Smooth Material Flow by strengthening Production Engineering

Profile of Mikito SHIRAI

- 1984 Graduate from Univ. of Tokyo, Naval Architect
- 1986 MTech, Univ. of Tokyo
- 1986-2002: IHI Ship & Offshore
  - Hull form design, Develop CFD for non linear bow wave simulation
  - In charge Production Design Hull and Production Engineering
  - Improve bending information, nesting process, accuracy control and block-outfitting process
- 2003 -2005: SAMSUNG, Korea
  - Responsible for improving the accuracy of hull steel work especially curved blocks
- 2006: Tsuneishi CEBU Philippine, GM Quality Assurance
- 2007-2009: Pipavav , India as Head of Production Engineering and Planning
  - Organized 25 fresh engineers to manage all production information for hull steel work
- 2009-: Head of Production, GBD Bharatishipyard
  - Installed Line heating method with help of YANO for bending and fairing
  - Organized 120 Indian workers directly and constructed Hull part of OSV

As for Production man of shipbuilding, I have been involved more than 180 projects partially or fully from aluminum boats to OSV, VLCC and FPSO.

Today’s presentation

1. What is the best productivity?
   & Where we are?
2. What are the differences?
3. PE is the start of the productivity and smooth
   material flow is the first activity of PE.
4. How to get good smooth material flow

Best Productivity

Type of Ship	VLCC (HSW 34,000Ton)	56BC (HSW 8,000Ton)	70m Loa OSV
Crane capacity	350ton x2 + 200ton x 2	200ton x 2	100ton x 2
Nos of Erection Blocks	200	100	40
Steel Cutting to Keel Lay	3month	4month	2month
Keel Lay to Launching	4month	2month	3month
Launching to Delivery	4month	3month	4 month
Total duration time	**11 month**	**9 month**	**9 month**
Productivity	**12.5h/ton**	**15h/ton**	**About 35h/ton**

In case of Navy vessels

Country	Ship type keel	Displacement Tonnes	Time	Man-hours to Commissioning
US	DD651	8315	30	5,000,000
US	FFG-7	3500	30	2,500,000
Japan	DD173	9485	34	2,036,000
Japan	DD158	4500	29	1,000,000
Italy	D-560	5400	42	-
Germany	F-215	4490	38	-
Canada	FFH300	5235	51	2,100,000
Canada	DD6280	5100	42	2,300,000
UK	F230	4200	54	-
India	Godavari Class	3600	72	10,800,000
India	Delhi class	6500	100	18,200,000

The Indian shipyards take about 10 times the man-hours taken by Japanese shipyards and 3 times the calendar months. There is a lot of room for improvement in modernising Indian shipyards and reducing build periods.

"Towards Modern Ship Design and Shipbuilding in India,
Vice Admiral Rajeshwer Nath, PVSM, AVSM, VSM (retd) "

Why 10 time more and 3 times longer?

Major facilities are same.

Monsoon rain affects only for 3month. Japan has rain in all month.

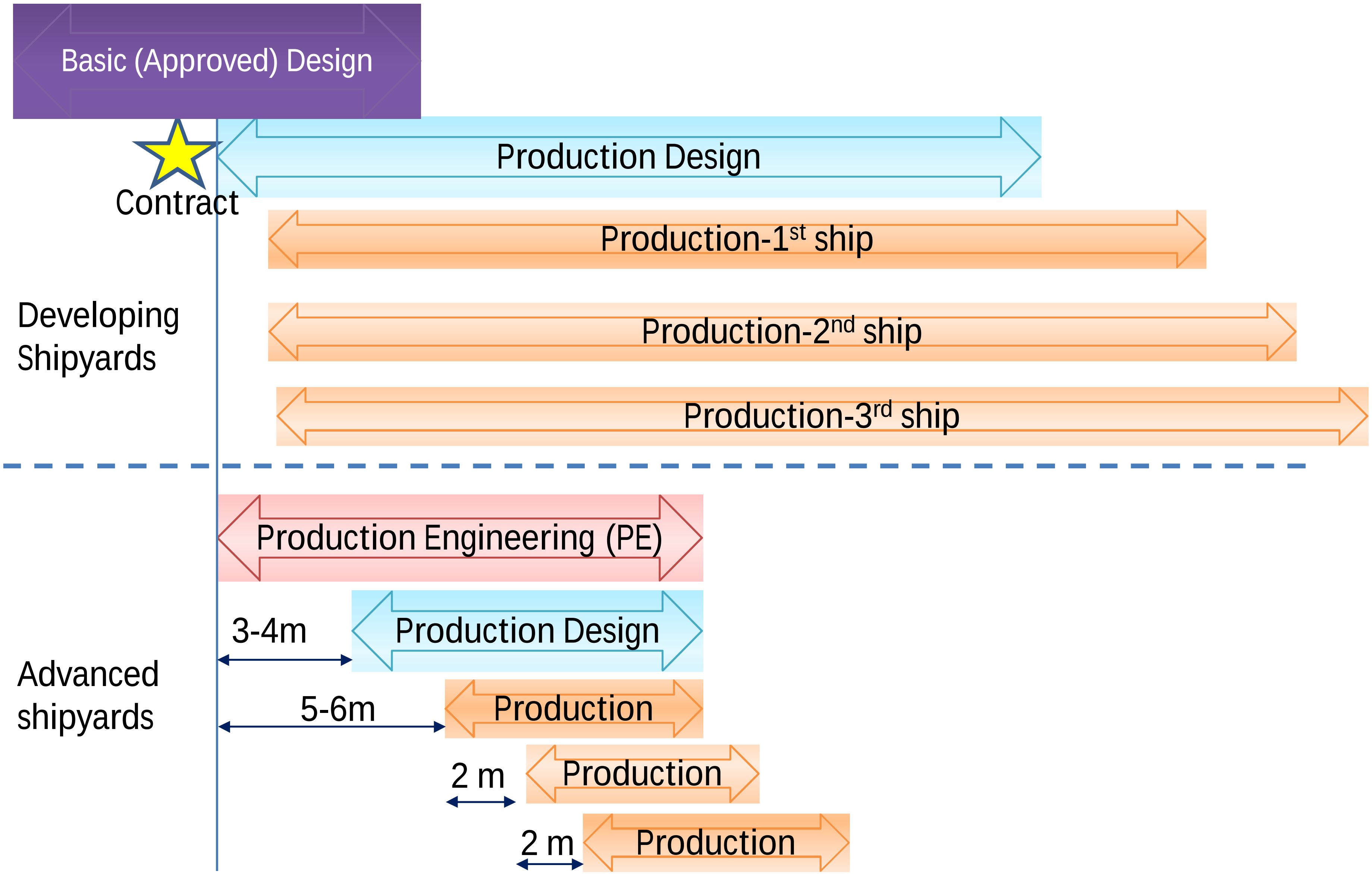
Based on experience of organizing 120 Indian workers directly for 1.5 years

- Indian workers show good discipline and absorb new techniques faster
- Indian fresh engineers have good potential

Lack of HR for Production Engineering

- Quality Problem for Production Design
- Quality problem of consumables and lack of small equipment
- Inefficient bending technology
- Lack of zone-wise pre-outfitting
- Insufficient engineering for smooth material flow

