APPENDIX A

PLANNING VITAL POINTS FOR A BULK CARRIER

I. Identifying Vital Points

A. Basic

Vital points are necessary for achieving accuracy specified for an end product. Thus, identifying vital points starts with the complete hull and proceeds, as any other planning activity, to address reverse production flow, i.e., erection, block assembly, sub-block assembly and part fabrication. Also, because they impose different problems, each major division of a ship body has its own vital-point explosion.

Vital points can be classified and sub-classified as:

1. At Erection Stage

   a. Hold Zone
   b. Curved Zone
   c. Stern Zone

2. At Block Assembly Stage

   a. Straight Block
   b. Curved Block
   c. Flat Panel Base
   d. Curved Panel Base

3. At Part Fabrication

B. Detail Descriptions

1. *Erection Stage*

   a. Hold Zone

   Usually accuracy of the hold zone impacts most on the overall form of the hull because it contains the most blocks. For vital-point matters, the hold zone can be subdivided into:

   - Tank Top Zone
   - Top Side Tank Zone

   The tank top zone is the base of the hold and incorporates vital points for controlling:

   - Center line of the ship.
   - Relativity between each double bottom block.
   - Level of tank top.

   See Attachment 1.

   The top side tank zone fixes the actual width and actual depth of the hull and contains vital points for controlling:

   - Straightness of the base line.
   - Width of the ship at main deck.
   - Height of the ship at main deck.
   - Level of main deck.

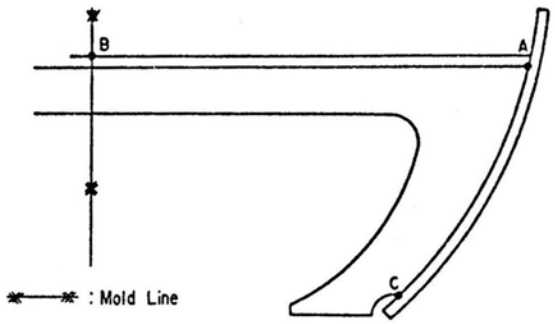
   Details are shown in Attachment 2.

   The vital points for setting each block on the ways is derived from the foregoing and noted for shipwright guidance as shown in Attachment 3.

b. Curved Zone

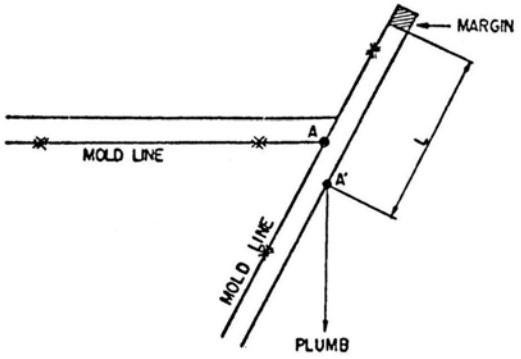
Vital points in the curved zone are dependent on the hold zone because the block erection sequence usually starts in the curved zone.

In order to set a curved block, fixing suitable points is necessary. For example:

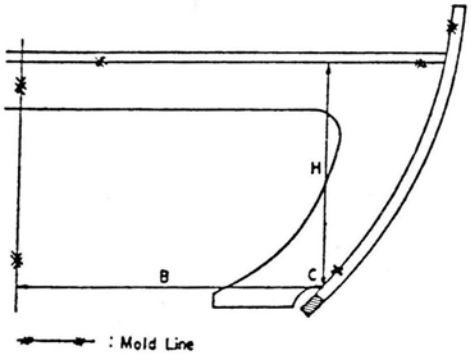


Point A: For setting the width.
Point B: For keeping straightness.
Point C: For setting the height, and checking the lower width.

Note 1: Loftsmen must prepare dimension L to locate A' on the shell:



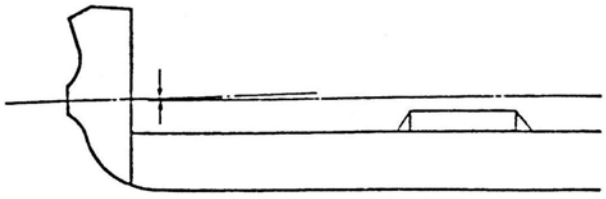
Note 2: To locate point C, lottsmen must provide dimensions H and B.



c. Stern Zone

Accuracy of the stern zone influences a ship's performance significantly. Accuracy of the shaft line involves:

- Accuracy of center of stern tube,
  - Centering.
  - Height.
- Relationship between center of stern tube and the shaft line projected to the main engine seat:



Notice: Keeping this relationship precise is especially hard because of movement of the stern block during welding. Thus, fixing vital points and maintaining their positions requires the greatest possible care.

Usually the relationship between shaft and rudder centers are fixed in one block during block assembly. However, it is still difficult to align both of them with sufficient accuracy in a building berth. The sequence for welding the plate joints located forward of the after peak-tank bulkhead is critical.

