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JANUARY, 1972

FABRICATION AND INSTALLATION OF PROTOTYPE PROTECTIVE BARRIER SYSTEM

Final Report

by
A. J. Palfey
B. A. Russell

HEADQUARTERS
Defense Nuclear Agency
Washington, D.C. 20305

THE DOW CHEMICAL COMPANY
FUNCTIONAL PRODUCTS AND SYSTEMS
MIDLAND, MICHIGAN 48640

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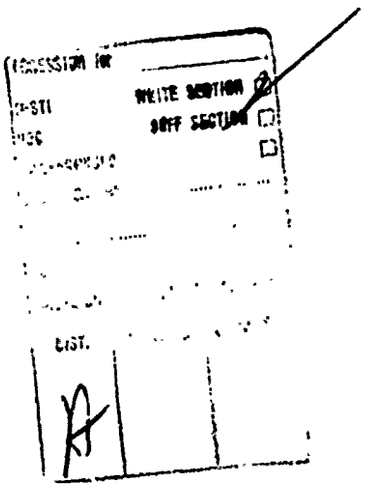

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13 ABSTRACT

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The Phase II program included the fabrication of the necessary rigid foam configurations, plus a full scale field demonstration installation of this complete system in a storage magazine at NAD Earle, New Jersey. Included are a discussion of the fabrication and packaging of the foam pieces plus a review of the assembly of the walls and sand addition at the site.

Also included are comparative economics for this system relative to the current sandbags.

Details of illustrations in this document may be better studied on microfiche

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DNA 2892F

JANUARY, 1972

FABRICATION AND INSTALLATION OF PROTOTYPE PROTOTECTIVE BARRIER SYSTEM

FINAL REPORT

THIS EFFORT SUPPORTED BY DEFENSE NUCLEAR AGENCY UNDER:

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DEFENSE NUCLEAR AGENCY

WASHINGTON, D. C. 20305

CONTRACT: DASA01-71-C-0018

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A. J. Palfey

B. A. Russell

THE DOW CHEMICAL COMPANY

FUNCTIONAL PRODUCTS AND SYSTEMS

MIDLAND, MICHIGAN 48640

SUMMARY

This report describes Phase II of a two-phase research program to develop an optimized prefabricated protective barrier system for munition storage magazines. Phase I defined a foam board system as the best candidate to meet the required objectives.

The Phase II program included the fabrication of the necessary rigid foam configurations, plus a full scale field demonstration installation of this complete system in a storage magazine at NAD Earle, New Jersey. Included are a discussion of the fabrication and packaging of the foam pieces plus a review of the assembly of the walls and sand addition at the site.

Also included are comparative economics for this system relative to the current sandbags.

FOREWORD

This final report covers Phase II of a two-phase project by The Dow Chemical Company for the development of a protective barrier system for munitions storage. Phase I, under the Defense Nuclear Agency Contract DASA01-71-C-0018, 1970 October 20 through 1971, August 31, covers the research and development of a system including laboratory testing of a full scale barrier wall model section.

Phase II covers the factory fabrication and field installation of a protective barrier system in a munitions storage magazine at NAD, Earle, New Jersey, with Dow providing fabricated materials and construction supervision.

The final report of the Phase II program includes the fabrication of the materials and their erection at the site to form the sand filled protective barrier system.

The DNA Contracting Officer Representative (COR) during Phase II is Major W. J. Shephard. Major Shephard, Mr. Charles L. Haney, and Mr. M. Stevens gave valuable assistance in guiding the project with their broad knowledge of munitions storage.

Special thanks go to Lt. P. V. Huebner and G.M.T.C. Koblenzer at NAD Earle for their assistance and support during the field installation.

In addition the authors wish to acknowledge the efforts of Mr. M. Reynolds in fabricating the foam pieces along with Aeroquip, Inc. who furnished the fabric ties.

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1.0 INTRODUCTION

In October, 1970, a research and development program was initiated with Dow Chemical U.S.A. to design an improved barrier system for munition protection in storage magazines. The current experience with stacked sandbag comparment walls has not been entirely satisfactory for various reasons such as deterioration of certain types of bag material, instability of walls due to settling of the sand and sand leakage, plus requirement for frequent inspection, and maintenance to prevent wall toppling and creating a hazard to stored weapons.

This research and development program identified an improved barrier system that had a superior combination of performance properties and economics. Details of this effort are reported in the Phase I Final Report. Part I of this report has the data and conclusions leading to the selection of this system, while Part II contains information for fabrication, erection, and maintenance of this improved barrier system.

This report deals with Phase II of this program, the field installation of a prototype protective barrier system in a typical storage magazine. The report describes the fabrication of the foam into kit form and the subsequent assembly and loading with sand to complete the protective barrier.

The installation was performed at magazine #23 NAD Earle, New Jersey.

The problems encountered and their solutions will be covered to allow future installations to proceed smoothly.

2.0 THE OPTIMUM BARRIER SYSTEM

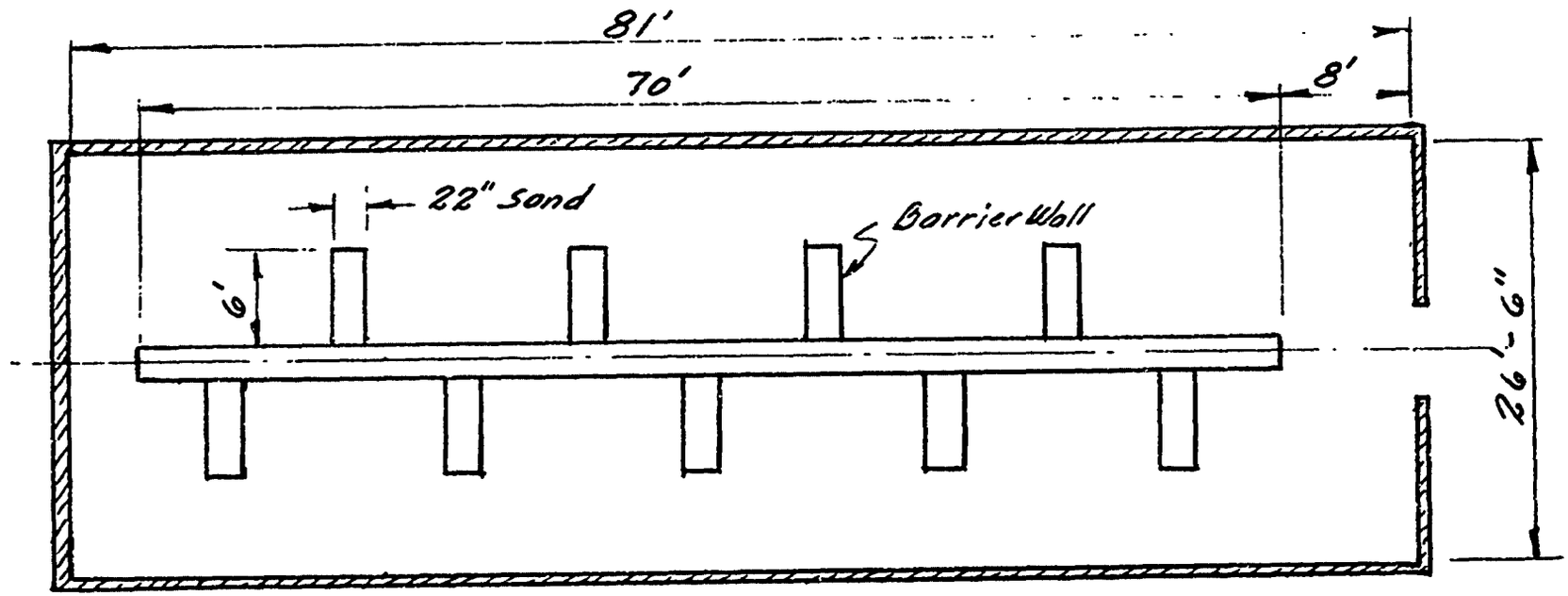
The optimum barrier system used for the test installation involves use of multicellular extruded rigid high density polystyrene foam boards to retain sand. A typical layout of this system in a compartmented magazine is shown in Figure 1. The system is built using three (3) inch thick foam board stock for the walls. A groove and spline design is used to interlock the various boards together to form a wall, Figure 2 shows a test barrier system. A loop tying system is used to tie the walls together, Figure 3. The loop ties not only support the sidewalls but assure proper (22") spacing between walls. The center wall is constructed in modules of 80" and 40" to allow for staggered joints while the wing walls are made from 6 foot boards.

3.0 THE QUALITY SURVEILLANCE PROGRAM

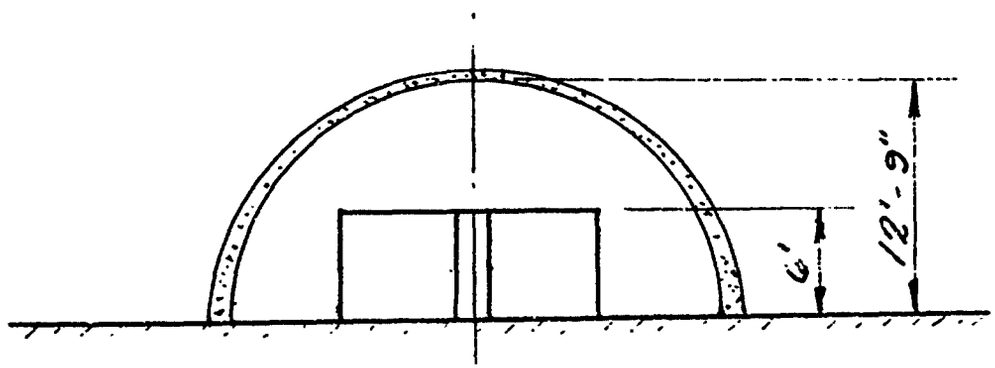
Immediately after start of Phase II a Quality Surveillance Program was generated. This was done to avoid quality problems and to provide visibility for immediate corrective action throughout the preparation of the kits. The good fit and smooth assembly of the foam pieces at the site were an indication of this program's effectiveness. The complete surveillance program with the results attained are included in this report in Appendix A page 47.

4.0 THE ASSEMBLY INSTRUCTIONS

With all kits there is need for accompanying assembly instructions for guidance and training. Such instructions were written for this demonstration installation, at NAD Earle and they are:



PLAN



CROSS SECTION

Fig. 1 - Typical Magazine Layout

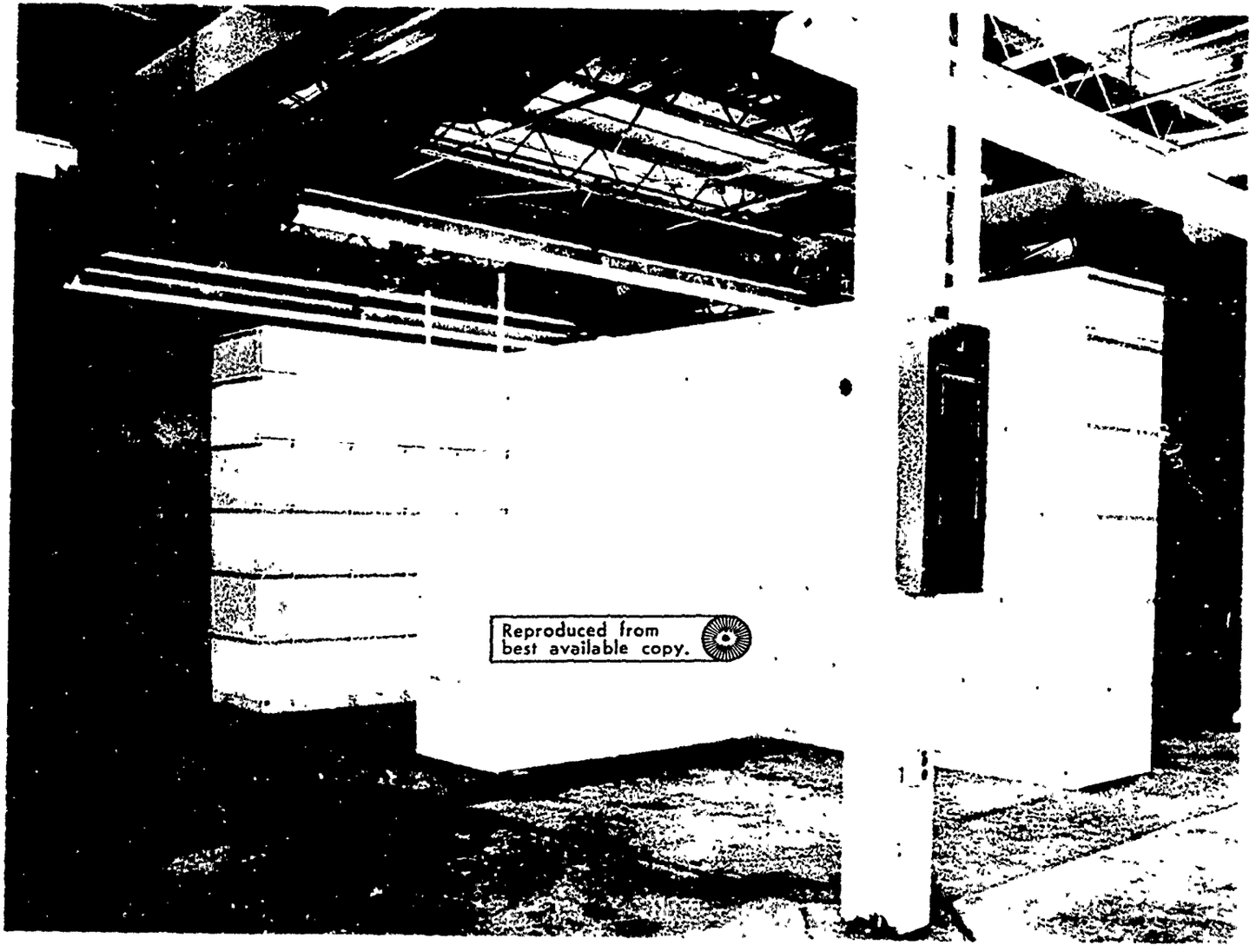


Fig. 2 - Typical Barrier System

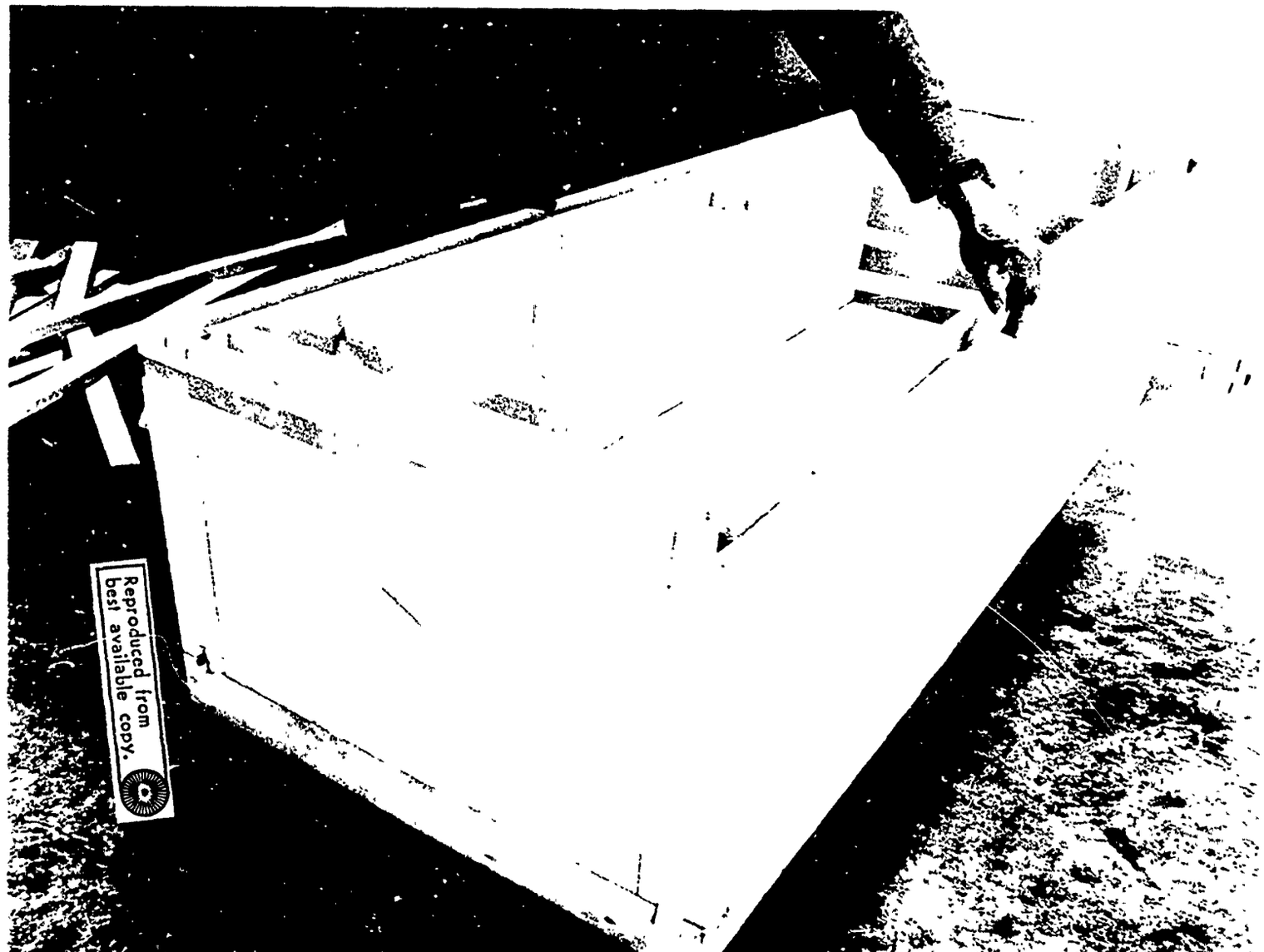


Fig. 3 - Wall Tie Being Installed

a). Packing Lists

b). Unpacking Instructions

c). Drawings of Parts

d). Assembly Instructions for walls

e). Sand filling instructions

f). Repair suggestions

The complete original assembly instruction package is included as Appendix B page 76 .

As expected, these instructions in actual practice could be improved. These improvements have been included in the revised assembly instructions for future installations which are included in Appendix C page 96 of this report.

5.0 RAW MATERIALS PROCUREMENT

As soon as the Phase II effort was approved, procurement of raw materials was initiated.

5.1 Foam

The high density extruded polystyrene foam in a fire retardant formulation is a Dow product, and sufficient material was in inventory to complete this demonstration. The material was placed on order for shipment to the fabrication area.

5.2 Packaging Materials

The plan called for palletizing the completed kits on 6 special 50" x 82" wooden pallets and using an opaque

polyethylene overwrap for protection. Figure 4 shows a sketch of the proposed pallets. The six pallets and the overwrap were placed on order.

This method was considered adequate, since the kits for the demonstration were to go as one unit truck load from Midland to the New Jersey site.

5.3 The Ties

In order to maintain the program schedule, it was decided to order nylon webbing ties like those under test in the prototype wall at Midland, Michigan. It was recognized that nylon webbing had stretch properties higher than desired, but a lower-stretch alternative material had not been located. Subsequently, a dacron material was found and enough test ties were ordered to compare these lower stretch ties to nylon in the test installation.

6.0 PRODUCTION OF THE BARRIER SYSTEM

The wood shop at the Dow Midland location was chosen for the actual fabrication. Wood and routing saws and tools were available here. Also, personnel in this shop are thoroughly familiar with handling foam and produced pieces for some of the prototype barrier walls under test in Midland. This assured high quality workmanship for the parts in this test.

6.1 Engineering Change

When the foam arrived at the fabrication shop, it was given routine incoming inspection. All properties were satisfactory except edge bow. A 100% check on the boards showed there were not enough to do the site work unless the part board widths were reduced from 16 inches

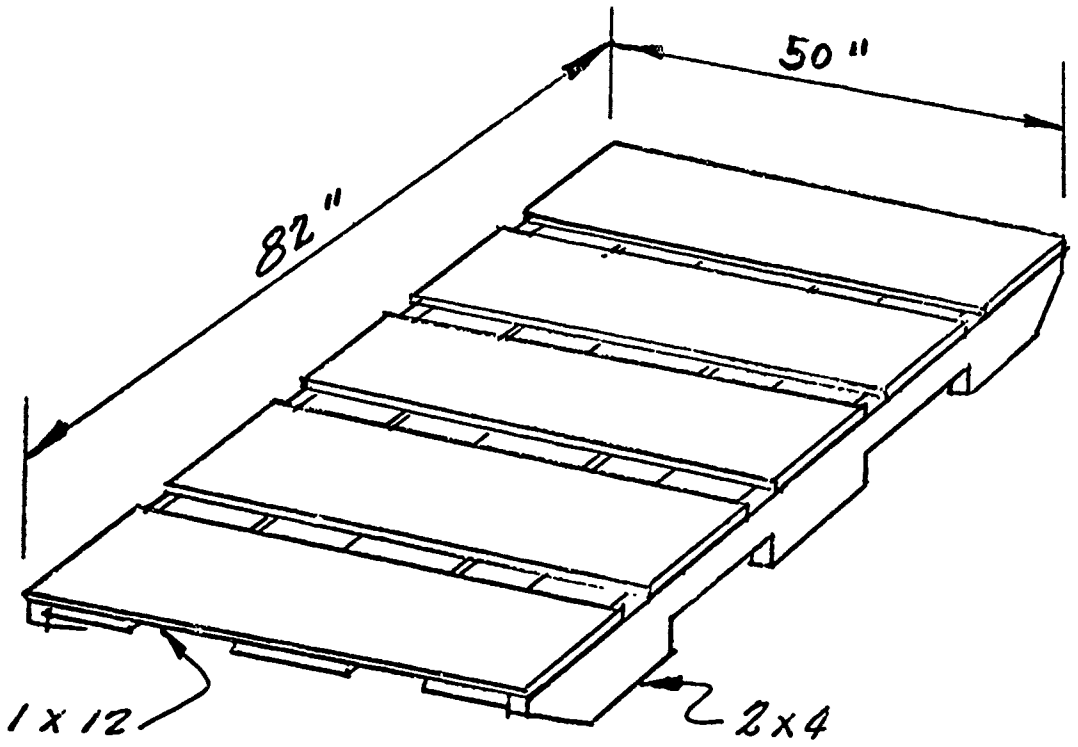


Fig. 4 - Wood Shipping Pallet

to 15.5 inches to allow for squaring the foam boards. It was decided to change the width of parts, since this would have no effect on overall barrier dimensions or structural strength, and the program could remain on schedule.

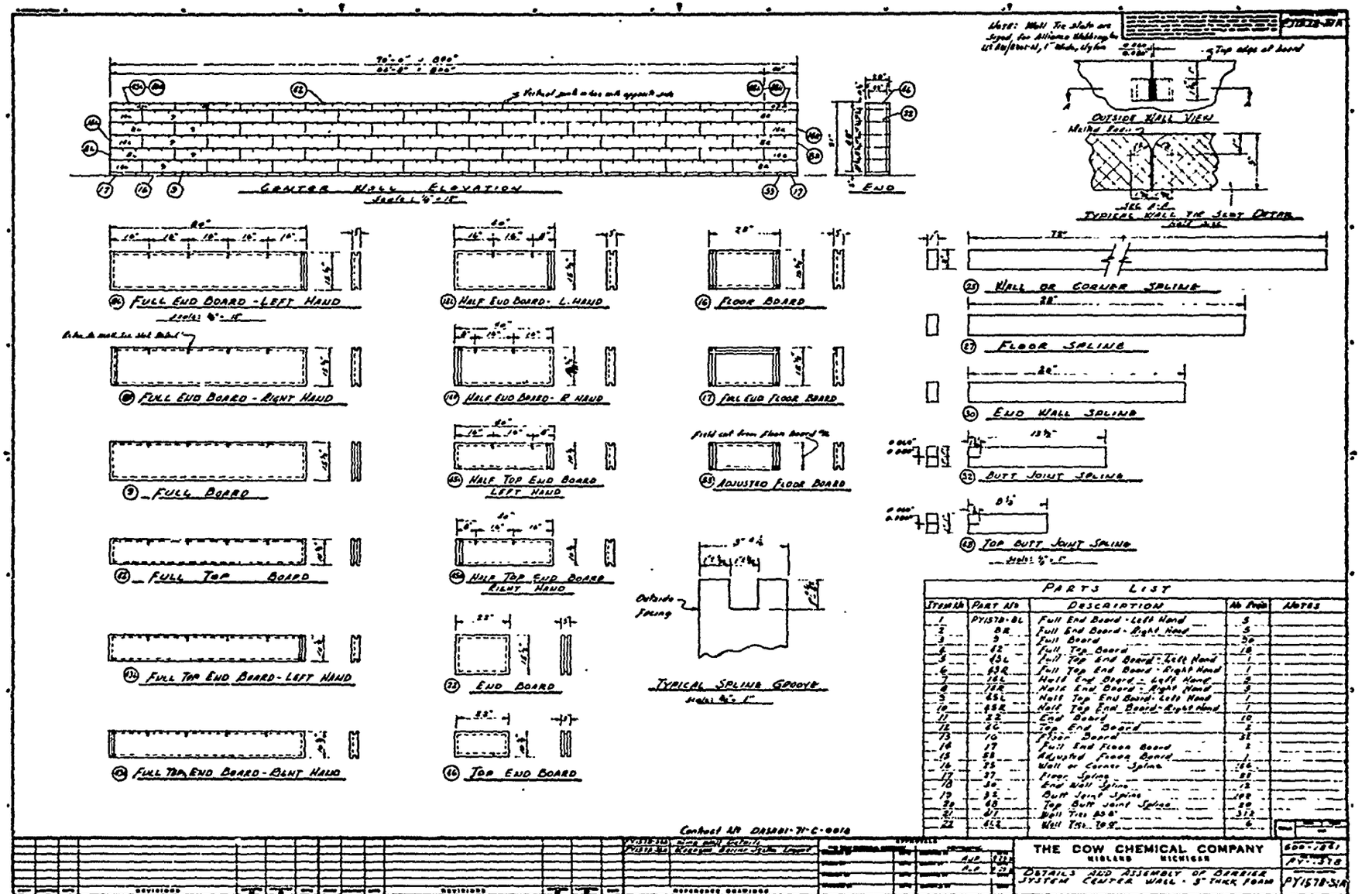
This change required a revision in the drawings for the parts as shown in Part II of the Phase I report. The revised drawings are shown in Figure 5 and Figure 6 and also are included as part of Appendix B, the original assembly instructions. As soon as the new drawings were available the part lists were made and the fabrication of the foam parts began.

6.2 Fabrication of Foam Pieces

An orderly material flow was set up to convert the raw foam boards into the final required configuration for the kits. Figure 7 shows the flow sheet for this movement.

Incoming foam boards were first cut to 15.5 inch width as mentioned before, then cut to length. Figure 8 shows a foam board being cut to length. Next the boards were routed to produce the necessary grooves for the foam spline. Figure 9 and Figure 10 shows typical routing being done on the edge and face of boards. At this point all floor boards and end boards were marked by part number, and quarantined for inspection prior to release for kit make-up inventory.

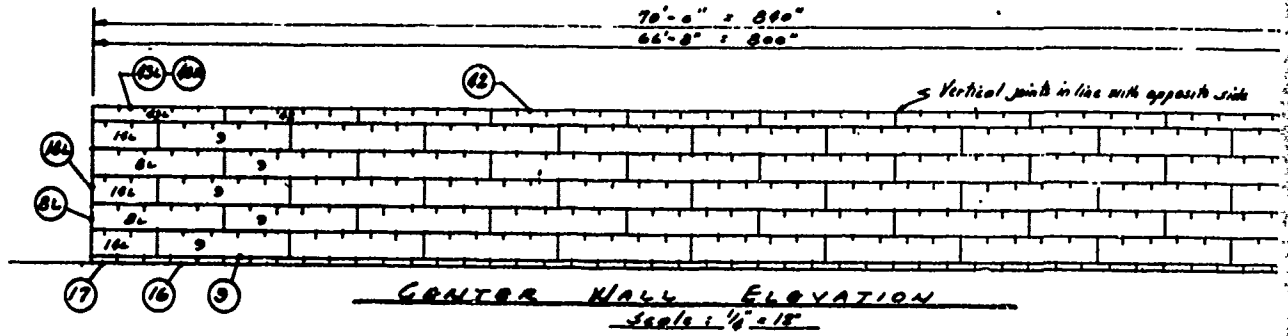
All wall boards require the addition of a radius and slot at the location of each tie loop. In the prototype test walls this had been done by hand with a soldering iron. In the interest of uniformity and to save time, The Dow Chemical Company funded the development of a special production jig to perform this operation. Figure 11 shows an overall view of this jig, while Figure 12 shows a close-up view of the radius being produced at the proper



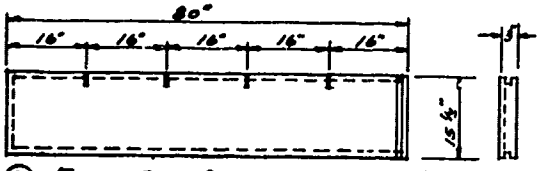
-10-a

10-b

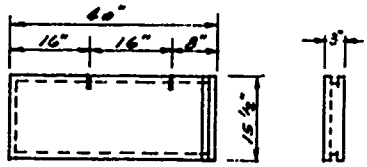
Fig. 5 10-c



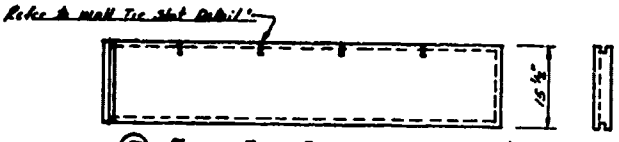
CENTER WALL ELEVATION
Scale: 1/8" = 1'



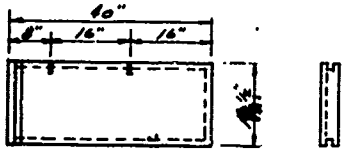
9L FULL END BOARD - LEFT HAND
Scale: ¾" = 1'



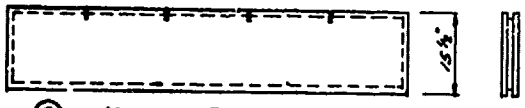
14L HALF END BOARD - L. HAND



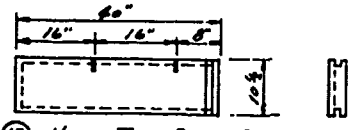
9R FULL END BOARD - RIGHT HAND



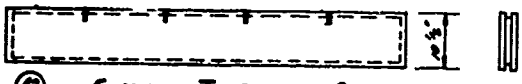
14R HALF END BOARD - R. HAND



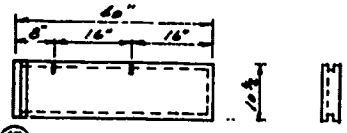
9 FULL BOARD



15L HALF TOP END BOARD
LEFT HAND

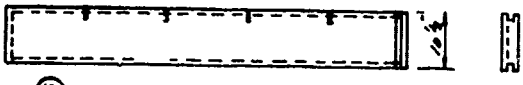


12 FULL TOP BOARD

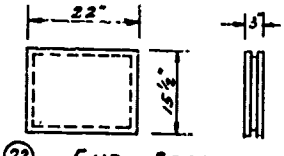


15R HALF TOP END BOARD
RIGHT HAND

Outside Facing

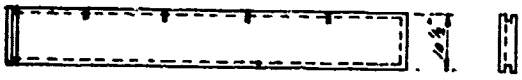


13L FULL TOP END BOARD - LEFT HAND

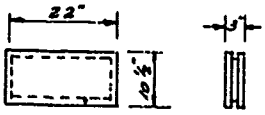


22 END BOARD

TYPIC



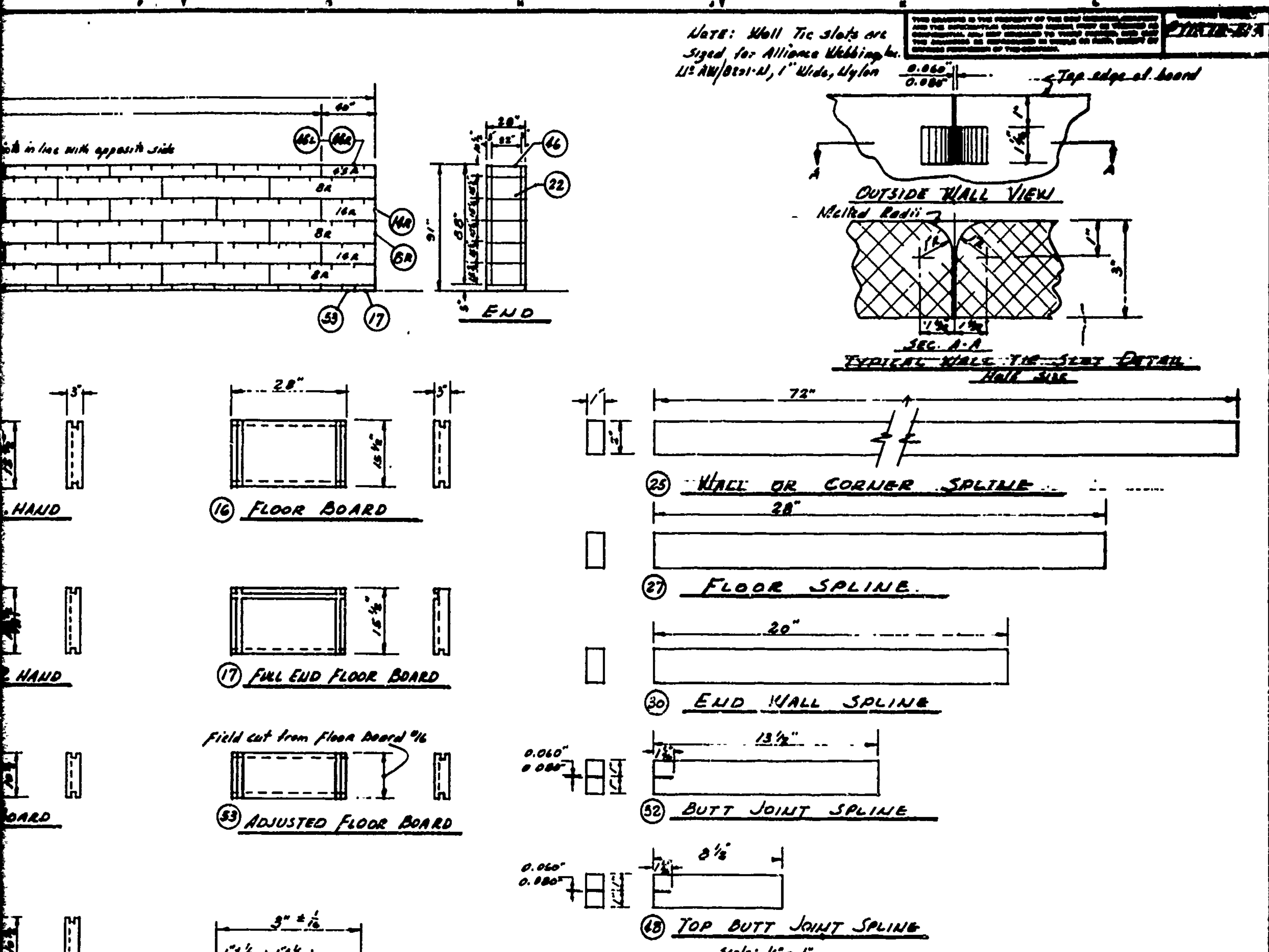
13R FULL TOP END BOARD - RIGHT HAND

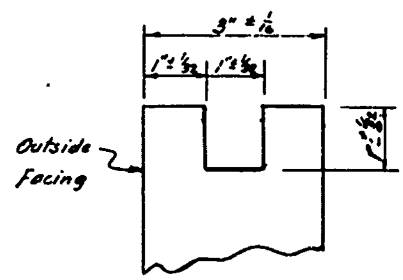


16 TOP END BOARD

REVISIONS

REVISIONS





PARTS LIST

Item No.	Part No.	Description	No. Req'd	Notes
1	PY1578-8L	Full End Board - Left Hand	5	
2	8R	Full End Board - Right Hand	5	
3	9	Full Board	30	
4	42	Full Top Board	10	
5	43L	Full Top End Board - Left Hand	1	
6	43R	Full Top End Board - Right Hand	1	
7	14L	Half End Board - Left Hand	5	
8	14R	Half End Board - Right Hand	5	
9	45L	Half Top End Board - Left Hand	1	
10	45R	Half Top End Board - Right Hand	1	
11	22	End Board	10	
12	46	Top End Board	2	
13	16	Floor Board	52	
14	17	Full End Floor Board	2	
15	53	Adjusted Floor Board	1	
16	25	Wall or Corner Spline	164	
17	27	Floor Spline	53	
18	30	End Wall Spline	12	
19	32	Butt Joint Spline	100	
20	48	Top Butt Joint Spline	20	
21	61.1	Wall Ties 83.0"	312	
22	61.2	Wall Ties 70.0"	6	

Contract No. DASA01-71-C-0018

REFERENCE DRAWINGS: PY1578-54A Wing Wall Details; PY1578-1A Magazine Barrier System Layout

