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#### A USER'S VIEW OF THE SPADES HULLOAD PROGRAM FOR SPECIFYING SHIP STRUCTURE

#### E. Eugene Mayer Livingston Shipbuilding Company Orange, Texas

As Engineering Hull Section Manager, Mr. Mayer is currently responsible for all engineering hull structural drawing development, N/C hulload coding, N/C development within shipyard and welding and hull structural standards development. He has 18 years experience in shipbuilding engineering spanning three shipbuilding concerns (Todd-Houston, Gulfport and Livingston) as drafting designer in all shipbuilding disciplines, drafting supervisor, assistant chief hull engineer and hull section manager.

#### INTRODUCTION

Livingston Shipbuilding is a medium to small shipbuilding complex that builds both conventional marine vessels and offshore drilling equipment. We have been involved with Numerical Control Lofting for over three (3) years and have built three (3) jack-up drilling rigs, two (2) drill ships, a Great Lakes products carrier and processed several industrial products, contracts with the N/C controlled burning machine.

The Engineering Hull Section is responsible for the loading of the data base with SPADES HULLAD program. This program defines the locations of decks, sight edges, longitudinal bulkheads and all structures that Comprise a marine vessel. This program is easy to implement and the Hull Section draftsmen are used as programmers for establishing this important part of the ship's data base.

#### HULLOAD MODULE

About three years ago I was called into the front office and told that I was chosen to participate in a new program called Numerical Controlled Lofting. Having been in shipyards for several years I knew what lofting was, but I had no previous knowledge of numerical control and being from engineering, what function I would have in relation to lofting. When told that the ultimate goal of N\C lofting was to automatically mark and cut ship parts out of steel, I was both amazed and curious. The next thing to do was to learn what this new system consisted of and exactly the role engineering would have.

N\C lofting is divided into four main parts; fairing the lines, defining the structural locations, generating the ship parts and nesting

hose parts on plates for marking and burning. The lines drawings are usually a function of the Engineering Design Section with input from the Hull Section concerning cant frame locations and additional frames for erection butts if required. The Hull Section with drawings sets the locations of hull structural item and it is only natural that the Engineering Hull Section be responsible for implementation of the N/C program that defines hull structures. Since the N/C system that Livingston chose was the SPADES (Ship Production and Design Engineering Systems) system, the particular name for the program that defines structural locations is called the HULLOAD program. Management felt that the N\C HULLOAD program should remain an Engineering Hull Section function rather than a loft function, as is the case in many other shipbuilding facilities.

The next problem to solve was how to implement this new system and who to choose for training in HULLOAD coding. We felt that our experienced draftsmen would be the best choice, since loading of hull structure into a data base is similar to defining structure locations on engineering drawings. The process of teaching our present staff of draftsmen would be easier than increasing our overhead specifically for computer oriented people who knew nothing about hull structures. The choice proved to be correct since the engineering people sent for training learned enough about HULLOAD coding in two weeks to become proficient enough for normal loading.

Of course, not everyone exposed to N\C coding can become proficient; however, out of the twenty plus people trained in our facility, only five percent are completely inapt with another fifteen percent limited

in their ability to fully code- SPADESN HULLOAD. This, of course, is not to say that our training procedure is that efficient, as it is actually a testament to the ease of the SPADES HULLOAD coding system.

The HULLOAD coding system developed by Cali and Associates is based on shipbuilding terms, or retire specifically abbreviations of shipbuilding terms. Such terms as DECK, CUTS, MANU and LINE are examples of the many such commands used for commands. Ah Engineering Hull Section draftsman has no trouble understanding the code words used with this system as for example, the code for longitudinal bulkhead ie "TRUD"

The codewords of this system are not the only part of HULLOAD coding that is easy for the coder to understand. The center of the program is the coordinate system which is built around the same system the manual system uses. Heights, halfbreadths and longitudinal center of gravity as represented by the X, Y, and Z axis-are as common to shipbuilding as is port and starboard. As for *port*, that *is the* side that the structure is normally loaded to; but, as ships and marine equipment are not always symmetrical., the option to load differences between port and starboard exist and is easy to do.

In the SPADES SYSTEM of coding, there are four cards or coding lines that precede each program. These are the \*JOB, INPS(input start), OPTN (options), and RMKS (remarks) commands. These commands set the conditions of loading such as the tape number, measurement system, load or no load and remain the same for each tape number loaded into the Data Base.