2. *Block Assembly Stage*

a. Straight Block

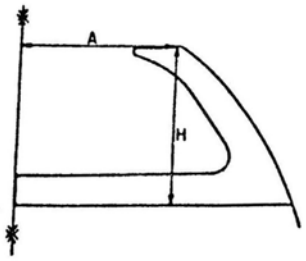
Straight blocks are located in the hold zone, there are several typical types defined by their locations. In order to define their vital points two questions should be asked:

- Which will be the most important points for hull erection?
- Which will be the most necessary points for block assembly?

A sample of a typical check sheet is in Attachment 4.

b. Curved Block

Flat-panel base, curved blocks are assembled on a platen in accordance with a sequence which is partly dependent upon internal structure.



As shown the curved shell plates are set on block internals. Therefore, vital points are set to maintain vital dimensions such as A and H. The shell plate edge alignment with internal structure is also vital. See Attachment 5.

Curved-panel base, curved blocks are assembled on a pin jig. The procedure is to first join already formed plates to create a curved panel, layout the internal arrangement, and thereafter to fit and weld internals. Typical vital points and dimensions and an applicable checking procedure are described in Attachment 6.

3. *Part Fabrication Stage*

As establishing vital points in all of the many parts is impractical, parts which could cause consequential block inaccuracies are first identified. These typically are parts for:

- bottom girders
- bottom side floors
- hopper side tank floors
- hold frames

Vital point details and check sheets are provided in Attachment 7.

Appendix A, Attachment 1

VITAL POINTS FOR ACCURACY AT ERECTION STAGE

In order to check and maintain accuracy of the tank top zone during the erection stage, three methods are necessary:

- *Center Line Check* of shift of each block in tank-top section.
- *Relativity Check* of center double bottom, center side double bottom, and bilge blocks in every hold and over the full tank-top length.
- *Level Check* of each block both on the tank top and bottom.

Descriptions

1. *Center Line Check*

When: Twice, once before fitting and once after welding.
Who: Worker and A/C engineer before fitting.
A/C engineer after welding.
Where: At the front of each block on tank top.
How: By transit (allowance max. 1/8").

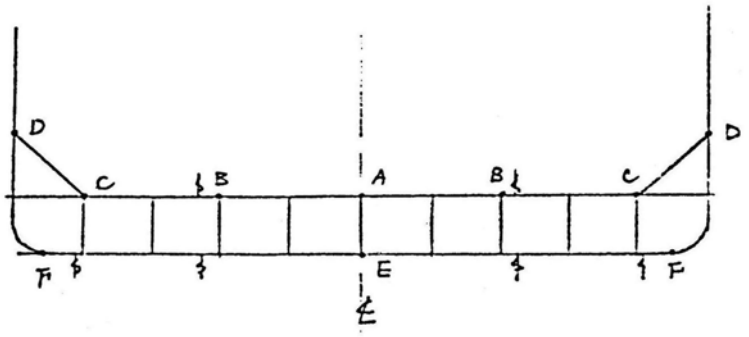
2. *Relativity Check*

When: Every block before fitting and once after welding an entire hold length.
Who: Worker and A/C engineer before fitting and A/C engineer after welding.
Where: At the front edge of each block.
How: By transit (allowance max. 1/8" at each target).
Notice: If the relativity is larger than allowed and that amount is less than 1/4", defer correction until welding is complete for a hold length.

3. *Level Check*

When: Every block before fitting and after welding.
Who: Worker and A/C engineer before fitting and A/C engineer after welding.
Where: At points A, B, C and D at forward frame of each block on tank top.

After welding, the level of the points at the bottom must be checked:

