BASIC SOIL PROPERTIES

MARINE CORPS ENGINEER SCHOOL
COMBAT ENGINEER INSTRUCTION COMPANY

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TABLE OF CONTENTS

Supercedes Programmed Text “Basic Soil Properties” dated January 1982, which is now obsolete.

PREFACE

This booklet contains a programmed course of instruction in basic soil properties. This text will help you to learn at your own speed. Although some of the material may seem very easy to you, Do Not Hurry. As you proceed through the text, you may review the items you have previously studied.

This form of programmed instruction is known as Linear Programming, because each exercise, or frame, is separated from other frames in a linear sequence. The frames will include information, questions and answers, or a combination of these. Responses to question will be made by filling in a missing word or performing a calculation. The location of the answer(s) to those questions will be specified at the end of each of each question. In most instances, the answer to the question will be located on the page immediately following the question. If your answer is correct, GO ON TO THE NEXT FRAME. If it is incorrect, cross out the wrong answer, reread the appropriate information frame, and write the correct answer beside the one crossed out. Then go on to the next frame.

Be sure to write your answer before checking the correct answer. Do Not Guess at any answer, because you can always find the correct answer by rereading the appropriate information frame.

Complete all frames in numerical sequence; when frame 46 is completed, return to page 4 for frame 47 and continue.

OBJECTIVES

Upon completion of this programmed text, you will be able to:

a. Describe the desirable characteristics of soil particle size, shape and gradation.

b. Describe the moisture states of a soil, and describe the significance of the various boundary moisture states

c. Determine the types of fines present in a soil with the use of the Casagrande Plasticity Chart, in accordance with FM 5-530 Materials Testing.

NOTE: In using this programmed text, study thoroughly the information in each frame before proceeding to the next frame. DO NOT attempt to memorize the material, STUDY IT.

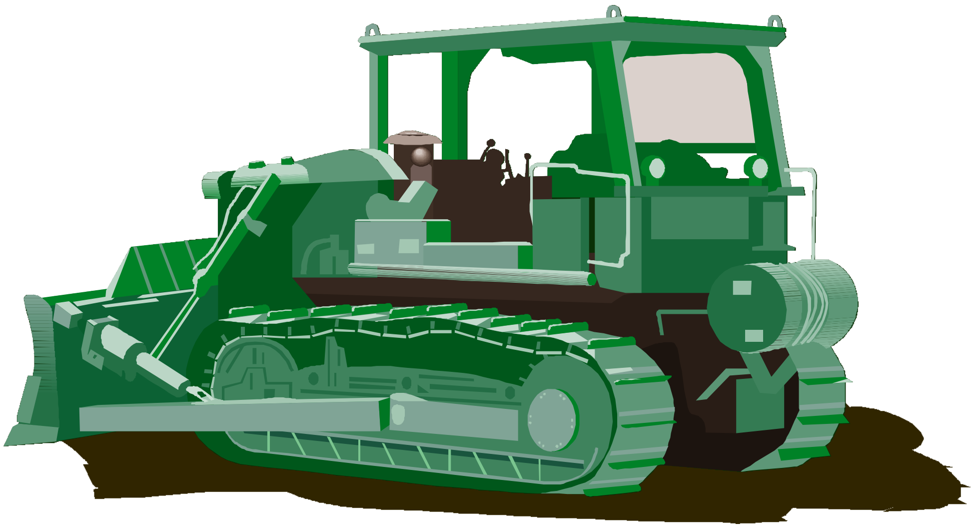
WELCOME to the wonderful world of SOIL MECHANICS. Through the use of programmed texts such as this one, multi-media presentations, and reference manuals, you are going to teach yourself those fundamentals of soils which you will need to be a successful military engineer.

Why do you need to know anything about SOILS?

The key to our modern Marine Corps is MOBILITY. The Corps must be able to move anywhere at anytime.

It is your responsibility as military engineers to provide this mobility. To do this, you must build roads, airfields, storage areas, maintenance facilities, waterways and shore facilities. All these construction projects have one thing in common -- SOIL. Soil is either a construction material or a foundation material in each of these projects. Consequently, if you are going to carry out you responsibilities as military engineers, you must have a basic understanding of soils engineering. This knowledge of soils will enable you to perform better and provide more economical construction.

Because so much of SOILS ENGINEERING is obtained through observation and experience, it is important that we adhere tenaciously to those procedures and concepts that we know will apply to our use of soil as a construction material. The key phrase when dealing with soil is QUALITY CONTROL. If we work within those limits that we know will provide safe, stabilized construction, we can avoid the pitfalls of the variability of soils.



Throughout this instruction, always keep in mind the significance to the interaction between water and soils. Our whole concept of Construction Quality Control is dependent upon the kind of soil, the density (weight per unit volume) of the soil, and the effect of the moisture with in the soil mass.

Now proceed to frame number 1 on the following page and begin you programmed instruction.

Frame 1

Before we go any further, what is Soil?

Frame 47

a. Describe the types of poorly graded soil.

Frame 2

Definition

Soil is a heterogeneous (non-uniform) accumulation of uncemented or loosely cemented mineral grains enclosing void spaces of varying sizes. These voids may contain air, water and/or organic matter in varying proportions.

Frame 48

ANSWER:

a. Gap-graded

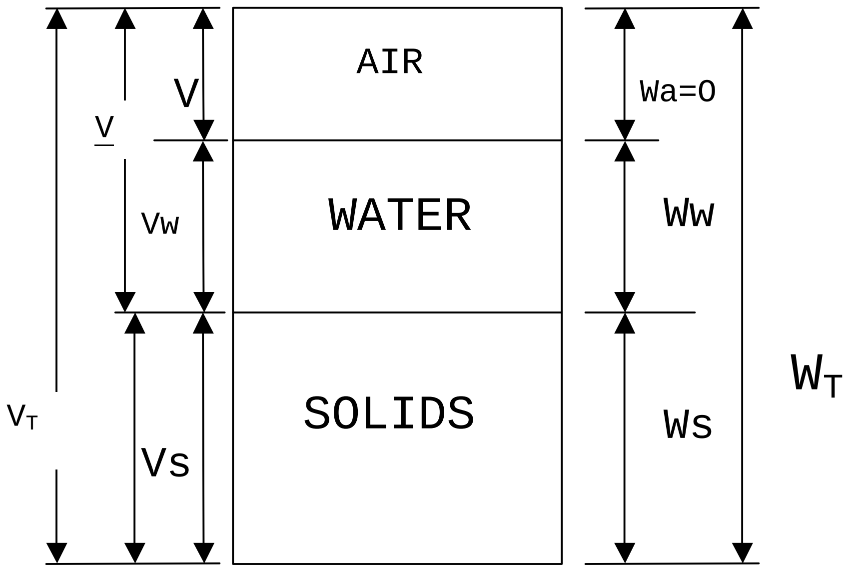
Some size groups are missing.

Uniformly-graded

All soil grains are about the same size.

Frame 3

Now that's quite a mouthful, is it not? Well, let's see if we can simplify this definition somewhat. Let's take a unit volume of soil and reduce it down to its three main components.



Separating a mass of soil into its components serves as the basis for weight volume relationships which will be developed in later lessons.

FIGURE 1

Vt = total volume	Wt = total weight
Vv = volume of voids	Wa = weight of Air = 0
Vs = volume of solids	Ww = weight of water
Va = volume of air	Ws = weight of solids
Vw = volume of water	

Frame 49

What type of gradation is best for construction?

Why?

Frame 4

Looking at Figure 1 again, which of the three components will contribute most to the strength of the soil? That's right, the solids will contribute most to the strength. Air is compressible and water can be expelled very easily by the application of a load. Therefore, we can generally say that the more solids we have per unit volume, the higher the density of the material will be, and thus the material will have a higher strength.

Frame 50

Well-graded

Results in the highest density and thus higher strength.

Plotting the sieve analysis data from frame 25 on a Grain Size Distribution Graph, we can determine the type of GRADATION for any soil. Material will be considered to be either well graded or poorly graded.

Frame 5

Using the figures below, answer the following questions:

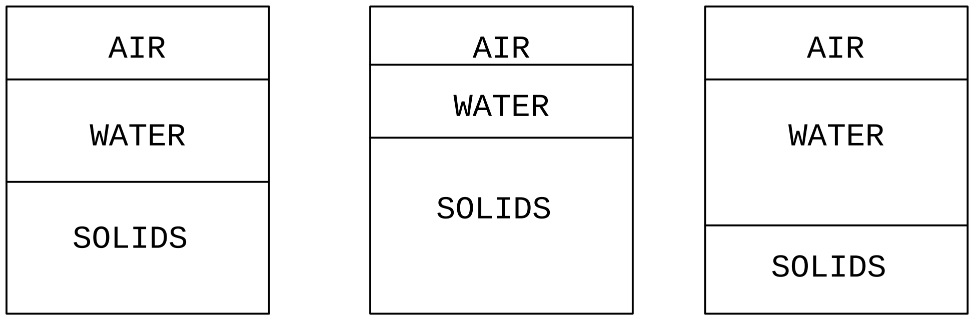


FIGURE 1 FIGURE 2 FIGURE 3

a. Which figure represents a unit of volume of higher density? _______
b. Usually, higher density means __________________ strength.
c. Which figure represents the strongest soil? _______________
d. Which figure represents the weakest soil? __________

Frame 51

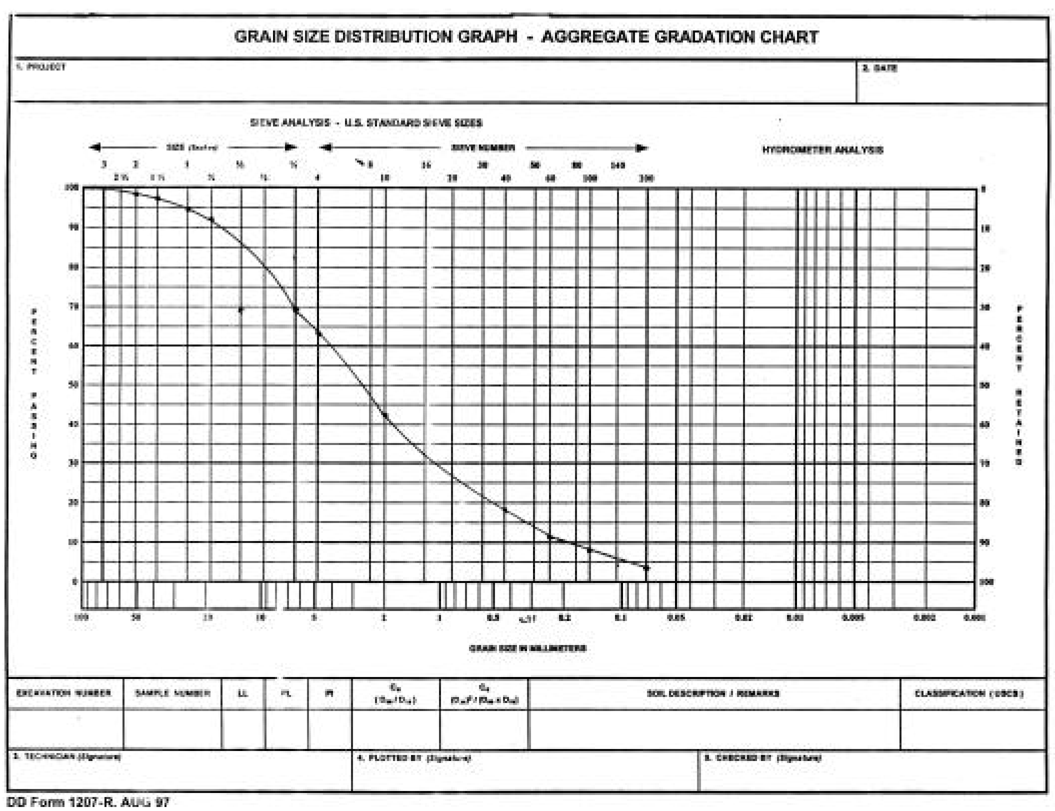


FIGURE 9

Frame 6

Answer:

a. Figure 3 - Has more solids per unit volume.
b. Higher
c. Figure 3
d. Figure 4 - has the least amount of solids.

Frame 52

In order to standardize gradation criteria, two coefficients were developed based on the Grain Size Distribution Curve; the Coefficient of Uniformity (Cu) and the Coefficient of Curvature (Cc). These coefficients are defined as follows:

$$Cu = \frac{D60}{D10} = \frac{\text{Diameter in millimeters of the 60\% passing size}}{\text{Diameter in millimeters of the 10\% passing size}}$$

Frame 7

Draw a unit of soil correctly labeling the weight and volume proportions.

a.

b. WT = ____________ + ____________

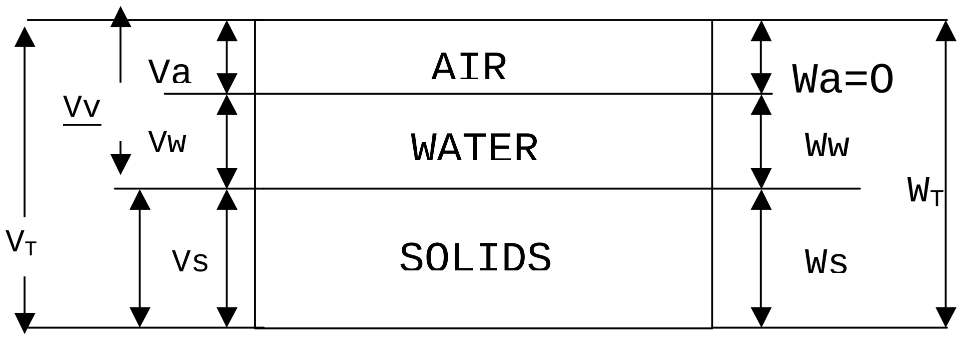
c. VT = ____________ + ____________ + ______________

Frame 53

$$Cc = \frac{(D30)^2}{D60XD10} = \frac{\text{(diameter in millimeters of the 30\% passing size)}}{\text{(Diameter in millimeters of the 60\% passing size X Diameter in millimeters of the 10\% passing size)}}$$

Frame 8
Answer:

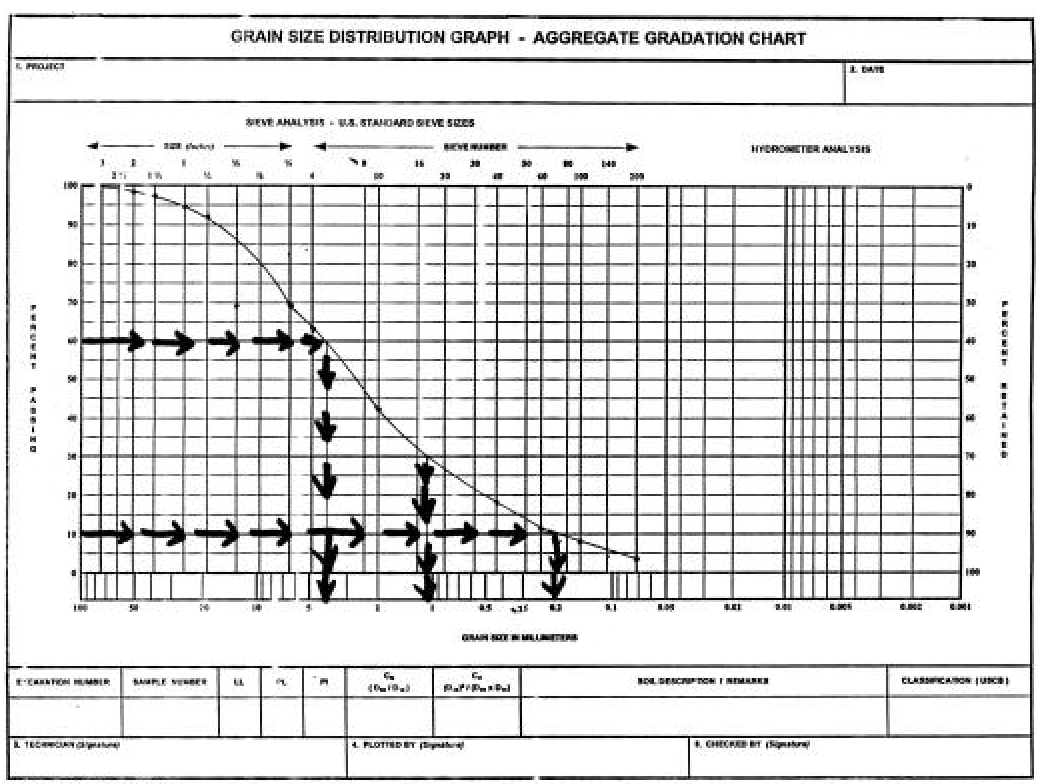
A.



c. WT = Ww + Ws

d. VT = Va + Vw + Vs

Frame 54



GRAIN SIZE DISTRIBUTION GRAPH

FRAME 9

Knowing that the mineral solids are responsible for the majority of the soil’s strength, let us now discuss some of the important physical properties that these solids possess which will aid the engineer in predicting the engineering properties of soils. One of the most important soil properties is particle size. Particles are defined according to their sizes by the use of sieves, which are nothing but screens attached to the bottom of shallow circular containers. Before we discuss the importance of size, let’s discuss the various sieve nomenclatures.

Frame 55

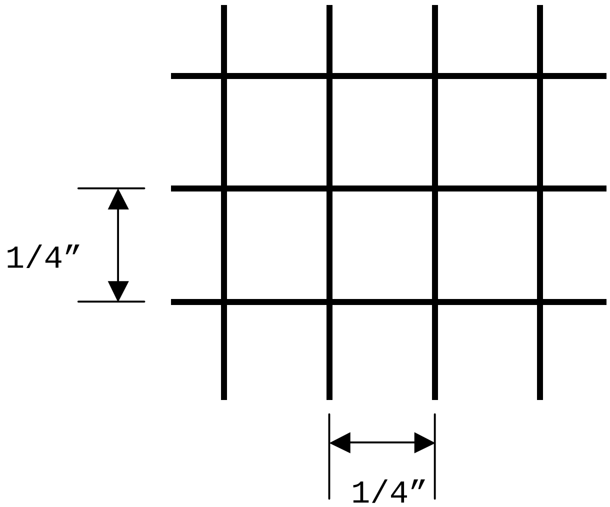
From the Grain Size Distribution Graph on page 11 frame 54.

a. What is the D60 for this material?

b. What is the D10 for this material?

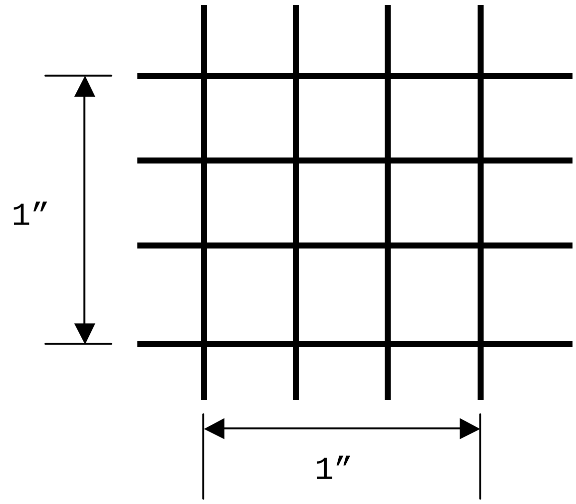
c. What is the D30 for this material?

Frame 10



1/4″ Sieve

FIGURE 5



1″ Sieve

FIGURE 6

All standard sieves are separated into two categories:

a. The larger size sieves, 3″ to ¼″, are designated by the size of the actual opening of the wire mesh, as shown in figure 5.

b. The smaller size sieves, #4 to #200, are designated by the number of openings per linear inch of the wire mesh, as shown in figure 6.

c. Some of the most common sieve sizes are:
3″, 2″, 1-1/2″, 1″, ¾″, ¼″, #4, #10, #40, #60, #100, and #200.

Frame 56

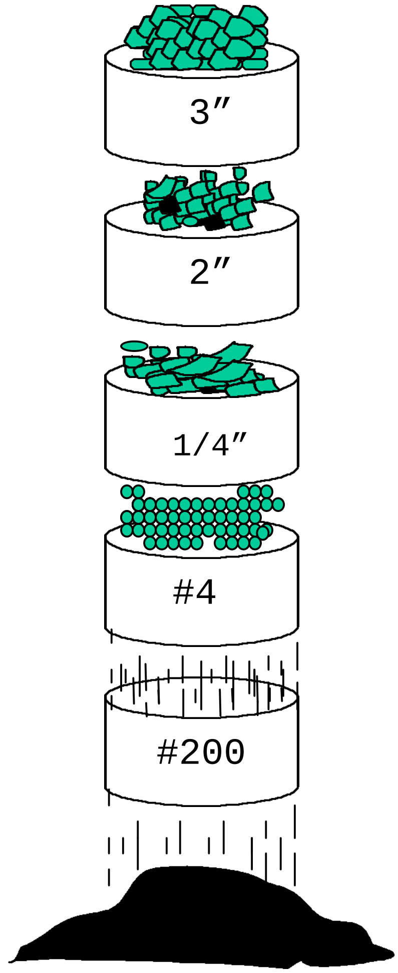
Answer:

a. D60 = 4.5 millimeters
b. D10 = 0.25 millimeters
c. D30 = 1.0 millimeters

Note that these values ere obtained by simply going to the percent passing by weight on the left vertical scale, then moving horizontally across to the until we intercept the grain size distribution curve and then vertically down to the horizontal axis where the diameter of the material is read in millimeters. NOTE values increase from right to left.

Go to Page 15 and continue work.

Frame 11



A stack of these sieves arranged with the largest on top and the smallest on the bottom is called a NEST OF SIEVES and is used to perform a sieve analysis.

Frame 12

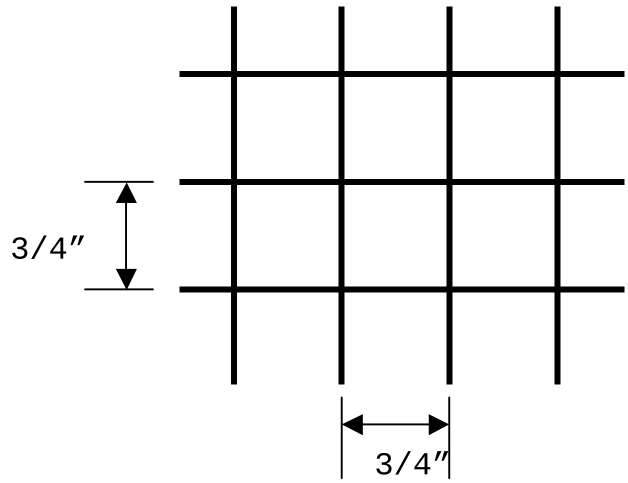


FIGURE 7

a. What size is represented by figure 7?

Go to page 17 frame 13 for the correct answer.

Frame 57

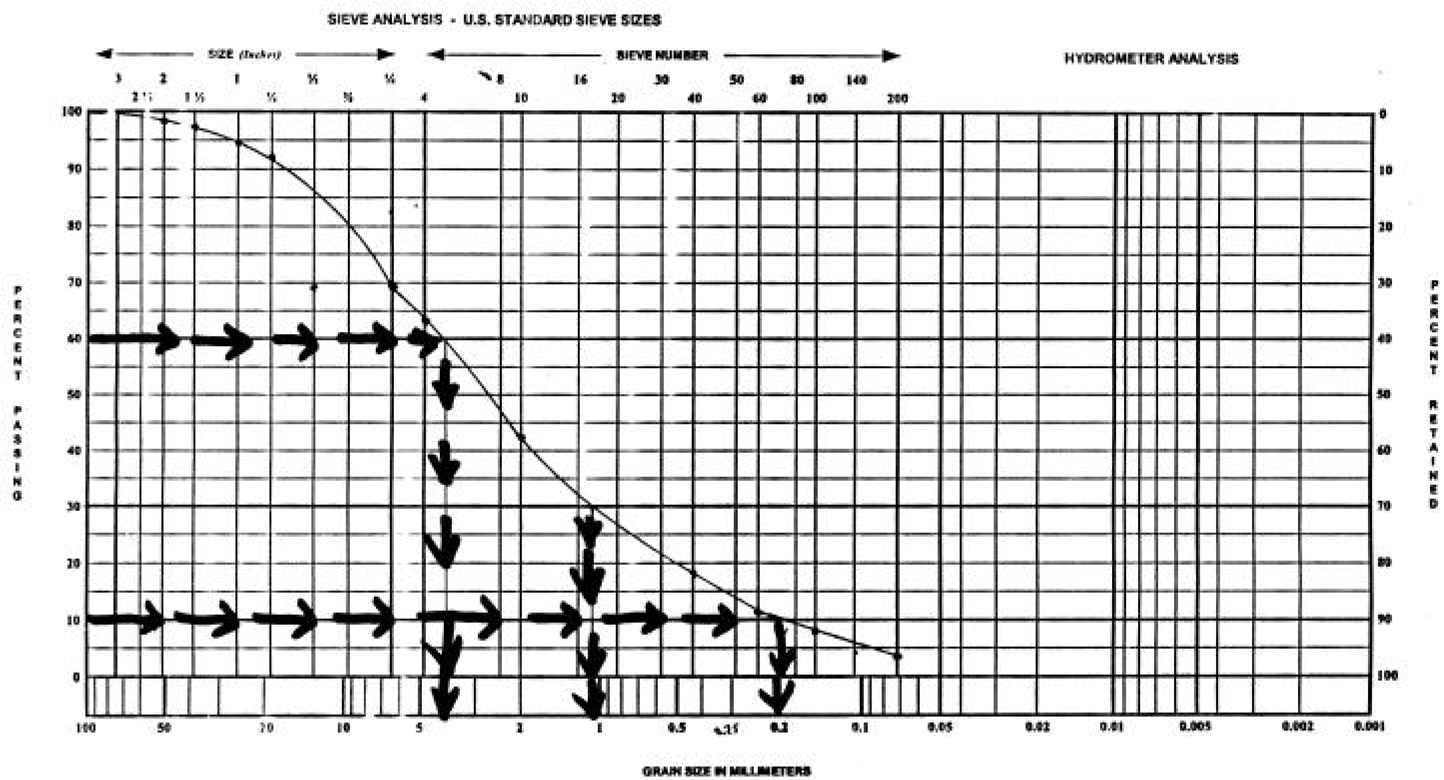
From the Grain Size Distribution Graph on page 11 frame 54:
What is the Cu and Cc for this material?

Go to Frame 58 page 17 for the correct answer.

Frame 57a

GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

1. PROJECT	2. DATE



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	C_u (D_{60}/D_{10})	C_c $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION / REMARKS	CLASSIFICATION (USCS)

3. TECHNICIAN (Signature)	4. PLOTTED BY (Signature)	5. CHECKED BY (Signature)

DD Form 1207-R, AUG 97

Frame 13

Answer:

a. ¾″ sieve

Frame 58

$$Cu = \frac{D60}{D10} = \frac{4.5mm}{0.25mm} = 18$$

$$Cc = \frac{(D30)^2}{D60 \times D10} = \frac{(1.0mm)^2}{4.5mm \times 0.25mm} = 0.89$$

Frame 14

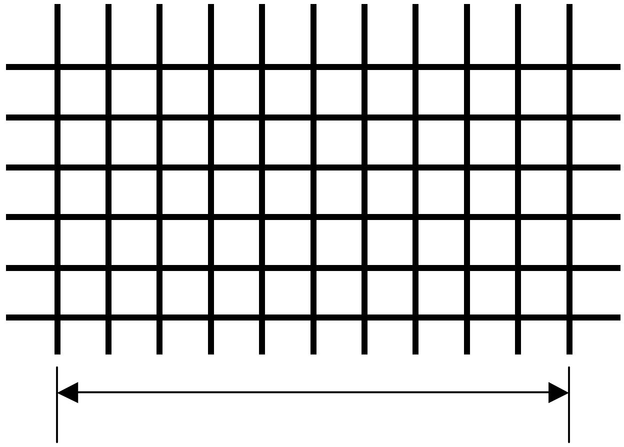


FIGURE 8

a. What size sieve is represented by figure 8?

b. Which sieve is larger, the one in figure 7 or figure 8?

Go to page 20 Frame 15 and continue work.

Frame 59

In order for a soil to be considered well-graded, it must meet the following criteria:

1. Its grain size distribution must plot a smooth curve. (the curve must not have any horizontal or vertical portions and must be continuous).

	PREDOMINANTLY GRAVEL	PREDOMINANTLY SAND
2. Cu must be > than	4	6
3. Cc must be	1 - 3	1 - 3

Go to page 20 and continue work.

Frame 60

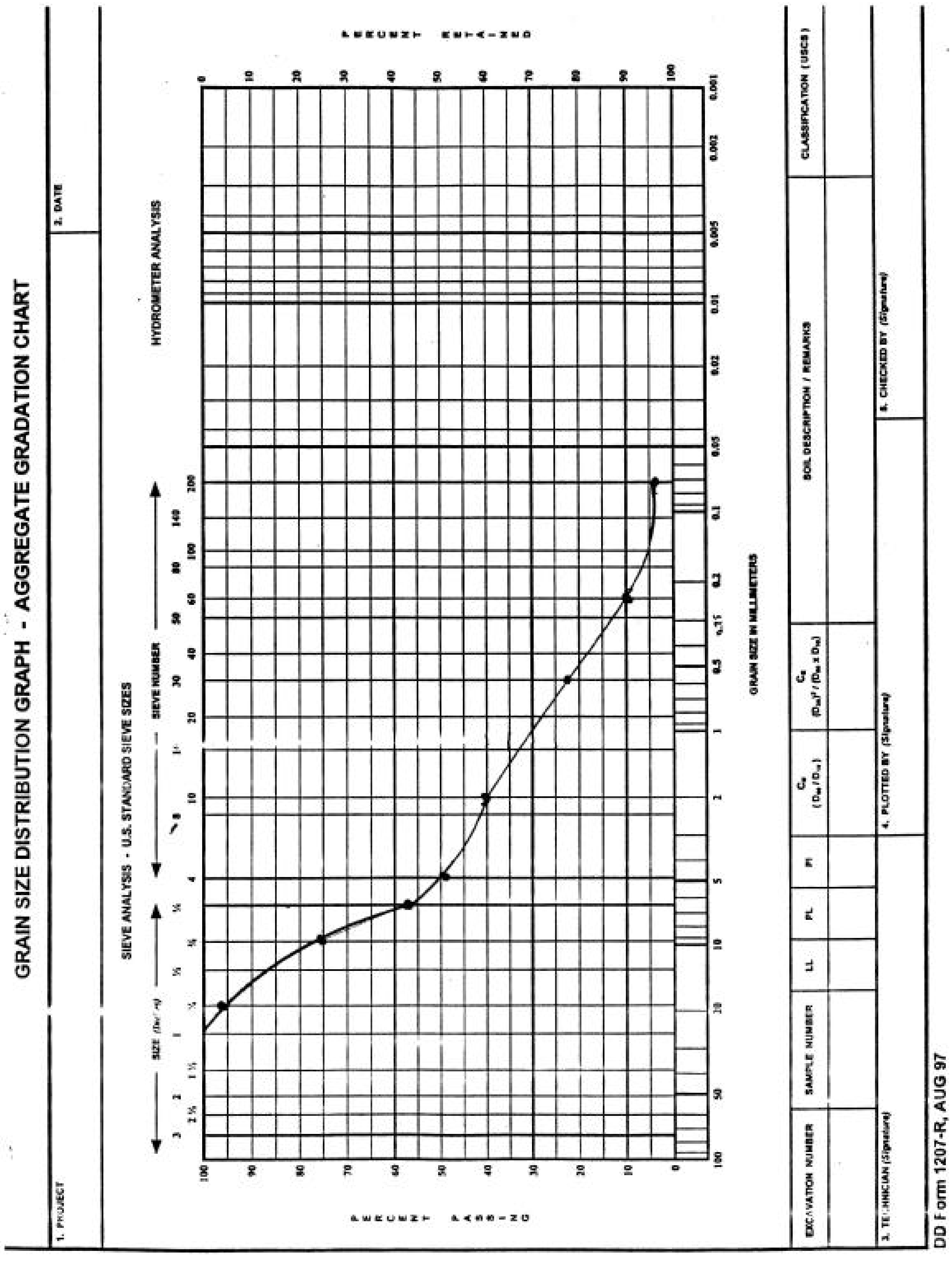


Fig. 12

Frame 15

a. #10 sieve
b. ¾" sieve

Go to frame 16 and continue work.

Frame 61

From our Sieve Analysis on page 30 we see that our material is composed of 36.9% Gravel, 58.6% Sand and 4.5% Fines. Our predominant fraction is sand since it's the largest fraction. With this information and the Gradation consideration from page 16, is this material well-graded or poorly-graded?

____

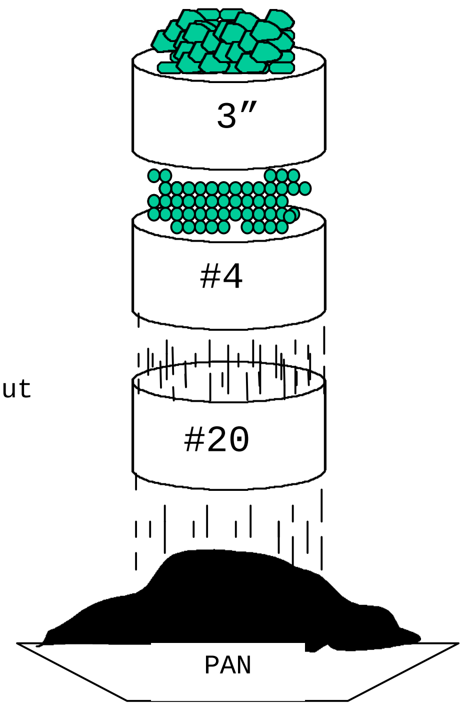
Why?

____

Frame 16

The Corps of Engineers separates all soil grain sizes into four main groups:

a. COBBLES - Materials larger than 3″ in diameter (retained on a 3″ sieve).



b. GRAVEL - Materials passing the 3″ sieve but retained on the #4 sieve.

c. SANDS - Materials passing the #4 sieve but Retained on the #200 sieve.

d. FINES - materials passing the #200 Sieve, no minimum size. (Includes silts and clays

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FRAME 62

ANSWER:

Poorly-graded

Cc for this material is only 0.89 and does not meet the gradation criteria for will-graded material which requires Cc between 1 - 3.

Frame 17

NOTE that fines can be silts, clays or a combination of both.

Silty Fines are sometimes also referred to as non-plastic fines or cohesionless fines.

Clayey Fines are also referred to as plastic fines or cohesive fines.

As you can see in the next lesson, the Unified Soil Classification System disregards all soil fractions larger than 3” in diameter (cobbles). Therefore, from this point on, our discussions of the various soil fractions will be restricted to Gravels, Sands and Fines.

Frame 63

Now, let’s see how much we have learned so far. Using the Grain Size Distribution Chart on page 19, answer the following questions:

a. Is the curve a smooth curve?______________________
b. What is the value of Cu?__________________________
c. What is the value of Cu?__________________________
d. What is the predominant material?_________________

HINT: Look at the #4 sieve. How much material is coarser than the #4 sieve and how much material lies between the #4 sieve and the #200 sieve?

e. What is the gradation of this material?_________________

The correct answers may be found in frame 64

Frame 19

What type materials are represented by the following size ranges:

SIZE RANGES	MATERIAL TYPE
Passing 3" - retained on #4	____________________
Passing #200	____________________
Passing #4 - retained on #200	____________________

Frame 64

ANSWER:

a. Yes

b. $Cu = \frac{D60}{D10} = \frac{7.0mm}{0.25\ mm} = 28$

c. $Cc = \frac{(D30)^2}{D60 \times D10} = \frac{(1.0mm)^2}{7.0mm \times 0.25} = 0.57$

d. Gravel = 52.0% GRAVEL is the largest predominant material
Sand = 44.0% since it has the largest fraction.
Fines = 4.0%

e. Poorly-graded gravel. Cc for this material is only 0.57 and does not meet the gradation criteria for well-graded material which requires Cc between 1 and 3.

Frame 20

ANSWER:

Gravel

Fines

Sand

Frame 65

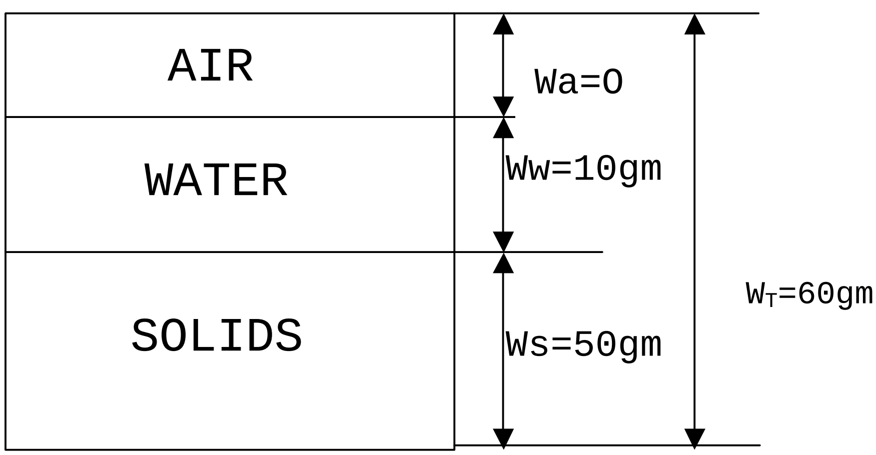
So far we have discussed the basic soil properties of size, shape, gradation and their effect on the Bearing Capacity of Soils. Now, let's see what happens when water is added to soil. Because certain amounts of water will always be present in most soils, we must have some understanding of its effect on soil properties and soil strength. In order to study the effect of water upon soil, a term is used that defines the amount of water present in a given soil sample. It is called the "moisture content" and is defined as follows:

$$W = \text{moisture content} = \frac{\text{Weight of water}}{\text{Weight of dry soil}} \times 100\% = \%$$

Frame 21

The fine-grained materials are either _____________ or _______________.

Frame 66



As an example of how this formula might be applied, suppose a sample of moist soil 60 grams. If the water weighs 10 grams, the weight of dry soil would be 50 grams. The moisture content is then obtained by dividing 10 by 50 and multiplying by 100 to convert to percent. It is equal to 20%.

Frame 22

Silts or Clays

Frame 67

Coarse-grained soils are not affected as much by moisture as fine-grained soils. Coarse-grained soils have larger void openings and, generally speaking, drain more rapidly. Capillary is no problem in gravels and sands having only, very small amounts of fines mixed with them. The solid particles in these soils are relatively large and they are, by weight, heavy in comparison to the films of moisture which might surround them.

Frame 23

The non-plastic fines are ________________ fines, while the cohesive fines are ____________________.

Frame 68

On the other hand, the small microscopic particles of fine-grained soils weigh so little that water within the voids has considerable effects on them. It's not unusual for clays to undergo very large volume changes with variations in moisture content. For example, unpaved roads containing clay, although often very hard when dry, will lose stability and turn into mud when wet.

Frame 24

Silty, Clays

Frame 69

Not only do clays swell and lose stability when they become wet, but because of their flat, plate like grain shapes and small size, they also retard the movement or drainage of water through the void spaces between the grains. Since drainage is of great importance in any construction project, the engineer must have some means of determining whether or not clay is present in a soil sample. Plasticity is usually the property of soils which shows if the sample contains clay.

Go to frame 70 and continue work.

Frame 25

SIEVE ANALYSIS DATA

1. DATE STARTED: 1 JANURARY 1984						
2. PROJECT: BLDG 247 RECONSTRUCTION			3. EXCAVATION: HOLE # 1			4. DATE COMPLETED: 1 JANUARY 1984
5. SAMPLE DESCRIPTION: YELLOW - WHITE GRAVELLY SAND WITH A SMALL AMOUNT OF FINES						6. SAMPLE NUMBER: 13
						7. PREWASHED (x one): X YES / NO
8. ORIGINAL SAMPLE WEIGHT: 3964 GRAMS			9. + # 200 SAMPLE WEIGHT: 3829			10. - # 200 SAMPLE WEIGHT: 135

11. SIEVE SIZE	12. WEIGHT OF SIEVE	13. WEIGHT OF SIEVE SAMPLE	14. WEIGHT RETAINED	15. CUMULATIVE WEIGHT RETAINED	16. PERCENT RETAINED	17. PERCENT PASSING
2"	634	679	45	45	1.1	98.9
1 ½"	598	649	51	96	1.3	97.6
1"	540	646	106	202	2.7	94.9
¾"	608	707	99	301	2.5	92.4
½"	488	1386	898	1199	22.6	69.8
No 4	510	773	263	1462	6.7	63.1
No 10	476	1254	778	2240	19.6	43.5
No 40	377	1404	1027	3267	25.9	17.6
No 60	366	615	249	3513	6.3	11.3
No 100	320	456	136	3652	3.4	7.9
No 200	303	435	132	3784	3.4	4.5

18. TOTAL WEIGHT RETAINED IN SIEVES (Sum Column 14): 3784		19. ERROR (8-23): 3964 -3964 0 grams
19. WEIGHT SIEVED THROUGH # 200 (Weight in Pan): 45		
20. WASHING LOSS 18- (9+10): 135		
21. TOTAL WEIGHT PASSING #200 (20+10): 180		
22. TOTAL WEIGHT OF FRACTIONS (18+22): 3964		
23. REMARKS: USCS ______ PERCENT – G ______ PERCENT – S ______ PERCENT – F ______		25. ERROR (Percent): ERROR (19) / ORIGINAL WT. (8) X 100=
26. TECHNICIAN	27. COMPUTED BY (Signature)	28. CHECKED BY (Signature)

DD Form 1206, DEC 86 Previous editions are obsolete

Frame 26

ANSWER:

Gravel = 36.9%
Sand = 58.6%
Fines = 4.5%

Remember that the #4 sieve separates Gravels from sands and the #200 sieve separates the Sand from the Fines. The percentage of fines is simply the percent of passing the #200 sieve, or 4.5%. To find the percentage of gravel, just subtract the percent passing the #4 sieve from 100% or (100% - 63.1%) = 36.9%. The percentage of sand is everything left, found as follows: 100% - 36.9% - 4.5% = 58.6%.

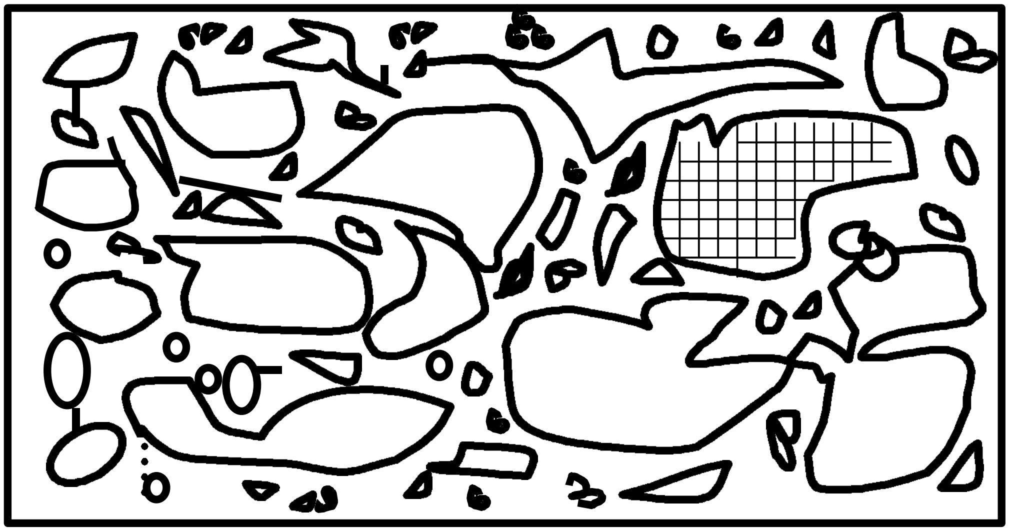
Frame 70

Go to frame 71 and continue work.

Frame 27

What effect would particle size have on Soil Strength or Soil Bearing in Capacity, the ability of the Soil to withstand a load?

Frame 28



Suppose we start with a compacted layer of material as shown above. This material will be at some known density (weight per unit volume). Now, if it were possible to remove one of the large particles (crosshatched) without disturbing the surrounding material, and replace it with as large an amount of smaller particles as possible, it is clear that in the process there would be introduced void spaces where previously there had existed a single large particle. This would result in a decrease in density within the volume replaced.

A lift is one layer of compacted soil as placed down during construction.

Frame 71

Do coarse-grained soils have better drainage than fine-grained soils?

Why?

The correct answers may be found in frame 73.

Frame 29

If the density of this material was decreased, what happened to its strength?________________________

Frame 30

Answer:

The material will generally loose strength with a decrease in density. As stated before, as a general rule, the higher the density, the higher the soil strength.

Frame 73

Answer:

Yes, because the void spaces between the solid particles are greater thus allowing water to drain more easily.

Frame 31

From experimental tests it has been found that generally speaking, coarse-grained soils (gravels and sands) can be compacted to greater density than fine-grained soils (silts and clays). As far as density is concerned, we would like to have as large a particle size as possible in our construction project. What is the largest practical size? For most construction projects the largest practical size will be ½ the lift compacted thickness.

Given a choice of material with a 3" maximum grain size and a soil with a 2" maximum grain size, which would you select if you wee compacting 4" lifts?______________________________

(A lift is one layer of compacted soil as placed down during construction)

Frame 74

What is moisture content"?______________________________

Frame 32

Answer:

2" material - this is the largest practical size for the 4" compacted layer.

Frame 75

$$W = \frac{\text{Weight of Water}}{\text{Weight of Dry Soil}} \times 100$$

The amount of water, in percent, present in a soil sample.

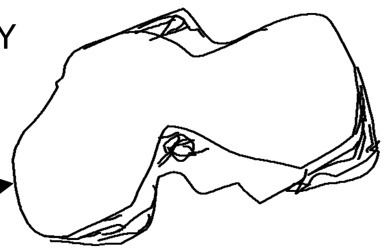
What property of soil identifies clay content?____________________

The correct answer may be found in frame 76.

Frame 33

THERE ARE 2 BASIC SOIL SHAPES

#1. PLATY



BAD

MICA, SHALE & CLAY FINES (CONSIDERABLE LOSS OF STRENGTH WHEN WET)

#2 BULKY

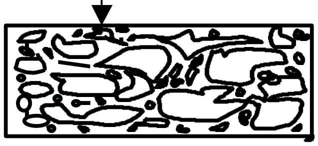
LIMESTONE, QUARTZ GRANITE & SILT FINES

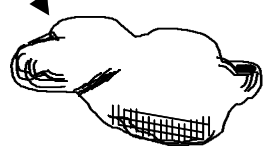
★ BEST

ANGULAR

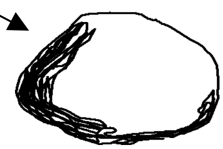
SUBANGULAR

Rough sides & sharp edges interlock & provide friction for high strength & resistance to penetration.



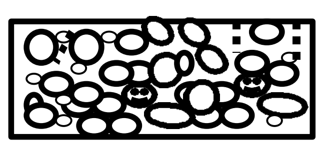


SUBROUNDED



ROUNDED

Smooth particles slide over each other providing very little resistance to penetration



NOTE: BULKY ANGULAR IS THE BEST SHAPE FOR CONSTRUCTION

Frame 34

GO TO FRAME 35

Frame 76

c. Plasticity.

Plasticity is a property of the fine-grained portion of a soil which permits it, under certain moisture conditions, to be remolded without crumbling or rupturing. A soil or soil fraction is called plastic if at some water content, it can be rolled out into thin threads. Since practically all fine-grained soils contain some clay, most of them will exhibit some amount of plasticity. The degree of plasticity a soil possesses can be used as a relative index of its clay content. In engineering practice the plasticity of a soil is determined by measuring the different states a plastic soil undergoes with changing moisture content.

Frame 35

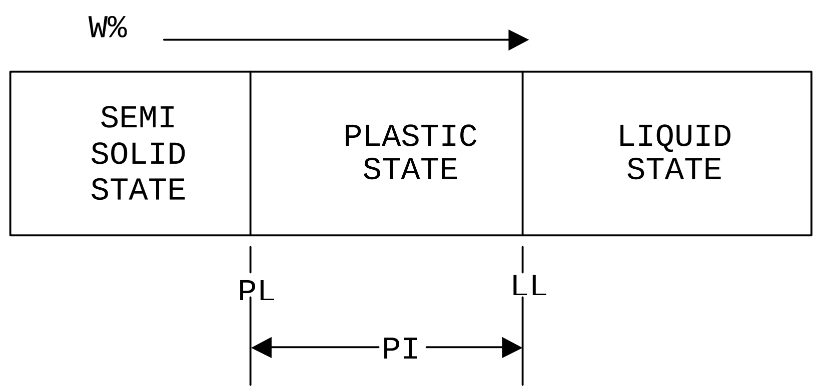
a. What are the four bulky shapes?

______________, ______________, _______________, and ________________

(Answer in frame 36)

Frame 77

Simplifying this statement with the following diagrams let's see what we are talking about:



Semi-solid State:	Material will crumble under a deforming pressure or load.
Plastic State:	When a deforming pressure is applied, the material will deform and remain in that deformed state when applied pressure is released.
Liquid State:	Material will be wet enough to flow under it's own Weight.

Frame 36

ANSWER:

a. Angular, Subangular, Subrounded, and Rounded

Frame 79

These states really don't tell us much about the properties of fine-grained soils. The moisture contents at the transition zones (Atterberg Limits) have been defined by Dr Casagrande, using Standard Laboratory procedures, as follows:

Frame 37

b. Which soil shape is the most desirable for construction purposes?

__________________________________.

(Answer in frame 39)

Frame 80

Plastic Limit (PL): The moisture content of a soil can be formed into a ball, then rolled to an 1/8" thread only once before crumbling. This soil moisture content at the boundary between Semi-Solid and Plastic States.

Frame 38

KEEP UP THE GOOD WORK!

Frame 81

Liquid Limit (LL): the soil moisture content at the boundary between the plastic and the liquid states. It is further defined as the moisture content of a soil at which the two halves of a soil pat, separated by a groove of standard dimension (1 cm deep) will join at the length of ½" under the impact of 25 blows in a standard device.

What type of soil does Plasticity help us to classify?

Frame 39

b. Bulky Angular

Frame 82

Plasticity helps us to classify FINE GRAINED soils.

Plasticity Index (PI): The numerical difference between the liquid limit and the Plastic Limit (PI = LL - PL).

NOTE: A step by step procedure for obtaining these values is discussed in paragraphs 2-86 thru 2-95, FM 5-530.

Frame 40

What shapes are:

Clay Particles? ___________________________________

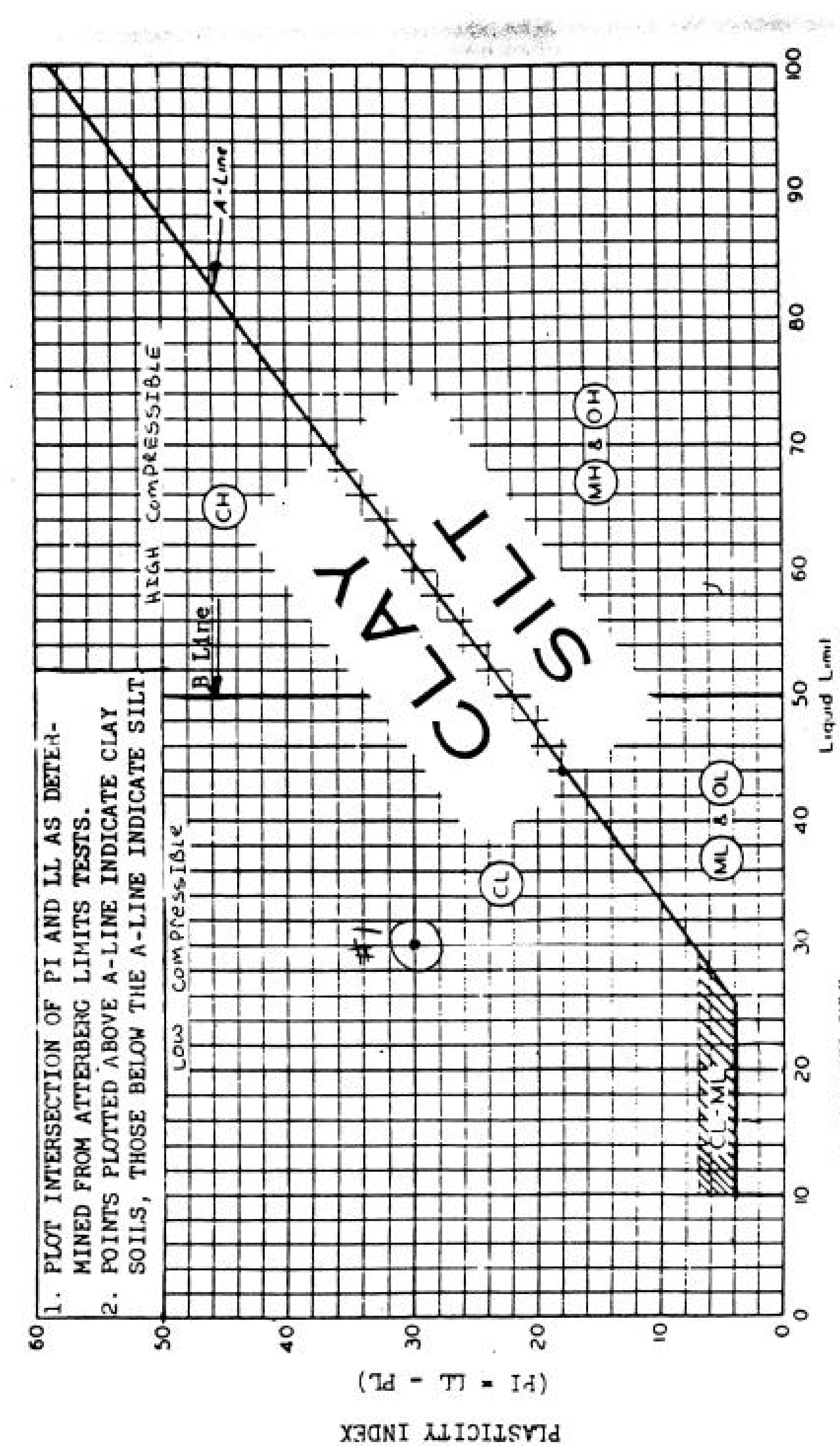
Silt Particles?____________________________________

(Answer in frame 41)

Frame 83

In 1942, Dr Casagrande developed the Plasticity Chart based on these limits by plotting the Plasticity Index vs. Liquid Limit. The Plasticity Chart, from here on out will provide us with a method for determining the type of fines present in our sample.

Frame 84



PLASTICITY CHART

FOR INSTRUCTIONAL PURPOSES ONLY
Exempt From Controls Required by AR 25-30

Frame 41

Platy

Bulky

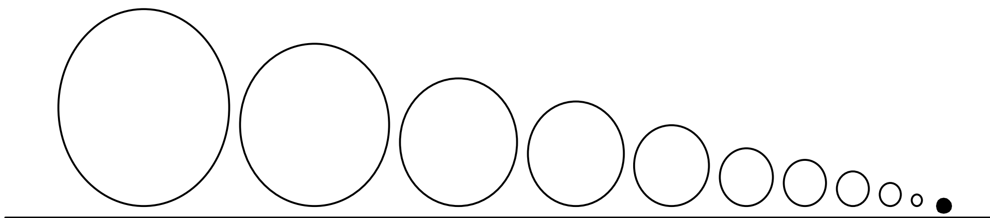
Frame 85

The A-line on the Plasticity Chart separates the clays from the silts. Any material whose values of PI vs. LL plot on the A-line or above will be classified as clay. And any material whose values of PI vs. LL plot below the A-line will be classified as silt. Materials whose limits plot within the cross-hatched area will exhibit both clayey and silty characteristics and therefore will be dual classified.

Frame 42

Another very important soil property is GRADATION. The gradation of a soil is its grain size distribution.

A well-graded soil is defined as one having a good representation of well-graded soil is shown below:



WELL GRADED SOIL

Frame 86

The B-line or LL =50% separates the High Compressible from the Low Compressible fine-grained soils. If the limits plot on, or to the right of the B-line, the material will be High Compressible. And, if the limits plot to the left of the B-line, the material will be classified as Low Compressible.

Frame 43

A poorly-graded soil does not have a good representation of all grain sizes.

If a soil sample is missing a significant percent of any one size group, it is called a gap-graded soil.

GAP-GRADED SOIL

Frame 87

From the Plasticity Chart on page 47

a. What type of fine-grained soil do we have at point #1?

____

b. Is this material Low or High Compressible?

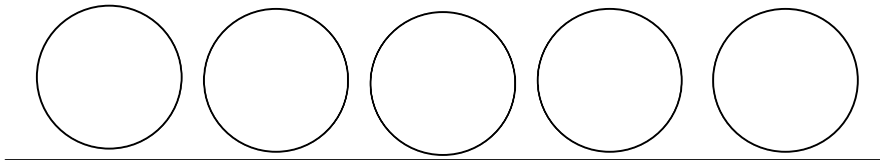
____

c. What is the plasticity based on?

____

Frame 44

If a soil is primarily all of one size group, it is called a uniformly-graded soil.



UNIFORMLY GRADED SOIL

Frame 88

a. Clay - Limits plot above A-line.

b. Low Compressible - Limits plot to the left of the B-line.

c. Plasticity Index vs. Liquid Limit.

Frame 45

A well-graded soil is best for construction because it can be easily compacted into a dense mass with a minimum of voids. Such a soil mass will create three advantages that a poorly-graded soil will not have:

1. The soil mass will be denser and because of the "interlocking" of particles thereby developed, it will be stronger and thus support heavier loads.

Frame 89

Given a soil which has a LL = 70 & PL = 50:

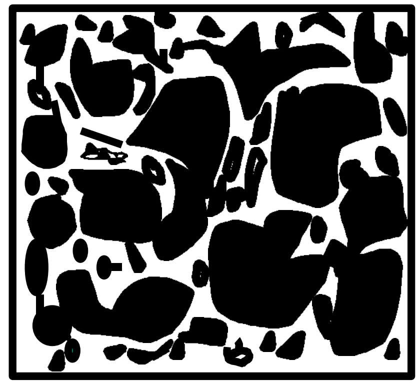
a. What type of material do we have?

____

b. What are its compressibility characteristics?

____

Frame 46



2. Since the particles are "form-fitted", the best load distribution downward will be realized.

3. When each particle is surrounded and locked by other particles, the tendency for displacement of the individual grains by loads or moisture is minimized.

Return to page 4 frame 47 to continue work!

Frame 90

a. Silt - PI = LL - PL
PI = 70 - 50 = 20

PI vs. LL plots below the A-line.

b. High Compressible - Limits plot to the right if the B-line.

This completes our discussion of Basic Soil Properties. Understanding basic soil properties and their effect on the Bearing Capacity of soils will enable us to understand other areas of soils engineering.

UNIFIED SOIL CLASSIFICATION SYSTEM

PROGRAMMED TEXT

JULY 2000

MARINE CORPS ENGINEER SCHOOL
COMBAT ENGINEER INSTRUCTION COMPANY

TABLE OF CONTENTS

Supersedes Programmed Text "Unified Soil Classification System" dated January 1977, which is now obsolete.

PREFACE

This text will present to you just the right amount of information to allow you to learn at your best rate of speed.

The test is arranged so that you proceed from the first frame to the 22^{nd} frame across the top of the pages and then back to the front of the text for the 23^{rd} through 45^{th} frame across the bottom of the pages.

If you have any difficulty answering the questions, review the material in the previous frames to find the correct answers. If you still have trouble, seek additional help from the instructor.

INTRODUCTION

The need for some classification system is evident when you consider the variety of soils that can be found in your own back yard, let alone all over the world. A system is required to classify any given soil and describe the pertinent engineer characteristics of that soil.

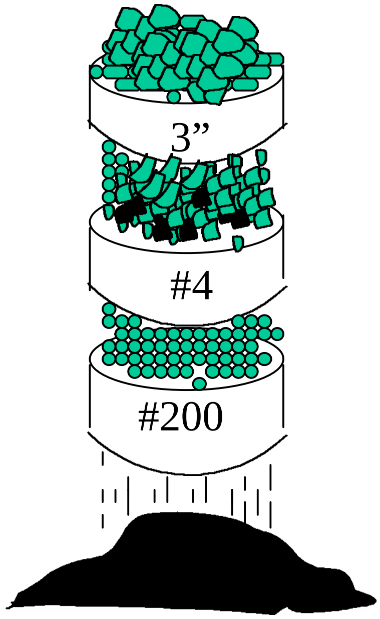
The Unified Soil Classification System (USCS) accomplishes this objective. However, it is only one system of many. The USCS is currently used by the Corps of Engineers and most states, and is gaining popularity with foreign countries and other engineering related agencies.

OBJECTIVE

At the completion of this text, you will be able to classify any soil according to the Unified Soil Classification System, given the gradation, size, and plasticity data.

Proceed now to Frame 1 on Page 1

1. The UNIFIED SOIL CLASSIFICATION SYSTEM (USCS) is a system of soil identification based on properties important in evaluating a soil for CONSTRUCTION purposes as opposed to agricultural purposes.



The Basis for the system is:

a. The % GRAVEL, % SAND, % FINES

b. GRADATION

c. PLASTICITY & COMPRESSIBILITY

The Unified Soil Classification System classifies soil according to soil propertied important for ________________ purposes.

Go to Page 2

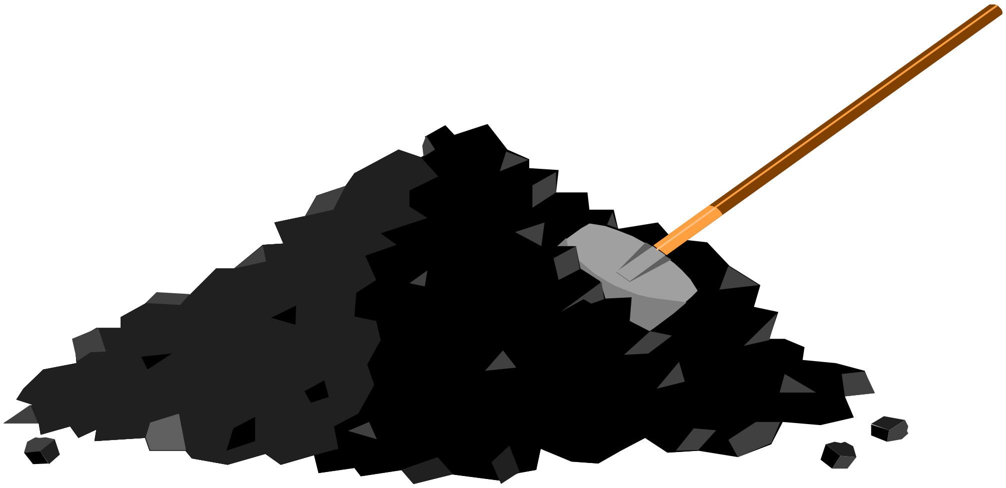
---

23. By George, I think you've got it. Now let's consider what happens when we increase the amount of fines. If we increase the amount of fines to greater that 12%, construction characteristics of the sample become dependent more on the TYPE OF FINES than on gradation, and our classification system reflects this transition.

Fines are divided into ____________________ and ______________________ fines.

Go to Page 2

ANSWER: CONSTRUCTION



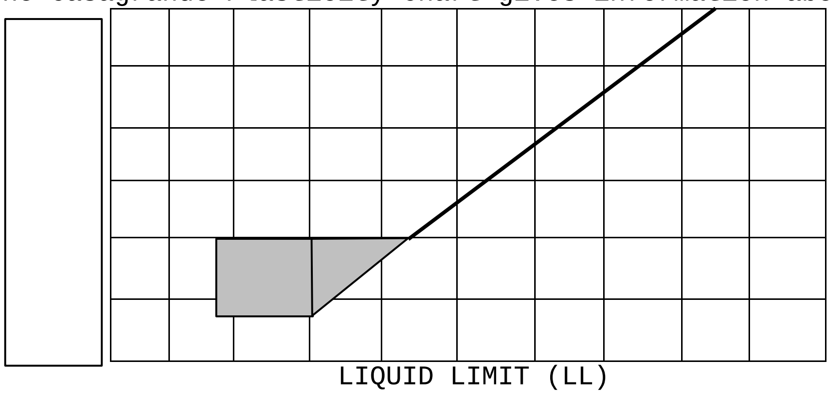
Go to Frame 2

ANSWER: SILTY AND CLAYEY

Go to Frame 24

2. From our knowledge of Basic soil Properties, we remember that the sieve analysis of soil will give us the information concerning the % GRAVEL, %SAND, % FINES AND **GRADATION.**

The Casagrande Plasticity Chart gives information about the ________&_______.



Go to Page 4

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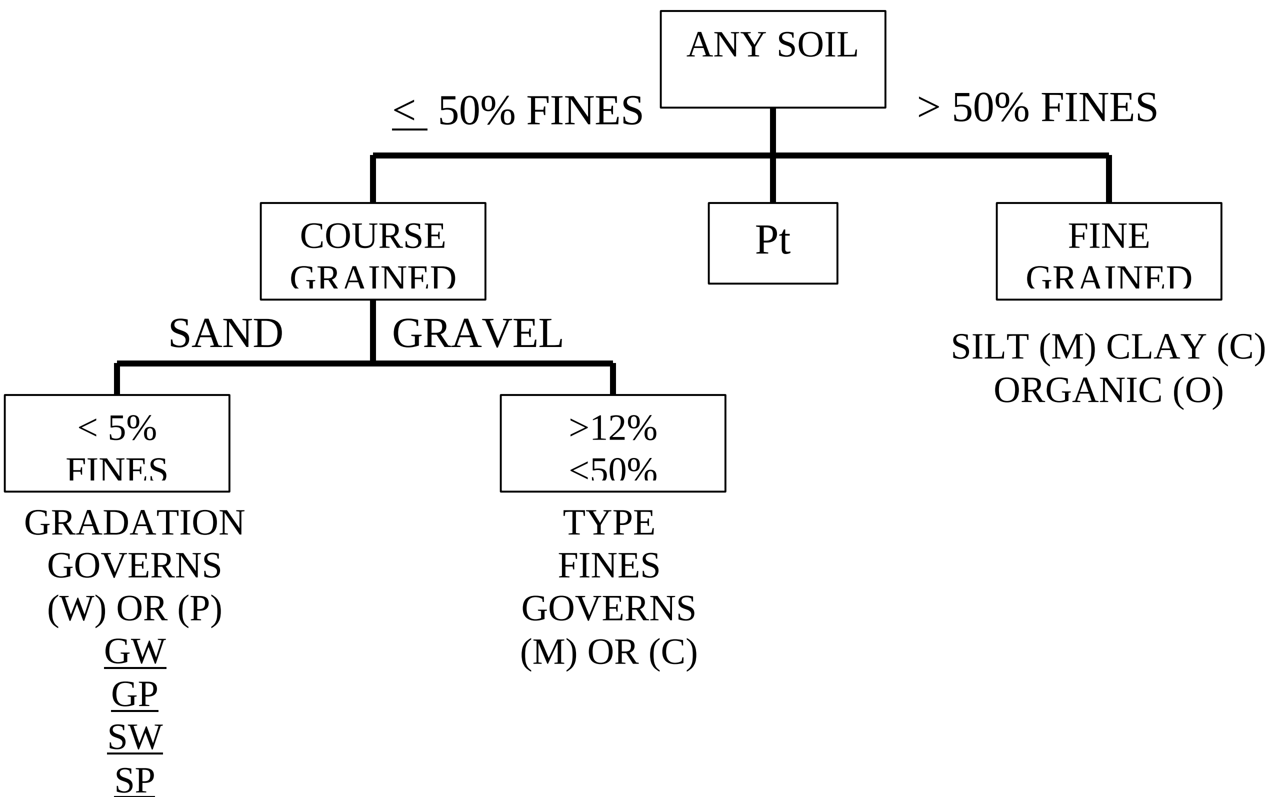
24. When a Coarse Grained (≤ 50% fines) soil has greater that 12% fines, the soil is described by a SECONDARY letter of M or C indicating the TYPE OF FINES.



To determine the TYPE OF FINES, you need to plot the __________________ and ______________________ on the plasticity Chart.

Go to Page 4

ANSWER: PLASTICITY AND COMPRESSIBILITY

Go to Frame 3

ANSWER: LIQUID LIMIT.
PLASTICITY INDEX

Go to Frame 25

3. If the soil has GREATER THAN 50% fines we say the soil is FINE GRAINED.

If the soil has LESS THAN or EQUAL TO 50% fines we say the material is COARSE GRAINED.

The basis for the USCS system is:

a. ____________________

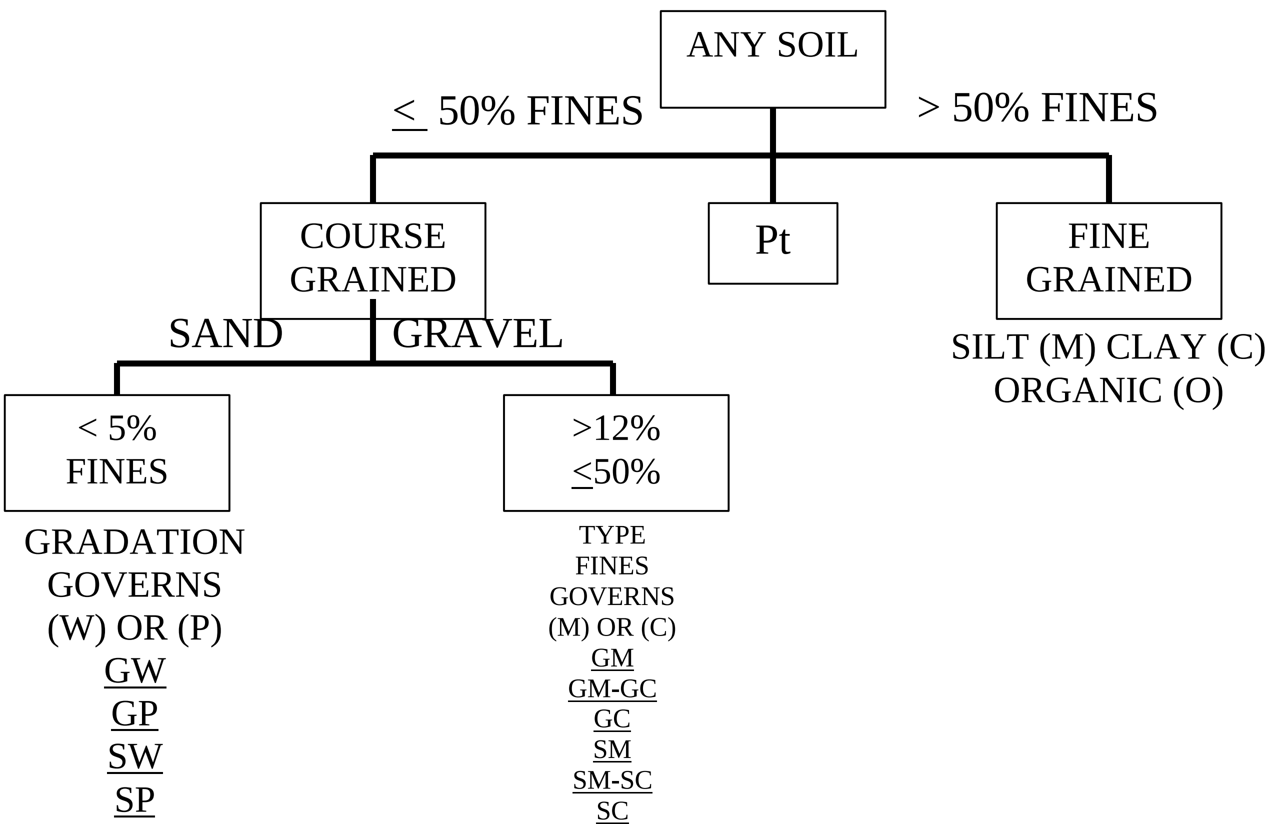
b. ____________________

c. ____________________ & ____________________

Go to Page 6

---

25. The possible classifications of soils with >12% but ≤50% fines are: **GM, GC, SM, SC** and the dual classifications of **GM-GC, SM-SC.**



Go to Frame 26

ANSWER:

1. % GRAVEL, % SAND, % FINES

2. GRADATION

3. PLASTICITY & COMPRESSIBILITY

Go to Frame 4

4. The UNIFIED SOIL CLASSIFICATION SYSTEM uses a system of two letter abbreviations to describe soil.

PRIMARY (1^{st} letter) _____ Identifies the Predominant Soil Fraction

SECONDARY (2^{nd} letter) ____ An adjective further describing the characteristics of the Predominant Soil Fraction.

The % Gravel, % Sand, % Fines, provides information necessary to choose the _________________letter.

Go to Page 8

---

26. Whoa! You're wondering, "what's this dual classification stuff?" Well if you'll remember, that the box at the base of the a-line on the Plasticity Chart, defined soil that could not be classified as either Silts or Clays so we classify soil of that type as both Silt and Clay.

The 1^{st} and 3^{rd} letter of the classification is the primary letter of the symbol. The 2^{nd} letter is always M and the 4^{th} letter is always C.

Classify this soil:

Gravel = 51%
Sand = 34%

LL =20
PL = 15 (Watch out! I said PL not PI)

Fines _____

The USCS symbol is ________

Go to Page 8

ANSWER: PRIMARY

Go to Frame 5

ANSWER: GM-GC

The soil is coarse grained and the predominant coarse grained fraction is gravel (51%). The primary letter therefore is G. Subtracting the PL from the LL we find that the PI = 5%. Plotting the LL & PI on the Plasticity Chart we see that the point falls within the box at the base of the A-line, indicating that a dual classification will be used. The 1st and 3rd letters are G, the 2nd letter is M and the 4th letter is C.

Go to Frame 27

5. Symbols used as PRIMARY LETTERS (used for describing the predominant soil fraction) are:

G - Gravel
S - Sand
C - Clay
M - Silt (stands for Mo, the Swedish word for Silt)
O - Organic

In the symbols GW, SP, GP, ML, OH circle the Primary letters.

