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ARMCO
AIR RAID SHELTERS
AND
MUNITION STORAGE MAGAZINES



Copyright 1941 By
THE ARMCO INTERNATIONAL CORPORATION
Middletown, Ohio, U. S. A.

FORWARD

A R M C O

AIR RAID SHELTERS AND MUNITION STORAGE MAGAZINES

A PRESENTATION OF DESIGNS

**COVERING STANDARD TYPES OF ARMCO AIR RAID
SHELTERS AND MUNITION STORAGE MAGAZINES**

**ARMCO DRAINAGE PRODUCTS ASSOCIATION
MIDDLETOWN, OHIO**

TECHNOLOGY
1027165

F O R E W O R D

Recent and vast increases in the range and striking power of aircraft make them almost universal in their action. Aerial squadrons can leap embattled armies and fleets to strike directly at cities and other vital areas far behind the lines of battle.

Anti-aircraft guns and fighter planes are not alone sufficient for defense. The area in which planes may operate is so great that it is difficult to intercept enemy bombers. In a determined air attack, many hostile planes are sure to reach their objective. Consequently, adequate air raid shelters must be provided for civilians, factory personnel and troops behind the lines of battle.

London and other English industrial cities are a case in point. Attack after attack has broken through a highly efficient and formidable defense system. Yet thanks to air raid shelters, civil and industrial life continues at a nearly normal pace. Without air raid shelters, demoralization of the civilian population would be much more severe, and national war effort would be greatly impaired.

There are many types of air raid shelters. On the following pages are designs for standard ARMCO Air Raid Protection units now in actual use. They include shelters for:

1. The protection of civil populations and troops stationed behind the actual lines of battle.
2. Storage of munitions and other supplies.
3. Combined pedestrian underpasses and air raid shelters — structures useful in both peace and war.

ARMCO Air Raid Shelters and Munition Storage Magazines are made in accordance with methods that have been followed for years on drainage and earth retention projects throughout the world. They are produced by mass production methods from standard materials, which means prompt delivery, maximum economy and speedy field erection. Once the emergency is over they can readily be converted to peaceful use as culverts, stream enclosures, storm sewers, conduits, small bridges, storage shelters and similar structures.

A R M C O A I R R A I D S H E L T E R S

For the protection of civilians, air base ground crews and troops

AMPLEY STRONG YET LIGHT IN WEIGHT

EASY TO ERECT ★ ECONOMICAL

PORTABLE ★ HIGH SALVAGE VALUE

ARMCO AIR RAID SHELTERS

DRAWING 411-H

A standard type of shelter unit that readily lends itself to mass production, prompt fabrication and delivery, and speedy field erection. Its full-round, flexible, corrugated metal design assures safe strength under heavy protective fills.

DESCRIPTION

BARREL: ARMCO Corrugated Nestable Culvert Type Structure, 72 or 84-inch standard diameters. Number 8 or 10 U. S. Gauge recommended for 72-inch diameter, number 8 for 84-inch. Lengths supplied in increments of one foot, with 25 feet recommended as standard. Shipped complete with assembly bolts and special tools for erection.

END WALLS: Fabricated from ARMCO Steelox Panels. Front wall furnished with door, rear wall without door. Shipped complete with tie rods and turnbuckles for securing end walls to pipe structures.

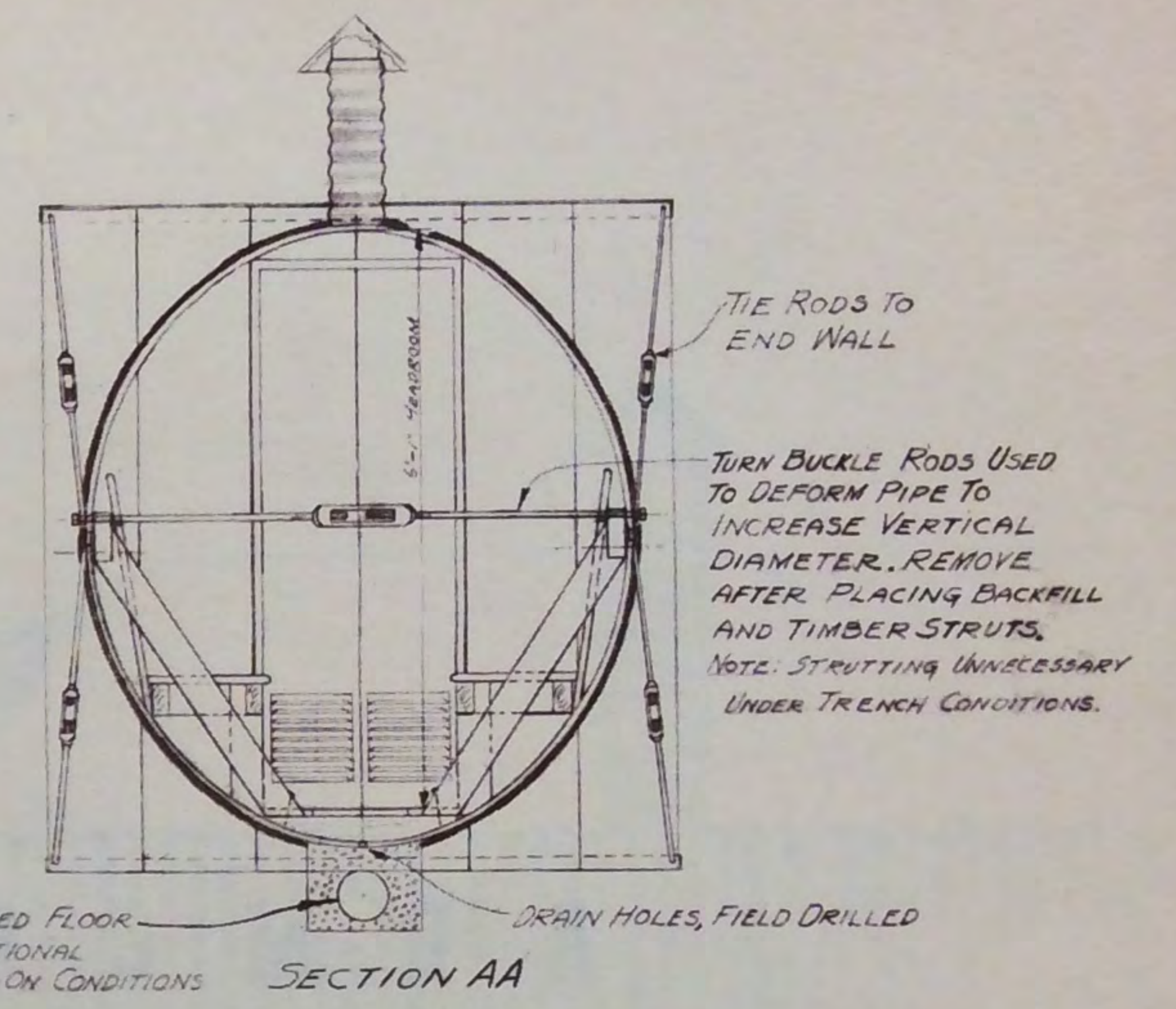
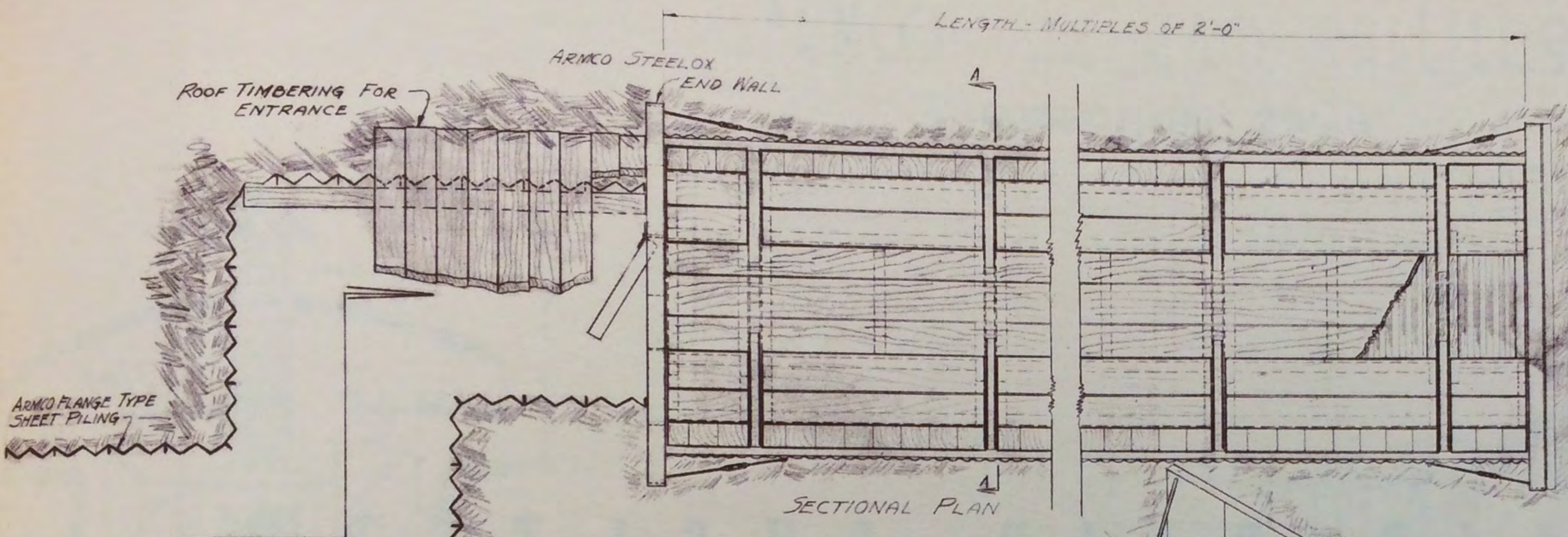
ENTRYWAY BULKHEAD: A typical entry using ARMCO Flange Type Steel Sheeting is shown on the drawing.

VENTILATOR STACKS: ARMCO Spiral Welded Pipe, 12-inch diameter, with adapter stub welded to barrel structure. Supplied with necessary covers and bolts. Number of ventilators depends upon size and capacity of structure.

SHIPMENT AND ERECTION: All parts shipped knocked-down and nested for export in bundles of convenient size for storing and handling. Structures can be erected easily and quickly using only hand tools. Erection drawings supplied with each shipment.

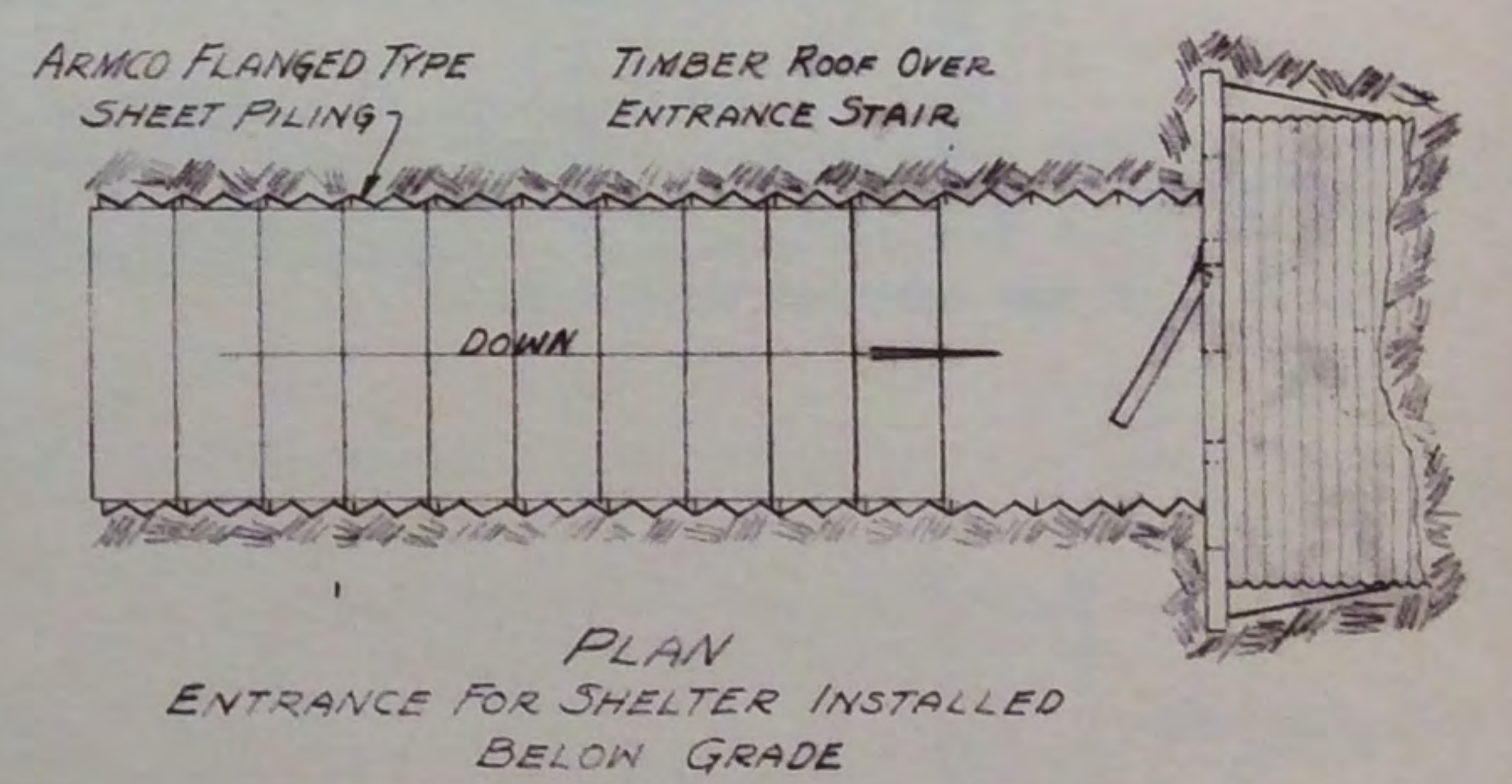
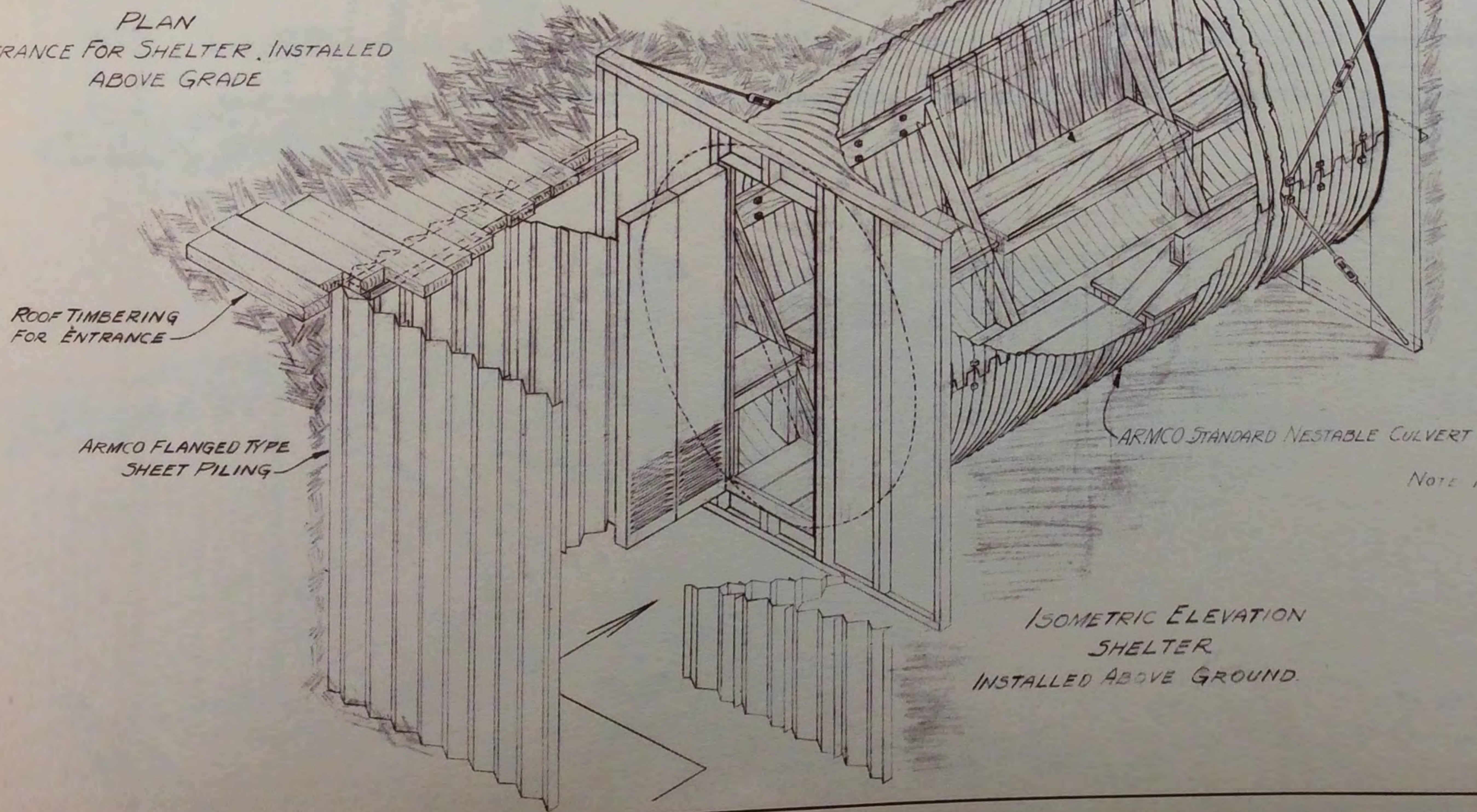
COATING: Any or all of the above material can be supplied galvanized or with non-metallic, protective coating at customer's option.

NOTE: Where the terrain is such that shelters can be installed in hillsides, tunneling with ARMCO Liner Plates is recommended as a speedy, economical method of erection. See drawings 4124-PR and H-227 for two types of shelters utilizing ARMCO Tunnel Liner Plates.



PLAN
ENTRANCE FOR SHELTER, INSTALLED
ABOVE GRADE

INTERIOR WOOD CONSTRUCTION BY OTHERS



NOTE FOR DETAILS OF ESCAPE TUNNEL
SEE DRAWING No 4137-N

THE ARMCO INTERNATIONAL CORP.		
ENGINEERING AND CONSTRUCTION DIVISION		
ARMCO 72" Ø NESTABLE PIPE AIR RAID SHELTER		
DESIGNED BY: WCB	DATE: 1/30/41	DRAWING NO: 411-H
SCALE: 3/4" = 1'-0"	SCALE: 1/2" = 1'-0"	