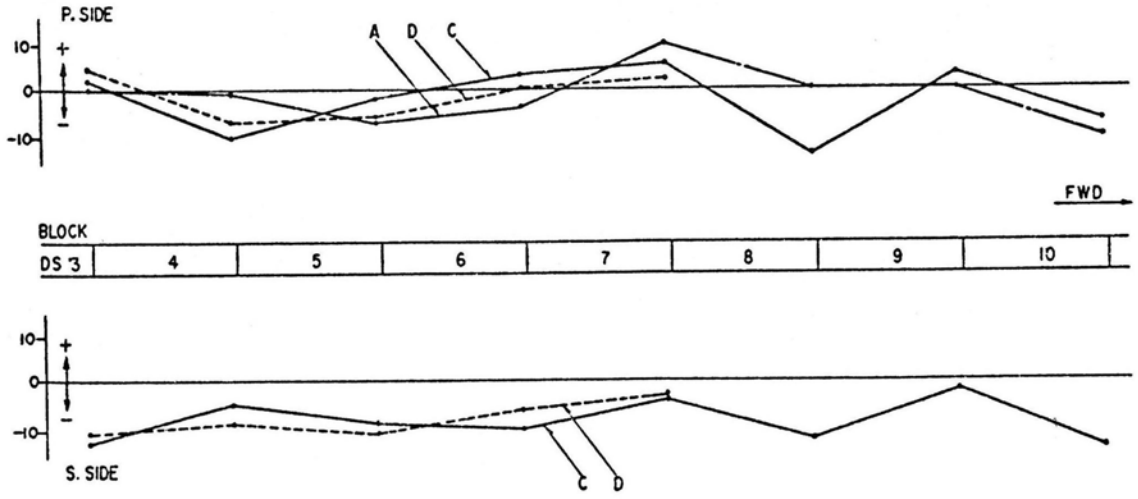


The data should be recorded and arranged in a simple style (picture, graph, chart, etc.). Further each record should contain the date, time, and temperature when the check was made. Recommended methods for recording these checks follow.

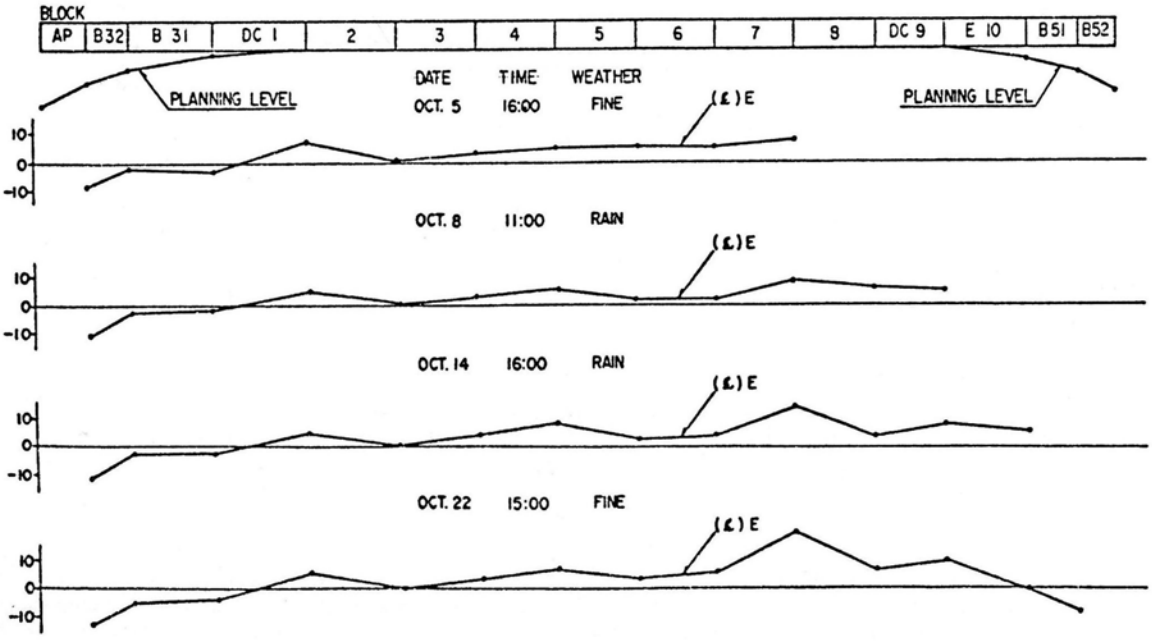
LEVEL AT EACH POINT ON T. TOP
(DS 3~DS 10)

OCT 15

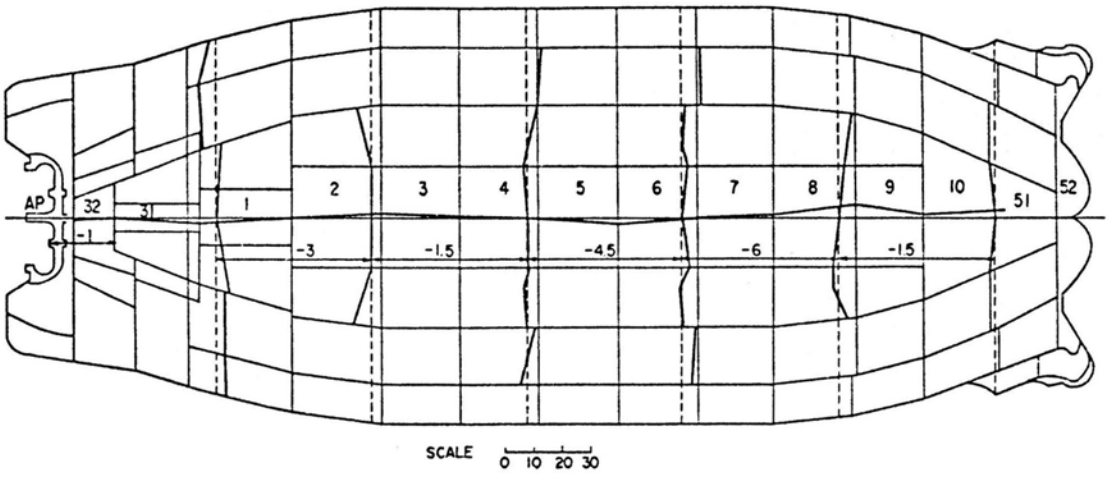
A ——·—— = ℄
C ———— = L-13 S. GIR
D - - - - - = TOP OF BILGE / BLOCK



