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SHIPBUILDING TECHNOLOGY FOR THE 90s

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1. INTRODUCTION

The shipbuilding industry is still coming out of a 15–year long crisis. During this period very few investments have been made in the shipyards throughout the world, with some limited exceptions.

Whereas other industries have adopted Computer Integrated Manufacturing and "Just In Time" concepts an have taken into use a wide range of other productivity tools, the shipbuilding industry remains basically unchanged.

Due to the bad times, recruitment and training of new personnel and development of new methods have not been given priority.

Most shipyards are keenly aware of their shortcomings and are trying to put modernization programs into action, but many yards have difficulties in coping with the problems.

In this new period of growth for the industry, it is important to select the correct and most cost–effective strategies for developing the production facilities and the human skills required for the next 10–year period.

2. STRATEGIC GOALS FOR IMPROVED PROFITABILITY

The strategy for the last 10 years has been for survival under very adverse market conditions, which has left very little room for major investments.

The strategy for the next 10 years should be geared to maximize profits in a period of good availability of new contracts, in an environment without subsidies and with a shortage of traditionally skilled shipbuilding personnel.

Figure 1: COST DISTRIBUTION IN SHIPBUILDING

These figures will of course vary, depending upon ship type and other circumstances.

Since the material available in the international market is in principe equal for all, what is interesting to know are the costs occuring in the shipyard.

The figure shows that 40% of the value is created in the shipyard, and that only 27.5% is labor cost.

If the labor cost is broken down, it appears that it is distributed almost equally between prefabrication, assembly,and outfitting.

The welding is a very important part of shipbuilding, as the welding man–hours may be around 25% of total labor cost and hence around 7% of the cost of the ship. However, there are many other areas that can create substantial cost savings.

Figure 2: MAIN SHIPBUILDING ACTIVITIES

Althought many shipyards still build ships in accordance with outdated methods, there is a basic agreement among shipbuilders that the principles behind this figure are correct.

— To have drawings and specifications for material purchase available at an early stage.
— To have a production facility that can be flexible in adapting to changes and delays in supply of material.
— To arrange material supply on the basis of "Just In Time" philosophy as far as possible.

On the basis of Figure 1 and 2, the following objectives leading to affect shipbuilding costs, can be formulated

Figure 3: OBJECTIVES TO BE ATTAINED TO REDUCED SHIPBUILDING COSTS

— Shortened construction time reduces financing costs.
— Shortened construction allows more shps to be built per year, reducing overhead costs per ship.
— Shortened construction time allows more time for engineering and purchasing.
— Improved productivity and quality in prefabrication reduce man–hours in prefabrication as well as in ship assembly.
— Integrated steel erection and outfitting dramatically reduces the assembly and outfitting man–hours.
— Use of advanced construction methods gives greater flexibility in completion of engineering and in material procurement.
— Shipyard product development and standardization.

The introduction of new technology, management and planning systems have to be coordinated to conform with the overall goals of the shipyard.

The arrangement of the products facilities is also one of the key areas to be improved to achieve the goals.

Figure 4: KEY AREAS FOR PRODUCTIVITY IMPROVEMENT

Key areas for productivity improvement are:
— Increased use of CAD/CAM
— Efficient planning system
— Efficient production engineering (work preparation)
— Mechanized prefabrication of components
— Dimensional accuracy of components
— Integration of stell assembly and outfitting
— Indoor construction
— Large block and ring unit assembly

3. PRODUCTION LINE TECHNOLOGY

To achieve the improvement in productivity and in dimensional accuracy, various production lines are taken into use in the prefabrication stage.

This is an important development towards the integrated manufacturing concept which is a condition for more extensive use of computer systems in the manufacturing process.

Greater use of production lines also permits the use of less skilled labor than by conventional methods.

The different production lines can be grouped as follows:

Web and Component Lines

For manufacturing of brackets, small assemblies,webs, and girders.

Figure 5: WEB LINE

Simple web line for mounting and welding of stiffeners at 90 degrees to the plate.

Figure 6: WEB LINE

Web Line installed at Kvaerner Govan in Scotland equipped with special gantries for mounting and welding of stiffeners to the plates.

Figure 7: MICRO PANEL LINE

N.C. controlled micro panel line for manufacturing of webs and brackets. This line, which is installed at the Wärtsila Turku yard, is controlled directly from the main computer, using the same type of software as for normal N.C. cutting machines. The line can automatically position and weld stiffeners on the plate within +/– 1.5 mm accuracy.

Panel Lines

There is a range of panel lines to produce the various types of panels normally found in ships. Normally between 50–70% of the steel of a ship can be produced on a panel line.

The panel line is a specialized device for production of flat or curved panels equipped with stiffeners, webs, and girders.

Figure 8: MINI PANEL LINE

Line for small panels and bulkheads with a gantry capable of mounting and welding stiffeners in all directions.

Figure 9: STANDARD PANEL AND BLOCK LINE

Standard panel and block line, usually 12 m wide and 80/120 m long.

Figure 10: LARGE PANEL LINE

This panel line differs from the other for the larger phisycal size and requirements to larger steel output.

Most panel lines today employ One–sides Welding (OSW) for the joining of plates. This technology is now well proven and plates from 4–25 mm can be welded in one pass, including plates of different thicknesses. The one–side welding station consists of a heavy clamping station where plates previously tack welded are joined to form a panel.

Figure 11: ONE–SIDE WELDING (OSW) STATION

Figure 12: OSW BACKING ARRANGEMENT

Figure 11 shows the special backing arrangement with a watercooled copper backing bar supporting the Submerged Arc Welding (SAW) procces.

Different types of moving gantries have been developed for the different tasks to be performed on the lines.

Figure 13: WELDING GANTRY

Gantries for mounting and welding of stiffeners.

Figure 14: STIFFENER WELDING GANTRY

The stiffener welding gantry can be equiped with different types of welding equipment and can be programmed for continuous or intermittent welding.

Panel lines for large shipyards have essentially the same functions as the standard panel line, but are normally wider and longer and equipped for higher performance.

Profile Cutting Lines

For preparation of the most common types of profiles there are two types of production lines; the numerically controlled (N.C.) line and the robot based line.

Figure 15: NUMERICALLY– CONTROLLED PROFILE CUTTING LINE

N.C. Profile Cutting Line installed at Kvaerner Govan in Scotland.

One of the main advantages of the N.C. line is that it can cut up to four profiles at the same time.

Figure 16: ROBOTIZED PROFILE CUTTING LINE

The robotized line is more advantageous when the stiffeners require beveling at the ends.

Until recently, robotized cutting was severely limited through inadequate software, but new programming software and the ARAC computer system, now make this technology much more attractive and reliable.

Plate Cutting & Sorting Line

A new area for mechanization, automation and use of computer capabilities is the plate cutting shop

It is well known that cutting machine utilization in shipyards is low. A recent survey of eight medium–sized shipyards showed a surprisingly low capacity utilization of the cutting machines, in many cases less than 40%. The machines also represent a considerable capital cost due to the traditional double widht, double length cutting tables.

A new approach to this problem resolver many of the traditional problems, and also reduces the requirement for intermediate storage of cut parts.

Figure 17: PLATE CUTTING SHOP

Arrangement of a plate cutting shop, which is automatically fed with the required amount of plates, has automatic loading and unloading of the cutting table, and a mechanized sorting and scrap removal arrangement.

Curved Panel Line

Curved block assembly has traditionally been a man–hour consuming operation.

Figures 18 and 19: CURVED PANEL LINE

Curved panel lines are already in use in at least two European shipyards.

4. RING UNIT CONSTRUCTION APPROACH

Assembly and oufitting of ships using the Ring Unit Construction Approach is a natural develpment of what has been known for years.

Figure 20: RING UNIT

Ring Unit is a term used to describe the joining of several structural units or blocks into a large hull slice at a shipyard location other than the final hull eretion site (slipway,berth, graving dock, etc.).

The principal benefit of this approach is the reduction in the time that the hull is occupying the valuable erection and lauching facility, since fewer blocks are needed to complete the hull.

A secondary but still major group of cost savings stems from efficiencies of access and increased outfitting that can be achieved when the block is assembled at ground level. Typical savings include:

— More fitting and welding at ground level.
— Less staging required.
— Easier access for and earlier preoutfitting.
— Less outfit trade interference after hull erection.
— Better environmental protection.
— Improved material handling.
— Reduced employee transit time from shop

facilities and material stores to the hull block.
— Simplified planning and improved production control.

5. HEAVY LOAD TRANSPORT TECHNOLOGY

In shipbuilding, there is a general need to lift and move heavy loads crucial to assembling and launching of ships.

It is also widely accepted that constructing the ship in large block, and outfitting them prior to final assembly, result in large productivity gains.

The following is a presentation of various heavy load movement technologies that can be employed with great profitability in shipbuilding.

Figure 21: ULTRA HEAVY LIFT SYSTEM (UHL)

The U.H.L. (Ultra Heavy Lift) system moves ring units and sections on the indoor section assembly line. The U.H.L. system consists of a series of lifting trains running on parallel rail tracks along the line, lifting the unit off the assembly stands and moving it to the next assembly station. The U.H.L. system terminates at a loadout station where the units are retrieved by crane, or lifted to required clearance on hydraulic cylinders for retrieval by wheeled transporters. The U.H.L. system can handle the weight of any section feasible to be assembled indoors.

Figure 22: DUAL WALKING BEAM SYSTEM (DWB)

The D.W.B. (Dual Walking Beam) system consists of three or more D.W.B. units, one powersource and one control system. Each D.W.B. unit can carry 100–400 tons (depending on unit type), the total load capacity being a multiple of the number of D.W.B. units in the system. The D.W.B. system can carry the load across uneven ground surfaces with coarse surface material such as gravel a.o. By hydraulic interconnection, the D.W.B. units will float the load, preventing road bumps to induce stress forces to the load construction. The D.W.B. system can turn and maneuver the load in very narrow areas and can also move up an incline, – a slipway for example. The D.W.B. system can be operated by one person, using a handheld wireless control unit.

Figure 23: TTS – SKIDDING TECHNOLOGY

One of the cheapest ways to move loads is by hydraulically opearted skidding systems.In shipyards, skidding can be used for moving large blocks or ring units into the launchways, along the launchways or as part of the launching process itself.

The TTS skidding systems are based on the use of gripper jacks for moving the load along steel beams in a simple push–pull mode.

Figure 24: TYPICAL GRIPPER JACK

A gripper jack consists of a hydraulic gripper and a double–acting hydraulic jacking cylinder. The gripper acts as a movable anchor, clamping itself to the skidbeam thus reacting tothe thrust from the power stroke of the jacking cylinder. After each power stroke, all grippers are unclamped, advanced, then reclamped in the new position for the next power stroke. This four–step cycle is repeated until the desired distance has been traveled.

Figure 25: SKIDDING APPLICATIONS

Figure 26: SKIDDING APPLICATIONS

Figure 27: TRANSFER SYSTEM

Figure 28: SHIP ASSEMBLY AT NEW INCHON, KOREA

Figure 29: KVAERNER GOVAN LTD.

Figure 30: KVAERNER FJELLSTRAND

Figure 31: BAT SERVICE, MANDAL

Figure 32: DWB & DOCKLIFT SYSTEM

Figure 33: SKIDDING & DOCKLIFT SYSTEM

Figure 34: SKIDDING & DOCKLIFT SYSTEM

SHIPBUILDING TECHNOLOGY FOR THE 90s FIGURES/OVERHEADS

N°

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2. Main Shipbuilding Activities
3. Objectives to be Attained to Reduce Shipbuilding Costs
4. Key Areas for Productivity Improvement
5. Web Line
6. Web Line
7. Micro Panel Line
8. Mini Panel Line
9. Standar Panel and Blok Line

10. Standard Panel Line
11. One–Side Welding (OSW)
12. OSW Backing Arrangement
13. Welding Gantry
14. Stiffener Welding Gantry
15. Numerically–Controlled Profile Cutting Line
16. Robotized Profile Cutting Line
17. Plate Cutting Shop
18. Curved Panel Line
19. Curved Panel Line
20. Ring Unit
21. Ultra Heavy Lift System (UHL)
22. Dual Walking Beam (DWB)
23. TTS – Skidding Technology
24. Typical Gripper Jack
25. Skidding Applications
26. Skidding Applications
27. Transfer System
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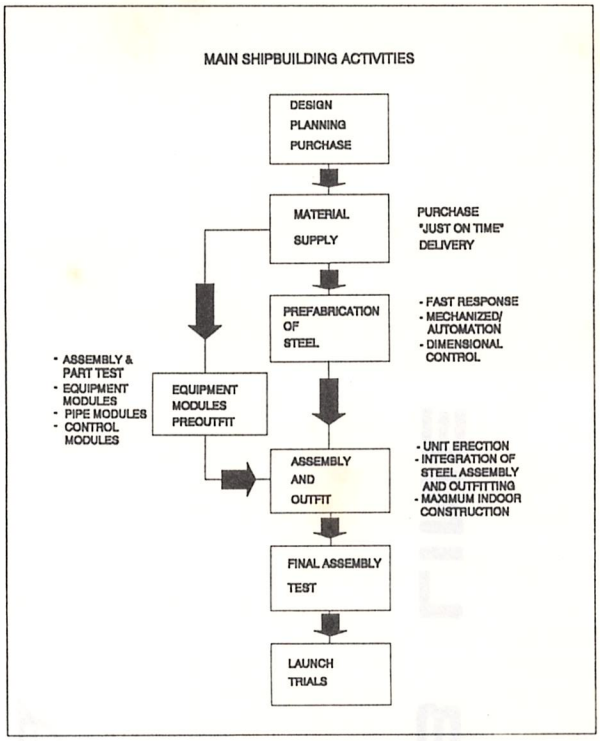
29. Kvaerner Govan Ltd.
30. Kvaerner Fjellstrand
31. Bat Service, Mandal
32. DWB & Doclift System
33. Skidding & Docklift System
34. Skidding & Docklift System

COST DISTRIBUTION IN SHIPBUILDING

1. Material Cost	60.0%	
2. Finance Cost	2.5%	} 40.0%
3. Management and Overhead	10.0%	
4. Labor Cost	27.5%	

For labor cost, the following average breakdown is assumed:

