE FOR EACH SEGMENT; REMOVALS IN CENTERLINE BULKHEADS MUST BE TREATED AS UNSYMMETRICAL.

SEGMENT NO. DO NOT INPUT	INNERBOTTOM DESIGN CRITERIA CARDS — NOTE: IF THERE IS NO INNERBOTTOM, THESE CARDS MUST BE OMITTED.												
	LIVE LOAD (psf)	VITAL/ NORMAL DAMAGE HEAD (feet)	TANK OVERFLOW HEAD (feet)	TANK TOP HEAD (feet)	DESIGN LENGTH (feet)		MIN. PLT. THICK. (CATALOG NO.)	MIN. TEE BEAM (CATALOG NO.)	END BRACKETS 0 = NO, 1 = YES	REASON FOR MIN. PLT. THICK.	TYPE OF MATERIAL		
					PANEL	BEAM					PLATE	BEAM	
1													
	1	2	3	4	5	6	7	8	9	10	11	12	

J DENOTES INNER BOTTOM SEGMENT NUMBER.

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	XLLIB(J)	F	LIVE LOAD FOR INNER BOTTOM SEGMENT J.
2	VNDIB(J)	F	VITAL/NORMAL-SPACE–DESIGN-DAMAGE HEAD ABOVE KEEL FOR INNER BOTTOM SEGMENT J.
3	TOFIB(J)	F	TANK-OVERFLOW HEAD ABOVE KEEL FOR INNER BOTTOM SEGMENT J.
4	TTPIB(J)	F	TANK-TOP HEAD, ABOVE LOWEST POINT OF INNER BOTTOM SEGMENT J.
5	PNLIB(J)	F	PANEL-DESIGN LENGTH FOR INNER BOTTOM SEGMENT J; PUT IN ONLY IF PNLXL=0.0 ON GENERAL INFORMATION CARD 2; OTHERWISE SUBMIT PNLIB(J)=0.0.
6	BMLIB(J)	F	BEAM-DESIGN LENGTH FOR INNER BOTTOM SEGMENT J; PUT IN ONLY IF XL1FLR=0.0 ON GENERAL INFORMATION CARD 2; OTHERWISE SUBMIT BMLIB(J)=0.0.

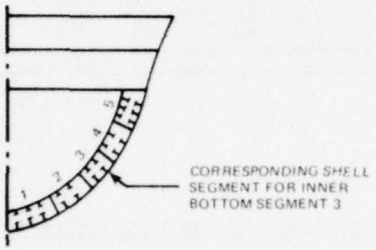
INNER BOTTOM-DESIGN CRITERIA CARDS—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
7	MTIB(J)	I	MINIMUM PLATE-THICKNESS CODE NUMBER FOR INNER BOTTOM SEGMENT J; REFER TO SECTION 11 FOR PLATE-THICKNESS CODE NUMBERS; IF THERE IS NO MINIMUM THICKNESS REQUIREMENT FOR SEGMENT, SUBMIT MTIB(J)=1; SPECIFICATION OF MTIB(J)=*NEGATIVE* CODE NUMBER WILL CAUSE THICKNESS OF INNER BOTTOM SEGMENT J TO BE HELD *FIXED* AT THICKNESS CORRESPONDING TO CODE NUMBER SPECIFIED.
8	MKIB(J)	I	MINIMUM T-BEAM CODE NUMBER FOR INNER BOTTOM SEGMENT J; REFER TO SECTION 11 FOR T-BEAM CODE NUMBERS; IF THERE IS NO MINIMUM T-BEAM REQUIREMENT FOR SEGMENT, SUBMIT MKIB(J)=1; SPECIFICATION OF MKIB(J)= *NEGATIVE* CODE NUMBER WILL CAUSE BEAMS OF INNER BOTTOM SEGMENT J TO BE HELD *FIXED* AT SIZE CORRESPONDING TO CODE NUMBER SPECIFIED.
9	LBKTIB(J)	I	INDICATOR FOR PRESENCE OF END BRACKETS IN DESIGN OF INNER BOTTOM SEGMENT J: SUBMIT EITHER LBKTIB(J)=0 FOR END BRACKETS NOT REQUIRED OR =1 FOR END BRACKETS REQUIRED.
10	MPRI(J)	I	INDICATOR TO IDENTIFY REASON FOR SPECIFYING MINIMUM PLATE THICKNESS FOR INNER BOTTOM SEGMENT J: SUBMIT EITHER MPRI(J)=0 FOR NO MINIMUM THICKNESS SPECIFIED OR =1 FOR BALLISTIC REQUIREMENT OR =2 FOR HELICOPTER/AIRCRAFT HANDLING AREA OR =3 FOR SPECIAL HANDLING REQUIREMENTS OR =4 FOR RUGGEDNESS REQUIREMENT.

INNER BOTTOM-DESIGN CRITERIA CARDS—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
11	MPLIB(J)	I	INDICATOR FOR TYPE OF PLATE MATERIAL FOR INNER BOTTOM SEGMENT J; *PUT IN ONLY IF I1MATL=0 ON GENERAL INFORMATION CARD 2:* SUBMIT EITHER MPLIB(J)=1 FOR MS OR =2 FOR HTS OR =3 FOR HY 80 OR =4 FOR HY 100 OR =5 FOR AL 5086-H 116 OR =7 FOR AL 5456-H 116.
12	MBMIB(J)	I	INDICATOR FOR TYPE OF BEAM MATERIAL FOR INNER BOTTOM SEGMENT J; PUT IN ONLY IF I1MATL=0 ON GENERAL INFORMATION CARD 2: SUBMIT EITHER MBMIB(J)=1 FOR MS OR =2 FOR HTS OR =3 FOR HY 80 OR =4 FOR HY 100 OR =6 FOR AL 5086-H 111 OR =8 FOR AL 5456-H 111.

NOTE: PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EACH INNER BOTTOM SEGMENT; NUMBER OF CARDS DEPENDS ON NUMBER OF INNER BOTTOM SEGMENTS SPECIFIED; PROGRAM REQUIRES THAT *ZERO* BE SUBMITTED FOR *LOADS* THAT DO NOT APPLY FOR AN INNER BOTTOM SEGMENT; AN INNER BOTTOM SEGMENT IS DESIGNED WITH OR WITHOUT BEAMS, DEPENDING ON WHETHER OR NOT THE CORRESPONDING SHELL SEGMENT IS DESIGNED WITH BEAMS; THE FOLLOWING SKETCH IS SHOWN TO CLARIFY THE MEANING OF A CORRESPONDING SHELL SEGMENT.



CENTER VERTICAL KEEL DESIGN CRITERIA CARD								NOTE: IF THERE IS NO INNERBOTTOM, THIS CARD MUST BE OMITTED.
				FOR WATERTIGHT CVK				
1 = WATERTIGHT 0 = NONWATERTIGHT	MIN. PLT. THICK. (CATALOG NO.)	PANEL DESIGN LENGTH (feet)	SLAM PRESSURE FOR D.B. GIRDER ANALYSIS (psi)	DAMAGE HEAD (feet)	TANK OVERFLOW HEAD (feet)	REASON FOR MIN. PLT. THICK.	TYPE OF MATERIAL FOR PLATE	
1	2	3	4	5	6	7	8	

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	I1WTC	I	INDICATOR FOR WATERTIGHTNESS OF CENTER VERTICAL KEEL: SUBMIT EITHER I1WTC=0 FOR NONWATERTIGHT CVK OR =1 FOR WATERTIGHT CVK.
2	MTCVK	I	MINIMUM PLATE-THICKNESS CODE NUMBER FOR CVK; REFER TO SECTION 11 FOR PLATE-THICKNESS CODE NUMBERS; IF THERE IS NO MINIMUM THICKNESS REQUIREMENT FOR CVK, SUBMIT MTCVK=1; SPECIFICATION OF MTCVK=*NEGATIVE* CODE NUMBER WILL CAUSE THICKNESS OF CVK TO BE HELD *FIXED* AT THICKNESS CORRESPONDING TO CODE NUMBER SPECIFIED.
3	PNLCVK	F	PANEL DESIGN LENGTH FOR CVK; PUT IN ONLY IF PNLXL=0.0 ON GENERAL INFORMATION CARD 2; OTHERWISE SUBMIT PNLCVK=0.0.
4	CVKSLM	F	SLAM PRESSURE FOR CVK DOUBLE BOTTOM GIRDER; PUT IN ONLY IF DOUBLE BOTTOM GIRDER ANALYSIS IS TO BE PERFORMED (IBTH1=1 ON GENERAL INFORMATION CARD 2); OTHERWISE SUBMIT CVKSLM=0.0.
5	DAMCVK	F	DESIGN-DAMAGE HEAD ABOVE KEEL FOR WATERTIGHT CENTER VERTICAL KEEL; FOR NONWATERTIGHT CVK, SUBMIT DAMCVK=0.0.
6	TOFCVK	F	TANK-OVERFLOW HEAD ABOVE KEEL FOR WATERTIGHT CENTER VERTICAL KEEL; FOR NONWATERTIGHT CVK, SUBMIT TOFCVK=0.0.

CENTER VERTICAL KEEL-DESIGN CRITERIA CARD—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
7	MPRC	I	INDICATOR TO IDENTIFY REASON FOR SPECIFYING MINIMUM PLATE THICKNESS FOR CENTER VERTICAL KEEL: SUBMIT EITHER MPRC=0 FOR NO-MINIMUM THICKNESS SPECIFIED OR =1 FOR BALLISTIC REQUIREMENT OR =2 FOR HELICOPTER/AIRCRAFT HANDLING AREA OR =3 FOR SPECIAL HANDLING REQUIREMENTS OR =4 FOR RUGGEDNESS REQUIREMENT.
8	MPLCVK	I	INDICATOR FOR TYPE OF PLATE MATERIAL FOR CVK; PUT IN ONLY IF I1MATL=0 ON GENERAL INFORMATION CARD 2: SUBMIT EITHER MPLCVK=1 FOR MS OR =2 FOR HTS OR =3 FOR HY 80 OR =4 FOR HY 100 OR =5 FOR AL 5086-H 116 OR =7 FOR AL 5456-H 116.

NOTE: CENTER VERTICAL KEEL IS DESIGNED WITHOUT STIFFENERS; PROGRAM REQUIRES THAT *ZERO* BE SUBMITTED FOR *LOADS* THAT DO NOT APPLY FOR CVK.

D.B. PLT. LONGL. NO. DO NOT INPUT	DOUBLE BOTTOM PLATE LONGITUDINAL DESIGN CRITERIA CARDS								NOTE: IF THERE ARE NO D.B. PLT. LONGLS., THESE CARDS MUST BE OMITTED.
	1 - WATERTIGHT 0 - NONWATERTIGHT	MIN. PLT. THICK. (CATALOG NO.)	PANEL DESIGN LENGTH (feet)	SLAM PRESSURE FOR D.B. GIRDER ANALYSIS (psi)	FOR WATERTIGHT DBL: DAMAGE HEAD (feet)	FOR WATERTIGHT DBL: TANK OVERFLOW HEAD (feet)	REASON FOR MIN. PLT. THICK.	TYPE OF MATERIAL FOR PLATE	
1									
	1	2	3	4	5	6	7	8	

J DENOTES NUMBER OF DOUBLE BOTTOM PLATE LONGITUDINAL.

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
1	I1WT(J)	I	INDICATOR FOR WATERTIGHTNESS OF DOUBLE BOTTOM PLATE LONGITUDINAL (DBL) J: SUBMIT EITHER I1WT(J)=0 FOR NONWATERTIGHT DBL OR =1 FOR WATERTIGHT DBL.
2	MTDBL(J)	I	MINIMUM PLATE-THICKNESS CODE NUMBER FOR DBL J; REFER TO SECTION 11 FOR PLATE-THICKNESS CODE NUMBERS; IF THERE IS NO MINIMUM THICKNESS REQUIREMENT FOR DBL J, SUBMIT MTDBL(J)=1; SPECIFICATION OF MTDBL(J)= *NEGATIVE* CODE NUMBER WILL CAUSE THE THICKNESS OF DBL J TO BE HELD *FIXED* AT THICKNESS CORRESPONDING TO CODE NUMBER SPECIFIED.
3	PNLDBL(J)	F	PANEL-DESIGN LENGTH FOR DBL J; PUT IN ONLY IF PNLXL=0.0 ON GENERAL INFORMATION CARD 2; OTHERWISE SUBMIT PNLDBL(J)=0.0.
4	DBLSLM(J)	F	SLAM PRESSURE FOR LONGITUDINAL J DOUBLE BOTTOM GIRDER; PUT IN ONLY IF DOUBLE BOTTOM GIRDER ANALYSIS IS TO BE PERFORMED (IBTH1=1 ON GENERAL INFORMATION CARD 2); OTHERWISE SUBMIT DBLSLM(J)=0.0.
5	DAMDBL(J)	F	DESIGN-DAMAGE HEAD ABOVE KEEL FOR WATERTIGHT DBL J; FOR NONWATERTIGHT DBL, SUBMIT DAMDBL(J)=0.0.

DOUBLE BOTTOM PLATE—LONGITUDINAL DESIGN CRITERIA CARDS—Continued

INPUT DATA SEQUENCE:	CODING SYMBOL	FORMAT	DEFINITION AND INSTRUCTIONS
6	TOFDBL(J)	F	TANK-OVERFLOW HEAD ABOVE KEEL FOR WATERTIGHT DBL J; FOR NONWATERTIGHT DBL, SUBMIT TOFDBL(J)=0.0.
7	MPRL(J)	I	INDICATOR TO IDENTIFY REASON FOR SPECIFYING MINIMUM PLATE THICKNESS FOR DBL J: SUBMIT EITHER MPRL(J)=0 FOR NO-MINIMUM THICKNESS SPECIFIED OR =1 FOR BALLISTIC REQUIREMENT OR =2 FOR HELICOPTER/AIRCRAFT HANDLING AREA OR =3 FOR SPECIAL HANDLING REQUIREMENTS OR =4 FOR RUGGEDNESS REQUIREMENT.
8	MPLDBL(J)	I	INDICATOR FOR TYPE OF PLATE MATERIAL FOR DBL J; PUT IN ONLY IF I1MATL=0 ON GENERAL INFORMATION CARD 2: SUBMIT EITHER MPLDBL(J)=1 FOR MS OR =2 FOR HTS OR =3 FOR HY 80 OR =4 FOR HY 100 OR =5 FOR AL 5086-H 116 OR =7 FOR AL 5456-H 116

NOTE: PREVIOUSLY DESCRIBED INPUT INFORMATION MUST BE SUBMITTED FOR EACH DBL; NUMBER OF CARDS DEPENDS ON NUMBER OF DBL's SPECIFIED; DBL's ARE DESIGNED WITHOUT STIFFENERS; PROGRAM REQUIRES THAT *ZERO* BE SUBMITTED FOR *LOADS* THAT DO NOT APPLY FOR A DBL.

SECTION 7. OUTPUT DESCRIPTION

TYPES OF OUTPUT

The desired level of output from SSDP is specified via the output indicator; see run-identification card 1 of Section 6. Completeness, computer paper, printing time, input data verification without execution, and associated costs must be considered in selecting output level. The program produces the following types of output.

- Title page, which lists principal hull dimensions, general design criteria, and assumed primary hull girder stresses.
- Complete listing of geometry and design criteria for shell, decks, bulkheads, inner bottom, and double bottom plate longitudinals.
- Printer plot of section.
- Summary of section scantlings at each iteration in the design process, i.e., number of stiffeners per segment, stiffener size identification code, plate panel thickness, and segment weight.
- Summary of section-strength properties at each iteration in the design process.
- Summary page showing the input-output primary stresses for the stress-consistent design. In addition, a statement concerning acceptability of the section is printed.
- Summary page showing the approximate area required at the extreme fibers to eliminate primary stress deficiencies as well as the actual area added to the section. This page is printed only if the calculated primary stresses for stress-consistent design exceed the allowable limiting primary stress.
- Detailed design printout of acceptable section, which includes the following items.

  1. The shell, deck, bulkhead and double bottom segment scantlings with their concomitant secondary loads, primary stresses, and factors of safety for each applicable loading condition.

  2. A weight-summation table for each structural element segment, listing the weights for the various schemes (spacing of beams).

- A summary of the final scantlings and sectional properties.
- Complete listing of the plate and structural shape catalogs.
- Tape for a Stromberg-Carlson 4020/CALCOMP section plot, if requested.

LOAD CONDITIONS

Load condition indicators (LCOND) are printed for the various structural elements in the detailed design printout. Table 3 gives a description of each load condition indicator for each structural element.

TABLE 3 — LOAD CONDITIONS

Structural Element	Load Condition Indicator LCOND	Description
Shell	1	Primary stress plus hydrostatic head.
	2	Tank-overflow head plus dead load.
	3	Primary stress plus tank-top head plus dead load.
	4	Slam pressure plus with or without primary stress.
	5	Nuclear airblast load.
Deck	1	Primary stress plus live load plus dead load.
	2	Primary stress plus tank-top head plus dead load.
	3	Tank-overflow head plus dead load.
	4	Vital-normal damage head plus dead load.
	5	Nuclear airblast load.
Bulkhead	1	Primary stress plus tank-top head plus dead load.
	2	Primary stress plus dead load.
	3	Tank-overflow head plus dead load.
	4	Vital-normal damage head plus dead load.
Inner Bottom	1	Primary stress plus live load plus dead load.
	2	Primary stress plus tank-top head plus dead load.
	3	Tank-overflow head plus dead load.
	4	Vital-normal damage head plus dead load.
	5	Hydrostatic breaching head.
Double Bottom Plate Longitudinal	1	Primary stress plus dead load.
	2	Tank overflow head plus dead load.
	3	Damage head plus dead load.
	4	Hydrostatic breaching head.

SECTION 7. OUTPUT DESCRIPTION

FACTORS OF SAFETY

Symbol	*Definition*
F_C	Column strength
L_B	Design length of beam
L_{PB}	Permissible span length of beam without lateral supports
Δ	Deflection of plate-beam combination
σ_{COM}	Primary axial compressive stress plus compressive double bottom plate longitudinal girder-bending stress
σ_{CR}	Critical buckling stress of plate panel
σ_{DY}	Dynamic yield strength
σ_{ULT}	Ultimate compressive stress of plate panel
σ_{WK}	Allowable working stress
σ_y	Nominal yield strength
σ_{1C}	Primary axial compressive stress
σ_{2C}	Compressive secondary bending stress in plate
σ_{2MAX}	Maximum secondary bending stress, tension or compression
σ_{1T}	Primary axial tensile stress
τ	Shear stress
τ_{CR}	Critical shear buckling stress of plate panel, pure shear

Factors of safety (FS) calculated in the program and printed in the detailed design output are:

(BUCK) Buckling Strength of Plate Panel

For loading on short edge

$$FS = \frac{\sigma_{CR}}{\sigma_{1C} + \sigma_{2C}} \qquad \text{(Stiffened)}$$

$$FS = \frac{\sigma_{CR}}{\sigma_{1C}} \qquad \text{(Unstiffened)}$$

For loading on long edge

$$FS = \frac{0.80\ \sigma_{CR}}{\sigma_{1C}}$$

(BUCK) Buckling Strength of Double Bottom Plate Longitudinals

When girder analysis is requested

$$FS = \frac{1}{\frac{\sigma_{COM}}{\sigma_{CR}} + \left(\frac{\tau}{\tau_{CR}}\right)^2}$$

(ULT) Ultimate Compressive Strength of Plate Panel

$$FS = \frac{0.80\ \sigma_{ULT}\ \frac{F_c}{\sigma_y}}{\sigma_{1C} + \sigma_{2C}} \qquad \text{(Stiffened)}$$

$$FS = \frac{0.80\ \sigma_{ULT}}{\sigma_{1C}} \qquad \text{(Unstiffened)}$$

SECTION 7. OUTPUT DESCRIPTION

(BEND/COMP) Combined Bending and Axial Compressive Stresses, Interaction Formula

$$FS = \frac{1}{\frac{\sigma_{1C}}{K\ F_c} + \frac{\sigma_{2MAX}}{\sigma_{WK}}}$$

$K = .67$ for $L/r > 60$

$K = .80$ for $L/r \leq 60$

(TENS) Combined Axial Tensile Stress and Maximum Secondary Tensile-Bending Stress

$$FS = \frac{\sigma_{WK}}{\sigma_{1T} + \sigma_{2T}}$$

For nuclear airblast load

$$FS = \frac{R_M}{R_R} = \frac{\text{maximum available load resistance of plate beam}}{\text{required load resistance of plate beam}}$$

(SHEAR) Shear Strength

$$FS = \frac{0.60\ \sigma_{WK}}{\tau}$$

For nuclear airblast load

$$FS = \frac{0.60\ \sigma_{DY}}{\tau}$$

(ILS) Lateral Stability of Beam

$$FS = \frac{L_{PB}}{L_B}$$

(DEFL) Deflection of Beam—Aluminum Alloys Only

$$FS = \frac{L_B/200}{\Delta}$$

PROGRAM-ERROR MESSAGES

Program-error messages reveal either manual input errors or imposition of requirements beyond the capability of the program. The program user should review all output for error messages. The following messages have been coded into the program, and corrective actions are either self-explanatory or as noted.

1. "* * * *LONGITUDINAL SPACING OF XXX.XX INCHES CANNOT BE USED FOR THIS SEGMENT* * * * * * *PROGRAM CONTINUES* * *."

   This message occurs in the design-application subroutines SHEL, DECK, and BULKHD. The numerical value for the longitudinal spacing will be printed for clarification. The program cannot select a plate-beam combination for the indicated spacing. Therefore, the next smaller panel width for the structural element segment is examined.

2. "ERROR-ERROR-ERROR . . . CHECK INPUT, ALL PANEL WIDTHS WITHIN SPECIFIED LIMITS WERE INVESTIGATED FOR SHELL SEGMENT XX SCANTLINGS COULD NOT BE DETERMINED. * * *PROGRAM STOPPED* * *".

3. "ERROR-ERROR-ERROR . . . CHECK INPUT, ALL THE COMPUTED PANEL WIDTHS FOR SHELL SEGMENT XX ARE LESS THAN THE MINIMUM PERMISSIBLE PANEL WIDTH SPECIFIED. * * *PROGRAM STOPPED* * *."

4. "ERROR-ERROR-ERROR . . . CHECK INPUT, ALL PANEL WIDTHS WITHIN SPECIFIED LIMITS WERE INVESTIGATED FOR BULKHEAD X, SEGMENT X, SCANTLINGS COULD NOT BE DETERMINED. * * *PROGRAM STOPPED* * *."

5. "ERROR-ERROR-ERROR . . . CHECK INPUT, ALL THE COMPUTED PANEL WIDTHS FOR BULKHEAD XX,'s SEGMENT XX,'s ARE LESS THAN THE MINIMUM PERMISSIBLE PANEL WIDTH SPECIFIED. * * *PROGRAM STOPPED* * *."

6. "ERROR-ERROR-ERROR . . . CHECK INPUT, ALL PANEL WIDTHS WITHIN SPECIFIED LIMITS WERE INVESTIGATED FOR REGION XX SCANTLINGS COULD NOT BE DETERMINED. * * *PROGRAM STOPPED* * *."

7. "ERROR-ERROR-ERROR . . . CHECK INPUT, ALL THE COMPUTED PANEL WIDTHS FOR DECK REGION XX ARE LESS THAN THE MINIMUM PERMISSIBLE PANEL WIDTH SPECIFIED. * * *PROGRAM STOPPED* * *."
8. "PROGRAM STOP . . . AFTER SEVEN AREA ADDITIONS, ACCEPTABLE SECTION STILL NOT ACHIEVED. SUGGEST CHECKING LIMITING STRESS AND/OR SHIP GEOMETRY."
9. "FIXED PLATE THICKNESSES EXIST IN TOP DECK OR SHEER STRAKE. AREA ADDITION IN THE TOP DECK CANNOT BE EXECUTED. * *PROGRAM STOPPED* *".
10. "* * *PROGRAM STOPPED* * *PANEL WIDTH OF XXX.XX INCHES CANNOT BE USED FOR INNER BOTTOM SEGMENT XX. CHECK IB LOADS AND GEOMETRY."
11. "* * *PROGRAM STOPPED* * *PANEL WIDTH OF XXX.XX INCHES CANNOT BE USED FOR DB PLATE LONGITUDINAL XX.CHECK LOADS AND GEOMETRY."
12. "* * *PROGRAM STOPPED* * *PANEL WIDTH OF XXX.XX INCHES CANNOT BE USED FOR CVK. CHECK LOADS AND GEOMETRY."
13. "PROGRAM STOPPED. .SCANTLINGS FOR DB GIRDER XX COULD NOT BE DETERMINED. CHECK IB LOADS AND GEOMETRY."
14. "FIXED PLATE THICKNESSES EXIST IN SHELL SEGMENT XX TO XX.AREA ADDITION IN THE BOTTOM CANNOT BE EXECUTED. * *PROGRAM STOPPED* *".
15. "INPUT DATA ERROR, ILLEGAL CHARACTER."

SECTION 8. DEMONSTRATION PROBLEMS

Four demonstration problems are provided to aid the user in preparing the input data—a sectional design of an aircraft carrier without sponsons, an analysis of a carrier cross section with sponsons, a printout of the design information of a surface effect ship, and a sectional design of a small-waterplane-area, twin-hull ship. These examples are not intended to represent the design or analysis of a section for an existing ship. They are idealized examples intended to illustrate the various design capabilities of the program. The designer should be guided by the practices normally followed in the manual method in determining the design parameters.

Basic differences in the demonstration problems are in the options elected, configurations, and structural elements involved. The user should review the design information and the sketch to obtain proper orientation for the particular problem. All the demonstration problems

contain a sketch of the section, input data listing, and printout of design information. The final sectional scantlings and strength properties are shown for demonstration problems 1, 2, and 4. For demonstration problems 1 and 2, the detailed-design printout of the acceptable section includes only typical output of selected structural element segments.

For demonstration problem 2, the sponson elements are considered as ineffective material in contributing to the hull girder-strength properties; however, they are analyzed for both primary and secondary bending stresses. The sectional weight reported includes the weight of both port and starboard sponsons.

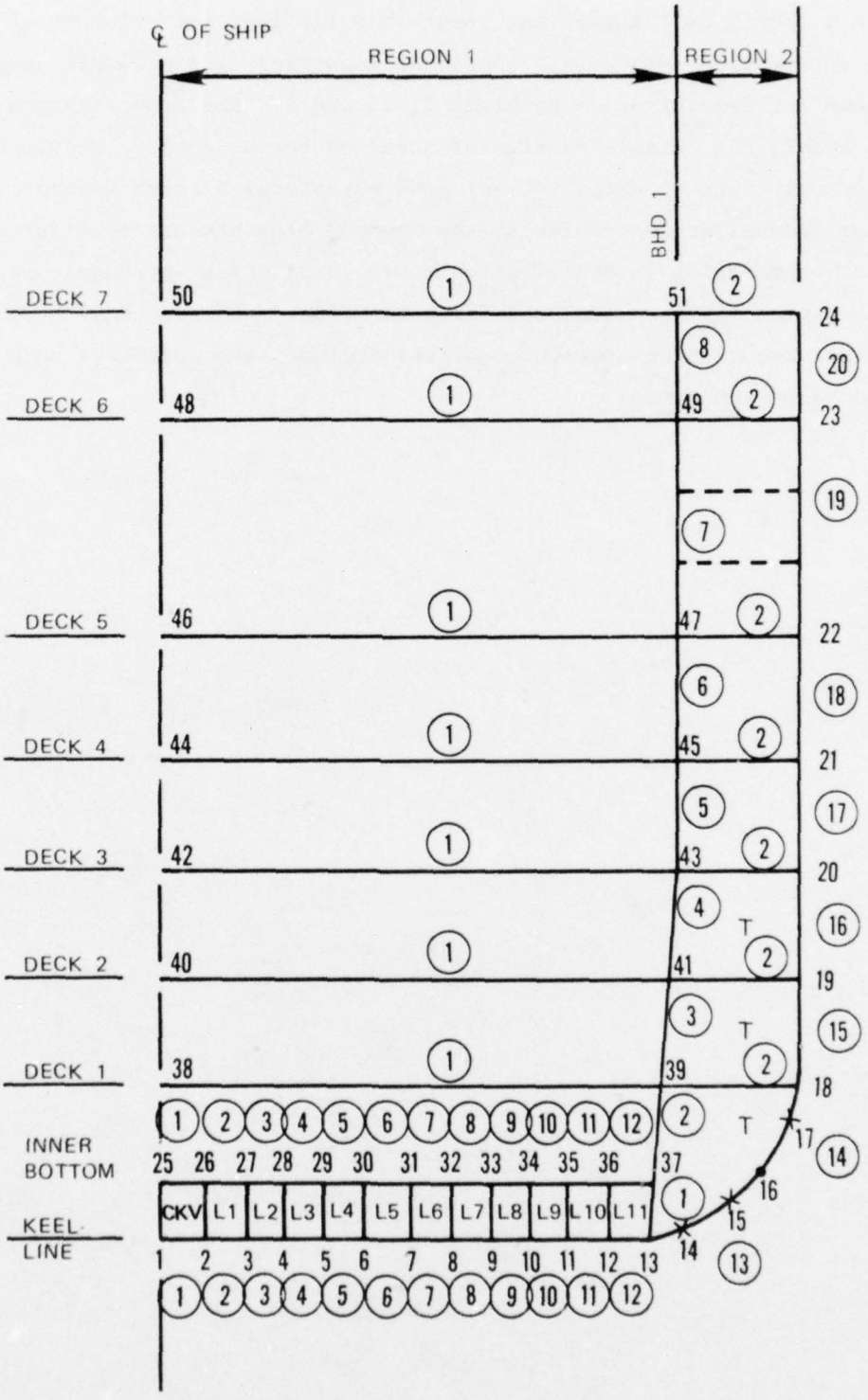


Figure 3 — Demonstration Problem 1

INPUT DATA LISTING: PROBLEM 1

```
1 0
  DEMONSTRATION PROBLEM 1    LEV/NAPPI/WALZ    227-1787    11/15/76
850.0  87.50  60.25  33.67  0.00  0.00  64.0 30.0 0.0 500.0 0.55
51 20  7  1  2  1 14  0  0  0  0  1  0  1  0  0 12 11  1 24.0  4.0  4.0  32.0
1120.0  500.0  0.500  0.5  0  0
425000.0  1962000.0  3250.0  -15000.0  -3250.0  15000.0  30000.0  17920.0
0.0  0.0  0.0  4.0  0.0  8.0  0.0  12.0  0.0  16.0
0.0  20.0  0.0  24.0  0.0  28.0  0.0  32.0  0.0  36.0
0.0  40.0  0.0  44.0  0.0  46.0  0.35  49.2  1.20  52.30
4.0  56.6  9.0  59.4  14.0 60.25  24.0  60.25  33.83  60.25
45.17  60.25  56.5  60.25  77.5  60.25  87.50  60.25  4.0  0.0
4.0  4.0  4.0 8.0  4.0 12.0  4.0 16.0  4.0 20.0
4.0  24.0  4.0  28.0  4.0  32.0  4.0  36.0  4.0  40.0
4.0  44.0  4.0  46.42  14.0  0.0  14.0  47.17  24.0  0.0
24.0  47.92  33.83  0.0  33.83  49.42  45.17  0.0  45.17  49.42
56.5  0.0  56.5  49.42  77.5  0.0  77.5  49.42  87.5  0.0
87.5  49.42
1  2  3  4  5  6  7  8  9 10 11 12 13 16 18 19 20 21 22
23 24
38 39 18
40 41 19
42 43 20
44 45 21
46 47 22
48 49 23
50 51 24
13 37 39 41 43 45 47 49 51
25 26 27 28 29 30 31 32 33 34 35 36 37
1 25  2 26  3 27  4 28  5 29  6 30  7 31  8 32  9 33  10 34  11
35  12 36
0  0  1  1  1  1  1
6.50  6.50  6.50  6.50  6.50  17.0  6.50
49.42  1  1  1  1  1  1  1
10.83  1  1  1  1  1  1  1
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  1  0  0  0  0  2  0
56.50  4.00  0.00  0.00  0.00  0.00  4.00  0.00  15  0  0  0  4  2  0
56.50  33.83  0.00  0.00  48.00  72.00  4.00  4.00  17  1  0  0  4  4  2
56.50  29.83  0.00  0.00  48.00  72.00  8.00  8.00  1  1  0  0  0  4  2
56.50  19.83  0.00  0.00  48.00  72.00  8.00  8.00  1  1  0  0  0  2  2
56.50  9.83  0.00  0.00  48.00  72.00  8.00  8.00  1  1  0  0  0  2  2
 0.00  0.00  0.00  0.00  48.00  72.00  8.00  8.00  1  1  0  0  0  2  2
 0.00  0.00  0.00  0.00  48.00  72.00  8.00  8.00  1  1  0  0  0  2  2
 0.00  0.00  0.00  0.00  48.00  72.00  8.00  8.00  1  1  0  0  0  2  2
 0.00  0.00  0.00  0.00  48.00  72.00  8.00  8.00  1  1  0  0  0  4  2
100.0  45.12  0.00  0.00  36.0  72.0  16.0  16.0  1  1  1  0  0  2  2
0.00  0.0  56.50  19.83  32.50  32.50  8.0  8.0  1  1  2  0  0  2  2
100.0  45.12  0.00  0.00  36.0  72.0  16.0  16.0  1  1  1  0  0  2  2
0.00  0.0  56.50  9.83  32.50  32.50  8.0  8.0  1  1  2  0  0  2  2
100.0  45.12  0.0  0.0  36.0  72.0  8.0  8.0  1  1  1  0  0  2  2
100.0  45.12  56.50  0.0  32.50  32.5  8.0  8.00  1  1  3  0  0  2  2
100.0  0.0  0.0  0.0  36.0  72.0  8.0  8.0  1  1  1  0  0  2  2
100.0  0.0  0.0  0.0  32.5  32.5  8.0  8.0  1  1  1  0  0  2  2
```

INPUT DATA LISTING: PROBLEM 1—Continued

```
300.0  0.0  0.0  0.0   36.0  72.0  8.0  8.0      1  1  1  0  0  2  2
300.0  0.0  0.0  0.0   32.5  32.5  8.0  8.0      1  1  1  0  0  2  2
100.0  0.0  0.0  0.0   36.0  72.0  32.0 32.0     1  1  1  0  0  2  2
100.0  0.0  0.0  0.0   32.5  32.5  8.0  8.0      1  1  1  0  0  2  2
300.0  0.0  0.0  0.0   36.0  72.0  8.0  8.0      19  1  4  0  2  4  2
300.0  0.0  0.0  0.0   32.5  32.5  8.0  8.0      19  1  4  0  2  4  2
0.0   56.5  33.83  0.0  0.0  4.0  0.0      1   0  3  0  0  2  0
45.17  56.50  29.83   30.0  48.0  8.0  8.0      1  1  2  0  0  2  2
45.17  56.50  19.83   30.0  48.0  8.0  8.0      1  1  2  0  0  2  2
45.17  56.50   9.83   30.0  48.0  8.0  8.0      1  1  2  0  0  2  2
45.17  0.0  0.0   30.0  48.0  8.0  8.0          1  1  1  0  0  2  2
45.17  0.0  0.0   30.0  48.0  8.0  8.0          1  1  1  0  0  2  2
0.0    0.0  0.0   30.0  48.0  8.0  8.0          1  1  1  0  0  2  2
0.0    0.0  0.0   30.0  48.0  8.0  8.0          1  1  1  0  0  4  2
1000.0   45.17   56.50   0.00   4.0  0.0        1  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0        1  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0        1  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0        1  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0        1  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0        1  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0        1  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0        1  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0        1  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0        1  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0        15  0  0  4  2  0
1  1   4.0   0.0   45.17   56.50   0  2
0  1  4.0  0.0   0.0  0.0    0  2
0  1  4.0  0.0   0.0  0.0    0  2
0  1  4.0  0.0   0.0  0.0    0  2
0  1  4.0  0.0   0.0  0.0    0  2
0  1  4.0  0.0   0.0  0.0    0  2
0  1  4.0  0.0   0.0  0.0    0  2
0  1  4.0  0.0   0.0  0.0    0  2
0  1  4.0  0.0   0.0  0.0    0  2
0  1  4.0  0.0   0.0  0.0    0  2
0  1  4.0  0.0   0.0  0.0    0  2
```

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

PRINCIPAL HULL DIMENSIONS

LENGTH BETWEEN PERPENDICULARS	=	850.00 FT.
MAXIMUM HALF BREADTH	=	60.25 FT.
DEPTH OF HULL	=	87.50 FT.
DESIGN FULL LOAD DRAFT	=	33.67 FT.
LENGTH BETWEEN TRANSVERSE BULKHEADS	=	64.00 FT.
NUMBER OF SHELL SEGMENTS	=	20
NUMBER OF DECKS	=	7
NUMBER OF BULKHEADS	=	1
NUMBER OF DOUBLE BOTTOM PLATE LONGITUDINALS	=	11
NUMBER OF INNER BOTTOM SEGMENTS	=	12

DESIGN CRITERIA

MATERIAL THROUGHOUT FOR PLATING	=	HYBRID
MATERIAL THROUGHOUT FOR STIFFENERS	=	HYBRID
MINIMUM PRESSURE FOR SHELL	=	500.00 PSF
MARGIN STRESS ADDED TO PRIMARY STRESS	=	1120.00 PSI
PRIMARY STRESS TOLERANCE (+ OR -)	=	500.00 PSI
DESIGN LIMITING PRI. STRESS, DECK FIBER	=	30000.00 PSI
DESIGN LIMITING PRI. STRESS, KEEL FIBER	=	17920.00 PSI
PRIMARY STRESS FACTOR	=	.5000
STRAKE TOLERENCE	=	.5000 IN.
BENDING MOMENT HOG CONDITION	=	1962000.00 FT-TONS
BENDING MOMENT SAG CONDITION	=	425000.00 FT-TONS
ANGLE OF HEEL	=	30.00 DEGREES
SHELL DESIGN HEAD	=	0.00 FT.
WAVE HEIGHT COEFFICENT	=	.550

NO SHORT SPANS (EQUAL SPANS)

SHELL SEGMENTS FOR AREA ADDITION IF REQUIRED
FROM SEG 1 TO SEG 14
SHIP NOT DESIGNED FOR NUCLEAR BLAST.
SHIP DESIGNED WITH INNER BOTTOM
SCANTLINGS FOR THE DOUBLE BOTTOM STRUCTURE
ARE TO BE CONSIDERED PRELIMINARY
GIRDER ANALYSIS REQUESTED
GIRDER DESIGN LENGTH = 32.00 FT.
MAXIMUM DEPTH OF I.B. STRINGER = 24.00 IN.