LEVEL OF CENTER LINE AT BOTTOM



RELATIVITY AND CENTER LINE CHECK
(AT EACH HOLD LENGTH)



Appendix A, Attachment 2

THE VITAL POINTS FOR ACCURACY AT ERECTION STAGE FOR TOP SIDE TANK ZONE

In order to check and maintain accuracy of the top side tank zone, four methods are necessary:

- Straightness of the base line
- Width of the ship at main deck
- Height of the ship at main deck
- Level of main deck

Descriptions

1. *Straightness of the Base Line*

When: Twice, once before welding and once after welding at each erection joint.
Who: Worker and A/C engineer before welding.
A/C engineer after welding.
Where: At the base line (see the figure at the end of this Attachment).
Notice: The base line must be marked on slabs before erection.
How: By transit.

2. *Width of the Ship at Main Deck*

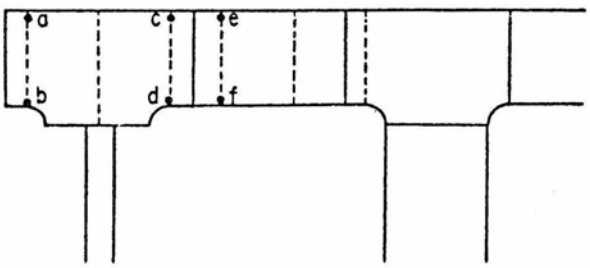
When: Twice, before and after welding.
Who: Worker and A/C engineer before welding.
A/C engineer after welding.
Where: At the base line of the front part of block (see the figure at the end of this Attachment).
How: By measuring.

3. *Height of the Ship at Main Deck*

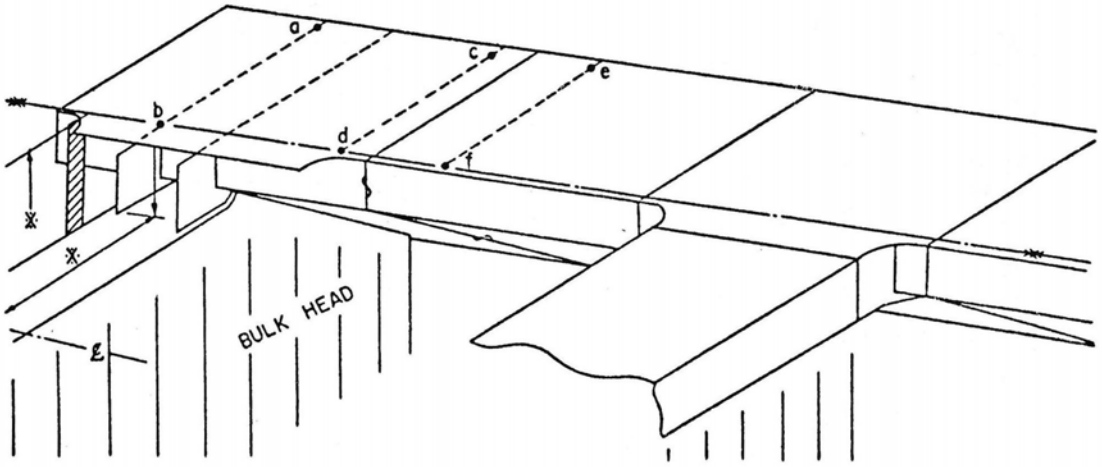
When: Twice, before and after welding.
Who: Worker and A/C engineer before welding.
A/C engineer after welding.
Where: At the point supported by the pillar (see the figure at the end of this Attachment).
How: By measuring.