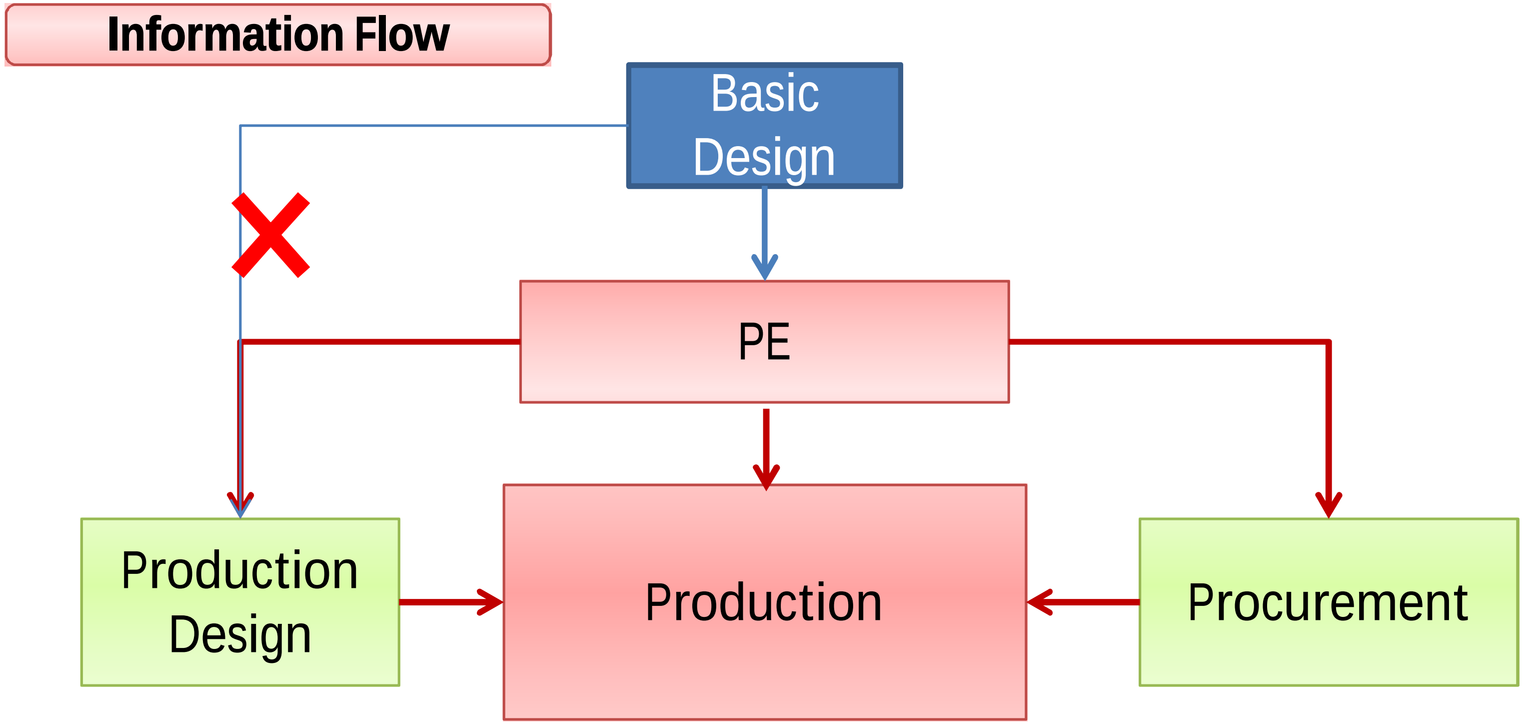
When Production Engineering is executed



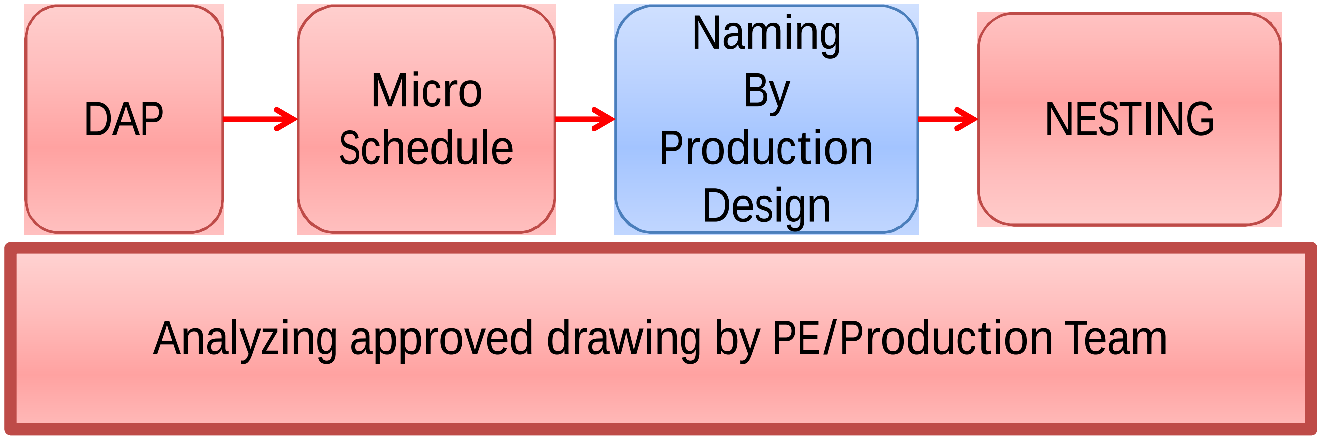
Status of PE

PE is a part of Production and independent from Production Design (PD)

PE is intelligence center of Production and PD follows instruction of PE.



Smooth Material flow of HULL Fabrication



DAP-1

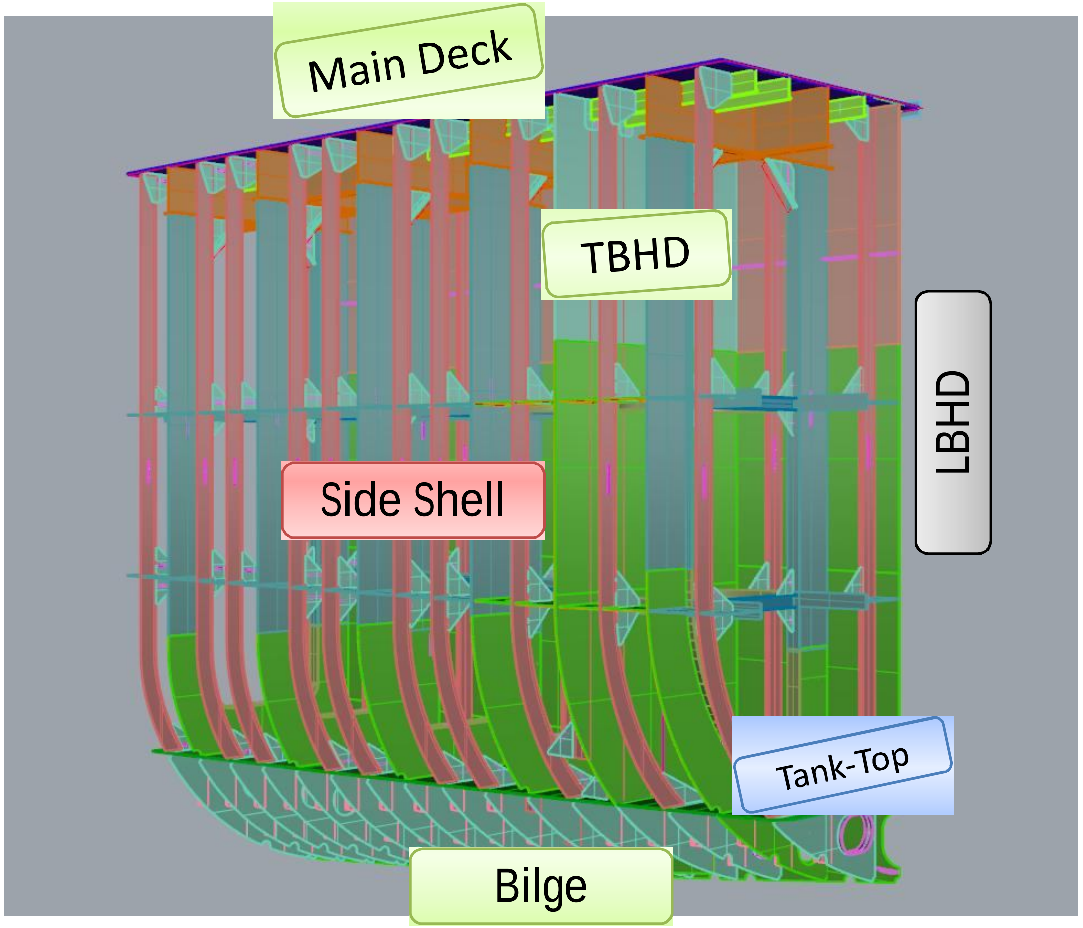
1st: Design rational Detail block Assembly Process