APPROVALS — Drawn by AJP; Checked by AJP

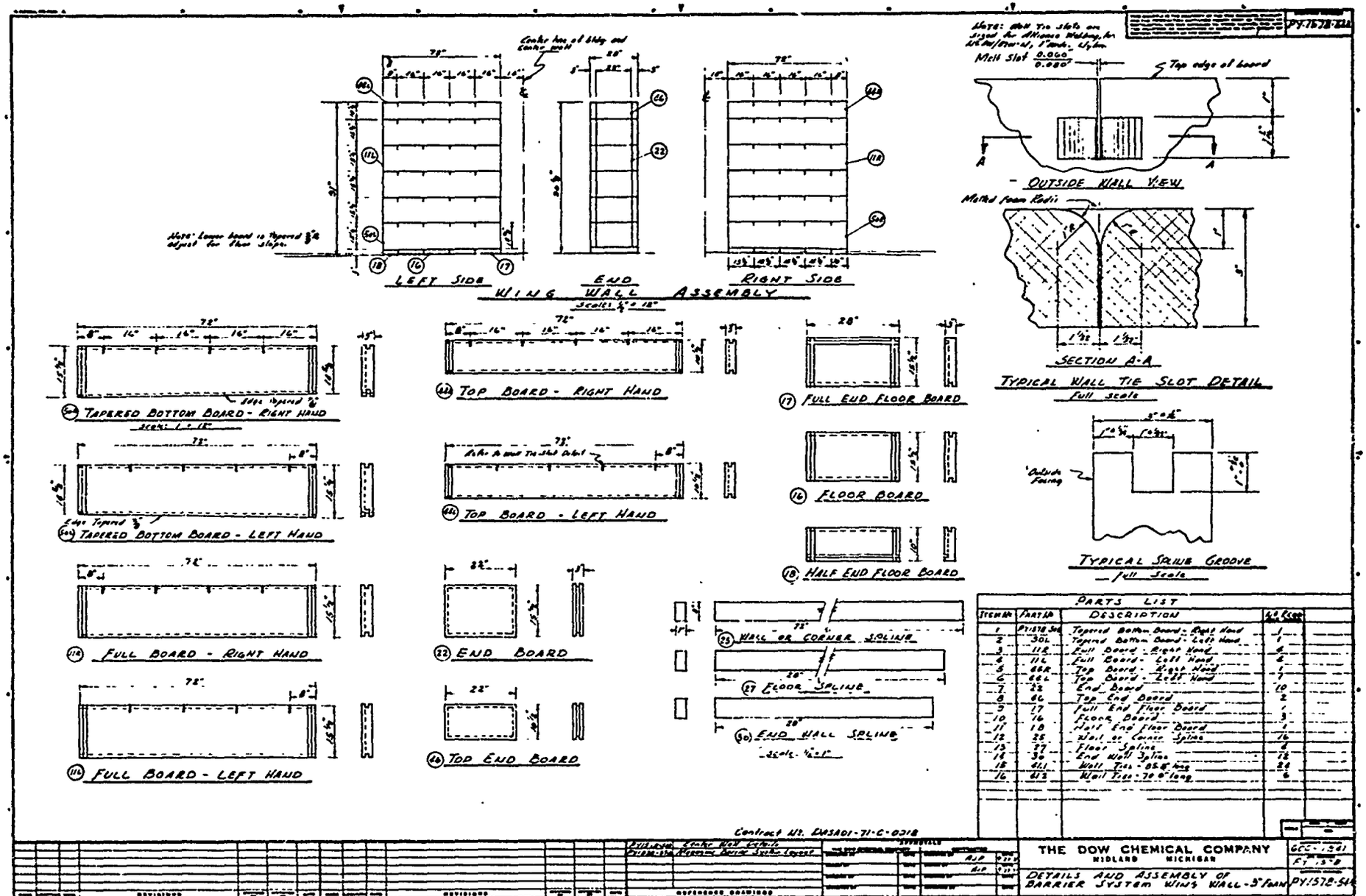
THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

DETAILS AND ASSEMBLY OF BARRIER SYSTEM CENTER WALL - 3" THICK FOAM

600-7841
PY-7828
PY1578-51A

10-b

Fig. 5 10-C



PARTS LIST

Item No.	Part No.	Description	No. Req'd
1	PY-1578-34	Tapered Bottom Board - Right Hand	1
2	34L	Tapered Bottom Board - Left Hand	1
3	11R	Full Board - Right Hand	4
4	11L	Full Board - Left Hand	4
5	44R	Top Board - Right Hand	1
6	44L	Top Board - Left Hand	1
7	22	End Board	10
8	44	Top End Board	2
9	17	Full End Floor Board	1
10	16	Floor Board	3
11	18	Half End Floor Board	1
12	25	Wall or Corner Spline	16
13	27	Floor Spline	4
14	30	End Wall Spline	12
15	611	Wall Tie - 65.8" long	24
16	612	Wall Tie - 70.8" long	6

Contract No. EMSA01-71-C-0318

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

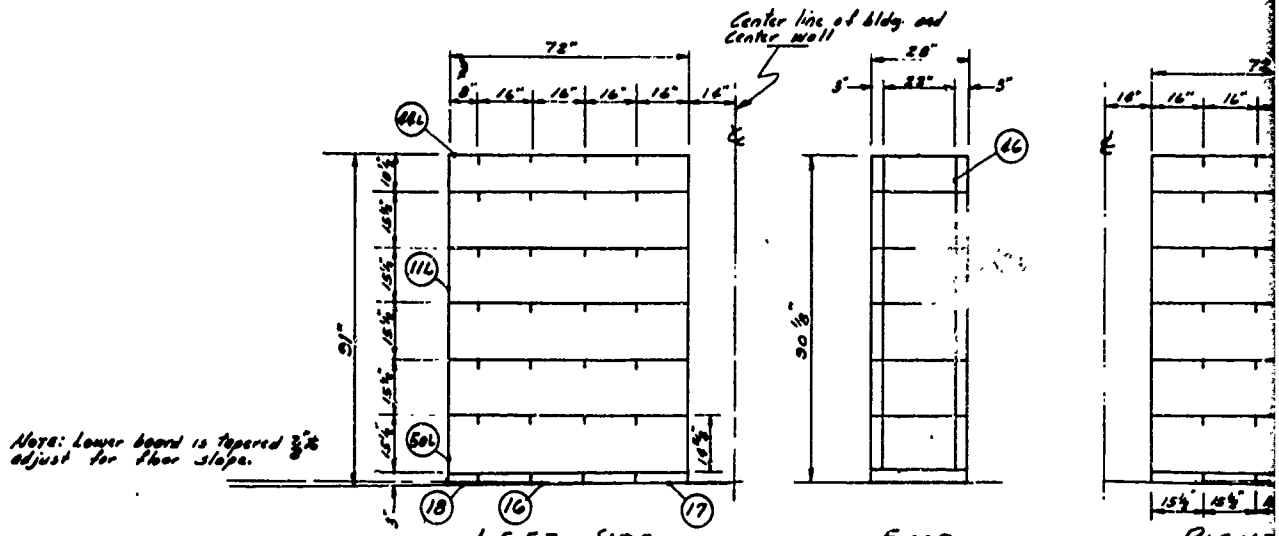
DETAILS AND ASSEMBLY OF BARRIER SYSTEM WING WALL - 5° FLARE

GCC - 1541
FT 1578
PY-1578-54

-11-a

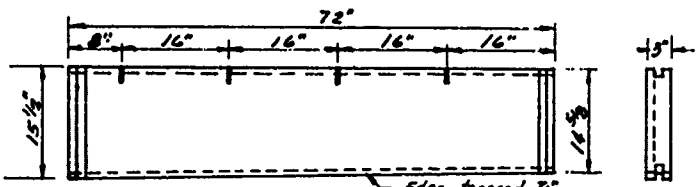
11-2

Fig. 6 11-C



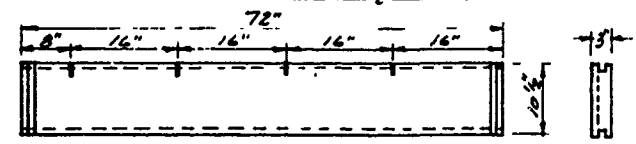
WING WALL ASSEMBLY

Scale: 1/2" = 1'

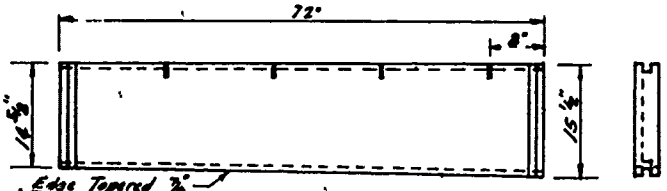


(50R) TAPERED BOTTOM BOARD - RIGHT HAND

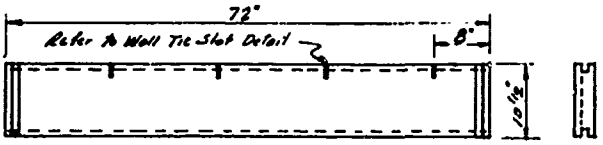
Scale: 1" = 1'



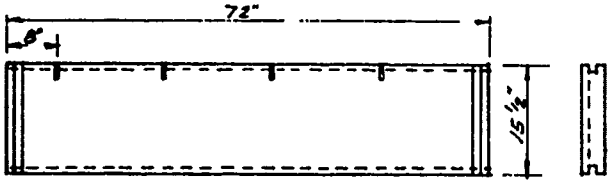
(44) TOP BOARD - RIGHT HAND



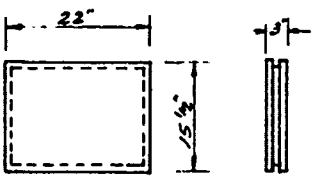
(50L) TAPERED BOTTOM BOARD - LEFT HAND



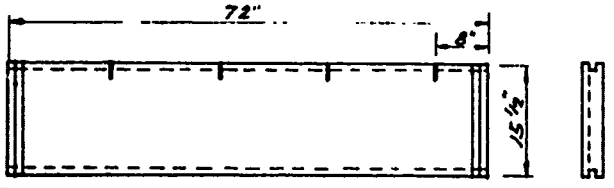
(44L) TOP BOARD - LEFT HAND



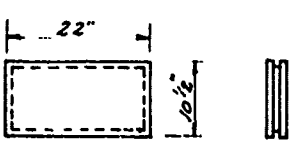
(11R) FULL BOARD - RIGHT HAND



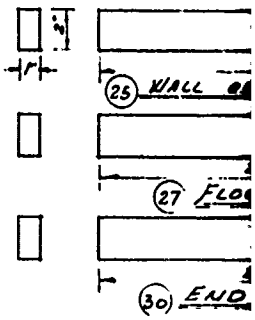
(22) END BOARD



(11L) FULL BOARD - LEFT HAND



(46) TOP END BOARD

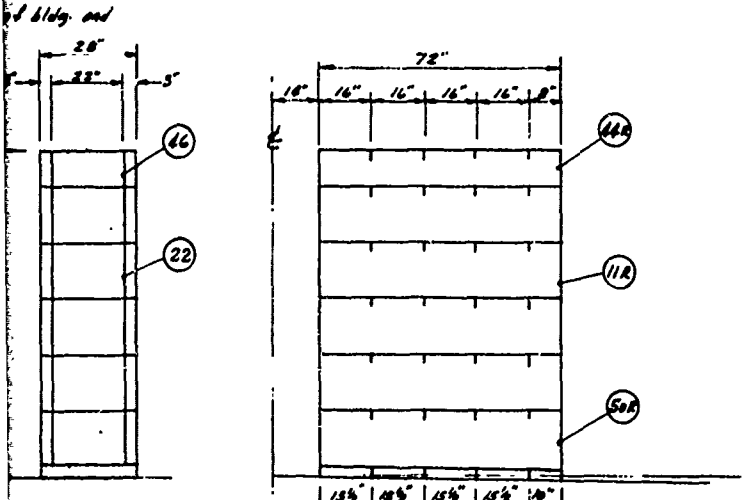


Contract

PY1370-SH	Center Wall Details
PY1370-SB	Mezzanine Barrier System

REVISIONS | REVISIONS | REFERENCE DRAWINGS

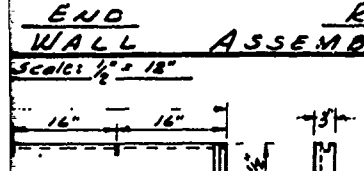
PY-1578-5A



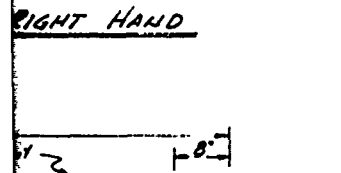
END WALL ASSEMBLY

Scale: ½" = 12"

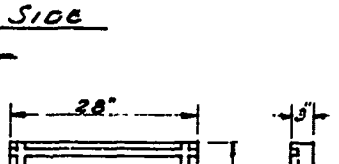
RIGHT SIDE



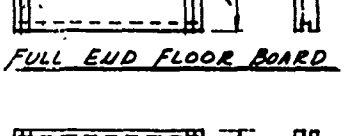
RIGHT HAND



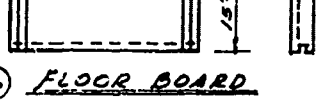
LEFT HAND



(17) FULL END FLOOR BOARD



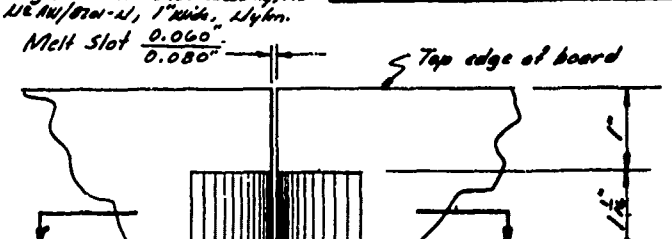
(16) FLOOR BOARD



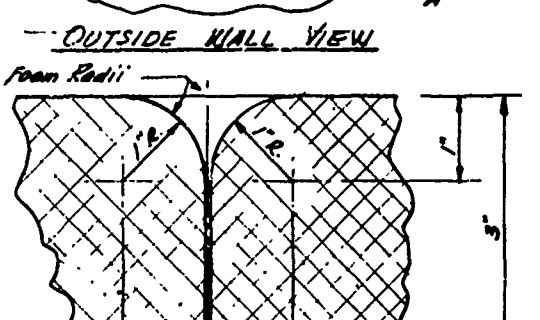
(18) HALF END FLOOR BOARD

Note: Wall Tie Slots are sized for Alliance Webbing, Inc. LE AW/8ow-1, 1" wide, Nylon.

Melt Slot 0.060" / 0.080"



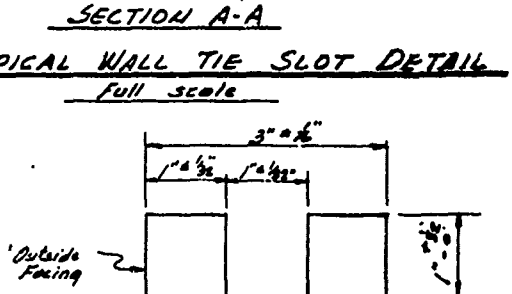
OUTSIDE WALL VIEW



SECTION A-A

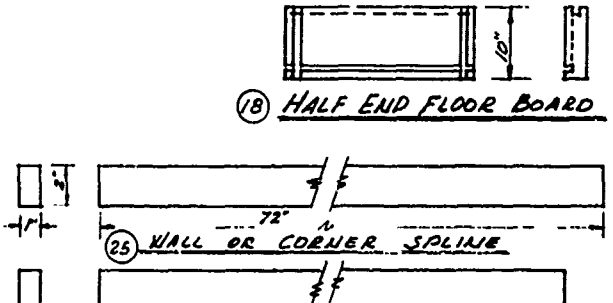
TYPICAL WALL TIE SLOT DETAIL

Full scale



TYPICAL SPLINE GROOVE

Full Scale



Scale: 1½" = 1"

PARTS LIST

ITEM No	PART No.	DESCRIPTION	No. Reqd
1	PY1578-50R	Tapered Bottom Board - Right Hand	1
2	50L	Tapered Bottom Board - Left Hand	1
3	11R	Full Board - Right Hand	4
4	11L	Full Board - Left Hand	4
5	44R	Top Board - Right Hand	1
6	44L	Top Board - Left Hand	1
7	22	End Board	10
8	46	Top End Board	2
9	17	Full End Floor Board	1
10	16	Floor Board	3
11	18	Half End Floor Board	1
12	25	Wall or Corner Spline	16
13	27	Floor Spline	8
14	30	End Wall Spline	12
15	41.1	Wall Ties - 85.5" long	26
16	41.2	Wall Ties - 70.0" long	6

Contract No. DASA01-71-C-0018

REFERENCE DRAWINGS

PY1578-5A Center Wall Details

PY1570-5A Mechanic Barrier System Layout

APPROVALS

AJP 7-27-71

AJP 7-27-71

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

DETAILS AND ASSEMBLY OF BARRIER SYSTEM WING WALL - 3" FOAM

600-1841

PY-1578

PY-1578-5A

11-A

Fig. 6 11-C

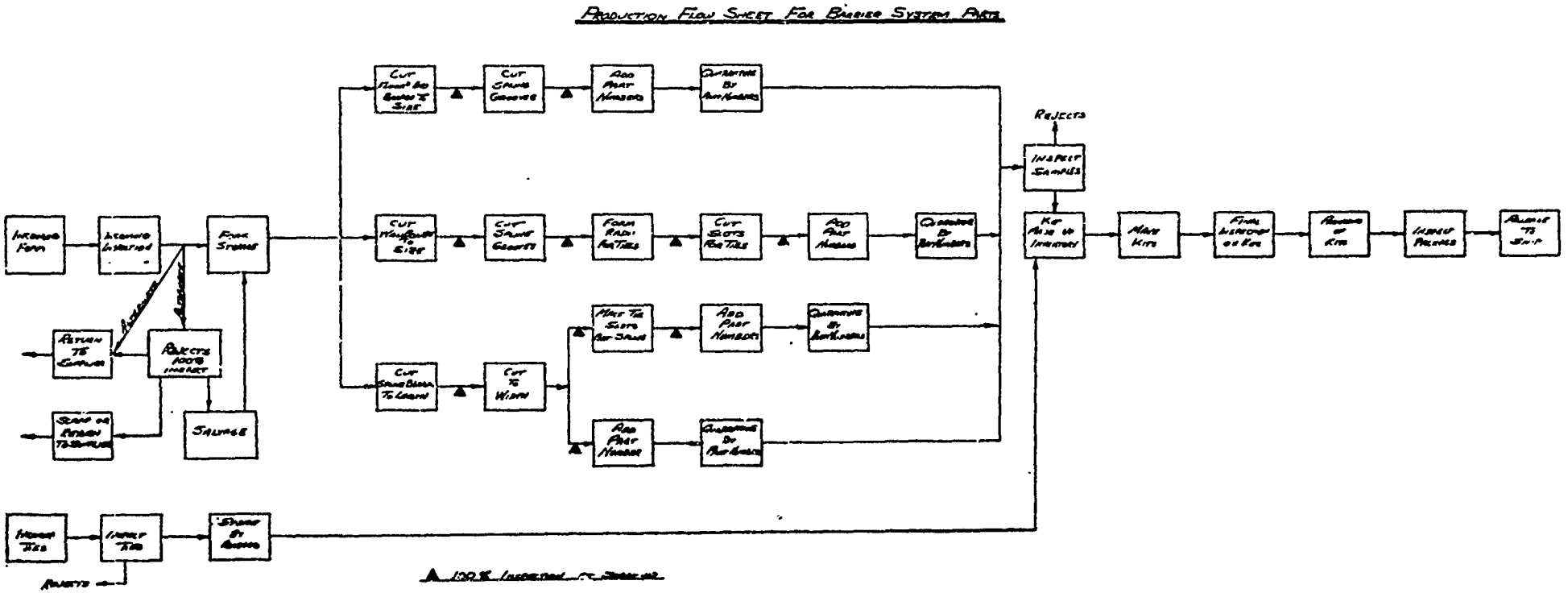

PRODUCTION FLOW SHEET FOR BARRIER SYSTEM PARTS
REJECTS
SALVAGE
100% INSPECTION

Fig. 7

Fig. 8 - Typical Foam Board Cut-Off

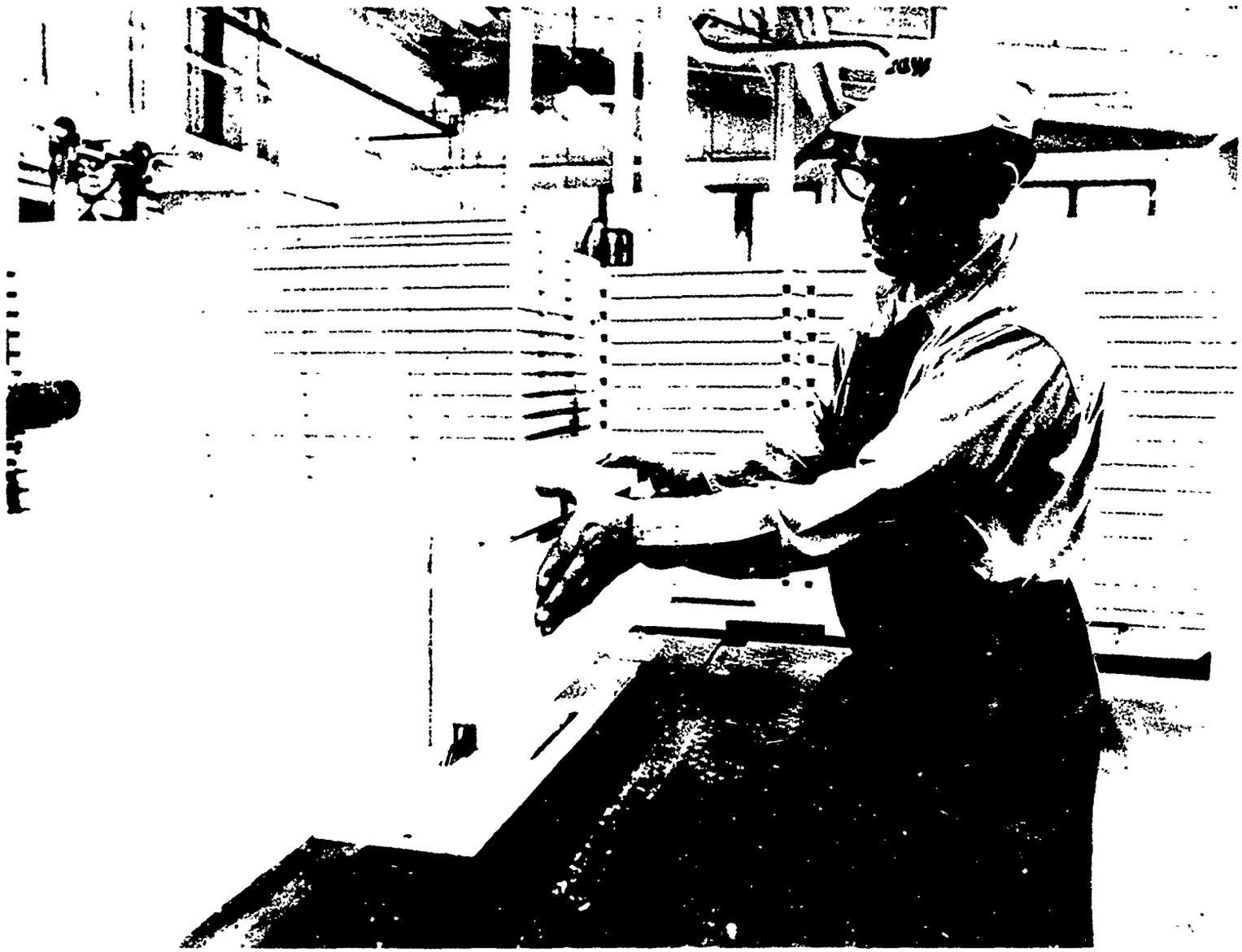


Fig. 10 - Routing for a Spline Butt Joint

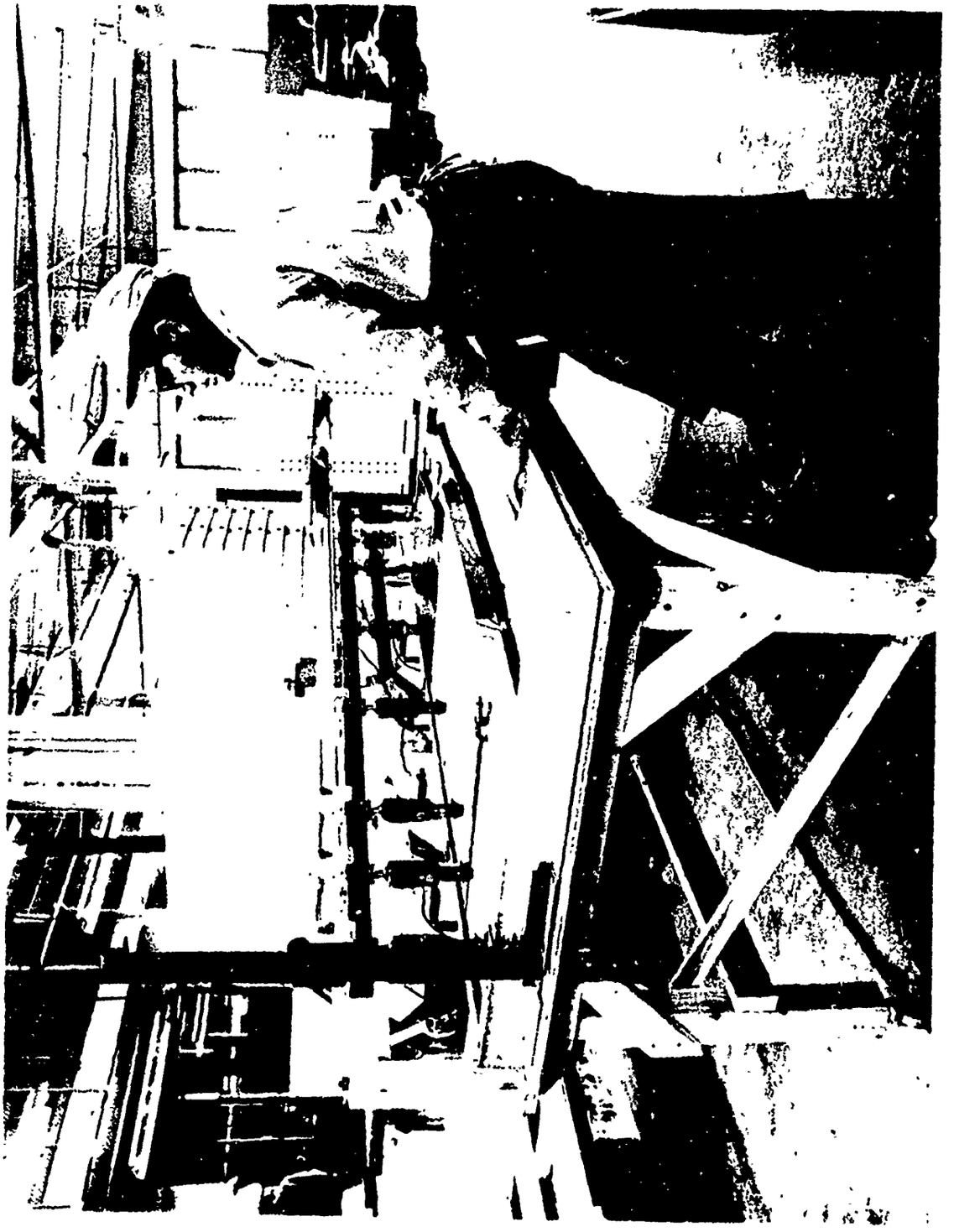


Fig. 11 - Radius Jig from Front

Fig. 12 - Radius Jig Close-up

location, and Figure 13 shows the completion of the tie slot using a hot wire.

After this operation, the part numbers were added and the wall boards placed in quarantine for inspection.

Splines were cut from excess board stock. Figure 14 shows typical splines being cut. Part numbers were added and the splines were segregated for inspection. The vertical center wall splines required the addition of a slot for the ties. These were put in using a hot wire cutter.

6.3 Production Time

To keep the fabrication proceeding smoothly, carbide cutting tools were used for sawing and routing the foam. Cutting rates for adjusting size were typically 30 feet per minute while routing was done at about half that rate because the foam can tear at high feed rates.

The jig for radius and tie slot formation required about one minute for each board.

6.4 Inspection

The various boards in quarantine were checked for compliance to dimensions and fit with a sampling scheme per MIL STD 105 D. Dimensions were checked with gauges produced for this job.

The gauge drawings and the complete inspection results are in Appendix A, the Quality Assurance Surveillance Program.

After inspection, the parts were released to the kit make-up inventory.

Fig. 13 - Radius Jig from Back

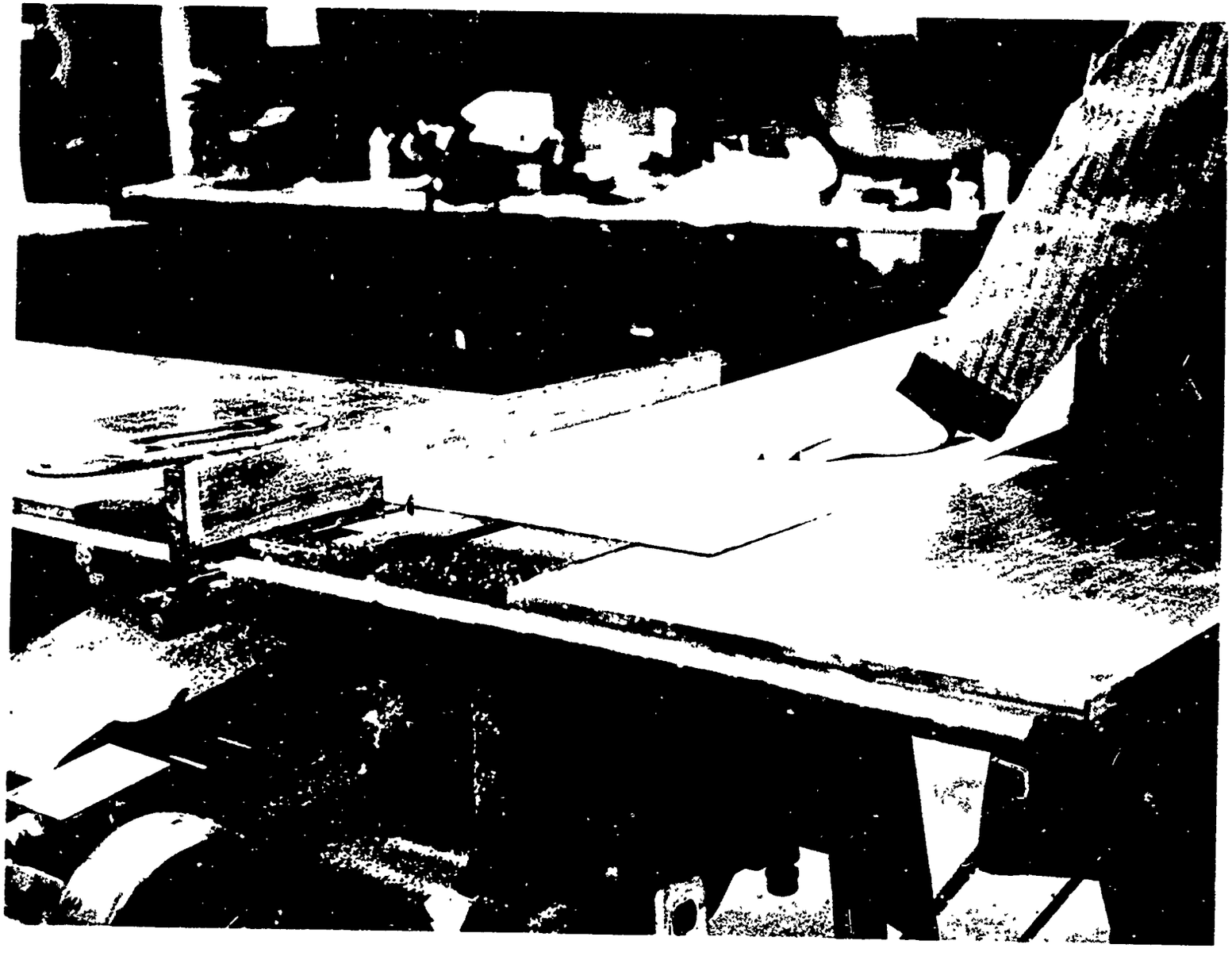


Fig. 14 - Typical Foam Board Spline Cutting

The parts list with number inspected and results are tabulated in Figures 15 and 16.

Six pallets were used with wing walls and center wall packaged separately. It was also felt that a planned pallet stacking sequence would be helpful as an unpacking and assembly aid. Figure 17 and Figure 18 show the stacking sequence for center wall pallets and wing wall pallets used for pallet stacking. Also, included with each pallet were a set of assembly instructions (see Appendix B) giving pallet parts lists, and instructions and drawings for assembly.

When the pallets were complete, glass tape was used to hold the foam to the pallet and the overwrap of opaque polyethylene film was added. Next, the pallet labels were added with appropriate markings.

The entire demonstration kit was shipped as one unit load from Midland to NAD Earle, New Jersey.

7.0 WORK AT THE SITE - NAD EARLE, NEW JERSEY

7.1 Unloading Shipment

The highway trailer carrying the shipment was unloaded at ground level for lack of headroom at the NAD warehouse dock. As the trailer vertical lift rear door was opened, most of the foam boards from the center wall pallet No. 1 fell 6 to 8 feet to the ground. About six boards were damaged. Glass fiber tape securing the boards to the pallet had broken. Typical breakage is shown on Figure 20 .

Remaining pallets were skidded to the door where they were removed with a fork truck. The 92" high pallets were removed with difficulty because this height and the single platform

Fig. 15

INSPECTION RECORD B. A. Russell

CONTRACT DASA 01-71C-0018

LOT-KIT DATA SHEET LOT D-18-1

PART	DATE	SAMPLE SIZE	DIMENSIONS	SPLINE GROOVES	TIE SLOTS	WORK MANSHIP	PART NO.
8L	10-14-71	6	OK	OK	OK	OK	OK
8R	10-14-71	6	OK	OK	OK	OK	OK
11L	10-15-71	13	OK	OK	OK	OK	OK
11R	10-15-71	13	OK	OK	OK	OK	OK
9	10-15-71	20	OK	OK	OK	OK	OK
42	10-15-71	5	OK	OK	OK	OK	OK
43L	10-15-71	2	OK	OK	OK	OK	OK
43R	10-15-71	2	OK	OK	OK	OK	OK
*14L	10-15-71	6	OK	OK	OK	OK	OK
*14R	10-15-71	6	OK	OK	OK	OK	OK
*45L	10-15-71	2	OK	OK	OK	OK	OK
*45R	10-14-71	2	OK	OK	OK	OK	OK
22	10-14-71	32	OK	OK	--	OK	OK
46	10-15-71	8	OK	OK	--	OK	OK
16	10-15-71	20	OK	OK	--	OK	OK
17	10-15-71	5	OK	OK	--	OK	OK
18	10-15-71	5	OK	OK	--	OK	OK
25	10-14-71	50	OK	--	--	OK	OK
27	10-14-71	20	OK	--	--	OK	OK
30	10-14-71	32	OK	--	--	OK	OK
32	10-14-71	20	OK	--	--	OK	OK
48	10-14-71	5	OK	--	OK	OK	OK
50L	10-20-71	5	OK	OK	OK	OK	OK
50R	10-20-71	5	OK	OK	OK	OK	OK
44L	10-20-71	5	OK	OK	OK	OK	OK
44R	10-20-71	5	OK	OK	OK	OK	OK
53	10-14-71	2	OK	OK	--	OK	OK
86" Tie	10-19-71	80	OK	--	--	OK	NA
**70" Tie	10-19-71	135	rej.	--	--	OK	NA

* 1st pieces had tie slots in wrong place; 2nd pieces were all OK
** Initial sample called for rejection, 100% inspected and 10 bad loops removed.