4. *Level of Main Deck*

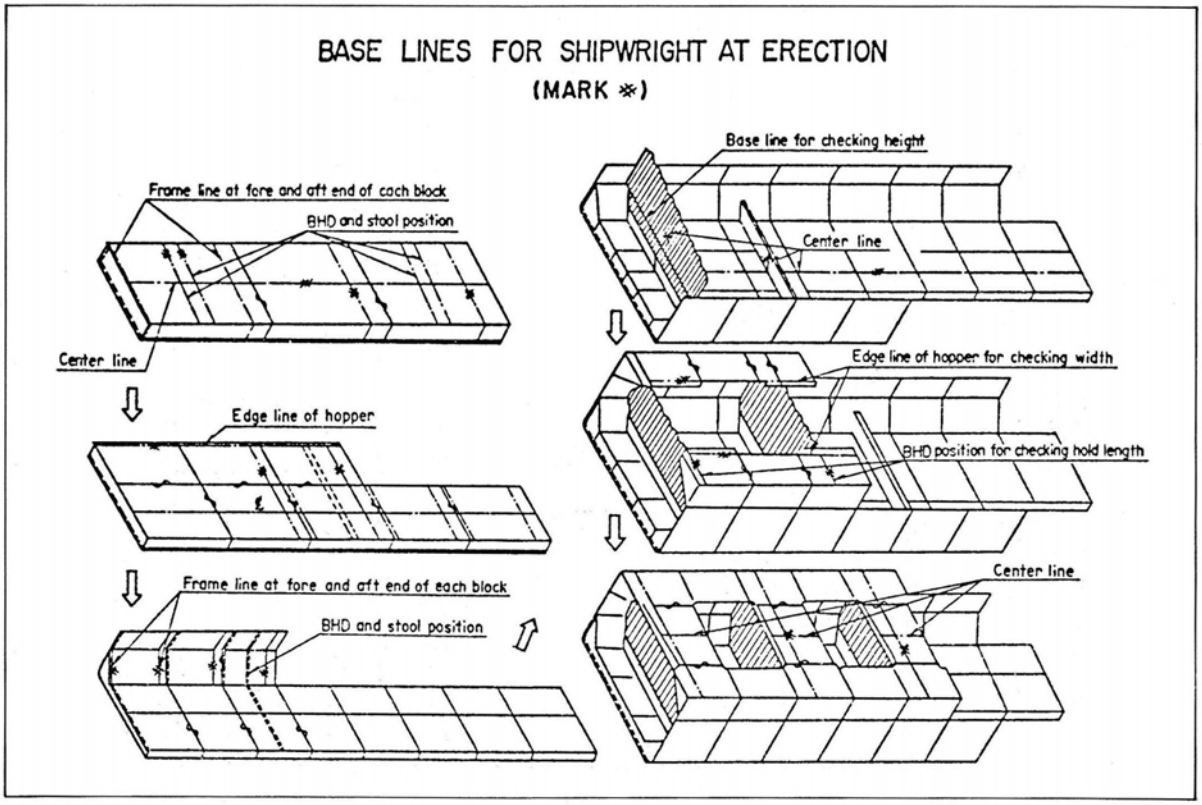
When: Twice, before and after welding.
Who: Worker and A/C engineer before welding.
A/C engineer after welding.
Where: At least 6 points as follows:



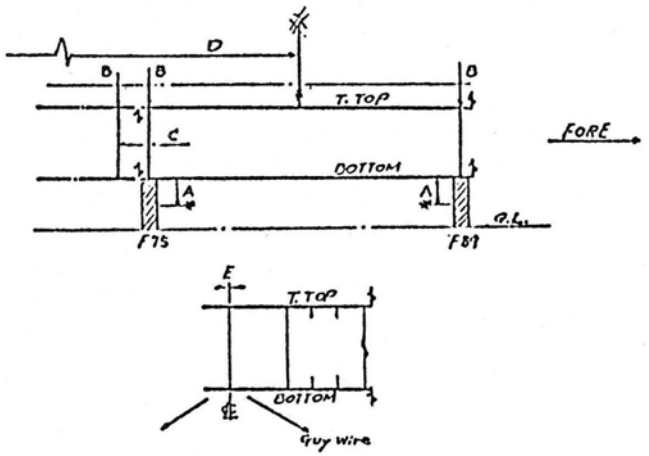
Notice: Points a & b at forward end.
Points c & d at aft end.
Points e & f at forward part of preceding block.
How: By transit.



Appendix A, Attachment 3

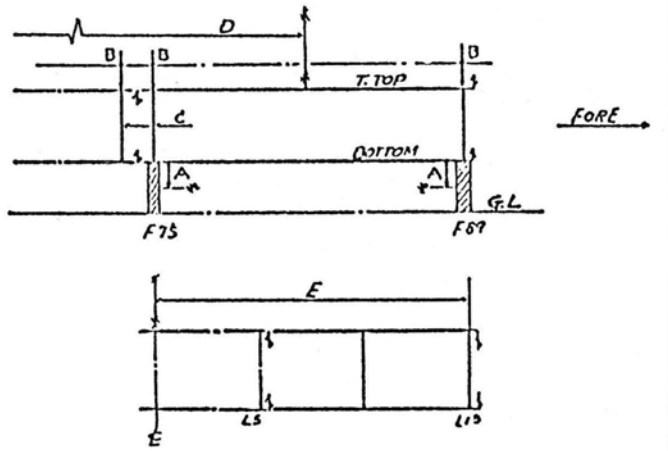


HULL NO.	UNIT	ERECTION SEQ.	WEIGHT (T)	SHIPWRIGHT
				BOTT. CENTER



MARK	DESCRIPTION	DIMENSIONS	TOLERANCE	CHARGE	NOTICE
A	Bottom Height			Worker	Measure at C.GIR by special gauge
B	Level			Worker AC	Measure at 4 corner points by Transit
C	Space Check			Worker	Measure by ruler
D	Space Check from Bhd. to Bhd.			Worker AC	Measure by ruler
E	Center line check			Worker AC	Adjust at forcend by guy wire. Measure by Transit