1. Prefabrication	30.0%
2. Ship Assembly	30.0%
3. Outfitting	40.0%



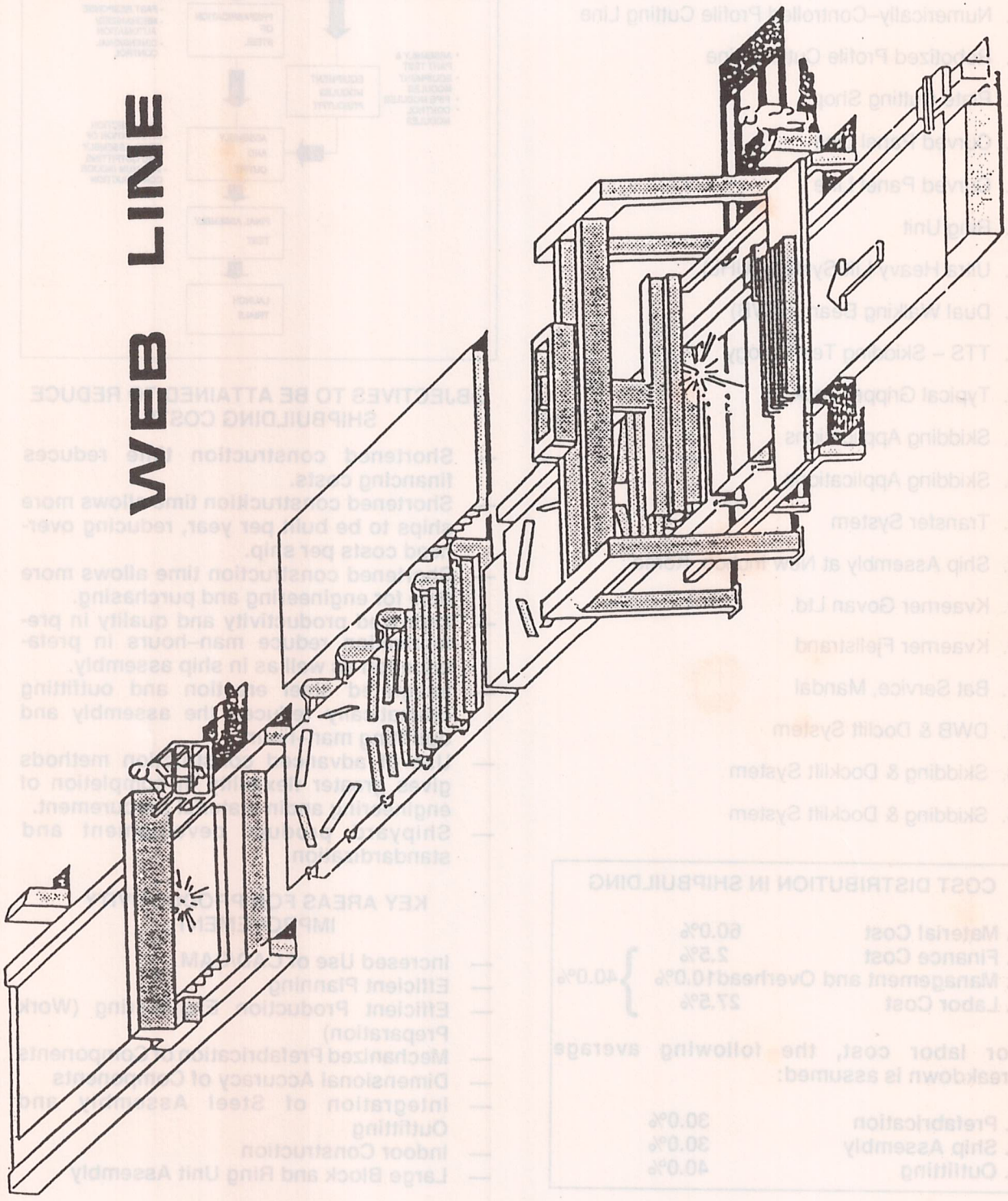
OBJECTIVES TO BE ATTAINED TO REDUCE SHIPBUILDING COSTS

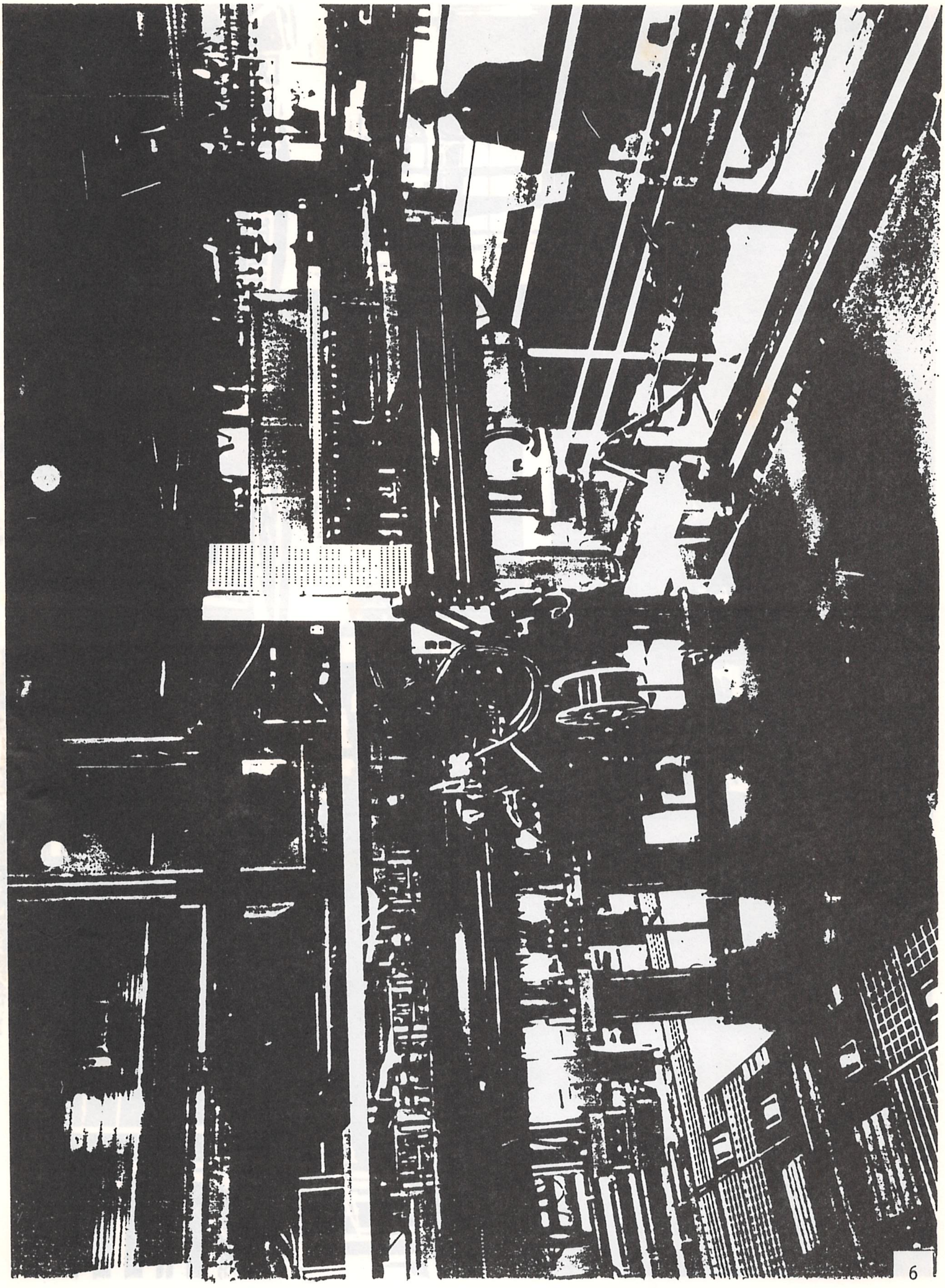
- Shortened construction time reduces financing costs.
- Shortened construcition time allows more ships to be built per year, reducing overhead costs per ship.
- Shortened construction time allows more time for engineering and purchasing.
- Improved productivity and quality in prefabrication reduce man–hours in prefabrication as well as in ship assembly.
- Integrated steel erection and outfitting dramatically reduces the assembly and outfitting man–hours.
- Use of advanced construction methods gives greater flexibility in completion of engineering andin material procurement.
- Shipyard product development and standardization.

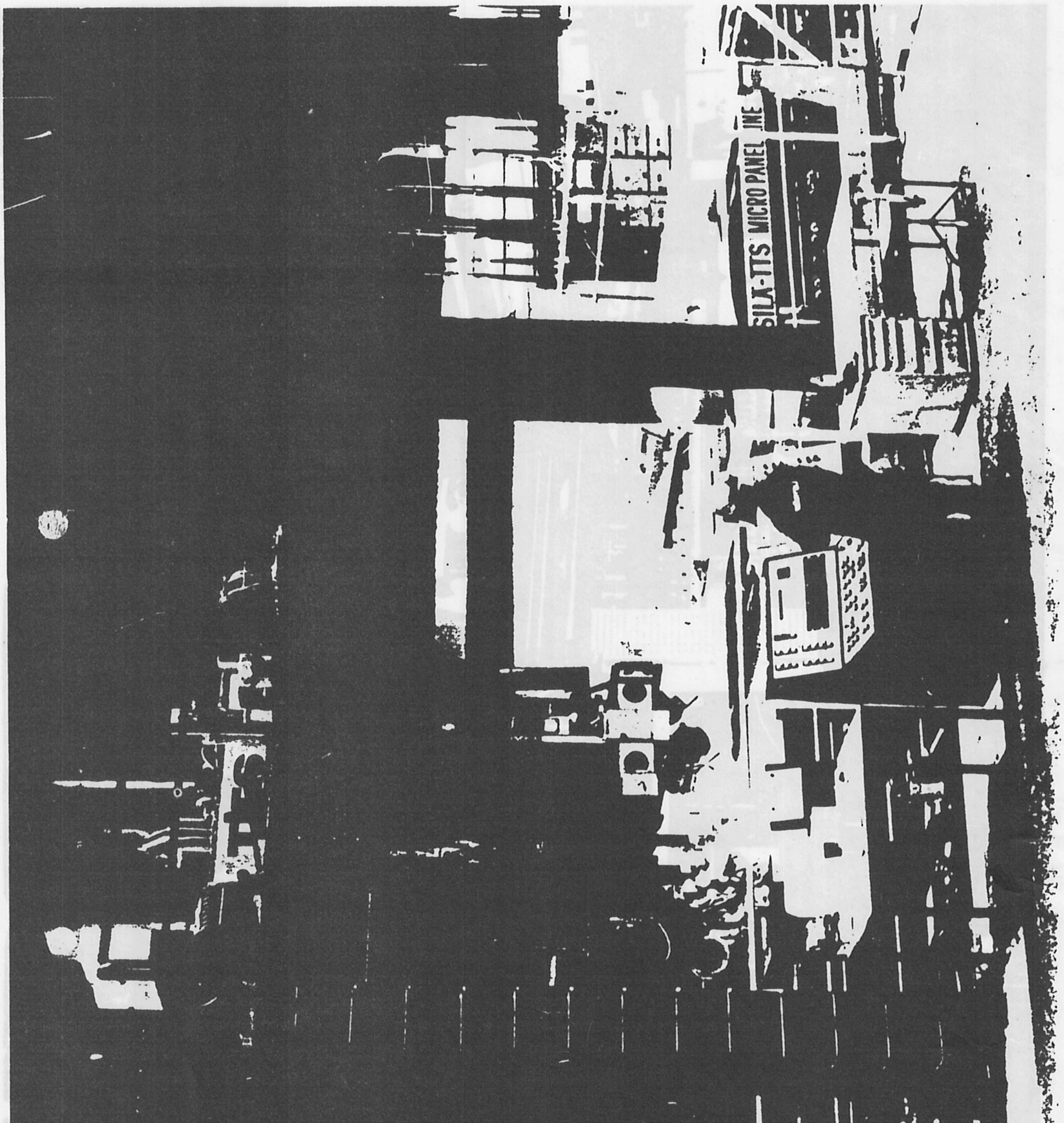
KEY AREAS FOR PRODUCTIVITY IMPROVEMENT

- Incresed Use of CAD/CAM
- Efficient Planning
- Efficient Production Engineering (Work Preparation)
- Mechanized Prefabrication of Components
- Dimensional Accuracy of Components
- Integration of Steel Assembly and Outfitting
- Indoor Construction
- Large Block and Ring Unit Assembly

WEB LINE







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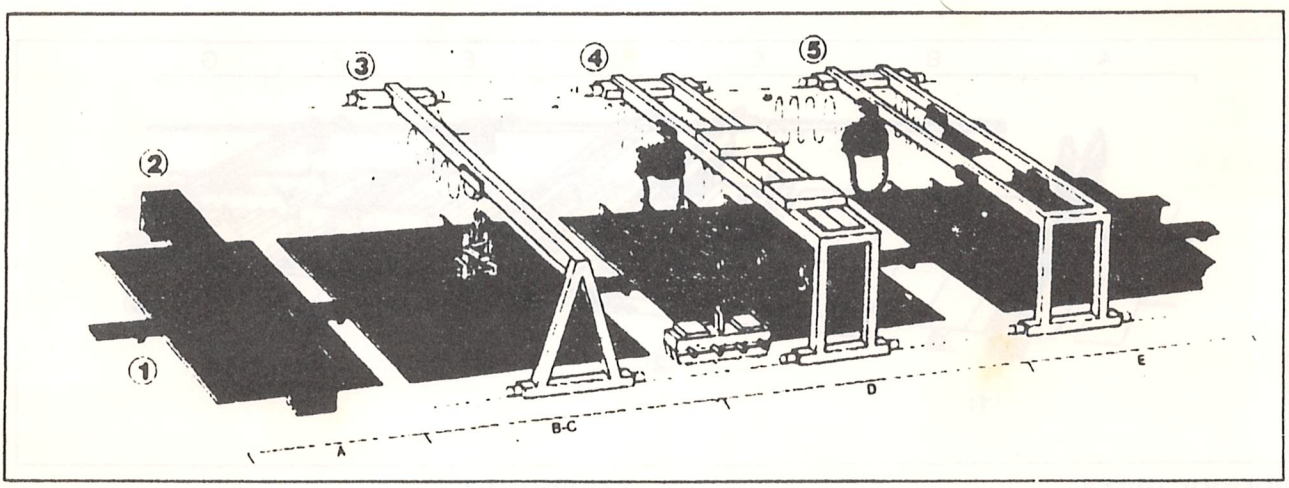
MINI PANEL LINE



PRODUCTIVITY

No. of panels per 8 hours shift: *1*
No. of workers *6*
No. of plate joints per hour: *1*
No. of stiffeners per 8 hours shift: ... *18*

EQUIPMENT

1. *Roller Bed with pulling chain.*
2. *One side Buttwelding Station.*
3. *Workshop Gantry with multidirectional stiffener mounting and Worktable with ESAB Semiautomatic Welding Unit.*
4. *Workshop Gantry with dual side multi gravity welding and fume extraction unit.*
5. *Workshop Gantry with Web Clamping Tool and Worktables with ESAB Semiautomatic Welding Units and fume extraction.*

DESCRIPTION

The TTS Mini Panel line provides the small yard with full scale line production facilities.

The Mini Panel Line will produce stiffened panels 7-12 meters wide, as well as stiffened webs and larger components.

The TTS Mini Panel Line has a roller bed for conveying of the panels, and provides one side plate buttwelding at a fixed position.

The panel assembly and finishing work is based on Mobile Workshop Gantries with suspending tool units providing hydraulic clamping and automatic or semiautomatic welding.

Stiffeners can be mounted at any angle in the horizontal plane, providing great product flexibility.

The Mini Panel Line can be expanded stepwise in accordance with increasing demand

A. PLATE JOINTING.
Plate alignment, clamping, tacking and automatic one side buttwelding.

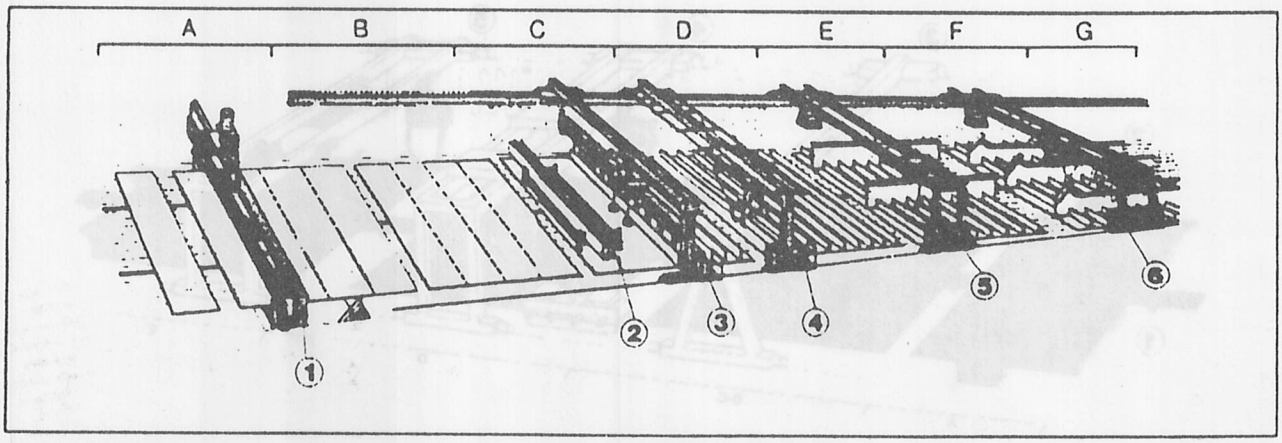
B. STIFFENER MOUNTING.
Stiffener alignment, clamping and tackwelding by Workshop Gantry equipped with stiffener mounting tool and semiautomatic MIG welding unit.

C. STIFFENER WELDING
by Workshop Gantry with dual side 8 pin gravity welding unit fitted.

D. WEB MOUNTING.
Web alignment and tacking by Workshop Gantry equipped with web hoists, clamping unit and semiautomatic MIG welding units.