ASSUMED STRESSES

PRIMARY STRESS AT DECK-HOG	=	-15000.00 PSI
PRIMARY STRESS AT KEEL-HOG	=	15000.00 PSI
PRIMARY STRESS AT DECK-SAG	=	3250.00 PSI
PRIMARY STRESS AT KEEL-SAG	=	-3250.00 PSI

SECTION 8. DEMONSTRATION PROBLEMS

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

SHELL

SHL SEG	********** GEOMETRY ********** Z1/ Z3	Y1/ Y3	Z2/ Z4	Y2/ Y4	TANK OVREL	TANK TOP HD	** SLAMMING CRITERIA ** PRES PL	PRES RM	COMB PRI	DEFOR IND	MINIMUM CODE ID PL	RM	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	RM	MATERIAL IND PL	RM
1	0.000 0.000	0.000 0.000	0.000 0.000	4.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
2	0.000 0.000	4.000 0.000	0.000 0.000	8.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
3	0.000 0.000	8.000 0.000	0.000 0.000	12.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
4	0.000 0.000	12.000 0.000	0.000 0.000	16.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
5	0.000 0.000	16.000 0.000	0.000 0.000	20.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
6	0.000 0.000	20.000 0.000	0.000 0.000	24.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
7	0.000 0.000	24.000 0.000	0.000 0.000	28.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
8	0.000 0.000	28.000 0.000	0.000 0.000	32.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
9	0.000 0.000	32.000 0.000	0.000 0.000	36.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
10	0.000 0.000	36.000 0.000	0.000 0.000	40.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
11	0.000 0.000	40.000 0.000	0.000 0.000	44.000 0.000	56.50	4.00	0.00		0	0	1		0.00	0.00	4.00		2	
12	0.000 0.000	44.000 0.000	0.000 0.000	46.000 0.000	56.50	4.00	0.00		0	0	15		0.00	0.00	4.00		2	
13	0.000 .350	46.000 49.200	4.000 1.200	56.600 52.300	56.50	33.83	0.00	0.00	0	0	17	1	48.00	72.00	4.00	4.00	4	2
14	4.000 9.000	56.600 59.400	14.000 0.000	60.250 0.000	56.50	29.83	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	4	2
15	14.000 0.000	60.250 0.000	24.000 0.000	60.250 0.000	56.50	19.83	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
16	24.000 0.000	60.250 0.000	33.830 0.000	60.250 0.000	56.50	9.83	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
17	33.830 0.000	60.250 0.000	45.170 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
18	45.170 0.000	60.250 0.000	56.500 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
19	56.500 0.000	60.250 0.000	77.500 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
20	77.500 0.000	60.250 0.000	87.500 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	4	2

** NO REMOVALS IN SHELL SPECIFIED **

DEMONSTRATION PROBLEM 1 LEV PPI/WALZ 227-1787 11/15/76

DECK

REGION 1 WIDTH= 49.42 FT.

DK	SEG	Z1	GEOMETRY Y1	Zc	Y2	LIVE LOAD	VITNOR DAM HD	TANK OVRFL	TANK TOP HD	SPAC IND	MINIMUM CODE PL	ID RM	REL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	RM	MATERIAL IND PL	RM
1	1	14.00	0.00	14.00	47.17	100.00	45.12	0.00	0.00	1	1	1	6.50	0	36.00	72.00	16.00	16.00	2	2
2	1	24.00	0.00	24.00	47.92	100.00	45.12	0.00	0.00	1	1	1	6.50	0	36.00	72.00	16.00	16.00	2	2
3	1	33.83	0.00	33.83	49.42	100.00	45.12	0.00	0.00	1	1	1	6.50	1	36.00	72.00	8.00	8.00	2	2
4	1	45.17	0.00	45.17	49.42	100.00	0.00	0.00	0.00	1	1	1	6.50	1	36.00	72.00	8.00	8.00	2	2
5	1	56.50	0.00	56.50	49.42	300.00	0.00	0.00	0.00	1	1	1	6.50	1	36.00	72.00	8.00	8.00	2	2
6	1	77.50	0.00	77.50	49.42	100.00	0.00	0.00	0.00	1	1	1	17.00	1	36.00	72.00	32.00	32.00	2	2
7	1	87.50	0.00	87.50	49.42	300.00	0.00	0.00	0.00	4	19	1	6.50	1	36.00	72.00	8.00	8.00	4	2

REGION 2 WIDTH= 10.83 FT.

DK	SEG	Z1	GEOMETRY Y1	Zc	Y2	LIVE LOAD	VITNOR DAM HD	TANK OVRFL	TANK TOP HD	SPAC IND	MINIMUM CODE PL	ID RM	REL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	RM	MATERIAL IND PL	RM
1	2	14.00	47.17	14.00	60.25	0.00	0.00	56.50	19.83	2	1	1	6.50	0	32.50	32.50	8.00	8.00	2	2
2	2	24.00	47.92	24.00	60.25	0.00	0.00	56.50	9.83	2	1	1	6.50	0	32.50	32.50	8.00	8.00	2	2
3	2	33.83	49.42	33.83	60.25	100.00	45.12	56.50	0.00	3	1	1	6.50	1	32.50	32.50	8.00	8.00	2	2
4	2	45.17	49.42	45.17	60.25	100.00	0.00	0.00	0.00	1	1	1	6.50	1	32.50	32.50	8.00	8.00	2	2
5	2	56.50	49.42	56.50	60.25	300.00	0.00	0.00	0.00	1	1	1	6.50	1	32.50	32.50	8.00	8.00	2	2
6	2	77.50	49.42	77.50	60.25	100.00	0.00	0.00	0.00	1	1	1	17.00	1	32.50	32.50	8.00	8.00	2	2
7	2	87.50	49.42	87.50	60.25	300.00	0.00	0.00	0.00	4	19	1	6.50	1	32.50	32.50	8.00	8.00	4	2

** NO REMOVALS IN DECKS SPECIFIED **

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

BULKHEAD

RHO	SEG	Z1	GEOMETRY Y1	Zc	Y2	VITNOR DAM HD	TANK OVRFL	TANK TOP HD	SPAC IND	MINIMUM CODE PL	ID RM	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	RM	MATERIAL IND PL	RM
1	1	0.00	46.00	4.00	46.42	0.00	56.50	33.83	3	1		0.00	0.00	4.00		2	
1	2	4.00	46.42	14.00	47.17	45.17	56.50	29.83	2	1	1	30.00	48.00	8.00	8.00	2	2
1	3	14.00	47.17	24.00	47.92	45.17	56.50	19.83	2	1	1	30.00	48.00	8.00	8.00	2	2
1	4	24.00	47.92	33.83	49.42	45.17	56.50	9.83	2	1	1	30.00	48.00	8.00	8.00	2	2
1	5	33.83	49.42	45.17	49.42	45.17	0.00	0.00	1	1	1	30.00	48.00	8.00	8.00	2	2
1	6	45.17	49.42	56.50	49.42	45.17	0.00	0.00	1	1	1	30.00	48.00	8.00	8.00	2	2
1	7	56.50	49.42	77.50	49.42	0.00	0.00	0.00	1	1	1	30.00	48.00	8.00	8.00	2	2
1	8	77.50	49.42	87.50	49.42	0.00	0.00	0.00	1	1	1	30.00	48.00	8.00	8.00	4	2

** NO REMOVALS IN BULKHEADS SPECIFIED **

SECTION 8. DEMONSTRATION PROBLEMS

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

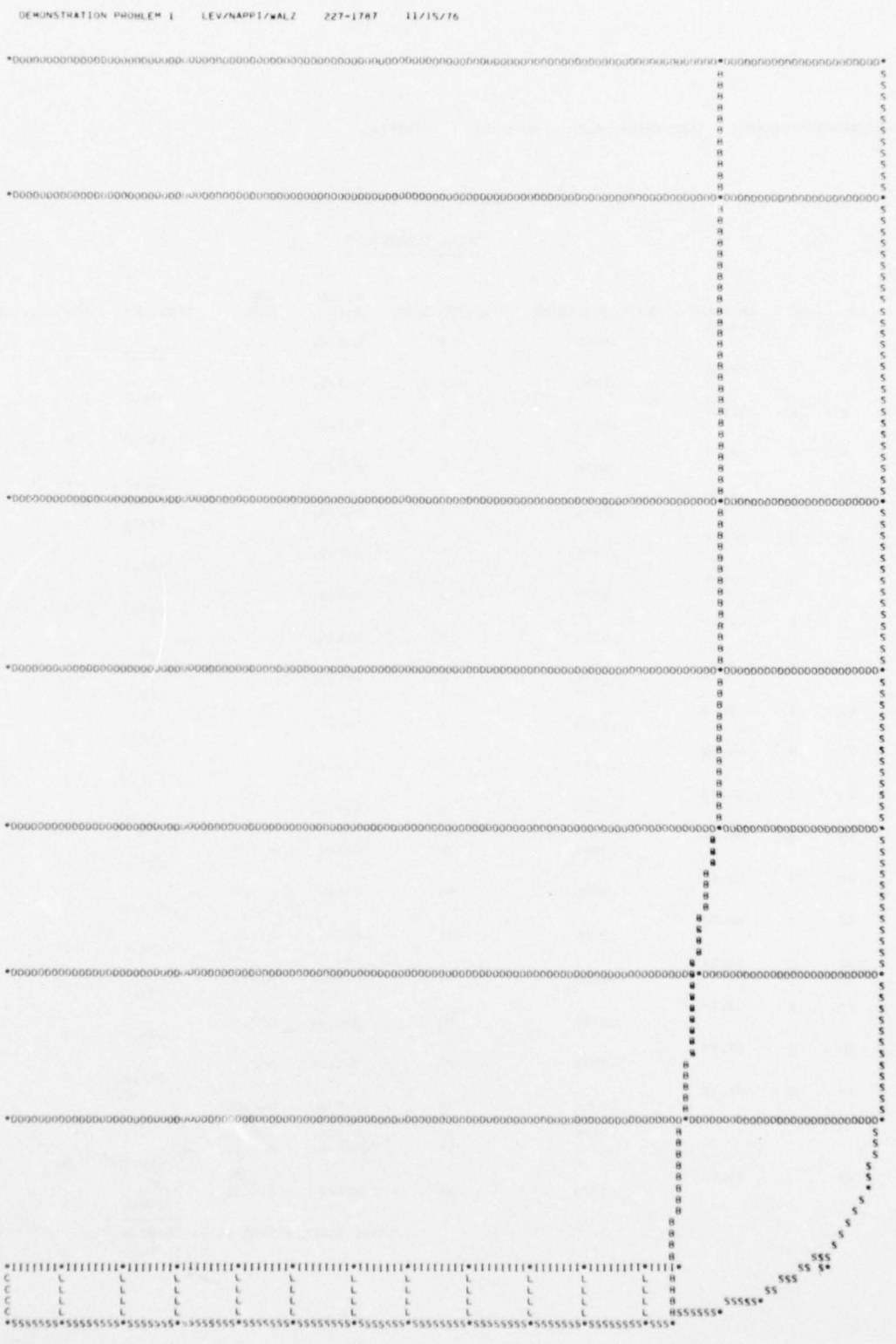
INNER BOTTOM

IB SEG	GEOMETRY Z1/ Z3	Y1/ Y3	Z2/ Z4	Y2/ Y4	LIVE LOAD	VIT NOR DAM HD	TANK OVRFL	TANK TOP HD	MINIMUM CODE ID PL	BM	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	4.000 0.000	0.000 0.000	4.000 0.000	4.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
2	4.000 0.000	4.000 0.000	4.000 0.000	8.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
3	4.000 0.000	8.000 0.000	4.000 0.000	12.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
4	4.000 0.000	12.000 0.000	4.000 0.000	16.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
5	4.000 0.000	16.000 0.000	4.000 0.000	20.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
6	4.000 0.000	20.000 0.000	4.000 0.000	24.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
7	4.000 0.000	24.000 0.000	4.000 0.000	28.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
8	4.000 0.000	28.000 0.000	4.000 0.000	32.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
9	4.000 0.000	32.000 0.000	4.000 0.000	36.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
10	4.000 0.000	36.000 0.000	4.000 0.000	40.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
11	4.000 0.000	40.000 0.000	4.000 0.000	44.000 0.000	1000.00	45.17	56.50	0.00	1		4.00		2	
12	4.000 0.000	44.000 0.000	4.000 0.000	46.420 0.000	1000.00	45.17	56.50	0.00	15		4.00		2	

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

DOUBLE BOTTOM PLATE LONGITUDINALS

LONG NO	GEOMETRY Z1	Y1	Z2	Y2	DESIGN CRITERIA WT=1 NWT=0	MIN THK	DMGE HEAD	TANK OVRFL	MATL PL	PL LENGTH	GIRDER PRES
CVK	0.000	0.000	4.000	0.000	1	1	45.17	56.50	2	4.00	0.00
1	0.000	4.000	4.000	4.000	0	1	0.00	0.00	2	4.00	0.00
2	0.000	8.000	4.000	8.000	0	1	0.00	0.00	2	4.00	0.00
3	0.000	12.000	4.000	12.000	0	1	0.00	0.00	2	4.00	0.00
4	0.000	16.000	4.000	16.000	0	1	0.00	0.00	2	4.00	0.00
5	0.000	20.000	4.000	20.000	0	1	0.00	0.00	2	4.00	0.00
6	0.000	24.000	4.000	24.000	0	1	0.00	0.00	2	4.00	0.00
7	0.000	28.000	4.000	28.000	0	1	0.00	0.00	2	4.00	0.00
8	0.000	32.000	4.000	32.000	0	1	0.00	0.00	2	4.00	0.00
9	0.000	36.000	4.000	36.000	0	1	0.00	0.00	2	4.00	0.00
10	0.000	40.000	4.000	40.000	0	1	0.00	0.00	2	4.00	0.00
11	0.000	44.000	4.000	44.000	0	1	0.00	0.00	2	4.00	0.00


DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

SHELL SCANTLINGS

SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	0	48.00	.6875	0	H.T.S.		112.2	0
2	0	48.00	.6875	0	H.T.S.		112.2	0
3	0	48.00	.6875	0	H.T.S.		112.2	0
4	0	48.00	.6875	0	H.T.S.		112.2	0
5	0	48.00	.6875	0	H.T.S.		112.2	0
6	0	48.00	.6875	0	H.T.S.		112.2	0
7	0	48.00	.6875	0	H.T.S.		112.2	0
8	0	48.00	.6875	0	H.T.S.		112.2	0
9	0	48.00	.6875	0	H.T.S.		112.2	0
10	0	48.00	.6875	0	H.T.S.		112.2	0
11	0	48.00	.6875	0	H.T.S.		112.2	0
12	0	24.00	.7500	0	H.T.S.		61.2	0
13	1	69.74	1.0000	26	HY100	H.T.S.	487.6	0
14	1	65.12	.8750	65	HY100	H.T.S.	423.9	0
15	1	60.00	.7500	57	H.T.S.	H.T.S.	324.8	0
16	1	58.98	.6875	51	H.T.S.	H.T.S.	292.5	0
17	1	68.04	.8750	46	H.T.S.	H.T.S.	419.6	0
18	1	67.98	.7500	35	H.T.S.	H.T.S.	357.8	0
19	4	50.40	.4375	26	H.T.S.	H.T.S.		
			.4375	17	H.T.S.	H.T.S.		
			.4375	12	H.T.S.	H.T.S.		
			.4375	10	H.T.S.	H.T.S.	403.0	0
20	1	60.00	.4375	26	HY100	H.T.S.	187.4	0
					TOTAL SHELL WEIGHT		4192.2	

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

DECK SCANTLINGS

REGION 1

DK	SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FR
1	1	15	37.07	.3750	72	H.T.S.	H.T.S.		0
2	1	15	37.07	.3750	61	H.T.S.	H.T.S.		0
3	1	15	37.07	.2500	12	H.T.S.	H.T.S.		0
4	1	15	37.07	.1563	17	H.T.S.	H.T.S.		0
5	1	15	37.07	.2188	26	H.T.S.	H.T.S.		0
6	1	15	37.07	.3750	75	H.T.S.	H.T.S.		0
7	1	15	37.07	1.2500	8	HY100	H.T.S.		0

REGION 1 WEIGHT 7617.6

REGION 2

DK	SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FR
1	2	4	32.49	.3438	26	H.T.S.	H.T.S.		0
2	2	4	32.49	.3125	17	H.T.S.	H.T.S.		0
3	2	3	32.49	.2500	17	H.T.S.	H.T.S.		0
4	2	3	32.49	.1563	12	H.T.S.	H.T.S.		0
5	2	3	32.49	.2188	17	H.T.S.	H.T.S.		0
6	2	3	32.49	.2188	12	H.T.S.	H.T.S.		0
7	2	3	32.49	1.2500	6	HY100	H.T.S.		0

REGION 2 WEIGHT 1425.0

TOTAL DECK WEIGHT 9042.6

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

BULKHEAD SCANTLINGS

BULKHEAD 1 SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FR
1	0	48.26						
			.6875	0	H.T.S.			
							112.8	0
2	3	30.08						
			.3750	53	H.T.S.	H.T.S.		
			.3750	26	H.T.S.	H.T.S.		
			.3750	26	H.T.S.	H.T.S.		
							188.1	0
3	3	30.08						
			.3438	26	H.T.S.	H.T.S.		
			.3125	26	H.T.S.	H.T.S.		
			.3125	17	H.T.S.	H.T.S.		
							158.0	0
4	2	39.78						
			.3750	26	H.T.S.	H.T.S.		
			.3438	17	H.T.S.	H.T.S.		
							162.2	0
5	3	34.06						
			.2188	17	H.T.S.	H.T.S.		
			.1875	15	H.T.S.	H.T.S.		
			.1563	12	H.T.S.	H.T.S.		
							107.3	0
6	3	33.94						
			.1250	6	H.T.S.	H.T.S.		
			.1250	6	H.T.S.	H.T.S.		
			.1250	6	H.T.S.	H.T.S.		
							70.5	0
7	7	31.50						
			.1250	6	H.T.S.	H.T.S.		
			.1563	6	H.T.S.	H.T.S.		
			.1563	6	H.T.S.	H.T.S.		
			.1563	6	H.T.S.	H.T.S.		
			.1563	10	H.T.S.	H.T.S.		
			.1875	6	H.T.S.	H.T.S.		
			.1875	6	H.T.S.	H.T.S.		
							168.5	0
8	3	30.00						
			.1875	6	HY100	H.T.S.		
			.1875	6	HY100	H.T.S.		
			.2188	6	HY100	H.T.S.		
							94.0	0
					BULKHEAD 1 WEIGHT		1061.4	
					TOTAL BULKHEAD WEIGHT		1061.4	

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

PRELIMINARY INNER BOTTOM SCANTLINGS

SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	0	48.00	.7500	0	H.T.S.		122.4	0
2	0	48.00	.7500	0	H.T.S.		122.4	0
3	0	48.00	.7500	0	H.T.S.		122.4	0
4	0	48.00	.7500	0	H.T.S.		122.4	0
5	0	48.00	.7500	0	H.T.S.		122.4	0
6	0	48.00	.7500	0	H.T.S.		122.4	0
7	0	48.00	.7500	0	H.T.S.		122.4	0
8	0	48.00	.7500	0	H.T.S.		122.4	0
9	0	48.00	.7500	0	H.T.S.		122.4	0
10	0	48.00	.7500	0	H.T.S.		122.4	0
11	0	48.00	.7500	0	H.T.S.		122.4	0
12	0	29.04	.7500	0	H.T.S.		74.1	0

TOTAL INNER BOTTOM WEIGHT 1420.5

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

PRELIMINARY DOUBLE BOTTOM PLATE LONGITUDINAL SCANTLINGS

LONG. NUMBER	PLATE THICKNESS	PLATE MATL	LBS./FT.
CVK	.6250	H.T.S.	51.0
1	.6250	H.T.S.	102.0
2	.6250	H.T.S.	102.0
3	.6250	H.T.S.	102.0
4	.6250	H.T.S.	102.0
5	.6250	H.T.S.	102.0
6	.6250	H.T.S.	102.0
7	.6250	H.T.S.	102.0
8	.6250	H.T.S.	102.0
9	.6250	H.T.S.	102.0
10	.6250	H.T.S.	102.0
11	.6250	H.T.S.	102.0

TOTAL DOUBLE BOTTOM PLATE LONGITUDINAL WEIGHT 1173.0

SECTION 8. DEMONSTRATION PROBLEMS

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

SECTION PROPERTIES

TOTAL EFFECTIVE AREA	=	8398.0	SQ.IN.
MOMENT OF INERTIA ABT. NEUTRAL AXIS	=	10297731.	SQ.IN.FT.-SQ.
DISTANCE FROM N.A. TO DECK FIBER	=	44.99	FEET
DISTANCE FROM N.A. TO KEEL FIBER	=	42.51	FEET
SECTION MODULUS AT DECK FIBER	=	228902.	SQ.IN.-FT.
SECTION MODULUS AT KEEL FIBER	=	242229.	SQ.IN.-FT.
TOTAL NORMALIZED LONGITUDINAL WEIGHT	=	33779.4	LBS./FT.

CALCULATED STRESSES

STRESS AT DECK-HOG	=	-19199.86 PSI
STRESS AT KEEL-HOG	=	18143.52 PSI
STRESS AT DECK-SAG	=	4158.99 PSI
STRESS AT KEEL-SAG	=	-3930.17 PSI

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

*** ***
CYCLE NO. 2

INPUT STRESSES

STRESS AT DECK-HOG	=	-19199.86 PSI
STRESS AT KEEL-HOG	=	18143.52 PSI
STRESS AT DECK-SAG	=	4158.99 PSI
STRESS AT KEEL-SAG	=	-3930.17 PSI

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

SECTION PROPERTIES

TOTAL EFFECTIVE AREA	=	8779.3	SQ.IN.
MOMENT OF INERTIA ABT. NEUTRAL AXIS	=	10716191.	SQ.IN.FT.-SQ.
DISTANCE FROM N.A. TO DECK FIBER	=	45.46	FEET
DISTANCE FROM N.A. TO KEEL FIBER	=	42.04	FEET
SECTION MODULUS AT DECK FIBER	=	235750.	SQ.IN.-FT.
SECTION MODULUS AT KEEL FIBER	=	254878.	SQ.IN.-FT.
TOTAL NORMALIZED LONGITUDINAL WEIGHT	=	35075.6	LBS./FT.

CALCULATED STRESSES

STRESS AT DECK-HOG	=	-18642.10 PSI
STRESS AT KEEL-HOG	=	17243.04 PSI
STRESS AT DECK-SAG	=	4038.17 PSI
STRESS AT KEEL-SAG	=	-3735.11 PSI

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

*** ***
CYCLE NO. 3

INPUT STRESSES

STRESS AT DECK-HOG	=	-18707.54 PSI
STRESS AT KEEL-HOG	=	17443.55 PSI
STRESS AT DECK-SAG	=	4052.35 PSI
STRESS AT KEEL-SAG	=	-3778.55 PSI

SECTION 8. DEMONSTRATION PROBLEMS

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

SECTION PROPERTIES

TOTAL EFFECTIVE AREA	=	8721.6	SQ.IN.
MOMENT OF INERTIA ABT. NEUTRAL AXIS	=	10646437.	SQ.IN.FT.-SQ.
DISTANCE FROM N.A. TO DECK FIBER	=	45.44	FEET
DISTANCE FROM N.A. TO KEEL FIBER	=	42.06	FEET
SECTION MODULUS AT DECK FIBER	=	234297.	SQ.IN.-FT.
SECTION MODULUS AT KEEL FIBER	=	253124.	SQ.IN.-FT.
TOTAL NORMALIZED LONGITUDINAL WEIGHT	=	34962.0	LBS./FT.

CALCULATED STRESSES

STRESS AT DECK-HOG	=	-18757.72 PSI
STRESS AT KEEL-HOG	=	17362.54 PSI
STRESS AT DECK-SAG	=	4063.22 PSI
STRESS AT KEEL-SAG	=	-3761.00 PSI

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

*** ***
CONSISTENT DESIGN

	ASSUMED INPUT(PSI)	CALCULATED OUTPUT(PSI)
STRESS AT DECK-HOG	-18707.54	-18757.72
STRESS AT KEEL-HOG	17443.55	17362.54
STRESS AT DECK-SAG	4052.35	4063.22
STRESS AT KEEL-SAG	-3778.55	-3761.00

FOR SCANTLING SUMMARY, REFER TO CYCLE NO. 3

SECTION NOT ACCEPTABLE
DESIGN PRIMARY STRESS EXCEEDS LIMITING DESIGN PRIMARY STRESS

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

*** ***
AREA ADDITION

SECTION HAS STRESS DEFICIENCY AT KEEL FIBER

APPROXIMATE AREA REQUIRED = 119.24 SQ.IN.

ACTUAL AREA ADDED = 120.00 SQ.IN.

.... MINIMUM PLATE THICKNESS CODE NUMBERS HAVE BEEN UPDATED ....

... PROGRAM RECYCLES ...

SECTION 8. DEMONSTRATION PROBLEMS

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

PRINCIPAL HULL DIMENSIONS

LENGTH BETWEEN PERPENDICULARS	=	850.00 FT.
MAXIMUM HALF BREADTH	=	60.25 FT.
DEPTH OF HULL	=	87.50 FT.
DESIGN FULL LOAD DRAFT	=	33.67 FT.
LENGTH BETWEEN TRANSVERSE BULKHEADS	=	64.00 FT.
NUMBER OF SHELL SEGMENTS	=	20
NUMBER OF DECKS	=	7
NUMBER OF BULKHEADS	=	1
NUMBER OF DOUBLE BOTTOM PLATE LONGITUDINALS	=	11
NUMBER OF INNER BOTTOM SEGMENTS	=	12

DESIGN CRITERIA

MATERIAL THROUGHOUT FOR PLATING	=	HYBRID
MATERIAL THROUGHOUT FOR STIFFENERS	=	HYBRID
MINIMUM PRESSURE FOR SHELL	=	500.00 PSF
MARGIN STRESS ADDED TO PRIMARY STRESS	=	1120.00 PSI
PRIMARY STRESS TOLERANCE (+ OR -)	=	500.00 PSI
DESIGN LIMITING PRI. STRESS, DECK FIBER	=	30000.00 PSI
DESIGN LIMITING PRI. STRESS, KEEL FIBER	=	17920.00 PSI
PRIMARY STRESS FACTOR	=	.5000
STRAKE TOLERENCE	=	.5000 IN.
BENDING MOMENT HOG CONDITION	=	1962000.00 FT-TONS
BENDING MOMENT SAG CONDITION	=	425000.00 FT-TONS
ANGLE OF HEEL	=	30.00 DEGREES
SHELL DESIGN HEAD	=	0.00 FT.
WAVE HEIGHT COEFFICENT	=	.550

NO SHORT SPANS (EQUAL SPANS)

SHELL SEGMENTS FOR AREA ADDITION IF REQUIRED
FROM SEG 1 TO SEG 14
SHIP NOT DESIGNED FOR NUCLEAR BLAST.
SHIP DESIGNED WITH INNER BOTTOM
SCANTLINGS FOR THE DOUBLE BOTTOM STRUCTURE
ARE TO BE CONSIDERED PRELIMINARY
GIRDER ANALYSIS REQUESTED
GIRDER DESIGN LENGTH = 32.00 FT.
MAXIMUM DEPTH OF I.B. STRINGER = 24.00 IN.

ASSUMED STRESSES

PRIMARY STRESS AT DECK-HOG	=	-18627.79 PSI
PRIMARY STRESS AT KEEL-HOG	=	16800.00 PSI
PRIMARY STRESS AT DECK-SAG	=	4035.07 PSI
PRIMARY STRESS AT KEEL-SAG	=	-3639.14 PSI

DEMONSTRATION PROBLEM 1 LEV/NAPPI/*ALZ 227-1787 11/15/76

S H E L L

SHL SEG	********** GEOMETRY ********** Z1/ Z3	Y1/ Y3	Z2/ Z4	Y2/ Y4	TANK OVRFL	TANK TOP HD	** SLAMMING CRITERIA ** PRES PL	PRES BM	COMB PRI	DEFOR IND	MINIMUM CODE ID PL	BM	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	0.000 0.000	0.000 0.000	0.000 0.000	4.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
2	0.000 0.000	4.000 0.000	0.000 0.000	8.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
3	0.000 0.000	8.000 0.000	0.000 0.000	12.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
4	0.000 0.000	12.000 0.000	0.000 0.000	16.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
5	0.000 0.000	16.000 0.000	0.000 0.000	20.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
6	0.000 0.000	20.000 0.000	0.000 0.000	24.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
7	0.000 0.000	24.000 0.000	0.000 0.000	28.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
8	0.000 0.000	28.000 0.000	0.000 0.000	32.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
9	0.000 0.000	32.000 0.000	0.000 0.000	36.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
10	0.000 0.000	36.000 0.000	0.000 0.000	40.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
11	0.000 0.000	40.000 0.000	0.000 0.000	44.000 0.000	56.50	4.00	0.00		0	0	15		0.00	0.00	4.00		2	
12	0.000 0.000	44.000 0.000	0.000 0.000	46.000 0.000	56.50	4.00	0.00		0	0	15		0.00	0.00	4.00		2	
13	0.000 .350	46.000 49.200	4.000 1.200	56.600 52.300	56.50	33.83	0.00	0.00	0	0	17	1	48.00	72.00	4.00	4.00	4	2
14	4.000 9.000	56.600 59.400	14.000 0.000	60.250 0.000	56.50	29.83	0.00	0.00	0	0	16	1	48.00	72.00	8.00	8.00	4	2
15	14.000 0.000	60.250 0.000	24.000 0.000	60.250 0.000	56.50	19.83	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
16	24.000 0.000	60.250 0.000	33.830 0.000	60.250 0.000	56.50	9.83	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
17	33.830 0.000	60.250 0.000	45.170 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
18	45.170 0.000	60.250 0.000	56.500 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
19	56.500 0.000	60.250 0.000	77.500 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
20	77.500 0.000	60.250 0.000	87.500 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	4	2

** NO REMOVALS IN SHELL SPECIFIED **

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

SECTION PROPERTIES

TOTAL EFFECTIVE AREA	=	8791.4	SQ.IN.
MOMENT OF INERTIA ABT. NEUTRAL AXIS	=	10821517.	SQ.IN.FT.-SQ.
DISTANCE FROM N.A. TO DECK FIBER	=	45.88	FEET
DISTANCE FROM N.A. TO KEEL FIBER	=	41.62	FEET
SECTION MODULUS AT DECK FIBER	=	235849.	SQ.IN.-FT.
SECTION MODULUS AT KEEL FIBER	=	260028.	SQ.IN.-FT.
TOTAL NORMALIZED LONGITUDINAL WEIGHT	=	35199.5	LBS./FT.

CALCULATED STRESSES

STRESS AT DECK-HOG	=	-18634.31 PSI
STRESS AT KEEL-HOG	=	16901.56 PSI
STRESS AT DECK-SAG	=	4036.48 PSI
STRESS AT KEEL-SAG	=	-3661.14 PSI

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

*** ***
CONSISTENT DESIGN

	ASSUMED INPUT(PSI)	CALCULATED OUTPUT(PSI)
STRESS AT DECK-HOG	-18627.79	-18634.31
STRESS AT KEEL-HOG	16800.00	16901.56
STRESS AT DECK-SAG	4035.07	4036.48
STRESS AT KEEL-SAG	-3639.14	-3661.14

FOR SCANTLING SUMMARY, REFER TO CYCLE NO. 1

SECTION NOT ACCEPTABLE
DESIGN PRIMARY STRESS EXCEEDS LIMITING DESIGN PRIMARY STRESS

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

*** ***
AREA ADDITION

SECTION HAS STRESS DEFICIENCY AT KEEL FIBER

APPROXIMATE AREA REQUIRED = 22.08 SQ.IN.

ACTUAL AREA ADDED = 24.00 SQ.IN.

.... MINIMUM PLATE THICKNESS CODE NUMBERS HAVE BEEN UPDATED ....

... PROGRAM RECYCLES ...

SECTION 8. DEMONSTRATION PROBLEMS

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

PRINCIPAL HULL DIMENSIONS

LENGTH BETWEEN PERPENDICULARS	=	850.00 FT.
MAXIMUM HALF BREADTH	=	60.25 FT.
DEPTH OF HULL	=	87.50 FT.
DESIGN FULL LOAD DRAFT	=	33.67 FT.
LENGTH BETWEEN TRANSVERSE BULKHEADS	=	64.00 FT.
NUMBER OF SHELL SEGMENTS	=	20
NUMBER OF DECKS	=	7
NUMBER OF BULKHEADS	=	1
NUMBER OF DOUBLE BOTTOM PLATE LONGITUDINALS	=	11
NUMBER OF INNER BOTTOM SEGMENTS	=	12

DESIGN CRITERIA

MATERIAL THROUGHOUT FOR PLATING	=	HYBRID
MATERIAL THROUGHOUT FOR STIFFENERS	=	HYBRID
MINIMUM PRESSURE FOR SHELL	=	500.00 PSF
MARGIN STRESS ADDED TO PRIMARY STRESS	=	1120.00 PSI
PRIMARY STRESS TOLERANCE (+ OR -)	=	500.00 PSI
DESIGN LIMITING PRI. STRESS, DECK FIBER	=	30000.00 PSI
DESIGN LIMITING PRI. STRESS, KEEL FIBER	=	17920.00 PSI
PRIMARY STRESS FACTOR	=	.5000
STRAKE TOLERENCE	=	.5000 IN.
BENDING MOMENT HOG CONDITION	=	1962000.00 FT-TONS
BENDING MOMENT SAG CONDITION	=	425000.00 FT-TONS
ANGLE OF HEEL	=	30.00 DEGREES
SHELL DESIGN HEAD	=	0.00 FT.
WAVE HEIGHT COEFFICENT	=	.550

NO SHORT SPANS (EQUAL SPANS)

SHELL SEGMENTS FOR AREA ADDITION IF REQUIRED
   FROM SEG 1 TO SEG 14
SHIP NOT DESIGNED FOR NUCLEAR BLAST.
SHIP DESIGNED WITH INNER BOTTOM
   SCANTLINGS FOR THE DOUBLE BOTTOM STRUCTURE
   ARE TO BE CONSIDERED PRELIMINARY
   GIRDER ANALYSIS REQUESTED
   GIRDER DESIGN LENGTH = 32.00 FT.
   MAXIMUM DEPTH OF I.B. STRINGER = 24.00 IN.

ASSUMED STRESSES

PRIMARY STRESS AT DECK-HOG	=	-18611.04 PSI
PRIMARY STRESS AT KEEL-HOG	=	16800.00 PSI
PRIMARY STRESS AT DECK-SAG	=	4031.44 PSI
PRIMARY STRESS AT KEEL-SAG	=	-3639.14 PSI

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1797 11/15/76

S H E L L

SHL SEG	Z1/ Z3	Y1/ Y3	Z2/ Z4	Y2/ Y4	TANK OVRFL	TANK TOP HD	** SLAMMING CRITERIA ** PRES PL	PRES HM	COMB PRI	DEFOR IND	MINIMUM CODE ID PL	BM	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	HM	MATERIAL IND PL	HM
1	0.000 0.000	0.000 0.000	0.000 0.000	4.000 0.000	56.50	4.00	0.00		0	0	17		0.00	0.00	4.00		2	
2	0.000 0.000	4.000 0.000	0.000 0.000	8.000 0.000	56.50	4.00	0.00		0	0	17		0.00	0.00	4.00		2	
3	0.000 0.000	8.000 0.000	0.000 0.000	12.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
4	0.000 0.000	12.000 0.000	0.000 0.000	16.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
5	0.000 0.000	16.000 0.000	0.000 0.000	20.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
6	0.000 0.000	20.000 0.000	0.000 0.000	24.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
7	0.000 0.000	24.000 0.000	0.000 0.000	28.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
8	0.000 0.000	28.000 0.000	0.000 0.000	32.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
9	0.000 0.000	32.000 0.000	0.000 0.000	36.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
10	0.000 0.000	36.000 0.000	0.000 0.000	40.000 0.000	56.50	4.00	0.00		0	0	16		0.00	0.00	4.00		2	
11	0.000 0.000	40.000 0.000	0.000 0.000	44.000 0.000	56.50	4.00	0.00		0	0	15		0.00	0.00	4.00		2	
12	0.000 0.000	44.000 0.000	0.000 0.000	46.000 0.000	56.50	4.00	0.00		0	0	15		0.00	0.00	4.00		2	
13	0.000 .350	46.000 49.200	4.000 1.200	56.600 52.300	56.50	33.83	0.00	0.00	0	0	17	1	48.00	72.00	4.00	4.00	4	2
14	4.000 9.000	56.600 59.400	14.000 0.000	60.250 0.000	56.50	29.83	0.00	0.00	0	0	16	1	48.00	72.00	8.00	8.00	4	2
15	14.000 0.000	60.250 0.000	24.000 0.000	60.250 0.000	56.50	19.83	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
16	24.000 0.000	60.250 0.000	33.830 0.000	60.250 0.000	56.50	9.83	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
17	33.830 0.000	60.250 0.000	45.170 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
18	45.170 0.000	60.250 0.000	56.500 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
19	56.500 0.000	60.250 0.000	77.500 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	2	2
20	77.500 0.000	60.250 0.000	87.500 0.000	60.250 0.000	0.00	0.00	0.00	0.00	0	0	1	1	48.00	72.00	8.00	8.00	4	2

** NO REMOVALS IN SHELL SPECIFIED **

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1747 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

SHELL SCANTLINGS

SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FR
1	0	48.00	1.0000	0	H.T.S.		163.2	0
2	0	48.00	1.0000	0	H.T.S.		163.2	0
3	0	48.00	.8750	0	H.T.S.		142.8	0
4	0	48.00	.8750	0	H.T.S.		142.8	0
5	0	48.00	.8750	0	H.T.S.		142.8	0
6	0	48.00	.8750	0	H.T.S.		142.8	0
7	0	48.00	.8750	0	H.T.S.		142.8	0
8	0	48.00	.8750	0	H.T.S.		142.8	0
9	0	48.00	.8750	0	H.T.S.		142.8	0
10	0	48.00	.8750	0	H.T.S.		142.8	0
11	0	48.00	.7500	0	H.T.S.		122.4	0
12	0	24.00	.7500	0	H.T.S.		61.2	0
13	1	69.74	1.0000	27	HY100	H.T.S.	488.2	0
14	1	65.12	.8750	65	HY100	H.T.S.	423.9	0
15	1	60.00	.7500	62	H.T.S.	H.T.S.	327.7	0
16	1	58.98	.6875	57	H.T.S.	H.T.S.	294.5	0
17	1	68.04	.8750	46	H.T.S.	H.T.S.	419.6	0
18	1	67.48	.7500	35	H.T.S.	H.T.S.	357.8	0
19	4	50.40	.5000 .4375 .4375 .4375	15 37 17 12	H.T.S. H.T.S. H.T.S. H.T.S.	H.T.S. H.T.S. H.T.S. H.T.S.	423.0	0
20	1	60.00	.5000	10	HY100	H.T.S.	209.7	0
					TOTAL SHELL WEIGHT		4596.9	

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

DECK SCANTLINGS

REGION 1 DK	SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FR
1	1	14	39.34	.4375	66	H.T.S.	H.T.S.		0
2	1	14	39.34	.3750	61	H.T.S.	H.T.S.		0
3	1	14	39.34	.2500	17	H.T.S.	H.T.S.		0
4	1	14	39.34	.1875	15	H.T.S.	H.T.S.		0
5	1	14	39.34	.2500	17	H.T.S.	H.T.S.		0
6	1	14	39.34	.3750	88	H.T.S.	H.T.S.		0
7	1	14	39.34	1.2500	8	HY100	H.T.S.		0
						REGION 1 WEIGHT		7808.1	

REGION 2 DK	SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FR
1	2	4	32.49	.3438	26	H.T.S.	H.T.S.		0
2	2	4	32.49	.3125	17	H.T.S.	H.T.S.		0
3	2	3	32.49	.2500	17	H.T.S.	H.T.S.		0
4	2	3	32.49	.1563	17	H.T.S.	H.T.S.		0
5	2	3	32.49	.2188	17	H.T.S.	H.T.S.		0
6	2	3	32.49	.2500	6	H.T.S.	H.T.S.		0
7	2	3	32.49	1.2500	8	HY100	H.T.S.		0
						REGION 2 WEIGHT		1440.1	
						TOTAL DECK WEIGHT		9248.2	

SECTION 8. DEMONSTRATION PROBLEMS

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

BULKHEAD SCANTLINGS

BULKHEAD 1 SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	0	48.25						
			.6875	0	H.T.S.			
							112.8	0
2	3	30.00						
			.4375	35	H.T.S.	H.T.S.		
			.3750	26	H.T.S.	H.T.S.		
			.3750	26	H.T.S.	H.T.S.		
							192.0	0
3	3	30.00						
			.3438	26	H.T.S.	H.T.S.		
			.3125	26	H.T.S.	H.T.S.		
			.3125	17	H.T.S.	H.T.S.		
							158.0	0
4	2	39.75						
			.3750	26	H.T.S.	H.T.S.		
			.3438	17	H.T.S.	H.T.S.		
							162.2	0
5	3	34.02						
			.2188	17	H.T.S.	H.T.S.		
			.1875	15	H.T.S.	H.T.S.		
			.1563	12	H.T.S.	H.T.S.		
							107.3	0
6	3	33.94						
			.1250	6	H.T.S.	H.T.S.		
			.1250	6	H.T.S.	H.T.S.		
			.1563	6	H.T.S.	H.T.S.		
							76.0	0
7	7	31.50						
			.1563	6	H.T.S.	H.T.S.		
			.1563	6	H.T.S.	H.T.S.		
			.1563	8	H.T.S.	H.T.S.		
			.1875	6	H.T.S.	H.T.S.		
			.1875	6	H.T.S.	H.T.S.		
			.1875	6	H.T.S.	H.T.S.		
			.2188	6	H.T.S.	H.T.S.		
							184.5	0
8	3	30.00						
			.2188	6	HY100	H.T.S.		
			.2188	6	HY100	H.T.S.		
			.2188	6	HY100	H.T.S.		
							107.0	0

BULKHEAD 1 WEIGHT 1094.8

TOTAL BULKHEAD WEIGHT 1094.8

AD-A048 162 DAVID W TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CE--ETC F/G 13/10
STRUCTURAL SYNTHESIS DESIGN PROGRAM.(U)
DEC 77 R W WALZ, F M LEV, N S NAPPI
UNCLASSIFIED DTNSRDC-77-0032 NL

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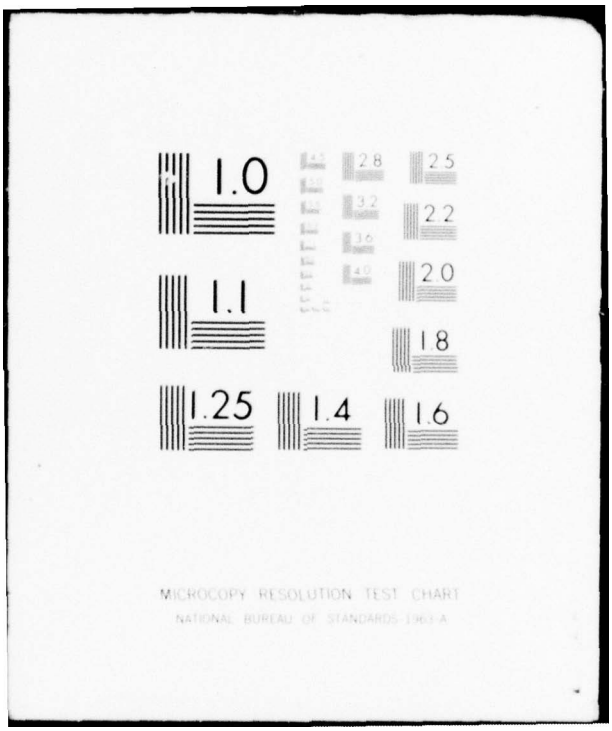
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1.1
1.25
1.4
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3.2
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

PRELIMINARY INNER BOTTOM SCANTLINGS

SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	0	48.00	.7500	0	H.T.S.		122.4	0
2	0	48.00	.7500	0	H.T.S.		122.4	0
3	0	48.00	.7500	0	H.T.S.		122.4	0
4	0	48.00	.7500	0	H.T.S.		122.4	0
5	0	48.00	.7500	0	H.T.S.		122.4	0
6	0	48.00	.7500	0	H.T.S.		122.4	0
7	0	48.00	.7500	0	H.T.S.		122.4	0
8	0	48.00	.7500	0	H.T.S.		122.4	0
9	0	48.00	.7500	0	H.T.S.		122.4	0
10	0	48.00	.7500	0	H.T.S.		122.4	0
11	0	48.00	.7500	0	H.T.S.		122.4	0
12	0	29.04	.7500	0	H.T.S.		74.1	0
						TOTAL INNER BOTTOM WEIGHT	1420.5	

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

PRELIMINARY DOUBLE BOTTOM PLATE LONGITUDINAL SCANTLINGS

LONG. NUMBER	PLATE THICKNESS	PLATE MATL	LBS./FT.
CVK	.6875	H.T.S.	56.1
1	.6875	H.T.S.	112.2
2	.6875	H.T.S.	112.2
3	.6875	H.T.S.	112.2
4	.6875	H.T.S.	112.2
5	.6875	H.T.S.	112.2
6	.6875	H.T.S.	112.2
7	.6875	H.T.S.	112.2
8	.6875	H.T.S.	112.2
9	.6875	H.T.S.	112.2
10	.6875	H.T.S.	112.2
11	.6250	H.T.S.	102.0
	TOTAL DOUBLE BOTTOM PLATE LONGITUDINAL WEIGHT		1280.1

SECTION 8. DEMONSTRATION PROBLEMS

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

SECTION PROPERTIES

TOTAL EFFECTIVE AREA	=	8815.4	SQ.IN.
MOMENT OF INERTIA ABT. NEUTRAL AXIS	=	10862970.	SQ.IN.FT.-SQ.
DISTANCE FROM N.A. TO DECK FIBER	=	46.00	FEET
DISTANCE FROM N.A. TO KEEL FIBER	=	41.50	FEET
SECTION MODULUS AT DECK FIBER	=	236169.	SQ.IN.-FT.
SECTION MODULUS AT KEEL FIBER	=	261737.	SQ.IN.-FT.
TOTAL NORMALIZED LONGITUDINAL WEIGHT	=	35281.1	LBS./FT.