A R M C O A I R R A I D S H E L T E R S

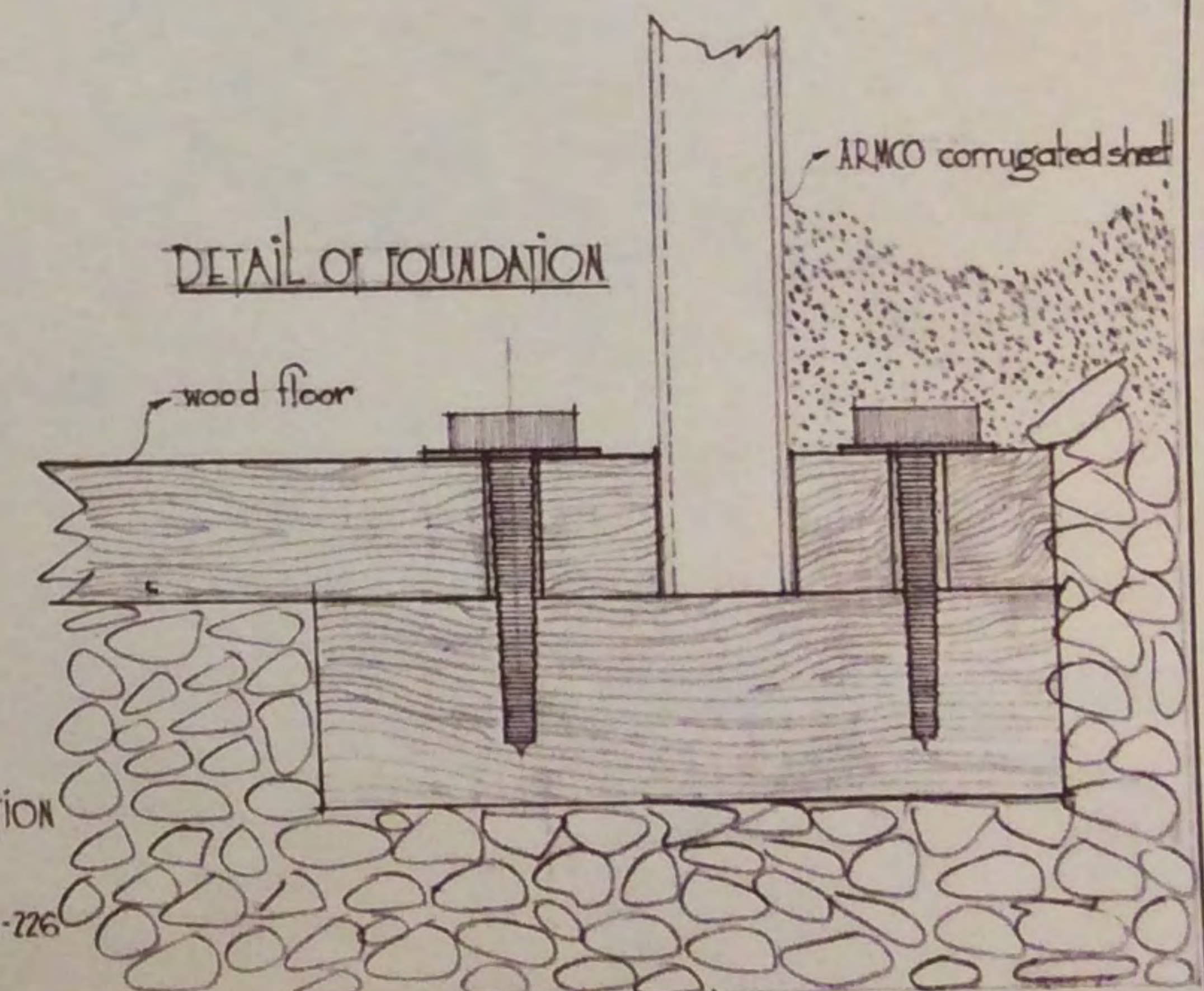
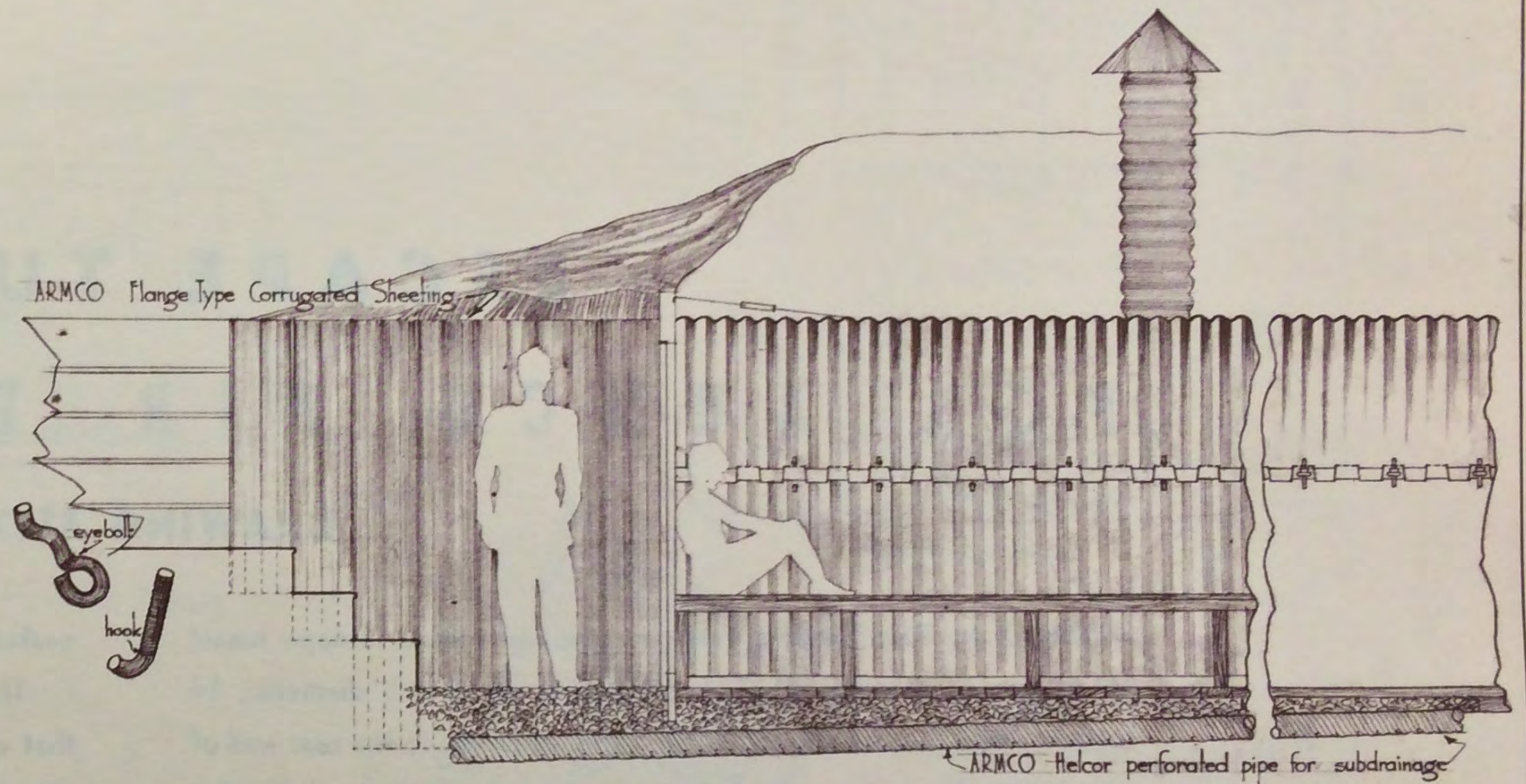
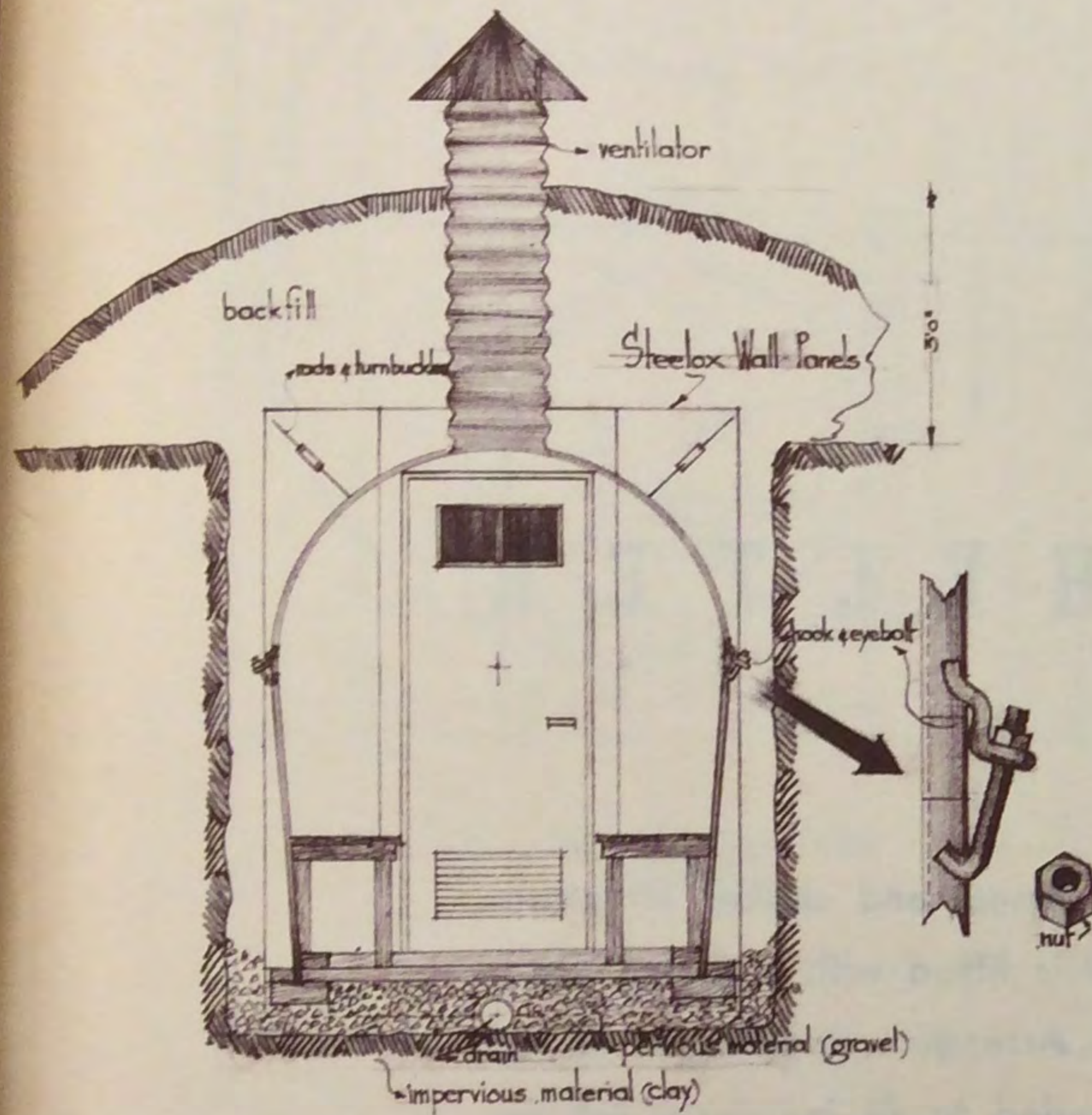
DRAWING H-226

An alternate design using straight sidewalls rather than the full-round construction. This structure does not provide quite the strength of the

one shown in drawing 411-H, although it is sometimes preferred because its arch construction provides a slightly larger floor area.

ARMCO AIR RAID SHELTERS

CORRUGATIONS $2\frac{2}{3}'' \times \frac{1}{2}''$



THE ARMCO INTERNATIONAL CORPORATION
 MIDDLETOWN, OHIO
 ENGINEERING DIVISION
 A. D. C. 1946 DRAWING H-226

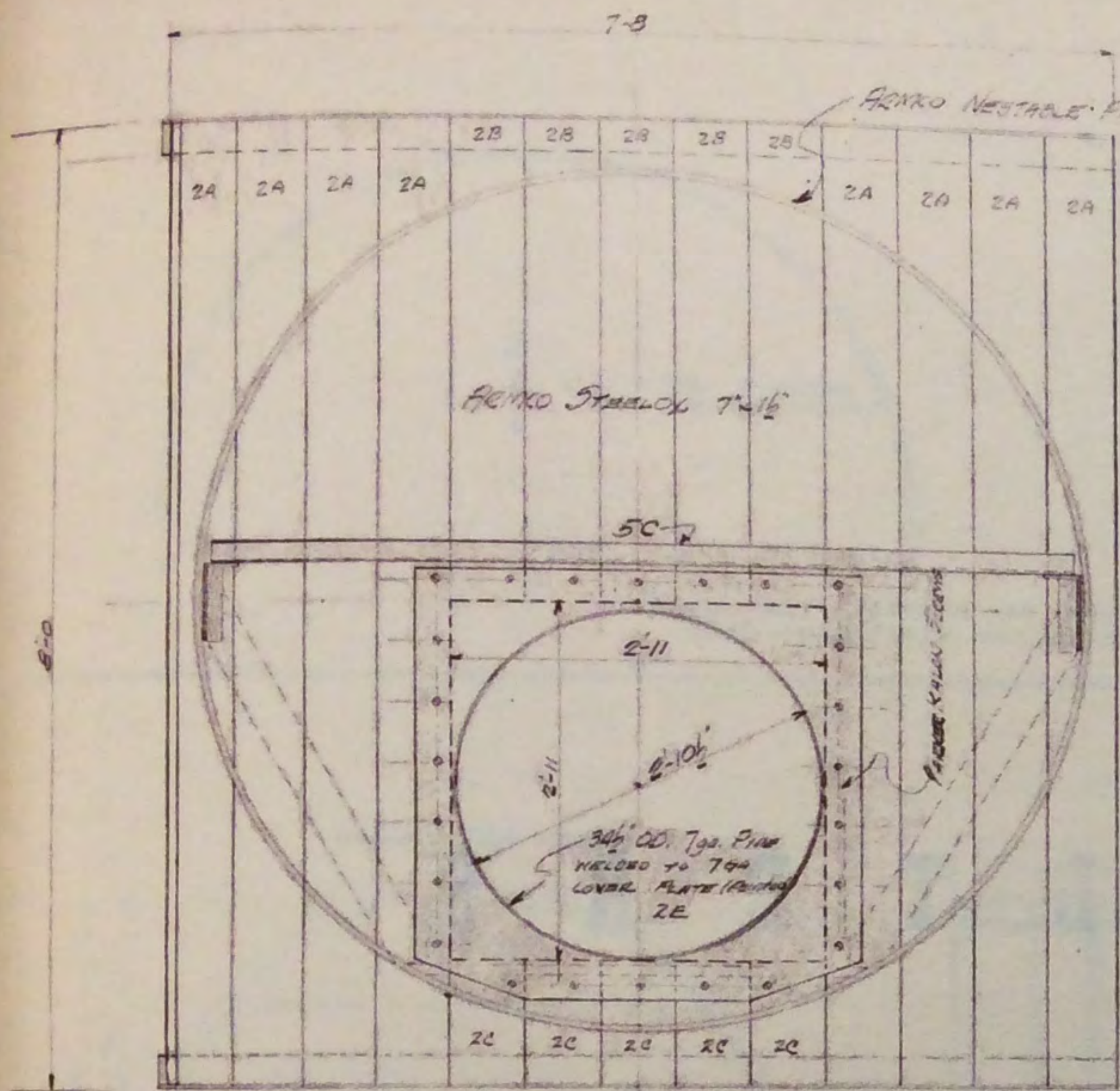
ESCAPE TUNNEL FOR ARMCO AIR RAID SHELTER

DRAWING 4137-N

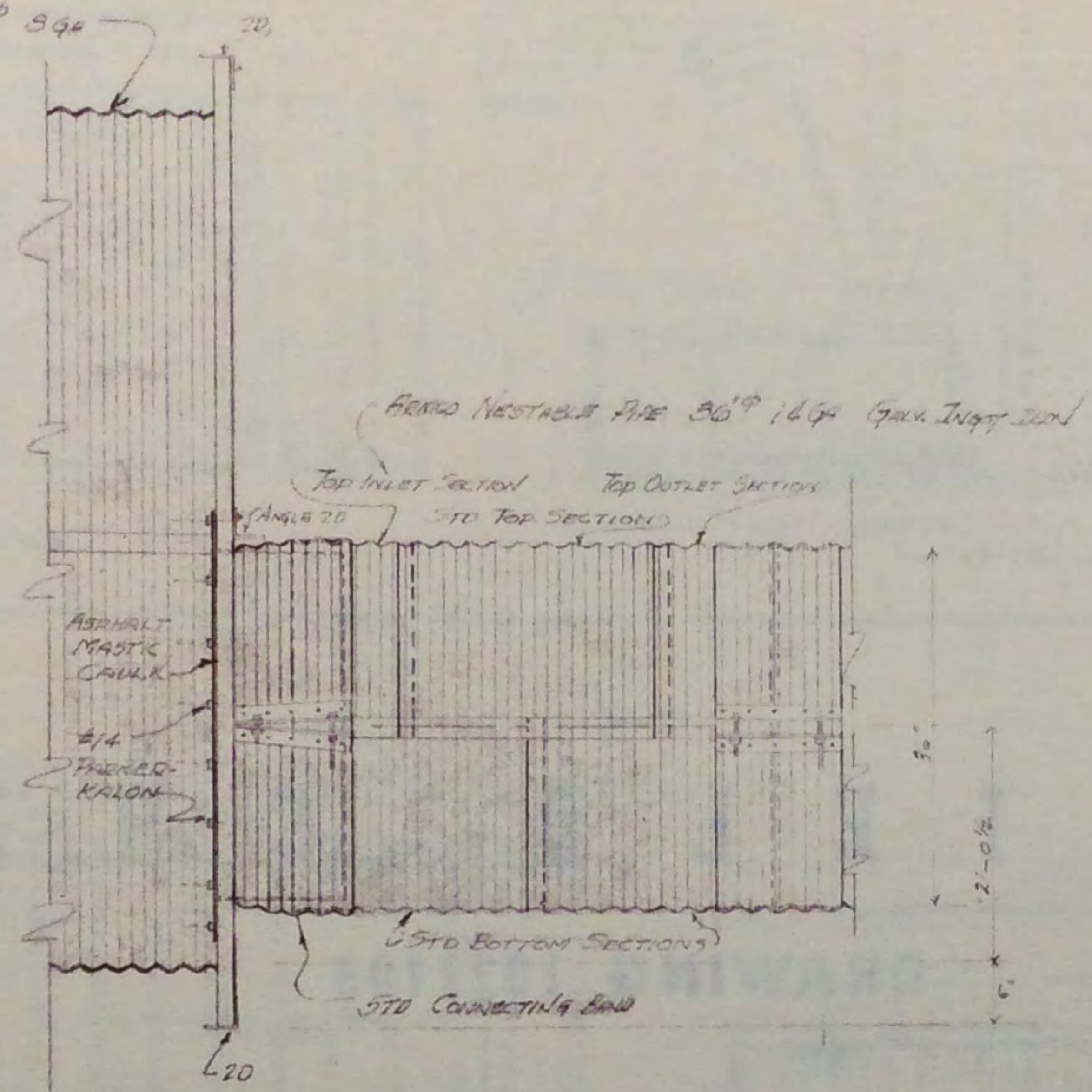
ARMCO Air Raid Shelters may be equipped with an escape tunnel as shown in drawing 4137-N. It consists of 36-inch diameter, 14 gauge, corrugated nestable culvert pipe, attached to the rear wall of the shelter by a corrugated connecting band and a 7 gauge, flat metal cover plate equipped with welded stub. A mastic coated

gasket assures a tight joint between tunnel and shelter structure.

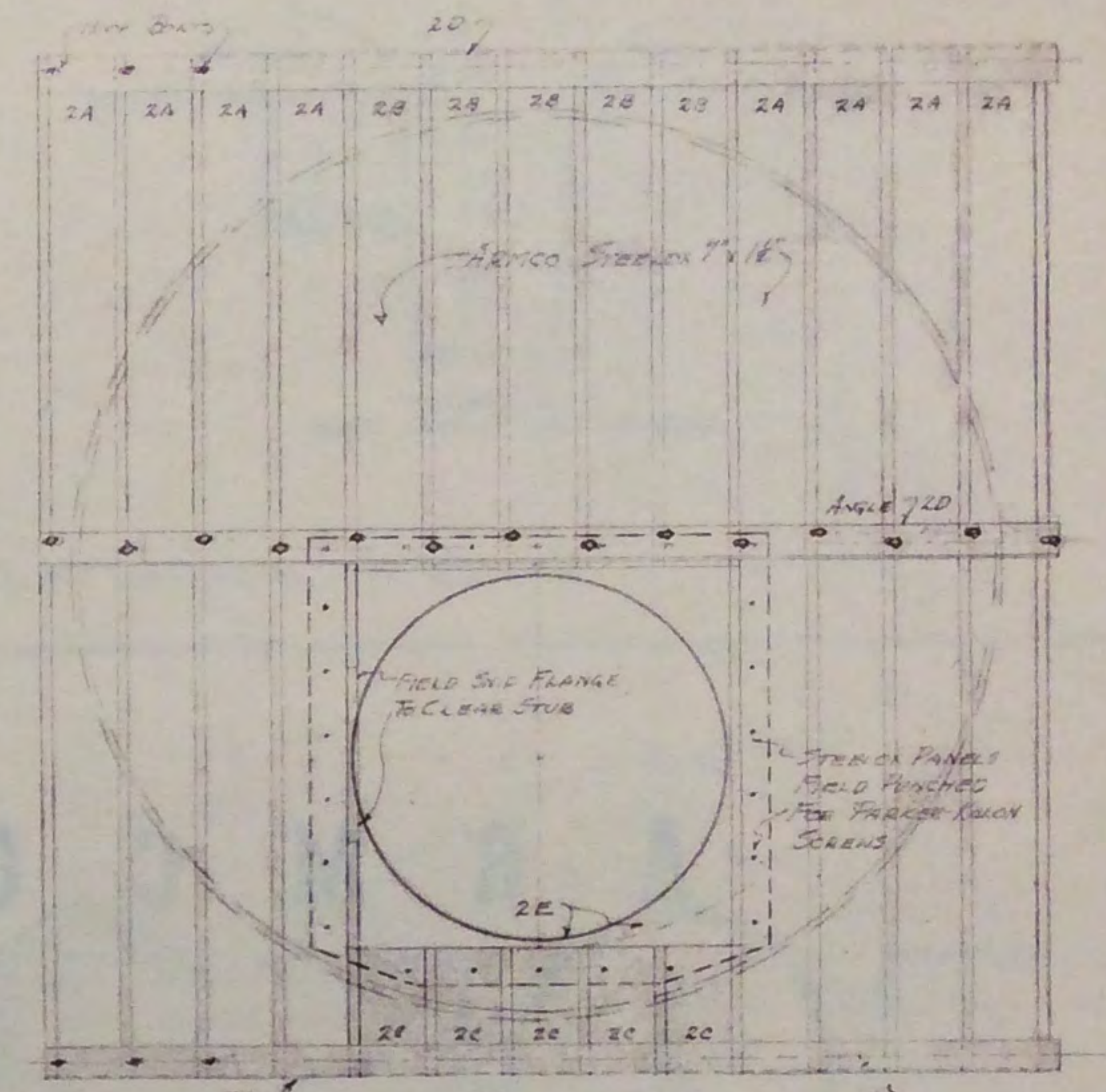
The exit end of the escape tunnel is fitted with a Calco Gate that can readily be opened or closed. Arrangement as shown on the plan is typical although this may be varied to fit individual job requirements. Easily attached to other types of air raid shelter units.



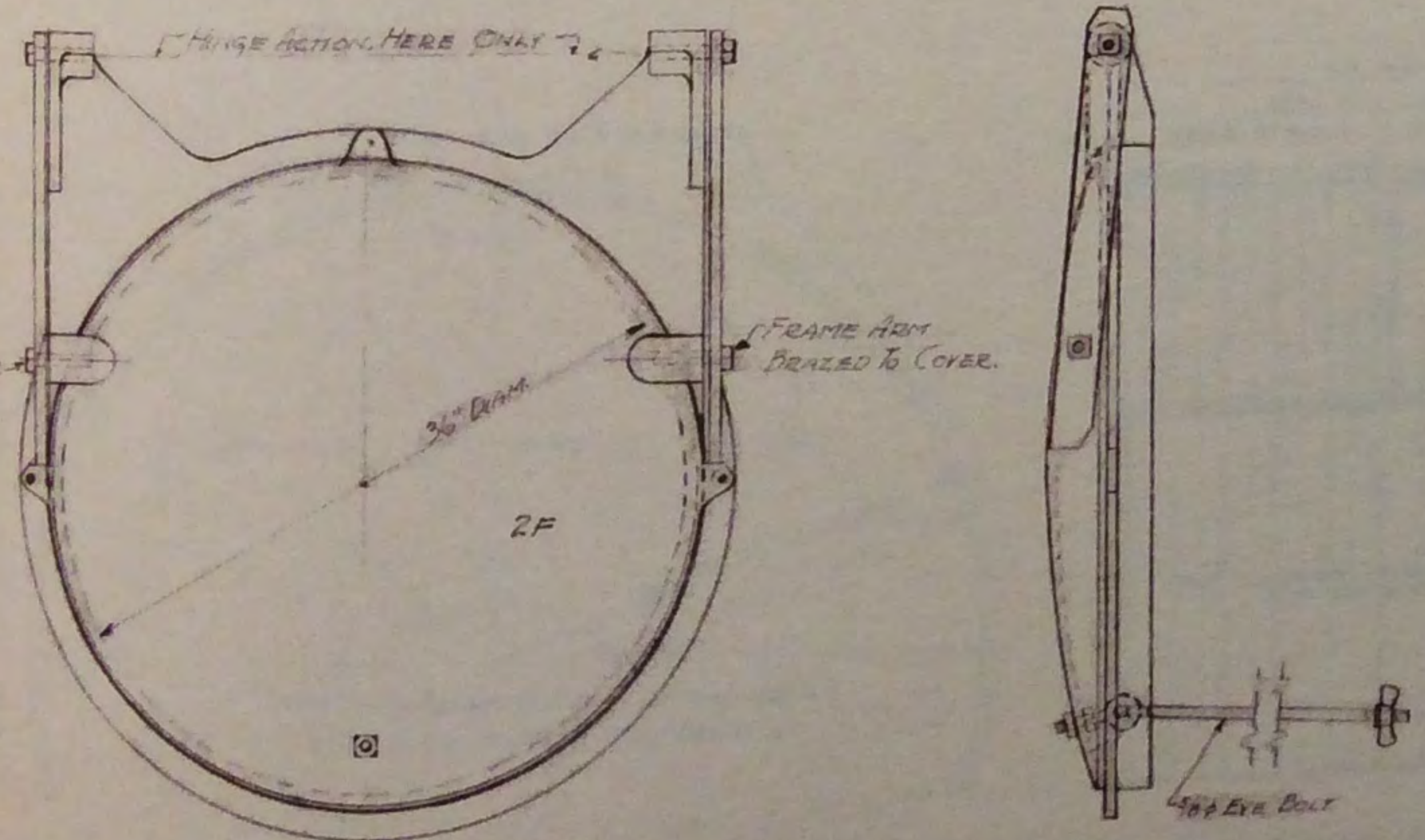
INSIDE ELEVATION
Scale 1/2"=1'-0"



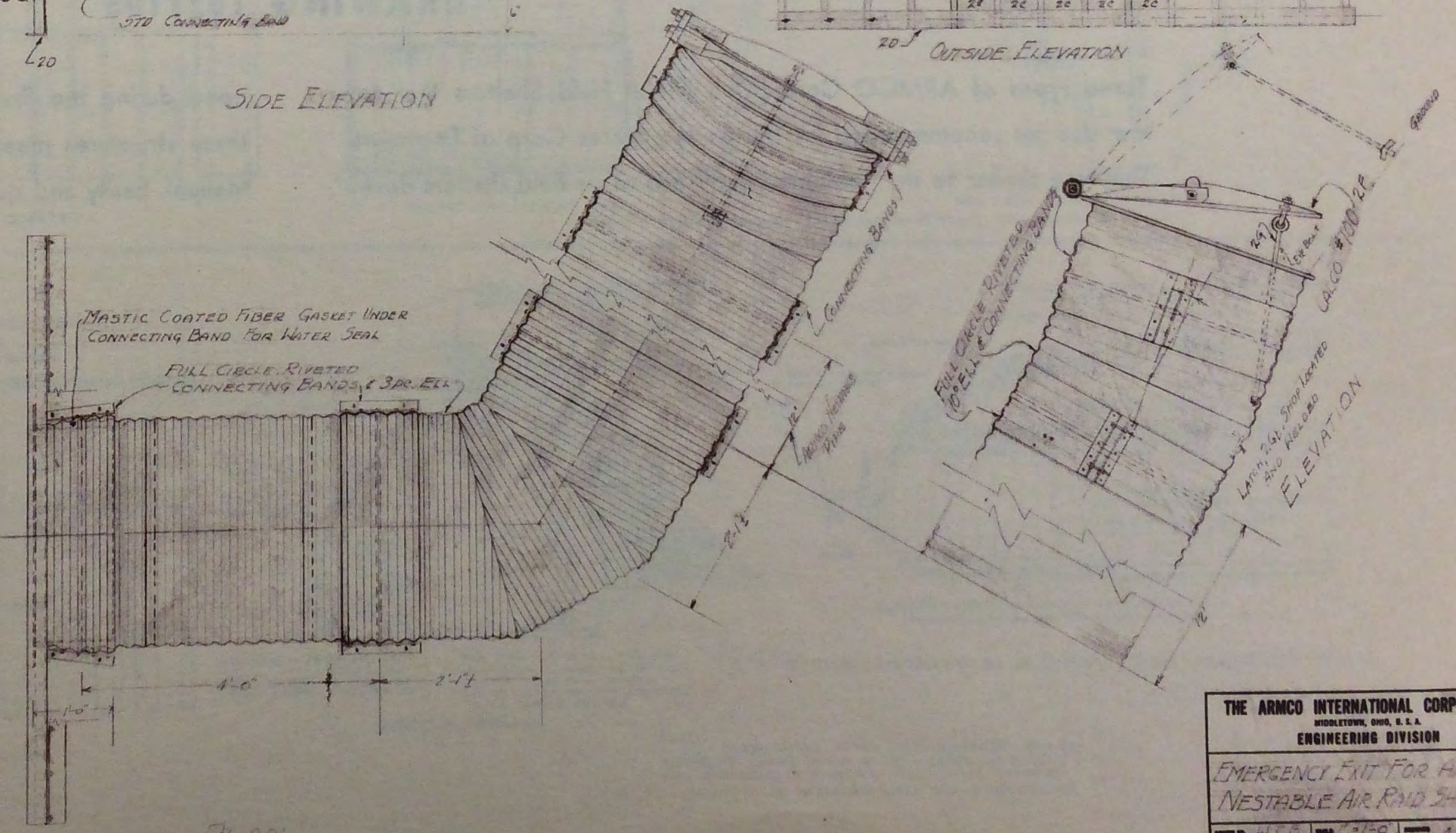
SIDE ELEVATION



OUTSIDE ELEVATION



ELEVATIONS, 36" ARMCO CALCO #100 GATE
SCALE 1/2"=1'-0"