E. WEB WELDING AND FINISHING.
Final welding of webs and fitting of smaller components by Workshop Gantry with semiautomatic MIG welding units.

STANDARD PANEL AND BLOCK LINE



PRODUCTIVITY

No. of panels per 8 hours shift: 2
No. of workers: 10
No. of plate joints per hour: 1,2
No. of stiffeners per 8 hours shift: 24-30
No. of webs per panel: 3

EQUIPMENT

1. *One side Buttwelding Station.*
2. *Stiffener Rack*
3. *Stiffener Mounting Gantry*
4. *Autowelding Gantry.*
5. *Web Mounting and Welding Gantry.*
6. *Web Welding Service Gantry.*
7. *Transport Bed.*

DESCRIPTION

The TTS Standard Panel and Block Line will meet the needs of a majority of shipyards ranging from 10.000 ton steel throughput per year.

The Standard Panel and Block Line will produce stiffened panels and panel blocks with 12 meters width and up to 200 ton block weight.

In an 8 hours shift 10 workers will produce 2 typical panels fitted with 12-15 stiffeners and 3 webs.

The TTS panel lines are based on specialized mobile tool gantries operating along a panel transport bed. The tool gantries are equipped with tool units or tooling systems required to meet with the customer's needs with respect to welding technology, capacity etc.

The equipment configuration of The Standard Panel and Block Line is based on experienced results from numerous installations worldwide, and will be a good approach to an optimal solution for most medium sized shipyards.

A. PLATE JOINTING.
Plate alignment by manipulators, clamping, tacking and automatic one side buttwelding.

B. MARKING AND EDGE TRIMMING
Optional functions.

C. STIFFENER MOUNTING.
Stiffener alignment, clamping and tacking by Stiffener Mounting Gantry.

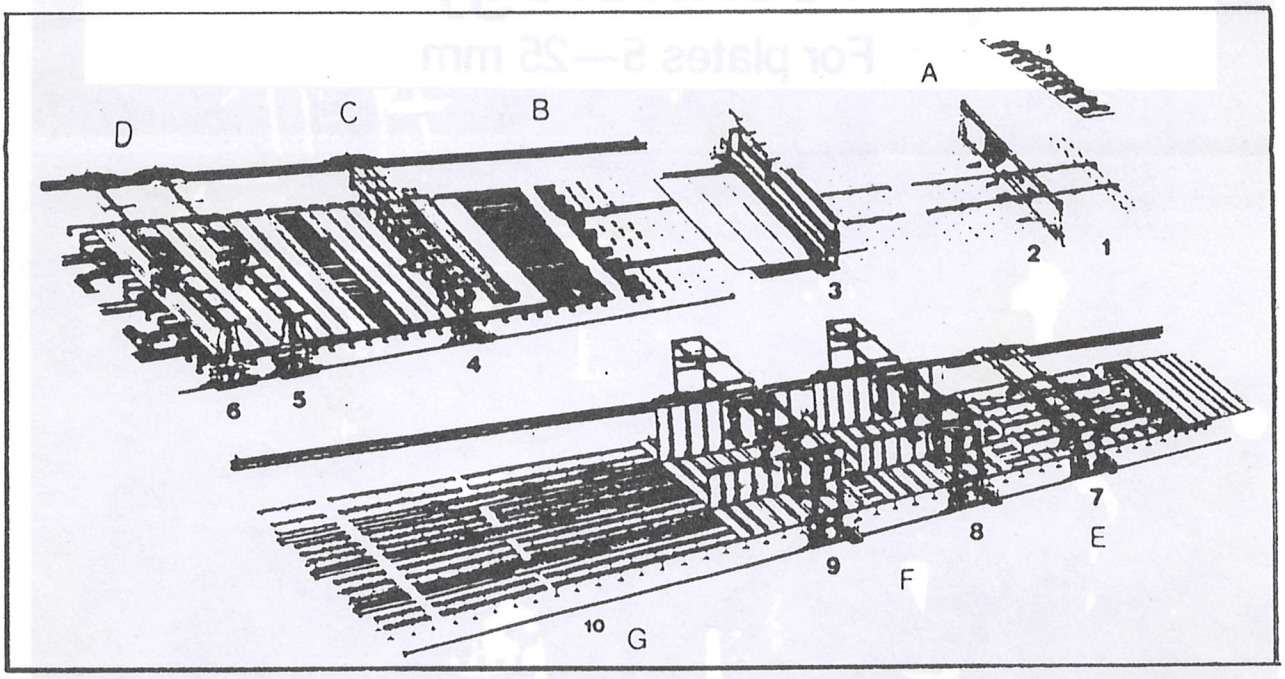
D. STIFFENER WELDING.
Dual side automatic filletwelding (SAW, MIG or FCAW) by Autowelding Gantry.

E. WEB MOUNTING.
Web alignment, clamping and tacking by Web Mounting and Welding Gantry.

F. WEB WELDING.
Final welding by Web Welding Service Gantry (semiautomatic MIG).

G. FINAL INSPECTION AND LOAD OUT.

LARGE PANEL LINE



PRODUCTIVITY

No. of panels per hour	*2*
No. of workers:	*15-20*
No. of plate joints per hour:	*1*
No. of stiffeners per 8 hours.	*30-40*
No. of webs/bulkheads per panel:	*3-4*

EQUIPMENT

1. *Roller bed.*
2. *Plate joint Tacking Station.*
3. *One side Buttwelding Station.*
4. *Stiffener Mounting Gantry.*
5./6. *Automatic Filletwelding Gantry.*
7. *Web Gantry.*
8./9. *Web welding Service Gantry.*
10. *U.H.L. Transport System.*

DESCRIPTION

The TTS panel lines for large shipyards differ from the other TTS panel lines mainly due to physical size and requirements to larger steel throughput.

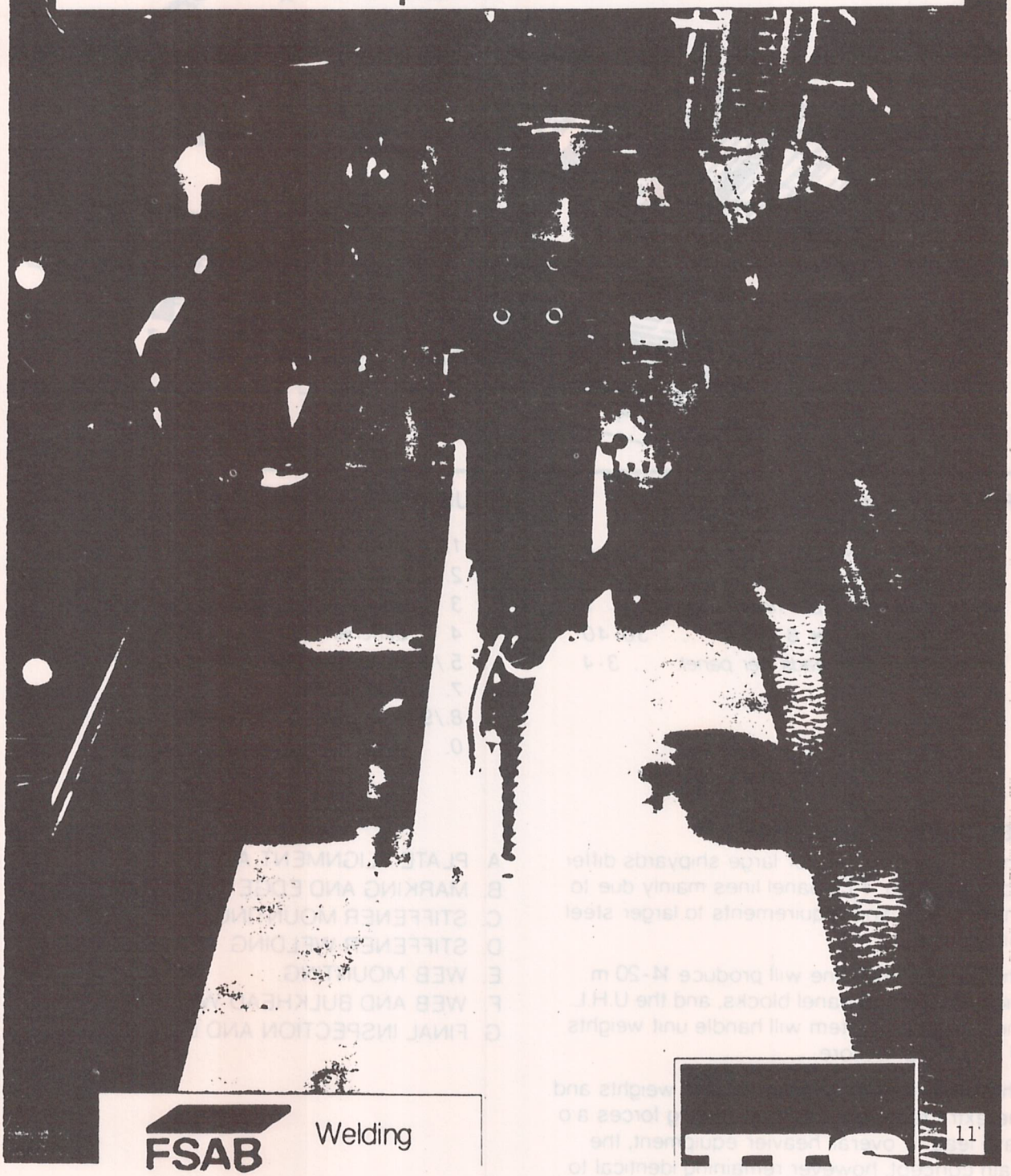
The Large Panel Line will produce 14-20 m wide panels and panel blocks, and the U.H.L. line transport system will handle unit weights of 100 ton and more.

The larger material thickness and weights and the extra requirements to clamping forces a.o have lead to overall heavier equipment, the main concept, however remaining identical to the other panel lines.

A PLATE ALIGNMENT AND TACKING
B. MARKING AND EDGE TRIMMING
C. STIFFENER MOUNTING
D. STIFFENER WELDING.
E. WEB MOUNTING.
F. WEB AND BULKHEAD WELDING.
G FINAL INSPECTION AND LOADOUT

TTS - One Side Welding Technology

For plates 5—25 mm



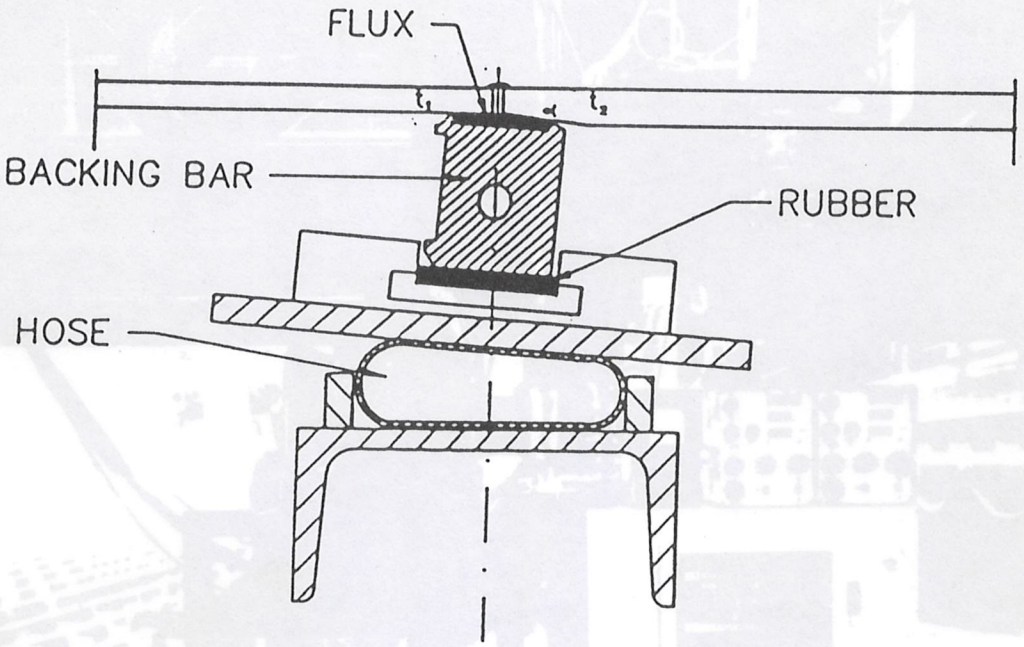
FSAB Welding

11

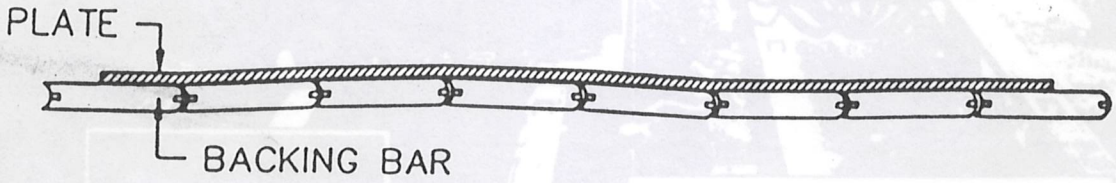
OSW

BACKING ARRANGEM.

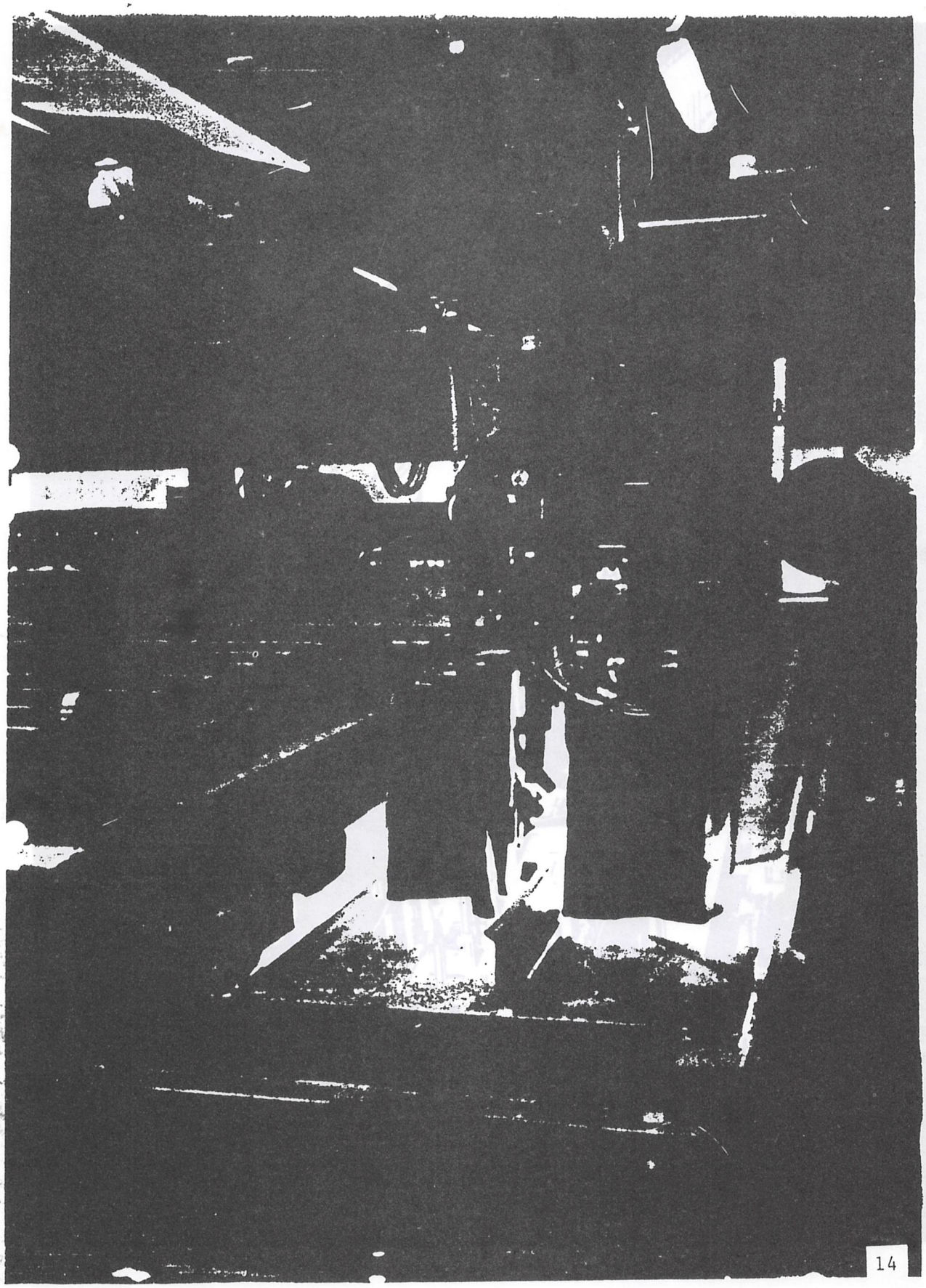
WHEN PLATES OF DIFFERENT THICKNESSES ARE WELDED, THE BACKING BAR SYSTEM WILL AUTOMATICALLY ADJUST ITSELF TO THE CONTOUR OF THE PLATES UNDERSIDE.