	Center Wall Kit		16 Wing Walls				
Part No.	Total Pallet 1	Total Pallet 2	Total Pallet 3	Total Pallet 4	Total Pallet 5	Total Pallet 6	Grand Total
8L	2	4	-	-	-	-	6
8R	2	4	-	-	-	-	6
11L	-	-	16	16	16	16	64
11R	-	-	16	16	16	16	64
9	50	50	-	-	-	-	100
42	10	10	-	-	-	-	20
43L	2	0	-	-	-	-	2
43R	2	0	-	-	-	-	2
14L	3	3	-	-	-	-	6
14R	3	3	-	-	-	-	6
45L	0	2	-	-	-	-	2
45R	0	2	-	-	-	-	2
22	7	8	40	40	40	40	175
46	1	2	8	8	8	8	35
16	30	26	12	12	12	12	104
17	2	2	4	4	4	4	20
18	-	-	4	4	4	4	16
25	80	80	64	64	64	64	416
27	30	23	16	16	16	16	117
30	6	6	48	48	48	48	204
32	55	55	-	-	-	-	110
48	12	13	-	-	-	-	25
50L	-	-	4	4	4	4	16
50R	-	-	4	4	4	4	16
44L	-	-	4	4	4	4	16
44R	-	-	4	4	4	4	16
53	0	2	-	-	-	-	2
Ties 86"	162	163	96	96	96	96	709
Ties 70"	5	5	25	25	25	25	110

Fig. 16

PALLET 1 & 2
STACKING PATTERN
ONE HALF OF CENTER WALL

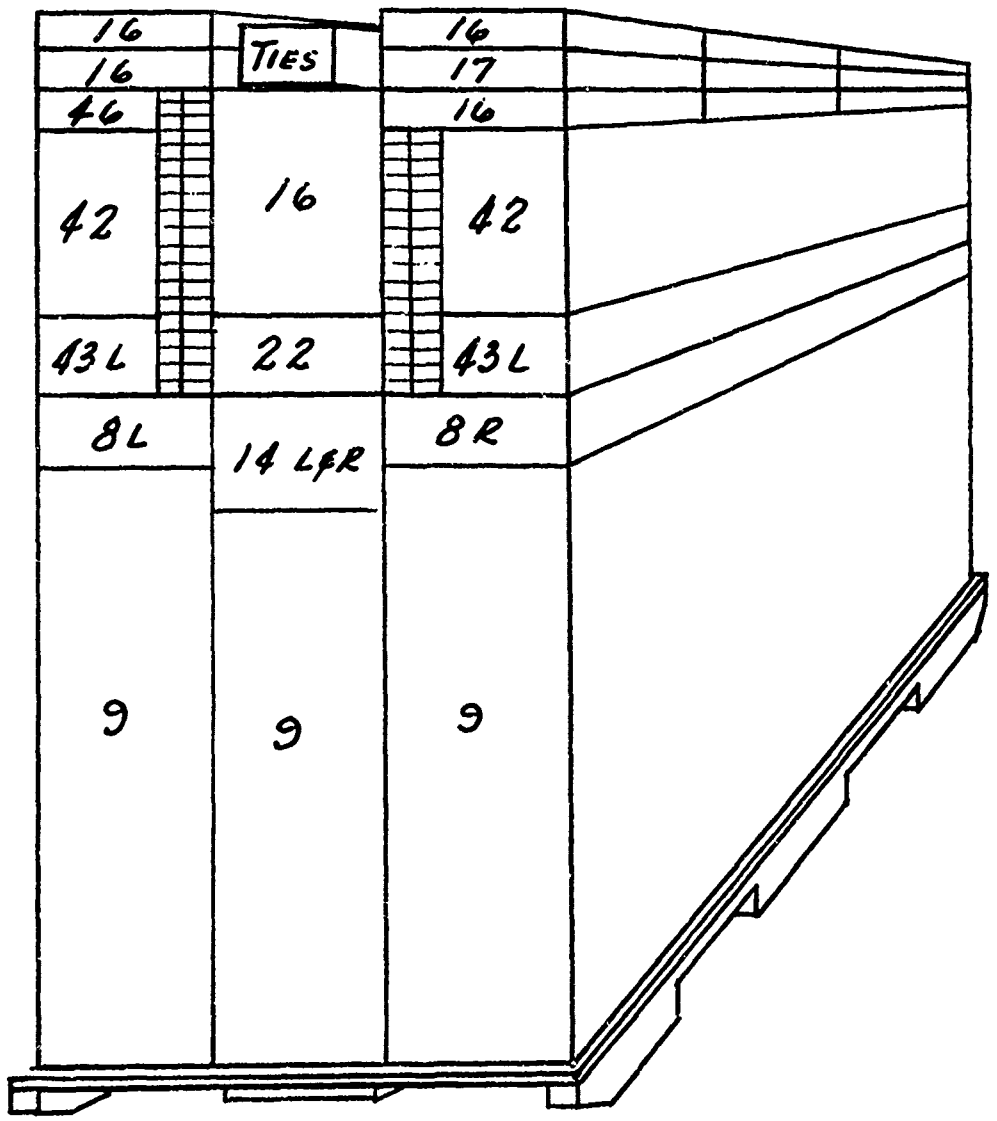


Fig. 17 - Stacking Pattern for
Pallets 1 and 2

PALLETS 3 THRU 6
STACKING PATTERN
4 WING WALLS EACH

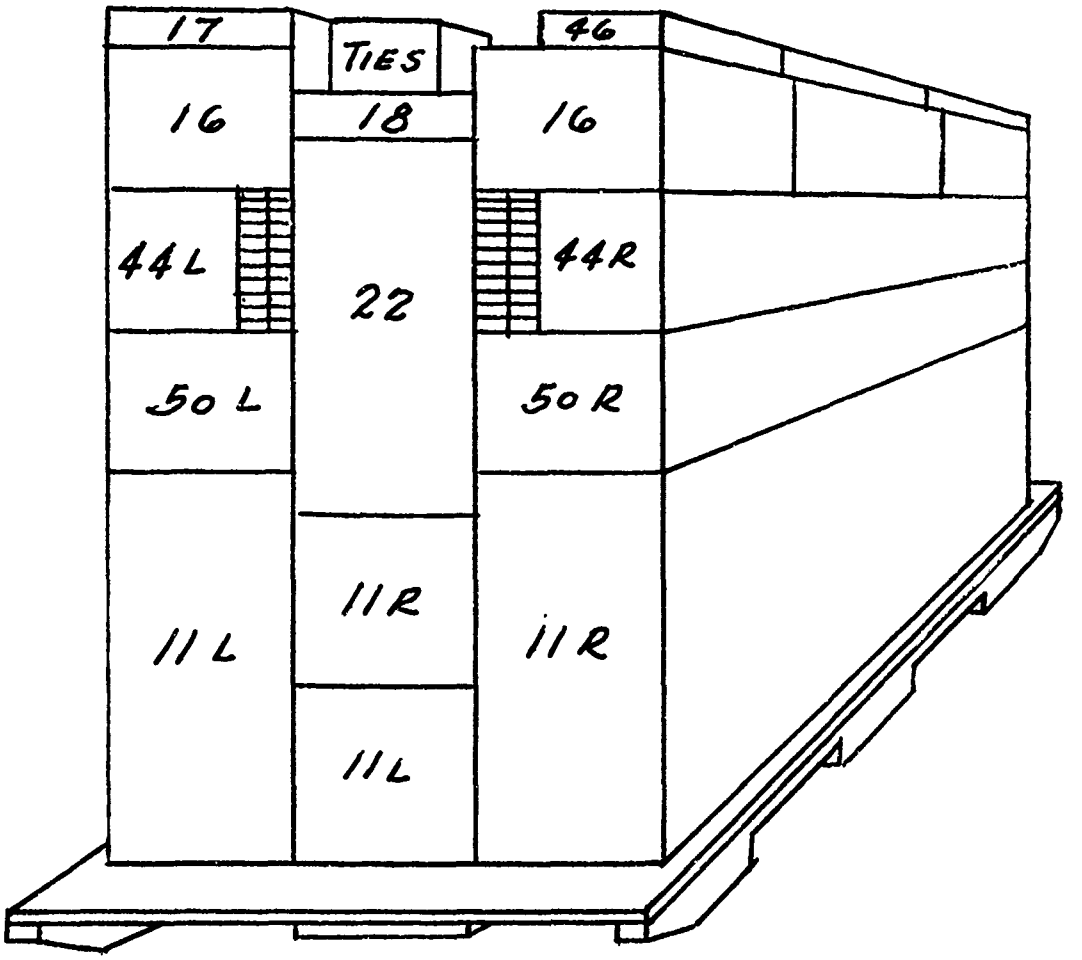
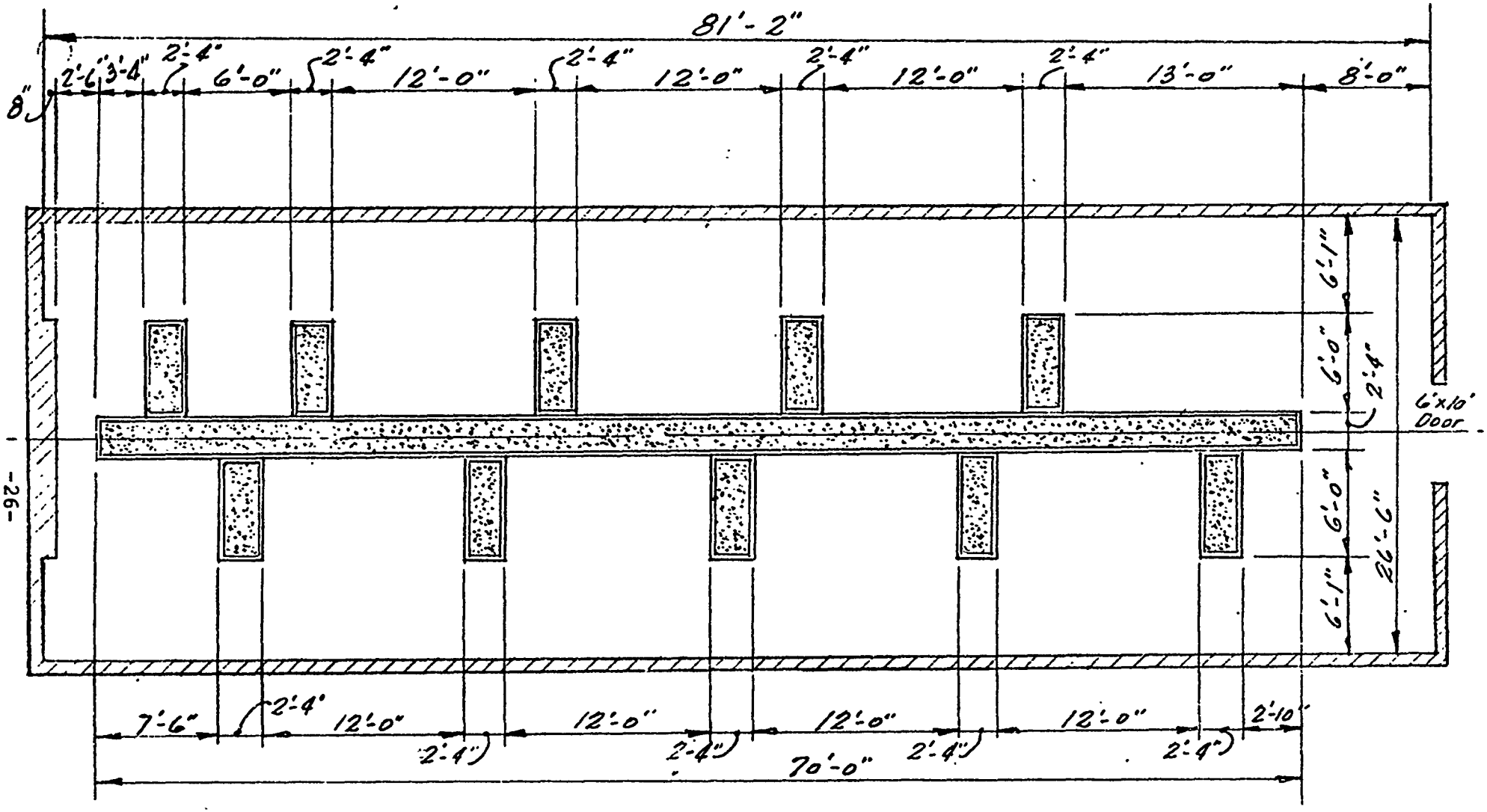


Fig. 18 - Stacking Pattern for
Pallets 3 thru 6



CONTRACT NUMBER DASA01-71-C-0018

Fig. 19 - Final Layout of #23 Magazine

DESIGNED BY	DATE
DRAWN BY A. J. P	DATE 11-19-71
CHECKED BY	DATE
APPROVED BY	DATE

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

FINAL LAYOUT OF NAD EARLE, N.J.
MAGAZINE № 23 COMPARTMENTS

ACCOUNT NUMBER 600-1841

JOB NUMBER PY-1578

DRAWING NUMBER PY-1578-56D

pallet did not permit fork lift tilting.

NAD personnel shipped the pallets to magazine #23 where they were stored outside.

7.2 Barrier Assembly Briefing

A meeting was held to discuss the barrier system and assembly procedures. Present were Lt. Huebner, G.M.T.C. Koblenzer, and the assembly crew of four seamen and two civilians. A half scale model was used to demonstrate assembly of the foam wall and the wall tieing system.

7.3 The Site-Magazine No. 23

Magazine #23 is a standard reinforced concrete type as per U. S. Naval Ammunition Depot, New York Area, H. E. Magazine Group M, Bureau of Yards and Docks drawings 278,779 and 278,780. It is serviced via a hard surface road and railway siding to a 48" high concrete loading dock. The dock is 12 ft. wide and is enclosed on three sides, including the magazine front wall. The doorway is 6 ft. wide x 10 ft. high.

The interior floor is smooth and slopes 1/8 per ft from the center line to gutters on the outside walls.

The magazine is ventilated with a 16" diameter gravity roof ventilator at the back-end of the magazine.

7.4 Barrier Wall Assembly

The initial barrier wall layout is shown on drawing PY 1578-55A, Appendix B. After erecting and loading three wing walls, it was requested larger compartments be made as per the layout on drawing PY-1578-56 D, Figure 19 .

Various stages of wall assembly are shown on Figures 20 thru 35.

Two pallets of foam boards were moved into the magazine. One contained materials to complete one half of the center wall and the other pallet supplied material to complete four wing walls.

Assembly and sand loading of the barrier walls was supervised by the authors. Navy personnel arranged for work crews, equipment and sand delivery to the site.

Assembly was started at the back-end of the magazine. The floor was marked to locate the center wall and the first two wing walls. Assembly and sand loading progressed first from the wing wall followed by the adjacent center wall. This procedure was followed to provide for a closer fit at the wing wall/center wall juncture. A sand loaded center wall bulges slightly near the bottom because of the stretch in the nylon wall ties used. The sand loaded wing wall-end is relatively straight and forms a plumb wall for center wall alignment.

The 6 ft. lower wing wall boards are tapered 7/8" to adjust for the floor slope. The workmen assemblying the foam boards soon selected the different boards by configuration rather than number. The tapered floor board was often mistaken for an untapered board and improper assembly often resulted.

Wing walls were preassembled then temporarily stored behind the sand filled walls. They were easily skidded into position when needed. The preassembled wing walls were first built 3 boards high, then 4 boards and finally five boards high. This was the maximum height the sand loader was capable of dumping a load.

Only minimum center wall length was preassembled. This procedure not only provided for more work area, but also

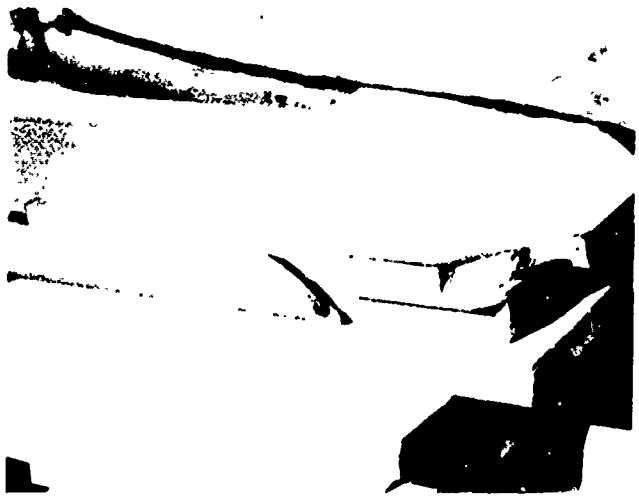


Fig. 20 - Parts Damaged Unloading at Site

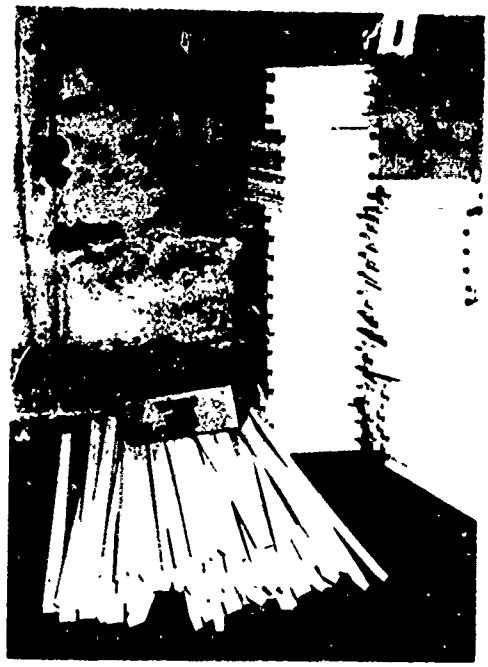


Fig. 21 - Parts Ready for Assembly

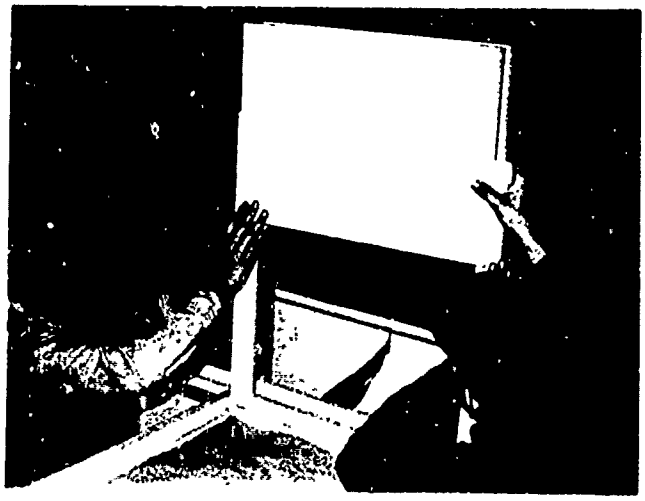


Fig. 22 - Assembling Wall

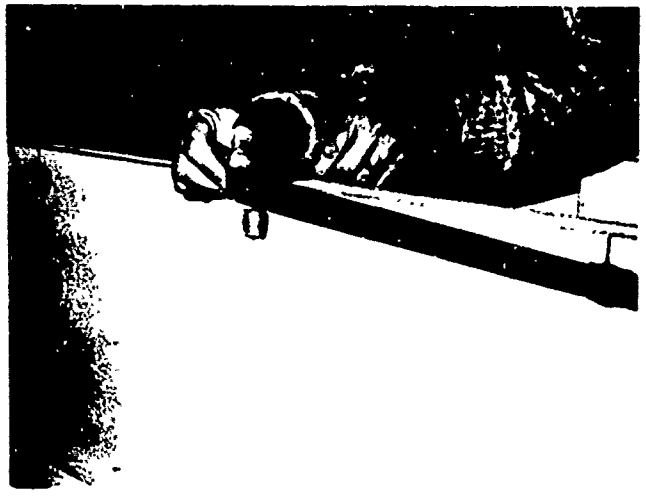


Fig. 23 - Installing Wall Tie

Fig. 24 - Wall Tie Installed

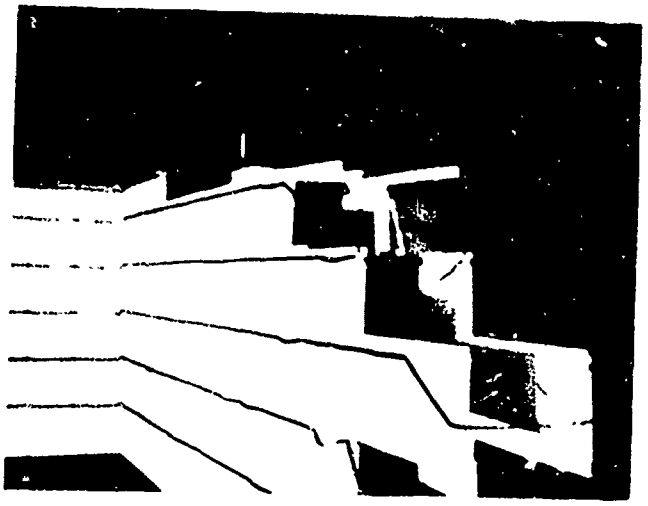


Fig. 25 - Center Wall Partially Assembled

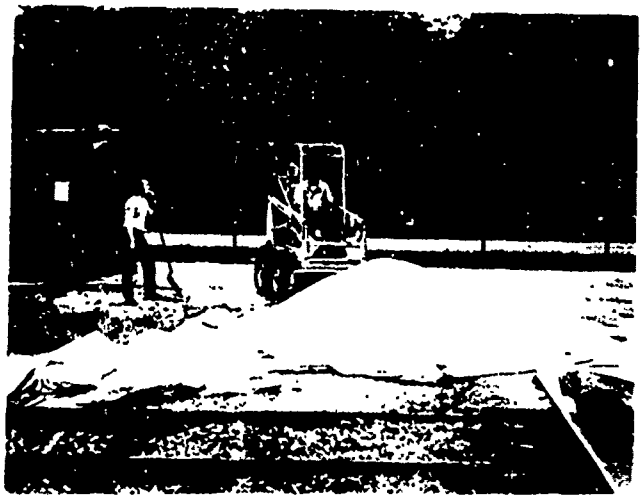


Fig. 26 - Loader Getting Sand

Fig. 27 - Loader on Ramp

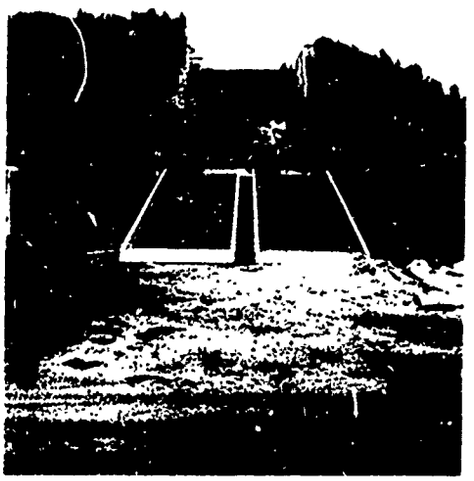


Fig. 28 - Second Ramp Installed

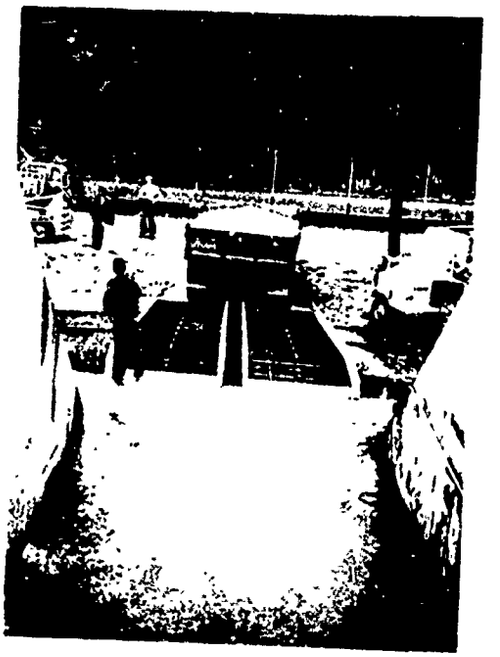


Fig. 29 - Dumping Sand by Dock Doorway

Fig. 30 - Loader Enters Magazine

Fig. 31 - Loader Dumping Sand

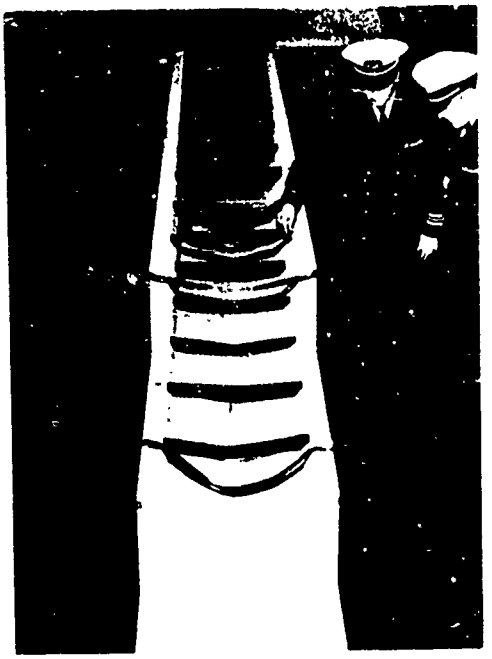


Fig. 32 - Center Wall

Fig. 33 - Walls Under Construction

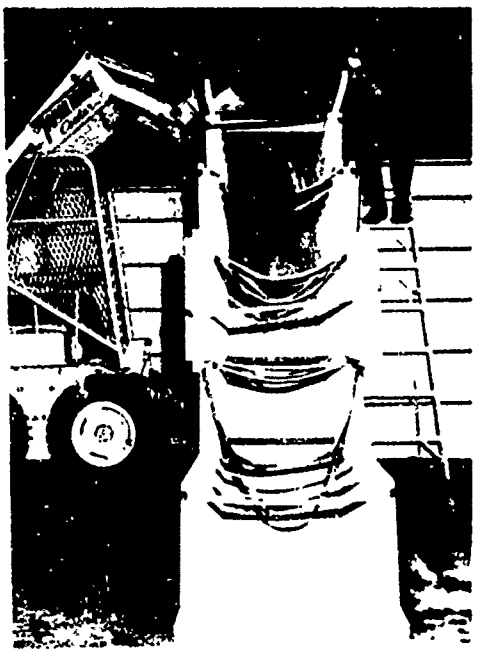


Fig. 34 - Filling Center Wall

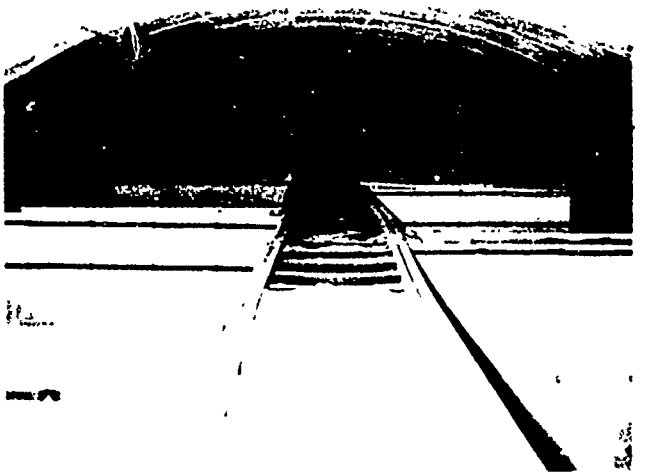


Fig. 35 - Completed Barrier Top View

limited butt joint opening while working on other parts of the wall. Once joints are opened and filled with sand, they are difficult to close.

7.5 Wall Ties

The nylon webbing used for wall ties was Alliance Webbing, Inc., No. AW8201 N, 1" wide x 0.035" thick, olive color, sewn into bands by the Aeroquip Corporation. Two wall tie lengths were used. Shorter 70" ties were used on outside wall ends and 85.8" lengths were used at all other locations.

There was some slack in the shorter nylon webbing. This slack was removed from all short ties on wall ends by tieing it to the adjacent long wall tie with glass fiber tape, inside the wall.

Wall ties made of Dacron were being tested concurrently with fabrication and shipment of the barrier system to Earle, N. J. Creep data of the nylon webbing suggested either stronger webbing or webbing made of Dacron would be more stable and would limit wall bulging. Creep and tensile properties of the nylon webbing used and properties of stonger nylon and Dacron webbing are reviewed in Appendix D page 122.

Similar Dacron wall ties were made and tested in the Earle installation in limited locations at the center end walls and at two wing wall ends.

7.6 Sand Data

The dried sand used was purchased from a local distributor. It is a medium grained sand having the following gradation analysis;

(1) 95% - 100% passing #20 U.S. Std. Sieve
(2) 5 - 20% #70 Sieve
(3) 0 - 3% passing #100
(4) Trace passing #200

Moisture content was below 0.6%

7.7 Sand Filling

Sand was loaded into the walls with a Watonn Series 1000 loader. Bucket capacity is about 1/4 yard which can be dumped at a maximum height of about 7 ft. This pneumatic tire loader is capable of turning inside its diagonal length, which was required for maximum loading efficiency of the center wall within the confines of the magazine.

Initially 8 yard loads of sand were dumped on the roadway outside the magazine. The loader scooped up the sand and drove up a ramp provided, then on through the 6 ft. magazine door. Later an additional ramp was placed on the dock and 8 yard truck loads of sand were dumped in the three wall area on the dock. This reduced the loader travel time and provided for cleaner and easier loading.

7.8 Rate of Sand Filling

The average loading rate per trip of the 1/4 yard loader was 3 minutes per wing wall and 4 minutes per center wall. Under constant wall loading conditions the total elapsed time for loading the 70 foot long center wall and 10 - 6 ft. wing walls is;

(1) Center Wall 941 cu. ft. or 32.6 cu. yds. = 8.8 hrs.

(2) Wing Wall 74 x 10 = 740 cu. ft. or 27.4 cu. yds. = 5.5 hrs.

Total loading time for 80 tons, or, 60 cu. yds. = 14.3 hrs.

Comments and cost data of this prototype field installation by the Commanding Officer, NAD, Earle, are included as Appendix E of this report.

7.9 Manpower Requirement

The labor required to erect the foam board barrier walls is proportional to the rate sand is loaded in the walls. At a maximum rate of 14.3 hrs. sand loading, the recommended manpower requirement and duties are as follows;

1 - Supervisor - full time
1 - Equipment Operator
1 - Equipment Operator Guide at the wall
3 - Wall assembly men

This is based on an average time of 20 minutes for two men to assemble a 6 board high, 91" or 96" high, wing wall 6 ft. long.

The actual time required to complete the prototype #23 magazine was 5 days. Actual working hours were reduced due to delays in sand delivery, time required for security checks and getting workmen on the job, and delays in establishing an improved magazine ventilating system.

7.10 Magazine Ventilation

The magazine gravity ventilator was augmented with an electrical generator powered air blower to vent toxic vapors exhausted by the mechanical loader. The inital arrangement was inadequate.

A check by the NAD Safety department found the magazine air to contain 400 parts per million of carbon monoxide, an unsatisfactory level. A larger generator was acquired to service lighting and two additional fans. These fans in the doorway, plus the roof vent blower, discharged air out through the doorway and reduced the carbon monoxide level below 70 ppm, which was considered acceptable.

Sand dust was tolerable without respirators, although workmen working at sand dumping locations wore face respirators.

7.11 Wall Damage

Only superficial damage developed during assembly. This was in the form of broken spline groove corners and abrasions from the mechanical loader tires. None of these contributed to sand leakage or structural weakening. Near the completion of the center wall at the doorway, the lower foam board was side-swiped by the loader bucket. Because of slight sand leakage and appearance at the front entrance it was decided to replace the lower half-boards. This was demonstrated by breaking the lower end board, cutting the two vertical corner splines and damming and removing sand. The lower course of half boards were removed intact together with wall ties and floor boards. A similar unbroken assembly was replaced without difficulty. A 1/2" plywood "U" shaped protector was placed around the end wall before proceeding with the completion of the loading operation. This was later removed.

7.12 Sand Leak Checks

After wall loading was completed, the floor was swept clean of sand, particularly adjacent to the barrier wall. Leaks can be easily detected by observing the floor. Several hours may be needed to detect small leaks. Some were found in this wall at butt joints which were open 3/16" or more, or where butt joint splines were omitted or not making contact with the

mating spline. Sand leaks were easily repaired by plugging with small wedges of foam.

7.13 Static Electricity

Under dry conditions a static electrical charge may be built up in the foam wall, caused by the flow of dry sand. After loading the barrier walls in #23 magazine, the walls were tested with a Keithley Instrument Co., Static Detector Model 200A. No charge could be detected, even on a 2 volt scale. The temperature in magazine 23 was lower than the outdoor temperature and moisture could be seen condensing on the floor. The high relative humidity in the magazine apparently prevented static electricity from accumulating.

8.0 ALTERNATE SAND LOADING AND UNLOADING SYSTEMS

Based on the Earle installation, it is estimated two men can assemble a foam board barrier center wall 70 ft. long with 10 - 6 ft. long wing walls, all 6 ft. high, in less than 8 hours. This time can be reduced to 4 hours with two additional men. It becomes obvious that the time required to complete a sand filled barrier system will be determined by the sand filling rate.

Although the 1/4 yard loader used on #23 magazine is capable of filling a similar wall system in the reasonable time of 14 hours, there are advantages of an alternate system in addition to faster filling.

For example, such a system is illustrated on Figure 36. This is based on a dry sand bulk hauler which may be spotted near the magazine loading dock. Such commercial haulers have a dry sand capacity from 80,000 to 200,000 lbs. Equipped with an engine driven compressor, sand can be conveyed at rates from 1000 to 3000 lbs. per minute with 15 to 20 psi air pressure.

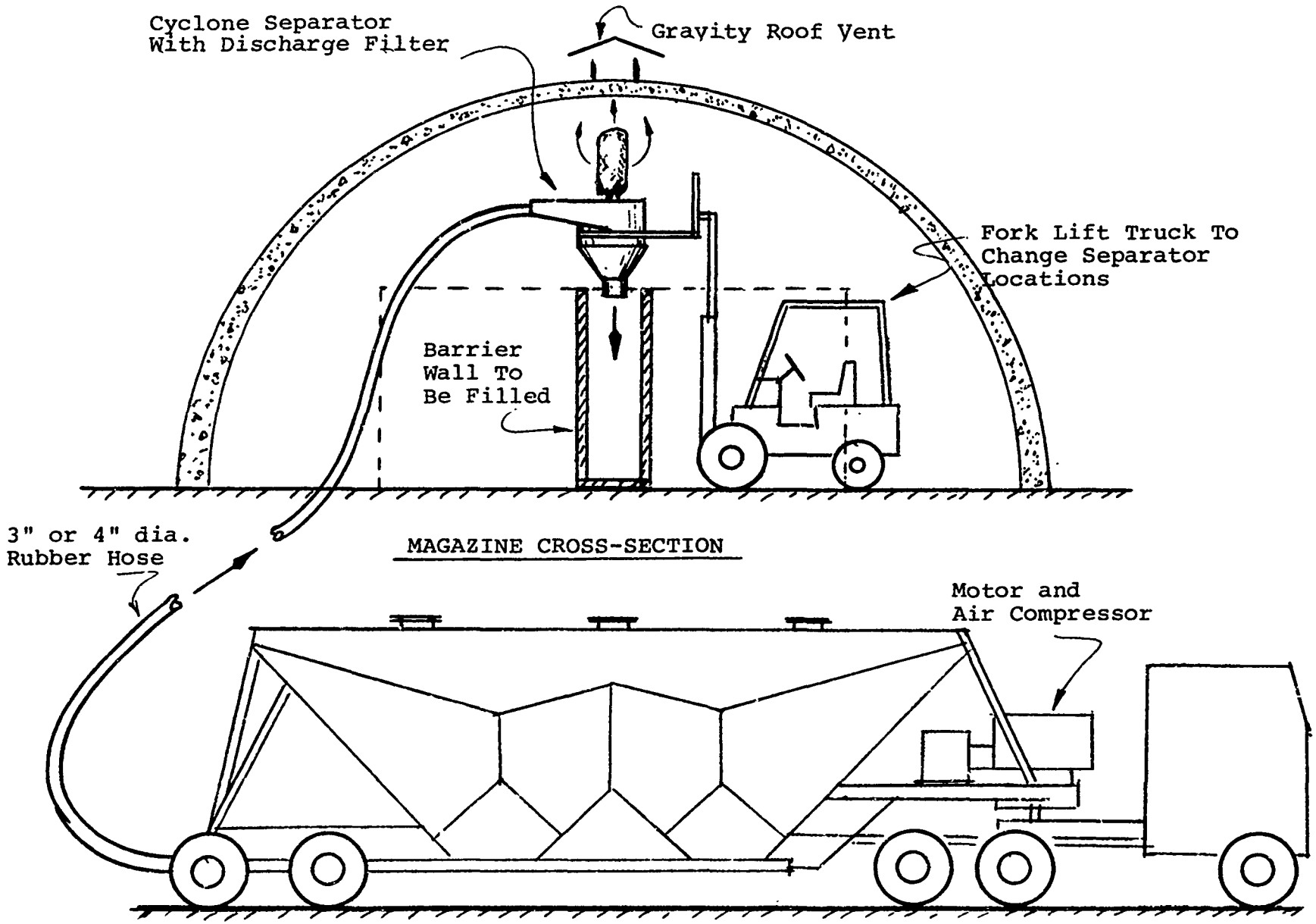


Figure 36 - Alternate Pneumatic Sand Filling System

Fig. 37 - A Typical Street and Sewer Vacuum Cleaning System Used to Evacuate Sand From an Experimental Barrier Wall

Fig. 38 - Flexible Hose, 12" Diameter, Evacuated Sand at a 12 Ton Per Hour Rate Through 80 Feet of Hose

Sand can be conveyed into the magazine through a 3" or 4" dia. rubber hose, discharging into a separator located over the wall to be filled.

Characteristically, high pressure pneumatic conveying systems operate with lower volumes of air, thus simplifying air/sand separation. Fine sand dust can be filtered with a cloth filter at the separator discharge.

The separator may be attached to a fork lift truck for portability to wall locations to be sand filled.

Theoretically, at a low sand discharge rate of 1000 lbs/minute, and allowing 50% time to locate the separator, a 10 wing 70 ft. center wall barrier system could be sand filled in 4.6 hours.

In additon to faster filling, such a system has these advantages;

(1). Elimination of toxic gasses exhausted from engine driven loaders.

(2). System is not sensitive to weather conditions and sand is protected from the elements.

(3). Less vehicular movement inside magazine and lower wall damage potential.

(4). Cleaner operation

8.1 Sand Unloading

Sand was successfully unloaded from the Midland, Michigan test wall with conventional street and sewer vacuum cleaning equipment as shown on photos Figure 37 and Figure 38.

9.0 ECONOMIC COMPARISON OF SAND BAGS TO FOAM BARRIER SYSTEM

9.1 Basis for Comparison

9.1.1 Magazine

Magazine is a standard type with layout of one center barrier wall 70 feet long, 6 feet high and 10 barrier wing walls - 6 feet long, and 6 feet high.

9.1.2 Sand

Sand bags are woven polypropylene costing 43¢ apiece, filled with 36 pounds of dry sand each. The number of bags needed is 5, 116, cost for filled bags delivered is 36¢ each, stacking takes 245 man hours @ $3.00.

9.1.3 Foam Barrier

Assume use of 3 inch thick high density extruded polystyrene foam. The magazine required 8,000 Bd.ft. at a value of 23¢/board foot. Ties are worth $438.00. Assume it takes 13.8¢/board foot for conversion to packaged kit form. (This includes fabrication and packaging, etc.) Labor Rate $6.00, 1971 level.

9.1.4 Sand

Assume the same sand for both barrier systems (return to Paragraph 7.6 for analysis). Cost for sand $5.52/ton, $.90/ton to deliver to site.

9.1.5 Loader

Rental cost $180. for week, or minimum.

9.2 Economics for Sand Bag System Installed

The calculation of the installed cost for sand bags is shown on Figure 39. The barrier with 70 ft. long center wall, and 10 wing wall, required 5,116 bags. The bags were filled and sewn before delivery to site and then stacked by hand to form the barrier wall.

9.3 Economics for Foam System

The calculation of the installed cost for the foam system is shown on Figure 40. The same size barrier is used with the same amount of sand. The hours to erect the walls and fill using a loader are based on the experience at NAD Earle. Pneumatic unloading of sand is included also for comparison purposes, and would allow erection of the walls first, with subsequent sand filling.

9.4 Comparison of Two Systems

The information is condensed and shown on Figure 41. which shows raw material, labor and total estimated installation cost for the two systems. The foam system appears to be comparable in installed cost and allows more rapid installation. In kit form, the foam system erection requires about the same labor skill levels as handling sand bags.

Life cycle costs have not been included, although it would appear that the foam barrier would not have to be replaced as often as the sand bag system.

10.0 CONCLUSIONS

1. The prototype foam wall field installation meets the research objectives specified.

2. The prefabricated kit with assembly instructions was installed satisfactorily. Workmen readily understood the system.

Fig. 39 - Economics for Sand Bags*

Bags 5116 @ 43¢ each	$2,200
Sand and Filling 36¢ each	1,842
Subtotal Delivered at Site	4,042
Labor to Foam Barrier 245 Hrs. @ $3.00	.735
Installed Cost	$4,777

*Furnished by NAD, Earle, N.J. - actual experience 1967.

FIG. 40 - ECONOMICS FOR FOAM BARRIER

Foam 8,000 Bd. Ft. @ 23¢		$1,840
Convert to Kit*		1,104
Ties*		438
Freight across Country 4¢/Bd. Ft.		320
Delivered Sand 75 Tons @ 6.40		480
Subtotal Delivered at Site		$4,182
Labor	Loader	Pneumatic Conveying
Assemble walls, 2 Men, 2 Days 32 Man Hrs. @ $6.00	$ 192	$ 192
Cost to Fill		
Loader @ $180 Min.	180	---
Driver 16 Man Hrs. @ $6.00	96	---
Driver Helper 16 Man Hrs. @ $6.00	96	---
Pneumatic System		
Cyclone Mover 16 Man Hrs. @	---	96
Installed Cost	$4,746	$4,470

*Projected Volume Figures

Fig. 41 - Economic Comparison

	Sand Bags	Foam Barrier
Materials to Site	$4,042	$4,182
Labor at Site	735	564
Estimated Total Installation Cost	$4,777	$4,746

3. The minor problems encountered were attributed to failures to check assemblies before loading sand.

4. The installed foam barrier wall system cost is comparable to conventional sand bag walls.

11.0 RECOMMENDATIONS

1. Lower elongation wall ties are recommended to reduce wall bulging and to provide greater freedom in sand loading procedure.

2. A temporary plywood shroud should be used to protect the doorway centerwall end.

3. Marking of wing wall bottom tapered board should be improved to distinquish them from other similar boards.

4. All wall assemblies, particularly wing walls, should be checked for correct assembly and location before loading sand.