PLAN

THE ARMCO INTERNATIONAL CORPORATION
MIDDLETOWN, OHIO, U. S. A.
ENGINEERING DIVISION

EMERGENCY EXIT FOR ARMCO
NESTABLE AIR RAID SHELTER

DATE: 11-1-40
DRAWN: T.L.S.
CHECKED: 11-1-40

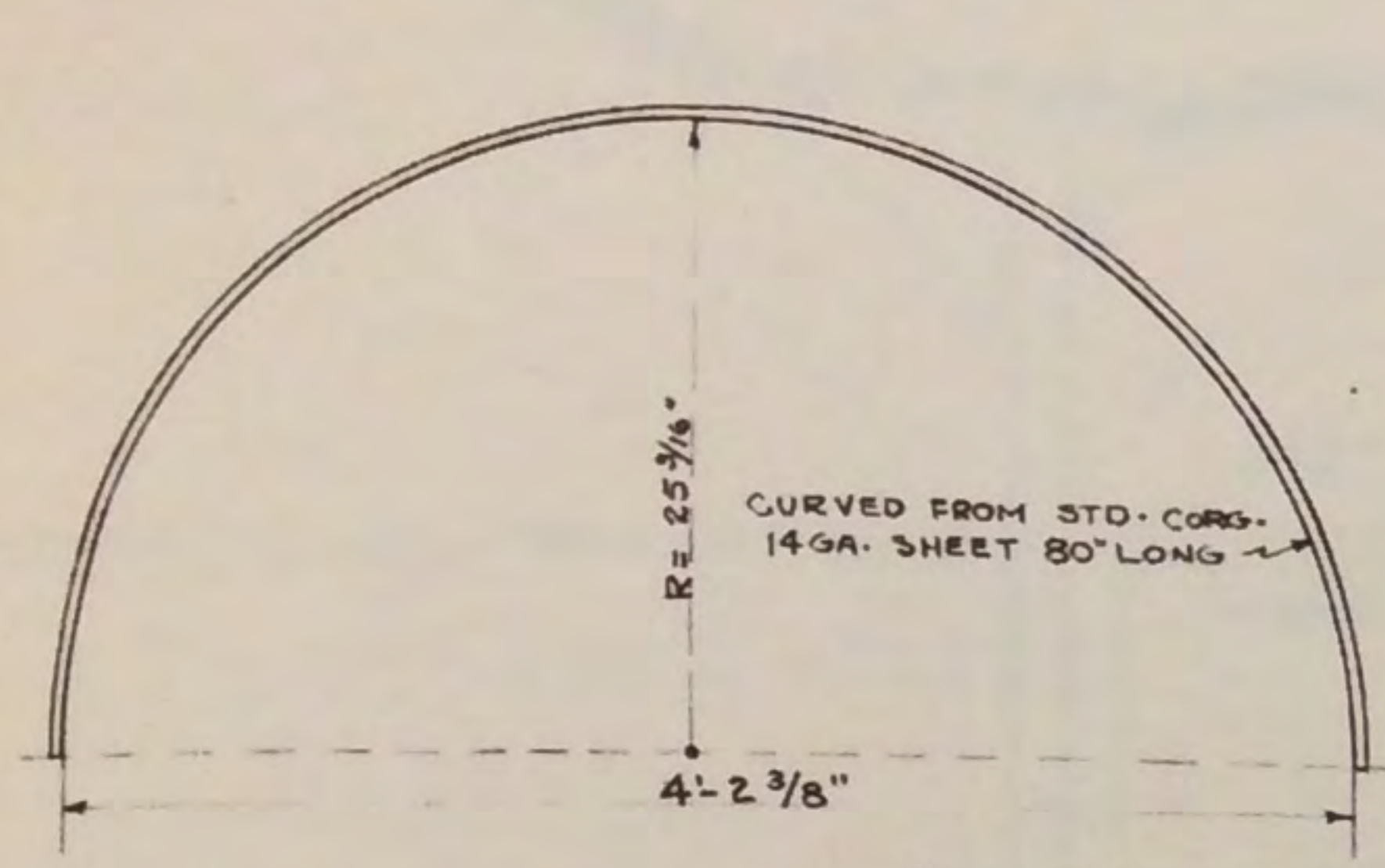
4137-N

A R M C O F I E L D S H E L T E R S

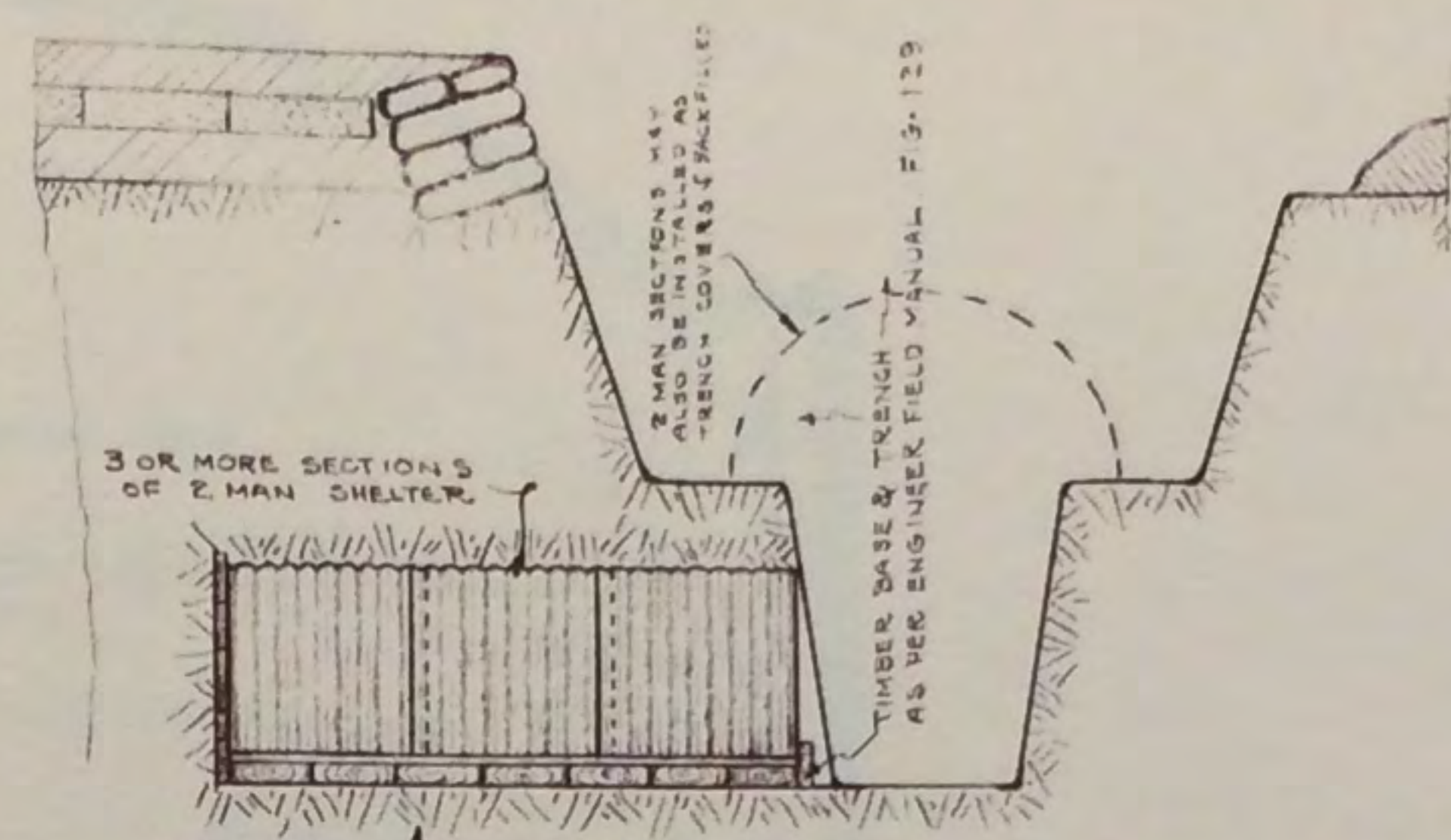
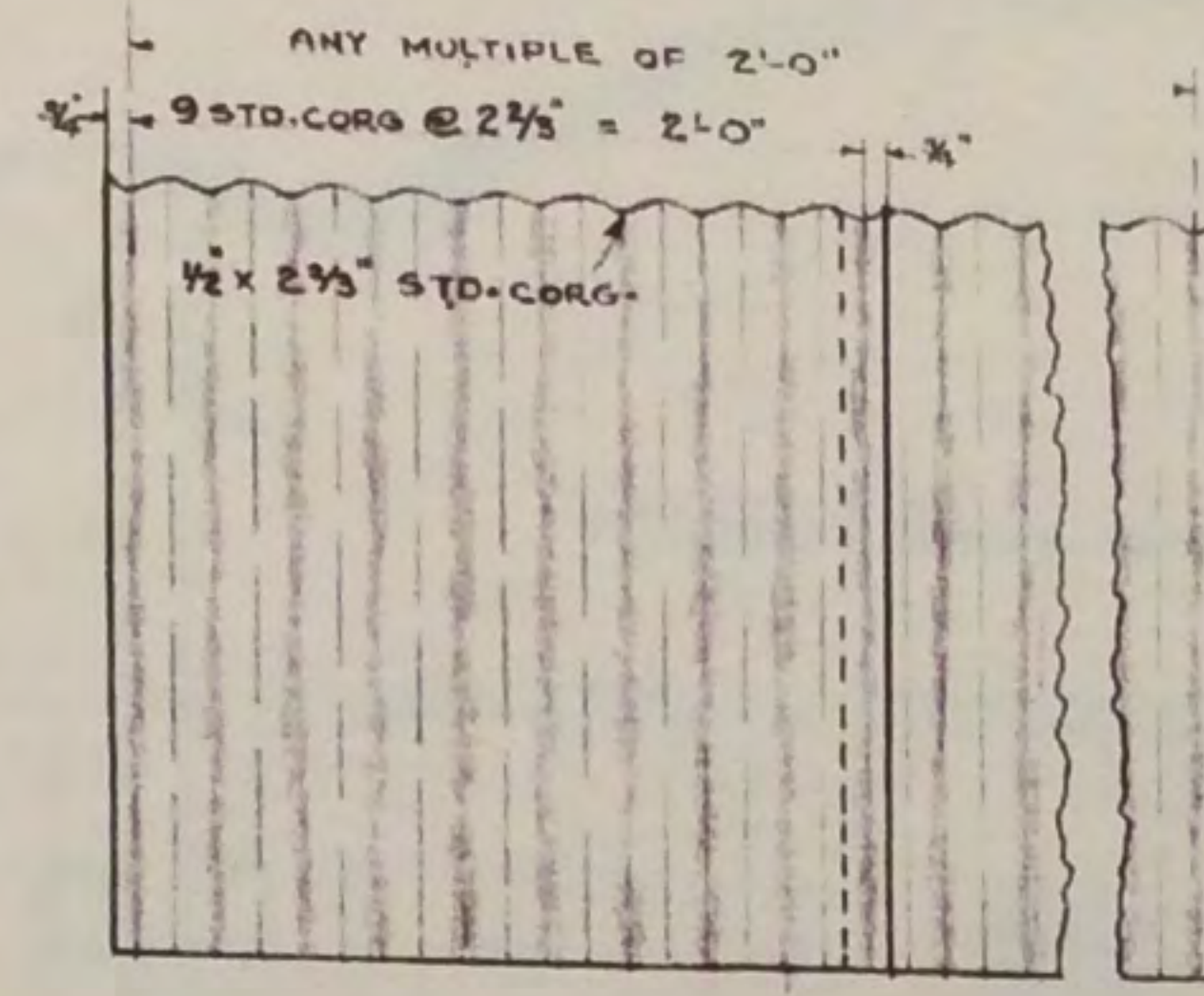
DRAWING 1021103

Three types of ARMCO Corrugated Metal Field Shelters that follow designs recommended by the United States Corp of Engineers. They are similar to the "elephant iron" and other field shelters devel-

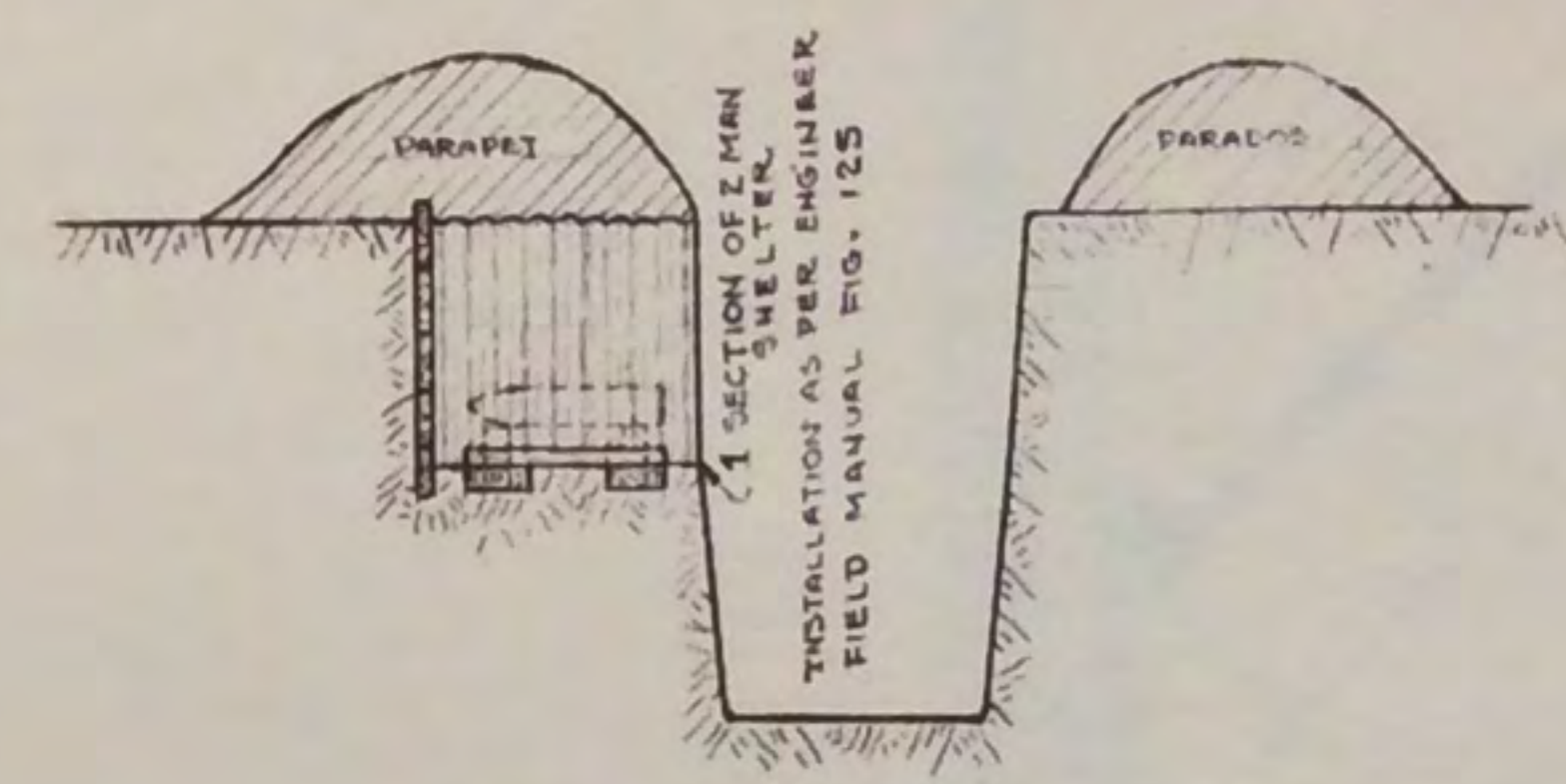
oped during the first World War. In their strength and application these structures meet all requirements set forth in the Engineer Field Manual. Easily and quickly field-assembled as circumstances demand.