Study what is the best process to make an erection block

How to divide one erection block into some sub-blocks

What it the best sequence to assembly sub-blocks

Sample of Erection Block

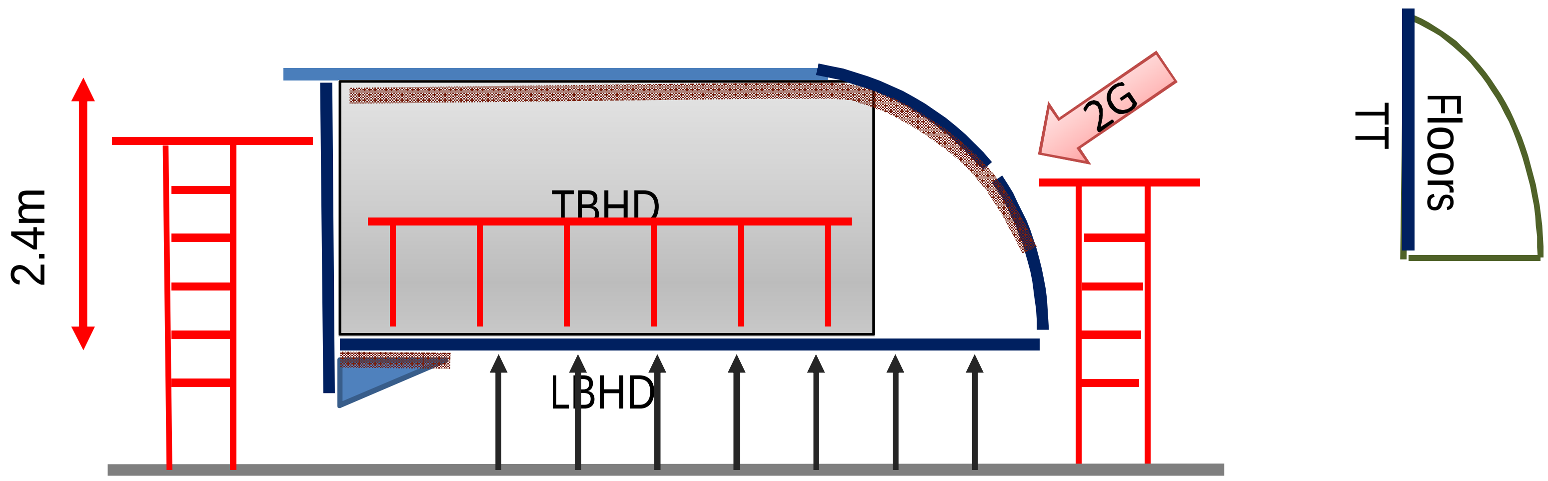


The left wing tank block consists of 6 panel.

What is the best practice? (Sequence Design)

Easier access and safer
Avoiding accuracy problems
Increasing downward welding
Reducing the number of parts to be delivered assembly directly

Sample Sequence (inadvisable)



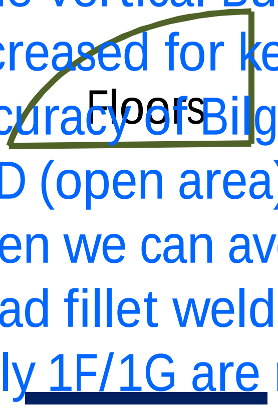
Lot of over head welding required

Horizontal seam welding (2G) is required

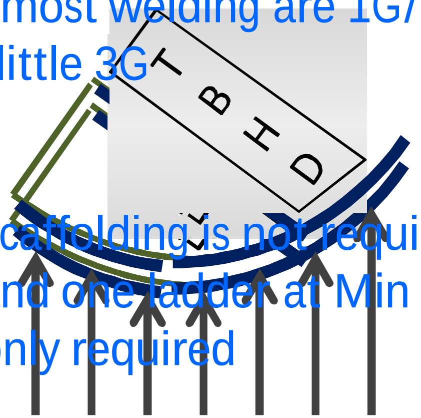
Scaffolding required both entire Inside and outside due to more than 2m height

Sample Sequence (advisable)

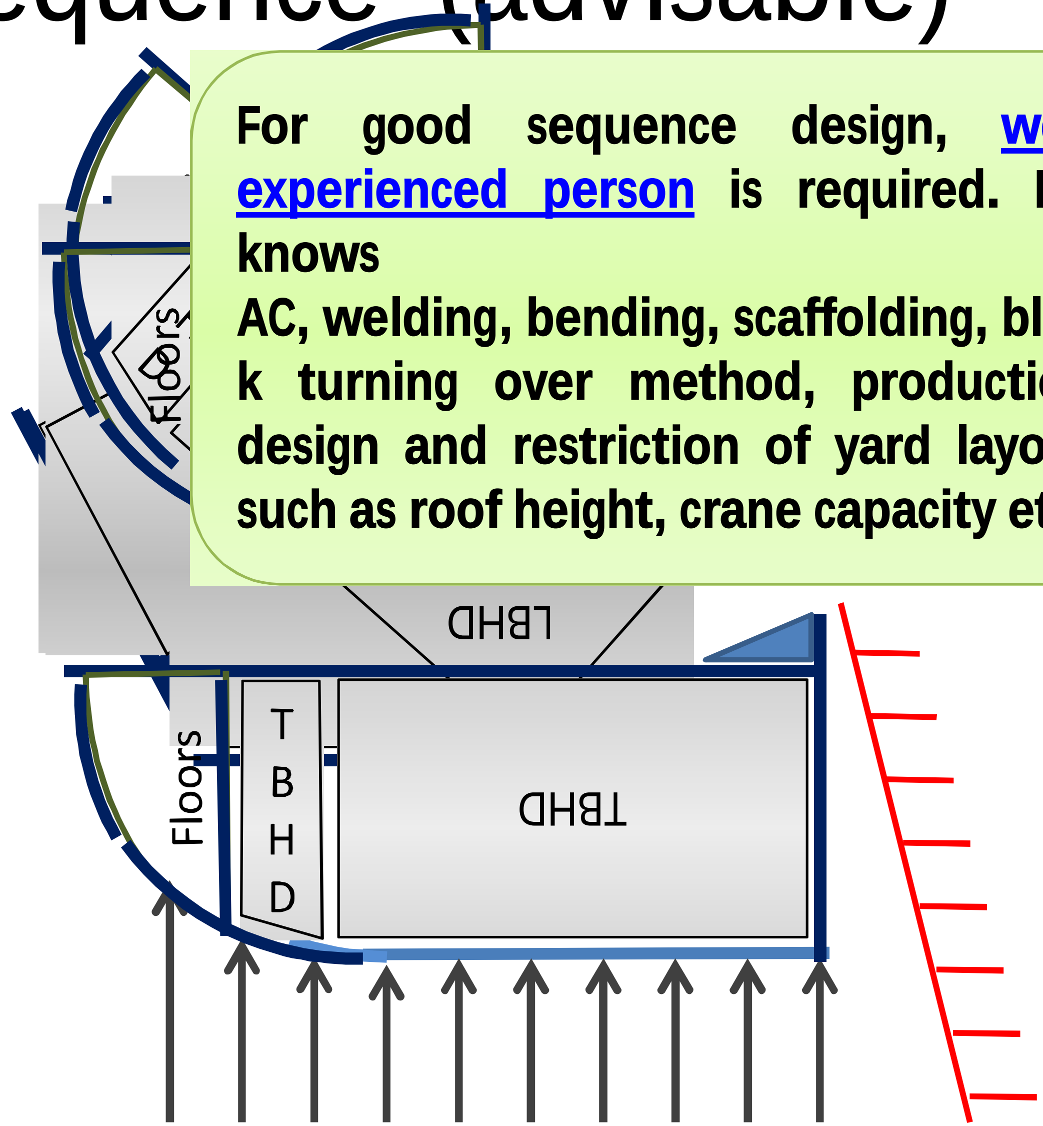
One Vertical Butt (3G) is increased for keeping accuracy of Bilge Unit on LBD (open area).
Then we can avoid over head fillet welding and only 1F/1G are required inside the block where poor accessibility.