CALCULATED STRESSES

STRESS AT DECK-HOG	=	-18609.03 PSI
STRESS AT KEEL-HOG	=	16791.23 PSI
STRESS AT DECK-SAG	=	4031.01 PSI
STRESS AT KEEL-SAG	=	-3637.24 PSI

DEMONSTRATION PROBLEM 1 LEV/NAPPI/WALZ 227-1787 11/15/76

••• •••
CONSISTENT DESIGN

	ASSUMED INPUT(PSI)	CALCULATED OUTPUT(PSI)
STRESS AT DECK-HOG	-18611.04	-18609.03
STRESS AT KEEL-HOG	16800.00	16791.23
STRESS AT DECK-SAG	4031.44	4031.01
STRESS AT KEEL-SAG	-3639.14	-3637.24

FOR SCANTLING SUMMARY, REFER TO CYCLE NO. 1

SECTION ACCEPTABLE
DESIGN PRIMARY STRESS LESS THAN LIMITING DESIGN PRIMARY STRESS

... DETAIL DESIGN PRINT-OUT OF ACCEPTABLE SECTION FOLLOWS ...
(HEIGHTS TO LONGITUDINALS ARE RELATIVE TO KEEL LINE)

SHELL SEGMENT NO. 1 GIRTH = 4.00 FT.

PRELIMINARY SCANTLING
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED EXCLUDING DOUBLE
BOTTOM GIRDER STRESSES.

		PRI DESIGN STRESS			MAX B/T	ACT			• FACTORS OF SAFETY •	
HEIGHT	HEAD	COMP	TENS	TH1	NOR LD	B/T	LBS./FT.	LCOND	BUCK	ULT
0.00	49.71	17920.0		1.0000	114.7			1		
	57.27	0.0		1.0000	106.8			2		
	4.77	17920.0		1.0000	370.3			3		
	PLATE SELECTED			1.0000		48.0	163.2		2.140	1.698

SHELL SEGMENT NO.13 GIRTH = 11.62 FT.

MINIMUM THICKNESS SPECIFIED FOR THIS SEGMENT BECAUSE
OF RUGGEDNESS REQUIREMENT.
LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LONGITUDINALS ARE DESIGNED WITHOUT LATERAL SUPPORTS.

1 LONGITUDINALS(SPACING = 69.74 IN.)

		PRI DESIGN STRESS			MAX B/T	TEE			•••••••••••••• FACTORS OF SAFETY ••••••••••••••						
											BEND/				
HEIGHT	HEAD	COMP	TENS	TH1	NOR LD	ID	LBS./FT.	LCOND	BUCK	ULT	COMP	TENS	SHEAR	ILS	DEFL
.98	52.16	17920.0		1.0000	117.2			1							
	57.27	0.0		1.0000	111.8			2							
	34.60	17920.0		1.0000	143.9			3							
	52.16	17920.0	-4759.1	1.0000		27		1	1.126	8.929	1.044	3.333	1.376	1.528	0.000
	57.16	0.0	0.0	1.0000		27		2	••••••	••••••	1.983	2.348	1.256	1.528	0.000
	34.49	17920.0	-4759.1	1.0000		27		3	1.126	8.929	1.247	4.269	2.081	1.528	0.000
	52.16	17920.0	-4759.1	1.1250		27		1	1.425	8.929	1.054	3.378	1.390	1.528	0.000
	57.24	0.0	0.0	1.1250		27		2	••••••	••••••	2.022	2.394	1.266	1.528	0.000
	34.57	17920.0	-4759.1	1.1250		27		3	1.425	8.929	1.255	4.312	2.097	1.528	0.000
	PLATE-TEE SELECTED			1.0000		27	488.2		ACTUAL B/T (NORMAL LOADS)= 48.0						

SHELL SEGMENT NO.13 WEIGHT DATA

SPACING(IN.)	LBS./FT.
69.74	488.2

SECTION 8. DEMONSTRATION PROBLEMS

SHELL SEGMENT NO.19 GIRTH = 21.00 FT.

LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LONGITUDINALS ARE DESIGNED WITHOUT LATERAL SUPPORTS.

3 LONGITUDINALS(SPACING = 63.00 IN.)

	PRI DESIGN STRESS			MAX B/T	TEE			•••••••••••••• FACTORS OF SAFETY ••••••••••••••						
HEIGHT	HEAD	COMP	TENS	THI	NOR LD	ID	LBS./FT.	LCOND	BUCK	ULT	BEND/ COMP	TENS	SHEAR	ILS	DEFL
61.75	10.35	7284.0		.5625	129.6			1							
	10.35	7284.0	-14207.0	.5625		26		1	1.024	1.934	1.608	1.715	3.077	1.039	0.000
	10.35	7284.0	-14207.0	.6250		17		1	1.237	1.875	1.262	1.520	2.377	1.103	0.000
	PLATE-TEE SELECTED			.5625		26	189.7		ACTUAL B/T (NORMAL LOADS)=112.0						
67.00	9.08	6849.2		.5625	138.4			1							
	9.08	6849.2	-15333.3	.5625		17		1	1.058	1.862	1.410	1.525	2.690	1.103	0.000
	9.08	6849.2	-15333.3	.6250		15		1	1.255	1.692	1.077	1.377	2.462	1.187	0.000
	PLATE-TEE SELECTED			.5625		17	127.9		ACTUAL B/T (NORMAL LOADS)=112.0						
72.25	8.45	5979.6		.5000	143.5			1							
	8.45	5979.6	-17585.8	.5000		46		1	1.004	2.178	2.951	1.821	6.108	1.087	0.000
	8.45	5979.6	-17585.8	.5625		12		1	1.108	1.687	1.038	1.218	2.181	1.171	0.000
	PLATE-TEE SELECTED			.5000		46	175.4		ACTUAL B/T (NORMAL LOADS)=126.0						

4 LONGITUDINALS(SPACING = 50.40 IN.)

	PRI DESIGN STRESS			MAX B/T	TEE			•••••••••••••• FACTORS OF SAFETY ••••••••••••••						
HEIGHT	HEAD	COMP	TENS	THI	NOR LD	ID	LBS./FT.	LCOND	BUCK	ULT	BEND/ COMP	TENS	SHEAR	ILS	DEFL
60.70	10.35	7370.9		.4375	124.6			1							
	10.35	7370.9	-13981.7	.4375		70		1	1.010	1.980	3.634	2.480	10.011	1.991	0.000
	10.35	7370.9	-13981.7	.5000		15		1	1.149	1.674	1.188	1.491	2.649	1.187	0.000
	10.35	7370.9	-13981.7	.5625		15		1	1.492	1.822	1.124	1.501	2.674	1.187	0.000
	PLATE-TEE SELECTED			.5000		15	135.6		ACTUAL B/T (NORMAL LOADS)=100.8						
64.90	9.34	7023.1		.4375	131.3			1							
	9.34	7023.1	-14882.8	.4375		37		1	1.001	1.962	2.313	1.960	5.457	1.075	0.000
	9.34	7023.1	-14882.8	.5000		12		1	1.204	1.696	1.087	1.403	2.442	1.171	0.000
	PLATE-TEE SELECTED			.4375		37	86.5		ACTUAL B/T (NORMAL LOADS)=115.2						
69.10	8.83	6675.3		.4375	135.0			1							
	8.83	6675.3	-15783.8	.4375		17		1	1.008	1.928	1.691	1.623	3.408	1.103	0.000
	8.83	6675.3	-15783.8	.5000		12		1	1.268	1.786	1.147	1.391	2.583	1.171	0.000
	PLATE-TEE SELECTED			.4375		17	82.4		ACTUAL B/T (NORMAL LOADS)=115.2						
73.30	8.32	5979.6		.4375	139.0			1							
	8.32	5979.6	-17585.8	.4375		12		1	1.035	1.771	1.297	1.328	2.714	1.171	0.000
	8.32	5979.6	-17585.8	.5000		10		1	1.338	1.733	1.074	1.250	2.498	1.230	0.000
	PLATE-TEE SELECTED			.4375		12	118.5		ACTUAL B/T (NORMAL LOADS)=115.2						

SHELL SEGMENT NO.19 WEIGHT DATA

SPACING(IN.)	LBS./FT.
63.00	493.0
50.40	423.0

REGION NO. 2 DECK NO. 2 SEGMENT NO. 2

GIRTH = 12.33 FT.

TYPE OF SPACE IDENTIFIER = 2
THIS DECK WAS SPECIFIED AS A PLATFORM AND IS NOT
DESIGNED FOR PRIMARY STRESSES.
LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LONGITUDINALS ARE DESIGNED WITHOUT LATERAL SUPPORTS.

LONGITUDINAL SPACING = 32.49 IN.

	PRI DESIGN STRESS			MAX B/T	TEE			•••••••••••••• FACTORS OF SAFETY ••••••••••••••						
HEAD	COMP	TENS	THI	NOR LD	ID	LBS./FT.	LCOND	BUCK	ULT	BEND/ COMP	TENS	SHEAR	ILS	DEFL
10.13	0.0		.1875	197.4			2							
32.64	0.0		.3125	110.3			3							
10.04	0.0	0.0	.3125		8		2	2.747	3.830	1.366	1.366	2.376	1.330	0.000
32.73	0.0	0.0	.3125		17		3	1.829	3.186	1.006	1.006	1.405	1.103	0.000
10.07	0.0	0.0	.3125		17		2	5.943	10.352	3.268	3.268	4.564	1.103	0.000
10.06	0.0	0.0	.3438		8		2	3.823	4.626	1.378	1.378	2.389	1.330	0.000
32.75	0.0	0.0	.3438		17		3	2.589	4.034	1.016	1.016	1.409	1.103	0.000
10.09	0.0	0.0	.3438		17		2	8.402	13.091	3.297	3.297	4.573	1.103	0.000
PLATE-TEE SELECTED			.3125		17			ACTUAL B/T (NORMAL LOADS)=104.0						

REGION NO. 2 DECK NO. 2 WEIGHT DATA

SPACING(IN.)	LBS./FT.
32.49	187.0

REGION NO. 2 DECK NO. 3 SEGMENT NO. 2

GIRTH = 10.83 FT.

TYPE OF SPACE IDENTIFIER = 3
LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LONGITUDINALS ARE DESIGNED WITHOUT LATERAL SUPPORTS.

LONGITUDINAL SPACING = 32.49 IN.

	PRI DESIGN STRESS			MAX B/T	TEE			•••••••••••••• FACTORS OF SAFETY ••••••••••••••						
HEAD	COMP	TENS	THI	NOR LD	ID	LBS./FT.	LCOND	BUCK	ULT	BEND/ COMP	TENS	SHEAR	ILS	DEFL
1.86	3316.4		.1875	293.1			1							
22.81	0.0		.2500	131.9			3							
11.48	0.0		.2500	236.1			4							
1.73	3316.4	-880.7	.2500		6		1	1.140	1.791	2.496	4.544	9.128	1.511	0.000
22.85	0.0	0.0	.2500		17		3	1.156	2.597	1.398	1.398	1.996	1.103	0.000
1.76	3316.4	-880.7	.2500		17		1	1.560	3.504	6.232	13.924	23.108	1.103	0.000
22.87	0.0	0.0	.2500		17		3	1.155	2.594	1.397	1.397	1.995	1.103	0.000
11.49	0.0	0.0	.2500		17		4	2.299	5.164	2.780	2.780	3.970	1.103	0.000
1.75	3316.4	-880.7	.2813		6		1	1.544	2.030	2.461	4.573	9.124	1.511	0.000
22.87	0.0	0.0	.2813		15		3	1.316	2.500	1.085	1.085	1.797	1.187	0.000
1.78	3316.4	-880.7	.2813		15		1	1.933	3.673	5.436	11.609	20.636	1.187	0.000
22.89	0.0	0.0	.2813		15		3	1.315	2.498	1.085	1.085	1.796	1.187	0.000
11.51	0.0	0.0	.2813		15		4	2.615	4.967	2.157	2.157	3.571	1.187	0.000
PLATE-TEE SELECTED			.2500		17			ACTUAL B/T (NORMAL LOADS)=130.0						

REGION NO. 2 DECK NO. 3 WEIGHT DATA

SPACING(IN.)	LBS./FT.
32.49	132.8

SECTION 8. DEMONSTRATION PROBLEMS

REGION NO. 1 DECK NO. 7 SEGMENT NO. 1

GIRTH = 49.42 FT.

TYPE OF SPACE IDENTIFIER = 4
MINIMUM THICKNESS SPECIFIED FOR THIS SEGMENT BECAUSE
IT IS HELICOPTER/AIRCRAFT HANDLING AREA.
LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LONGITUDINALS ARE DESIGNED WITHOUT LATERAL SUPPORTS.

LONGITUDINAL SPACING = 65.89 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	BUCK	ULT	HEND/ COMP	TENS	SHEAR	ILS	DEFL
4.99	5151.4		1.2500	260.3			1							
5.49	5151.4	-19731.0	1.2500		10		1	5.593	2.659	1.057	1.150	2.956	1.330	0.000
5.57	5151.4	-19731.0	1.3750		10		1	6.809	2.418	1.048	1.148	2.977	1.330	0.000

PLATE-TEE SELECTED ..... 1.2500 10 ACTUAL B/T (NORMAL LOADS)= 52.7

LONGITUDINAL SPACING = 59.30 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	BUCK	ULT	HEND/ COMP	TENS	SHEAR	ILS	DEFL
4.99	5151.4		1.2500	252.8			1							
5.49	5151.4	-19731.0	1.2500		10		1	7.040	3.098	1.116	1.196	3.285	1.330	0.000
5.57	5151.4	-19731.0	1.3750		10		1	8.536	3.123	1.174	1.222	3.304	1.330	0.000

PLATE-TEE SELECTED ..... 1.2500 10 ACTUAL B/T (NORMAL LOADS)= 47.4

LONGITUDINAL SPACING = 53.91 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	BUCK	ULT	HEND/ COMP	TENS	SHEAR	ILS	DEFL
4.99	5151.4		1.2500	248.6			1							
5.49	5151.4	-19731.0	1.2500		10		1	8.638	3.618	1.222	1.224	3.613	1.330	0.000
5.57	5151.4	-19731.0	1.3750		8		1	9.732	2.697	1.092	1.196	2.897	1.330	0.000

PLATE-TEE SELECTED ..... 1.2500 10 ACTUAL B/T (NORMAL LOADS)= 43.1

LONGITUDINAL SPACING = 49.42 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	BUCK	ULT	HEND/ COMP	TENS	SHEAR	ILS	DEFL
4.99	5151.4		1.2500	246.6			1							
5.49	5151.4	-19731.0	1.2500		8		1	9.634	2.712	1.012	1.184	3.126	1.330	0.000
5.57	5151.4	-19731.0	1.3750		8		1	11.127	2.954	1.060	1.222	3.160	1.330	0.000

PLATE-TEE SELECTED ..... 1.2500 8 ACTUAL B/T (NORMAL LOADS)= 39.5

LONGITUDINAL SPACING = 45.62 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	BUCK	ULT	HEND/ COMP	TENS	SHEAR	ILS	DEFL
4.99	5151.4		1.2500	246.3			1							
5.49	5151.4	-19731.0	1.2500		8		1	11.046	3.061	1.071	1.210	3.387	1.330	0.000
5.57	5151.4	-19731.0	1.3750		8		1	11.964	3.307	1.118	1.247	3.423	1.330	0.000

PLATE-TEE SELECTED ..... 1.2500 8 ACTUAL B/T (NORMAL LOADS)= 36.5

LONGITUDINAL SPACING = 42.36 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	BUCK	ULT	HEND/ COMP	TENS	SHEAR	ILS	DEFL
4.99	5151.4		1.2500	246.3			1							
5.49	5151.4	-19731.0	1.2500		8		1	11.860	3.418	1.130	1.235	3.647	1.330	0.000
5.57	5151.4	-19731.0	1.3750		8		1	12.631	3.662	1.175	1.269	3.686	1.330	0.000

PLATE-TEE SELECTED ..... 1.2500 8 ACTUAL B/T (NORMAL LOADS)= 33.9

LONGITUDINAL SPACING = 39.54 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	BUCK	ULT	HEND/ COMP	TENS	SHEAR	ILS	DEFL
4.99	5151.4		1.2500	246.3			1							
5.49	5151.4	-19731.0	1.2500		8		1	12.522	3.778	1.189	1.258	3.987	1.330	0.000
5.57	5151.4	-19731.0	1.3750		8		1	13.164	4.016	1.232	1.298	3.949	1.330	0.000

PLATE-TEE SELECTED ..... 1.2500 8 ACTUAL B/T (NORMAL LOADS)= 31.6

LONGITUDINAL SPACING = 37.07 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	BUCK	ULT	HEND/ COMP	TENS	SHEAR	ILS	DEFL
4.99	5151.4		1.2500	246.3			1							
5.50	5151.4	-19731.0	1.2500		8		1	13.061	4.139	1.248	1.280	4.167	1.330	0.000
5.58	5151.4	-19731.0	1.3750		8		1	13.596	4.367	1.289	1.310	4.212	1.330	0.000

PLATE-TEE SELECTED ..... 1.2500 8 ACTUAL B/T (NORMAL LOADS)= 29.7

REGION NO. 1 DECK NO. 7 WEIGHT DATA

SPACING(IN.)	LBS./FT.
65.89	2569.3
59.30	2575.0
53.91	2580.8
49.42	2578.3
45.62	2583.3
42.36	2588.4
39.54	2593.4
37.07	2598.4

BULKHEAD NO. 1 SEGMENT NO. 1 GIRTH = 4.02 FT.

TYPE OF SPACE IDENTIFIER = 3

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX H/T NOR LO	ACT H/T	LBS./FT.	LCOND	* FACTORS OF SAFETY * BUCK	ULT
2.00	31.98	17056.6		.6875	142.3			1		
	54.76	0.0		.6875	104.7			3		
	PLATE SELECTED			.6875		69.8	112.8		1.018	9.381

BULKHEAD NO. 1 SEGMENT NO. 2 GIRTH = 10.03 FT.

TYPE OF SPACE IDENTIFIER = 2
LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LONGITUDINALS ARE DESIGNED WITHOUT LATERAL SUPPORTS.

2 LONGITUDINALS(SPACING = 40.11 IN.)

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX H/T NOR LO	TEE ID	LBS./FT.	LCOND	********** FACTORS OF SAFETY ********** BEND/ BUCK	ULT	COMP	TENS	SHEAR	ILS	DEFL
7.33	29.98	16193.3		.5000	115.1			1							
	52.69	0.0		.5000	86.8			3							
	41.36	0.0		.5000	124.4			4							
	29.99	16193.3	-4300.6	.5000		149		1	1.002	1.283	2.107	7.436	17.328	3.148	0.000
	52.89	0.0	0.0	.5000		149		3	23.299	29.442	22.895	22.895	9.827	3.148	0.000
	41.56	0.0	0.0	.5000		149		4	29.650	37.477	29.136	29.136	12.506	3.148	0.000
	30.01	16193.3	-4300.6	.5625		40		1	1.175	1.182	1.041	2.513	2.278	1.123	0.000
	52.71	0.0	0.0	.5625		40		3	7.008	7.763	1.114	1.114	1.297	1.123	0.000
	41.38	0.0	0.0	.5625		40		4	8.926	9.888	1.419	1.419	1.652	1.123	0.000
	30.03	16193.3	-4300.6	.6250		40		1	1.471	1.426	1.046	2.546	2.290	1.123	0.000
	52.73	0.0	0.0	.6250		40		3	10.067	9.758	1.126	1.126	1.304	1.123	0.000
	41.40	0.0	0.0	.6250		40		4	12.822	12.429	1.434	1.434	1.661	1.123	0.000
	PLATE-TEE SELECTED			.5625		40	127.9		ACTUAL H/T (NORMAL LOADS)= 71.3						
10.67	23.31	13315.4		.5000	130.5			1							
	46.02	0.0		.5000	92.9			3							
	34.69	0.0		.5000	135.8			4							
	23.33	13315.4	-3536.3	.5000		26		1	1.102	1.412	1.024	1.946	2.132	1.039	0.000
	46.01	0.0	0.0	.5000		37		3	5.068	6.491	1.091	1.091	1.400	1.075	0.000
	23.35	13315.4	-3536.3	.5000		37		1	1.110	1.422	1.148	2.688	2.758	1.075	0.000
	46.02	0.0	0.0	.5000		37		3	5.067	6.490	1.091	1.091	1.400	1.075	0.000
	34.69	0.0	0.0	.5000		37		4	6.722	8.610	1.447	1.447	1.857	1.075	0.000
	23.35	13315.4	-3536.3	.5625		26		1	1.420	1.566	1.028	1.970	2.143	1.039	0.000
	46.03	0.0	0.0	.5625		37		3	7.648	8.473	1.104	1.104	1.408	1.075	0.000
	23.37	13315.4	-3536.3	.5625		37		1	1.430	1.584	1.205	2.727	2.773	1.075	0.000
	46.04	0.0	0.0	.5625		37		3	7.647	8.472	1.104	1.104	1.407	1.075	0.000
	34.71	0.0	0.0	.5625		37		4	10.144	11.237	1.465	1.465	1.867	1.075	0.000
	PLATE-TEE SELECTED			.5000		37	113.8		ACTUAL H/T (NORMAL LOADS)= 80.2						

3 LONGITUDINALS(SPACING = 30.08 IN.)

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX H/T NOR LO	TEE ID	LBS./FT.	LCOND	********** FACTORS OF SAFETY ********** BEND/ BUCK	ULT	COMP	TENS	SHEAR	ILS	DEFL
6.50	29.98	16193.3		.3750	115.1			1							
	52.64	0.0		.3750	86.8			3							
	41.31	0.0		.3750	124.5			4							
	29.96	16193.3	-4300.6	.4375		35		1	1.215	1.286	1.015	2.368	2.540	1.165	0.000
	52.67	0.0	0.0	.4375		35		3	5.281	5.589	1.062	1.062	1.444	1.165	0.000
	41.34	0.0	0.0	.4375		35		4	6.728	7.121	1.353	1.353	1.840	1.165	0.000
	30.00	16193.3	-4300.6	.5000		35		1	1.626	1.443	1.020	2.409	2.555	1.165	0.000
	52.69	0.0	0.0	.5000		35		3	8.474	7.519	1.078	1.078	1.454	1.165	0.000
	41.36	0.0	0.0	.5000		35		4	10.795	9.579	1.373	1.373	1.853	1.165	0.000
	PLATE-TEE SELECTED			.4375		35	78.2		ACTUAL H/T (NORMAL LOADS)= 68.8						
9.00	24.98	14034.9		.3750	126.1			1							
	47.64	0.0		.3750	91.3			3							
	36.31	0.0		.3750	132.8			4							
	24.96	14034.9	-3727.4	.3750		26		1	1.022	1.309	1.121	2.476	2.625	1.039	0.000
	47.65	0.0	0.0	.3750		26		3	3.901	4.996	1.044	1.044	1.375	1.039	0.000
	36.32	0.0	0.0	.3750		26		4	5.118	6.555	1.369	1.369	1.804	1.039	0.000
	24.98	14034.9	-3727.4	.4375		26		1	1.434	1.518	1.131	2.526	2.639	1.039	0.000
	47.67	0.0	0.0	.4375		26		3	6.803	7.200	1.061	1.061	1.383	1.039	0.000
	36.34	0.0	0.0	.4375		26		4	8.925	9.445	1.392	1.392	1.814	1.039	0.000
	PLATE-TEE SELECTED			.3750		26	47.3		ACTUAL H/T (NORMAL LOADS)= 80.2						
11.50	22.48	12955.7		.3438	132.9			1							
	45.13	0.0		.3438	93.8			3							
	33.80	0.0		.3438	137.6			4							
	22.45	12955.7	-3440.7	.3438		93		1	1.005	1.429	2.369	7.120	10.462	2.173	0.000
	45.22	0.0	0.0	.3438		93		3	7.317	10.405	7.980	7.980	5.193	2.173	0.000
	33.89	0.0	0.0	.3438		93		4	9.762	13.886	10.648	10.648	6.929	2.173	0.000
	22.46	12955.7	-3440.7	.3750		17		1	1.072	1.372	1.021	1.892	2.228	1.103	0.000
	45.14	0.0	0.0	.3750		26		3	4.117	5.273	1.101	1.101	1.451	1.039	0.000
	22.48	12955.7	-3440.7	.3750		26		1	1.111	1.423	1.232	2.766	2.915	1.039	0.000
	45.15	0.0	0.0	.3750		26		3	4.117	5.273	1.101	1.101	1.451	1.039	0.000
	33.82	0.0	0.0	.3750		26		4	5.496	7.039	1.470	1.470	1.937	1.039	0.000
	22.48	12955.7	-3440.7	.4375		17		1	1.512	1.562	1.022	1.924	2.262	1.103	0.000
	45.16	0.0	0.0	.4375		26		3	7.181	7.600	1.120	1.120	1.459	1.039	0.000
	22.50	12955.7	-3440.7	.4375		26		1	1.558	1.649	1.243	2.822	2.930	1.039	0.000
	45.17	0.0	0.0	.4375		26		3	7.180	7.599	1.120	1.120	1.459	1.039	0.000
	33.84	0.0	0.0	.4375		26		4	9.584	10.143	1.494	1.494	1.948	1.039	0.000
	PLATE-TEE SELECTED			.3750		26	66.5		ACTUAL H/T (NORMAL LOADS)= 80.2						

BULKHEAD NO. 1 SEGMENT NO. 2 WEIGHT DATA

SPACING(IN.)	LBS./FT.
40.11	241.7
30.08	192.0

INNER BOTTOM SEGMENT NO. 1 GIRTH = 4.00 FT.

P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED EXCLUDING DOUBLE
BOTTOM GIRDER STRESSES.

		PRI DESIGN STRESS			MAX B/T	ACT			• FACTORS OF SAFETY •	
HEIGHT	HEAD	COMP	TENS	TH1	NOR LD	B/T	LBS./FT.	LCOND	BUCK	ULT
4.00	15.93	17056.6		.6250	128.6			1		
	52.98	0.0		.6250	111.1			3		
	41.65	0.0		.6250	159.1			4		
	45.71	0.0		.6250	119.6			5		
	PLATE SELECTED			.6250		76.8	102.0		1.064	1.292

INNER BOTTOM SEGMENT NO. 12 GIRTH = 2.42 FT.

MINIMUM THICKNESS SPECIFIED FOR THIS SEGMENT BECAUSE
OF RUGGEDNESS REQUIREMENT.
P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED EXCLUDING DOUBLE
BOTTOM GIRDER STRESSES.

		PRI DESIGN STRESS			MAX B/T	ACT			• FACTORS OF SAFETY •	
HEIGHT	HEAD	COMP	TENS	TH1	NOR LD	B/T	LBS./FT.	LCOND	BUCK	ULT
4.00	15.93	17056.6		.7500	102.5			1		
	53.07	0.0		.7500	88.4			3		
	41.74	0.0		.7500	126.6			4		
	48.90	0.0		.7500	92.1			5		
	PLATE SELECTED			.7500		38.7	74.1		2.458	1.988

CENTER VERTICAL KEEL PLATE .... WATERTIGHT

P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED EXCLUDING DOUBLE
BOTTOM GIRDER STRESSES.

		PRI DESIGN STRESS			MAX B/T	ACT			* FACTORS OF SAFETY *	
HEIGHT	HEAD	COMP	TENS	THI	NOR LD	B/T	LBS./FT.	LCOND	BUCK	ULT
2.00	.15	17488.3		.6250	*****			1		
	54.70	0.0		.6250	109.3			2		
	43.37	0.0		.6250	155.9			3		
	47.71	0.0		.6250	117.0			4		
	PLATE SELECTED			.6250		76.8	102.0		1.037	1.260

DOUBLE BOTTOM PLATE LONGITUDINAL NO. 1 .... NONWATERTIGHT

P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED EXCLUDING DOUBLE
BOTTOM GIRDER STRESSES.

		PRI DESIGN STRESS			MAX B/T	ACT			* FACTORS OF SAFETY *	
HEIGHT	HEAD	COMP	TENS	THI	NOR LD	B/T	LBS./FT.	LCOND	BUCK	ULT
2.00	.15	17488.3		.6250	*****			1		
	PLATE SELECTED			.6250		76.8	102.0		1.037	1.260

PRELIMINARY DOUBLE BOTTOM GIRDER ANALYSIS
FOR DOUBLE BOTTOM PLATE LONGITUDINALS

GIRDER	LCOND	PRI DESIGN STRESS COMP	PRI DESIGN STRESS TENS	GIRDER STRESS	SEC MOD GIRDER	SHEAR STRESS	THI	**** FACTORS OF SAFETY **** BUCK	ULT	TENS	SHEAR
0	HYDR-END	17056.6	-5251.2	6591.2	1974.9	6658.2	.6250	.944	1.218	3.746	3.424
		17920.0	-4759.1	-5385.7	2416.9						
0	HYDR-END	17056.6	-5251.2	6506.1	2000.7	6052.9	.6875	1.147	1.311	3.761	3.767
		17920.0	-4759.1	-5344.9	2435.4						
0	HYDR-MID	17056.6	-5251.2	-3253.0	2000.7	0.0	.6875	1.293	1.377	4.468	******
		17920.0	-4759.1	2672.5	2435.4						
0	LIVE-END	17056.6	-5251.2	-2107.8	2000.7	1961.0	.6875	1.273	1.369	5.164	11.627
		17920.0	-4759.1	1731.6	2435.4						
0	LIVE-MID	17056.6	-5251.2	1053.9	2000.7	0.0	.6875	1.253	1.347	6.756	******
		17920.0	-4759.1	-865.8	2435.4						
1	HYDR-END	17056.6	-5251.2	6591.2	1974.9	6658.2	.6250	.944	1.218	3.746	3.424
		17920.0	-4759.1	-5385.7	2416.9						
1	HYDR-END	17056.6	-5251.2	6506.1	2000.7	6052.9	.6875	1.147	1.311	3.761	3.767
		17920.0	-4759.1	-5344.9	2435.4						
1	HYDR-MID	17056.6	-5251.2	-3253.0	2000.7	0.0	.6875	1.293	1.377	4.468	******
		17920.0	-4759.1	2672.5	2435.4						
1	LIVE-END	17056.6	-5251.2	-2107.8	2000.7	1961.0	.6875	1.273	1.369	5.164	11.627
		17920.0	-4759.1	1731.6	2435.4						
1	LIVE-MID	17056.6	-5251.2	1053.9	2000.7	0.0	.6875	1.253	1.347	6.756	******
		17920.0	-4759.1	-865.8	2435.4						
2	HYDR-END	17056.6	-5251.2	6625.1	1964.8	6662.5	.6250	.951	1.227	3.638	3.422
		17920.0	-4759.1	-5686.0	2289.3						
2	HYDR-END	17056.6	-5251.2	6541.6	1989.9	6056.8	.6875	1.155	1.320	3.655	3.764
		17920.0	-4759.1	-5638.2	2308.7						
2	HYDR-MID	17056.6	-5251.2	-3270.8	1989.9	0.0	.6875	1.288	1.372	4.459	******
		17920.0	-4759.1	2819.1	2308.7						
2	LIVE-END	17056.6	-5251.2	-2119.3	1989.9	1962.2	.6875	1.270	1.366	5.156	11.619
		17920.0	-4759.1	1826.6	2308.7						
2	LIVE-MID	17056.6	-5251.2	1059.7	1989.9	0.0	.6875	1.254	1.349	6.699	******
		17920.0	-4759.1	-913.3	2308.7						

SHELL SEGMENT NO. 1 GIRTH = 4.00 FT.

P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED INCLUDING DOUBLE
BOTTOM GIRDER STRESSES WHICH ARE PRINTED UNDERNEATH
THE PRIMARY DESIGN STRESSES.

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX R/T NOR LD	ACT R/T	LBS./FT.	LCOND	• FACTORS OF SAFETY • BUCK	ULT
0.00		17920.0								
		2672.5								
	PLATE SELECTED			1.0000		48.0	163.2		1.862	1.478

INNER BOTTOM SEGMENT NO. 1 GIRTH = 4.00 FT.

P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED INCLUDING DOUBLE
BOTTOM GIRDER STRESSES WHICH ARE PRINTED UNDERNEATH
THE PRIMARY DESIGN STRESSES.

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX R/T NOR LD	ACT R/T	LBS./FT.	LCOND	• FACTORS OF SAFETY • BUCK	ULT
4.00		17056.6								
		6506.1								
	PLATE SELECTED			.7500		64.0	122.4		1.109	1.071

INNER BOTTOM SEGMENT NO. 12 GIRTH = 2.42 FT.

MINIMUM THICKNESS SPECIFIED FOR THIS SEGMENT BECAUSE
OF RUGGEDNESS REQUIREMENT.
P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED INCLUDING DOUBLE
BOTTOM GIRDER STRESSES WHICH ARE PRINTED UNDERNEATH
THE PRIMARY DESIGN STRESSES.

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX R/T NOR LD	ACT R/T	LBS./FT.	LCOND	• FACTORS OF SAFETY • BUCK	ULT
4.00		17056.6								
		6691.8								
	PLATE SELECTED			.7500		38.7	74.1		1.765	1.428

..... END OF DETAIL DESIGN PRINT-OUT .....