THE BACKING BAR ELEMENT WILL ALSO ADJUST ITSELF TO POSSIBLE DEFORMATIONS ON THE UNDERSIDE OF THE PANEL.



BACKING BAR IS BUILT UP OF ELEMENTS OF 250MM LENGTH.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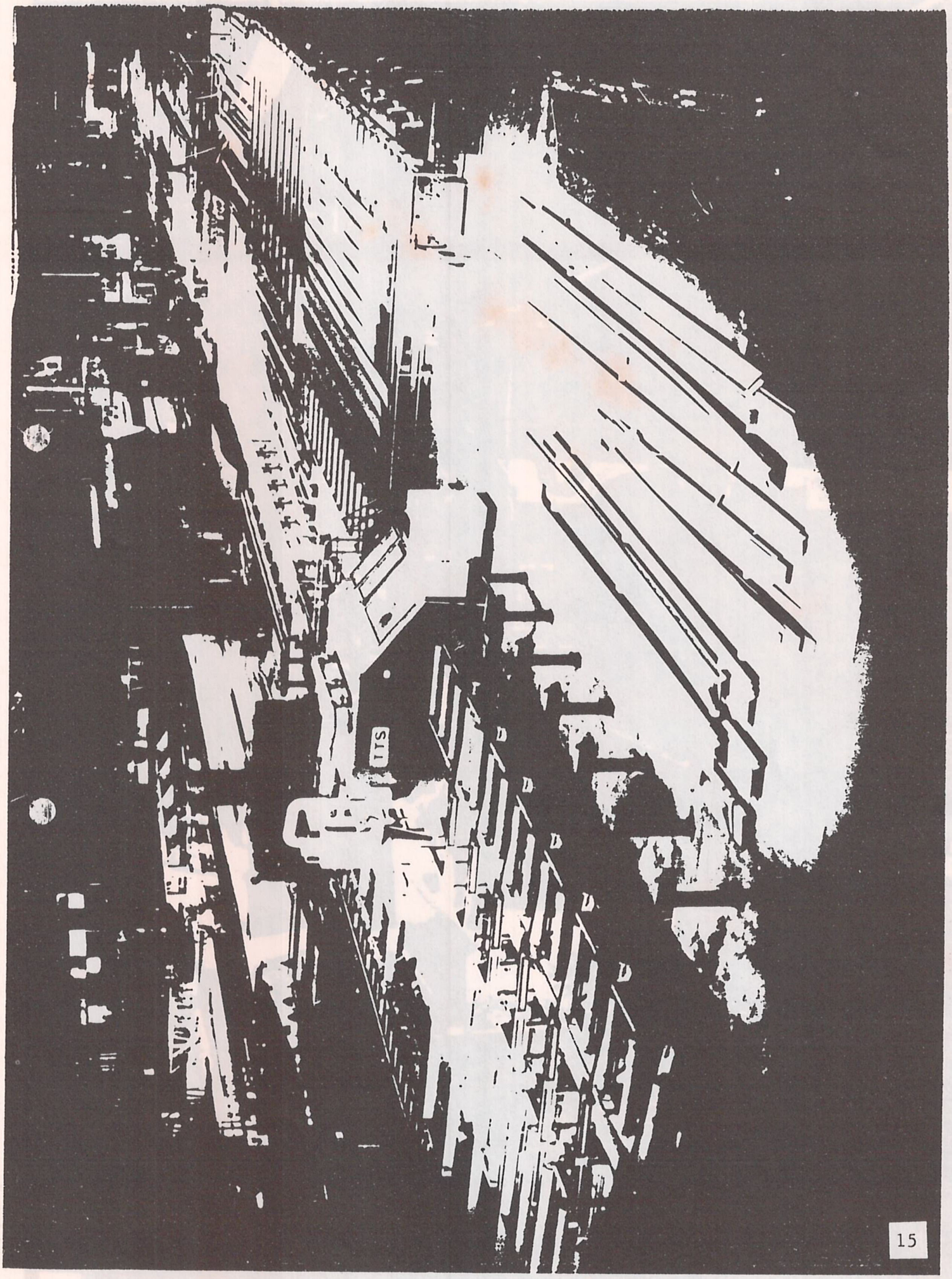

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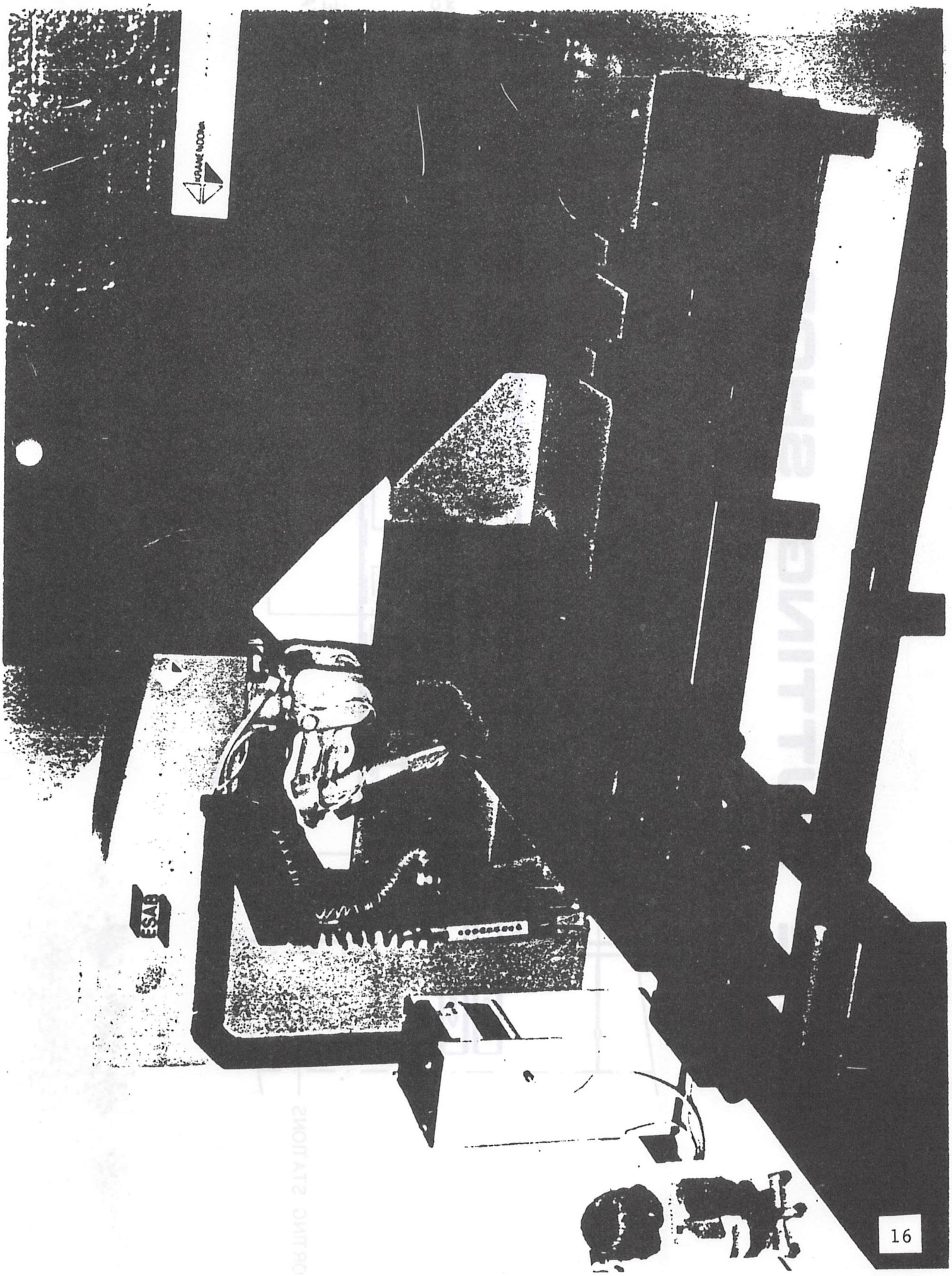

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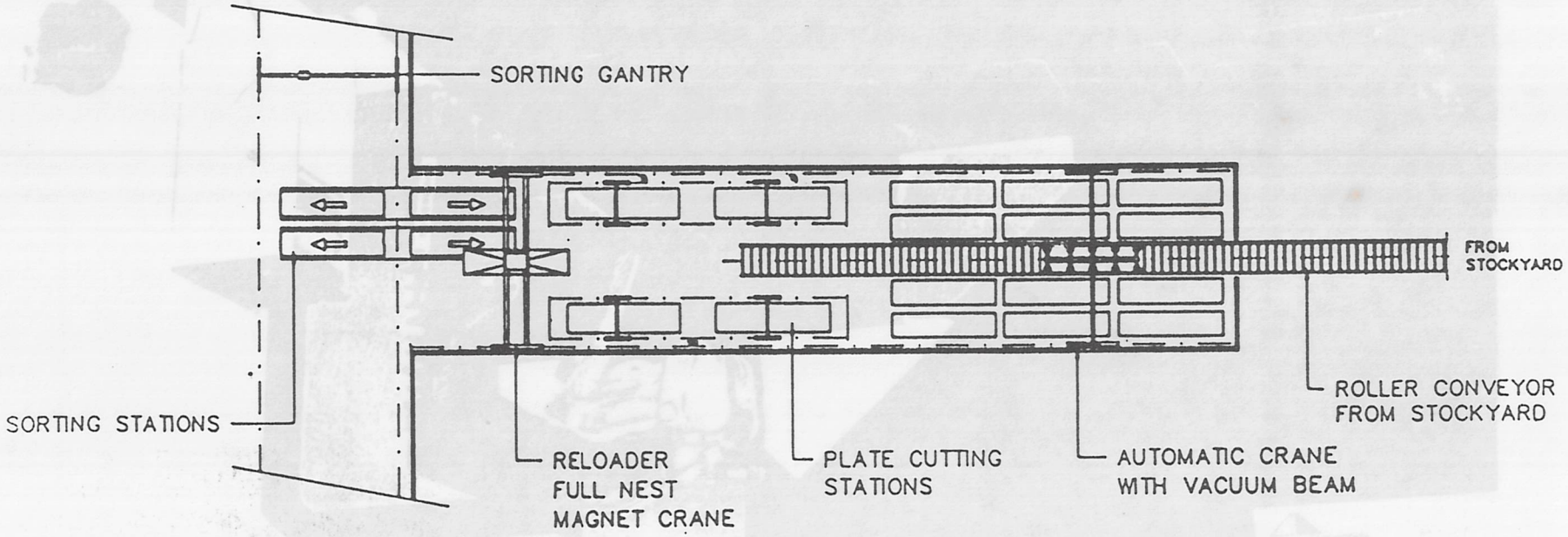
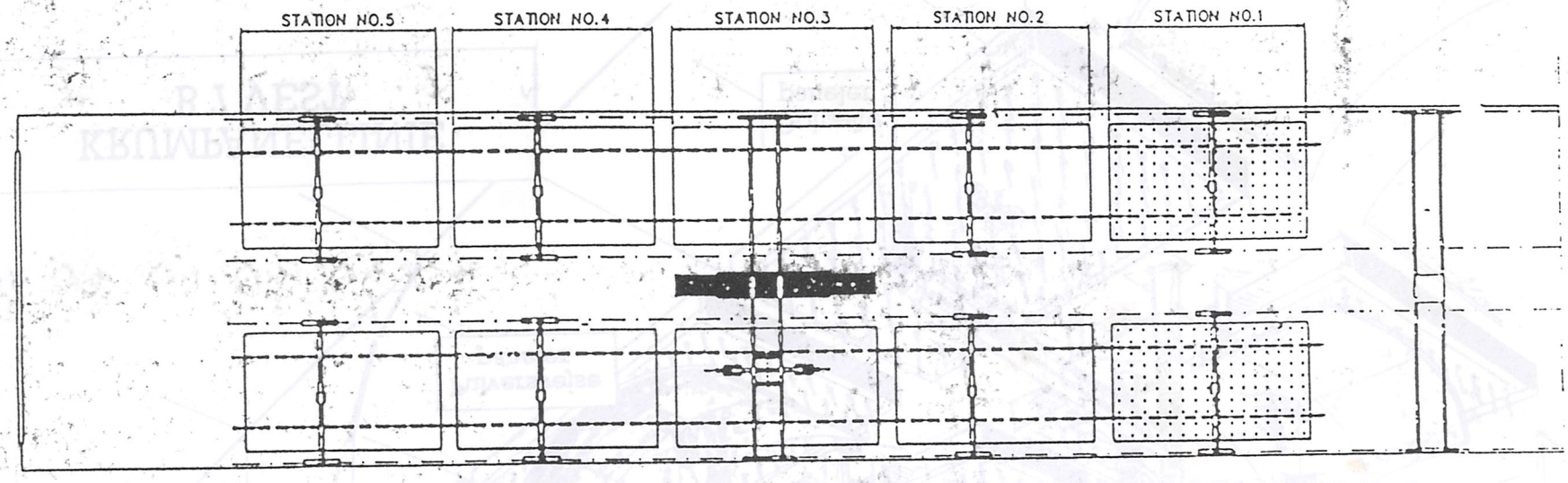
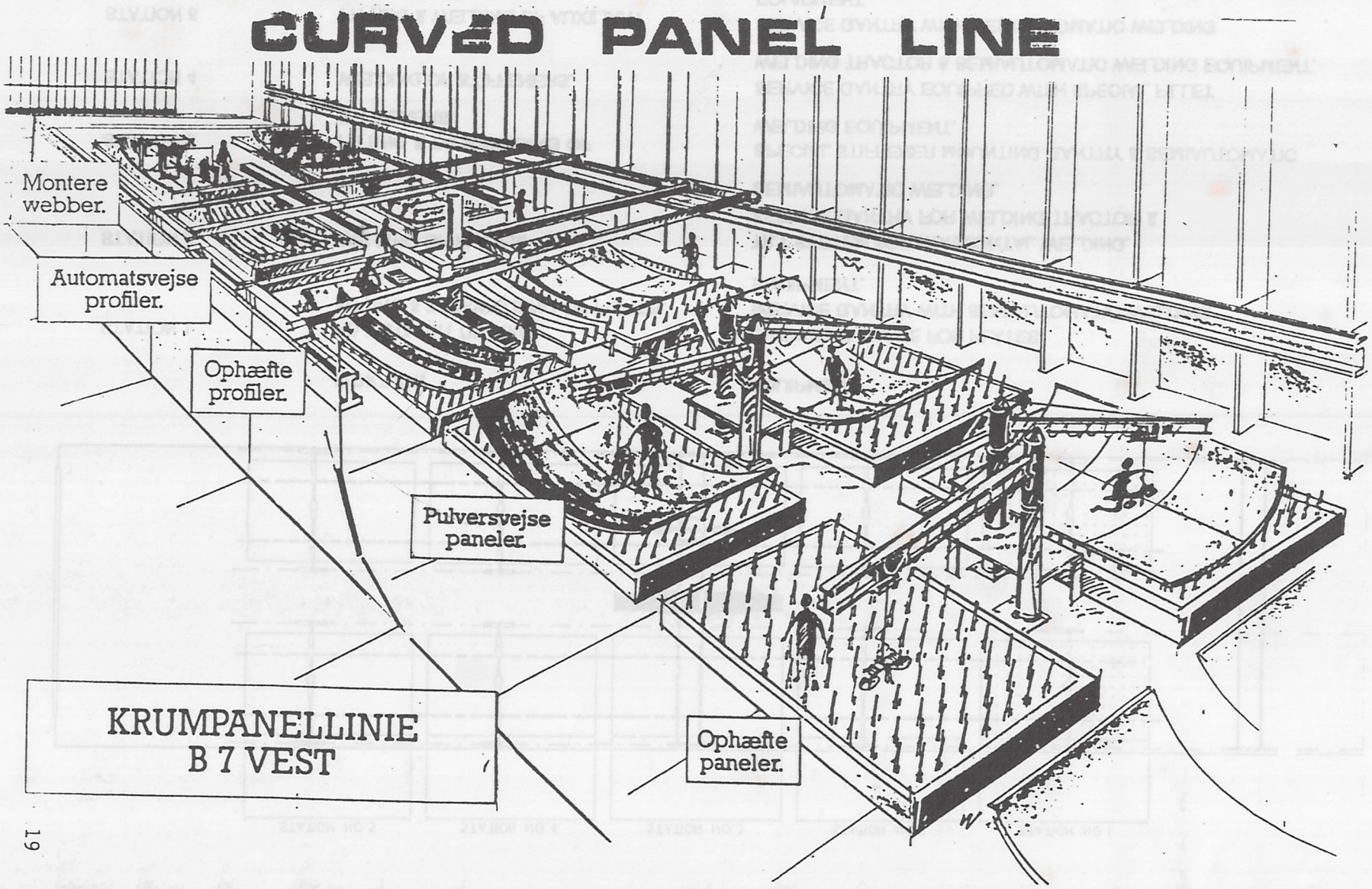
PLATE CUTTING SHOP