Almost welding are 1G/1F and a little 3G



Scaffolding is not required and one ladder at Min Deck only required



For good sequence design, [well experienced person] is required. He knows AC, welding, bending, scaffolding, block turning over method, production design and restriction of yard layout such as roof height, crane capacity etc.

DAP-2

2nd; Design fabrication lanes

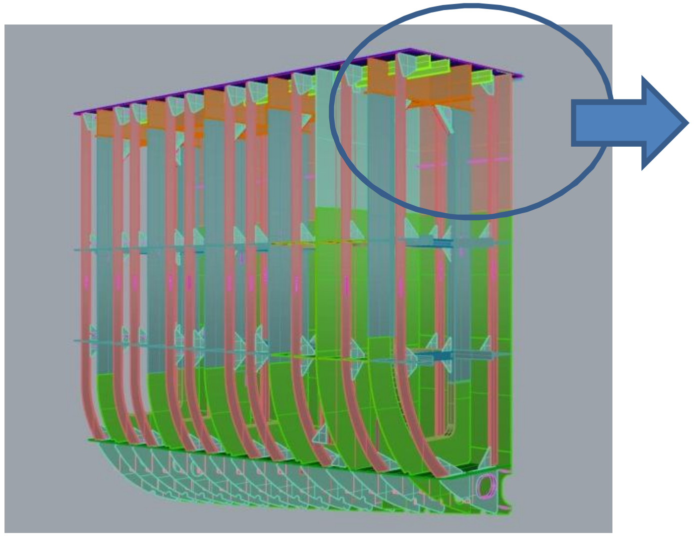
After cutting, where each part is delivered ?

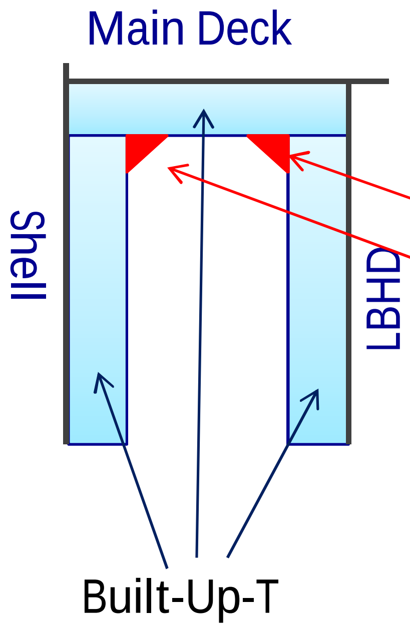
After bending or sub-assembly, where each part or element is delivered?

All parts are to be given specific and rational fabrication lane

Sample of Rational Lane Design (2)

(SAMPLE)



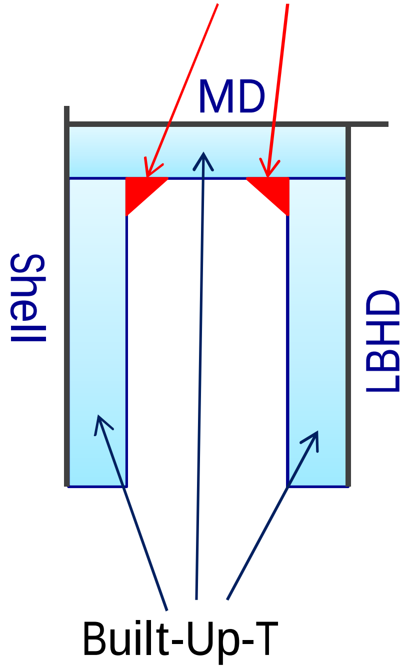


Each panel has Web Frames (Built-Up-T bar) and connected by Brackets

Where flange brackets to be delivered ?

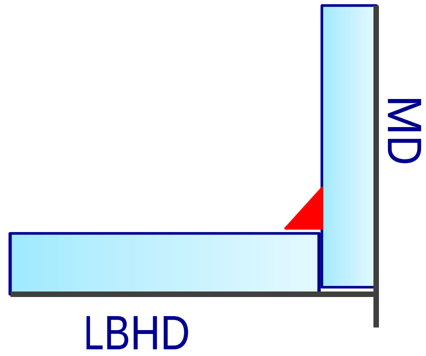
Rational Definition of fabrication lane

Where brackets to be delivered ?

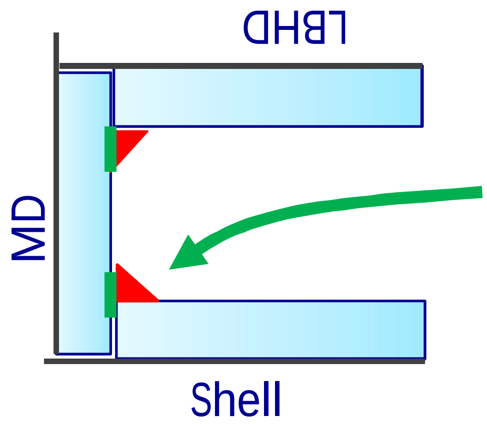


Many developing yards apply following procedure

Is it good?