SECTION 8. DEMONSTRATION PROBLEMS

STEEL STRUCTURAL SHAPE CATALOG

CODE NUM.(K)	NOMINAL SIZE	CODE NUM.(K)	NOMINAL SIZE	CODE NUM.(K)	NOMINAL SIZE	CODE NUM.(K)	NOMINAL SIZE
1	3X 17/8X 2.7T	44	10X 4X 19I-T	87	12X10X 53I-T	130	16I/2X111/2X65T
2	31/2X21/8X2.5T	45	5X 53/4X 14.5T	88	9X 83/4X 35T	131	18X113/4X 96I-T
3	4X 21/4X 3.25T	46	12X 4X 19I-T	89	8X 81/2X 35.5T	132	24X 9X 94 I-T
4	6X 17/8X4.4I-T	47	10X 53/4X 21I-T	90	16X 7X 50I-T	133	21X 9X 96 I-T
5	7X 21/8X5.5I-T	48	7X 63/4X 15T	91	14X 8X 53I-T	134	24X12X130 I-T
6	3X 4X 4.25T	49	6X 61/2X 15.5T	92	101/2X81/4X 36T	135	27X10X 94 I-T
7	5X 23/4X 4.5T	50	8X 61/2X 24I-T	93	18X 71/2X 50I-T	136	16I/2X111/2X70T
8	4X 4X 5T	51	12X 4X 22I-T	94	12X10X 58I-T	137	18X113/4X105I-T
9	8X 21/4X6.5I-T	52	7X 63/4X 17T	95	12X 9X 38T	138	18X12X 75T
10	5X 4X 5.75T	53	10X 53/4X 25I-T	96	9X 83/4X 38.5T	139	27X10X102 I-T
11	6X 3X 5.90T	54	6X 61/2X 18T	97	8X 81/2X 39T	140	21X13X112 I-T
12	6X 4X 8.5I-T	55	8X 7X 18T	98	18X 71/2X 55I-T	141	18X113/4X114I-T
13	3X 4X 6T	56	8X 61/2X 28I-T	99	14X10X 61I-T	142	24X12X110 I-T
14	4X 4X 6.5T	57	12X 61/2X 27I-T	100	16X 81/2X 58I-T	143	30X101/2X10AI-T
15	6X 4X 7T	58	7X 63/4X 19T	101	12X 9X 42T	144	24X12X120 I-T
16	10X 23/4X 9I-T	59	10X 53/4X 29I-T	102	18X 71/2X 60I-T	145	27X10X114 I-T
17	8X 4X 10I-T	60	8X 7X 20T	103	16X 81/2X 64I-T	146	30X101/2X116I-T
18	5X 4X 7.5T	61	12X 61/2X 31I-T	104	18X 83/4X 64I-T	147	24X14X130 I-T
19	4X 4X 7.5T	62	14X 63/4X 30I-T	105	14X10X 68I-T	148	30X101/2X124I-T
20	3X 4X 8T	63	10X 8X 33I-T	106	21X81/4X62 I-T	149	33X111/2X130I-T
21	6X 4X 8.25T	64	8X 7X 22.5T	107	12X 9X 47T	150	30X101/2X132I-T
22	6X 4X 12I-T	65	14X 63/4X 34I-T	108	131/2X10X 47T	151	24X14X145 I-T
23	5X 4X 8.5T	66	12X 61/2X 36I-T	109	14X10X 74I-T	152	27X14X145 I-T
24	4X 51/4X 8.5T	67	9X 71/2X 25T	110	18X 83/4X 70I-T	153	33X111/2X141I-T
25	7X 4X 8.5T	68	8X 7X 25T	111	16X 81/2X 71I-T	154	24X14X160 I-T
26	10X 4X 11.5I-T	69	10X 8X 39I-T	112	12X12X 50T	155	27X14X160 I-T
27	12X 3X 11.8I-T	70	16X 7X 36I-T	113	21X81/4X68 I-T	156	33X111/2X152I-T
28	5X 4X 9.5T	71	12X 8X 40I-T	114	14X12X 78I-T	157	36X12X 150I-T
29	6X 4X 9.5T	72	14X 63/4X 38I-T	115	131/2X10X 51T	158	30X15X 172I-T
30	8X 4X 13I-T	73	9X 71/2X 27.5T	116	9X113/4X 52.5T	159	36X12X 160I-T
31	4X 51/4X 10T	74	16X 7X 40I-T	117	21X81/4X73 I-T	160	27X14X177 I-T
32	5X 53/4X 10.5T	75	8X 81/2X 29T	118	15X101/2X 54T	161	36X12X 170I-T
33	6X 4X 11T	76	10X 8X 45I-T	119	18X 83/4X 77I-T	162	30X15X 190I-T
34	6X 4X 16I-T	77	14X 8X 43I-T	120	16X 81/2X 78I-T	163	36X12X 182I-T
35	8X 4X 15I-T	78	9X 71/2X 30T	121	24X 9X 76 I-T	164	33X153/4X200I-T
36	12X 4X 14I-T	79	12X 8X 45I-T	122	131/2X10X 57T	165	36X12X 194I-T
37	10X 4X 15I-T	80	101/2X81/4X 31T	123	15X101/2X 58T	166	30X15X 210I-T
38	8X 51/4X 17I-T	81	9X 83/4X 32T	124	16X111/2X 88I-T	167	33X153/4X220I-T
39	5X 53/4X 12.5T	82	8X 81/2X 32T	125	21X 9X 82 I-T	168	36X161/2X230I-T
40	10X 4X 17I-T	83	16X 7X 45I-T	126	12X12X 60T	169	33X153/4X240I-T
41	12X 4X 16.5I-T	84	14X 8X 47I-T	127	18X 83/4X 85I-T	170	36X161/2X245I-T
42	6X 61/2X 13.5T	85	12X 8X 50I-T	128	24X 9X 84 I-T	171	36X161/2X260I-T
43	8X 51/4X 20I-T	86	101/2X81/4X 34T	129	16X111/2X 96I-T	172	36X161/2X280I-T
						173	36X161/2X300I-T

STEEL PLATE CATALOG

CODE NUMBER	THICKNESS, INCHES
1	.1250
2	.1563
3	.1875
4	.2188
5	.2500
6	.2813
7	.3125
8	.3438
9	.3750
10	.4375
11	.5000
12	.5625
13	.6250
14	.6875
15	.7500
16	.8750
17	1.0000
18	1.1250
19	1.2500
20	1.3750
21	1.5000
22	1.7500
23	2.0000

ALUMINUM PLATE CATALOG

CODE NUMBER	THICKNESS, INCHES
1	.1250
2	.1875
3	.2500
4	.3125
5	.3750
6	.4375
7	.5000
8	.5625
9	.6250
10	.7500
11	.8750
12	1.0000
13	1.1250
14	1.2500
15	1.3750
16	1.5000
17	1.7500
18	2.0000

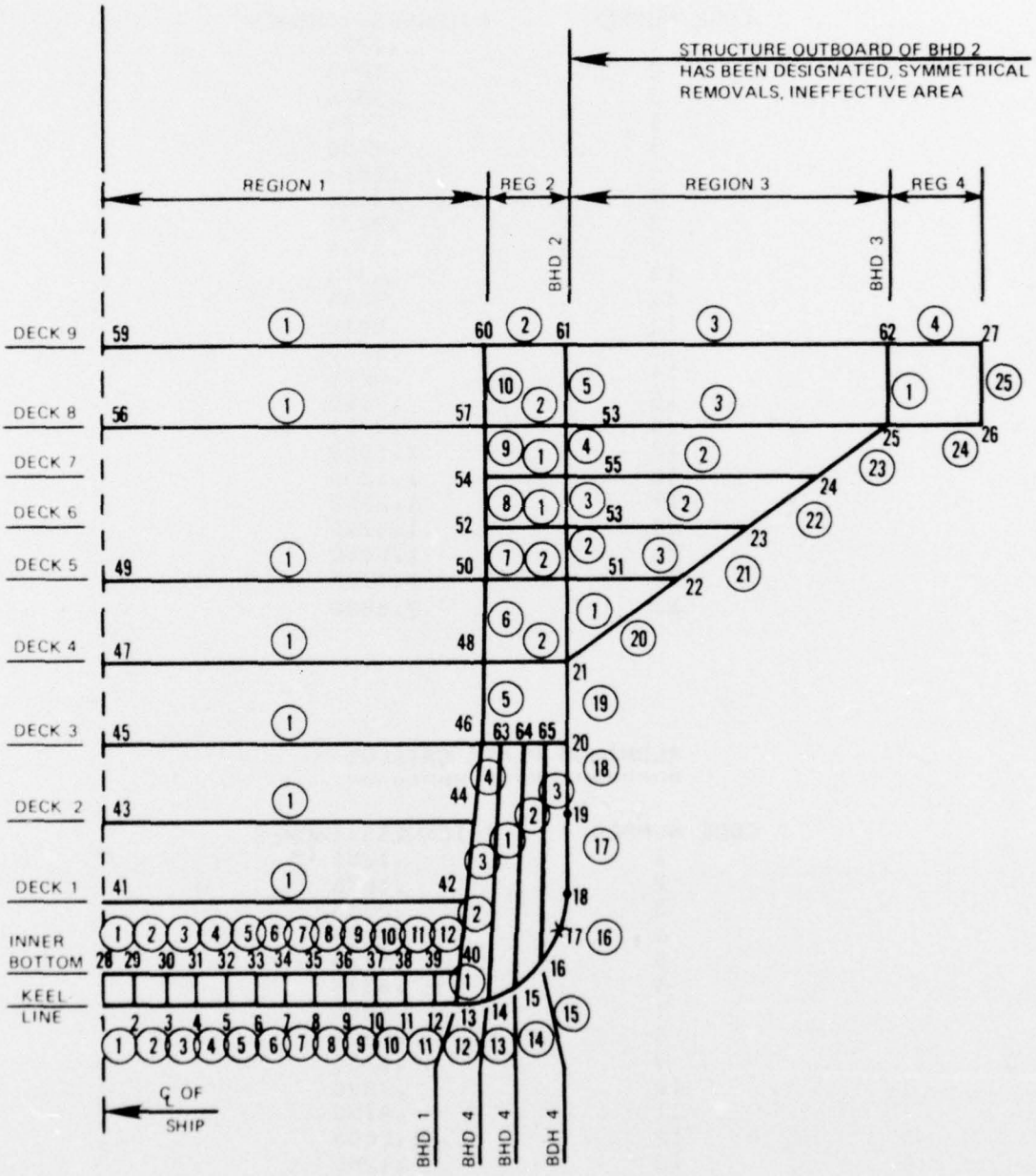

Figure 4 — Demonstration Problem 2

INPUT DATA LISTING: PROBLEM 2

```
1 0
  DEMONSTRATION PROBLEM 2    LEV/NAPPI/WALZ    227-1787    11/15/76
850.0  87.50 116.25  33.67  0.00  0.00  64.0 30.0 0.0 500.0 0.55
65  25   4  4  4  1  14  6  6  1  0  1  0  1  1  0  12  11  0  24.0 4.0 4.0  0.0
1120.0  500.0  0.500  0.5  1  0
500000.0  2000000.0  4110.  -16440.0  -3200.0  12800.0  17920.0  17920.0
0.0  0.0  0.0  4.0  0.0  8.0  0.0  12.0  0.0  16.0
0.0  20.0  0.0  24.0  0.0  28.0  0.0  32.0  0.0  36.0
0.0  40.0  0.0  44.0  0.0  48.0  0.35  49.2  1.20  52.30
4.0  56.6  4.0  59.4  14.0 60.25  24.0  60.25  33.83  60.25
45.17 60.25  56.50 75.54  63.50 85.05  70.50 94.53  77.50 104.0
77.50 116.25  87.50 116.25  4.0 0.00  4.00  4.00  4.0 8.0
4.0 12.0  4.0  16.0  4.0  20.0  4.0  24.0  4.0  28.0
4.0  32.0  4.0  36.0  4.0  40.0  4.0  44.0  4.0  46.42
14.0  0.0  14.0  47.17  24.0  0.0  24.0  47.92  33.83  0.0
33.83  49.42  45.17  0.0  45.17  49.42  56.50  0.0  56.50  49.42
56.50  60.25  63.5  49.42  63.5  60.25  70.5  49.42  70.5  60.25
77.50  0.0  77.50  49.42  77.5  60.25  87.5  0.0  87.5  49.42
87.5  60.25  87.5  104.0  33.83 52.13  33.83 54.84  33.83 57.54
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 18 19 20 21 22 23 24 25 26 27
41 42
43 44
45 46 63 64 65 20
47 48 21
49 50 51 22
52 53 23
54 55 24
56 57 58 25
59 60 61 62 27
13  40  42  44  46  48  50  52  54  57  60
21 51 53 55 58 61
25 62
14 63 0  15 64 0  16 65
28 29 30 31 32 33 34 35 36 37 38 39 40
1 28  2 29 3 30 4 31 5 32 6 33 7 34  8 35 9 36 10 37 11 38 12 39
0 0 1 1 1 0 0 1 1
6.5  6.5  6.5  6.5  6.5  0.0  0.0  0.0  6.5
49.42  1  1  1  1  1  0  0  1  1
10.83  0  0  0  1  1  1  1  1  1
43.75  0  0  0  0  1  1  1  1  1
12.25  0  0  0  0  0  0  0  0  1
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50   4.00   0.00   0.00   0.00   0.00   4.00   0.00   -14  0  0  0  0  2  0
56.50  33.83  0.0  0.0  0.0  0.0  4.0  0.0       -16  0  0  0  4  4  0
56.50  33.48  0.0  0.0  0.0  0.0  4.0  0.0       -16  0  0  0  4  4  0
56.50  32.63  0.0  0.0  0.0  0.0  4.0  0.0       -16  0  0  0  4  4  0
56.50  29.83  0.0  0.0  60.0  60.0  8.0  8.0   -16  -51  0  0  4  4  2
56.50  19.83  0.00  0.00  60.0  60.0  8.0  8.0          -16 -51  0  0  0  2  2
56.50   9.83  0.00  0.00  60.0  60.0  8.0  8.0          -15 -51  0  0  0  2  2
 0.00  0.00  0.00  0.00  68.0  68.0  8.0  8.0          -15 -51  0  0  0  2  2
0.0  0.0  11.11  11.11  24.0  24.0  8.0  8.0    -5 -10  0  0  0  2  2
0.0  0.0   6.94   6.94  24.0  24.0  8.0  8.0    -5 -10  0  0  0  2  2
0.0  0.0   6.94   6.94  24.0  24.0  8.0  8.0    -5 -10  0  0  0  2  2
0.0  0.0   6.94   6.94  24.0  24.0  8.0  8.0    -5 -10  0  0  0  2  2
0.0  0.0  0.0  0.0  18.0  18.0  8.0  8.0        -5 -10  0  0  0  2  2
0.0  0.0  0.0  0.0  18.0  18.0  8.0  8.0       -11 -10  0  0  0  4  2
20  2  1  45.17  56.50
21  2  1  56.50  63.50
22  2  1  63.5  70.50
23  2  1  70.50  77.50
24  2  1  104.0  116.25
25  2  1  77.50  87.50
```