5. It is recommended wall heights be selected in increments of the 16 inch foam board widths to simplify production, packaging and wall assembly.

6. A trial foam wall installation should be evaluated using a pneumatic sand loading system.

7. When internal combustion engine driven loaders are used inside the magazine, ample auxillary ventilation should be provided to maintain the carbon monoxide level below 75 ppm. Refer to American Conference of Governmental Industrial Hygienist (ACGIH).

8. If the foam wall barrier system is adopted, a military field manual should be written to describe and illustrate assembly, sand filling and maintenance procedures.

APPENDIX A

QUALITY ASSURANCE SURVEILLANCE PROGRAM

QUALITY ASSURANCE SURVEILLANCE PROGRAM

PROTECTIVE BARRIER SYSTEM

MAGAZINE

NAD EARLE, NEW JERSEY

B. A. Russell
Revision 1, October 12, 1971

TABLE OF CONTENTS

I. PURPOSE - ASSURANCE OF QUALITY

A. QUALITY ASSURANCE

Quality will be a prime consideration in the design of the Barrier System through selection, where possible, of items available from companies with an established reputation as reliable suppliers.

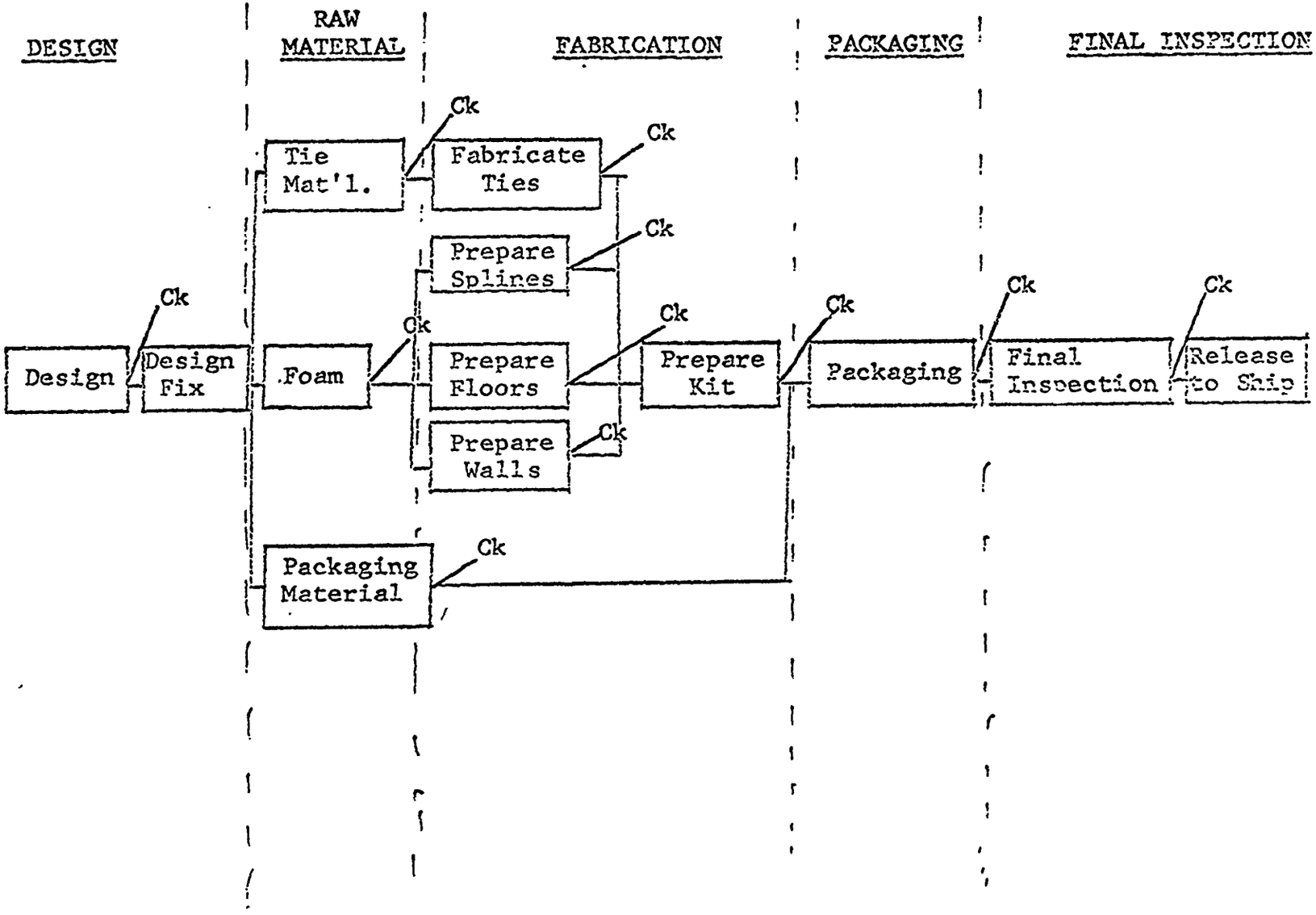
Assurance of quality will be through use of the Project Surveillance Program outlined in Figure 1 which shows a flow chart of the design, procurement, fabrication, and assembly process with appropriate check points for evaluating the design and for observing any later deviations from the fixed design configuration. These checks will be by the Project Manager or his deputy through use of check lists and will be performed on the parts in the kit(s). This approach will give visibility and allow the opportunity for immediate corrective action throughout the project.

II. DESIGN CHECK

There will be a detailed review of the final design from a quality framework to assess potential problems and to prepare check lists for monitoring the project.

Figure 1

QUALITY SURVEILLANCE PROGRAM



III. RAW MATERIAL ACCEPTANCE

This includes the materials needed for the Barrier System and the acceptance procedure for them.

Material	Acceptance
Extruded High Density Polystyrene Foam	By plant release to specification plus visual inspection for workmanship and dimensions.
Woven Tie Material	Manufacturer release to specification with visual inspection for workmanship and dimension.
Packaging Material	Manufacturer release with incoming visual inspection for workmanship.

Any non-conforming material will be reviewed by a group composed of the Project Manager, Engineering Representative, and Production Representative for disposition and/or disposal.

FOAM BOARD CHECK LIST

Date 9/21/71 Checked By BAR, AJP

Sampling will be per MIL STD 105D single normal sampling, major defects use AQL 2.5%, minor defects use AQL 4.0% unless indicated otherwise.

Attribute		Defect Level
Dimensions		
Length	108" - 0 + 1"	Minor (AQL 6.5%)
Width	16" ± 1/16	Minor
Thickness	3" ± 1/16	Minor
Straightness		
Edge Bow	1/8" Max.	Major
Face Bow	1/2" Max.	Major
Saucer	1/16" Max.	Major
Appearance		
Surface:	Reasonably free of nicks, gouges, dents	Minor
Color	Light Blue	Minor (AQL 6.5%)

Number of boards checked 240 (all)

Number of boards rejected 120 for edge bow

Results of check (accept, reject) unacceptable

Problems Notable to make spline groove straight

Disposition Review Board decided to change width of boards to 15.5" on parts for Earle demonstration. This was done because of low inventory on foam and desire to maintain program schedule. No impact on structural strength or overall Barrier dimensions. BAR

Comments

WOVEN MATERIAL

CHECK LIST

Date _____ By _____

Sampling will be per MIL STD 105D single normal sampling, major defects use AQL 2.5%, minor defects use AQL 4.0% unless otherwise noted.

Attribute	Defect Level
Dimensions	
Width	Minor
Workmanship	Minor

Number Checked _____

Number Rejected _____

Result (accept, reject) _____

Disposition _____

Comments _____

Alternate Check Woven Material - Purchased Lapped and Sewn

Date 10/20/71 By BAR, AJP

Sampling will be per MIL STD 105D single normal sampling, major defects use AQL 2.5%, minor defects use AQL 4.0% unless otherwise noted. Reference Drawing PY 1578-41D.

Attribute	Defect Level
Dimensions	
Width	Minor
Length of Tie	Major AQL 1.0%
Length of Lap	Major
Sewing	
Pattern Correct	Major AQL 1.0%
Workmanship	Major
Part Number Present	Major

	86"	70"
Number Checked	80	20
Number Rejected	None	2
Result (accept, reject)	Accept	Rej.
Disposition	OK to use	100% inspect & use good ones
Comments		

Tie Strength

Sampling will be MIL STD 105D level S-1, specimens tested to failure

Number Tested 4

Average Test Result of Strength 1300

Number Rejected None

Result (accept, reject) Accept

Disposition Release to kit makeup

Comments

PACKAGING MATERIAL

CHECK LIST

Date 10/1/71 By BAR

Sampling will be per MIL STD 105D single normal sampling, major defects use AQL 2.5% minor defects use 4%

Attribute	Defect Level
Pallets	
Workmanship	
Pallet intact	Major
Overwrap	
Workmanship	
Coating Uniform	Major
Material Not torn	Minor
Color Light	Minor

Pallets

Number Checked 6 (all)
Number Rejected None
Results _____

Comments OK to use

_____

Overwrap Checked 10/21/71 BAR

Number Checked 3 rolls
Number Rejected None
Results Release to pkg.

Comments _____

_____

IV. FOAM PIECES CHECK LIST

This section deals with the necessary checks for the various foam boards and splines that make up the walls for confining sand. A complete parts list and individual drawings for the pieces are included as Appendix A. This includes:

A. Floor Boards
B. End Boards
C. Wall Boards
D. Splines

A. FLOOR BOARD CHECK LIST

Date 10/12/71 By BAR

Sampling will be per MIL STD 105D single normal sampling, major defects use AQL 2.5%, minor defects use AQL 4% unless otherwise indicated.

Attribute	Defect Level	
Length	Minor	
Width	Minor	
Location of Spline Groove	Major	AQL 1.0%
Depth & Width of Spline Groove	Major	AQL 1.0%
Part Number Present	Major	
Workmanship	Minor	

Reference Drgs.
PY 1578-51A & 54A

Part No.	Description	Number Checked	Number Rejected
16	Board-Floor-Std	20	0
17	" Std End	5	0
18	" Half End	5	0
53	" Adjustable	2	0

Comments OK for kit makeup BAR

B. END BOARD CHECK LIST

Date 10/14/21 By BAR

Sampling will be per MIL STD 105D
Single normal sampling, major defects use AQL 2.5%, minor defects use AQL 4.0% unless otherwise indicated.

Attribute	Defect Level
Length	Minor
Width	Minor
Location of Spline Grooves	Major AQL 1.0%
Depth & Width of Spline Groove	Major AQL 1.0%
Part Number Present	Major
Workmanship	Minor

Reference Dwgs.
PY 1578-51A & 54A

Part No.	Description	Number Checked	Number Rejected
22	Board-End-Std	32	0
46	Board-End-Top	8	o

Comments Release to kit makeup

C. WALL BOARD CHECK LIST

Date 10/14/71 By BAR

Sampling will be per MIL STD 105D
Single normal sampling. Major defects use 2.5%, minor defects use 4.0% unless otherwise indicated.

Attribute	Defect Level
Length	Minor
Width	Minor
Location of Spline Grooves	Major AQL 1.0%
Depth & Width of Spline Grooves	Major AQL 1.0%
Location of Tie Slots	Major AQL 1.0%
Depth & Width of Tie Slots	Major AQL 1.0%
Presence of Radius at Bottom of Tie Slot	Major AQL 1.0%
Part Number Present	Major
Workmanship	Minor

Reference Dwgs.
PY 1578-51A & 54A

Part No.	Description	Number Checked	Number Rejected
8 L&R	Board-Wall-Full-End	12	0
9	Board-Wall-Full-Std	20	0
42	Board-Wall-Full-Std Top	5	0
43 L&R	Board-Wall-Top End	2	0
11 L&R	Board-Wall-Wing	26	0
44 L&R	Board-Wall-Wing Top	10	0
14 L&R	Board-Wall-Half End	12	12*
45 L&R	Board-Wall-Half End Top	4	4*
50 L&R	Tapered Wing Wall Board	10	0

Comments OK for kit makeup BAR

*The tie slots were in wrong place. These boards scrapped and produced over. The second boards were all OK & released for kit makeup.

D. SPLINE CHECK LIST

Date 14 Oct. 72 By BAR

Sampling will be per MIL STD 105D
Single normal sampling. Major defects use 2.5% minor defects use 4.0% unless otherwise indicated.

Attribute	Defect Level
Length	Minor
Width	Major
Height	Major
Tie Groove Present	Major AQL 1.0%
Depth & Width Tie Groove	Major AQL 1.0%
Part Number Present	Major
Workmanship	Minor

Reference Dwgs.
PY 1578-51A & 54A

Part No.	Description	Number Checked	Number Rejected
25	Spline-Corner Vert-Wall Horiz.	- 50	- 0
27	Spline-Bottom (Floor)	- 20	- 0
30	Spline-End-Horizontal	- 32	- 0
32	Spline-Wall-Vertical	- 20	- 0
48	Spline-Wall-Vertical 1/2	- 5	- 0

Comments Released to kit make-up

V. TIES CHECK LIST

Date 10/20/71 By BAR, AJP

This section deals with the necessary checks for the wall ties. Drawings of the ties are in Appendix A labeled Dwg. PY 1578-41D.

Sampling will be per Mil Std 105D. Single normal sample, major defects use AQL 2.5%, minor defects use AQL 4.0% unless otherwise indicated.

Attribute	Defect Level
Dimensions	
Width	Minor
Length of Tie	Major AQL 1.0%
Length of Lap	Major
Sewing	
Pattern Correct	Major AQL 1.0%
Workmanship	Major
Part Number Present	Major

Reference Dwg.	Description	Number Checked	Number Rejected
PY 1578-41D	86" Tie	80	OK
PY 1578-41D	70" Tie	135	10*

Tie Strength

Sampling will be MIL STD 105D level S-2, specimens tested to failure.

Number tested 4 Average Test Result of Strength 1300

Number Rejected 0 Result (accept, reject) Accept

Disposition _____ Comments *100% inspected for length since sample showed a problem

Note: If purchased already fabricated, see Page 5 for incoming inspection check.

VI. KIT & ASSEMBLY CHECK

Date 10/21/71 By BAR, AJP

Kit Check

This section deals with the necessary checks of the unitized kit prior to packaging for shipment. The intent is to assure that the parts list, instructions, and all necessary items are present. A check will be made of each pallet.

Attribute	Defect Level
Parts List Present	Critical 100% inspection
Assembly Instructions Present	Critical 100% inspection
All Parts Present	Critical 100% inspection

Number of Pallets Checked 6
Number of Defects Checked 0

Comments OK to ship

Assembly Check

Random parts of floor boards, wall boards, splines, and ties will be selected and a partial assembly made to check the spline, spline groove fit, the tie fit in the tie slots, etc.

Number of Boards Selected 6
Number of Ties Selected 4
Number of Splines Selected 8
Results (pass, fail) OK

Comments

VII. FINAL INSPECTION

Date 10/21/71 By BAR

This section deals with the checks on the packaged kits ready to ship. Sampling will be 100% and a check made for proper packaging, proper labeling.

Packaging

Proper Materials ok OK
Workmanship ok OK

Labeling

Manufacturer Lot Number D-18-1 OK
Contract Number OK
Address Right OK
Weight & Volume Present OK
Identification as to type of wall OK

Number of Pallets Checked 6
Number of Pallets Rejected 0

Comments OK to ship

VIII. NON-CONFORMING MATERIAL

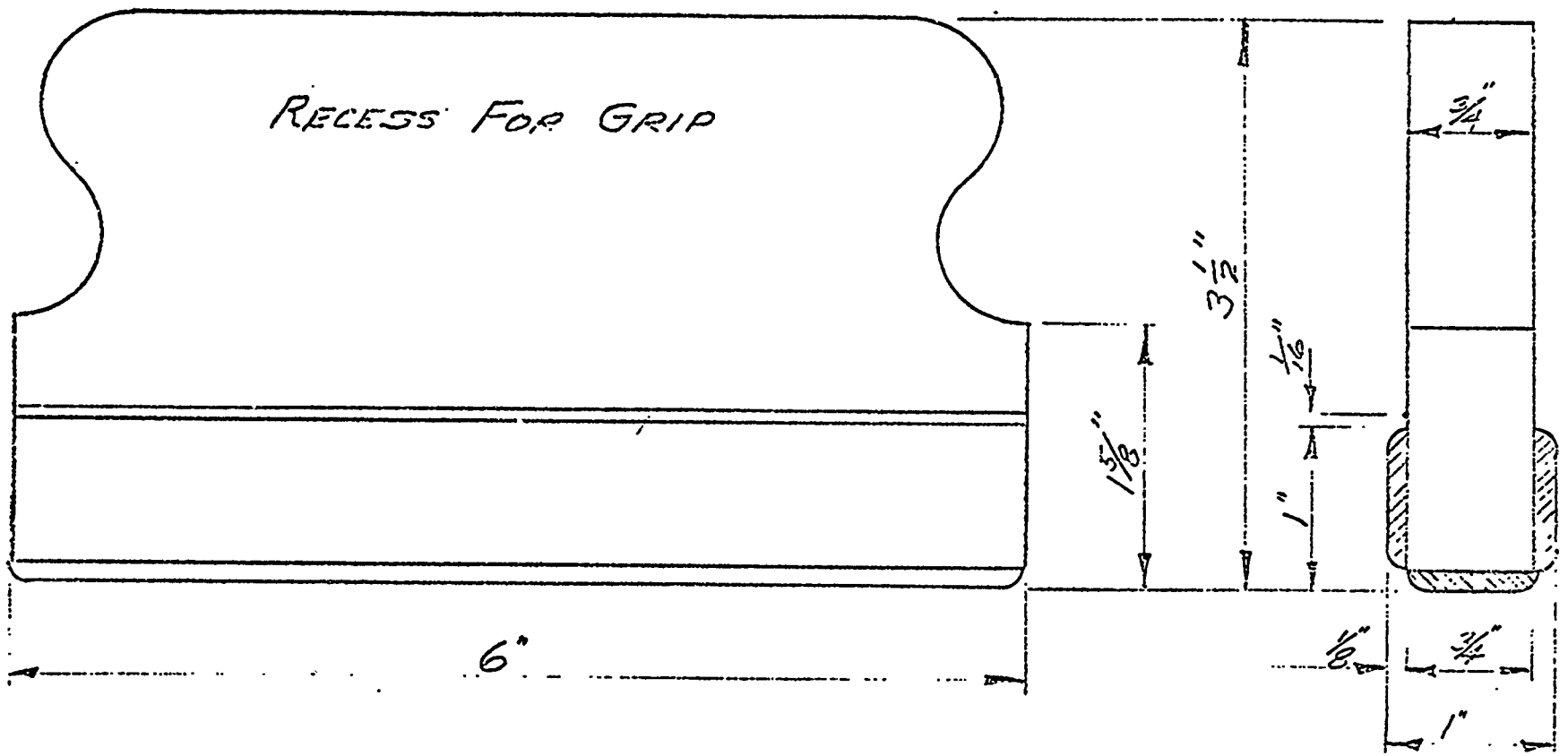
Non-conforming material generated during the program will be placed in quarantine and labeled with red tag until such time as a review can be held to decide on rework, scrap, or other disposition.

APPENDIX A

Gauge & Test Fixture Drawings

Drawings Engineering & Associated Lists

Assembly Drawings & Illustrations



1. MAT'L - WHITE PINE WITH CROSS-HATCHED AREA-HARDWOOD
2. RADIUS ALL CORNERS

CONTRACT NUMBER DASA01-71-C-0018

SIGNED BY	DATE
DRAWN BY [illegible]	DATE 2-1-71
CHECKED BY	DATE
APPROVED BY	DATE

THE DOW CHEMICAL COMPANY

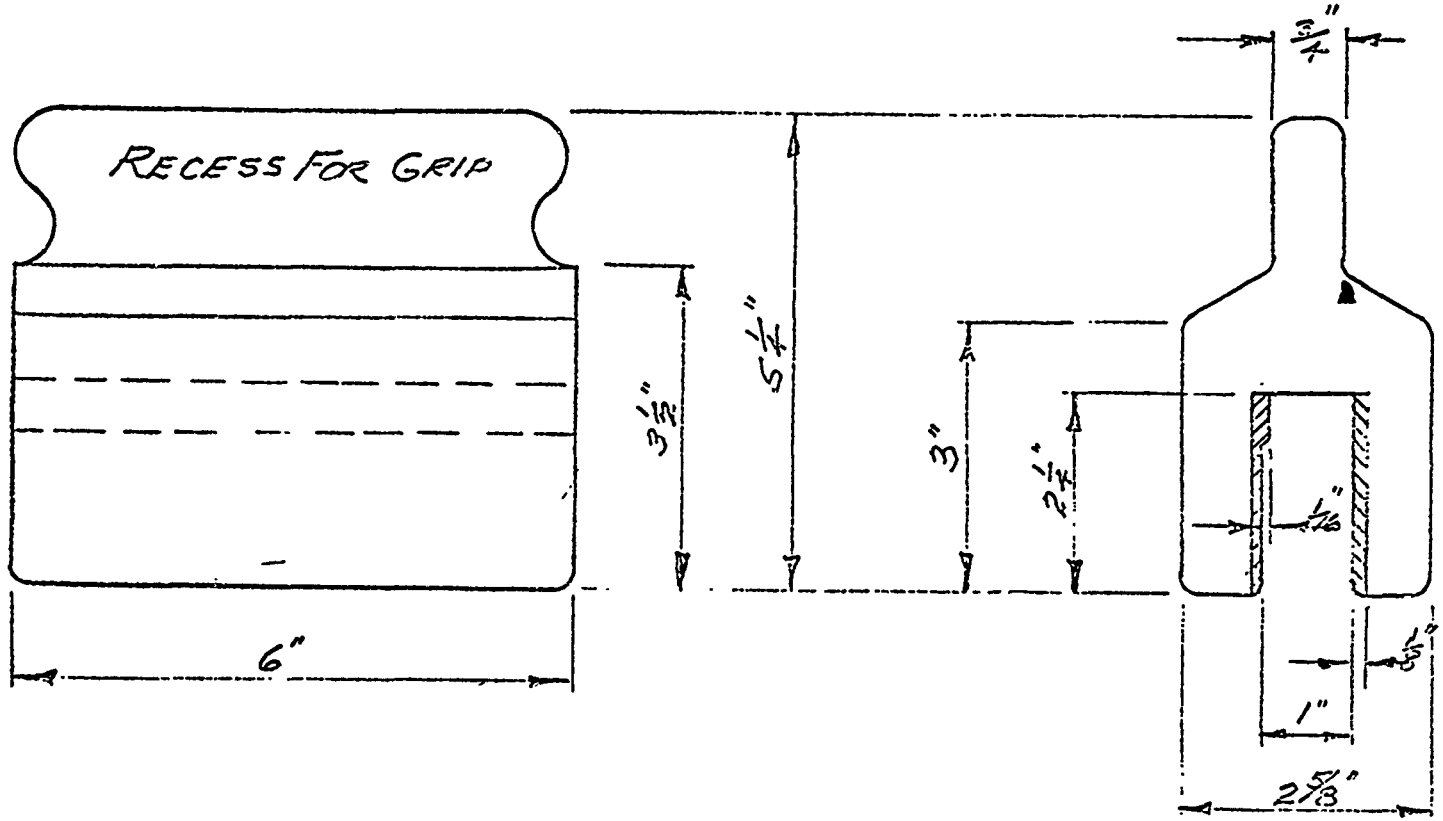
MIDLAND MICHIGAN

GROOVE DEPTH AND WIDTH GAGE

ACCOUNT NUMBER 1041-600

JOB NUMBER PY1573

DRAWING NUMBER PY1573-101D



1. MAT'L - WHITE PINE . WITH CROSS HATCHED AREA - HARDWOOD
2. RADIUS ALL CORNERS

CONTRACT NUMBER DASA01-71-C-0018

SIGNED BY	DATE
DRAWN BY	DATE 9/4/71
CHECKED BY	DATE
APPROVED BY	DATE

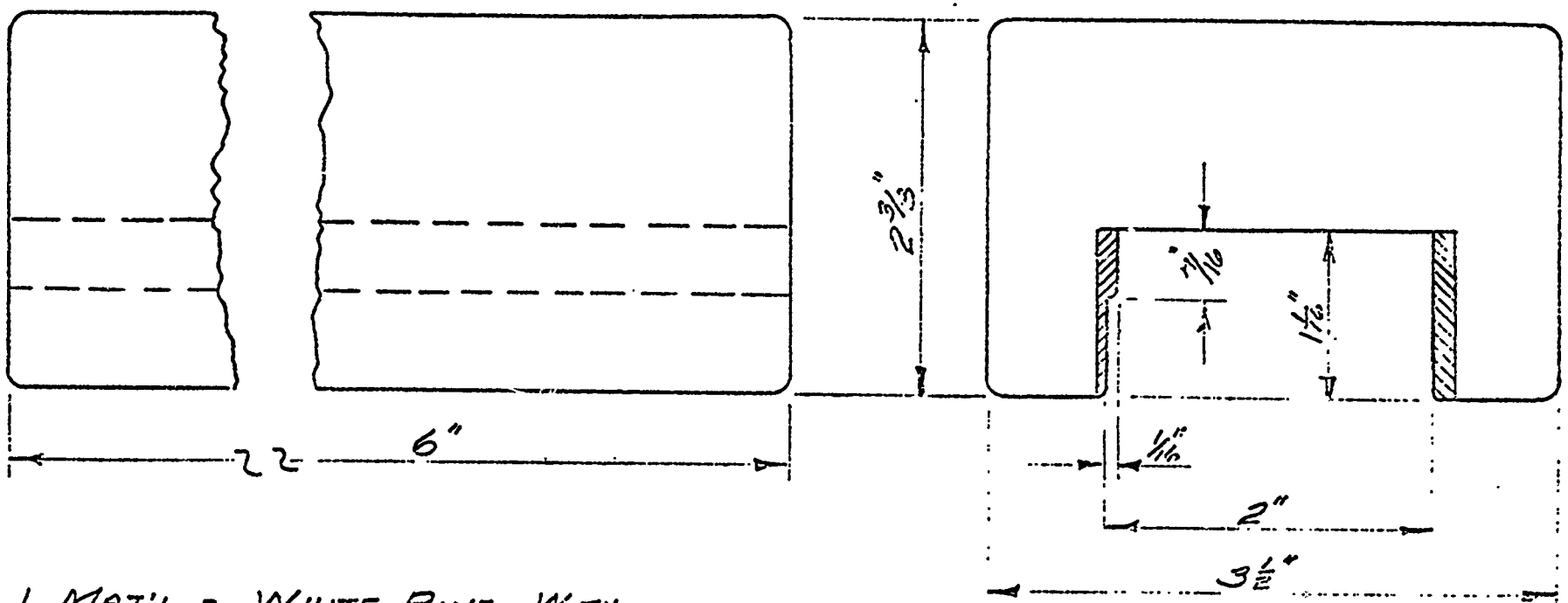
THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

SPLINE THICKNESS & GROOVE LOCATION GAGE

ACCOUNT NUMBER 1841-600

JOB NUMBER PY1318

DRAWING NUMBER PY1318-102D

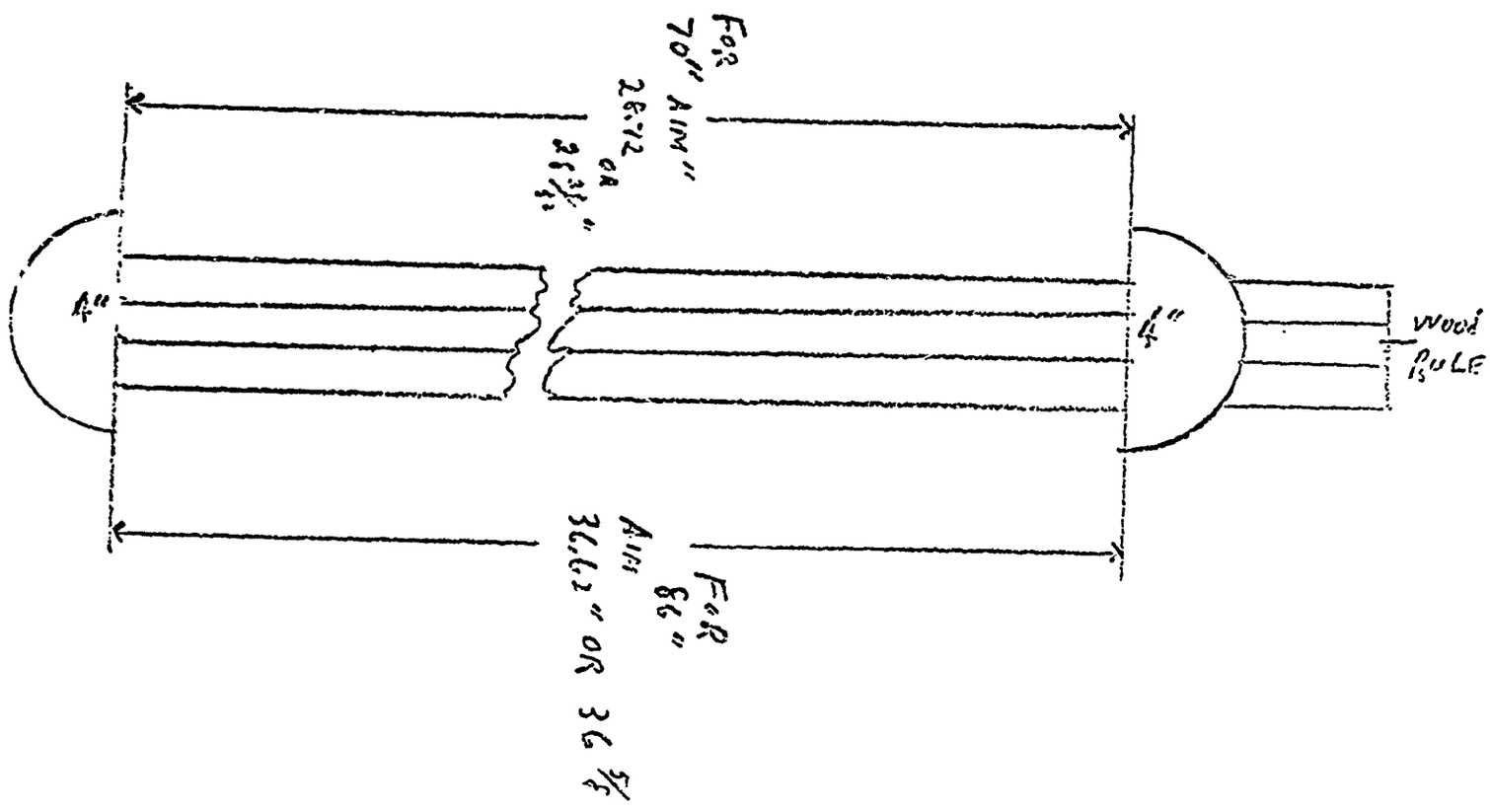


1. MAT'L - WHITE PINE WITH CROSS-HATCHED AREA TO BE HARDWOOD
2. RADIUS ALL CORNERS
3.

CONTRACT NUMBER DASA01-71-C-0018

DESIGNED BY	DATE	
DRAWN BY	DATE	THE DOW CHEMICAL COMPANY MIDLAND MICHIGAN
CHECKED BY	DATE	SPLINE WIDTH GAGE
APPROVED BY	DATE	

ACCOUNT NUMBER 1841-600
JOB NUMBER PY1578
DRAWING NUMBER PY1578-103D



CONTRACT NUMBER DASA01-71-C-0018

DESIGNED BY		DATE
DRAWN BY	R.F	DATE 7/22/71
CHECKED BY		DATE
APPROVED BY		DATE

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

WALL TIE CHECKER

ACCOUNT NUMBER

JOB NUMBER PY 1572

DRAWING NUMBER PY 1572-104D

Magazine Barrier System Layout. Drawing Nr. PY-1578-55A - See Appendix C, Page Nr. 108.

Details and Assembly of Barrier System Center Wall - 3" Thick Foam. Drawing Nr. PY-1578-51A - See Appendix C, Page Nr. 110.

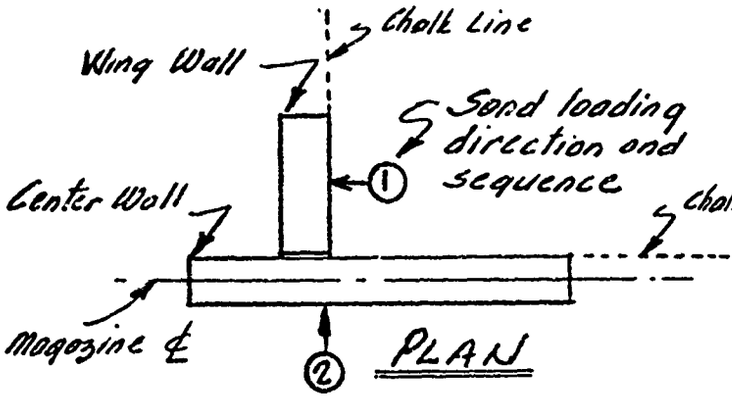
Details and Assembly of Barrier System Wing Wall - 3" Thick Foam. Drawing Nr. PY-1578-54A - See Appendix C, Page Nr. 111.

BARRIER SYSTEM ASSEMBLY AND SAND LOADING PROCEDURE

A.J.P. Oct. 8, 1971

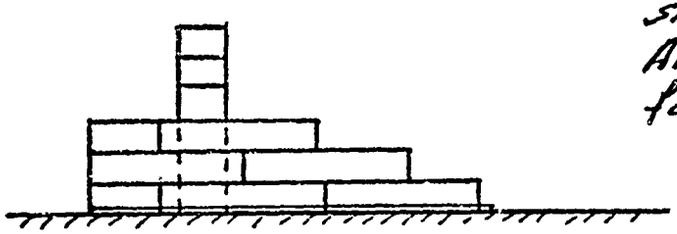
DWG. No. PY1578-56D

Contract No. DASA01-71-C-0018



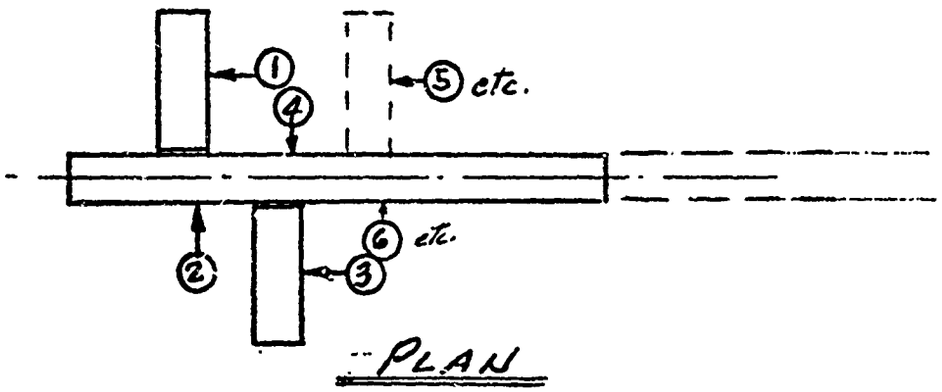
PLAN

NOTE: Wing Wall assembly and sand loading is to precede center wall assembly to assist in establishing a plumb and snug fit between walls. Alternate ① and ② until full height is reached.