With this program. the easiest structrual items to load are the decks and longitudinal bulkheads. A flat deck and straight longitudinal bulkhead can be loaded with **only** a one card description each. Decks with shear and more commonly camber take a minimum of five cards with loading for shear taking the most because of the offsets required. Longitudinal bulkheads may be loaded in almost any configuration including different off centerline dimensions and sloped hopper type commonly used in cargo holds.

Defining shell, longitudinal bulkhead and deck traces are also easy to load; but due to the number of traces usually required on a marine vessel, it is time consuming. A seam or stiffener trace usually requires only three lines or cards for straight line loading and with new commands REFR (reference) and RLTV (relative) even less cards are required. The new commands load each trace parallel to a previous trace by the given increments. Also, for adjustments to traces after loading is complete, a single trace can be moved without disturbing other traces with the new \* SLT (select) command. This command will also work for changing decks and longitudinal bulkheads.

Probably the most difficult to load and teach how to load is the cutout definition for stiffener notches. The reason for this difficulty is the number of different cutouts usually required for ships and the description consists of manual line and circle commands which require about seven cards each. The orientation of cutout loading is also a problem due to the numerous ways stiffeners can be positioned on a ship. Loading the stiffener size itself is done with the MEMB (member) and type commands. This series of commands loads the structural members and the type of notch required to its respective trace.

The SPADES HULLOAD program is priobably the best of such programs, but there are still some problems. For instance, there is a difficulty in loading sight edges to the extreme ends of a fine lined ship, but this can be implemented with manual manipulations of the input points. Another item that is causing some difficulty is the loading of additional frames or transverse lines in between frame spaces for such things as master erection butts. However, this too can be implemented by loading additional frames with the Lines Fairing Program. So, the only real problem that the program has left the user shipyard with is the inability offloading transverse bulkheads. Even this may soon become a possibility for SPADES Users.

#### NEW FEATURES IN HULLOAD

Due to be released are several new features for ease of HULLOAD coding, such as the use of a "RANGE" command for the laborious. coding of member type structural definition commands. The ability to override with the use of "Exclude" and "Include" features will be used in conjunction with commands like "RANGE" for dissimilarities in structure locations. New commands for HULLOAD that are now used in parts generation module are the "LOO", ''REP" (repetition), SUB\* (sub-input data set), "JUMP", and logical "IF" commands all of which should ease the amount of coding required for each new, contract.

Another item that should help ease the amount of HULLOAD coding will be the ability to load a surface (deck or longitudinal bulkhead) relative to an existing trace or another surface. Also to be included in the next release will be the mathematical definition of flat surfaces such as deck

and bulkheads with straight sheer and/or camber, will be **stored on the** data base as part of the future surface control records.

#### THE FUTURE PROSPECTS FOR HULLOAD

The future of the HULLOAD module is very bright and will be the trend setter for all such programs. The SPADES HULLOAD module will shortly have the capacity of storing on the data base complete <u>surface</u> <u>definitions</u> for all decks, longitudinal and <u>transverse</u> bulkheads. Also **to** be stored on the data base for each defined surface are the traces of all intersecting surfaces including the shell and defined in the plan of the surface if flat or in the appropriate view plan, elevation, or transverse). To be stored for each appropriate surface will be the traces of all defined stiffeners (longitudinal, transverse, horizontal and vertical) seams and butts in the plan of the surface if flat or in the appropriate surface if flat or in the appropriate surface.

In association with surfaces and traces on surfaces the structural shapes, details and associated cut-outs will be stored on the data base for each defined stiffener on each appropriate surface. The ranges of the definitions will be included so that at any location along the sur**face** stiffener, the stiffener type, size, detail and associated cut-out can be obtained from the data base. Plate thicknesses and associated clearance cuts will be stored for each defined seam and butts on each appropriate surface similar to as described above for stiffeners.

The loading of the data base for all crossing, intersecting or secondary surfaces or frames can be. preformed almost automatically with a minimum amount of input data given by utilizing all of the above

surface and detail data. This will also improve the cross-reference and integrity of the data base.

Before, with the lines fairing and the HULLOAD modules, a ship or marine vessel was a series of interconnecting lines composed of frames, decks, sight edges, waterlines, buttocks, etc., similar to a three dimensional wire line diagram. When the future plans for the HULLOAD module become reality, we not only have a wire type diagram, but also have the planes in between so that the computer ship now represents more fully the true ship shape and configuration.