Z MAN SPLINTERPROOF OR LIGHT SHELTER
CORR. METAL ARCH SECTIONS

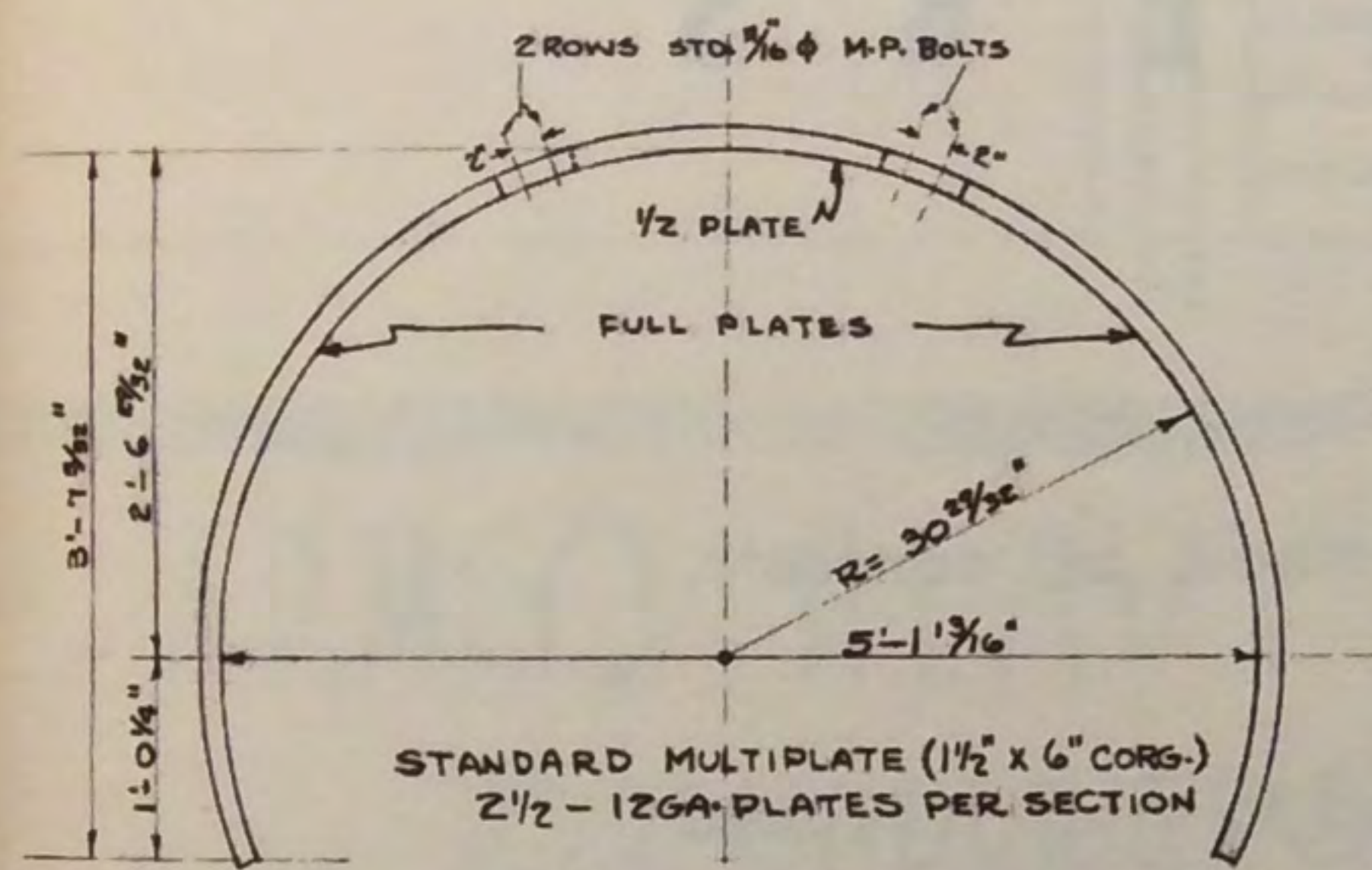


ELEVATION - LIGHT SHELTER

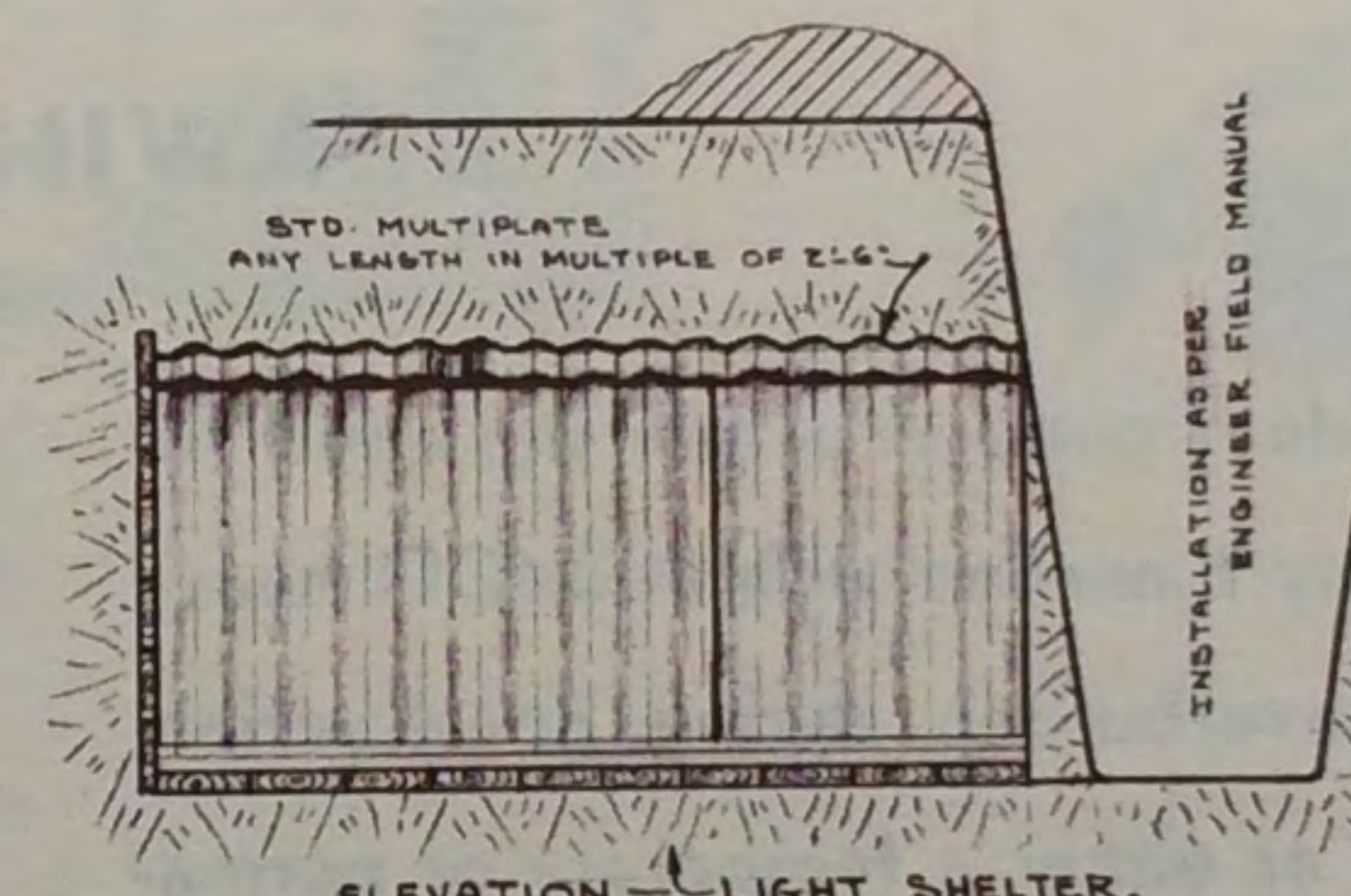
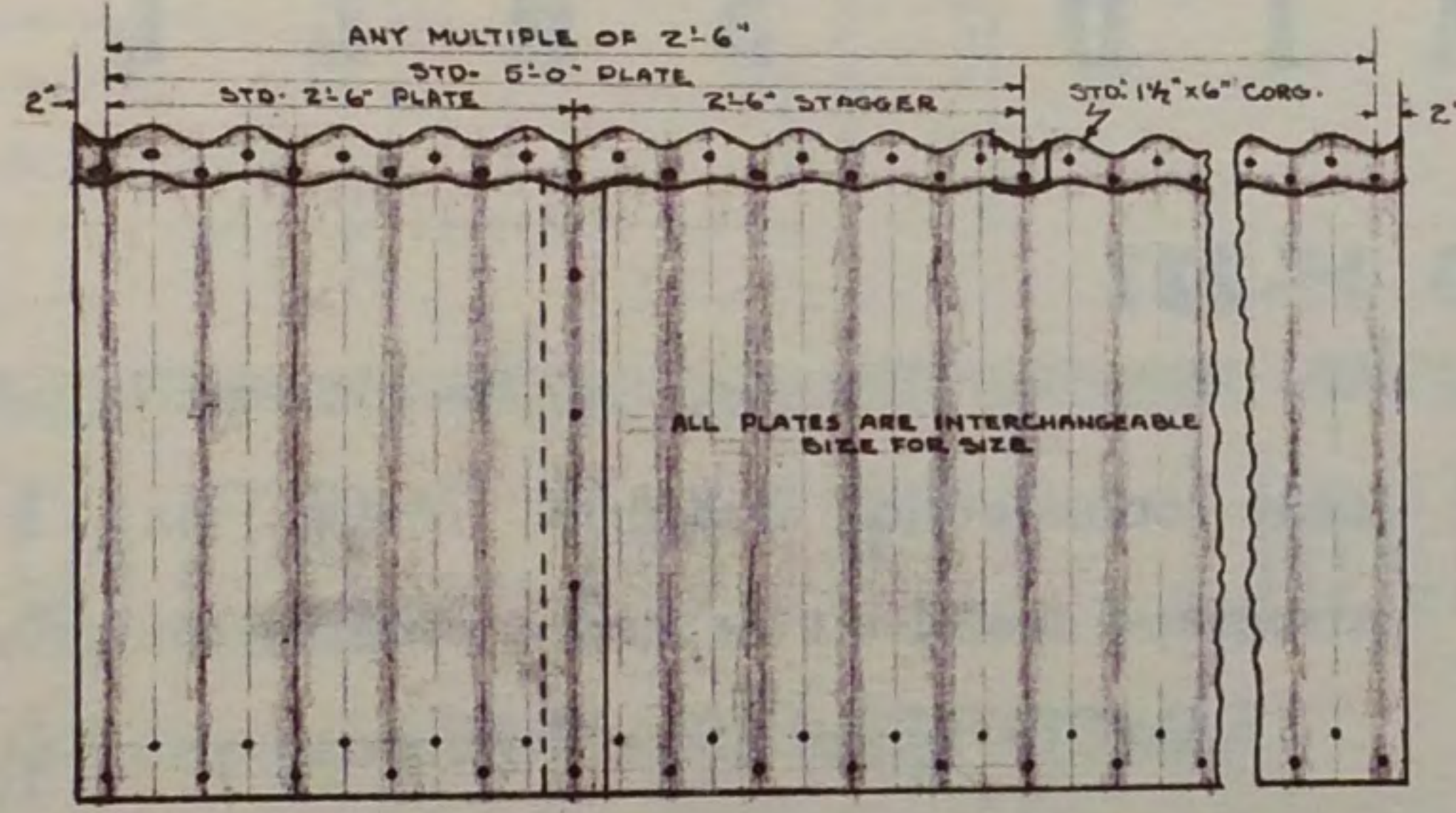


ELEVATION
75 M.M. AMMUNITION STORAGE

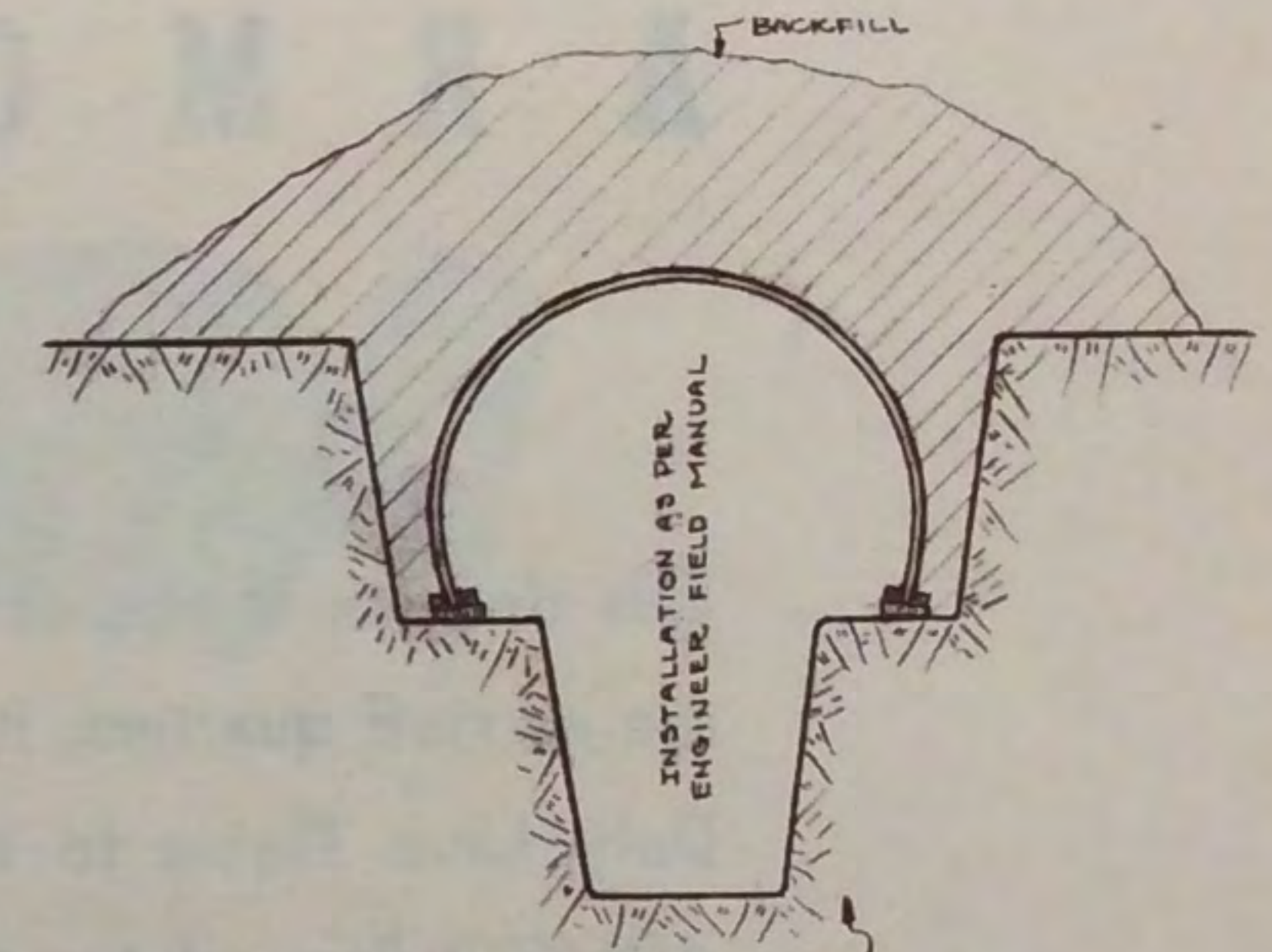
TYPICAL INSTALLATIONS OF "Z MAN" CORR. METAL ARCH SECTIONS



LIGHT ELEPHANT TYPE SPLINTERPROOF OR LIGHT SHELTER

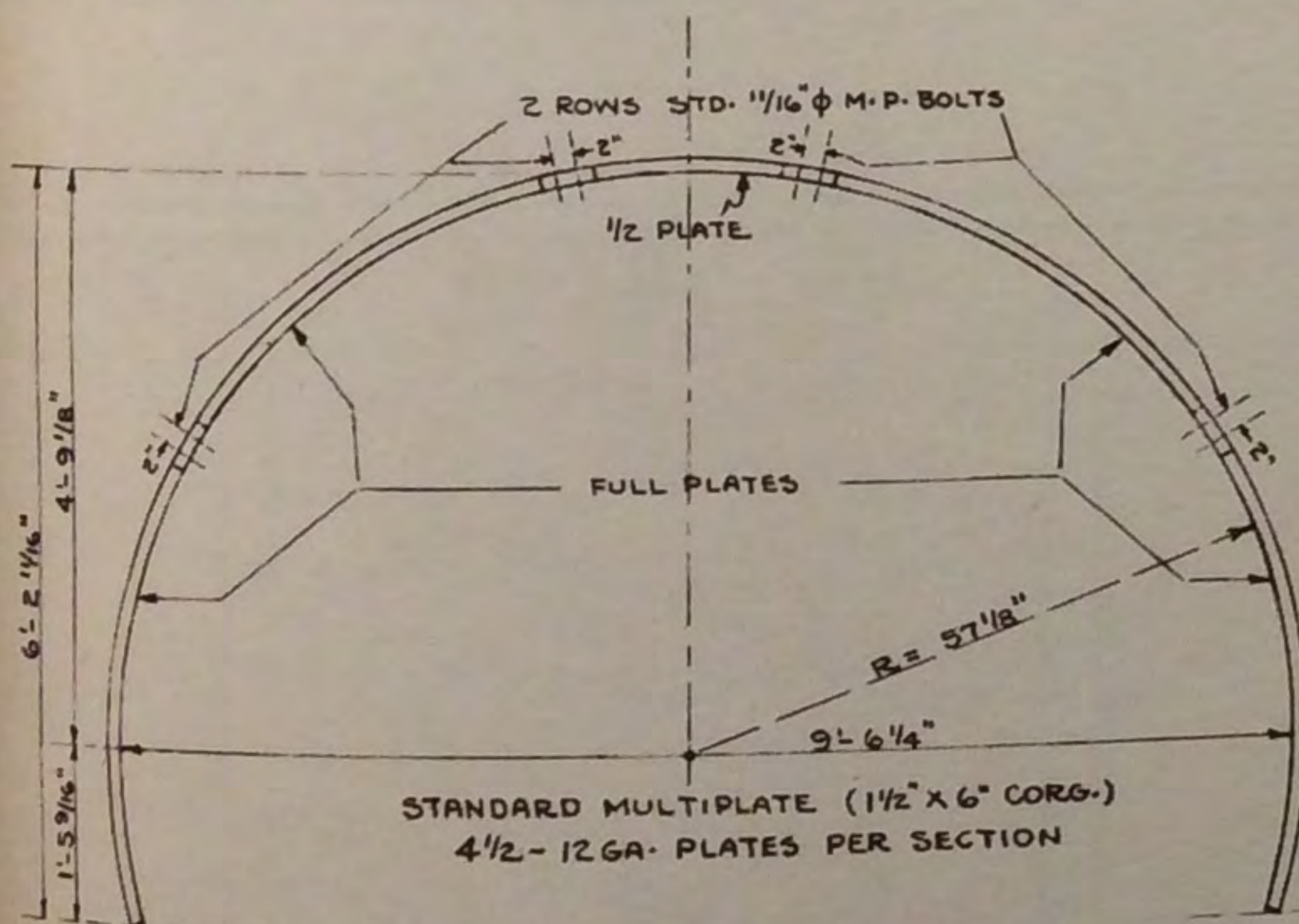


ELEVATION - LIGHT SHELTER

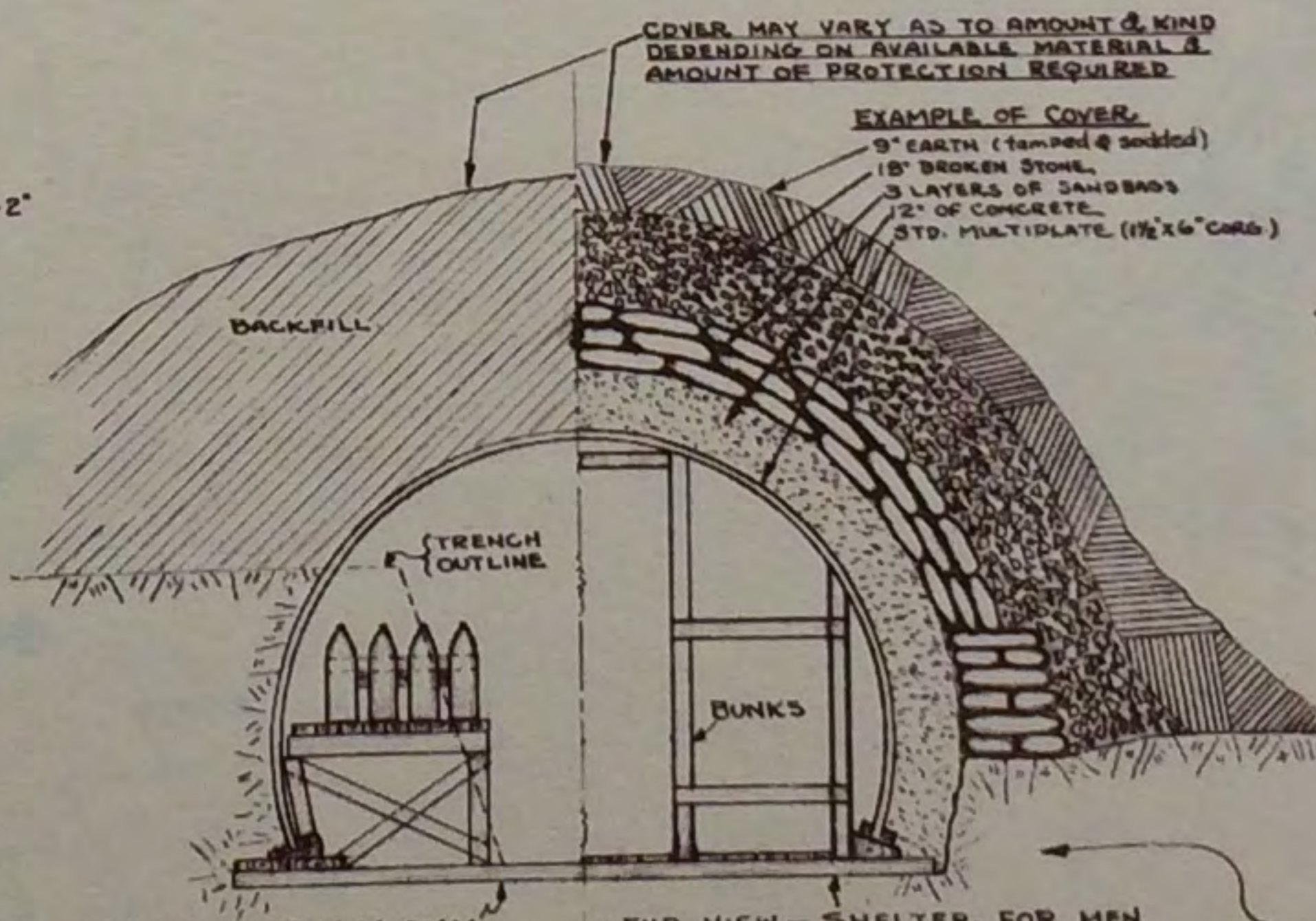
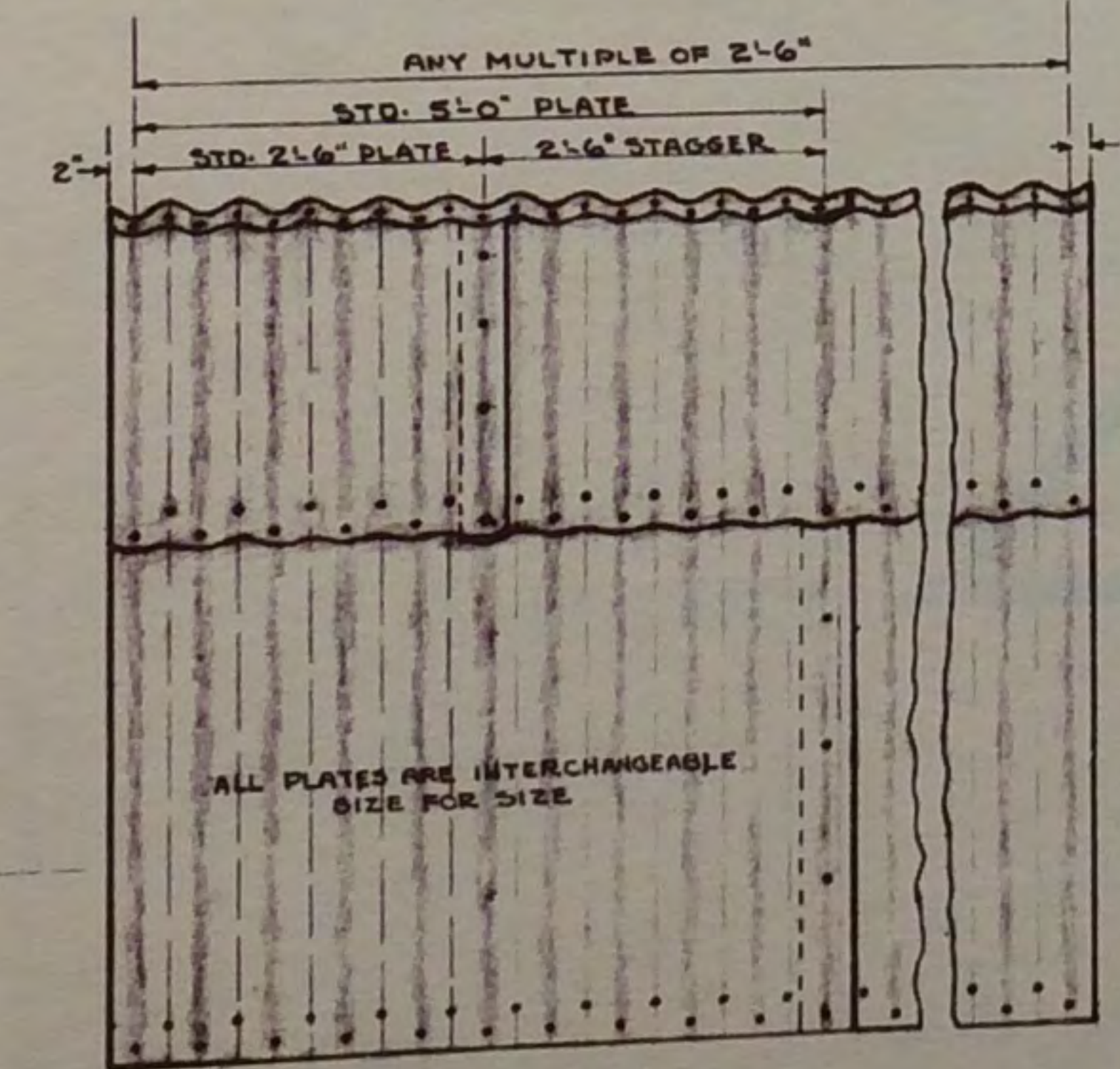


END VIEW - TRENCH COVER

TYPICAL INSTALLATIONS OF "LIGHT ELEPHANT TYPE" MULTIPLATE ARCHES



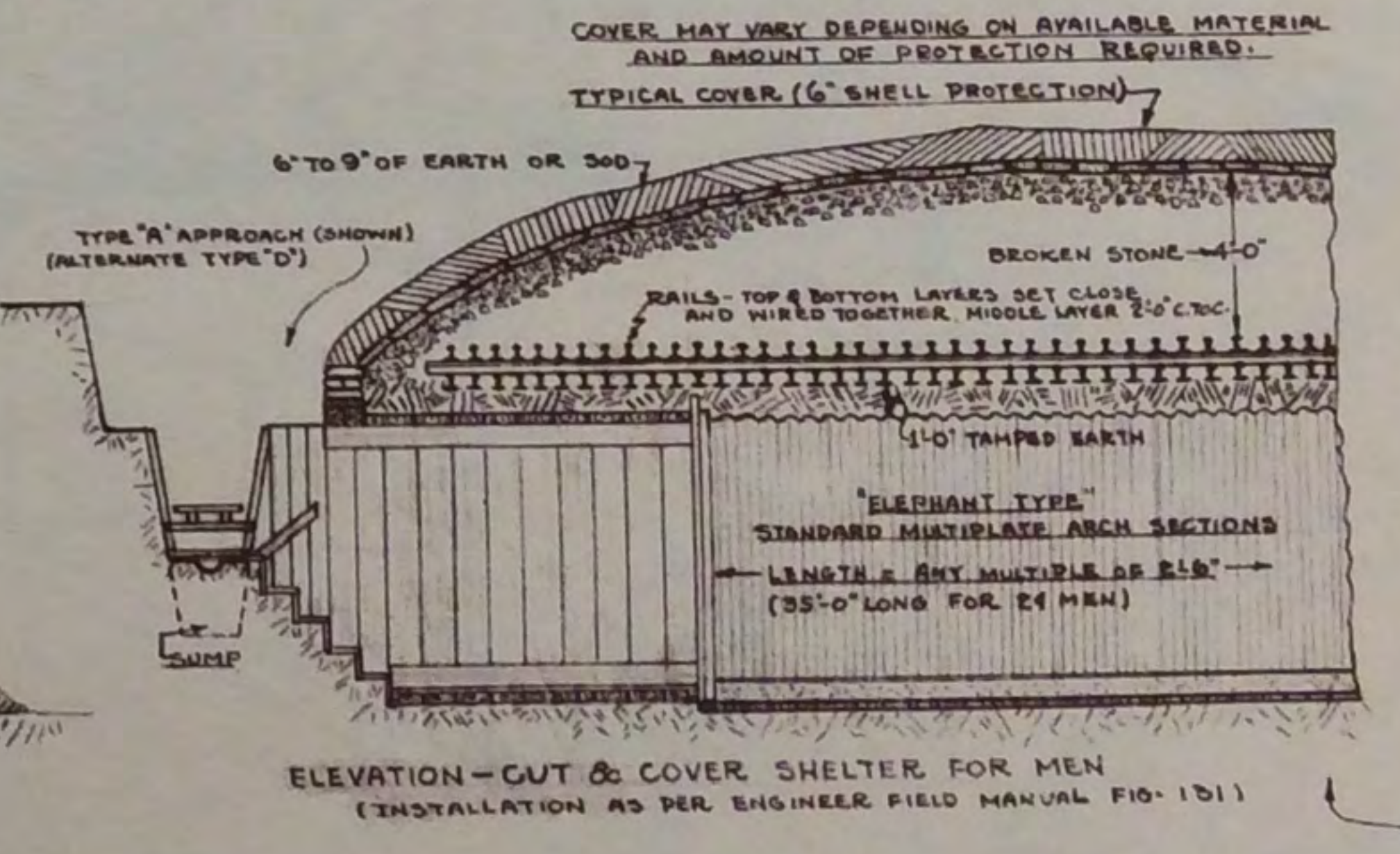
ELEPHANT TYPE - LIGHT SHELLPROOF SHELTER