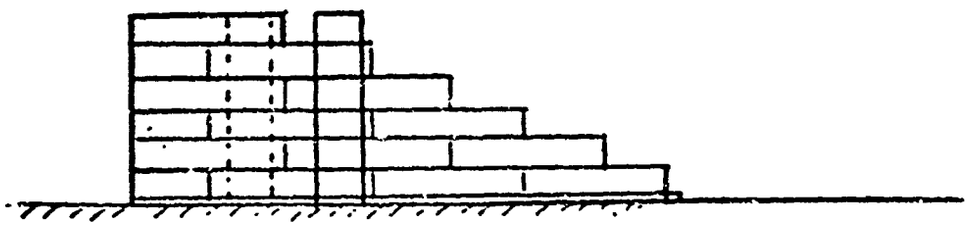


ELEVATION

INITIAL ASSEMBLY PROCEDURE



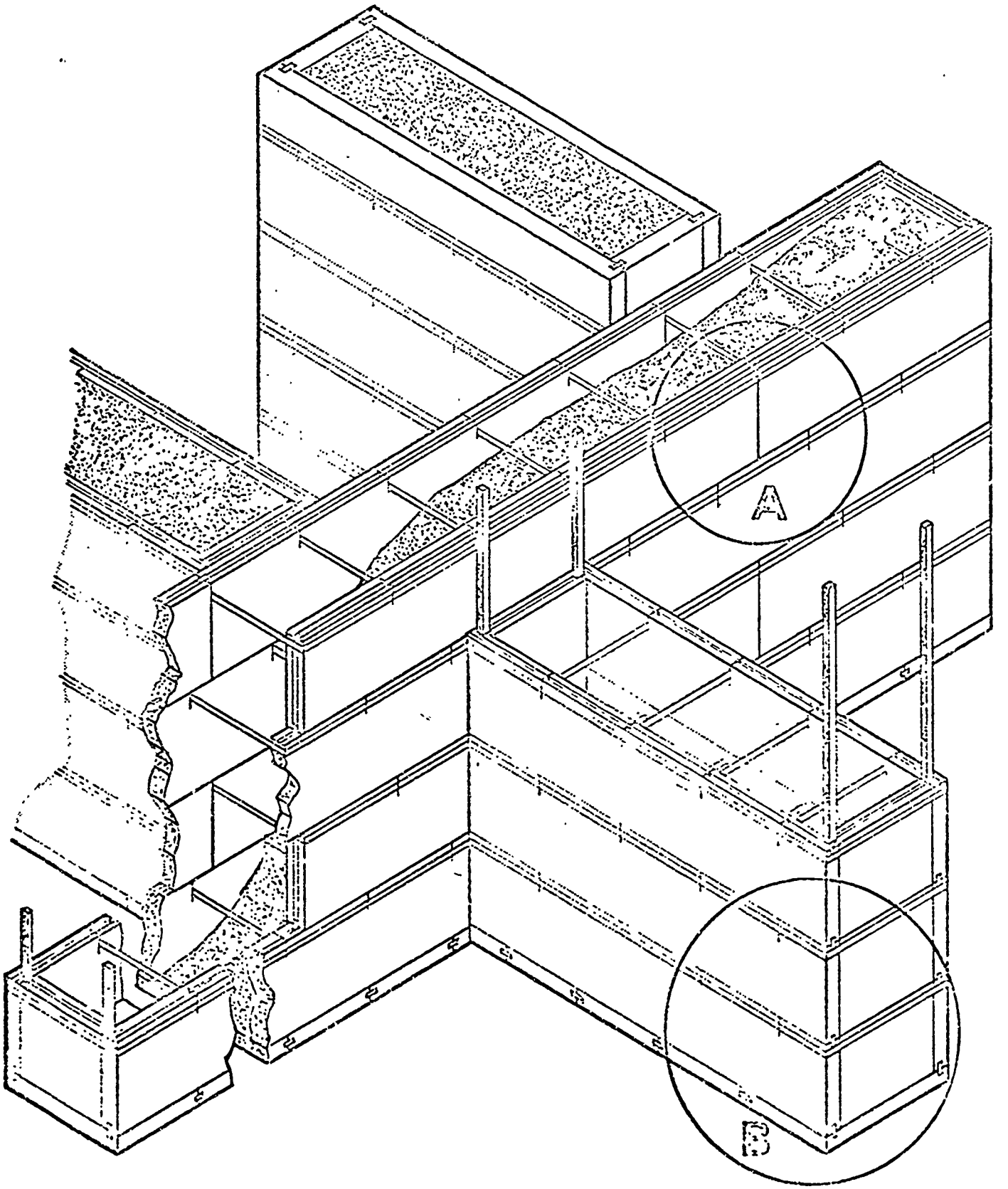
PLAN



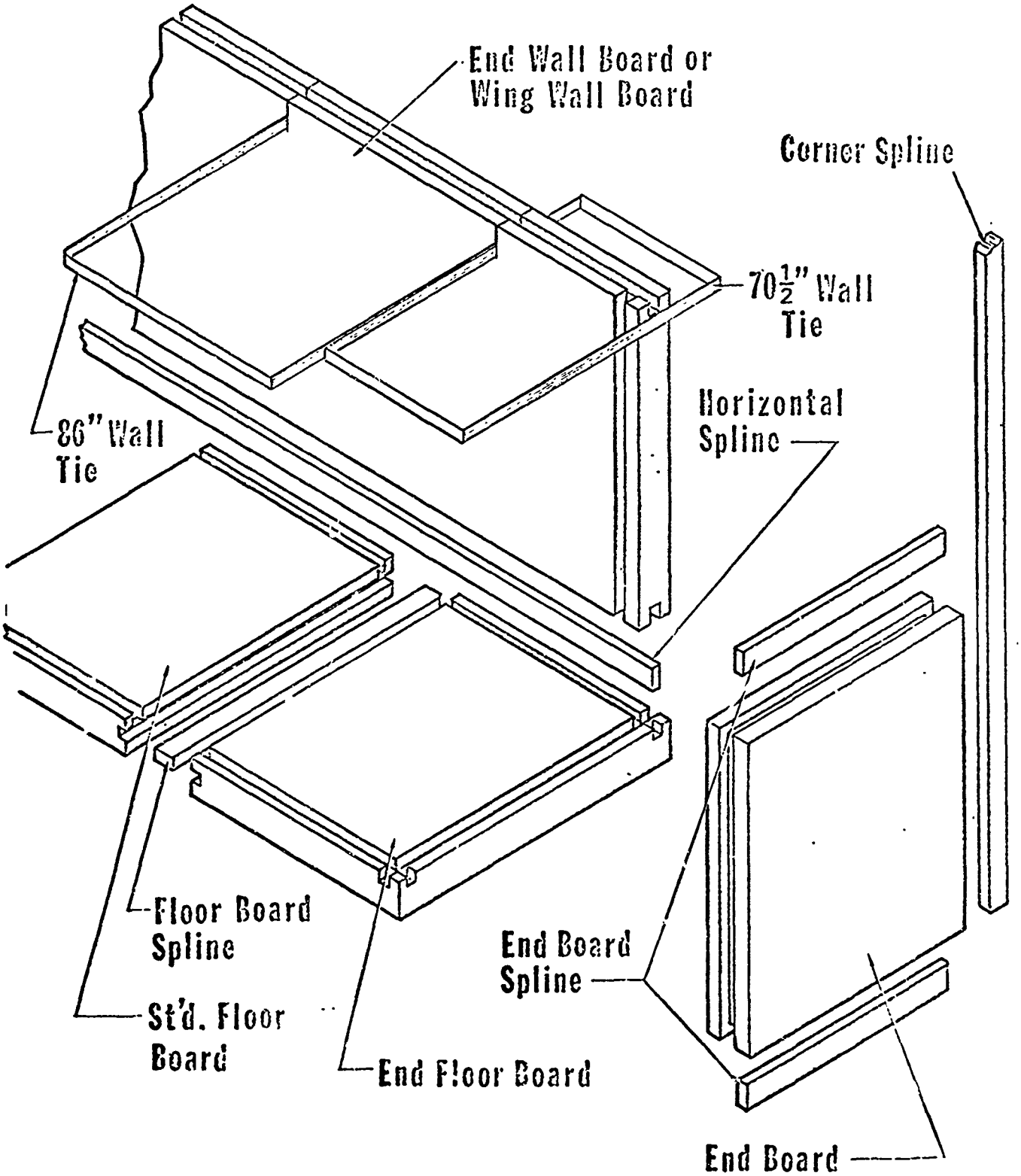
ELEVATION

CONTINUING ASSEMBLY PROCEDURE

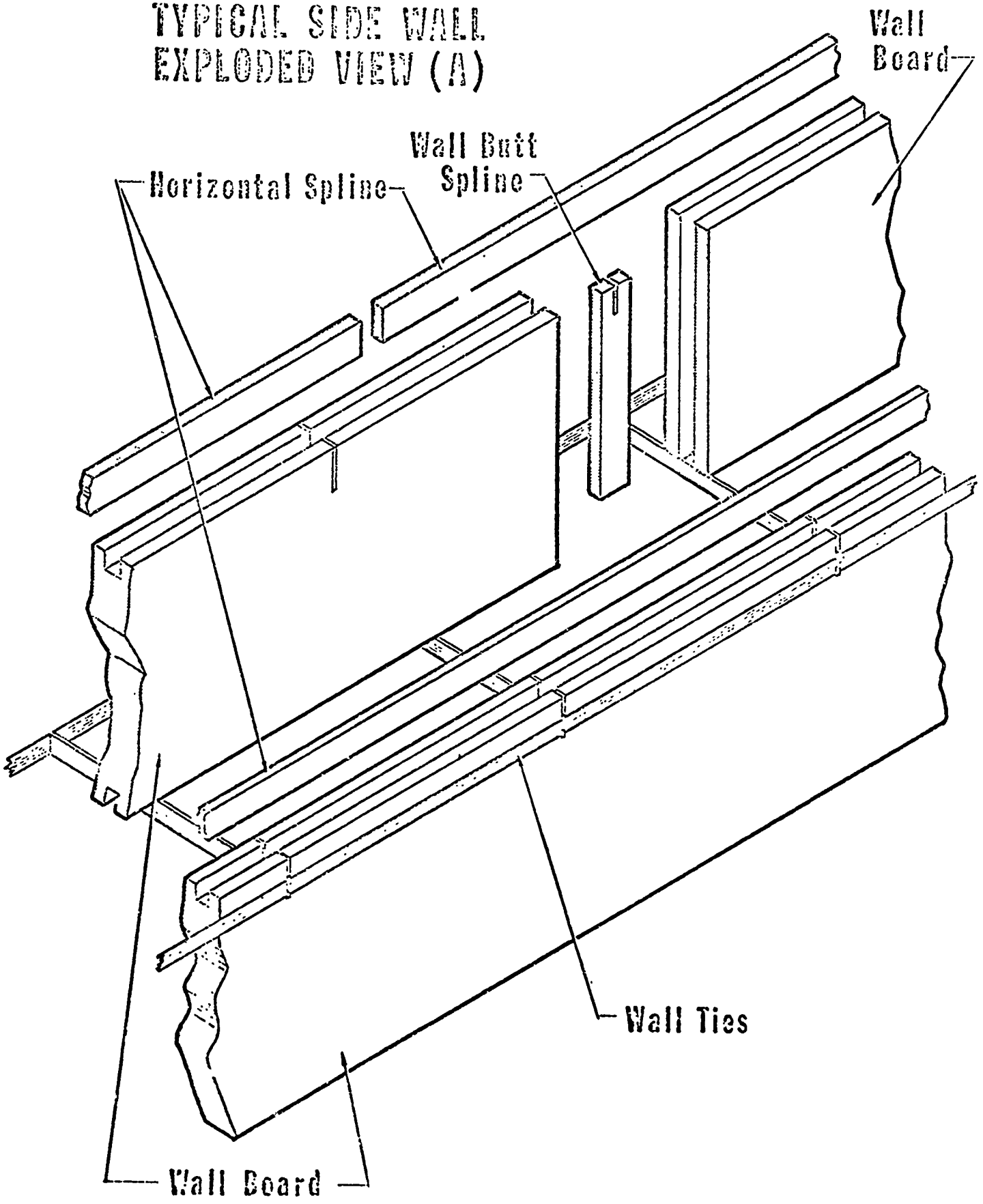
TYPICAL COMPARTMENTED MAGAZINE SECTION



TYPICAL WALL SECTION-EXPLODED VIEW (B)



TYPICAL SIDE WALL EXPLODED VIEW (A)



APPENDIX B

THE ASSEMBLY INSTRUCTIONS FOR NAD, EARLE

ASSEMBLY PACKAGE INCLUDES

Assembly Instructions

Packing list - total

Packing list - Pallet 1

Packing list - Pallet 2

Packing list - Pallet 3, 4, 5, & 6

Drawing PY 1578-55A - System Layout

Drawing PY 157 56D - Assembly Sequence

Drawings PY 1578-51A & 54A - Details

Fig. 15, 16, & 17 Exploded Views

Drawings PY 1578-39D & 40D - Repairs

ASSEMBLY INSTRUCTIONS -

PROTECTIVE BARRIER SYSTEM

Step 1 - Get Tools Needed

-Saw
-Measuring tape up to 80'
-Level
-Chalk line & chalk
-Sand - 76 Cubic Yards
-Warehouse Knife
-Sand handling equipment - such as front end loader
-Broom and shovel for clean up
-Glass Filament tape - (Scotch brand good)

Step 2 - Unpack Protective Barrier Kit

-Check pallets, 6 total - No. 1 & 2 contain center wall, No. 3, 4, 5, & 6 contain wing walls
-Remove overwrap and discard
-Remove instructions, parts lists, and drawings
-Check components against parts list for completeness
-Any missing or damaged parts should be noted and supplier notified at once.

Step 3 - Magazine Layout - See Drawing PY 1578-55A for layout sketch.

-With measuring tape, locate magazine center line and chalk. Draw chalk line 14" each side of center line to locate center wall.
-Locate and chalk position of each wing wall.

Step 4 - Erection Sequence - See Drawing PY 1578-56D

If the entire center wall is constructed and filled with sand, it will bulge slightly at the bottom. This would prevent the wing walls from laying flush with the center wall where they meet. To prevent this, the barrier system will be erected in a stepwise sequence starting with a short length of center wall, adding the wing walls and sand as the erection proceeds from the interior end toward the door end.

Where the wing walls & center walls meet, the wing wall height should be kept above the center wall during erection. This will allow use of the end of the wing wall to keep the center wall plumb and flush.

Step 5 - Erection of Barrier - Begin erection with center wall - See drawing PY 1578-51A details for center wall, Fig. 15, 16, 17 General & Exploded Views.

-Start at interior end with bottom end board and bottom spline from pallet No. 1. Continue for 15 boards. Use chalk line to keep wall straight. Place wall spline (72") in position as you go.

-Start adding wall boards from interior end. Using the end spline, place end board in place. At the same time, place left and right (80") end wall boards in place. Continue placing standard wall boards and butt joint splines in place to end of floor boards.

Caution: Slot in butt spline must be at top. Then add vertical corner spline (72") at both corners.

-As first course of wall boards continues, start placing wall ties in place. See Fig. 1

Note: Ties go to bottom of slot below the horizontal wall splines.

-When all ties are installed, add wall splines above them and start the second course back at far end.

-The next course starts with left and right half length (40") boards and then continues with regular boards. This is done to stagger vertical joints in the wall.

Caution: Vertical joints must be in line with opposite side on each course or the ties will not fit.

-Continue as above for five courses, then add the special course of top boards.

-Double check butt joints for a good fit. A gap in one joint will be duplicated in courses laid above.

Step 6 - Erection of Wing Walls

See Drawing PY 1578-54A detail wing wall Fig. 1, 2, & 3 General and Exploded Views.

-Double check wing wall(s) location and commence as before with bottom boards first, next add wall splines. The first wing wall side boards are specially cut to match the floor slope and thus level the wall (see Dwg. PY 1578-54A). The vertical splines and end boards may be added next before the wall ties are installed.

Note: The short ties end of the wall will be away from the center wall.

-After the ties are in place, the regular left and right wall boards can be installed along with the end boards.

-Continue adding regular boards for four more courses then add the specially cut top boards to bring the overall height to 91" at the center wall.

-This procedure is followed for the rest of the wing walls.

Step 7 - Addition of Sand

For ease and convenience, it is recommended that sand be added as the wall erection proceeds. Mechanical equipment such as a front end loader has proven fast and effective. When the center wall is 32" in height, (two boards) fill the space with sand. Follow this procedure until the wall is full. The loader can operate on one side or the other of the center wall as erection proceeds forward.

Note: Use level to check and straighten a wall. Sand can exert off center loads and cause wall to lean.

Use same procedure for each wing wall. It is important to keep the level of sand nearly the same in the center and adjacent wing wall during filling to prevent a gap where they meet.

Step 8 - Continue the barrier, as described above, by extending the center wall, adding wing walls, and sand until the barrier is complete.

Note: The last bottom board before the bottom end board may have to be field cut to adjust total length of the center wall. Also, the last horizontal wall splines will extend beyond the end of the center wall. Cut them off flush with the end of the wall.

Step 9 - Damage Repair

See Drawings PY 1578-39D & PY 1578-40D, wall repair.

During erection, damage may occur to the walls. Holes in the foam boards may be repaired as shown in the Drawings mentioned above. Broken boards may be replaced from the spare parts that were included with the barrier kit.

Step 10 - Clean up sand from the magazine floor and check walls for sand leaks. Superficial leaks from joints may be plugged by using a small piece of foam.

Step 11 - Store Spare Parts

After the complete Barrier System is installed, there will be spare parts. It is recommended that these parts be stored on top of the barrier walls for later use in repairs.

The assembly instructions should be retained for future use such as dismantling and reassembling the wall when desired.

PACKING LIST

CONTRACT DASA01-71-C-0018 P00001

	Center Wall Kit		16 Wing Walls				
Part No.	Total Pallet 1	Total Pallet 2	Total Pallet 3	Total Pallet 4	Total Pallet 5	Total Pallet 6	Grand Total
8L	2	4	-	-	-	-	6
8R	2	4	-	-	-	-	6
11L	-	-	16	16	16	16	64
11R	-	-	16	16	16	16	64
9	50	50	-	-	-	-	100
42	10	10	-	-	-	-	20
43L	2	0	-	-	-	-	2
43R	2	0	-	-	-	-	2
14L	3	3	-	-	-	-	6
14R	3	3	-	-	-	-	6
45L	0	2	-	-	-	-	2
45R	0	2	-	-	-	-	2
22	7	8	40	40	40	40	175
46	1	2	8	8	8	8	35
16	30	26	12	12	12	12	104
17	2	2	4	4	4	4	20
18	-	-	4	4	4	4	16
25	80	80	64	64	64	64	416
27	30	23	16	16	16	16	117
30	6	6	48	48	48	48	204
32	55	55	-	-	-	-	110
48	12	13	-	-	-	-	25
50L	-	-	4	4	4	4	16
50R	-	-	4	4	4	4	16
44L	-	-	4	4	4	4	16
44R	-	-	4	4	4	4	16
53	0	2	-	-	-	-	2
Ties 86"	162	163	96	96	96	96	709
Ties 70"	5	5	25	25	25	25	110

CONTRACT DASA01-71-C-0018 P00001

Packing List For Barrier System
Pallet 1-First Half Center Wall

PARTS LIST

Part No.		Total on Pallet
8L	Full End Board - Left Hand	2
8R	Full End Board - Right Hand	2
9	Full Board	50
42	Full Top Board	10
43L	Full Top End Board - Left Hand	2
43R	Full Top End Board - Right Hand	2
14L	Half End Board - Left Hand	3
14R	Half End Board - Right Hand	3
45L	Half Top End Board - Left Hand	0
45R	Half Top End Board - Right Hand	0
22	End Board	7
46	Top End Board	1
16	Floor Board	30
17	Full End Floor Board	2
53	Adjusted Floor Board	0
25	Wall or Corner Spline	80
27	Floor Spline	30
30	End Wall Spline	6
32	Butt Joint Spline	55
48	Top Butt Joint Spline	12
Ties 86"	Loop	162
Ties 70"	Loop	5

CONTRACT DASA01-71-C-0018 P00001

Packing List For Barrier System
Pallet 2-Second Half Center Wall

PARTS LIST

Part No.		Total on Pallet
8L	Full End Board - Left Hand	4
8R	Full End Board - Right Hand	4
9	Full Board	50
42	Full Top Board	10
43L	Full Top End Board - Left Hand	0
43R	Full Top End Board - Right Hand	0
14L	Half End Board - Left Hand	3
14R	Half End Board - Right Hand	3
45L	Half Top End Board - Left Hand	2
45R	Half Top End Board - Right Hand	2
22	End Board	8
46	Top End Board	2
16	Floor Board	26
17	Full End Floor Board	2
53	Adjusted Floor Board	2
25	Wall or Corner Spline	80
27	Floor Spline	23
30	End Wall Spline	6
32	Butt Joint Spline	55
48	Top Butt Joint Spline	13
Ties 86"	Loop	163
Ties 70"	Loop	5

CONTRACT DASA01-71-C-0018 P00001

Packing List For Barrier System
Pallets 3, 4, 5, & 6 With 4 Wing Walls On Each

PART LIST

Part Number		Total For 1 Wing	Total On Each Pallet
11L	Left Side Wing Wall Board	4	16
11R	Right Side Wing Wall Board	4	16
50L	Left Side Tapered Wing Wall Board	1	4
50R	Right Side Tapered Wing Wall Board	1	4
44L	Left Side Top Wall Board	1	4
44R	Right Side Top Wall Board	1	4
16	Floor Board	3	12
18	Half End Floor Board	1	4
17	Full End Floor Board	1	4
22	End Board	10	40
46	Top End Board	2	8
25	Wall or Corner Spline	16	64
30	End Wall Spline	12	48
27	Floor Splines	4	16
Ties	86" Loop	24	96
Tie	70" Loop	6	25

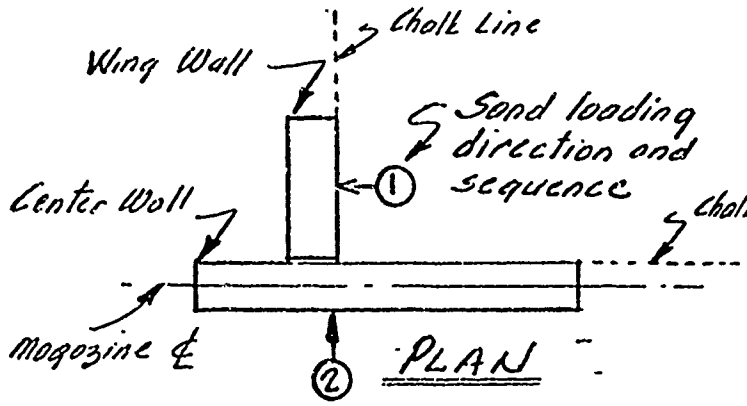
Magazine Barrier System Layout. Drawing Nr. PY-1578-55A - See Appendix C, Page Nr. 108.

BARRIER SYSTEM ASSEMBLY AND SAND LOADING PROCEDURE

A.J.P. Oct. 8, 1971

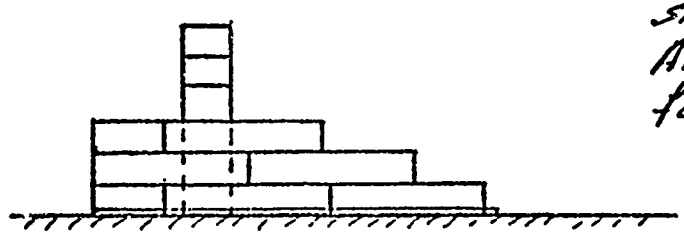
DWG. No. PY1578-56D

Contract No. DASA01-71-C-0016



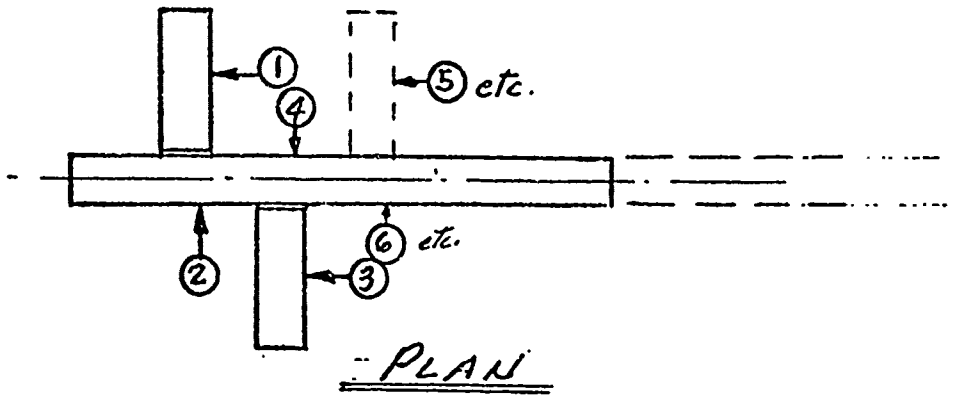
PLAN

NOTE: Wing Wall assembly and sand loading is to precede center wall assembly to assist in establishing a plumb and snug fit between walls. Alternate ① and ② until full height is reached.

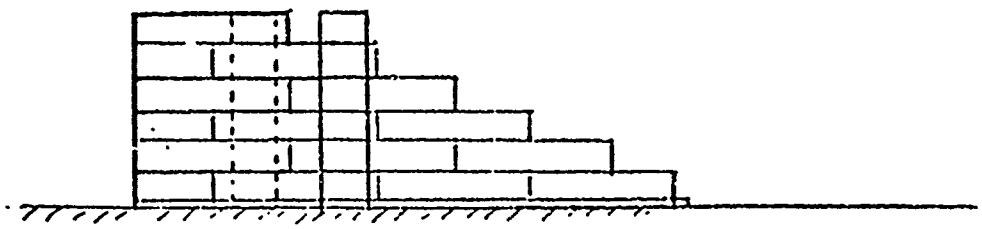


ELEVATION

INITIAL ASSEMBLY PROCEDURE



PLAN



ELEVATION

CONTINUING ASSEMBLY PROCEDURE

Details and Assembly of Barrier System Center Wall - 3" Thick Foam. Drawing Nr. Py-1578-51A - See Appendix C, Page Nr. 110.

Details and Assembly of Barrier System Wing Wall - 3" Thick Foam. Drawing Nr. PY-1578-54A - See Appendix C, Page Nr. 111.

TYPICAL COMPARTMENTED MAGAZINE SECTION

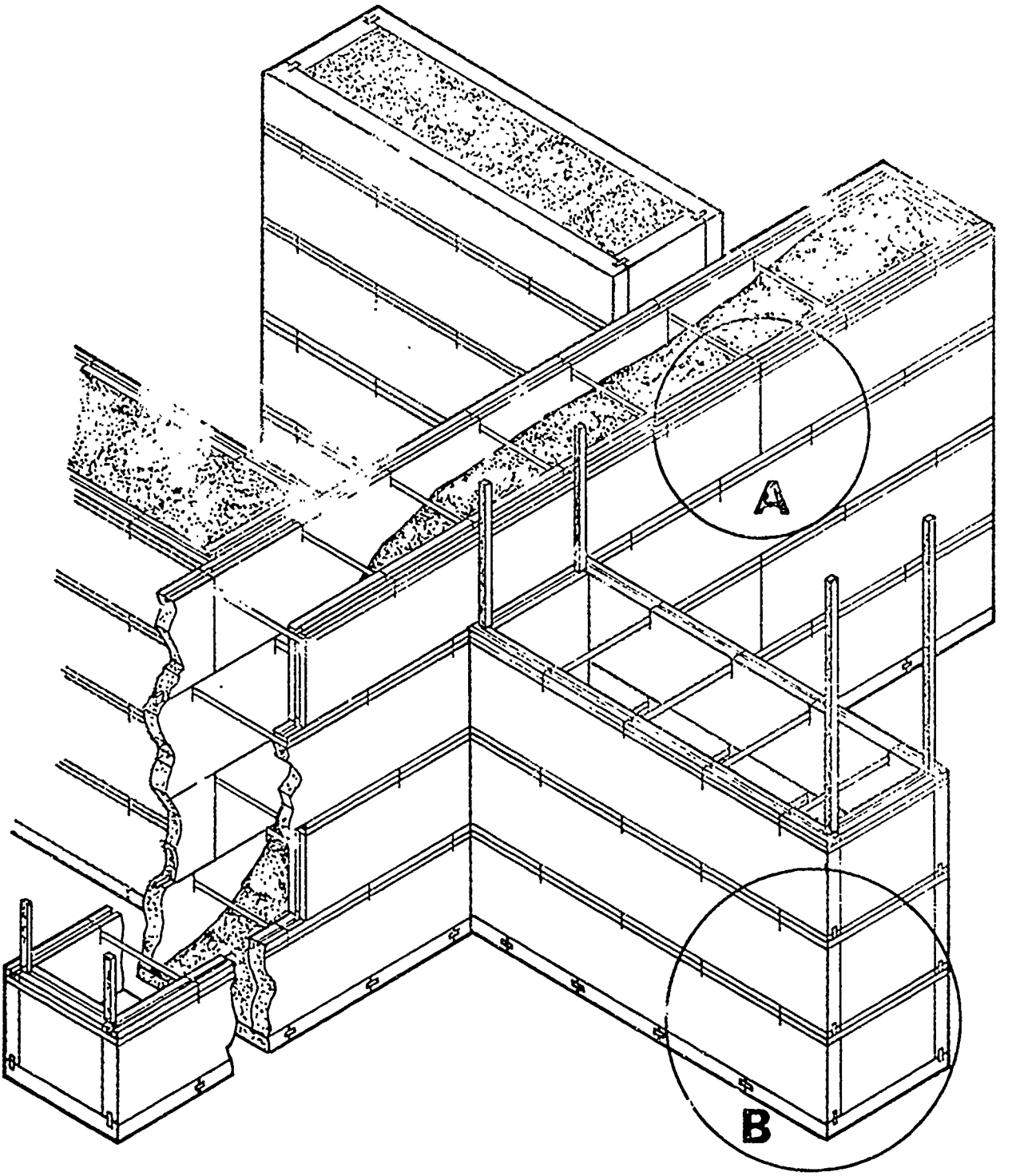


Fig. 1

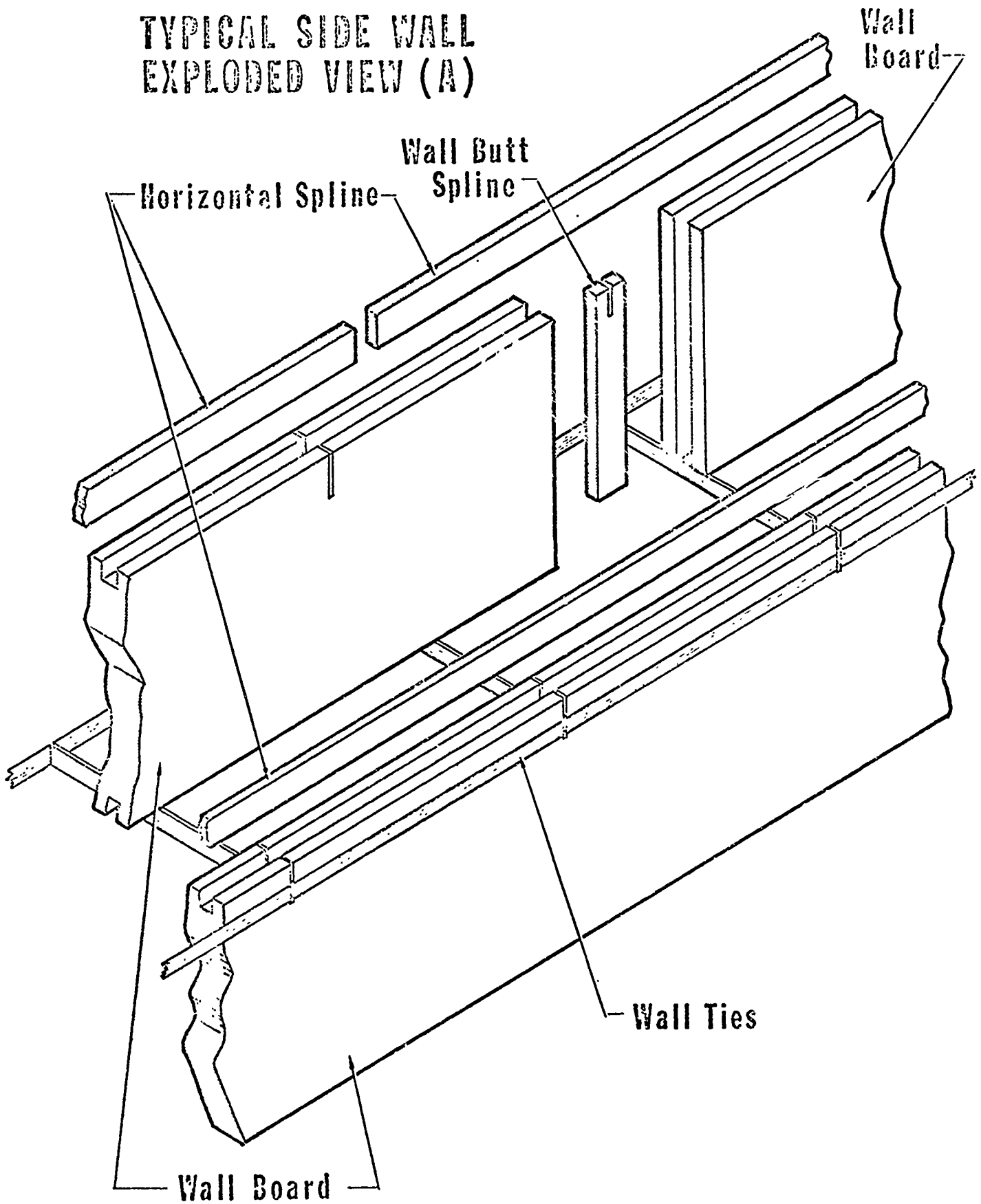

TYPICAL SIDE WALL
EXPLODED VIEW (A)
Wall
Board
Wall Butt
Spline
Horizontal Spline
Wall Ties
Wall Board

Fig. 2

TYPICAL WALL SECTION-EXPLODED VIEW (B)

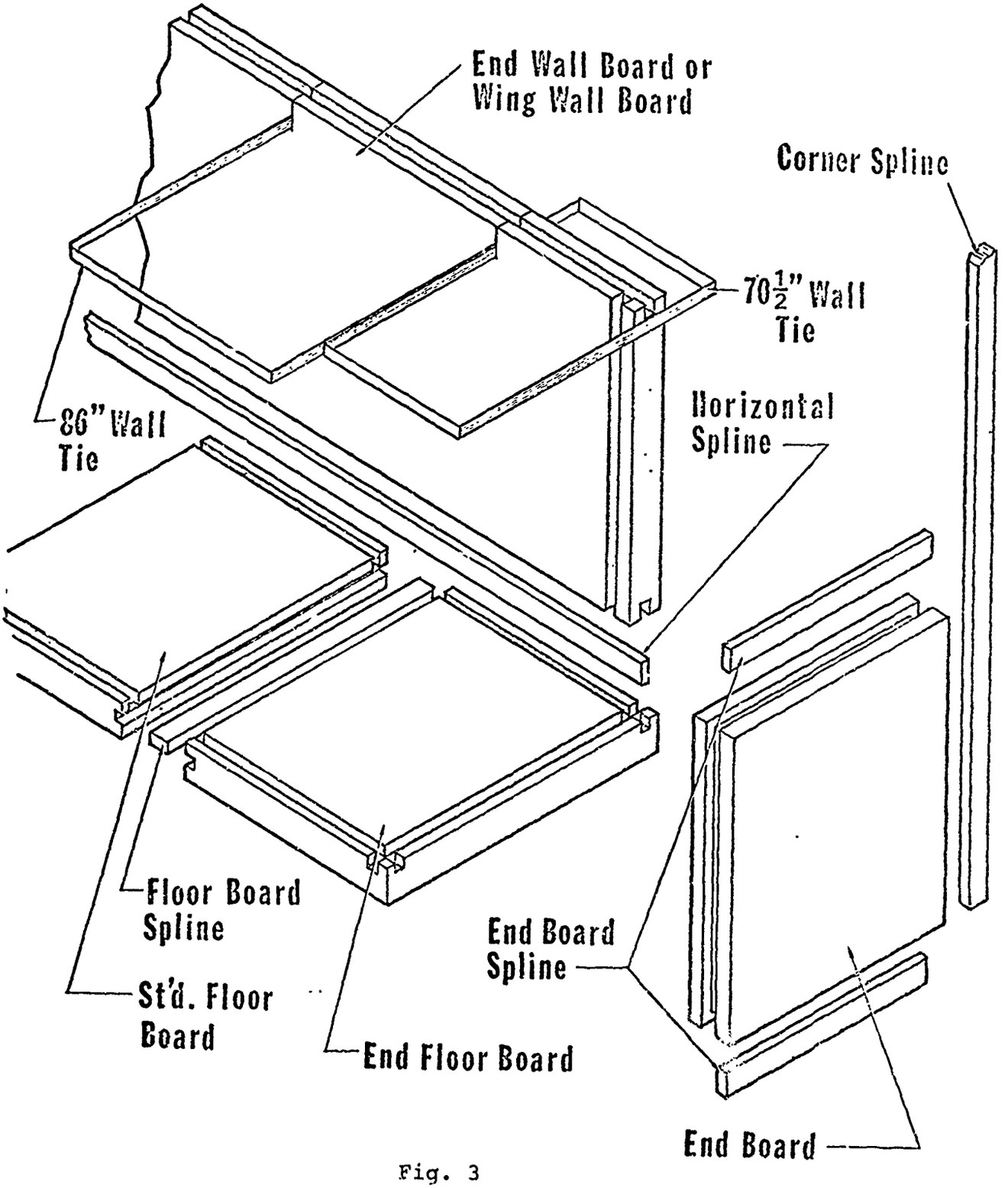
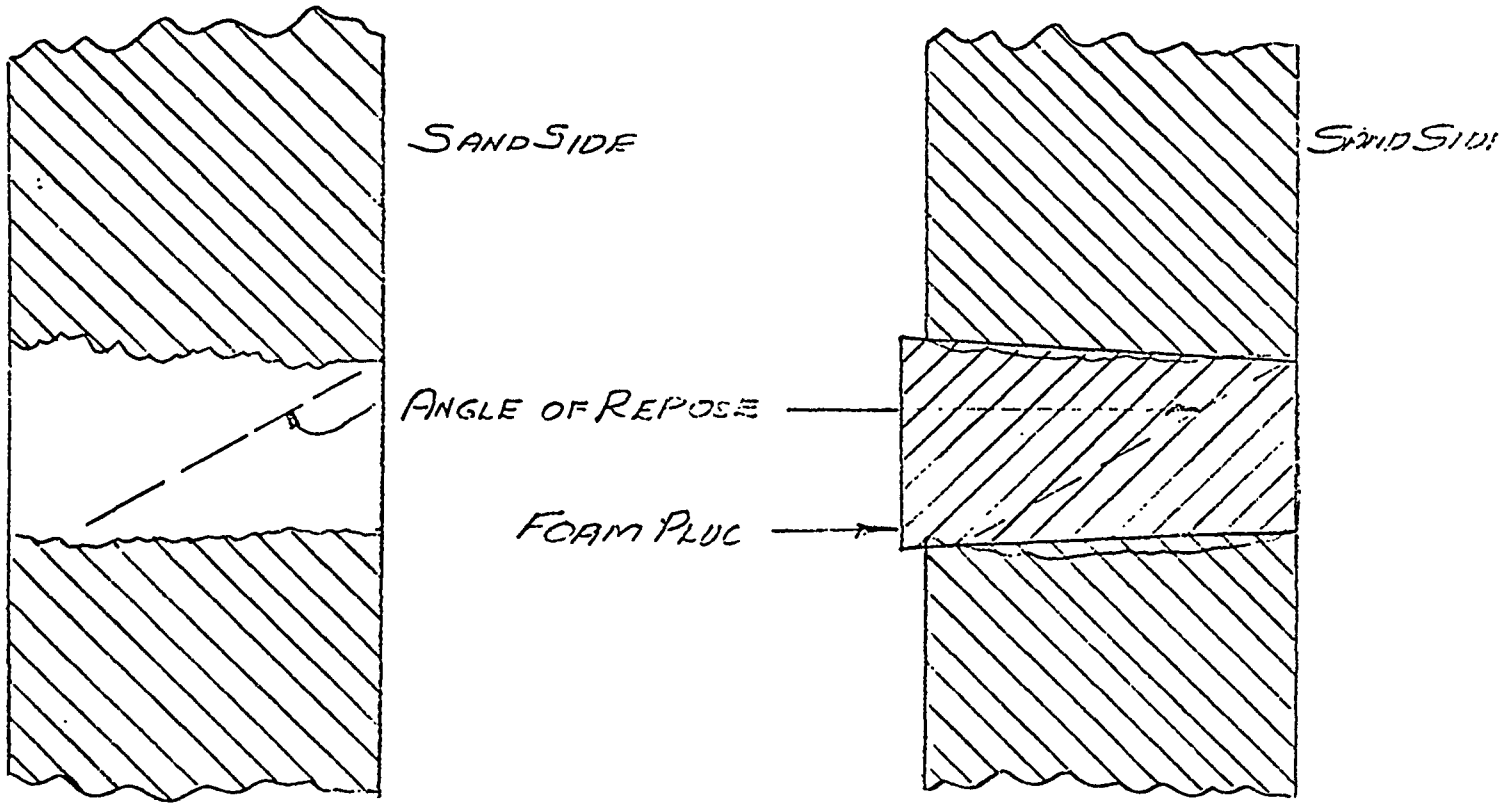


Fig. 3



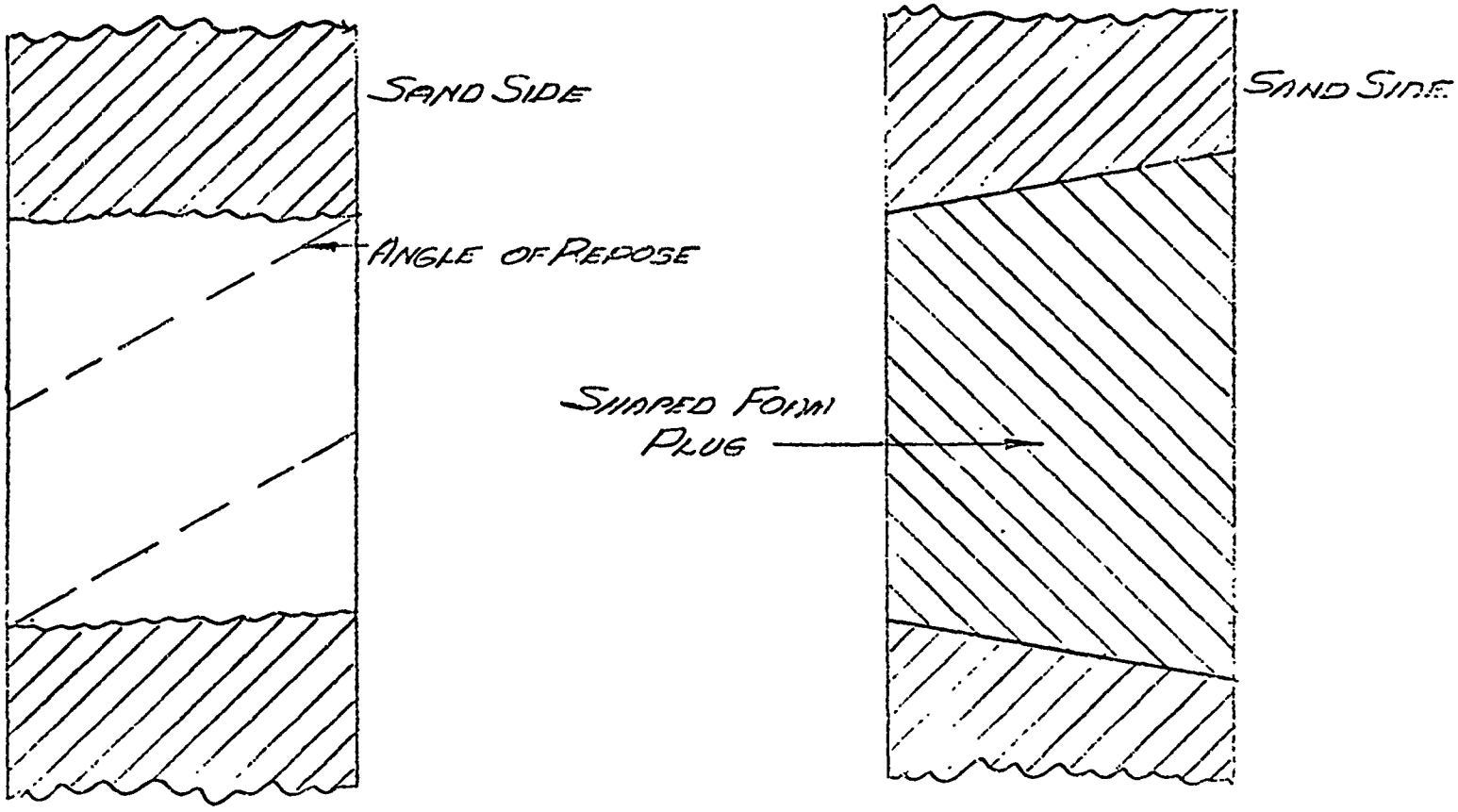
METHOD OF WALL REPAIR
SMALL HOLE WITH PLUG

DESIGNED BY	DATE
DRAWN BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

DETAIL OF
WALL REPAIR

ACCOUNT NUMBER	1841-600
JOB NUMBER	PY1375
DRAWING NUMBER	PY1375-37D



METHOD OF WALL REPAIR
LARGE HOLE - PLUG

DESIGNED BY	DATE
DRAWN BY	DATE
CHECKED BY	DATE
APPROVED BY	DATE

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

ACCOUNT NUMBER

JOB NUMBER

DRAWING NUMBER

APPENDIX C

THE REVISED ASSEMBLY INSTRUCTION PACKAGE

ASSEMBLY PACKAGE INCLUDES

Assembly Instructions

Packing list - total

Packing list - Pallet 1

Packing list - Pallet 2

Packing list - Pallet 3, 4, 5, & 6

Drawing PY 1578-55A - System Layout

Drawing PY 1578-56D - Assembly Sequence

Drawings PY 1578-51A & 54A - Details

Fig. 15, 16, & 17 Exploded Views

Drawings PY 1578-39D & 40D - Repairs

ASSEMBLY INSTRUCTIONS - PROTECTIVE BARRIER SYSTEM

Step 1 - Get Tools Needed

-Saw
-Measuring tape up to 80'
-Level
-Chalk line & chalk
-Sand - 76 Cubic Yards
-Warehouse Knife
-Sand handling equipment - such as front end loader
-Broom and shovel for clean up
-Glass Filament tape - (Scotch brand good)
-Step ladder
-Front Load Generator - lights and ventilating fans

Step 2 - Unpack Protective Barrier Kit

-Check pallets, Center wall and wing walls, are packaged separately
-Remove overwrap and discard
-Remove instructions, parts lists, and drawings
-Check components against parts list for completeness
-Any missing or damaged parts should be noted and supplier notified at once.