Go to Page 10

---

27. Want to do another one? I thought so. Try this one.

Gravel = 23%	LL = 63%
Sand = 37%	PI = 15%
Fines =____	

`

Go to page 10

ANSWER: <u>G</u>W, <u>S</u>P, <u>G</u>P, <u>M</u>L, <u>O</u>H

Go to Frame 6

ANSWER: <u>SM</u>

The amount of fines is 40% which is less than 50%. Therefore, the soil is coarse grained. The primary letter is S since Sand is the predominant coarse fraction. As there are more than 12%fines the TYPE OF FINES will govern the selection of a secondary letter. The LL of 63% and the PI of 15% plot below the a-line on the plasticity chart indicating that the fines are silty. The secondary letter, therefore is the symbol for SILT or <u>M.</u>

Easy, huh?

Go to Frame 28

6. Symbols used as SECONDARY letters in the USCS are:

W - Well Graded P - Poor Graded	Used to describe Sands and Gravels containing less than 12% fines
M - Silty Fines C - Clayey Fines	Used with sands and Gravels containing more that 5% but less than or equal to 50% fines.
L - Low compressibility (LL<50%) H - High Compressibility (LL≥50%)	Used to describe fine grained soils (silts, clays organics)

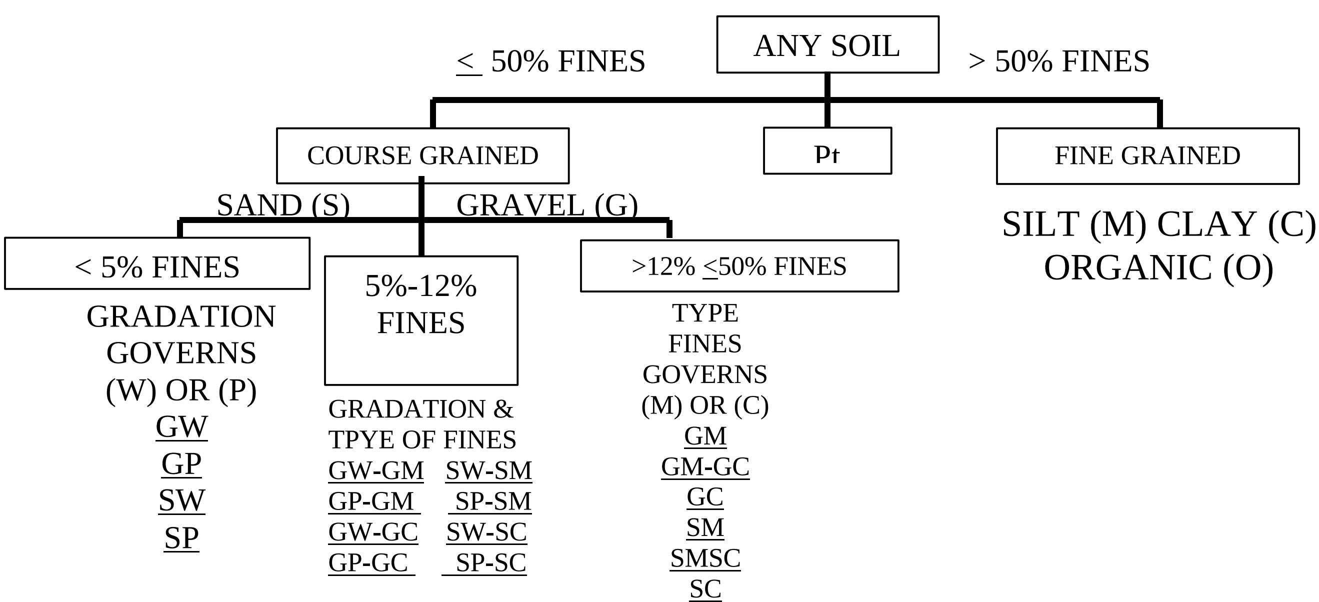
All fine grained soils (> 50% fines) will have secondary letters of _________ or __________.

Go to Page 12

---

28. That takes care of coarse grained soil with <5% fines and >12% fines but what about those soils with 5% or more fines but with less that or equal to 12% fines? A soil that falls in this range can be WELL GRADED (W) or POORLY GRADED (P) but the amount of fines are enough to be significant when considering the soil for use as a construction material.

Therefore, when a soil has 5% - 12% fines we use a dual classification to reflect both the GRADATION and the TYPE of FINES.



Go to Frame 29

ANSWER: L, Low Compressible, and LL <50%
H, High Compressible, LL<50%

Go to Frame 7

7. The PRIMARY letters of G (Gravel) & S (Sand) are used only for soils with ≤ 50% fines.

The symbol used depends upon which COARSE GRAINED fraction is dominant.

A coarse grained soil (≤ 50% fines) having more gravel than sand, the primary letter for the classification would be ___________________________.

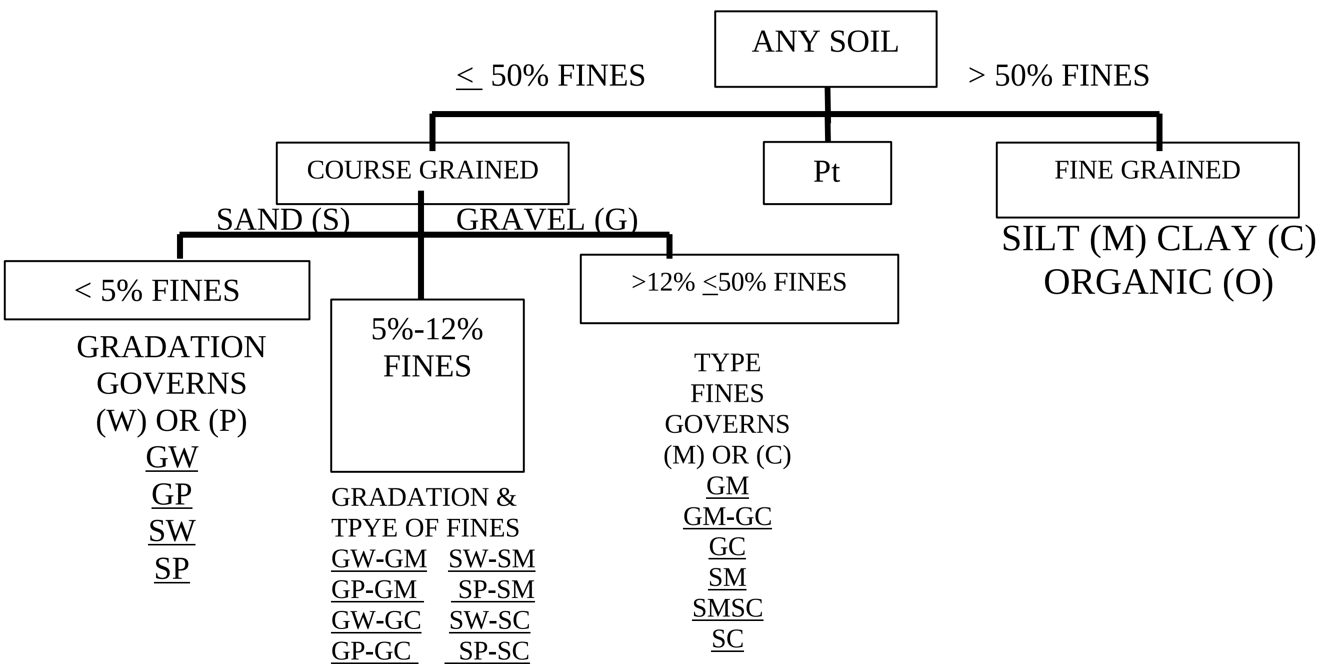
Go to Page 14

---

29. The 1st and 3rd letters of the dual classification are always the same and are always the PRIMARY LETTER of the classification.

The 2nd letter describes the GRADATION characteristics of the soil and the 4th letter indicates the TYPE OF FINES.

The possible classifications for soils of this type are shown below.



Go to Frame 30

ANSWER: G (GRAVEL)

Go to Frame 8

8. M (Silt), C (Clay) & O (Organic) are used as PRIMARY letters <u>only</u> with fine grained soils (>50%fines).

Is <u>MP</u> a valid combination of PRIMARY & SECONDARY letters? Why?

Go to Page 16

---

30. To classify a COARSE GRAINED SOIL with 5% - 12% fines you need to determine the ___________________ & _______________.

Go to Page 16

ANSWER: NO. M (silt) can only be used as a primary letter with FINE GRAINED soils while P (poorly graded) can only be used as a secondary letter for COARSE GRAINED SOILS.

Go to Frame 9

ANSWER: GRADATION & TYPE OF FINES.

Go to Frame 31

9. An inorganic soil has 52% Fines, a LL of 47% and a PI of 12%. The primary letter for this soil is __________________.

Go to Page 18

---

31. To show me you got it, classify this soil.

Gravel = 50%	Cu = 17	LL = 27
Sand = 40%	Cc = 4.2	PI = 16
Fines = ____	smooth curve	

The Unified Soil Classified Symbol is _________________.

Go to Page 18

ANSWER: M (SILT)

The material is fine grained and the Liquid Limit and the Plasticity Index plot below the A-line on the Casagrande plasticity chart

Go to Frame 10

ANSWER: GP - GC

The soil is COARSE GRAINED and, since the gravel fraction is larger, G is the primary letter. Since there are 10% fines we will have a dual classification. The 1st and 3rd letters will be G the primary letter. The 2nd letter is determined from the GRADATION data. In this case the 2nd letter is P because Cc = 4.2 which does not fall within the limits of 1-3. The 4th letter is determined by plotting the plasticity data. By plotting the LL & PI in this problem, the type of fines are determined to be clayey fines, therefore, the 4th letter is a C. The total classification then is GP - GC.

Go to Frame 32

10. A sieve analysis provided the following data on a soil:

42% Gravel
40% Sand
___ Fines

The primary letter for the USCS symbol is ________________.

Go to page 20

---

32. If you solved the last problem correctly you should not have any problem with this one:

Gravel = 26%
Sand = 67%
Fines = ___

LL = 62%
PI = 18%

Cu = 3.8
Cc = 2.4
Most of the material falls between the #10 and #40 sieve.

What is the Unified Soil Classification ________________?

Go to Page 20

ANSWER: G (Gravel). The soil is COARSE GRAINED (less that 50 % fines) and the predominant coarse grained fraction is gravel.

Go to Frame 11

ANSWER: SP-SM

Fines = 7%. The soil is coarse grained and, since sand is the predominant fraction, S is the primary letter. With 7% fines we know that we will have a DUAL classification and that we have to consider both GRADATION and TYPE OF fines. The soil does not meet the gradation criteria for sand, Cu = 3.8 which is not greater than 6. Therefore, the 2nd letter will be a P. By plotting the LL and the PI on the Casagrande plasticity chart we see that the fines are silty. Therefore, the 4th letter is M. With the 1st and 3rd letters of our classification being the primary letter S, the whole symbol is SP-SM.

Go To Frame 33

11. M (silty fines) and C (clayey fines) are used as secondary letters in a COARSE GRAINED soil to describe the relative plasticity of the fines.

A SECONDARY letter of __________ would indicate non-plastic fines.

Go to Page 22

---

33. That does it for the COARSE-GRAINED SOILS. You can now classify ANY coarse grained soil.

Now, let's see what we have to do to classify FINE-GRAINED soils.

Do you remember that FINE GRAINED soils have GREATER THAT 50% fines (passes the #200 sieve)

The 3 types of fine-grained soils ____________, ______________, and ________________.

Go to Page 22

ANSWER: M (silty fines) non-plastic and non-cohesive fines mean silty type fines.

Go to Frame 12

ANSWER: Silt, Clay, Organic

Go to Frame 34

12. (Low Compressible) and H (High Compressible) are used as Secondary letters to describe the compressibility of a fine-grained soil (>50% fines).

A soil with Low Compressibility has a liquid limit which is ________________.

Go to Page 24

---

34. Since we have three types of fine-grained Soil - silt, clay and organic - our primary letters for FINE GRAINED material will be either

M - Silt
C - Clay
O - Organic

We determined whether the fines are silt or clays by using the _____________.

Go to Page 24

ANSWER: < 50%

Go to frame 13

ANSWER: Casagrande Plasticity Chart

GO TO Frame 35

13. A fine-grained soil whose liquid limit is 65% would have a SECONDARY letter of ______________________.

Go to Page 26

---

35. The plasticity characteristics of ORGANIC fines plot below the A-line of the plasticity chart as do SILT fines.

ORGANIC fines can be differentiated from SILT fines by their dark color and their musty odor.

A dark, musty soil whose LL is 52% and whose PI is 10% would have a primary letter of ______________.

Go to Page 26

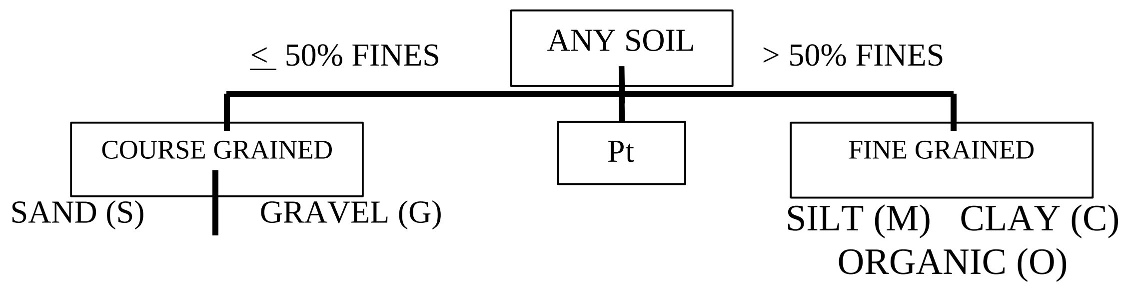
ANSWER: H

Go to Frame 14

ANSWER: O (Organic)

Go to Frame 36

14. Let's build a unified soil classification chart now that will help us with the classification of a soil. From our previous discussion, do you think a logical initial breakdown would be to divide the soil into categories of COARSE-GRAINED soil and FINE-GRAINED soil? I do, and so did Dr. Casagrande.



Go to Frame 15

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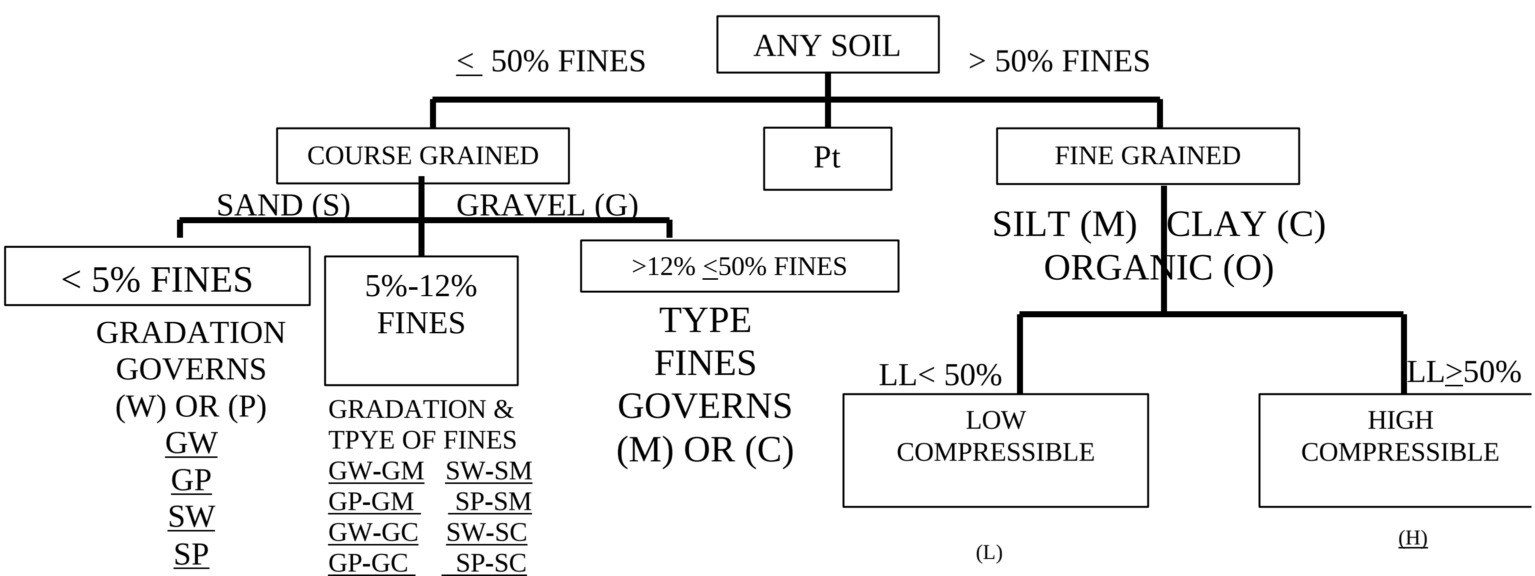
36. For fine-grained soils we further identify the soil by its COMPRESSIBILITY.

Soils with a Liquid limit (LL) < 50% are LOW COMPRESSIBLE (L)
Soils with a Liquid Limit ≥ 50% are HIGH COMPRESSIBLE (H)



Go to Frame 37

15. COARSE-GRAINED soils will be given a primary symbol of ___________ or _______________.

Go to Page 30

---

37. L & H are ______________ letters in the classification of FINE-GRAINED SOILS.

Go to Page 30

ANSWER: S - Sand or G - Gravel

Go to Frame 16

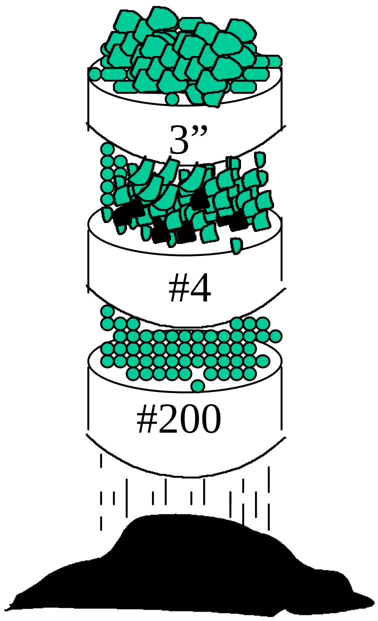
ANSWER: Secondary

Go to Frame 38

16. If a COARSE GRAINED soil had

56% Gravel
37% Sand

The primary letter for the USCS Classification would be ________________.



Go to Page 32

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38. For a LOW COMPRESSIBLE fine-grained soil the possible classifications are:

ML
CL
OL
ML-CL (By now you know that this dual classification means that this material will plot in the box at the base of the A-line.)

Go to Frame 39

ANSWER: G

Go to 17

17. If a COARSE-GRAINED soil has LESS than 5% fines, the fines will not significantly affect the construction properties of the soil. Soils with less that 5% fines are therefore classified according to the GRADATION of coarse fraction.

Go to Page 34

---

39. After successfully classifying the coarse grained soils, classifying this FINE-GRAINED soil should be a snap:

LL = 40%
PI = 25%
% of Fines = 62%

The Unified Soil Classification is ____________________________.

Go to Page 34

NOTE: If fines interfere with free draining properties use double symbol such as GW - GM, etc.

Go to Frame 18

ANSWER: CL

The Liquid Limit (LL) is less than 50% so the secondary letter will be L (low compressible). The LL & PI plot above the A-line so the material is CLAY and the PRIMARY letter is C. The classification, then, is CL.

Go to Frame 40

18. A Coarse Grained soil with <5% fines will have a primary letter of _________ or _________ and a secondary letter of ________ or _______.

Go to Page 36

---

40. Are you ready for this one? Try is, you'll like it!

Black in color with a musty, leafy odor.

LL = 37
PI = 4

The USCS symbol is ______________________.

Go to Page 36

ANSWER: S OR G
W OR P

Go to Frame 19

ANSWER: OL

The LL is below 50% so the SECONDARY letter is L. The LL & PI plot below the A-line on the plasticity chart indicating either a silt or organic material. The description if the soil gives you the clue that the material is Organic (O). The primary letter is O and the complete symbol is OL.

Go to Frame 41

19. The possible classifications for a COARSE GRAINED soil with <5% fines are:

GW (Well-graded Gravel)
GP (Poorly-graded Gravel)
SW (Well-graded Sand)
SP (Poorly-graded Sand)

Go to Frame 20

---

41. Classifying the HIGH COMPRESSIBLE soils should be pretty obvious by now. In fact you tell me what the possible classifications are?

____________________, ________________________,_________________________

Go to Page 38

ANSWER: MH, CH, 0H

Go to Frame 42

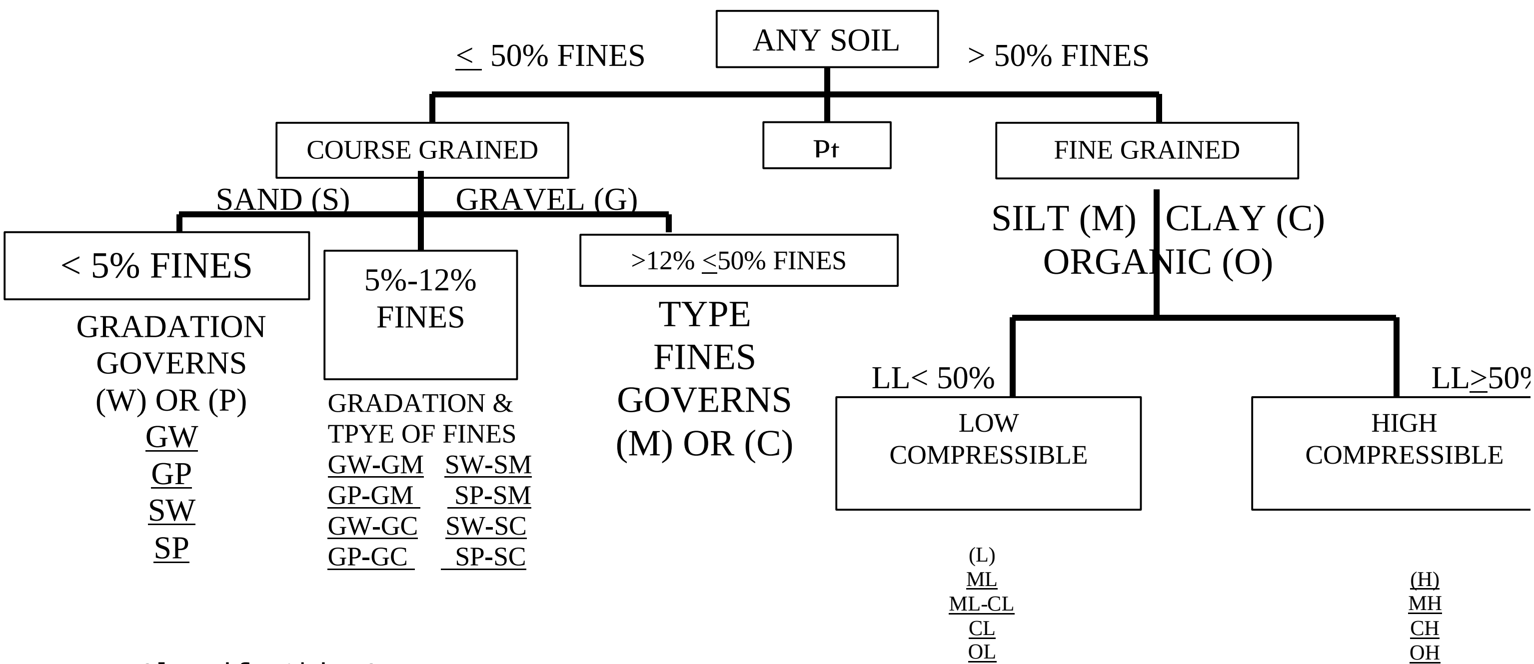
20. For a soil to be well graded all three of the following requirements must be met:

a. The grain size distribution curve must be _________________.
b. Cu (Coefficient of Uniformity) must be ______________ for sand and __________for gravel.
c. Cc (Coefficient of Curvature) must be ____________.

Go to Page 40

---

42. The HIGH COMPRESSIBLE soils have LL equal to or above 50%.



Classify this Gem.

LL = 62%
PL = 42%
Non-organic

% Fines = 75%

The USCS symbol is ______________

Go to Page 40

ANSWER: a. Smooth
b. >6 for sand and >4 for gravel
c. 1-3 for either sand or gravel

Go to Frame 21

ANSWER: MH

The soil is FINE GRAINED and is HIGH COMPRESSIBLE and the LL (62%) is greater than 50%.

The PI is 20% (62% - 42%). The LL & PI plot below the A-line indicating either silt or organic fines. Since the material is described as non-organic the soil is silt and the primary letter is <u>M</u>. The total symbol then is <u>MH.</u>

Go to Frame 43

21. How are we doing so far? Let's classify the following soil and find out if we have any difficulties.

Gravel = 56%
Sand = 40%
Fines = ___

Smooth Curve
Cu = 15
Cc = 1.8

The USCS symbol is _____________.

Go to Page 42

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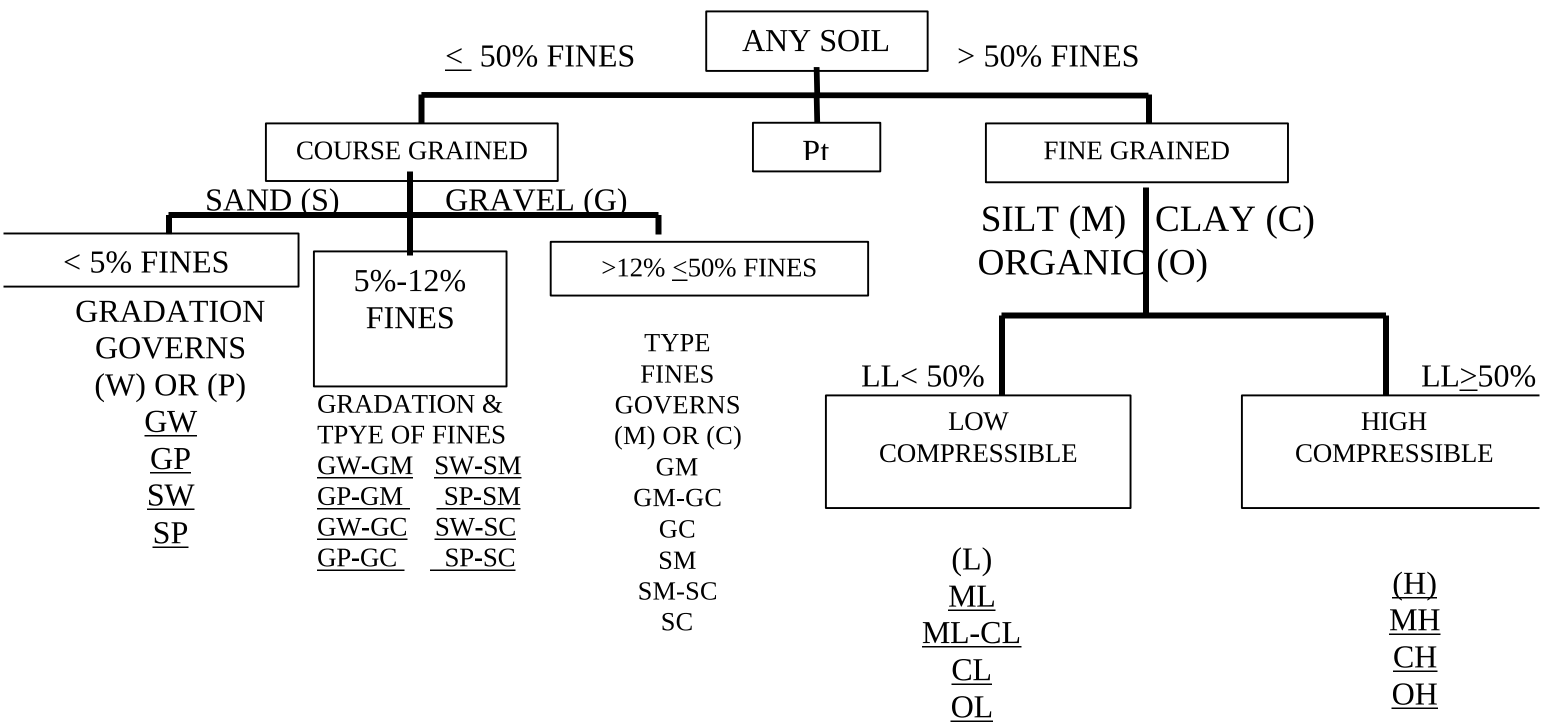
43. The only classification we have left is the symbol for PEAT which Pt.

Peat is a fibrous organic material such as Peat Moss. It is completely unsuitable for construction and is identified visually.



Go to Frame 44

ANSWER: GW % Fines = 4%

The soil is coarse grained ($\leq$ 50% fines) and the predominant coarse-grained fraction is gravel (56% vs40%). Therefore, the PRIMARY letter is G. Since there are less that 5% fines gradation governs the selection of the secondary letter. In this case the soil is WELL GRADED because it meets all 3 of the well graded criteria.

1. Smooth grain size distribution curve
2. Cu >4 (for gravel)
3. Cc is 1-3

The SECONDARY LETTER, therefore is a W.

Go to Frame 22

22. That wasn't too hard now, was it? How about one more?

Gravel = 48%	1. Smooth grain size distribution curve
Sand = 50%	2. Cu = 5.3
Fines =_____	3. Cc = 1.7

The USCS symbol for this soil is ______________________.

Go to Page 44

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44. That completes the classification chart. Look at it. The soil classifications are arranged in descending order of construction durability from left to right and from top to bottom (excluding Pt) that is the very best construction material is GW soil and the worst is OH, generally speaking.

Given a choice between a GP-GM soil and a SC soil, which would you pick for construction purposes?

Go to Page 44

ANSWER: SP %Fines = 2%

The soil is coarse grained (%fines $\leq$ 50%). The predominant Coarse-grained fraction is SAND, so the PRIMARY letter is S. There are less than 5% fines, so GRADATION will determine the secondary letter. Because Cu is not greater than 6 (for sand), the soil is POORLY GRADED, therefore the SECONDARY letter is P.

Now, go back to Page 1
Frame 23

ANSWER: GP-GM

The GP-GM will have higher densities (i.e. strength), will be better draining, will be less frost susceptible and will not be as compressible as the SC soil.

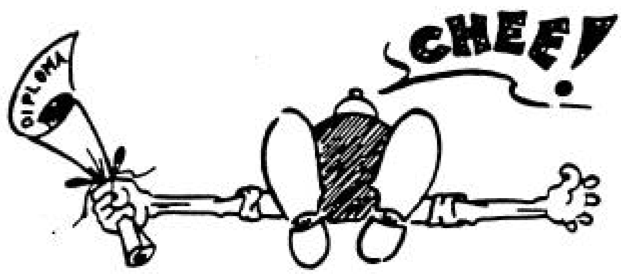
Go to Frame 45

45. You can now classify any soil according to the Unified Soil Classification System given the data on:

   a. % Gravel, % Sand, % fines
   b. The gradation
   c. The plasticity and compressibility

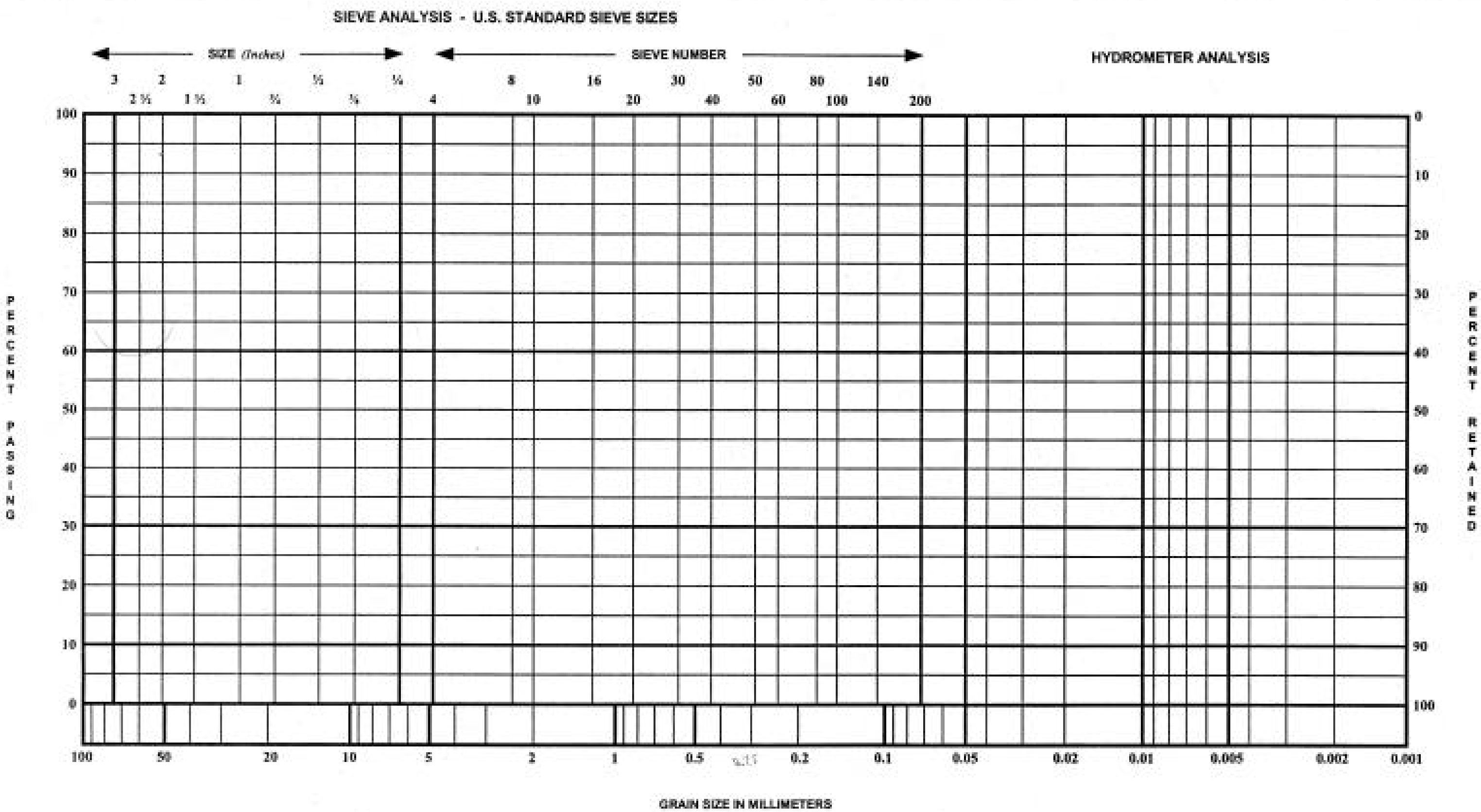
   Using the USCS chart and the plasticity chart, work the problems assigned to you in your student workbook.

   Good luck!



GRAIN SIZE DISTRIBUTION GRAPH - AGGREGATE GRADATION CHART

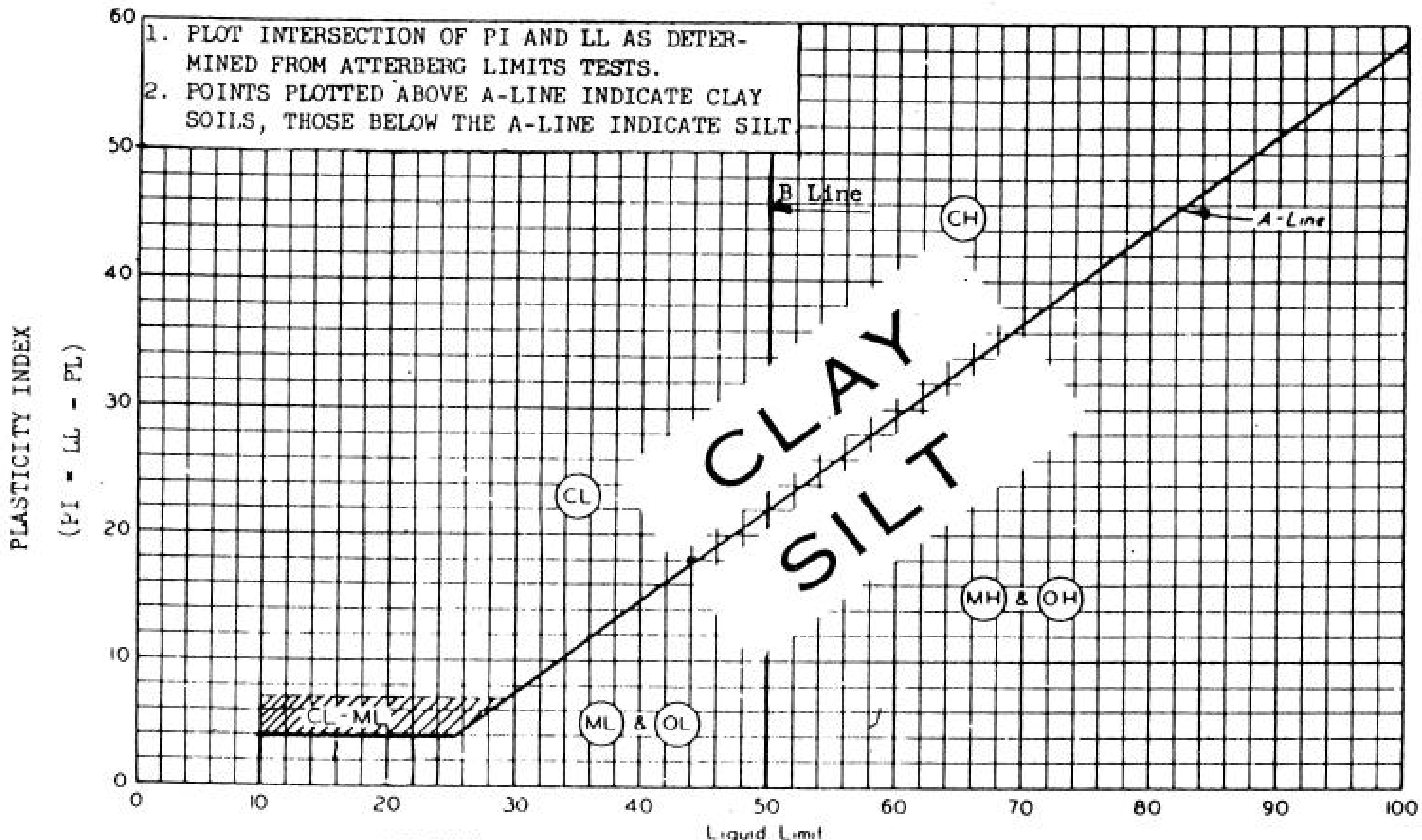
1. PROJECT	2. DATE



EXCAVATION NUMBER	SAMPLE NUMBER	LL	PL	PI	C_u (D_{60}/D_{10})	C_c $(D_{30})^2/(D_{60} \times D_{10})$	SOIL DESCRIPTION / REMARKS	CLASSIFICATION (USCS)

3. TECHNICIAN (Signature)	4. PLOTTED BY (Signature)	5. CHECKED BY (Signature)

DD Form 1207-R, AUG 97



FOR INSTRUCTIONAL PURPOSES ONLY
Exempt From Controls Required by AR 25-30

PLASTICITY CHART

R-011853-C

SCRAPER PRODUCTION WORK SHEET

STEP 1: ***(ASW)***

HAUL	RETURN	
		WEIGHT OF SOIL DRY (CY) ***(TABLE* # 2-2)**
X 1.		INITIAL MOISTURE CONTENT
		ACTUAL SOIL WEIGHT *(ASW)* (PER CY**)**

NEVER ROUND OFF

STEP 2: ***(CY) A LOAD***

HAUL	RETURN	
48,000		MAX. RATED CAPACITY LBS.
÷		ACTUAL SOILWEIGHT **(PER CY)**
		CUBIC YARDS A LOAD
OR 18	OR	NO MORE THAN 18 CY

STEP 3: ***(BUCKETS LOADED)***

HAUL	RETURN	
		CUBIC YARDS A LOAD
÷		BUCKET SIZE OF LOADER TABLE # 3-2
		BUCKETS LOADED
OR	**OR**	ROUND DOWN TO FULL BUCKETS

STEP 4: ***(LOAD SIZE)***

HAUL	RETURN	
		# OF BUCKETS LOADED
X		BUCKET SIZE OF LOADER
		ACTUAL LOAD SIZE (ALS)

NEVER ROUND OFF ALS

STEP 5: ***(LW)***

HAUL	RETURN	
		ASW
X		ALS
		LOAD WEIGHT

NEVER ROUND OFF LOAD WEIGHT

STEP 6: ***(St.)***

HAUL	RETURN	
		LOAD WEIGHT (LW) (FROM STEP 5)
+ 66,590	**+ 66,590**	WEIGHT OF TRACTOR (CONSTANT FOR 621B)
	66,590	GROSS WEIGHT
÷ 2,000	**÷ 2,000**	**ONE TON**
	33.30	***(St.) SHORT TONS***

NEVER ROUND OFF SHORT TONS

STEP 7: ***(RR)***

HAUL	RETURN	
	33.30	**(St.) SHORT TONS**
X	**X**	**(RRF) ROLLING RESISTANCE FACTOR** (TABLE #4-2)
		(RR) ROLLING RESISTANCE
OR	**OR**	5 OR GREATER ROUND UP 4 OR LESS ROUND DOWN (RR).

STEP 8: ***(GR/A)***

HAUL	RETURN	
	33.30	**(St.) SHORT TONS**
X 20	**X 20**	LBS. CONSTANT
X	**X**	% of GRADE (NOTE DO NOT CONVERT % TO DEC)
		(GR/A) GRADE RESISTANCE OR ASSISTANCE
OR	**OR**	5 OR GREATER ROUND UP 4 OR LESS ROUND DOWN (GR/A)

STEP 9: ***(REQPP) / (TS)***

HAUL	RETURN	
		(RR) ROLLING RESISTANCE TAKEN FROM ABOVE
		(GR/A) **PLUS** OR **MINUS** GRADE
		(REQPP) REQUIRED POUNDS OF PULL

SUB STEP 9: ***TRAVEL SPEED (TS)***. (TABLE #5-2)

	HAUL	**RETURN**
GEAR		
TRAVEL SPEED MPH	**(take to step 10)**	**(take to step 10)**

STEP 10: (CT)

haul distance in feet

_____ TS X 88 = _____ HAUL Time (HT)

(from step 9)

return distance in feet

______ TS X 88 = ______ RETURN Time (RT)

(from step 9)

______ + ______ + _____________ = ______________***MIN.***

(HT) + (RT) + Fixed Time (FT) = *CYCLE TIME* (CT)

(TABLE 6-2)

NOTE: NEVER ROUND OFF TIME .

STEP 11: (TPH)

60 WORKING MIN. PER/HR

________________________ = ***TRIPS PER HOUR (TPH)***

NEVER ROUND OFF (TPH)

CYCLE TIME

STEP 12: (LCYPH)

_____ **X** ______ **X** _________________________ = _______________________________

(TPH) X ALS X EFFICIENCY FACTOR (TABLE #7-2) **=** ***PRODUCTION RATE*****(LCYPH)**

(from step#4) ROUND DOWN (CYPH)

STEP 13: (SC) (IF NEEDED)

_______ **X**______________________________ = _____**OR**________ **(C CYPH)**

(LCYPH) **X** CONVERSION FACTOR (TABLE #1-1) = ***SOIL CONVERTED (C CYPH)***

ROUND DOWN (CYPH)

STEP 14: (HOURS REQ)

VOLUME NEEDED (C CY)

____ = ***HOURS REQUIRED***

X

C CYPH) X NUMBER OF SCRAPERS

STEP 15: TOTAL PRODUCTION (DAYS)

____________ ÷ ________________ = ___________

HOURS REQUIRED ÷ HOURS WORKED A DAY = **DAYS**

NOTE: ROUND DAYS TO NEXT FULL DAY

MARINE CORPS ENGINEER SCHOOL
Marine Corps Base
Camp Lejeune, North Carolina

Combat Engineer Instruction Company

LOGISTICAL SUPPORT REFERENCE

Extracts from:
MCWP 3-17, MAGTF Engineer Operations
MCO P8011.1, Marine Corps Table of Allowance for Class V (Peacetime)
Consolidated Memorandum Receipt Listing
TM 2320-10/11A, Operators Manuel for Trucks, LVS
TM 2320-20/7A, Technical Manual for HMMWV's
TM 9-2320-272-20-1, Technical Manual for 5-Tons's
TM 11240-15/4B, Principal Technical Characteristics of U.S. Marine Corps Motor Transport Equipment
TM 11275-15/3C, Principal Technical Characteristics of U.S. Marine Corps Engineer Equipment

August 2000

TABLE OF AUTHORIZED MATERIAL CONTROL NUMBER (TAMCN) CATEGORIES

A – Communications

B – Engineer

C – General Supply

D – Motor Transportation

E – Weapons Systems

G – Garrison Mobile Equipment

H – Communications

K – General Supply

M – Test Kits

U – Expendable Materials

V – 782 Gear

Sequential Listing of Equipment

TAMCN	NOMENCLATURE
B0471	DEMOLITION EQUIPMENT
B0472	DEMOLITION EQUIPMENT SET, INDIVIDUAL
B0475	DETECTING SET MINE, PORTABLE METALLIC (AN/PSS-11)
B0475	AN/PSS-12 METALLIC MINE DETECTOR
B1298	MK 2 MOD O MINE CLEARANCE SYSTEM, TRAILER-MOUNTED
B1315	MK 1 MOD O MINE CLEARANCE SYSTEM
B1320	MINEFIELD MARKING SET
B1326	MIXER, CONCRETE, TRAILER-MOUNTED, 11S
B1924	SHOP EQUIPMENT, CONSTRUCTION KIT #l
B1943	SHOP EQUIPMENT, CONSTRUCTION KIT #2
B1944	SHOP EQUIPMENT, CONSTRUCTION KIT #3
B2210	TOOL KIT, CARPENTER, ENGINEER PLATOON
B2220	TOOL KIT, CARPENTER, USMC
B2250	TOOL KIT, PIONEER, ENGINEER PLATOON
B2260	TOOL KIT, PIONEER, ENGINEER SQUAD
B2370	TOOL SET, MASON AND CONCRETE FINISHERS
B2566	TRUCK, FORKLIFT, ROUGH TERRAIN
B2567	TRACTOR, RUBBER-TIRED, ARTICULATED STEERING, MULTI-PURPOSE (TRAM)
B2567	SL-3 COMPONENTS FOR TRAM
B2561	TRUCK, FORKLIFT, EXTENDABLE BOOM (EBFL)
BO391	CONTAINER HANDLER
B0443	CRANE, HIGH SPEED, HIGH MOBILITY, W/O PILE DRIVER CAPABILITY
B0443	CRANE, HIGH SPEED, HIGH MOBILITY
B0171	BUCKET CLAMSHELL
B0446	AIR MOBILE CRANE, ROUGH TERRAIN, HYDRAULIC, LIGHT
B1300	MAINTENANCE PLATFORM, AIR MOBILE CRANE
B1082	MOTORIZED ROAD GRADER
B2460	TRACTOR, FULL-TRACKED, W/ANGLE BLADE, T-5
B2464	TRACTOR, FULL-TRACKED, W/MULTI-PURPOSE BUCKET
B2462	TRACTOR, MEDIUM, FULL-TRACKED
B0525	DRAWBAR ATTACHMENT, FIXED REAR MOUNTING
B1775	RIPPER ATTACHMENT, THREE SHANK, REAR MOUNTING
B2705	WINCH ATTACHMENT, SINGLR DRUM
U3187	TRACTOR, PROTECTIVE KIT
B2482	TRACTOR, ALL WHELL DRIVE W/ATTACHMENTS
B1785	ROLLER, COMPACTOR, VIBRATORY
B1922	SCRAPER-TRACTOR
B0591	EXCAVATOR, HYDRAULIC, WHEEL, 1085C W/ ATTACHMENTS
B0589	EXCAVATOR, COMBAT, M9 ARMORED COMBAT EARTHMOVER (ACE)
B2127	SWEEPER, RUNWAY VACUMN

TAMCN	NOMENCLATURE
B0395	COMPRESSOR, AIR
B0355	DITCHING MACHINE
B0152	MEDIUM GIRDER BRIDGE (MGB)
B1720	REINFORCEMENT SET, FOR MGB
B0120	BRIDGE ERECTION SET – MGB
B1625	CONSTRUCTION OUTFIT, RAFT, RIBBON BRIDGE
B0155	BRIDGE, FLOATING, 70 TON, RIBBON BRIDGE SET
B0114	BOAT, BRIDGE ERECTION
U3185	PIPE FASCINE, MAXI
B0490	DRAFTING EQUIPMENT SET, INDIVIDUAL
B0510	DRAFTING INSTRUMENT SET
B2120	SURVEYING SET, GENERAL PURPOSE
B1220	KIT, ASSAULT, TRACKWAY
B1945	SHOP EQUIPMENT, CONTACT MAINTENANCE, TRUCK-MOUNTED, SET #3
B2685	WELDING MACHINE, ARC, TRAILER-MOUNTED
B0635	FLOODLIGHT SET
B0730	GENERATOR SET, 3 KW, 60 HZ SKID MOUNTED, MEP-016B
B0891	GENERATOR SET, 10 KW, 60 HZ SKID MOUNTED,MEP-003A
B0953	GENERATOR SET,30 KW, 60 HZ SKID MOUNTED, MEP-005A
B1021	GENERATOR SET,60 KW, 60 HZ SKID MOUNTED, MEP-006A
B1045	GENERATOR SET,100 KW,60 HZ SKID MOUNTED, MEP-007A
B0579	DUMMY LOAD, GENERATOR SET, 100 KW
B0595	15 KW ELECTRIC POWER DISTRIBUTION SYSTEM
B0600	30 KW ELECTRIC POWER DISTRIBUTION SYSTEM
B0605	100 KW ELECTRIC POWER DISTRIBUTION SYSTEM
B0608	FIELD WIRING HARNESS
B1290	LIGHT SET, GENERAL ILLUMINATION SMALL
B1280	LIGHT SET, GENERAL ILLUMINATION LARGE
B2240	TOOL KIT, LINEMAN, ELECTRICAN
B0571	DRUM, FABRIC, COLLAPSIBLE, POTABLE WATER,500 GAL.
B2730	YOKE, TOWING AND LIFTING
B2086	STORAGE MODULE, WATER (SIXCON)
B1581	PUMP MODULE, WATER (SIXCON)
B2130	TANK, FABRIC, COLLAPSIBLE, 3K GAL ONION
B2623	TANK, FABRIC, COLLAPSIBLE, 20K GAL
B2393	TACTICAL WATER DISTRIBUTION SYSTEM (TWDS) DISTRIBUTION POINT
B0676	FORWARD AREA WATER POINT SUPPLY SYSTEM (FAWPSS)
B1620	PUMP SET, 65 GPM, 50 FT HEAD
B1582	PUMP, WATER, 350 GPM
B1595	PUMP, RECIPROCATING, POWER DRIVEN
B2604	REVERSE OSMOSIS WATER PURIFICATION UNIT (ROWPU)
B2641	WATER CHILLER, SMALL MOBILE (SMWC)
B0055	BATH, SHOWER UNIT

TAMCN	NOMENCLATURE
B1266	LAUNDRY UNIT
B1710	REFRIGERATOR, RIGID BOX
B1645	REFRIGERATION UNIT, RIGID BOX, 350 CUBIC FT
B1180	ICE MAKING MACHINE, FLAKE
B2085	STORAGE MODULE, FUEL (SIXCON)
B1580	PUMP MODULE, FUEL (SIXCON)
B1570	PUMP ASSEMBLY, EXPEDITER REFUELER
B1135	HELICOPTER EXPIDIENT REFUELING SYSYTEM (HERS)
B6075	FUEL DISPENSING SYSTEM, TACTICAL AIRFIELD (TAFDS)
B0685	FUEL SYSTEM, AMPHIBIOUS ASSAULT, 600K GAL (AAFS)
B0570	DRUM, FABRIC COLLAPSIBLE, LIQUID FUEL, 500 GAL
D1158	TRUCK, UTILITY, CARGO, TROOP, 11/4 TON (M998 SERIES HMMWV)
D1059	TRUCK, CARGO, DROPSIDE, 5 TON (M923)
D1061	TRUCK, CARGO, XLWB, 5 TON (M927)
D1072	TRUCK, DUMP, 5 TON (M929)
D1134	TRUCK, TRACTOR, 5 TON (M931)
D0215	SEMITRAILER, TANK, 5K GAL, AIRCRAFT REFUELER (M970)
D1212	TRUCK, WRECKER, 5TON (M936)
D0880	TRAILER, TANK, WATER, 400 GAL, 11/2 TON, 2 WHEEL (M149A2 WATER BULL)
D0860	TRAILER, CARGO 11/2 TON, 2 WHEEL (M105A2)
D0080	CHASSIS, TRAILER, GENERAL PURPOSE, 31/2 TON, 2 WHEEL (M353)
D0209	POWER UNIT, FRONT, 4X4 (MK 48)
D0876	TAILER, POWERED, CONTAINER HAULER (MK14)
D0877	TRAILER, POWERED, WRECKER/RECOVERY (MK15)
D0878	TRAILER, POWERED, FIFTH WHEEL, SEMITRAILER ADAPTER (MK 16)
D0879	TRAILER, POWERED, DROPSIDE, CARGO W/ CRANE (MK17)
D0881	TRAILER, SELF LOADING CONTAINER AND RIBBON BRIDGE TRANSPORTER (MK 18)
D0235	SEMITRAILER, LOW BED, 40 TON, CONSTRUCTION EQUIPMENT TRANSPORTER (M870A1)

TEN CLASSES OF SUPPLY SUPPORT

CLASS I – SUBSISTANCE

“A” rations – Designed for large group feeding. Mainly fresh or frozen items requiring refrigeration.

“B” rations – Designed for large group feeding. Composed of canned or dehydrated nonperishables.

“T” rations – Designed for large group feeding. Complete meal packaged on a tray and heated when ready to serve.

MRE’s – Designed for individual feeding. Composed of hydrated and dehydrated items. Must have “A” or “B” rations every ten days.

CLASS II – INDIVIDUAL EQUIPMENT
Clothing, tentage, tool sets, administrative and housekeeping supplies.

CLASS III – PETROLEUM, OILS, AND LUBRICANTS (POL)
TAM (Table of Authorized Material) or equipment Technical Manual (TM) provides consumption rates.

CLASS IV – CONSTRUCTION MATERIALS
Lumber, timber, barbed wire, sand bags. Normally held by Engineer Units. Must be computed for each specific mission.

CLASS V – AMMUNITION
Ground allowance: Peacetime: MCBul P8011; wartime MCO 8010.1
Aviation allowance: OPNAVNOTE C800 series.

CLASS VI - PERSONAL DEMAND ITEMS
Items normally found in an exchange: candy, soap, shaving gear

CLASS VII – MAJOR END ITEMS
Vehicles, Artillery pieces, missile launchers, major weapons system. Table of Equipment (T\E) provides equipment density.

CLASS VIII – MEDICAL MATERIALS (including medical repair parts)
Medicine, stretchers, surgical insturments

CLASS IX – REPAIR PARTS (less medical repair parts)
Repair parts and components for maintenance of all equipment including batteries, axles, sparkplugs, etc. On deployment, quantity of parts is determined by Equipment Density list (EDL) and history file.

CLASS X – MATERIAL FOR NON-MILITARY PROGRAMS
Agricultural and economic development projects: farm tools, commercial tractors.

MISCELLANEOUS – Water, maps, captured enemy gear, salvaged materials

DEMOLITION EQUIPMENT

TAMCN B0471	NSN 1375-00-047-3750 1375-00-212-4589	ID 00482B 00482A

DESCRIPTION AND FUNCTION

The Demolition Equipment Set is for use by engineer squad demolitionists. It consists of tools, accessories, and specially designed containers and carrying attachments, less explosives, for performing demolition tasks.

Action Code: SSEE

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		80 lb
Width:		18 in
Length:		33 in
Height:		13 in
Cube:		4.5 ft^3
Square Stowage:		4.1 ft^2

For Components See SL-3-00482A

DEMOLITION EQUIPMENT SET, INDIVIDUAL

TAMCN B0472 NSN 1385-00-212-4591 ID 01518A

DESCRIPTION AND FUNCTION

The Demolition Equipment Set, Individual is for use by individual demolitionists. It consists of tools, accessories, and specially designed containers and carrying attachments, less explosives, for performing demolition tasks.

Action Code: SSEE

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		7 lb
Width:		9.1 in
Length:		10.5 in
Height:		7.5 in
Cube:		.4 ft^3
Square Stowage:		.7 ft^2

For Components See SL-3-01518A

DETECTING SET, MINE, PORTABLE, METALLIC PSS\11

TAMCN 60475	NSN 6665-01-288-9997	ID 03701D
	6665-00-181-0432	03701C
	6665-00-144-7655	037016
	6665-00-966-9071	03701A

DESCRIPTION AND FUNCTION

The Detecting Set, Mine, Portable, Metallic is a portable device for detecting metallic objects, specifically intended for detecting buried metallic anti-tank and anti-personnel mines. The presence of a metallic object is aurally indicated by either a 2,500 cycle headset tone in the ANPSS-11 (ID 03701B) and P-153 (ID 03701A and ID 03701C) or rapid geiger counter-like clicking in the AF-108 (ID 03701D). False responses caused by operation over salt water or magnetic soil are effectively eliminated by a compensating circuit within the mine detector. These detectors can be adjusted to a range of sensitivities. The ANPSS-11 and P-153 are powered by a 6A-1389 U battery. The AF-108 is powered by four BA-30 batteries. The only detector now supportable is the AF-108, pictured above.

Action Code: SSEC

OPERATING AND SHIPPING DATA

	Operating Mode* ID 03701D	Shipping Mode* ID 03701D
Weight:	15 lb	26 lb
Width:	11 in	16 in
Length:	63 in**	31 in
Height:		7 in
Cube:		1.8 ft^3
Square Stowage:		3.4 ft^2

*All figures rounded up
** Handle extended
For Components See SL-3-03701A

AN/PSS-12 METALLIC MINE

TAMCN B0475 NSN XXXX-XX-XXX-XXXX ID XXXXX

DESCRIPTION AND FUNCTION

The primary function of the AN/PSS-12 Metallic Mine Detector is to locate land mines during minefield breaching, road sweeping and follow-on clearance operations. The AN/PSS-12 Metallic Mine Detector replaces the AN/PSS-11 Metallic Mine Detector. The PSS-11 had reached its end of service life and needed to be replaced with state-of-the-art technology. The AN/PSS-12 represents a world-class mine detector capable of detecting small amounts of metal such as small firing pins, in plastic or wood in modern land mines. The AN/PSS-12 Metallic Mine Detector is lightweight, hand held, and capable of detecting mines in fresh or salt water, and objects buried up to 20 inches in the ground. The telescopic pole consists of an inner plastic tube and outer aluminum tube. Operating time is 70 hours with 4 “D” cell, 1.5V batteries. Current inventory is 547. Approximately 300 are currently fielded to FMF units and training commands. The majority of these assets are held in CEB, ESB, and MWSS units. The AN/PSS-12 Metallic Mine Detector is manufactured by Schiebel Instruments with a unit replacement cost of $1,196.

Action Code: SSEC

OPERATING AND SHIPPING DATA

	Operating Mode*	Shipping Mode*
Weight:	8.5lb	13.7lb
Width:	xx in	xx in
Length:	xx in**	xx in
Height:		x in
Cube:		xx.x ft^3
Square Stowage:		x.x ft^2

*All figures rounded up
** Handle extended

For Components See SL-X-XXXXXX

MK 2 MOD O MINE CLEARANCE SYSTEM, TRAILER-MOUNTED

TAMCN B1298 NSN 1055-01-281-2770 ID 09153A

DESCRIPTION AND FUNCTION

The MK 155 MOD 0/1 is a hydraulically elevated launch rail and container frame for the M58 Linear Demolition Charge (LDC). It mounts to the M353 general purpose trailer chassis. This mobility allows it to provide the only responsive, explosive minefield/obstacle clearing capability in the Marine Corps inventory, The system is operated from inside the host vehicle thus protecting the operators from direct and indirect fires during employment. The M58 Linear Demolition Charge will breach a lane approximately 8m wide by 100m long. When combined with-the M353 or M200 trailer chassis, an M58/68 line charge and MK22 rocket, the MK 155 becomes the MK 2 MOD O Mine Clearance System. (M68 is the inert round.)

Action Code: SSEC

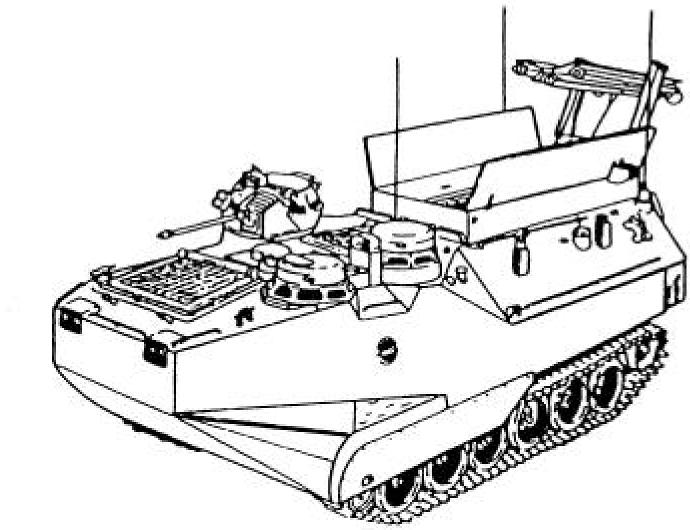
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight: w/LDC and Rocket	6800 lb	910 lb
Width:	95 in	65 in
Length:	187 in	102 in
Height:	71 in	74 in
Cube:	729.9 ft^3	283.9 ft^3
Square Stowage:	123.4 ft^2	46 ft^2

Includes M353 Trailer, M58 Linear Demolition Charge and MK22 Rocket
For Components See SL-3-09153A

MK 1 MOD O MINE CLEARANCE SYSTEM

TAMCN B1315 NSN 1055-01-226-6338 ID 09962A



DESCRIPTION AND FUNCTION

The MK 154 Mine Clearance Launcher is a hydraulically elevated launch rail and container frame for three (3) M59 Linear Demolition Charges. This kit is easily installed in an AAVP7A1 when required, and removed when not needed. The MK 154 launcher provides the only mobile, multiple shot, explosive minefield clearance capability in the U.S. inventory. The system has the capability to launch from the water and employ against Shallow Water Mines (SWM) and continue inland. Operators deploy the line charges from inside the AAV, thus offering them protection from direct and indirect fires. The kit has the potential to clear one 8m x 300m lane or three 8m x 100m lanes, when all charges are deployed. When combined with the AAV, three M59/69 line charges and three MK 22 rockets, the system becomes the MK 1 MOD O Mine Clearance System. (The M69 is the inert round.)

Action Code: SSEC

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	3,040 lb	8,790 lb
Width:	75 in	95.9 in
Length:	140 in	175.8 in
Height:	48 in	60.5 in
Cube:	291.7 ft^3	591.6 ft^3
Square Stowage:	72.9 ft^2	117.3 ft^2

Without vehicle, line charges, and rockets

For Components See SL-3-09962A

MINEFIELD MARKING SET

TAMCN B1320 NSN 9905-01-186-7253 ID 01291B

DESCRIPTION AND FUNCTION

The Minefield Marking Set consists of signs and other materials required for marking a safe lane of 400 yards through a minefield. It includes cyalume nightsticks for night markings.

Action Code: SSEC

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight: (3 boxes)		900 lb
Width: (Stacked)		32 in
Length: (Stacked)		34.5 in
Height: (Stacked)		45 in
Cube: (Stacked)		28.8 ft^3
Square Stowage: (Stacked)		7.7 ft^2

Weight and Dimensions (Each Box):
Box 1: 150 lb; 32 x 25.5 x 15.75 in
Box 2: 150 lb; 28 x 22 x 13.75 in
Box 3: 600 lb; 16 x 34.5 x 15.5 in

For Components See SL-3-01291B

MIXER, CONCRETE, TRAILER-MOUNTED, 11S

TAMCN B1326 NSN 3895-01-294-8235 ID 09206A

DESCRIPTION AND FUNCTION

The Mixer, Concrete, Trailer-Mounted, 11S is a four-wheeled trailer-mounted, diesel engine unit that has the capability of producing 11 cubic feet of concrete per batch. The non-tilting drum is skip-loaded from the front, and concrete is chute-discharged from the rear.

Manufacturer: Mighty Inc. Action Code: SSEA

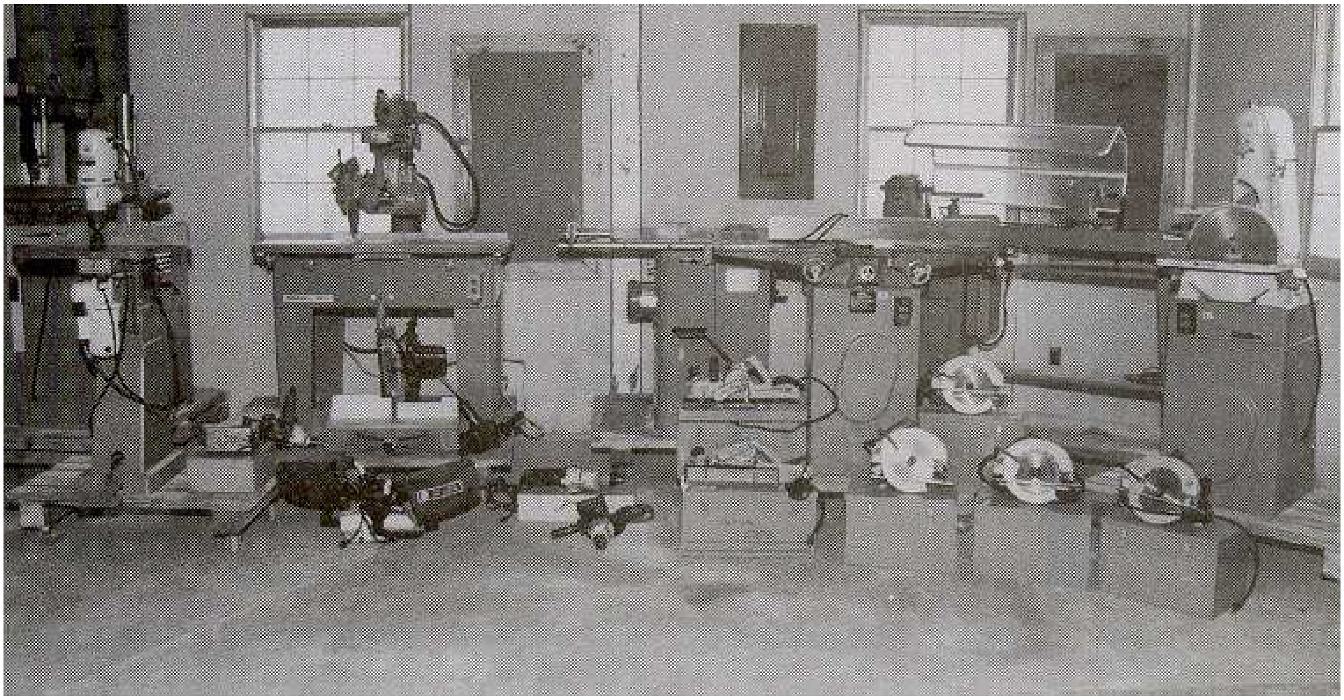
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	5,600 lb	5,600 lb
Width:	98 in	98 in
Length:	112 in	112 in
Height:	102 in	102 in
Cube:	647.9 ft^3	647.9 ft^3
Square Stowage:	76.2 ft^2	76.2 ft^2

For Components See SL-3-09206A

SHOP EQUIPMENT, CONSTRUCTION KIT #l

TAMCN B1942 NSN 5180-01-061-9292 ID 08165A



DESCRIPTION AND FUNCTION

The Shop Equipment, Construction Kit #l consists of an assortment of electrically powered tools that will support the Marine Division engineer unit’s vertical construction and/or non-standard bridging mission.

Action Code: 837-4

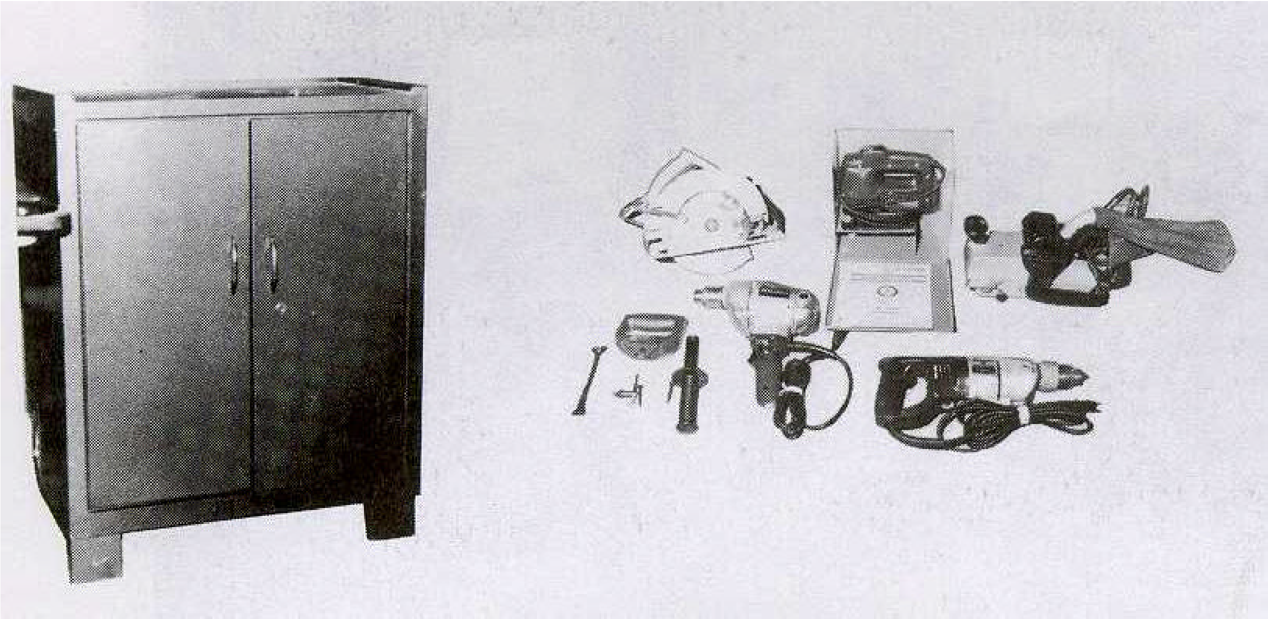
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		3,177 lb
Width:		223 in
Length:		297 in
Height:		330 in
Cube:		12,646 ft^3
Square Stowage:		459.9 ft^2

For Components See SL-3-08165A

SHOP EQUIPMENT, CONSTRUCTION KIT #2

TAMCN B1943 NSN 5180-01-061-9291 ID 08164A



DESCRIPTION AND FUNCTION

The Shop Equipment, Construction Kit #2 consists of an assortment of electrically powered tools that will support the Marine Air Wing engineer unit’s vertical construction and/or non-standard bridging mission.

Action Code: 837-4

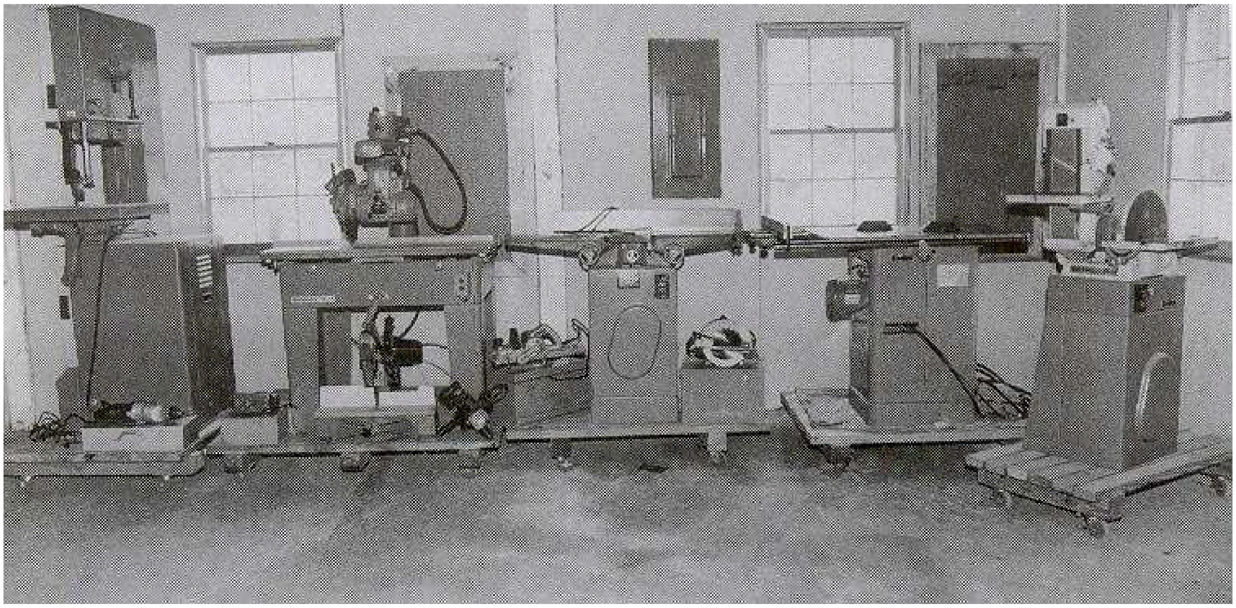
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		3,568 lb
Width:		264 in
Length:		380 in
Height:		377 in
Cube:		21,886.9 ft^3
Square Stowage:		696.7 ft^2

For Components See SL-3-08164A

SHOP EQUIPMENT, CONSTRUCTION KIT #3

TAMCN B1944 NSN 5180-01-061-0392 ID 08163A



DESCRIPTION AND FUNCTION

The Shop Equipment, Construction Kit #3 consists of an assortment of electrically powered tools that will support the Marine Force Service Support Group engineer unit’s vertical construction and/or non-standard bridging mission.