END VIEW - 155 M.M. AMM. STORAGE
INSTALLATION AS PER ENGINEER FIELD MANUAL FIG. 126

SURFACE SHELTER

END VIEW - SHELTER FOR MEN
(ANY LENGTH IN MULTIPLES OF 2'-6")
(17'-6" LONG FOR 12 MEN)
INSTALLATION AS PER ENGINEER FIELD MANUAL FIG. 125



ELEVATION - CUT & COVER SHELTER FOR MEN
(INSTALLATION AS PER ENGINEER FIELD MANUAL FIG. 151)

TYPICAL INSTALLATIONS OF "ELEPHANT TYPE" MULTIPLATE ARCHES

NOTE
ALL CORRUGATED METAL ARCH MATERIAL FOR ALL SHELTERS SHOWN SHALL BE GALVANIZED OR COATED WITH ONE SHOP COAT OF SUITABLE PROTECTIVE COATING SEAMS TO BE WEATHERPROOFED WHERE NECESSARY

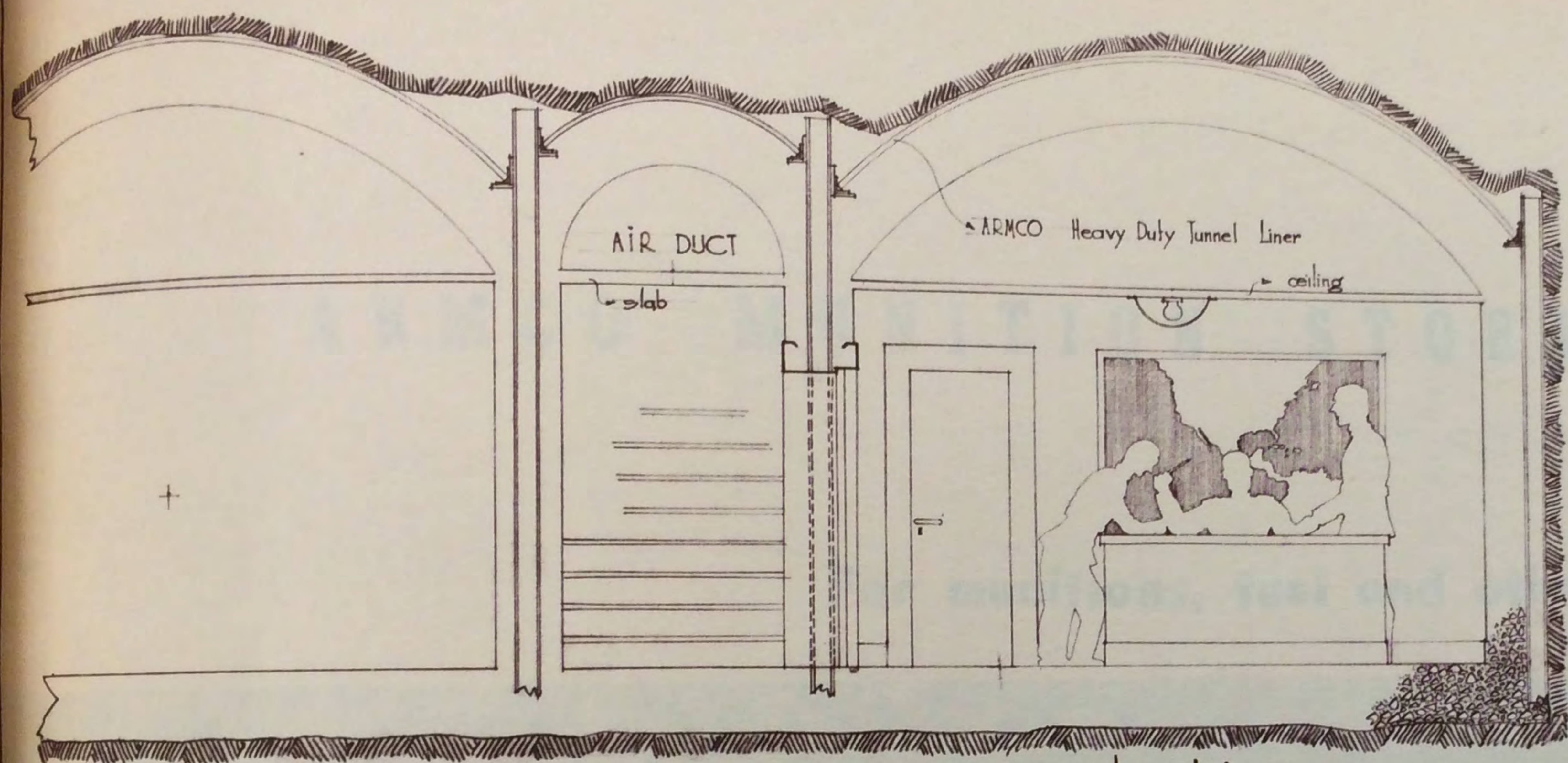
ARMCO AIR RAID SHELTERS

DRAWING H-227

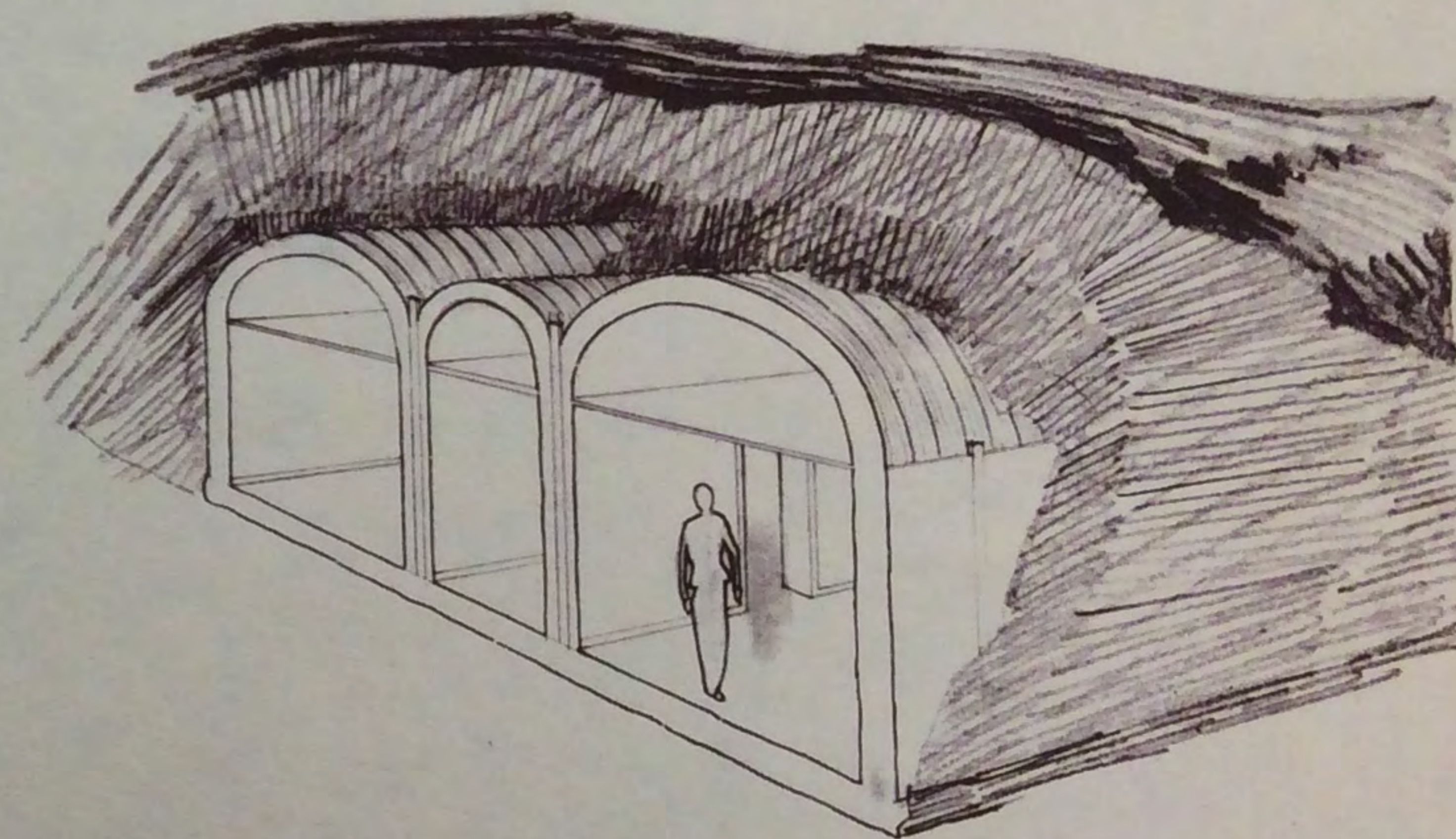
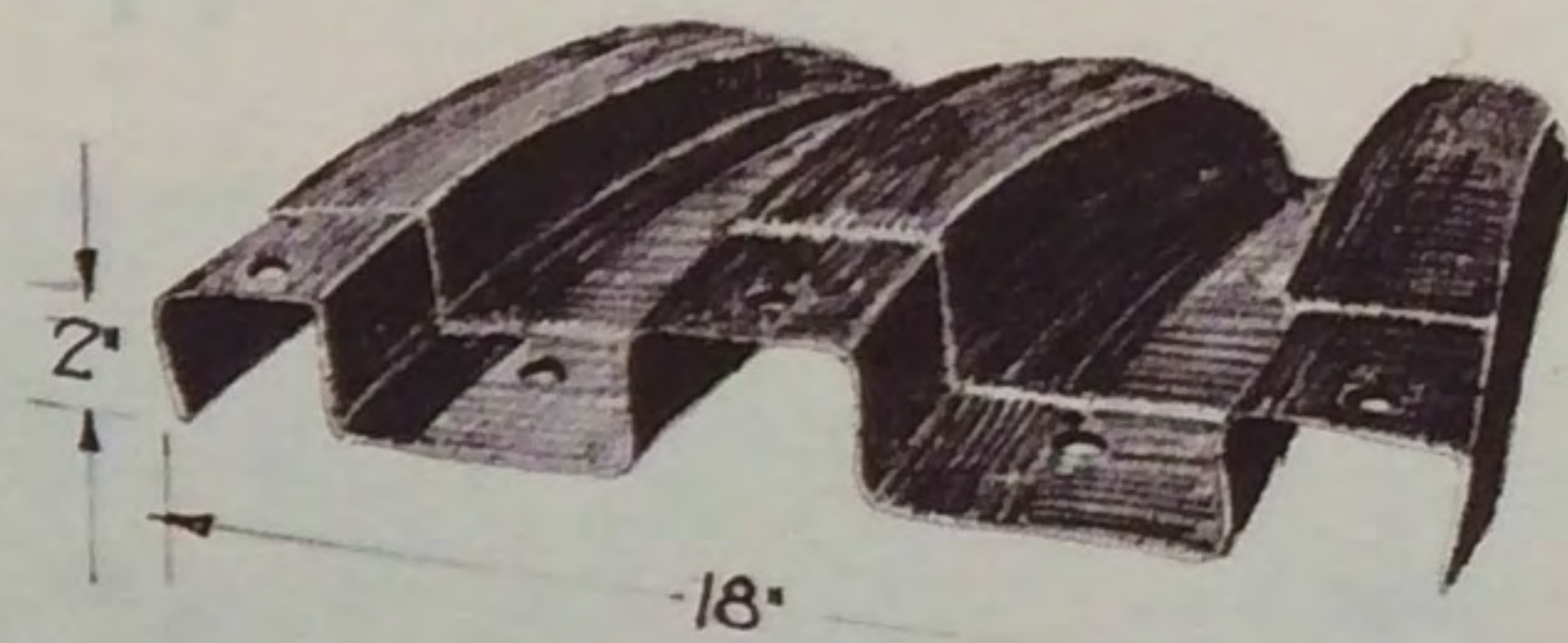
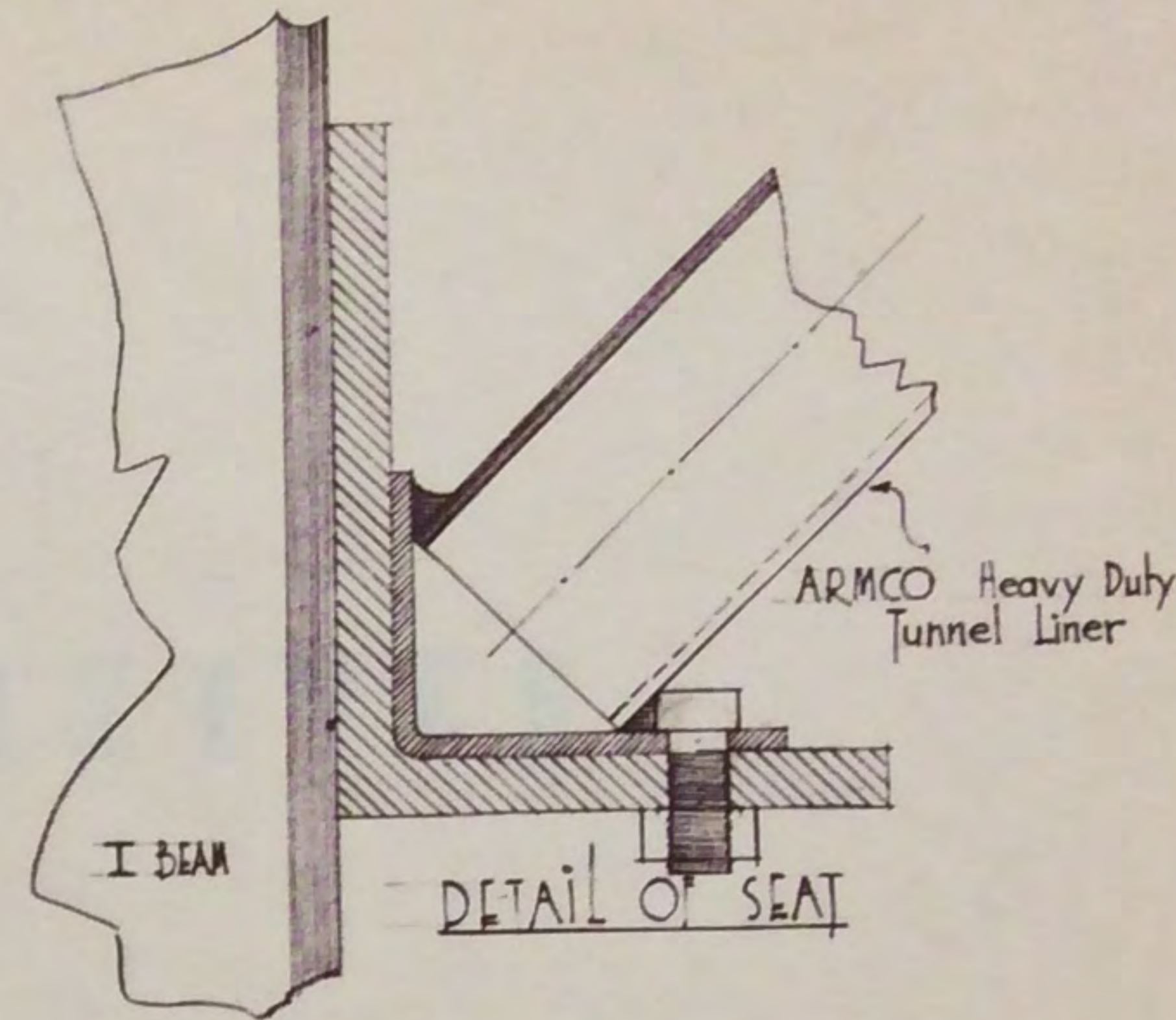
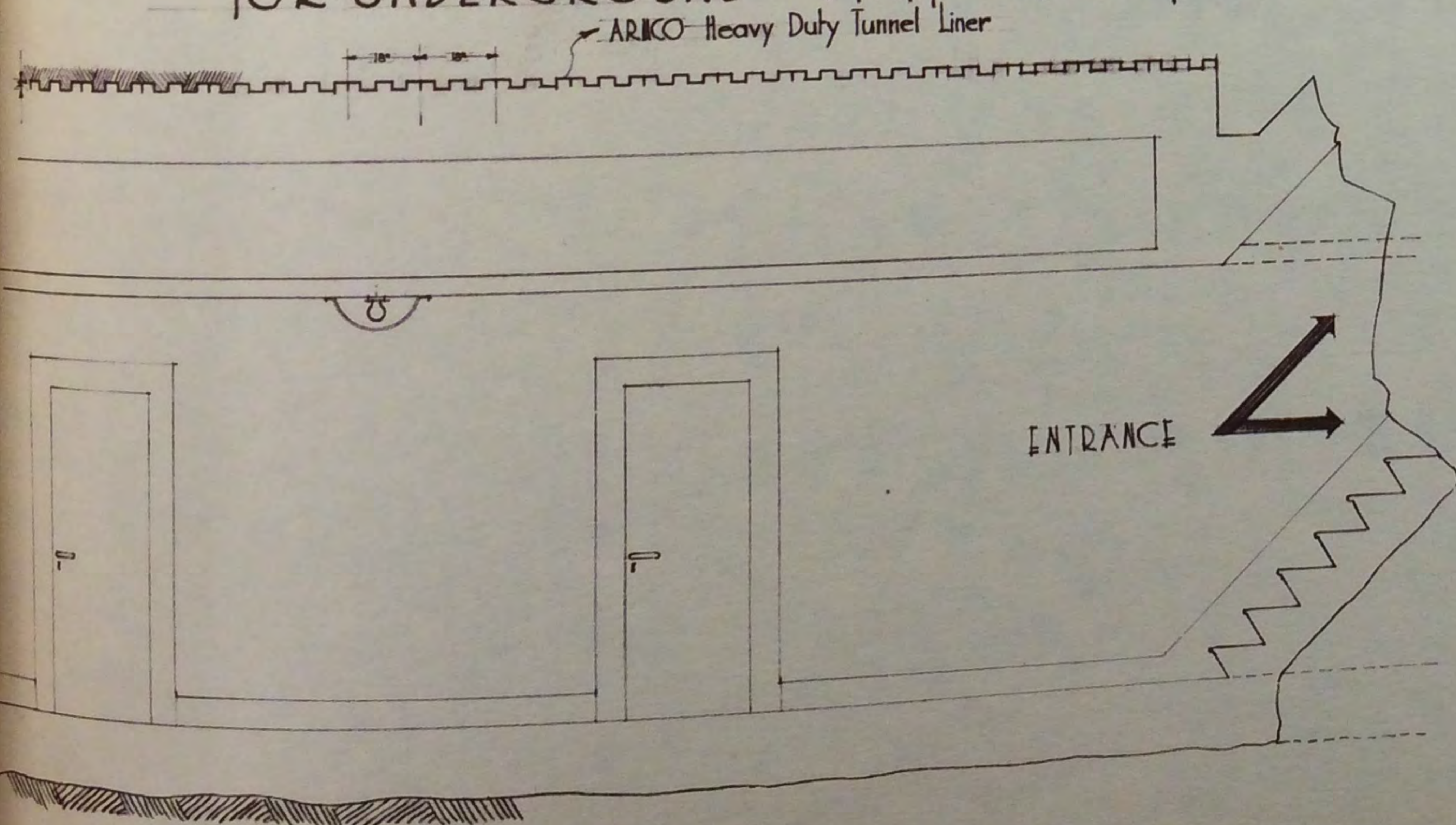
This drawing illustrates a typical underground structure designed for use as staff quarters. It is installed by tunneling with ARMCO heavy Duty Liner Plates to support the overburden during construction. ARMCO liner plates may be used as either a temporary or perma-

nent construction material. Walls may be made of concrete, structural members or other suitable materials.

ARMCO Tunnel Liner Plates can also be used to erect full-round structures. See combined underpass and shelter in Drawing 4124-PR.



ARMCO HEAVY DUTY TUNNEL LINER FOR UNDERGROUND STAFF QUARTERS



THE ARMCO INTERNATIONAL CORPORATION
MIDDLETOWN, OHIO
ENGINEERING DIVISION
A. J. G. 1940 DRAWING H-227

ARMCO MUNITION STORAGE MAGAZINES

For munitions, fuel and other supplies

AMPLEY STRONG YET LIGHT IN WEIGHT

EASY TO ERECT ★ ECONOMICAL

PORTABLE ★ HIGH SALVAGE VALUE

ARMCO MUNITION STORAGE MAGAZINES

DRAWINGS H-225, 4126-N, 736C40 AND 4133-H

A standard structure well adapted to rapid fabrication and erection.

DESCRIPTION

ARCH: ARMCO MULTI PLATE, 20-foot span, 10-foot 2⁵/₈-inch rise, length in increments of 2¹/₂ feet with 50 feet a recommended standard. Furnished complete with assembly bolts and erection wrenches, bearing channels for seating on wood or concrete foundations, asphalt-asbestos mastic for water-proofing all joints.

END WALLS: Fabricated of channel sections 24 inches wide, flanges outstanding, punched for field bolting. Supplied complete, with bolts, tie rods, turnbuckles, accessories for attaching end walls to arch, cap and base channel framing, louvers and doors.

DRIVEWAY BULKHEAD: ARMCO Bin-Type Retaining Walls, height and length to suit installation requirements. For an alternate entryway adaptable to this and similar structures, see drawing 4133-H.

ROOF VENTILATOR AND SMOKE STACK: Each structure can be supplied with roof ventilator and smoke stack, 18 inches in diameter by 5 feet or more high, equipped with cover caps. Stubs provided for attachment to arch plates.