Step 3 - Magazine Layout - See Drawing PY 1578-55A for typical layout sketch. Spacing of wing walls may be varied as desired.

-With measuring tape, locate magazine center line and chalk. Draw chalk line 14" each side of center line to locate center wall.

-Locate and chalk position of each wing wall.

Step 4 - Erection Sequence Using a Loader - See Drawing PY 1578-56D

If the entire center wall is constructed and filled with sand, it may bulge slightly at the bottom. This could prevent the wing walls from laying flush with the center wall where they meet. To prevent this, the barrier system will be erected in a stepwise sequence starting with a short length of center wall, adding the wing walls and sand as the erection proceeds from the interior end toward the door end.

Where the wing walls & center walls meet, the wing wall height should be kept above the center wall during erection. This will allow use of the end of the wing wall to keep the center wall plumb and flush.

Step 5 - Erection of Barrier - Begin erection with center wall - See Drawing PY 1578-51A details for center wall, Figure 15, 16, 17 General & Exploded Views.

-Start at interior end with bottom end board and bottom spline from pallet No. 1. Continue for 15 boards. Use chalk line to keep wall straight. Place wall spline (72") in position as you go.

-Start adding wall boards from interior end. Using the end spline, place end board in place. At the same time, place left and right (80") end wall boards in place Continue placing standard wall boards and butt joint splines in place to end of floor boards.

Caution: Slot in butt spline must be at top. Then add vertical corner spline (72") at both corners.

-As first course of wall boards continues, start placing wall ties in place. See Figure 2, page 113.

Note: Ties go to bottom of slot below the horizontal wall splines.

-When all ties are installed, add wall splines above them and start the second course back at far end.

-The next course starts with left and right half length (40") boards and then continues with regular boards. This is done to stagger vertical joints in the wall.

Caution: Vertical joints must be in line with opposite side on each course or the ties will not fit.

-Continue as above for five courses, then add the special course of top boards.

-Double check butt joints for a good fit. A gap in one joint will be duplicated in courses laid above.

Step 6 - Erection of Wing Walls

See Drawing PY 1578-54A detail wing wall Figures 1, 2, & 3
3 General and Exploded Views.

-Double check wing wall(s) location and commence as before with bottom boards first, next add wall splines.

*Caution: The first wing wall side boards are specially cut to match the floor slope and thus level the wall (see Dwg. PY 1578-54A). The vertical splines and end boards may be added next before the wall ties are installed.

*Assign one crew member responsibility for inspecting each assembled wing wall before starting sand addition to be sure the proper wall board is on the bottom, and the short ties end of wall is away from center wall.

Important Note: The short ties end of the wall must be away from the center wall.

-After the ties are in place, the regular left and right wall boards can be installed along with the end boards.

-Continue adding regular boards for four more courses then add the specially cut top boards, if desired, to bring the overall height to 91" at the center wall.

-This procedure is followed for the rest of the wing walls.

ALTERNATE I

Step 7A - Addition of Sand with a Front End Loader

For ease and convenience, it is recommended that sand be added as the wall erection proceeds. Mechanical equipment such as a front end loader has proven effective. When the center wall is up to height, fill the space with sand. The loader can operate on one side or the other of the center wall as erection proceeds forward.

Note: Use level to check and straighten a wall. Sand can exert off center loads and cause wall to lean.

Use same procedure for each wing wall. It is important to keep the level of sand nearly the same in the center and adjacent wing wall during filling to prevent a gap where they meet.

Caution: Adequate ventilation is imperative with a gasoline vehicle to avoid a safety hazard to personnel.

Step 8 - Continue the barrier, as described above, by extending the center wall, adding wing walls, and sand until the barrier is complete.

Note: The last bottom board before the bottom end board may have to be field cut to adjust total length of the center wall. Also, the last horizontal wall splines will extend beyond the end of the center wall. Cut them off flush with the end of the wall.

ALTERNATE II - Pneumatic Sand Conveying

Step 7B - Addition of Sand with Air Conveying

If available, pneumatic conveying may be used for filling the space between walls. In this case, the entire center wall and wing walls may be assembled before addition of the sand.

Note: The center wall will be quite loose and floppy. It may be stabilized by using spare floor boards as spacers at the top. This can be removed as the sand is added.

After assembly is complete, the bulk sand may be brought in with a vehicle having a pneumatic system. Sufficient hose will be needed to reach the front end of the magazine. A moveable (See Figure 36) cyclone separation is needed to control the flow of sand into the space between walls. A filter bag should be placed over the cyclone air discharge to keep sand dust down.

Caution: Personnel should be equipped with dust masks and goggles during sand addition.

As before, the sand level on the wing walls should be kept above the center wall during filling to maintain close fit where they meet.

Continue sand addition until the barrier is complete. Excess sand on floor may then be swept up.

Step 9 - Damage Repair

See Drawings PY 1578-39D & PY 1578-40D, wall repair.

During erection, damage may occur to the walls. Holes in the foam boards may be repaired as shown in the Drawings mentioned above. Broken boards may be replaced from the spare parts that were included with the barrier kit.

Step 10 - Clean up sand from the magazine floor and check walls for sand leaks. Superficial leaks from joints may be plugged by using a small piece of foam.

Step 11 - Store Spare Parts

After the complete Barrier System is installed, there will be spare parts. It is recommended that these parts be stored on top of the barrier walls for later use in repairs.

The assembly instructions should be retained for future use such as dismantling and reassembling the wall when desired.

PACKING LIST

CONTRACT DASA01-71-C-0018 P00001

	Center Wall Kit		16 Wing Walls				
Part No.	Total Pallet 1	Total Pallet 2	Total Pallet 3	Total Pallet 4	Total Pallet 5	Total Pallet 6	Grand Total
8L	2	4	-	-	-	-	6
8R	2	4	-	-	-	-	6
11L	-	-	16	16	16	16	64
11R	-	-	16	16	16	16	64
9	50	50	-	-	-	-	100
42	10	10	-	-	-	-	20
43L	2	0	-	-	-	-	2
43R	2	0	-	-	-	-	2
14L	3	3	-	-	-	-	6
14R	3	3	-	-	-	-	6
45L	0	2	-	-	-	-	2
45R	0	2	-	-	-	-	2
22	7	8	40	40	40	40	175
46	1	2	8	8	8	8	35
16	30	26	12	12	12	12	104
17	2	2	4	4	4	4	20
18	-	-	4	4	4	4	16
25	80	80	64	64	64	64	416
27	30	23	16	16	16	16	117
30	6	6	48	48	48	48	204
32	55	55	-	-	-	-	110
48	12	13	-	-	-	-	25
50L	-	-	4	4	4	4	16
50R	-	-	4	4	4	4	16
44L	-	-	4	4	4	4	16
44R	-	-	4	4	4	4	16
53	0	2	-	-	-	-	2
Ties 86"	162	163	96	96	96	96	709
Ties 70"	5	5	25	25	25	25	110

CONTRACT DASA01-71-C-0018 P00001

Packing List For Barrier System
Pallet 1-First Half Center Wall

PARTS LIST

Part No.		Total on Pallet
8L	Full End Board - Left Hand	2
8R	Full End Board - Right Hand	2
9	Full Board	50
42	Full Top Board	10
43L	Full Top End Board - Left Hand	2
43R	Full Top End Board - Right Hand	2
14L	Half End Board - Left Hand	3
14R	Half End Board - Right Hand	3
45L	Half Top End Board - Left Hand	0
45R	Half Top End Board - Right Hand	0
22	End Board	7
46	Top End Board	1
16	Floor Board	30
17	Full End Floor Board	2
53	Adjusted Floor Board	0
25	Wall or Corner Spline	80
27	Floor Spline	30
30	End Wall Spline	6
32	Butt Joint Spline	55
48	Top Butt Joint Spline	12
Ties 86"	Loop	162
Ties 70"	Loop	5

CONTRACT DASA01-71-C-0018 P00001

Packing List For Barrier System
Pallet 2-Second Half Center Wall

PARTS LIST

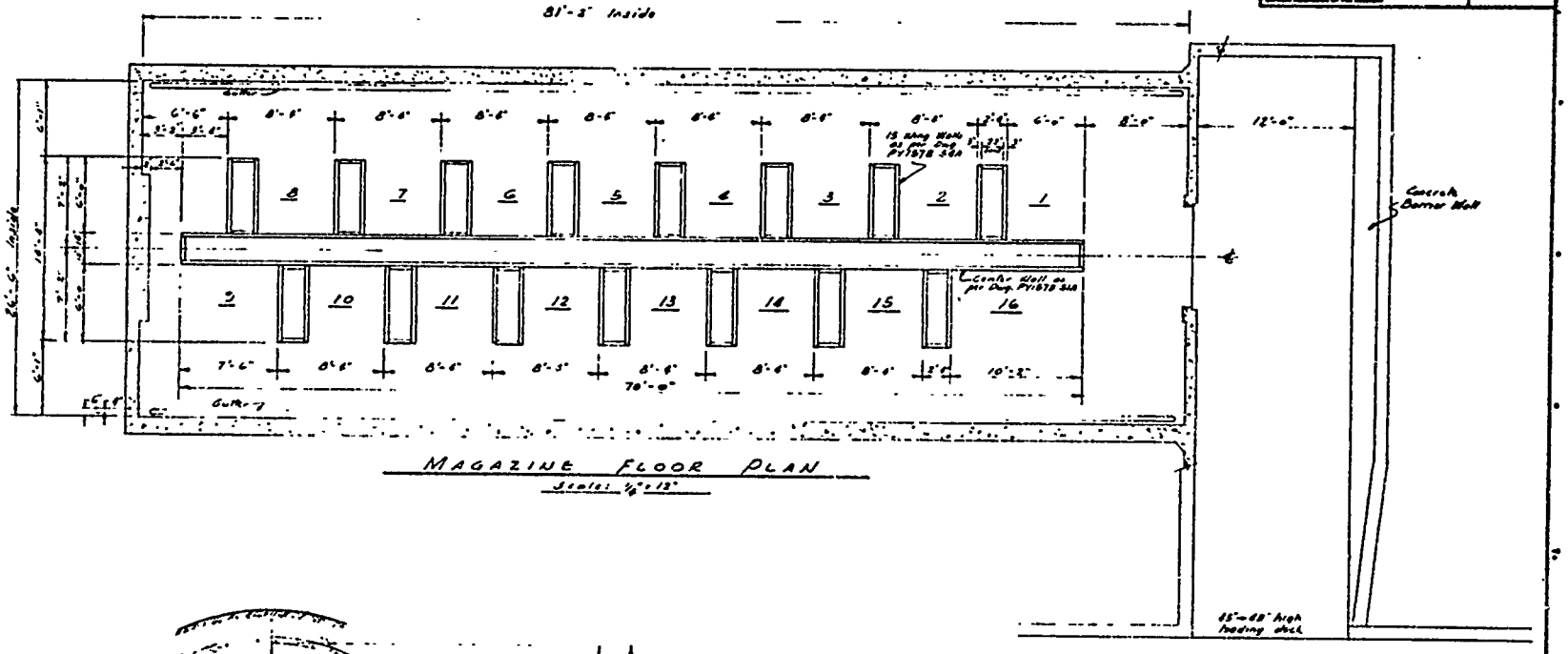
Part No.		Total on Pallet
8L	Full End Board - Left Hand	4
8R	Full End Board - Right Hand	4
9	Full Board	50
42	Full Top Board	10
43L	Full Top End Board - Left Hand	0
43R	Full Top End Board - Right Hand	0
14L	Half End Board - Left Hand	3
14R	Half End Board - Right Hand	3
45L	Half Top End Board - Left Hand	2
45R	Half Top End Board - Right Hand	2
22	End Board	8
46	Top End Board	2
16	Floor Board	26
17	Full End Floor Board	2
53	Adjusted Floor Board	2
25	Wall or Corner Spline	80
27	Floor Spline	23
30	End Wall Spline	6
32	Butt Joint Spline	55
48	Top Butt Joint Spline	13
Ties 86"	Loop	163
Ties 70"	Loop	5

CONTRACT DASA01-71-C-0018 P00001

Packing List For Barrier System
Pallets 3, 4, 5, & 6 With 4 Wing Walls On Each

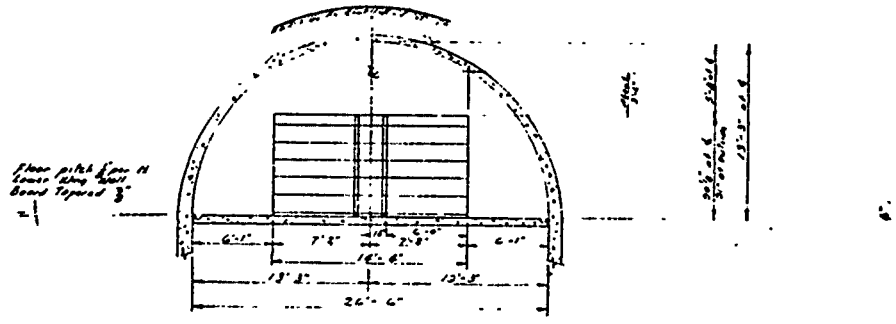
PART LIST

Part Number		Total For 1 Wing	Total On Each Pallet
11L	Left Side Wing Wall Board	4	16
11R	Right Side Wing Wall Board	4	16
50L	Left Side Tapered Wing Wall Board	1	4
50R	Right Side Tapered Wing Wall Board	1	4
44L	Left Side Top Wall Board	1	4
44R	Right Side Top Wall Board	1	4
16	Floor Board	3	12
18	Half End Floor Board	1	4
17	Full End Floor Board	1	4
22	End Board	10	40
46	Top End Board	2	8
25	Wall or Corner Spline	16	64
30	End Wall Spline	12	48
27	Floor Splines	4	16
Ties	86" Loop	24	96
Tie	70" Loop	6	25



MAGAZINE FLOOR PLAN

Scale: 1/8" = 1'



MAGAZINE CROSS-SECTION

Scale: 1/8" = 1'

Contract No. DASA01-71-C-0018

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

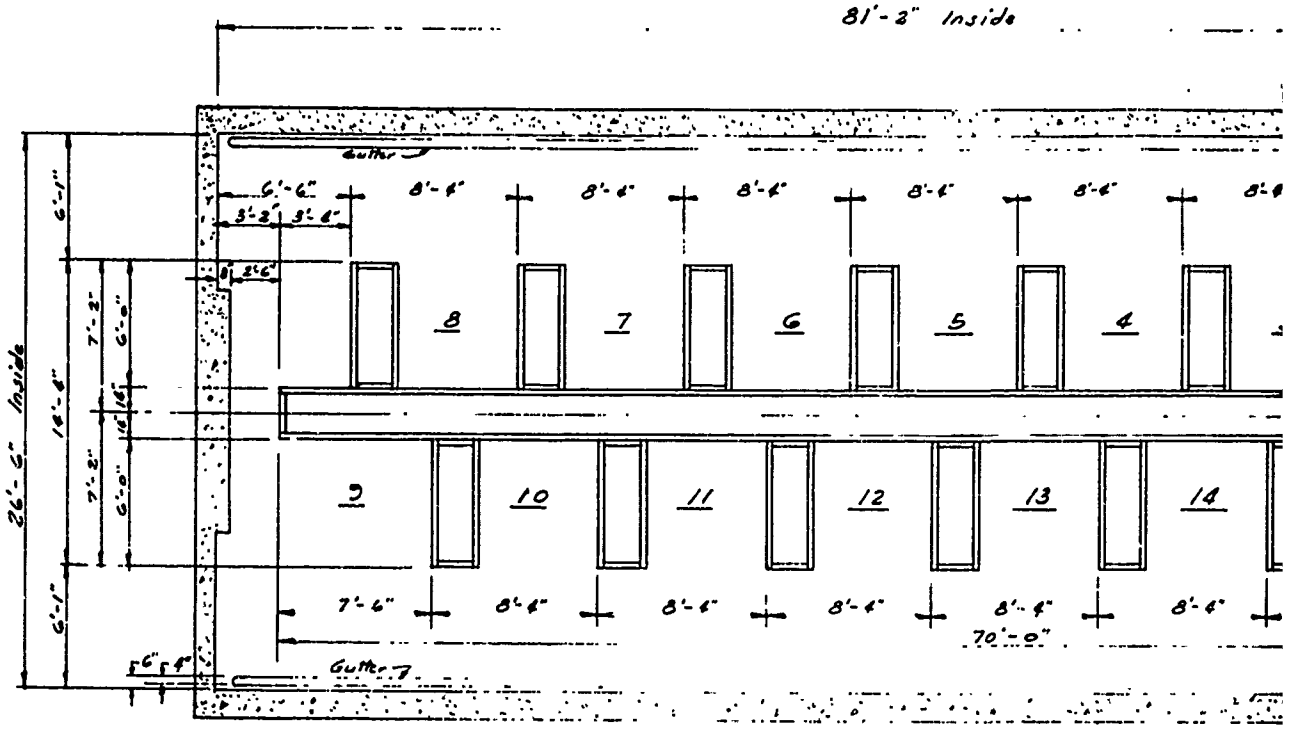
MAGAZINE BARRIER SYSTEM LAYOUT

PY-1678-55A

-108-1

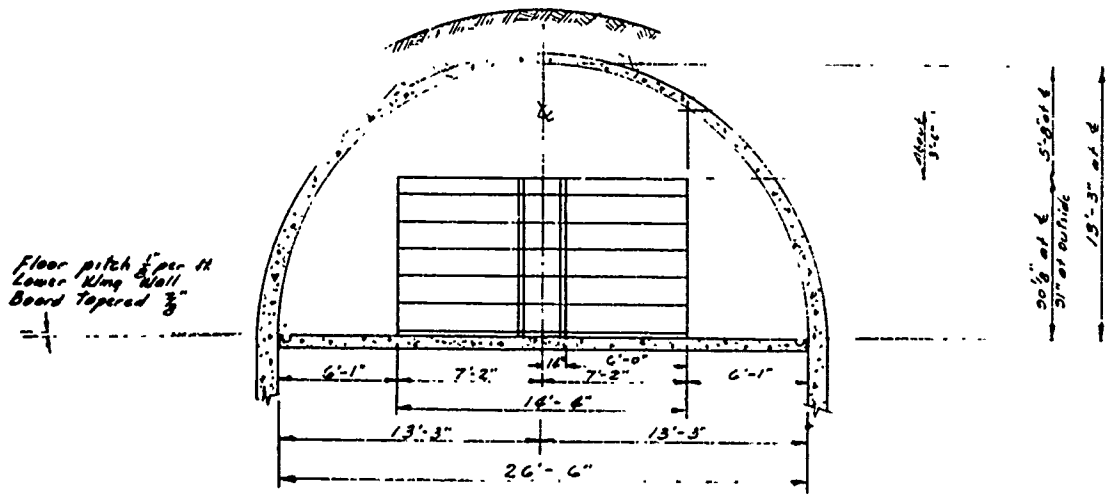
108-2

108-3



MAGAZINE FLOOR PLAN

Scale: 1/4" = 12"

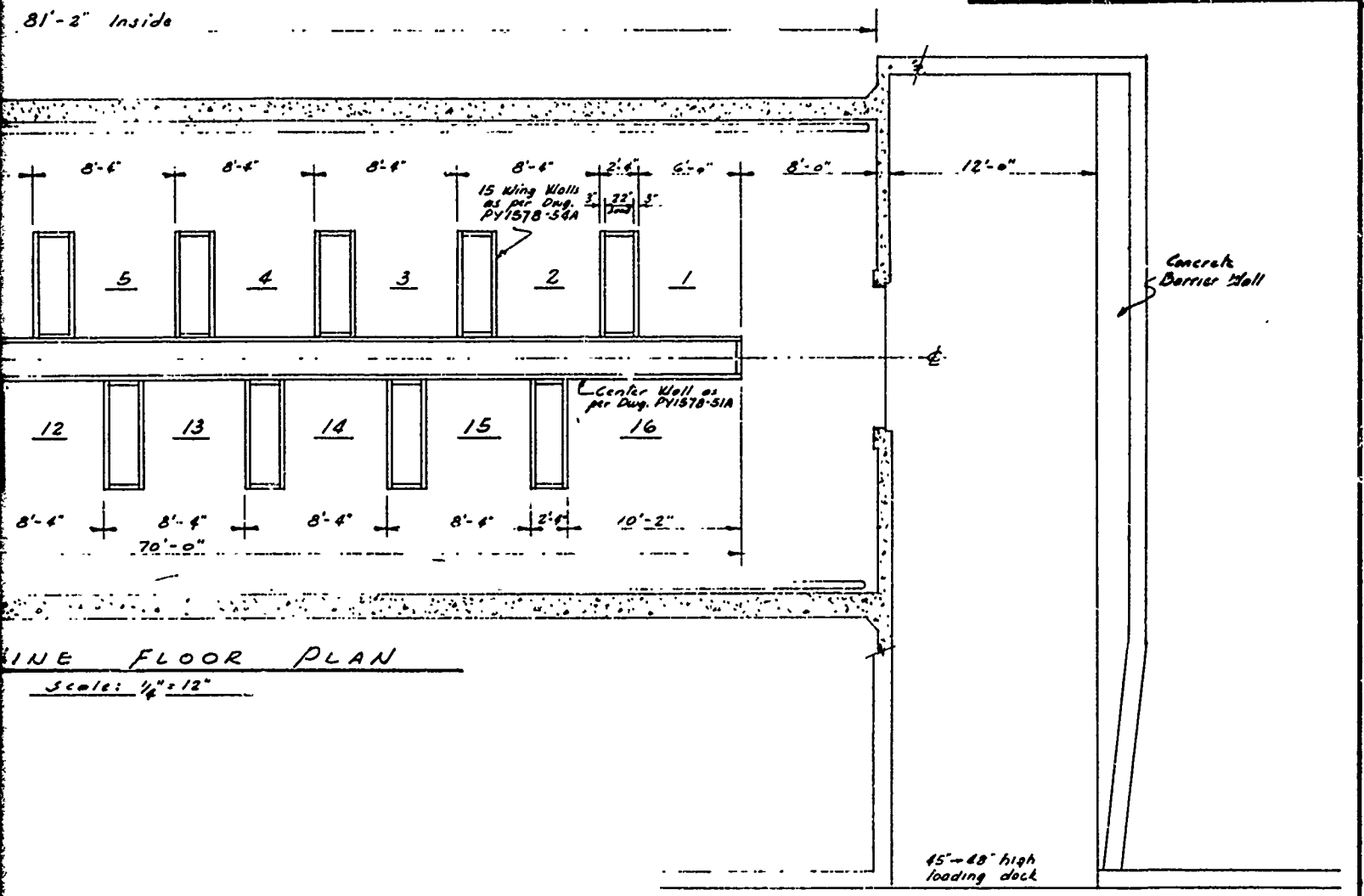


MAGAZINE CROSS-SECTION

Scale: 1/4" = 12"

REVISIONS				REVISIONS			REFERENCE DRAWINGS
							Y-1378-31A Center Wall Details
							Y-1378-31B Wing Wall Details

PY1578-55A



INE FLOOR PLAN

Scale: 1/4" = 1'-0"

30½" at ℄ 31" at outside

5'-9" at ℄

13'-3" at ℄

℄ R.R. Tracks

Contract No DA-SA01-71-C-0018

PY1578-51A	Center Wall Details		
PY1578-51A	Wing Wall Details		

REFERENCE DRAWINGS

APPROVALS

THE DOW CHEMICAL COMPANY — DESIGNED BY AJP 10-1-71

CONTRACTOR — DRAWN BY AJP 10-1-71

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

MAGAZINE BARRIER SYSTEM LAYOUT

SCALE 1/4" = 1'

600-1841

PY1578

PY1578-55A

108-2

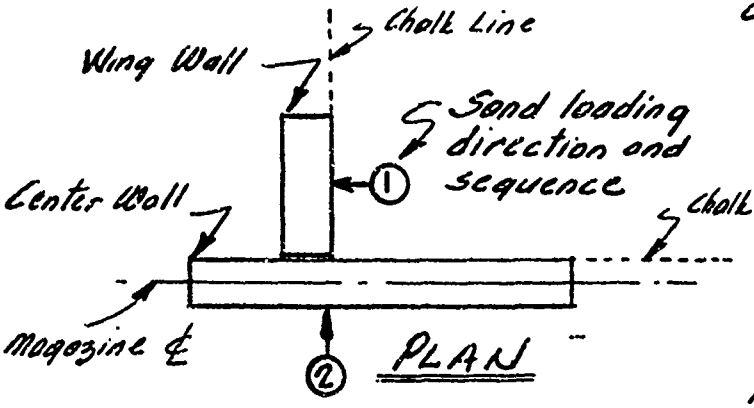
108-3

BARRIER SYSTEM ASSEMBLY AND SAND LOADING PROCEDURE

A.J.P. Oct. 8, 1971

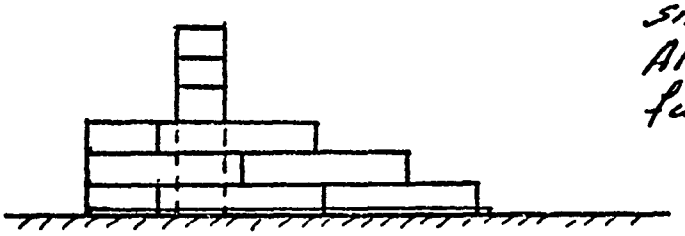
DWG. No. PY1578-56D

Contract No. DASA01-71-C-0018



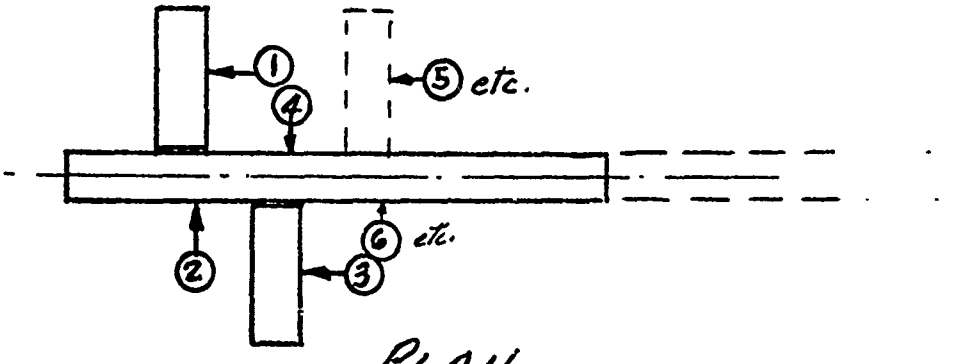
PLAN

NOTE: Wing Wall assembly and sand loading is to precede center wall assembly to assist in establishing a plumb and snug fit between walls. Alternate ① and ② until full height is reached.

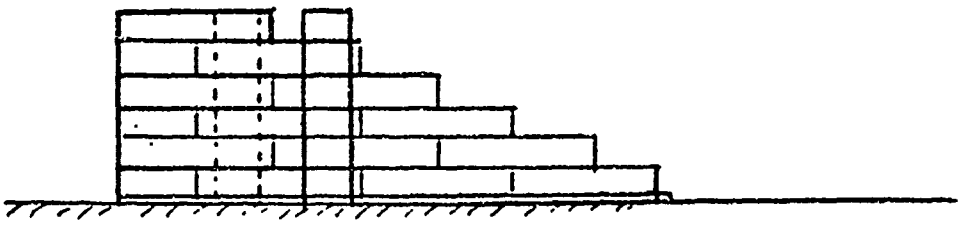


ELEVATION

INITIAL ASSEMBLY PROCEDURE

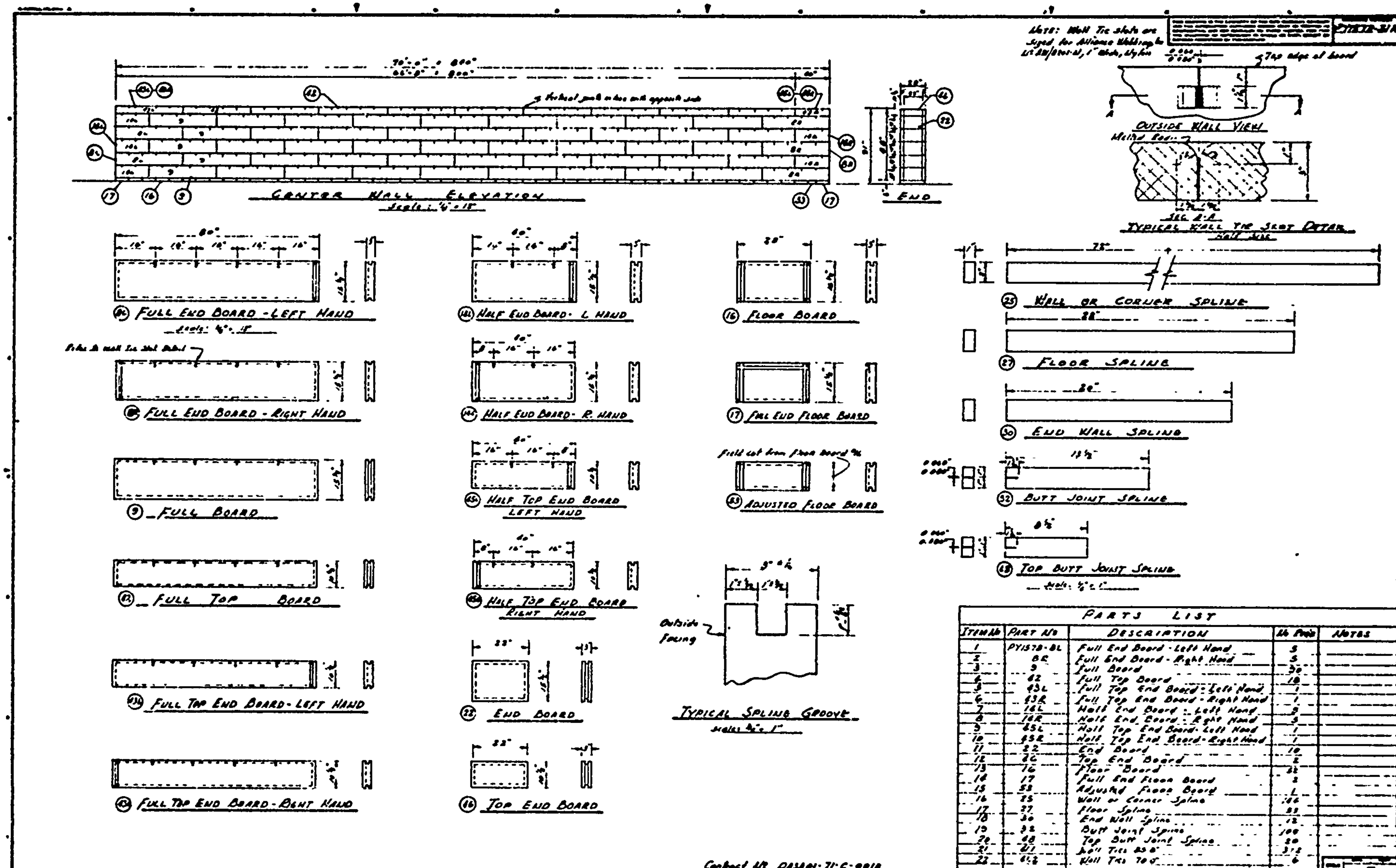


PLAN



ELEVATION

CONTINUING ASSEMBLY PROCEDURE



PARTS LIST

Item No	Part No	Description	No Reqd	Notes
1	PY1578-8L	Full End Board - Left Hand	5	
2	8R	Full End Board - Right Hand	5	
3	9	Full Board	30	
4	62	Full Top Board	10	
5	43L	Full Top End Board - Left Hand	1	
6	43R	Full Top End Board - Right Hand	1	
7	16L	Half End Board - Left Hand	5	
8	16R	Half End Board - Right Hand	5	
9	65L	Half Top End Board - Left Hand	1	
10	65R	Half Top End Board - Right Hand	1	
11	22	End Board	10	
12	66	Top End Board	2	
13	76	Floor Board	32	
14	17	Full End Floor Board	2	
15	53	Adjusted Floor Board	2	
16	25	Wall or Corner Spline	166	
17	27	Floor Spline	33	
18	30	End Wall Spline	12	
19	32	Butt Joint Spline	100	
20	68	Top Butt Joint Spline	20	
21	21	Wall Ties 83 0	378	
22	61.2	Wall Ties 70 0	6	

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

DETAILS AND ASSEMBLY OF BARRIER SYSTEM CENTER WALL - 3" THKK FOAM

600-1081

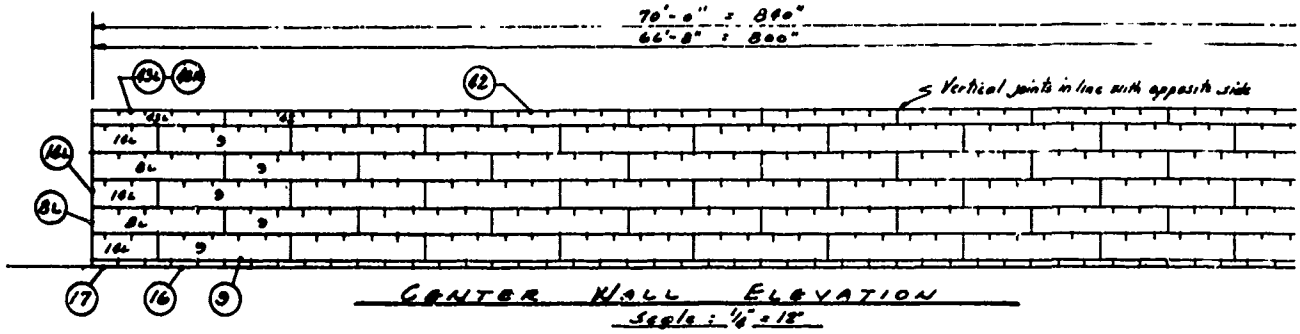
PY-1578

PY1578-S1A

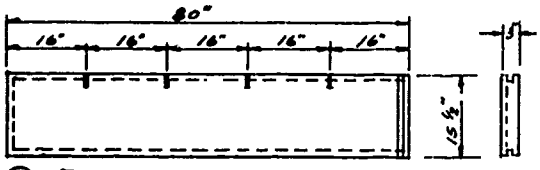
•-110-1

110-2

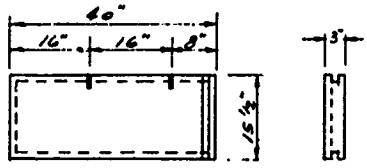
110-3



CENTER WALL ELEVATION
Scale: 1/8" = 1'