Vertical fillet welding happens

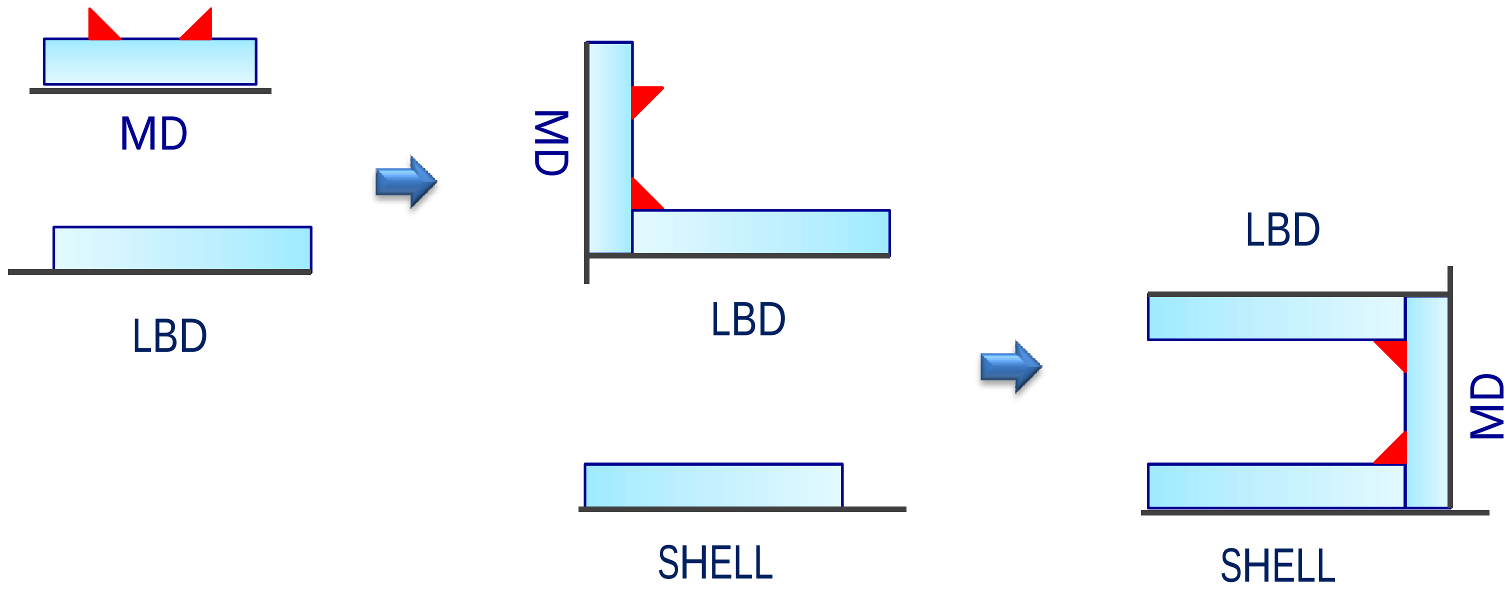


Vertical fillet welding happens
&
Bringing brackets is very tough

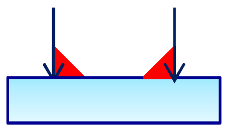
Usually there are many similar structures in one ship

That lane definition is inadvisable.

Advisable procedure



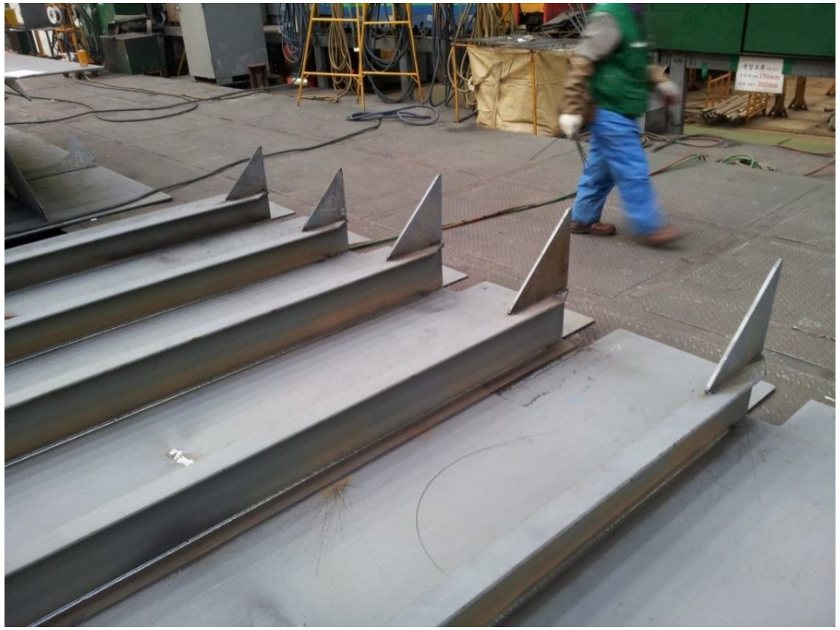
Once Brackets are fitted on Built-Up-T fabrication process, all welding becomes down-ward and material handling of Assembly is reduced lot.



Important point is fitting position of brackets

But that process is done in open space and simple structure. Then we can develop countermeasure.

Actual sample of brackets fitting in advance



DAP-3

3rd; Visualization Drawing including SUB/Y-SUB assembly process

Principle

1. Not Text but 2D or 3D drawings
2. Before start of the Production Drawing
3. User of DAP;
   - Production Design,
   - Indent Nesting
   - Production
   - Procurement

Once visualizing clearly, misunderstanding between users becomes much less than Text.

Micro Scheduling-1

Calculate quantities

Calculating welding length and number of work by each step and each stage wise

In case of cutting stage, indent nesting is required to estimate work load.

Quantity (Number & Welding length) calculation by Group (Fabrication Group & Process wise)

Process (TOTAL 40 step)

CUT BEND B-T-bar SUB/Y-SUB ASSY/G-ASSY

		CUT		Bend			BARA	B-UP				SUB/Y-SUB							ASSY							
		PL	HP	Inner	Shell	Sh-L/F		NOS	WL-1F	WL-3F	WL-1G	Nos	1F	3F	4F	1G	2G	3G	Nos	1F	3F	4F	1G	2G	3G	SAW
Fr40	A1	3	0	0																						6
Fr40	S1	18	3	8				2	11	0	0	14	9	0	0	0	0	0								
Fr40	S2	8	0	4			0	0	0	0	0	8	9	0	0	0	0	0								
Fr40	A2	0	0	0		0	6	0	0	0	0	0	0	0	0	0	0	0	8	56	4	1		1		
Fr40	S3	8		4								8	9													
Fr40	A3																		4	9						
MD	S1	15	6	0		0	7	14	33																	
MD	A1	2	0	0		0	2																			10
MD	S2	18	0	12		0		18	43																	
MD	A2																		6	79	0	10				
MD	A3	3	0	0	0	0	3					0	0	0	0	0	0	0	3	0	0	0	0	0	0	0
MD	A4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	6	34	2					
BG	S1	25	66	8								91	107					1								
BG	A0	1																	1							0
BG	A1	2			2																					10
BG	A2	0																	16	62	2					
BG	S2	21	3	10				2	2			19	33													
BG	A3						10												16	29						
BG	S3	10	10			10						20	8													
BG	A4																		11	108						
SS	S1	10	10			10						20	16													
SS	S2	33	0	3				33	42																	
SS	S3	10	0	5				10	54																	
SS	A1	3			1																		20			
SS	A2																		10	121						
SS	A3																		14	32	11					
SS	A4																		5	61	11	1	2			
LBD	S1	10	10									20	16						24	149						
LBD	S2	33	0	3				33	49																	
LBD	S3	10	0	5				10	60																	
LBD	S4	70						70	75																	
LBD	A1	4																	4							29
LBD	A2	14					14																			
LBD	A3																		14	32	11					
LBD	A4																		5	75	11	1	2			
GA	A1																		4	17	2	0	1		1	
GA	A2																			21	25	8				
GA	A3																			77			2		6	
GA	S1	32		16								32	20													
GA	A4																		20	112	29	4	10		6	
Summary		363	108	78	3	20	42	192	369	0	0	232	228	0	0	0	0	1	171	1073	108	25	36	1	13	54

Image of B-T-bar

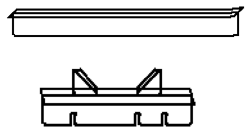


Image of SUB/Y-SUB

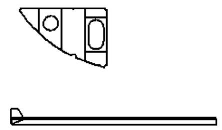


Image of ASSY

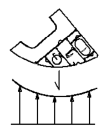
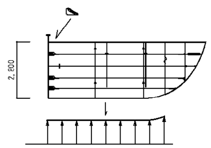
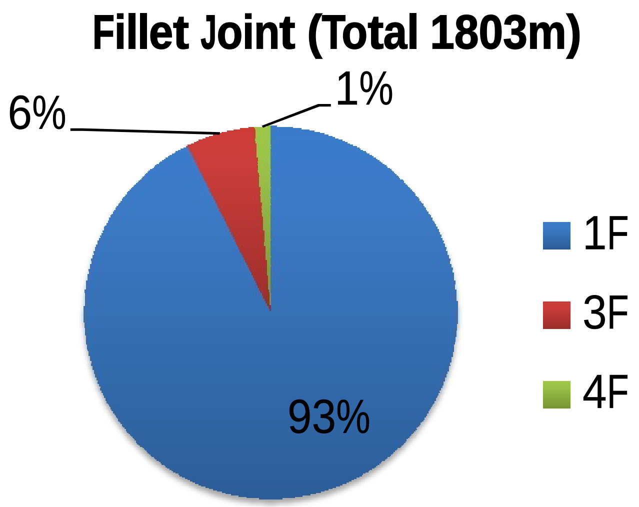