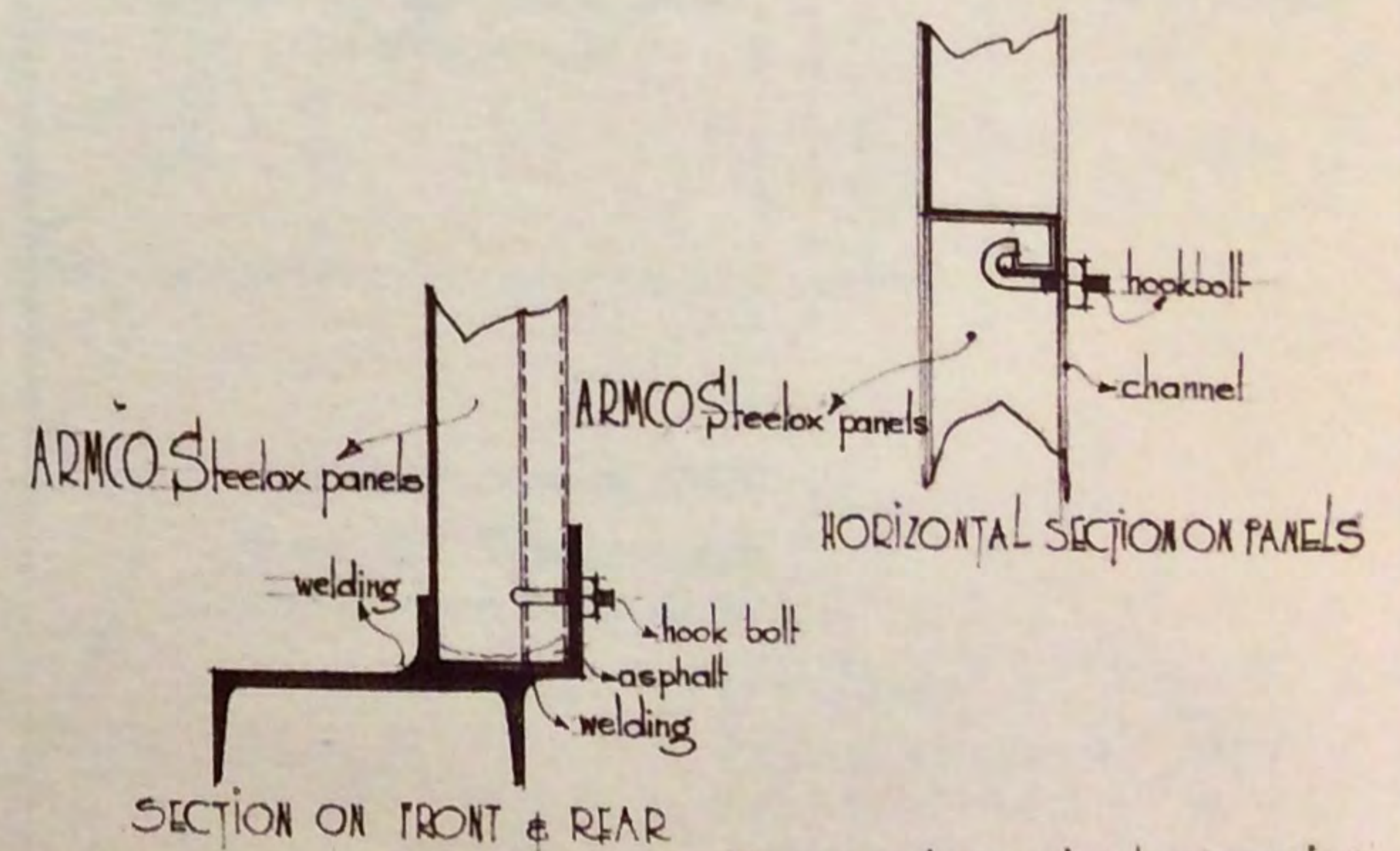
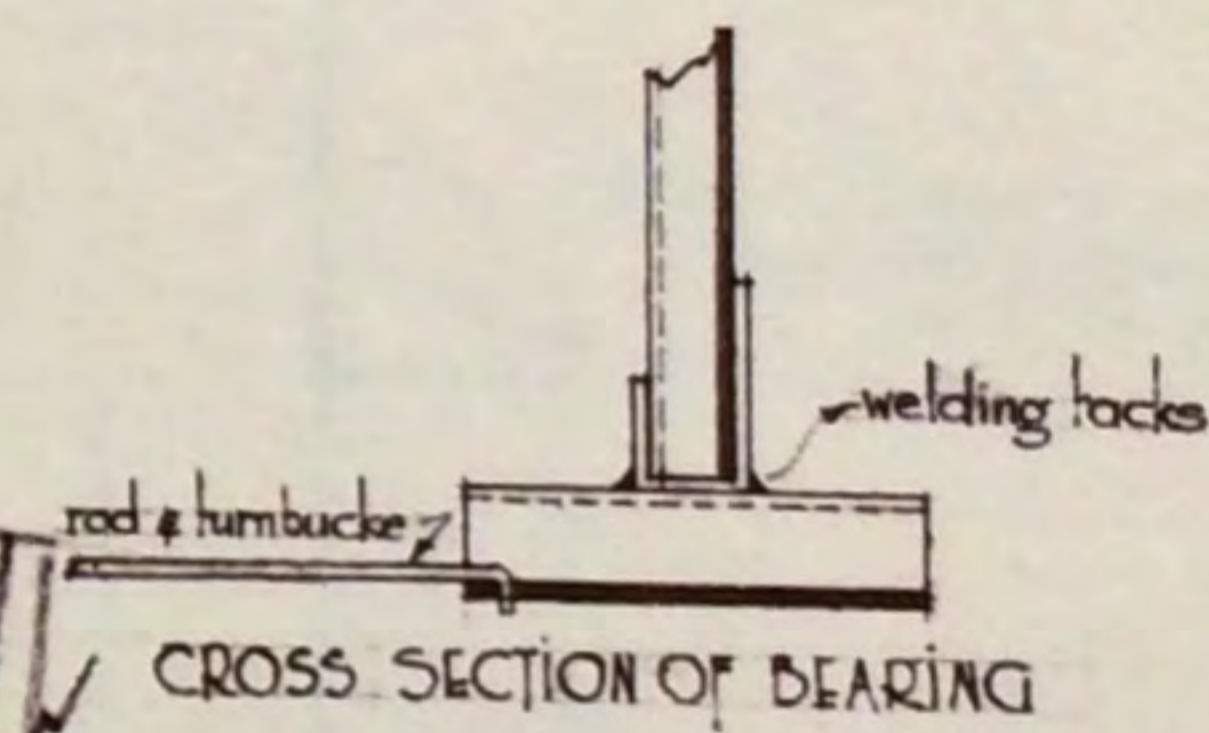
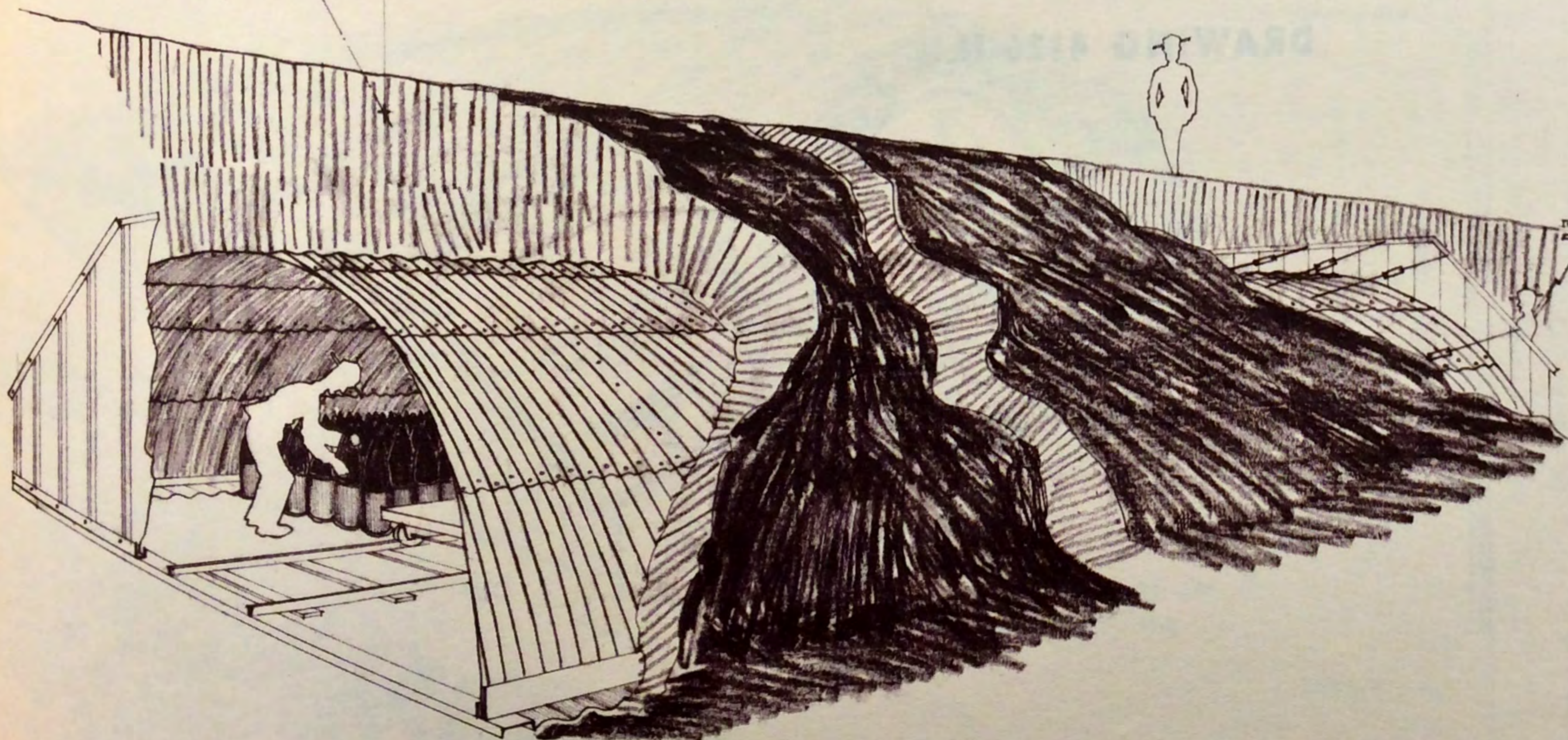
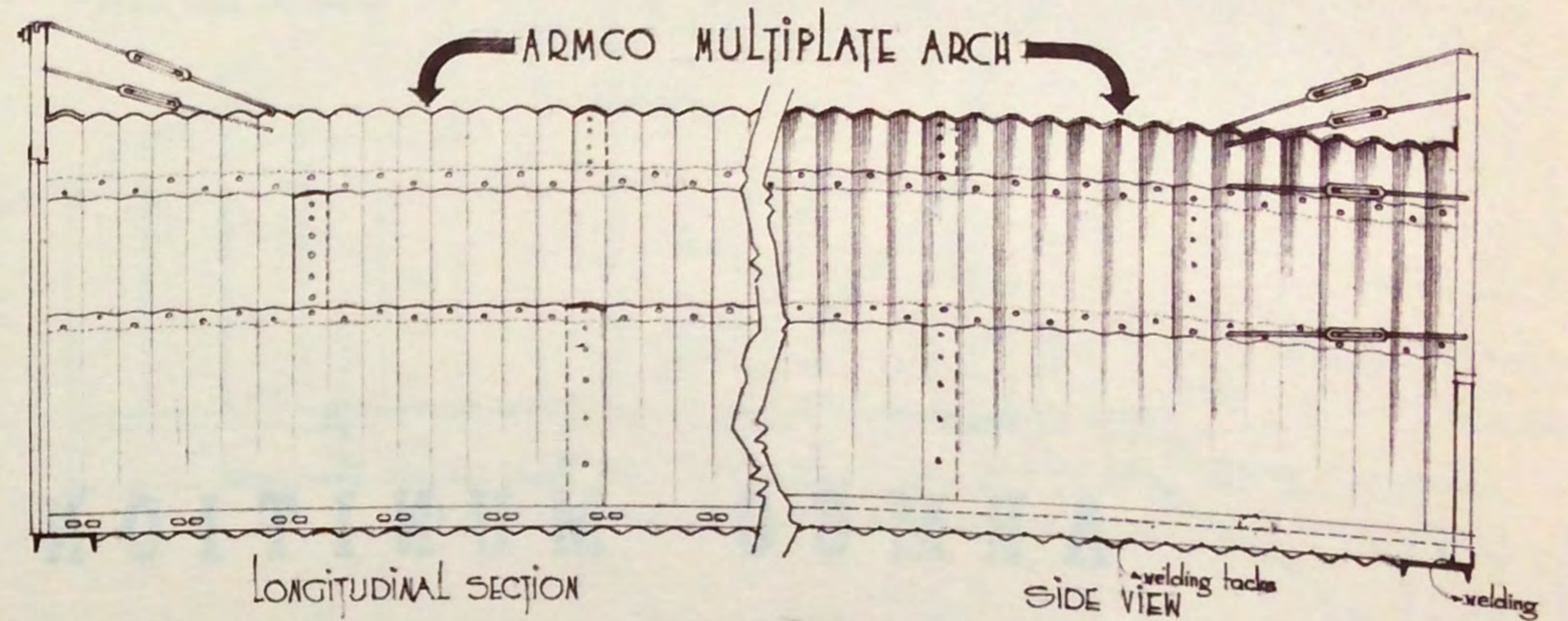
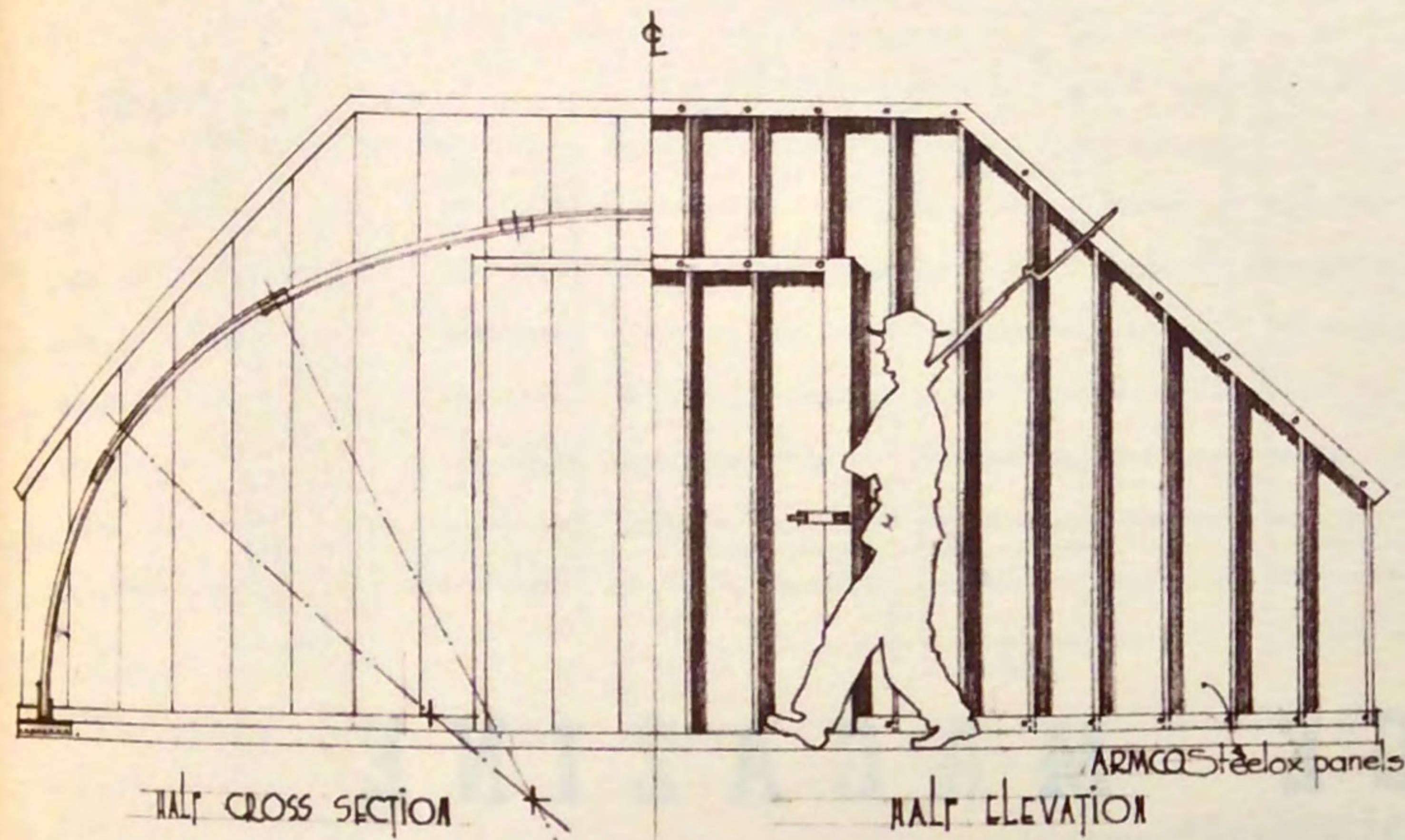
SHIPMENT: All parts are shipped knocked-down and nested for export in bundles of convenient size for storing and handling.

ERECTION: Structures can be easily and quickly erected using only hand tools. Assembly drawings supplied with each shipment. These structures are designed for installation at grade or with floor level below ground level. At least three feet of fill should be placed over the crown of the finished arch.

COATING: Any or all of the above material can be supplied galvanized or with non-metallic, protective coating at purchaser's option.

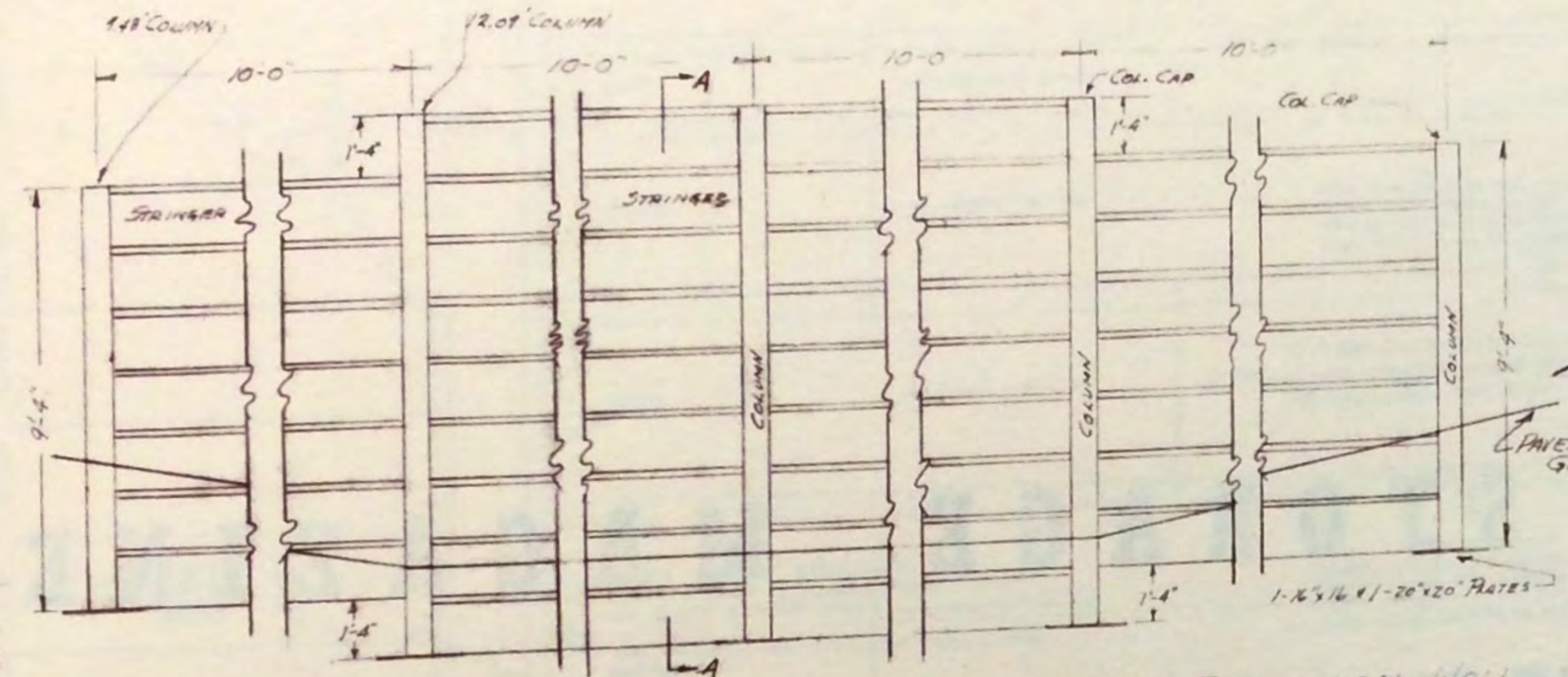
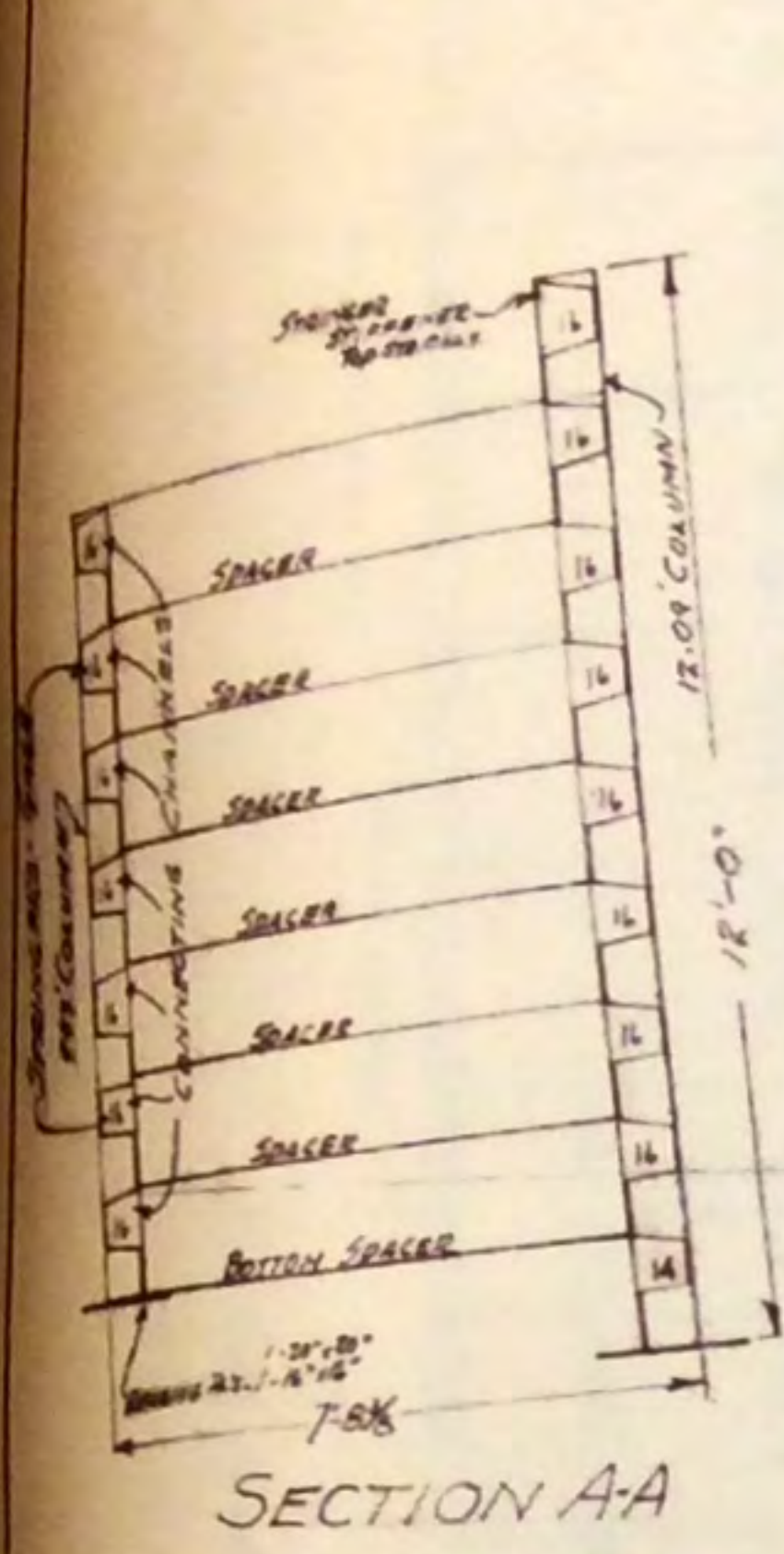
ARMCO MULTIPLATE UNDERGROUND STORAGE

. CORRUGATIONS 6" x 1/2"