Action Code: 837-4

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		4,021 lb
Width:		322 in
Length:		467 in
Height		522 in
Cube:		45,425.5 ft^3
Square Stowage:		1,044.3 ft^2

For Components See SL-3-08163A

TOOL KIT, CARPENTER, ENGINEER PLATOON

TAMCN B2210	NSN 5180-00-293-2873	ID O1106B
	5180-00-293-2877	O1106A

DESCRIPTION AND FUNCTION

The Tool Kit, Carpenter, Engineer Platoon contains various hand tools and hardware used in general carpentry including sawing, drilling, filling, fastening and shaping wood. It is stowed and transported in a single chest.

Action Code: SSEA

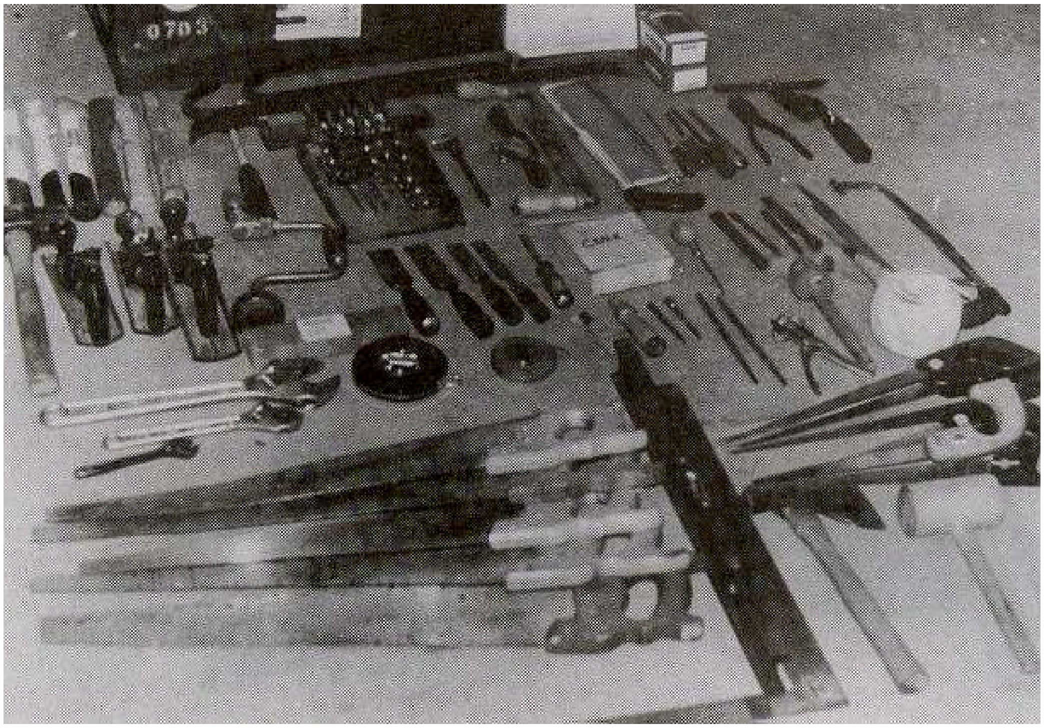
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		165 lb
Width:		23.5 in
Length:		38.6 in
Height:		10.1 in
Cube:		5.3 ft^3
Square Stowage:		6.3 ft^2

For Components See SL-3-O1106B   SL-3-O1106A

TOOL KIT, CARPENTER, USMC

TAMCN B2220 NSN 5180-00-540-5741 ID 00414A



DESCRIPTION AND FUNCTION

The Tool Kit, Carpenter, USMC consists of an assortment of carpenter’s tools and materials used to build, repair, or alter wood or frame structures. It is stowed and transported in a single chest.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		220 lb
Width:		18 in
Length:		35 in
Height:		12 in
Cube:		4.4 ft^3
Square Stowage:		4.4 ft^2

For Components See SL-3-00414A

TOOL KIT, PIONEER, ENGINEER PLATOON

TAMCN B2250 NSN 5180-00-596-1537 ID O1093B

DESCRIPTION AND FUNCTION

The Tool Kit, Pioneer, Engineer Platoon consists of hand tools and materials used for clearing land, building emplacements and fortifications, and other manual labor. It is stowed and transported in four chests.

Action Code: SSEE

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		1,000 lb
Width: (Stacked)		25 in
Length: (Stacked)		67 in
Height: (Stacked)		18 in
Cube: (Stacked)		17.4 ft^3
Square Stowage: (Stacked)		11.6 ft^2

(Chest (3) each: 250 lb, 19” X 67” X 17”)
(Chest (1) each: 250 lb, 25” X 50” X 18”)

For Components See SL-3-O1O93B

TOOL KIT, PIONEER, ENGINEER SQUAD

TAMCN B2260 NSN 5180-00-596-1547 ID 01171A

DESCRIPTION AND FUNCTION

The Tool Kit, Pioneer, Engineer Squad consists of hand tools and equipment used by engineer squads to clear land, build emplacements, and for general manual labor. It is stowed and transported in three chests.

Action Code: SSEE

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		404 lb (Total)
Width: (Stacked)		17.2 in
Length: (Stacked)		65.2 in
Height: (Stacked)		16.5 in
Cube: (Stacked)		10.7 ft^3
Square Stowage: (Stacked)		7.8 ft^2

Chest 1 : 17.2″ X 40.2″ X 16.5″
Chest 2 : 17.2″ X 40.2″ X 16.5″
Chest 3 : 17.2″ X 65.2″ X 16.5″

For Components See SL-3-01171A

TOOL SET, MASON AND CONCRETE FINISHERS

TAMCN B2370 NSN 5180-00-540-5745 ID O0425A

DESCRIPTION AND FUNCTION

The Tool Set, Mason and Concrete Finishers consists of hand tools used in shaping and laying stone, brick, and building block. Trowels are included for plastering, brick pointing, and concrete finishing. The level and plumb are used for establishing the horizontal or vertical plane. A six foot folding ruler is included for measuring. Twine is included to use in suspending the plumb bob and to use as guidelines for the mason. A cotton duck bag is provided for tool storage.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		28 lb
Width:		13 in
Length:		26 in
Height:		10 in
Cube:		2 ft^3
Square Stowage:		2.3 ft^2

For Components See SL-3-00425A

TRUCK, FORKLIFT, ROUGH TERRAIN

TAMCN B2566 NSN 3930-01-275-6420 ID 09135A

DESCRIPTION AND FUNCTION

The Truck, Forklift, Rough-Terrain, 4000-pound is a self-propelled, four-wheel drive, rubber-tired, diesel-powered forklift with a modified mast and enhanced side shift capability. It is air transportable. Its primary function is to stuff and unstuff 8 x 8 x 20 foot containers. It will also serve as an auxiliary mover for the M-198 Howitzer.

Manufacturer: Defense Technology Inc. Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	11,080 lb	11,080 lb
Width:	78 in	78 in
Length:	196 in	196 in
Height:	79 in	79 in
Cube:	698.9 ft^3	698.9 ft^3
Square Stowage:	106.2 ft^2	106.2 ft^2

For Components See SL-3-09135A

TRACTOR, RUBBER-TIRED, ARTICULATED STEERING, MULTI-PURPOSE (TRAM)

TAMCN B2567 NSN 3805-01-279-3635 ID 09148A

DESCRIPTION AND FUNCTION

The Tractor, Rubber-Tired, Articulated Steering, Multi-Purpose (TRAM) is a diesel-powered, four-wheel drive, rubber-tired, articulated steering tractor capable of operating in rough terrain and in 60 inches of water. The TRAM is outfitted with a Bucket, Multi-Purpose, 4-In-1, 2 1/2 Yard (TAMCN B0215) and a Forklift Attachment, 10,000 Lbs (TAMCN B0647).

Manufacturer: John Deere Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode		Shipping Mode
	w/ Fork att.	w/ Bucket	
Weight:	36,686 lb	36,336 lb	33,426 lb
Width:	104 in	108 in	104 in
Length:	342.6 in	308 in	266.7 in
Height:	131.7 in	131.7 in	131.7 in
Cube:	2,715.6 ft^3	2,535.2 ft^3	2,113.9 ft^3
Square Stowage:	247.4 ft^2	231 ft^2	192.6 ft^2

For Components See SL-3-09148A

SL-3 COMPONENTS FOR B2567 (TRAM)

FORKLIFT ATTACHMENT 10,000 LBS

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	3,250 lb	3,250 lb
Width:	78.8 in	78.8 in
Length:	88.5 in	88.5 in
Height:	62.5 in	62.5 in
Cube:	252.2 ft^3	252.2 ft^3
Square Stowage:	48.4 ft^2	48.4 ft^2

BUCKET MULTI-PURPOSE 4-IN-1 21/2 YARD

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	2,910 lb	2,910 lb
Width:	108 in	108 in
Length:	49.8 in	49.8 in
Height:	50 in	50 in
Cube:	155.6 ft^3	155.6 ft^3
Square Stowage:	37.4 ft^2	37.4 ft^2

TRUCK, FORKLIFT, EXTENDABLE BOOM (EBFL)

TAMCN B2561 NSN 3930-01-305-2111 ID 09276A

DESCRIPTION AND FUNCTION

The Truck, Forklift, Extendable Boom (EBFL) is a diesel-powered, four-wheel drive, rubber-tired forklift with two-wheel, four-wheel and crab steering. The EBFL will be capable of moving all palletized classes of material, up to the forklift's rated capacity of 10,000 lbs.

Manufacturer: LULL Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	25,600 lb	25,600 lb
Width:	102 in	102 in
Length:	315 in	315 in
Height:	101 in	101 in
Cube:	1,878 ft^3	1,878 ft^3
Square Stowage:	223.1 ft^2	223.1 ft^2

For Components See SL-3-09276A

CONTAINER HANDLER

TAMCN B0391	NSN 3930-01-082-3758 (MPS and Preponor only)	ID 08758A
	3930-01-269-4938 (All Others)	09117A

DESCRIPTION AND FUNCTION

The Container Handler is a diesel-powered, all-wheel drive, articulated steer container (8 x 8 x 20 foot ISO/ANSI container module) handler with a lift capacity of 50,000 pounds. It has a fording capacity of 60 inches. The top handler is shipped separately.

Manufacturer: Caterpillar   Action Code: SSEA

OPERATING AND SHIPPING DATA

	Shipping Mode ID 09117A	Shipping Mode ID 08758A
Weight:	103,730 lb	103,230 lb
Width:	138 lb	140 in
Length:	420 in	423 in
Height:	166 in	167 in
Cube:	5567.9 ft^3	5,723.2 ft^3
Square Stowage:	402.5 ft^2	411.3 ft^2

(Top handler: 3,960 lb, 94.5 in x 238.3 in x 18.6 in)

For Components See SL-3-09117A

CRANE, HIGH SPEED, HIGH MOBILITY

TAMCN B0443 | NSN 3810-01-268-1737 | ID 09109A

DESCRIPTION AND FUNCTION

The Crane, High Speed, High Mobility is a diesel-powered, rubber-tired crane with a hydraulic boom and the capability to mount/operate the Pile Driver. It is capable of all general crane operations, clamshell, container handling, and general lifting up to 50,000 lbs. It is capable of operating over rough terrain and in 60 inches of water. The Heavy Crane attachments include: Pile Driver, Self-Powered, Diesel (TAMCN U3195); Bucket, Concrete (TAMCN B0176); and Bucket, Clamshell (TAMCN B0171).

Manufacturer: Harnischfeger Corp. Action Code: SSEA

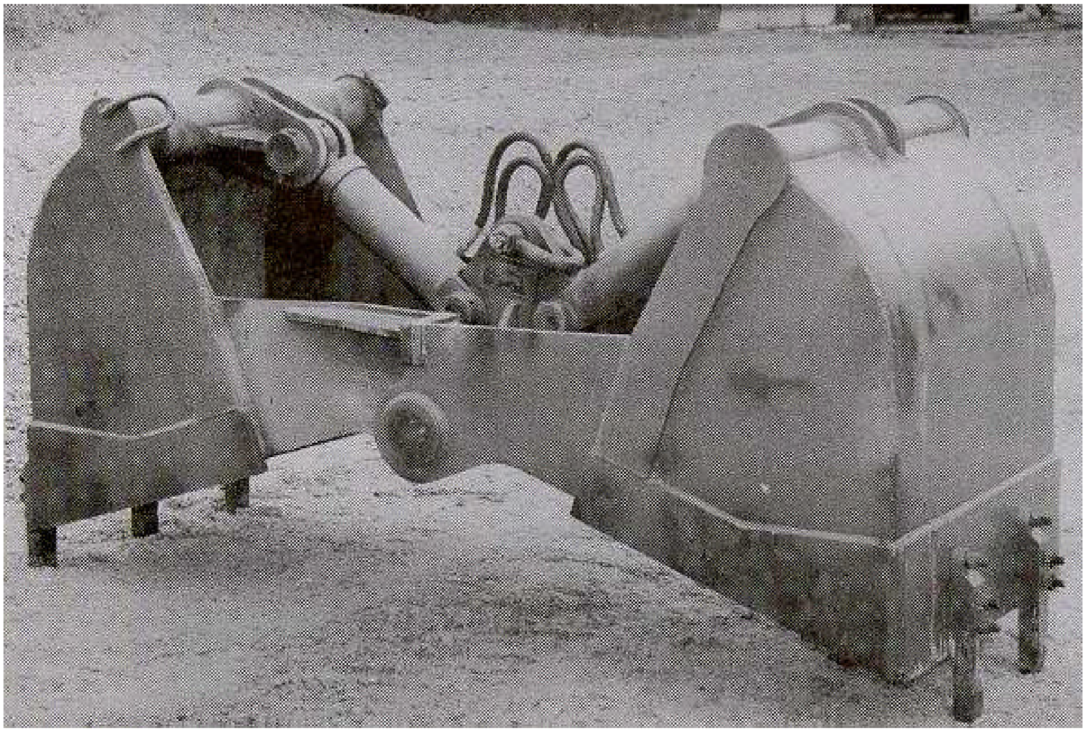
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	69,825 lb	69,825 lb
Width:	102 in	102 in
Length:	499.8 in	499.8 in
Height:	138.9 in	138.9 in
Cube:	4,097.8 ft^3	4,097.8 ft^3
Square Stowage:	354 ft^2	354 ft^2

For Components See SL-3-09109A

BUCKET, CLAMSHELL

TAMCN B0171 NSN 3815-01-291-9224 ID 09198A



DESCRIPTION AND FUNCTION

The Bucket, Clamshell is hydraulically operated and capable of working at, above and below ground level. It is capable of digging loose to medium type soils and suitable for excavating vertical shafts or footings, filling bins or hoppers, and unloading aggregate from flat bottom gondola railroad cars. The Bucket, Clamshell is used on the Crane, High Speed, High Mobility (TAMCN B0443) .

Manufacturer: HAWCO Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	2700 lb	2700 lb
Width:	39 in	39 in
Length:	75 in	75 in
Height:	73 in	73 in
Cube:	123.6 ft^3	123.6 ft^3
Square Stowage:	20.3 ft^2	20.3 ft^2

For Components See SL-3-09198A

AIR MOBILE CRANE, ROUGH TERRAIN, HYDRAULIC, LIGHT

TAMCN B0446 NSN 3810-01-165-0646 ID 09166A

DESCRIPTION AND FUNCTION

The Air Mobile Crane, Rough Terrain, Hydraulic, Light is an air transportable, diesel-powered, rubber-tired, four-wheel drive, four-wheel steer, 7.5 ton capacity, hydraulically operated crane. It performs general material handling, construction tasks, and aviation support. It is capable of operating in or over unimproved areas and rough terrain, and has a 60 inch fording capacity. The attachment is the Maintenance Platform, Air Mobile Crane (TAMCN B1300).

Manufacturer: Koehring Crane Action Code: SSEA

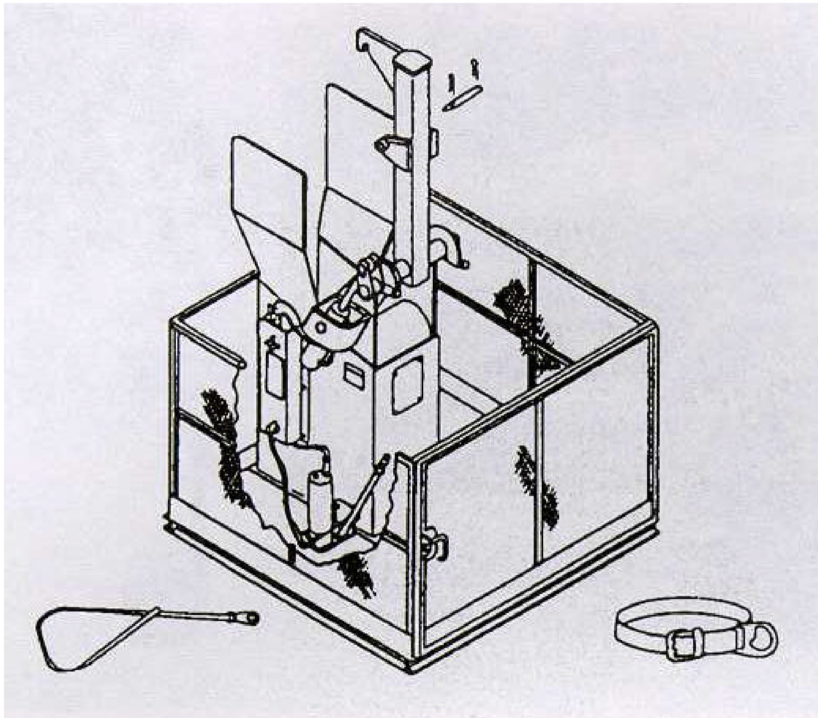
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	26,000 lb	26,000 lb
Width:	96 in	96 in
Length:	324 in	324 in
Height:	102 in	102 in
Cube:	1,836 ft^3	1,836 ft^3
Square Stowage:	216 ft^2	216 ft^2

For Components See SL-3-09166A

MAINTENANCE PLATFORM, AIR MOBILE CRANE

TAMCN B1300 NSN 2320-01-312-2616 ID 09377A



DESCRIPTION AND FUNCTION

The Maintenance Platform, Air Mobile Crane, a boom-attached work platform, provides a leveling platform intended for raising personnel and equipment to a work situation. Allowable load including personnel and equipment is 600 lbs. The Platform is used with Air Mobile Crane (B0446).

Manufacturer: Koehring Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		1005 lb
Width:	64 in	64 in
Length:	64 in	76 in
Height:	90 in	66 in
Cube:		185.7 ft^3
Square Stowage:		33.7 ft^2

For Components see SL-3-09377A

MOTORIZED ROAD GRADER

TAMCN B1082 NSN 3805-01-303-1652 (MPS and Preponor only) ID 09089A

3805-01-150-4795 (All Others) 09089B

DESCRIPTION AND FUNCTION

The Motorized Road Grader is a self-propelled grading machine powered by a diesel engine. It is rubber-tired, four-wheel drive, and has an articulated frame and front-wheel steer design. The primary use is for building and maintaining roads and airfields.

Manufacturer: Caterpillar Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	30,790 lb	30,790 lb
Width:	95 in	95 in
Length:	327 in	327 in
Height:	127 in	127 in
Cube:	2,283.1 ft^3	2,283.1 ft^3
Square Stowage:	215.7 ft^2	215.7 ft^2

For Components See SL-3-09089A
SL-3-09089B

TRACTOR, FULL-TRACKED, W/ANGLE BLADE, T-5

TAMCN B2460 NSN 2410-01-254-1667 ID 09062A

DESCRIPTION AND FUNCTION

The Tractor, Full-Tracked, W/Angle Blade, T-5 is a full-tracked, diesel engine driven tractor with a hydraulically operated angle blade and winch. It is air transportable.

Manufacturer: J. I. Case Action Code: SSEA

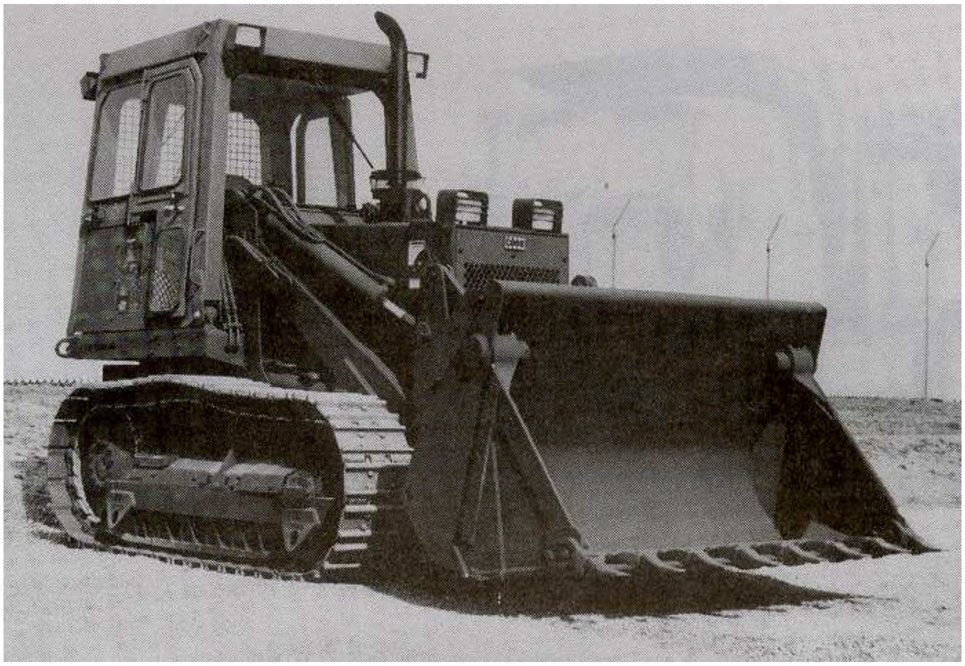
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	25,100 lb	25,100 lb
Width:	110 in	110 in
Length:	191 in	191 in
Height:	116 in	116 in
Cube:	1,410.4 ft^3	1,410.4 ft^3
Square Stowage:	145.9 ft^2	145.9 ft^2

For Components See SL-3-09062A

TRACTOR, FULL-TRACKED, W/MULTI-PURPOSE BUCKET

TAMCN B2464 NSN 3805-01-315-1091 ID 09426A



DESCRIPTION AND FUNCTION

The Tractor, Full-Tracked with Multi-purpose Bucket is a diesel engine-driven, hydraulically operated, crawler-type front end loader. The multipurpose bucket is capable of performing operations of clamshell, dozer, and scraper, as well as front end shovel. The tractor is intended for digging, lifting, transporting, and dumping operations under rough terrain conditions.

Manufacturer: J.I. Case Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
WEIGHT:	27,750 lb	27,750 lb
Width:	81.2 in	81.2 in
Length:	195.9 in	195.9 in
Height:	114 in	114 in
Cube:	1049.5 ft^3	1049.5 ft^3
Square Stowage:	110.5 ft^2	110.5 ft^2

For Components See SL-3-09426A

TRACTOR, MEDIUM, FULL-TRACKED

TAMCN B2462 NSN 2410-01-155-1588 ID 08757A

DESCRIPTION AND FUNCTION

The Tractor, Medium, Full-Tracked is a diesel-powered, full-tracked, medium size tractor (Model D7G) for earthmoving and general construction work.

Manufacturer: Caterpillar Action Code: SSEA

OPERATING AND SHIPPING DATA

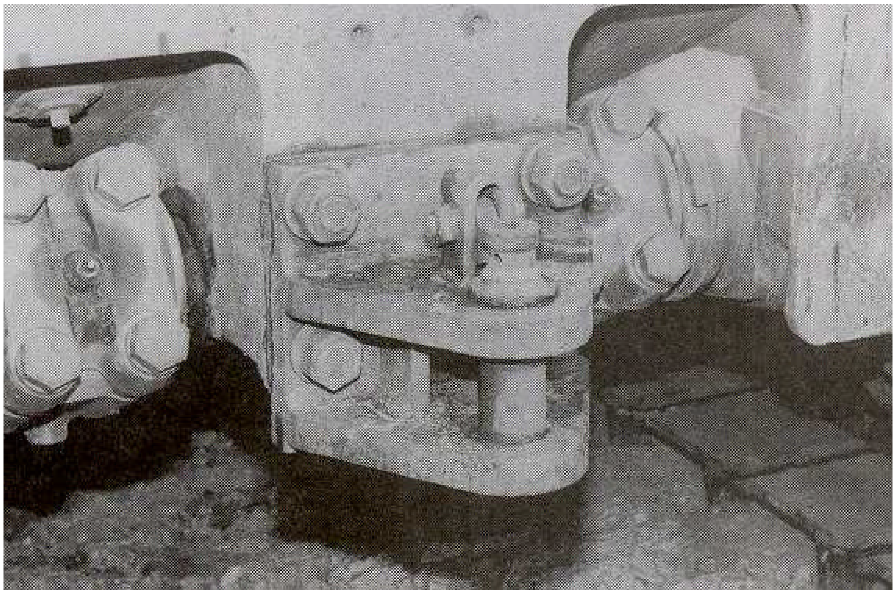
	Operating Mode	Shipping Mode
Weight:	50,000 lb	44,300 lb
Width:	144 in	144 in
Length:	273 in	208 in
Height:	132 in	132 in
Cube:	3,003 ft^3	2,288 ft^3
Square Stowage:	273 ft^2	208 ft^2

Fuel Type: Diesel
Fuel Tank Capacity: 120 gal
Fuel Consumption/hr: 6 gal

For Components See TM 08757A-14/1

DRAWBAR ATTACHMENT, FIXED REAR MOUNTING

TAMCN B0525 NSN 2590-01-155-1586 ID 06536B



DESCRIPTION AND FUNCTION

The Drawbar Attachment, Fixed Rear Mounting is mounted on the rear of the Tractor, Medium, Full-Tracked (TAMCN B2462) and serves as a towing hitch for artillery pieces, heavy duty cargo trailers, and towed earthmoving equipment.

Manufacturer: Caterpillar Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	406 lb	406 lb
Width:	14 in	14 in
Length:	27 in	27 in
Height:	30 in	30 in
Cube:	6.6 ft^3	6.6 ft^3
Square Stowage:	2.6 ft^2	2.6 ft^2

SL-3 To Be Determined

RIPPER ATTACHMENT, THREE SHANK, REAR MOUNTING

TAMCN B1775 NSN 3830-01-171-5776 ID 06538D

DESCRIPTION AND FUNCTION

The Ripper Attachment, Three Shank, Rear Mounting is mounted on the Tractor, Medium, Full-Tracked (TAMCN B2462) and is used to break up hard materials too compacted to be cut by the blades of tractors, graders, or scrapers. It is not normally used for breaking concrete or large tree roots.

Manufacturer: Caterpillar Action Code: SSEA

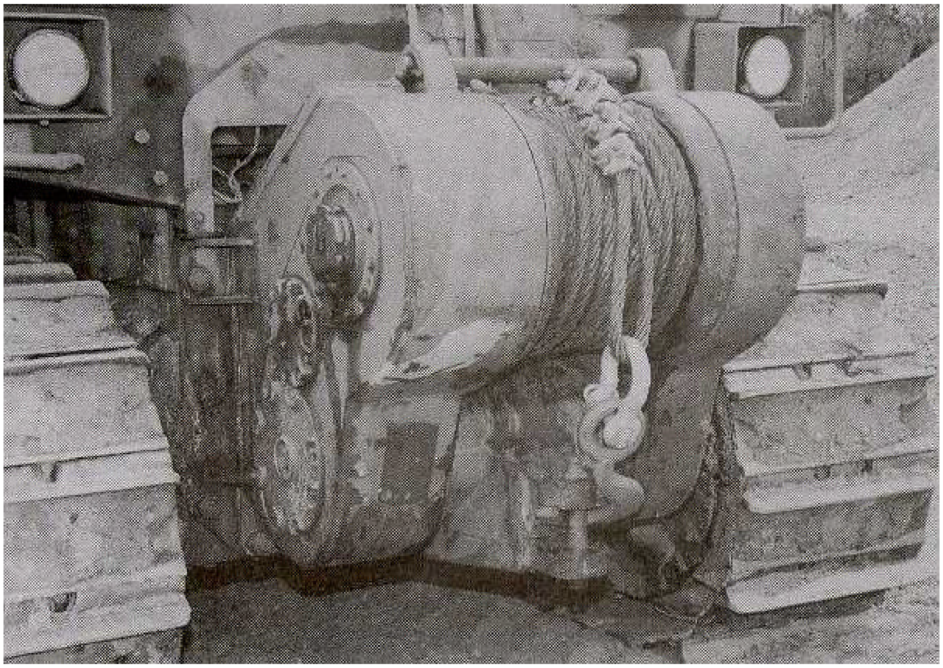
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	5,800 lb	5,800 lb
Width:	95.5 in	95.5 lb
Length:	82 in	82 in
Height:	77 in	77 in
Cube:	349 ft^3	349 ft^3
Square Stowage:	54.4 ft^2	54.4 ft^2

For Components See SL-3-06538D

WINCH, ATTACHMENT, SINGLE DRUM

TAMCN B2705 NSN 3830-01-155-1587 ID 06537B



DESCRIPTION AND FUNCTION

The Winch, Attachment, Single Drum is a hydraulically powered winch. It is mounted on the Tractor, Medium, Full-Tracked (TAMCN B2462). The winch is used for towing, loading, recovery, and self-recovery operations.

Manufacturer: Caterpillar Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	3,165 lb	3,165 lb
Width:	43 in	43 in
Length:	39 in	39 in
Height:	47 in	47 in
Cube:	45.6 ft^3	45.6 ft^3
Square Stowage:	11.6 ft^2	11.6 Ft^2

For Components See SL-4-06537B

TRACTOR, PROTECTIVE KIT

TAMCN U3187 NSN To Be Determined ID XXXXXX

DESCRIPTION AND FUNCTION

The Tractor, Protective Kit (TPK) is a ballistic steel-plated kit used on the Tractor, Medium, Full-Tracked D7G (B2464) to protect the operator and the D7G major components from small arms fire.

Manufacturer: Depot Maintenance Activity MCLB, Albany Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode		
		Communications Kit	Armor Kit	Armor Kit
Weight:	9460 lb	582 lb	6680 lb	4780 lb
Width:		44 in	89 in	72 in
Length:		69 in	118 in	118 in
Height:		26 in	31 in	27 in
Cube:		45.7ft^3	188 ft^3	132 ft^3
Square Stowage:		21ft^2	73 ft ^{2}	59 ft^2

* Shipped in three containers

SL-3 To Be Determined

TRACTOR, ALL WHEEL DRIVE W/ATTACHMENTS

TAMCN B2482 NSN 2420-01-160-2754 ID 07080D

DESCRIPTION AND FUNCTION

The Tractor, All Wheel Drive W/Attachments is a lightweight rubber-tired, diesel-powered tractor equipped with a front end loader and backhoe excavator. It is capable of rapidly excavating a variety of holes, pits, trenches, and earthworks. It is equipped with on-board hydraulic tools, i.e., chainsaw, pavement breaker, and impact wrench. It can be transported by both CH-53 and C-130 type aircraft, and is suitable for amphibious shipping.

Manufacturer: Freightliner Action Code: SSEE

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	16,136 lb	16,000 lb
Width:	96 in	96 in
Length:	240 in	240 in
Height:	102 in	102 in
Cube:	1,360 ft^3	1,360 ft^3
Square Stowage:	160 ft^2	160 ft^2

Fuel Type: Diesel Fuel Tank Capacity: 23.8 gal Fuel Consumption/hr: 4 gal

For Components See TM 07080B-15

ROLLER, COMPACTOR, VIBRATORY

TAMCN: B NSN: 0000-00-000-0000 ID: 00000A

DESCRIPTION AND FUNCTION

The CS-563D and the CP-563D are single-drum soil compactors used in medium-size construction applicatiojns. The CS-563D has a smooth drum, and the CP-563D has a padded drum. The 563D is equipped with a leveling blade. The blade is 96 inches wide and has a maximum cutting depth of 3 inches. A two-post, rollover protection structure is standard saftey equipment. Another saftey feature is the steering frame lock pin. This locks the front and rear and rear frames together which prevents machine articulation during transport and maintenance. The drum and axle on the 563D are hydrostatically driven. The hydrostatic propel system has ywo speed ranges: high and low. Drum width is 84 inches. The drum diameter is 60 inches on the smooth drum, and 61 inches on the padded drum.

Typical applications include landfill liner compaction, highway and street construction, industrial site preperation, airport construction, large building sites, and large trenching operations. The best material to be compacted is dirt/soil. The 563D is also capable of compacting gravel and blacktop. Sand cannot be compacted.

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	24,171 lb*	
Width:		
Length:		
Height:		
Cube:		
Square Stowage:		

Fuel Type: Diesel Fuel Tank Capacity: 60 gal Fuel Consumption/hr: 4 gal

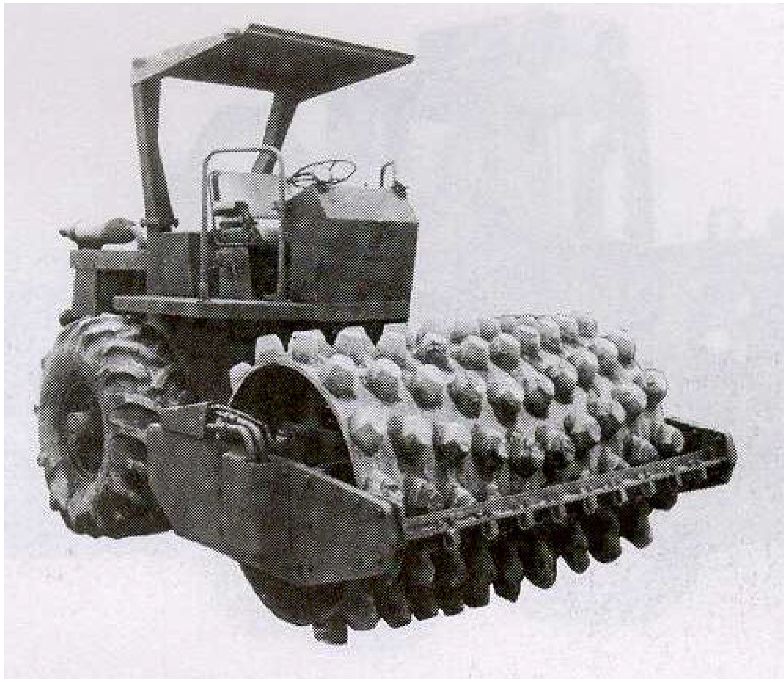
* With Smooth Drum

(with Padded drum: Weight 24,824 lb; Width 84 in; Diameter 61 in)

for Components See SL-3-

ROLLER, COMPACTOR, VIBRATORY

TAMCN B1785 NSN 3895-01-135-3703 ID 08602A



DESCRIPTION AND FUNCTION

The Roller, Compactor, Vibratory is a diesel-powered, articulated steer item equipped with a padded vibratory drum for compacting cohesive-type soils such as clay, and a smooth drum conversion kit for compacting loose, poorly graded gravel. It is not intended for use on asphalt. It must always be shipped with the smooth drum installed.

Manufacturer: Raygo Inc. Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	23,700 lb	23,700 lb*
Width:	104 in	104 in
Length:	207 in	207 in
Height:	131 in	131 in
Cube:	1,632 ft^3	1,632 ft^3
Square Stowage:	149.5 ft^2	149.5 ft^2

Fuel Type: Diesel Fuel Tank Capacity: 60 gal Fuel Consumption/hr: 4 gal

* With Smooth Drum

(Padded drum: Weight 10,100 lb; Width 84 in; Diameter 60 in)

For Components See SL-3-08602A

SCRAPER-TRACTOR

TAMCN B1922 NSN 3805-01-153-1854 ID 08900A

DESCRIPTION AND FUNCTION

The Scraper-Tractor is an open bowl, pneumatic-tired, 2-axle, 14-18 cubic yard capacity, single diesel-powered, articulated frame-steer scraper. It is employed by engineer units in earthmoving operations in the main battle area. It can be used as an earthmover and extractor during road or airfield construction, construction of anti-armor ditches, weapon emplacements, and the hauling and employment of material for obstacles.

Manufacturer: Caterpillar Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	65,000 lb	65,000 lb
Width:	136 in	136 in
Length:	499 in	499 in
Height:	141 in	141 in
Cube:	5,537.5 ft^3	5,537.5 ft^3
Square Stowage:	471.3 ft^2	471.3 ft^2

Fuel Type: Diesel Fuel Tank Capacity: 135 gal Fuel Consumption/hr: 6 gal

For Components See TM 5-3805-248-14&P/2

EXCAVATOR, HYDRAULIC, WHEEL, 1085C

TAMCN B0591 NSN 3815-01-318-3415 ID 09445A

DESCRIPTION AND FUNCTION

The Excavator, Hydraulic, Wheel, 1085C is a pneumatic, medium weight, hydraulically operated excavator. It is used in the development of field fortifications, trenching operations, emplacement of culverts, drainage ditch construction and maintenance, quarry support operations, and loading vehicles from material stockpiles. Attachments (pictured on the following page) include 5/8 cu yd Ditch Clean Out Bucket, 5/8 cu yd Excavating Bucket, 1 1/2 cu yd Front Bucket, 24 inch Auger, Hydraulic Vibrator Compactor, and Hydraulic Impact Hammer.

Manufacturer: J. I. Case Co. Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	40,960 lb	40,960 lb
Width:	97 in	97 in
Length:	365 in	365 in
Height:	154 in	154 in
Cube:	3,155.3 ft^3	3,155.3 ft^3
Square Stowage:	245.9 ft^2	245.9 ft^2

(Attachments are not included in shipping data.)

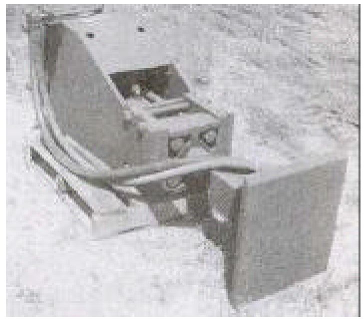
For Components See SL-3-09445A

ATTACHMENTS FOR EXCAVATOR, HYDRAULIC, WHEEL, 1085C (B0591)

24 INCH AUGER

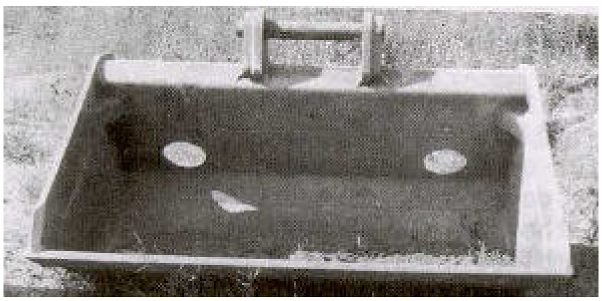
Width: 24 in
Height: 24 in
Length: 97 in
Weight: 700 lb

HYDRAULIC IMPACT HAMMER



Width: 19 in
Height: 30 in
Length: 56 in
Weight: 1700 lb

5/8 CU YD DITCH CLEAN OUT BUCKET



Width: 38 in
Height: 37 in
Length: 61 in
Weight: 1005 lb

1 1/2 CU YD FRONT BUCKET

Width: 42 in
Height: 40 in
Length: 60 in
Weight: 1100 lb

5/8 CU YD EXCAVATING BUCKET

Width: 41 in
Height: 45 in
Length: 54 in
Weight: 1220 lb

HYDRAULIC VIBRATOR COMPACTOR

Width: 34 in
Height: 47 in
Length: 50 in
Weight: 2230lb

EXCAVATOR, COMBAT, M9 ARMORED COMBAT EARTHMOVER (ACE)

TAMCN B0589 NSN 2350-00-808-7100 ID XXXXXX

DESCRIPTION AND FUNCTION

The M9 ACE is a highly mobile, full-tracked, armored earthmover capable of supporting the manuever element in offensive and defensive operations. It accomplishes critical combat engineer tasks such as preparing hull defilade fighting positions for guns and tanks, and preparing protected positions for other critical battlefield systems to increase their survivability. It will prepare combat roads, remove roadblocks and other obstacles, and prepare access routes at water obstacles. It also performs countermobility tasks such as antitank ditches. The M9 ACE requires a single operator, travels at 30 mph on land, and swims at 3 mph in calm water, It is configured for on/off loading in the C130, C141, and C5 airlift aircraft, and is compatible with existing U.S. Navy amphibious shipping.

Manufacturer: BMY Inc. Action Code: SSEE

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	54,000 lb (ballasted)	36,000 lb (travel mode)
Width:	126 in (w/extensions)	110 in (w/o extensions)
Length:	246 in	246 in
Height:	107 in (windshield stowed)	96 in (reducible)
Cube:	1,919 f^{t3}	1,503 ft^3
Square Storage:	215 ft^2	188 ft^2

Fuel Tank Capacity: 132 gal/Diesel Fuel Consumption: 6.9 gal/hr

For Components See TM 5-2350-262-10

SWEEPER, RUNWAY VACUUM

TAMCN B2127 NSN 3825-01-136-2920 ID 09199A

DESCRIPTION AND FUNCTION

The Sweeper, Runway, Vacuum is an engine-driven, self-propelled, truck-mounted vacuum machine used for cleaning runways and other stabilized areas.

Manufacturer: TYMCO Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	15,000 lb	15,000 lb
Width:	96 in	96 in
Length:	248 in	248 in
Height:	110 in	110 in
Cube:	1,516 ft^3	1,516 ft^3
Square Stowage:	165 ft^2	165 ft^2

For Components See SL-3-09199A

COMPRESSOR, AIR

TAMCN B0395 NSN 3820-00-950-8584 ID 08917A

DESCRIPTION AND FUNCTION

The Compressor, Air is a trailer-mounted unit which furnishes compressed air at a rate of 250 cubic feet per minute, at a pressure of 100 pounds per square inch. It is designed to operate to its rated capacity under widely adverse conditions of heat, cold, rain, and dust and will operate pneumatic tools as well as provide compressed air for bridging and bulk fuel operations. The components are shipped in tool boxes attached to the trailer.

Manufacturer: Ingersol-Rand Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	7,300 lb	7,300 lb
Width:	96 in	96 in
Length:	200 in	200 in
Height:	78 in	78 in
Cube:	866.7 ft^3	866.7 ft^3
Square Stowage:	133.3 ft^2	133.3 ft^2

Fuel Type: Diesel Fuel Tank Capacity: 36.5 gal Fuel Consumption/hr: 3.5 gal

For Components See SL-3-08917A

DITCHING MACHINE

TAMCN B0355 NSN 3805-01-240-0995 ID 1005OA

DESCRIPTION AND FUNCTION

The Ditching Machine is a pneumatic-tired, diesel-powered, 4-wheel drive, hydraulically operated, ladder-type ditching machine. It is used by Marine communicators for the laying of communications cable and wire.

Manufacturer: Ditch Witch Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	3,300 lb	3,300 lb
Width:	57 in	57 in
Length:	149 in	149 in
Height:	82 in	82 in
Cube:	403 ft^3	403 ft^3
Square Stowage:	59 ft^2	59 ft^2

Fuel Type: Diesel
Fuel Tank Capacity: 6.3 gal
Fuel Consumption/hr: .02 gal

For Components See SL-3-10050A

MEDIUM GIRDER BRIDGE (MGB)

TAMCN B0152 NSN 5420-00-172-3520 ID 08676A

DESCRIPTION AND FUNCTION

The Medium Girder Bridge (MCB is lightweight, easily transportable bridging equipment, which can be erected by hand in various configurations to cover the full range of bridging requirements. It is designed for use by wheeled and tracked vehicles up to military load class (MLC) 60. To provide maximum flexibility, the longitudinal girders can be constructed in a single or double story construction. A span of 100 feet with double story construction (MLC 70) can be accommodated with one MGB. All materials can be transported in eight 8 x 8 x 20 foot ISO containers. The bridge requires Bridge, Erection Set - MGB (TAMCN 90120) to be erected.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		63,719 lb
Width:		96 in
Length:		96 in
Height:		240 in
Cube:		1280 ft^3
Square Stowage:		

Weight is total weight for the eight containers.
Dimensions are of each container.

For Components See SL-3-08676A

REINFORCEMENT SET, F/MGB

TAMCN B1720 NSN 5420-01-139-1503 ID 09710A

DESCRIPTION AND FUNCTION

The Reinforcement Set, F/MGB consists of reinforcing links which are connected to form a pair of chains beneath each bridge girder. Links are connected to bottom panels at the ends of the bridge by reinforcing posts which enable the system to be tensioned as the posts are pulled towards a vertical position by cable jacks. The kit is manufactured in the same light alloy material as the bridge. It is used with the Medium Girder Bridge (MGB) (TAMCN B0152).

Action Code: SSEA

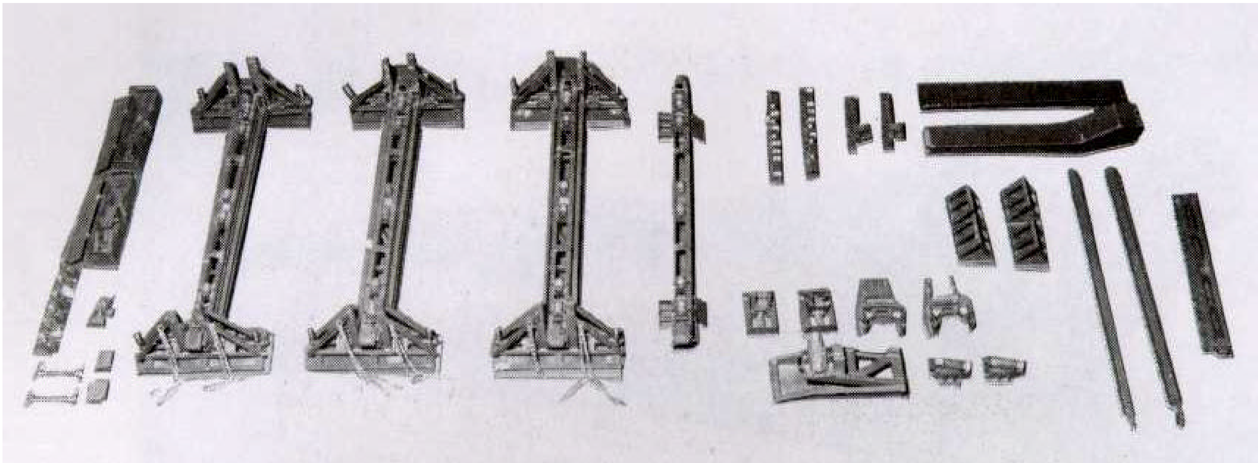
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	14,700 lb	14,700 lb
Width:	96 in	96 in
Length:	96 in	96 in
Height:	240 in	240 in
Cube:	1,280 ft^3	1,280 ft^3
Square Stowage:	64 ft^2	64 ft^2

For Components See SL-3-O871OA

BRIDGE ERECTION SET - MGB

TAMCN B0120 NSN 5420-00-172-3519 ID 08675A



DESCRIPTION AND FUNCTION

The Bridge Erection Set - MGB contains those components necessary to erect the single story and double story Medium Girder Bridge (TAMCN B0152).

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		5,960 lb
Width:		81 in
Length:		171 in
Height:		91 in
Cube:		729.4 ft^3
Square Stowage:		96.2 ft^2

For Components See SL-3-08675A

CONSTRUCTION OUTFIT, RAFT, RIBBON BRIDGE

TAMCN B1625 NSN 2090-01-316-2576 ID 09439A

DESCRIPTION AND FUNCTION

The Construction Outfit, Raft, Ribbon Bridge consists of two (2) ramp bays, five (5) interior bays and the necessary components to construct a 5-bay conventional floating raft, capable of carrying tracked/wheeled vehicles up to military load class (MLC) 70 in currents up to 8 fps. Shipping information includes a MK18 LVS rear body unit used to transport both types of bays.

Manufacturer: KETMAR Industries, Inc. Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode*
Weight:	12,000 lbs	31,000 lb
Width:	320 in	126.6 in
Length:	272.5 in	272.5 in
Height:	44 in	152 in
Cube:	2220.4 ft^3	3,034.6 ft^3
Square Stowage:	605.6 ft^2	239.6 ft^2

* The operating and shipping data is for one interior bay.

LVS Rear Body Unit MK18
Weight: 19,000 lbs
Width: 136 in
Length: 251 in
Height: 61 in
For Components See SL-3-09438A

BRIDGE, FLOATING, 70 TON, RIBBON BRIDGE SET

TAMCN BO155 NSN 5420-01-316-2587 ID 09439A

DESCRIPTION AND FUNCTION

The Bridge, Floating, 70 Ton, Ribbon Bridge Set is a floating, modular bridge with a gap crossing capability of MLC 70 in currents up to eight feet per second (fps). A complete Ribbon Bridge Set consists of five (5) ramp bays and twelve (12) interior bays. This bridge set is capable of spanning a wet gap up to 300 feet or combining the individual bays to form two MLC 70 rafts for ferrying operations. Shipping information includes a MK18 LVS rear body unit used to transport both types of bays.

Manufacturer: KETMAR Industries, Inc. Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode*
Weight:	12,000 lbs	31,000 lb
Width:	320 in	126.6 in
Length:	272.5 in	272.5 in
Height:	44 in	151 in
Cube:	2,220.4 ft^3	3,014.6 ft^3
Square Stowage:	605.6 ft^2	239.6 ft^2

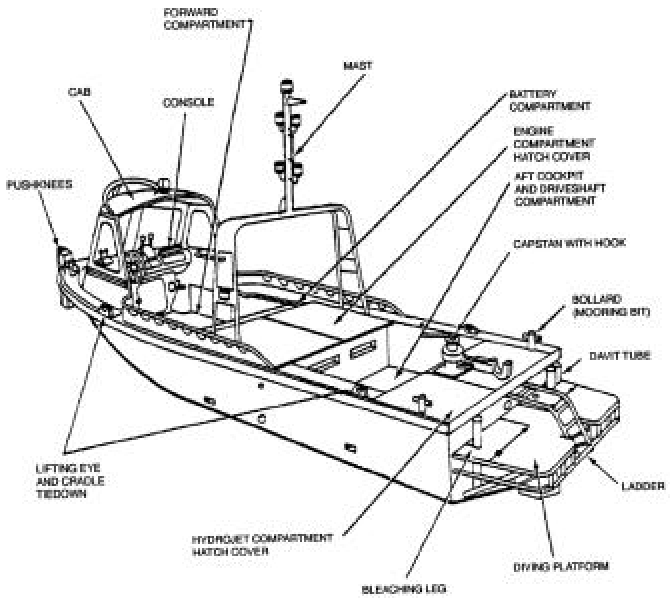
* The operating and shipping data is for one interior bay.

LVS Rear Body Unit MK18
Weight: 19,000 lbs
Width: 136 in
Length: 251 in
Height: 61 in

For Components See SL-3-09439A

BOAT, BRIDGE ERECTION

TAMCN B0114 NSN 1940-01-218-9165 ID 1002OA



DESCRIPTION AND FUNCTION

The Boat, Bridge Erection is designed to support bridging and amphibious operations. It may also be used as a general purpose work boat in support of diving operations and maritime projects, for inland water patrols, and as a safety boat for amphibious river crossings. When used to ferry troops or cargo, it may safely transport a maximum of 15 fully equipped men or 4,400 pounds of cargo. A cradle is used during shipment and a MK18 LVS rear body unit is used to transport the boat.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		8,800 lb
Width:		98 in
Length:		324 in
Height:		178 in
Cube:		3262 ft^3
Square Stowage:		

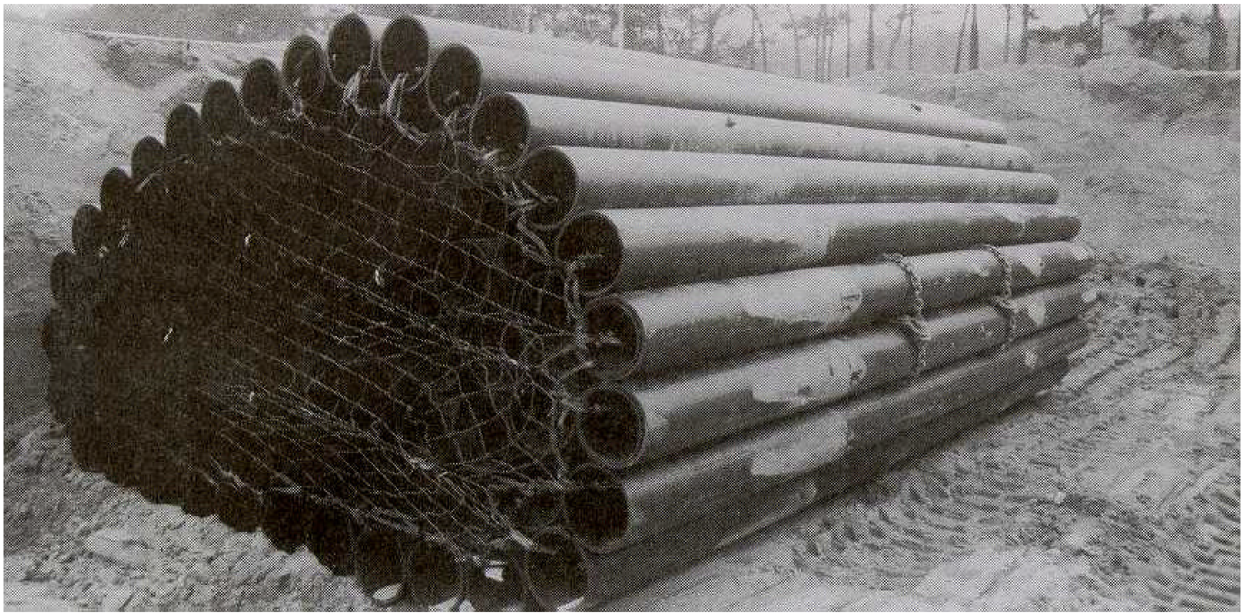
Fuel Type: Diesel
Fuel Tank Capacity: 75 gal
Fuel Consumption/hr: 9 gal

LVS Rear Body Unit MK18:
Weight: 19,000 lb
Width: 136 in
Length: 251 in
Height: 61 in

For Components See SL-3-10020A

PIPE FASCINE, MAXI

TAMCN U3185 NSN 4710-99-772-1832 ID To be det.



DESCRIPTION AND FUNCTION

Pipe Fascine, Maxi fills the profiles of wet or dry gaps up to 10.5 M wide and 3 M deep, thereby providing a secure, level, and rapid means of crossing for all classes of tracked vehicles up to 70 tons (wheeled vehicles of any weight). The fascine system is constructed of a number of high density plastic pipes. The outer band of pipes are made into a continuous loop and a number of inner loose pipes are retained by netting at each end of the fascine.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	5,513 lb	5,513 lb
Width:	86.6 in	86.6 in
Length:	181.11 in	181.11 in
Height:	86.6 in	86.6 in
Cube:	786.3 ft^3	786.3 ft^3
Square Stowage:	108.9 ft^2	108.9 ft^2

SL-3 To Be Determined.

DRAFTING EQUIPMENT SET, INDIVIDUAL

TAMCN B0490 NSN 6675-00-690-4513 ID 02669A

DESCRIPTION AND FUNCTION

The Drafting Equipment Set, Individual is a portable, compact assortment of instruments and supplies suitable for field use. Uses of the set include mechanical drawing, schematic drawing, chart and graph making, and other related operations.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		285 lb
Width:		45 in
Length:		63 in
Height:		13.7 in
Cube:		22.5 ft^3
Square Stowage:		19.7 ft^2

For Components See SL-3-02669A

DRAFTING INSTRUMENT SET

TAMCN B0510 NSN 6675-00-641-3531 ID 01285A

DESCRIPTION AND FUNCTION

The Drafting Instrument Set is generally utilized by engineer topographic units for drawings, map layouts, map compilations, and color separation drafting. The set is larger and more complete than the general purpose field set which meets normal troop requirements.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		4 lb
Width:		7 in
Length:		13 in
Height:		2 in
Cube:		.1 ft^3
Square Stowage:		.6 ft^2

For Components See SL-3-01285A

SURVEYING SET, GENERAL PURPOSE

TAMCN B2120	NSN 6675-00-514-5540 6675-01-273-7812	ID 01321B 01321A

DESCRIPTION AND FUNCTION

The Surveying Set, General Purpose is an instrument used for measuring vertical and horizontal angles. It is capable of providing an erect, bright, high contrast image at 30x magnification that permits precise pointing even inpoor light.

Action Code: SSEA

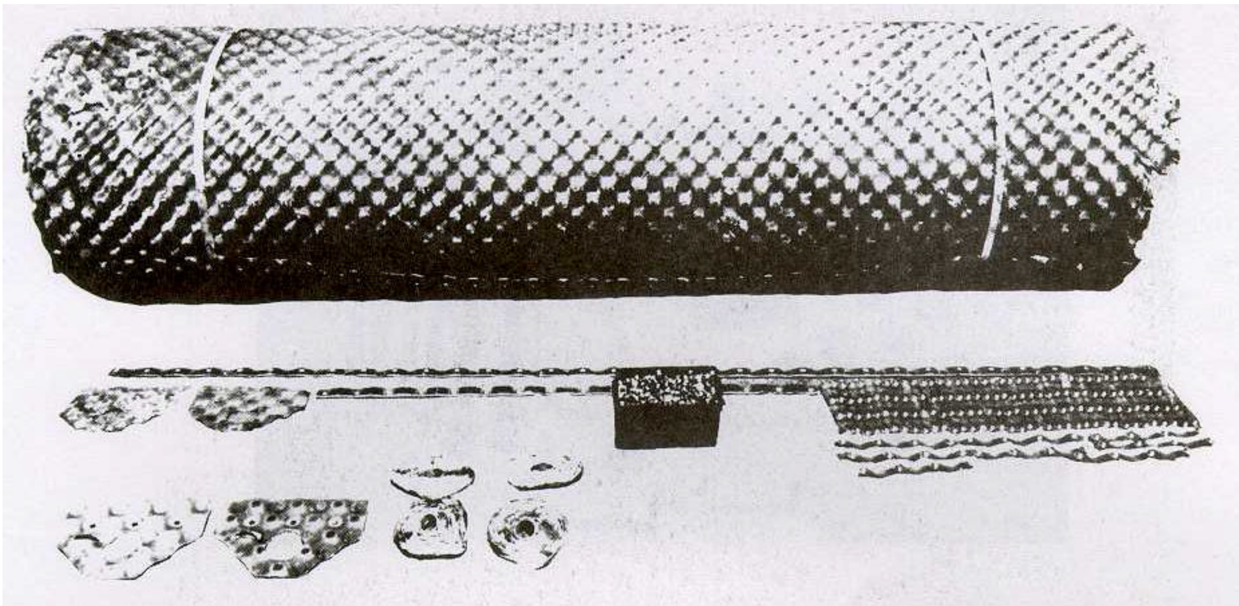
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	620 lb	620 lb
Width:	71 in	71 in
Length:	215 in	215 in
Height:	97 in	97 in
Cube:	856 ft^3	856 ft^3
Square Stowage:	106 ft^2	106 ft^2

For Components See SL-3-01321A

KIT, ASSAULT, TRACKWAY

TAMCN B1220	NSN 5680-00-490-1384	ID 06831B
	5680-00-806-864	06831A



DESCRIPTION AND FUNCTION

The Kit, Assault, Trackway is a ground mobility system that quickly converts impassable terrain of mud, sand, snow, etc., to a surface condition capable of supporting the operation of wheeled vehicles, helicopters and light support aircraft. It is used for river fording and construction of modular buildings and tunnels.

Action Code: SSEE

OPERATING AND SHIPPING DATA

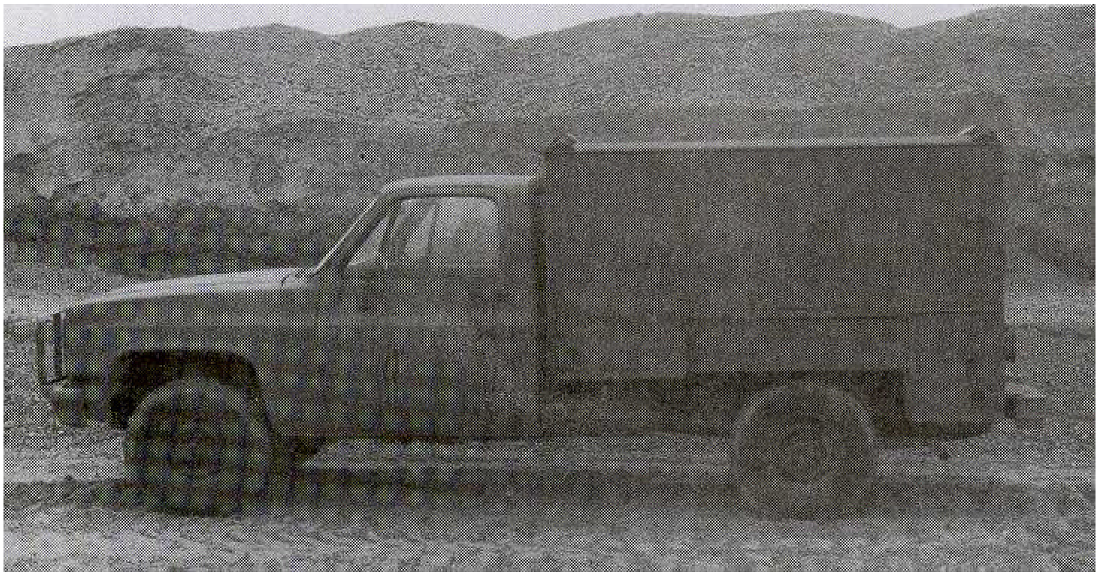
	Operating Mode	Shipping Mode”
Weight:		622 lb
Width:		54 in
Length:		180 in
Height:		72 in
Cube:		405 ft^3
Square Stowage:		67.5 ft^2

* Dimensions represent rolled up kit.

For Components See SL-3-06831B

SHOP EQUIPMENT, CONTACT MAINTENANCE, TRUCK-MOUNTED, SET NO. 3

TAMCN B1945 NSN 4930-01-208-6400 ID 03540E



DESCRIPTION AND FUNCTION

The Shop Equipment, Contact Maintenance, Truck-Mounted, Set No. 3 consists of a compartmentalized body mounted on a 4 x 4 cab/truck chassis Model 1031 (TAMCN D1105). Eight compartments in the body of the shop set provide storage space for all tools and equipment. The shop set is equipped with a Power Take-off (PTO) driven alternator which provides alternating current to the welder, 115 volt receptacles, and the air compressor. This item is used by maintenance organizations at the job site and in the shop.

Manufacturer: Southwest Mobile Systems Corp. Action Code: SSEA

OPERATING AND SHIPPING DATA

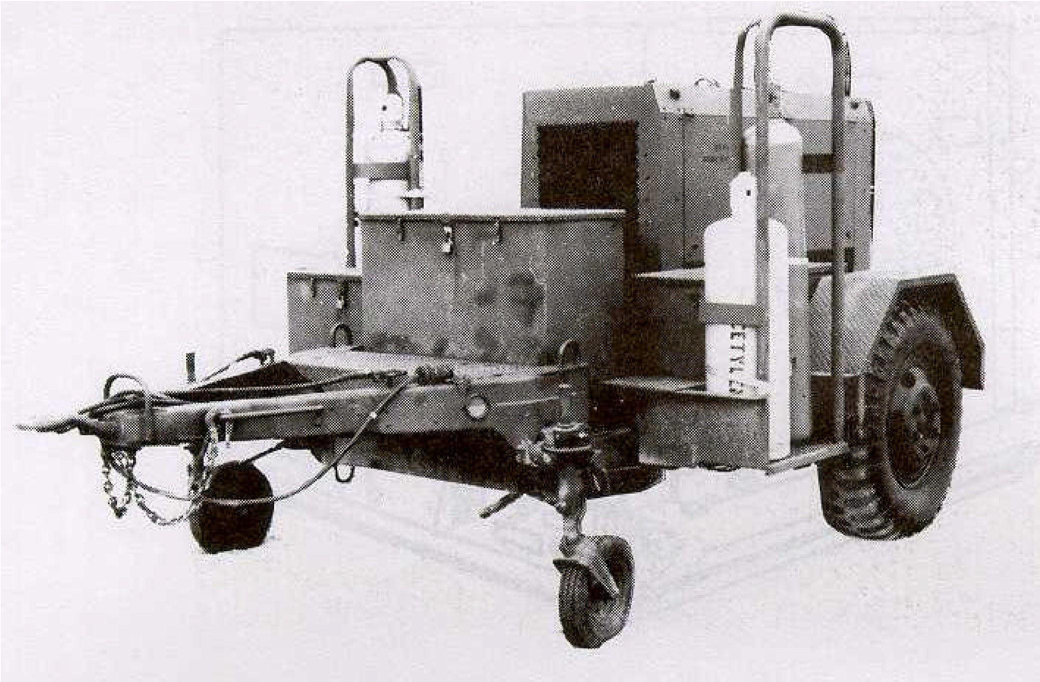
	Operating Mode	Shipping Mode
Weight:	9,000 lb	9,000 lb
Width:	84 in	84 in
Length:	219 in	219 in
Height:	82 in	82 in
Cube:	873 ft^3	873 ft^3
Square Stowage:	127.8 ft^2	127.8 ft^2

Fuel Type: Diesel Fuel
Tank Capacity: 20 gal
Fuel Consumption/hr: N/A

For Components See TM 5-4940-221-15

WELDING MACHINE, ARC, TRAILER-MOUNTED

TAMCN B2685 NSN 3431-01-153-9585 ID 04055C



DESCRIPTION AND FUNCTION

The Welding Machine, Arc, Trailer-Mounted is a 350 Amp constant current, constant voltage diesel-powered welding machine mounted on a steel skid and secured to a two-wheeled M353 trailer chassis. Included are an inert gas welding gun and a wire feeder used in welding non-ferrous metals. Also included is an argon cylinder. Tool boxes are mounted on the trailer for storage of existing welding kits and sets (TAMCN J3315, J3330, J3335, J3350). Storage is also provided for one oxygen cylinder and one acetylene cylinder.

Manufacturer: Hobart Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	8,100 lb	8,100 lb
Width:	96 in	96 in
Length:	182 in	186 in
Height:	88 in	88 in
Cube:	889.8 ft^3	909.3 ft^3
Square Stowage:	121.3 ft^2	124 ft^2

For Components See TM 04055C-15/1

FLOODLIGHT SET

TAMCN B0635 NSN 6230-01-170-1408 ID 08857A

DESCRIPTION AND FUNCTION

The Floodlight Set is skid-mounted and consists of four relocatable ground level lights and a single telescoping tower. A generator is not included, but the skid will contain space for a MEP generator. For flexibility, the set is configured so that it can be mounted on a standard USMC trailer.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	2,000 lb	2,000 lb*
Width:	43 in	43 in
Length:	134 in	134 in
Height:	65 in	65 in
Cube:	216.7 ft^3	216.7 ft^3
Square Stowage:	40 ft^2	40 ft^2

* Weight with 10 Kw Generator:
Dry: 3,240 lb
Wet: 3,320 lb

<u>Power Source Requirements</u>:
Frequency: 60Hz
Voltage/Phase: 120/208 V/3 Phase
Wires: 4 Wire
Maximum Power Consumption: 5 Kw

For Components See TM 08857A-14/1

GENERATOR SET, 3 KW, 60 HZ, SKID-MOUNTED, MEP-016B

TAMCN B0730 NSN 6115-01-150-4140 ID 05926B

DESCRIPTION AND FUNCTION

The Generator Set, 3 Kw, 60 Hz, Skid-Mounted, MEP-016B is a self-contained, portable unit. It is powered by a diesel engine which is directly coupled to the generator.

Manufacturer: Onan Corp. Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	500 lb	500 lb*
Width:	23.8 in	23.8 in
Length:	39 in	39 in
Height:	28 in	28 in
Cube:	15 ft^3	15 ft^3
Square Stowage:	6.4 ft^2	6.4 ft^2

Fuel Type: Diesel
Fuel Tank Capacity: 4.8 gal
Fuel Consumption/hr: .5 gal

* Dry: 440 lb
Wet: 498 lb

Frequency: 60 Hz
Power Output: 3 Kw
Voltage: 120/208/240 V

For Components See SL-3-05926B

GENERATOR SET, 10 KW, 60 HZ, SKID-MOUNTED, MEP-003A

TAMCN B0891	NSN 6115-00-465-1030 6115-00-097-8021	ID 05684C 05684B

DESCRIPTION AND FUNCTION

The Generator Set, 10 Kw, 60 Hz, Skid-Mounted, MEP-003A consists of a revolving field alternator powered by an air-cooled diesel engine.

Manufacturer: Onan Corp. Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	1,240 lb	1,283.5 lb
Width:	32 in	41.3 in
Length:	62 in	75.8 in
Height:	37 in	47.6 in
Cube:	42.5 ft^3	86.2 ft^3
Square Stowage:	13.8 ft^2	21.7 ft^2

Fuel Type: Diesel
Fuel Tank Capacity: 12.5 gal
Fuel Consumption/hr: 3 gal

Frequency: 60 Hz
Power Output: 10 Kw
Voltage/Phase:
120/208/240/416 V/3 Phase

For Components See SL-3-05684C
SL-3-05684B

GENERATOR SET, 30 KW, 60 HZ, SKID-MOUNTED, MEP-005A

TAMCN B0953 NSN 6115-00-118-1240 ID 06859D

DESCRIPTION AND FUNCTION

The Generator Set, 30 Kw, 60 Hz, Skid-Mounted, MEP-005A is a fully enclosed, self-contained, portable unit. It is equipped with controls, instruments, and accessories which enable it to be operated as a single unit or in parallel with two or more units of the same size.

Manufacturer: Libby Welding Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	3,500 lb	3,500 lb
Width:	34 in	34 in
Length:	80 in	80 in
Height:	57 in	57 in
Cube:	89.7 ft^3	89.7 ft^3
Square Stowage:	18.9 ft^2	18.9 ft^2

Fuel Type: Diesel
Fuel Tank Capacity: 25 gal
Fuel Consumption/hr: 2.9 gal

Frequency: 60 Hz
Power Output: 30 Kw
Voltage/Phase:
120/208/240/416 V/3 Phase

For Components See SL-3-06859D
SL-3-06859B

GENERATOR SET, 60 KW, 60 HZ, SKID-MOUNTED, MEP-006A

TAMCN B1021 NSN 6115-00-118-1243 ID 00038G

DESCRIPTION AND FUNCTION

The Generator Set, 60 Kw, 60 Hz, Skid-Mounted, MEP-006A is a portable, self-contained unit. It is provided with controls, instruments, and accessories necessary for operation as a single unit or in parallel with up to two other units of the same class and mode.

Manufacturer: Ferment Div. Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	4,300 lb	4,300 lb
Width:	36 in	36 in
Length:	87 in	87 in
Height:	59 in	59 in
Cube:	106.9 ft^3	106.9 ft^3
Square Stowage:	21.8 ft^2	21.8 ft^2

Fuel Type: Diesel
Fuel Tank Capacity: 55 gal
Fuel Consumption/hr: 6 gal

Frequency: 60 Hz
Power Output: 60 Kw
Voltage/Phase:
120/208/240/416 V/3 Phase

For Components See SL-3-00038G

GENERATOR SET, 100 KW, 60 HZ, SKID-MOUNTED, MEP-007A

TAMCN B1045 NSN 6115-00-036-6374 ID 07464B

DESCRIPTION AND FUNCTION

The Generator Set, 100 Kw, 60 Hz, Skid-Mounted, MEP-007A is a multi-purpose, portable self-contained unit. It is designed to accept a variety of kits to extend its capabilities.

Manufacturer: Consolidated Diesel Electric Company Action Code:SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	7,500 lb	7,500 lb
Width:	38 in	38 in
Length:	106 in	106 in
Height:	65 in	65 in
Cube:	151.5 ft^3	151.5 ft^3
Square Stowage:	28 ft^2	28 ft^2

Fuel Type: Diesel
Fuel Tank Capacity: 90 gal
Fuel Consumption/hr: 12 gal

Frequency: 60 Hz
Power Output: 100 Kw
Voltage/Phase:
120/208/240/416 V/3 Phase

For Components See SL-3-07464B

DUMMY LOAD, GENERATOR SET, 100 KW

TAMCN B0579 NSN 6625-00-471-0223 ID 07500A

DESCRIPTION AND FUNCTION

The Dummy Load, Generator Set, 100 Kw provides electrical load simulating capabilities for maintenance and operational evaluation of mobile electrical power sources. It is a self-contained, forced air-cooled, transportable, skid-mounted unit, suitable for indoor and outdoor use.

Manufacturer: Essex Electro Engineers, Inc. Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	4450 lb	4,450 lb
Width:	88 in	88 in
Length:	36 in	36 in
Height:	45 in	45 in
Cube:	96.3 ft^3	96.3 ft^3
Square Stowage:	22.2 ft^2	22.2 ft^2

Fuel Type: N/A
Fuel Tank Capacity: N/A
Fuel Consumption/hr: N/A

Power Source Requirements:
Frequency: 60/400 Hz
Power Output: N/A
Voltage/Phase:
120/208/240/416 V/3 Phase

For components See TM 077500A-14

15 KW ELECTRIC POWER DISTRIBUTION SYSTEM

TAMCN B0595 NSN 6110-01-273-2387 ID 09127A

DESCRIPTION AND FUNCTION

The 15 Kw Power Distribution System is a skid-mounted unit used in combination to provide a network of multiple 120/208 volt, l-phase loads and 120 volt, l-phase loads from a remote generator or facility power. Circuit breakers are accessed through a hinged cabinet cover and input/output receptacles are covered. Cables interconnect the individual power distribution panel board assemblies. All assemblies consist of a box and frame assembly and a cover assembly. It is equipped with a circuit board assembly, indicator lights, and input/output receptacles. It includes one input and two output cables.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	585 lb	585 lb
Width:	33 in	33 in
Length:	78 in	78 in
Height:	34 in	34 in
Cube:	50.6 ft^3	50.6 ft^3
Square Stowage:	17.9 ft^2	17.9 ft^2

Panel Dimensions:
Weight: 56 lb
Width: 24 in
Length: 18 in
Height: 16 in

For Components See SL-3-09127A

30 KW ELECTRIC POWER DISTRIBUTION SYSTEM

TAMCN B0600 NSN 6110-01-272-6953 ID 09125A

DESCRIPTION AND FUNCTION

The 30 Kw Power Distribution System is a skid-mounted unit used in combination to provide a network of multiple 120/208 volt, l-phase loads and 120 volt, l-phase loads from a remote generator or facility power. Circuit breakers are accessed through a hinged cabinet cover and input/output receptacles are covered. Cables interconnect the individual power distribution panel board assemblies. All assemblies consist of a box and frame assembly, and a cover assembly. It is equipped with circuit breaker and rear access door assemblies, and front and rear receptacles. This set includes one input and nine output cables, and an eyebolt for lifting.