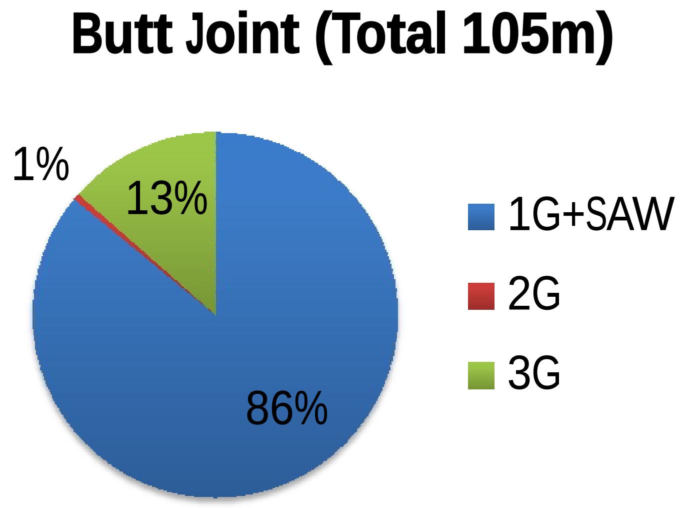
Image of G-ASSY



Required allowance of welding length calculation is 5% deviation only for each process between Approved Drawings and Final Production Drawings

Summary of Quantity calculation -1





Due to optimized DAP, 93% of fillet welding is 1F and 6% for 3F and 1% for 4F. We can apply special FCAW for 1F, which can achieve double speed compared to a wire for all position

Due to optimized DAP, 86% of butt joint is 1G/SAW and 13% is 3G.
2G (Horizontal) is inefficiency position and it is only 1%.

Micro Schedule

INPUT

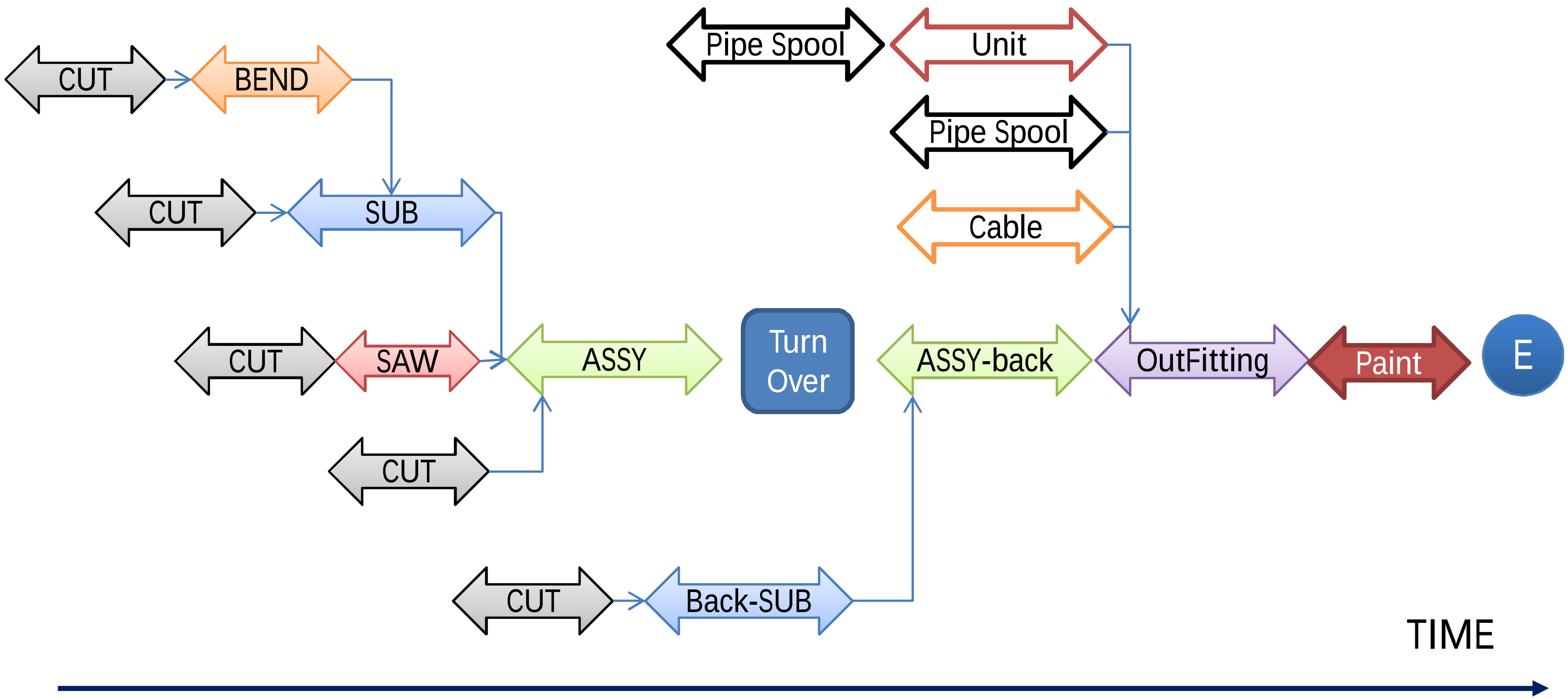
- DAP (Sequence)
- Quantity by Step and stage wise
- Productivity parameter
- Tact Time
- SKID restriction

OUTPUT

Daily manpower, Schedule of each stage,
(Cutting, Bending, SUB-Assy, Built-Up T-bar, Curved block Assembly, Square Block Assembly, Combined Assembly (Grand Assembly), pipe-spool, equipment-unit, pre-outfitting, block-blasting & paint)