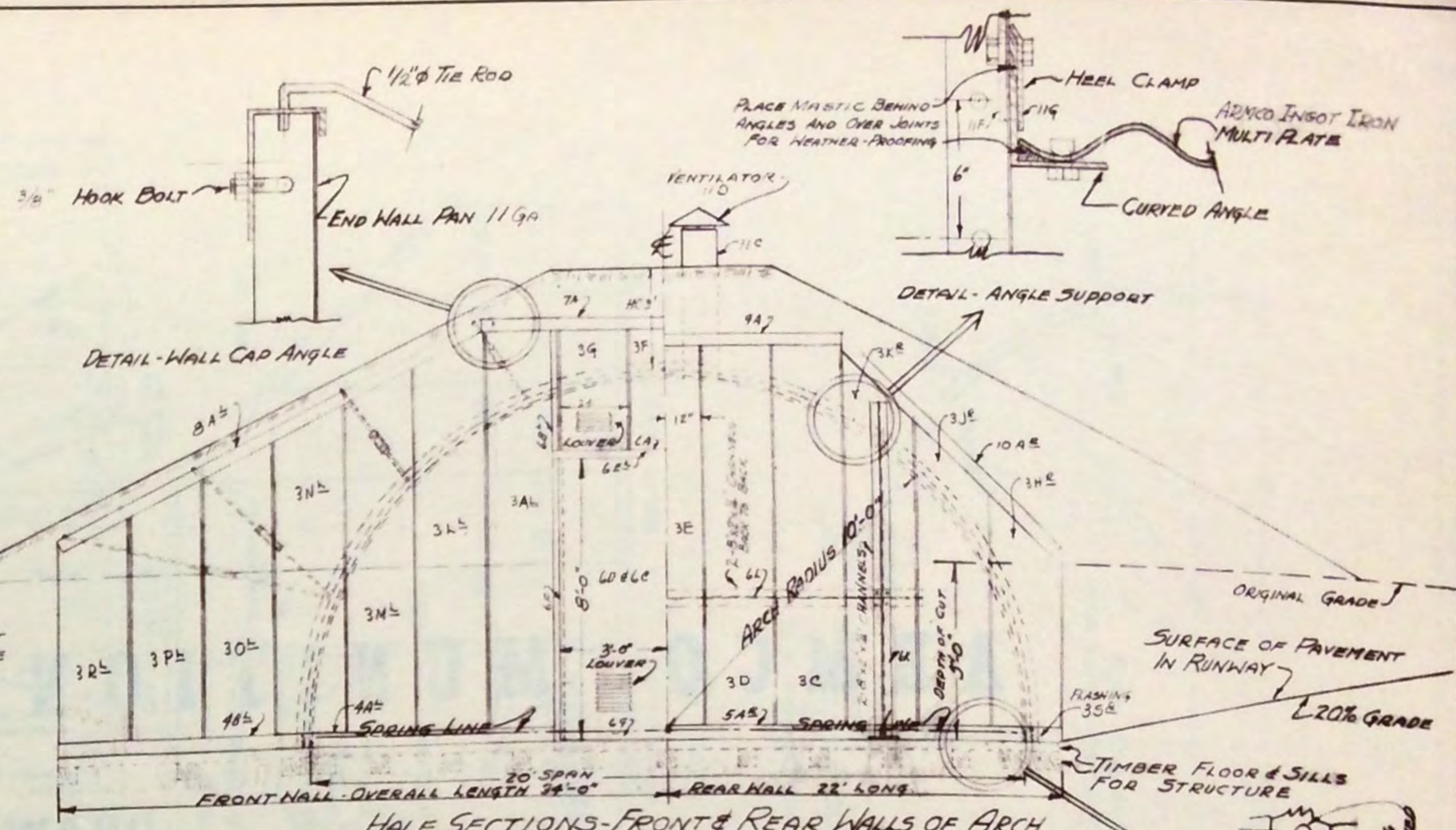


A R M C O M U N I T I O N S T O R A G E M A G A Z I N E

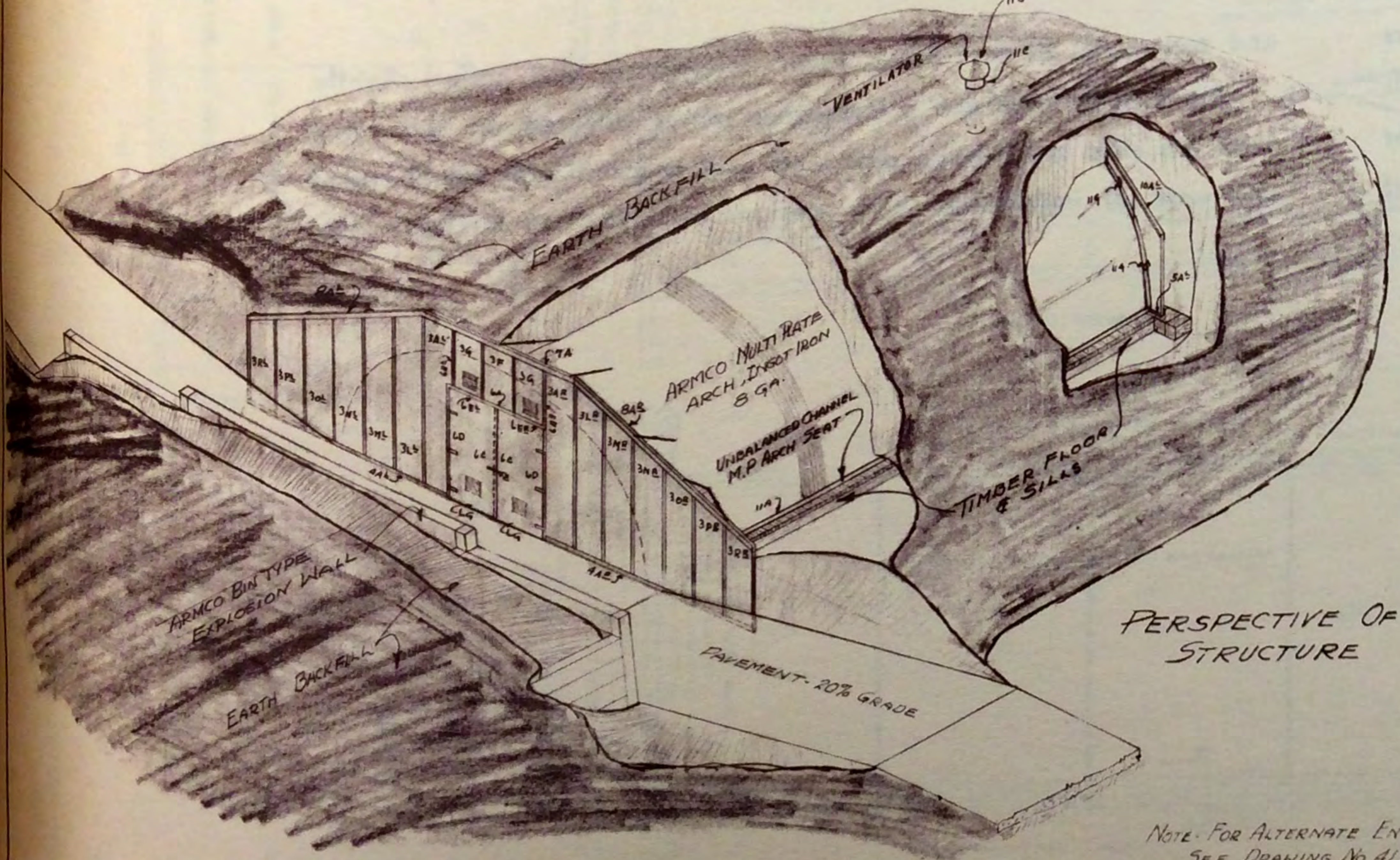
DRAWING 4126-N



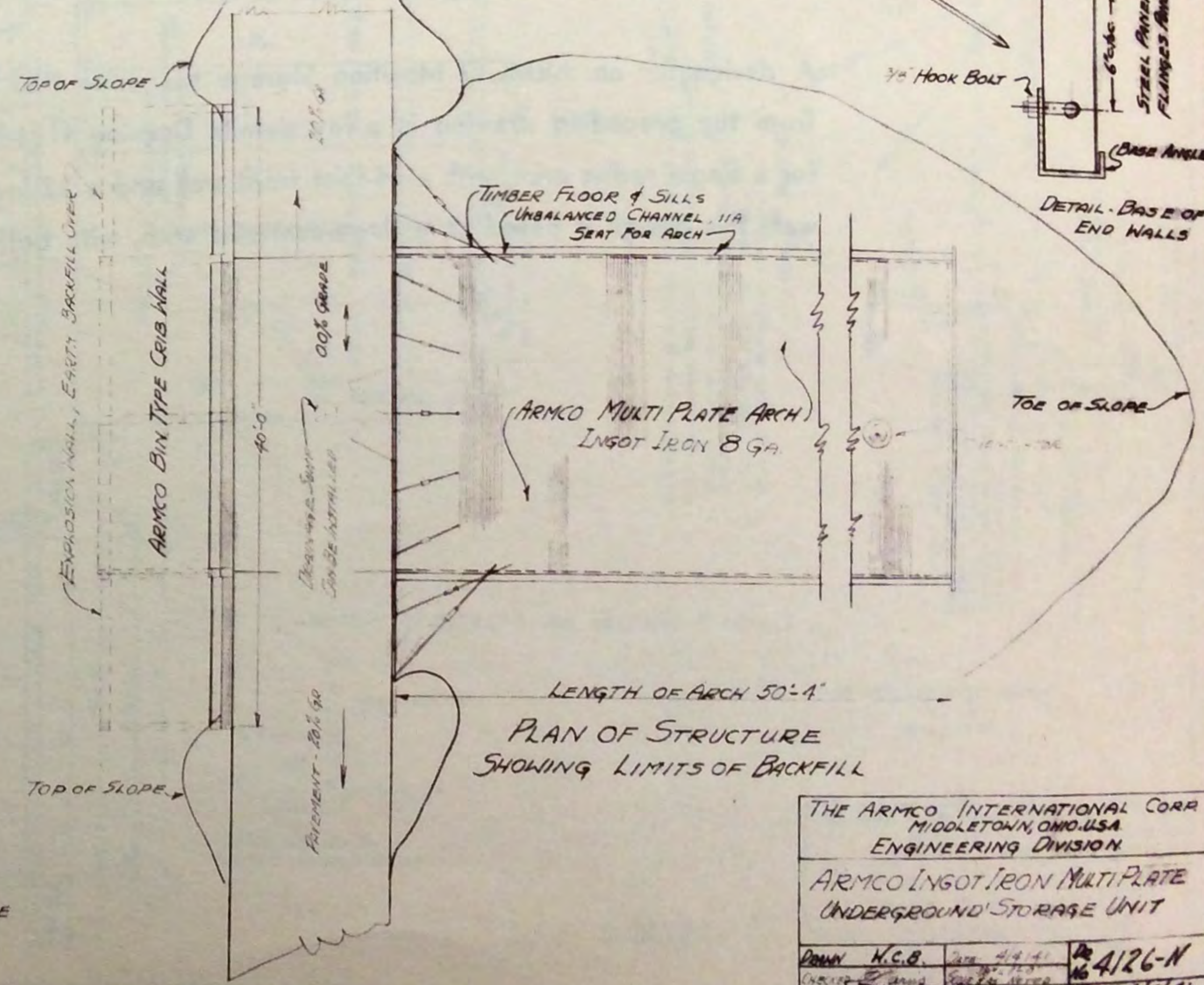
FRONT ELEVATION ARMCO INGOT IRON BIN TYPE EXPLOSION WALL DESIGN 'B'



HALF SECTIONS-FRONT & REAR WALLS OF ARCH



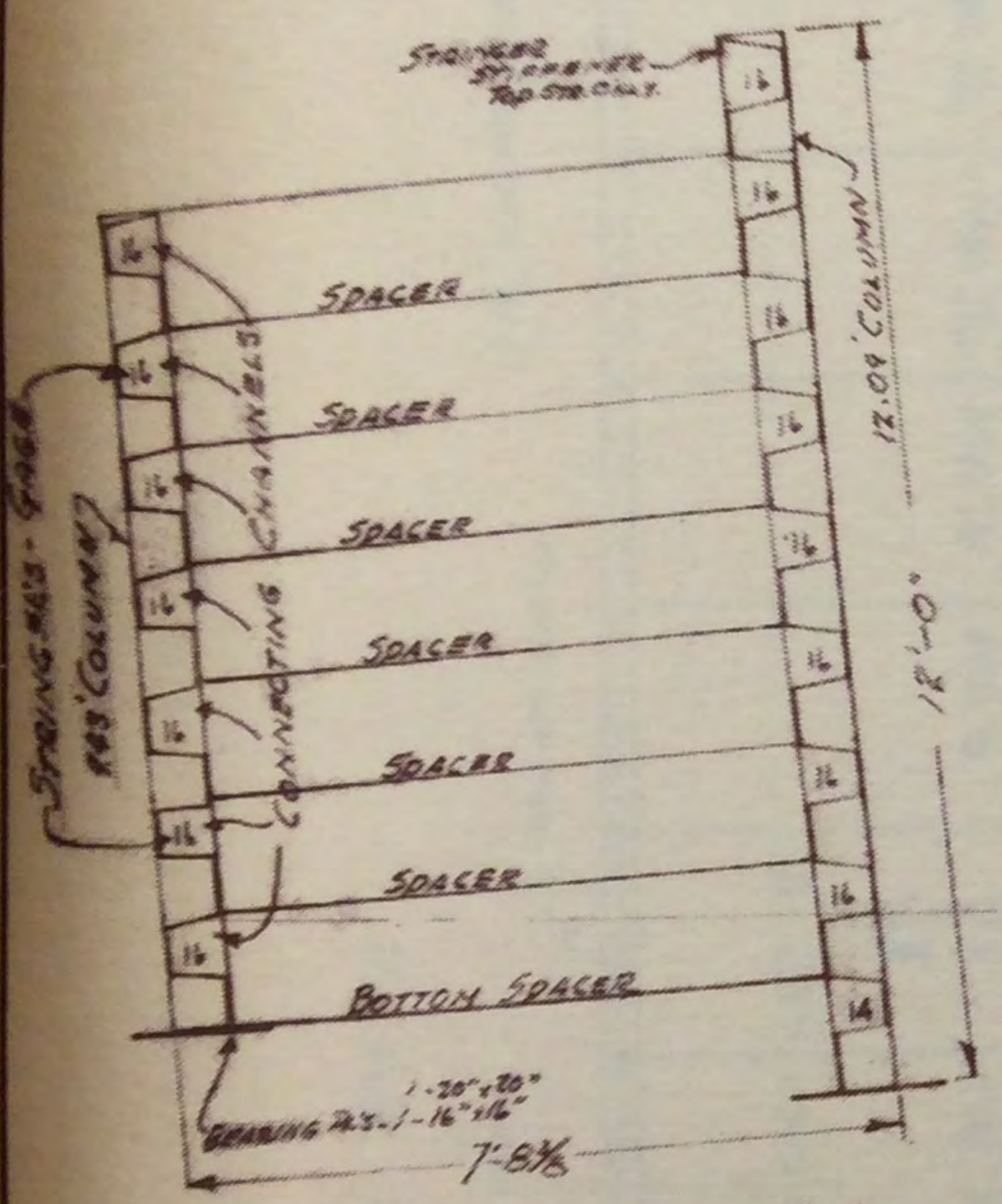
PERSPECTIVE OF STRUCTURE



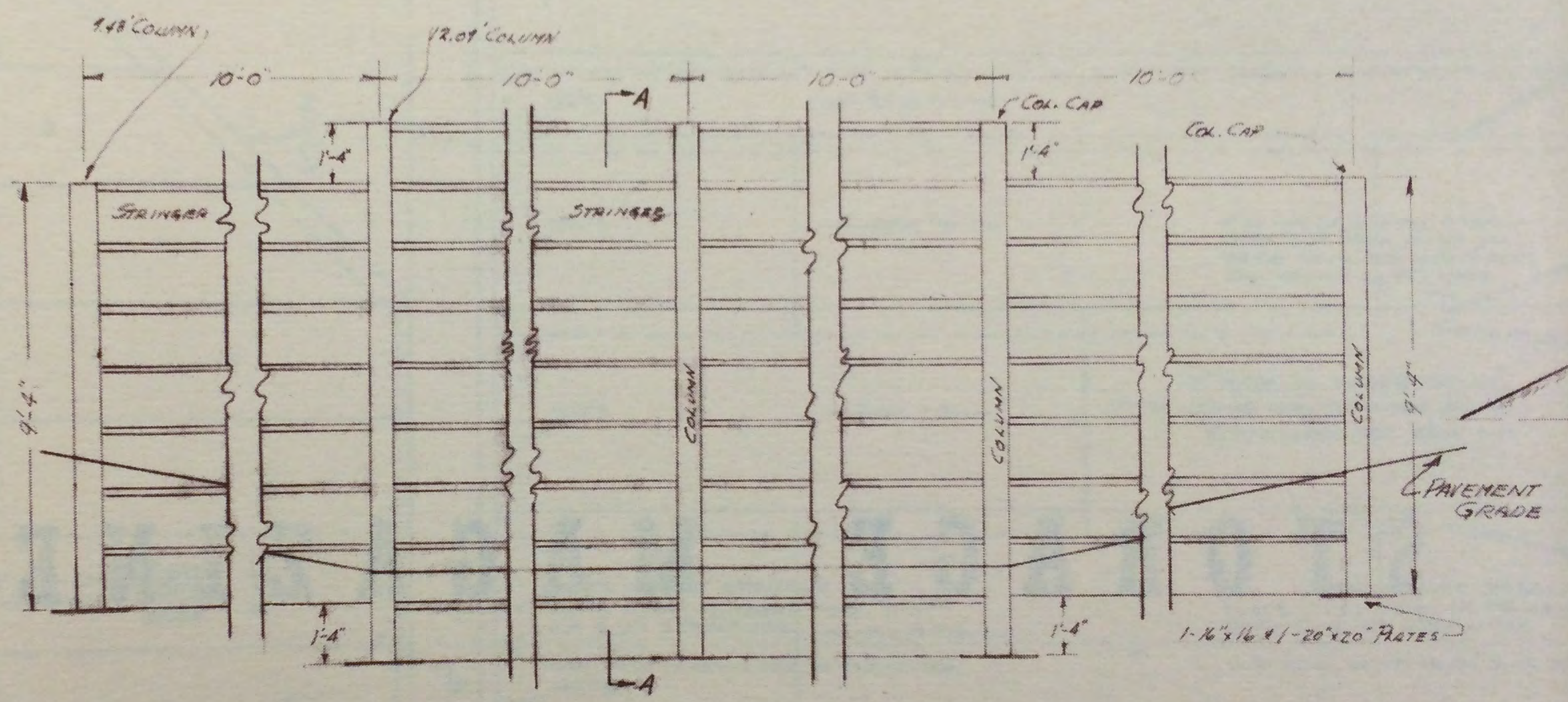
PLAN OF STRUCTURE SHOWING LIMITS OF BACKFILL

NOTE: FOR ALTERNATE ENTRANCE SEE DRAWING NO 4133-N

THE ARMCO INTERNATIONAL CORP MIDDLETOWN, OHIO, U.S.A. ENGINEERING DIVISION			
ARMCO INGOT IRON MULTI PLATE UNDERGROUND STORAGE UNIT			
Drawn	H.C.B.	Date	4/9/41
Checked		Date	4/9/41
		Drawn	4/26-N
		Checked	4/9/41

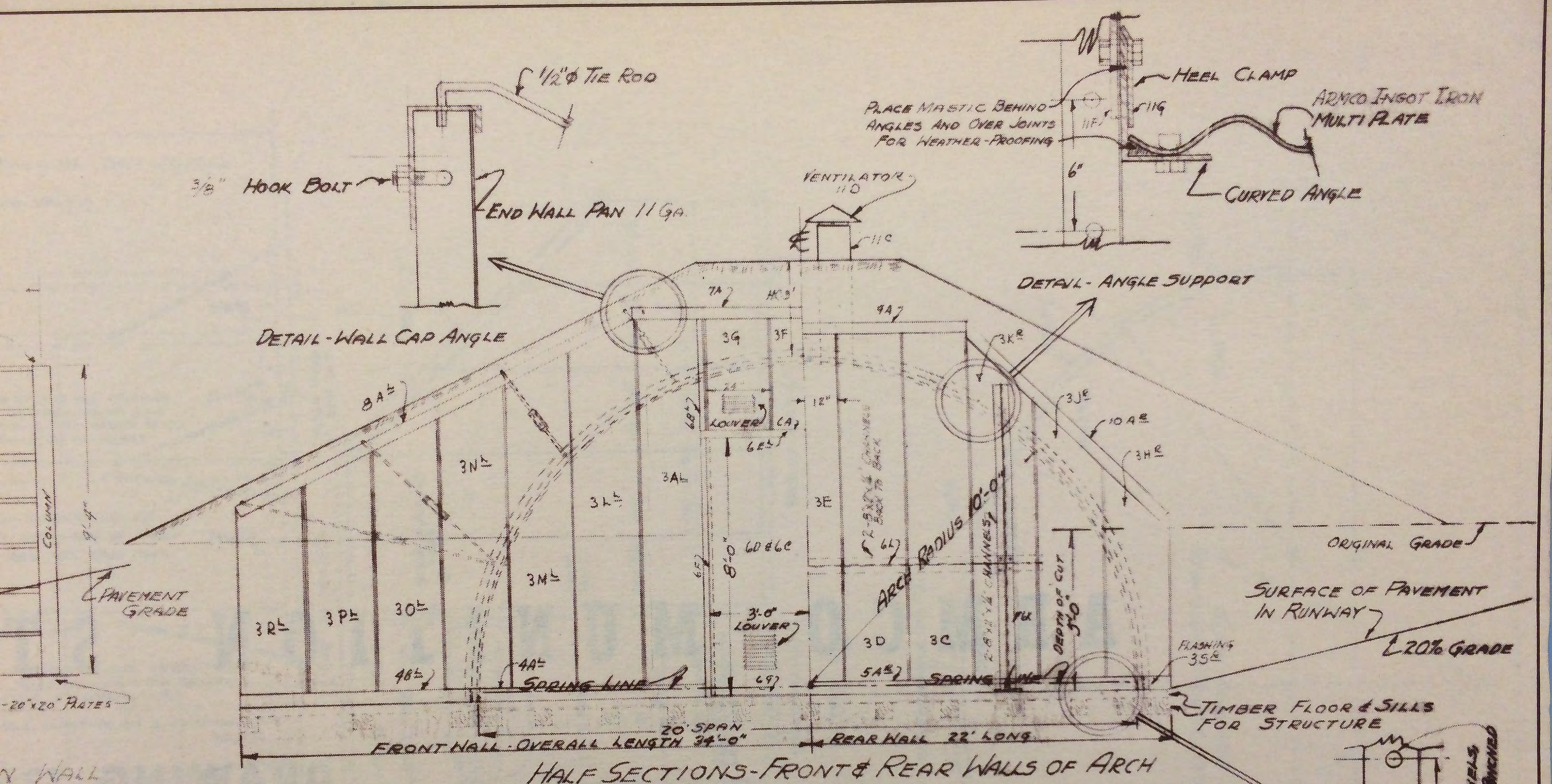


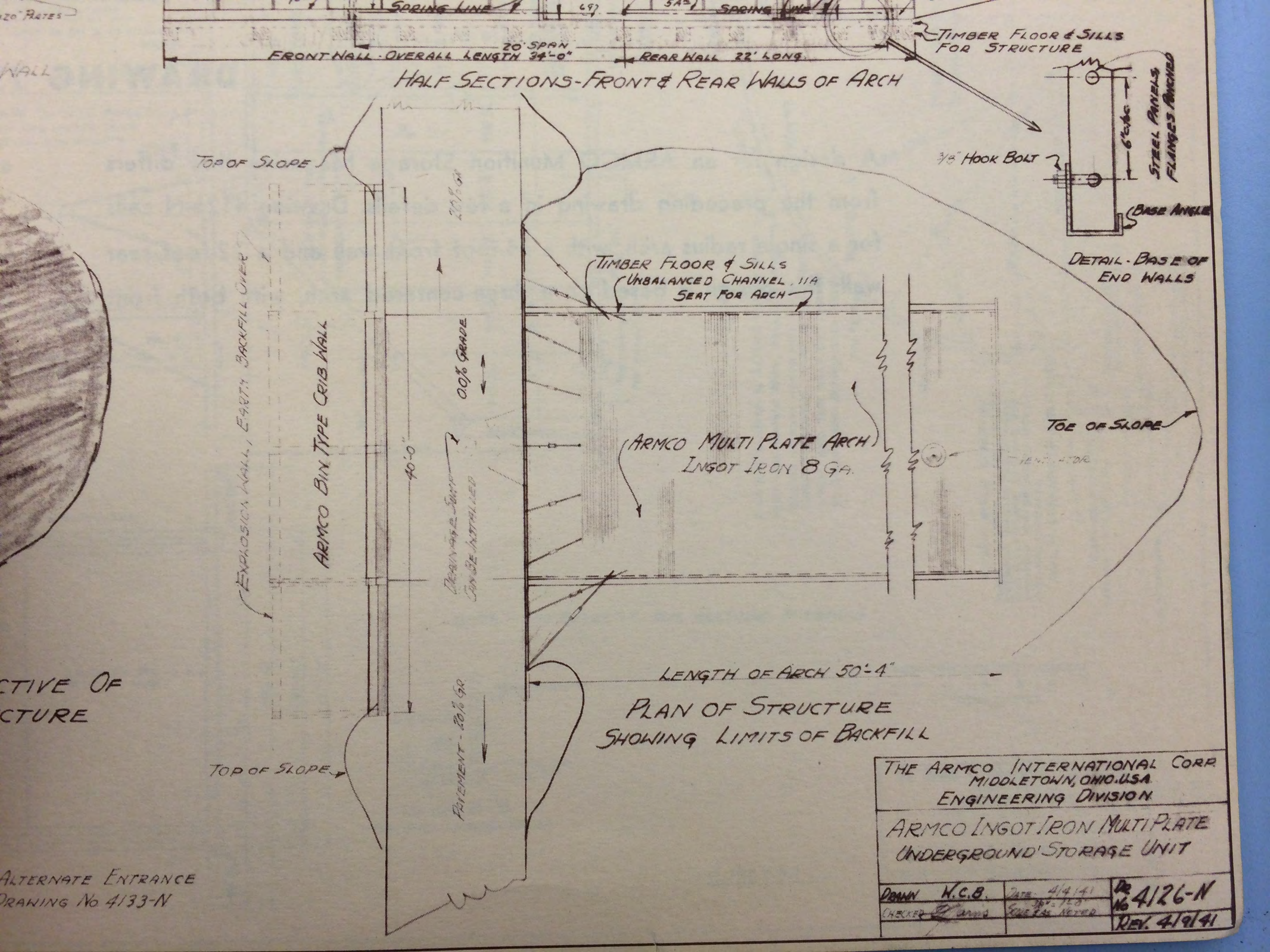
SECTION A-A



FRONT ELEVATION ARMCO INGOT IRON BIN TYPE EXPLOSION WALL DESIGN 'B'







ALTERNATE ENTRANCE
DRAWING No 4133-N

THE ARMCO INTERNATIONAL CORP MIDDLETOWN, OHIO, U.S.A. ENGINEERING DIVISION		
ARMCO INGOT IRON MULTI PLATE UNDERGROUND STORAGE UNIT		
DRAWN H.C.B.	DATE 4/4/41	DR 4126-N
CHECKED [Signature]	SCALE AS NOTED	REV. 4/9/41

ARMCO MUNITION STORAGE MAGAZINE

DRAWING 736 C 40

A design for an ARMCO Muniton Storage Magazine that differs from the preceding drawing in a few details. Drawing 4126-N calls for a single radius arch, with a 34-foot front wall and a 22-foot rear wall; this design is based on a three-centered arch, with both front

and rear walls 24 feet long. Floor assemblies also differ slightly.