Action Code: SSEA

OPERATING AND SHIPPING DATA

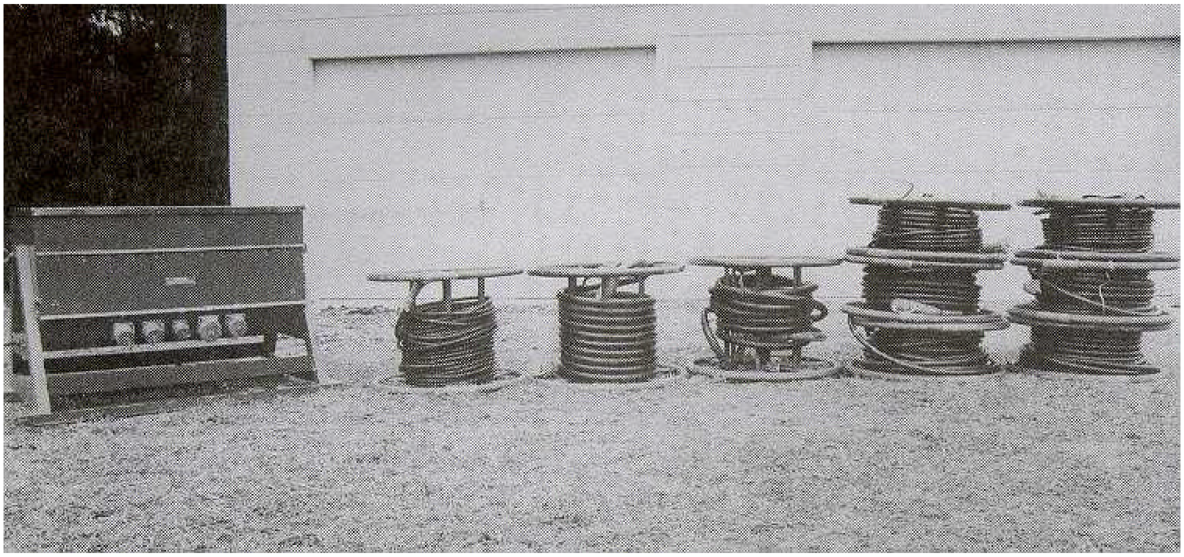
	Operating Mode	Shipping Mode
Weight:	1775 lb	1,775 lb
Width:	33 in	33 in
Length:	58 in	58 in
Height:	119 in	119 in
Cube:	131.8 ft^3	131.8 ft^3
Square Stowage:	13.3 ft^2	13.3 ft^2

Panel Dimensions:
Weight: 161 lb
Width: 38 in
Length: 32 in
Height: 35 in

For Components See SL-3-09125A

100 KW ELECTRIC POWER DISTRIBUTION SYSTEM

TAMCN B0605 NSN 6110-01-272-6952 ID 09124A



DESCRIPTION AND FUNCTION

The 100 Kw Power Distribution System is a skid-mounted unit used in combination to provide a network of multiple 120/208 volt, l-phase loads and 120 volt, l-phase loads from a remote generator or facility power. Circuit breakers are accessed through a hinged cabinet cover and input/output receptacles are covered. Cables interconnect the individual power distribution panel board assemblies. All assemblies consist of a box and frame assembly, and a cover assembly. It is equipped with benelex and rear access door assemblies, and front and rear panel receptacles. This set includes 5 input and 17 output cables, and an eyebolt for lifting.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	3,905 lb	3,905 lb
Width:	50 in	50 in
Length:	62 in	62 in
Height:	215 in	215 in
Cube:	385.7 ft^3	385.7 ft^3
Square Stowage:	21.5 ft^2	21.5 ft^2

Panel Dimensions:
Weight: 345 lb
Width: 57 in
Length: 32 in
Height: 35 in

For Components See SL-3-09124A

FIELD WIRING HARNESS

TAMCN B0608 NSN 6150-01-254-1666 ID 09049A

DESCRIPTION AND FUNCTION

The Field Wiring Harness provides the capability to rapidly install lighting and electrical outlets for distribution of electrical power to field tents and shelters. The set is used to supplement the existing Light Set, General Illumination, Small (TAMCN B1290). One set will provide lighting and power outlets for one general maintenance tent, two command post tents or 10 general purpose tents.

Action Code: SSEA

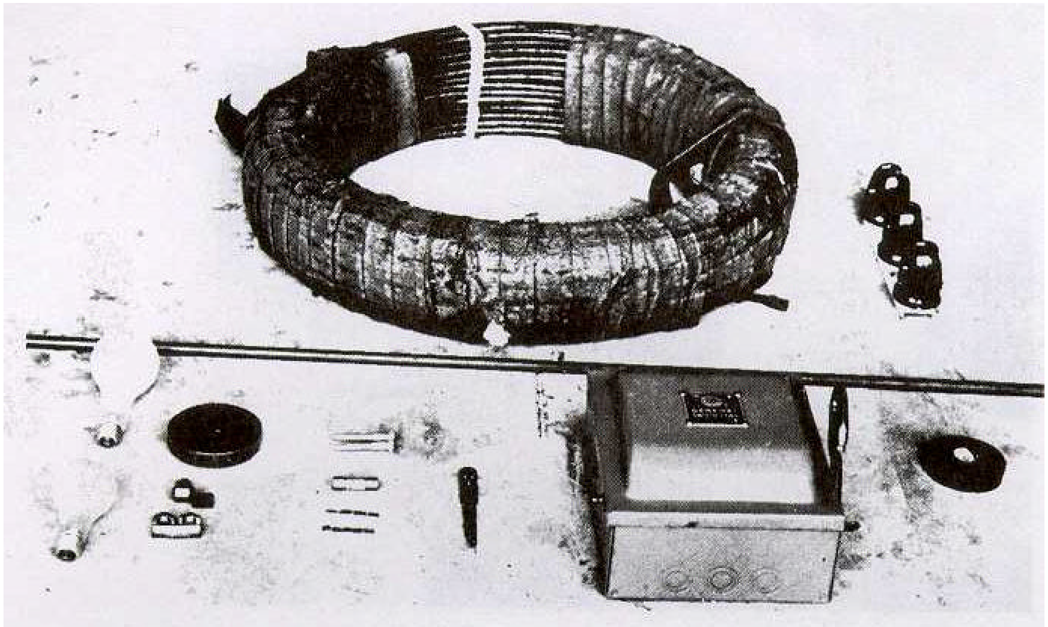
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	764 lb	764 lb
Width:	48 in	48 in
Length:	48 in	48 in
Height:	24 in	24 in
Cube:	32 ft^3	32 ft^3
Square Stowage:	23 ft^2	23 ft^2

For Components see SL-3-09049A

LIGHT SET, GENERAL ILLUMINATION, SMALL

TAMCN B1290 NSN 6230-00-212-6379 ID 01290A



DESCRIPTION AND FUNCTION

The Light Set, General Illumination, Small consists of electrical materials used in conjunction with Light Set, General Illumination, Large when additional, more powerful lighting is required at field installations.

Action Code: SSEA

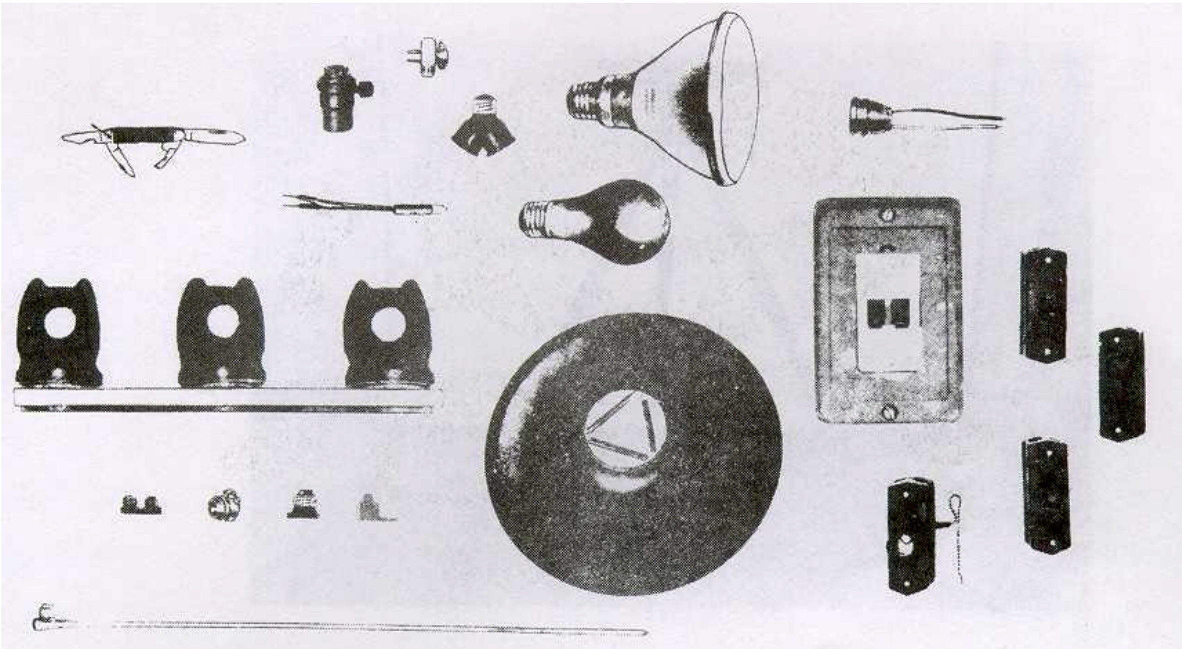
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		550 lb
Width:		48 in
Length:		48 in
Height:		48 in
Cube:		64 ft^3
Square Stowage:		16 ft^2

For Components See SL-3-01290A

LIGHT SET, GENERAL ILLUMINATION, LARGE

TAMCN B1280 NSN 6230-00-212-6378 ID 00941A



DESCRIPTION AND FUNCTION

The Light Set, General Illumination, Large is a complete set of electrical materials for lighting field installations. The light system easily dismantled and reassembled to suit various lighting requirements.

Action Code: SSEA

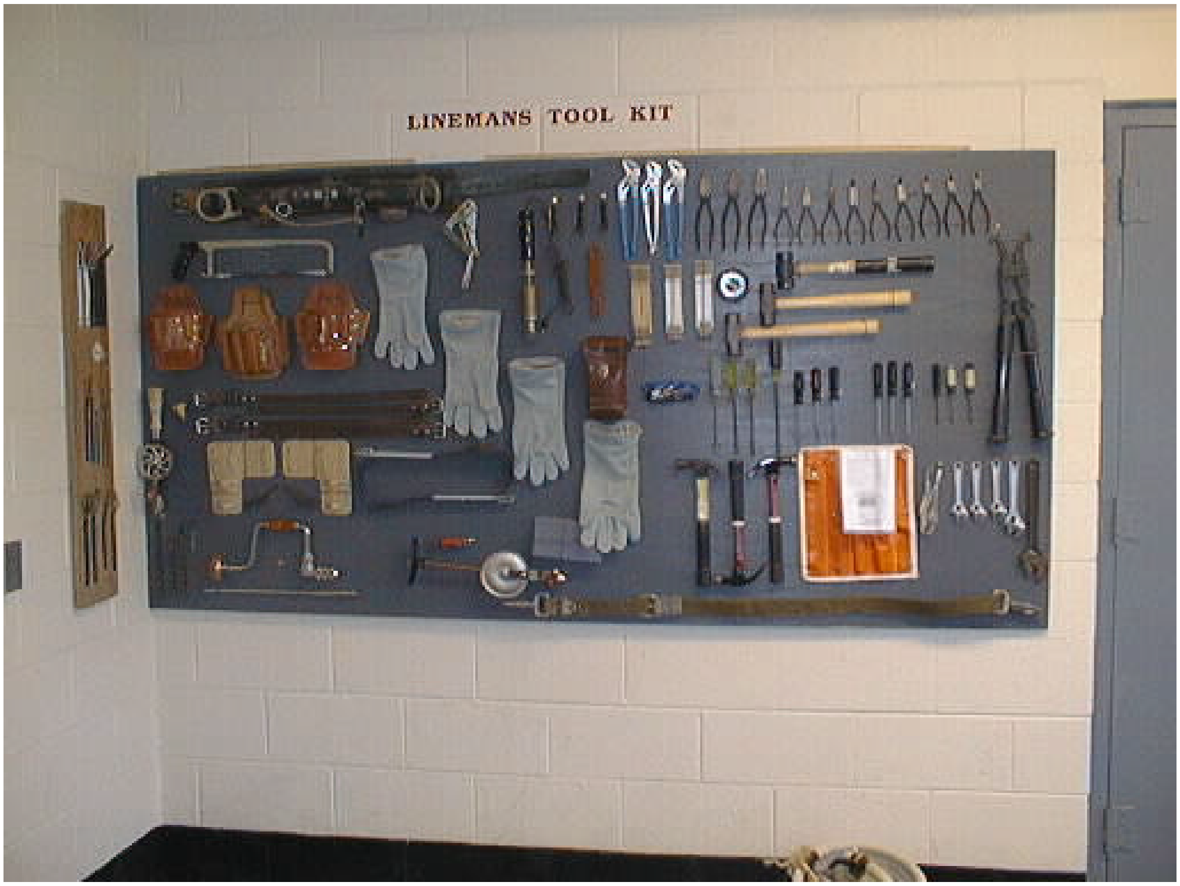
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		5,050 lb
Width:		23 in
Length:		66 in
Height:		13 in
Cube:		11.4 ft^3
Square Stowage:		10.5 ft^2

For Components See SL-3-00941A

TOOL KIT, LINEMAN, ELECTRICIAN

TAMCN B2240 NSN 5180-00-596-1531 ID 01204A



DESCRIPTION AND FUNCTION

The Tool Kit, Lineman, Electrician consists of tools and equipment required for installation, maintenance, and repair of telephone and telegraph lines. Included are pole climbing equipment, cable grip tools, wire splicing clamps, hand cutting tools, bolt cutters, and miscellaneous items. It is stowed and transported in a single chest.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		106 lb
Width:		19.6 in
Length:		33.3 in
Height:		14.4 in
Cube:		5.4 ft^3
Square Stowage:		4.5 ft^2

For Components See SL-3-01204A

DRUM, FABRIC, COLLAPSIBLE, POTABLE WATER, 500 GALLON

TAMCN B0571 NSN 8110-01-122-0015 ID 08935A

DESCRIPTION AND FUNCTION

The Drum, Fabric, Collapsible, Potable Water, 500 gallon is a pillow type, synthetic rubber-impregnated nylon drum. It is designed for use with the Forward Area Water Point Supply System (FAWPSS). The drum is fitted with two 2-inch cam-lock type filler/discharge ports and may be folded for storage.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	4,645, lb	365 lb
Width:	47 in*	46 in
Length:	80 in	94 in
Height:		45 in
Cube:		113 ft^3
Square Stowage:		30 ft^2

* Diameter

SL-3 To Be Determined.

YOKE, TOWING AND LIFTING

TAMCN B2730 NSN 8110-00-856-6243 ID 04485B

DESCRIPTION AND FUNCTION

The Yoke, Towing and Lifting provides the means for towing the Drum, Fabric, Collapsible, Liquid Fuel, 500 Gallon (TAMCN B0570) and the Drum, Fabric, Collapsible, Potable Water, 500 Gallon (TAMCN B0571) short distances and lifting them with power equipment or by helicopter. The yoke is collapsible and is constructed of two sections consisting of an upper leg, connecting leg, and brace. When assembled, the two sections connect at the braces with the upper leg forming an eye attaching to a shackle on each end of the drum.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		80 lb
Width:		
Length:		
Height:		
Cube:		1 ft^3
Square Stowage:		2 ft^2

For Components See SL-4-04485B

STORAGE MODULE, WATER (SIXCON)

TAMCN B2086 NSN 5430-01-203-9971 ID 08990A

DESCRIPTION AND FUNCTION

The Storage Module, Water contains a 900-gallon rigid metal tank mounted in a steel frame and is a component of SIXCON. Six modules can be attached together to form an 8 x 8 x 20 foot ISO/ANSI configured unit. The larger configuration is capable of holding 5,400 gallons of water and can be transported by helicopter or truck. It is compatible for transport on container ships. It is used with Pump Module, Water (TAMCN B1581).

Action Code: SSEA

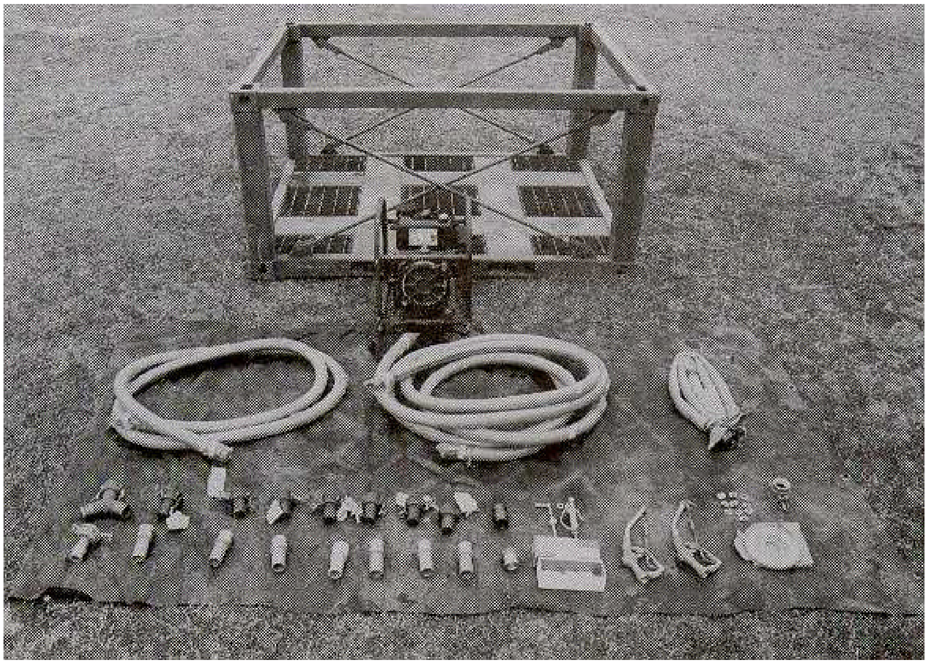
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	9,730 lb	2,530 lb
Width:	96 in	96 in
Length:	80 in	80 in
Height:	48 in	48 in
Cube:	213.3 ft^3	213.3 ft^3
Square Stowage:	53.3 ft^2	53.3 ft^2

For Components See TM 08990A-15&P/1

PUMP MODULE, WATER (SIXCON)

TAMCN B1581 NSN 4320-01-318-1853 ID 08922B



DESCRIPTION AND FUNCTION

The Pump Module, Water includes an engine and a pump. It is a component of SIXCON. It is mounted in a shipping frame (TAMCN C4905). It can be connected to five storage modules in an 8 x 8 x 20 foot ISO/ANSI configured module for transport by prime movers and logistics trailers. The water pump module has the capability to pump water from storage modules at a rate of 125 gallons per minute. It is used with Storage Module, Water (TAMCN B2086).

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	3,000 lb	3,000 lb
Width:	80 in	80 in
Length:	96 in	96 in
Height:	48 in	48 in
Cube:	213.3 ft^3	213.3 ft^3
Square Stowage:	53.3 ft^2	53.3 ft^2

For Components See TM 08922A-24P/2

TANK, FABRIC, COLLAPSIBLE, 3,000 GALLON, ONION

TAMCN B2130 NSN 5430-01-170-6984 ID 01034D

DESCRIPTION AND FUNCTION

The Tank, Fabric, Collapsible, 3,000 Gallon, Onion is a collapsible tank designed for easy erection in the field. It may serve as a temporary or semi-permanent water storage facility.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	24,120 lbs	120 lb (Empty)
Width:	*	25 in
Length:	*	45 in
Height:	60 in	18 in
Cube:		11.7 ft^3
Square Stowage:		7.8 ft^2

* Diameter: 120 in

For Components See TM 01034C-15/1

TANK, FABRIC, COLLAPSIBLE, POTABLE WATER, 20,000 GALLON

TAMCN 62632 NSN 5430-01-106-9678 ID 08845A

DESCRIPTION AND FUNCTION

The 20,000 Gallon Collapsible Fabric Potable Water Tank is a pillow type synthetic rubber-impregnated nylon tank. It is fitted with 4-inch cam-lock type filler/discharge ports and may be folded for storage. A repair kit is also provided.

Action Code: SSEA

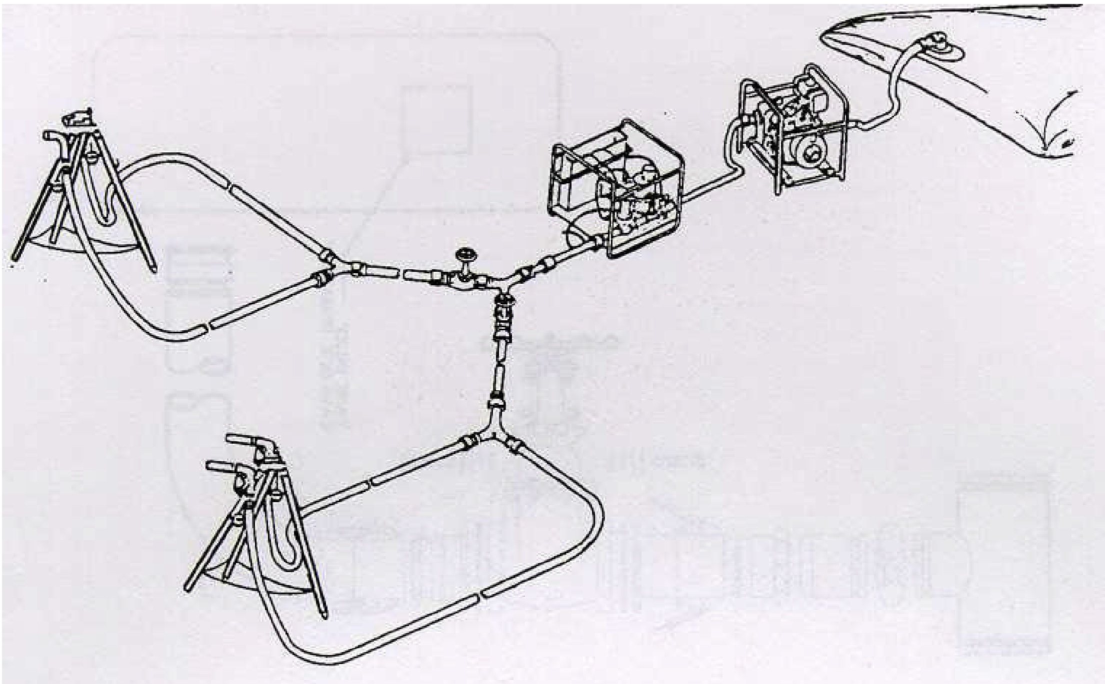
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		1,100 lb
Width:		31 in
Length:		138 in
Height:		18 in
Cube:		45 ft^3
Square Stowage:		30 ft^2

SL-3 To Be Determined.

TWDS DISTRIBUTION POINT

TAMCN B2393 NSN 4320-01-128-4246 ID 09536A



DESCRIPTION AND FUNCTION

Designed to be used in conjunction with the Tactical Water Distribution System (TWOS) Storage Assembly, the TWDS Distribution Point contains the Hypochlorination Unit (TAMCN B1140), the 125 gpm pump, Lister Bags, valves, hoses, and related components for installation.

Action Code: SSEA

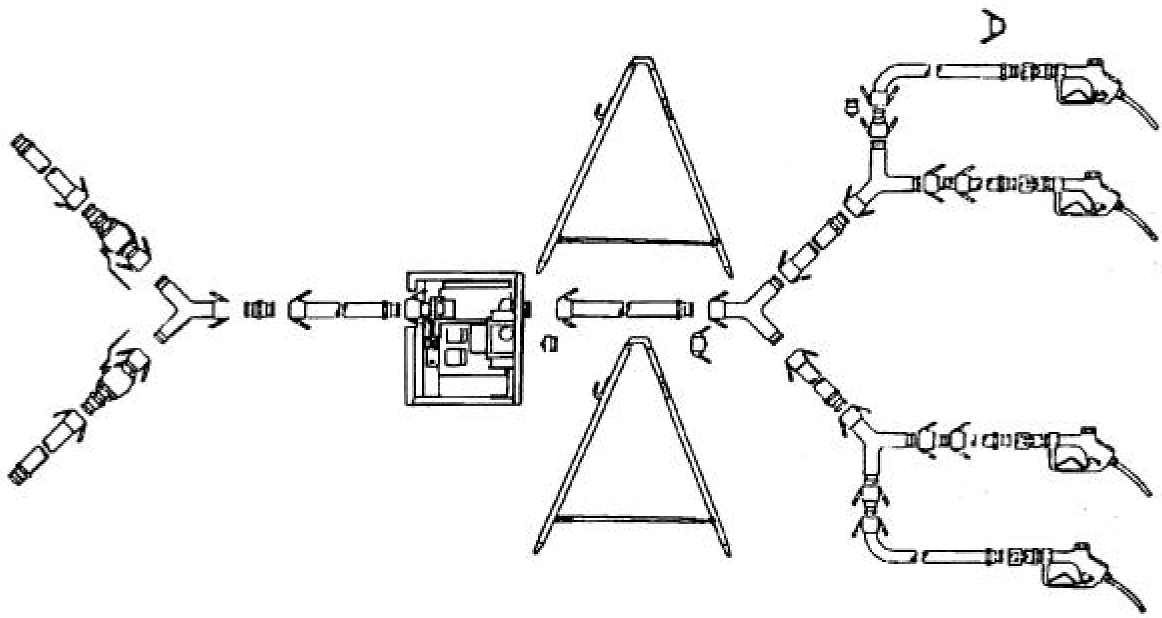
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		1,500 lb
Width:		63 in
Length:		63 in
Height:		48 in
Cube:		111 ft^3
Square Stowage:		28 ft^2

For Components See TM 5-4320-303-10

FORWARD AREA WATER POINT SUPPLY SYSTEM

TAMCN B0676 NSN 4320-01-110-1993 ID 08936A



DESCRIPTION AND FUNCTION

The Forward Area Water Point Supply System (FAWPSS) is a portable, self-contained water storage and dispensing set for potable water. It consists of a 125 gpm diesel-powered water pump, six 500-gallon drums, four distribution nozzles, nozzle stands, hoses, valves and associated components. The 500-gallon drums are supplied separately.

Action Code: SSEA

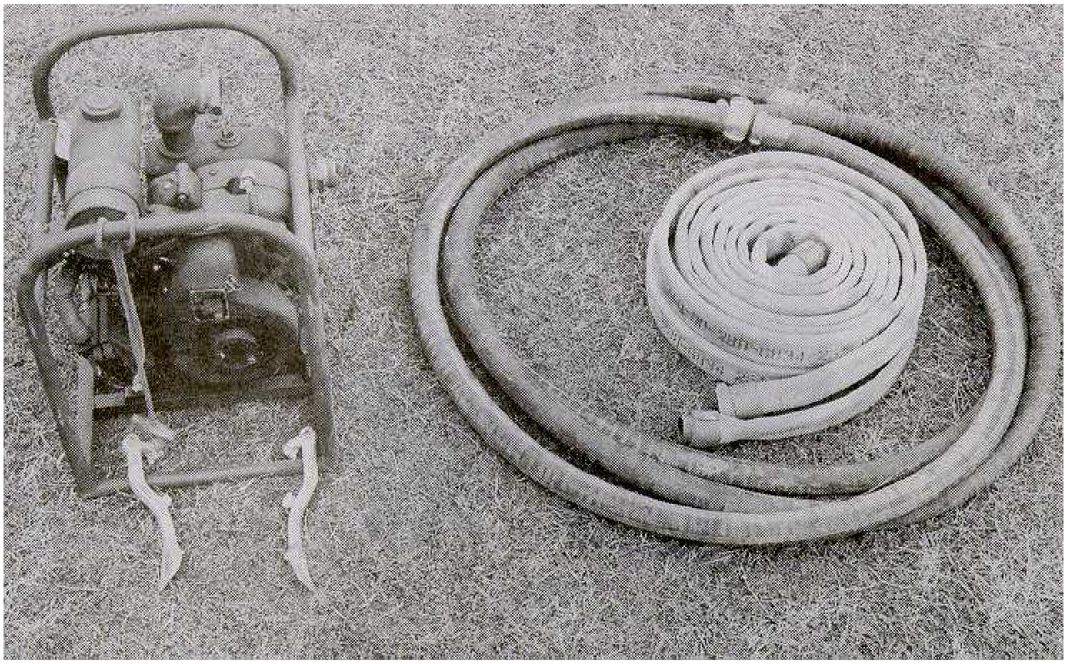
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		600 lb
Width:		48 in
Length:		120 in
Height:		36 in
Cube:		120 ft^3
Square Stowage:		40 ft^2

SL-3 To Be Determined.

PUMP SET, 65 GPM, 50 FT HEAD

TAMCN B1620 NSN 4320-01-149-7857 ID 00970C



DESCRIPTION AND FUNCTION

The Pump Set, 65 Gpm, 50 Ft head is a compact, base-mounted, portable water pump. It is comprised of a single stage centrifugal pump directly connected to an air-cooled gasoline engine.

Manufacturer: E.C. Schleyer Pump Co. Action Code: 837-2

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		220 lb
Width:		20 in
Length:		28 in
Height:		30 in
Cube:		9.7 ft^3
Square Stowage:		3.9 ft^2

Fuel Type: Gasoline
Fuel Tank Capacity: 1 gal
Fuel Consumption/hr: .5 gal

For Components See SL-3-00970C

PUMP, WATER, 350 GPM

TAMCN B1582 NSN 4320-01-158-2954 ID 09540A

DESCRIPTION AND FUNCTION

The Pump, Water, 350 GPM is the primary pump within the water supply tank farm. It is a trailer-mounted, diesel engine driven, centrifugal type pump rated at 350 gpm with 275 foot total dynamic head. Both intake and discharge ports are 4-inch cam-lock type fittings. A repair kit is provided.

Action Code: SSEA

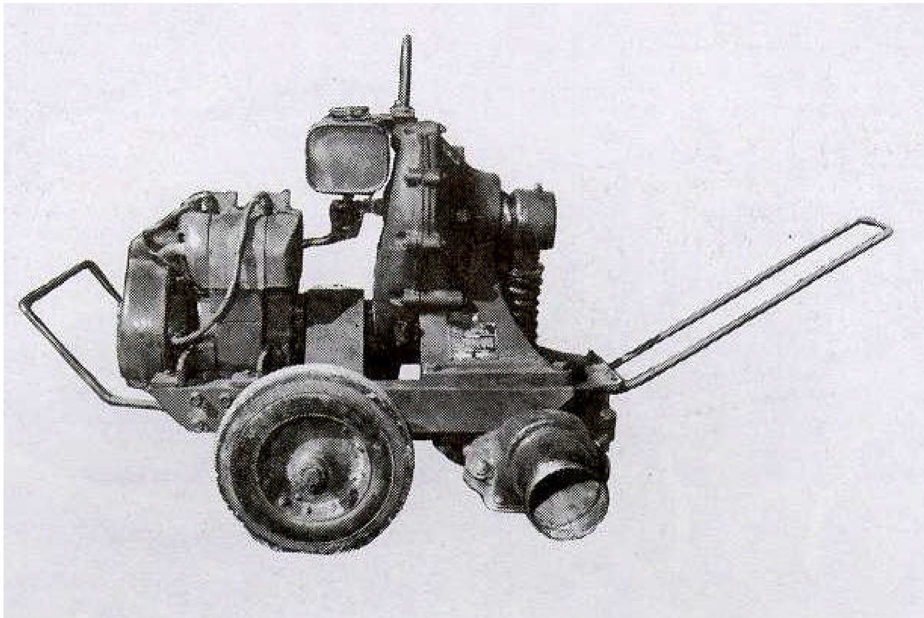
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		2,140 lb
Width:		70 in
Length:		78 in
Height:		68 in
Cube:		215 ft^3
Square Stowage:		38 ft^2

SL-3 To Be Determined.

PUMP, RECIPROCATING, POWER DRIVEN

TAMCN B1595 NSN 4320-00-407-2582 ID 07683A



DESCRIPTION AND FUNCTION

The Pump, Reciprocating, Power Driven is powered by an air-cooled, one cylinder, gasoline engine. The torque from the engine is transferred to the pump through a flexible coupling. The engine and the pump are bolted to a two-wheeled steel trailer. It is used in dewatering applications where water bears sand, gravel or any other solids (mud hog).

Action Code: SSEA

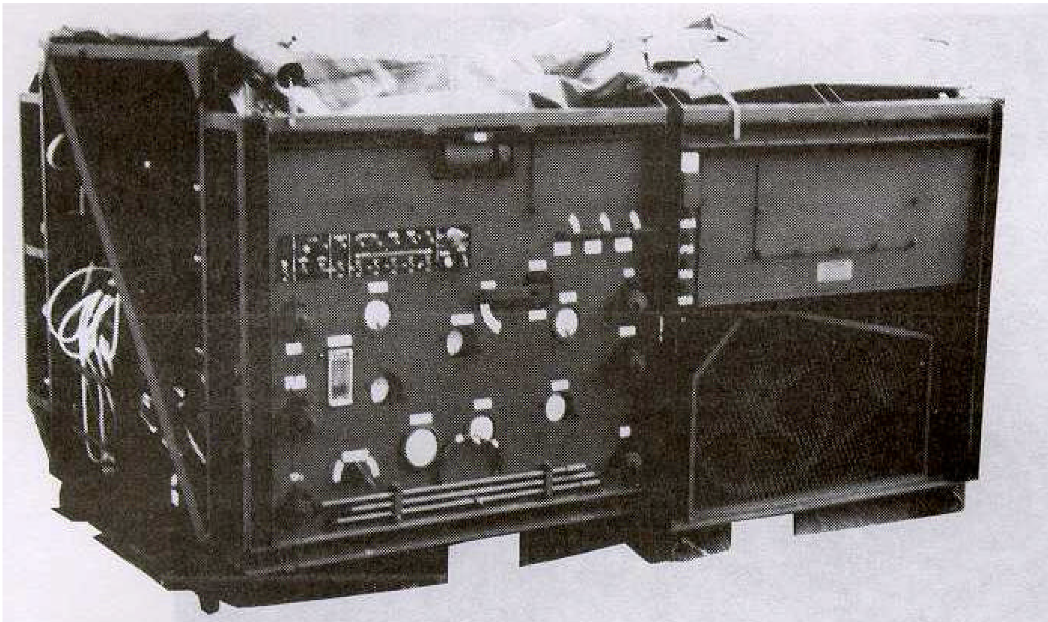
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	2,350 lb	2,350 lb
Width:	81 in	81 in
Length:	126 in	126 in
Height:	58 in	58 in
Cube:	342.6 ft^3	342.6 ft^3
Square Stowage:	70.9 ft^2	70.9 ft^2

For Components See SL-3-07683A

REVERSE OSMOSIS WATER PURIFICATION UNIT

TAMCN B2604 NSN 4610-01-113-8651 ID 08580A



DESCRIPTION AND FUNCTION

The Reverse Osmosis Water Purification Unit (ROWPU) is an IS0 frame-mounted, portable water purification system capable of purifying water from almost any shallow well, deep well and surface water raw water source. The ROWPU is capable of removing NBC contaminants, minerals, and biological impurities. The single greatest benefit of the RO process is the ability to desalinate sea water. The ROWPU is capable of producing potable water at a rate of 600 gph. The ROWPU is powered by a 30 Kw generator set.

Action Code: SSEA

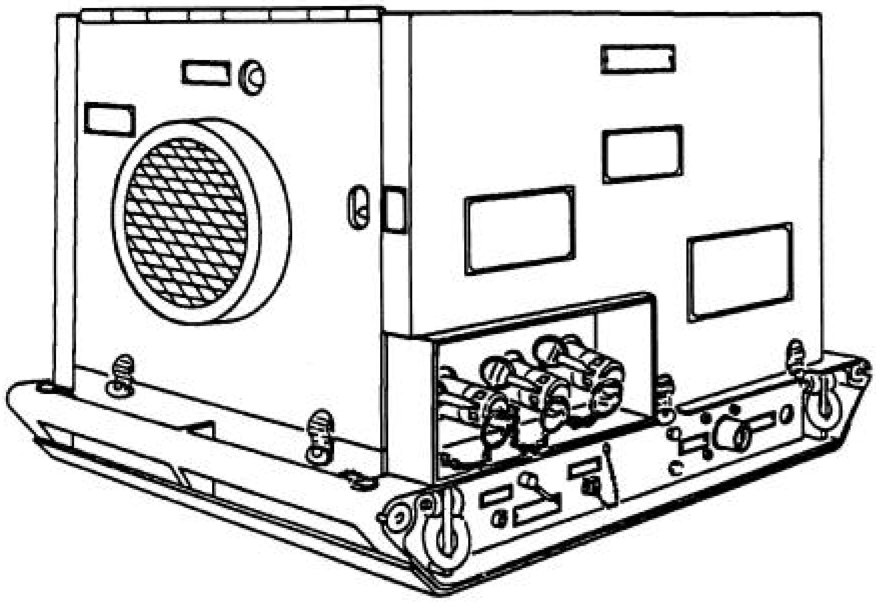
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	7,300 lb	7,300 lb
Width:	96 in	96 in
Length:	120 in	120 in
Height:	96 in	96 in
Cube:	640 ft^3	640 ft^3
Square Stowage:	80 ft^2	80 ft^2

For Components See SL-3-08580A

WATER CHILLER, SMALL MOBILE

TAMCN B2641 NSN 4130-01-131-2685 ID 09503A



DESCRIPTION AND FUNCTION

The Water Chiller, Small Mobile is a skid-mounted, gasoline engine driven cooling unit designed to cool potable water from 120°F to 60°F at a rate of 40 gallons per minute. Although designed for operation with the M149 Water Trailer, the Water Chiller’s compatibility with other water storage assets in the Marine Corps has broadened its intended use.

Action Code: SSEA

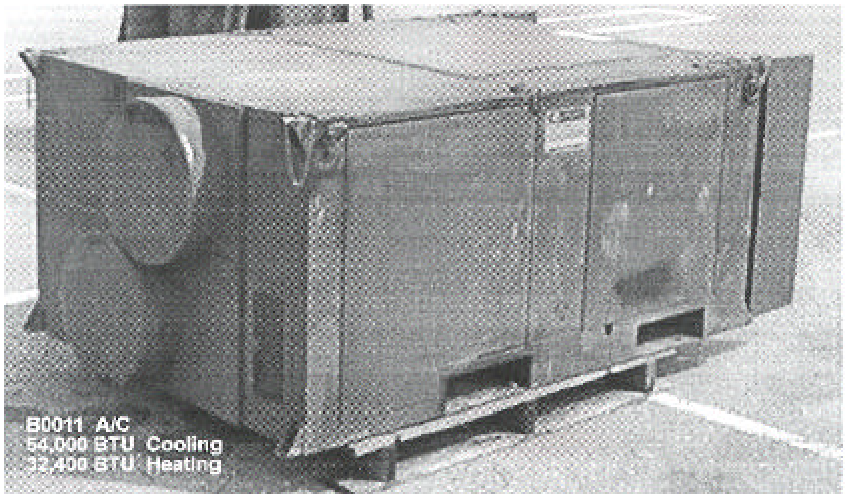
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		680 lb
Width:		32 in
Length:		41 in
Height:		45 in
Cube:		34 ft^3
Square Stowage:		9 ft^2

SL-3 To Be Determined.

AIR CONDITIONER, MCS, SKID-MOUNTED

TAMCN B0011 **NSN 4120-01-150-8112** **ID 07710B**
4120-00-323-7780 **07710A**
4120-00-323-7781



DESCRIPTION AND FUNCTION

The Air Conditioner, MCS, Skid-Mounted is an electrically powered air conditioner. A new concept is incorporated into the unit whereby components are packaged in a ruggedized frame and cabinet to allow transport without crating. It is not intended for support of electromagnetic interference sensitive equipment.

Manufacturer: American Air Filter Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	940 lb	1260 lb
Width:	48 in	54 in
Length:	67 in	81 in
Height:	32 in	41 in
Cube:	59.6 ft^3	103.8 ft^3
Square Stowage:	22.3 ft^2	30.4 ft^2

Capacity: Btu/h (Cooling) 60,000
Power Source Requirements:
(Heating) 31,000 Frequency: 60 Hz
Nominal Cooling Capacity: 54,000 Voltage/Phase: 208 V/3 Phase
Wires: 4 wire
Optimal Temperature Range:
Cooling: 50° to 125°F Maximum power consumption/
Heating: -50° to 80°F minimum power factor:
Conditioned Air Flow: 2250 SCFM at 0”H20 10.5 Kw/0.80 PF

For Components See TM 4120-15/1C

LAUNDRY UNIT

TAMCN B1226 NSN 3510-01-165-6845 ID 09950A

DESCRIPTION AND FUNCTION

Both currently fielded laundry units will be replaced by the Laundry Unit, Model No. MTR-3510-013 (B1226). The B1226 Laundry Unit is a pallet mounted, self-contained unit consisting of a washer, dryer, extractor, and air compressor mounted on two pallets with removable 463L locking rail assemblies. The M-80 Water Heater, supplied with the laundry unit, is a self-contained oil-fired boiler capable of providing 120 "F water at a rate of 20 gallons per minute. The laundry unit will provide the capability to launder all washable fabrics worn by individual Marines and flat and bulky organizational items with a maximum output of 120 pounds per hour.

Action Code: SSEA

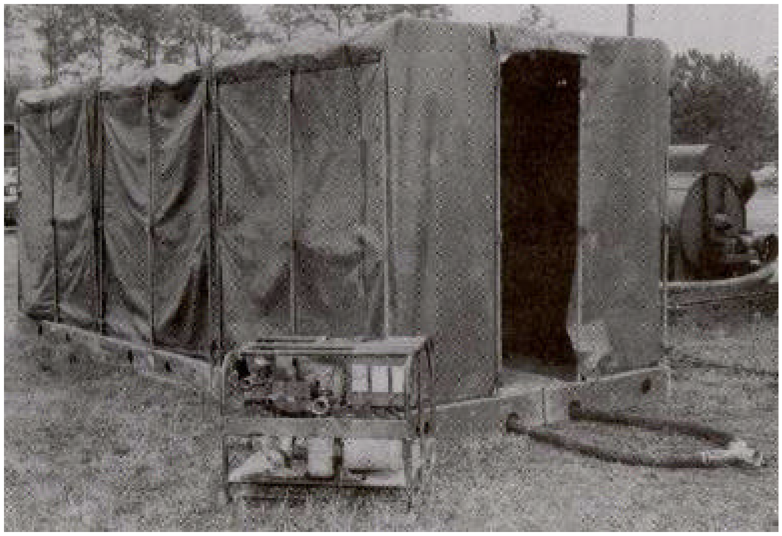
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	10,000 lb	10,000 lb
Width:	96 in	96 in
Length:	480 in	240 in
Height:	96 in	96 in
Cube:	1,280 ft^3	1,280 ft^3
Square Stowage:	160 ft^2	160 ft^2

SL-3 To Be Determined.

BATH, SHOWER UNIT

TAMCN B0055	NSN 4510-01-163-6775	ID 10006A



DESCRIPTION AND FUNCTION

The Bath, Shower Unit will replace all trailer mounted units. It consists of six separate but identical and interchangeable shower modules, with interconnecting hoses, electric feed water and drain pumps, and a drain hose. The M-80 Water Heater supplied with the unit is a self-contained, oil-fired boiler capable of providing 120 °F water at 20 gallons per minute. Each module consists of a fiberglass base, a top frame, six vertical supports, a cover, and two shower heads. The individual modules can be connected together in any quantity desired.

Action Code: SSEA

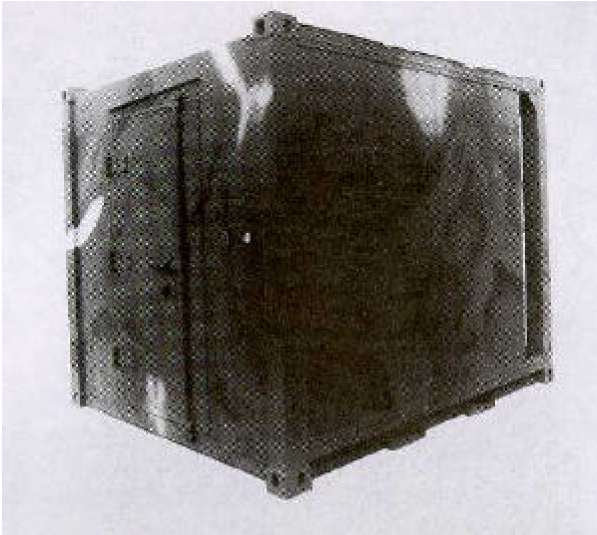
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	1000 lbs	1,000 lbs
Width:	72 in	36 in
Length:	216 in	72 in
Height:	72 in	72 in
Cube:		108 ft^3
Square Stowage:		18 ft^2

For Components See TM 10006A-14&P/1

REFRIGERATOR, RIGID BOX

TAMCN B1710 NSN 4110-01-107-9078 ID 08407A



DESCRIPTION AND FUNCTION

The Refrigerator, Rigid Box is an insulated 300 cubic foot capacity container without a refrigeration unit. The overall refrigerated container assembly is a one-piece welded steel frame with permanently assembled riveted aluminum alloy panels.

Action Code: SSEA

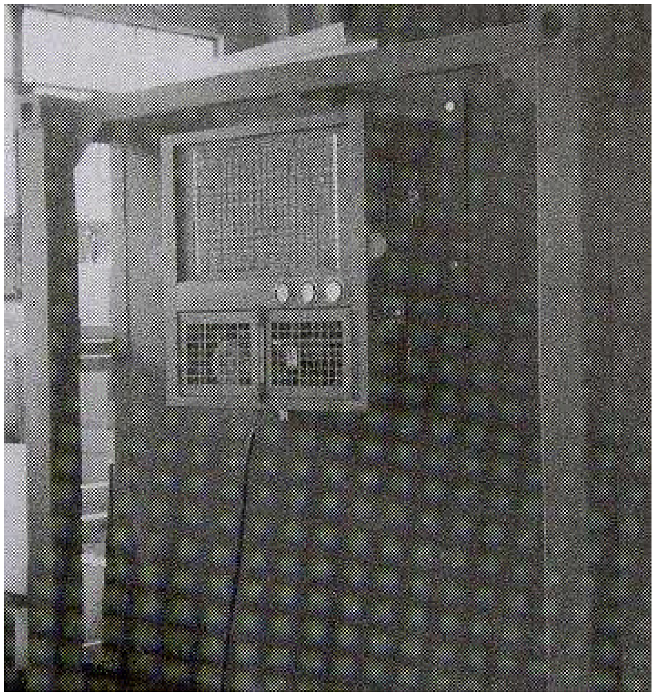
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		10,000 lb
Width:		96.3 in
Length:		117.3 in
Height:		96.3 in
Cube:		629.6 ft^3
Square Stowage:		78.4 ft^2

For Components See TM 08407A-13/1

REFRIGERATION UNIT, F/RIGID BOX, 350 CUBIC FT

TAMCN B1645 NSN 4110-01-152-1946 ID 08713A



DESCRIPTION AND FUNCTION

The 4,000 Btu Refrigeration Unit, F/Rigid Box, 350 Cubic Feet is a portable, self-contained modular unit. It is designed to be used with an insulated container of rigid construction to form a complete combination freezer and chill box.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	530 lb	680 lb
Width:	42 in	42 in
Length:	31 in	31 in
Height:	41 in	41 in
Cube:	30.8 ft^3	30.9 ft^3
Square Stowage:	9 ft^2	9 ft^2

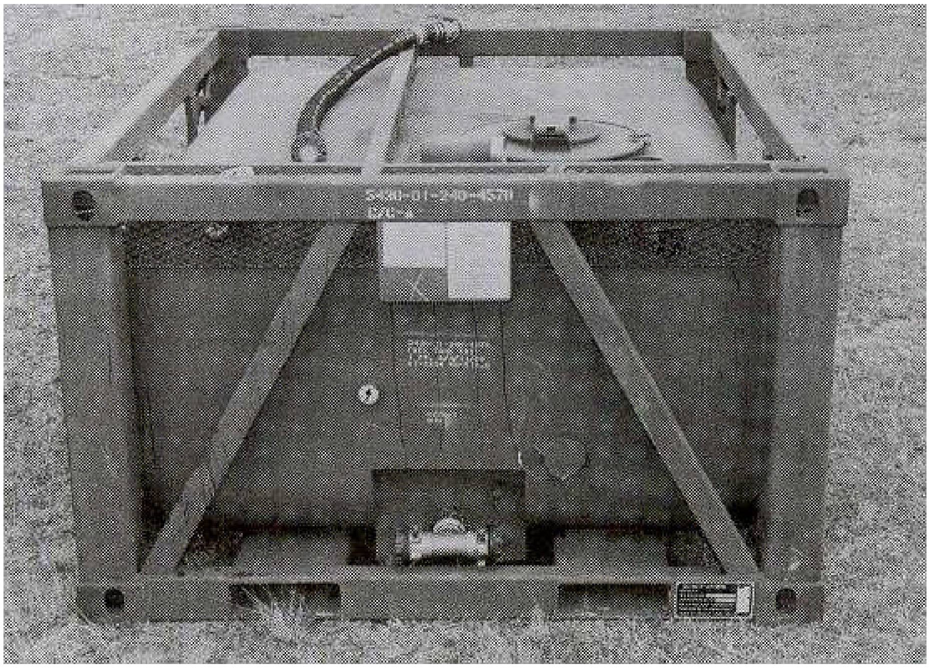
Power Source Requirements:

Frequency: 60 Hz
Voltage/Phase: 208 V/3 Phase
Wires: 4 Wire
Maximum power consumption: 5 Kw

SL-3 To Be Determined.

STORAGE MODULE, FUEL (SIXCON)

TAMCN B2085 NSN 5430-01-240-4578 ID 09002A



DESCRIPTION AND FUNCTION

The Storage Module, Fuel contains a 900-gallon rigid metal tank mounted in a steel frame and is a component of SIXCON. Five fuel storage modules along with one fuel pump can be attached together to form an 8 x 8 x 20 foot ISO/ANSI configured unit which can store and pump 4,500 gallons of fuel. This container can be transported by helicopter or truck to remote areas, and is suitable for transport aboard container ships. It is used with Pump Module, Fuel (TAMCN B1580).

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	9,550 lb	2,530 lb
Width:	96 in	96 in
Length:	80 in	80 in
Height:	48 in	48 in
Cube:	213.3 ft^3	213.3 ft^3
Square Stowage:	53.3 ft^2	53.3 ft^2

For Components See SL-3-09002A

ICE MAKING MACHINE, FLAKE

TAMCN B1180	NSN 4110-00-143-9241	ID 00935J
	4110-01-252-0855	00935H
	4110-01-037-1188	O0935G

DESCRIPTION AND FUNCTION

The Ice Making Machine, Flake is a self-contained unit capable of producing 1,250 pounds of flaked ice every 24 hours. The ice machine is enclosed by removable side, front, rear, and top panels. A 750 pound capacity storage bin is in the bottom section.

Action Code: SSEA

OPERATING AND SHIPPING DATA

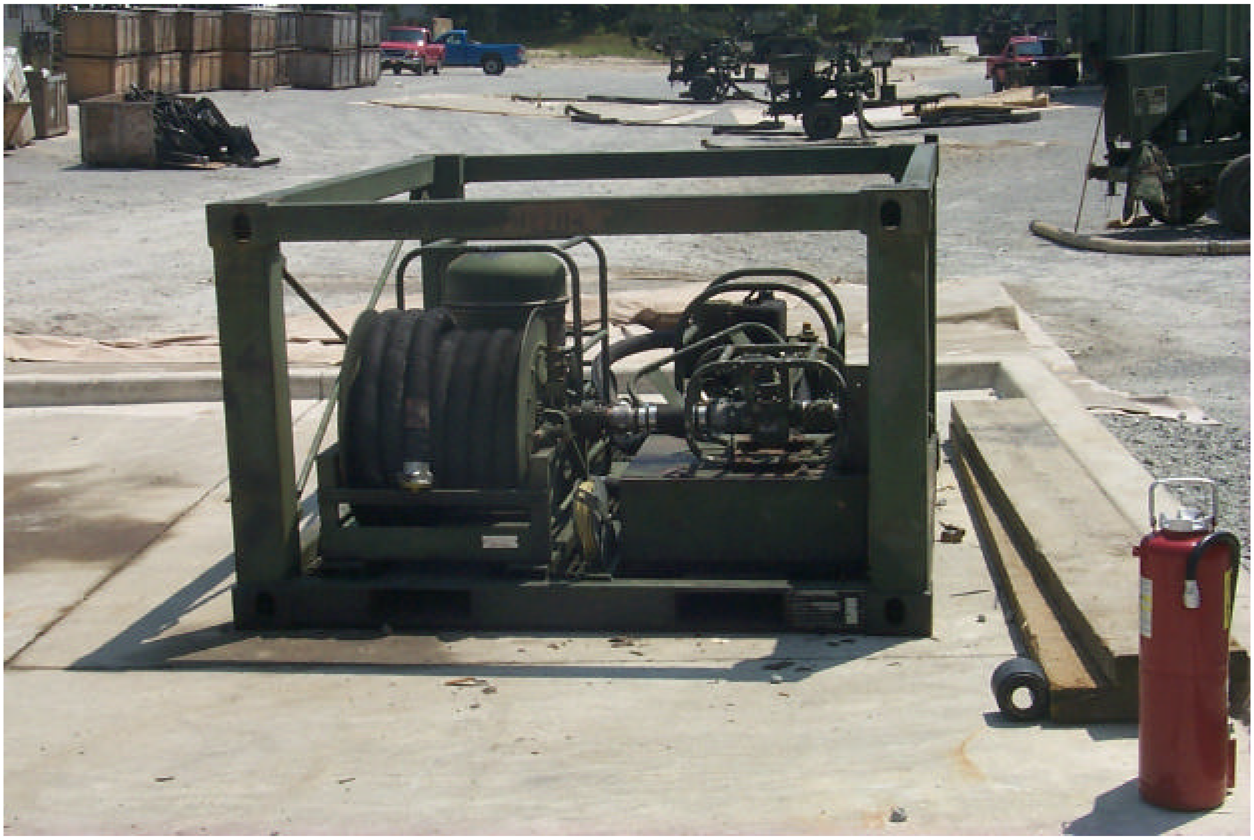
	Operating Mode	Shipping Mode
Weight:		664 lb
Width:		42.4 in
Length:		32.4 in
Height:		65.8 in
Cube:		52.3 ft^3
Square Stowage:		9.5 ft^2

Power Source Requirements:
Frequency: 60 Hz
Voltage/Phase: 120 V / l-Phase
Wires: 3 wire
Maximum power consumption: 4 Kw

For Components See SL-3-00935H, SL-4-00935G

PUMP MODULE, FUEL (SIXCON)

TAMCN B1580 NSN 4930-01-240-4579 ID 09003A



DESCRIPTION AND FUNCTION

The Pump Module, Fuel provides the capability to store, transport, and pump up to 5,0O0 gallons in a single module. The fuel pump module is a component of a SIXCON, a six module unit which consists of five fuel storage modules and one fuel pump module. The six modules attach together to form an ISO/ANSI configured 8 x 8 x 20 foot module which can be lifted by helicopter or transported by trucks or container ship. It is used with Storage Module, Fuel (TAMCN 62085).

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	4,000 lb	4,000 lb
Width:	80 in	80 in
Length:	96 in	96 in
Height:	48 in	48 in
Cube:	213.3 ft^3	213.3 ft^3
Square Stowage:	53.3 ft^2	53.3 ft^2

For Components See SL-3-09003A

PUMP ASSEMBLY, EXPEDIENT REFUELER

TAMCN B1570	NSN 4930-01-182-5028	ID 03707F
	4320-01-113-7146	03707E
	4320-00-232-9236	03707C

DESCRIPTION AND FUNCTION

The Pump Assembly, Expedient Refueler is a portable, compact, self-contained fuel pump delivery system with a maximum output of 125 gallons per minute. This unit is to be used in conjunction with the Drum, Fabric, Collapsible, Liquid Fuel, 500-Gallon (TAMCN B0570). The components are secured to a lightweight skid-pallet.

Action Code: SSEA

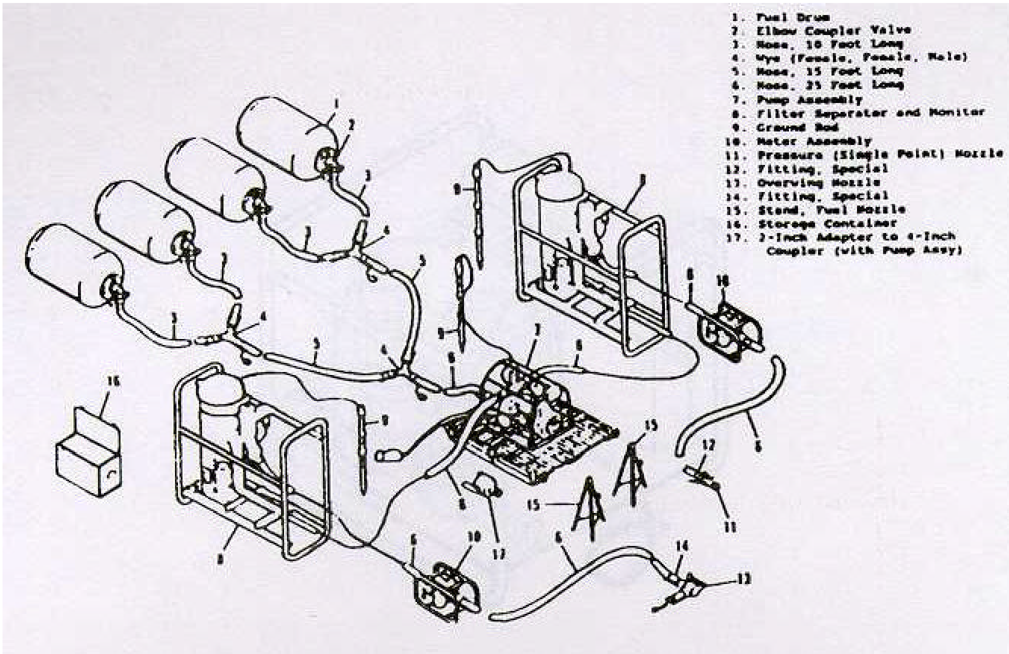
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		243 lb
Width:		40 in
Length:		50.6 in
Height:		26.9 in
Cube:		31.5 ft^3
Square Stowage:		14.1 ft^2

For Components See SL-3-03707C

HELICOPTER EXPEDIENT REFUELING SYSTEM

TAMCN B1135 NSN 4930-01-114-9930 ID 07387C
4930-00-188-1701 07387B



DESCRIPTION AND FUNCTION

The Helicopter Expedient Refueling System is an air-transportable fuel dispensing system for use in forward areas. It is capable of receiving and dispensing up to 9,000 gallons of fuel at the rate of 125 gallons per minute. The system is comprised of eighteen 500-gallon collapsible drums and assorted fuel dispensing hardware.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		6,134 lb
Width:		900 in
Length:		1,800 in
Height:		144 in
Cube:		135,000 ft^3
Square Stowage:		11,250 ft^2

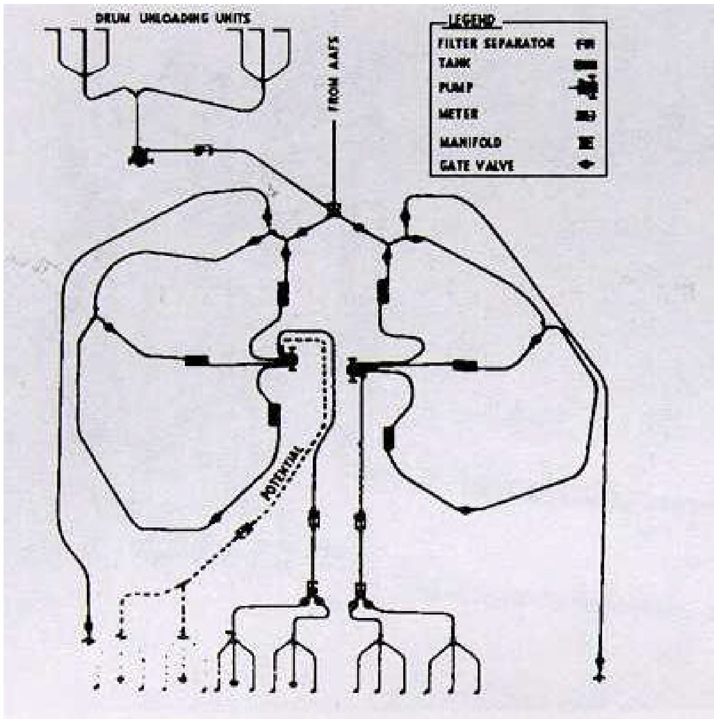
MAJOR COMPONENTS

Qty	Nomenclature
18	500-gallon collapsible tanks
2	pump assemblies, 100-125 gpm
2	filter-separator assemblies

For Components See SL-3-07387C
SL-3-07387B

FUEL DISPENSING SYSTEM, TACTICAL AIRFIELD

TAMCN B0675 NSN 4930-01-094-0026 ID 07391B



DESCRIPTION AND FUNCTION

The Fuel Dispensing System, Tactical Airfield is an assembly of fuel dispensing and fuel drum loading/unloading equipment. The system is capable of receiving and storing 120,000 gallons of aircraft fuel and simultaneously dispensing fuel at six refueling stations.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		36,327 lb
Width:		203 in
Length:		420 in
Height:		52.9 in
Cube:		2,610.1 ft^3
Square Stowage:		592.1 ft^2

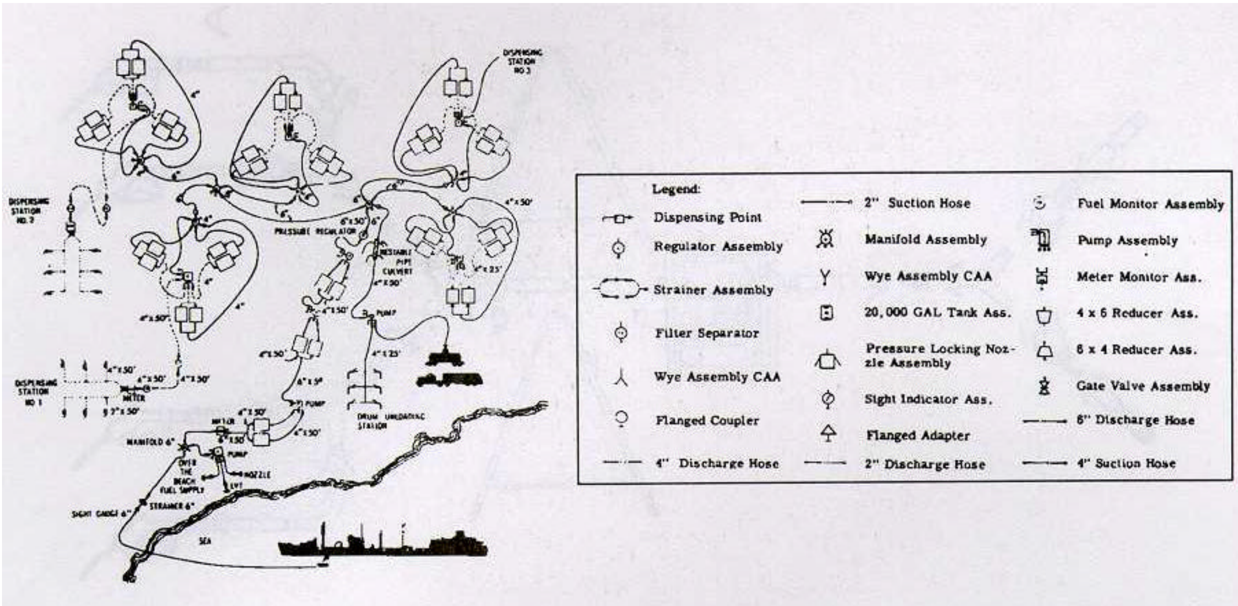
MAJOR COMPONENTS

Qty	Nomenclature
6	20,000 gal collapsible tank
3	trailer mounted fuel pump, 350 gpm/600 gpm
6	350 gpm filter separator

For Components See SL-3-07391B

FUEL SYSTEM, AMPHIBIOUS ASSAULT, 600,000 GALLON CAPACITY

TAMCN B0685 NSN 4930-01-113-9173 ID 06674C



DESCRIPTION AND FUNCTION

The Fuel System, Amphibious Assault, 600,000 Gallon Capacity is an assemblage of a number of self-contained unit components capable of receiving, storing, and bulk reducing aviation turbine and ground fuels.

Action Code: SSEA

OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:		140,164 lb
Width:		630 in
Length:		650 in
Height:		48 in
Cube:		11,375 ft^3
Square Stowage:		2,843.8 ft^2

MAJOR SUBSYSTEMS

Qty	Nomenclature
1	beach unloading assembly
1	drum unloading assembly
2	booster pump assemblies
5	tank farms, 120,000 gal capacity
2	fuel dispensing assemblies, six outlets each
2	adapter assemblies

For Components See SL-3-06674C

DRUM, FABRIC, COLLAPSIBLE, LIQUID FUEL, 500 GALLON

TAMCN B0570 NSN 8110-00-965-2313 ID 04486B

SAME AS COLLAPSIBLE WATER DRUM, AND BLACK IN COLOR

DESCRIPTION AND FUNCTION

The Drum, Fabric, Collapsible, Liquid Fuel, 500 Gallon is a durable, non-vented, hermetically sealed, collapsible fabric container used to store or transport gasoline, oil, lubricants, diesel and jet fuels, and other petroleum products. It is cylindrical when filled to capacity. Yoke, Towing and Lifting (TAMCN B2730) is required if the drum is to be towed or lifted. This unit may be air-dropped. The drum is supported by the Pump Assembly, Expedient Refueler (TAMCN B1570).

Action Code: SSEA

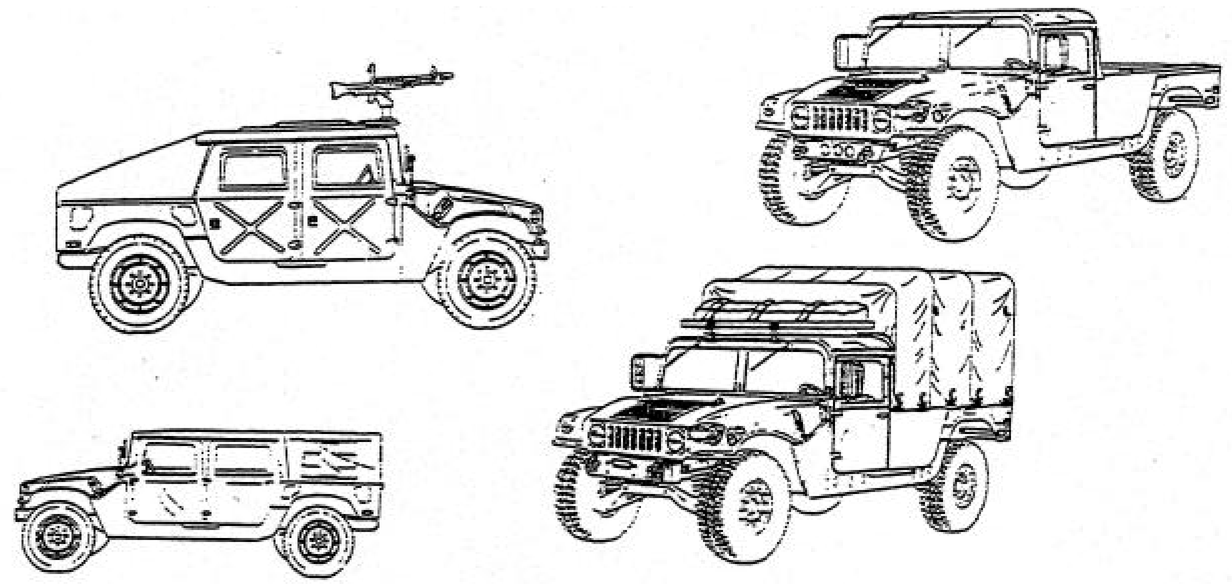
OPERATING AND SHIPPING DATA

	Operating Mode	Shipping Mode
Weight:	3,235 lb (Full)	365 lb (Empty)
Width:	47 in	42 in
Length:	80 in	80 in
Height:	32 in	15 in
Cube:	69.6 ft^3	29.2 ft^3
Square Stowage:	26.1 ft^2	23.3 ft^2

For Components See SL-3-04486B

TRUCK, UTILITY, CARGO, TROOP, 1¼ TON

TAMCN D1158



DESCRIPTON AND FUNCTION

M998 series of vehicles are designed for use over all types of roads as well as cross-country in all weather conditions. Commonly known as the high Mobility, Multi-Purpose, Wheeled Vehicle(HMMWV). Four wheel drive, hydraulic service brakes, mechanical parking brake. All are equipped with a rear pintle hook for towing. Tiedown and lifting eyes are common to all in the M998 series. All in this series have run-flat tires good for 20 miles.

OPERATING AND SHIPPING DATA

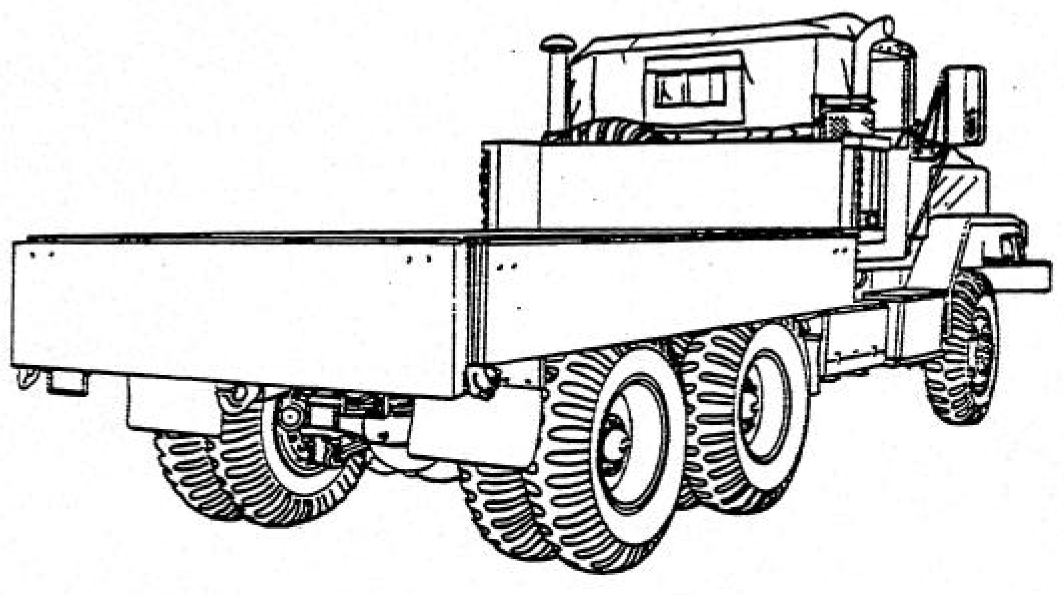
Weight:	5,060
Width:	85″
Length:	180″
Height:	69″ reducible to 55″
Cube:	488 ft^3
Fuel type:	Diesel
Fuel capacity:	25 US gal
Fuel consumption:	1.7 gal/hr
Fording depth:	30″ as built, 60″ with fording kit
Passenger capacity:	9 plus operator
Cargo capacity:	2,500 lbs

VARIATIONS

M998 – Cargo /troop carrier	M996 – 2 litter ambulance, Armored
M1038 – Cargo/troop carrier w/winch	M997 – 4 litter ambulance, Armored
M1036 – TOW carrier, Armored w/winch	M1035 – 2 litter ambulance, Soft top (TAMCN D1002)

TRUCK, CARGO, DROPSIDE, 5 TON

TAMCN D1059



DESCRIPTION AND FUNCTION

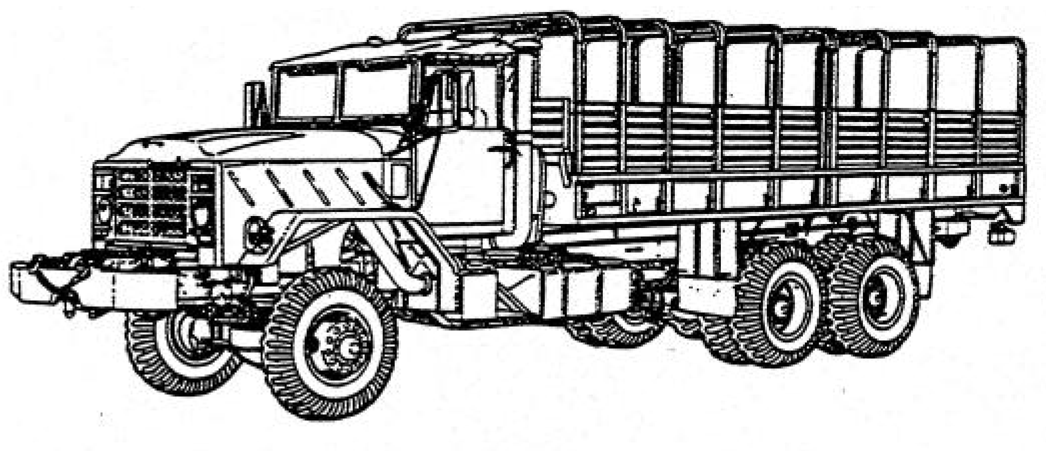
M923 W/o winch, M925 w/winch. Used to transport cargo and troops. Removable dropsides and tailgate permit hauling extra wide loads and easy access for unloading cargo. Troop seats, bows and canvas are available. Has a rear pintle hook for towing or tiedown, lifting shackles for air, sea, or rail. Also equipped with front and rear servicing couplings for improved towing of disabled vehicles.