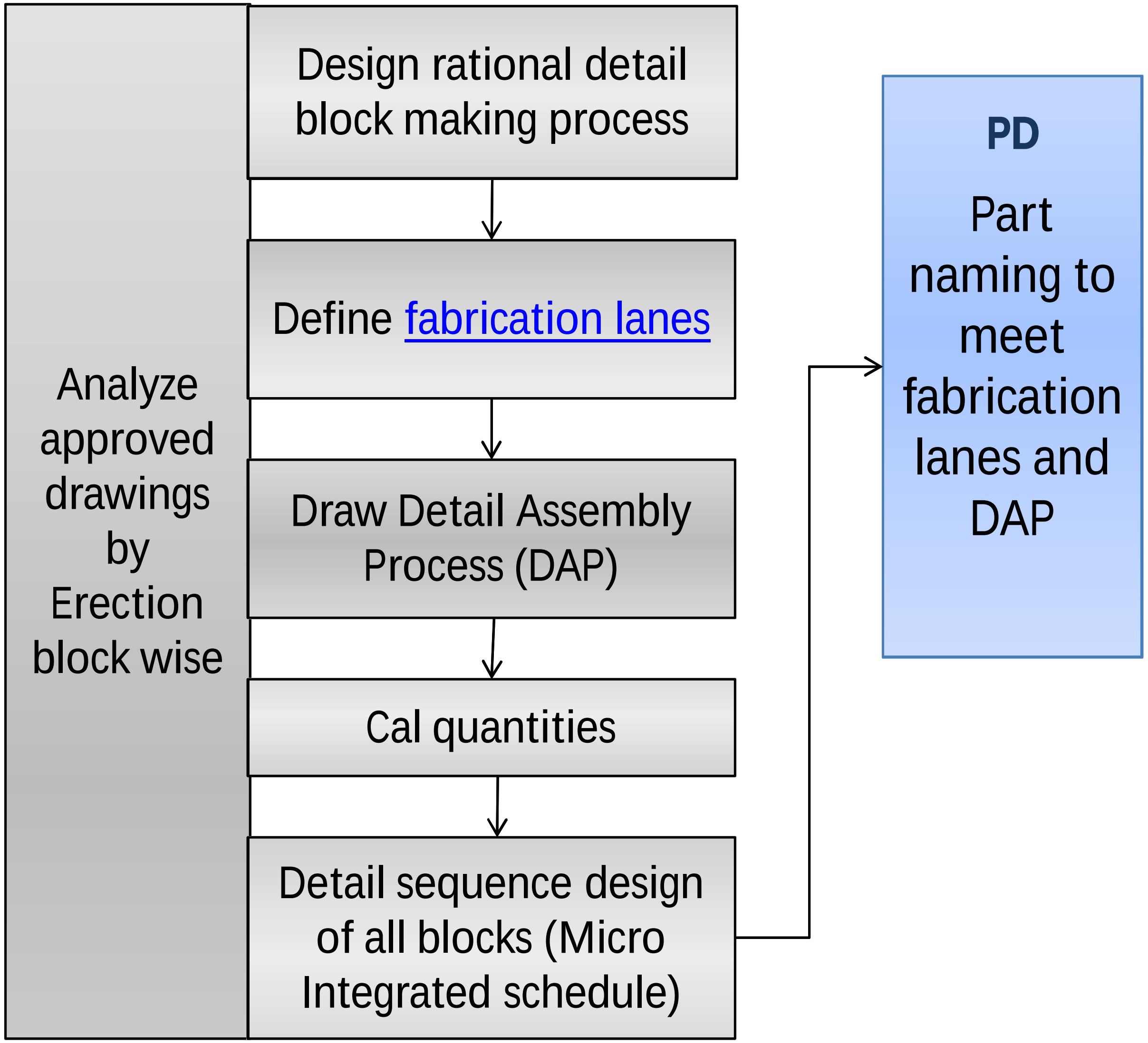
Fluctuation allowance of daily manpower is to be within 10-20% for coming 6month

Micro Scheduling-2 (micro sequence)



It is not easy to keep schedule but we must keep micro sequence strictly. And every week, follow-up meeting is required with Production, Production Design and Procurement to keep Erection Date by whatever cost.

Naming for Smooth Material Flow



Proper Part Naming

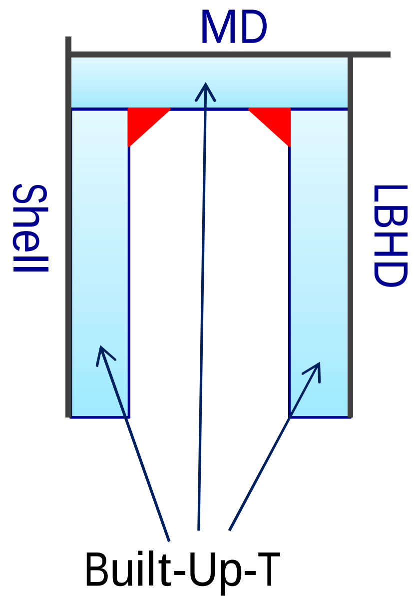
A cutting shop should be given proper naming which they can segregate parts and deliver them to defined fabrication lane without checking production drawing.

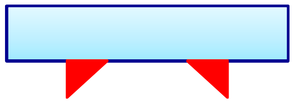
Today, several kinds of naming system are proposed.

A proper naming system indicates “Fabrication lanes” of each part.

Sample of Good Naming

Following names are applied to several Japanese shipyards





<MD>-ZBT1-ZW1

<MD>-ZBT1-ZT1

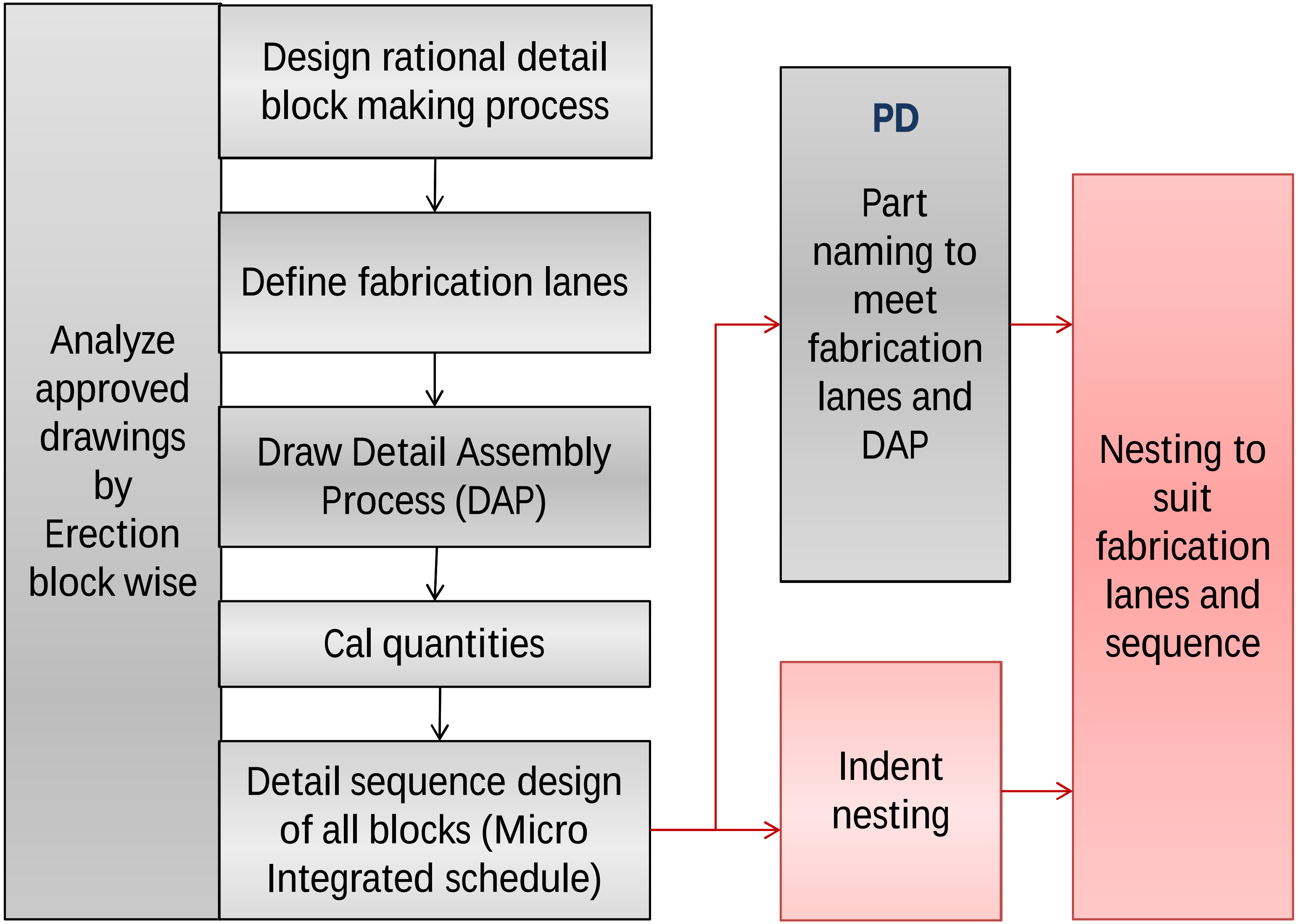
<MD>-ZBT1-ZB1
or
<MD>-ZBT1-ZKB1

In the left case, there are many common built-up T-bars on Main Deck panels.