We can only visualize the true meaning this has for the shipbuilding industry and the impact on engineering and lofting manhours. The updated SPADES HULLOAD program, in conjunction with a new SPADES module called "DEMO", will be able to produce engineering drawings that require only hand finishing for dimensions and notes. The future of Numerical Control Lofting, or should I say Numerical Control Engineering and Lofting, becomes very bright indeed.

#### ACKNOWLEDGMENTS

Jan Ulsteen of Cali and Associates for his contributions in regard to the new features and the future of the SPADES HULLOAD program.

#### APPENDIX

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  - B. Diagram of Example Cut-out Coding
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## SPADES SYSTEM INPUT DATA FORM

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SPADES SYSTEM INPUT DATA FORM . •

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IILB2 12" LBI CENTER LINE FR. 90 FR.32 FR,30 FR. 18 Ϊ. FVD. ong' JLKHEAD LOADING B EXAMPLE

<u>I</u>.B.

FRAME = 60750	LCG = 300	2.000		*********	**********			FRAME	= 60750
		RECORD LO	NDED 02/10/7	6 21/10/19	REV. 10				
L8HD 518-	9797 DT	X	Y 21 500	ANGLE (DEGR)	SEG.AT SHE	LL	•		
	END PT.	35,448	21.500	0.001	s				
		[	BHD CONTOUR	•••	-	• • • • •	· ·		······································
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,	1 34.30	58 0.0 0.0	-1.079	+21.500		- 1.	079 21.500 448 21.500		
·	TOTAL NO. C	OF LONGITUDIA	ALS-SEAMS =	21	- ,		• • • •		•• • • • • • • • • • •
	NAME	SEG KN A	BSOLUTE COOP	RDINATES	NV		ORIENT.	TANGENT	CUTOUT M
	LONG 1	1 0	3.000	21.500	0.0	0.0	90.000 N	0.0	100 NT
	DECK TT	1 0	5.000	21,500	******	*****	90.0 ?	0.000	100 NT -
	LONG 2	1 0 -	7.000	21,500	0.0	0.0	90.000 N	. 0.0	100 NT
	LONG 3	1 0	9,000	21,500	0.0	0.0	90.000 N	0.0	100 NT
	LONG 4	•1 • 0 •	11.000	21.500	0.0	0.0	90.000 N		
	LONG 6	1 0	15,000	-21,500	0.0	0.0	90.000 N	0.0	100 NT
•••••	SEAM B	iŏ	15,750	21.500	0.0	0.0 -	- 90.000 N	- 0.0	100 NT
	LONG 6A	1 0	17.000	21.500	0.0	0.0	90.000 N	0.0	100 NT
		1 0	19,000	21,500	0.0	0.0	90.000 N	0.0 0.0	100 NT
	LONG 10	1 0	23.000	21.500	0.0	0.0	90.000 N	0.0	100 NT
	DECK UTD	1 0	25,000	21,500	******	******	90,000	0.000	100 NT
• • • • • • • • •	SEAM C	1 0	25.750	21.500	0.0 -	0.0	. 90.000 N	• • • • •	-100 NT
	LONG 12	1 0	27.000	21.500	0.0	0.0	90.000 N	2.0	100 NT
	LUNG 15	1 0	- 31 000 -	21,500	0.0	0.0	90.000 N		100 NI
	LONG 15	iŭ	33,000	21,500	0.0	0.0	90.000 N	0.0	100 NT
	SEAM D	1 0	33,750	21.500	0.0	0.0	90.000 N	0.0	100 NT
	DECK MDK	. 1 0	35.448	21,500	******	******	91.768	0,000 🖓	- 100 NT
		RECORD LO	ADED 02/10/7	6 21/08/28	REV. 15			••	· •
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## SPADES SYSTEM INPUT DATA FORM H PROGRAM MEMBER & TYPE -TAPE 32