OPERATING AND SHIPPING DATA

Weight:	5,060
Width:	85″
Length:	180″
Height:	69″ reducible to 55″
Cube:	488 ft^3
Fuel type:	Diesel
Fuel capacity:	25 US gal
Fuel consumption:	1.7 gal/hr
Fording depth:	30″ as built, 60″ with fording kit
Passenger capacity:	9 plus operator
Cargo capacity:	2,500 lbs

TRUCK, CARGO, XLWB, 5 TON

TAMCN D1061



DESCRIPTION AND FUNCTION

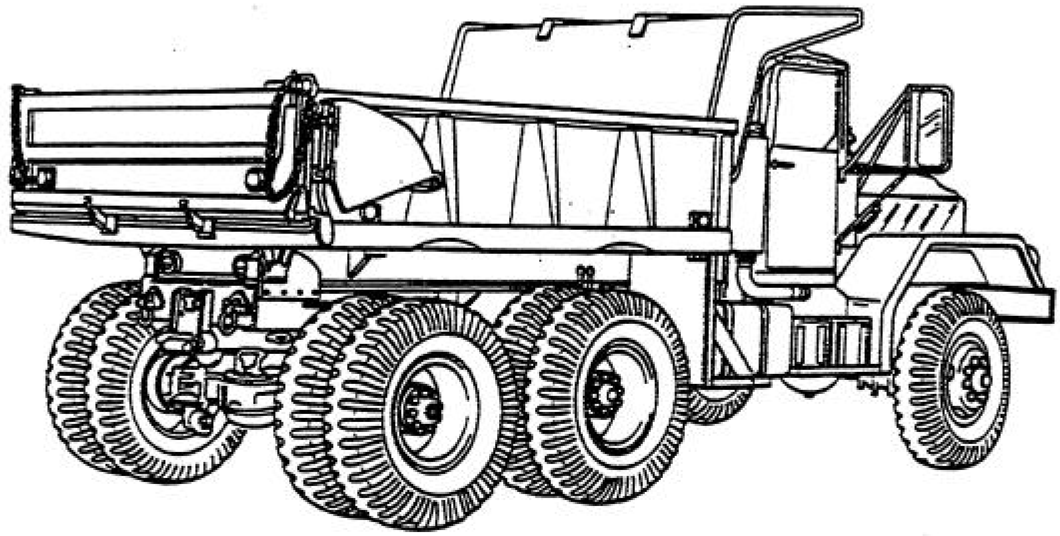
M927 w/o winch, M928 w/winch. Same characteristics as M923, but with an additional 76 inches of bed length. Sides are permanently welded in the up position. The vehicle has arear pintle hook for towing and tiedown, lifting shackles for air, sea, or rail. Also equipped with front and rear servicing couplings for improved towing of disabled vehicles.

OPERATING AND SHIPPING DATA

Weight:	25,620 lbs
Width:	98 in
Length:	410 in
Height:	124 in, reducable to 94 in
Cube:	2,176 ft^3
Fuel type:	Diesel
Fuel capacity:	81 US gal
Fuel consumption:	11.5 gal/hr
Payload	20,000 lbs

TRUCK, DUMP, 5 TON

TAMCN D1072



DESCRIPTION AND FUNCTION

M929 w/o winch, m930 w/ winch. Used for hauling and dumping. Able to hold side racks, troop seats, bows, and canvas for troop transport. Has a rear pintle hook for towing and tiedown, lifting shackles for air, rail, and sea. Also equipped with front and rear servicing couplings for improved towing of disabled vehicles.

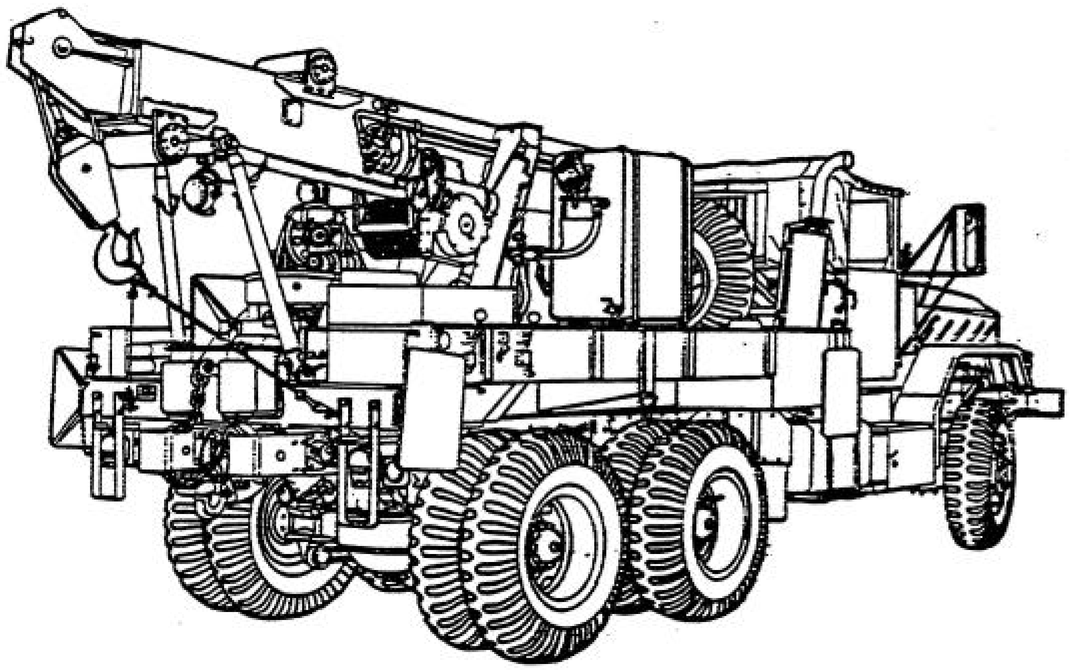
OPERATING AND SHIPPING DATA

Weight:	24,960 lbs
Width:	97 in
Length:	295 in
Height:	124 in
Cube:	1,552 ft^3

Fuel type:	Diesel
Fuel capacity:	116 US gal
Fuel consumption:	11.5 gal/hr
Payload:	5 cu yd (8 cu yd heaped)

TRUCK, WRECKER, 5 TON

TAMCN: D1212



DESCRIPTION AND FUNCTION

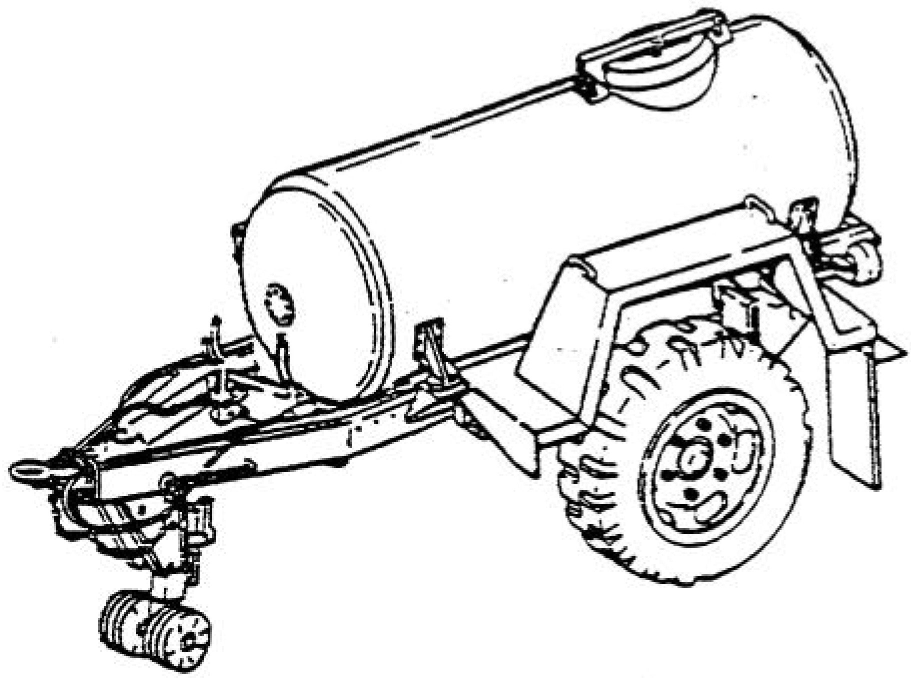
M936 is used for wrecker and salvage operations. Has a revolving hydraulic crane with self-supporting extendable boom. Boom-to-ground supports and outriggers provided. Also has front and rear winches. Has a rear pintle hook for towing or tiedown, lifting shckles for air, sea, or rail. Also equipped with front and rear servicing couplings for improved towing of disabled vehicles.

OPERATING AND SHIPPING DATA

Weight:	36,910 lbs
Width:	98 in
Length:	362 in
Height:	120 in, reducable to 109 in
Cube:	2,203 ft^3
Fuel type:	Diesel
Fuel capacity:	139 US gal
Fuel consumption:	13 gal/hr
Front winch capacity:	20,000 lbs
Rear winch capacity:	45,000 lbs
Crane capacity:	20,000 lbs

TRAILER, TANK, WATER 400 GALLON, 1-1/2 TON, 2 WHEEL

TAMCN: D0880



DESCRIPTION AND FUNCTION

Designed to transport potable or nonpotable water on highways and cross country terrain. The water tank is constructed of stainless steel with double walls. Two inches of urethane foam is used as insulation between the walls. It is equipped with dispensing equipment consisting of four bronze faucets, a rear self drain faucet and brass piping. A shut-off valve is provided to complete drainage from the exterior plumbing. A manhole located on top of the tank provides access for bulk filling and cleaning. The trailer is also equipped with a bracket at the manhole to allow for heating of the water with the standard M67 immersion heater. The trailer can be towed on highways at 50 MPH and cross-country at 30 MPH by 2-1/2 ton or larger vehicles.

OPERATING AND SHIPPING DATA

Weight:	2,800 lbs
Width:	80.3 in
Length:	161.5 in
Height:	79.3 in
Cube:	595 ft^3
Square:	90 ft^2
Fuel type:	Diesel
Cargo capacity:	3,332 lbs

CHASSIS, TRAILER, GENERAL PUPOSE, 3-1/2 TON, 2 WHEEL

TAMCN: D0080 NSN: 2330 00 542 2831 ID: 05945A

DESCRIPTION AND FUNCTION

The M353 is a single axle, 2-wheel, heavy duty chassis designed to be towed by 2-1/2 or 5 ton trucks equipped with towing pintles. It is designed to 7,000 lbs such as generators, air compressors, and welders. The M353 has a raised A-frame bolted to the front of the chassis with an attached lunette, saftey chains, lifting shackles and bars for handling. The frame has steel wheel covers and two hand brake levers mounted forward of the wheels beside the swivel caster landing gear. There are two rubber tires mounted on retractable landing gear located on the front corners. The landing gear are also used to level the trailer when loaded and stationary. Maximum towing speed for the M#%# is 50 MPH on highways and 25 MPH cross-country.

OPERATING AND SHIPPING DATA

Weight:	2,650 lbs
Width:	95.9 in
Length:	187.5 in
Height:	48,125 in
Cube:	539 ft^3
Square:	127 ft^2
Cargo capacity:	7,000 lbs cross country
	8,000 lbs highway

TRAILER, CARGO, 1-1/2 TON, 2 WHEEL

TAMCN: D0860

DESCRIPTION AND FUNCTION

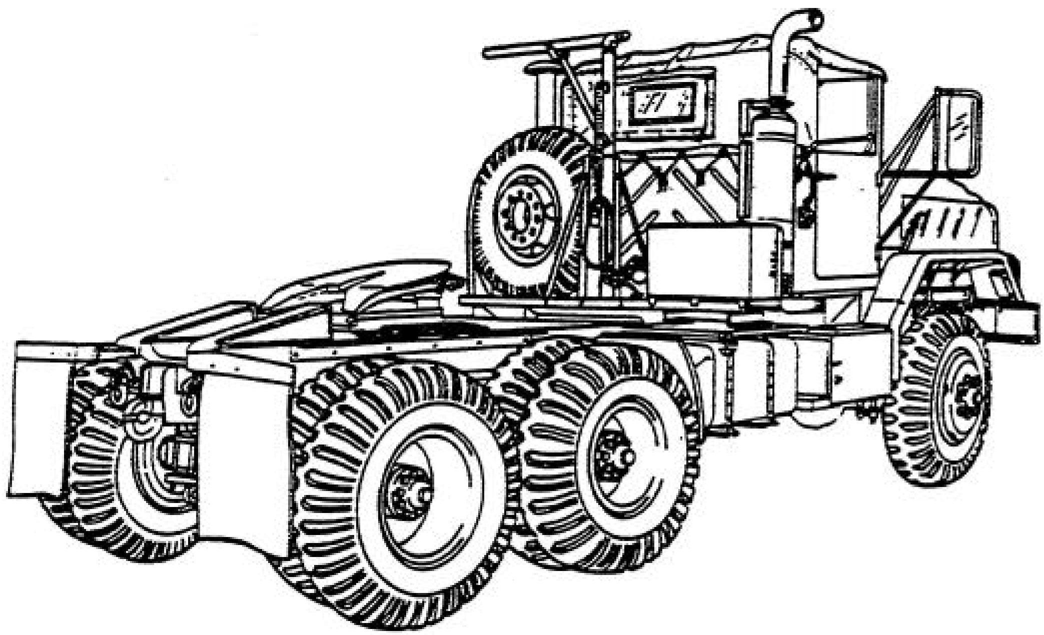
The M105 is a 2-wheel, single axle trailer with leaf-spring suspension designed to be towed by 2-1/1 ton and larger vehicles equipped with towing pintles. It has a welded box cargo body mounted on a welded steel frame. The frame includes an intergral A-frame with a towing lunette and retractable landing gear to support the front of the trailer when uncoupled from its prime mover. The trailer has manually operated parking brake, 24-volt electrical system and automatic emergency braking system in case the trailer breaks away from the prime mover. The cargo body includes a tailgate, removable wooden side extensions and a tarpulin.

OPERATING AND SHIPPING DATA

Weight:	2,650 lbs
Width:	83 in
Length:	165.5 in
Height:	98 in, reducible to 55 in
Cube:	779 ft^3
Square:	95 ft^2
Cargo capacity:	3,000 lbs

TRUCK, TRACTOR, 5 TON

TAMCN D1134



DESCRIPTION AND FUNCTION

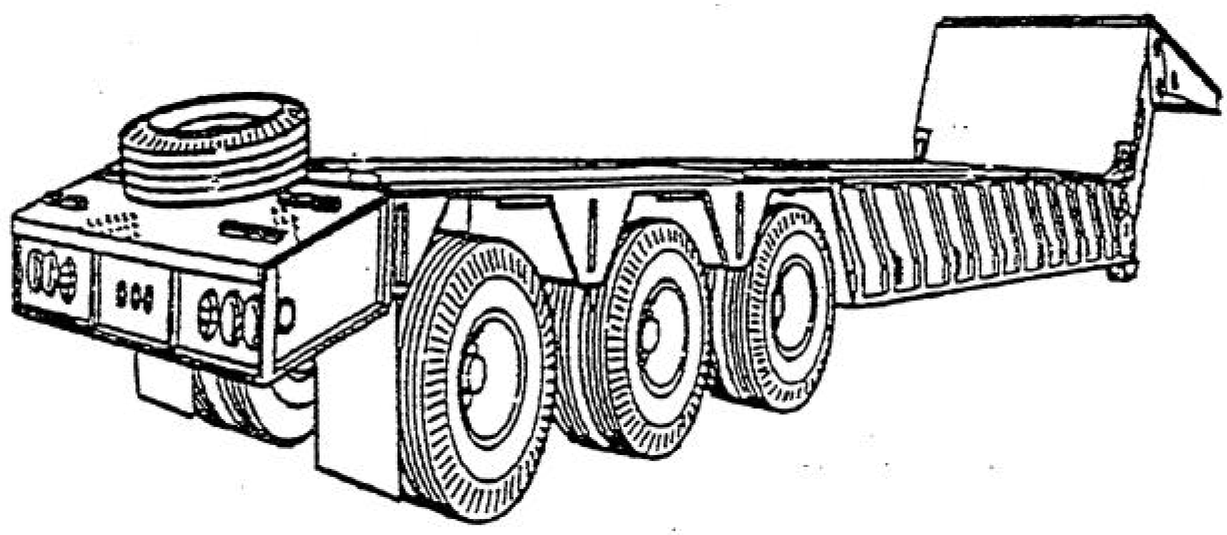
M931 w/o winch, M932 w/ winch. Both equipped with a fifth wheel and used to haul semitrailers, typically the M970 Refueler. Fifth wheel is capable of pivoting 21 degrees up, 15 degrees down, or 7 degrees sideways. Has a rear pintle hook for towing or tiedown, lifting shackles for air, sea, or rail. Also equipped with front and rear servicing couplings for improved towing of disabled vehicles.

OPERATING AND SHIPPING DATA

Weight:	19,895 lbs
Width:	97 in
Length:	265 in
Height:	121 in, reducable to 94 in
Cube:	1,403 ft^3
Fuel type:	Diesel
Fuel capacity:	116 US gal
Fuel consumption:	11.5 gal/hr

SEMITRAILER, LOW BED, 40 TON, CONSTRUCTION EQUIPMENT TRANSPORTER

TAMCN: D0235



DESCRIPTION AND FUNCTION

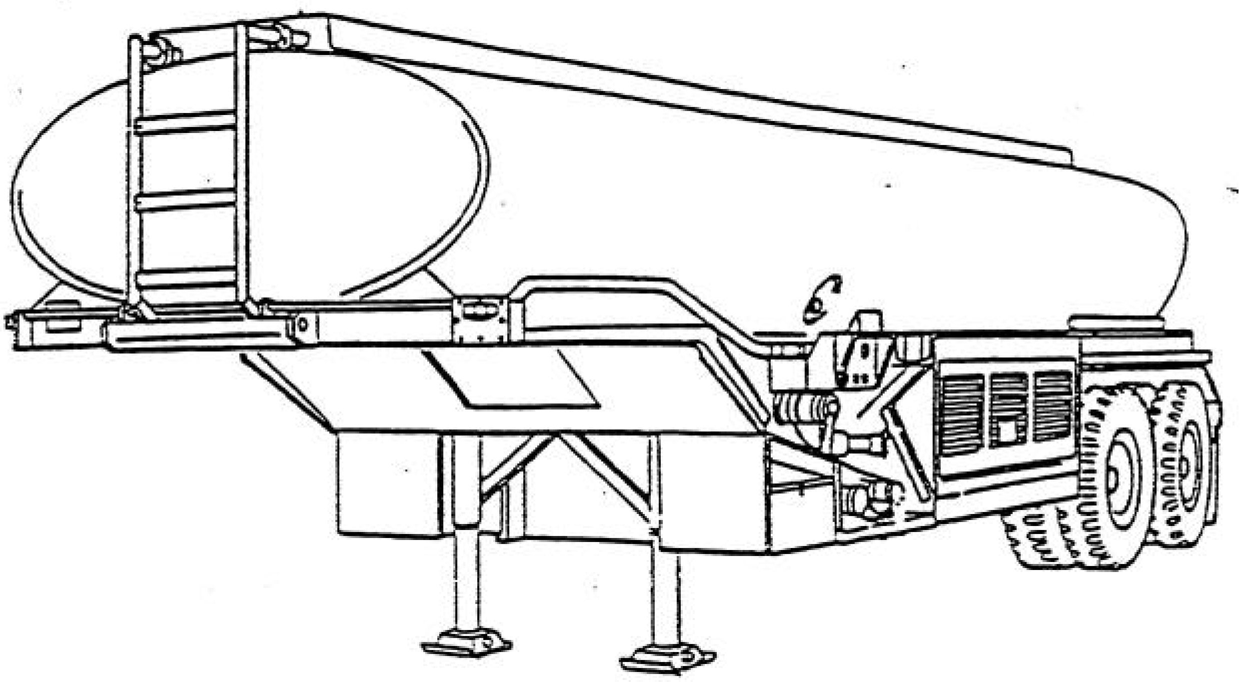
The M870A1 is a newer version of the M870 with the same mission of transporting construction equipment and material. It is towed by the MK 48/16 LVS semi trailer adapter configuration. The semi trailer can transport a payload of 40 tons cross-country at 20 MPH and on highway at 40 MPH. The gooseneck of the M870A1 drops down to form a ramp for loading and unloading of equipment. To widen the bed and to help stabilize and support the load, twenty

OPERATING AND SHIPPING DATA

Weight:	19,000 lbs
Width:	96 in, expandable to 120 in
Length:	510 in
Height:	72.87 in
Cube:	2,068 ft^3
Square:	340 ft^2
Cargo capacity:	40 tons

SEMI TRAILER, TANK, 5,00 GAL, AIRCRAFT REFUELER

TAMCN: D2015 NSN: 2330 01 050 5635 ID: 08089A



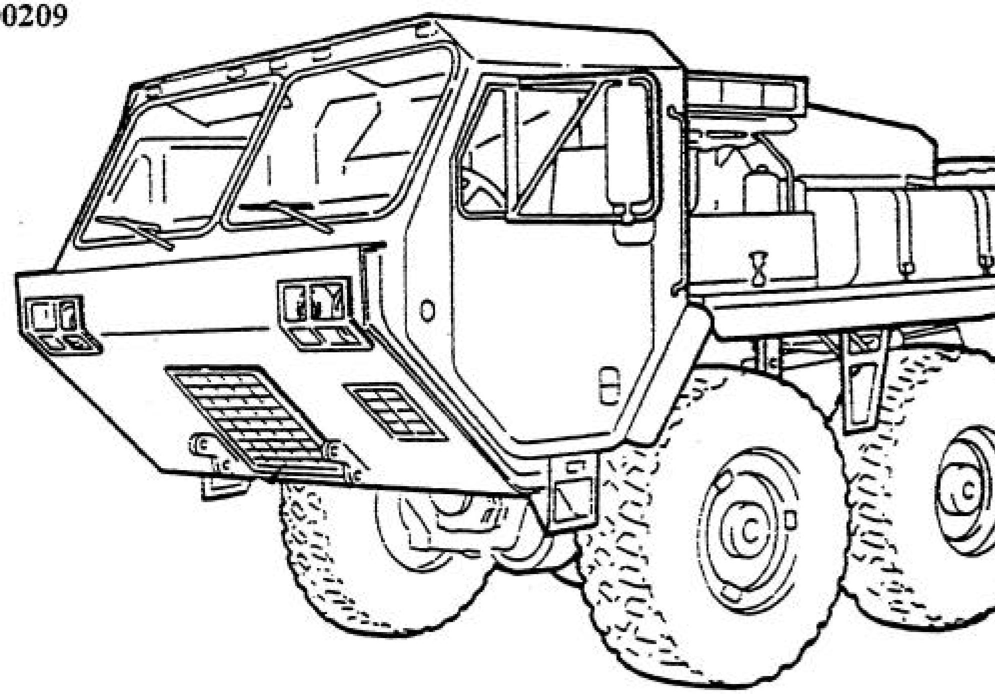
DESCRIPTION AND FUNCTION

OPERATING AND SHIPPING DATA

Weight:	15,300 lbs
Width:	96 in
Length:	366 in
Height:	104.5 in
Cube:	2,126 ft^3
Square:	244 ft^2
Fuel type:	Diesel
Fuel capacity:	5000 gal hwy 3800 gal cross country
Fording depth:	depends on prime mover, and payload

POWER UNIT, FRONT, 4X4

TAMCN D0209



DESCRIPTION AND FUNCTION

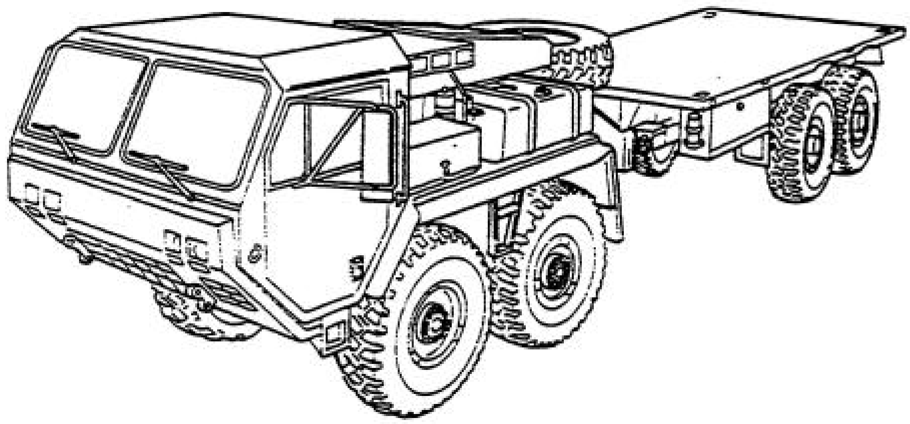
MK 48 contains the entire power train components and is the primary source of power for all four trailers. It has the ability to turn while the trailer remains in place. The MK 48 has articulated steering, both sets of wheels can turn the same direction. The MK 48 in conjunction with one of the four trailers makes up the Logistics Vehicle System (LVS)

OPERATING AND SHIPPING DATA

Weight:	25,300 lbs
Width:	96 in
Length:	239 in
Height:	102 in
Cube:	1,917 ft^3
Fuel type:	Diesel
Fuel capacity:	75 gal
Fuel consumption:	16.66 gal/hr
Fording depth:	60 in
Towing capacity:	64,000 lbs GVW

TRAILER, POWERED, CONTAINER HAULER

TAMCN: D0876



DESCRIPTION AND FUNCTION

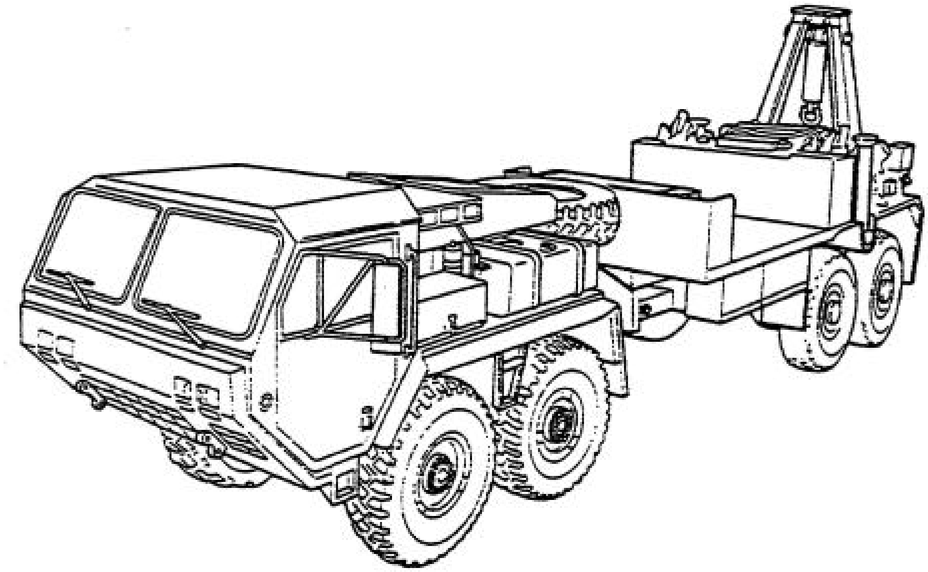
MK 48/14's primary mission is to transport ISO/ANSI containers, standardized cargo, shelters and functional modules from the landing beach to unit supply points. The bed of the MK14 is steel, 20x8 ft with ISO/ANSI container locks. An additional MK 14 may be pulled in tandem using a rear body towing unit. May be airlifted by a CH-53E. Turning radius is 38.5 ft.

OPERATING AND SHIPPING DATA

Weight:	16,000 lbs
Width:	96 in
Length:	240 in
Height:	61 in
Cube:	667 ft^3
Payload:	
Off road	12.5 tons
Highway	22.5 tons

TRAILER, POWERED, WRECKER/RECOVERY

TAMCN: D0877



DESCRIPTION AND FUNCTION

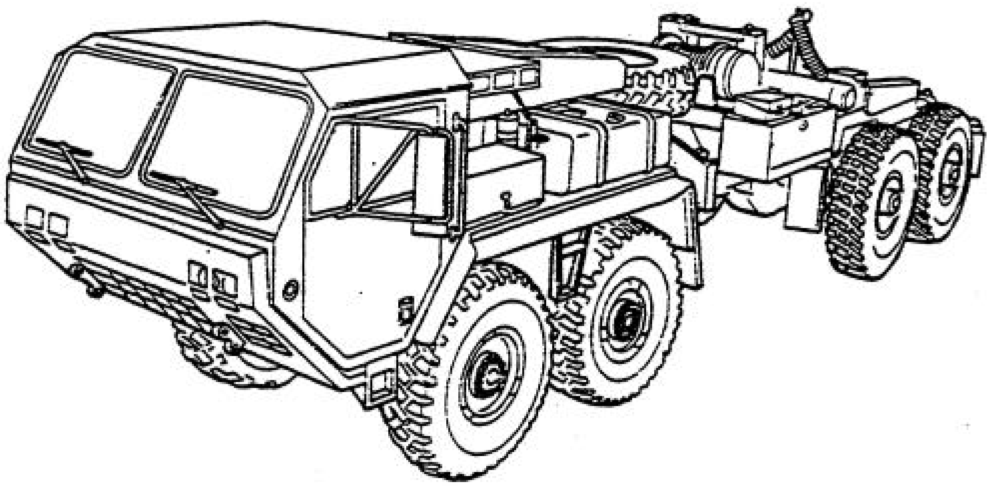
MK 48/15 is primarily used for recovery of all LVS vehicles. It is also capable of lifting and towing all other motor transport vehicles. A rear winch enables the freeing of mired vehicles. The MK 48/15 also contains a crane for loading equipment and ISO containers onto it's 7 foot bed. A remote control allows the operation of crane and winch from a distance.

OPERATING AND SHIPPING DATA

Weight:	28,400 lbs		
Width:	96 in		
Length:	228 in		
Height:	96 in		
Cube:	1,280 ft^3		
Fuel type:	Diesel		
Fuel capacity:			
Fuel consumption:			
Payload:	10 tons		
Lifting capacity:			
Crane:	9,000 lbs		
		Rear winch:	60,000 lbs

TRAILER, POWERED, FIFTH WHEEL, SEMMI TRAILER ADAPTER

TAMCN: D0878



DESCRIPTION AND FUNCTION

Mk 48/16 is used to transport semi-trailers with 3.5 inch kingpins, typically the 870 trailer. It also has a pintle hook for towing other trailers. It contains a remote control for operation of the winch. Fifth wheel is fully oscillating.

OPERATING AND SHIPPING DATA

Weight:	16,200 lbs
Width:	96 in
Length:	195 in
Height:	87 in
Cube:	943 ft^3

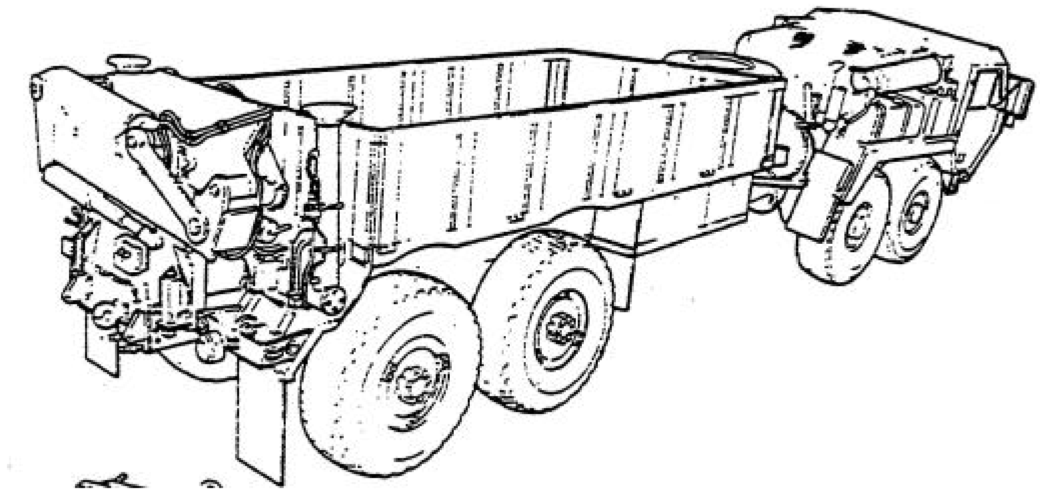
Pulling capacity:

Rear winch: 60,000 lbs

Fifth wheel: 46,000 lbs

TRAILER, POWERED, DROPSIDE, CARGO W/ CRANE

TAMCN: D0879



DESCRIPTION AND FUNCTION

MK 48/17 is used primarily to transport palletized cargo and ISO/ANSI containers. Side panels can be dropped for ease in loading nad unloading. Side panels also provide troop seats, bows, and canvas. A material handling crane is mounted on back to load and unload. MK 48/17 is also intended to tow and position the M198 Howitzer and its ordanace. The steel beb is 16 feet long, 8 feet wide and contains ISP locks

OPERATING AND SHIPPING DATA

Weight:	21,900 lbs
Width:	96 in
Length:	240 in
Height:	96 in
Cube:	1,280 ft^3
Fuel type:	Diesel
Fuel capacity:	
Fuel consumption:	
Cargo capacity:	
Off road:	10 tons
On road:	20 tons
Crane capacity:	9,000 lbs

SELF LOADING CONTAINER AND RIBBON BRIDGE TRANSPORTER

TAMCN: D0881

DESCRIPTION AND FUNCTION

The MK 48/18 is capable of self loading and off loading fully loaded 20 foot standard containers, the Ribbon Bridge interior and ramp bays, and the Bridge Erection Boat. The MK 48/18A1 is currently being produced and differs from the MK18 in the loading and off loading mechanism

OPERATING AND SHIPPING DATA

Weight:	45,400 lbs
Width:	101 in
Length:	461 in
Height:	148 in
Cube:	3,407 ft^3

Cargo capacity:

On road	44,200 lbs
Off road	25,000 lbs

CONCRETE
STUDENT WORKBOOK

09 JUNE 1998

MARINE CORPS ENGINEER SCHOOL
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

TABLE OF CONTENTS

REFERENCES

FM 5-742	Concrete and Masonry
FM 5-530	Materials Testing
FM 5-551	Carpentry
TM 3895-12/1	11-S Mixer

LESSON 1: Concrete Mix Proportions

1. COMPONENTS OF CONCRETE (Para 1-1, FM 5-742, pg 1-1).

2. DESIRABLE PROPERTIES OF CONCRETE (Para 1-3 & 4, FM 5-742, pg 1-3).

a. Plastic Concrete is easily molded.

1. Workability 2. Homogeneity 3. Uniformity

b. Hardened Concrete has completed hydration.

1. Strength 2. Durability 3. Watertightness

3. PORTLAND CEMENT (Para 2-1, FM 5-742, pg 2-1).

a. Standard Types

	Standard Types	Name	Design Strength at
(1)	I	Normal	28 days
(2)	II	Modified	45 days
(3)	III	High-Early	7 days
(4)	IV	Low Heat	90 days
(5)	V	Sulfate Resistant	60 days

b. Properties

(1) Specific Gravity -

(2) Weight/Sack - lb/sack

(3) Volume/Sack - 1 sack = cubic foot

4. WATER (Para 2-3, FM 5-742, pg 2-3).

a. Water - free of organics, oils, acids, alkalies

b. Salt Water - reduces strength 10-20%; should not be used in reinforced concrete

c. Amount - 4-7 gallons per sack - 2 1/2 gallons (hydration)

1 1/2 to 4 1/2 gallons (workability)

d. Weight - lbs per gallon

lbs per cubic foot

e. Rule of thumb for ordering water is 8 gal. per sack of cement.

f. Specific Gravity of water is ______________

5. WATER/CEMENT RATIO (W/C).

a. Expressed as a decimal: mathematical relationship between the Weight of Water per unit volume of concrete and the Weight of Cement per unit volume of concrete.

Example: W/C of .50 = $\frac{\text{300 lbs of water per cubic yard of concrete}}{\text{600 lbs of cement per cubic yard of concrete}}$

b. Expressed in gallons of water per sack of cement:

Example: 5.6 gallons of water/sack of cement
Note: This is equal to a W/C ratio of 0.50.

$$\frac{\_\_\_\_\_\_\_ \times 8.33 \text{ lb/gal}}{94 \text{ lb/sack}} = \_\_\_\_\_\_\_\_\_\_$$

6. AGGREGATES (Para 2-4, FM 5-742, pg 2-5).

a. Purpose

(1) Reduce Shrinkage Cracks

(2) Economy

b. Specific Properties

(1) Fine Aggregate (Sand)

(a) Gradation: Passes #4 sieve, retained on #200 sieve.

(b) Fineness Modulus - An index to the relative fineness or coarseness of fine aggregate with typical values ranging from 2.3 to 3.1. (FM 5-742, pg 2-7)

(c) Maximum Allowable Fines - (percent by weight of material finer than a No. 200 sieve.)

- Abrasive Structure ≤ ________%

- Non Abrasive Structure ≤ ________%

(2) Coarse Aggregate (Gravel)

(a) Gradation: Passes 3 inch sieve, retained on #4 sieve.

(b) Maximum Allowable fines ≤ _______%.

(c) Maximum Size Aggregate (MSA) (FM 5-742, pg 2-8)

1 MSA ≤ 1/5 of the WALL thickness.

2 MSA ≤ 1/3 of the SLAB thickness.

3 MSA ≤ 3/4 of the (MCS) minimum clear space.

4 MSA for the type of mixing equipment.

11-S ≤ 3"

5 Select the smallest of the four rules.

c. Moisture Conditions (Para 2-4h, FM 5-742, pg 2-10)

7. **AIR ENTRAINMENT** (Para 2-8, FM 5-742, pg 2-14).

a. Advantages - Increases Durability, Workability and Watertightness

b. Disadvantages - Decreases Strength (.5% for 1% air)

c. Methods - (1) Air entraining cement
(2) Chemical Admixtures

EXAMPLE PROBLEM: Obtain the preliminary proportions for a one cubic yard concrete mix to be used in a reinforced concrete retaining wall. It will be constructed at Camp Lejeune, NC. The climate is extreme. An 11-S Mixer is available. (Figure 3-5, pg 3-15.)

SPECIFICATIONS
Strength @ 28 days - 3,000 psi
Cement Types Available - I, IA, III
Water available from a potable source

Fine Aggregate:	F.M.	S.G.	B.U.W.	%FINES
Source A	2.50	2.65	120 lb/cf	4
Source B	2.95	2.60	125 lb/cf	6

Course Aggregate:	TYPE	MSA	S.G.	B.U.W	%FINES
Source A	Gravel	2"(-)	2.85	110 lb/cf	0.5
Source B	Gravel	1"(-)	2.69	95 lb/cf	1.0
Source C	Gravel	1/2"(-)	2.70	103 lb/cf	1.3

PROCEDURE

(1) Select Cement Type:

a. Availability I, IA, III
b. Climate EXTREME
c. Specifications 3,000 PSI

(2) Select Aggregates:

a. Fine Aggregate

(1) Source ____________

(2) Fineness Modulus (FM) ____________

(3) Specific Gravity (SG) ____________

(4) Bulk Unit Weight (BUW) ____________

(5) Percent Fines ____________

b. Coarse Aggregate

(1) Maximum Size Aggregate allowable for the project:

1/5 x Thickness of Wall = 1/5 x ____________ = ____________

1/3 x Thickness of Slab = 1/3 x ____________ = ____________

3/4 x Min. clear space = 3/4 x ____________ = ____________

MSA for mixing equipment 1 1/2 " or 3" = ____________

MSA for the Project (Smallest of above) = ____________

(2) Chosen Aggregate

(a) Source ____________

(b) Type ____________

(c) Max. size aggregate (MSA) ____________

(d) Specific Gravity (SG) ____________

(e) Bulk Unit Weight (BUW) ____________

(f) Percent Fines ____________

(3) Select Water/Cement Ratio:

(a) Strength (Table 3-2, FM 5-742 Pg. 3-2) = ____________

(b) Durability/Watertightness: = _______________
(Table 3-1, FM 5-742, Pg. 3-2)

(c) Choose the lowest of the above; w/c Ratio = ____________

(4) Select Design Slump (Table 3-4, FM 5-742 Pg. 3-5): ____________

(5) Select Water Content and Percent Air:
(Table 3-3, FM 5-742 Pg 3-4)

(a) Water Content ___________________

(b) Percent Air ______________________

(6) Calculate Cement Content:

$$\text{Cement} = \frac{\text{Water (lb/cu yd)}}{\text{W/C ratio}} = \_\_\_\_\_\_\_\_\_\_ = \_\_\_\_\_\_\_\_\_\_$$

(7) Calculate Gravel Content: (Table 3-6, FM 5-742 Pg. 3-10)

(a) Loose Volume of Gravel = ________________

(b) Weight of Gravel = BUW x Loose Volume

________________ x ________________ = _________________

(8) **Calculate Sand Content:**

(a) **Convert to Absolute Volumes**

1 Cement = $\frac{\text{lb of cement}}{3.15 \times 62.4}$ = __________ = __________

2 Water = $\frac{\text{1 lb of water}}{1.0 \times 62.4}$ = __________ = __________

3 Gravel = $\frac{\text{lb of gravel}}{\text{S.G.} \times 62.4}$ = __________ = __________

4 Air = Percent Air x 27 cf/cy = ______ x 27 = ______

5 Partial Volume (PV) = Summation = ______________

(b) Absolute Volume of Sand = 27 - PV

27 - __________ = __________

(c) Weight of Sand = Abs Vol x S.G. x 62.4

__________ x __________ x 62.4 = ______________

(d) Loose Volume Sand = $\frac{\text{Weight of Sand}}{\text{BUW Sand}}$ = ________ = __________

(9) Preliminary Mix Proportions for a one cubic yard batch:

SUMMARY

Cement____________lbs/cy ____________ sacks/cy

Water____________lbs/cy ____________ gallons/cy

Sand____________lbs/cy ____________ cf/cy

Gravel____________lbs/cy ____________ cf/cy

Air____________%

Slump____________in.

NOTE: These proportions assume a Saturated Surface Dry (SSD) moisture condition for the aggregates. Adjustment must be made for the actual moisture condition of the aggregates on the job site. The procedure will be covered in the Quality Control Block.

REVIEW PROBLEM:

1. What is the water/cement ratio of the concrete used in the construction of a reinforced concrete wall in a severe climate? There is 1 1/2 inches of concrete cover over the reinforcing steel. The concrete will be air entrained and must have a compressive strength of at least 3,000 pounds (lbs) per square inch.

2. Express a water/cement ratio of 6 gallons/ sack in a decimal form.

3. What is the specific gravity for portland cement?

4. What is the maximum allowable fines for coarse aggregates used in concrete production?

5. What amount of 2 inch coarse aggregate should be used in a cubic yard batch of concrete if the fine aggregate has a fineness modulus of 2.75?

6. If the Partial Volume (the summation of the absolute volumes of the cement, water, coarse aggregate, and air) of a concrete mix is 19.63 cubic feet, what is the loose volume of sand required for the mix? The sand has a Specific Gravity of 2.60 and a Bulk Unit Weight of 115 pounds.

7. If your compressive strength is 3000 psi, how many pounds of cement will be required? You will be constructing a sea wall which must be watertight and will be located in a severe climate. Only Type IIA cement is available. MSA is 1 inch, and the slump is 4 inches.

LESSON 2: Concrete Formwork

1. FORCES ON FORMWORK.

    a. Hydrostatic Fluid Pressure (Fig 4-3, FM 5-742, pg 4-5)

$$P\ max = 150 + \frac{9000\ R}{T} \quad \text{for } R < 7 \text{ ft/hr, } T = {}^{o}F$$

    b. Rate of placement (R) is expressed in feet per hour. For an economical form design, the recommended placement rate should not exceed 5 feet per hour.

    c. There are two stipulations. P max cannot exceed 2000 psf for wall forms and 3,000 psf for column forms.

    d. External Forces - wind, men, and equipment will move forms out of place or tend to tip them over. Braces are used to prevent this possible movement.

2. WALL FORM DESIGN.

    a. Nomenclature (Fig. 4-1, FM 5-742, pg 4-2)

    b. Design Procedure (Para 4-7, FM 5-742, pg 4-4)

EXAMPLE PROBLEM: Design the forms for the concrete retaining wall in lesson 1 (fig. 3-5, pg.3-15). An 11-S Mixer will be used. It can produce 1 cy of concrete every 12 min. Materials available are 3/4-inch plywood, 2-inch by 4-inch lumber, and #8 tie wire. The concrete temperature is estimated to be 70 degrees Fahrenheit.

PROCEDURE

(1) Select Materials and Grain Direction:

(2) Mixer Output:

$$\frac{\text{Mixer Capacity 11 (cf)} \times 60\ \text{min/hr} \times \#\ \text{Mixers}}{\text{Batching Cycle (min)}} = \text{Mixer Output}$$

$$\frac{\_\_\_\_\_\_\_\_\ \text{(cf)} \times 60\ \text{min/hr} \times \_\_\_\_\_\_\_\_}{\text{(min)}} = \_\_\_\_\_\_\_\_\ \text{cf/hr}$$

(3) Plan Area:

Length (ft) x width (ft) = Plan Area sf

________(ft) X ________(ft) = ________ sf

(4) Rate of placement:

$$\frac{\text{Mixer Output}}{\text{Plan Area}} = \text{Rate in ft/hr}$$

$$\frac{\_\_\_\_\_\_\_\_\ \text{(cf/hr)}}{\text{(sf)}} = \_\_\_\_\_\_\_\_\ \text{ft/hr}$$

(5) Estimated Concrete Temperature = ________

(6) Concrete Pressure (Figure 4-3, FM 5-742, pg.4-5):

=_______________ lb/sf

(7) Maximum Stud Spacing (Table 4-1 board sheathing or 4-2 plywood sheathing, FM 5-742, pg. 4-5,6):

=_______________ in

(8) Uniform Load on the Stud (ULS):

$$\frac{\text{Concrete Pressure (lb/sf) x Stud Spacing (in)}}{\text{12 in/ft}} = \text{ULS}$$

$$\frac{\text{\_\_\_\_\_\_\_\_\_\_ (lb/sf) X \_\_\_\_\_\_\_\_\_\_ (in)}}{\text{12 in/ft}} = \text{\_\_\_\_\_\_\_\_ lb/lf}$$

(9) Maximum Wale Spacing (Table 4-3, FM 5-742 pg. 4-7):

=_______________ in

(10) Uniform Load on the Wale (ULW):

$$\frac{\text{Concrete Pressure (lb/sf) x Wale Spacing (in)}}{\text{12 in/ft}} = \text{ULW}$$

$$\frac{\text{\_\_\_\_\_\_\_\_\_\_ (lb/sf) X \_\_\_\_\_\_\_\_\_\_ (in)}}{\text{12 in/ft}} = \text{\_\_\_\_\_\_\_\_ lb/lf}$$

(11) Tie Spacing based on ULW (Table 4-3 or 4-4, FM 5-742 pg. 4-7):

TS (wale) = ____________________ in

(12) Tie Spacing based on the strength of the tie (Table 4-5, FM 5-742 pg. 4-8): (round down)

$$\frac{\text{Tie Strength (lb)} \times 12 \text{ in/ft}}{\text{ULW (lb/lf)}} = \text{Tie spacing (tie)}$$

$$\frac{\_\_\_\_\_\_\_\_\_\_ \text{(lb)} \times 12 \text{ in/ft}}{\text{(lb/lf)}} = \_\_\_\_\_\_\_\_\_\_ \text{in}$$

(13) Maximum Tie Spacing (smaller of 11 and 12) = ______________

(14) Adjusted Tie/Stud Spacing (Wire Ties Only):

TS = __________

SS = __________

Select the smaller of the two. ______________

(15) Required number of studs per side. (Round up)

$$\frac{\text{length of form (ft)} \times 12 \text{ (in/ft)}}{\text{stud spacing (in)}} + 1 = \#\text{ studs}$$

$$\frac{\_\_\_\_\_\_\_\_ \text{(ft)} \times 12 \text{ (in/ft)}}{\text{(in)}} + 1 = \_\_\_\_\_\_\_\_\_\_$$

Note: The spacing between the last two studs may be <u>less</u> than the maximum allowable spacing.

(16) Required number of wales per side. (round up)

$$\frac{\text{height of form (ft)} \times 12 \text{ (in/ft)}}{\text{wale spacing (in)}} = \text{\# wales}$$

$$\frac{\_\_\_\_\_\_\_\_\text{(ft)} \times 12 \text{ (in/ft)}}{\text{(in)}} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_$$

(17) Time required to place concrete.

$$\frac{\text{height of form (ft)}}{\text{rate of placement}} = \text{Time Required}$$

$$\frac{\_\_\_\_\_\_\_\_\text{(ft)}}{\text{(ft/hr)}} = \_\_\_\_\_\_\_\_ \text{ hr}$$

SUMMARY

Component	Material	Spacing (in)	Quantity
Sheathing	________	________	________
Studs	________	________	________
Wales	________	________	________
Ties	________	________	________

3. BRACES FOR WALL FORMS (paragraph 4-8, FM 5-742).

a. Nomenclature. (Figure 4-4, FM 5-742 pg. 4-12)

b. Design

(1) Exact (Para 4-8, FM 5-742, pg 4-10)

(2) Expedient

a) Brace every stud or every other stud

b) Ensure brace angle is between 20 to 60 degrees.

c) Brace supports are required if angle brace is greater than 6.5 feet.

REVIEW PROBLEMS

1. Which components of wall forms resists external forces (men, wind, equipment)?

2. Design the formwork for a concrete wall that is to be 5 feet high, 140 feet long, and 18 inches thick. You will be mixing the concrete with three 11-S mixers (11 CF capacity), each having a batch cycle time of 5 minutes. The concrete temperature is expected to be 80 degrees Fahrenheit. Determine the number of studs, wales and ties required for the wall forms. The materials available are listed below.

Materials

1" x 12" boards
2" x 4" for studs
2" x 4" doubled for wales
3,000 lb snap ties

3. Design the formwork for a concrete wall that is to be 6.5 feet high, 92 feet long, and 12 inches thick. You will use three 11-S Mixers with a batch cycle 1 cubic yard every 4 minutes. The concrete temperature is expected to be 50 degrees fahrenheit. Determine the stud spacing, wale spacing, and tie spacing required . The materials available are listed below.

Materials

5/8" plywood sheathing
2" x 4" lumber for studs
4" x 4" lumber for wales
#9 wire for ties

4. Refer to question 3. What is the wale spacing and tie spacing if the sheathing is used the weakway?

LESSON 3: Concrete Slab On Grade Thickness Design

1. **Basic Assumptions.**

   a. Minimum slab thickness for class 1, 2, and 3 floors will be 4 inches.

   b. Only flexural strength and load area will be considered.

   c. Edges will be thickened by 50% if they receive loads.

2. **Construction Methods.**

   a. Use a free draining material (coarse sand or gravel) under the slab.

   b. Always use some form of steel reinforcement in the slab.

   c. Cure the concrete properly.

EXAMPLE PROBLEM: Determine the thickness of a slab on grade to be used as a vehicle parking pad in a motor pool. The worst case expected Static Load on the concrete slab will be 9000 lbs acting over a 50 square inch loaded area. The slab will experience foot and pneumatic wheel loads.

PROCEDURE

1. Determine floor classification (table 4-9, pg 4-20, FM 5-742).

2. Determine minimum compressive strength. - (table 4-10, pg 4-20, FM 5-742).

   F'_c = ________________

3. Determine allowable flexural tensile strength.

   $F_t = 4.6 \sqrt{F'_c}$

   4.6 X __________ = ____________

4. Determine the Equivalent Static Load (ESL).

   ESL = SL x (1+25%)

   ____________ X 1.25 = ____________

5. Determine the Corrected Equivalent Static Load (CESL).

   $$CESL = ESL \times \frac{300}{F_t}$$

   ____________ X 300 = ____________

6. Determine slab thickness (figure 4-6, pg 4-21, FM 5-742)

7. Determine minimum cement content. (Table 4-11, pg 4-21, FM 5-742.)

REVIEW PROBLEMS:

1. What factor must be taken into consideration if the loaded area of the slab exceeds 80 square inches?

2. If the equivalent static load (ESL) is equal to 10,000 lbs and the allowable flexural tensile strength is equal to 272 psi calculate the slab thickness when the loaded area is 60 square inches.

3. Using a static load of 10,200 lbs and a loaded area of 30 square inches, determine the proper minimum slab thickness. You want a class 5 floor.

4. How can frost heave be prevented under a slab on grade?

LESSON 4: Concrete Mixing Equipment

1. Concrete Mixing Equipment Available at the Company Level.

a. <u>11S MODEL MIXER</u>

(1) 11cf capacity per batch.

(2) Drum rotation speed is 17 RPM when charged.

(3) Charging time takes 2 1/2 minutes.

(4) Mixing time is 1 1/2 minutes after all materials and water are in the drum.

(5) Discharge time is 1 minute.

b. <u>HAND MIXING</u>. One person can produce about 1 cubic yard per hour.

REVIEW PROBLEMS

1. How long will it take to produce 14 cubic yards of concrete with one 11-S Mixer?

2. How long will it take to produce 61 cubic yards of concrete with two 11-S Mixers?

3. How long will it take two people to produce 6 cubic yards of concrete mixing by hand?

LESSON 5: Reinforced Concrete

1. BASIC THEORY (paragraph 6-1, FM 5-742, pg. 6-1).

2. IDENTIFICATION OF STEEL

   a. Deformed Steel Bars (Table 6-1, FM 5-742, pg. 6-7)

   b. Welded Wire Fabric (paragraph 6-6f, FM 5-742, pg. 6-13)

      (1) Used to prevent shrinkage cracks

      (2) Does not add reinforcement

3. FABRICATION.

   a. Splicing (Table 6-4, FM 5-742 pg. 6-9)

   b. Lap Welded Wire Fabric one square plus 2 inches

   c. Cut Reinforcing Steel with:

      (1) Boltcutters

      (2) Hacksaw

      (3) Rebar Cutting Set

   d. Bending of bars (Table 6-3, FM 5-742, pg. 6-8)

4. PLACEMENT.

   a. Spacing is based on specifications. Check alignment and overlap.

   b. Cover Minimums (Table 6-2, FM 5-742 pg. 6-8)

   c. Tolerances

      (1) Specified by construction drawings

      (2) Based on ACI 117-81

   d. Supports (paragraph 6-6a, FM 5-742, pg. 6-10)

      (1) Manufactured - High Chairs, Bolsters

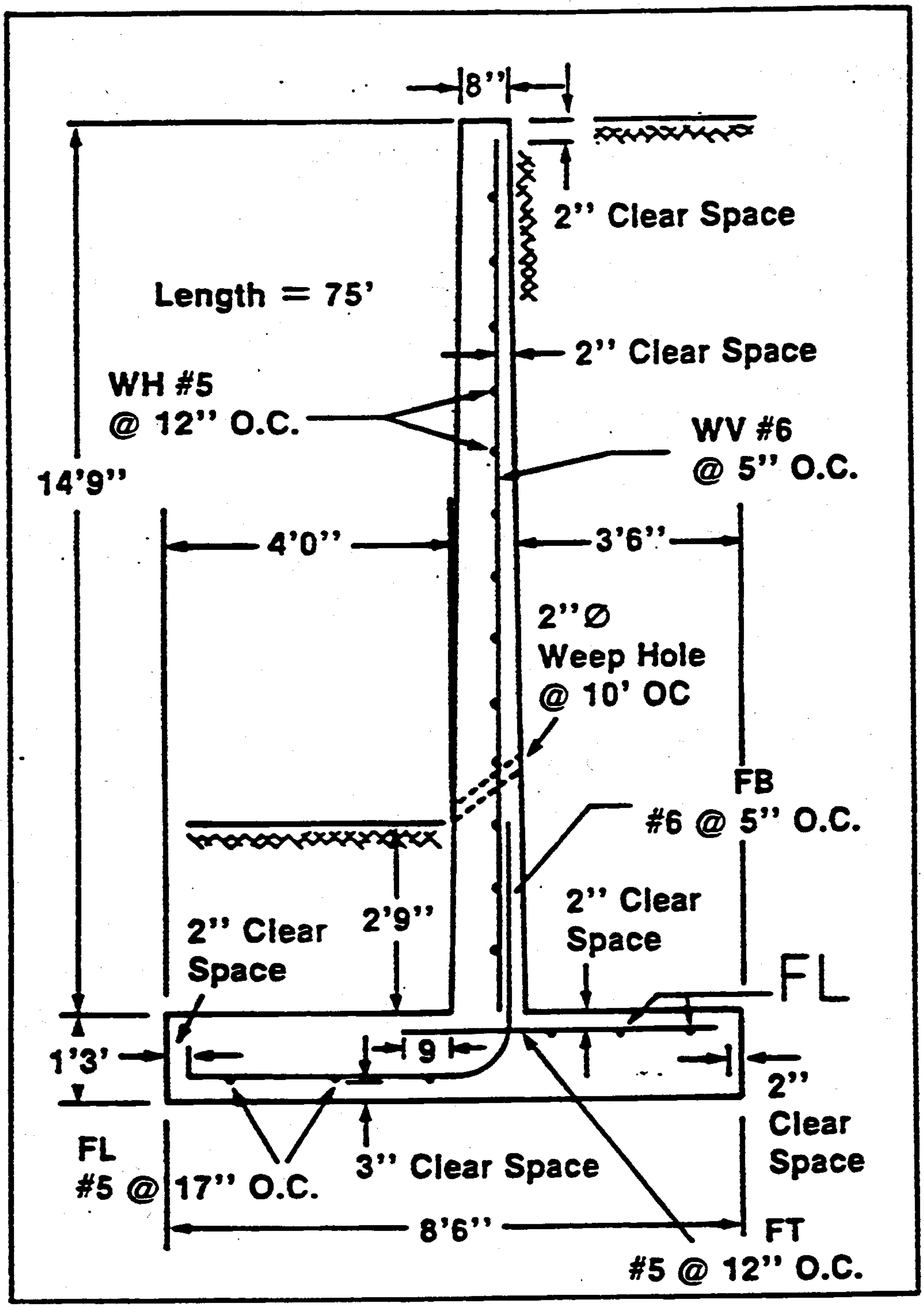
      (2) Field Expedient - Wire Fabric, Mortar Cubes

5. DETERMINING REINFORCING REQUIREMENTS

EXAMPLE PROBLEM: Determine the reinforcing requirements for the Retaining Wall shown on the next page. Develop a reinforcing bar schedule showing location; size and spacing, length in place, number required, and appropriate remarks. Design strength at 28 days is 3,000 PSI.

BAR SCHEDULE

LOCATION	SIZE AND SPACING	LENGTH OF UNIT	QUANTITY	SPLICE	NOTES


8''
2'' Clear Space
Length = 75'
2'' Clear Space
WH #5
@ 12'' O.C.
WV #6
@ 5'' O.C.
14'9''
4'0''
3'6''
2''Ø
Weep Hole
@ 10' OC
FB
#6 @ 5'' O.C.
2'' Clear
Space
2'9''
2'' Clear
Space
FL
1'3'
9
2''
Clear
Space
FL
#5 @ 17'' O.C.
3'' Clear Space
8'6''
FT
#5 @ 12'' O.C.

REVIEW PROBLEMS

1. What is the minimum bend diameter for:

   a. a #4 bar? ____________

   b. a #11 bar? ____________

   c. a #3 bar? ____________

   d. a #14 bar? ____________

2. What is the minimum splice overlap for a #6 bar placed horizontally, 13 inches above the bottom of the form in 3,000 psi concrete?

3. How many vertical #6 rebars are required in a 120 foot long wall if they are spaced 10" on center? There is a 2 inch minimum clear space on all sides.

4. What should be the minimum cover for a #6 bar in concrete that will be exposed to the weather?

LESSON 6: Quality Control

1. Planning Phase.

    a. Testing Materials

        (1) Cement

            (a) Storage

                1 Keep Dry, Pelletized, Covered

                2 Use old cement first

                3 Stack 14 bags high if used < 60 days

                4 Stack 7 bags high if used > 60 days

            (b) Partial Hydration

                1 Lumpy, Gritty

                2 Has lost some strength

                3 Will not break down to powder

            (c) Warehouse Pack

                1 Looks solid

                2 Will return to powder form

                3 Useable

        (2) Excess Fines on Sand (Para 4-11, TM 5-530)

            (a) Lab Test - Sieve Analysis

            (b) Field Test - 2" Sand, 3" Water

                1 Shake

                2 Let Stand 1 hour

                3 1/8" Silt or less is good sand

(c) Course of Action

1 Find another source

2 Resift, Wash

(3) Organic Materials on Aggregates (Pg 4-20, TM 5-530)

(a) Test Procedure - 4 oz Sand, 8 oz (3%) NaOH

1 Shake, let stand one day

2 Clear liquid is good

(b) Courses of Action

1 Dig deeper in sand source

2 Find another source

b. Materials Estimation (Para 3-9, FM 5-742, pg 3-14)

EXAMPLE PROBLEM: The S-3 has approved your mix design. He tells you to order all of the components that you will need. Estimate the quantities of cement, water, sand, and gravel required to construct the concrete retaining wall from lesson 1 (fig. 3-5, pg. 3-15). Use the mix design from lesson 1.

SUMMARY

Cement	641.3	lbs/cy	6.8	sacks/cy
Water	295	lbs/cy	35.4	gallons/cy
Sand	1045	lbs/cy	8.7	cu ft/cy
Gravel	1796	lbs/cy	18.9	cu ft/cy

Procedure

1. Project Volume = L ft X W ft X H ft ÷ 27 cf

   Wall______ X ______ X ______ = ______ cf ÷ 27 cf = ______ cy

   Slab______ X ______ X ______ = ______ cf ÷ 27 cf = ______ cy

   +

   Total = ______ cy

2. Volume > 200 CY, Waste Factor = 5%
   Volume ≤ 200 CY, Waste Factor = 10%

   Project Volume with the waste factor = PV (1 + WF)

   ______ X ______ = ______ cy Round up ______ cy

Order Quantities

3. Cement ____________________
4. Water ____________________
5. Sand ____________________
6. Gravel ____________________

2. **Construction Phase**

a. **Prior to Mixing**

(1) **Free Surface Moisture (Para 3-8, FM 5-742, pg 3-12)**

EXAMPLE PROBLEM: The materials are on site and you are now ready to start mixing operations. But, first you must check your aggregates for free surface moisture. Adjust the mix proportions for the free surface moisture on the aggregates. Your informed that you have 4% moisture on your fine aggregate and 1% moisture on your course aggregate.

SUMMARY

Cement	641.3	lbs/cy	6.8	sacks/cy
Water	295	lbs/cy	35.4	gallons/cy
Sand	1045	lbs/cy	8.7	cu ft/cy
Grave	1796	lbs/cy	18.9	cu ft/cy

Procedure

1. Determine the total amount of water on the aggregates.

2. Decrease the mixing water.

3. Adjust the aggregates by volume using the bulking factor (BF) obtained from figure 3-4 on page 3-13.

Vw = Vd (1+ BF) ________ X ________ = ________ cf/cy

Adjusted Mix Design

Cement	________________
Water	________________
Sand	________________
Gravel	________________
Air	________________

b. Prior to Placing (Para 5-22, FM 5-742, pg 5-15)

(1) Check placement of forms and rebar

(2) Slump Test (App A, FM 5-742, pg A-1)

(a) Test 3 times a day as specs dictate

(b) Acceptance ± 1 inch

(3) Air Content (Air-entrained concrete only)

(a) Air Entrainment Meter

(b) Acceptance $\pm 1\%$

(4) Concrete Temperature

(a) Concrete Thermometer

(b) Acceptance $\pm 5\ ^{\circ}F$

(c) Adjustment $Ra = \frac{(Rd \times Ta)}{Td}$

c. Joints (Para 4-21, FM 5-742, pg 4-31)

(1) Isolation Joints

(2) Control joints

(3) Construction Joints

d. Placing (Para 5-22 thru 5-25, FM 5-742)

(1) Against Previous Load

(2) Free Fall < 5'

(3) Chutes no flatter than 3:1 and no stepper than 2:1

(4) Vibration - every foot, 3-5 seconds

e. Finishing (Para 5-27 thru 5-30, FM 5-742)

(1) Screed

(2) Float

(3) Trowel

(4) Finish

f. Anchor Bolts (Para 4-22, FM 5-742, pg 4-33)

(1) Meet Specification

(2) Properly aligned

g. Curing (Para 5-31, FM 5-742, pg 5-25)

(1) Moisture - (Table 5-5, FM 5-742, pg 5-27)

(2) Temperature - 73 degrees Fahrenheit

(3) Time - 3-14 days

h. Strength Tests For Hardened Concrete (Para 4-11, TM 5-530)

(1) Cylinders/Beams Acceptance ±500 psi, Average number equals the design strength.

(2) Rebound Method - Schmidt Hammer

(3) Penetration Method - Windsor Probe

(4) Core Sampling

3. Adverse Weather Conditions

a. Hot weather - (Para 5-33, FM 5-742, pg 5-29)

(1) Effects

(a) Rapid Evaporation

(b) Flash Set - Cracking

(c) Reduced Workability

(2) Courses of Action

(a) Retarder Admixture

(b) Cool aggregates - Ice water

(c) Work at night

(d) Shade, Cover

(e) Flood, Spray

b. Cold Weather

(1) Effects

(a) Slow curing

(b) Freezing concrete

(2) Courses of Action

(a) Accelerator Admixture - 2% CaCl

(b) Use Type III Cement

(c) Heat Aggregates, Water

(d) Insulate

(e) Enclose and heat structure

c. Wet Weather Concreting

(1) Effects

(a) Change water cement ratio

(b) Affect finish

(2) Courses of Action

(a) Delay project

(b) Cover

(c) Increase Crew size

Review Problems

1. When storing bagged cement for over 90 days, is it a good practice to store the bags in stacks that are 10-bags high?

2. How many sacks of cement, gallons of water, tons of coarse aggregate; and tons of fine-aggregate do you need to take to the construction site for a concrete hard stand that is to be 20 feet by 50 feet by 10 inches? The one cubic yard mix proportions for the project are summarized below.

Cement:	789.5 pounds
Water:	300.0 pounds
Sand:	1,093.0 pounds
Gravel:	1,923.0 pounds

3. Adjust the mix proportions in problem 2 for aggregate moisture content. The Material Quality Specialist's lab results are listed below.

Fine Aggregate:	BUW = 103 lb/cf
	Fineness Modulus = 3.0
	Free Surface Moisture = 6.3%
Coarse Aggregate:	MSA = 1 1/2"
	BUM = 94 lb/cf
	Free Surface Moisture = 0.5%

Give your answers in volumetric units.

4. At what concrete temperature should you become concerned about hot weather placing and curing?

5. You are placing concrete into wall forms that were designed for a concrete temperature of 85 degrees and a placement rate of 5 ft/hr. The concrete is being delivered to the forms at a temperature of 75 degrees. What should you do?

Appendix A

Concrete Fundamentals and Mix Design

Answers to Review Problems (page 8)

1. W/C for strength (Table 3-2): 0.46
   W/C for durability/water tightness (Table 3-1) = 0.45 (thin section)

   Use W/C = 0.45

2. A decimal W/C ratio is the ratio of the weight of water to the weight of cement:

$$\frac{6 \text{ gallons/sack} \times 8.33 \text{ lbs/gal}}{94 \text{ lbs/sack}} = 0.53$$

3. 3.15

4. 1 percent by weight

5. Interpolating Table 3-6 with and MSA of 2 inches and a FM of 2.75:

FM	Loose Volume CA
2.60	20.5
2.75	c
2.80	20.0

First solve for a:

$$a/A = b/B$$
$$a = A(b)/B$$
$$a = (0.5 \times 0.15)/0.20 = 0.375$$

Where:
$A = 20.5 - 20.0 = 0.5$
$b = 2.75 - 2.60 = 0.15$
$B = 2.80 - 2.60 = 0.2$

Second solve for c:

$c = 20.5 - a$
$c = 20.5 - 0.375 = 20.125$ cf/cy = Loose Volume of CA

6. Absolute Volume of Sand = 27 cf - PV
= 27 cf - 19.63 cf
= 7.37 cf

Weight of Sand = Abs. Vol. Sand x S. G. Sand x 62.4 lbs/cf
= 7.37 cf x 2.60 x 62.4 lbs/cf
= 1195.7 lbs

Loose Volume of Sand = (Weight of sand) /BUW sand
= 1195.7 lbs / 115 lbs/cf
= 10.4 cf

7. Weight of cement = $\frac{\text{weight of water}}{\text{w/c ratio}}$

water = 295 lb/cy (table 3-3)
w/c ratio - strength = .46 (table 3-2)
- watertightness =.45 (table 3-1)
- choose .45

cement = $\frac{295 \text{ lb/cy}}{.45}$ = 655.6 lb/cy

CONCRETE FORMWORK

Answers to Review Problems (page 15)

1. The component which resists external forces on the forms is the diagonal braces.

2. Wall Form Design:

(1) Select Materials.

Sheathing	-	1" x 12" boards
Studs	-	2" x 4"
Wales	-	2" x 4"
Ties	-	3000 lb Snap Ties

(2) Mixer Output = $\frac{11 \text{ cf} \times 60 \text{ min/hr} \times 3}{5 \text{ min}}$ = 396 cf/hr

(3) Plan Area = 140' x 1.5' = 210 sf

(4) Rate of Placement (R) = $\frac{396 \text{ cf/hr}}{210 \text{ sf}}$ = 1.9 ft/hr

(5) Concrete Temperature = 80 degrees F

(6) Max. Conc. Pressure = 360 lb/sf (Figure 4-3)

(7) Stud Spacing = 18" (Table 4-1)

(8) ULS = $\frac{\text{360 lb/sf x 18"}}{\text{12 in/ft}}$ = 540 lb/lf

(9) Wale spacing = 24" (Table 4-3)

(10) ULW = $\frac{\text{360 lb/sf x 24"}}{\text{12 in/ft}}$ = 720 lb/lf

(11) TS (wale) = 30" (Table 4-4)

(12) TS (tie) = $\frac{\text{3000 lb x 12 in/ft}}{\text{720 lb/lf}}$ = 50"

(13) Tie Spacing = 30"

(14) Tie - Stud Adjustment: N/A for tie rods

(15) No. Studs (one side) = $\frac{\text{140' x 12 in/ft}}{\text{18 in}}$ + 1 = 95

For both sides: 95 x 2 = 190 studs

NOTE: You must also construct end wall forms for each end of the wall. They will require one stud at each end plus one in the center(the wall is 18" wide and the stud spacing is 18").

(16) No. Wales (one side) = $\frac{\text{5' x 12 in/ft}}{\text{24 in}}$ = 2.5 round to 3

NOTE: The wales should rap around the ends of the wall and connect to the wale on the other side.

(17) Time Required = $\frac{\text{5 ft}}{\text{1.9 ft/hr}}$ = 2.6 hrs

Final Design

Component	Material	Spacing (in)	Total Quantity
Sheathing	1" x 12"		
Studs	2" x 4" (sgl)	18	198
Wales	2" x 4" (dbl)	24	3
Ties	3000 lb snap ties	30	174

Answers to Review Problems (page 15 cont.)

3. Wall Form Design:

(1) Select Materials

Sheathing	-	5/8" plywood
Studs	-	2" x 4" lumber
Wales	-	4" x 4" lumber
Ties	-	1420 lb wire

(2) Mixer Output = $\frac{11\ \text{cf} \times 60\ \text{min/hr} \times 3}{5\ \text{min}}$ = 396 cf/hr

(3) Plan Area = 92' x 1' = 92 sf

(4) Rate of Placement (R) = $\frac{396\ \text{cf/hr}}{92\ \text{sf}}$ = 4.3 ft/hr

(5) Concrete Temperature = 50 degrees F.

(6) Maximum Concrete Pressure = $150 + \frac{9000\ (4.3)}{50}$ = 924 psf

(7) Stud Spacing = 9" (Table 4-2)

(8) ULS = $\frac{924\ \text{psf} \times 9"}{12\ \text{in/ft}}$ = 693 lb/lf

(9) Wale Spacing = 22" (Table 4-3)

(10) ULW = $\frac{924\ \text{psf} \times 22"}{12\ \text{in/ft}}$ = 1694 lb/lf

(11) Tie Spacing (wale) = 22" (Table 4-3)

(12) Tie Spacing (tie) = $\frac{1420\ \text{lb} \times 12\ \text{in/ft}}{1694\ \text{lb/lf}}$ = 10.09 round to 10"

(13) Tie Spacing = 10"

(14) Tie - Stud Adjustment: 9"

4. Refer to Question 3.

(1) Stud Spacing = 7" (Table 4-2)

(2) ULS = $\frac{924\ \text{psf} \times 7"}{12\ \text{in/ft}}$ = 539 lb/lf

Answers to Review Problems (Page 15 cont.)