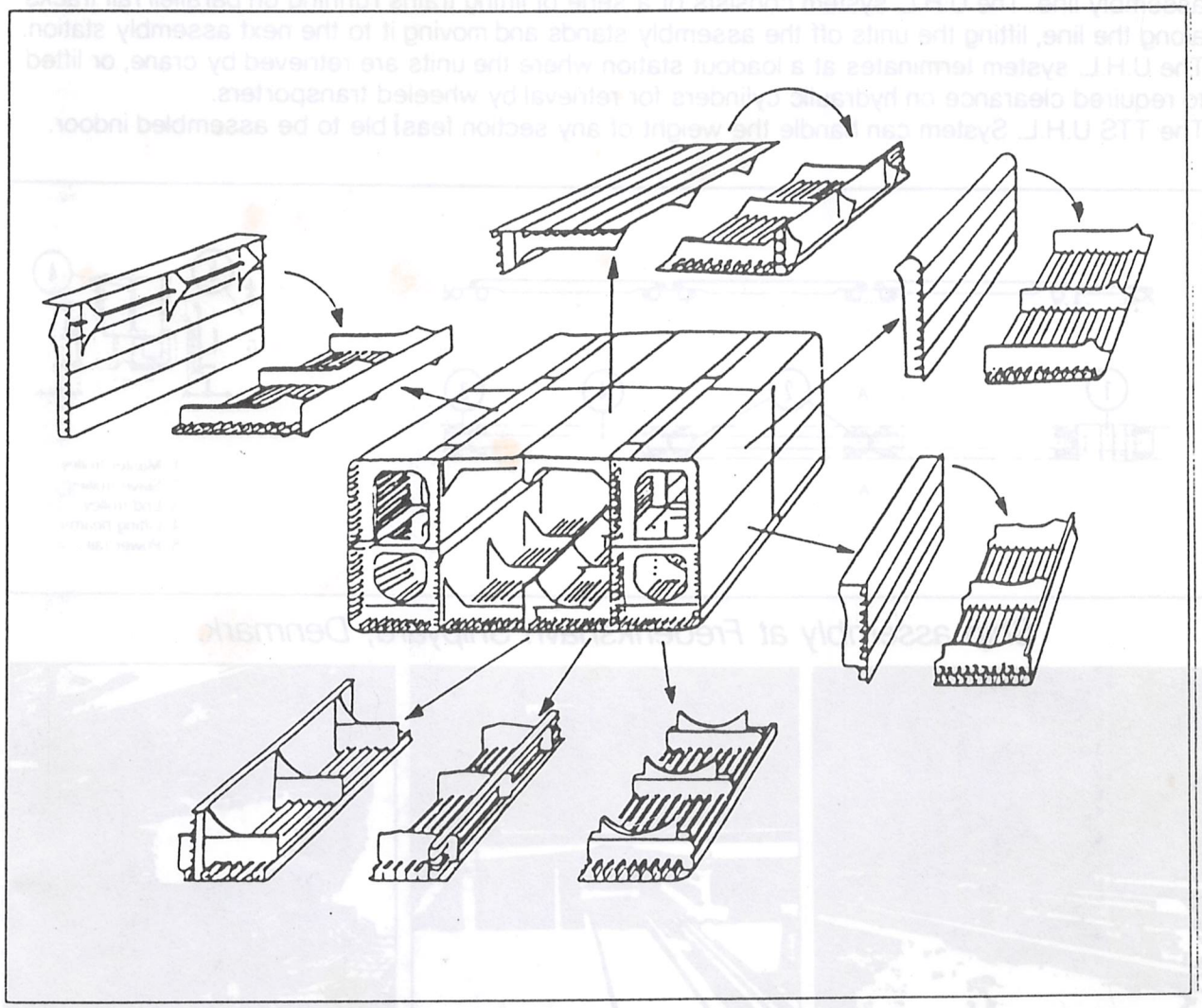
CURVED PANEL LINE



	FUNCTION	EQUIPMENT
STATION 1	ADJUSTMENT OF PINS. FITTING & TACKWELDING OF PLATES.	OVERHEAD CRANE FOR PLATES. SERVICE GANTRY WITH SEMIAUTOMATIC WELDING EQUIPMENT.
STATION 2	WELDING OF PLATES.	TILT SYSTEM FOR HORIZONTAL WELDING. SERVICE GANTRY FOR WELDING TRACTOR & SEMIAUTOMATIC WELDING.
STATION 3	FITTING & TACKWELDING OF STIFFENERS.	SPECIAL STIFFENER MOUNTING GANTRY & SEMIAUTOMATIC WELDING EQUIPMENT.
STATION 4	WELDING OF STIFFENERS.	SERVICE GANTRY EQUIPPED WITH SPECIAL FILLET WELDING TRACTOR & SEMIAUTOMATIC WELDING EQUIPMENT.
STATION 5	FITTING & WELDING OF AUXILIARY COMPONENTS.	SERVICE GANTRY WITH SEMIAUTOMATIC WELDING EQUIPMENT.


CURVED PANEL LINE
Montere webber.
Automatsvejse profiler.
Ophæfte profiler.
Pulversvejse paneler.
KRUMPANELLINIE
B 7 VEST
Ophæfte paneler.

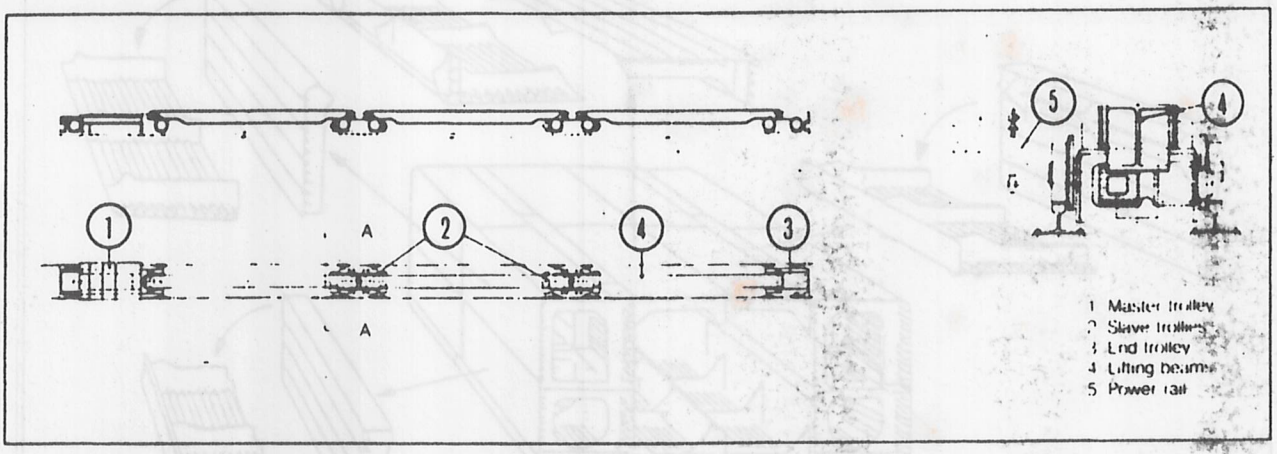
RING UNIT



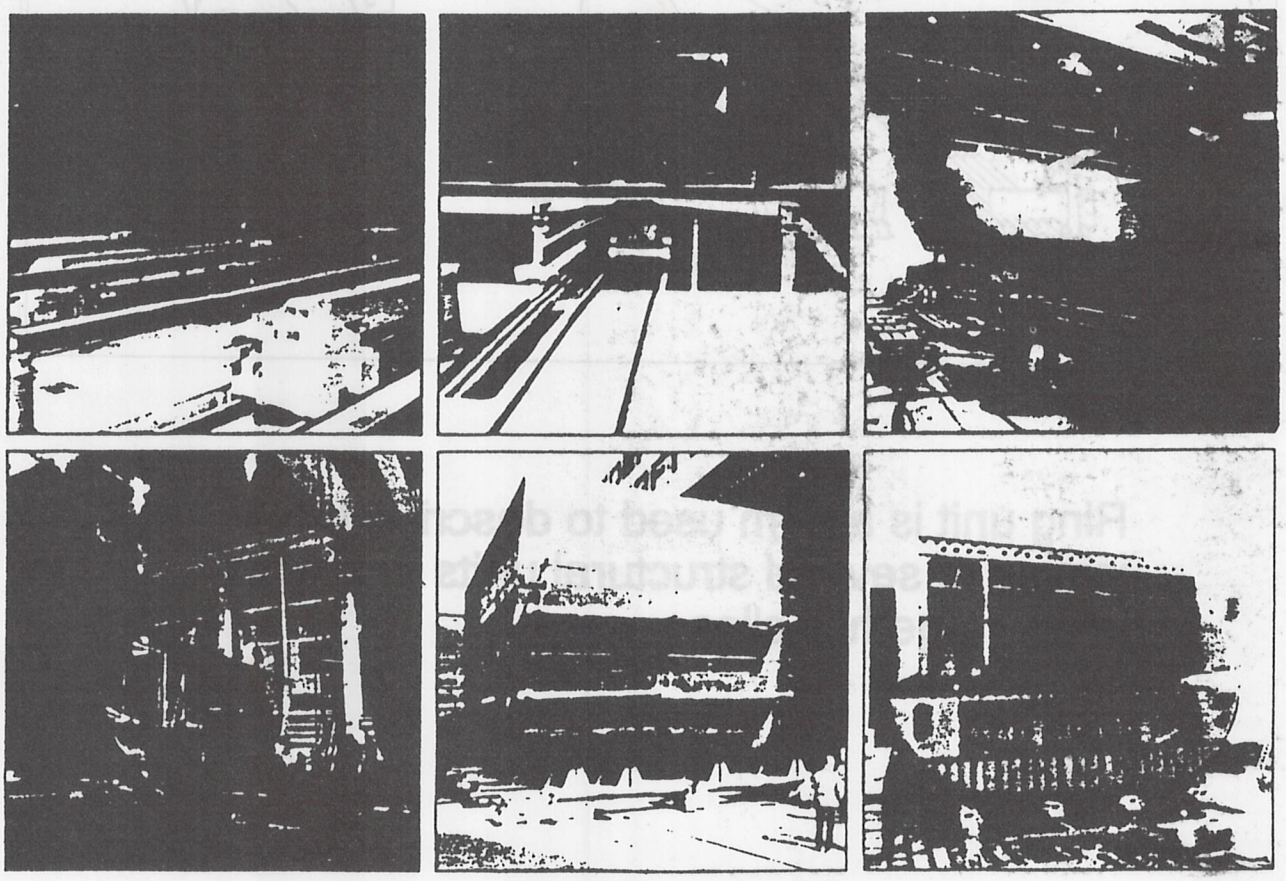
Ring unit is a term used to describe the joining of several structural units or blocks into a large hull slice.

TTS - U.H.L. SYSTEM

The TTS U.H.L. (Ultra Heavy Lift) system moves ring units and sections on the indoor section assembly line. The U.H.L. system consists of a serie of lifting trains running on parallell rail tracks along the line, lifting the units off the assembly stands and moving it to the next assembly station. The U.H.L. system terminates at a loadout station where the units are retrieved by crane, or lifted to required clearance on hydraulic cylinders for retrieval by wheeled transporters.
The TTS U.H.L. System can handle the weight of any section feasible to be assembled indoor.

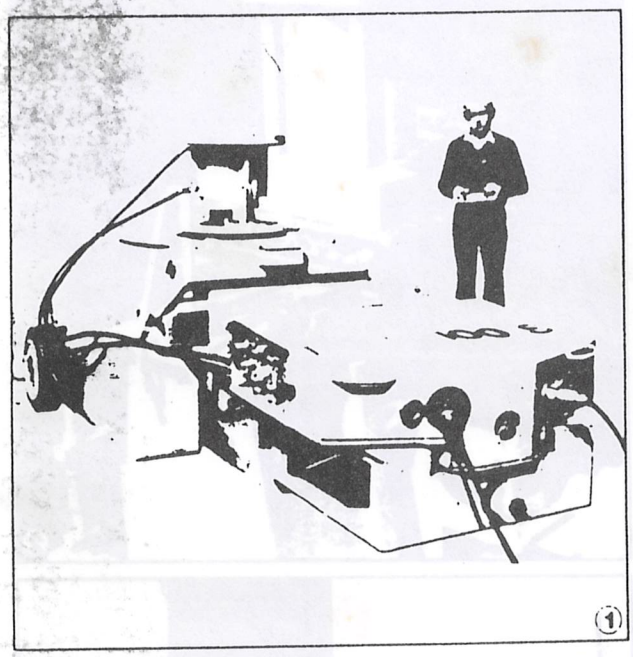


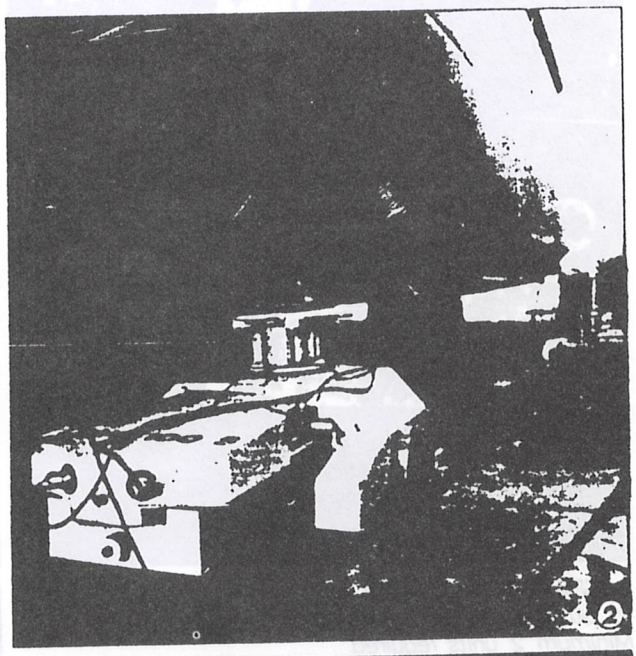
Ship assembly at Frederikshavn Shipyard, Denmark.