INPUT DATA LISTING: PROBLEM 2—Continued

```
100.0   45.17   0.00   0.00   36.0  36.0  16.0  16.0     -9 -38 1  0  0  2  2
100.0   45.17   0.00   0.00   36.0  36.0  16.0  16.0     -9 -38 1  0  0  2  2
100.0  45.17  0.0  0.0  36.0  36.0  8.0  8.0      -17 -17  1  0  0  2  2
100.0  45.17  56.50  0.0  0.0  0.0  8.0  0.0     -15  0  3  0  0  2  0
100.0  45.17  56.50  0.0  0.0  0.0  8.0  0.0     -15  0  3  0  0  2  0
100.0  45.17  56.50  0.0  0.0  0.0  8.0  0.0     -15  0  3  0  0  2  0
100.0  45.17  56.50  0.0  0.0  0.0  8.0  0.0     -15  0  3  0  0  2  0
100.0  0.0  0.0  0.0   36.0  36.0  8.0  8.0     -5 -17 1  0  0  2  2
100.0  0.0  0.0  0.0   32.5  32.5  8.0  8.0     -5 -17 1  0  0  2  2
300.0  0.0  0.0  0.0   36.0  36.0  8.0  8.0    -11 -33 1  0  0  2  2
300.0  0.0  0.0  0.0   32.5  32.5  8.0  8.0    -11 -6  1  0  0  2  2
100.0  0.0  0.0  0.0  18.0  18.0  8.0  8.0       -5 -6  1  0  0  2  2
100.0  0.0  0.0  0.0  16.25 16.25 8.0  8.0       -5 -6  1  0  0  2  2
100.0  0.0  0.0  0.0  18.0  18.0  8.0  8.0       -5 -6  1  0  0  2  2
100.0  0.0  0.0  0.0  16.25 16.25 8.0  8.0       -5 -6  1  0  0  2  2
100.0  0.0  0.0  0.0  18.0  18.0  8.0  8.0       -5 -6  1  0  0  2  2
100.0  0.0  0.0  0.0   36.0  36.0  32.0  32.0    -9 -33 1  0  0  2  2
100.0  0.0  0.0  0.0   32.5  32.5  8.0  8.0      -9 -6  1  0  0  2  2
100.0  0.0  0.0  0.0  18.0  18.0  8.0  8.0      -5 -6  1  0  0  2  2
300.0  0.0  0.0  0.0   36.0  36.0  8.0  8.0     -21 -33 4  0  2  4  2
300.0  0.0  0.0  0.0   32.5  32.5  8.0  8.0     -21 -33 4  0  2  4  2
300.0  0.0  0.0  0.0   18.0   18.0 8.0  8.0     -15 -6  4  0  2  4  2
300.0  0.0  0.0  0.0   18.0   18.0 8.0  8.0     -15 -6  4  0  2  4  2
5  3  2  1  60.25  75.5M
6  2  2  1  60.25  85.05
7  2  2  1  60.25  94.53
8  3  2  1  60.25  104.0
9  3  2  1  60.25  104.0
9  4  2  1  104.0  116.25
0.0   56.5  33.83   0.0  0.0  4.0  0.0    -14  0  3  0  0  2  0
45.17  56.50  29.83   0.00  0.00  8.0  0.0      -19 0  2  0  0  2  2
45.17  56.50  19.83   0.0  0.0    8.0  0.0      -19 0  2  0  0  2  2
45.17  56.50   9.83   0.0   0.0   8.0  0.0      -17 0  2  0  0  2  2
45.17  0.0  0.0    40.0  40.0 8.0  8.0         -11 -6  1  0  0  2  2
 0.0   0.0  0.0   40.0  40.0  8.0  8.0         -11 -6  1  0  0  2  2
0.0  0.0  0.0  42.0  42.0  8.0  8.0           -11 -6   1  0  0  2  2
0.0  0.0  0.0  42.0  42.0  8.0  8.0           -11 -6   1  0  0  2  2
0.0  0.0  0.0  42.0  42.0  8.0  8.0           -11 -6   1  0  0  2  2
0.0    0.0  0.0   40.0  40.0  8.0  8.0        -11 -6  1  0  0  4  2
0.0    0.0  0.0   68.0  68.0  8.0  8.0        -15 -17 1  0  0  2  2
0.0    0.0  0.0   42.0  42.0  8.0  8.0        -11 -6  1  0  0  2  2
0.0    0.0  0.0   42.0  42.0  8.0  8.0        -11 -6  1  0  0  2  2
0.0    0.0  0.0   42.0  42.0  8.0  8.0        -11 -6  1  0  0  2  2
0.0    0.0  0.0   40.0  40.0  8.0  8.0        -11 -6  1  0  0  4  2
0.0    0.0  0.0   18.0  18.0  8.0  8.0        -11 -6  1  0  0  4  2
0.0  56.50  33.48  24.0  24.0  8.0  8.0         -17  -6  3  0  1  4  2
0.0  56.0  32.83  48.0  48.0  8.0  8.0  -19  -17  3  0  1  4  2
0.0  56.50  29.83  24.0  24.0  8.0  8.0  -17  -6  3  0  1  4  2
3  1  2  1  77.50  87.50
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1000.0   45.17   56.50   0.00   4.0  0.0       -15  0  0  0  2  0
1 -14  4.0   0.0   45.17   56.50   0  2
0 -14 4.0  0.0   0.0  0.0    0  2
0 -14 4.0  0.0   0.0  0.0    0  2
0 -14 4.0  0.0   0.0  0.0    0  2
0 -14 4.0  0.0   0.0  0.0    0  2
0 -14 4.0  0.0   0.0  0.0    0  2
0 -14 4.0  0.0   0.0  0.0    0  2
0 -14 4.0  0.0   0.0  0.0    0  2
0 -14 4.0  0.0   0.0  0.0    0  2
0 -14 4.0  0.0   0.0  0.0    0  2
0 -14 4.0  0.0   0.0  0.0    0  2
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DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

PRINCIPAL HULL DIMENSIONS

LENGTH BETWEEN PERPENDICULARS	=	850.00 FT.
MAXIMUM HALF BREADTH	=	116.25 FT.
DEPTH OF HULL	=	87.50 FT.
DESIGN FULL LOAD DRAFT	=	33.67 FT.
LENGTH BETWEEN TRANSVERSE BULKHEADS	=	64.00 FT.
NUMBER OF SHELL SEGMENTS	=	25
NUMBER OF DECKS	=	9
NUMBER OF BULKHEADS	=	4
NUMBER OF DOUBLE BOTTOM PLATE LONGITUDINALS	=	11
NUMBER OF INNER BOTTOM SEGMENTS	=	12

DESIGN CRITERIA

MATERIAL THROUGHOUT FOR PLATING	=	HYBRID
MATERIAL THROUGHOUT FOR STIFFENERS	=	HYBRID
MINIMUM PRESSURE FOR SHELL	=	500.00 PSF
MARGIN STRESS ADDED TO PRIMARY STRESS	=	1120.00 PSI
PRIMARY STRESS TOLERANCE (+ OR -)	=	500.00 PSI
DESIGN LIMITING PRI. STRESS, DECK FIBER	=	17920.00 PSI
DESIGN LIMITING PRI. STRESS, KEEL FIBER	=	17920.00 PSI
PRIMARY STRESS FACTOR	=	.5000
STRAKE TOLERENCE	=	.5000 IN.
BENDING MOMENT HOG CONDITION	=	2000000.00 FT-TONS
BENDING MOMENT SAG CONDITION	=	500000.00 FT-TONS
ANGLE OF HEEL	=	30.00 DEGREES
SHELL DESIGN HEAD	=	0.00 FT.
WAVE HEIGHT COEFFICENT	=	.550

NO SHORT SPANS (EQUAL SPANS)

SHIP DESIGNED WITH ILS IF REQUIRED
SHELL SEGMENTS FOR AREA ADDITION IF REQUIRED
FROM SEG 1 TO SEG 14
SHIP NOT DESIGNED FOR NUCLEAR BLAST.
SHIP DESIGNED WITH INNER BOTTOM
SCANTLINGS FOR THE DOUBLE BOTTOM STRUCTURE
ARE TO BE CONSIDERED PRELIMINARY
NO GIRDER ANALYSIS REQUESTED
MAXIMUM DEPTH OF I.B. STRINGER = 24.00 IN.

ASSUMED STRESSES

PRIMARY STRESS AT DECK-HOG	=	-16440.00 PSI
PRIMARY STRESS AT KEEL-HOG	=	12800.00 PSI
PRIMARY STRESS AT DECK-SAG	=	4110.00 PSI
PRIMARY STRESS AT KEEL-SAG	=	-3200.00 PSI

SECTION 8. DEMONSTRATION PROBLEMS

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

SHELL

SML SEG	GEOMETRY Z1/Z3	Y1/Y3	Z2/Z4	Y2/Y4	TANK OVHFL	TANK TOP HD	SLAMMING CRITERIA PRES PL	PRES HM	COMB PRI	DEFOR IND	MINIMUM CODE ID PL	HM	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	HM	MATERIAL IND PL	HM
1	0.000 0.000	0.000 0.000	0.000 0.000	4.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
2	0.000 0.000	4.000 0.000	0.000 0.000	8.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
3	0.000 0.000	8.000 0.000	0.000 0.000	12.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
4	0.000 0.000	12.000 0.000	0.000 0.000	16.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
5	0.000 0.000	16.000 0.000	0.000 0.000	20.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
6	0.000 0.000	20.000 0.000	0.000 0.000	24.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
7	0.000 0.000	24.000 0.000	0.000 0.000	28.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
8	0.000 0.000	28.000 0.000	0.000 0.000	32.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
9	0.000 0.000	32.000 0.000	0.000 0.000	36.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
10	0.000 0.000	36.000 0.000	0.000 0.000	40.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
11	0.000 0.000	40.000 0.000	0.000 0.000	44.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
12	0.000 0.000	44.000 0.000	0.000 0.000	46.000 0.000	56.50	4.00	0.00		1	0	-14		0.00	0.00	4.00		2	
13	0.000 0.000	46.000 0.000	.350 0.000	49.200 0.000	56.50	33.83	0.00		1	0	-16		0.00	0.00	4.00		4	
14	.350 0.000	49.200 0.000	1.200 0.000	52.300 0.000	56.50	33.48	0.00		1	0	-16		0.00	0.00	4.00		4	
15	1.200 0.000	52.300 0.000	4.000 0.000	56.600 0.000	56.50	32.63	0.00		1	0	-16		0.00	0.00	4.00		4	
16	4.000 9.000	56.600 59.400	14.000 0.000	60.250 0.000	56.50	29.83	0.00	0.00	1	0	-16	-51	60.00	60.00	8.00	8.00	4	2
17	14.000 0.000	60.250 0.000	24.000 0.000	60.250 0.000	56.50	19.83	0.00	0.00	1	0	-16	-51	60.00	60.00	8.00	8.00	2	2
18	24.000 0.000	60.250 0.000	33.830 0.000	60.250 0.000	56.50	9.83	0.00	0.00	1	0	-15	-51	60.00	60.00	8.00	8.00	2	2
19	33.830 0.000	60.250 0.000	45.170 0.000	60.250 0.000	0.00	0.00	0.00	0.00	1	0	-15	-51	68.00	68.00	8.00	8.00	2	2
20	45.170 0.000	60.250 0.000	56.500 0.000	75.580 0.000	0.00	0.00	11.11	11.11	1	0	-5	-10	24.00	24.00	8.00	8.00	2	2
21	56.500 0.000	75.580 0.000	63.500 0.000	85.050 0.000	0.00	0.00	6.94	6.94	1	0	-5	-10	24.00	24.00	8.00	8.00	2	2
22	63.500 0.000	85.050 0.000	70.500 0.000	94.530 0.000	0.00	0.00	6.94	6.94	1	0	-5	-10	24.00	24.00	8.00	8.00	2	2
23	70.500 0.000	94.530 0.000	77.500 0.000	104.000 0.000	0.00	0.00	6.94	6.94	1	0	-5	-10	24.00	24.00	8.00	8.00	2	2
24	77.500 0.000	104.000 0.000	77.500 0.000	116.250 0.000	0.00	0.00	0.00	0.00	1	0	-5	-10	18.00	18.00	8.00	8.00	2	2
25	77.500 0.000	116.250 0.000	87.500 0.000	116.250 0.000	0.00	0.00	0.00	0.00	1	0	-11	-10	18.00	18.00	8.00	8.00	4	2

REMOVALS

SEG	TYPE	SYM	ZLYI	ZUYO
20	2	1	45.170	56.500
21	2	1	56.500	63.500
22	2	1	63.500	70.500
23	2	1	70.500	77.500
24	2	1	104.000	116.250
25	2	1	77.500	87.500

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

DECK

REGION 1 WIDTH= 49.42 FT.

DK	SEG	GEOMETRY Z1	Y1	Z2	Y2	LIVE LOAD	VITNOR DAM HD	TANK OVRFL	TANK TOP HD	SPAC IND	MINIMUM CODE ID PL	BM	BEL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	1	14.00	0.00	14.00	47.17	100.00	45.17	0.00	0.00	1	-9	-38	6.50	0	36.00	36.00	16.00	16.00	2	2
2	1	24.00	0.00	24.00	47.92	100.00	45.17	0.00	0.00	1	-9	-38	6.50	0	36.00	36.00	16.00	16.00	2	2
3	1	33.83	0.00	33.83	49.42	100.00	45.17	0.00	0.00	1	-17	-17	6.50	1	36.00	36.00	8.00	8.00	2	2
4	1	45.17	0.00	45.17	49.42	100.00	0.00	0.00	0.00	1	-5	-17	6.50	1	36.00	36.00	8.00	8.00	2	2
5	1	56.50	0.00	56.50	49.42	300.00	0.00	0.00	0.00	1	-11	-33	6.50	1	36.00	36.00	8.00	8.00	2	2
6	0																			
7	0																			
8	1	77.50	0.00	77.50	49.42	100.00	0.00	0.00	0.00	1	-9	-33	0.00	1	36.00	36.00	32.00	32.00	2	2
9	1	87.50	0.00	87.50	49.42	300.00	0.00	0.00	0.00	4	-21	-33	6.50	1	36.00	36.00	8.00	8.00	4	2

REGION 2 WIDTH= 10.83 FT.

DK	SEG	GEOMETRY Z1	Y1	Z2	Y2	LIVE LOAD	VITNOR DAM HD	TANK OVRFL	TANK TOP HD	SPAC IND	MINIMUM CODE ID PL	BM	BEL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	0																			
2	0																			
3	2	33.83	49.42	33.83	52.13	100.00	45.17	56.50	0.00	3	-15		6.50	1	0.00	0.00	8.00		2	
3	3	33.83	52.13	33.83	54.84	100.00	45.17	56.50	0.00	3	-15		6.50	1	0.00	0.00	8.00		2	
3	4	33.83	54.84	33.83	57.54	100.00	45.17	56.50	0.00	3	-15		6.50	1	0.00	0.00	8.00		2	
3	5	33.83	57.54	33.83	60.25	100.00	45.17	56.50	0.00	3	-15		6.50	1	0.00	0.00	8.00		2	
4	2	45.17	49.42	45.17	60.25	100.00	0.00	0.00	0.00	1	-5	-17	6.50	1	32.50	32.50	8.00	8.00	2	2
5	2	56.50	49.42	56.50	60.25	300.00	0.00	0.00	0.00	1	-11	-6	6.50	1	32.50	32.50	8.00	8.00	2	2
6	1	63.50	49.42	63.50	60.25	100.00	0.00	0.00	0.00	1	-5	-6	0.00	0	16.25	16.25	8.00	8.00	2	2
7	1	70.50	49.42	70.50	60.25	100.00	0.00	0.00	0.00	1	-5	-6	0.00	0	16.25	16.25	8.00	8.00	2	2
8	2	77.50	49.42	77.50	60.25	100.00	0.00	0.00	0.00	1	-9	-6	0.00	1	32.50	32.50	8.00	8.00	2	2
9	2	87.50	49.42	87.50	60.25	300.00	0.00	0.00	0.00	4	-21	-33	6.50	1	32.50	32.50	8.00	8.00	4	2

REGION 3 WIDTH= 43.75 FT.

DK	SEG	GEOMETRY Z1	Y1	Z2	Y2	LIVE LOAD	VITNOR DAM HD	TANK OVRFL	TANK TOP HD	SPAC IND	MINIMUM CODE ID PL	BM	BEL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	0																			
2	0																			
3	0																			
4	0																			
5	3	56.50	60.25	56.50	75.58	100.00	0.00	0.00	0.00	1	-5	-6	6.50	1	18.00	18.00	8.00	8.00	2	2
6	2	63.50	60.25	63.50	85.05	100.00	0.00	0.00	0.00	1	-5	-6	0.00	0	18.00	18.00	8.00	8.00	2	2
7	2	70.50	60.25	70.50	94.53	100.00	0.00	0.00	0.00	1	-5	-6	0.00	0	18.00	18.00	8.00	8.00	2	2
8	3	77.50	60.25	77.50	104.00	100.00	0.00	0.00	0.00	1	-5	-6	0.00	1	18.00	18.00	8.00	8.00	2	2
9	3	87.50	60.25	87.50	104.00	300.00	0.00	0.00	0.00	4	-15	-6	6.50	1	18.00	18.00	8.00	8.00	4	2

REGION 4 WIDTH= 12.25 FT.

DK	SEG	GEOMETRY Z1	Y1	Z2	Y2	LIVE LOAD	VITNOR DAM HD	TANK OVRFL	TANK TOP HD	SPAC IND	MINIMUM CODE ID PL	BM	BEL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	0																			
2	0																			
3	0																			
4	0																			
5	0																			
6	0																			
7	0																			
8	0																			
9	4	87.50	104.00	87.50	116.25	300.00	0.00	0.00	0.00	4	-15	-6	6.50	1	18.00	18.00	8.00	8.00	4	2

REMOVALS

DK	SEG	TYPE	SYM	YI	YO
5	3	2	1	60.250	75.580
6	2	2	1	60.250	85.050
7	2	2	1	60.250	94.530
8	3	2	1	60.250	104.000
9	3	2	1	60.250	104.000
9	4	2	1	104.000	116.250

SECTION 8. DEMONSTRATION PROBLEMS

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

BULKHEAD

BHD	SEG	GEOMETRY Z1	Y1	Z2	Y2	VITNOR DAM HO	TANK OVRFL	TANK TOP HO	SPAC IND	MINIMUM CODE ID PL	BM	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	1	0.00	46.00	4.00	46.42	0.00	56.50	33.83	3	-14		0.00	0.00	4.00		2	
1	2	4.00	46.42	14.00	47.17	45.17	56.50	29.83	2	-19		0.00	0.00	8.00		2	
1	3	14.00	47.17	24.00	47.92	45.17	56.50	19.83	2	-19		0.00	0.00	8.00		2	
1	4	24.00	47.92	33.83	49.42	45.17	56.50	9.83	2	-17		0.00	0.00	8.00		2	
1	5	33.83	49.42	45.17	49.42	45.17	0.00	0.00	1	-11	-6	40.00	40.00	8.00	8.00	2	2
1	6	45.17	49.42	56.50	49.42	0.00	0.00	0.00	1	-11	-6	40.00	40.00	8.00	8.00	2	2
1	7	56.50	49.42	63.50	49.42	0.00	0.00	0.00	1	-11	-6	42.00	42.00	8.00	8.00	2	2
1	8	63.50	49.42	70.50	49.42	0.00	0.00	0.00	1	-11	-6	42.00	42.00	8.00	8.00	2	2
1	9	70.50	49.42	77.50	49.42	0.00	0.00	0.00	1	-11	-6	42.00	42.00	8.00	8.00	2	2
1	10	77.50	49.42	87.50	49.42	0.00	0.00	0.00	1	-11	-6	40.00	40.00	8.00	8.00	4	2
2	1	45.17	60.25	56.50	60.25	0.00	0.00	0.00	1	-15	-17	68.00	68.00	8.00	8.00	2	2
2	2	56.50	60.25	63.50	60.25	0.00	0.00	0.00	1	-11	-6	42.00	42.00	8.00	8.00	2	2
2	3	63.50	60.25	70.50	60.25	0.00	0.00	0.00	1	-11	-6	42.00	42.00	8.00	8.00	2	2
2	4	70.50	60.25	77.50	60.25	0.00	0.00	0.00	1	-11	-6	42.00	42.00	8.00	8.00	2	2
2	5	77.50	60.25	87.50	60.25	0.00	0.00	0.00	1	-11	-6	40.00	40.00	8.00	8.00	4	2
3	1	77.50	104.00	87.50	104.00	0.00	0.00	0.00	1	-11	-6	18.00	18.00	8.00	8.00	4	2
4	1	.35	49.20	33.83	52.13	0.00	56.50	33.48	3	-17	-6	24.00	24.00	8.00	8.00	4	2
4	2	1.20	52.30	33.83	54.84	0.00	56.00	32.63	3	-19	-17	48.00	48.00	8.00	8.00	4	2
4	3	4.00	56.60	33.83	57.54	0.00	56.50	29.83	3	-17	-6	24.00	24.00	8.00	8.00	4	2

REMOVALS

BHD	SEG	TYPE	SYM	ZL	ZU
3	1	2	1	77.500	87.500

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

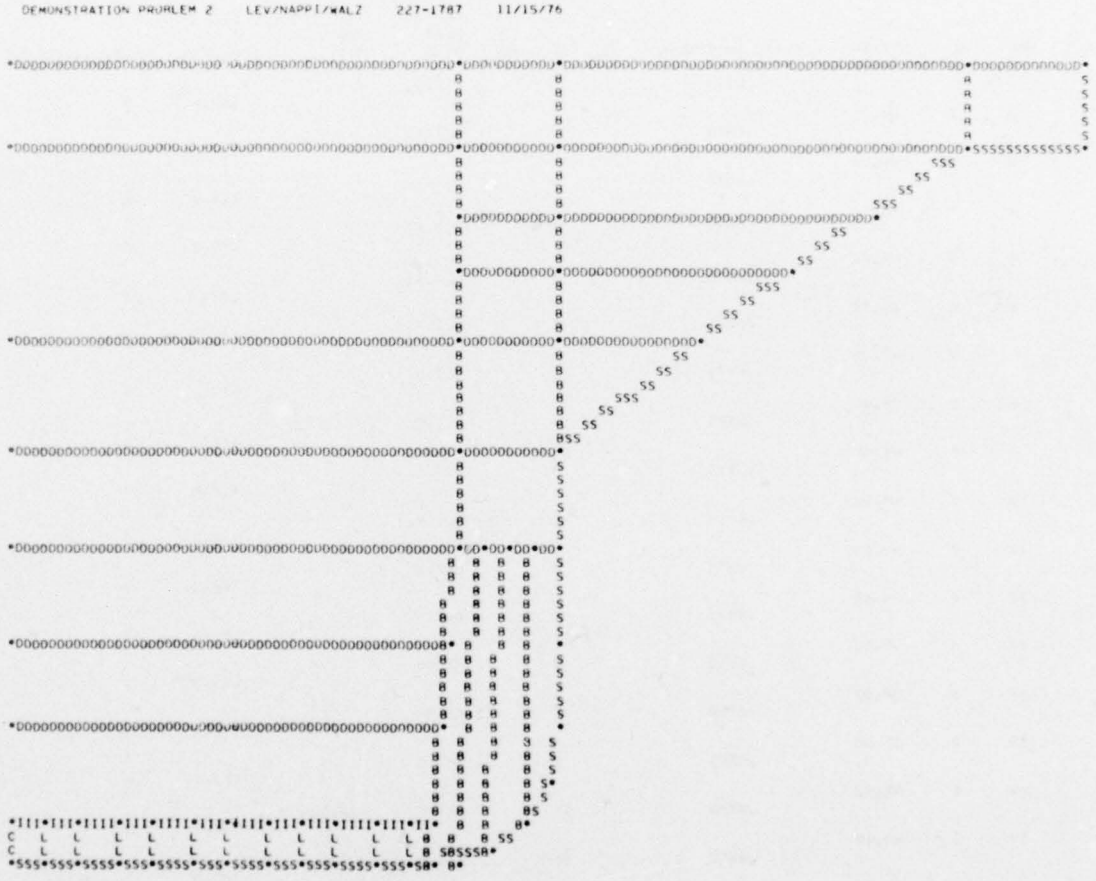
INNER BOTTOM

IB SEG	GEOMETRY Z1/ Z3	Y1/ Y3	Z2/ Z4	Y2/ Y4	LIVE LOAD	VIT NOR OAM HD	TANK OVRFL	TANK TOP HD	MINIMUM CODE ID PL	BM	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	4.000 0.000	0.000 0.000	4.000 0.000	4.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
2	4.000 0.000	4.000 0.000	4.000 0.000	8.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
3	4.000 0.000	8.000 0.000	4.000 0.000	12.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
4	4.000 0.000	12.000 0.000	4.000 0.000	16.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
5	4.000 0.000	16.000 0.000	4.000 0.000	20.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
6	4.000 0.000	20.000 0.000	4.000 0.000	24.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
7	4.000 0.000	24.000 0.000	4.000 0.000	28.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
8	4.000 0.000	28.000 0.000	4.000 0.000	32.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
9	4.000 0.000	32.000 0.000	4.000 0.000	36.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
10	4.000 0.000	36.000 0.000	4.000 0.000	40.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
11	4.000 0.000	40.000 0.000	4.000 0.000	44.000 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	
12	4.000 0.000	44.000 0.000	4.000 0.000	46.420 0.000	1000.00	45.17	56.50	0.00	-15		4.00		2	

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

DOUBLE BOTTOM PLATE LONGITUDINALS

	GEOMETRY				DESIGN CRITERIA						
LONG NO	Z1	Y1	Z2	Y2	WT=1 NWT=0	MIN THK	DMGE HEAD	TANK OVRFL	MATL PL	PL LENGTH	GIRDER PRES
CVK	0.000	0.000	4.000	0.000	1	-14	45.17	56.50	2	4.00	0.00
1	0.000	4.000	4.000	4.000	0	-14	0.00	0.00	2	4.00	0.00
2	0.000	8.000	4.000	8.000	0	-14	0.00	0.00	2	4.00	0.00
3	0.000	12.000	4.000	12.000	0	-14	0.00	0.00	2	4.00	0.00
4	0.000	16.000	4.000	16.000	0	-14	0.00	0.00	2	4.00	0.00
5	0.000	20.000	4.000	20.000	0	-14	0.00	0.00	2	4.00	0.00
6	0.000	24.000	4.000	24.000	0	-14	0.00	0.00	2	4.00	0.00
7	0.000	28.000	4.000	28.000	0	-14	0.00	0.00	2	4.00	0.00
8	0.000	32.000	4.000	32.000	0	-14	0.00	0.00	2	4.00	0.00
9	0.000	36.000	4.000	36.000	0	-14	0.00	0.00	2	4.00	0.00
10	0.000	40.000	4.000	40.000	0	-14	0.00	0.00	2	4.00	0.00
11	0.000	44.000	4.000	44.000	0	-14	0.00	0.00	2	4.00	0.00


DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

DEMONSTRATION PROBLEM 2 LEV/NAPPI/#ALZ 227-1787 11/15/76

MINIMUM #EIGHT DATA FOR HALF SECTION

SHELL SCANTLINGS

SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FR
1	0	48.00	.6875	0	H.T.S.		112.2	0
2	0	48.00	.6875	0	H.T.S.		112.2	0
3	0	48.00	.6875	0	H.T.S.		112.2	0
4	0	48.00	.6875	0	H.T.S.		112.2	0
5	0	48.00	.6875	0	H.T.S.		112.2	0
6	0	48.00	.6875	0	H.T.S.		112.2	0
7	0	48.00	.6875	0	H.T.S.		112.2	0
8	0	48.00	.6875	0	H.T.S.		112.2	0
9	0	48.00	.6875	0	H.T.S.		112.2	0
10	0	48.00	.6875	0	H.T.S.		112.2	0
11	0	48.00	.6875	0	H.T.S.		112.2	0
12	0	24.00	.6875	0	H.T.S.		56.1	0
13	0	38.63	.8750	0	HY100		114.9	0
14	0	38.57	.8750	0	HY100		114.8	0
15	0	61.58	.8750	0	HY100		183.2	0
16	1	65.12	.8750	51	HY100	H.T.S.	412.7	0
17	1	60.00	.8750	51	H.T.S.	H.T.S.	390.6	0
18	1	58.98	.7500	51	H.T.S.	H.T.S.	326.0	0
19	1	68.04	.7500	51	H.T.S.	H.T.S.	363.8	0

20	9	22.87						
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
							246.2	0
21	5	23.55						
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
							148.8	0
22	5	23.57						
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
							148.9	0
23	5	23.55						
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
							148.8	0
24	7	18.38						
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
			.2500	10	H.T.S.	H.T.S.		
							168.0	0
25	6	17.14						
			.5000	10	HY100	H.T.S.		
			.5000	10	HY100	H.T.S.		
			.5000	10	HY100	H.T.S.		
			.5000	10	HY100	H.T.S.		
			.5000	10	HY100	H.T.S.		
			.5000	10	HY100	H.T.S.		
							241.3	0
					TOTAL SHELL WEIGHT		4298.4	

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

DECK SCANTLINGS

REGION 1 DK	SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS	TEE/FB
1	1	15	37.07	.3750	38	H.T.S.	H.T.S.		1	S.31X .4375
2	1	15	37.07	.3750	38	H.T.S.	H.T.S.		1	4.69X .3750
3	1	15	37.07	1.0000	17	H.T.S.	H.T.S.		0	
4	1	15	37.07	.2500	17	H.T.S.	H.T.S.		0	
5	1	15	37.07	.5000	33	H.T.S.	H.T.S.		0	
6	0									
7	0									
8	1	15	37.07	.3750	33	H.T.S.	H.T.S.		3	3.08X .2500
9	1	15	37.07	1.5000	33	HY100	H.T.S.		0	
						REGION 1	WEIGHT	9947.9		

REGION 2 DK	SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS	TEE/FB
1	0									
2	0									
3	2	^	32.52	.7500	0	H.T.S.			0	
3	3	0	32.52	.7500	0	H.T.S.			0	
3	4	0	32.40	.7500	0	H.T.S.			0	
3	5	0	32.52	.7500	0	H.T.S.			0	
4	2	3	32.49	.2500	17	H.T.S.	H.T.S.		0	
5	2	3	32.49	.5000	6	H.T.S.	H.T.S.		0	
6	1	7	16.25	.2500	6	H.T.S.	H.T.S.		0	
7	1	7	16.25	.2500	6	H.T.S.	H.T.S.		0	
8	2	3	32.49	.3750	6	H.T.S.	H.T.S.		0	
9	2	3	32.49	1.5000	33	HY100	H.T.S.		0	
						REGION 2	WEIGHT	1867.0		

REGION 3 DK	SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS	TEE/FB
1	0									
2	0									
3	0									
4	0									
5	3	10	18.10	.2500	6	H.T.S.	H.T.S.		0	
6	2	16	18.10	.2500	6	H.T.S.	H.T.S.		0	
7	2	22	18.10	.2500	6	H.T.S.	H.T.S.		0	
8	3	28	18.10	.2500	6	H.T.S.	H.T.S.		0	
9	3	28	18.10	.7500	6	HY100	H.T.S.		0	
						REGION 3	WEIGHT	3032.8		

REGION 4 DK	SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS	TEE/FB
1	0									
2	0									
3	0									
4	0									
5	0									
6	0									
7	0									
8	0									
9	4	7	18.38	.7500	6	HY100	H.T.S.		0	
						REGION 4	WEIGHT	408.2		
						TOTAL DECK WEIGHT		15255.9		

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

BULKHEAD SCANTLINGS

BULKHEAD 1

SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FR
1	0	48.26						
			.6875	0	H.T.S.			
							112.8	0
2	0	120.34						
			1.2500	0	H.T.S.			
							511.4	0
3	0	120.34						
			1.2500	0	H.T.S.			
							511.4	0
4	0	119.33						
			1.0000	0	H.T.S.			
							405.7	0
5	2	45.36						
			.5000	6	H.T.S.	H.T.S.		
			.5000	6	H.T.S.	H.T.S.		
							239.8	0
6	2	45.32						
			.5000	6	H.T.S.	H.T.S.		
			.5000	6	H.T.S.	H.T.S.		
							239.6	0
7	1	42.00						
			.5000	6	H.T.S.	H.T.S.		
							147.1	0
8	1	42.00						
			.5000	6	H.T.S.	H.T.S.		
							147.1	0
9	1	42.00						
			.5000	6	H.T.S.	H.T.S.		
							147.1	0
10	2	40.00						
			.5000	6	HY100	H.T.S.		
			.5000	6	HY100	H.T.S.		
							212.5	0

					BULKHEAD 1	WEIGHT	2674.5	

BULKHEAD 2

SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FR
1	1	67.98						
			.7500	17	H.T.S.	H.T.S.		
							354.1	0
2	1	42.00						
			.5000	6	H.T.S.	H.T.S.		
							147.1	0
3	1	42.00						
			.5000	6	H.T.S.	H.T.S.		
							147.1	0
4	1	42.00						
			.5000	6	H.T.S.	H.T.S.		
							147.1	0
5	2	40.00						
			.5000	6	HY100	H.T.S.		
			.5000	6	HY100	H.T.S.		
							212.5	0

					BULKHEAD 2	WEIGHT	1007.8	

BULKHEAD 3 SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	6	17.14						
			.5000	6	HY100	M.T.S.		
			.5000	6	HY100	M.T.S.		
			.5000	6	HY100	M.T.S.		
			.5000	6	HY100	M.T.S.		
			.5000	6	HY100	M.T.S.		
			.5000	6	HY100	M.T.S.		
							229.5	0
						BULKHEAD 3 WEIGHT	229.5	

BULKHEAD 4 SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	16	23.72						
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
							1439.2	0
2	7	49.04						
			1.2500	17	HY100	M.T.S.		
			1.2500	17	HY100	M.T.S.		
			1.2500	17	HY100	M.T.S.		
			1.2500	17	HY100	M.T.S.		
			1.2500	17	HY100	M.T.S.		
			1.2500	17	HY100	M.T.S.		
			1.2500	17	HY100	M.T.S.		
							1721.3	0
3	14	23.86						
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
			1.0000	6	HY100	M.T.S.		
							1277.2	0
						BULKHEAD 4 WEIGHT	4437.7	
						TOTAL BULKHEAD WEIGHT	8349.5	

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

PRELIMINARY INNER BOTTOM SCANTLINGS

SEG	NL	SPACING	PLATE THICKNESS	TEE (IU CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FR
1	0	48.00	.7500	0	H.T.S.		122.4	0
2	0	48.00	.7500	0	H.T.S.		122.4	0
3	0	48.00	.7500	0	H.T.S.		122.4	0
4	0	48.00	.7500	0	H.T.S.		122.4	0
5	0	48.00	.7500	0	H.T.S.		122.4	0
6	0	48.00	.7500	0	H.T.S.		122.4	0
7	0	48.00	.7500	0	H.T.S.		122.4	0
8	0	48.00	.7500	0	H.T.S.		122.4	0
9	0	48.00	.7500	0	H.T.S.		122.4	0
10	0	48.00	.7500	0	H.T.S.		122.4	0
11	0	48.00	.7500	0	H.T.S.		122.4	0
12	0	29.04	.7500	0	H.T.S.		74.1	0

						TOTAL INNER BOTTOM WEIGHT	1420.5	

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

MINIMUM WEIGHT DATA FOR HALF SECTION

PRELIMINARY DOUBLE BOTTOM PLATE LONGITUDINAL SCANTLINGS

LONG. NUMBER	PLATE THICKNESS	PLATE MATL	LBS./FT.
CVK	.6875	H.T.S.	56.1
1	.6875	H.T.S.	112.2
2	.6875	H.T.S.	112.2
3	.6875	H.T.S.	112.2
4	.6875	H.T.S.	112.2
5	.6875	H.T.S.	112.2
6	.6875	H.T.S.	112.2
7	.6875	H.T.S.	112.2
8	.6875	H.T.S.	112.2
9	.6875	H.T.S.	112.2
10	.6875	H.T.S.	112.2
11	.6875	H.T.S.	112.2

	TOTAL DOUBLE BOTTOM PLATE LONGITUDINAL WEIGHT		1290.3

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

MIDSHIP SECTION PROPERTIES

TOTAL EFFECTIVE AREA	=	2000.1	SQ.IN.
MOMENT OF INERTIA ABT. NEUTRAL AXIS	=	643390.	SQ.IN.FT.-SQ.
DISTANCE FROM N.A. TO DECK FIBER	=	20.40	FEET
DISTANCE FROM N.A. TO KEEL FIBER	=	38.85	FEET
SECTION MODULUS AT DECK FIBER	=	31540.	SQ.IN.-FT.
SECTION MODULUS AT KEEL FIBER	=	16561.	SQ.IN.-FT.
TOTAL NORMALIZED LONGITUDINAL WEIGHT	=	7065.7	LBS./FT.

CALCULATED STRESSES

STRESS AT DECK-HOG	=	-693.39 PSI
STRESS AT KEEL-HOG	=	1320.55 PSI
STRESS AT DECK-SAG	=	478.47 PSI
STRESS AT KEEL-SAG	=	-911.25 PSI

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

••• •••
CONSISTENT DESIGN

	ASSUMED INPUT(PSI)	CALCULATED OUTPUT(PSI)
STRESS AT DECK-HOG	-16440.00	-16456.20
STRESS AT KEEL-HOG	12800.00	12796.89
STRESS AT DECK-SAG	4110.00	4114.05
STRESS AT KEEL-SAG	-3200.00	-3199.22

FOR SCANTLING SUMMARY, REFER TO CYCLE NO. 1

SECTION ACCEPTABLE
DESIGN PRIMARY STRESS LESS THAN LIMITING DESIGN PRIMARY STRESS

... DETAIL DESIGN PRINT-OUT OF ACCEPTABLE SECTION FOLLOWS ...
(HEIGHTS TO LONGITUDINALS ARE RELATIVE TO KEEL LINE)

SHELL SEGMENT NO. 1 GIRTH = 4.00 FT.

PROPELLER IMMERSED SECTION
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED EXCLUDING DOUBLE
BOTTOM GIRDER STRESSES.

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX B/T NOR LD	ACT B/T	LBS./FT.	LCOND	* FACTORS OF SAFETY * BUCK	ULT
0.00	49.71	13920.0		.6875	114.7			1		
	57.03	0.0		.6875	107.0			2		
	4.53	13920.0		.6875	380.0			3		
	PLATE SELECTED			.6875		69.8	112.2		1.577	1.701

SHELL SEGMENT NO.16 GIRTH = 10.85 FT.

MINIMUM THICKNESS SPECIFIED FOR THIS SEGMENT BECAUSE
OF RUGGEDNESS REQUIREMENT.
LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LATERAL SUPPORTS FOR THE LONGITUDINALS ARE PROVIDED
IF REQUIRED. THE FACTOR OF SAFETY FOR ILS REVEALS
THE CONDITION PRIOR TO PLACEMENT OF THE LATERAL SUPPORTS.

I LONGITUDINALS(SPACING = 65.12 IN.)

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	•••••••••••••• FACTORS OF SAFETY •••••••••••••• BUCK	ULT	BEND/ COMP	TENS	SHEAR	ILS	DEFL
8.70	53.99	13193.2		.8750	114.6			1							
	53.17	0.0		.8750	115.5			2							
	30.50	13193.2		.8750	152.5			3							
	53.99	13193.2	-4785.8	.8750		51		1	1.266	2.377	.776	1.257	1.042	1.126	0.000
	53.11	0.0	0.0	.8750		51		2	9.504	17.841	1.103	1.103	1.060	1.126	0.000
	30.44	13193.2	-4785.8	.8750		51		3	1.346	2.526	1.129	2.540	1.849	1.126	0.000
	PLATE-TEE SELECTED			.8750		51	412.7		ACTUAL B/T (NORMAL LOADS)= 74.4						

SHELL SEGMENT NO.16 WEIGHT DATA

SPACING(IN.)	LBS./FT.
65.12	412.7

SHELL SEGMENT NO.21 GIRTH = 11.78 FT.

LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LATERAL SUPPORTS FOR THE LONGITUDINALS ARE PROVIDED
IF REQUIRED. THE FACTOR OF SAFETY FOR ILS REVEALS
THE CONDITION PRIOR TO PLACEMENT OF THE LATERAL SUPPORTS.

S LONGITUDINALS(SPACING = 23.55 IN.)

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	•••••••••••••• FACTORS OF SAFETY •••••••••••••• BUCK	ULT	BEND/ COMP	TENS	SHEAR	ILS	DEFL
57.67	18.02	6279.1		.2500	94.2			1							
	15.62	6279.1		.2500	101.2			4							
	18.02	6279.1	-12235.7	.2500		10		1	1.046	1.494	1.077	1.446	2.355	1.230	0.000
	15.62	6279.1	-12235.7	.2500		10		4	.981	1.401	.998	1.341	2.396	1.230	0.000
	PLATE-TEE SELECTED			.2500		10	35.8		ACTUAL B/T (NORMAL LOADS)= 94.2						
58.83	17.58	6238.1		.2500	95.4			1							
	15.62	6238.1		.2500	101.2			4							
	17.58	6238.1	-12443.9	.2500		10		1	1.061	1.516	1.100	1.453	2.414	1.230	0.000
	15.62	6238.1	-12443.9	.2500		10		4	.984	1.405	.999	1.332	2.396	1.230	0.000
	PLATE-TEE SELECTED			.2500		10	25.8		ACTUAL B/T (NORMAL LOADS)= 94.2						
60.00	17.36	6197.0		.2500	96.0			1							
	15.62	6197.0		.2500	101.2			4							
	17.36	6197.0	-12652.1	.2500		10		1	1.071	1.530	1.112	1.451	2.445	1.230	0.000
	15.62	6197.0	-12652.1	.2500		10		4	.987	1.410	1.001	1.322	2.396	1.230	0.000
	PLATE-TEE SELECTED			.2500		10	25.8		ACTUAL B/T (NORMAL LOADS)= 94.2						
61.17	17.13	6156.0		.2500	96.6			1							
	15.62	6156.0		.2500	101.2			4							
	17.13	6156.0	-12860.3	.2500		10		1	1.081	1.545	1.125	1.449	2.477	1.230	0.000
	15.62	6156.0	-12860.3	.2500		10		4	.991	1.415	1.002	1.312	2.396	1.230	0.000
	PLATE-TEE SELECTED			.2500		10	25.8		ACTUAL B/T (NORMAL LOADS)= 94.2						
62.33	16.91	6074.0		.2500	97.3			1							
	15.62	6074.0		.2500	101.2			4							
	16.91	6074.0	-13276.8	.2500		10		1	1.096	1.565	1.140	1.436	2.509	1.230	0.000
	15.62	6074.0	-13276.8	.2500		10		4	.997	1.424	1.004	1.294	2.396	1.230	0.000
	PLATE-TEE SELECTED			.2500		10	35.8		ACTUAL B/T (NORMAL LOADS)= 94.2						

SHELL SEGMENT NO.21 WEIGHT DATA

SPACING(IN.)	LBS./FT.
23.55	148.8

REGION NO. 1 DECK NO. 1 SEGMENT NO. 1

GIRTH = 47.17 FT.

TYPE OF SPACE IDENTIFIER = 1
THIS DECK WAS SPECIFIED AS A PLATFORM AND IS NOT
DESIGNED FOR PRIMARY STRESSES.
LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LATERAL SUPPORTS FOR THE LONGITUDINALS ARE PROVIDED
IF REQUIRED. THE FACTOR OF SAFETY FOR ILS REVEALS
THE CONDITION PRIOR TO PLACEMENT OF THE LATERAL SUPPORTS.

LONGITUDINAL SPACING = 37.07 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	FACTORS OF SAFETY BUCK	ULT	BEND/ COMP	TENS	SHEAR	ILS	DEFL
1.86	0.0		.3750	293.1			1							
31.46	0.0		.3750	142.6			4							
1.86	0.0	0.0	.3750		38		1	6.787	9.337	5.634	5.634	13.424	.813	0.000
31.47	0.0	0.0	.3750		38		4	.497	.684	.357	.357	.798	.813	0.000
PLATE-TEE SELECTED			.3750		38			ACTUAL B/T (NORMAL LOADS)= 98.8						

REGION NO. 1 DECK NO. 1 WEIGHT DATA

SPACING(IN.)	LBS./FT.
37.07	905.1

REGION NO. 1 DECK NO. 9 SEGMENT NO. 1

GIRTH = 49.42 FT.

TYPE OF SPACE IDENTIFIER = 4
MINIMUM THICKNESS SPECIFIED FOR THIS SEGMENT BECAUSE
IT IS HELICOPTER/AIRCRAFT HANDLING AREA.
LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LATERAL SUPPORTS FOR THE LONGITUDINALS ARE PROVIDED
IF REQUIRED. THE FACTOR OF SAFETY FOR ILS REVEALS
THE CONDITION PRIOR TO PLACEMENT OF THE LATERAL SUPPORTS.

LONGITUDINAL SPACING = 37.07 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	FACTORS OF SAFETY BUCK	ULT	BEND/ COMP	TENS	SHEAR	ILS	DEFL
4.99	5230.0		1.5000	246.3			1							
5.70	5230.0	-17560.0	1.5000		33		1	16.178	10.154	2.719	1.780	9.085	1.504	0.000
PLATE-TEE SELECTED			1.5000		33			ACTUAL B/T (NORMAL LOADS)= 24.7						

REGION NO. 1 DECK NO. 9 WEIGHT DATA

SPACING(IN.)	LBS./FT.
37.07	3195.3

REGION NO. 3 DECK NO. 8 SEGMENT NO. 3

GIRTH = 43.75 FT.

TYPE OF SPACE IDENTIFIER = 1
LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LATERAL SUPPORTS FOR THE LONGITUDINALS ARE PROVIDED
IF REQUIRED. THE FACTOR OF SAFETY FOR ILS REVEALS
THE CONDITION PRIOR TO PLACEMENT OF THE LATERAL SUPPORTS.

LONGITUDINAL SPACING = 18.10 IN.

PRI DESIGN STRESS HEAD	COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	FACTORS OF SAFETY BUCK	ULT	BEND/ COMP	TENS	SHEAR	ILS	DEFL
1.86	4166.9		.2500	293.1			1							
.19	0.0		.2500	*****			4							
1.77	4166.9	-13990.6	.2500		6		1	3.760	2.968	2.983	2.146	16.122	1.511	0.000
.20	0.0	0.0	.2500		6		4	******	******	78.107	10.217	******	1.511	0.000
PLATE-TEE SELECTED			.2500		6			ACTUAL B/T (NORMAL LOADS)= 72.4						

REGION NO. 3 DECK NO. 8 WEIGHT DATA

SPACING(IN.)	LBS./FT.
18.10	565.3

BULKHEAD NO. 1 SEGMENT NO. 2 GIRTH = 10.03 FT.

TYPE OF SPACE IDENTIFIER = 2

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX B/T NOR LD	ACT B/T	LBS./FT.	LCOND	* FACTORS OF SAFETY * BUCK	ULT
9.00	24.98	10649.3		1.2500	141.5			1		
	47.98	0.0		1.2500	102.1			3		
	36.65	0.0		1.2500	148.3			4		
	PLATE SELECTED			1.2500		76.8	511.4		.912	15.024

BULKHEAD NO. 2 SEGMENT NO. 5 GIRTH = 10.00 FT.

TYPE OF SPACE IDENTIFIER = 1
LONGITUDINALS ARE DESIGNED WITHOUT END BRACKETS.
LATERAL SUPPORTS FOR THE LONGITUDINALS ARE PROVIDED
IF REQUIRED. THE FACTOR OF SAFETY FOR ILS REVEALS
THE CONDITION PRIOR TO PLACEMENT OF THE LATERAL SUPPORTS.

2 LONGITUDINALS(SPACING = 40.00 IN.)

HEIGHT	HEAD	PRI DESIGN STRESS COMP	TENS	THI	MAX B/T NOR LD	TEE ID	LBS./FT.	LCOND	•••••••••••• FACTORS OF SAFETY •••••••••••• BUCK	ULT	BEND/ COMP	TENS	SHEAR	ILS	DEFL
80.83	.15	4521.3		.5000				2							
	.19	0.0		.5000	*****			4							
	.17	4521.3	-15180.4	.5000		6		2	3.646	3.161	2.675	2.439	91.779	1.511	0.000
	.17	0.0	0.0	.5000		6		4	******	******	47.209	47.209	91.779	1.511	0.000
	PLATE-TEE SELECTED			.5000		6	106.3		ACTUAL B/T (NORMAL LOADS)= 80.0						
84.17	.15	5230.0		.5000				2							
	.19	0.0		.5000	*****			4							
	.17	5230.0	-17560.0	.5000		6		2	3.158	2.738	2.331	2.116	91.779	1.511	0.000
	.17	0.0	0.0	.5000		6		4	******	******	47.209	47.209	91.779	1.511	0.000
	PLATE-TEE SELECTED			.5000		6	106.3		ACTUAL B/T (NORMAL LOADS)= 80.0						

BULKHEAD NO. 2 SEGMENT NO. 5 WEIGHT DATA

SPACING(IN.)	LBS./FT.
40.00	212.5

INNER BOTTOM SEGMENT NO. 1 GIRTH = 4.00 FT.

P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED EXCLUDING DOUBLE
BOTTOM GIRDER STRESSES.

		PRI DESIGN STRESS			MAX B/T	ACT			* FACTORS OF SAFETY *	
HEIGHT	HEAD	COMP	TENS	THI	NOR LD	B/T	LBS./FT.	LCOND	BUCK	ULT
4.00	15.93	13193.2		.7500	128.6			1		
	53.07	0.0		.7500	111.0			3		
	41.74	0.0		.7500	158.9			4		
	45.71	0.0		.7500	119.6			5		
	PLATE SELECTED			.7500		64.0	122.4		1.980	1.913

INNER BOTTOM SEGMENT NO. 2 GIRTH = 4.00 FT.

P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED EXCLUDING DOUBLE
BOTTOM GIRDER STRESSES.

		PRI DESIGN STRESS			MAX B/T	ACT			* FACTORS OF SAFETY *	
HEIGHT	HEAD	COMP	TENS	THI	NOR LD	B/T	LBS./FT.	LCOND	BUCK	ULT
4.00	15.93	13193.2		.7500	128.6			1		
	53.07	0.0		.7500	111.0			3		
	41.74	0.0		.7500	158.9			4		
	45.71	0.0		.7500	119.6			5		
	PLATE SELECTED			.7500		64.0	122.4		1.980	1.913

CENTER VERTICAL KEEL PLATE .... WATERTIGHT

P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED EXCLUDING DOUBLE
BOTTOM GIRDER STRESSES.

		PRI DESIGN STRESS			MAX B/T	ACT			* FACTORS OF SAFETY *	
HEIGHT	HEAD	COMP	TENS	THI	NOR LD	B/T	LBS./FT.	LCOND	BUCK	ULT
2.00	.15	13556.6		.6875	*****			1		
	54.72	0.0		.6875	109.3			2		
	43.39	0.0		.6875	155.8			3		
	47.71	0.0		.6875	117.0			4		
	PLATE SELECTED			.6875		69.8	112.2		1.619	1.747

DOUBLE BOTTOM PLATE LONGITUDINAL NO.11 .... NONWATERTIGHT

P•R•E•L•I•M•I•N•A•R•Y S•C•A•N•T•L•I•N•G•S
THIS SEGMENT IS PART OF THE DOUBLE BOTTOM STRUCTURE.
FACTORS OF SAFETY ARE COMPUTED EXCLUDING DOUBLE
BOTTOM GIRDER STRESSES.

		PRI DESIGN STRESS			MAX B/T	ACT			* FACTORS OF SAFETY *	
HEIGHT	HEAD	COMP	TENS	THI	NOR LD	B/T	LBS./FT.	LCOND	BUCK	ULT
2.00	.15	13556.6		.6875	*****			1		
	PLATE SELECTED			.6875		69.8	112.2		1.619	1.747

..... END OF DETAIL DESIGN PRINT-OUT .....

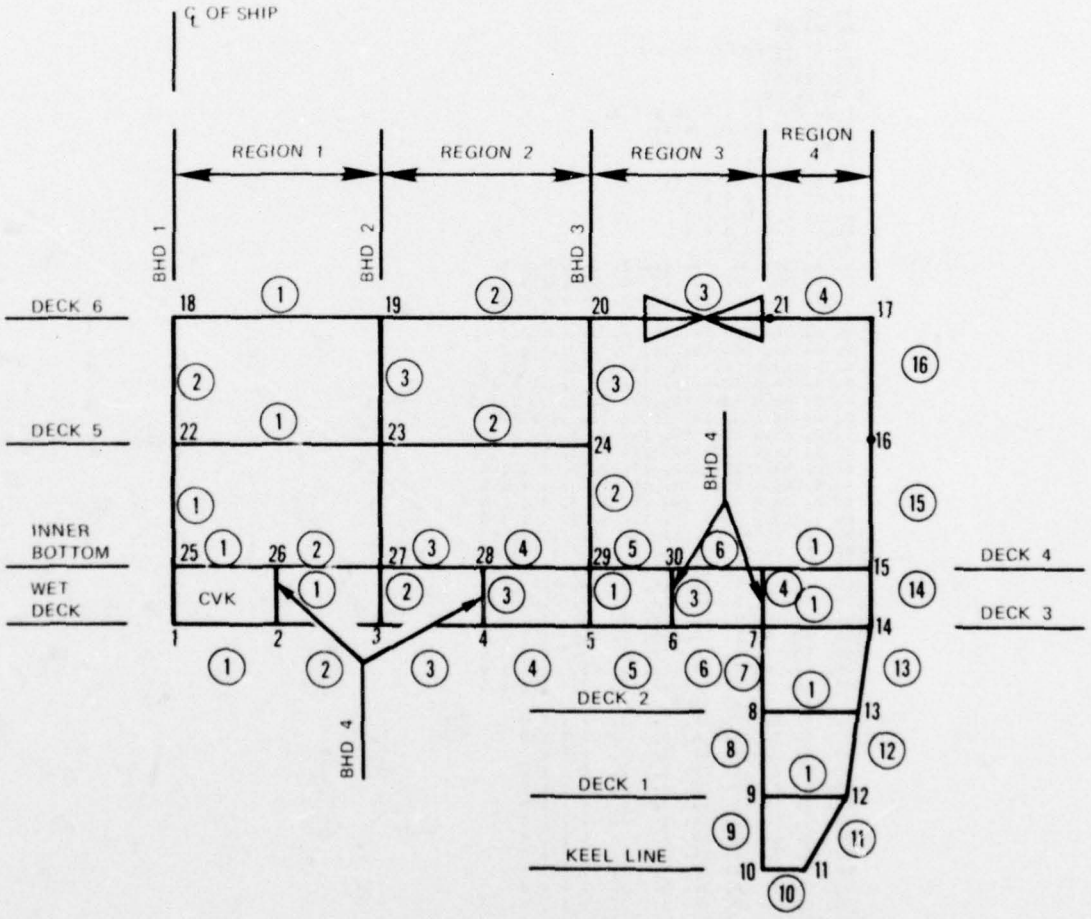


Figure 5 — Demonstration Problem 3

SECTION 8. DEMONSTRATION PROBLEMS

INPUT DATA LISTING: DEMONSTRATION PROBLEM 3