(3) Wale Spacing = 24" (Table 4-3)

(4) $ULW = \dfrac{924 \text{ psf} \times 24"}{12 \text{ in/ft}} = 1848 \text{ lb/lf}$

(5) Tie Spacing (wale) = 21"

(6) Tie Spacing (tie) = $\dfrac{1420 \text{ lb} \times 12 \text{ in/ft}}{1848 \text{ lb/lf}} = 9"$

(7) Tie - Stud Adjustment: 7"

CONCRETE SLAB ON GRADE DESIGN

Answers to Review Problems (page 18)

1. Whenever the loaded area exceeds 80 square inches, the soil bearing capacity must be considered.

2. CESL = ESL X (300 / allowable tensile stress)
   = 10,000 X (300 / 272)
   = 11,029 lbs

   Thickness = Just over 7 inches (round up to) 7.25. (Fig 4-6)

3. F'_c = 4500 psi
   f_t = 4.6 x 4500 = 308.6
   ESL = 10,200 x 1.25 = 12,750 lb
   CESL = $12{,}750 \times \dfrac{300}{308.6} = 12{,}394.7$ lb

   Thickness = Just over 7 3/4 inches (round up to) 8 inches.

4. Remove silt and fine sand from under the slab and replace with either coarse sand or gravel.

CONCRETE MIXING EQUIPMENT

Answers to Review Problems (page 20)

1. It will take 2 hours and 54 minutes to produce 14 yards of concrete.

$$14 \text{ yd} \div 4.8 = 2.9 = 2 \text{ hrs and } 54 \text{ min}$$

2. It will take 6 hours and 18 minutes for two 11-S mixers to produce 61 cubic yards of concrete.

$$61 \text{ yd} \div 4.8 = \frac{10}{2 \text{ mixers}} = 6.3 \text{ hrs}$$

3. It will take 3 hours for two people to produce 6 cubic yards of concrete mixing by hand.

$$6 \text{ yd} \div 1 = \frac{6}{2 \text{ people}} = 3 \text{ hrs}$$

REINFORCED CONCRETE

Answers to Review Problems (page 24)

1. Use Table 6-3

   a. 3"
   b. 12"
   c. 2.25"
   d. 18.75"

2. From Table 6-4, top bar, minimum splice length = 46"

3. $\frac{(119' \times 12") + 8"}{10" \text{ o.c.}} + 1 = 144.6$ bars round up to 145

   Bar type is not a factor in this problem.

4. From Table 6-2, 2"

Quality Control

Answers to Review Problems (page 33)

1. No, it is not good practice to store bagged cement 10-bags high for this length of time. Cement that is to be stored longer than 60 days should be stacked no higher than 7-bags high. The additional weight on the lower bags will increase the chances of warehouse packing. The bags should be stacked tightly together to reduce the flow of air around them, or pallets, and covered with waterproof material if they are to be stored this long.

2. Calculate the volume of concrete to be produced:

   Vol = 20 x 50 x 10/12 = 833.33 cubic feet
   833.33 - 27 CF/CY = 30.9 cubic yards
   Apply the appropriate waste factor:

   Vol X (1+BF) 30.9 x 1.10 = 33.99 (round up) 34 cubic yards

   Determine quantities of dry materials (round answers up):

Cement:	789.5 lb/cy x 34 cy = 26,843 lbs 26,843 lbs ÷ 94 lbs/sack = 285.6 sacks, 286 sacks
Sand:	1093 lb/cy x 34 cy = 37,162 lbs 37,162 lbs ÷ 2000 lbs/ton = 18.6 tons, 19 tons
Gravel:	1923 lb/cy x 34 cy = 65,382 lbs 65,382 lbs - 2000 lbs/ton = 32.7 tons, 33 tons

Determine the approximate amount of water needed on the job site (mixing, form prep, clean-up , etc.):

8 gal/sack x 286 sacks = 2288 gallons

SUMMARY

Cement:	286 sacks
Water:	2288 gallons
Sand:	19 tons
Gravel:	33 tons

3. Determine the weight of water that will be added by the aggregates (use the original design mix):

Sand: Free Surface Moisture (FSM) = 6.3%

Water on Sand = 1093 x 0.063 = 68.9 lbs

Gravel: Free Surface Moisture (FSM) = 0.5%

Water on Gravel: 1923 x 0.005 = 9.6 lbs

Total weight of water added by the aggregates: 78.5 lbs

Adjust the mixing water:

300 - 78.5 = 221.5 lbs of water

Adjust the aggregates by volume.

Sand: FM = 3.0

FSM = 6.3%

BF = 17% From Figure 3-4

Vol wet = 10.6 x (1+.17) = 12.4 cf

Gravel: No change in volume due to moisture .

Adjusted Mix Design

Cement:	789.5 lbs	8.4 sacks
Water:	221.5 lbs	26.6 gallons
Sand:	1,161.9 lbs	12.4 cubic feet
Gravel:	1,932.6 lbs	20.5 cubic feet

4. Temperatures greater than 90 °F.

5. Since there is a 5 degree or more drop in temperature, you need to recalculate your rate of placement so that the design concrete pressure of the form work isn't exceeded.

$$Ra = \frac{Rd \times Ta}{Td}$$

Where: Ra = Actual Rate of Placement

Rd = Design Rate of Placement

Ta = Actual Concrete Temperature

Td = Design Concrete Temperature

Substituting the known values:

$$Ra = 5 \text{ ft/hr} \times 75 \div 85 = 4.4 \text{ ft/hr}$$

You should reduce your mixer output so that the concrete rises in the forms at a rate of 4.4 ft/hr.

Appendix B

GLOSSARY

1. ABBREVIATIONS:

BF	Bulking Factor
BUW	Bulk Unit Weight
CF, cf	Cubic Foot (Feet)
CY, cy	Cubic Yard (s)
CESL	Corrected Equivalent Static Load
ESL	Equivalent Static Load
FM	Fineness Modulus
FSM	Free Surface Moisture
FT, ft	Foot (Feet)
F_c	Minimum Compressive Strength
F_t	Allowable Flexural Tensile Strength
Gal	Gallons (s)
IN, in	Inch (s)
LB, lb	Pound (s)
MCS	Minimum Clear Space
MSA	Maximum Size Aggregate
OC	On Center
PSI	Pounds per Square Inch
PSF	Pounds per Square Foot
PLF	Pounds per Linear Foot
PV	Partial Volume
S4S	Surface Four Sided
SG	Specific Gravity
SL	Static Load
ULS	Uniform Load on the Stud
ULW	Uniform Load on the Wale
Vd	Volume dry
Vw	Volume Wet
W/C	Water Cement Ratio

Appendix C

PROCEDURE

1. Select Cement Type:

   a. Availability ____________
   b. Climate ____________
   c. Specifications ____________ ____________

2. Select Aggregates

   a. Fine Aggregate

      (1) Source ____________

      (2) Fineness Modulus (FM) ____________

      (3) Specific Gravity (SG) ____________

      (4) Bulk Unit Weight (BUW) ____________

      (5) Percent Fines ____________

   b. Coarse Aggregate

      (1) Maximum Size Aggregate allowable for the project:

      1/5 x Thickness of Wall = 1/5 x ________ = ________

      1/3 x Thickness of Slab = 1/3 x ________ = ________

      3/4 x Min. clear space = 3/4 x ________ = ________

      MSA for mixing equipment 1 1/2 " or 3" = ________

      MSA for the Project (Smallest of above) = ________

      (2) Chosen Aggregate

         (a) Source ____________

         (b) Type ____________

         (c) Max. size aggregate (MSA) ____________

         (d) Specific Gravity (SG) ____________

         (e) Bulk Unit Weight (BUW) ____________

         (f) Percent Fines ____________

3. Select Water/Cement Ratio:

a. Strength (Table 3-2, FM 5-742 Pg. 3-2) = ______

b. Durability/Watertightness: = ______
(Table 3-1, FM 5-742, Pg . 3-2)

c. Choose the lowest of the above; w/c Ratio = ______

4. Select Design Slump (Table 3-4, FM 5-742 Pg. 3-5) : ______

5. Select Water Content and Percent Air:
(Table 3-3, FM 5-742 Pg 3-4)

a. Water Content ______

b. Percent Air ______

6. Calculate Cement Content:

$$\text{Cement} = \frac{\text{Water (lb/cu yd)}}{\text{W/C ratio}} = \underline{\qquad\qquad} = \underline{\qquad\qquad}$$

7. Calculate Gravel Content: (Table 3-6, FM 5-742 Pg. 3-10)

a. Loose Volume of Gravel = ______

b. Weight of Gravel = BUW x Loose Volume

______ x ______ = ______

8. Calculate Sand Content:

a. Convert to Absolute Volumes

(1) Cement = $\frac{\text{lb of cement}}{3.15 \times 62.4}$ = ____________ = ____________

(2) Water = $\frac{\text{lb of water}}{1.0 \times 62.4}$ = ____________ = ____________

(3) Gravel = $\frac{\text{lb of gravel}}{\text{S.G.} \times 62.4}$ = ____________ = ____________

(4) Air = Percent Air x 27 cf/cy = ________ x 27 = ______

(5) Partial Volume (PV) = Summation = ________________

b. Absolute Volume of Sand = 27 - PV

27 - ____________ = ____________

c. Weight of Sand = Abs Vol x S.G. x 62.4

____________ x ___________ x 62.4 = __________

d. Loose Volume Sand = $\frac{\text{Weight of Sand}}{\text{BUW Sand}}$ = _________ = __________

9. Preliminary Mix Proportions for a one cubic yard batch:

SUMMARY

Cement	________lbs/cy	____________sacks/cy
Water	________lbs/cy	____________gallons/cy
Sand	________lbs/cy	____________cf/cy
Gravel	________lbs/cy	____________cf/cy
Air	________ %	
Slump	________ in.	

NOTE: These proportions assume a Saturated Surface Dry (SSD) moisture condition for the aggregates. Adjustment must be made for the actual moisture condition of the aggregates on the job site. The procedure will be covered in the Quality Control Block.

Appendix D

PROCEDURE

1. Select Materials and Grain Direction:

2. Mixer Output:

$$\frac{\text{Mixer Capacity (cf)} \times 60 \text{ min/hr} \times \text{\# Mixers}}{\text{Batching Cycle (min)}} = \text{Mixer Output}$$

$$\frac{\_\_\_\_\_\_\_\_ \text{(cf)} \times 60 \text{ min/hr} \times \_\_\_\_\_\_\_\_}{\text{(min)}} = \_\_\_\_\_\_\_\_ \text{cf/hr}$$

3. Plan Area:

Length (ft) x width (ft) = Plan Area sf

__________(ft) X ____________ (ft) = ______________ sf

4. Rate of placement:

$$\frac{\text{Mixer Output}}{\text{Plan Area}} = \text{Rate in ft/hr}$$

$$\frac{\_\_\_\_\_\_\_\_ \text{(cf/hr)}}{\text{(sf)}} = \_\_\_\_\_\_\_\_ \text{ft/hr}$$

5. Estimated Concrete Temperature = ____________

6. Concrete Pressure (Figure 4-3, FM 5-742, pg.4-5):

= ____________________ lb/sf

7. **Maximum Stud Spacing (Table 4-1 board sheathing or 4-2 plywood sheathing, FM 5-742, pg. 4-5,6):**

= ____________________ in

8. **Uniform Load on the Stud (ULS):**

$$\frac{\text{Concrete Pressure (lb/sf) x Stud Spacing (in)}}{\text{12 in/ft}} = \text{ULS}$$

$$\frac{\_\_\_\_\_\_\text{(lb/sf) X}\_\_\_\_\_\_\text{(in)}}{\text{12 in/ft}} = \_\_\_\_\_\_\text{lb/lf}$$

9. **Maximum Wale Spacing (Table 4-3, FM 5-742 pg. 4-7):**

= __________ in

10. **Uniform Load on the Wale (ULW):**

$$\frac{\text{Concrete Pressure (lb/sf) x Wale Spacing (in)}}{\text{12 in/ft}} = \text{ULW}$$

$$\frac{\_\_\_\_\_\_\text{(lb/sf) X}\_\_\_\_\_\_\text{(in)}}{\text{12 in/ft}} = \_\_\_\_\_\_\text{lb/lf}$$

11. **Tie Spacing based on ULW (Table 4-3 or 4-4, FM 5-742 pg. 4-7):**

TS (wale) = __________ in

12. Tie Spacing based on the strength of the tie (Table 4-5, FM 5-742 pg. 4-8): (round down)

$$\frac{\text{Tie Strength (lb)} \times 12 \text{ in/ft}}{\text{ULW (lb/lf)}} = \text{Tie spacing (tie)}$$

$$\frac{\_\_\_\_\_\_\_\_\_\_ \text{(lb)} \times 12 \text{ in/ft}}{\text{(lb/lf)}} = \_\_\_\_\_\_\_\_\_\_ \text{ in}$$

13. Maximum Tie Spacing (smaller of 11 and 12) = ____________________

14. Adjusted Tie/Stud Spacing (Wire Ties Only):

TS = ________________

SS = ________________

Select the smaller of the two. ______________

15. Required number of studs per side. (Round up)

$$\frac{\text{length of form (ft)} \times 12 \text{ (in/ft)}}{\text{stud spacing (in)}} + 1 = \text{\# studs}$$

$$\frac{\_\_\_\_\_\_\_\_\_\_ \text{(ft)} \times 12 \text{ (in/ft)}}{\text{(in)}} + 1 = \_\_\_\_\_\_$$

Note: The spacing between the last two studs may be <u>less</u> than the maximum allowable spacing.

16. Required number of wales per side. (round up)

$$\frac{\text{height of form (ft)} \times 12 \text{ (in/ft)}}{\text{wale spacing (in)}} = \# \text{ wales}$$

$$\frac{\_\_\_\_\_\_\_\_\_\_ \text{(ft)} \times 12 \text{ (in/ft)}}{\text{(in)}} = \_\_\_\_\_\_\_$$

17. Time required to place concrete .

$$\frac{\text{height of form (ft)}}{\text{rate of placement}} = \text{Time Required}$$

$$\frac{\_\_\_\_\_\_\_\_\_\_ \text{(ft)}}{\text{(ft/hr)}} = \_\_\_\_\_\_\_\_\_\_\_\_\_\_ \text{hr}$$

SUMMARY

Component	Material	Spacing (in)	Quantity
Sheathing	________	________	________
Studs	________	________	________
Wales	________	________	________
Ties	________	________	________

Appendix E

PROCEDURE

1. Determine floor classification (table 4-9, pg 4-20, FM 5-742).

2. Determine minimum compressive strength. (table 4-10, pg 4-20, FM 5-742).

   F'_c = ____________

3. Determine allowable flexural tensile strength.

   $F_t = 4.6 \sqrt{F'_c}$

   4.6 X __________ = ______________

4. Determine the Equivalent Static Load (ESL).

   ESL = SL x (1+25%)

   ____________ x 1.25 = ________________

5. Determine the Corrected Equivalent Static Load (CESL).

   $CESL = ESL \times \frac{300}{F_t}$

   ___________ x $\underline{300}$ = _____________

6. Determine slab thickness (figure 4-6, pg 4-21, FM 5-742)

7. Determine minimum cement content. (table 4-11, pg 4-21, FM 5-742).

Appendix F

Procedure

1. Project Volume = $\frac{L}{ft} \times \frac{W}{ft} \times \frac{H}{ft} \div 27$ cf

Wall________ X __________ X __________ = ______ cf ÷ 27 cf = _______ cy

Slab________ X __________ X __________ = ______ cf ÷ 27 cf = _______ cy

+

Total = _______ cy

2. Volume > 200 CY, Waste Factor = 5%
Volume ≤ 200 CY, Waste Factor = 10%

Project Volume with the waste factor = PV (1 + WF)

___________ X ___________ = __________ cy Round up ___________ cy

Order Quantities

3. Cement ____
4. Water ____
5. Sand ____
6. Gravel ____

Appendix G

Procedure

1. Determine the total amount of water on the aggregates.

2. Decrease the mixing water.

3. Adjust the aggregates by volume using the bulking factor (BF) obtained from figure 3-4 on page 3-13.

   Vw = Vd (1+ BF)____________ X ________________ = _____________ cf/cy

Adjusted Mix Design

Cement	____________________
Water	____________________
Sand	____________________
Gravel	____________________
Air	____________________

STRONGBACK & SEA HUT CONSTRUCTION STUDENT HANDOUT

MARINE CORPS ENGINEER SCHOOL
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

TROPICAL STRONGBACK

I. BILL OF MATERIALS

MATERIAL	QTY	BFM	FINISH DIMENSION	REMARKS	LOC
2" x 6" x 16'	6	96	2" x 6" x 16'	mud sill	A
2" x 4" x 16'	6	floor 64	2" x 4" x 16'	mud sill sleeper	B
2" x 4" x 16'	17	181	2" x 4" x 15' - 8 3/4"	floor joist	C
2" x 4" x 8'	16	85	2" x 4" x 22 1/2"	fire blocking	D
3/4" x 4' x 8'	16 sh		3/4" x 4' x 8'	flooring (ply)	E
2" x 4" x 16'	4	43	2" x 4" x 16'	sole plate	F
2" x 4" x 8'	4	21	2" x 4" x 6'- 3 3/4"	sole plate	G
2" x 4" x 8'	26	139	2" x 4" x 5'- 2 3/4"	studs	H
2" x 4" x 8'	4	21	2" x 4" x 6'-2"	jamb	I
1" x 6" x 8'	8	32	1" x 6" x 5'- 7 1/2"	corner bracing	K
2" x 6" x 16'	4	64	2" x 6" x 16'	top plate	L
2" x 4" x 8'	4	21	2" x 4" x 5'-11 3/4"	top plate	M
1/2" x 4' x 8'	6 sh		1/2" x 2' x 8'	sheathing	N
Screen	2 rl		4' x 50'	exterior covering	O
2" x 4" x 8'	2	11	2" x 4" x 2'-9 1/4"	door header	P
2" x 4" x 8'	4	21	2" x 4" x 6'- 3"	end rafter	Q
2" x 4" x 16'	1	11	2" x 4" x 16'	ridge board	R
2" x 4" x 16'	10	107	2" x 4" x 9'- 2"	rafters	S
2" x 4" x 16'	5	53	2" x 4" x 2'	collar beam	T
2" x 4" x 16'	4	43	2" x 4" x 12'- 2"	hip rafter	U
2" x 4" x 8'	4	21	2" x 4" x 4'- 7"	hip jack	V
2" x 4" x 8'	2	11	2" x 4" x 2'- 9"	hip rafter tie	W
2" x 4" x 8'	4	21	2" x 4" x 7'- 6"	rafter	X
1/2" x 2" x 4'	345' of 2" x 4" x 8'	29	1/2" x 2" x 4'	lathe, use 38 bf	Y
1" x 3" x 8'	4	8	1" x 3" x 6'- 2"	stiles	Z
1" x 3" x 8'	2	4	1" x 3" x 2'- 3/4"	top & middle rails	AA
1" x 12" x 8'	1	8	1" x 12" x 2'- 3/4"	kick plate	AB
1" x 2" x 8'	1	2	1" x 2" x 2'- 6" 3 bf of 2"x4"x8'	header stop, use	AC
1" x 2" x 8'	4	6	1" x 2" x 6'-1 1/4" 8 bf of 2"x4"x8'	jamb stop, use	AD
Wood preservative	1 cn			for mudsills	
Paint thinner	1 gl				
Brush, paint	2 ea			3 1/2" bristles	
Hinges	4 ea		4" x 4"	butt type	
16d comm	75 lbs			nails	
8d comm	25 lbs			nails	
4d comm	12 lbs			nails	
Fasteners	12 lbs		3/4"	corrugated	
Staple gun	2 ea				
Staples	2 bx		1/2"		

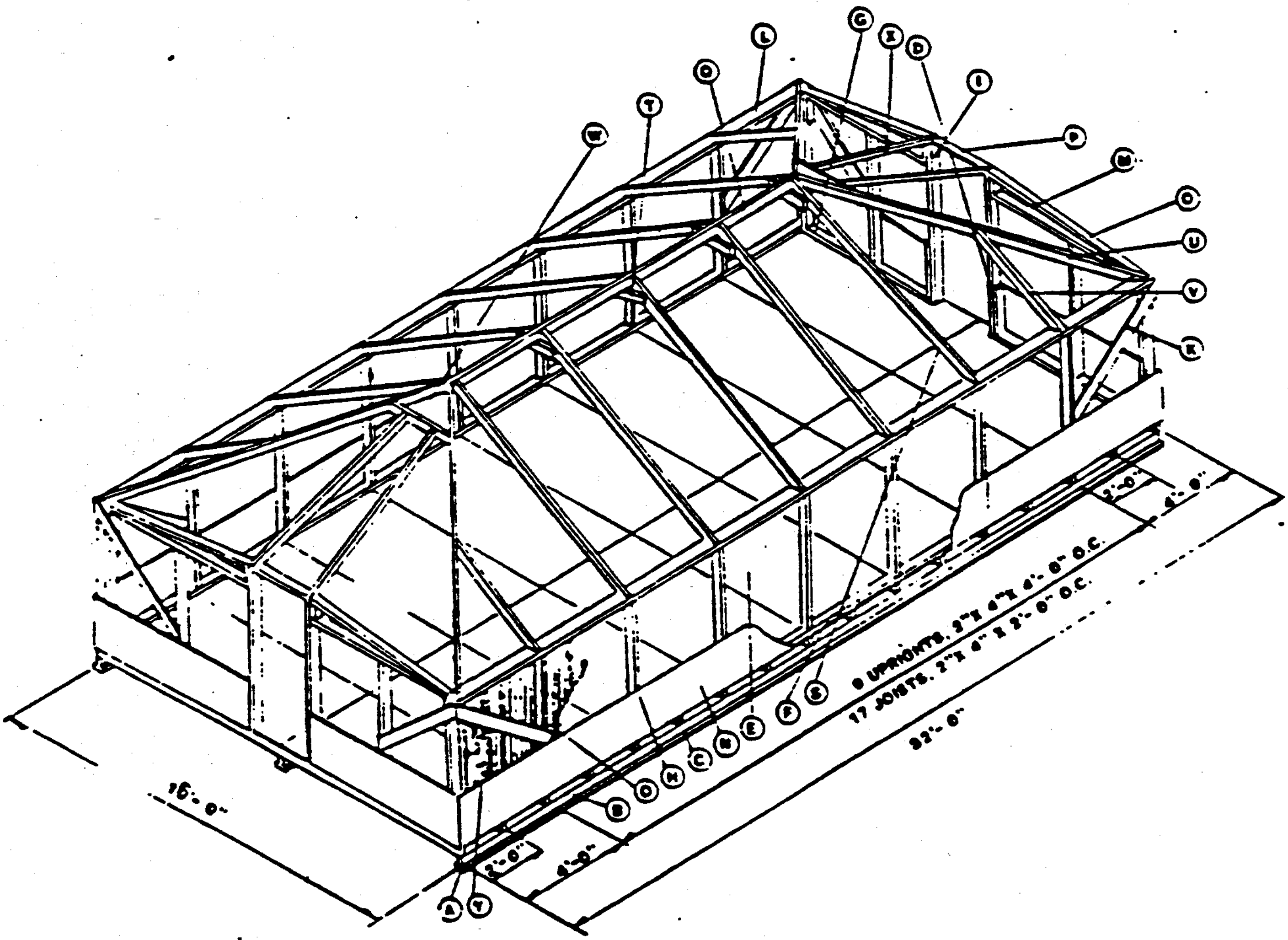
TROPICAL STRONGBACK

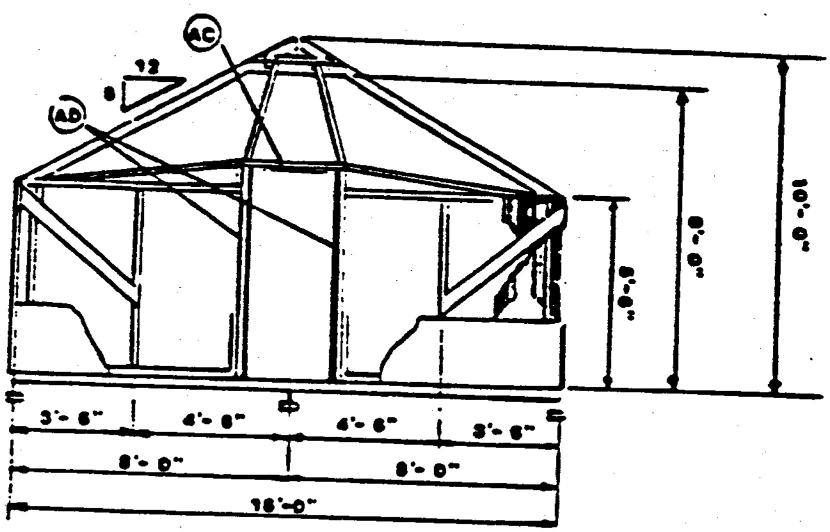
II. MATERIAL TO PURCHASE

MATERIAL	QTY	NSN	U/P	TOTAL PRICE	REMARKS
1" x 3" x 8'	13 bf	5510 00 267 2385	.27	3.51	
1" x 6" x 8'	35 bf	5510 00 220 6080	.32	11.20	
1" x 12" x 8'	9 bf	5510 00 220 6086	.33	2.97	
2" x 4" x 8'	457 bf	5510 00 220 6194	.33	130.81	
2" x 4" x 16'	566 bf	5510 00 220 6194	.33	140.78	
2" x 6" x 16'	176 bf	5510 00 220 6196	.32	56.77	
3/4" x 4' x 8'	16 sh	5530 00 618 8073	10.38	166.88	plywood C-C
1/2" x 4' x 8'	6 sh	5530 00 618 6958	14.60	87.60	plywood A-B
Screen	2 rl	8305 00 927 3829	125.00	250.00	4' x 50'
16d comm	1 1/2 bx	5315 00 010 4663			nails (75 lbs)
8d comm	1/2 bx	5315 00 010 4659			nails (25 lbs)
4d case	1/4 bx	5315 00 010 4655			nails (12 lbs)
5/8" fasteners	1/4 bx	5315 00 597 9767			corrugated (12 lbs)
Hinges, 4" x 4"	4 ea	5340 00 664 1326			butt type
Staple gun	2 ea	5120 00 889 1796			
Staples	2 bx	5318 00 889 2605			1/2"
Wood preservative	1 cn	8030 00 559 9883			for mudsills
Paint thinner	1 gl	8010 00 160 5794			
Brush, paint	2 ea	8020 00 597 4770			3 1/2" bristles

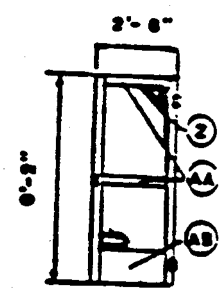
* Wood materials are ordered in board feet of material (BFM), which is not the actual length of material required.

* 10% WASTE FACTOR INCLUDED IN THE MATERIAL ESTIMATE


UPRIGHTS, 2" X 4" X 4'-0" O.C.
17 JOISTS, 2" X 4" X 2'-0" O.C.
32'-0"
15'-0"
2'-0"
4'-0"



END ELEVATION



DOOR DETAIL

NOTE: 1. DOOR MUST SWING IN BOARD
SO AS NOT TO RIP THE TENT

TROPICAL SEA HUT

I. BILL OF MATERIALS

MATERIAL	QTY	BFM	FINISH DIMENSION	REMARKS
2" x 8" x 16'	5	107	2" x 8" x 16"	footings
4" x 4" x 16'	15	64	4" x 4" x 3'	footing post
2" x 6" x 16'	12	192	2" x 6" x 16'	girders
2" x 4" x 8'	4	21	2" x 4" x 16"	scabbing
2" x 4" x 16'	4	43	2" x 4" x 16'	joist header
2" x 4" x 16'	17	181	2" x 4" x 15'- 8 3/4"	floor joists
2" x 4" x 8'	16	85	2" x 4" x 22 1/2"	fire blocking
3/4" x 4' x 8'	16 sh		3/4" x 4' x 8'	flooring (ply)
2" x 4" x 16'	4	43	2" x 4" x 16'	sole plate
2" x 4" x 8'	4	21	2" x 4" x 6'- 3 3/4"	sole plate
2" x 4" x 8'	42	224	2" x 4" x 7'- 7 5/8"	studs
2" x 4" x 8'	32	171	2" x 4" x 3'- 11 3/16"	bracing
2" x 4" x 16'	8	85	2" x 4" x 16'	double top plate
2" x 4" x 16'	4	43	2" x 4" x 16'	double top plate
2" x 4" x 8'	3	16	2" x 4" x 1'- 11 3/16"	bracing
Any 2" x 4" scrap	8		2" x 4" x 4"	blocking
2" x 4" x 8'	4	21	2" x 4" x 6'- 10"	jamb
2" x 4" x 8'	2	11	2" x 4" x 2'- 9 1/4"	header
2" x 4" x 16'	17	181	2" x 4" x 16'	roof joists
2" x 4" x 12'	34	272	2" x 4" x 9'- 11 3/4"	rafters
2" x 8" x 16'	2	43	2" x 8" x 16'	ridge board
1" x 6" x 16'	16	128	1" x 6" x 16'	purlins
1/2" x 4' x 8'	24 sh		1/2" x 4' x 8'	sheathing/shutters
1" x 6" x 16'	4	32	1" x 6" x 16'	fascia
2" x 4" x 16'	6	64	2" x 4" x 4'- 11"	collar beam
2" x 4" x 8'	5	27	2" x 4" x 17 1/2"	rafting brace
Roofing	37 sh		26" x 120"	corrugated metal
1" x 6" x 8"	12	48	1" x 6" x 5'- 7"	louvers
1" x 2" x 8'	4	5	cut to length	battens, use 7 bf of 2" x 4" x 8'
1" x 3" x 8'	8	16	1" x 3" x 4'	bottom rail
1" x 3" x 8'	16	32	1" x 3" x 3'- 4"	side rails
1" x 3" x 8'	4	8	1" x 3" x 6'- 9 1/2"	stiles
1" x 3" x 8'	2	4	1" x 3" x 2'- 2 1/4"	top and middle rails
1" x 12" x 8'	1	8	1" x 12" x 2'- 2 1/4"	kick plate
2" x 12" x 8'	4	64	cut according to height of sea hut	stair stringer
2" x 4" x 16'	4	43	2" x 4" x 3'	treads
1" x 2" x 8'	4	5	1" x 2" x 6'- 8 3/4"	jamb stop, use 7 bf of 2" x 4" x 8'
1" x 2" x 8'	1	1	1" x 2" x 2'- 5 1/2"	header stop, use 2 bf of 2" x 4" x 8'
Hinges	36 ea		4" x 4"	butt type
Screen	2 rl		4' x 50'	door/exterior covering

TROPICAL SEA HUT

I. BILL OF MATERIALS (Cont.)

MATERIAL	QTY	BFM	FINISH DIMENSION	REMARKS
16d comm	75 lbs			nails
8d comm	25 lbs			nails
Roofing nails	25 lbs			corrugated metal
Wood preservative	1 cn			for mudsills
Paint thinner	2 gl			
Brush, paint	2 ea			3 1/2" bristles
Staple gun	2 ea			
Staples	1 bx		1/2"	
Ridge cap	34 lf			3" x 12" pitch

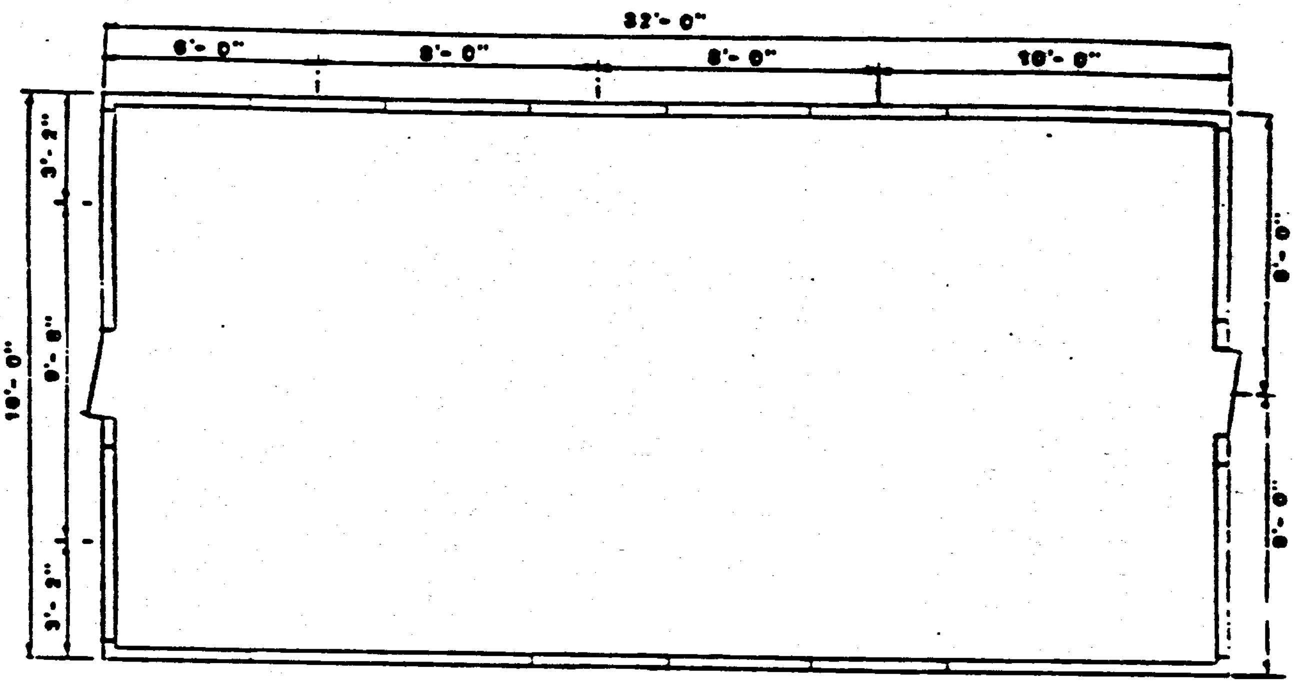
TROPICAL SEA HUT

II. MATERIAL TO PURCHASE

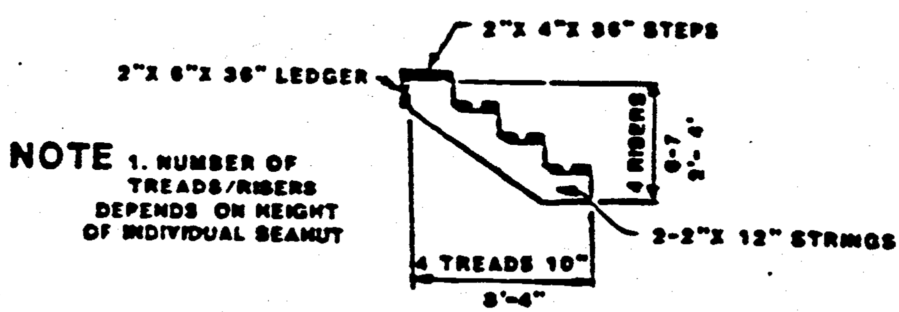
MATERIAL	QTY	NSN	U/P	TOTAL PRICE	REMARKS
1" x 3" x 8'	75 bf	5510 00 267 2385	.27	20.25	
1" x 6" x 8'	53 bf	5510 00 220 6080	.33	16.96	
1" x 6" x 16'	176 bf	5510 00 220 6080	.33	58.08	
1" x 12" x 8'	9 bf	5510 00 220 6086	.33	3.07	
2" x 4" x 8'	672 bf	5510 00 220 6194	.33	221.76	
2" x 4" x 16'	751 bf	5510 00 220 6194	.33	247.83	
2" x 4" x 12'	299 bf	5510 00 220 6194	.33	98.67	
2" x 6" x 16'	211 bf	5510 00 220 6196	.32	67.52	
2" x 8" x 16'	165 bf	5510 00 220 6198	.34	56.10	
2" x 12" x 8"	70 bf	5510 00 220 6198	.36	25.20	
4" x 4" x 16'	71 bf	5510 00 220 6226	.30	21.30	
1/2" x 4' x 8'	26 sh	5530 00 618 6958	14.60	379.60	plywood
3/4" x 4' x 8'	18 sh	5530 00 618 8073	10.38	186.84	plywood
Roofing	41 sh	NO NSN-26" x 120"	8.99ea	368.59	corrugated metal
Ridge cap	34 lf	NO NSN	13.50	459.00	3" x 12" pitch
Screen	2 rl	8305 00 927 3829	250.00	250.00	4' x 50'
16d comm	1 1/2 bx	5315 00 010 4663	17.50bx	26.25	nails (75 lbs)
8d comm	1/2 bx	5315 00 010 4659			nails (25 lbs)
Roofing nails	1/2 bx	5315 00 889 2735			corrugate metal (25 lbs)
Hinges	36 ea	5340 00 664 1326			4"x4" butt type
Wood preservative	1 cn	8030 00 559 9883			for mudsills
Paint thinner	1 gl	8010 00 160 5794			
Brush, paint	2 ea	8020 00 594 4770			3 1/2" bristles
Staple gun	2 ea	2120 00 889 1796			
Staples	2 bx	5315 00 889 2605			1/2"

* Wood materials are ordered in board feet of material (BFM), which is <u>not</u> the actual length of material required.

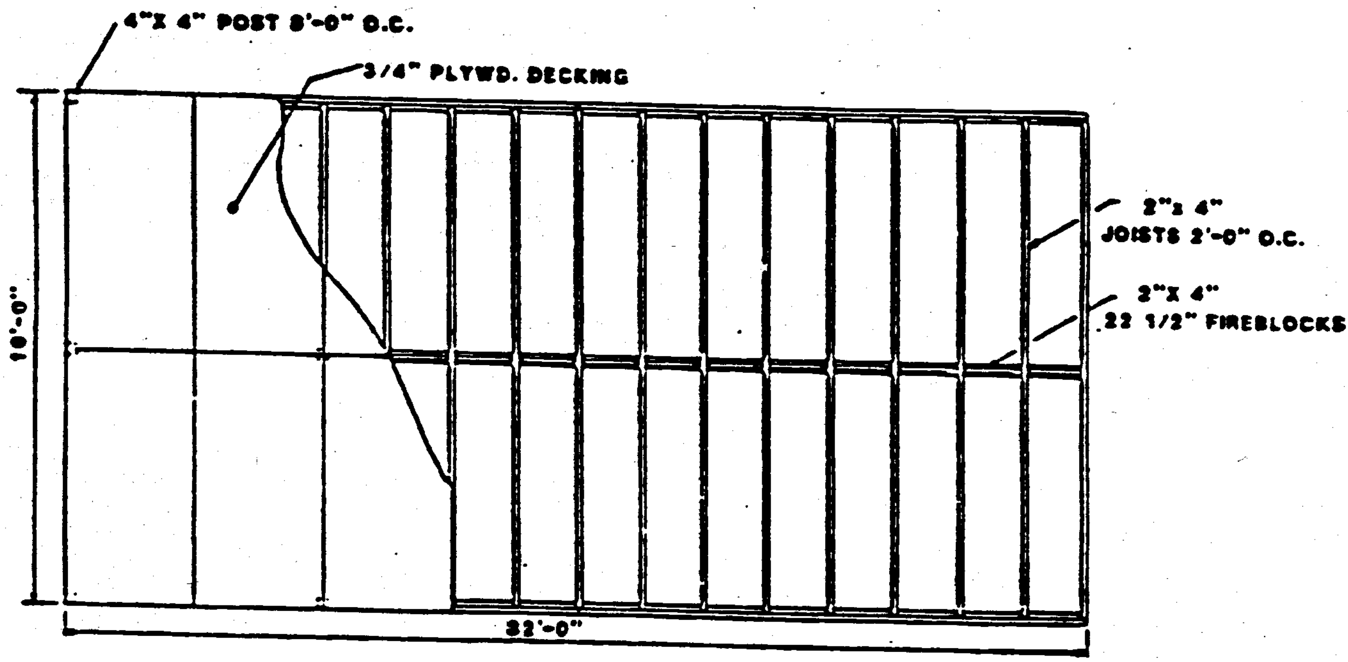
* 10% WASTE FACTOR INCLUDED IN THE MATERIAL ESTIMATE



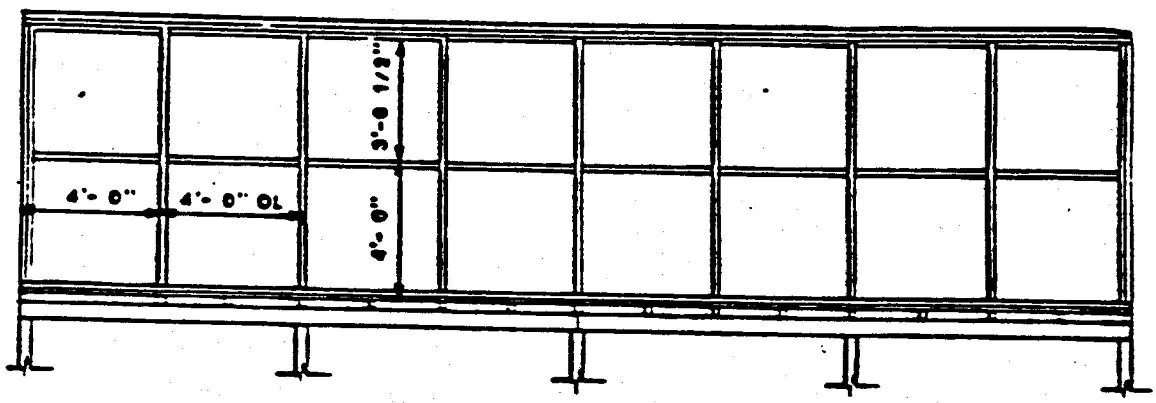
FLOOR PLAN



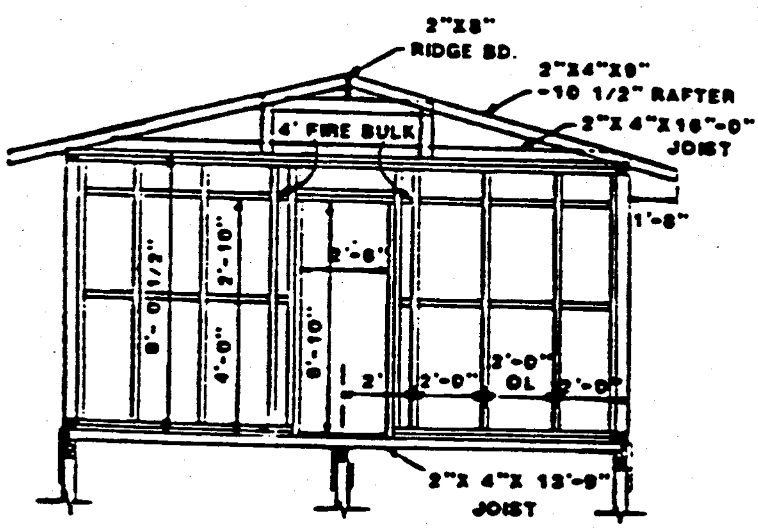
STAIR DETAIL



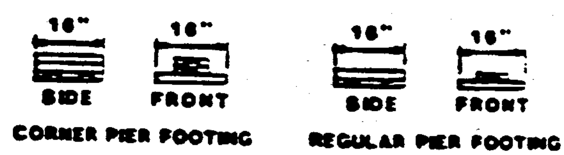
FLOOR FRAMING PLAN



SIDE FRAMING PLAN

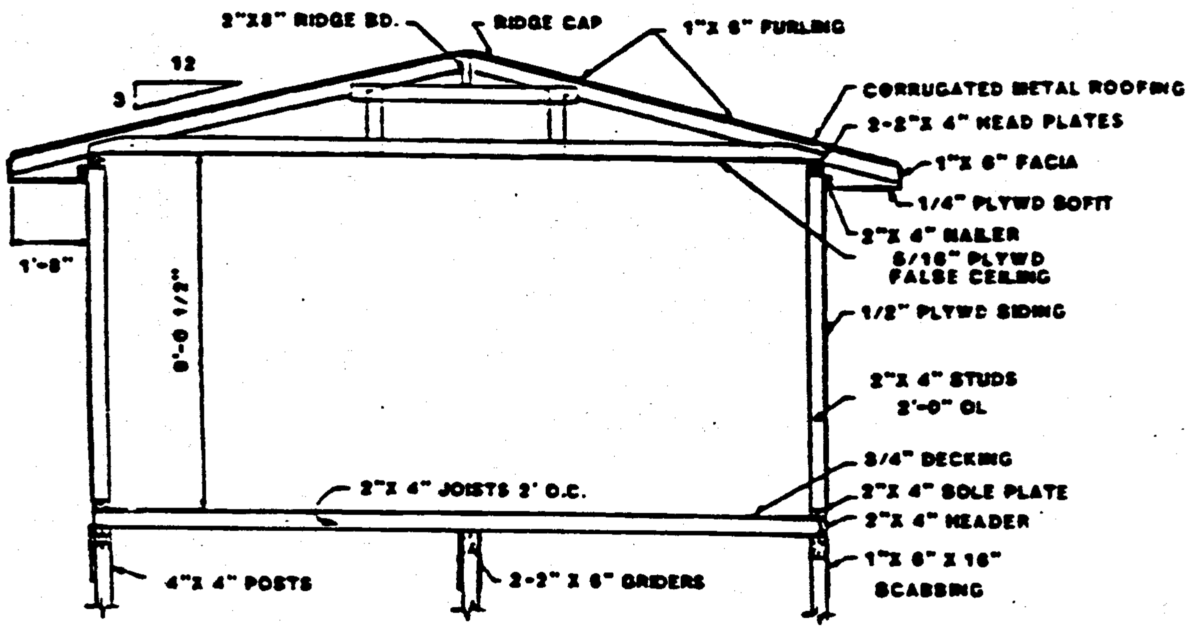


FRONT & BACK FRAMING PLAN (TYP)

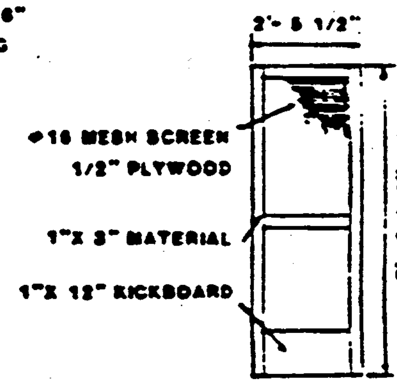


FOOTING DETAILS

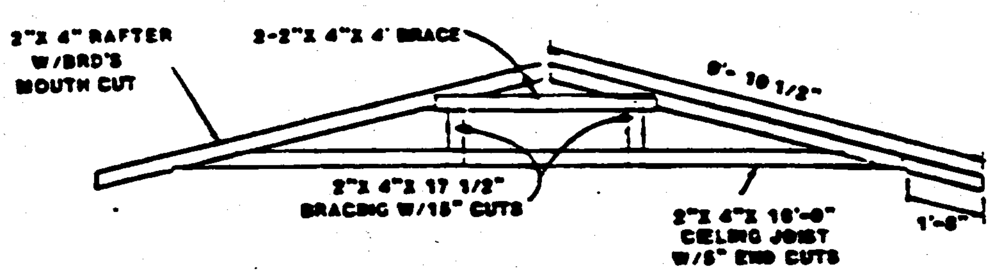
NOTE:
FOOTINGS MADE
FROM 2"X 8" MATERIAL



SECTION A-A

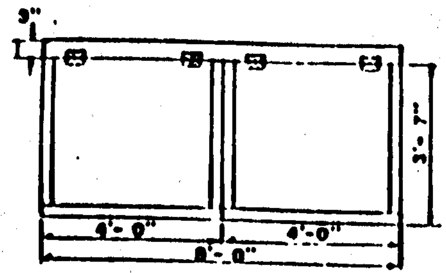


FRONT VIEW
(REVERSE TYPE)

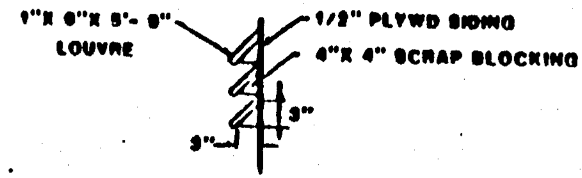


RAFTER DETAIL

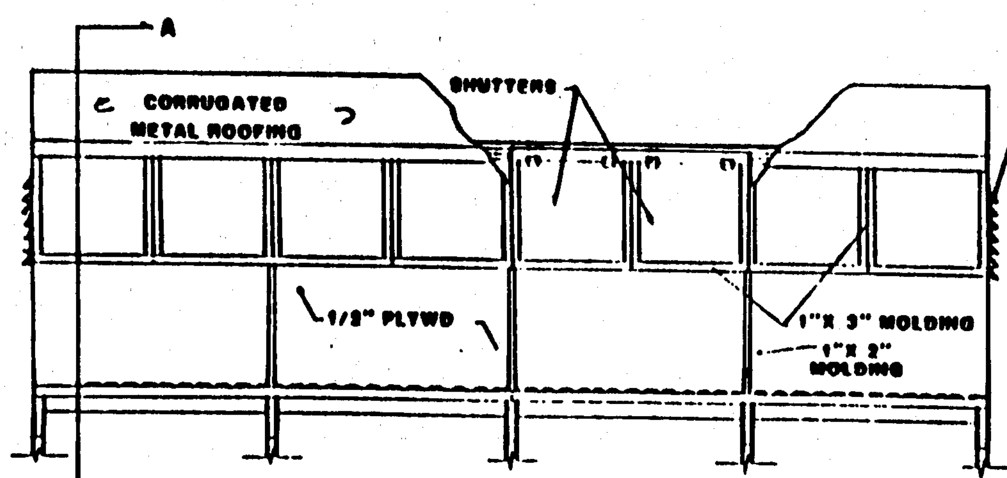
NOTE:
1. RAFTERS TO BE BRACED 2'-0" O.C.



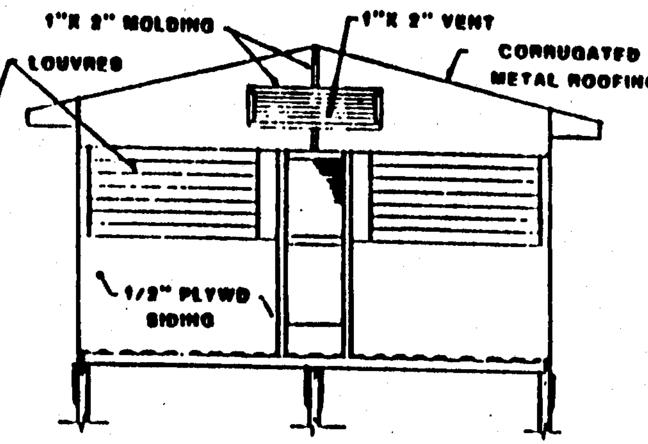
SHUTTER DETAIL



LOUVRE DETAIL



SIDE ELEVATION



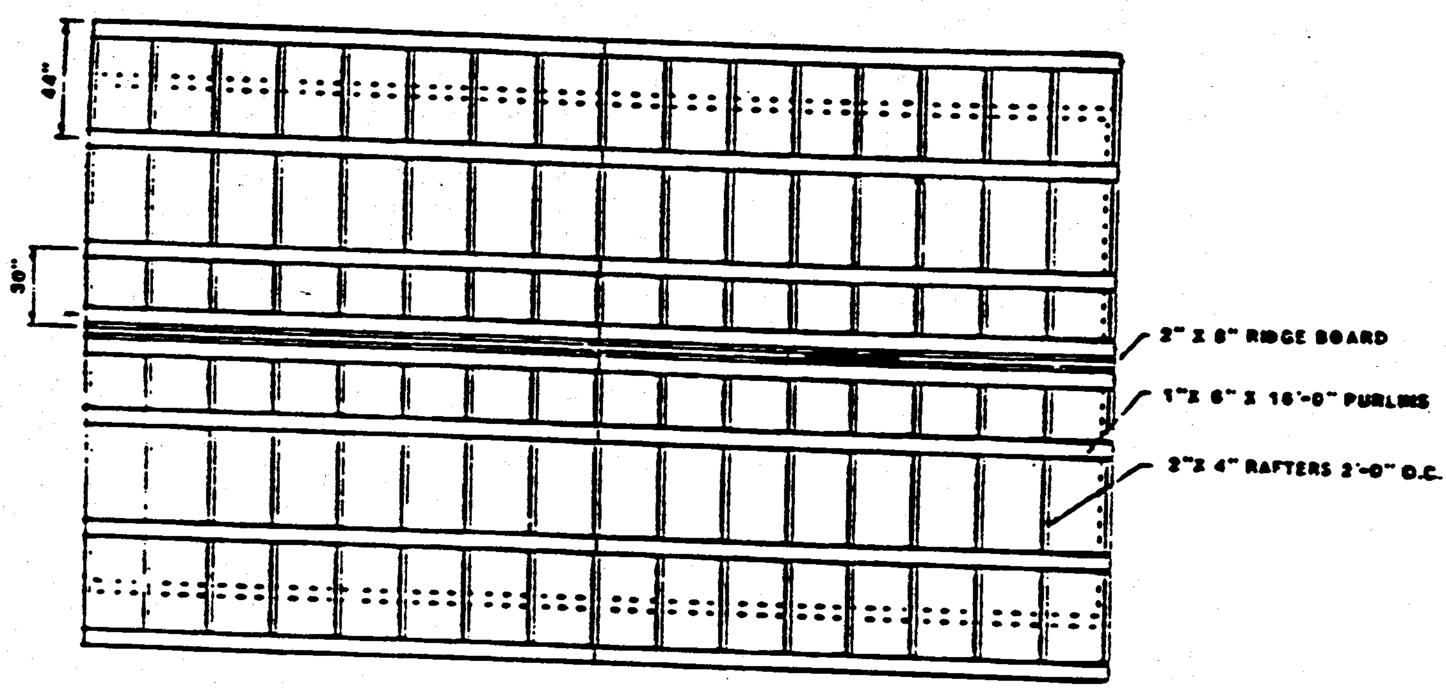
FRONT & BACK ELEVATION (TYP)

NOTES:

1. A CUT WILL BE MADE AT THE 3" MARK. CUTTING THROUGH THE FULL LENGTH OF THE PLYWD SHEET, ANOTHER CUT WILL BE MADE AT THE 4'-0" MARK WILL BE CUT 3-7" DEEP. THIS WILL ENABLE THE SHUTTERS TO BE OPENED OR CLOSED AS DESIRED AFTER THE HINGES HAVE BEEN INSTALLED.

NOTE:

1. THE AREA ENCLOSED BY SHUTTERS AND LOUVRES WILL BE COVERED BY #16 MESH SCREENING.



ROOF FRAMING PLAN

WINTERIZED SEA HUT

I. BILL OF MATERIALS

MATERIAL	QTY	BFM	FINISH DIMENSION	REMARKS
2" x 8" x 16'	5	107	2" x 8" x 16"	footings
4" x 4" x 8'	15	64	4" x 4" x 3'	footing post
2" x 6" x 16'	12	192	2" x 6" x 16'	girders
2" x 4" x 8'	4	21	2" x 4" x 16"	scabbing
2" x 4" x 16'	4	43	2" x 4" x 16'	joist header
2" x 4" x 16'	17	181	2" x 4" x 15'- 8 3/4"	floor joists
2" x 4" x 8'	16	85	2" x 4" x 22 1/2"	fire blocking
3/4" x 4' x 8'	16 sh		3/4" x 4' x 8'	flooring (ply)
2" x 4" x 16'	4	43	2" x 4" x 16'	sole plate
2" x 4" x 8'	4	21	2" x 4" x 6'- 3 3/4"	sole plate
2" x 4" x 8'	42	224	2" x 4" x 7'- 7 5/8"	studs
2" x 4" x 8'	6	32	2" x 4" x 3'-11 3/16"	bracing
2" x 4" x 8'	6	32	2" x 4" x 3'-11 3/16"	window sill
2" x 4" x 8'	6	32	2" x 4" x 3'-11 3/16"	window heaper
2" x 4" x 8'	3	16	2" x 4" x 3'	window cripple
2" x 4" x 16'	8	85	2" x 4" x 16'	double top plate
2" x 4" x 16'	4	43	2" x 4" x 16'	double top plate
2" x 4" x 8'	3	16	2" x 4" x 1'- 11 3/16"	bracing
Any 2" x 4" scrap	8		2" x 4" x 4"	blocking
2" x 4" x 8'	4	21	2" x 4" x 6'- 10"	jamb
2" x 4" x 8'	2	11	2" x 4" x 2'- 9 1/4"	header
2" x 4" x 16'	17	181	2" x 4" x 16'	roof joists
2" x 4" x 12'	34	272	2" x 4" x 9'- 10 1/2"	rafters
2" x 8" x 16'	2	43	2" x 8" x 16	ridge board
1" x 6" x 16'	16	128	1" x 6" x 16'	purlins
1/2" x 4' x 8'	24 sh		1/2" x 4' x 8'	sheathing
1" x 6" x 16'	4	32	1" x 6" x 16'	fascia
2" x 4" x 16'	6	64	2" x 4" x 4'- 11"	collar beam
2" x 4" x 8'	5	27	2" x 4" x 17 1/2"	rafter brace
Roofing	37 sh		26" x 120"	corrugated metal
Ridge cap	34 lf			3" x 12" pitch
1/2" x 4' x 8'	4 sh		1/2" x 2'-10" x 5'-6"	shutters
1/2" x 4' x 8'	3 sh		1/2" x 2'-6" x 3'-10 1/2	shutters
1" x 2" x 8'	11	15	cut to length	battens, use 25 bf of 2" x 4" x 8'
1" x 3" x 8'	12	24		shutter trim
1" x 3" x 8'	12	24		shutter frame
1/2" x 4' x 8'	2 sh		1/2"x2'-5 1/2"x6'-9 1/2"	door
1" x 3" x 8'	8	16	1" x 3" x 6'-9 1/2"	stiles
1" x 3" x 8'	3	6	1" x 3" x 2'—2 1/4"	top/bottom rails
1" x 3" x 8'	2	4	1" x 3" x 7'-4"	diagonal brace
5/16" x 4' x 8'	16 sh		5/16" x 4' x 8'	ceiling (ply)
2" x 12" x 8'	4	64	cut according to height of sea hut	stair stringer
2" x 4" x 16'	4	43	2" x 4" x 3'	treads
1" x 2" x 8'	4	5	1" x 2" x 6'-8 3/4"	jamb stop, use 7 bf of 2" x 4" x 8'

WINTERIZED SEA HUT

I. BILL OF MATERIALS (Cont.)

MATERIAL	QTY	BFM	FINISH DIMENSION	REMARKS
1" x 2" x 8'	1	1	1" x 2" x 2'-5 1/2"	header stop, use 2 bf of 2" x 4" x 8'
1/4" x 4" x 8'	4 sh		1/2" x 20" x 8'	soffit
Hinges	24 ea		4" x 4"	butt type
Screen	1 rl		4" x 50'	window covering
16d comm	75 lbs			nails
8d comm	25 lbs			nails
Roofing nails	25 lbs			corrugated metal
Wood preservative	1 cn			for mudsills
Paint, thinner	1 gl			
Brush, paint	2 ea			3 1/2" bristles
Staple gun	2 ea			
Staples	2 bx		1/2"	
U.S. Army diesel Space heater	1 ea			
Flashing Stovepipe	1 ea			for sloped roof 6" hole

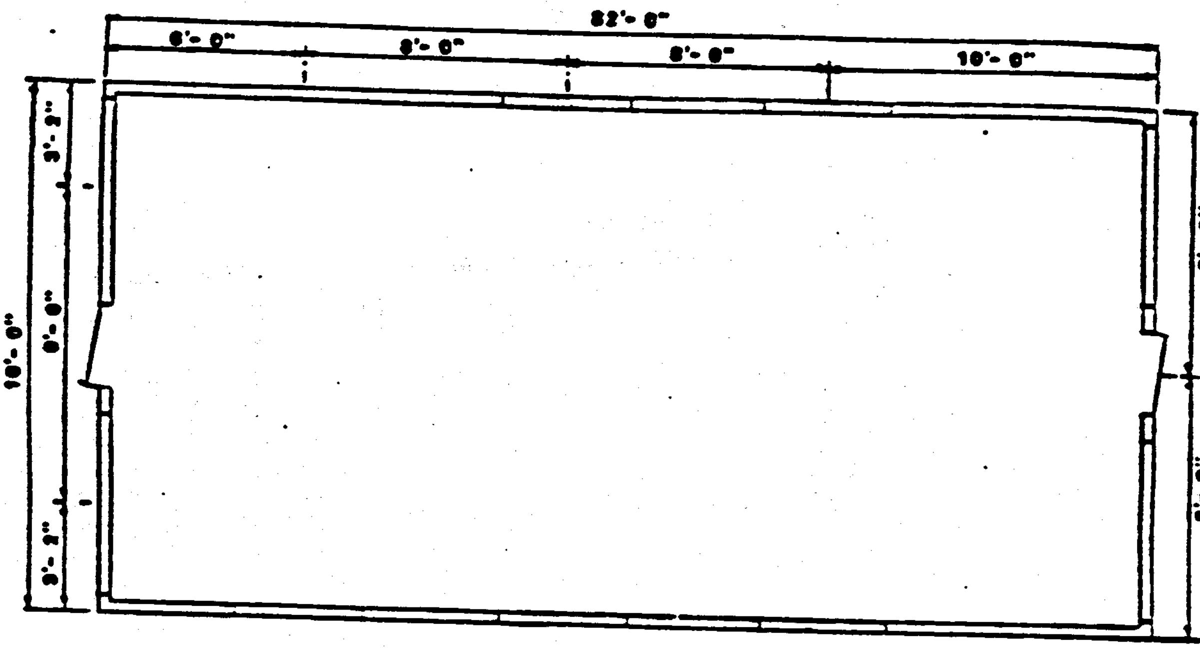
WINTERIZED SEA HUT

II. MATERIAL TO PURCHASE

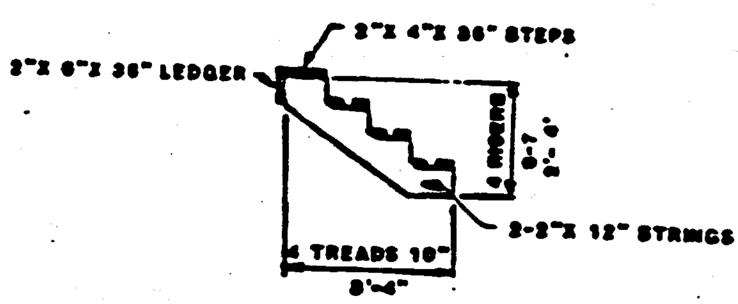
MATERIAL	QTY	NSN	U/P	TOTAL PRICE	REMARKS
1" x 3" x 8'	82 bf	5510 00 267 2385			
1" x 6" x 16'	176 bf	5510 00 220 6080			
2" x 4" x 8'	626 bf	5510 00 220 6194			
2" x 4" x 16'	751 bf	5510 00 220 6194			
2" x 4" x 12'	299 bf	5510 00 220 6194			
2" x 6" x 16'	211 bf	5510 00 220 6196			
2" x 8" x 16'	165 bf	5510 00 220 6198			
2" x 12" x 8'	70 bf	5510 00 220 6198			
4" x 4" x 8'	71 bf	5510 00 220 6226			
1/2" x 4' x 8'	36 sh	5530 00 618 6958			plywood
5/16" x 4' x 8'	17 sh	5530 00 926 4531			plywood
3/4" x 4' x 8'	17 sh	5530 00 618 8073			plywood
Roofing	37 sh	NO NSN-26" x 120"			corrugated metal
Ridge cap	34 lf	NO NSN			3" x 12" pitch
Screen	1 rl	8305 00 927 3829			4' x 50'
16d comm	1 1/2 bx	5315 00 010 4663			nails (75 lbs)
8d comm	1/2 bx	5315 00 010 4659			nails (25 lbs)
Roofing nails	1/2 bx	5315 00 889 2735			corrugated metal (25 lbs)
Hinges, 4" x 4"	24 ea	5340 00 664 1326			butt type
Wood preservative	1 cn	8030 00 559 9863			for mudsills
Paint thinner	1 gl	8010 00 160 5794			
Brush, paint	2 ea	8020 00 597 4770			3 1/2" bristles
Staple gun	2 ea	5120 00 889 1796			
Staples	1 bx	5315 00 889 2605			1/2"
1/4" x 4" x 8'	4 sh	5530 00 128 4115			offset
U.S. Army diesel Space heater	1 ea				
Flashing	1 ea				for sloped roof
Stovepipe					6" hole

* Wood materials are ordered in board feet of material (BFM), which is not the actual length of material required.

* 10% WASTE FACTOR INCLUDED IN THE MATERIAL ESTIMATE

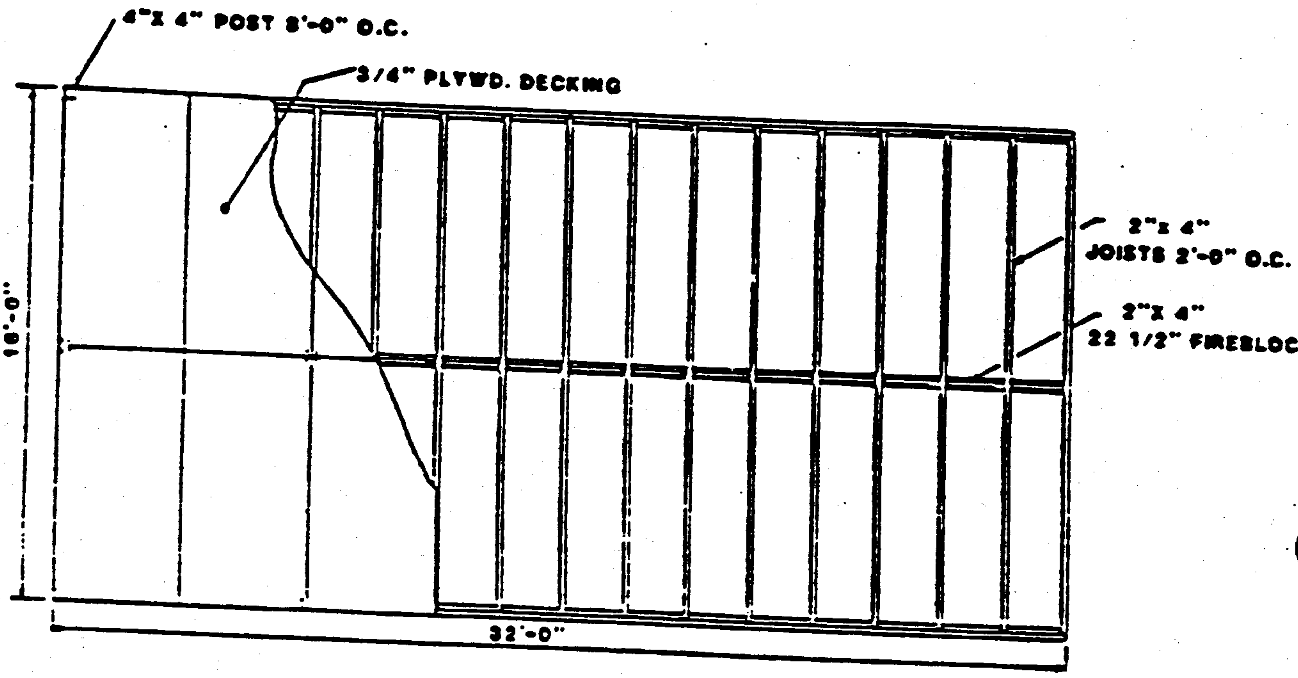


FLOOR PLAN

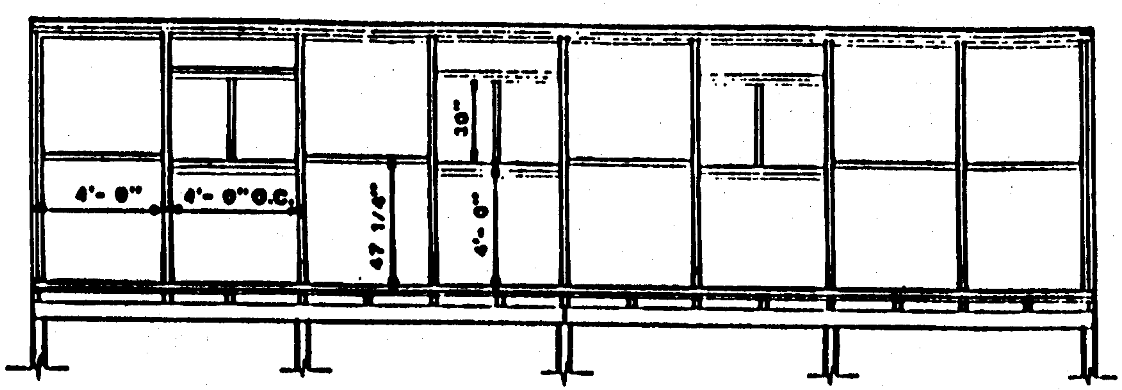


STAIR DETAIL

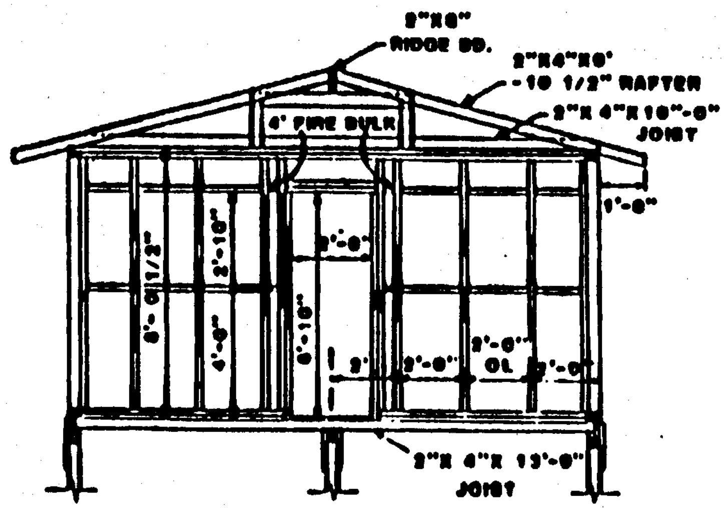
NOTE 1. NUMBER OF TREADS/RISERS DEPENDS ON HEIGHT OF INDIVIDUAL SEAHUT



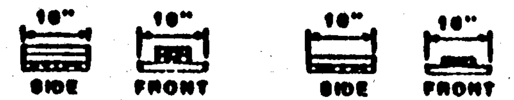
FLOOR FRAMING PLAN



SIDE FRAMING PLAN



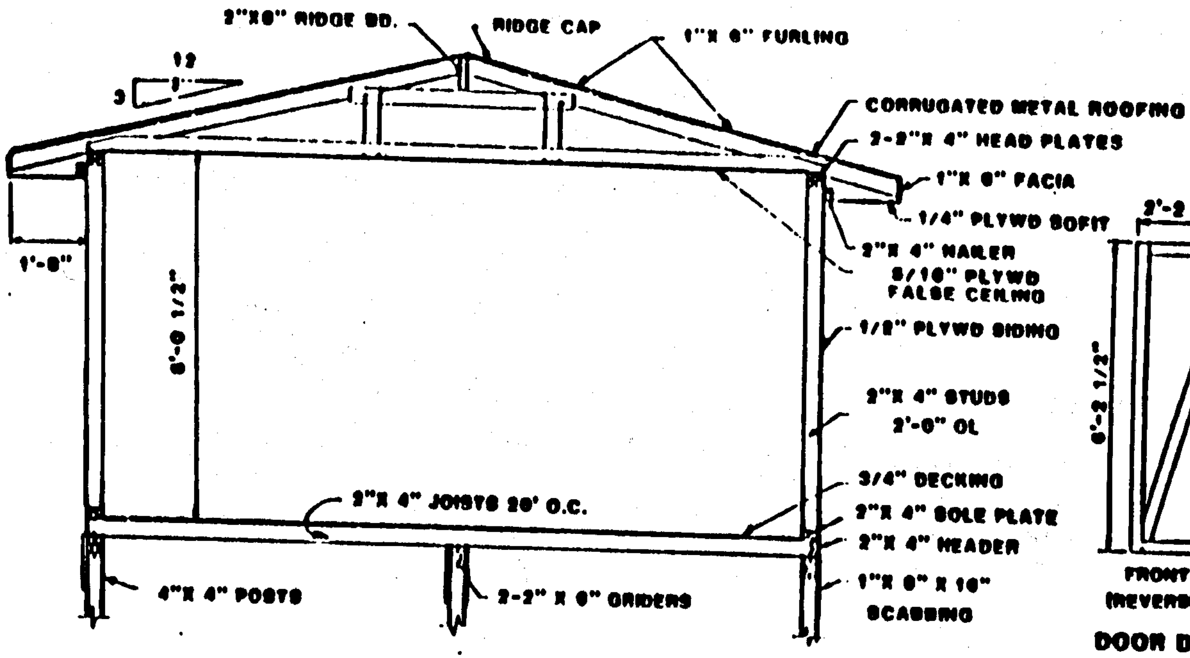
FRONT & BACK FRAMING PLAN (TYP)



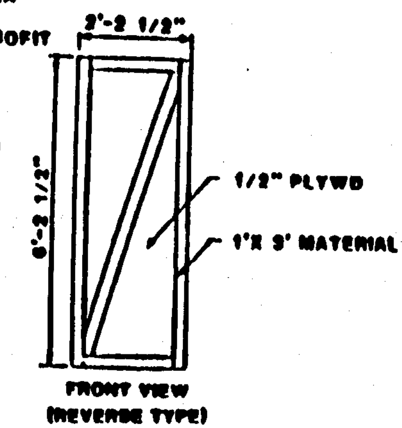
CORNER PIER FOOTING REGULAR PIER FOOTING

FOOTING DETAILS

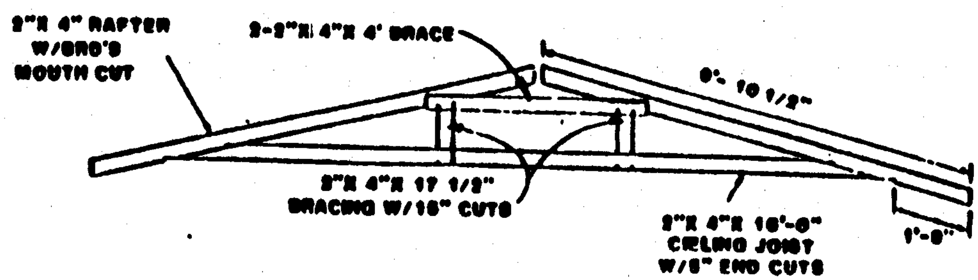
NOTE:
FOOTINGS MADE
FROM 2"X 8" MATERIAL



SECTION A-A



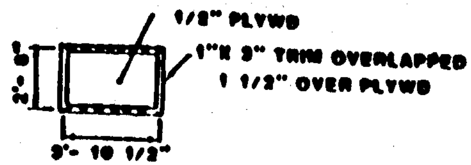
DOOR DETAIL



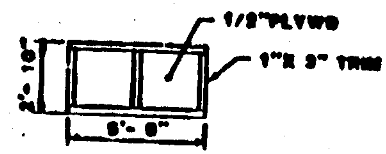
RAFTER DETAIL

NOTE:

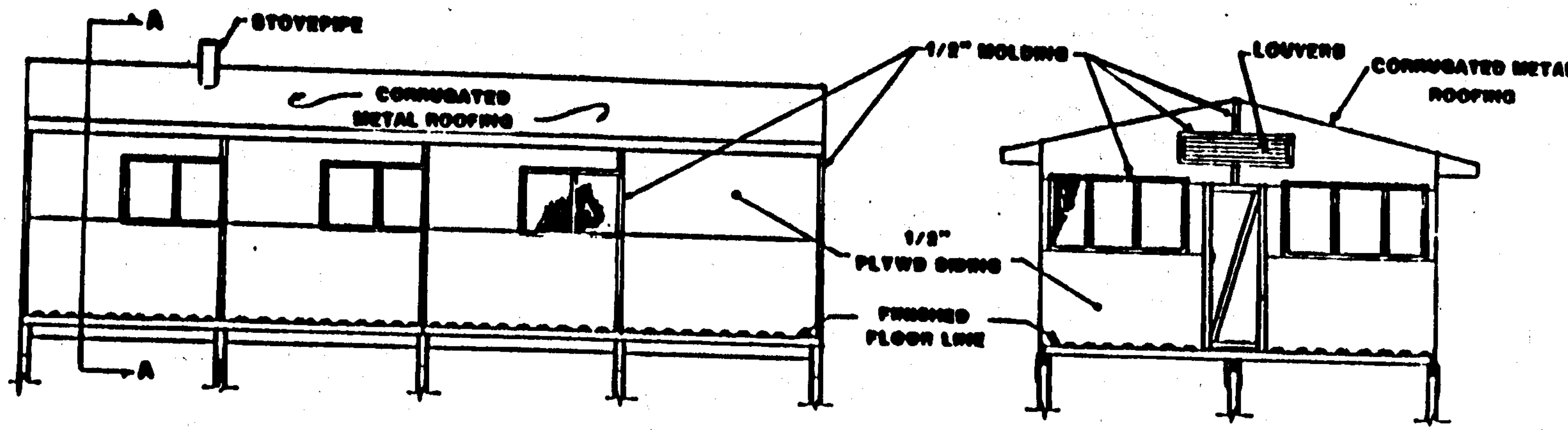
1. RAFTERS TO BE BRACED 2'-0" O.C.