TTS - D.W.B. SYSTEM

The D.W.B. (Dual Walking Beam) system consists of 3 or more D.W.B. units, 1 powersource and 1 control sytem.
Each D.W.B. unit can carry 100-400 ton (depending of unit type), the total load capacity being a multiple of the number of D.W.B. units in the system.
The D.W.B. system can carry the load across uneven ground surfaces with coarse surface material such as gravel a.o.. By hydraulic interconnection, the D.W.B. units will «float» the load, preventing road bumps to induce stress forces to the load construction.
The D.W.B. system can turn and maneuver the load in very narrow areas and can also move up an incline, - a slipway for example.
The D.W.B. system can be operated by one of person, using a handheld wireless control unit.

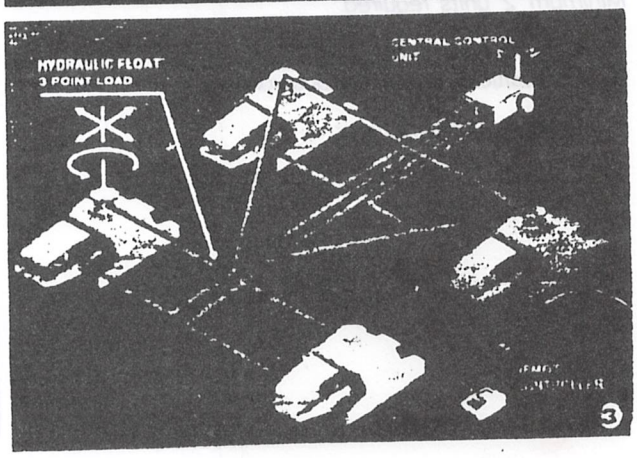




1. TYPICAL 100 TON D.W.B. UNIT.

2. D.W.B. MOVING RING SECTION.
One out of four D.W.B. units moving a 350 ton section for assembly in a dry dock

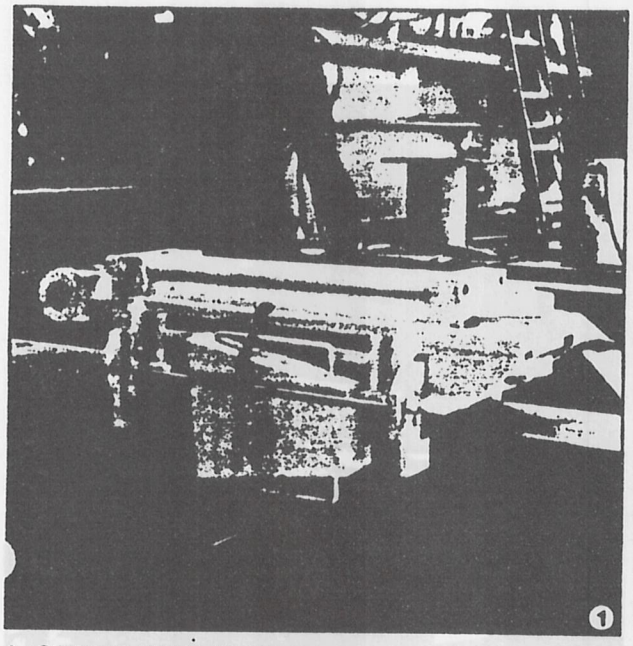
3. BASIC D.W.B. SYSTEM.
By combining several groups of D.W.B. units, loads in excess of 10.000 ton can be handled.

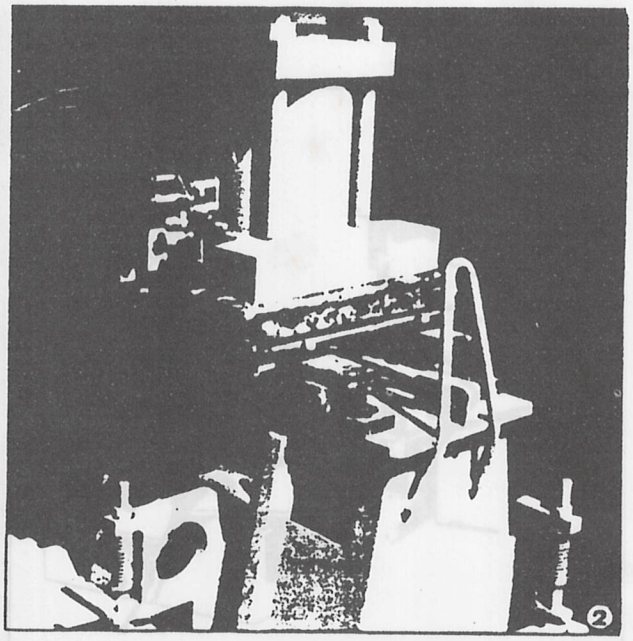


TTS - SKIDDING TECHNOLOGY
for cost-effective moving of heavy loads

One of the cheapest ways to move loads is by hydraulically operated skidding systems. In shipyards, skidding can be used for moving large blocks or ring units onto the launchways, along the launchways or as part of the launching process itself.

The TTS skidding systems are based on the use of gripper jacks for moving the load along steel beams in a simple push-pull mode. The jack thrusts are reacted into the beams through powerful clamps that are repositioned after each stroke, automatically anchoring the jack at successive locations as the load advances on the rails.

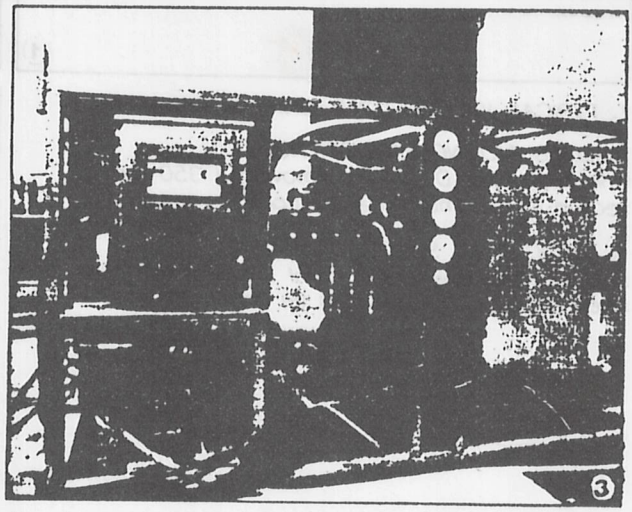


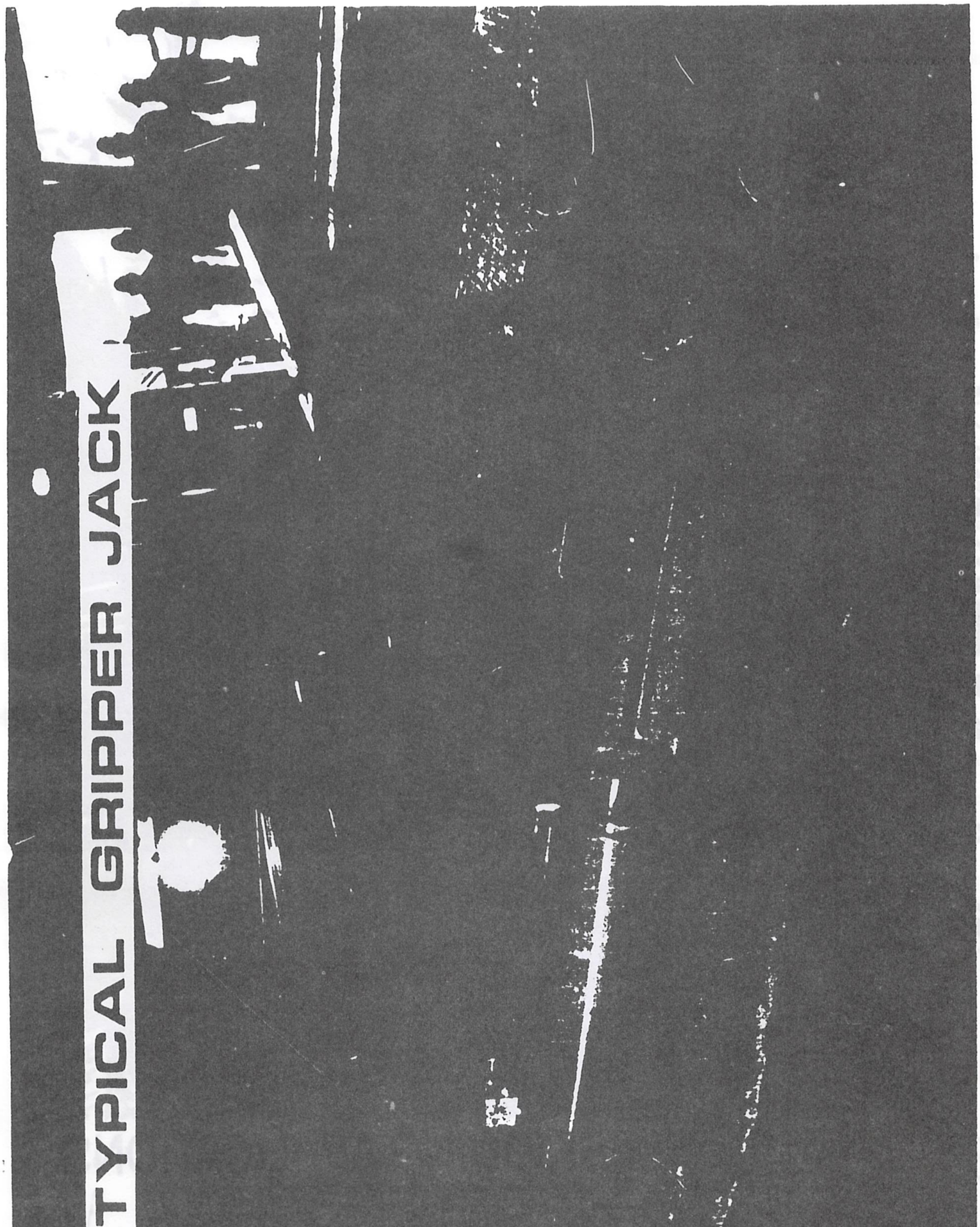


1. *GRIPPER JACK (TYPICAL)*
for pushing the load along steel beams.
Minimum 2 units required.

2. *POSITIONING JACK*
4-way positioning jack for positioning.

3. *TYPICAL POWER PACK*




TYPICAL GRIPPER JACK
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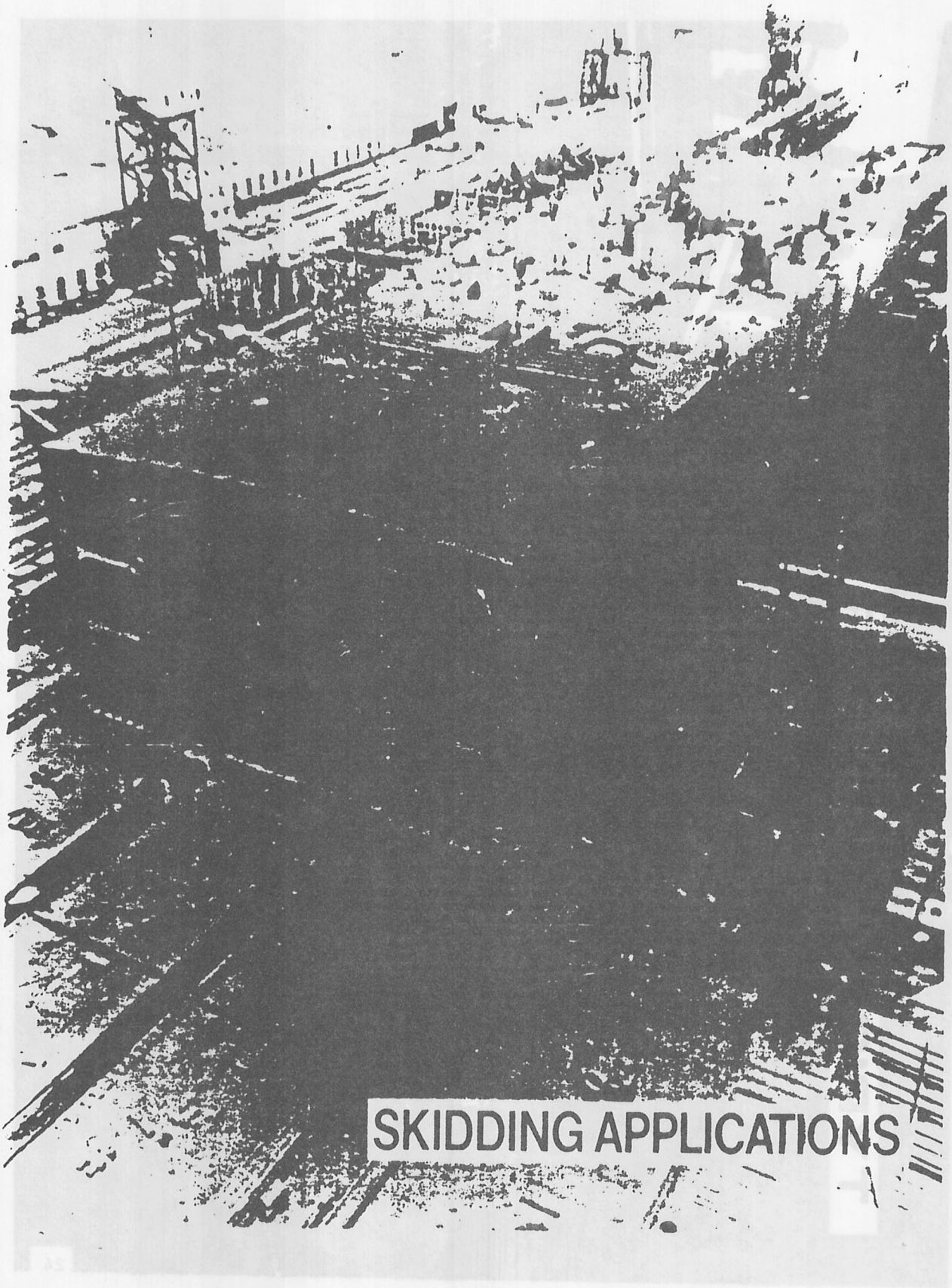
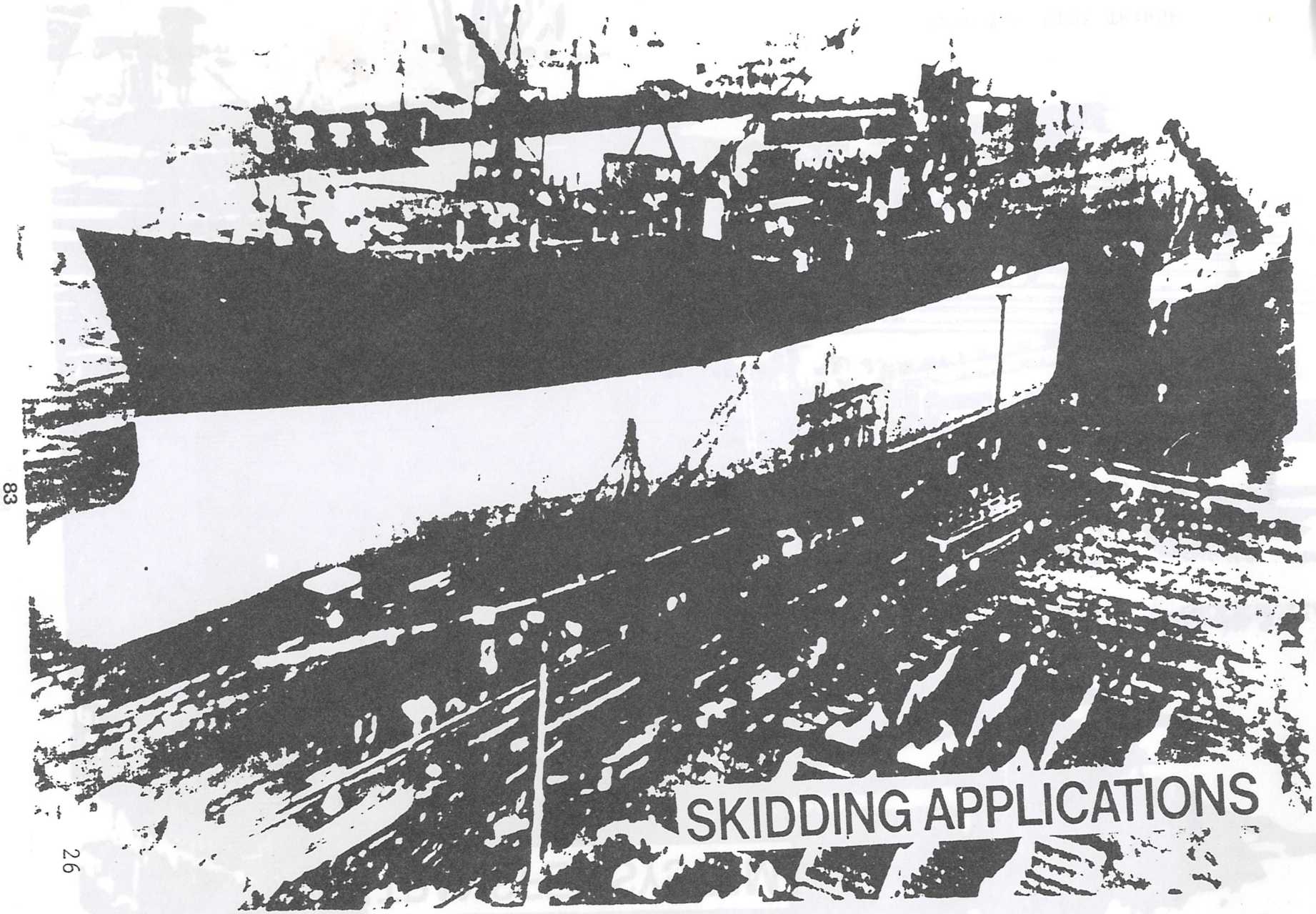
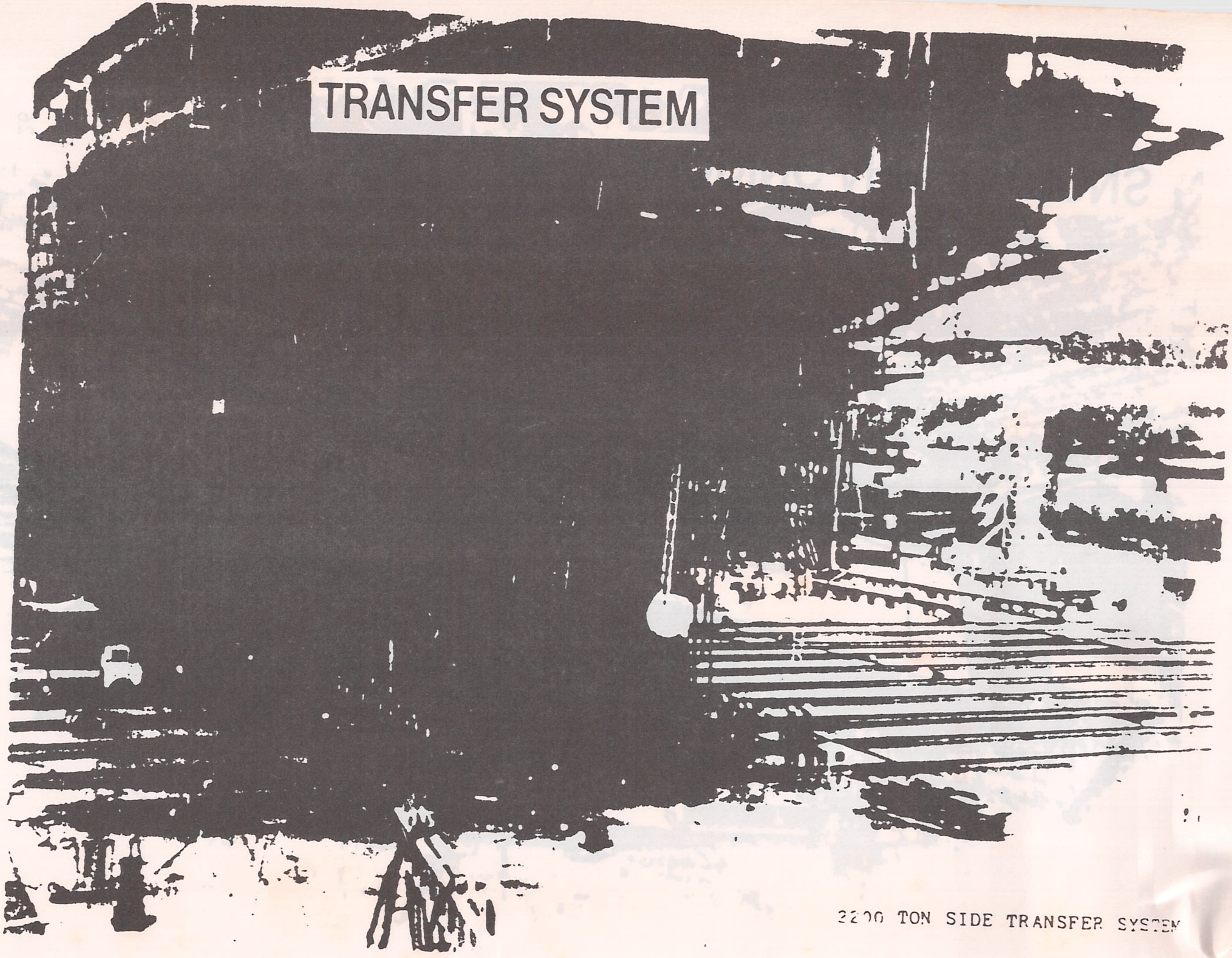