```
1 1
 DEMONSTRATION PROBLEM 3     LEV/NAPPI/WALZ      227-1787     01-17-77
 240. 40. 50.  18. 3. 3. 36. 10.  0. 500. .55
 31 16 6 4 4 9 11 0 1 0 11 1 0 1 0 0 6 0 0 24. 3. 3. 0
 0. 500. .25 .5 0 0
143000. 91000. 16000. -10500. -16000. 10500. 17000.  17000.
 18. 0. 18. 7.33 18. 14.67 18. 22. 18. 29.33
 18. 35.9 18. 42.5 11.5 42.5 5. 42.5 0. 42.5
 0. 45. 5. 47.5 11.5 48.75 18. 50. 22. 50.
 31. 50. 40. 50. 40. 0. 40. 14.67 40. 29.33
 40. 42.5 31. 0. 31. 14.67 31. 29.33 22. 0.
 22. 7.33 22. 14.67 22. 22. 22. 29.33 22. 35.9
 22. 42.5
 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17
 9 12
 8 13
 7 14
 31 15
 22 23 24
 18 19 20 21 17
 25 22 18
3 27 23 19
5 29 24 20
 2 26 0 4 28 0 6 30 0 7 31
 25 26 27 28 29 30 31
 1 25
 0 0 1 1 1 1
 3. 4.5 4.5 2. 7. 7.
 14.67 0 0 0 0 1 1
 14.66 0 0 0 0 1 1
 13.17 0 0 0 0 0 1
 7.5 1 1 1 1 0 1
 0. 0. 38. 38. 10. 10. 3. 3. 1 1 2 0
 0. 0. 38. 38. 10. 10. 3. 3. 1 1 2 0
 0. 0. 38. 38. 10. 10. 3. 3. 1 1 2 0
 0. 0. 38. 38. 10. 10. 3. 3. 1 1 2 0
 0. 0. 38. 38. 10. 10. 3. 3. 1 1 2 0
 0. 0. 38. 38. 10. 10. 3. 3. 1 1 2 0
 0. 0. 13.4 13.4 10. 10. 3. 3. 7 1 1 0
 0. 0. 13.4 13.4 10. 10. 3. 3. 11 1 1 0
 0. 0. 13.4 13.4 10. 10. 3. 3. 13 1 1 0
 0. 0. 60. 60. 10. 10. 3. 3. 15 1 1 0
 0. 0. 13.4 13.4 10. 10. 3. 3. 13 1 1 0
 0. 0. 13.4 13.4 10. 10. 3. 3. 11 1 1 0
 0. 0. 13.4 13.4 10. 10. 3. 3. 7 1 1 0
 0. 0. 13.4 13.4 10. 10. 3. 3. 1 1 1 0
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 0. 0. 13.4 13.4 10. 10. 3. 3. 1 1 1 0
100. 0. 0. 0. 10. 10. 3.  3.  1 1 1 0
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200. 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
100. 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
100. 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
100. 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
100. 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
100. 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
100. 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 6 3 2 1 33.25 42.5
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
 40. 0. 0. 10. 10. 3.  3.  1 1 1 0
500.0  40.0  0.0  0.0  3.0  3.0      1  1  0
500.0  40.0  0.0  0.0  3.0  3.0      1  1  0
500.0  40.0  0.0  0.0  3.0  3.0      1  1  0
500.0  40.0  0.0  0.0  3.0  3.0      1  1  0
200.0  40.0  0.0  0.0  3.0  3.0      1  1  0
200.0  40.0  0.0  0.0  3.0  3.0      1  1  0
1 1 3. 0. 40. 0.
```

DEMONSTRATION PROBLEM 3 LEV/NAPPI/WALZ 227-1787 01-17-77

PRINCIPAL HULL DIMENSIONS

LENGTH BETWEEN PERPENDICULARS	=	240.00 FT.
MAXIMUM HALF BREADTH	=	50.00 FT.
DEPTH OF HULL	=	40.00 FT.
DESIGN FULL LOAD DRAFT	=	18.00 FT.
LENGTH BETWEEN TRANSVERSE BULKHEADS	=	36.00 FT.
NUMBER OF SHELL SEGMENTS	=	16
NUMBER OF DECKS	=	6
NUMBER OF BULKHEADS	=	4
NUMBER OF DOUBLE BOTTOM PLATE LONGITUDINALS	=	0
NUMBER OF INNER BOTTOM SEGMENTS	=	6

DESIGN CRITERIA

MATERIAL THROUGHOUT FOR PLATING	=	5456-H321
MATERIAL THROUGHOUT FOR STIFFENERS	=	5456-H111
MINIMUM PRESSURE FOR SHELL	=	500.00 PSF
MARGIN STRESS ADDED TO PRIMARY STRESS	=	0.00 PSI
PRIMARY STRESS TOLERANCE (+ OR -)	=	500.00 PSI
DESIGN LIMITING PRI. STRESS, DECK FIBER	=	17000.00 PSI
DESIGN LIMITING PRI. STRESS, KEEL FIBER	=	17000.00 PSI
PRIMARY STRESS FACTOR	=	.5000
STRAKE TOLERENCE	=	.2500 IN.
BENDING MOMENT HOG CONDITION	=	91000.00 FT-TONS
BENDING MOMENT SAG CONDITION	=	143000.00 FT-TONS
ANGLE OF HEEL	=	10.00 DEGREES
SHELL DESIGN HEAD	=	0.00 FT.
WAVE HEIGHT COEFFICENT	=	.550

NO SHORT SPANS (EQUAL SPANS)

SHELL SEGMENTS FOR AREA ADDITION IF REQUIRED
FROM SEG 9 TO SEG 11
SHIP NOT DESIGNED FOR NUCLEAR BLAST.
SHIP DESIGNED WITH INNER BOTTOM
SCANTLINGS FOR THE DOUBLE BOTTOM STRUCTURE
ARE TO BE CONSIDERED PRELIMINARY
NO GIRDER ANALYSIS REQUESTED
MAXIMUM DEPTH OF I.B. STRINGER = 24.00 IN.

ASSUMED STRESSES

PRIMARY STRESS AT DECK-HOG	=	-10500.00 PSI
PRIMARY STRESS AT KEEL-HOG	=	10500.00 PSI
PRIMARY STRESS AT DECK-SAG	=	16000.00 PSI
PRIMARY STRESS AT KEEL-SAG	=	-16000.00 PSI

DEMONSTRATION PROBLEM 3 LEV/NAPPI/WALZ 227-1787 01-17-77

SHELL

SHL SEG	GEOMETRY Z1/ Z3	Y1/ Y3	Z2/ Z4	Y2/ Y4	TANK OVRFL	TANK TOP HD	SLAMMING CRITERIA PRES PL	PRES BM	COMB PRI	DEFOR IND	MINIMUM CODE PL	MINIMUM CODE BM	DESIGN PANEL WIDTH MIN	DESIGN PANEL WIDTH MAX	DESIGN LENGTH FOR PL	DESIGN LENGTH FOR BM	MATERIAL IND PL	MATERIAL IND BM
1	18.000 0.000	0.000 0.000	18.000 0.000	7.330 0.000	0.00	0.00	38.00	38.00	0	2	1	1	10.00	10.00	3.00	3.00	7	8
2	18.000 0.000	7.330 0.000	18.000 0.000	14.670 0.000	0.00	0.00	38.00	38.00	0	2	1	1	10.00	10.00	3.00	3.00	7	8
3	18.000 0.000	14.670 0.000	18.000 0.000	22.000 0.000	0.00	0.00	38.00	38.00	0	2	1	1	10.00	10.00	3.00	3.00	7	8
4	18.000 0.000	22.000 0.000	18.000 0.000	29.330 0.000	0.00	0.00	38.00	38.00	0	2	1	1	10.00	10.00	3.00	3.00	7	8
5	18.000 0.000	29.330 0.000	18.000 0.000	35.900 0.000	0.00	0.00	38.00	38.00	0	2	1	1	10.00	10.00	3.00	3.00	7	8
6	18.000 0.000	35.900 0.000	18.000 0.000	42.500 0.000	0.00	0.00	38.00	38.00	0	2	1	1	10.00	10.00	3.00	3.00	7	8
7	18.000 0.000	42.500 0.000	11.500 0.000	42.500 0.000	0.00	0.00	13.40	13.40	0	1	7	1	10.00	10.00	3.00	3.00	7	8
8	11.500 0.000	42.500 0.000	5.000 0.000	42.500 0.000	0.00	0.00	13.40	13.40	0	1	11	1	10.00	10.00	3.00	3.00	7	8
9	5.000 0.000	42.500 0.000	0.000 0.000	42.500 0.000	0.00	0.00	13.40	13.40	0	1	13	1	10.00	10.00	3.00	3.00	7	8
10	0.000 0.000	42.500 0.000	0.000 0.000	45.000 0.000	0.00	0.00	60.00	60.00	0	1	15	1	10.00	10.00	3.00	3.00	7	8
11	0.000 0.000	45.000 0.000	5.000 0.000	47.500 0.000	0.00	0.00	13.40	13.40	0	1	13	1	10.00	10.00	3.00	3.00	7	8
12	5.000 0.000	47.500 0.000	11.500 0.000	48.750 0.000	0.00	0.00	13.40	13.40	0	1	11	1	10.00	10.00	3.00	3.00	7	8
13	11.500 0.000	48.750 0.000	18.000 0.000	50.000 0.000	0.00	0.00	13.40	13.40	0	1	9	1	10.00	10.00	3.00	3.00	7	8
14	18.000 0.000	50.000 0.000	22.000 0.000	50.000 0.000	0.00	0.00	13.40	13.40	0	1	1	1	10.00	10.00	3.00	3.00	7	8
15	22.000 0.000	50.000 0.000	31.000 0.000	50.000 0.000	0.00	0.00	13.40	13.40	0	1	1	1	10.00	10.00	3.00	3.00	7	8
16	31.000 0.000	50.000 0.000	40.000 0.000	50.000 0.000	0.00	0.00	13.40	13.40	0	1	1	1	10.00	10.00	3.00	3.00	7	8

** NO REMOVALS IN SHELL SPECIFIED **

DEMONSTRATION PROBLEM 3 LEV/NAPPI/WALZ 227-1787 01-17-77

D E C K

REGION 1 WIDTH= 14.67 FT.

DK	SEG	GEOMETRY Z1	Y1	Z2	Y2	LIVE LOAD	VITNOR DAM WD	TANK OVRFL	TANK TOP WD	SPAC IND	MINIMUM CODE PL	ID BM	BEL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	0																			
2	0																			
3	0																			
4	0																			
5	1	31.00	0.00	31.00	14.67	100.00	40.00	0.00	0.00	1	1	1	7.00	1	10.00	10.00	3.00	3.00	7	8
6	1	40.00	0.00	40.00	14.67	100.00	40.00	0.00	0.00	1	1	1	7.00	1	10.00	10.00	3.00	3.00	7	8

REGION 2 WIDTH= 14.66 FT.

DK	SEG	GEOMETRY Z1	Y1	Z2	Y2	LIVE LOAD	VITNOR DAM WD	TANK OVRFL	TANK TOP WD	SPAC IND	MINIMUM CODE PL	ID BM	BEL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	0																			
2	0																			
3	0																			
4	0																			
5	2	31.00	14.67	31.00	29.33	100.00	40.00	0.00	0.00	1	1	1	7.00	1	10.00	10.00	3.00	3.00	7	8
6	2	40.00	14.67	40.00	29.33	100.00	40.00	0.00	0.00	1	1	1	7.00	1	10.00	10.00	3.00	3.00	7	8

REGION 3 WIDTH= 13.17 FT.

DK	SEG	GEOMETRY Z1	Y1	Z2	Y2	LIVE LOAD	VITNOR DAM WD	TANK OVRFL	TANK TOP WD	SPAC IND	MINIMUM CODE PL	ID BM	BEL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	0																			
2	0																			
3	0																			
4	0																			
5	0																			
6	3	40.00	29.33	40.00	42.50	100.00	40.00	0.00	0.00	1	1	1	7.00	1	10.00	10.00	3.00	3.00	7	8

REGION 4 WIDTH= 7.50 FT.

DK	SEG	GEOMETRY Z1	Y1	Z2	Y2	LIVE LOAD	VITNOR DAM WD	TANK OVRFL	TANK TOP WD	SPAC IND	MINIMUM CODE PL	ID BM	BEL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	1	5.00	42.50	5.00	47.50	100.00	0.00	0.00	0.00	1	1	1	3.00	0	10.00	10.00	3.00	3.00	7	8
2	1	11.50	42.50	11.50	48.75	100.00	0.00	0.00	0.00	1	1	1	4.50	0	10.00	10.00	3.00	3.00	7	8
3	1	18.00	42.50	18.00	50.00	100.00	40.00	0.00	0.00	1	1	1	4.50	1	10.00	10.00	3.00	3.00	7	8
4	1	22.00	42.50	22.00	50.00	200.00	40.00	0.00	0.00	1	1	1	2.00	1	10.00	10.00	3.00	3.00	7	8
5	0																			
6	4	40.00	42.50	40.00	50.00	100.00	40.00	0.00	0.00	1	1	1	7.00	1	10.00	10.00	3.00	3.00	7	8

REMOVALS

DK	SEG	TYPE	SYM	YI	YO
6	3	2	1	33.250	42.500

DEMONSTRATION PROBLEM 3 LEV/NAPPI/WALZ 227-1787 01-17-77

BULKHEAD

BHD	SEG	GEOMETRY Z1	Y1	Z2	Y2	VITNOR DAM MD	TANK OVRFL	TANK TOP MD	SPAC IND	MINIMUM CODE ID PL	BM	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	1	22.00	0.00	31.00	0.00	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
1	2	31.00	0.00	40.00	0.00	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
2	1	18.00	14.67	22.00	14.67	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
2	2	22.00	14.67	31.00	14.67	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
2	3	31.00	14.67	40.00	14.67	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
3	1	18.00	29.33	22.00	29.33	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
3	2	22.00	29.33	31.00	29.33	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
3	3	31.00	29.33	40.00	29.33	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
4	1	18.00	7.33	22.00	7.33	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
4	2	18.00	22.00	22.00	22.00	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
4	3	18.00	35.90	22.00	35.90	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8
4	4	18.00	42.50	22.00	42.50	40.00	0.00	0.00	1	1	1	10.00	10.00	3.00	3.00	7	8

** NO REMOVALS IN BULKHEADS SPECIFIED **

DEMONSTRATION PROBLEM 3 LEV/NAPPI/WALZ 227-1787 01-17-77

INNER BOTTOM

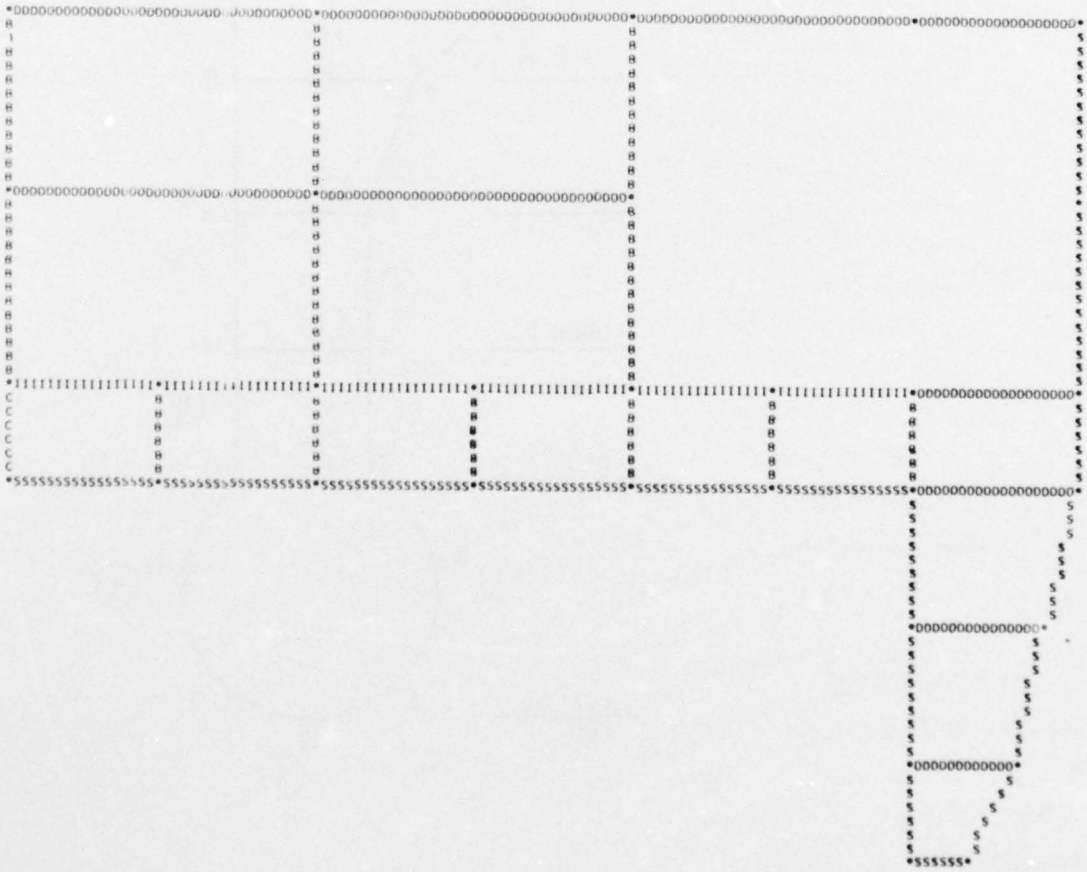
IB SEG	GEOMETRY Z1/ Z3	Y1/ Y3	Z2/ Z4	Y2/ Y4	LIVE LOAD	VIT NOR DAM MD	TANK OVRFL	TANK TOP MD	MINIMUM CODE ID PL	BM	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	22.000 0.000	0.000 0.000	22.000 0.000	7.330 0.000	500.00	40.00	0.00	0.00	1	1	3.00	3.00	7	8
2	22.000 0.000	7.330 0.000	22.000 0.000	14.670 0.000	500.00	40.00	0.00	0.00	1	1	3.00	3.00	7	8
3	22.000 0.000	14.670 0.000	22.000 0.000	22.000 0.000	500.00	40.00	0.00	0.00	1	1	3.00	3.00	7	8
4	22.000 0.000	22.000 0.000	22.000 0.000	29.330 0.000	500.00	40.00	0.00	0.00	1	1	3.00	3.00	7	8
5	22.000 0.000	29.330 0.000	22.000 0.000	35.900 0.000	200.00	40.00	0.00	0.00	1	1	3.00	3.00	7	8
6	22.000 0.000	35.900 0.000	22.000 0.000	42.500 0.000	200.00	40.00	0.00	0.00	1	1	3.00	3.00	7	8

DEMONSTRATION PROBLEM 3 LEV/NAPPI/WALZ 227-1787 01-17-77

DOUBLE BOTTOM PLATE LONGITUDINALS

LONG NO	GEOMETRY Z1	Y1	Z2	Y2	DESIGN CRITERIA WT=1 NWT=0	MIN TMK	DMGE HEAD	TANK OVRFL	MATL PL	PL LENGTH	GIRDER PRES
CVK	18.000	0.000	22.000	0.000	1	1	40.00	0.00	7	3.00	0.00

DEMONSTRATION PROBLEM 3 LEV/NAPPI/WALZ 227-1787 01-17-77



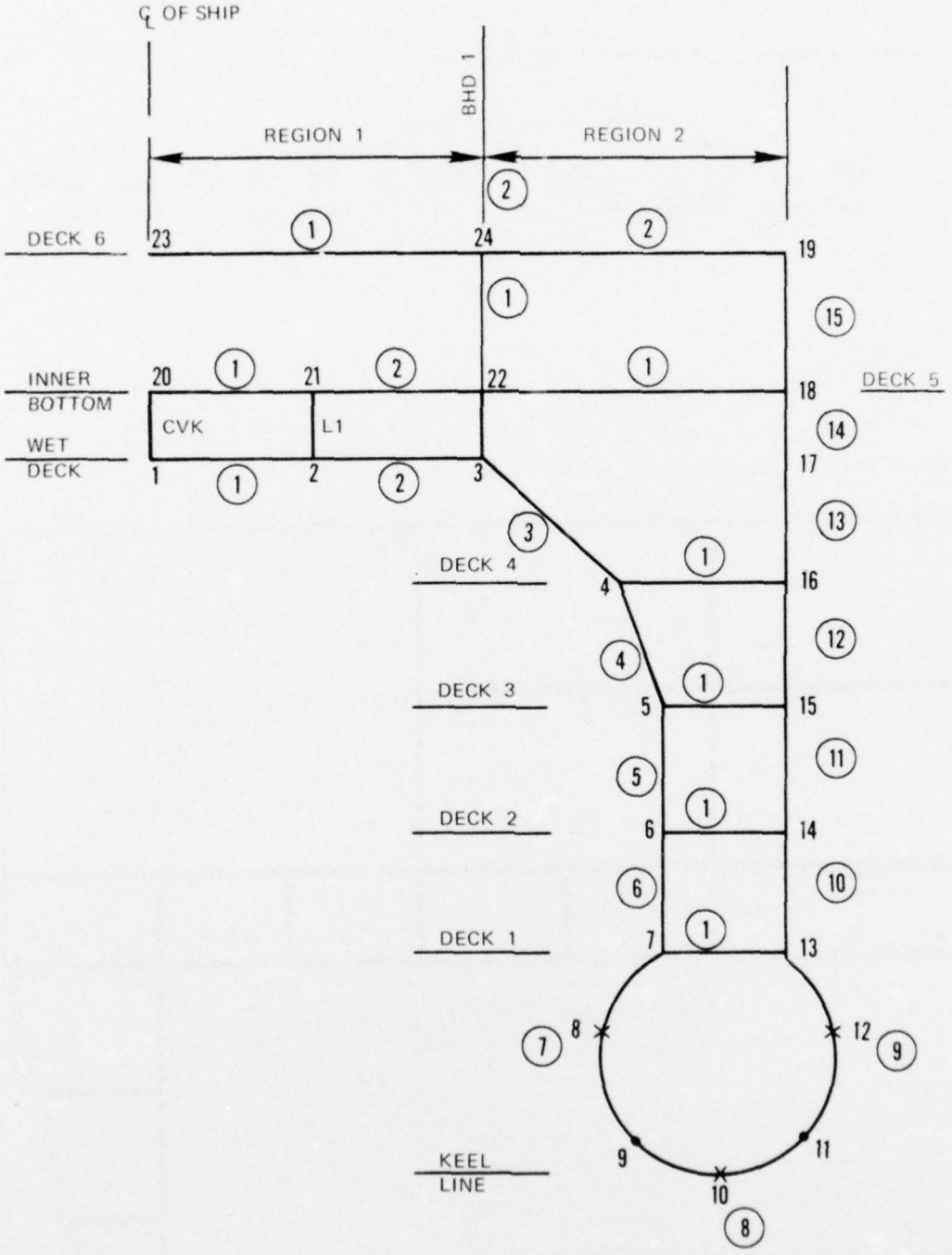


Figure 6 — Demonstration Problem 4

INPUT DATA LISTING: PROBLEM 4

```
1 2
  DEMONSTRATION PROBLEM 4     LEV/NAPPI/WALZ   227-1787   1-18-77
240.   59.25 41.   26.25   0.  0.    44.0  30.   53.   500.    .55
24  15  6  1  2  8  8  0  0  0 2  .2 0 1 0 0 2 1 1 24. 2. 2. 36.3
1120.  500.   .25   .25    0   0
6737.  9763.  2000.  -2000.   -2000.  2000.   21280.  21280.
46.25  0.0    46.25  10.5   46.25  21.    38.    30.    30.    33.5
22.    33.5   14.    33.5   8.5    29.82  2.     32.15  0.     37.25
2.     42.35  8.5    44.68  14.    41.    22.    41.    30.    41.
38.    41.    46.25  41.    50.25  41.    59.25  41.    50.25  0.
50.25  10.5   50.25  21.    59.25  0.0   59.25  21.0
  1  2  3  4  5  6  7  9 11 13 14 15 16 17 18 19
  7 13
  6 14
5 15
4 16
22 18
23 24 19
3 22 24
20 21 22
1 20 2 21
1 0 0 0 1 1
6.     6.     6.     6.     10.   7.
21.     0 0 0 0 0 1
20.     1 1 1 1 1 1
0.0   0.0   50.0   50.0   0.0   0.0   2.0   2.0 10  1  2  0  0
0.0   0.0   50.0   50.0   0.0   0.0   2.0   2.0 10  1  2  0  0
0.0   0.0   50.0   50.0   0.0   0.0   2.0   2.0  9  1  2  0  0
0.0   0.0   50.0   50.0   0.0   0.0   2.0   2.0  9  1  2  0  0
0.0   0.0   50.0   50.0   0.0   0.0   2.0   2.0  9  1  2  0  0
0.0   0.0    0.0    0.0    0.0   0.0   2.0   2.0  7  1  2  0  0
0.0   0.0    0.0    0.0    0.0   0.0   2.0   2.0  7  1  2  0  0
0.0   0.0    0.0    0.0    0.0   0.0   2.0   2.0  7  1  2  0  0
0.0   0.0    0.0    0.0    0.0   0.0   2.0   2.0  6  1  2  0  0
0.0   0.0    0.0    0.0    0.0   0.0   2.0   2.0  6  1  2  0  0
0.0   0.0    0.0    0.0    0.0   0.0   2.0   2.0  6  1  2  0  0
0.0   0.0    0.0    0.0    0.0   0.0   2.0   2.0  7  1  2  0  0
0.0   0.0    0.0    0.0    0.0   0.0   2.0   2.0  7  1  2  0  0
0.0   0.0    0.0    0.0    0.0   0.0   2.0   2.0  3  1  2  0  0
0.0   0.0    0.0    0.0    0.0   0.0   2.0   2.0  3  1  2  0  0
200.0  50.25  0.0   0.0   0.0   0.0   2.0   2.0        1  1  1  0  0
150.0   0.0   0.0   0.0   0.0   0.0   2.0   2.0        1  1  1  0  0
150.0   0.0   0.0   0.0   0.0   0.0   2.0   2.0        1  1  1  0  0
200.0   0.0   0.0   0.0   0.0   0.0   2.0   2.0        1  1  1  0  0
150.0  50.25  0.0   0.0 120. 120. 2. 16.0              6  1  1  0  0
256.0   0.0   0.0   0.0 126. 126. 2.0 16.0             7  1  4  0  0
256.0   0.0   0.0   0.0 120. 120. 2.0 16.0             7  1  4  0  0
50.25  0.0   0.0   0.0   0.0   0.0   0.0     3  1  1  0  0
 0.0   0.0   0.0   0.0   0.0   2.0   2.0     3  1  1  0  0
200.0  0.0   59.25  0.0   2.0   2.0        10  1  0  0
200.0  0.0   59.25  0.0   2.0   2.0        10  1  0  0
1  1  2.0  10.0  50.25  59.25  0
1  1  2.0  10.0  50.25  59.25  0
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DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

PRINCIPAL HULL DIMENSIONS

LENGTH BETWEEN PERPENDICULARS	=	240.00 FT.
MAXIMUM HALF BREADTH	=	41.00 FT.
DEPTH OF HULL	=	59.25 FT.
DESIGN FULL LOAD DRAFT	=	26.25 FT.
LENGTH BETWEEN TRANSVERSE BULKHEADS	=	44.00 FT.
NUMBER OF SHELL SEGMENTS	=	15
NUMBER OF DECKS	=	6
NUMBER OF BULKHEADS	=	1
NUMBER OF DOUBLE BOTTOM PLATE LONGITUDINALS	=	1
NUMBER OF INNER BOTTOM SEGMENTS	=	2

DESIGN CRITERIA

MATERIAL THROUGHOUT FOR PLATING	=	H.T.S.
MATERIAL THROUGHOUT FOR STIFFENERS	=	H.T.S.
MINIMUM PRESSURE FOR SHELL	=	500.00 PSF
MARGIN STRESS ADDED TO PRIMARY STRESS	=	1120.00 PSI
PRIMARY STRESS TOLERANCE (+ OR -)	=	500.00 PSI
DESIGN LIMITING PRI. STRESS+ DECK FIBER	=	21280.00 PSI
DESIGN LIMITING PRI. STRESS+ KEEL FIBER	=	21280.00 PSI
PRIMARY STRESS FACTOR	=	.2500
STRAKE TOLERENCE	=	.2500 IN.
BENDING MOMENT HOG CONDITION	=	9763.00 FT-TONS
BENDING MOMENT SAG CONDITION	=	6737.00 FT-TONS
ANGLE OF HEEL	=	30.00 DEGREES
SHELL DESIGN HEAD	=	53.00 FT.
WAVE HEIGHT COEFFICENT	=	.550

SHORT SPANS ARE 3/4 LENGTH.

SHELL SEGMENTS FOR AREA ADDITION IF REQUIRED
FROM SEG 8 TO SEG 8
SHIP NOT DESIGNED FOR NUCLEAR BLAST.
SHIP DESIGNED WITH INNER BOTTOM
SCANTLINGS FOR THE DOUBLE BOTTOM STRUCTURE
ARE TO BE CONSIDERED PRELIMINARY
GIRDER ANALYSIS REQUESTED
GIRDER DESIGN LENGTH = 36.30 FT.
MAXIMUM DEPTH OF I.B. STRINGER = 24.00 IN.

ASSUMED STRESSES

PRIMARY STRESS AT DECK-HOG	=	-2000.00 PSI
PRIMARY STRESS AT KEEL-HOG	=	2000.00 PSI
PRIMARY STRESS AT DECK-SAG	=	2000.00 PSI
PRIMARY STRESS AT KEEL-SAG	=	-2000.00 PSI

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

SHELL

SHL SEG	********** GEOMETRY ********** Z1/ Z3	Y1/ Y3	Z2/ Z4	Y2/ Y4	TANK OVRFL	TANK TOP HD	** SLAMMING CRITERIA ** PWES PL	PRES BM	COMB PRI	DEFOR IND	MINIMUM CODE ID PL	BM	DESIGN PANEL WIDTH MIN	MAX	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	46.250 0.000	0.000 0.000	46.250 0.000	10.500 0.000	0.00	0.00	50.00		0	2	10		0.00	0.00	2.00		2	
2	46.250 0.000	10.500 8.000	46.250 0.000	21.000 0.000	0.00	0.00	50.00		0	2	10		0.00	0.00	2.00		2	
3	46.250 0.000	21.000 0.000	38.000 0.000	30.000 0.000	0.00	0.00	50.00		0	2	9		0.00	0.00	2.00		2	
4	38.000 0.000	30.000 0.000	30.000 0.000	33.500 0.000	0.00	0.00	50.00		0	2	9		0.00	0.00	2.00		2	
5	30.000 0.000	33.500 0.000	22.000 0.000	33.500 0.000	0.00	0.00	50.00		0	2	9		0.00	0.00	2.00		2	
6	22.000 0.000	33.500 0.000	14.000 0.000	33.500 0.000	0.00	0.00	0.00		0	2	7		0.00	0.00	2.00		2	
7	14.000 8.500	33.500 29.820	2.000 0.000	32.150 0.000	0.00	0.00	0.00		0	2	7		0.00	0.00	2.00		2	
8	2.000 0.000	32.150 37.250	2.000 0.000	42.350 0.000	0.00	0.00	0.00		0	2	7		0.00	0.00	2.00		2	
9	2.000 8.500	42.350 44.680	14.000 0.000	41.000 0.000	0.00	0.00	0.00		0	2	6		0.00	0.00	2.00		2	
10	14.000 0.000	41.000 0.000	22.000 0.000	41.000 0.000	0.00	0.00	0.00		0	2	6		0.00	0.00	2.00		2	
11	22.000 0.000	41.000 0.000	30.000 0.000	41.000 0.000	0.00	0.00	0.00		0	2	6		0.00	0.00	2.00		2	
12	30.000 0.000	41.000 0.000	38.000 0.000	41.000 0.000	0.00	0.00	0.00		0	2	7		0.00	0.00	2.00		2	
13	38.000 0.000	41.000 0.000	46.250 0.000	41.000 0.000	0.00	0.00	0.00		0	2	7		0.00	0.00	2.00		2	
14	46.250 0.000	41.000 0.000	50.250 0.000	41.000 0.000	0.00	0.00	0.00		0	2	3		0.00	0.00	2.00		2	
15	50.250 0.000	41.000 0.000	59.250 0.000	41.000 0.000	0.00	0.00	0.00		0	2	3		0.00	0.00	2.00		2	

** NO REMOVALS IN SHELL SPECIFIED **

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

D E C K

REGION 1 WIDTH= 21.00 FT.

DK	SEG	GEOMETRY Z1	Y1	Z2	Y2	LIVE LOAD	VITNOR DAM HD	TANK OVRFL	TANK TOP HD	SPAC IND	MINIMUM CODE PL	MINIMUM ID BM	BEL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	DESIGN PANEL WIDTH MAX	DESIGN LENGTH FOR PL	DESIGN LENGTH FOR BM	MATERIAL IND PL	MATERIAL IND BM
1	0																			
2	0																			
3	0																			
4	0																			
5	0																			
6	1	59.25	0.00	59.25	21.00	256.00	0.00	0.00	0.00	4	7	1	7.00	1	126.00	126.00	2.00	16.00	2	2

REGION 2 WIDTH= 20.00 FT.

DK	SEG	GEOMETRY Z1	Y1	Z2	Y2	LIVE LOAD	VITNOR DAM HD	TANK OVRFL	TANK TOP HD	SPAC IND	MINIMUM CODE PL	MINIMUM ID BM	BEL CLR	CONT DECK	DESIGN PANEL WIDTH MIN	DESIGN PANEL WIDTH MAX	DESIGN LENGTH FOR PL	DESIGN LENGTH FOR BM	MATERIAL IND PL	MATERIAL IND BM
1	1	14.00	33.50	14.00	41.00	200.00	50.25	0.00	0.00	1	1		6.00	1	0.00	0.00	2.00		2	
2	1	22.00	33.50	22.00	41.00	150.00	0.00	0.00	0.00	1	1		6.00	0	0.00	0.00	2.00		2	
3	1	30.00	33.50	30.00	41.00	150.00	0.00	0.00	0.00	1	1		6.00	0	0.00	0.00	2.00		2	
4	1	38.00	30.00	38.00	41.00	200.00	0.00	0.00	0.00	1	1		6.00	0	0.00	0.00	2.00		2	
5	1	50.25	21.00	50.25	41.00	150.00	50.25	0.00	0.00	1	6	1	10.00	1	120.00	120.00	2.00	16.00	2	2
6	2	59.25	21.00	59.25	41.00	256.00	0.00	0.00	0.00	4	7	1	7.00	1	120.00	120.00	2.00	16.00	2	2

** NO REMOVALS IN DECKS SPECIFIED **

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

B U L K H E A D

BHD	SEG	GEOMETRY Z1	Y1	Z2	Y2	VITNOR DAM HD	TANK OVRFL	TANK TOP HD	SPAC IND	MINIMUM CODE PL	MINIMUM ID BM	DESIGN PANEL WIDTH MIN	DESIGN PANEL WIDTH MAX	DESIGN LENGTH FOR PL	DESIGN LENGTH FOR BM	MATERIAL IND PL	MATERIAL IND BM
1	1	46.25	21.00	50.25	21.00	50.25	0.00	0.00	1	3		0.00	0.00	2.00		2	
1	2	50.25	21.00	59.25	21.00	0.00	0.00	0.00	1	3		0.00	0.00	2.00		2	

** NO REMOVALS IN BULKHEADS SPECIFIED **

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

INNER BOTTOM

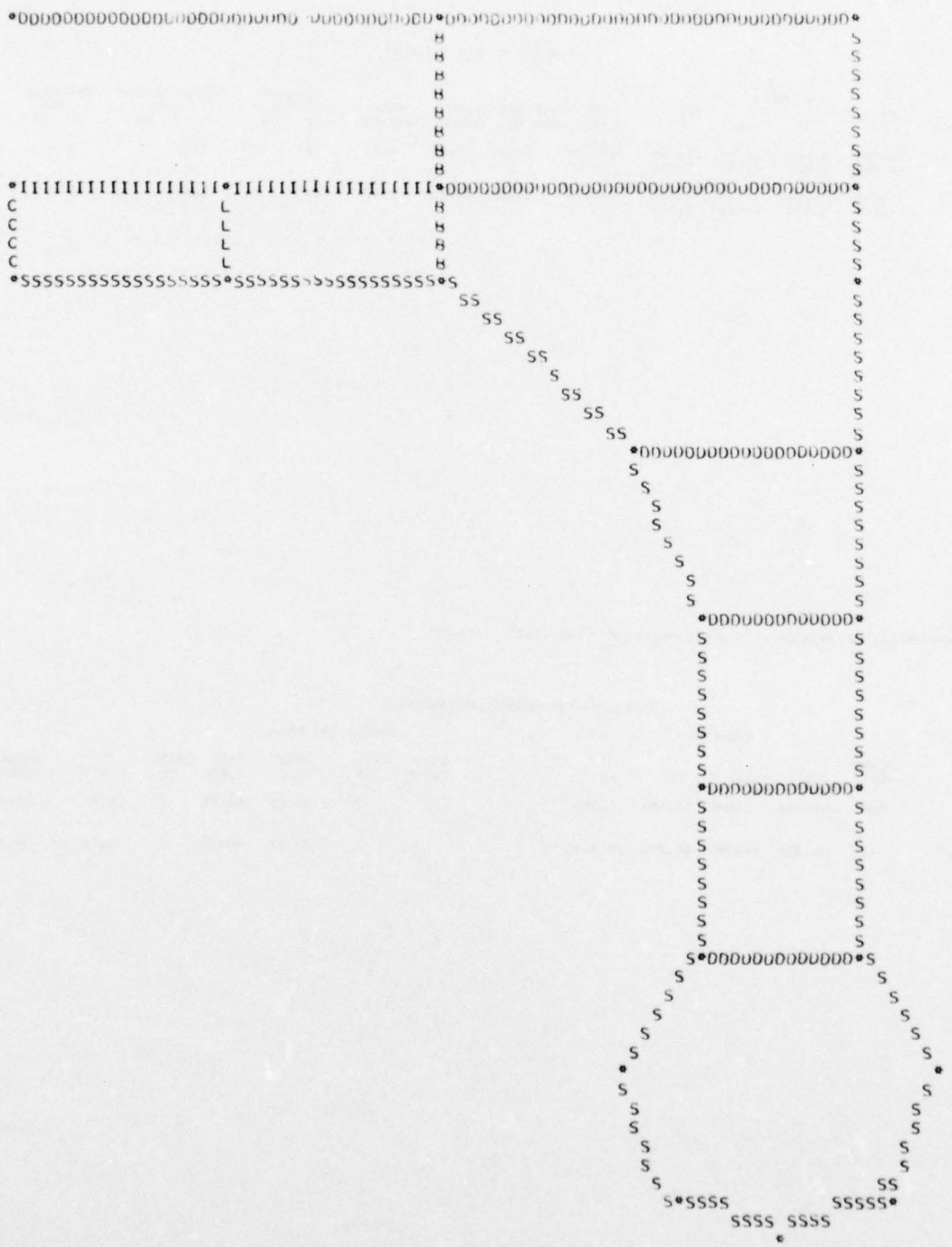
IB SEG	GEOMETRY Z1/ Z3	Y1/ Y3	Z2/ Z4	Y2/ Y4	LIVE LOAD	VIT DAM	NOR HD	TANK OVRFL	TANK TOP HD	MINIMUM CODE ID PL	BM	DESIGN LENGTH FOR PL	BM	MATERIAL IND PL	BM
1	50.250	0.000	50.250	10.500	200.00		0.00	59.25	0.00	10		2.00		2	
	0.000	0.000	0.000	0.000											
2	50.250	10.500	50.250	21.000	200.00		0.00	59.25	0.00	10		2.00		2	
	0.000	0.000	0.000	0.000											

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

DOUBLE BOTTOM PLATE LONGITUDINALS

LONG NO	GEOMETRY Z1	Y1	Z2	Y2	DESIGN CRITERIA WT=1 NWT=0	MIN THK	DMGE HEAD	TANK OVRFL	MATL PL	PL LENGTH	GIRDER PRES
CVK	46.250	0.000	50.250	0.000	1	1	50.25	59.25	2	2.00	10.00
1	46.250	10.500	50.250	10.500	1	1	50.25	59.25	2	2.00	10.00

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77



DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

SECTION PROPERTIES

TOTAL EFFECTIVE AREA	=	2000.1	SQ.IN.
MOMENT OF INERTIA ABT. NEUTRAL AXIS	=	643390.	SQ.IN.FT.-SQ.
DISTANCE FROM N.A. TO DECK FIBER	=	20.40	FEET
DISTANCE FROM N.A. TO KEEL FIBER	=	38.85	FEET
SECTION MODULUS AT DECK FIBER	=	31540.	SQ.IN.-FT.
SECTION MODULUS AT KEEL FIBER	=	16561.	SQ.IN.-FT.
TOTAL NORMALIZED LONGITUDINAL WEIGHT	=	7065.7	LBS./FT.

CALCULATED STRESSES

STRESS AT DECK-HOG	=	-693.39 PSI
STRESS AT KEEL-HOG	=	1320.55 PSI
STRESS AT DECK-SAG	=	478.47 PSI
STRESS AT KEEL-SAG	=	-911.25 PSI

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

*** ***
CYCLE NO. 2

INPUT STRESSES

STRESS AT DECK-HOG	=	-670.08 PSI
STRESS AT KEEL-HOG	=	1309.53 PSI
STRESS AT DECK-SAG	=	462.39 PSI
STRESS AT KEEL-SAG	=	-903.65 PSI

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

MINIMUM WEIGHT DATA FOR HALF SECTION

SHELL SCANTLINGS

SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	0	126.00	.4375	0	H.T.S.		187.4	0
2	0	126.00	.4375	0	H.T.S.		187.4	0
3	0	146.51	.4375	0	H.T.S.		217.9	0
4	0	104.79	.4375	0	H.T.S.		155.9	0
5	0	96.00	.4375	0	H.T.S.		142.8	0
6	0	96.00	.3125	0	H.T.S.		102.0	0
7	0	166.98	.3125	0	H.T.S.		177.4	0
8	0	133.99	.3125	0	H.T.S.		142.4	0
9	0	166.98	.2813	0	H.T.S.		159.7	0
10	0	96.00	.2813	0	H.T.S.		91.8	0
11	0	96.00	.3125	0	H.T.S.		102.0	0
12	0	96.00	.3125	0	H.T.S.		102.0	0
13	0	99.00	.3125	0	H.T.S.		105.2	0
14	0	48.00	.1875	0	H.T.S.		30.6	0
15	0	108.00	.1875	0	H.T.S.		68.9	0
					TOTAL SHELL WEIGHT		1973.4	

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

MINIMUM WEIGHT DATA FOR HALF SECTION

DECK SCANTLINGS

REGION 1 DK	SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	0								
2	0								
3	0								
4	0								
5	0								
6	1	1	126.00	.3125	55	H.T.S.	H.T.S.		0
						REGION 1 WEIGHT		295.3	

REGION 2 DK	SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	1	0	90.00	.2188	0	H.T.S.			0
2	1	0	90.00	.1250	0	H.T.S.			0
3	1	0	90.00	.1250	0	H.T.S.			0
4	1	0	132.00	.1250	0	H.T.S.			0
5	1	1	120.00	.2813	42	H.T.S.	H.T.S.		0
6	2	1	120.00	.3125	50	H.T.S.	H.T.S.		0
						REGION 2 WEIGHT		713.4	
						TOTAL DECK WEIGHT		1008.7	

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

MINIMUM WEIGHT DATA FOR HALF SECTION

BULKHEAD SCANTLINGS

BULKHEAD 1 SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	0	48.00	.1875	0	H.T.S.		30.6	0
2	0	108.00	.1875	0	H.T.S.		68.9	0
					BULKHEAD 1 WEIGHT		99.4	
					TOTAL BULKHEAD WEIGHT		99.4	

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

MINIMUM WEIGHT DATA FOR HALF SECTION

PRELIMINARY INNER BOTTOM SCANTLINGS

SEG	NL	SPACING	PLATE THICKNESS	TEE (ID CODE)	PLATE MATL	TEE MATL	LBS./FT.	NILS.....TEE/FB
1	0	126.00	.4375	0	H.T.S.		187.4	0
2	0	126.00	.4375	0	H.T.S.		187.4	0
				TOTAL INNER BOTTOM WEIGHT			374.9	

DEMONSTRATION PROBLEM 4 LEV/NAPPI/WALZ 227-1787 1-18-77

MINIMUM WEIGHT DATA FOR HALF SECTION

PRELIMINARY DOUBLE BOTTOM PLATE LONGITUDINAL SCANTLINGS

LONG. NUMBER	PLATE THICKNESS	PLATE MATL	LBS./FT.
CVK	.3125	H.T.S.	25.5
1	.3125	H.T.S.	51.0
	TOTAL DOUBLE BOTTOM PLATE LONGITUDINAL WEIGHT		76.5

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

MIDSHIP SECTION PROPERTIES

TOTAL EFFECTIVE AREA	=	13908.2	SQ.IN.
MOMENT OF INERTIA ABT. NEUTRAL AXIS	=	13400296.	SQ.IN.FT.-SQ.
DISTANCE FROM N.A. TO DECK FIBER	=	49.22	FEET
DISTANCE FROM N.A. TO KEEL FIBER	=	38.28	FEET
SECTION MODULUS AT DECK FIBER	=	272238.	SQ.IN.-FT.
SECTION MODULUS AT KEEL FIBER	=	350085.	SQ.IN.-FT.
TOTAL NORMALIZED LONGITUDINAL WEIGHT	=	61229.0	LBS./FT.

CALCULATED STRESSES

STRESS AT DECK-HOG	=	-16456.20 PSI
STRESS AT KEEL-HOG	=	12796.89 PSI
STRESS AT DECK-SAG	=	4114.05 PSI
STRESS AT KEEL-SAG	=	-3199.22 PSI

DEMONSTRATION PROBLEM 2 LEV/NAPPI/WALZ 227-1787 11/15/76

••• •••
CONSISTENT DESIGN

	ASSUMED INPUT(PSI)	CALCULATED OUTPUT(PSI)
STRESS AT DECK-HOG	-16440.00	-16456.20
STRESS AT KEEL-HOG	12800.00	12796.89
STRESS AT DECK-SAG	4110.00	4114.05
STRESS AT KEEL-SAG	-3200.00	-3199.22

FOR SCANTLING SUMMARY, REFER TO CYCLE NO. 1

SECTION ACCEPTABLE
DESIGN PRIMARY STRESS LESS THAN LIMITING DESIGN PRIMARY STRESS

... DETAIL DESIGN PRINT-OUT OF ACCEPTABLE SECTION FOLLOWS ...
(HEIGHTS TO LONGITUDINALS ARE RELATIVE TO KEEL LINE)

SECTION 9. MATERIAL PROPERTIES AND STRUCTURAL SHAPE AND PLATE CATALOGS

The mechanical properties of steels and aluminum alloys used in the program are presented in Table 4

TABLE 4 — MECHANICAL PROPERTIES OF STEELS AND ALUMINUM ALLOYS

Alloy Products	Nominal Yield Strength psi	Dynamic Yield Strength psi	Proportional Limit psi	Allowable Working Stress psi	Effective Width Constant $2\ E/\sigma_y$
Medium Steel Shapes-Plt	33,000	45,000	25,000	27,000	60
High Tensile Steel Shapes-Plt	45,000	50,000	34,000	38,000	51
HY 80 Shapes-Plt	80,000	80,000	60,000	55,000	39
HY 100 Shapes-Plt	100,000	100,000	75,000	66,000	35
5086 - H 116 Plates	* 22,000	** 28,000	***22,000	18,000	†35
5086 - H 111 Shapes	* 16,000	** 21,000	***16,000	14,000	–
5456 - H 116 Plates	* 26,000	** 33,000	***26,000	21,000	†35
5456 - H 111 Shapes	* 21,000	** 26,000	***21,000	17,000	–

Note: Modulii of elasticity used in program are 29.6×10^3 ksi for all steel materials and 10×10^3 ksi for all aluminum materials, and allowable shear stress is taken as 60 percent of allowable working stress for all materials.

* Nominal yield strength as welded.

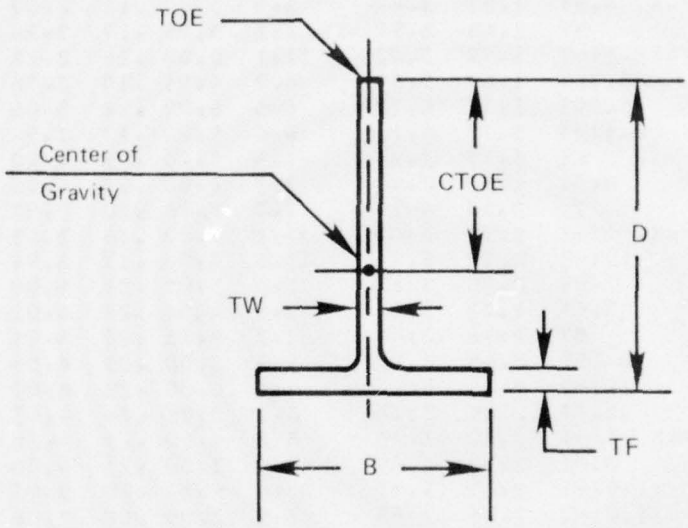
** Reduction in yield strength of weld zones is neglected in determining design dynamic yield strength for blast loading; therefore, dynamic yield strength equals yield strength of prime material; conservative, since possible increase in yield strength due to dynamic rate of strain is not included.