"Z" means "common"
"BTi"; means Built-Up T-bar sub-assy
"BT" indicates those parts are delivered T-bar fabrication stage after cutting.

"Wi"; means base part of SUB—Assy
"Ti": means face plate
"Bi"; means bracket
"KBi"; means flange bracket
"K" means knuckle-bend
KBi is to be cut one day before other parts and to be sent to bending shop
<MD> means ZBT1 is delivered to MD panel after sub-assembly

NESTING

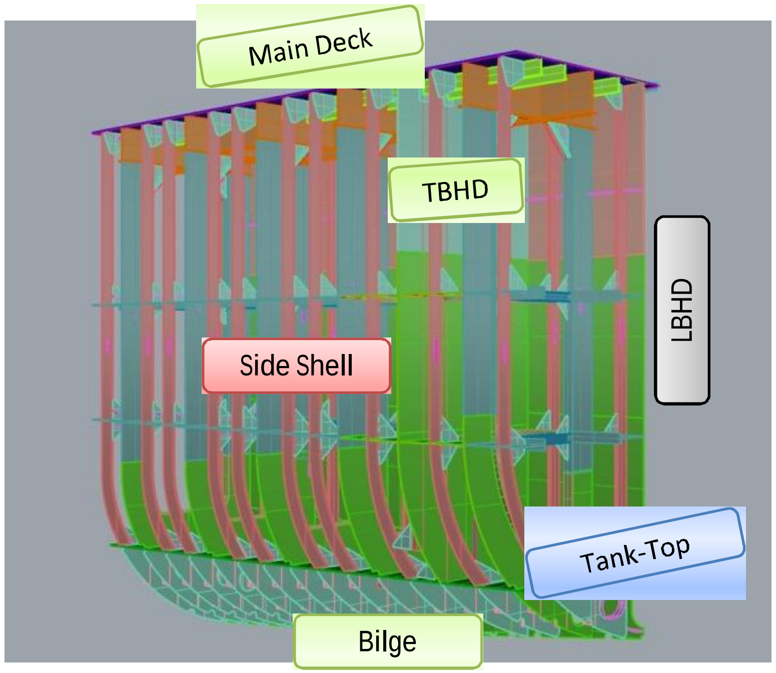


Analyze approved drawings by Erection block wise
Design rational detail block making process
Define fabrication lanes
Draw Detail Assembly Process (DAP)
Cal quantities
Detail sequence design of all blocks (Micro Integrated schedule)
PD
Part naming to meet fabrication lanes and DAP
Indent nesting
Nesting to suit fabrication lanes and sequence

Proper NESTING

The word “Block wise nesting” creates lots of segregation problem and courses of lack of parts. Many developing yards nest and cut all parts of Erection block and suffer from lack of parts and low scrap ratio.

First of all definition “Block” is foggy.
When advanced shipyard people say “Block wise nesting”, correct meaning is not “Erection Block wise nesting” but “Middle Assembly block wise nesting” or “Panel block wise nesting”.



In case of that left wing tank block,
It consists of 6 middle assembly blocks
Then total 6 units are to be nested independently at least.

Then segregation problem is solved.

Reducing Intermediate stock

- It is preferable to cut parts just before using.

  If we cut parts in advance, we will lose some of them when we need and assembly is hold.

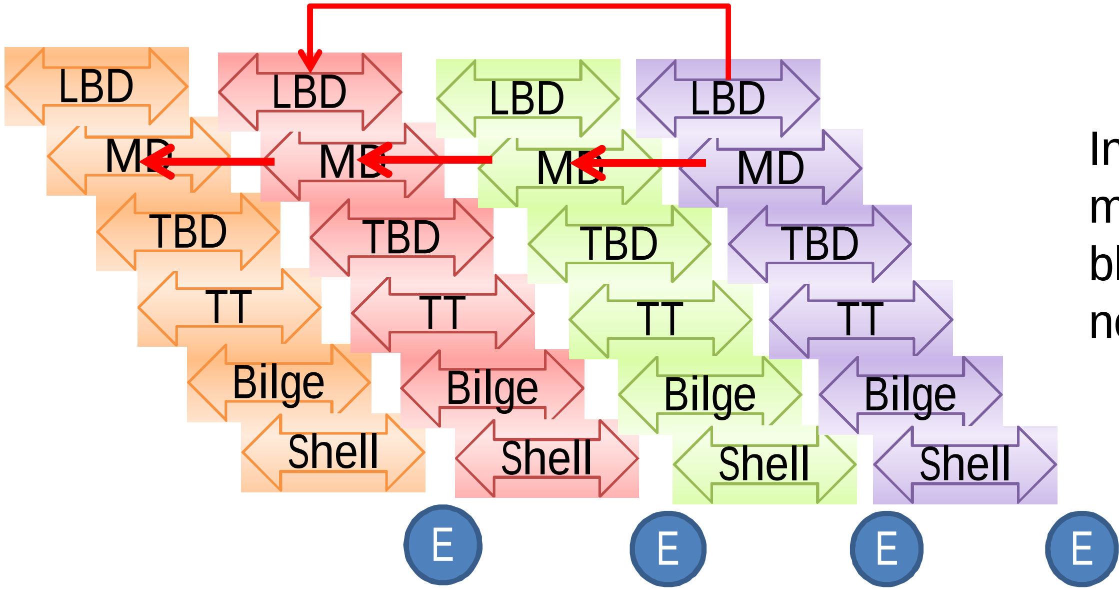
  And also segregation problem happen.

  For example, SAMSUNG does not allow to keep cut parts more than 3 days.

  However, special material such as DH36, EH36 and common parts are exception. They are controlled separately and strictly.

  Selection of special control items is also scope of PE.

In general, there are several similar blocks in one ship. And they are fabricated not at once but staggered to meet erection schedule



In between similar middle assembly blocks, multi-block nesting is advisable.

Necessity of Indent Nesting

- Usually our shipyards use standard size plates such as 2.5m x 10m. Then scrap ratio is worse than Japanese or Korean shipyards. Whether using standard size or ready made size is depended on a yard policy.
- Even though using standard plates, Indent Nesting is advisable .

  Estimation of cutting work load for CNC needs not “weight” but “the number of plates” per shift.

  Considering cost of inventory, it is advisable to procure plates periodically instead of procurement all plates per project.

  All multi-block nesting parts should be defined at Indent Nesting.

Conclusion

1. PE is essential before start of Production Design for good productivity.

2. PE is the part of Production.

3. Analyzing approved drawing and making DAP and Micro Schedule.

4. Part naming by PD has to indicate fabrication lanes and also common parts.

5. Nesting is to be done by middle assembly block wise and multi block nesting between similar middle blocks is to be applied.

6. Once above all process are done, smooth material flow and good scrap ratio are achieved.

Quick “Copy” and “Execution” is required

Dr.Hisahi Shinto
one of the most prominent Japanese industrialist after WWII and leaded Japanese shipbuilding industries to the best productivity in the world.
And I am a grand-pupil of Dr. Shinto.

Learning is “Copy” and “Copy” and “Copy” before discussion of ideas.
After more than enough, we can start modification of “Copy”.

I wish to start “copy” not from next project but from next block or tomorrow.

Thank you for your attention.