SKIDDING APPLICATIONS

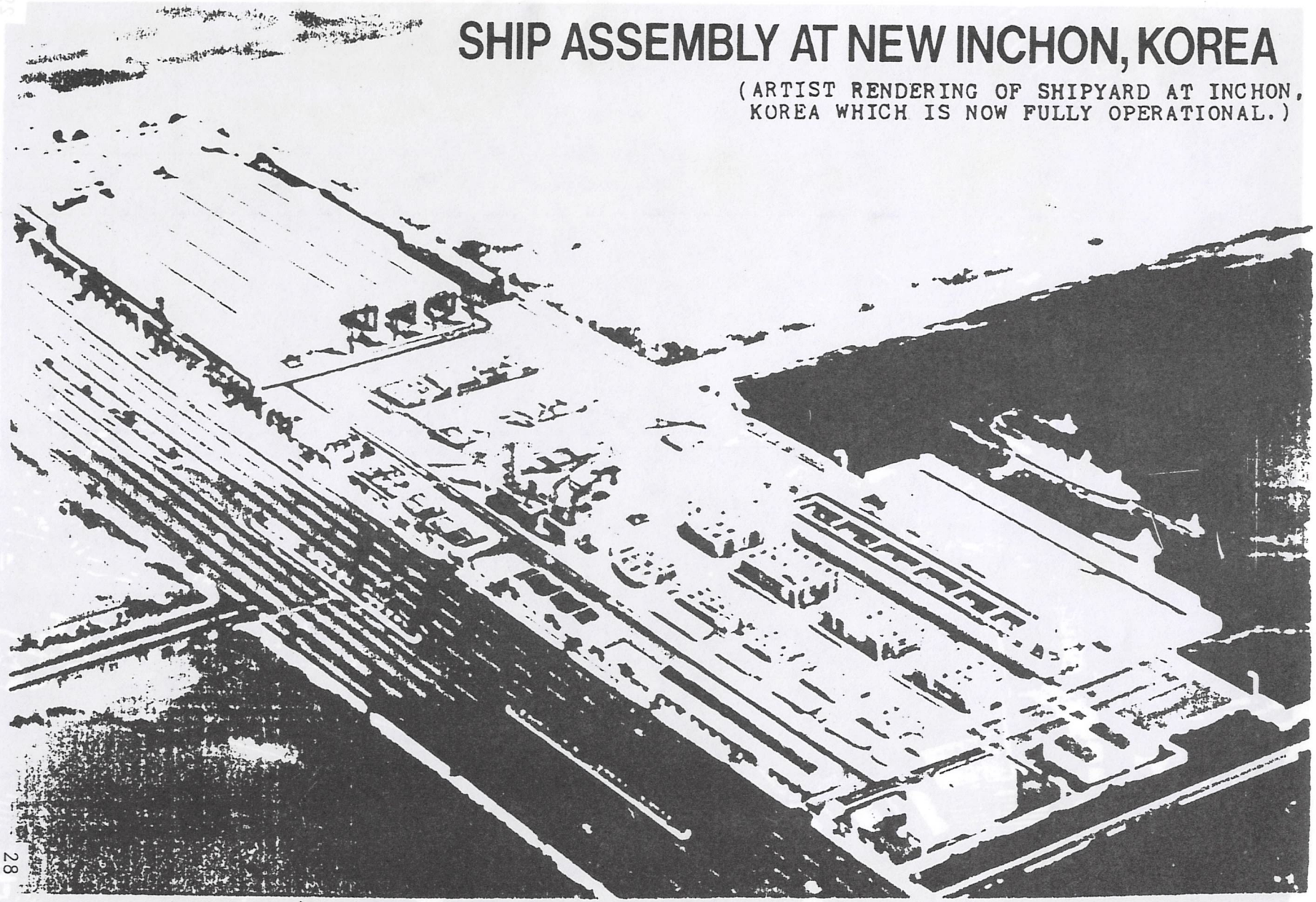

SKIDDING APPLICATIONS

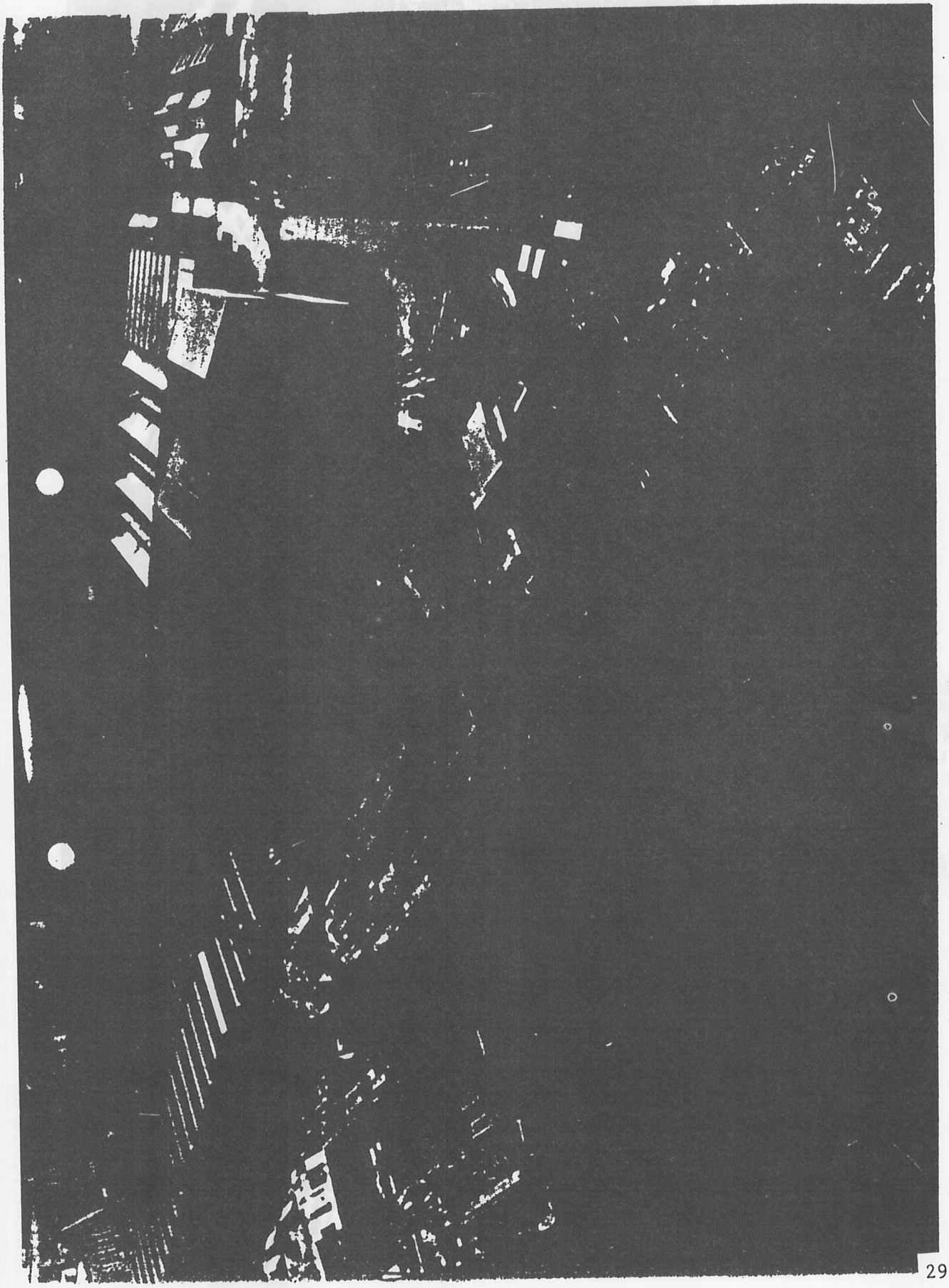


2200 TON SIDE TRANSFER SYSTEM

SHIP ASSEMBLY AT NEW INCHON, KOREA

(ARTIST RENDERING OF SHIPYARD AT INCHON, KOREA WHICH IS NOW FULLY OPERATIONAL.)





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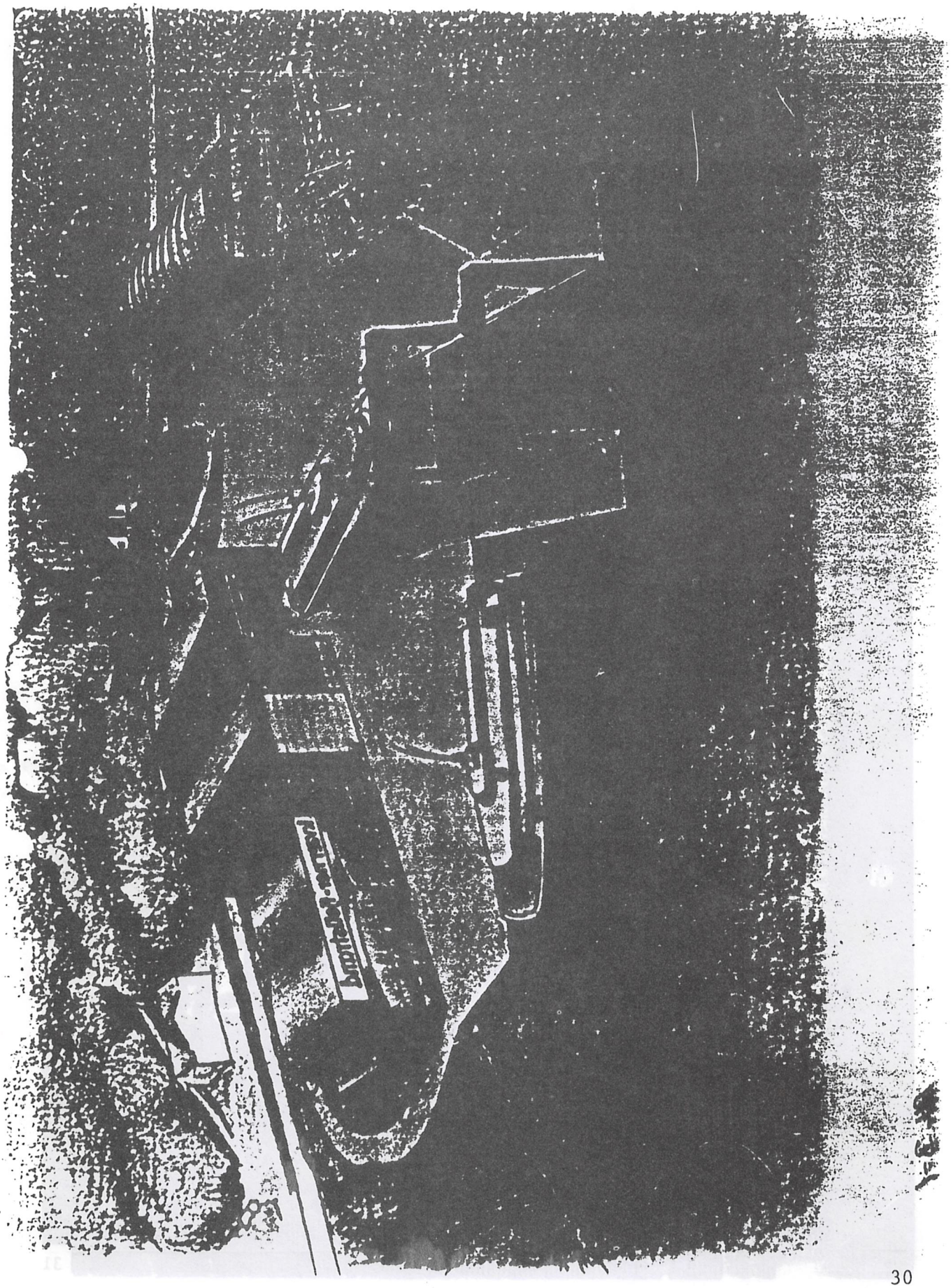