Aside from these and a few other minor differences, the structures are alike and can be delivered and erected with equal speed and ease of installation. Both designs provide high salvage value.

ENTRYWAY TUNNEL

FOR ARMCO MUNITION STORAGE MAGAZINE

DRAWING 4133-H

COMBINED

ARMCO AIR RAID SHELTER AND PEDESTRIAN UNDERPASS

A structure useful in both peace and war

AMPLEY STRONG YET LIGHT IN WEIGHT

EASY TO ERECT ★ ECONOMICAL

PORTABLE ★ HIGH SALVAGE VALUE

COMBINED

ARMCO AIR RAID SHELTER AND PEDESTRIAN UNDERPASS

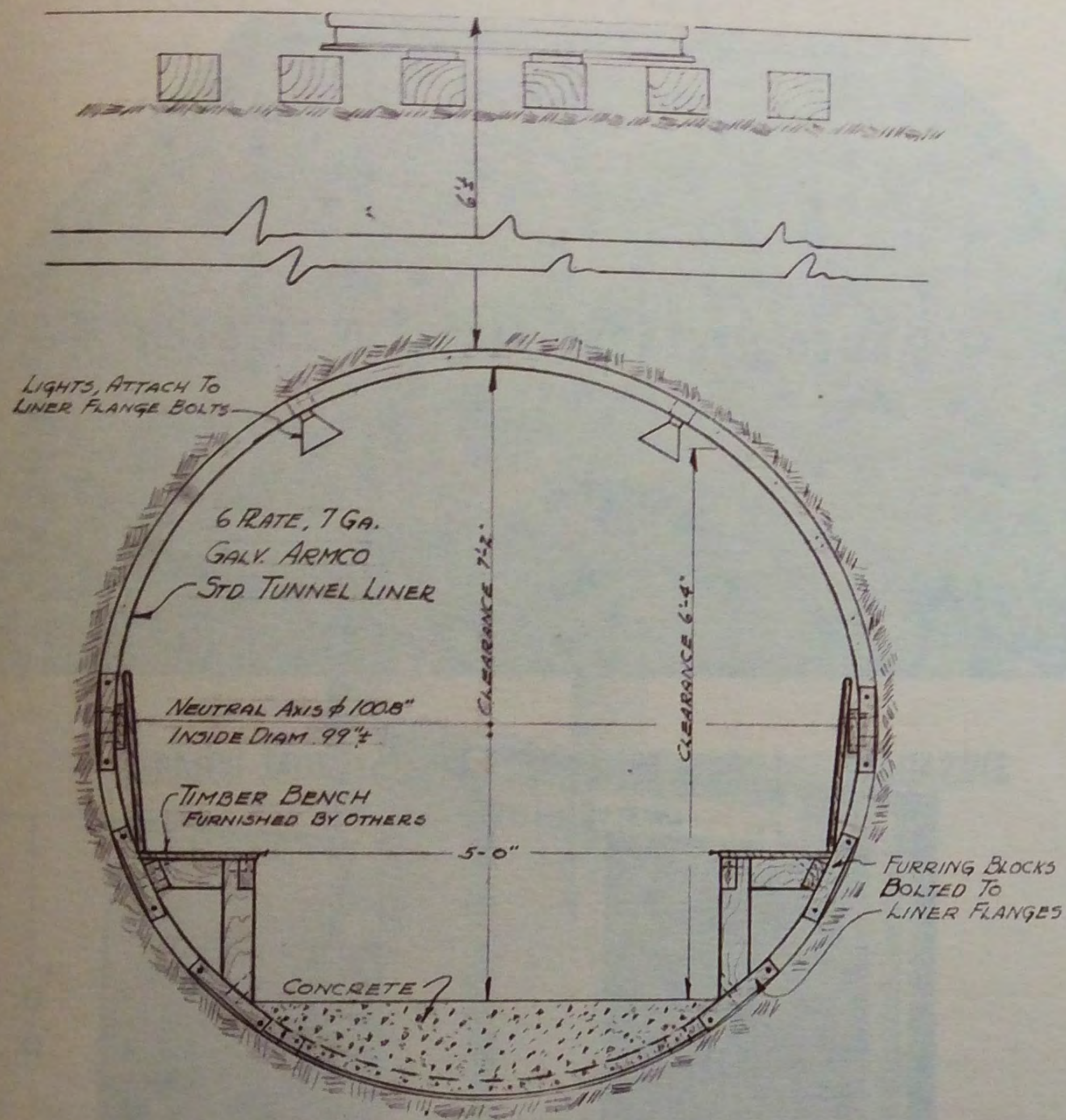
DRAWING 4124 PR

ARMCO Air Raid Shelters can be designed for use in peace as well as war. Thus they become a justifiable investment for regular revenues, rather than an expense that can pay dividends only in case of actual combat.

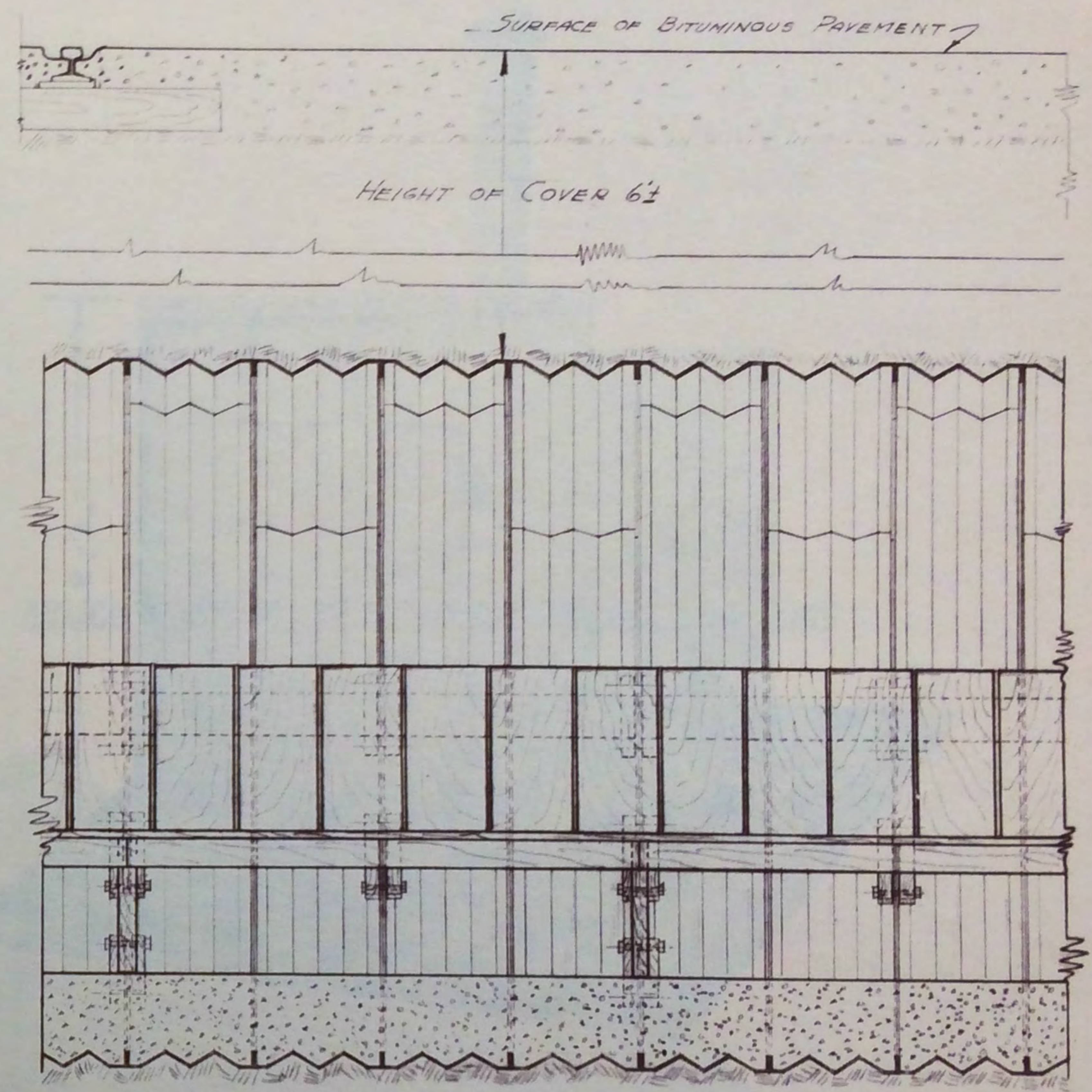
By using ARMCO Tunnel Liner Plates, pedestrian underpasses can be installed quickly and easily under busy thoroughfares near factories, schools, hospitals and other public buildings. This type of construction is also adaptable to industrial tunnels and conduits.

With the addition of end walls and interior benches, any of these structures can readily be converted into effective air raid shelter units.

The drawing on the opposite page shows a typical combined structure designed for use in one of our defense areas. This design will be found ideal when conditions are favorable for the tunneling method of installation. In other instances, ARMCO MULTI PLATE structures may be found the most economical solution to the problem.



CROSS SECTION THRU SHELTER
CONSTRUCTED OF 7 GA. ARMCO TUNNEL
LINER



LONGITUDINAL SECTION

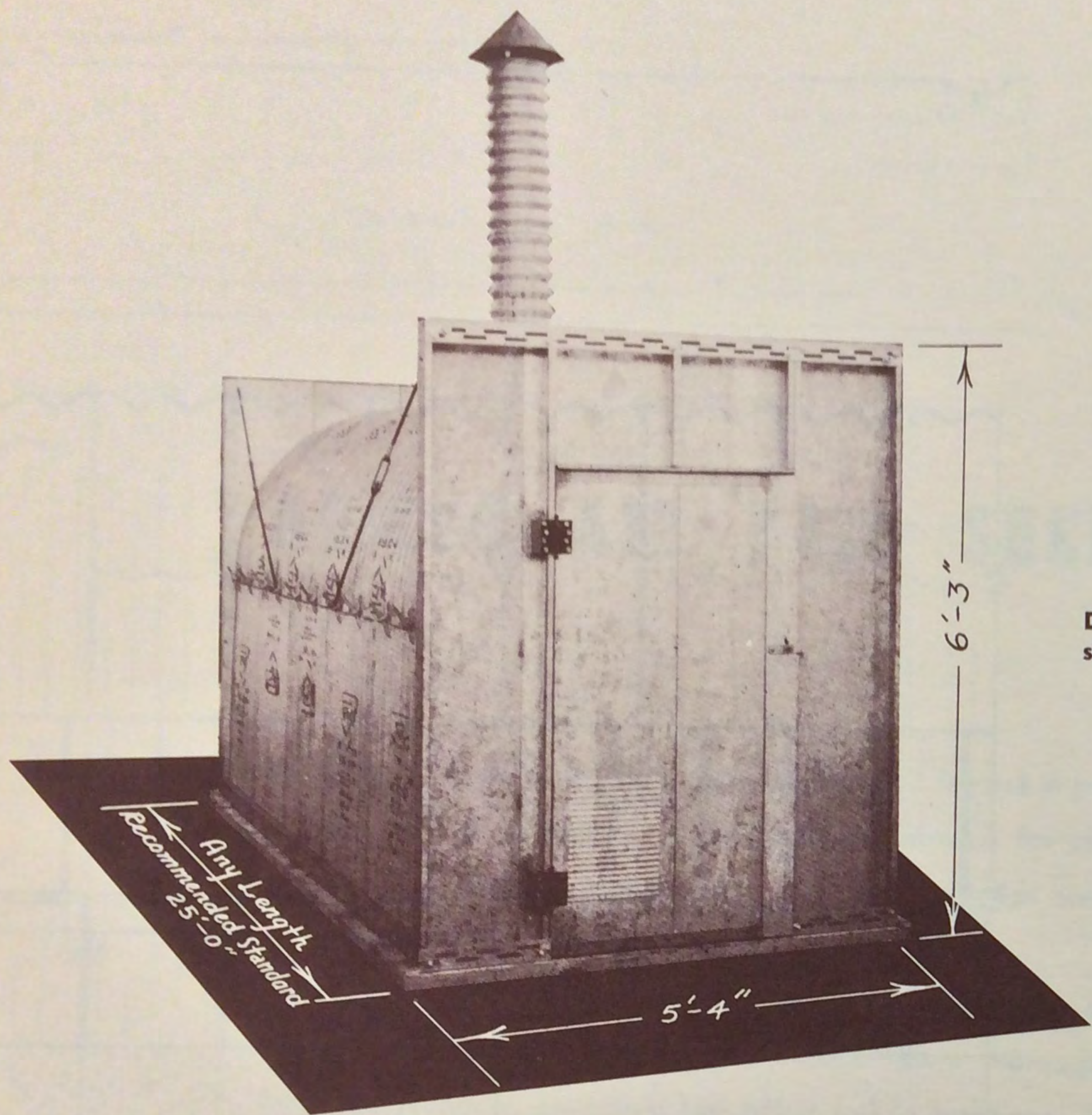
LINER RATE DETAILS

RATES PER RING	COVERING LENGTH	BLANK LENGTH	TYPE
1	52 3/4"	55 3/4"	DOUBLE MALE
1	52 3/4"	55 1/2"	DOUBLE FEMALE
4	52 3/4"	55 5/8"	STD.

THE ARMCO INTERNATIONAL CORP.
MIDDLETOWN, OHIO U.S.A.
ENGINEERING DIVISION

PROPOSED ARMCO AIR RAID
SHELTER & PEDESTRIAN UNDERPASS

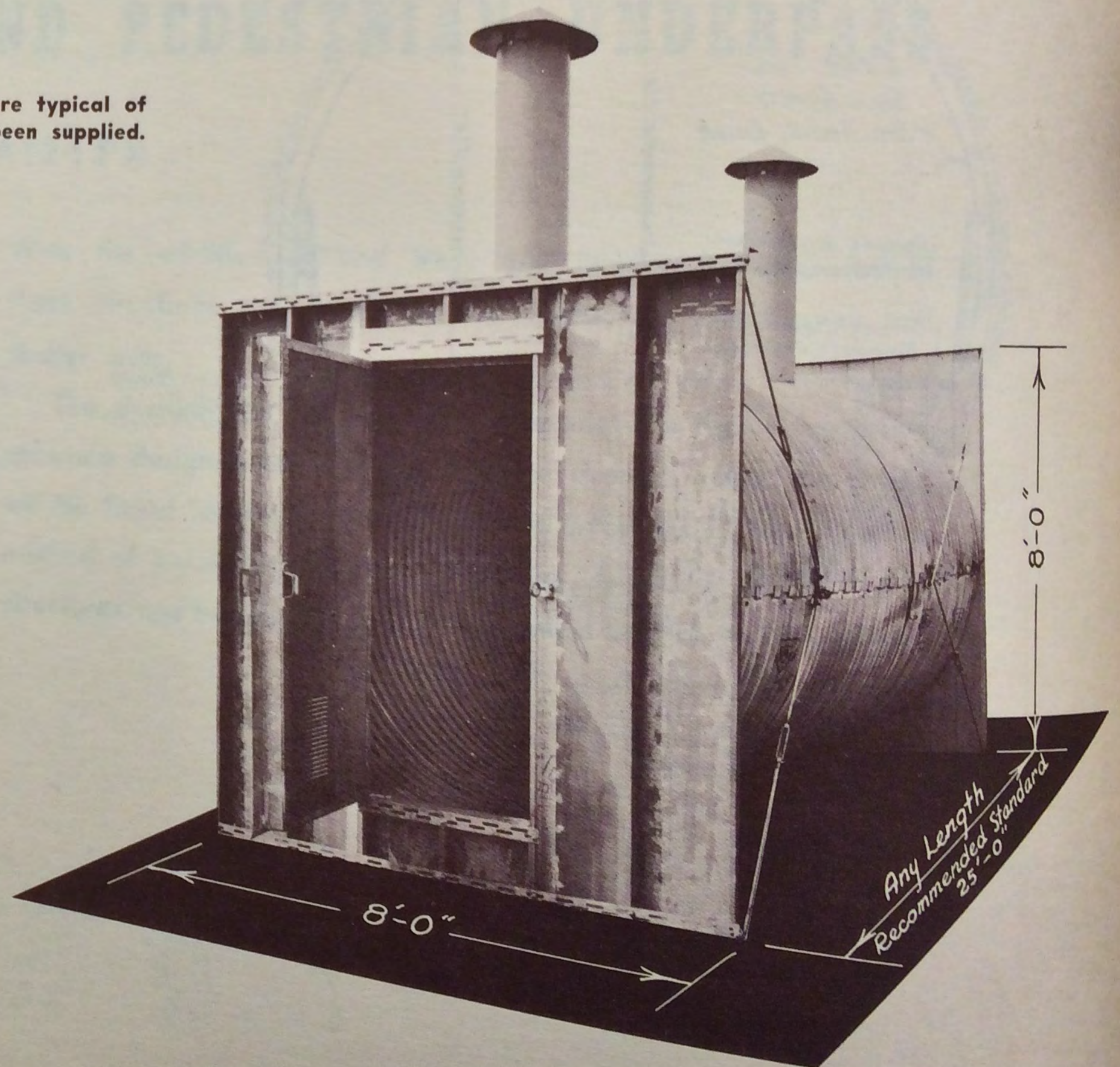
DRAWN W.C.B. DATE 4/1/41 DR. No. 4124-P.R.
CHECKED [Signature] SCALE 3/4" = 1'-0"



ARMCO NESTABLE AIR RAID SHELTER
 (WITH STRAIGHT SIDEWALLS—DRAWING H-226)

Dimensions indicated are typical of structures that have been supplied.

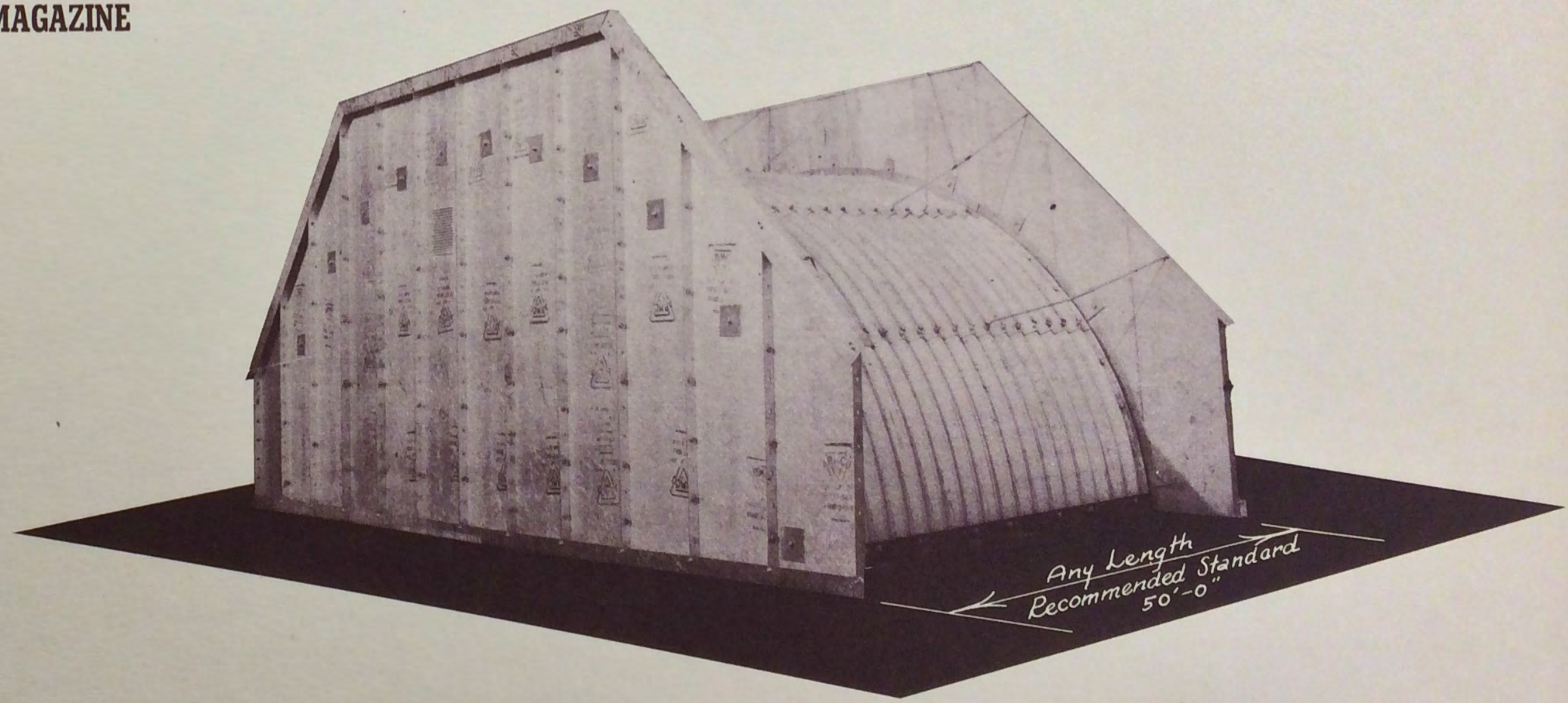
ARMCO NESTABLE AIR RAID SHELTER
 (DRAWING 411-H)





ARMCO MULTI PLATE MUNITION STORAGE MAGAZINE
(SIDE AND END VIEW)

ARMCO MULTI PLATE MUNITION STORAGE MAGAZINE
(FRONT VIEW)



Dimensions indicated are typical of structures that have been supplied.