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PAGE 70 12/21/76 21/42/13 COMPUTER OUTPUT FOR LS03 75.09 --- TABLE OF TRACES ----\*\*\*\*\*\*\*\*\*\*\*\*\*\* \* \* FRAME # 82000 LCG = 200.000 FRAME # 82000 RECORD LOADED 11/23/76 00/14/27 REV. 15 TOTAL NUMBER OF SHELL TRACES = 27 TANGENT CUTUUT ORIENT. MENB. SEG KN ABSOLUTE COORDINATES NAHE DX - NU -DY NO. X Y 0.0 90.000 100 NT 500 \*\*\*\*\*\*\* LBHD CVK 0.0 9.0 \*\*\*\*\*\* 0.0 STRG STRG CL j 0.0 0.0 0.0 0.0 0.0 -0.000 N 90.000 100 NT 500 1 0 • -101 NT =0.000 N İ, 90.000 500 1 ۵ 5.000 . 0.0 0.0 180.000 N . Α. · 0:0 0.0 90.000 100 NT 500 SEDG 0 3,750 1 : -0.000 N -0.000 N 101 NT SIRG -3 - 1 0 0.0 4.292 0.0 0.0 90,000 500 1 , •--101 NT STRG 0.0 16.583 0.0 90.000 500 Ø 0.0 -0.000 N 90.000 101 NT. STRG 4 1 0 8.875 0.0 0.0 500 -0.000 N 180.000 N 90.000 101 NT 500 STRG 5 Ô 0.0 11.167 0.0 0.0 • . . . . \*\* "100 NT 8 0.0 90.000 500 SEDG . 0 0.0 0.0 9.0.000 - 101 NT . . 500 -0.000 N STRG **b** ' 1 0.0 13.450 0:0 0.0 LSK L8H0 STRG 0.0 90.000 100 NT 500 \*\*\*\*\*\* \*\*\*\*\*\* · 0 0.0 15.750 ۰. 101 'NT 500 -0.000 N 90.000 7 . 0 18.042 0.0 0.0 , 180.000 N 90.000 100 NT 500 -C . SEUG 19.750 0.0 0 0.0 0.0 101 'NT -0.000 N 200 STRG 18 20.333 0.0 0.0 90,000 ٥ 0.0 0.0 9 ..... 101 NT 500 -U.200 N 90.000 0.0 0.0 STRG 0 55.95 500 · STRG . 21.017 0.0 0.0 90.000 101 NT 10 0 0.0 0.0 90.000 101 NT 500 ⇒0,000 N STRG 11 0 27.208 0.0 . 0.0 .. 0.0 Ď. . . ---- 100 NT -500 ° 27.750 180.000 N 90.000 SEDG 0 0.0 0.0 1 0.0 500 } -0.000 N 90.000 101 NT STRG 12 0 29,500 0.0 0.0 2. 0.0 4.000 90.000 N 0.0 100 NT 500 32,500 SEDG E 0 0.0 Ē .... . . - 11.000 0.0 ----- 100 NT SEDG 32.500 0.0 -90.000 N 500. 3 0 0.0 0.0 100" NT - 1 2F -90.000 500 DECK 3 0 12.167 32.500 \*\*\*\*\*\* \*\*\*\*\*\* 0.0 1 0.0 90,000 N 0.0 100 NT 500 SEDG G 3 Û 18.000 32.500 DECK 19F 19.750 32.500 \*\*\*\*\*\* -90,000 0.0 100 UT 500 'n. \*\*\*\*\*\* - 3 90.000 N 100 NT 500 0.0 0.0 0.0 SEDG н 3 0 25.000 . 32,500 -88.107 DECK MOK 0 32.500 \*\*\*\*\*\* \*\*\*\*\*\* 0.0 100 NT .500 3 29.000 ----J · •• • × -.... 500 SEDG 0 29.750 32.500 0.0 0.0 90.000 N 0.0 FRAME = 83000 LCG = 202.500 FRAME = 83000 RECORD LOADED 11/23/76 00/14/28 REV. 15 TOTAL NUMBER OF SHELL TRACES = 27 -----NAME SEG KN ABSOLUTE COORDINATES ORIENT. TANGENT CUTOUT HEMB. NO. NO. Y DX DY • X 0.0. --.0\*0\_. \*\*\*\*\*\*\* \*\*\*\*\*\*\* LOHD CVK 500 0.0 ۰6 -0.000 N 100 NT STRG CL Ō 0.0 0.0 0.0 90.000 500 1 0.0 2.000 -101 NT -0,000 N 90,000 500 STRG 1 0 0.0 0.0 0.0 1 . 100 NT 500 ..... A 90,000 180,000 N SEDG 0 0.0 3.750 0.0 0.0 • 101 NT 500 8TRG 2 0 0.0 -0.000 N 90.000 0.0 4.292 0.0 -----X.E

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BPADES SYSTEM INPUT DATA FORM

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