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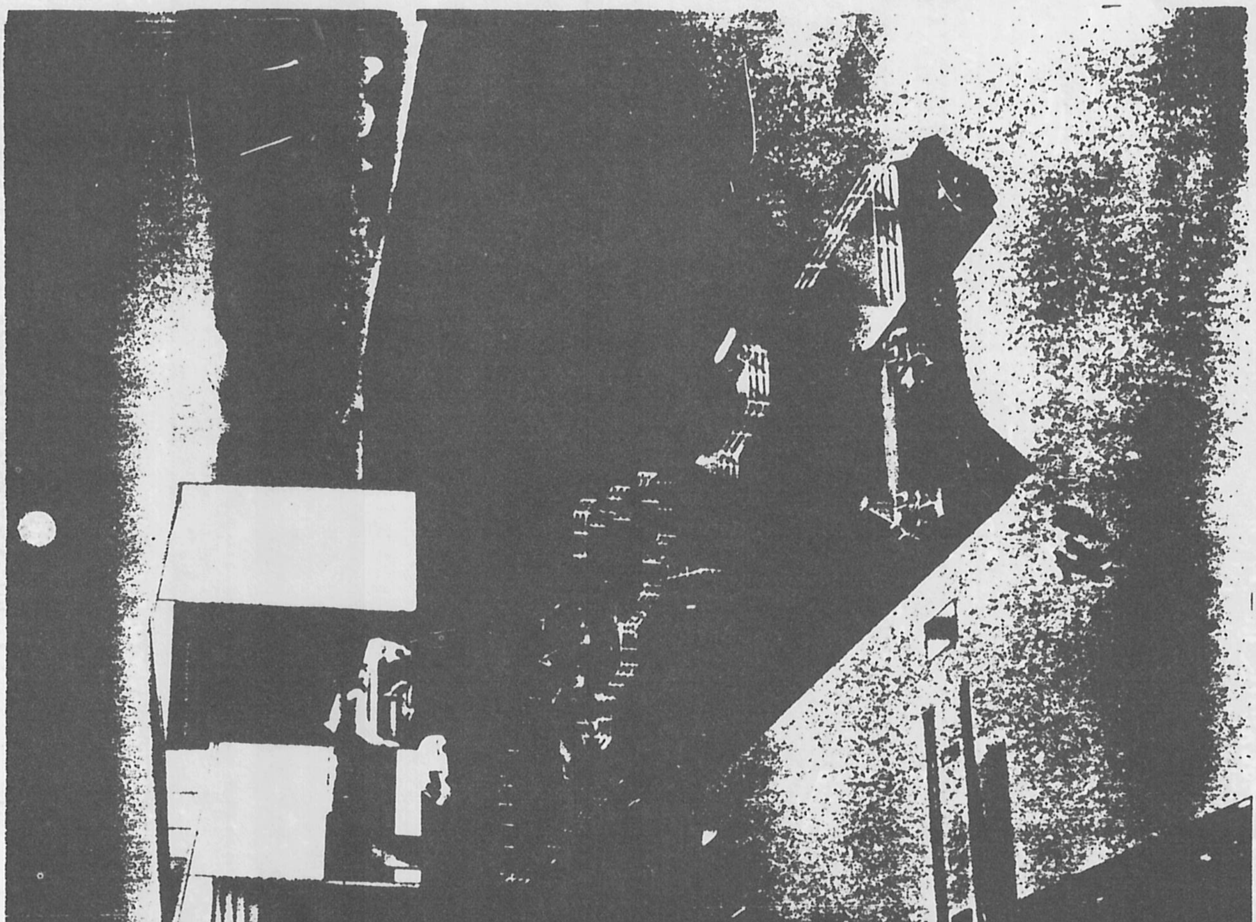

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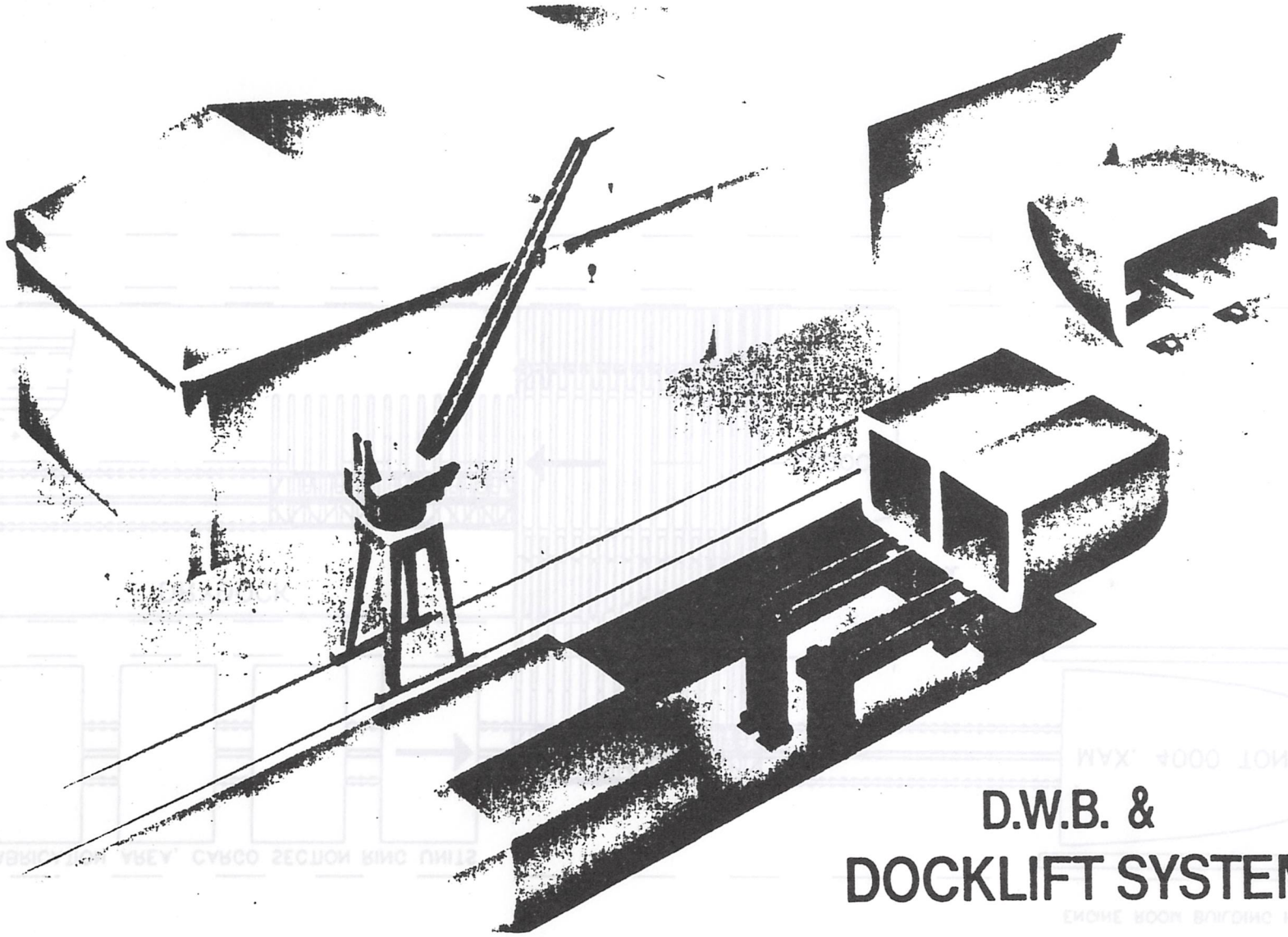
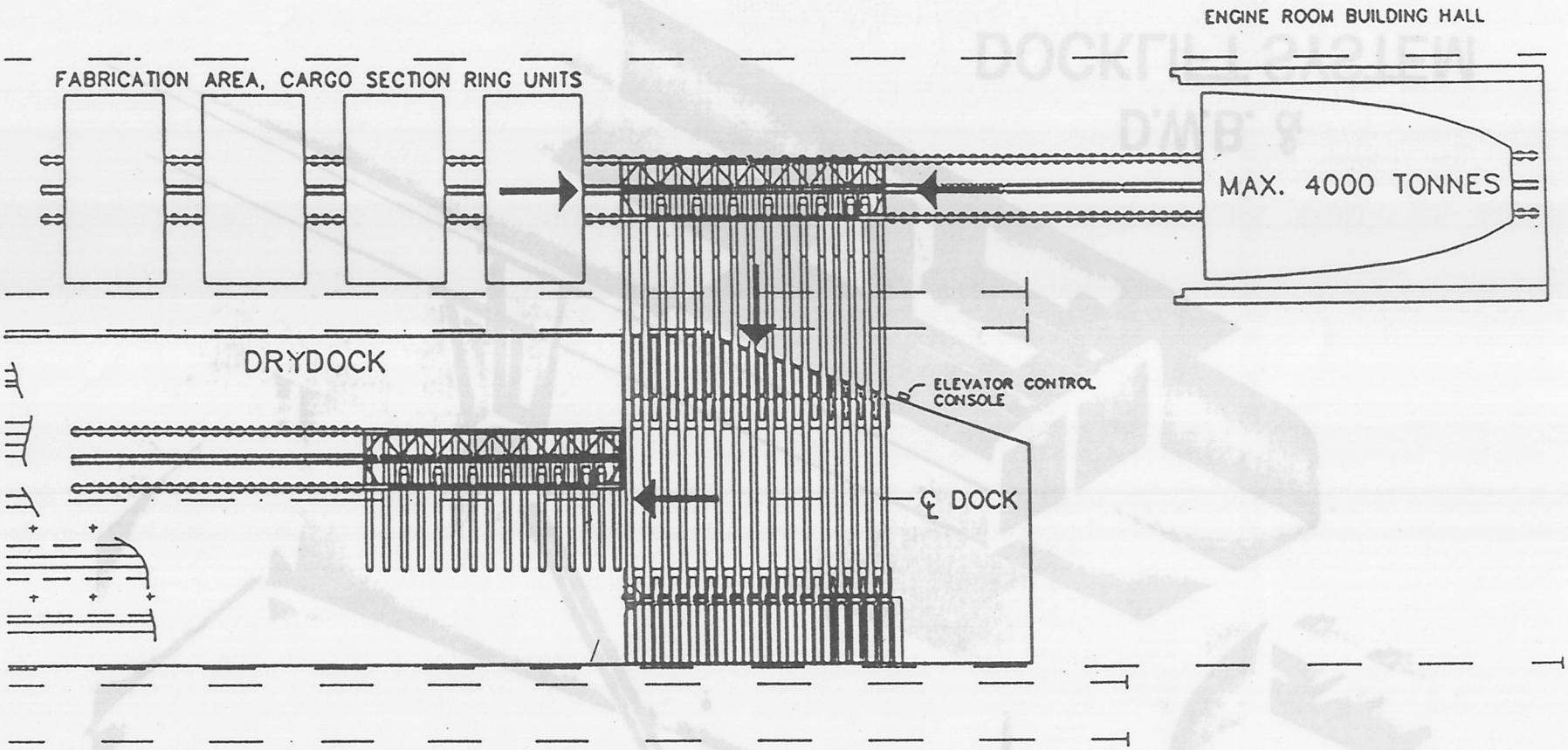
TTS

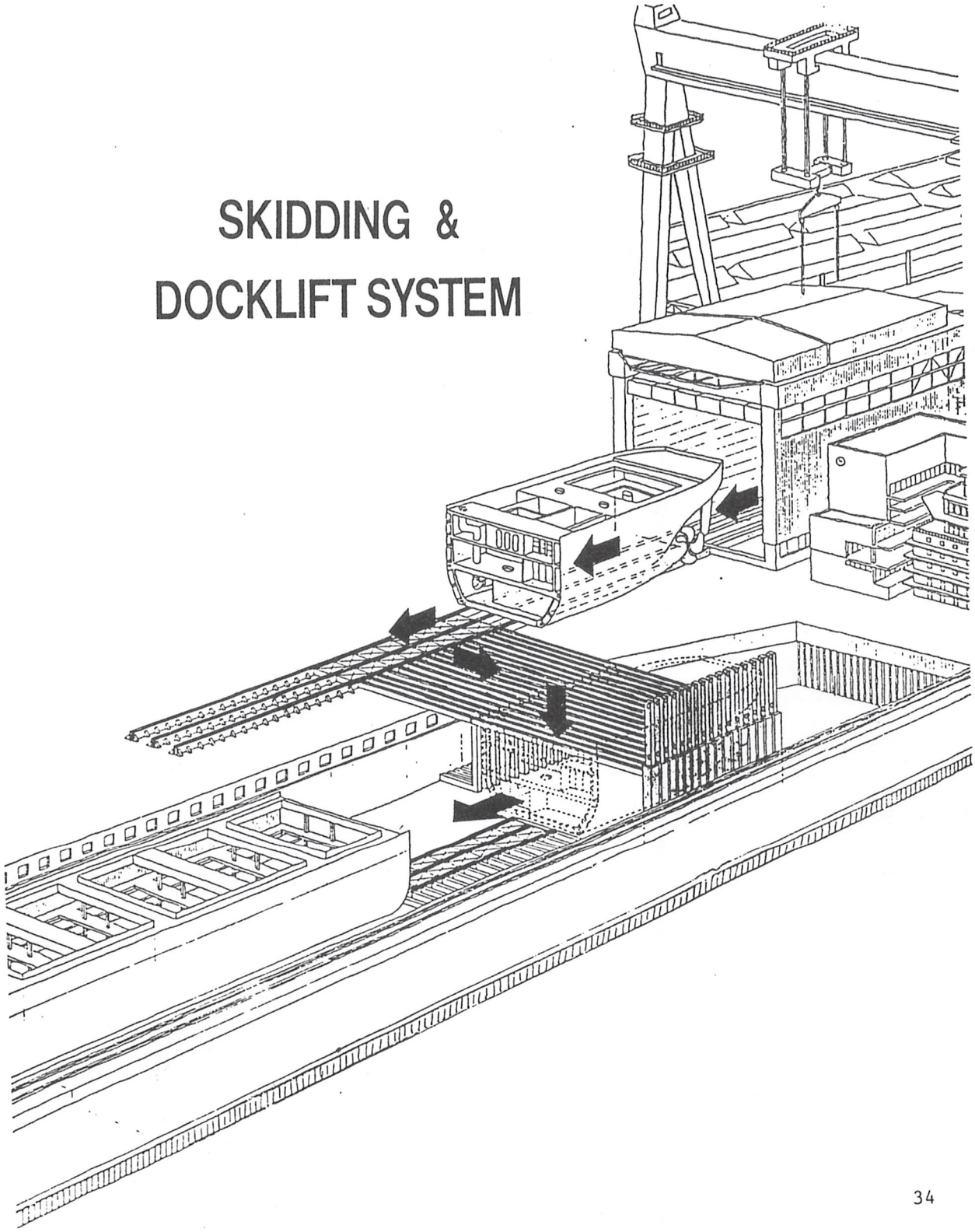


D.W.B. &
DOCKLIFT SYSTEM



SKIDDING AND DOCKLIFT SYSTEM

SKIDDING &
DOCKLIFT SYSTEM



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