SIDE WINDOW SHUTTER



FRONT (REAR) WINDOW SHUTTER



SIDE ELEVATION

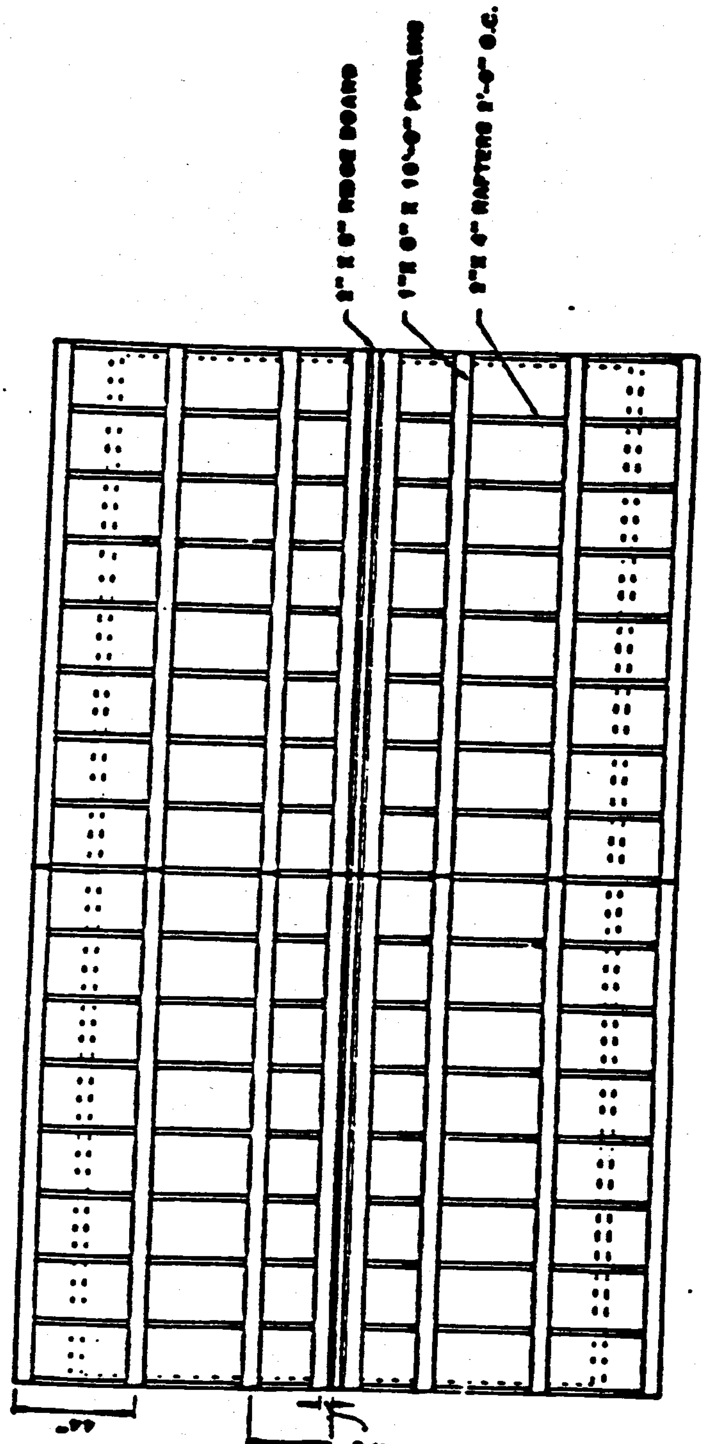
FRONT BACK ELEVATION

NOTES:

1. SIDE WINDOW SHUTTERS TO BE PLACED ON EXTERIOR OF SEAHUT.
2. SHUTTERS TO BE HINGED AS NEEDED

NOTES:

1. FRONT (REAR) WINDOW SHUTTERS TO BE PLACED IN INTERIOR OF E SEAHUT CENTERED ON ROUGH OPENING.
2. SHUTTERS TO BE HINGED AS NEEDED.



ROOF FRAMING PLAN

TYPHOON TIE DOWN UNIT

I. MATERIAL TO PURCHASE FOR TYPHOONIZATION OF THE STRONGBACK

NSN	MATERIAL	QTY	U/P	TOTAL PRICE
DD 1149	Wire rope, 1/2"	90 ft		
	Turnbuckle for 1/2" dia. wire rope	6 ea		
	Clip for 1/2" dia. wire rope	6 ea		
	Bolt, eye - 5/8" x 10" with nuts	6 ea		
	Locking bolts	12 ea		
	Concrete, Ready-mix	15 cf		

II. MATERIAL TO PURCHASE FOR TYPHOONIZATION OF THE SEA HUT AND STRONGBACK

NSN	MATERIAL	QTY	U/P	TOTAL PRICE
DD1149	Wire rope, 1/2"	150 ft		
	Turnbuckles for 1/2" dia. wire rope	6 ea		
	Clip for 1/2" dia. wire rope	6 ea		
	Bolt, eye - 5/8" x 10" with nuts	6 ea		
	Locking bolts	12 ea		
	Concrete, Ready-mix	18 cf		

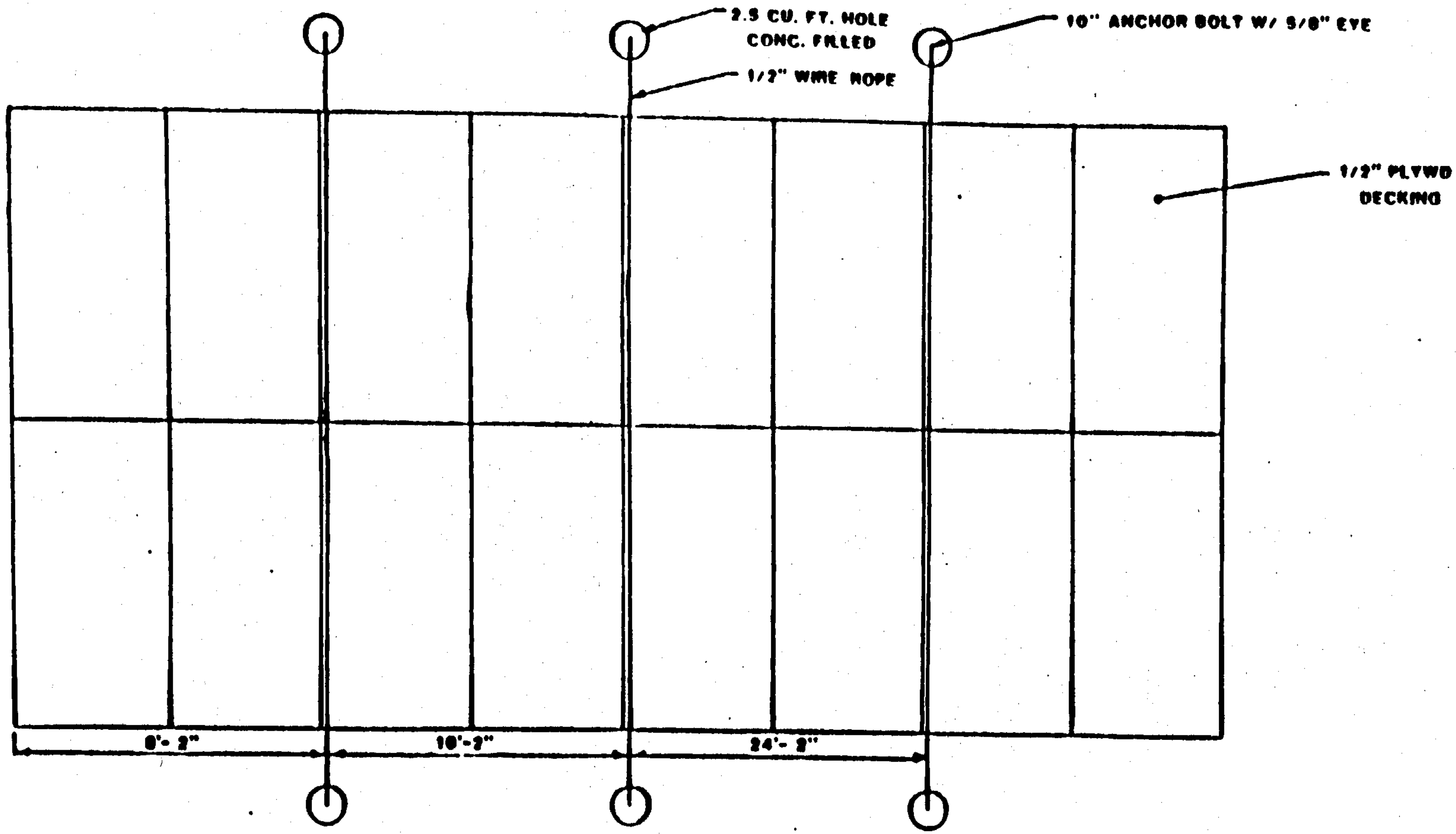
III. MANUFACTURE OF CONCRETE

1. Ready-mix concrete may not always be available for your construction project due to the sometimes remote locations of Base Camps in Southeast Asia. Therefore, concrete can be mixed at the job site and substituted for ready-mix concrete to complete typhoonization.

2. Concrete mixing proportions and material to purchase. A bag of cement contains one cubic foot . Concrete is normally ordered in cubic yards (cd) and there are 27 cubic feet in one cubic yard.

NSN	MATERIAL	PROPORTIONS	U/P	TOTAL PRICE
5610 00 V04 8369	Cement, 1 cf/bag	3 cf		
5610 00 267 7134	Sand, washed	6 cf		
5610 00 V00 8687	Gravel, 3/4" minus	9 cf		
		18 cf		

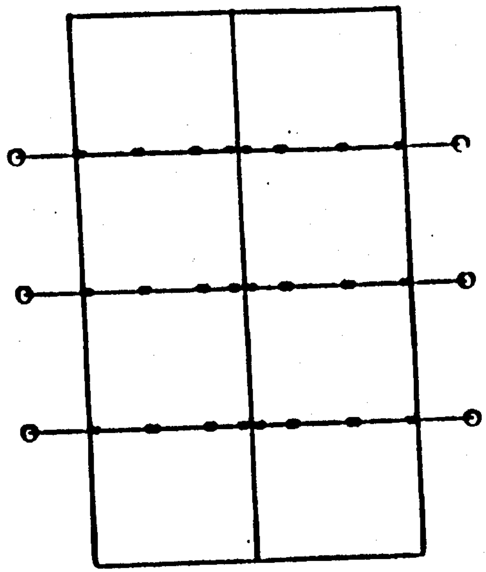
* Add six (6) gallons of fresh water for each bag of cement.



NOTES:

1. A 5/8" HOLE MUST BE DRILLED IN THE STRONGBACK'S KICKBOARD APPROX. 2" ABOVE THE FINISHED DECKING SO THAT THE WIRE ROPE CAN EXTEND ACROSS THE DECKING AND INTO THE ANCHOR BOLTS.

2. ANCHOR BOLT, TURNBUCKLE AND WIRE ROPE ASSEMBLY IS IDENTICAL TO ASSEMBLY USED ON SEAHUT/NEAHUT TYPHOONIZATION. SEE ENCLOSURE 4, PAGE 3.



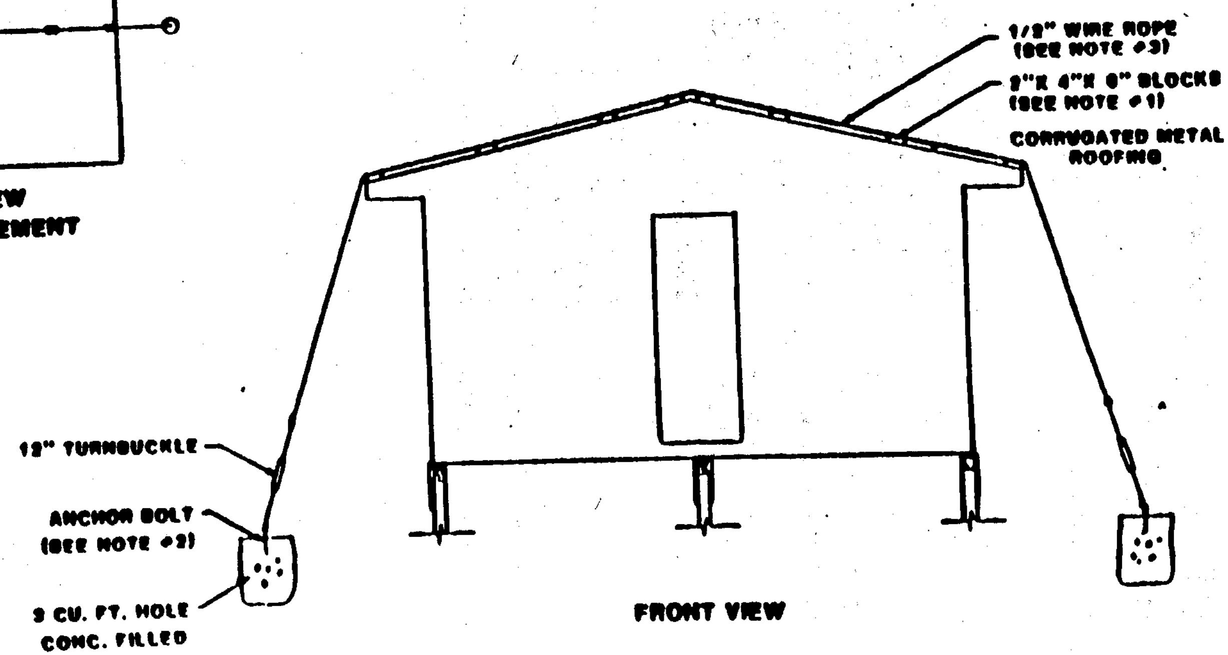
TOP VIEW
BLOCK PLACEMENT

NOTES:

1. 1/2" WIRE ROPE SITS ATOP 2"X 4"X 8' BLOCKS WHICH ARE PLACED ON TOP OF THE CORRUGATED METAL ROOFING AND OVER THE ROOF PURLINS (SEE ROOF FRAMING PLAN) SPACING OF THE 2"X 4"X 8" BLOCKS IS IDENTICAL TO THE SPACING OF THE PURLINS.

2. 10" ANCHOR BOLTS W/5/8" EYE SET 8" IN 3 CU. FT. CONCRETE HOLE.

3. WIRE ROPE TYPHOONIZATION UNITS REQUIRED PER SEAHUT/NEAHUT, SET AT 8' INTERVALS.

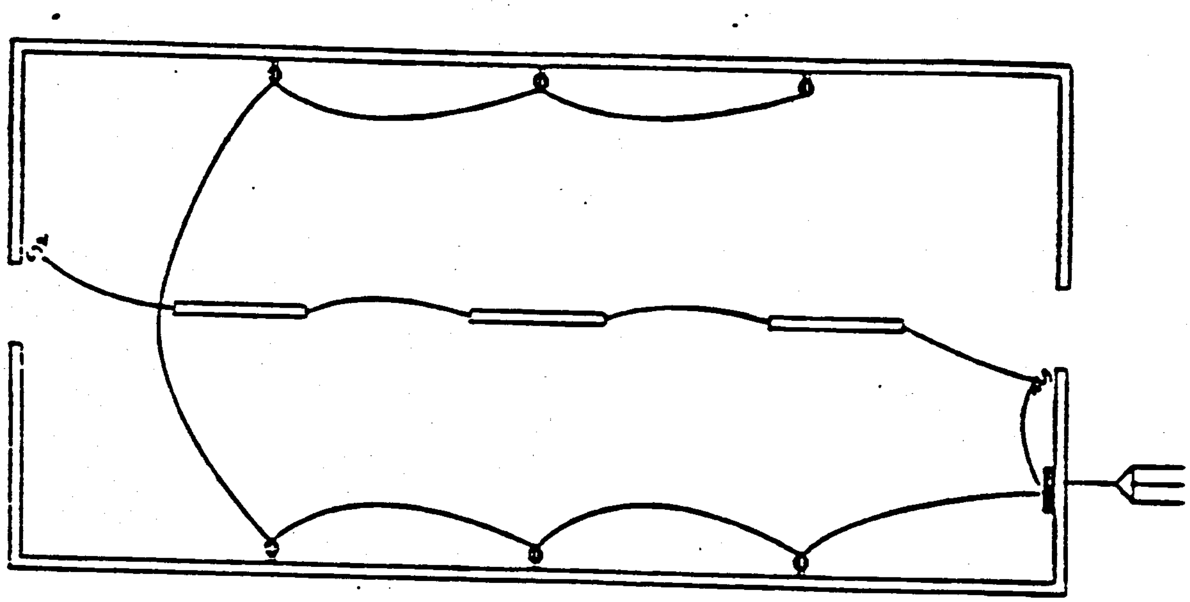


FRONT VIEW

ELECTRICAL UNIT

I. MATERIAL TO PURCHASE

NSN	MATERIAL	QTY	U/P	TOTAL PRICE
6145 00 841 8308	Cable, romex #12 2-CDR, 600v 250'	1/4 cl		
6145 00 824 2454	Cable, romex #12 3-CDR, 600v 250'	1/2 cl		
5925 00 930 5560	Circuit breaker, 2-15A in nema-1, enclosure	1 ea		
5940 00 502 1260	Splice conductor #8 AWG	2 ea		
6210 00 892 5294	Fixture, fluorescent 2-40 W	3 ea		
6210 01 004 3107	Lamp, fluorescent 35 W	6 ea		
5970 00 284 5451	Rack, 3-wire w/spools	1 ea		
5970 00 419 4291	Tape, plastic, elec. insulation 3/4" wide	1 rl		
5306 00 100 5094	Lagscrew, 1/2" x 6"	3 ea		
5975 00 284 5827	Box utility, 2 1/8" deep 1/2" KD	6 ea		
5935 01 012 3080	Receptacle, duplex flush 3 wire, 125 V	6 ea		
5975 00 682 0559	Plate, f/duplex receipt stainless steel	6 ea		
5975 00 152 1144	Box connector straight 3/8" to 1/2"	20 ea		
5930 00 644 6730	Switch, toggle, single volt 10 amp, 125 V	2 ea		



ELECTRICAL PLAN

STUDENT HANDOUT

CONSTRUCTION PRINT READING

SH 1300-05

09 JUNE 1998

MARINE CORPS ENGINEER SCHOOL
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

CONSTRUCTION PRINT READING

CONTENTS

SECTION 1

PRINCIPLES AND METHODS

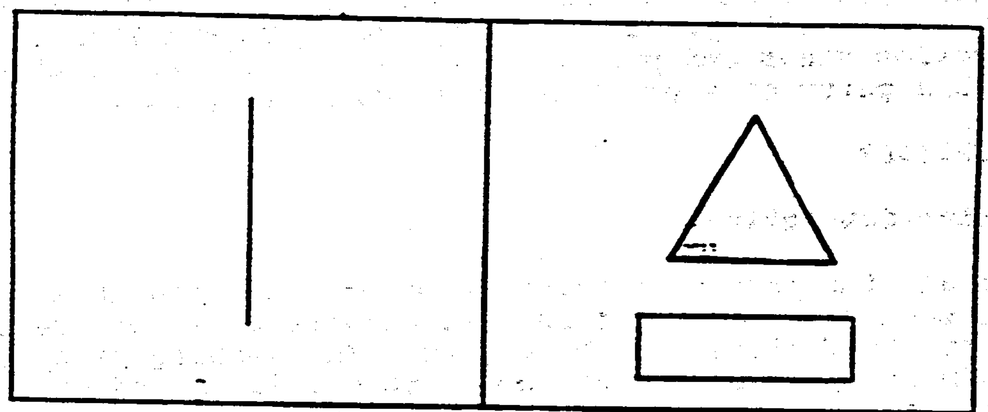
Introduction. It would be almost impossible for an engineer or an inventor to describe the size and shape of a simple object without a drawing of some kind. When building any structure, construction specifications must be followed precisely. This study unit will enable you to identify the terms and symbols used in construction views and projections. You will also be able to name both the parts of a print and the types of prints.

LINE CONVENTIONS

Types of Line Conventions

To include all the necessary information on a drawing in a meaningful manner, different types and weights of lines are used to represent the features of the object. The meaning of a line with certain characteristics has been standardized, and will be the same on any drawing. These line conventions must be understood in order to read drawings. The line conventions most often encountered in construction prints are presented in this lesson.

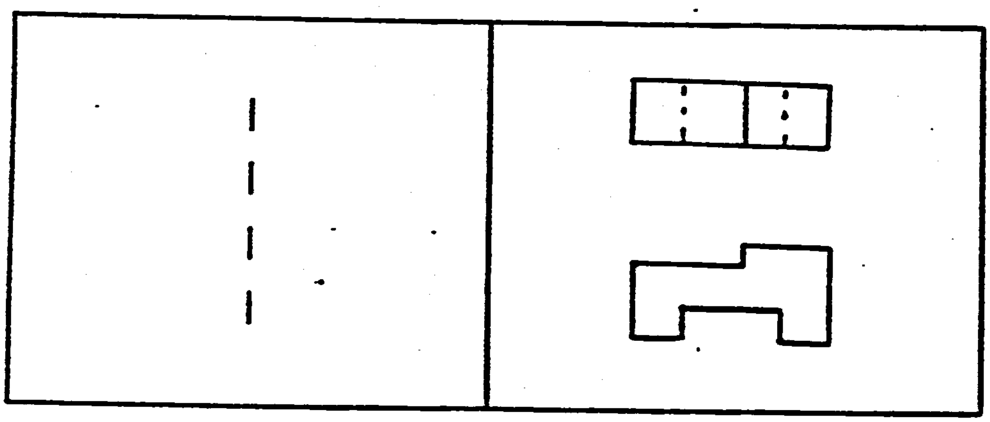
a. Visible lines. A heavyweight unbroken line is used for the primary feature of a drawing (fig 1-1). For drawings of objects, this line convention represents the edge, the intersection of two surfaces, or the surface limit that is visible from the viewing angle of the drawing. This line is often called the outline.



Convention Example

Fig 1-1. Visible Lines.

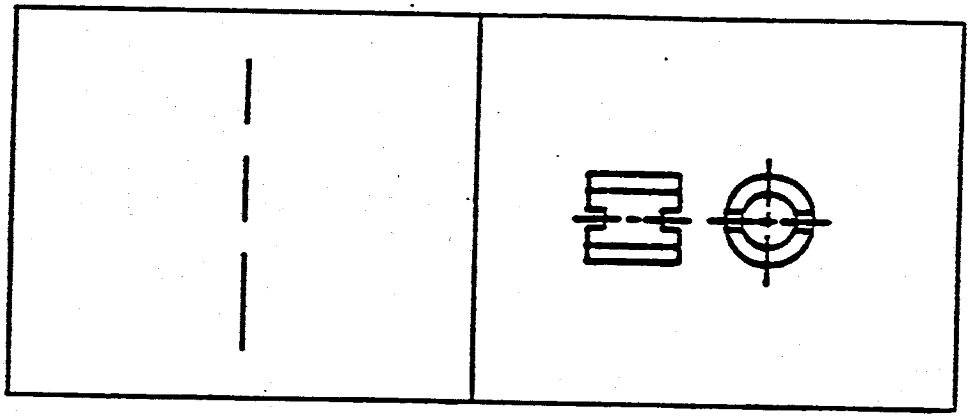
b. Hidden lines. A medium-weight line (fig 1-2) of evenly spaced short dashes represents an edge, the intersection of two surfaces, or the surface limit which is not visible from the viewing angle of the drawing.



Convention Example

Fig 1-2. Hidden lines.

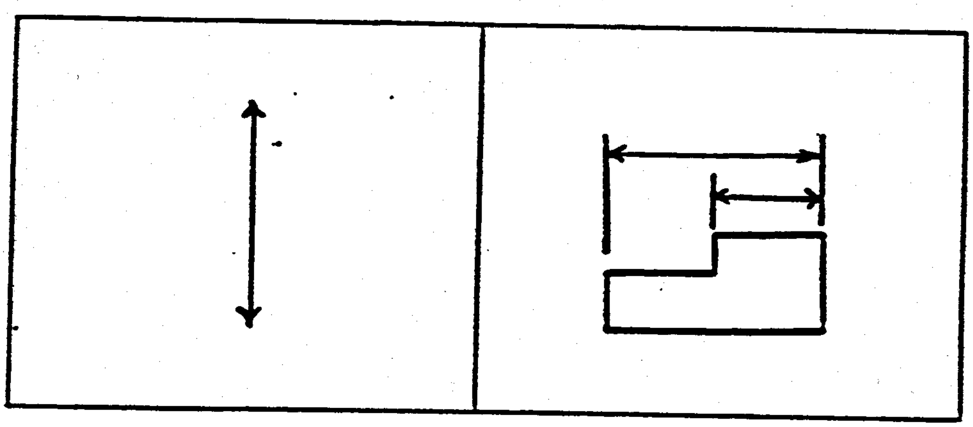
c. Center lines. A thin (light) line (fig 1-3) composed of alternate long and short dash lines. It is used to signify the center of a circle or arc and to divide object into equal or symmetrical parts.



Convention Example

Fig 1-3. Center Lines.

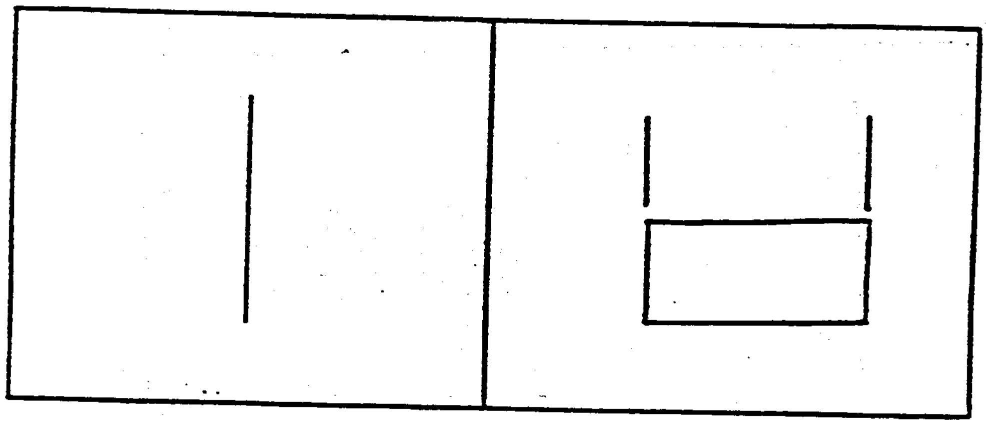
d. Dimension lines. A solid continuous line terminating in arrowheads at each end. Dimension lines (fig 1-4) are broken only to permit writing in dimension measurements. The only time this is not done is when completing construction drawings. The points of the arrowhead touch the extension lines which mark the limits of the dimension. The dimension is expressed in feet and inches on architectu-ral drawings and in feet and decimal fractions of a foot on engineering drawings.



Convention Example

Fig 1-4. Dimension lines.

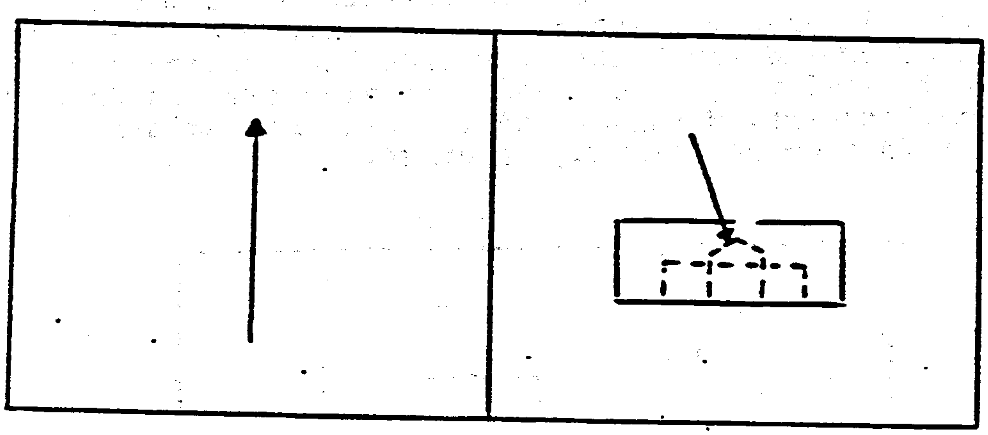
e. Extension lines. An extension line (fig 1-5) is a (light) unbroken line that is used to indicate the extent of the visible lines of an object when it is not convenient to draw a dimension line directly between the visible lines. There is always a small space between the extension line and the visible line.



Convention Example

Fig 1-5. Extension lines.

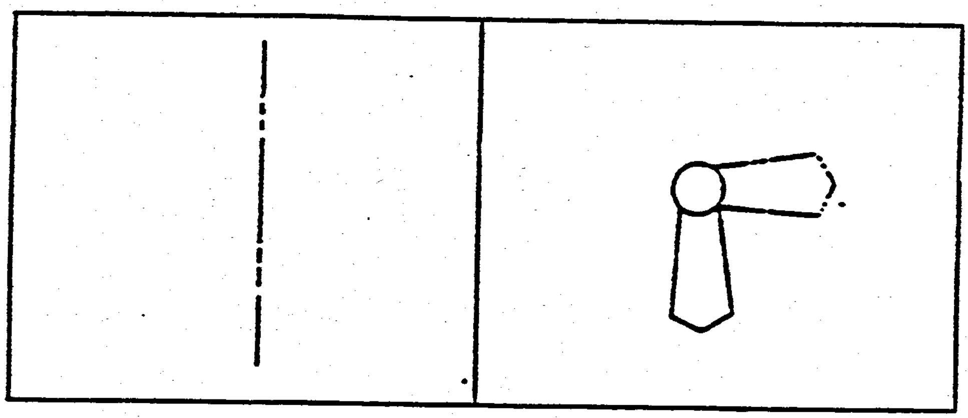
f. Leaders. A leader (fig 1-6) is a thin (light) line terminated with an arrowhead that is used to indicate the part or feature to which a number, note or other information refers.



Convention Example

Fig 1-6. Leaders.

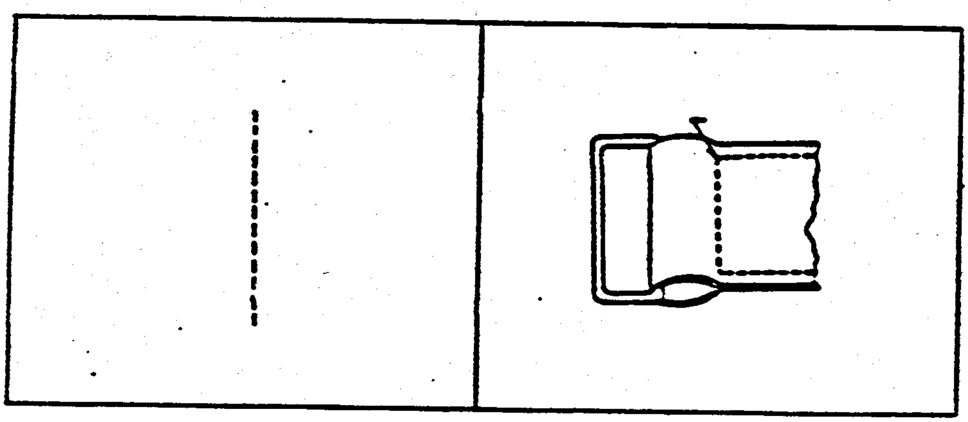
g. Phantom lines or Datum Lines. A medium wei-ght line made of long dashes broken by two short dashes is called a phantom line (fig 1-7) and indicates one of three things: the relative position of an absent part, and alternative position of a part, or repeated detail which is not drawn.



Convention Example

Fig 1-7. Phantom lines or datum line.

h. Stitch lines. A medium line (fig 1-8) made of short dashes evenly spaced and labeled; used to indicate stitching or sewing.



Convention Example

Fig 1-8. Stitch Lines.

i. <u>Break (LONG) lines</u>. A thin (light) line interrupted by a z-shaped symbol. The break line (fig 1-9) indicates that the object has been shortened to save space on the drawing. The true length is indicated by the dimension specified.

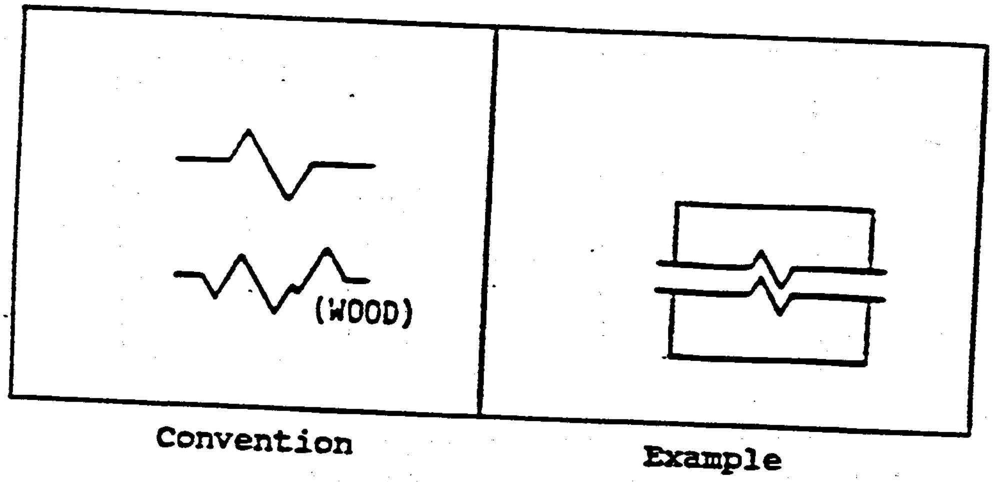
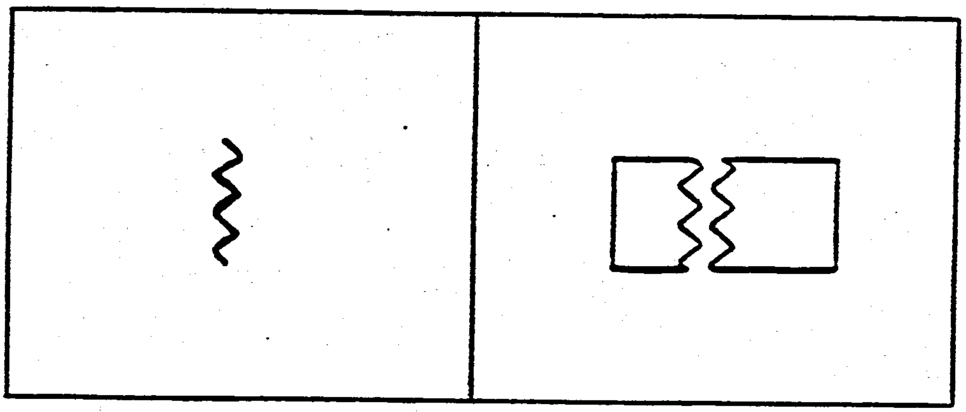


Fig 1-9. Break (LONG) line.

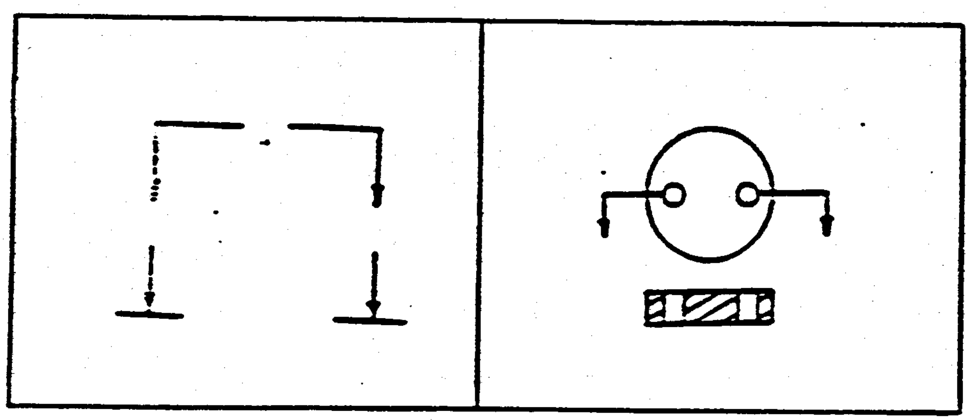
j. Break (SHORT) Lines. The break, or short, line convention varies with shape and material, as shown in figure 1-10. It indicates that part of the object has been cut away to show section detail or hidden features.



Convention Example

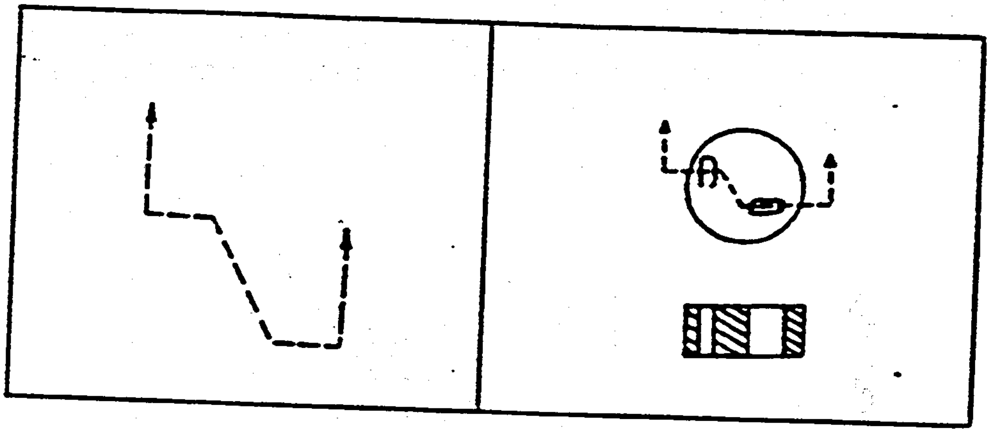
Fig 1-10. Break (SHORT) Lines.

k. Cutting plane lines. A pair of short, heavy lines with arrowheads projected at 90 degrees indicates the cutting plane when a drawing includes a section view. Figure 1-11a shows cutting or viewing plane with an optional view. Figure 1-11b shows cutting plane for complex or offset views. Letters (AA,BB,et-c.) are usually placed at the arrowheads to identify the section view. The arrowheads show the viewing direction of the section viewed. Where necessary, the section lines may be connected by a line of short, heavy dashes indicating the exact path of the cutting plane.



Convention Example

Fig 1-11a. Cutting or viewing plane lines.

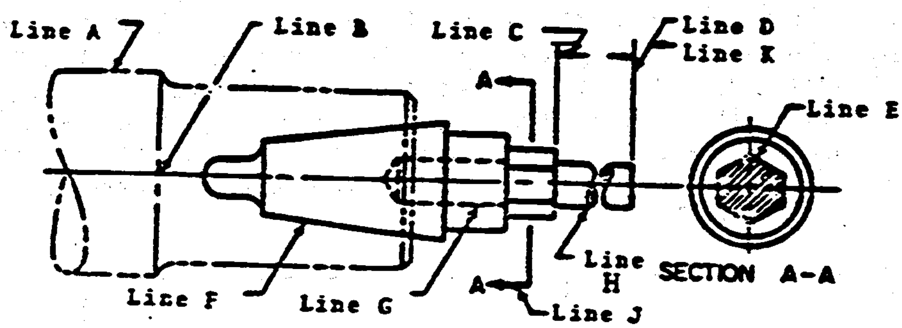


Convention Example

Fig 1-11b. Cutting Plane for Complex or Offset Views.

EXERCISE: Complete items 1 through 5 by performing the action required.

<u>Note</u>: Use the following illustration to answer items 1 through 5.



1. Which line convention is located at line A?

   a. Break
   b. Visible
   c. Center
   d. Phantom

2. Which line convention is located at line H?

   a. Break
   b. Hidden
   c. Extension
   d. Leader

3. Which line convention is located at line F?

   a. Section
   b. Visible
   c. Dimension
   d. Break

4. Which line convention is located at line G?

   a. Center
   b. Cutting
   c. Hidden
   d. Leader

5. Which line convention is located at line C?

   a. Dimension
   b. Extension
   c. Visible
   d. Break

PROJECTIONS AND DRAWINGS

Types of Projection and Drawings

When learning to read a construction print, you must develop the ability to visualize the object (fig 1-12). This is done by learning to properly interpret the various types of lines, dimensions, sections, details, symbols, and other media that are used to describe the object or parts of an object on a construction print.

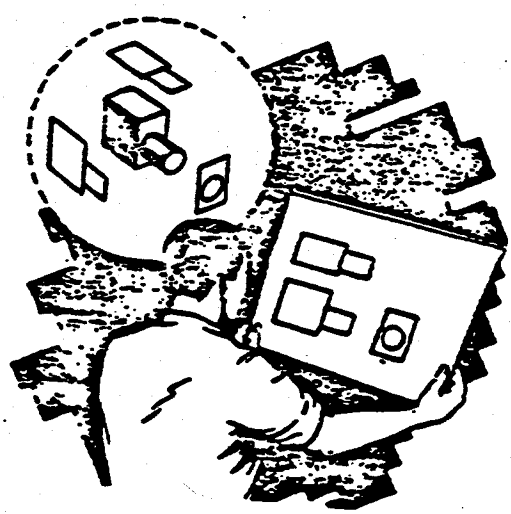


Fig 1-12. Visualizing from a print.

An object can be viewed, and therefore drawn, from an infinite number of positions. Some views are easier to draw and interpret than others. It is common to present an object on a drawing as an orthograhic projection or as a pictorial drawing. A pictorial drawing, such as the perspective projection in figure 1-13, presents the object as it would appear to the eye.

In an orthographic projection, the object is presented as if it were viewed through a transparent drawing plane from an infinite distance (fig 1-13). An orthographic projection is made by projecting each point on the object perpendicular to the drawing plane.

a. <u>Orthographic projection</u>. Almost all drawings which serve as guides intended for production or construction are drawn by orthographic projection.

The major advantage of an orthographic projection is that it shows every part of an object that is parallel to the drawing plane in true relative size and position.

The number of views to be used in projecting a drawing is governed by the complexity of the shape of the drawing. Complex objects are normally drawn showing six views; that is, both ends, front, top, rear, and bottom.

Figure 1-14 shows an object placed in a transparent box. The projections of the object on the sides of the box are the views seen by looking straight at the object through each side. If the outlines are scribed on each surface and the box opened and laid flat, the result is a six-view, orthographic projection drawing. It should be noted that the rear view may appear in any one of four positions (to the right of the right side view, to the left of the left side view, above the top view, or below the bottom view).

As a general rule, you will find that most drawings will be presented in three views. For a simple object, three views are adequate to completely describe the object when dimensions are added (fig 1-15). Occasionally, you will see two-view drawings, particularly for cylindrical objects. The most common three-view drawing arrangement shows the front, top and right side view of an object.

In a three-view drawing, the front view shows the most characteristic feature of the object. Note in figure 1-15 that the right side or end view is projected to the right of the front. Also notice that all the horizontal outlines of the front view are extended horizontally to make up the side view and all the vertical outlines of the front view are extended vertically to make up the top view.

By studying the drawing you should obtain the following information about the object: the shape of the object, its overall length (2 1/8 inches), its width (1 1/2 inches), and its height (1 3/8 inches). It is notched 1 1/8 inches from the right side and 7/8 inch from the bottom. After having studied each view of the object, you should be able to visualize the object as it appears in figure 1-16. If a hole is drilled in the notched portion of the object, the drawing would appear as in figure 1-17. The position of the hole is indicated by hidden lines in the front and side views and as a circle in the top view. The location of the center of the drilled hole is indicated by a center line.

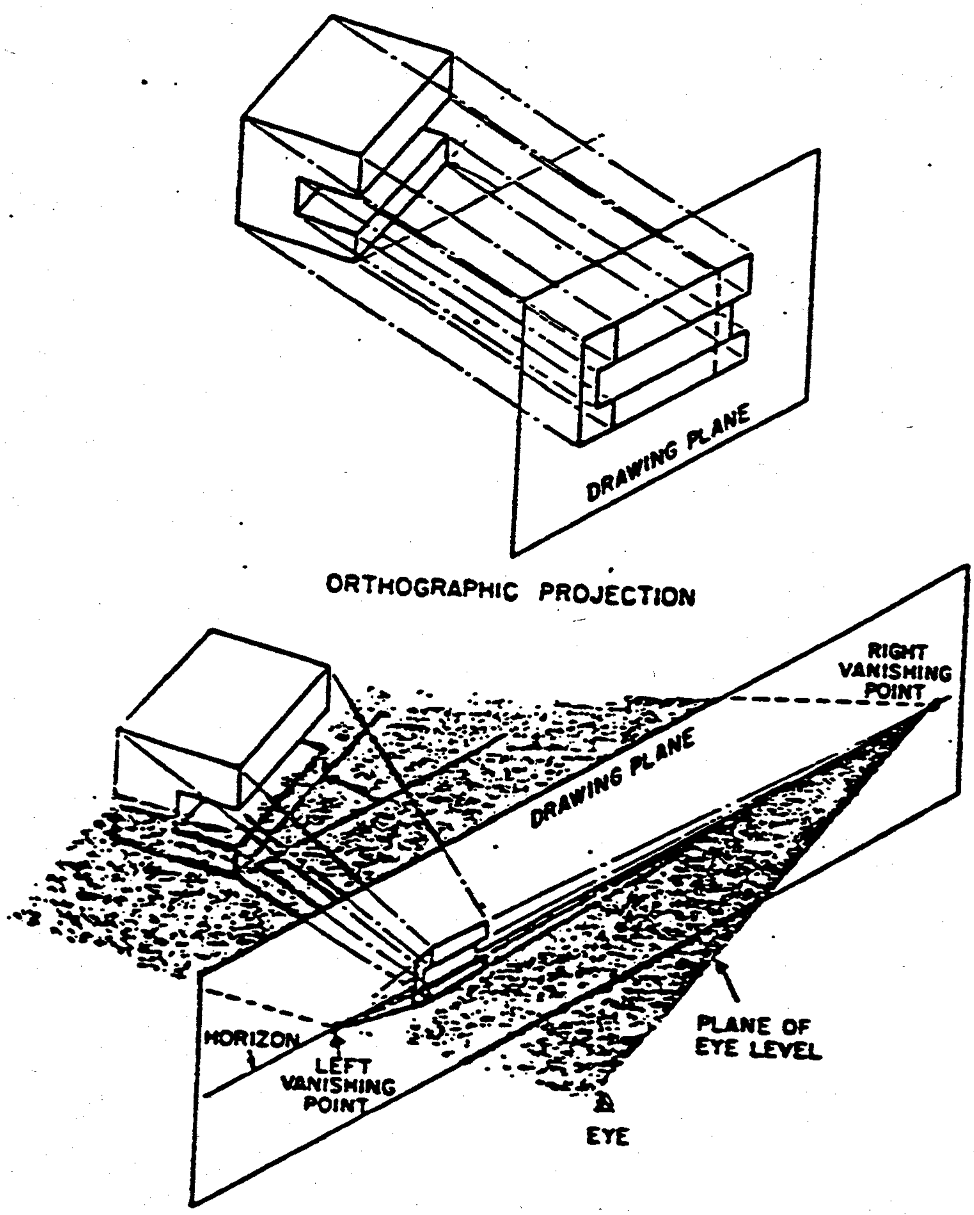


Fig 1-13. Orthographic versus perspective projection.

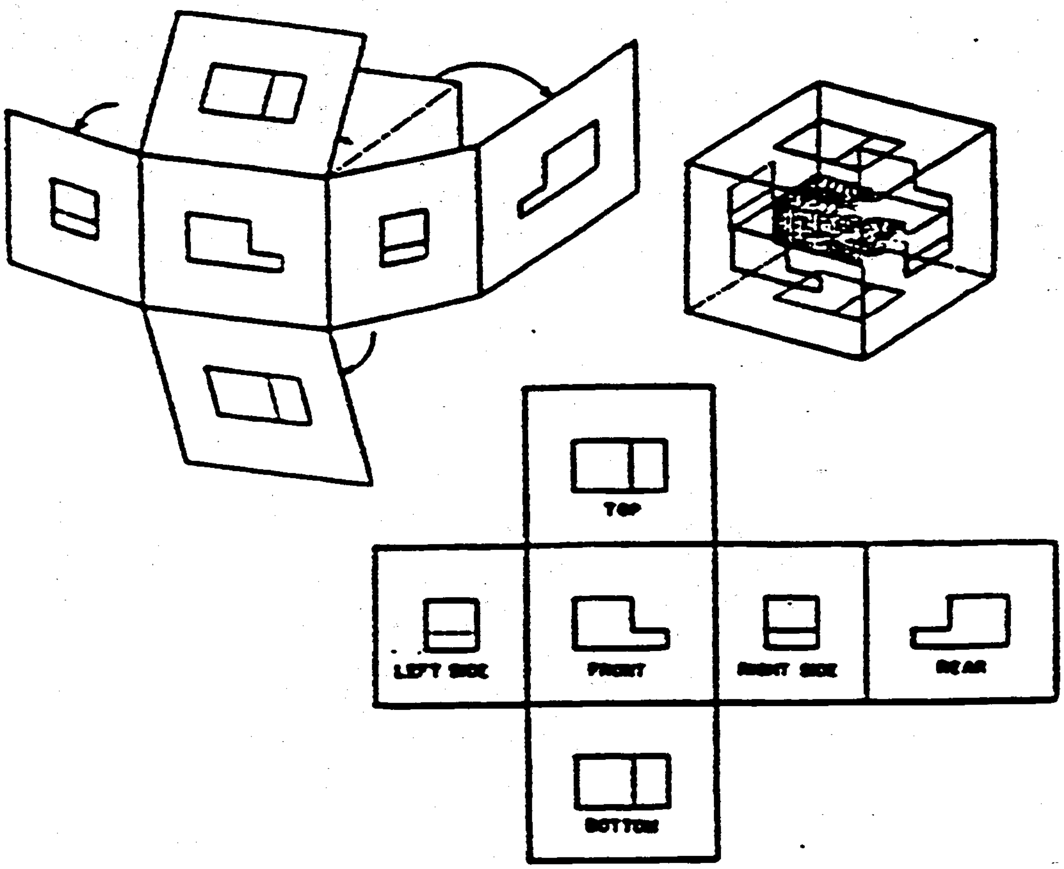


Fig 1-14. Third angle orthographic projection.

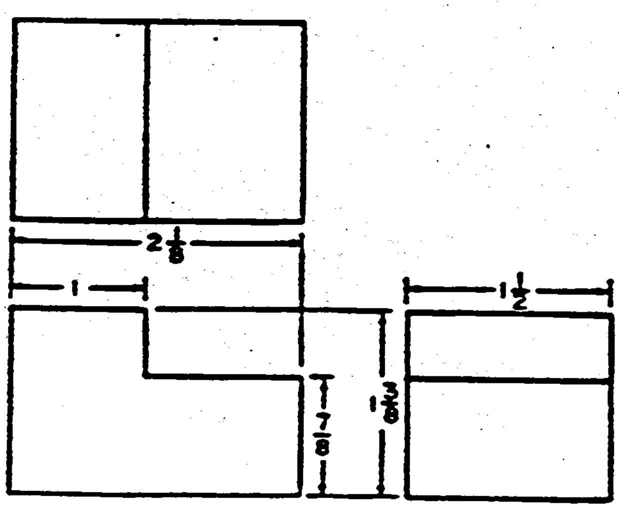


Fig 1-15. Three-view drawing.

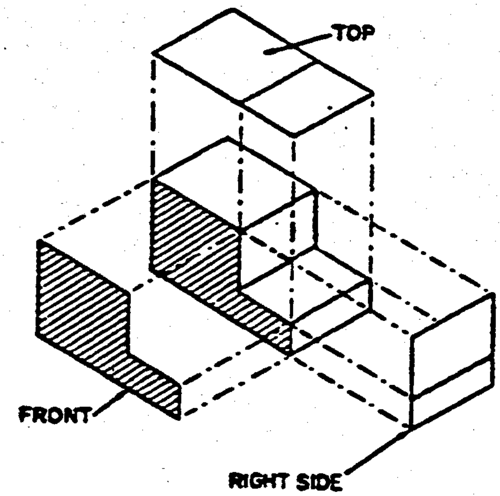


Fig 1-16. Interpretation of a three-view drawing.

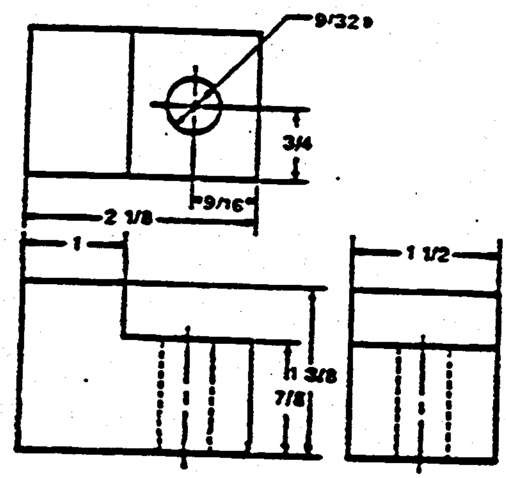


Fig 1-17. Hidden lines in a three-view drawing.

b. Isometric drawings. The isometric drawing is an easy drawing to be used by the beginner who wants to make a three dimensional effect. In an isometric drawing, all lines that are parallel on the object are also parallel on the drawing. Vertical lines are shown in a vertical position, but the lines representing horizontal lines are drawn at an angle of 30o with the horizontal. Also, on an isometric drawing, all the lines which represent the horizontal and vertical lines on an object have true length.

Since all isometric lines are spread equally 120°, the same scale of measure is used on the three visible sides. Isometric drawings (fig 1-18) may be dimensioned, and blueprints of these drawings may be used for making simple objects. However, isometric drawings alone cannot be used for complicated parts or structures. Isometric drawings may be used as an aid in clarifying the orthographic drawings that are the foundation of all construction prints.

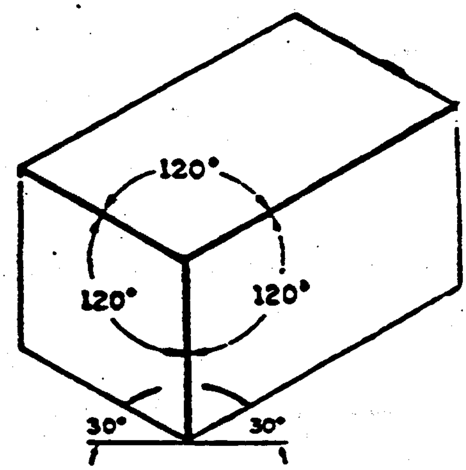


Fig 1-18. Isometric drawing.

c. <u>Oblique drawings</u>. In oblique drawings, (fig 1-19), the front face of the object is drawn in orthographic form, full scale. One or more sides are then added at an angle to the front face, either full scale, or foreshortened. Any angle and scale may be used. An oblique drawing in which the receding or oblique lines are drawn full-scale at 45° yis called a <u>cavalier drawing</u> (fig 1-19). The result does not create a realistic appearance, but allows the use of one scale for the entire drawing.

(1) A <u>cabinet drawing</u> is an oblique drawing which uses half-scale measurements on the oblique sides (fig 1-19). These drawings are commonly drawn with the oblique lines at 30° or 45° angle to the front plane. The name came into being because most of these drawings were of cabinet work.

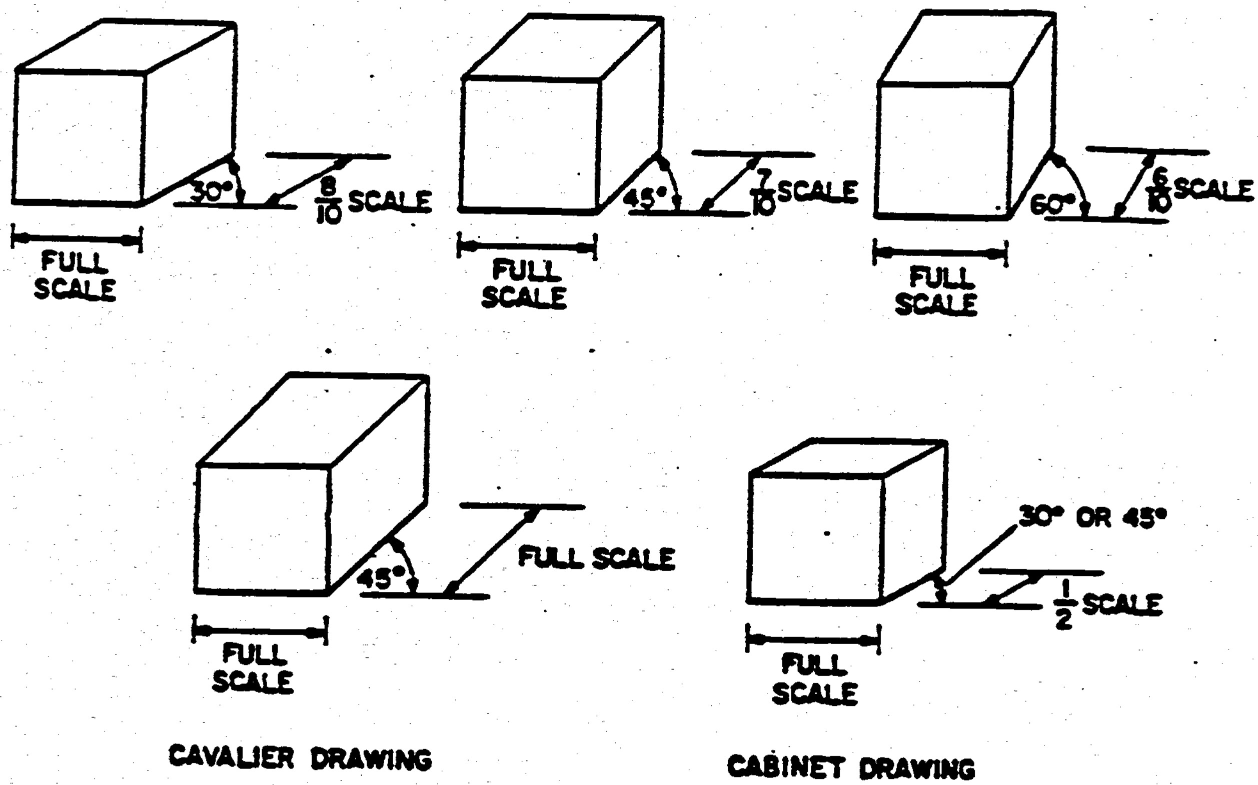


Fig 1-19. Oblique drawings of a cube.

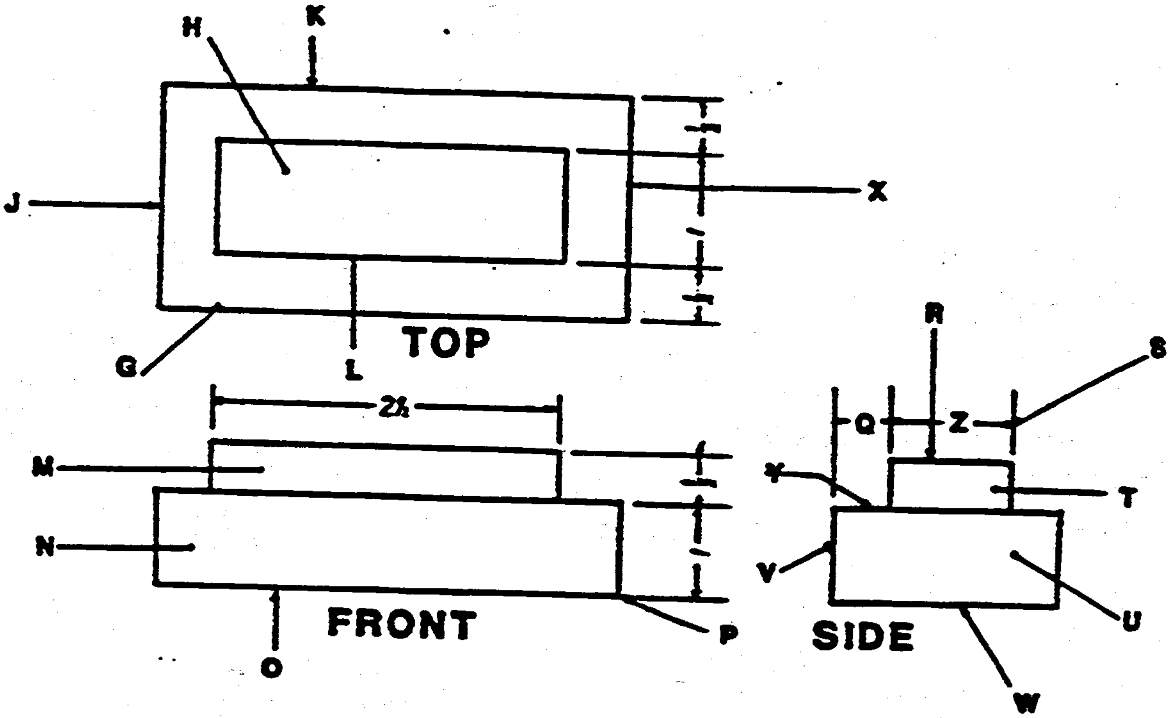
EXERCISE: Complete items 1 through 6 by performing the action required.

1. As a general rule, most orthographic drawings will be presented in ____________ views.

   a. three
   b. four
   c. five
   d. six

2. The illustration below is an example of a three view

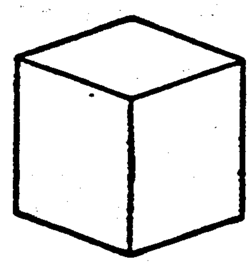
   a. isometric drawing.
   b. orthographic projection.
   c. trimetric view.
   d. auxiliary projection.



3. On an isometric drawing, all lines are drawn to true scale and the horizontal lines are drawn at an angle of ______________________ to the horizontal.

a. 60o
b. 45o
c. 30o
d. 15o

4. The illustration below is an example of a(an)

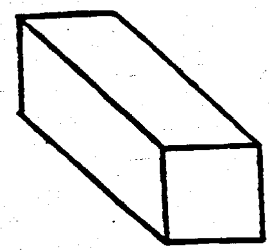


a. orthographic view.
b. cabinet drawing.
c. diametric view.
d. isometric drawing.

5. When the sides are added to the front face of an oblique drawing, they may be at any angle and at __________ scale.

a. only 8/10
b. only 6/10
c. only 4/10
d. any

6. The illustration below is an example of a(an)



a. oblique drawing.
b. perspective view.
c. rotation drawing.
d. section view.

SPECIAL VIEWS

Types of Special Views

When complex objects are involved, three-view drawings are often not sufficient to convey all the necessary details. Special views are added to provide additional information. The special views which may be encountered are auxiliary, rotation, section, and phantom views.

a. Auxiliary views. If a feature of an object is in a plane which is not parallel to one of the drawing planes, it will not appear in true size or shape in any of the three normal views. The sloping surface of the object in figure 1-20, for example, appears in both the top and right side views but is foreshortened in both. In this case, an auxiliary projection is added. The auxiliary view is obtained by projecting lines to a drawing plane which is parallel to the slanted face. The auxiliary view is normally placed alongside a view which shows the true length of the edge of the slanted surface as shown in figure 1-21. In this case, the auxiliary view is related to the front view in the same way as the top or right side view is related to the front view.

If the feature to be covered in an auxiliary view is not in a plane perpendicular to one of the normal orthographic drawing planes, or if there is not enough room in the normal position, the auxiliary view will be placed somewhere else on the drawing. In this case, the auxiliary view will usually be labeled as "view A" (or B, C, etc.) with an arrow pointing to the face.

Auxiliary views do not usually show the entire object as seen from the auxiliary view angle; only the surface parallel to the auxiliary drawing plane is covered. Figure 1-22 shows an auxiliary view compared with a right side view of the same object. Note that the circles appear as ellipses in the right side view, with the distance between centers foreshortened. The auxiliary view only shows the slanted face of the object, the holes appear in true shape, and the distance in true length.

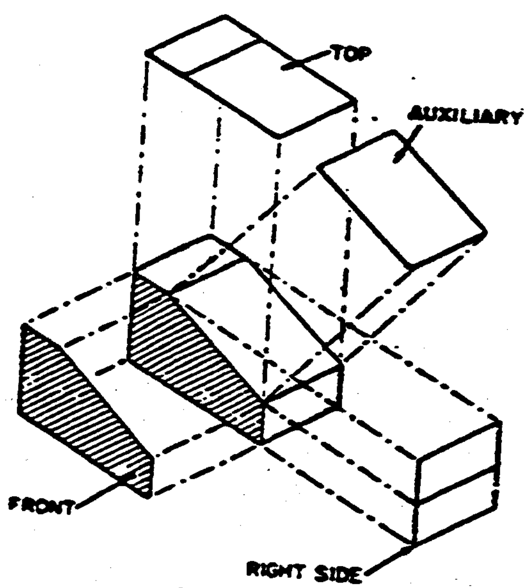


Fig 1-20. Auxiliary projection principle.

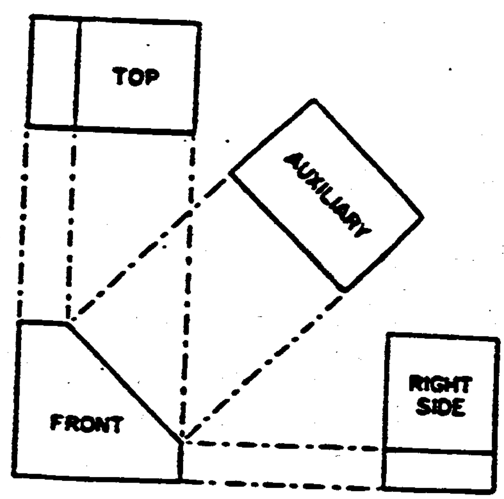


Fig 1-21. Auxiliary arrangement.

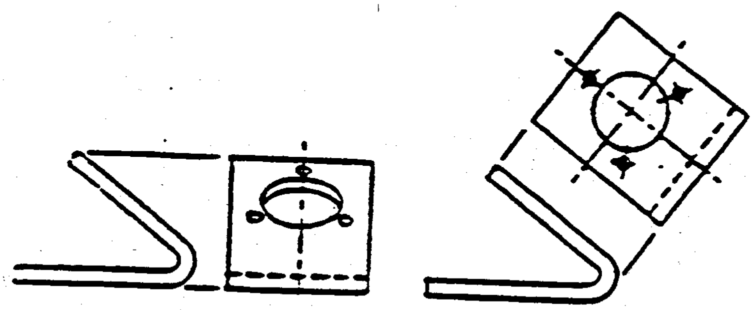


Fig 1-22. Auxiliary and side views compared.

b. <u>Rotation</u>. Occasionally, if no confusion will result from the practice, a separate auxiliary view is omitted and a side or top view is provided. This is drawn as if the object were bent to bring the slanted surface parallel to the drawing plane (fig 1-23). This is called a rotation, and the fact that it has been done will be indicated in some manner on the drawing. In figure 1-23, for example, the fact that one view is higher than the other, plus the curvature of the upper center line shows immediately that the right hand view is a rotation.

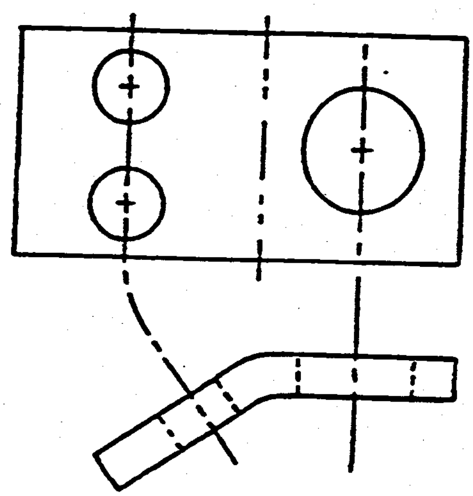


Fig 1-23. Rotation.

c. <u>Sections.</u> Section views are used to give a clear view of the interior or hidden features of the object which normally cannot be clearly observed from conventional outside views. A section view is obtained by cutting away part of an object to show the shape and construction at the cutting plane. The most common position of the cutting plane is through the longest dimension, or main longitudinal axis and parallel to the front view as shown in figure 1-24. The cutting plane may be drawn parallel to any plane of projection if it shows the required features of the object. When section views are drawn, the part that is cut by the cutting plane is marked with closely spaced, parallel (section) lines. The section lines indicate the surfaces which were created by the cutting plane and which do not exist on the uncut object. When two or more parts are cut in one view, a different slant or style of section line is used for each part. All rules of projection apply, but hidden lines complete the understanding of the view. Notice how the cutting plane is shown on a drawing as illustrated in view 1 of figure 1-24.

The cutting plane in view 2 of figure 1-24 illustrates where the imaginary cut is made. The object as it would look if it were cut in half is shown in view 3. The section view as it would appear on a drawing is shown in view 4.

(1) <u>Full-sections</u>. When the cutting plane is a single continuous plane passing entirely through the object, the resulting view is called a full-section, view 1 figure 1-25. The cutting plane is usually made straight through on the main axis or center line.

(2) <u>Half-sections</u>. The cutting plane will not always be made completely through the object. You will notice that view 2, figure 1-25 shows a half-section. The cutting plane passes only halfway through the object. This is common practice for symmetrical objects. In the case illustrated, the top half, if sectioned, would be identical to the bottom half, providing no additional information. The half-section permits both the internal and external features to be shown as well as their relationship to one another.

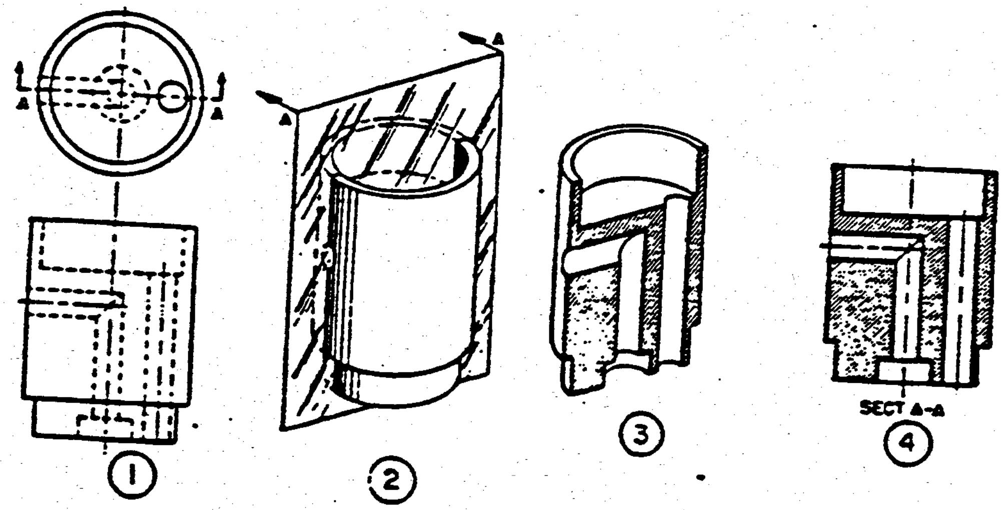


Fig 1-24. Action of the cutting plane.