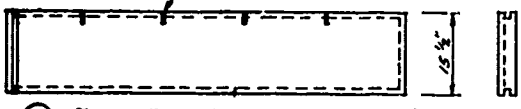


(8L) FULL END BOARD - LEFT HAND
Scale: ½" = 1'

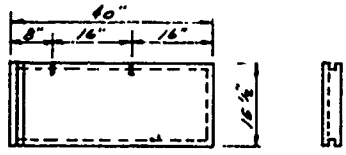


(18L) HALF END BOARD - L. HAND

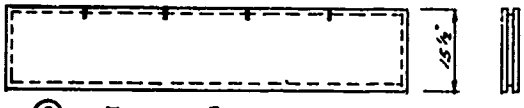
Refer to wall Tie Slot Detail



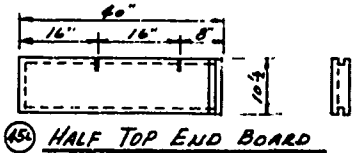
(8R) FULL END BOARD - RIGHT HAND



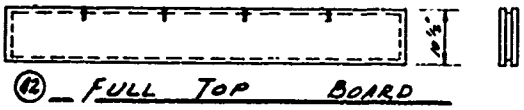
(18R) HALF END BOARD - R. HAND



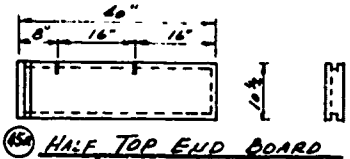
(9) FULL BOARD



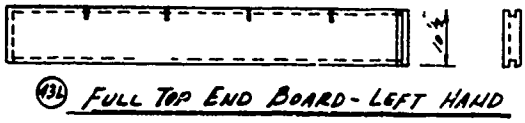
(45L) HALF TOP END BOARD
LEFT HAND



(12) FULL TOP BOARD

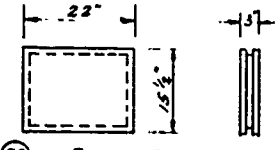


(45R) HALF TOP END BOARD
RIGHT HAND



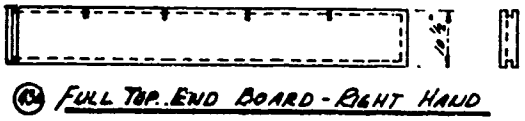
(13L) FULL TOP END BOARD - LEFT HAND

Outside Facing

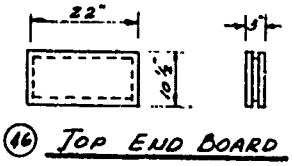


(22) END BOARD

TYPICA



(13R) FULL TOP END BOARD - RIGHT HAND



(16) TOP END BOARD

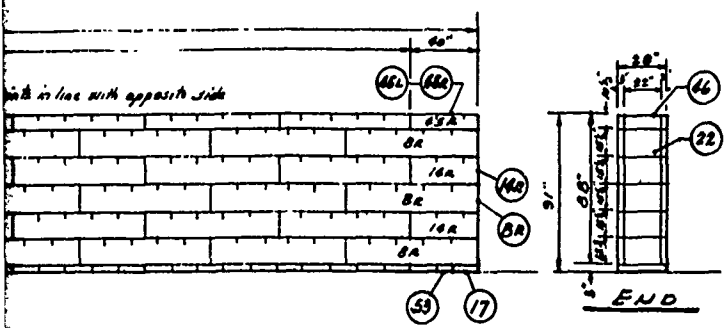
Co

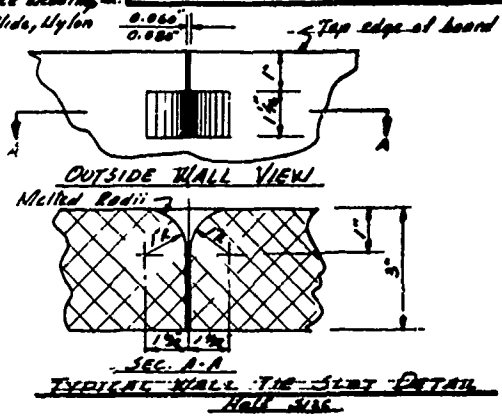
REVISIONS

REVISIONS

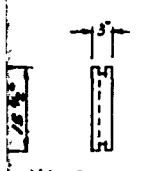
PY1578-51A

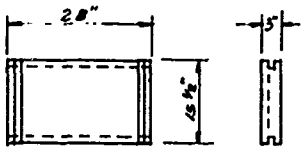
Note: Wall Tie slots are sized for Alliance Webbing Co. #: AW/8301-U, 1" Wide, Nylon



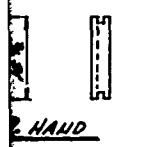


TYPICAL WALL TIE SLOT DETAIL
Half Size

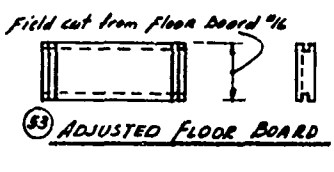




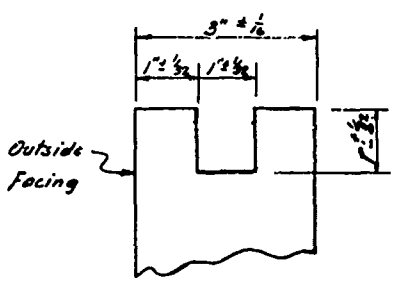
(16) FLOOR BOARD



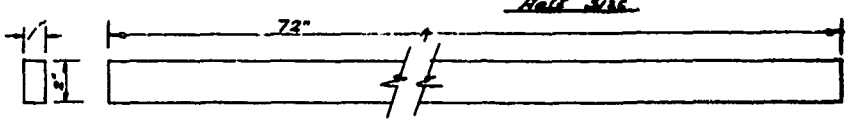
(17) FULL END FLOOR BOARD



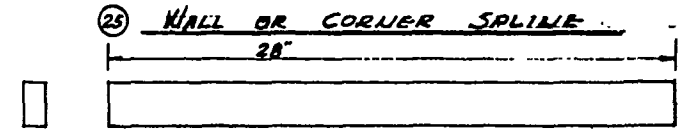
(53) ADJUSTED FLOOR BOARD



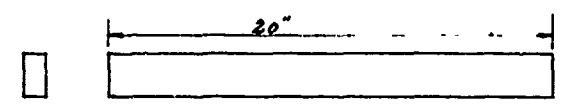
TYPICAL SPLINE GROOVE
scale: 3/4" = 1"



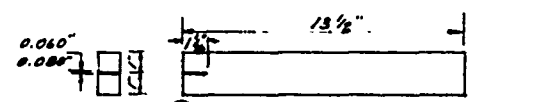
(25) WALL OR CORNER SPLINE



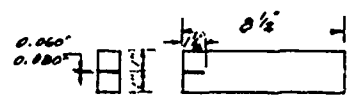
(27) FLOOR SPLINE



(30) END WALL SPLINE



(32) BUTT JOINT SPLINE



(48) TOP BUTT JOINT SPLINE
scale: 1/2" = 1"

PARTS LIST

ITEM No.	PART No.	DESCRIPTION	No. Req'd	NOTES
1	PY1578-BL	Full End Board - Left Hand	5	
2	BR	Full End Board - Right Hand	5	
3	9	Full Board	30	
4	42	Full Top Board	18	
5	43L	Full Top End Board - Left Hand	1	
6	43R	Full Top End Board - Right Hand	1	
7	16L	Half End Board - Left Hand	5	
8	16R	Half End Board - Right Hand	5	
9	45L	Half Top End Board - Left Hand	1	
10	45R	Half Top End Board - Right Hand	1	
11	22	End Board	10	
12	46	Top End Board	2	
13	16	Floor Board	52	
14	17	Full End Floor Board	2	
15	53	Adjusted Floor Board	1	
16	25	Wall or Corner Spline	144	
17	27	Floor Spline	59	
18	30	End Wall Spline	12	
19	32	Butt Joint Spline	100	
20	48	Top Butt Joint Spline	20	
21	41.1	Wall Ties 83.6"	312	
22	41.2	Wall Ties 70.0"	6	

Contract No. DE-AC01-71-C-0018

REFERENCE DRAWINGS
PY1578-PIC Wing Wall Details
PY1578-51A Magazine Barrier System Layout

APPROVALS
AJP 7-28-71
AJP 7-28-71

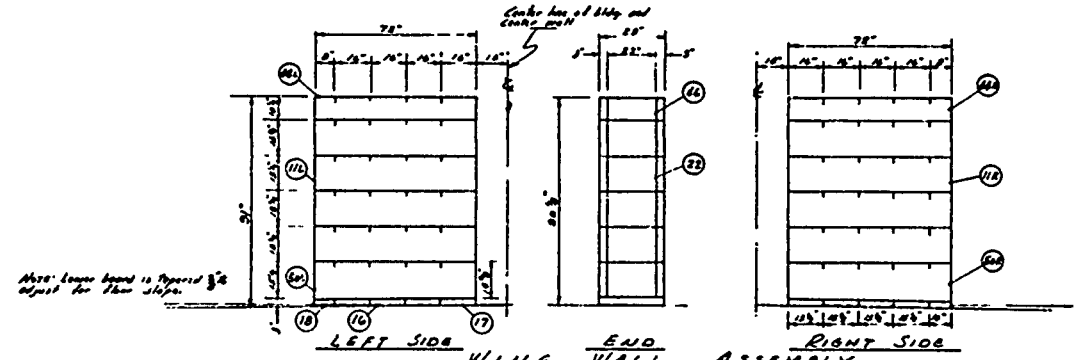
THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

DETAILS AND ASSEMBLY OF BARRIER SYSTEM CENTER WALL - 3" THKK FOAM

600-7821
PY-1578
PY1578-51A

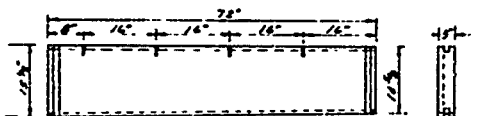
167-2

110.3

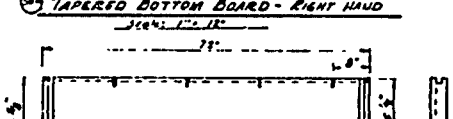


WING WALL ASSEMBLY

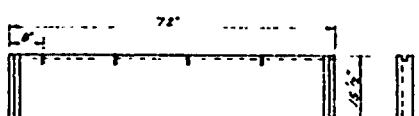
Scale: ½" = 1'-0"



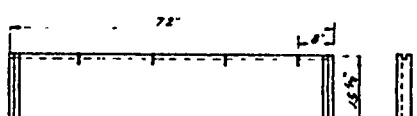
50a TAPERED BOTTOM BOARD - RIGHT HAND



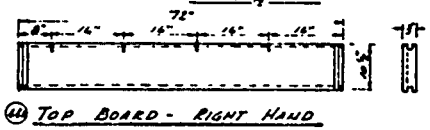
50b TAPERED BOTTOM BOARD - LEFT HAND



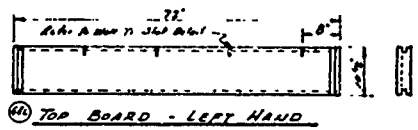
112 FULL BOARD - RIGHT HAND



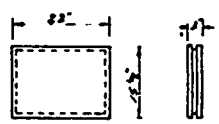
111 FULL BOARD - LEFT HAND



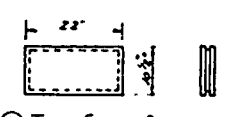
44 TOP BOARD - RIGHT HAND



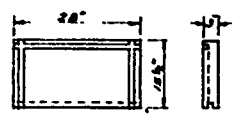
44A TOP BOARD - LEFT HAND



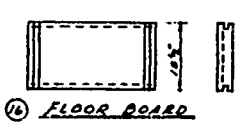
22 END BOARD



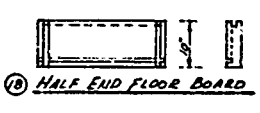
46 TOP END BOARD



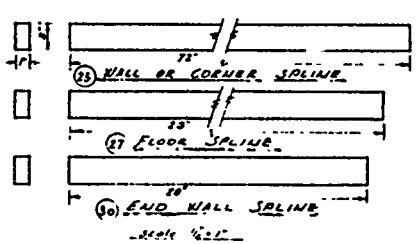
17 FULL END FLOOR BOARD



16 FLOOR BOARD

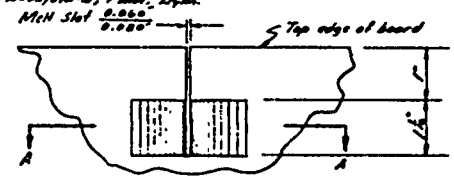


18 HALF END FLOOR BOARD

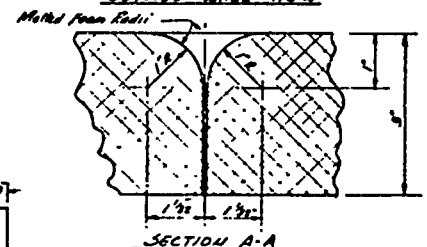


Scale: 1"=1'

Note: Slot Tie Slots are spaced for Alliance Building Inc. 24 tie/four-ft, 5 rods, styles.

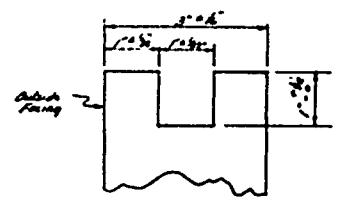


OUTSIDE WALL VIEW



TYPICAL WALL TIE SLOT DETAIL

Full Scale



TYPICAL SPLINE GROOVE

Full Scale

PARTS LIST

ITEM NO.	PART NO.	DESCRIPTION	NO. REQ'D
1	PY1578-SLE	Tapered Bottom Board - Right Hand	1
2	50L	Tapered Bottom Board - Left Hand	1
3	112	Full Board - Right Hand	6
4	111	Full Board - Left Hand	6
5	44A	Top Board - Right Hand	1
6	44L	Top Board - Left Hand	1
7	22	End Board	10
8	46	Top End Board	2
9	17	Full End Floor Board	1
10	16	Floor Board	3
11	18	Half End Floor Board	1
12	25	Wall or Corner Spline	16
13	27	Floor Spline	4
14	30	End Wall Spline	12
15	611	Wall Ties - 85.6" long	24
16	612	Wall Ties - 70 0" long	6

Contract No. EJA5A01-71-C-0018

REVISIONS				APPROVED		

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

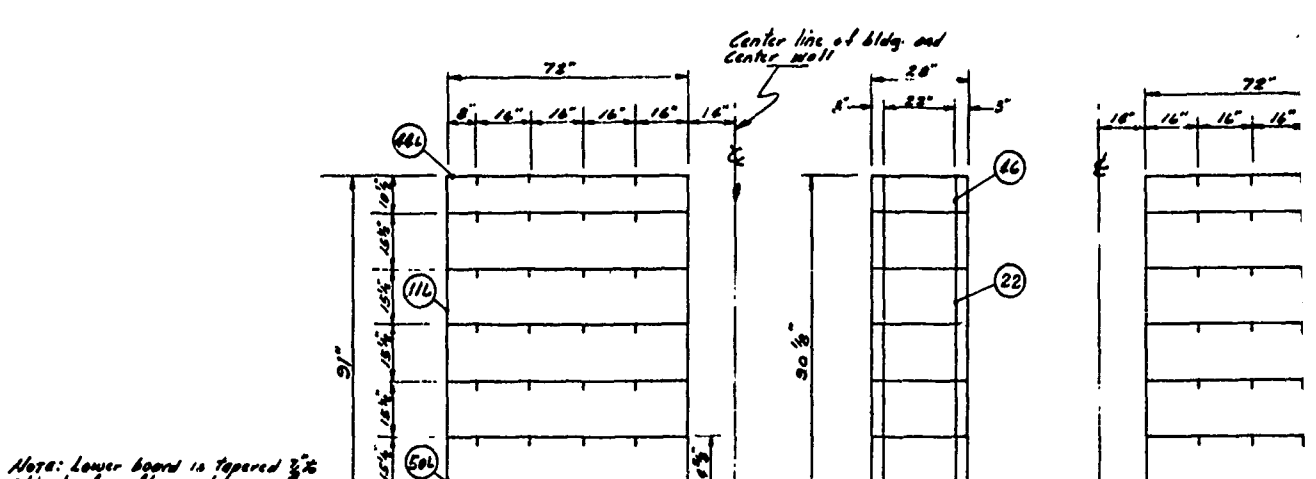
DETAILS AND ASSEMBLY OF BARRIER SYSTEM WING WALL - 5' Span

600-1841
PY-1578
PY1578 SLE

-111-1

111-2

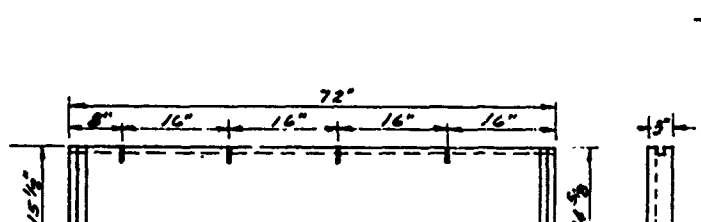
111-3



LEFT SIDE END RIGHT

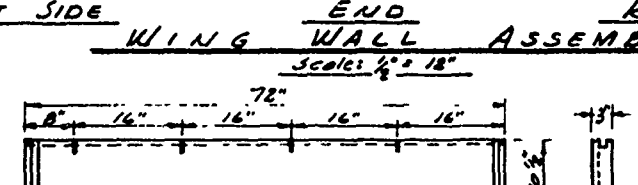
WING WALL ASSEMBLY

Scale: ½" = 1'

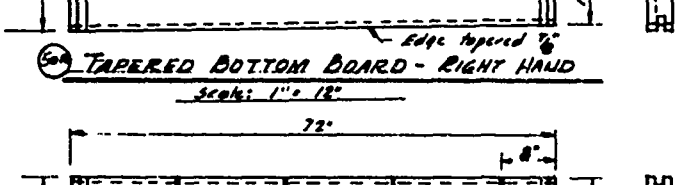


50R TAPERED BOTTOM BOARD - RIGHT HAND

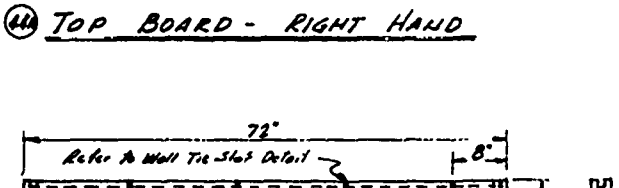
Scale: 1" = 1'



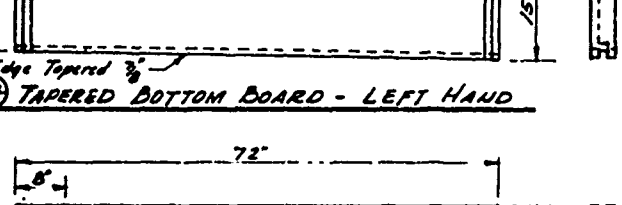
44R TOP BOARD - RIGHT HAND



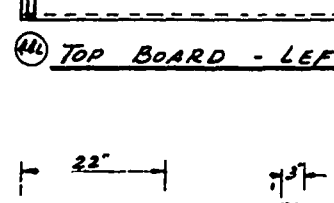
50L TAPERED BOTTOM BOARD - LEFT HAND



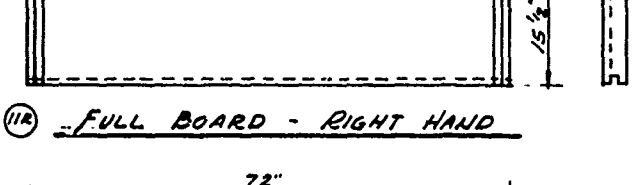
44L TOP BOARD - LEFT HAND



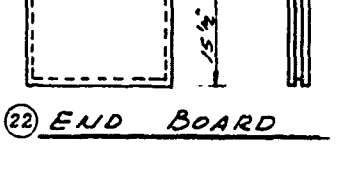
11R FULL BOARD - RIGHT HAND



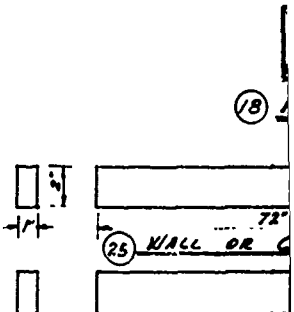
22 END BOARD



111 FULL BOARD - LEFT HAND



46 TOP END BOARD



Scale: ½

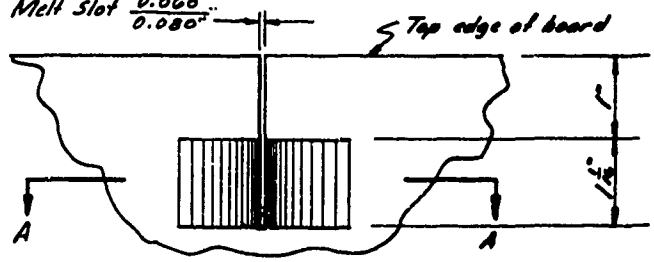
Contract No.

REVISIONS	REVISIONS	REFERENCE DRAWINGS
		DY1530-5M Center Wall Details
		DY1530-15M Manure Barrier System Layout

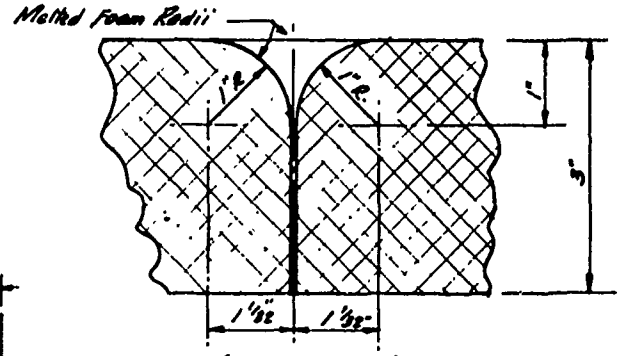
PY-1678-SAL

Note: Wall Tie Slots are sized for Alliance Webbing, Inc. LR AW/BTW-1, 1" wide, Nylon.

Melt Slot 0.060" / 0.080"

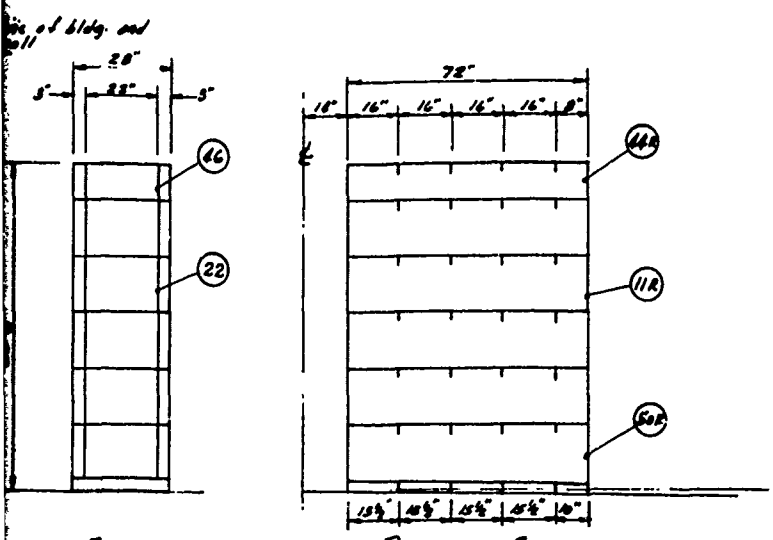


OUTSIDE WALL VIEW



SECTION A-A

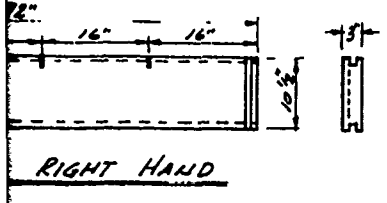
TYPICAL WALL TIE SLOT DETAIL
Full scale



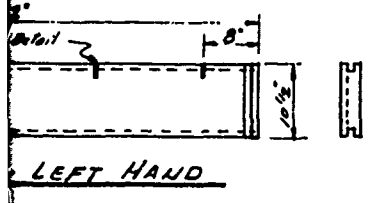
END WALL ASSEMBLY
Scale: ½" = 12"

END WALL

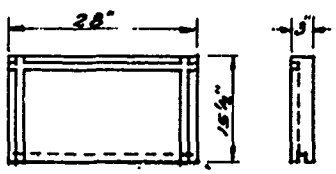
RIGHT SIDE



RIGHT HAND



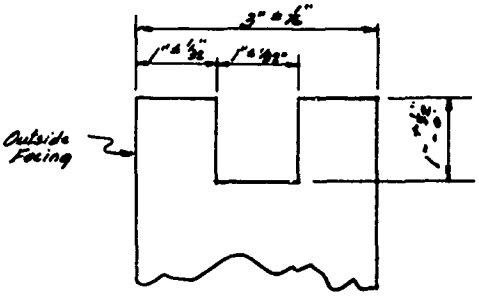
LEFT HAND



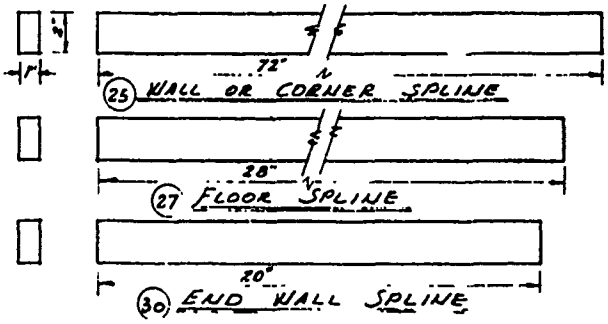
(17) FULL END FLOOR BOARD

(16) FLOOR BOARD

(18) HALF END FLOOR BOARD



TYPICAL SPLINE GROOVE
Full Scale



(25) WALL OR CORNER SPLINE

(27) FLOOR SPLINE

(30) END WALL SPLINE

Scale: ½" = 1"

PARTS LIST

ITEM No.	PART No.	DESCRIPTION	REQ'D
1	PY1578-SAR	Tapered Bottom Board - Right Hand	1
2	50L	Tapered Bottom Board - Left Hand	1
3	11R	Full Board - Right Hand	4
4	11L	Full Board - Left Hand	4
5	44R	Top Board - Right Hand	1
6	44L	Top Board - Left Hand	1
7	22	End Board	10
8	46	Top End Board	2
9	17	Full End Floor Board	1
10	16	Floor Board	3
11	18	Half End Floor Board	1
12	25	Wall or Corner Spline	16
13	27	Floor Spline	6
14	30	End Wall Spline	12
15	61.1	Wall Ties - 85.8" long	22
16	61.2	Wall Ties - 70.0" long	6

Contract No. DASA01-71-C-0018

REFERENCE DRAWINGS
PY1578-SAA Center Wall Details
PY1578-SAB Modular Center System Layout

APPROVALS
AJP 9-27-71
AJP 9-27-71

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

DETAILS AND ASSEMBLY OF BARRIER SYSTEM WING WALL - 3" FOAM

600-1841
PY-1878
PY1578-SAA

TYPICAL CONTAINERIZED MAGAZINE SECTION

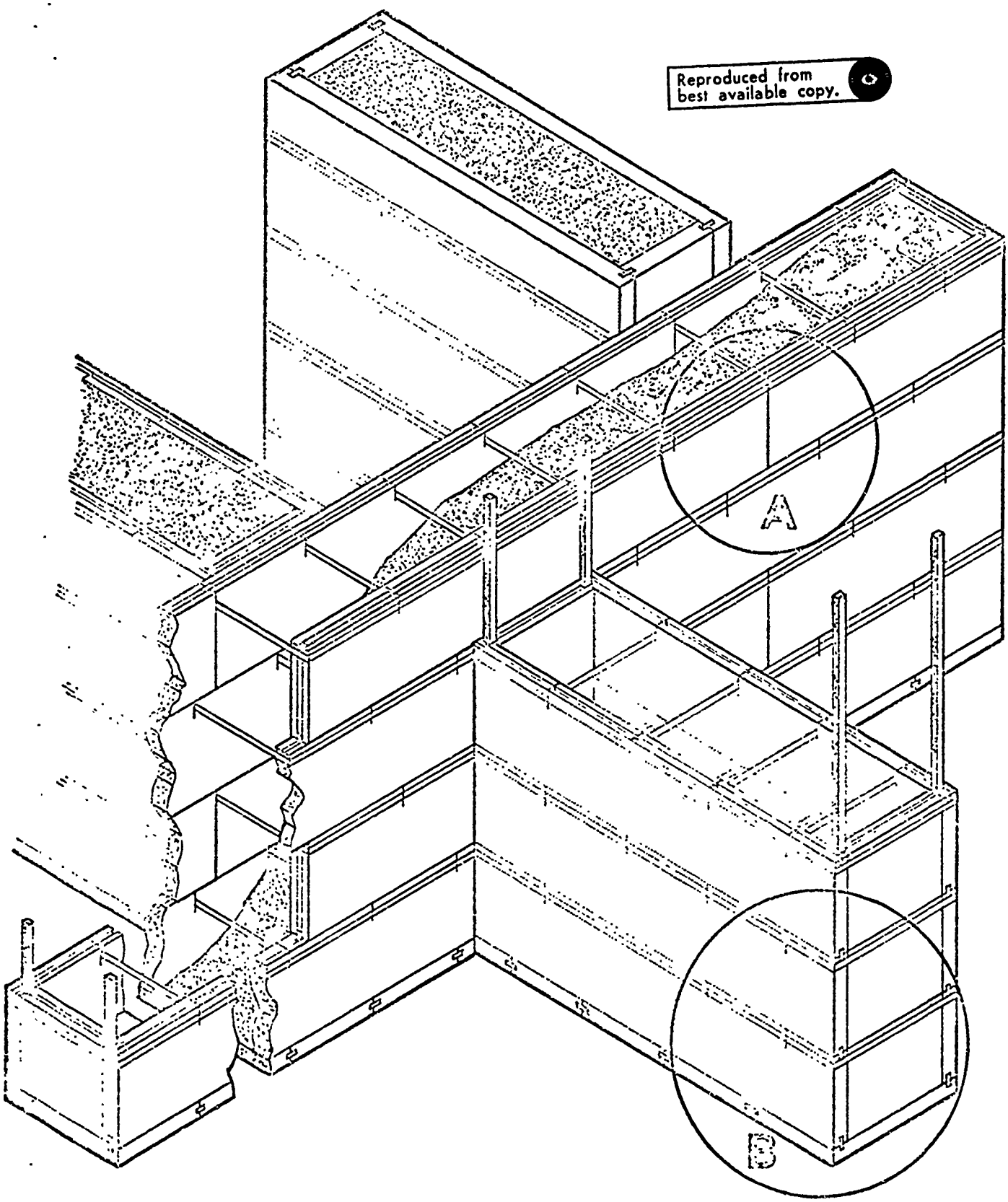


Fig. 1

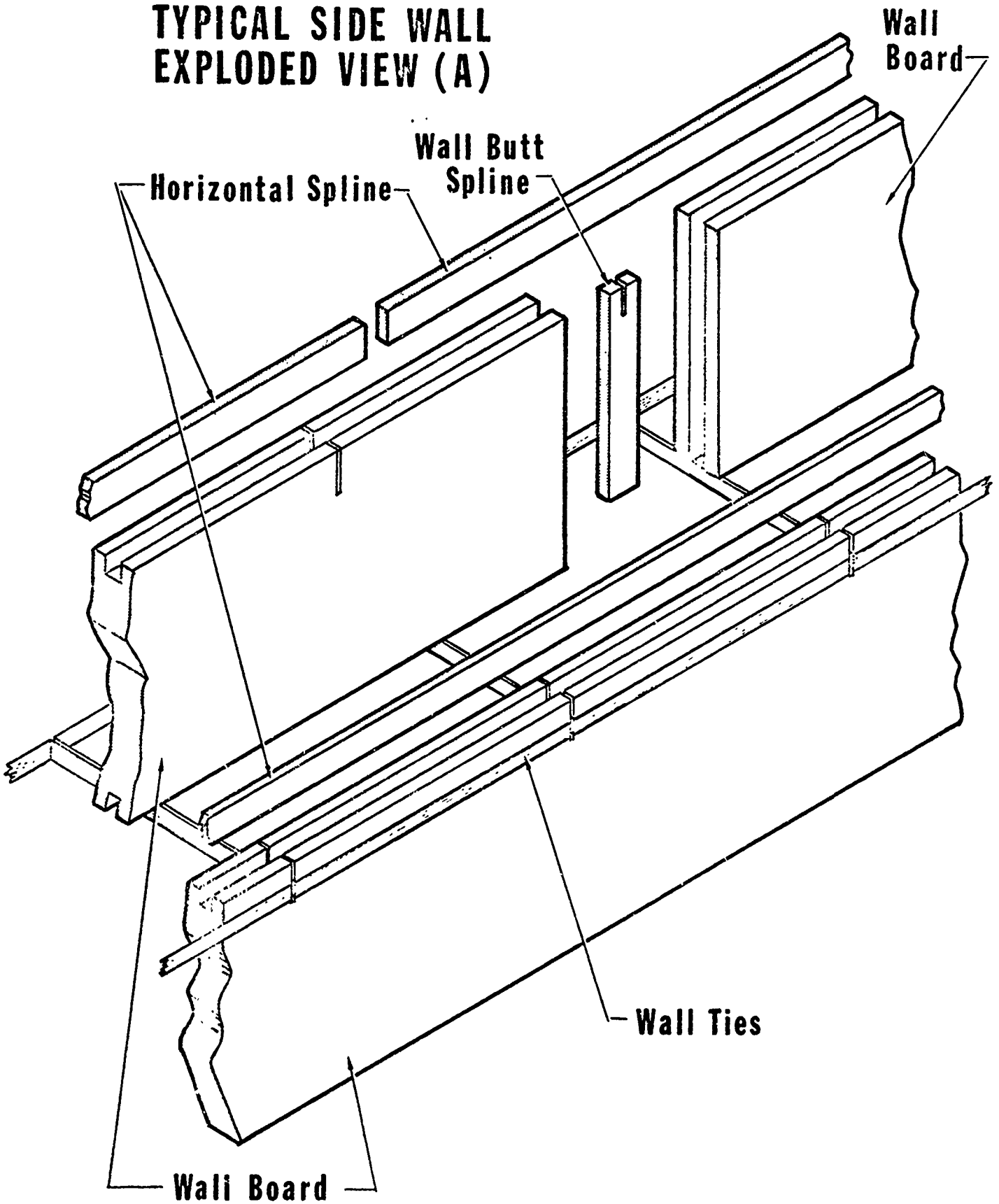

TYPICAL SIDE WALL
EXPLODED VIEW (A)
Wall
Board
Wall Butt
Spline
Horizontal Spline
Wall Ties
Wall Board

Fig. 2

TYPICAL WALL SECTION-EXPLODED VIEW (B)