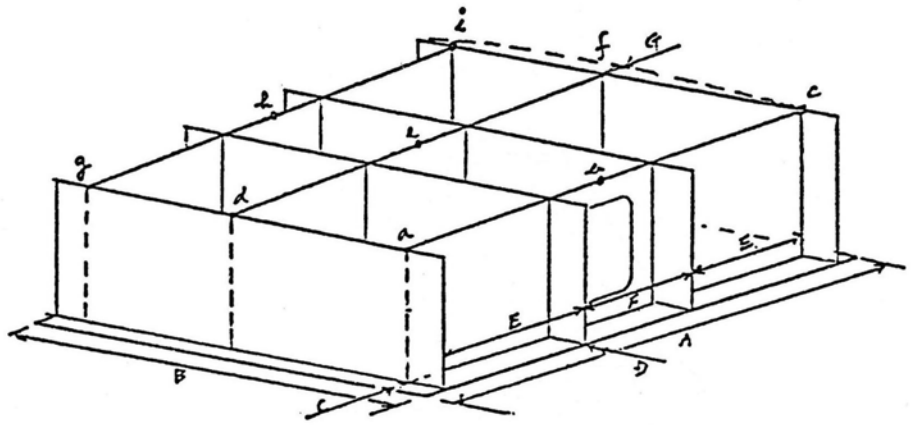
HULL NO.	UNIT	ERECTION SEQ.	WEIGHT (T)	SHIPWRIGHT
				BOTT. SIDE



MARK	DESCRIPTION	DIMENSIONS	TOLERANCE	CHARGE	NOTICE
A	Bottom Height			Worker	Measure at L13 by special gauge.
B	Level			Worker AC	Measure at 4 corner points by Transit.
C	Space Check			Worker	Measure by ruler.
D	Space check from Bhd. to Bhd.			Worker AC	Measure by ruler.
E	Width from C. line to L13.			Worker	Measure at fore & aft end by transit.

ACCURACY CHECK SHEET

Ship No.	Block No.	Shop	Condition
			Before combined with bottom plate

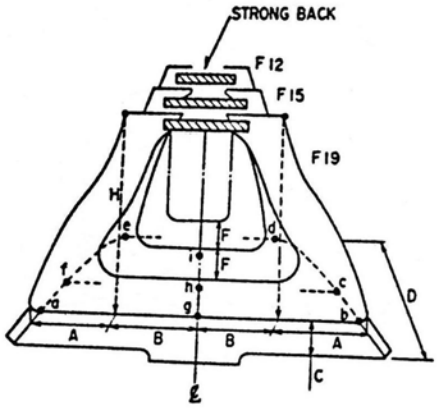


Mark	Item	Dim's in Drawings	Allow. Tol.	Actual Dimension	Chg.	Notice
C			P S		Worker AC	Both side (P.S)
D	Edge Alignment		F A		"	Every Girder Both Side (F.A.)
E	Girder Spacing		P S		"	Every Frame
F	"			FORE AFT	"	Both side (F.A.)
G	Straightness				"	Each girder show maximum.
H	Level			a b c d e f g h i j	"	9 points a - i

Notice : After fitting, welding

ACCURACY CHECK SHEET

Ship No.	Block No.	Shop	Condition
	232 (233)-1/2		Lower Engine Flat Base

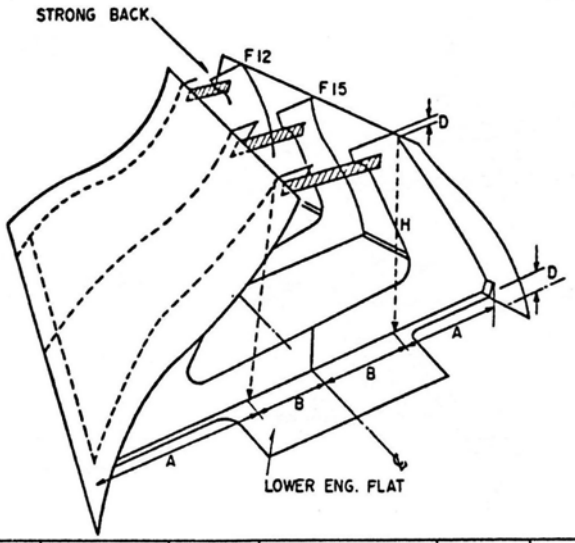


Mark	Item	Dim's in Drawings	Allow. Tol.	Actual Dimension	Chg.	Notice
G	Lower Eng. Flat Level				AC Worker	a~i 9 points Keep horizontal plane
A B	Width				AC Worker	Plumb at every frame
H	Vertical Height				AC Worker	Plumb at every frame Check the vertical
C	Edge Alignment				"	Aft & Fore
F	Space				"	Each space at frame web
D	Length				"	

Notice 1) Keep the level and fix the flat panel.
2) Need support and strong back.