*** Taken to be same as yield strength, welded.

† Based on yield strength of prime material of 33,000 psi for aluminum alloys.

SECTION 9. MATERIAL PROPERTIES AND STRUCTURAL SHAPES AND PLATE CATALOGS

The structural shape catalogs contain the section properties of the standard I-T and T-beams for steel and the standard and builtup T-beam for aluminum. The steel structural shape catalog was taken from Reference 4 while the aluminum structural shape catalog was based on reference 5. The beams are arragned in order of increasing sectional area. The following sketch identifies the symbols used in the listings.



where K is catalog code number for T-beam

SIZE is beam designation: S is for standard extruded beams, beam depth x wt/ft; B is for builtup beams, web depth x flange width x web thickness/flange thickness

CTOE is distance from center of gravity to toe of T-beam in inches

XI1T is moment of inertia of T-beam in inch^4

B is flange width of T-beam in inches

D is depth of T-beam in inches

TW is thickness of web in inches

TF is thickness of flange in inches

A5T is cross sectional area of T-beam in square inches

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[4]Society of Naval Architects and Marine Engineers, "Manual of Properties of Combined Beam and Plate, Part I, Tees and Angles," for Dept. of Commerce, NAVSHIPS 250-443-1, Part I (undated).

[5]Lev, F. M., and N. S. Nappi, "Properties of Combined Aluminum Beam and Plate," NSRDC Report 4336 (1974).

SECTION 9. MATERIAL PROPERTIES AND STRUCTURAL SHAPES AND PLATE CATALOGS

STEEL STRUCTURAL SHAPE CATALOG (I-T AND T.)

K	SIZE	A5T	CTOE	XI1T	D	TW	B	TF
1	3X 17/8X 2.2T	.65	2.16	.6	3.00	.11	1.84	.17
2	31/2X21/8X2.8T	.80	2.49	1.0	3.50	.13	2.08	.18
3	4X 21/4X 3.25T	.96	2.82	1.6	4.00	.14	2.28	.19
4	6X 17/8X4.4I-T	0.99	3.94	3.9	6.00	.11	1.84	0.19
5	7X 21/8X5.5I-T	1.25	4.51	6.7	7.00	.13	2.08	0.19
6	3X 4X 4.25T	1.25	2.28	.9	2.92	.17	3.94	.19
7	5X 23/4X 4.5T	1.32	3.47	3.5	5.00	.16	2.68	.20
8	4X 4X 5T	1.48	2.99	2.2	3.95	.17	3.94	.20
9	8X 21/4X6.5I-T	1.53	5.02	11.2	8.00	.14	2.28	0.19
10	5X 4X 5.75T	1.69	3.59	4.2	4.94	.18	3.95	.20
11	6X 3X 5.90T	1.72	4.12	6.6	6.00	.18	3.06	.23
12	6X 4X 8.5I-T	1.77	4.11	6.6	5.82	.17	3.94	0.19
13	3X 4X 6T	1.77	2.33	1.3	3.00	.23	4.00	.28
14	4X 4X 6.5T	1.91	2.97	2.9	4.00	.23	4.00	.25
15	6X 4X 7T	2.07	4.20	7.7	5.96	.20	3.97	.22
16	10X 23/4X 9I-T	2.17	6.08	25.2	10.00	.16	2.69	0.19
17	8X 4X 10I-T	2.19	5.32	15.6	7.90	.17	3.94	0.20
18	5X 4X 7.5T	2.20	3.63	5.5	5.00	.23	4.00	.27
19	4X 4X 7.5T	2.22	3.06	3.3	4.06	.25	4.01	.31
20	3X 4X 8T	2.36	2.46	1.7	3.13	.26	4.03	.40
21	6X 4X 8.25T	2.43	4.24	9.0	6.00	.23	4.00	.27
22	6X 4X 12I-T	2.49	4.25	9.6	6.00	.23	4.00	0.28
23	5X 4X 8.5T	2.49	3.74	6.1	5.06	.24	4.01	.33
24	4X 51/4X 8.5T	2.50	3.16	3.2	4.00	.23	5.25	.31
25	7X 4X 8.6T	2.53	4.89	13.2	7.00	.21	4.00	.27
26	10X 4X 11.5I-T	2.63	6.35	29.0	9.86	.18	3.95	0.20
27	12X 3X 11.8I-T	2.75	7.53	41.9	12.00	.18	3.06	0.25
28	5X 4X 9.5T	2.80	3.85	6.7	5.13	.25	4.02	.39
29	6X 4X 9.5T	2.81	4.41	10.2	6.08	.24	4.01	.35
30	8X 4X 13I-T	2.88	5.32	20.5	8.00	.23	4.00	0.25
31	4X 51/4X 10T	2.94	3.24	3.7	4.07	.25	5.27	.38
32	5X 53/4X 10.5T	3.10	3.88	6.3	4.94	.24	5.75	.34
33	6X 4X 11T	3.24	4.53	11.7	6.16	.26	4.03	.42
34	6X 4X 16I-T	3.26	4.52	13.7	6.24	.26	4.03	0.40
35	8X 4X 15I-T	3.27	5.50	24.0	8.12	.25	4.01	0.31
36	12X 4X 14I-T	3.30	7.46	52.3	11.90	.20	3.97	0.22
37	10X 4X 15I-T	3.40	6.47	38.2	10.00	.23	4.00	0.27
38	8X 51/4X 17I-T	3.48	5.75	24.1	8.00	.23	5.25	0.31
39	5X 53/4X 12.5T	3.67	4.02	7.1	5.04	.25	5.76	.43
40	10X 4X 17I-T	3.77	6.68	43.5	10.12	.24	4.01	0.33
41	12X 4X 16.5I-T	3.86	7.55	62.0	12.00	.23	4.00	0.27
42	6X 61/2X 13.5T	3.98	4.77	11.4	5.98	.24	6.50	.40
43	8X 51/4X 20I-T	4.03	5.94	28.6	8.14	.25	5.27	0.38
44	10X 4X 19I-T	4.18	6.87	49.7	10.24	.25	4.02	0.39
45	5X 53/4X 14.5T	4.27	4.06	8.4	5.11	.29	5.80	.50
46	12X 4X 19I-T	4.34	7.87	72.3	12.16	.24	4.01	0.35
47	10X 53/4X 21I-T	4.35	7.04	46.5	9.90	.24	5.75	0.34
48	7X 63/4X 15T	4.41	5.34	19.0	6.93	.27	6.73	.38
49	6X 61/2X 15.5T	4.56	4.82	13.0	6.04	.27	6.52	.47
50	8X 61/2X 24I-T	4.63	6.04	30.2	7.92	.25	6.50	0.40

STEEL STRUCTURAL SHAPE CATALOG (I-T AND T.)

	SIZE	A5T	CTOE	XI1T	D	TW	B	TF
51	12X 4X 22I-T	4.94	8.05	85.0	12.30	.26	4.03	0.42
52	7X 63/4X 17T	5.00	5.45	21.1	7.00	.29	6.75	.45
53	10X 53/4X 25I-T	5.06	7.32	55.8	10.08	.25	5.76	0.43
54	6X 61/2X 18T	5.29	4.86	15.3	6.12	.31	6.56	.56
55	8X 7X 18T	5.40	6.03	30.7	7.93	.30	6.99	.43
56	8X 61/2X 28I-T	5.42	6.12	36.3	8.06	.29	6.54	0.46
57	12X 61/2X 27I-T	5.53	8.60	87.1	11.94	.24	6.50	0.40
58	7X 63/4X 19T	5.59	5.50	23.5	7.06	.31	6.78	.51
59	10X 53/4X 29I-T	5.88	7.41	66.6	10.22	.29	5.80	0.50
60	8X 7X 20T	5.88	6.18	33.2	8.00	.31	7.00	.50
61	12X 61/2X 31I-T	6.30	8.74	100.9	12.08	.27	6.52	0.47
62	14X 63/4X 30I-T	6.38	9.57	137.2	13.86	.27	6.73	0.38
63	10X 8X 33I-T	6.45	7.33	64.6	9.74	.29	7.96	0.43
64	8X 7X 22.5T	6.62	6.19	37.8	8.06	.35	7.04	.56
65	14X 63/4X 34I-T	7.15	9.79	156.3	14.00	.29	6.75	0.45
66	12X 61/2X 36I-T	7.34	8.83	120.4	12.24	.31	6.56	0.54
67	9X 71/2X 25T	7.35	6.86	53.9	9.00	.36	7.50	.57
68	8X 7X 25T	7.35	6.24	42.2	8.13	.38	7.07	.63
69	10X 8X 39I-T	7.54	7.57	77.0	9.94	.32	7.99	0.53
70	16X 7X 36I-T	7.78	10.78	219.3	15.84	.30	6.99	0.43
71	12X 8X 40I-T	7.91	8.88	123.0	11.94	.29	8.00	0.52
72	14X 63/4X 38I-T	7.96	9.91	176.8	14.12	.31	6.78	0.51
73	9X 71/2X 27.5T	8.09	6.90	59.6	9.06	.39	7.53	.63
74	16X 7X 40I-T	8.50	11.08	243.6	16.00	.31	7.00	0.50
75	8X 81/2X 29T	8.52	6.23	43.6	7.93	.41	8.46	.65
76	10X 8X 45I-T	8.66	7.74	90.8	10.12	.35	8.02	0.62
77	14X 8X 43I-T	8.70	9.95	180.8	13.68	.31	8.00	0.53
78	9X 71/2X 30T	8.82	6.95	64.8	9.12	.42	7.56	.70
79	12X 8X 45I-T	8.94	8.93	141.2	12.06	.34	8.04	0.58
80	101/2X81/4X 31T	9.12	7.90	93.7	10.49	.40	8.24	.62
81	9X 83/4X 32T	9.40	7.01	61.8	8.94	.40	8.71	.69
82	8X 81/2X 32T	9.40	6.27	48.3	8.00	.44	8.50	.72
83	16X 7X 45I-T	9.59	11.13	278.4	16.12	.35	7.04	0.56
84	14X 8X 48I-T	9.70	10.04	205.2	13.80	.34	8.03	0.59
85	12X 8X 50I-T	9.94	9.01	159.7	12.18	.37	8.08	0.64
86	101/2X81/4X 34T	10.01	7.98	102.8	10.57	.43	8.27	.69
87	12X10X 53I-T	10.16	9.25	151.9	12.06	.35	10.00	0.58
88	9X 83/4X 35T	10.28	7.04	68.1	9.00	.44	8.75	.75
89	8X 81/2X 35.5T	10.43	6.31	54.0	8.08	.49	8.54	.80
90	16X 7X 50I-T	10.65	11.21	315.0	16.24	.38	7.07	0.63
91	14X 8X 53I-T	10.72	10.14	230.1	13.94	.37	8.06	0.66
92	101/2X81/4X 36T	10.73	8.02	110.2	10.62	.46	8.29	.74
93	18X 71/2X 50I-T	10.76	12.30	390.6	18.00	.36	7.50	0.57
94	12X10X 58I-T	11.05	9.40	167.5	12.18	.36	10.01	0.64
95	12X 9X 38T	11.18	8.95	151.1	11.95	.44	8.98	.68
96	9X 83/4X 38.5T	11.32	7.09	75.3	9.08	.48	8.79	.83
97	8X 81/2X 39T	11.46	6.35	60.0	8.16	.53	8.59	.88
98	18X 71/2X 55I-T	11.84	12.39	435.2	18.12	.39	7.53	0.63
99	14X10X 61I-T	11.92	10.46	243.5	13.90	.38	10.00	0.64
100	16X 81/2X 58I-T	12.00	11.26	332.7	15.86	.41	8.46	0.65

STEEL STRUCTURAL SHAPE CATALOG (I-T AND T.)

K	SIZE		A5T	CTOE	XI1T	D	TW	B	TF
101	12X 9X	42T	12.35	9.07	165.9	12.04	.47	9.01	.77
102	18X 71/2X 60	I-T	12.87	12.50	481.4	18.24	.42	7.56	0.70
103	16X 81/2X 64	I-T	13.23	11.37	372.1	16.00	.44	8.50	0.72
104	18X 83/4X 64	I-T	13.29	12.63	471.6	17.86	.40	8.71	0.69
105	14X10X	68I-T	13.31	10.64	270.6	14.16	.42	10.04	0.72
106	21X81/4X62	I-T	13.54	14.12	672.6	20.98	.40	8.24	0.62
107	12X 9X	47T	13.81	9.16	185.9	12.15	.52	9.06	.87
108	131/2X10X	47T	13.83	10.04	238.5	13.45	.49	9.99	.75
109	14X10X	74I-T	14.49	10.65	307.3	14.18	.45	10.07	0.78
110	18X 83/4X 70	I-T	14.55	12.72	522.5	18.00	.44	8.75	0.75
111	16X 81/2X 71	I-T	14.70	11.47	421.7	16.16	.49	8.54	0.80
112	12X12X	50T	14.71	9.46	176.7	12.00	.47	12.00	.78
113	21X81/4X68	I-T	14.82	14.27	745.5	21.12	.43	8.27	0.69
114	14X12X	78I-T	14.84	10.87	294.7	14.06	.43	12.00	0.72
115	131/2X10X	51T	15.01	10.14	257.7	13.53	.52	10.02	.83
116	9X113/4X	52.5T	15.43	7.34	93.9	9.16	.55	11.79	.91
117	21X81/4X73	I-T	15.87	14.36	806.4	21.24	.46	8.29	0.74
118	15X101/2X	54T	15.88	10.88	349.5	14.91	.55	10.48	.76
119	18X 83/4X 77	I-T	16.02	12.83	586.2	18.16	.48	8.79	0.83
120	16X 81/2X 78	I-T	16.17	11.57	472.9	16.32	.53	8.59	0.88
121	24X 9X 76	I-T	16.71	16.00	1075.3	23.90	.44	8.98	0.68
122	131/2X10X	57T	16.77	10.22	288.9	13.64	.57	10.07	.93
123	15X101/2X	58T	17.07	11.06	371.8	15.00	.56	10.50	.85
124	16X111/2X 88	I-T	17.36	12.04	475.3	16.16	.50	11.50	0.80
125	21X 9X 82	I-T	17.61	14.27	859.3	20.86	.50	8.96	0.80
126	12X12X	60T	17.64	9.54	213.6	12.16	.56	12.09	.93
127	18X 83/4X 85	I-T	17.75	12.89	660.9	18.32	.53	8.84	0.91
128	24X 9X 84	I-T	18.35	15.80	1343.2	24.08	.47	9.01	0.77
129	16X111/2X 96	I-T	18.89	12.19	525.3	16.32	.54	11.53	0.88
130	161/2X111/2X65	T	19.13	12.18	513.0	16.55	.58	11.51	.86
131	18X113/4X 96	I-T	19.15	13.38	671.9	18.16	.51	11.75	0.83
132	24X 9X 94	I-T	20.49	16.37	1364.4	24.28	.52	9.06	0.87
133	21X 9X 96	I-T	20.63	14.45	1032.2	21.14	.58	9.04	0.94
134	24X12X100	I-T	20.73	17.04	1323.0	24.00	.47	12.00	0.78
135	27X10X 94	I-T	20.75	17.92	1695.2	26.90	.49	9.99	0.75
136	161/2X111/2X70	T	20.76	12.36	551.8	16.66	.60	11.53	.96
137	18X113/4X105	I-T	20.95	13.49	747.3	18.32	.55	11.79	0.91
138	18X12X	75T	22.08	13.13	696.7	17.92	.63	11.97	.94
139	27X10X102	I-T	22.41	18.12	1854.0	27.06	.52	10.02	0.83
140	21X13X112	I-T	22.43	15.42	1059.9	21.00	.53	13.00	0.87
141	18X113/4X114	I-T	22.77	13.60	826.3	18.48	.60	11.83	0.99
142	24X12X110	I-T	22.80	17.15	1474.2	24.16	.51	12.04	0.86
143	30X101/2X108	I-T	24.38	19.43	2428.2	29.82	.55	10.48	0.76
144	24X12X120	I-T	24.91	17.21	1628.4	24.30	.56	12.09	0.93
145	27X10X114	I-T	25.01	18.29	2098.4	27.28	.57	10.07	0.93
146	30X101/2X116	I-T	25.93	19.74	2626.8	30.00	.56	10.50	0.85
147	24X14X130	I-T	26.42	17.53	1688.4	24.24	.57	14.00	0.90
148	30X101/2X124	I-T	27.53	19.97	2825.1	30.16	.59	10.52	0.93
149	33X111/2X130	I-T	29.15	21.72	3592.4	33.10	.58	11.51	0.86
150	30X101/2X132	I-T	29.28	20.09	3036.0	30.30	.62	10.55	1.00

STEEL STRUCTURAL SHAPE CATALOG (I-T AND T.)

	SIZE		A5T	CTOE	XI1T	D	TW	B	TF
151	24X14X145	I-T	29.34	17.78	1908.3	24.48	.61	14.04	1.02
152	27X14X145	I-T	30.01	19.11	2393.7	26.88	.60	13.96	0.98
153	33X111/2X141	I-T	31.36	22.04	3930.1	33.30	.61	11.53	0.96
154	24X14X160	I-T	32.33	17.98	2137.4	24.72	.66	14.09	1.14
155	27X14X160	I-T	33.12	19.23	2679.1	27.08	.66	14.02	1.08
156	33X111/2X152	I-T	33.62	22.28	4268.6	33.50	.64	11.56	1.06
157	36X12X 150	I-T	33.79	23.42	4886.0	35.84	.63	11.97	0.94
158	30X15X 172	I-T	35.83	21.12	3546.1	29.88	.66	14.98	1.07
159	36X12X 160	I-T	35.89	23.62	5244.5	36.00	.65	12.00	1.02
160	27X14X177	I-T	36.75	19.35	3022.0	27.30	.73	14.09	1.19
161	36X12X 170	I-T	37.96	23.81	5607.8	36.16	.68	12.03	1.10
162	30X15X 190	I-T	39.48	21.32	3963.7	30.12	.71	15.04	1.19
163	36X12X 182	I-T	40.69	23.89	6063.3	36.32	.73	12.07	1.18
164	33X153/4X200	I-T	42.21	22.98	5193.9	33.00	.72	15.75	1.15
165	36X12X 194	I-T	43.43	23.99	6526.5	36.48	.77	12.12	1.26
166	30X15X 210	I-T	43.65	21.50	4458.3	30.38	.78	15.10	1.32
167	33X153/4X220	I-T	46.20	23.29	5685.5	33.24	.78	15.81	1.28
168	36X161/2X230	I-T	48.56	25.02	6979.8	35.88	.77	16.47	1.26
169	33X153/4X240	I-T	50.27	23.50	6271.3	33.50	.83	15.86	1.40
170	36X161/2X245	I-T	51.56	25.19	7482.6	36.06	.80	16.51	1.35
171	36X161/2X260	I-T	54.79	25.32	8028.3	36.24	.85	16.55	1.44
172	36X161/2X280	I-T	58.73	25.58	8739.3	36.50	.86	16.59	1.57
173	36X161/2X300	I-T	63.01	25.69	9490.7	36.72	.94	16.65	1.68

A L U M I N U M

STRUCTURAL SHAPE CATALOG (T AND BUILT"UP T)

K		SIZE	AST	CTOE	XIIT	D	TW	B	TF
1	S	3 X 1.50 T	1.32	2.28	1.0	3.00	.188	3.00	.257
2	S	4 X 2.00 T	1.75	3.07	2.5	4.00	.188	4.00	.254
3	S	5 X 2.50 T	2.19	3.84	4.9	5.00	.188	4.50	.282
4	S	6 X 3.00 T	2.61	4.11	9.2	6.00	.219	4.50	.291
5	S	7 X 3.50 T	3.04	5.11	14.9	7.00	.225	4.75	.312
6	S	8 X 4.00 T	3.48	5.56	23.4	8.00	.258	4.75	.300
7	S	8 X 4.50 T	3.91	5.79	25.0	8.00	.258	4.75	.396
8	S	8 X 5.00 T	4.34	5.84	27.2	8.00	.277	4.75	.459
9	S	10 X 5.75 T	4.99	6.68	53.3	10.00	.324	5.00	.352
10	S	10 X 6.50 T	5.64	7.02	58.0	10.00	.324	5.00	.492
11	S	10 X 7.25 T	6.30	7.09	63.4	10.00	.349	5.00	.578
12	S	12 X 8.00 T	6.95	7.87	106.7	12.00	.391	5.00	.457
13	S	12 X 9.00 T	7.81	8.26	116.4	12.00	.391	5.00	.645
14	S	12 X 10.00 T	8.68	8.28	128.0	12.00	.430	5.00	.732
15	B	14X 8X .313/ .563T	8.88	10.69	189.2	14.56	.313	8.00	.563
16	B	14X 6X .375/ .625T	9.00	10.05	202.8	14.62	.375	6.00	.625
17	B	16X 8X .313/ .500T	9.00	11.67	258.0	16.50	.313	8.00	.500
18	B	14X10X .313/ .500T	9.38	10.87	194.2	14.50	.313	10.00	.500
19	B	16X 6X .375/ .563T	9.38	10.98	276.2	16.56	.375	6.00	.563
20	B	16X 8X .313/ .563T	9.50	11.92	269.2	16.56	.313	8.00	.563
21	B	14X 8X .375/ .563T	9.75	10.36	214.3	14.56	.375	8.00	.563
22	B	16X 6X .375/ .625T	9.75	11.20	287.6	16.62	.375	6.00	.625
23	B	14X10X .313/ .563T	10.00	11.10	202.1	14.56	.313	10.00	.563
24	B	16X10X .313/ .500T	10.00	12.12	276.9	16.50	.313	10.00	.500
25	B	14X 8X .375/ .625T	10.25	10.57	222.9	14.62	.375	8.00	.625
26	B	16X 8X .375/ .563T	10.50	11.55	304.5	16.56	.375	8.00	.563
27	B	14X 6X .438/ .750T	10.63	10.12	241.3	14.75	.438	6.00	.750
28	B	16X10X .313/ .563T	10.63	12.38	288.3	16.56	.313	10.00	.563
29	B	14X10X .375/ .563T	10.87	10.77	229.9	14.56	.375	10.00	.563
30	B	16X 8X .375/ .625T	11.00	11.78	316.6	16.62	.375	8.00	.625
31	B	18X 8X .375/ .563T	11.25	12.71	415.0	18.56	.375	8.00	.563
32	B	14X 6X .500/ .750T	11.50	9.89	263.5	14.75	.500	6.00	.750
33	B	14X10X .375/ .625T	11.50	10.97	238.5	14.62	.375	10.00	.625
34	B	16X 6X .438/ .750T	11.50	11.28	341.7	16.75	.438	6.00	.750
35	B	16X10X .375/ .563T	11.62	12.01	327.2	16.56	.375	10.00	.563
36	B	18X 8X .375/ .625T	11.75	12.96	431.5	18.62	.375	8.00	.625
37	B	14X 8X .438/ .750T	12.12	10.65	265.2	14.75	.438	8.00	.750
38	B	14X 6X .500/ .875T	12.25	10.19	280.6	14.87	.500	6.00	.875
39	B	16X10X .375/ .625T	12.25	12.24	339.7	16.62	.375	10.00	.625
40	B	18X10X .375/ .563T	12.37	13.22	446.7	18.56	.375	10.00	.563
41	B	16X 6X .500/ .750T	12.50	11.01	372.9	16.75	.500	6.00	.750
42	B	14X 8X .500/ .750T	13.00	10.40	290.3	14.75	.500	8.00	.750
43	B	16X 8X .438/ .750T	13.00	11.87	376.2	16.75	.438	8.00	.750
44	B	18X10X .375/ .625T	13.00	13.48	463.9	18.62	.375	10.00	.625
45	B	14X 6X .563/ .875T	13.13	9.97	303.2	14.87	.563	6.00	.875
46	B	16X 6X .500/ .875T	13.25	11.34	396.7	16.88	.500	6.00	.875
47	B	18X12X .375/ .563T	13.50	13.64	473.2	18.56	.375	12.00	.563
48	B	14X10X .438/ .750T	13.62	11.06	283.8	14.75	.438	10.00	.750
49	B	14X 6X .563/1.000T	13.87	10.24	320.7	15.00	.563	6.00	1.000
50	B	18X 8X .438/ .750T	13.87	13.05	512.2	18.75	.438	8.00	.750

A L U M I N U M

STRUCTURAL SHAPE CATALOG (T AND BUILT"UP T)

K		SIZE	AST	CTOE	XIIT	D	TW	B	TF
51	B	14X 8X .500/ .875T	14.00	10.72	308.4	14.87	.500	8.00	.875
52	B	16X 8X .500/ .750T	14.00	11.59	411.4	16.75	.500	8.00	.750
53	B	16X 6X .563/ .875T	14.25	11.11	428.4	16.88	.563	6.00	.875
54	B	18X12X .375/ .625T	14.25	13.90	490.6	18.62	.375	12.00	.625
55	B	14X10X .500/ .750T	14.50	10.81	311.6	14.75	.500	10.00	.750
56	B	16X10X .438/ .750T	14.50	12.33	403.6	16.75	.438	10.00	.750
57	B	14X 6X .625/1.000T	14.75	10.05	343.6	15.00	.625	6.00	1.000
58	B	14X 8X .563/ .875T	14.87	10.50	334.1	14.87	.563	8.00	.875
59	B	16X 6X .563/1.000T	15.00	11.40	452.6	17.00	.563	6.00	1.000
60	B	16X 8X .500/ .875T	15.00	11.94	436.9	16.88	.500	8.00	.875
61	B	18X 8X .500/ .750T	15.00	12.75	559.7	18.75	.500	8.00	.750
62	B	21X 8X .438/ .750T	15.19	14.80	767.2	21.75	.438	8.00	.750
63	B	18X10X .438/ .750T	15.37	13.57	550.6	18.75	.438	10.00	.750
64	B	14X 6X .625/1.125T	15.50	10.29	361.6	15.12	.625	6.00	1.125
65	B	16X10X .500/ .750T	15.50	12.05	442.5	16.75	.500	10.00	.750
66	B	14X10X .500/ .875T	15.75	11.13	330.0	14.87	.500	10.00	.875
67	B	14X 8X .563/1.000T	15.87	10.78	352.5	15.00	.563	8.00	1.000
68	B	16X 6X .625/1.000T	16.00	11.19	484.8	17.00	.625	6.00	1.000
69	B	16X 8X .563/ .875T	16.00	11.69	472.8	16.88	.563	8.00	.875
70	B	18X 8X .500/ .875T	16.00	13.13	594.1	18.87	.500	8.00	.875
71	B	18X10X .500/ .750T	16.50	13.26	602.9	18.75	.500	10.00	.750
72	B	21X 8X .500/ .750T	16.50	14.45	837.7	21.75	.500	8.00	.750
73	B	14X10X .563/ .875T	16.62	10.91	358.5	14.87	.563	10.00	.875
74	B	21X10X .438/ .750T	16.69	15.39	826.3	21.75	.438	10.00	.750
75	B	14X 8X .625/1.000T	16.75	10.58	378.7	15.00	.625	8.00	1.000
76	B	16X 6X .625/1.125T	16.75	11.45	509.5	17.12	.625	6.00	1.125
77	B	16X10X .500/ .875T	16.75	12.41	468.7	16.88	.500	10.00	.875
78	B	18X12X .438/ .750T	16.88	14.00	582.2	18.75	.438	12.00	.750
79	B	16X 8X .563/1.000T	17.00	12.00	498.7	17.00	.563	8.00	1.000
80	B	18X 8X .563/ .875T	17.12	12.86	642.4	18.87	.563	8.00	.875
81	B	21X 8X .500/ .875T	17.50	14.87	888.8	21.88	.500	8.00	.875
82	B	14X 8X .625/1.125T	17.75	10.83	397.6	15.12	.625	8.00	1.125
83	B	16X10X .563/ .875T	17.75	12.16	508.4	16.88	.563	10.00	.875
84	B	18X10X .500/ .875T	17.75	13.65	638.7	18.87	.500	10.00	.875
85	B	14X10X .563/1.000T	17.87	11.20	377.3	15.00	.563	10.00	1.000
86	B	16X 8X .625/1.000T	18.00	11.78	535.1	17.00	.625	8.00	1.000
87	B	18X12X .500/ .750T	18.00	13.69	638.9	18.75	.500	12.00	.750
88	B	21X10X .500/ .750T	18.00	15.03	903.6	21.75	.500	10.00	.750
89	B	24X10X .438/ .750T	18.00	17.16	1174.3	24.75	.438	10.00	.750
90	B	18X 8X .563/1.000T	18.13	13.19	677.4	19.00	.563	8.00	1.000
91	B	21X12X .438/ .750T	18.19	15.88	875.7	21.75	.438	12.00	.750
92	B	14X10X .625/1.000T	18.75	11.00	406.2	15.00	.625	10.00	1.000
93	B	21X 8X .563/ .875T	18.81	14.57	960.4	21.88	.563	8.00	.875
94	B	18X10X .563/ .875T	18.87	13.37	692.0	18.87	.563	10.00	.875
95	B	16X 8X .625/1.125T	19.00	12.06	561.6	17.12	.625	8.00	1.125
96	B	16X10X .563/1.000T	19.00	12.47	535.1	17.00	.563	10.00	1.000
97	B	18X 8X .625/1.000T	19.25	12.95	726.4	19.00	.625	8.00	1.000
98	B	21X10X .500/ .875T	19.25	15.47	957.4	21.88	.500	10.00	.875
99	B	18X12X .500/ .875T	19.50	14.08	675.3	18.87	.500	12.00	.875
100	B	21X12X .500/ .750T	19.50	15.52	959.4	21.75	.500	12.00	.750

ALUMINUM

STRUCTURAL SHAPE CATALOG (T AND BUILT"UP T)

K	SIZE	AST	CTOE	XIIT	D	TW	B	TF
101	B 24X10X .500/ .750T	19.50	16.76	1283.2	24.75	.500	10.00	.750
102	B 24X12X .438/ .750T	19.50	17.71	1246.6	24.75	.438	12.00	.750
103	B 21X14X .438/ .750T	19.69	16.30	917.6	21.75	.438	14.00	.750
104	B 21X 8X .563/1.000T	19.81	14.94	1011.9	22.00	.563	8.00	1.000
105	B 14X10X .625/1.125T	20.00	11.25	425.6	15.12	.625	10.00	1.125
106	B 16X10X .625/1.000T	20.00	12.25	575.4	17.00	.625	10.00	1.000
107	B 18X10X .563/1.000T	20.12	13.72	728.3	19.00	.563	10.00	1.000
108	B 18X 8X .625/1.125T	20.25	13.25	761.9	19.12	.625	8.00	1.125
109	B 21X10X .563/ .875T	20.56	15.15	1036.0	21.88	.563	10.00	.875
110	B 18X12X .563/ .875T	20.63	13.80	733.1	18.87	.563	12.00	.875
111	B 24X10X .500/ .875T	20.75	17.24	1359.3	24.87	.500	10.00	.875
112	B 21X12X .500/ .875T	21.00	15.97	1014.6	21.88	.500	12.00	.875
113	B 21X14X .500/ .750T	21.00	15.94	1007.3	21.75	.500	14.00	.750
114	B 24X12X .500/ .750T	21.00	17.30	1364.0	24.75	.500	12.00	.750
115	B 24X14X .438/ .750T	21.00	18.19	1308.5	24.75	.438	14.00	.750
116	B 27X10X .500/ .750T	21.00	18.46	1748.7	27.75	.500	10.00	.750
117	B 21X 8X .625/1.000T	21.12	14.67	1084.4	22.00	.625	8.00	1.000
118	B 16X10X .625/1.125T	21.25	12.53	602.7	17.12	.625	10.00	1.125
119	B 18X10X .625/1.000T	21.25	13.47	782.4	19.00	.625	10.00	1.000
120	B 21X10X .563/1.000T	21.81	15.54	1090.2	22.00	.563	10.00	1.000
121	B 18X12X .563/1.000T	22.12	14.15	770.0	19.00	.563	12.00	1.000
122	B 21X 8X .625/1.125T	22.12	15.00	1136.7	22.12	.625	8.00	1.125
123	B 24X10X .563/ .875T	22.25	16.89	1469.8	24.87	.563	10.00	.875
124	B 27X10X .500/ .875T	22.25	18.98	1852.0	27.87	.500	10.00	.875
125	B 21X12X .563/ .875T	22.31	15.65	1099.8	21.88	.563	12.00	.875
126	B 18X10X .625/1.125T	22.50	13.78	819.3	19.12	.625	10.00	1.125
127	B 24X12X .500/ .875T	22.50	17.80	1442.9	24.87	.500	12.00	.875
128	B 24X14X .500/ .750T	22.50	17.77	1434.1	24.75	.500	14.00	.750
129	B 27X12X .500/ .750T	22.50	19.05	1860.1	27.75	.500	12.00	.750
130	B 21X14X .500/ .875T	22.75	16.39	1063.0	21.88	.500	14.00	.875
131	B 21X12X .563/1.000T	23.81	16.04	1155.4	22.00	.563	12.00	1.000
132	B 21X10X .625/1.000T	23.13	15.26	1169.9	22.00	.625	10.00	1.000
133	B 18X12X .625/1.000T	23.25	13.90	828.8	19.00	.625	12.00	1.000
134	B 24X10X .563/1.000T	23.50	17.32	1546.4	25.00	.563	10.00	1.000
135	B 27X10X .563/ .875T	23.94	18.59	2001.6	27.87	.563	10.00	.875
136	B 24X12X .563/ .875T	24.00	17.44	1562.3	24.87	.563	12.00	.875
137	B 27X12X .500/ .875T	24.00	19.60	1968.1	27.87	.500	12.00	.875
138	B 27X14X .500/ .750T	24.00	19.57	1957.7	27.75	.500	14.00	.750
139	B 21X14X .563/ .875T	24.06	16.07	1154.3	21.88	.563	14.00	.875
140	B 24X14X .500/ .875T	24.25	18.28	1514.5	24.87	.500	14.00	.875
141	B 21X10X .625/1.125T	24.38	15.61	1224.9	22.12	.625	10.00	1.125
142	B 18X12X .625/1.125T	24.75	14.22	866.3	19.12	.625	12.00	1.125
143	B 24X10X .625/1.000T	25.00	17.00	1658.3	25.00	.625	10.00	1.000
144	B 21X12X .625/1.000T	25.12	15.75	1241.9	22.00	.625	12.00	1.000
145	B 27X10X .563/1.000T	25.19	19.06	2105.3	28.00	.563	10.00	1.000
146	B 24X12X .563/1.000T	25.50	17.88	1641.6	25.00	.563	12.00	1.000
147	B 27X12X .563/ .875T	25.69	19.20	2129.2	27.87	.563	12.00	.875
148	B 24X14X .563/ .875T	25.75	17.92	1642.3	24.87	.563	14.00	.875
149	B 27X14X .500/ .875T	25.75	20.13	2068.5	27.87	.500	14.00	.875
150	B 21X14X .563/1.000T	25.81	16.47	1210.5	22.00	.563	14.00	1.000

A L U M I N U M

STRUCTURAL SHAPE CATALOG (T AND BUILT"UP T)

K		SIZE	AST	CTOE	XIIT	D	TW	B	TF
151	B	24X10X .625/1.125T	26.25	17.38	1735.7	25.12	.625	10.00	1.125
152	B	21X12X .625/1.125T	26.62	16.11	1298.2	22.12	.625	12.00	1.125
153	B	27X10X .625/1.000T	26.88	18.71	2256.7	28.00	.625	10.00	1.000
154	B	24X12X .625/1.000T	27.00	17.56	1762.7	25.00	.625	12.00	1.000
155	B	21X14X .625/1.000T	27.12	16.18	1303.2	22.00	.625	14.00	1.000
156	B	27X12X .563/1.000T	27.19	19.68	2237.5	28.00	.563	12.00	1.000
157	B	27X14X .563/ .875T	27.44	19.72	2240.6	27.87	.563	14.00	.875
158	B	24X14X .563/1.000T	27.50	18.36	1723.0	25.00	.563	14.00	1.000
159	B	27X10X .625/1.125T	28.13	19.12	2361.2	28.13	.625	10.00	1.125
160	B	24X12X .625/1.125T	28.50	17.95	1842.8	25.12	.625	12.00	1.125
161	B	21X14X .625/1.125T	28.87	16.53	1360.1	22.12	.625	14.00	1.125
162	B	27X12X .625/1.000T	28.87	19.32	2400.7	28.00	.625	12.00	1.000
163	B	24X14X .625/1.000T	29.00	18.03	1852.6	25.00	.625	14.00	1.000
164	B	27X14X .563/1.000T	29.19	20.22	2351.6	28.00	.563	14.00	1.000
165	B	27X12X .625/1.125T	30.37	19.75	2509.7	28.13	.625	12.00	1.125
166	B	24X14X .625/1.125T	30.75	18.43	1934.2	25.12	.625	14.00	1.125
167	B	27X14X .625/1.000T	30.87	19.85	2526.1	28.00	.625	14.00	1.000
168	B	27X14X .625/1.125T	32.62	20.29	2637.8	28.13	.625	14.00	1.125

SECTION 9. MATERIAL PROPERTIES AND STRUCTURAL SHAPES AND PLATE CATALOGS

STEEL PLATE CATALOG

CODE NUMBER	THICKNESS, INCHES
1	.1250
2	.1563
3	.1875
4	.2188
5	.2500
6	.2813
7	.3125
8	.3438
9	.3750
10	.4375
11	.5000
12	.5625
13	.6250
14	.6875
15	.7500
16	.8750
17	1.0000
18	1.1250
19	1.2500
20	1.3750
21	1.5000
22	1.7500
23	2.0000

ALUMINUM PLATE CATALOG

CODE NUMBER	THICKNESS, INCHES
1	.1250
2	.1875
3	.2500
4	.3125
5	.3750
6	.4375
7	.5000
8	.5625
9	.6250
10	.7500
11	.8750
12	1.0000
13	1.1250
14	1.2500
15	1.3750
16	1.5000
17	1.7500
18	2.0000

SECTION 10. BLANK INPUT FORMS

The following set of blank input forms may be removed and reproduced by the program user.

DATA SHEET NO. 1

RUN IDENTIFICATION CARD 1

NUMBER OF SECTIONS	OUTPUT INDICATOR	

RUN IDENTIFICATION CARD 2

JOB IDENTIFICATION, USER'S NAME, PHONE NUMBER, DATE, ETC.