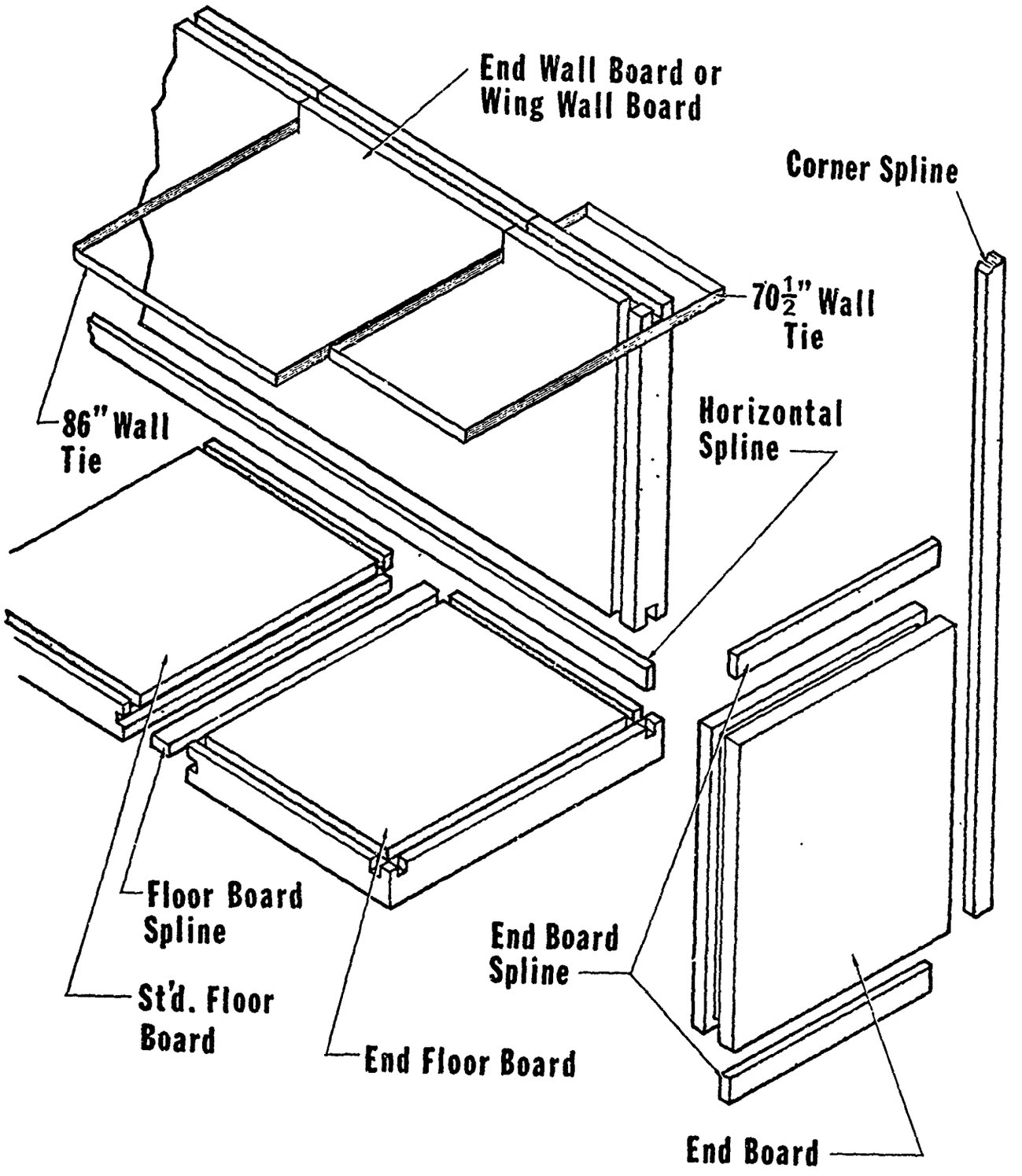
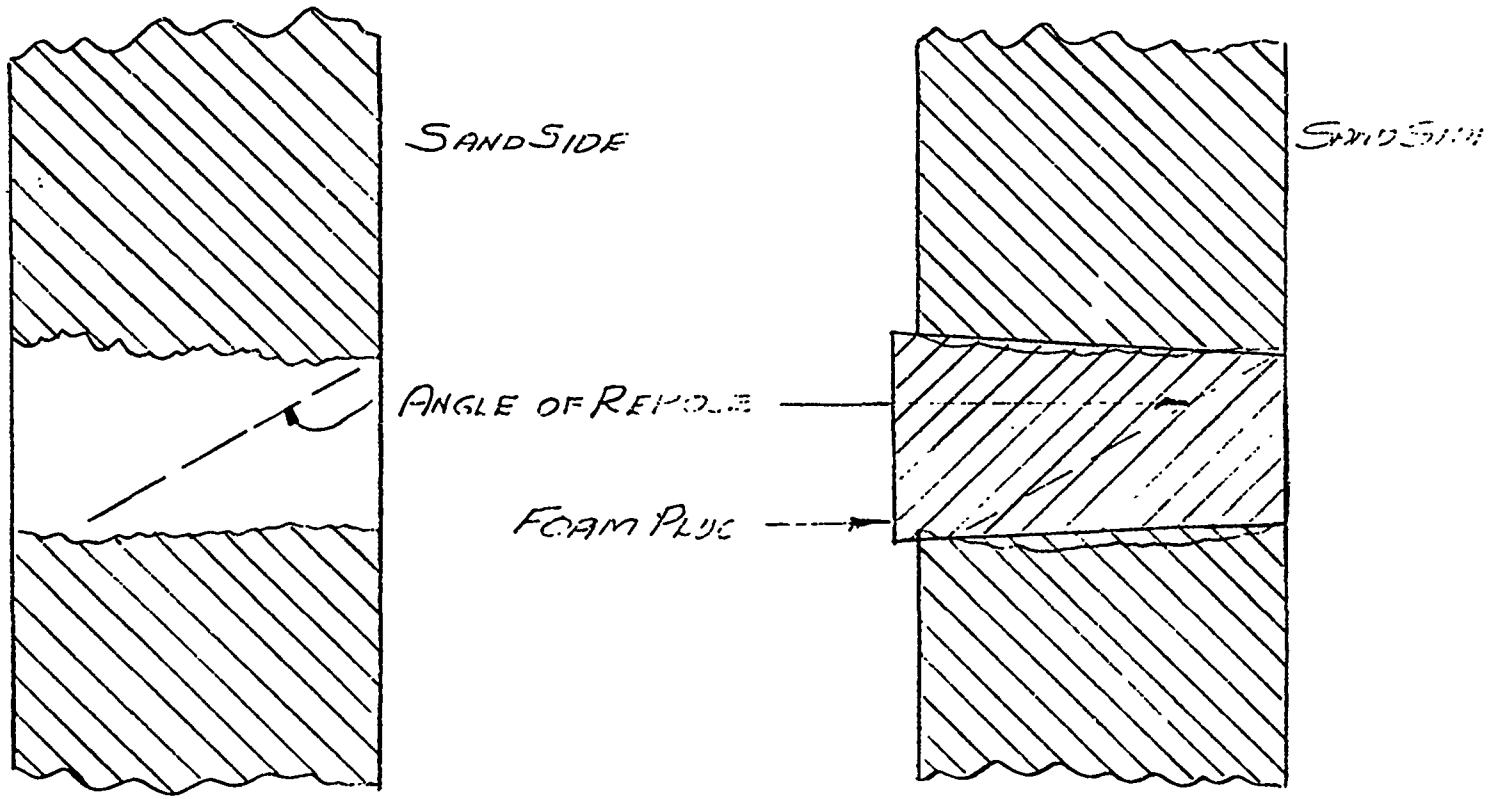


Fig. 3



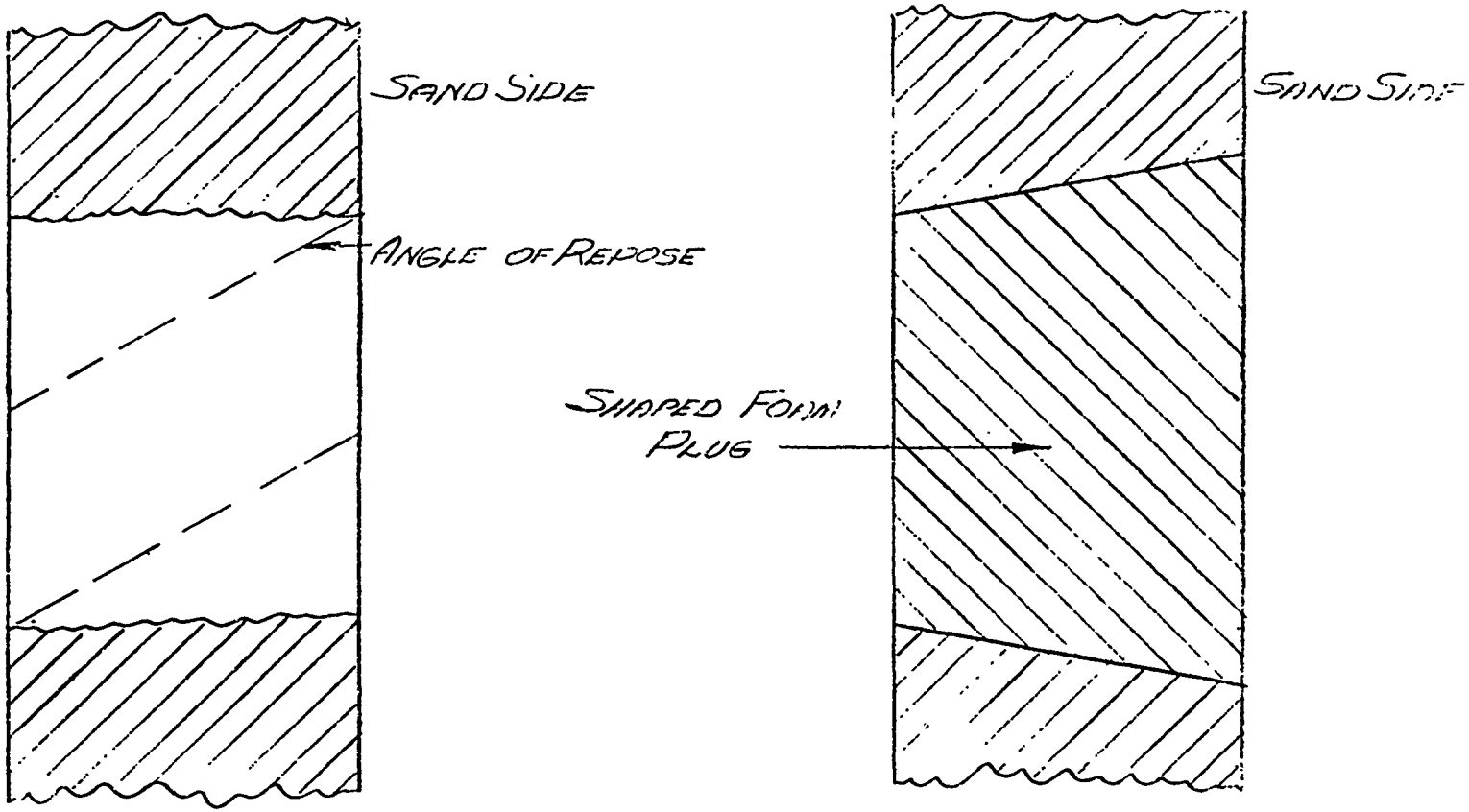
METHOD OF WALL REPAIR
SMALL HOLE WITH [illegible]

DESIGNED BY		DATE
DRAWN BY	[illegible]	DATE [illegible]
CHECKED BY	[illegible]	DATE [illegible]
APPROVED BY	[illegible]	DATE

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

[illegible]
[illegible]

ACCOUNT NUMBER	1841-600
JOB NUMBER	PY1515
DRAWING NUMBER	PY1515-37D



METHOD OF WALL REPAIR
LARGE HOLE - PLUG

DESIGNED BY		DATE
DRAWN BY	[illegible]	DATE [illegible]
CHECKED BY	[illegible]	DATE [illegible]
APPROVED BY	[illegible]	DATE

THE DOW CHEMICAL COMPANY
MIDLAND MICHIGAN

[illegible]

ACCOUNT NUMBER	1941-60
JOB NUMBER	PY[illegible]
DRAWING NUMBER	PY-78-[illegible]

APPENDIX D

COMPARISON OF WALL TIE MATERIAL

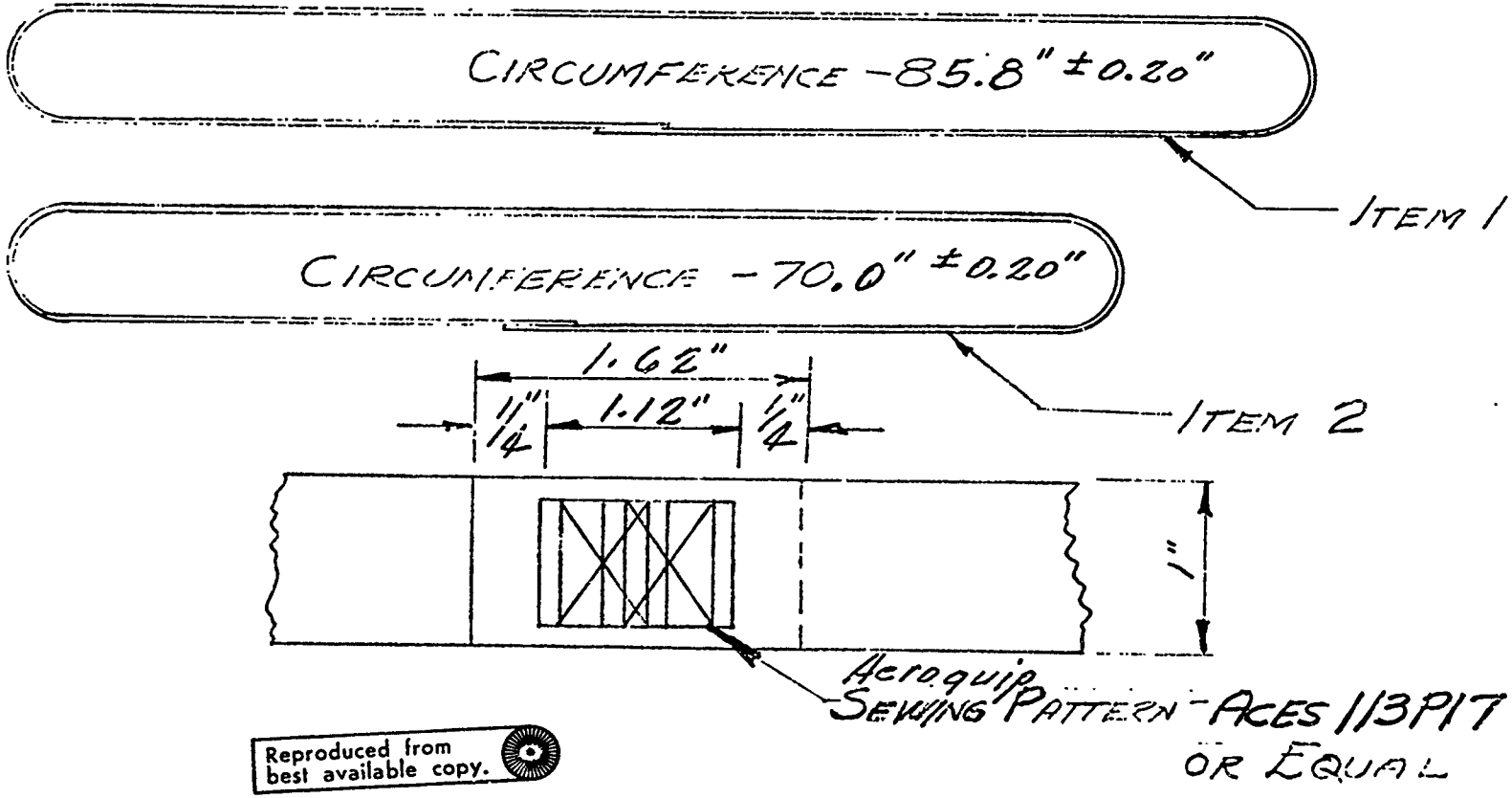
The initial nylon webbing selected and used for the prototype magazine 23 installation was Alliance Webbing, Inc. No. AW/8201-N 1" wide, MIL-T-5038, Type IV. The long and short wall ties were cut and sewn into bands by the Aeroquip Corp., Van Wert, Ohio, as per drawing PY 1578-41D, Figure 1.

Enough wall ties were purchased from Aeroquip to construct one sand filled wing wall at Midland and to run tensile strength tests. Typical tensile and elongation data are plotted on Figure 2.

The maximum wall bulge measured on the sand filled wing wall, with similar wall ties, was 7/16" on one side. Taken from the plot on Figure 2, this is equivalent to a 150 lbs. load on the wall tie. The average breaking strength of the ties was 2200 lbs. Although this provides for a 14.5 safety factor, webbing material with lower elongation is preferred to limit wall bulging.

Tests on heavier nylon and Dacron webbing materials were made concurrently with packaging and shipment of the NAD, Earle, N. J. prototype materials. Results plotted on Figure 3 show a considerable reduction in elongation compared with the lighter nylon webbing. Load at failure is less than the Figure 2 results because all breaks occurred in the stitching. Creep tests were run on the new materials with a 160 lb. constant load. The results plotted on Figure 4 shows creep to level off after about 30 days.

Dacron webbing, 0.060" thick, is installed at the ends of the center wall and throughout two wing walls on the NAD, Earle installation.



MAT'L - Alliance Webbing, Inc. No AW/8201-N
1" wide, Nylon, Gray or white.
Mil-T-5038, Type IV
Changed lengths from 86" & 70.5" Sept. 20, '71 AJP

CONTRACT NUMBER DAAG01-71-C-0018

DESIGNED BY	DATE	THE DOW CHEMICAL COMPANY MIDLAND MICHIGAN	ACCOUNT NUMBER 1841-600
DRAWN BY [illegible]	DATE 9/11/71		JOB NUMBER PY575
CHECKED BY	DATE	WALL TIES - ITEMS No. 1 & 2	DRAWING NUMBER PY578-41D
APPROVED BY AJP	DATE 9-20-71		

Fig. 1

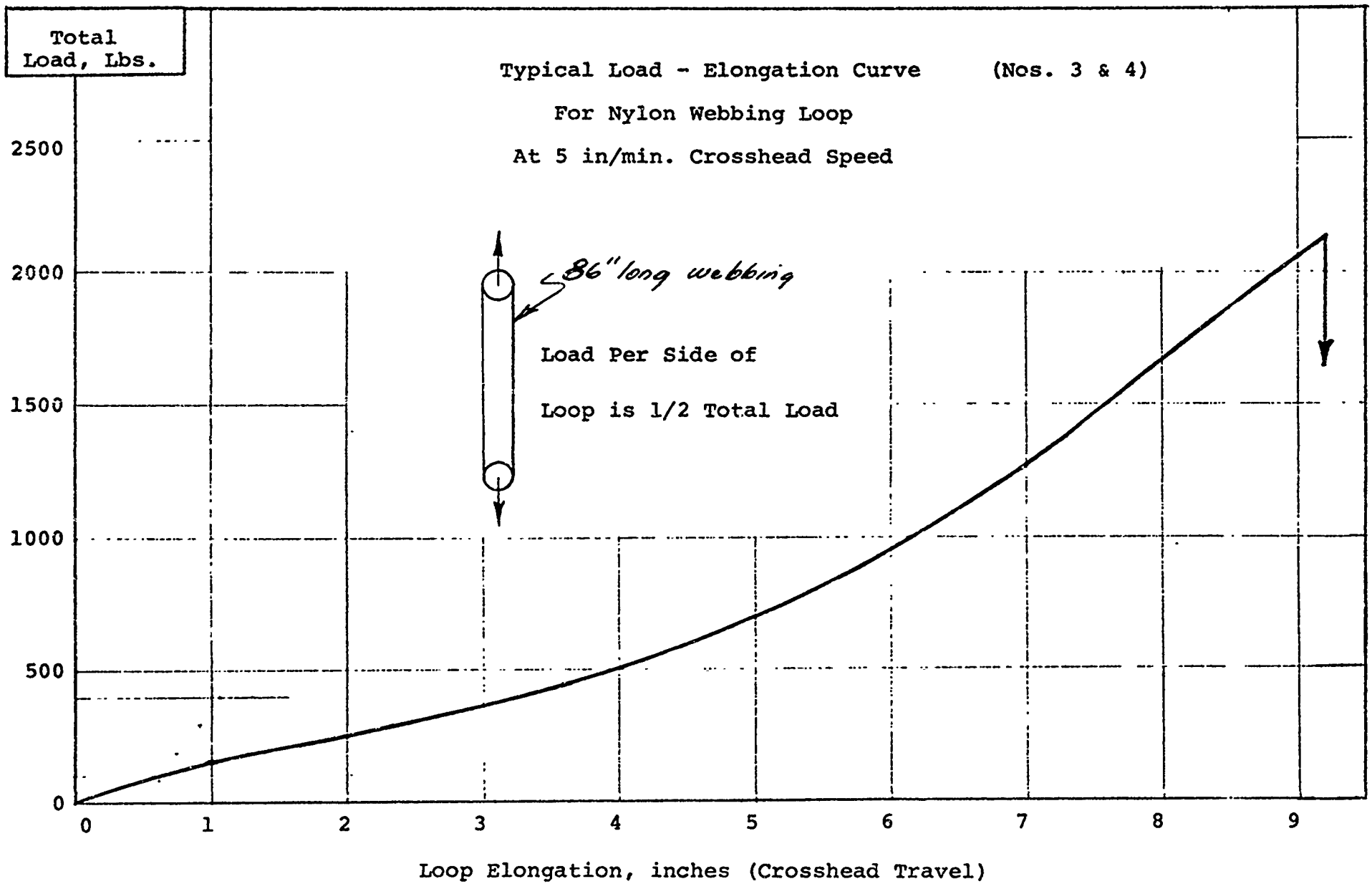


Fig. 2 - Webbing Used on NAD, Earle, N.J. Installation

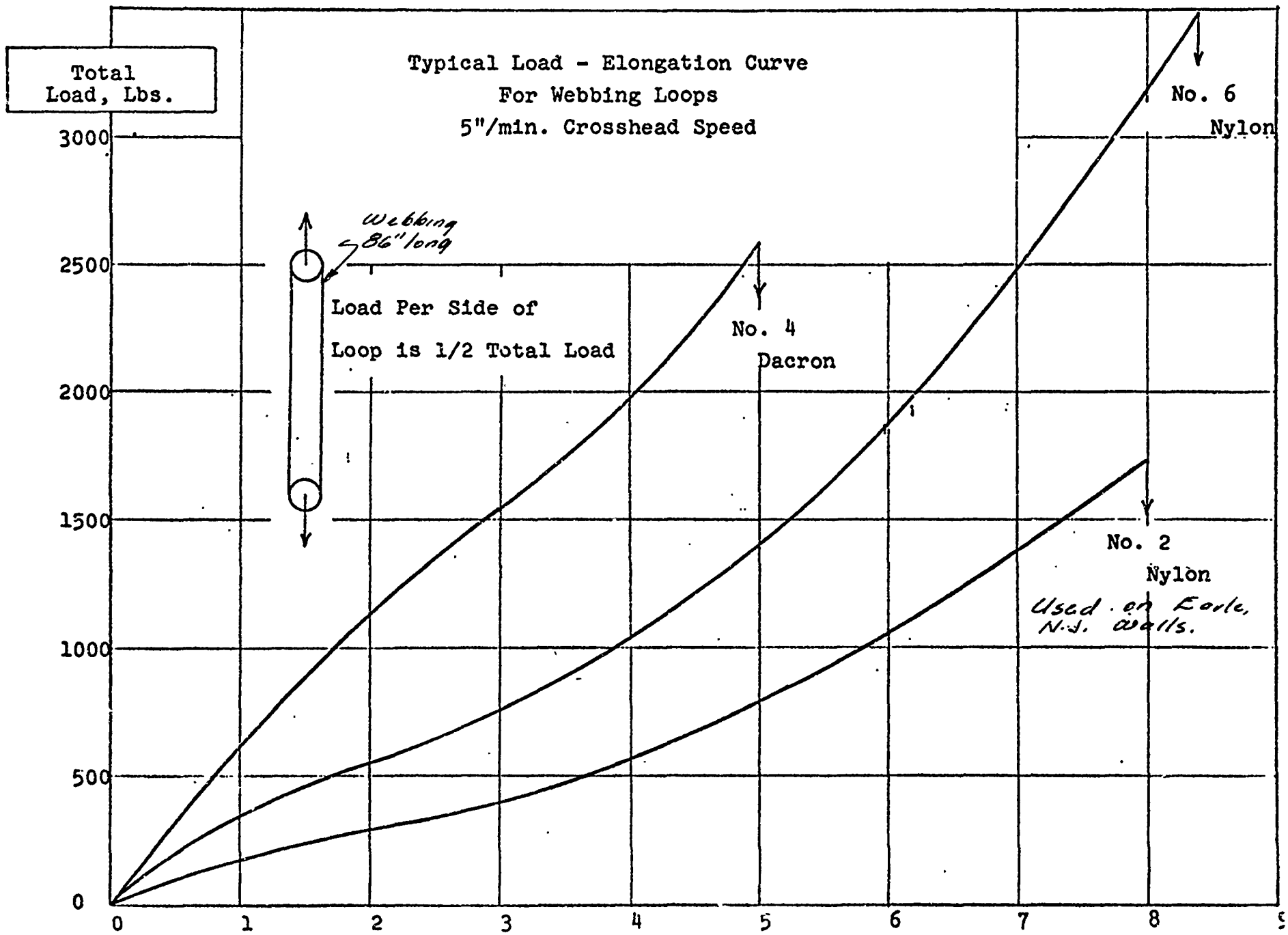


Fig. 3 - Loop Elongation, inches (Crosshead Travel)

Item	Description	Webbing Break Strength	* Sewn Break Strength	% Elongation
1	Nylon - Alliance Webbing, Inc. #AW8201, MIL-T-5038D, Type IV 1" Wide, 0.035" Thick, Olive Color	1048#	885#	21.6
2	Nylon - Aeroquip #30101 G 1" Wide, 0.045" Thick, Gray	---	1820	21.5
3	Dacron, Aeroquip #30200E 1" Wide, 0.060" Thick, Natural	---	1210	11.4

* Stitching Failures
Specimens were tested at a rate of 5 inches/minute

TENSILE TESTS OF NYLON/DACRON WEBBING

Figure 4

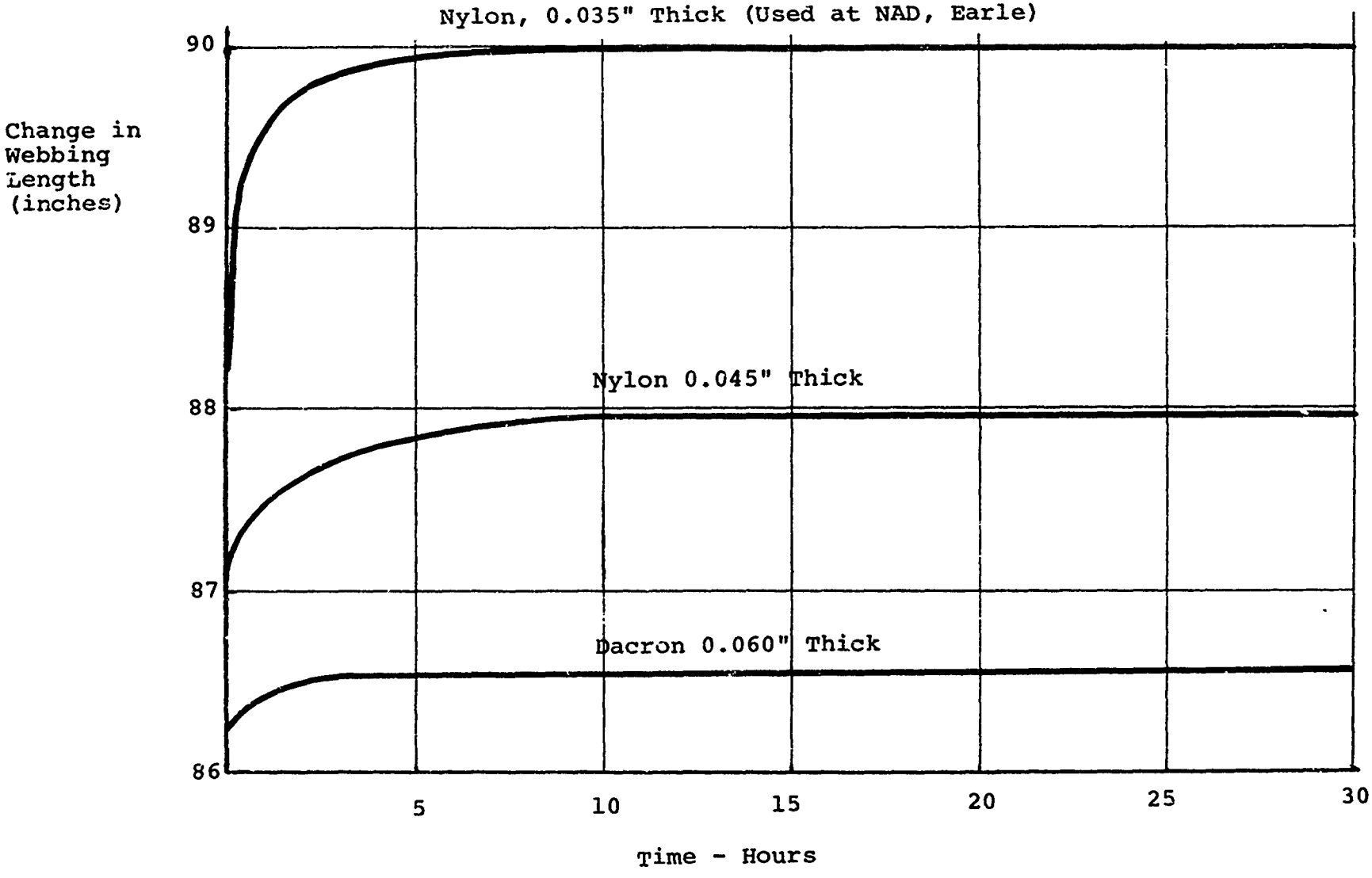


Figure 5- Creep Tests Of Nylon/Dacron Webbing With 160 Lb. Load Applied

ORD-0523C/457:CDM

[illegible] 1971

FIRST ENDORSEMENT on NAD Earle ltr 240:PVH:lcd of 3 Dec 1971

From: Commander, Naval Ordnance Systems Command
To: Mr. Bruce A. Russell, Project Manager, Dow Chemical Company
Midland, Michigan 48640

Subj: Contract No. DASA 01-71-C-0018. Installation of Prototype Protective Barrier System at NAD Earle

1. Forwarded.

Riley B. Lane

RILEY B. LANE, JR.
By direction

Copy to:
NAD Earle

TEL. 462-9800

IN REPLY REFER TO NO.

NAVAL AMMUNITION DEPOT EARLE
COLTS NECK, NEW JERSEY 07722

240:PVH:lcd

3 DEC 1971

From: Commanding Officer, Naval Ammunition Depot Earle
To: Mr. Bruce A. RUSSELL, Project Manager, Dow Chemical Company
Midland, Michigan 48640
Via: Commander, Naval Ordnance Systems Command, Code (ORD-08222)

Subj: Contract No. DASA 01-71-C-0018. Installation of Prototype Protective Barrier System at NAD Earle

Encl: (1) List of Personnel Present at Installation
(2) Drawing of Present Installation
(3) Photographs and Negatives of Installation

1. This report is forwarded for use in the preparation of the report being compiled by the Dow Chemical Company of the subject barrier installation. Enclosures (1), (2) and (3) are forwarded for information and use.

2. Subject installation was conducted commencing at 0730 26 October and completed at 1030 on 4 November 1971.

a. Equipment Used

(1) M-600 Bob Cat front end loader.

(2) 2 loading dock ramps.

(3) 5 KW light trailer to provide required electrical power.

(4) 3 banks of 3,200 watt lamps.

(5) 2 large floor fans.

(6) 1 enclosed blower for forced air through existing magazine vent.

(7) 1 fork lift.

(8) Shovels, brooms, knives and other small tools.

(9) Chalk line and measuring equipment.

b. Material Required

(1) 70 cubic yards of dry sand screened on a 20 mesh gauge screen with 0% retained.

(2) Canvas as required.

(3) Photographic equipment and supplies.

c. Personnel Required

(1) Project Officer, LT Paul V. HUEBNER

(2) Project Supervisor, GMTC Charles KOBLENZER

(3) 2 Ordnance Workers

(4) 2 Equipment Operators

(5) 4 Military Helpers

(6) 1 Photographer

d. Cost

(1)	Labor	$1,011.71
(2)	Overhead	5,617.20
(3)	Material	1,025.70
(4)	Total	$7,654.61

3. The basic material was positioned on Tuesday, 26 October 1971. After instructions and inventory of material, work was secured. On Wednesday, 27 October, four truck loads of sand were received from the South River Sand Company, using government owned trucks. It was unsatisfactory to use these trucks as they were used on other projects and large rocks, nuts and bolts were found in the sand. The South River Sand Company and the Zahn Trucking Company were contacted and the presidents of both companies came to the project site to find out the requirements. After careful consideration of all possible ways of moving sand, Mr. ZAHN said he could not feasibly modify his equipment to do this particular job on such short notice and the fact only one barrier would be installed. The idea of power operated equipment to put the sand into the barrier from the truck was a prime point, but being advised that the dust problem created in a confined space even with a separator and the length of ridged hose required, this idea was scrapped. The only feasible conveyance was the front end loader, Bob Cat M-600, which was in present use. The requirement to lift the load over a 91 inch high wall and fit through a six foot wide door required use of the M-600 and, in turn, would only allow the use of a small capacity bucket. The first attempts to convey the sand from ground level to the barrier by use of a ramp to the loading platform of the magazine required extensive time and maneuvering of the loader. A second ramp was obtained and the loaded truck was backed up the ramps onto the loading dock and the sand was dumped close to the door. This

provided an estimated 60% gain in time to deposit each load in the barrier. With the decrease in time the gasoline operated loader was out of the magazine, the carbon monoxide increased to 400 counts per million parts of air and required work stoppage. Two floor fans were obtained; one positioned at floor level and one at about four feet high at the door. In addition, the flow from the enclosed blower was reversed to force air into the magazine through the installed vent reducing the carbon monoxide to below 100 counts per million allowing work to proceed. Although the ventilation appeared to be adequate for the work being done, if a continuous supply of sand were available at the work site it is felt that the carbon monoxide level would again have increased to a danger point.

4. The material received from Dow Chemical was delivered Tuesday morning, 26 October, by truck. The material was palletized and had a cover sheet of plastic over it; nylon tape was used to keep it in place. The material was damaged on the first pallet as it had shifted in the truck. The extent of the damage was such that if a 10% overage had not been shipped the wall as prescribed in the assembly manual could not have been completed.

5. The barrier was designed to provide 16 six-foot bays which would be satisfactory at some storage areas. At NAD Earle the requirement for 12-foot bays exists and to provide a positive evaluation the size of bays was changed to accommodate all sizes of units to be stored at Earle. Enclosure (2) describes the present installation.

6. The material left over by the increase in the size of bays is such that four wing walls are available for use by other activities as a model for assembly and filling. These extra wing walls will be made available as directed by Naval Ordnance Systems Command.

7. Near the completion of the barrier, damage was sustained to the barrier when the front end loader struck the styrofoam and required the replacement of one board. Although during assembly this could be changed, problems would arise if the barrier had been completed. The present plans are now to glue heavy canvas on all corners of the barrier to help prevent damage while moving units in and out of the bays.

8. After completion, a check of the barrier for static electricity was conducted by Dow Chemical and negative results were received. The barrier was not sprayed with the detergent provided by Dow Chemical Company to remove static electricity.

9. At present, no evaluation can be made of the installed barrier. Some small leaks have been observed and were easily patched with plugs. At the completion of the installation it appeared the barrier would be far superior to sand bags for stability, neatness of storage and functional use.

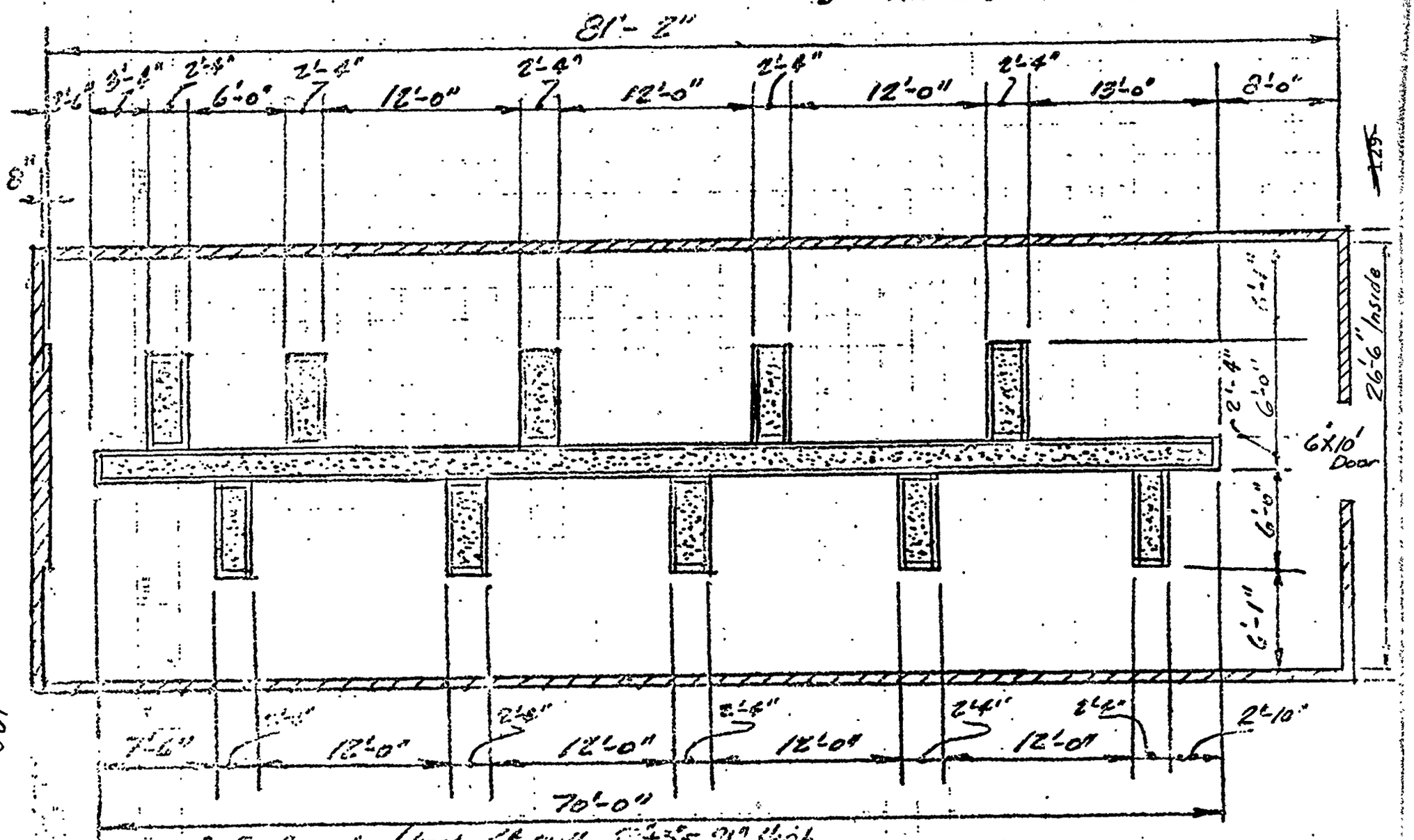
A. G. HAMILTON, JR.

LIST OF PERSONNEL PRESENT AT INSTALLATION

ALLEN, Garald F.	Dow Chemical Company
CHURCH, Wayne C. LT	WPN STA Charleston, S. C.
CURRY, R. K. CWO-2	NAS Cecil Field, Fla.
ECKERT, J. C.	POMFPAC, Keyport, Wash.
HAGAN, Daniel J.	NWS Seal Beach, Calif.
IWAISU, David K. LCDR	WPN STA Concord, Calif.
LAVALLET, Jack L. LTJG	NWS Yorktown, Va.
MEHARD, William LT	NAD Oahu, Hawaii
PALFEY, Albert J.	Dow Chemical Company
RUSSELL, Bruce A.	Dow Chemical Company
TRAYNOR, L. E. CDR	NAS Cecil Field, Fla.
STEVEN, M. E.	DIRECTOR, DNA, Washington, D. C.
DURDEN, R. C.	POMFLANT, Charleston, S. C.
MURDOCK, C. D. LCDR	NAVORDSYSCOM, Washington, D. C.
GIARDINA, J. A. LT	NAVORDSYSCOM, Washington, D. C.
HOWARD, T. C. MAJ, USA	FT Belvoir, Va.

Enclosure (1)

M-23, NRD, Earle, N.J. Plastic Form Retaining Wall
3" Thick Walls.



0.5 Cu yds / linear Ft wall 2'-3" High
1333 / lin Ft wall / linear Ft wall
2.75 cu. yds. / wing wall
27.5 + 35.0 = 62.5 cu yds.

N.J. Rdwy Exp. [illegible]

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