ACCURACY CHECK SHEET

Ship No.	Block No.	Shop	Condition
	232(233)-2/2		Final Assembly



Mark	Item	Dim's in Drawings	Allow. Tol.	Actual Dimension	Chg.	Notice
A B	Width				AC	Plumb Keep horizontalplane
D	Shift				AC Worker	
H	Height				AC	Plumb

Notice After fitting and after welding.

Appendix A, Attachment 6
Curved Panel Base Blocks

1. A.C. Data Diagram

FIG. 1

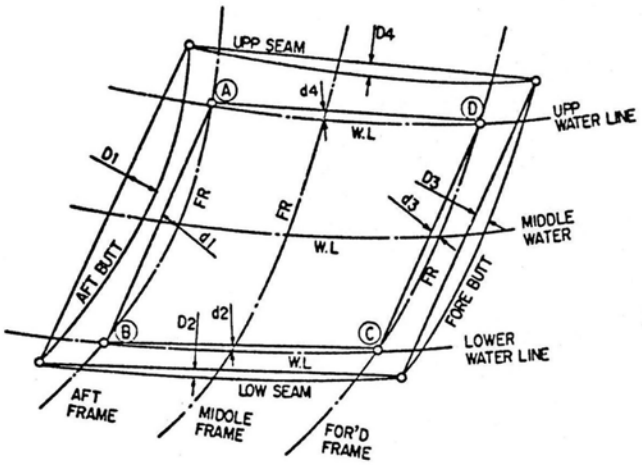
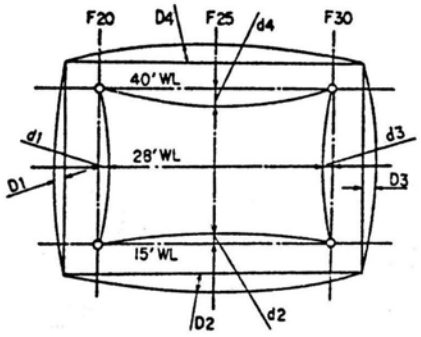


FIG. 2



1. *A.C. Data Diagram*

It is generally difficult to check deformation of the curved unit shape. However, from the point of view of accuracy control it is necessary to check deformation of the curved unit shape during assembly work.

Then, the deformation checking data of the curved block should be prepared by the mold loft before they begin the assembly work.

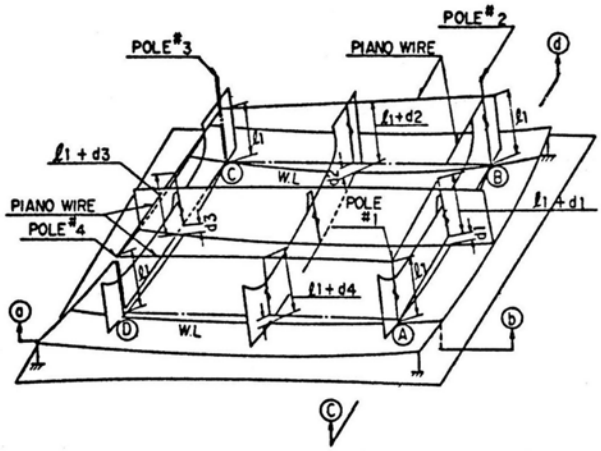
Calculate the maximum curvature depths at the aft butt, for'd butt, upper erection seam, and the lower erection seam. Join AD, BC, AB and CD as shown in Fig. 1.

Calculate the upper waterline section's depth and the lower waterline section's depth at the middle frame. And also calculate the aft frame section's depth and for'd frame section's depth at middle waterline.

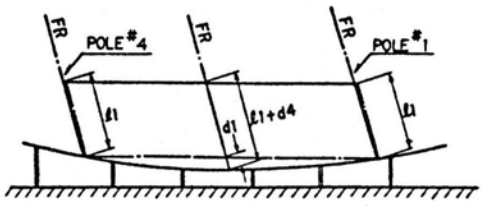
Using the results of the above calculation, draw the checking data diagram as shown in Fig. 2.