GENERAL INFORMATION CARD 1

LENGTH BETWEEN PERPS. (feet)	DEPTH OF HULL (feet)	MAX. HALF-BREADTH (feet)	FULL LOAD DRAFT (feet)	OUTSIDE DOUBLE BOTTOM		LENGTH BETWEEN TRANSVERSE BULKHEADS (feet)	ANGLE OF HEEL (degrees)	SHELL DESIGN HEAD (feet)	MIN. SHELL DESIGN PRESSURE (psf)	WAVE HEIGHT COEF.	
				BEAM DESIGN LENGTH (feet)	PANEL DESIGN LENGTH (feet)						

GENERAL INFORMATION CARD 2

TOTAL NUMBER OF POINTS FOR ONE SIDE	NUMBER OF SHELL SEGMENTS FOR ONE SIDE	NUMBER OF DECKS	NUMBER OF BULKHEADS FOR ONE SIDE	NUMBER OF DECK REGIONS	AREA ADDITION BOTTOM SHELL SEG. NOS.		REMOVALS			INDICATORS						IF INNERBOTTOM INDICATOR = 0, THEN THESE DATA ITEMS ARE TO BE OMITTED						
					FROM	TO	TOTAL NUMBER IN SHELL (ONE SIDE)	TOTAL NUMBER IN DECKS (ONE SIDE)	TOTAL NUMBER IN BULKHEADS (ONE SIDE)	TYPE OF MATERIAL	BEAM SPAN DESCRIPTION	NUCLEAR BLAST 0 = NO, 1 = YES	INNER BOTTOM 0 = NO, 1 = YES	BEAM I.L.S. 0 = NO, 1 = YES	SC 4020 PLOT 0 = NO, 1 = YES	NUMBER OF I.B. SEGMENTS (ONE SIDE)	NUMBER OF D.B. PLT. LONGLS. (ONE SIDE)	D.B. GIRDER ANALYSIS 0 = NO, 1 = YES	MAX. PERMISSIBLE DEPTH OF I.B. BEAMS (inches)	WITHIN DOUBLE BOTTOM		D.B. GIRDER DESIGN LENGTH (feet)	
																			BEAM DESIGN LENGTH (feet)	PANEL DESIGN LENGTH (feet)		

DATA SHEET NO. 2

GENERAL INFORMATION CARD 3

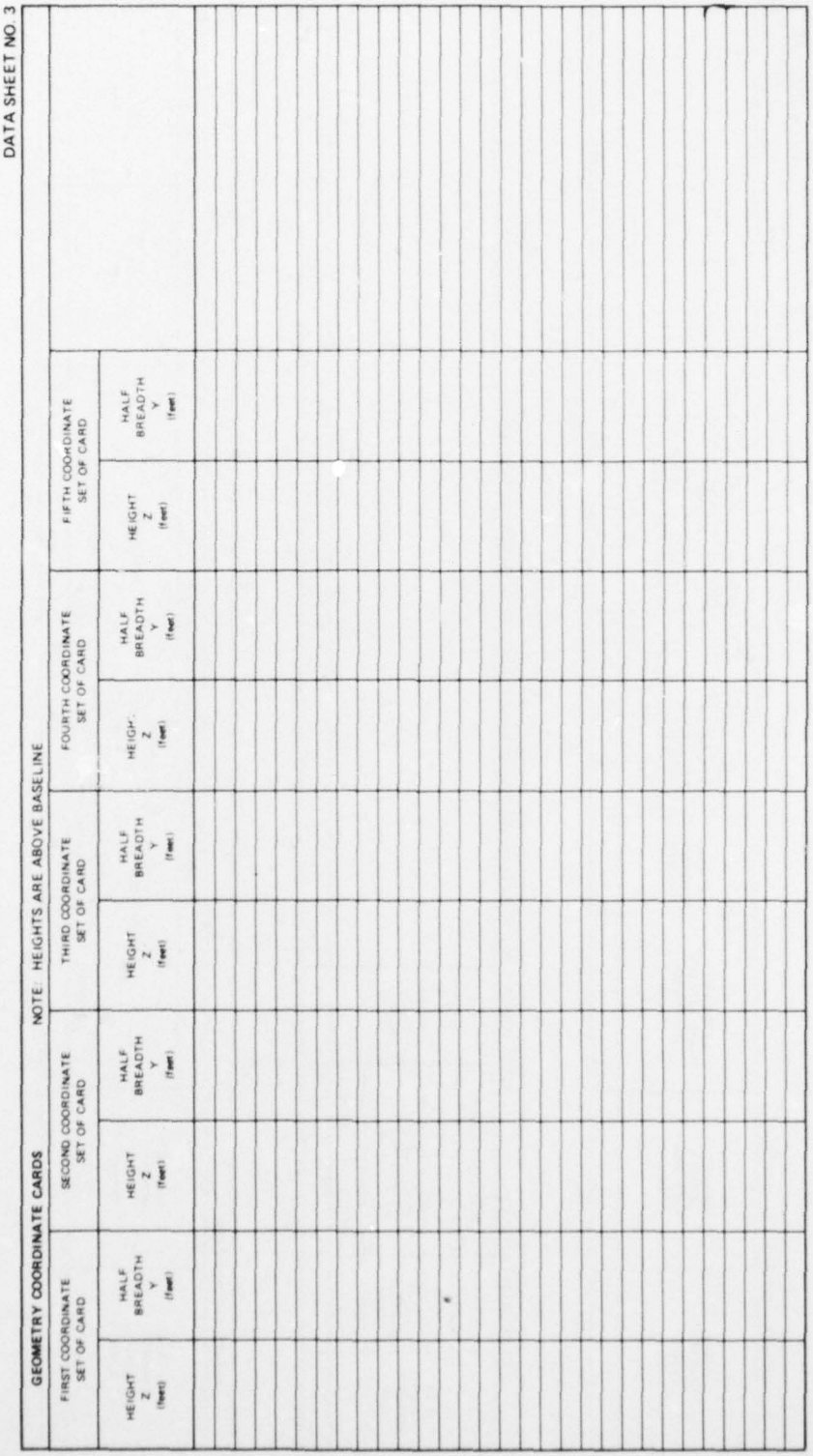
DESIGN MARGINAL STRESS (psi)	PRIMARY STRESS TOLERANCE (psi)	STRINGER - SHEERSTRAKE TOLERANCE (inches)	PRIMARY STRESS FACTOR	COMBINE PRIMARY STRESS WITH SLAM STRESS 0 = NO, 1 = YES	USE K vs. PE CURVE 0 = NO, 1 = YES	INPUT VALUES - K vs. PE CURVE			
						K FOR POINT 1	PE FOR POINT 1	PE FOR POINT 2	

NUCLEAR BLAST CARD NOTE: IF SHIP IS **NOT** TO BE DESIGNED FOR NUCLEAR BLAST, THIS CARD **MUST BE OMITTED.**

PEAK OVER-PRESSURE (psi)	HEIGHT OF SUPER-STRUCTURE ABOVE WEATHER DECK (feet)	DUCTILITY FACTORS		WEAPON YIELD (megatons)	
		RATIO OF MAXIMUM PLASTIC DEFL. TO ELASTIC DEFL.			
		SHELL	DECK		

PRIMARY STRESS CARD

BENDING MOMENT SAG (ft - tons)	BENDING MOMENT HOG (ft - tons)	ASSUMED CALCULATED PRIMARY STRESSES (psi)				DESIGN LIMITING PRIMARY STRESS	
		DECK FIBER		KEEL FIBER		DECK FIBER (psi)	KEEL FIBER (psi)
		SAGGING	HOGGING	SAGGING	HOGGING		
		+	-	-	+		



DATA SHEET NO. 3

GEOMETRY COORDINATE CARDS

NOTE: HEIGHTS ARE ABOVE BASELINE

FIRST COORDINATE SET OF CARD		SECOND COORDINATE SET OF CARD		THIRD COORDINATE SET OF CARD		FOURTH COORDINATE SET OF CARD		FIFTH COORDINATE SET OF CARD		
HEIGHT Z (feet)	HALF BREADTH Y (feet)	HEIGHT Z (feet)	HALF BREADTH Y (feet)	HEIGHT Z (feet)	HALF BREADTH Y (feet)	HEIGHT Z (feet)	HALF BREADTH Y (feet)	HEIGHT Z (feet)	HALF BREADTH Y (feet)	

DATA SHEET NO. 4

SHELL MASTER FLAG CARD NOTE: CONTINUE FLAGS ONTO SECOND CARD IF NEEDED.

FLAGS DEFINE SHELL SEGMENT EXTREMITIES N = NUMBER OF SHELL SEGMENTS FOR ONE SIDE

1ST FLAG	2ND FLAG	3RD FLAG	4TH FLAG	5TH FLAG	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	NTH FLAG	N + 1 FLAG	

DECK MASTER FLAG CARDS

FLAGS DEFINE DECK SEGMENT EXTREMITIES N = NUMBER OF SEGMENTS FOR DECK

DECK NUMBER DO NOT INPUT	1ST FLAG	2ND FLAG	3RD FLAG	4TH FLAG	5TH FLAG	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	NTH FLAG	N + 1 FLAG	
1																				
2																				
3																				
4																				
5																				
6																				
7																				
8																				
9																				
10																				
11																				
12																				

DATA SHEET NO. 5

BULKHEAD MASTER FLAG CARDS NOTE: IF NO BULKHEADS ARE SPECIFIED, THESE CARDS **MUST BE OMITTED.**

FLAGS DEFINE BULKHEAD SEGMENT EXTREMITIES N = NUMBER OF SEGMENTS FOR BULKHEAD

BULKHEAD NO. DO NOT INPUT	1ST FLAG	2ND FLAG	3RD FLAG	4TH FLAG	5TH FLAG	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	NTH FLAG	N+1 FLAG	
1																				
2																				
3																				
4																				
5																				
6																				
7																				

INNERBOTTOM MASTER FLAG CARD NOTE: IF THERE IS NO INNERBOTTOM, THIS CARD **MUST BE OMITTED.**

FLAGS DEFINE INNERBOTTOM SEGMENT EXTREMITIES N = NUMBER OF INNERBOTTOM SEGMENTS FOR ONE SIDE

1ST FLAG	2ND FLAG	3RD FLAG	4TH FLAG	5TH FLAG	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	NTH FLAG	N+1 FLAG	

CVK AND DOUBLE BOTTOM PLATE LONGITUDINAL MASTER FLAG CARD NOTE: CONTINUE FLAGS ONTO SECOND CARD IF NEEDED.

NOTE: IF THERE IS NO INNERBOTTOM, THIS CARD **MUST BE OMITTED.**

CVK-SHL FLAG	CVK-IB FLAG	1ST DBL-SHL FLAG	1ST DBL-IB FLAG	2ND DBL-SHL FLAG	2ND DBL-IB FLAG	3RD DBL-SHL FLAG	3RD DBL-IB FLAG	4TH DBL-SHL FLAG	4TH DBL-IB FLAG	5TH DBL-SHL FLAG	5TH DBL-IB FLAG	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	. . .	NTH DBL-SHL FLAG	NTH DBL-IB FLAG	

DATA SHEET NO. 6

DECK IDENTIFICATION CARD

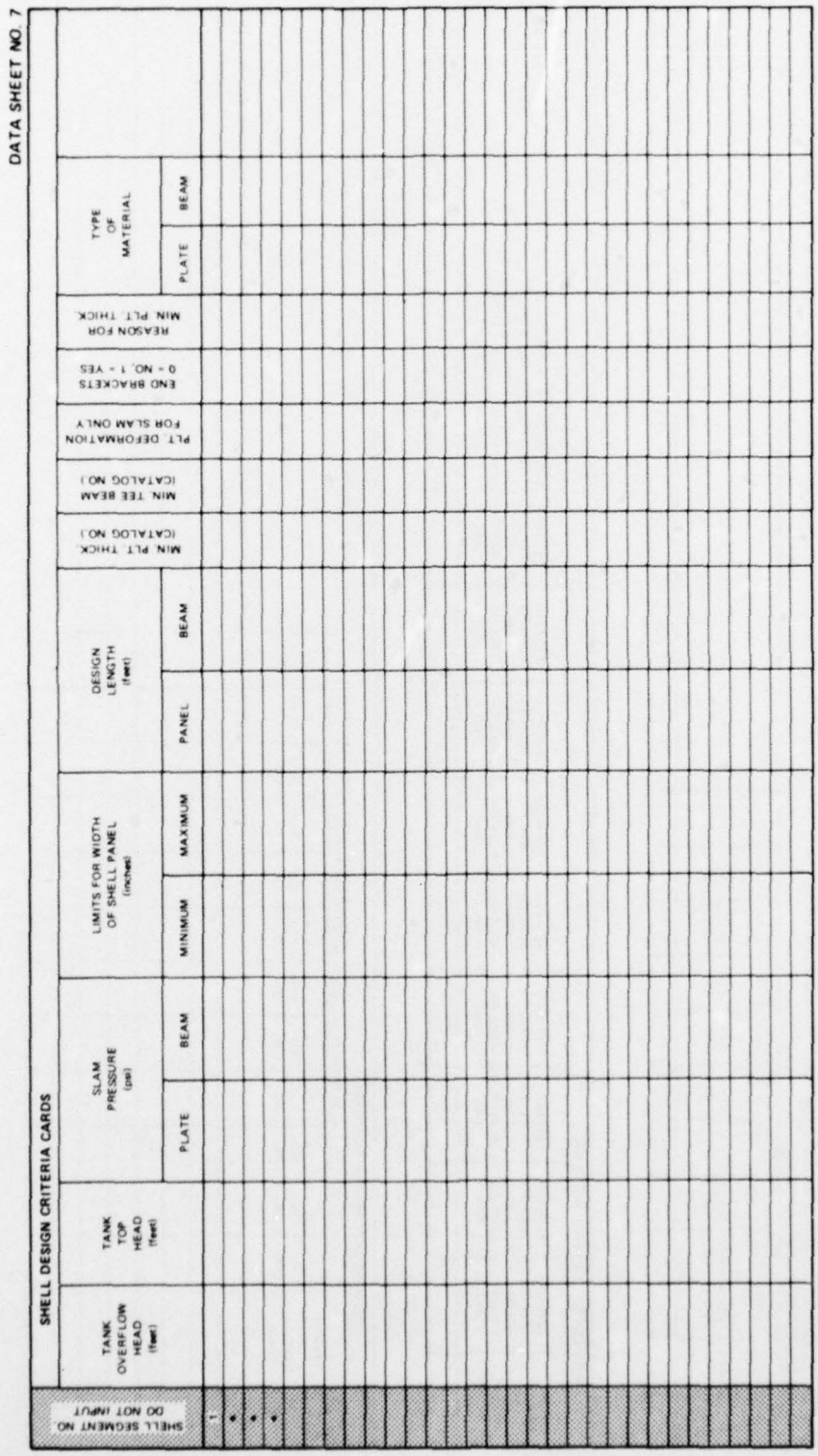
1 = CONTINUOUS DECK, 0 = INTERCOSTAL DECK												
1ST DK.	2ND DK.	3RD DK.	4TH DK.	5TH DK.	6TH DK.	7TH DK.	8TH DK.	9TH DK.	10TH DK.	11TH DK.	12TH DK.	

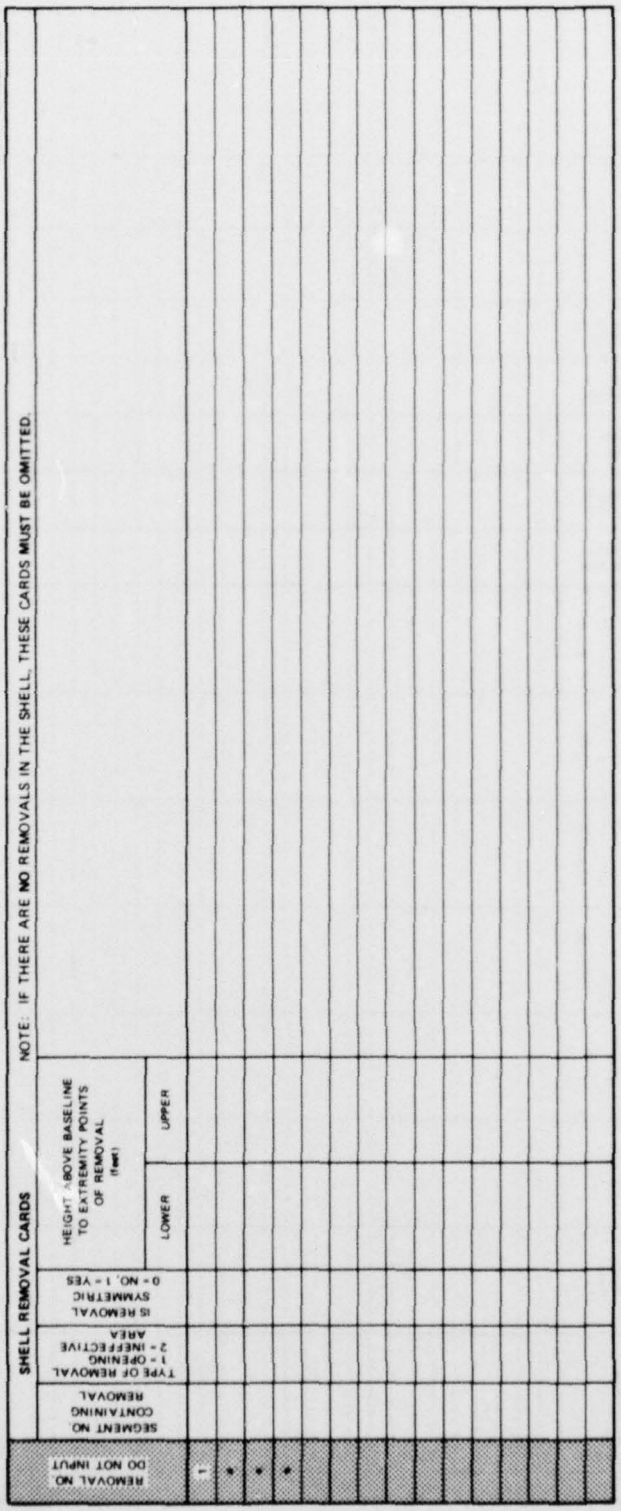
BETWEEN DECK CLEARANCE CARD

BETWEEN DECK #1 AND BOTTOM STRUCTURE (feet)	BETWEEN DECK #2 AND DECK #1 (feet)	BETWEEN DECK #3 AND DECK #2 (feet)	BETWEEN DECK #4 AND DECK #3 (feet)	BETWEEN DECK #5 AND DECK #4 (feet)	BETWEEN DECK #6 AND DECK #5 (feet)	BETWEEN DECK #7 AND DECK #6 (feet)	BETWEEN DECK #8 AND DECK #7 (feet)	BETWEEN DECK #9 AND DECK #8 (feet)	BETWEEN DECK #10 AND DECK #9 (feet)	BETWEEN DECK #11 AND DECK #10 (feet)	BETWEEN DECK #12 AND DECK #11 (feet)	

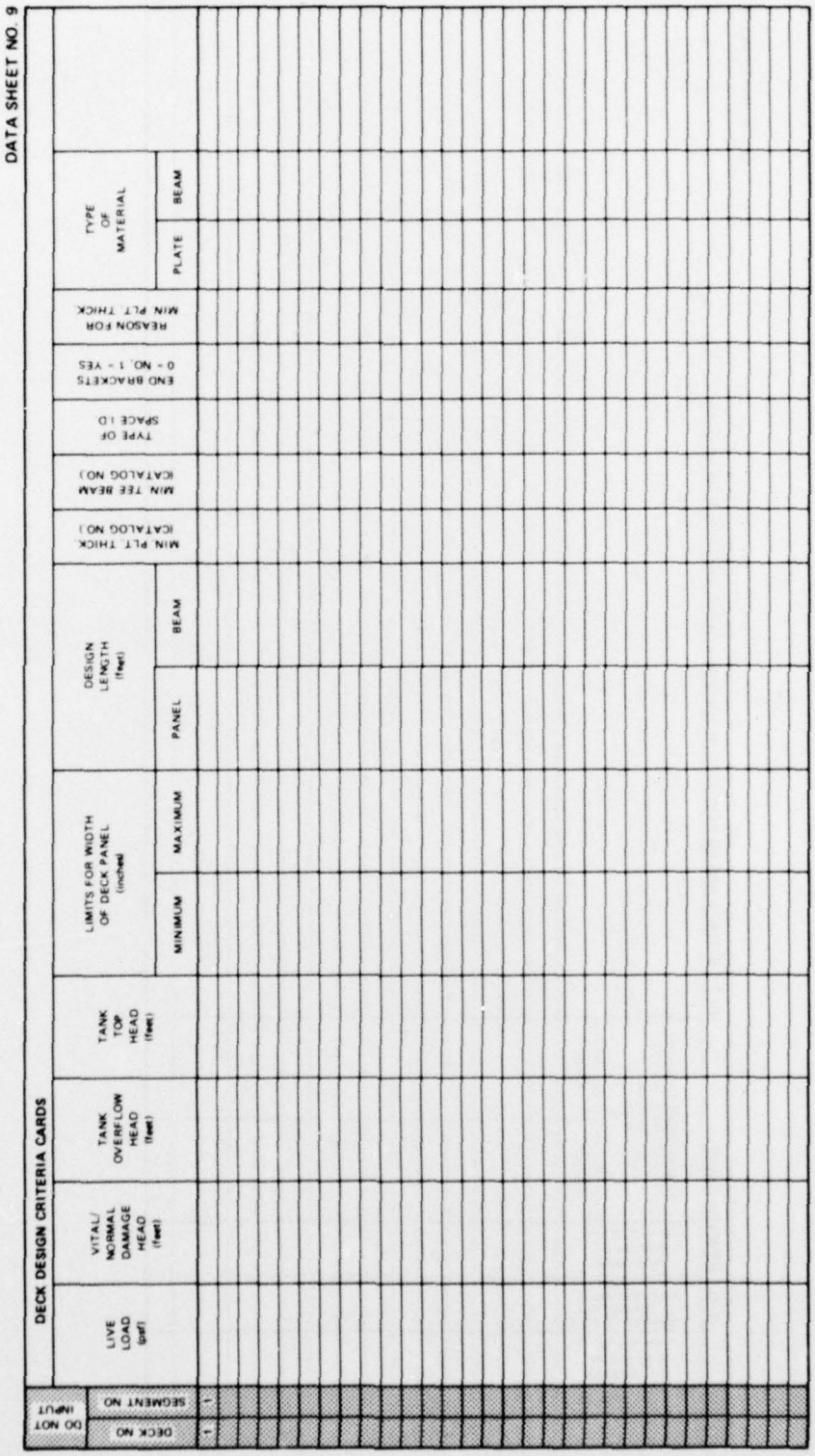
DECK REGION DESCRIPTION CARDS

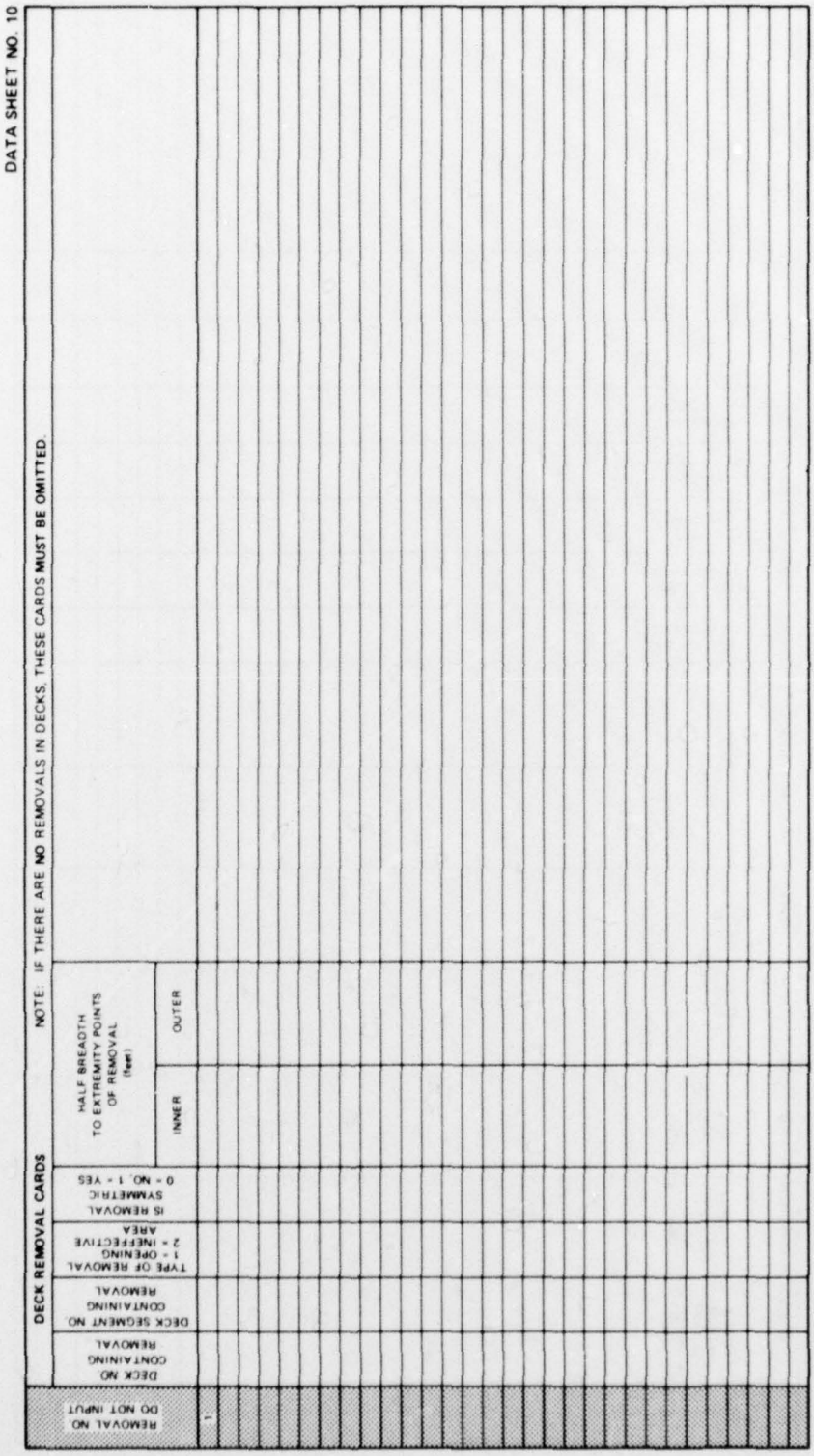
REGION NO. DO NOT INPUT	WIDTH OF REGION (feet)	NUMBER OF SEGMENTS PER DECK PER REGION												
		1ST DK.	2ND DK.	3RD DK.	4TH DK.	5TH DK.	6TH DK.	7TH DK.	8TH DK.	9TH DK.	10TH DK.	11TH DK.	12TH DK.	
1														
2														
3														
4														
5														
6														
7														
8														

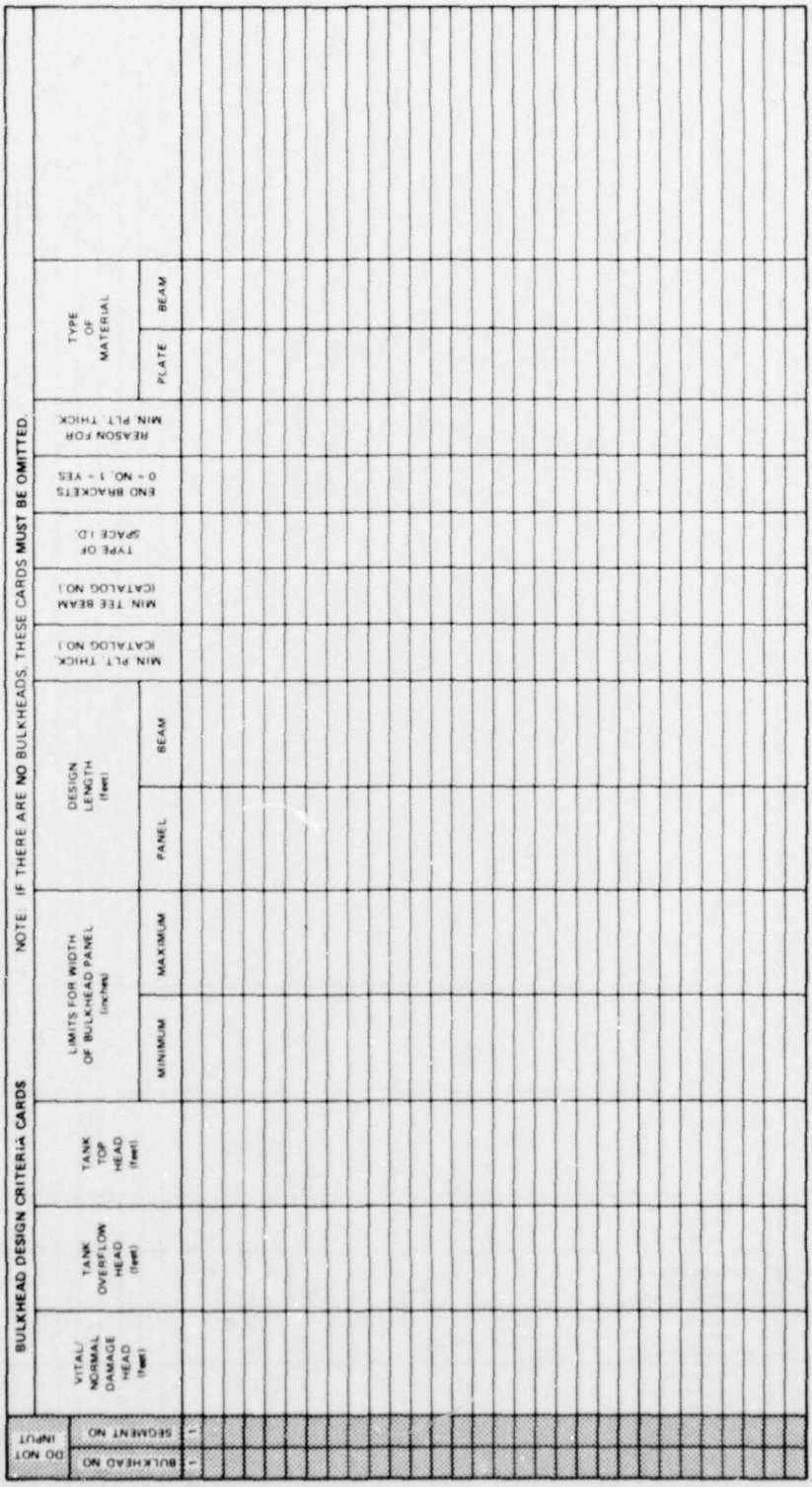

DATA SHEET NO. 7
SHELL DESIGN CRITERIA CARDS
SHELL SEGMENT NO
DO NOT INPUT
TANK OVERFLOW HEAD (feet)
TANK TOP HEAD (feet)
SLAM PRESSURE (psi)
PLATE
BEAM
LIMITS FOR WIDTH OF SHELL PANEL (inches)
MINIMUM
MAXIMUM
DESIGN LENGTH (feet)
PANEL
BEAM
MIN. PLT. THICK (CATALOG NO.)
MIN. TEE BEAM (CATALOG NO.)
PLT. DEFORMATION FOR SLAM ONLY
END BRACKETS 0 = NO, 1 = YES
REASON FOR MIN. PLT. THICK
TYPE OF MATERIAL
PLATE
BEAM
1
*
*
*


DATA SHEET NO. 8
NOTE: IF THERE ARE NO REMOVALS IN THE SHELL, THESE CARDS MUST BE OMITTED.
SHELL REMOVAL CARDS
REMOVAL NO
DO NOT INPUT
SEGMENT NO CONTAINING REMOVAL
TYPE OF REMOVAL 1 - OPENING 2 - INEFFECTIVE AREA
IS REMOVAL SYMMETRIC 0 - NO, 1 - YES
HEIGHT ABOVE BASELINE TO EXTREMITY POINTS OF REMOVAL (feet)
LOWER
UPPER
1
*
*
*

SECTION 10. BLANK INPUT FORMS



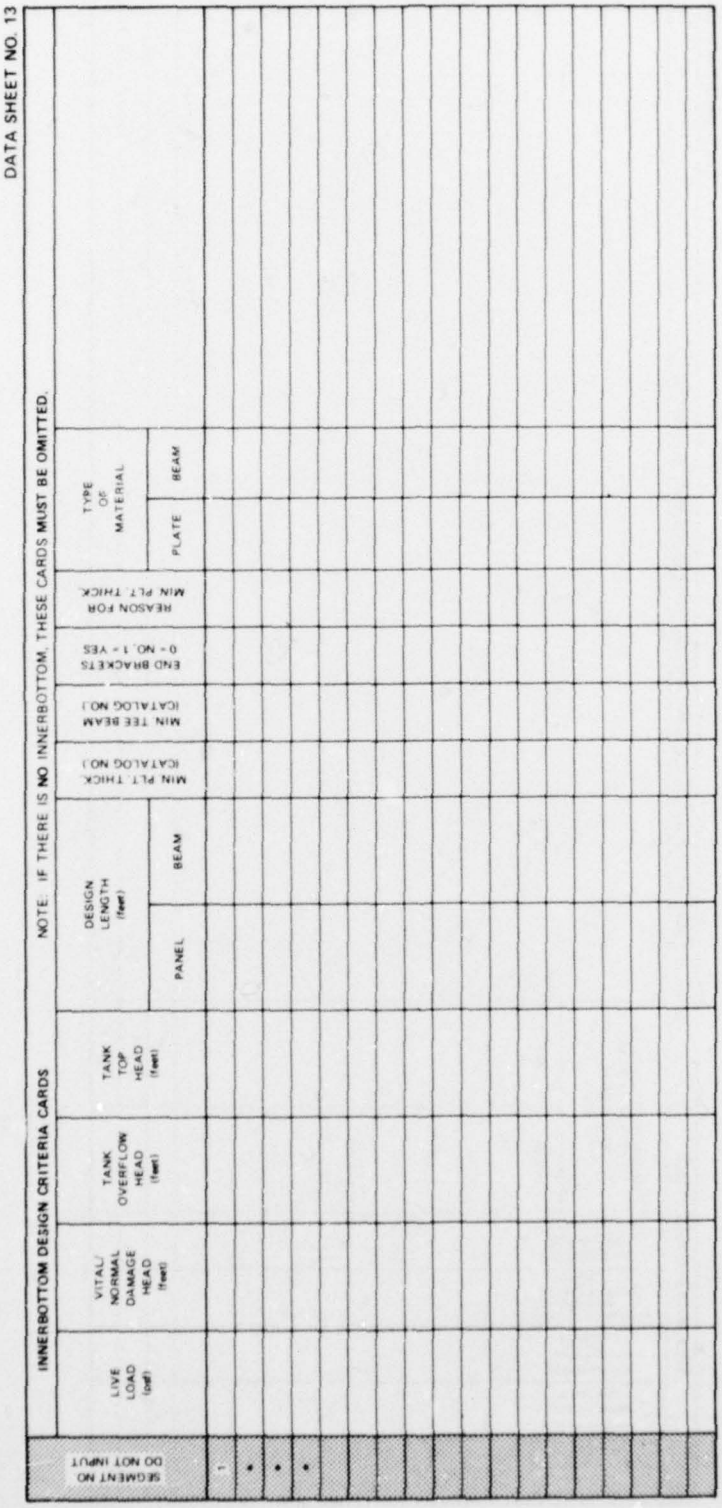

DATA SHEET NO. 10
DECK REMOVAL CARDS
NOTE: IF THERE ARE NO REMOVALS IN DECKS, THESE CARDS MUST BE OMITTED.
REMOVAL NO
DO NOT INPUT
DECK NO CONTAINING REMOVAL
DECK SEGMENT NO CONTAINING REMOVAL
TYPE OF REMOVAL
1 = OPENING
2 = INEFFECTIVE AREA
IS REMOVAL SYMMETRIC
0 = NO, 1 = YES
HALF BREADTH TO EXTREMITY POINTS OF REMOVAL (feet)
INNER
OUTER
1


DATA SHEET NO. i1
BULKHEAD DESIGN CRITERIA CARDS
NOTE: IF THERE ARE NO BULKHEADS, THESE CARDS MUST BE OMITTED.
DO NOT INPUT
BULKHEAD NO
SEGMENT NO
VITAL/ NORMAL DAMAGE HEAD (feet)
TANK OVERFLOW HEAD (feet)
TANK TOP HEAD (feet)
LIMITS FOR WIDTH OF BULKHEAD PANEL (inches)
MINIMUM
MAXIMUM
DESIGN LENGTH (feet)
PANEL
BEAM
MIN PLT. THICK. (CATALOG NO.)
MIN TEE BEAM (CATALOG NO.)
TYPE OF SPACE I.D.
END BRACKETS 0 = NO, 1 = YES
REASON FOR MIN PLT. THICK.
TYPE OF MATERIAL
PLATE
BEAM

DATA SHEET NO. 12

BULKHEAD REMOVAL CARDS NOTE: IF THERE ARE **NO** REMOVALS IN BULKHEADS, THESE CARDS **MUST BE OMITTED**

REMOVAL NO DO NOT INPUT	BULKHEAD NO CONTAINING REMOVAL	SEGMENT NO CONTAINING REMOVAL	TYPE OF REMOVAL 1 = OPENING 2 = INEFFECTIVE AREA	IS REMOVAL SYMMETRIC 0 = NO, 1 = YES	HEIGHT ABOVE BASELINE TO EXTREMITY POINTS OF REMOVAL (feet) LOWER	HEIGHT ABOVE BASELINE TO EXTREMITY POINTS OF REMOVAL (feet) UPPER
-	*	*	*			



DATA SHEET NO. 13

INNERBOTTOM DESIGN CRITERIA CARDS

NOTE: IF THERE IS NO INNERBOTTOM, THESE CARDS MUST BE OMITTED.

SEGMENT NO DO NOT INPUT	LIVE LOAD (psf)	VITAL/ NORMAL DAMAGE HEAD (feet)	TANK OVERFLOW HEAD (feet)	TANK TOP HEAD (feet)	DESIGN LENGTH (feet)		MIN PLT. THICK (CATALOG NO.)	MIN TEE BEAM (CATALOG NO.)	END BRACKETS 0 - NO, 1 - YES	REASON FOR MIN PLT. THICK	TYPE OF MATERIAL	
					PANEL	BEAM					PLATE	BEAM
1												
*												
*												
*												

DATA SHEET NO. 14

CENTER VERTICAL KEEL DESIGN CRITERIA CARD — NOTE: IF THERE IS NO INNERBOTTOM, THIS CARD MUST BE OMITTED.

1 = WATERTIGHT 0 = NONWATERTIGHT	MIN. PLT. THICK. (CATALOG NO.)	PANEL DESIGN LENGTH (feet)	SLAM PRESSURE FOR D.B. GIRDER ANALYSIS (psi)	FOR WATERTIGHT CVK		REASON FOR MIN. PLT. THICK.	TYPE OF MATERIAL FOR PLATE	
				DAMAGE HEAD (feet)	TANK OVERFLOW HEAD (feet)			

DOUBLE BOTTOM PLATE LONGITUDINAL DESIGN CRITERIA CARDS — NOTE: IF THERE ARE NO D.B. PLT. LONGLS., THESE CARDS MUST BE OMITTED.

D.B. PLT. LONGL. NO. DO NOT INPUT	1 = WATERTIGHT 0 = NONWATERTIGHT	MIN. PLT. THICK. (CATALOG NO.)	PANEL DESIGN LENGTH (feet)	SLAM PRESSURE FOR D.B. GIRDER ANALYSIS (psi)	FOR WATERTIGHT DBL		REASON FOR MIN. PLT. THICK.	TYPE OF MATERIAL FOR PLATE	
					DAMAGE HEAD (feet)	TANK OVERFLOW HEAD (feet)			
1									
↓									
↓									
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REFERENCES

1. Nappi, N. S. and F. M. Lev, "Midship Section Design for Naval Ships", NSRDC Report 3815 (1972).

2. Aronne, E. L. et al., "Structural Weight Determination for SWATH Ships," American Institute of Aeronautics and Astronautics Paper 74-326, Advanced Marine Vehicles Conference, San Diego, Calif. (Feb 1974).

3. Department of the Navy, "General Specifications for Ships of the United States Navy," Naval Ship Engineering Center Section 100, General Requirements for Hull Structure, (1 Jan 1972).

4. Society of Naval Architects and Marine Engineers, "Manual of Properties of Combined Beam and Plate, Part I, Tees and Angles," for Dept. of Commerce, NAVSHIPS 250-443-1, Part I (undated).

5. Lev, F. M., and N. S. Nappi, "Properties of Combined Aluminum Beam and Plate," NSRDC Report 4336 (1974).