2. A.C. Checking Procedure

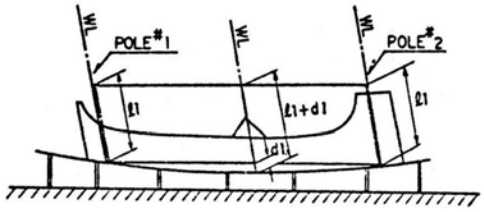
FIG. 3



SECTION ⓐ-ⓑ



SECTION ⓒ-ⓓ



2. *A.C. Checking Procedure*

Using the checking data diagram, accuracy control activity is carried out as follows:

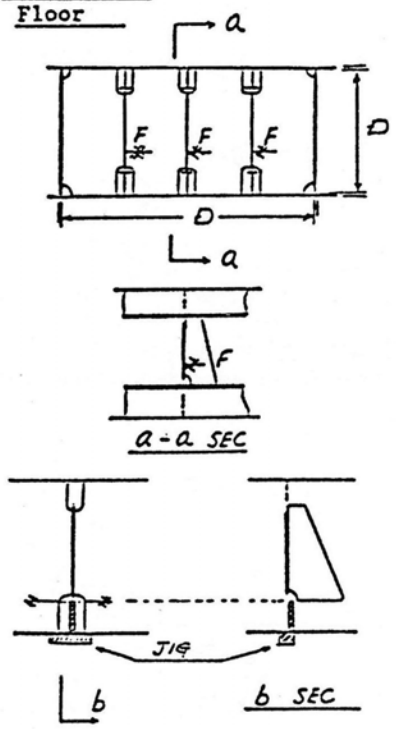
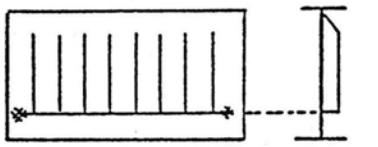
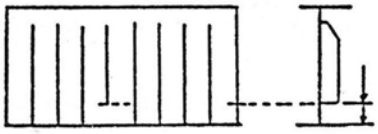
(1) After plate joining, check the curvature depth at the aft butt, fore butt, upper seam and lower seam.

(2) Before welding of the internal structures, set the poles at four (4) points (A, B, C and D) and strain piano wires as shown in the above Fig. 3. Measure the distance between the piano wire and the checking point on the shell plate. Mark down the level mark on each pole for deformation checking.

(3) After the welding of internal structures, again set the poles at the same points, and check the distances in the same way as mentioned above.

Check the level mark on each pole for deformation of the block.

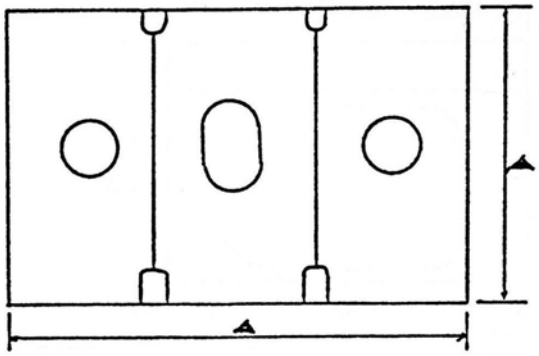
HULL 751 (Zone-1) BASE LINE & CHECK LINE FOR VITAL POINTS 1

MEMBER & ITEM	MEANING & PURPOSE	NOTES
Bottom Floor 	D : Dimension to be checked *The dimension is marked by NC operator and measured after cutting and sub-assembly. F : Guide lines for fitting stiffeners. *To be marked by NC burning machine . *To be used for fitting stiffeners at sub-assembly *Two methods to be useful 1) to be marked at the end of stiffeners (Jig to be used) 2) to be marked at the fixed points.	Limited to the case of the neat cut before sub-assembly.
Tight Floor & Wall 	*To be marked at the end of stiffeners.	
	*The dimension should be indicated in case that only one stiffener is different from others.	

ACCURACY CHECK SHEET

Ship No.	Unit No.	Shop	Condition
		Cut. Sub.As	Sampling check

BOTTOM CENTER UNIT FLOOR



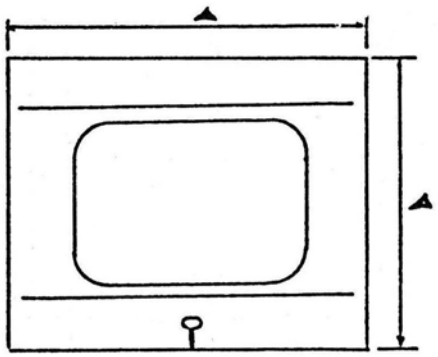
WRITER

PIECE NAME	HEIGHT	WIDTH

ACCURACY CHECK SHEET

Ship No.	Unit No.	Shop	Condition
		Cut. Sub.As.	

BOTTOM CENTER UNIT FLOOR



WRITER

PIECE NAME	HEIGHT	UPPER SIDE WIDTH	LOWER SIDE WIDTH