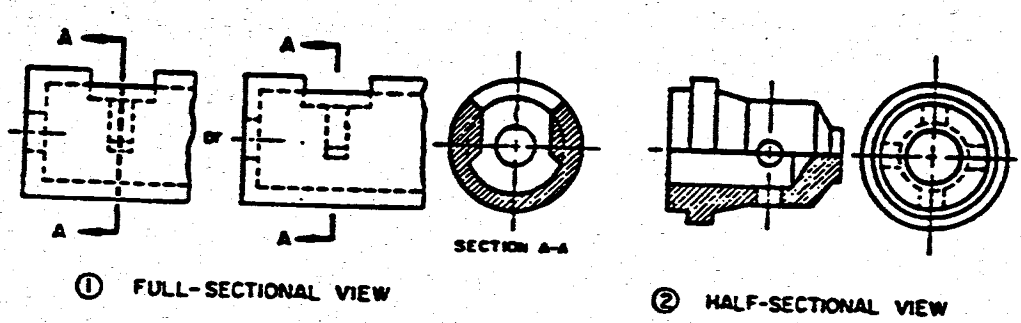


Fig 1-25. Full and half-sectional views.

(3) Offset section. A section view with a cutting plane that changes direction backward and forward (zig-zag), to show important features, is known as an offset section. The offset cutting plane in figure 1-26 is arranged to show the hole on the right side, in section. The sectional view is the front view, and the top views show the offset cutting plane line. Notice that there is no line on the section view at the point where the cutting plane goes straight back.

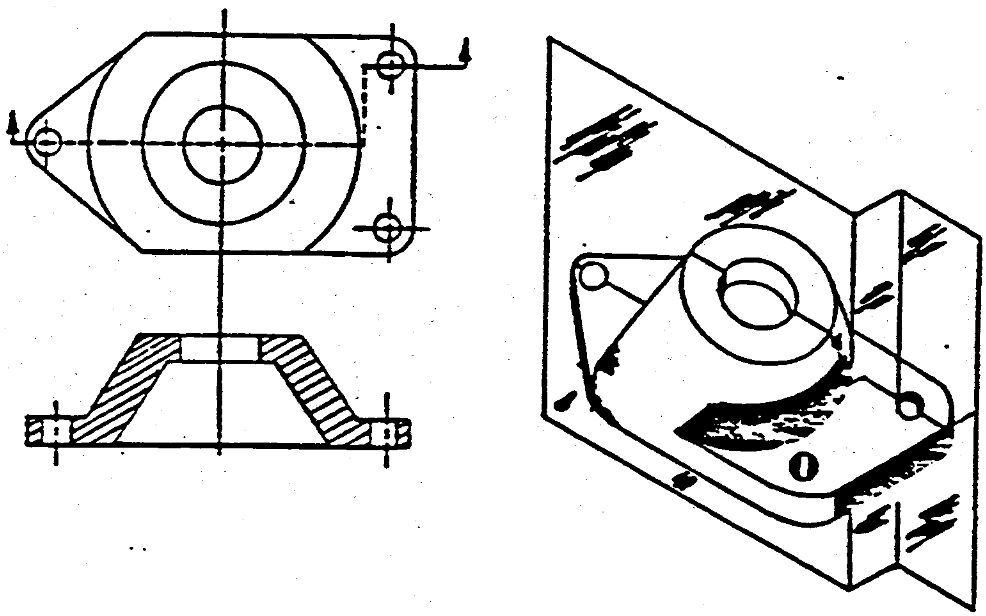


Fig 1-26. Offset section.

(4) Revolved section. To eliminate drawing extra views of rolled shapes, ribs, and similar forms, a revolved section is used. It is a drawing within a drawing, and it clearly describes the object's shape at a certain cross-section station or point. The sectional view of the rib in figure 1-27 has been revolved so that you can look at it head-on.

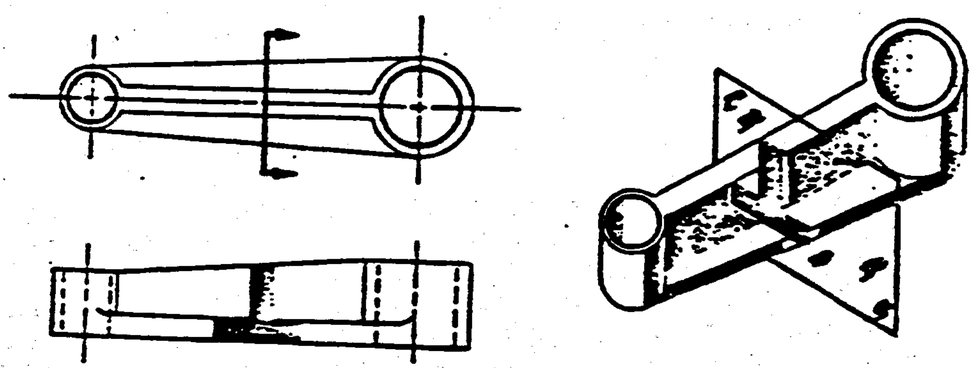


Fig 1-27. Revolved section.

(5) Removed section. Removed sections are normally used to illustrate particular parts of an object (fig 1-28). They are drawn like the revolved section, except that they are placed at one side to bring out important details. They are often drawn to a larger scale than the one used on the view where they are illustrated.

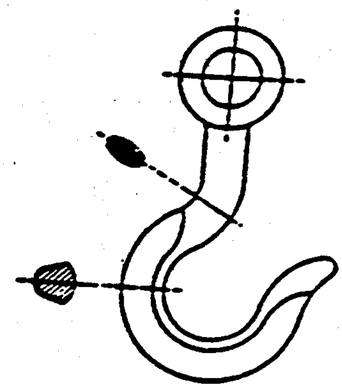


Fig 1-28. Removed section.

(6) Broken-out section. A broken-out section is a partial section used on an exterior view to show the interior detail without drawing a complete full or half section. The limit of the broken-out section is indicated with an irreguarly broken line. In figure 1-29, the inside of the fitting is better illustrated because of the broken-out section.

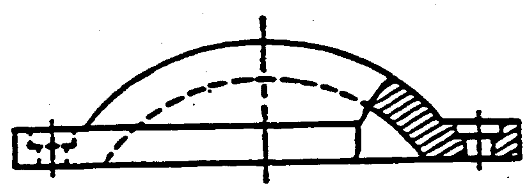


Fig 1-29. Broken out section.

(7) Aligned section. Look at the front view of the handwheel in figure 1-30 and notice the cutting plane line AA. When a true sectional view might be misleading, parts such as ribs or spokes are drawn as if they are rotated into or out of the cutting plane. Notice that the spokes in section A-A are not sectioned. In some cases, though not in this figure, if the spokes were sectioned, the first impression would be that the wheel had a solid web rather than spokes.

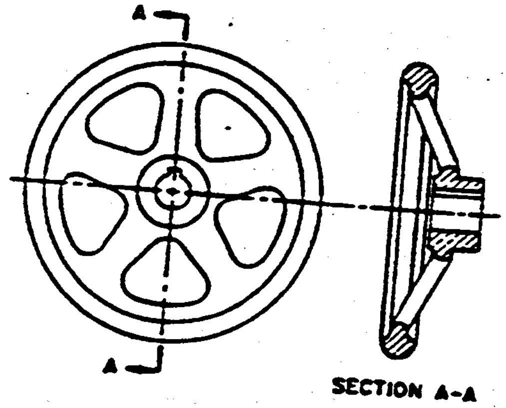


Fig 1-30. Aligned section.

d. Phantom views. Phantom views are used to indicate the alternate position and path of motion of parts, repeated details, or the relative position of an absent part. Figure 1-31 shows the alternate position of a part as a phantom view (the part on the left side).

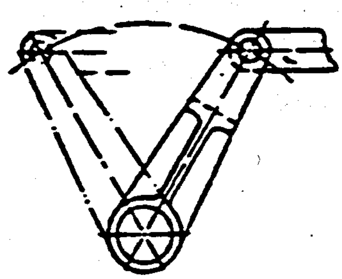


Fig 1-31. Phantom view.

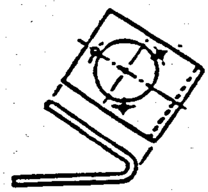
EXERCISE: Complete items 1 through 8 by performing the action required.

1. A drawing that is obtained by projecting lines to a drawing plane which is parallel to the slanted face is known as a(an)

   a. aligned section.
   b. phantom view.
   c. removed section.
   d. auxiliary view.

2. The illustration below is an example of a(an)

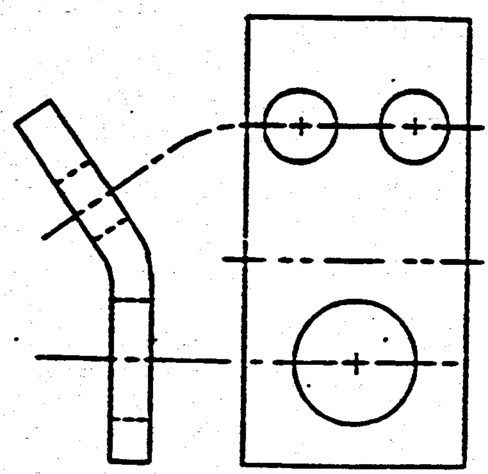
a. section view.
b. broken-out section.
c. phantom view.
d. auxiliary view.



3. A drawing that is drawn as if the object were bent to bring the slanted surface parallel to the drawing plane is called a(an)

a. rotation view.
b. offset section.
c. aligned view.
d. removed section.

4. The illustration below is an example of a(an)

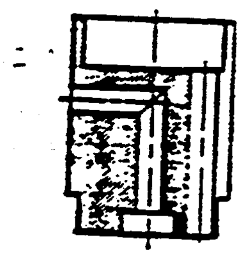


a. exploded view.
b. offset section.
c. phantom cut.
d. rotation view.

5. Which view is obtained by cutting away part of an object to show the shape and construction at the cutting plane?

a. Auxiliary
b. Rotation
c. Phantom
d. Section

6. The illustration below is an example of a(an) ______ view.

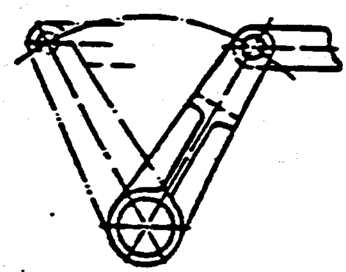


a. section
b. phantom
c. rotation
d. auxiliary

7. Which view is used to indicate the alternate position and path of motion parts?

a. Auxiliary
b. Rotation
c. Phantom
d. Section

8. The illustration below is an example of a(an)



a. auxiliary projection.
b. phantom view.
c. aligned section.
d. development view.

PRINTS

Types of Prints

Drawings are normally classified as original drawings, intermediate or reproducibles, and prints. The original drawing is the one produced by the draftsman. An intermediate drawing is a copy of the original which is used to make prints. An intermediate drawing is used to avoid the risk of damaging the original or because the original is not suitable for the type of reproduction process used to make prints. However, prints may also be made directly from the original without using an intermediate drawing. A print is a working copy used on the job.

Many processes are used to make prints from originals or intermediates. They can be classified as either negative or positive contact processes or optical processes. Contact processes require a transparent or translucent original. Optical copies can be made from opaque originals. Contact processes are normally used in construction work. Optical copies are usually more expensive and introduce more distortion.

a. Negative Contact Processes.

(1) Blueprints. A blueprint is made by placing a sheet of tracing paper (transparent or translucent original) in contact with a sensitized paper and exposing the paper through the tracing. When the paper is developed, the unexposed portions where the light is blocked by lines on the original remain white, while the exposed portions turn dark blue. This produces a print with white lines on a blue background. Blueprints, in general, have better contrast than other commonly used processes of comparable cost, but the wet developing process causes some distortion, and marking the prints is difficult.

(2) Brownprints. The brownprint process (often called Van Dyke) is similar to the blueprint process except that the paper is transparent and exposed areas turn brown when developed. This yields transparent lines on a brown background. Brownprints are frequently used as intermediate copy which will produce a print that has blue lines on a white background and it is called a white print.

b. Positive Contact Processes.

(1) Ozalid prints. The ozalid process is a contact process like blueprinting but the unexposed areas of the sensitized paper turn blue when developed in ammonia vapor producing blue lines on a white background. Ozalid prints are also called blueline prints. Also available is paper which yields black lines (called blackline prints). The development in this process is dry and causes less distortion than the blueprint process, but the contrast usually is not as good.

Note: There are machines available which produce ozalid-process prints but which project and reduce the image optically instead of by contact-printing. Prints produced by this process will usually be marked "Reduced Size Print-Do Not Scale."

(2) Brownline prints. Brownline prints have the same function in the ozalid process as the brownprints have in the blueprint process. They produce brown lines on a transparent background and are often used as an intermediate for making blueline prints. Brownline prints are often called sepsepia intermediates.

(3) Special materials. There are materials available for use with the ozalid process which produce a large variety of results, including many colored lines on white paper or colored lines on a clear plastic background.

c. Optical Processes.

(1) Electrostatic. An electrostatic copier (Xerox machine for example) projects an image of the original on paper and then causes an electrostatic charge to be deposited where the image of a line occurs. A black powdered "ink" is then applied to the paper and adheres where the electrostatic charge occurs. The image is then fused to the paper. This process produces a dark gray image on a white background. The amount of distortion depends on the type and quality of the optical system which projects the image on the copy paper.

(2) Photostat. The photostat process is a photographic process which uses a special camera and film. The film is opaque paper instead of transparent film as in ordinary photography. Since the negative is opaque and cannot be viewed from the back, the camera is designed to produce an erect image instead of a reversed image as with ordinary cameras.

The photostat process produces white lines on a black background (negative photostat) which can then be rephotographed to produce a black image on a white background (positive photostat). The image can be enlarged or reduced in the photostat process, usually to 1/2 or 2 times original size in each stage.

(3) Microfilm. For economy of storage space and for insurance against destruction of the original, many drawings are photographically copied on microfilm. When a drawing is no longer in frequent use, the original is often disposed of and only the microfilm copy is retained. Equipment is available for viewing microfilm copies (similar to a slide viewer) and for making prints directly from microfilm copies. Since the image must go through the original optical reduction, developing of the microfilm, enlargement, and the final print process, the chance of producing a distorted copy is high.

EXERCISE: Complete items 1 through 4 by performing the action required.

1. Which process is used to make blueprints and brownprints?

____

2. What process is used to make brownline and ozalid prints?

____

3. What process is used to make electrostatic, photostat, and microfilm prints?

____

4. What are the three processes used to make prints from originals or intermediates?

a. ______________________________

b. ______________________________

c. ______________________________

Proper Handling of Prints

A completed drawing represents too much time and effort to be treated casually. It is a valuable record; hence, it must be preserved with care. If an original drawing were to be used on the job and passed from man to man, it would soon become worn and too dirty to be read. For this reason, working drawings used on the job are almost always reproductions of original drawings.

A little time spent in carefully folding and filing prints at the start will prevent a lot of inconvenience later on. The method of folding depends on the facilities available for storage. Some filing equipment commonly used is shown in figure 1-32. When manufactured filing equipment is not available in the field, storage facilities should be constructed. Prints should be folded so the drawing number is visible when the print is filed. If storage space is available to accommodate rolls, prints over 40 inches long are usually rolled instead of folded. Original drawings or intermediates used for contact process reproduction should never be folded; the creases will prevent close contact with the copy paper.

When using prints on the job, avoid long exposure to direct sunlight or the prints will fade. If it is necessary to mark a print, be neat and use a colored pencil. A red pencil is normally used to show additions, and a yellow pencil is used to indicate deletions. After using a print, refold it carefully to avoid adding unnecessary creases.

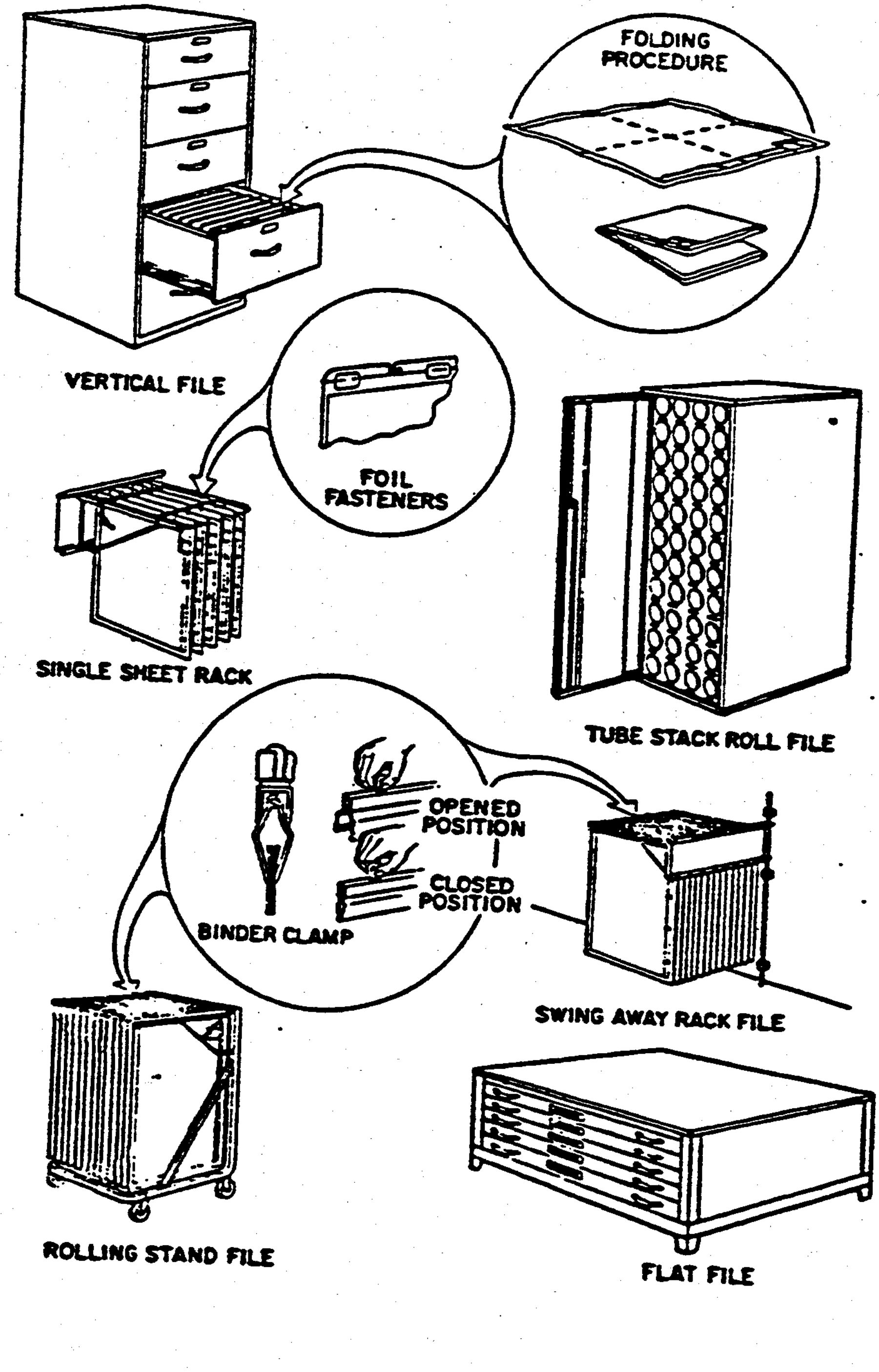


Fig 1-32. Print and drawing storage.

EXERCISE: Complete items 1 and 2 by performing the action required.

1. How are prints over 40 inches long stored or filed?

____

2. When prints are filed, they should be folded so the ____.

PARTS OF A PRINT

Characteristic of a Print

A drawing not only provides information about the size and shape of the object being represented but also provides information that enables the drawing to be identified, processed, and filed methodically. The systematic arrangement of the drawing sheet to provide a consistent location for this information is known as the format of a drawing. Sizes and formats for military drawings are arranged in accordance with certain standards.

Military drawings are prepared in standard sizes, designated by letters. These sizes are listed in table 1-1. Roll size drawings are normally prepared with an extra 4-inch margin for protection, if possible, without exceeding the 144 inch length limit. Complete details on military drawings may be found in MIL-STD-100A.

Table 1-1. Finished format sizes (inches)

SIZE	HEIGHT	LENGTH	MARGIN
	Flat Sizes		
A	81/2	11	.25 & .38*
A	11	81/2	.25 & .38*
B	11	17	.38
C	17	22	.50
D	22	34	.50
E	34	44	.50
F	28	40	.50
	Roll Sizes		
G	11	42 to 144	.38
H	28	48 to 144	.50
J	34	48 to 144	.50
K	40	48 to 144	.50

*Horizontal margins .38 inch vertical margins .25 inch

a. Title block. A typical title block, as illustrated in figure 1-33, shows the name and address of the preparing agency (A), the title of the drawing (B), the drafting record (C), authentication and date (D), the scale and specification number (E), and the drawing number and sheet number for multiple-sheet drawings (F).

(1) Drawing number. Each drawing is identified by a drawing number, which appears in a number block. The purpose of numbering a drawing is to permit its identification quickly. If a drawing has more than one sheet and each sheet has the same number, this information is included in the number block indicating the sheet number and the number of sheets in the series. When using construction drawings, always check to be sure that all necessary sheets are on hand.

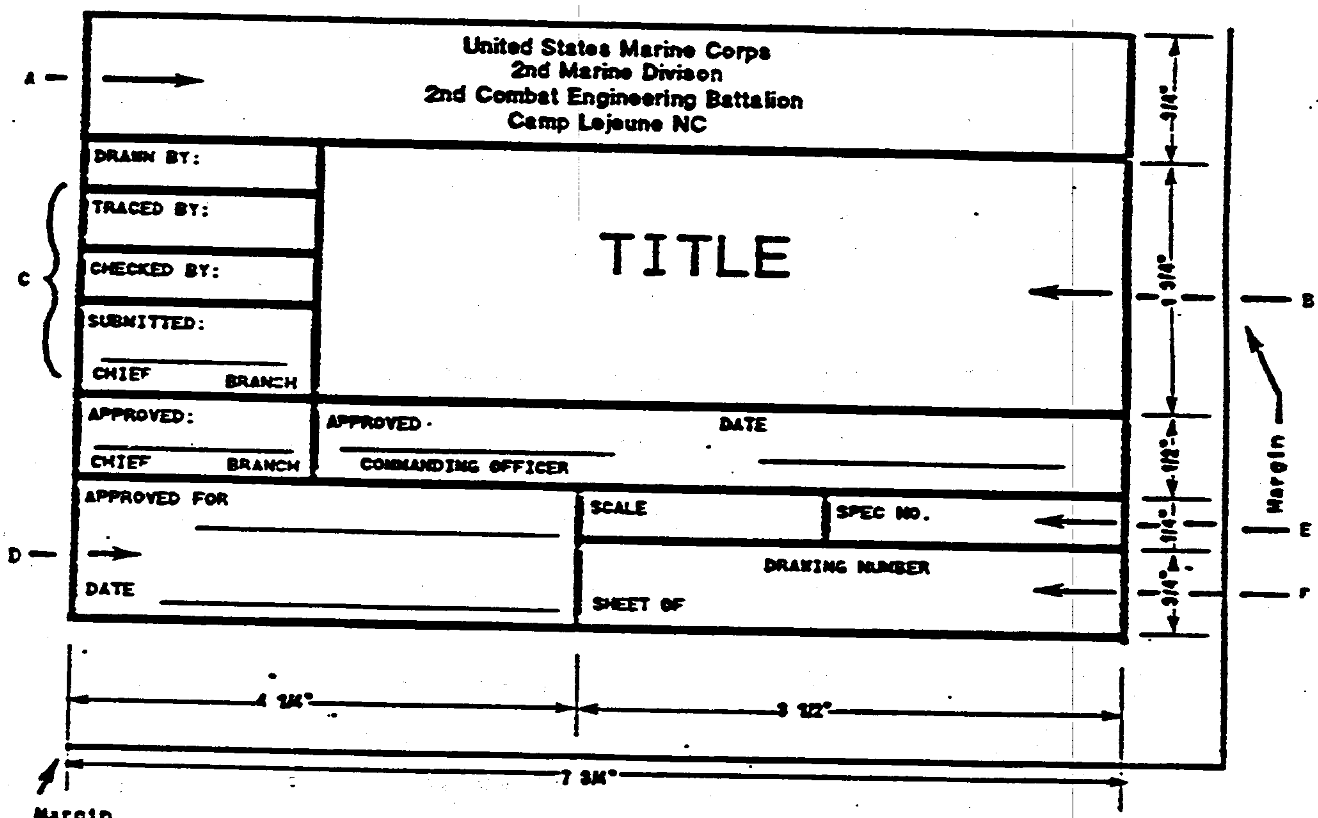


Fig 1-33. Typical title block.

(2) Scale block. The scale block will indicate the scale used on the drawing, either as a ratio (for example: 1/4 or 1:4 meaning 1 inch on the drawing equals 4 inches on the object, or 12" = 1" meaning 12 inches on the drawing equals 1 inch on the object) or as a graphic scale as shown in figure 1-34. If the same scale is not used on all parts of a drawing, the scale block may be marked "as noted" or left blank, and the scale noted underneath each part of the drawing.

If graphic scales are used, several scales may be shown with numbers (fig 1-34) and the appropriate scale number noted alongside each part of the drawing. When you read drawings, always follow the dimensions specified on the drawing first, and use the scale on the drawing where dimensions are not given. Do not measure with an architect's or engineer's scale directly on a print, since the print may be enlarged or reduced or the paper may shrink during the copying process.

(3) Specification number. The specification number indicates the specification the draftsmen followed for assistance in interpreting the drawing.

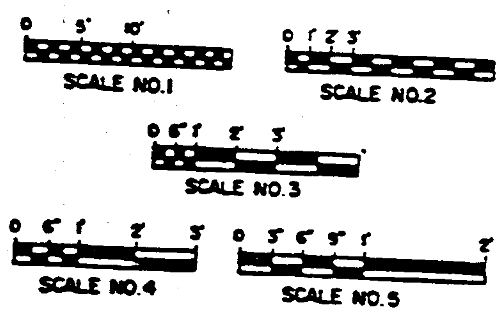


Fig 1-34. Graphic scales.

b. Bill of materials. A special block on the drawing may contain a list of the pieces of stock or standard parts necessary to construct the object on the drawing, and the quantity of each item required. This list may also be called a list of materials, schedule of equipment, or parts list. If several sheets are required for a particular object, the bill of materials may appear on a separate sheet(s).

c. Revision block. Space is always left on a drawing to list revisions as they are made. The revision block will show the revision symbol, A, B, C, etc. consecutively as encountered, a brief description of the revision, the revision date and supervisor's approval, and sometimes the zone on the drawing where the revision was made. If more than one copy of a drawing is available, the revision block should be checked to find the drawing with the latest revision.

d. Notes and specifications. Notations explaining construction methods or specifying materials which are not indicated by symbols are called specifications. The notes may list allowable substitutions, special provisions for certain locations, additional reference material, and so forth. The notes must always be read before beginning construction.

EXERCISE: Complete the following items 1 through 5 by performing the action required.

1. In which part of a drawing will you find the title of the drawing, the drafting record, and the scale used?

   ____

2. What part of the drawing will list pieces of stock or standard parts necessary in the construction of an object?

   ____

3. Where will revisions be listed on a drawing?

   ____

4. Notations explaining construction methods or specifying materials which are not indicated by symbols will be found in the

   ____.

5. Name the four parts that may be found in a print.

   a. ____

   b. ____

   c. ____

   d. ____

MILITARY DRAWINGS

Classifications of Military Drawings

Military drawings are classified as construction or production drawings depending on the method of manufacture of the object or assembly represented. The format of each type is arranged differently, although sheet and margin sizes are common to both.

a. Construction drawings. Construction drawings are drawings developed to illustrate the design of structures or other constructions and the services, utilities, approaches, or any other features involved.

Maps (except those with construction drawings), reports, sketches, presentation drawings, or renderings are not considered to be construction drawings within the meaning of this standard.

b. Production drawings. Production drawings describe equipment or articles that are suitable for production in quantity. The same basic information is normally included on a production drawing format as on a construction drawing format although the arrangement is different.

EXERCISE: Complete items 1-3 by performing the action required.

1. Drawings developed to illustrate the design of structures or other constructions are known as

____.

2. Drawings that describe equipment or articles that are suitable for quantity production are called

____.

3. What are the two classifications of military drawings?

a. ____.

b. ____.

Fundamental Steps in Interpreting Drawings

The objects used for illustrations thus far have been simple, and interpretation of the drawings nearly obvious. To interpret more complex or irregular drawings may require more effort.

The principles introduced here, along with the conventions peculiar to certain fields which will be discussed in the following study units, will enable you to interpret any properly prepared drawing. The orthographic projection principles are fundamental to all fields, and a thorough understanding of these principles is necessary if you are to read any type of physical prints.

The fundamental step in interpreting a drawing is relating the different views. If you pick a point on a front view, the same point on the right side view will be directly to the right of it. Similarly, the same point on the top view will be directly above the point on the front view. These relationships are illustrated in view 1 of figure 1-35, by the horizontal and vertical datum lines between the views. The same relationship exists between the top and right side views but is not obvious because they are not hinged together. If the outside edges of both views are extended horizontally or vertically until they cross, as in view 2 of figure 1-35, and a line is drawn connecting these points of intersection, the relationship can be seen. The line connecting the points of intersection will be at a 45 degree angle with the horizontal. All other points in the views can be related by bending their project line at this 45 degree line. If the same point appears on three views, the three occurrences will be related as shown by point 1 in view 2 of figure 1-35. On complex drawings, it is often helpful to draw this 45 degree line to be sure you are looking at the same point on all three views when interpreting the drawing.

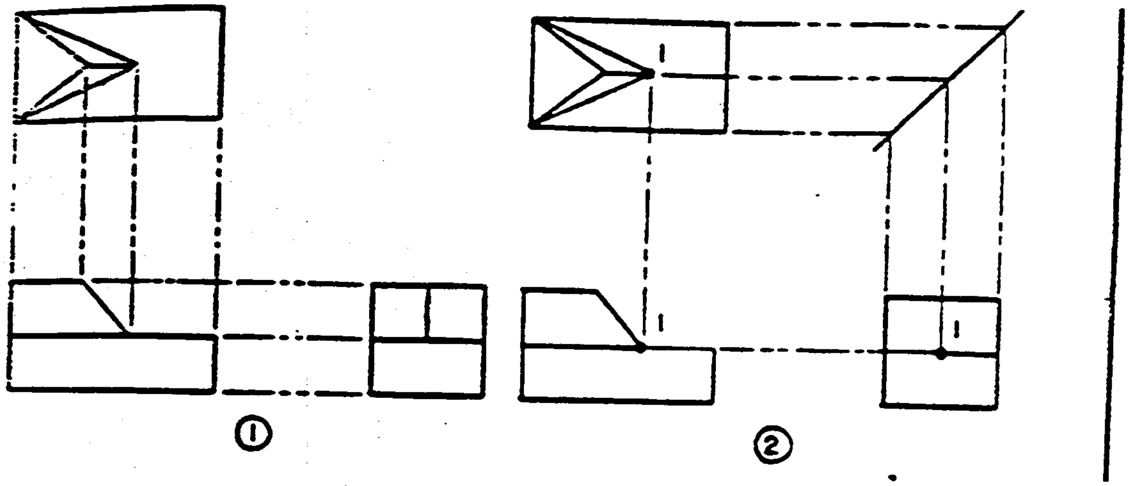


Fig 1-35. Relationships in orthographic projection.

Figure 1-36 is a three-view drawing of an object, along with an isometric outline of a box with the same overall dimensions of the object. Trace the isometric outline and points on a separate piece of paper and sketch in the details as you read the paragraph. This will help you learn to visualize the object as you interpret a construction print. Looking at the right hand side of the front view, and the corresponding parts of the top and side views, interpretation of the completed part of the isometric diagram that has been completed should be apparent. Note the point marked "a" on the top view. From the projection indicated it must be the same as the point marked "a" on the right side view. Projecting these two points to the front view, you will see that the point marked "a" on all three views is the same point and it is located at "a" on the isometric diagram. Next, look at the line "a h" on the front view. Point "h" on the front view may correspond to point "g" or point "f" on the top view, but there is no line from "a" to "f" on the top view. Line "a h" therefore, must correspond to line "a g," and transferring points to the right side view to line "a e." On the isometric view, this corresponds to the line from "a" to "n," which can now be drawn on the isometric view. Line "a b" on the front view must correspond to line "a c" on the top view, and to line "a d" on the right side view.

This translates as a line from "a" to "q" on the isometric view. At this stage, it is evident that line "e l" (right side view) is the same as line "h j" (front view), and a line has been drawn from "p" to "n" on the isometric view. Similarly, line "f c" (top) is the same as line "h b" (front), and a line has been drawn from "m" to "q" on the isometric view. Line "c g" (top) may correspond to either "h b" or "j a" (front), but not to "h a," which has already been established. If "c g" corresponds to "j a", it would also have to correspond to "l a" in the right side view, because point "a" has been established and "c g" does not project to "l a" in the right side view.

Therefore, "c g" corresponds to "h b" in the front view and to "e d" in the right side view. Line "c g" must correspond to a line from "n" to "g" on the isometric view. All that remains is to complete the isometric view with the only possible lines which do not contradict one or more of the three views; lines from "p" to "a", from "a" to "r", and from "r" to "g" produce an isometric which should look like figure 1-37.

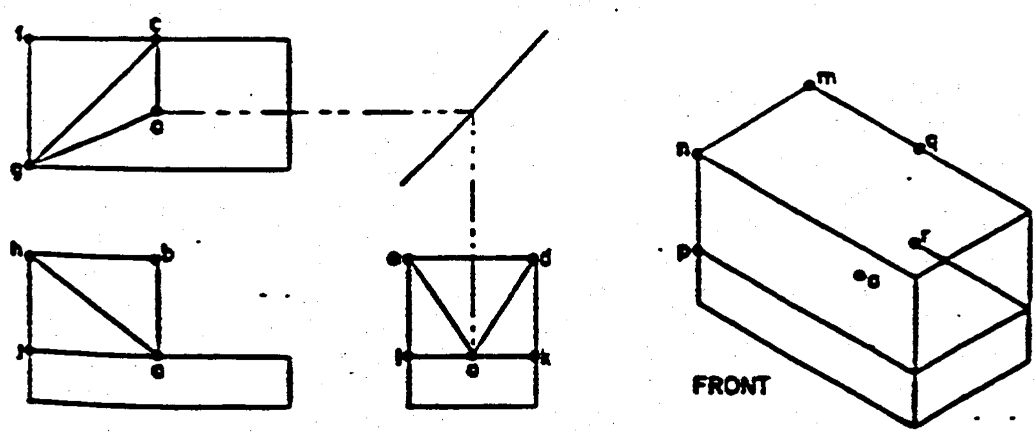


Fig 1-36. Exercise in interpretation.

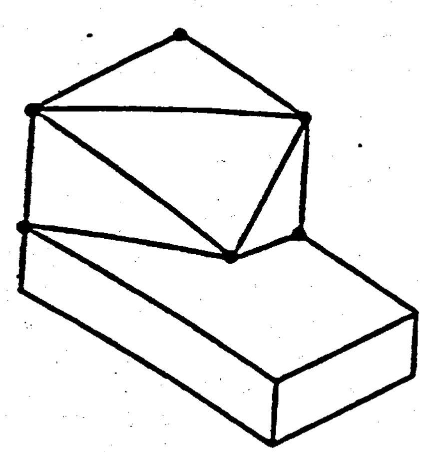
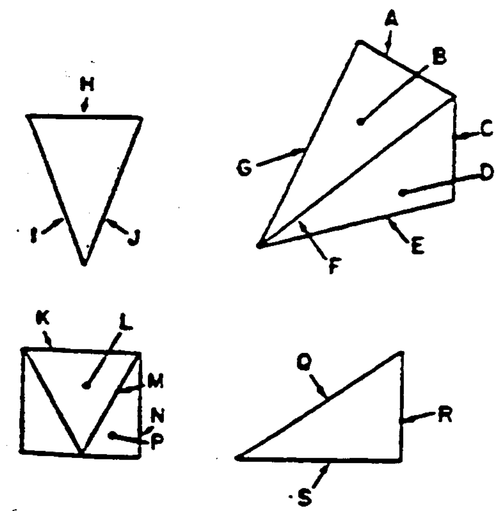


Fig 1-37 Completed exercise.

EXERCISE: Complete items 1-4 by performing the action required.



1. Which surface on the isometric drawing is represented by surface L on the front view?

   ______________________________.

2. Which surface on the isometric drawing is represented by surface P on the front view?

   ______________________________.

3. Which line on the isometric view is represented by line Q on the right side view?

   ______________________________.

4. Which line on the top view represents line F on the isometric view?

   ______________________________.

SECTION 2

PLANS AND DRAWINGS

Introduction. Working drawings plus specifications are the principal sources of information for supervisors and technicians responsible for the actual work of construction. The construction working drawing presents a complete graphic description of the structure to be erected, the construction site, the material to be used, and the construction method to be followed. Most construction drawings consist of orthographic views. A set of working drawings includes both general and detail drawings. General drawings consist of plans and elevations, while detail drawings comprise sections and detail views. This study unit will enable you to identify symbols and abbreviations that are used in site, foundation, floor, and elevation plans and drawings. You will also be able to read site plans, floor plans, and elevation plans.

SITE PLAN

Contour Lines

The site plan will normally be shown on the first sheet of a set of construction prints. The site plan shows, as necessary, the property lines and locations, contours and profiles, existing and new utilities, sewer and waterlines, building lines, location of structure to be constructed, existing structures, approaches, finished grade, and other pertinent data.

When used with a site plan, elevation is the height of any point on the lot measured from a ground point. Do not confuse the term elevation on a site plan with an elevation drawing. Elevation drawing means the side view of a building or structure. Elevations are normally given for the more prominent points on the site plan, for example, sidewalks, driveway, or finished levels of a building. Elevation is usually measured in feet and decimal feet rather than in feet and inches. Most elevations are measured from a reference point used in that area. The most common reference points used are: Mean sea level, mean lake level, or a datum point which has been established by the local town, city, county or state.

Contour lines are drawn on a site plan to indicate the elevation of the earth's surface. All points on a contour have the same elevation. They may be one, two, five, or ten feet apart.

Each contour line has an assigned value (elevation) and lies at a definite interval above and below other contour lines. Contour lines are the most accurate method of showing elevation on a site plan. To better illustrate this, the figure 2-1 represents an imaginary hill in the middle of the ocean, the shore line would be the base or zero contour, because it is at sea level (0' elevation).

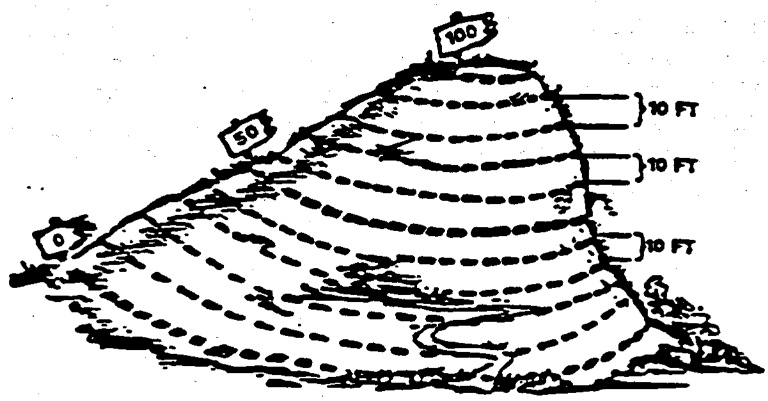


Fig 2-1. Side view of contour lines.

If the sea level should rise 10 feet, it would leave a high-water mark like the 10-foot contour line. Similarly, the successive rises above zero elevation (sea level) would leave high-water marks or rings around the hill, like contour lines. Figure 2-2 gives an oblique view of the same hill. When viewed from directly above, the hill and the contour lines would appear as in figure 2-3. This is the view point of a map or site plan taken from directly above. When the picture of the hill is removed (fig 2-4), the hill is represented by contours alone.

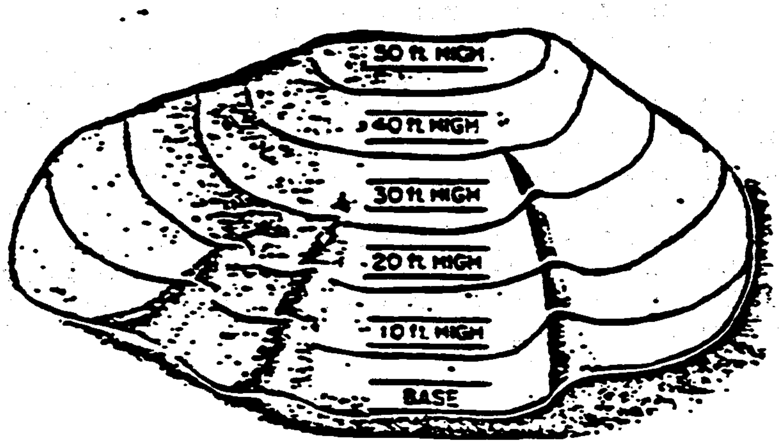


Fig 2-2. Oblique view of contour lines.

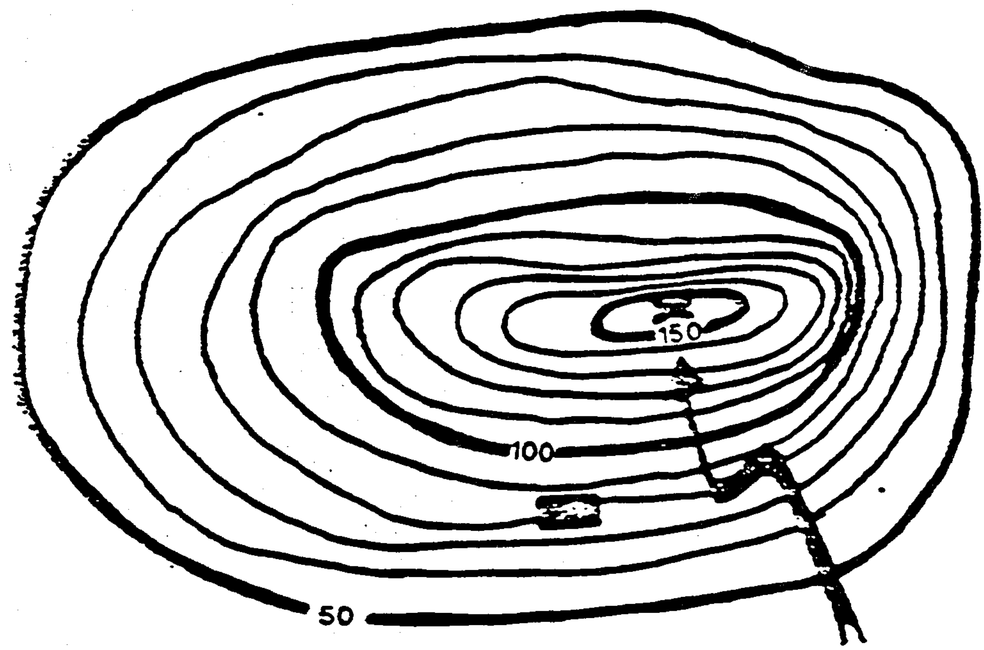


Fig 2-3. Top view of contour lines.

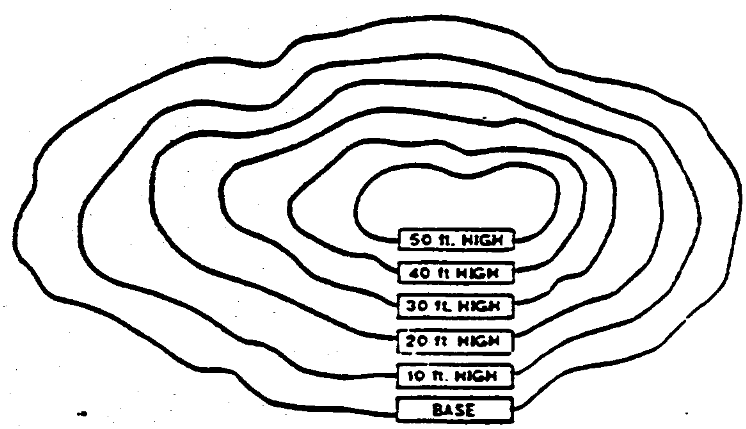


Fig 2-4. Hill shown on a map by contours.

Contour lines on a map are continuous and they always join together. A site plan shows only a small part of an area; therefore the lines do not always join.

Figure 2-5 illustrates the relationship of contour lines. The contour interval in figure 2-5 is 50 feet; however, on the site plan the interval will normally be one foot. The smaller the contour interval, the more detailed the view on the plan. As the slope of the hill becomes steeper, the lines run closer together. The further apart the lines are, the gentler the slope.

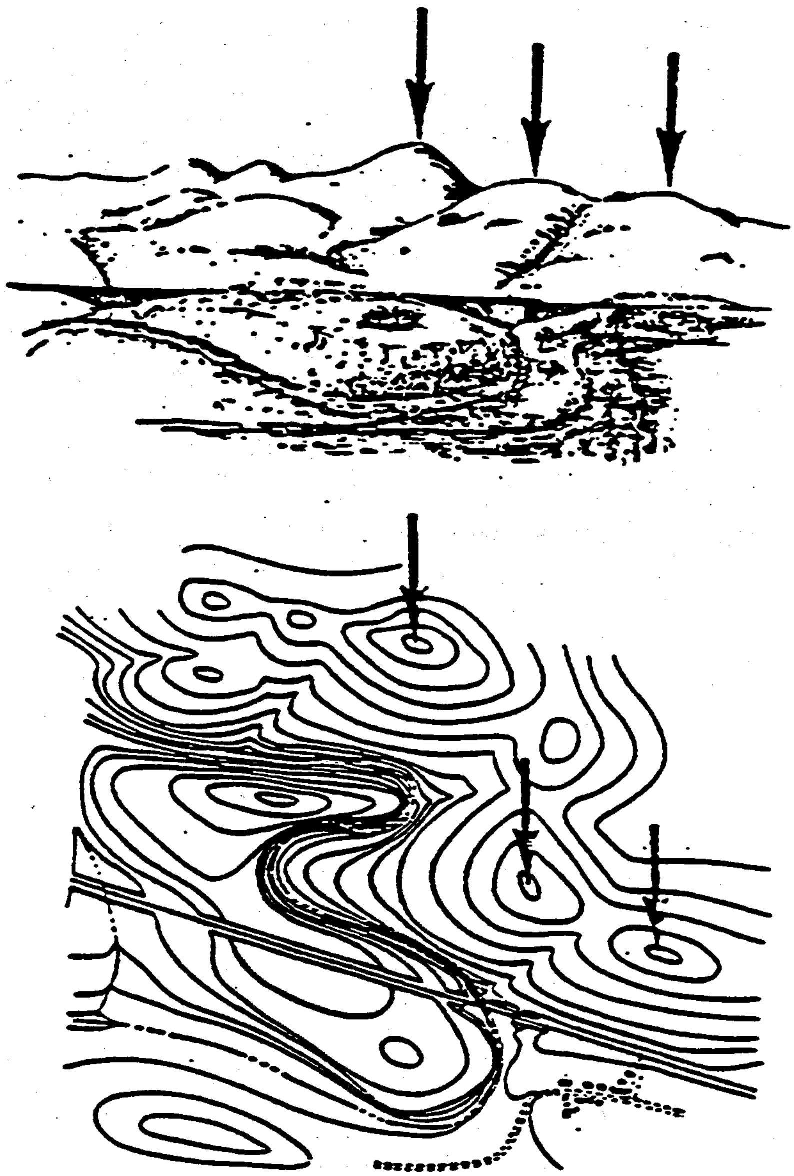


Fig 2-5. How contour lines help to analyze terrain.

a. <u>Spot elevation</u>. Points on a site plan, where the elevation is indicated by a number are known as spot elevation. It is printed on or adjacent to an important feature. On a site plan, this elevation number will be marked by a cross (+112 +126, etc).

b. <u>Grade</u>. The contour lines on a site plan help the builder to visualize the slope of a lot. When the lot is not suited for building, the slope must be changed by moving earth from the high points to the low areas. When you do this, you change the natural grade (NG) to a finished grade (FG). The natural grade is usually shown by a dashed line, and the finished grade normally will be shown by a solid line. Usually, the natural grade and the finished grade contour lines will appear on a site plan if the grade has been altered.

Locating Facilities

As stated at the beginning of this section, the site plan will show, as needed, the property lines and locations, new and existing utilities, sewer and water lines, and building lines. Figure 2-6 shows a typical site plan without the contour lines or spot elevations. The plan is oriented by a north pointing arrow to indicate site north (or magnetic north).

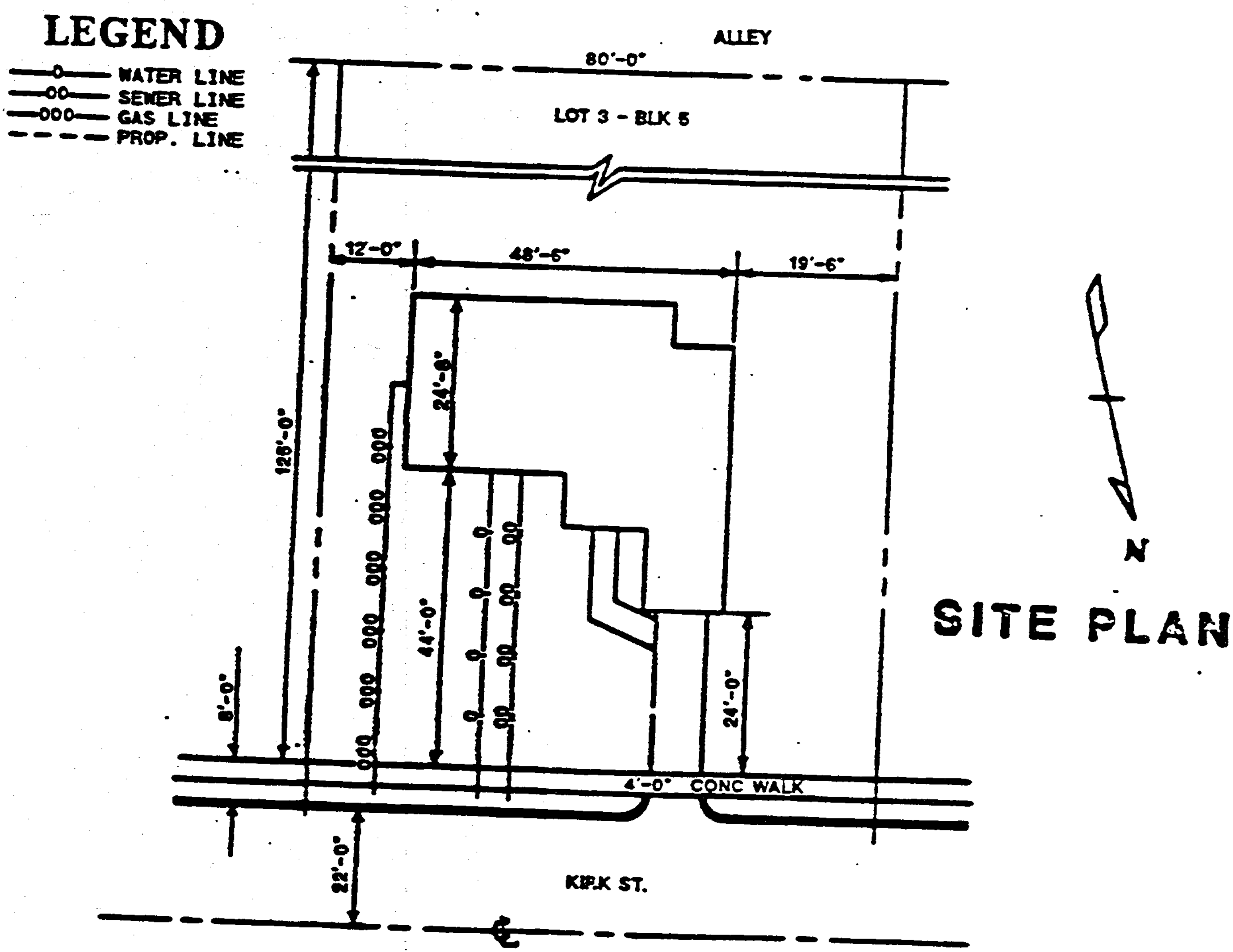


Fig 2-6. Typical site plan.

a. Property lines. Property lines or lot lines are normally indicated by long lines separated by dashes or dots. The draftsman will usually indicate in the legend if something other than these marks are used. On some site plans the corners will be given in degrees because some lots will have three, five, six, or more sides. Property lines and corners must be accurate so that the building can be correctly located within the site.

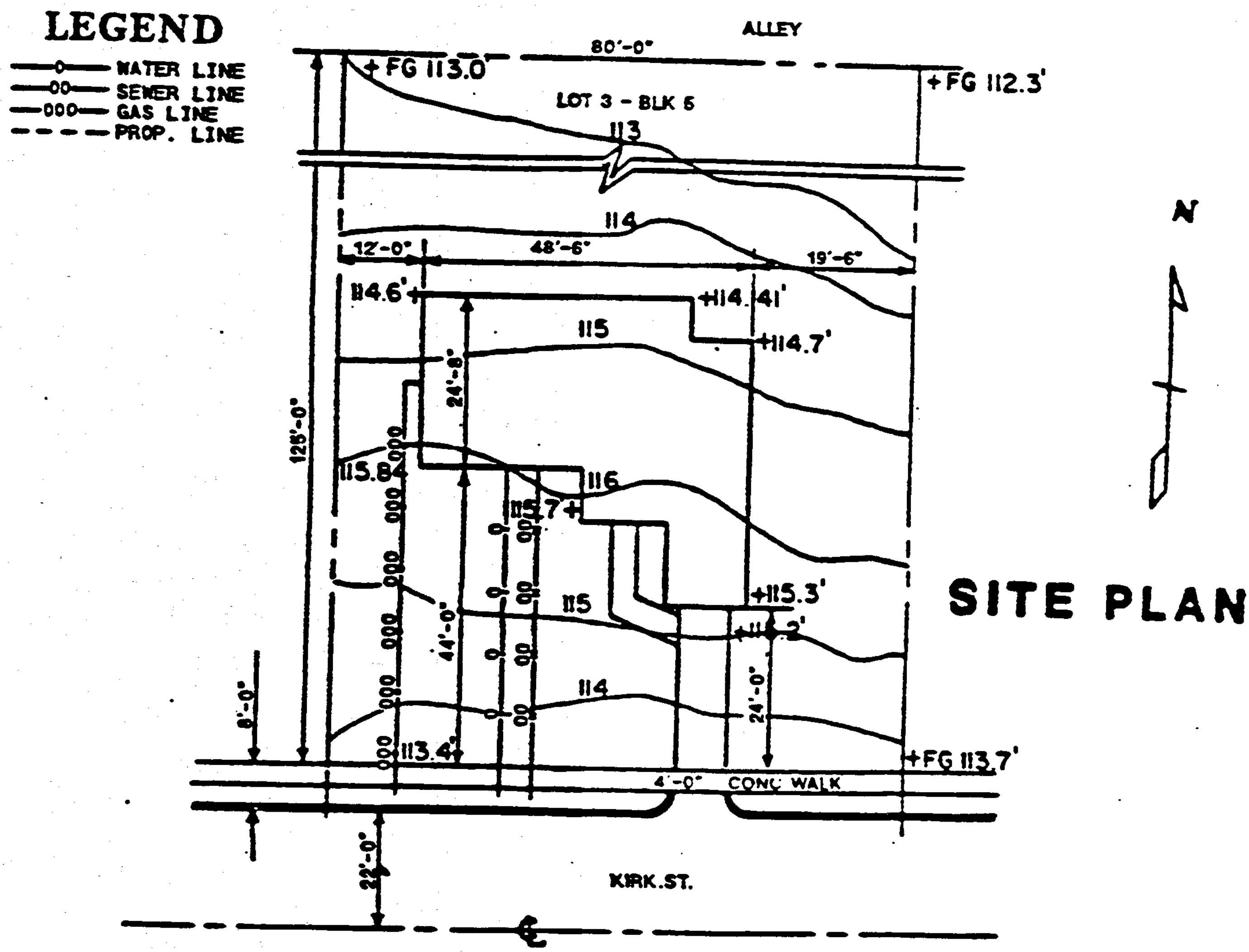
b. Location of buildings and facilities. Buildings and other facilities are located in relation to the property lines or to some other prominent feature such as a road. The distance between principal details and the property lines are furnished. All distances indicated in a plan view of the site express a horizontal measurement between two points and do not take into consideration terrain irregularities. The size of the proposed facility or building as well as the distance of the object from the property line is shown. In figure 2-6 one corner of the house is located 44 feet from the walk and the other corner is located 24 feet from the curb to the house side of the walk. You may need several dimensions to locate a building if the building is set at an odd angle to the property.

c. Sidewalks and roadways. Both existing and new approaches to the facilities will be shown on the site plan. The position and the sizes of the approach will normally be given. The existing road and highway usually will be located by their centerlines. In figure 2-6 the walkway is 24 feet from the front of the building on the plan.

d. Location of existing utilities. The site plan will show the location and the types of existing and new facilities.. The symbols for utilities normally are dash-lines and a "W" for water, dash-line and "G" for gas, dash-line and "S" for sewer, and dash-line and "E" for electricity. However, not all architects use the same symbols; therefore, the architect will usually include these symbols in the legend. Figure 2-6 shows different utility symbols than those previously stated. However, the symbols used are the same as those shown in the legend: dash-line O for water, dash-line OO for sewer, and dash-line OOO for gas. If there is any doubt about where the utilities are to be placed, the architect should be consulted.

EXERCISE: Complete items 1 through 9 by performing the action required. Check your responses against those listed at the end of this study unit.

<u>Note</u>: Use the illustration below to answer items 1-3.



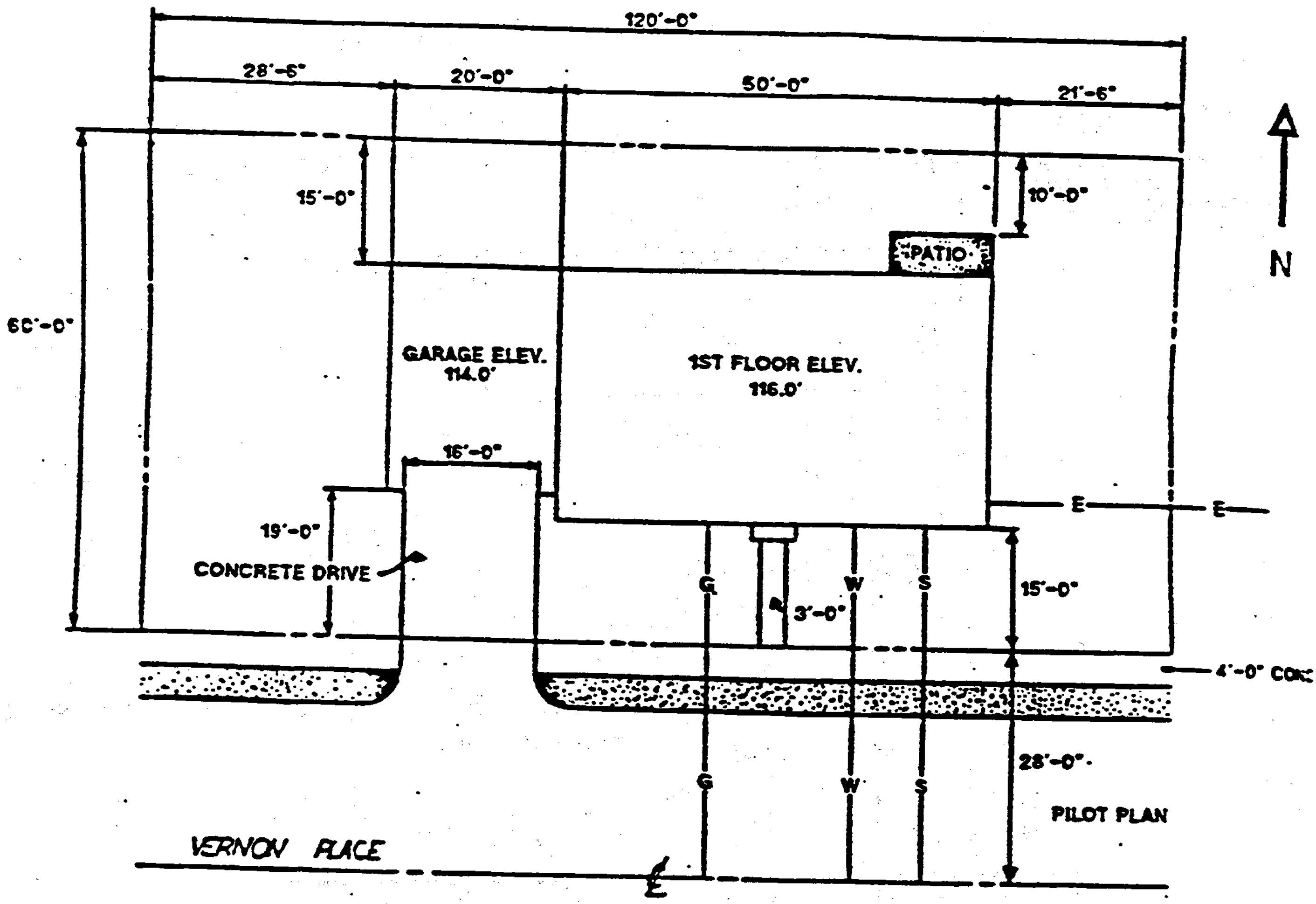
1. The finished grade at the northwest corner of the house is __________ feet.

2. The finished grade at the southwest corner of the property is _______ feet.

3. What is the finished grade at the north end of the driveway?

____

Note: Use the illustration below to answer items 4-9.



4. What is the distance between the garage and the west property line?

____

5. The patio is located how many feet from the north property line? _______________________

6. What is the distance between the house and the center line of Vernon place?

____

7. What is the length of the north property line?

____

8. What is the width of the concrete walk leading to the house?

____

9. The street walk is located how many feet from the garage?

____

FOUNDATION PLAN

Column Foundations

A foundation is a plan view of a structure projected on a horizontal plane which is achieved by looking down (in imagination, of course) from the top of the structure to be built to the foundations. The foundation plan will show the plan view. A foundation plan will normally give all the information needed to build the foundation of the structure. Foundations vary according to their intended use and the type of material to be used.

The material may be cut stone, rock, brick, concrete, tile, or wood, depending upon the weight which the foundation is expected to support. Foundations may be classified as wall or column (pier) foundations.

a. <u>Footings</u>. The footings are the base of the foundation and transmit the superimposed load to the soil. The type and size of the footing should be suitable to the soil condition. In cold climates the footings should be implanted far enough below ground level to be protected from frost action. Local codes usually establish this depth, which usually is four feet or more in northern sections of the United States.

Placed concrete footings are more dependable than those of other materials and are recommended when used in house foundations. Where fill has been used, the foundation should extend below the fill into the undisturbed earth. In areas where adobe soil is prevalent or where soil moisture may cause shrinkage, irregular settlement of the foundation and building supports may occur.

b. <u>Column footings</u>. Footings for columns (fig 2-7) should be square and should include a pedestal on which the member will bear. A protruding steel pin is ordinarily set in the pedestal to anchor a wood post. Bolts for the bottom plate of a steel post are usually set when the pedestal is poured. At other times, steel posts are placed directly on the footing and the concrete floor is poured around them.

Footings vary in size depending on the allowable soil pressure and spacing of the columns. Common sizes are 24 by 24 by 12 inches, and 30 by 30 by 12 inches. The pedestal is sometimes poured after the footing. The minimum height should be about 3 inches above the finished basement floor and 12 inches above finish grade in crawl-space areas.

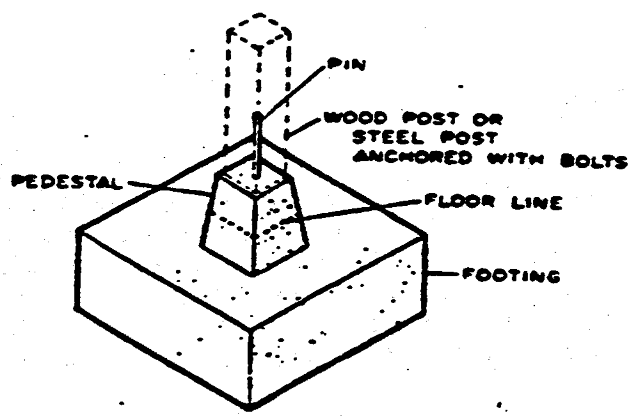


Fig 2-7. Column footing.

c. <u>Column foundations</u>. Column, post, or pier foundations save time and labor. They may be constructed of masonry, steel, or wood. The columns are spaced according to the weight to be carried. In most cases, the spacing is from 6 to 10 feet. Figure 2-8 shows some of the different types of columns with different types of footings. Wood columns are used in most cases since they are installed with the least time and labor. When wood columns are 3 feet or more above the ground, braces are required (fig 2-9).

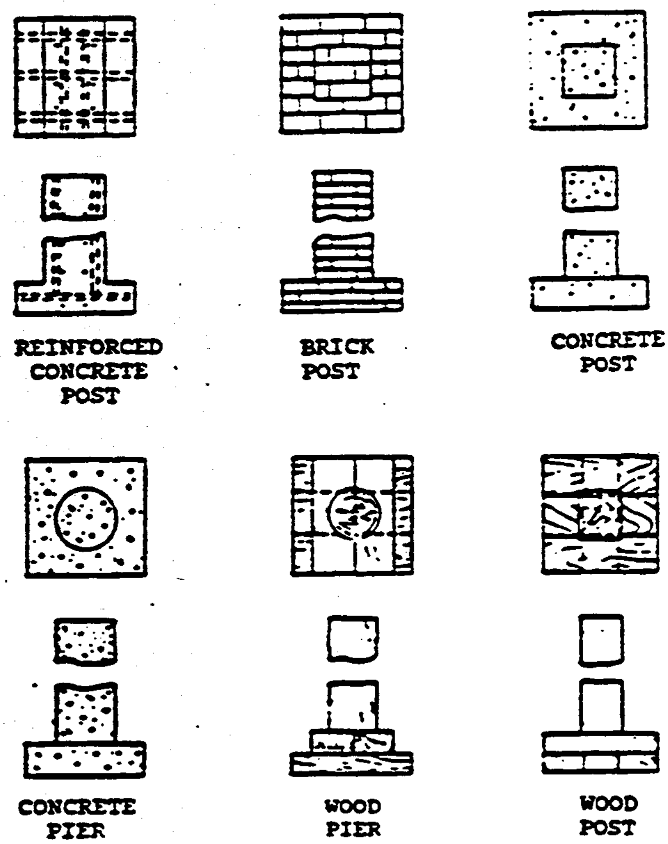


Fig 2-8. Types of columns.

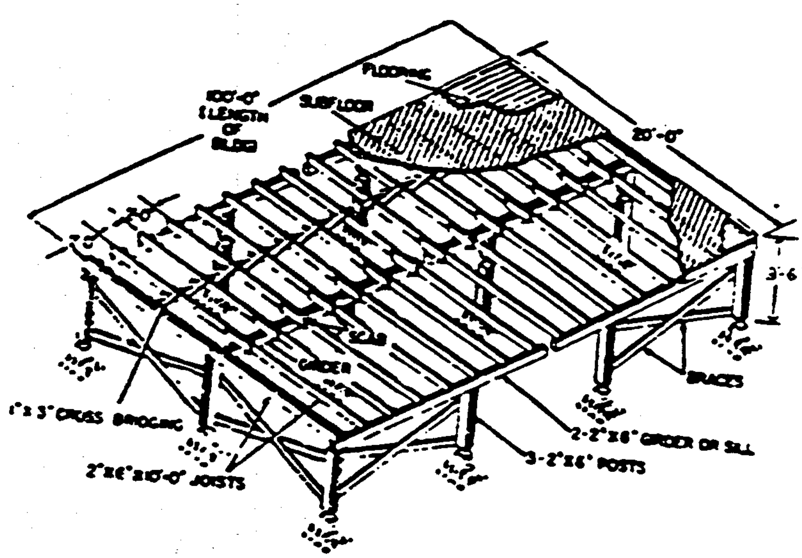


Fig 2-9. Braced column.

Footings are located by distance between centerlines and distance from reference to property lines. Figure 2-10 shows a typical column foundation plan where footings are used; the condition for 20 and 60 foot spans are shown. You can see that the spacing of the footing along the 120-foot spans is the same for both conditions. The footing details noted in A2 and B2 on figure 2-10, are shown in figure 2-11. Note that the footing details indicate the sill of the various members. In some cases, the lengths are given, while in others the bill of materials accompanying the print specifies the required lengths of the various members. Detail A2 shows the type of footing used for the 60-foot span and detail B2 the type of footing used for the 20-foot span. You can see that the heavier footing construction includes diagonal bracing (detail A2, side elevation), whereas the footing shown in detail B2 uses scabs only. Note that the height of the footing is marked "varies," meaning that the height depends upon the ground elevation.

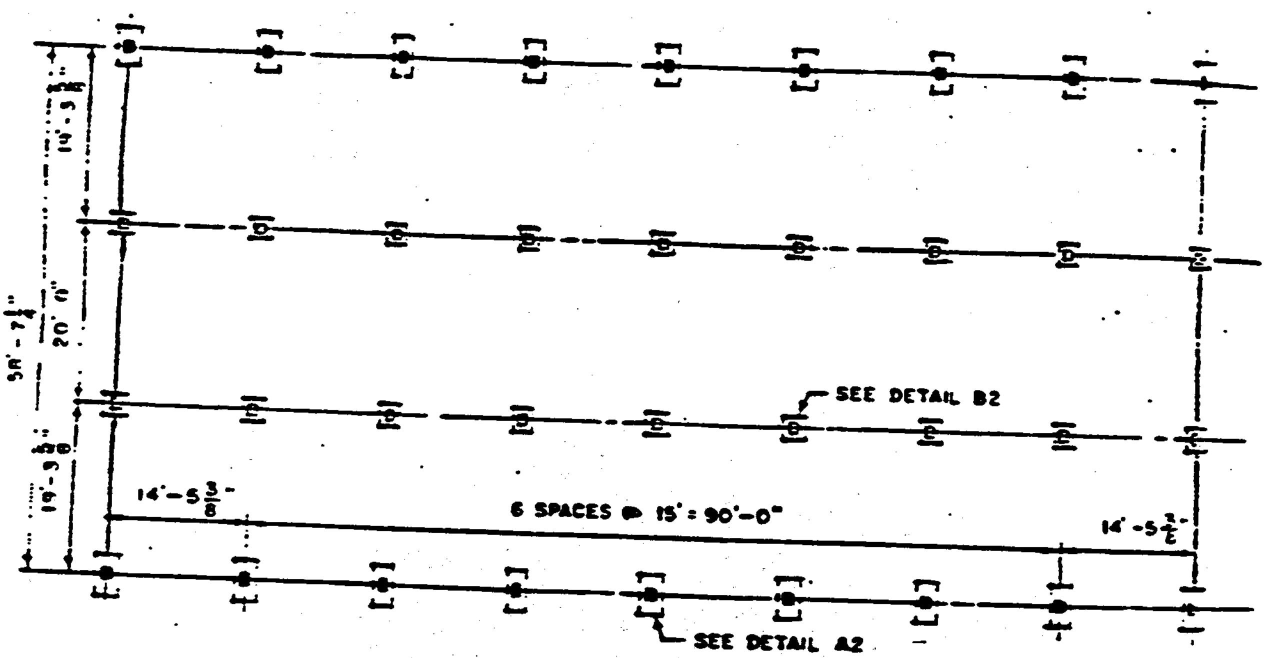
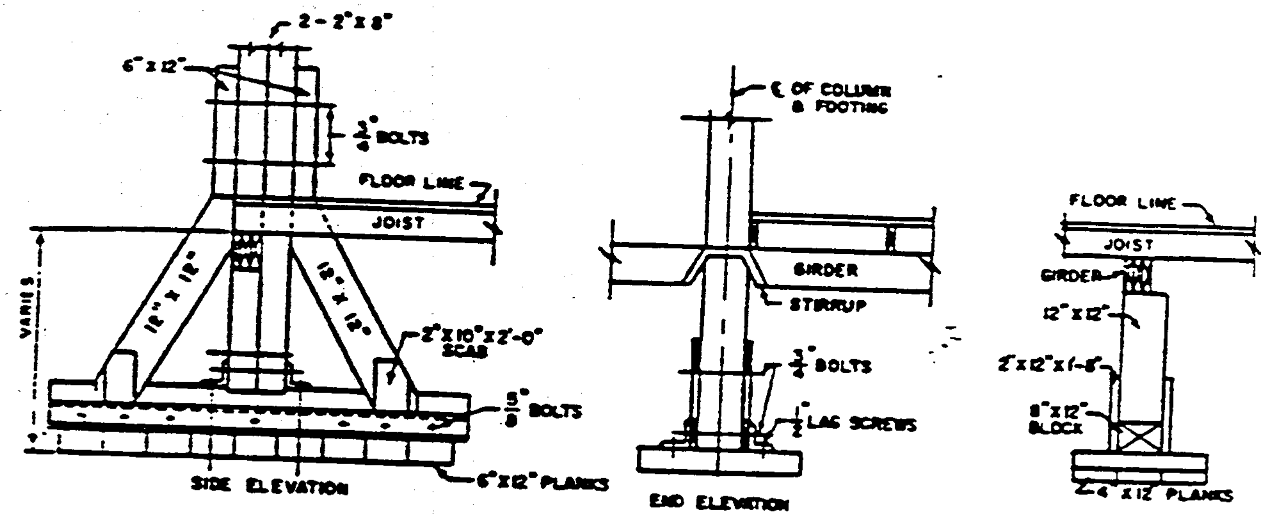


Fig 2-10. Column foundation plan.



DETAIL A2

DETAIL B2

Fig 2-11. Footing details.

Wall Foundations

Well designed wall foundations are important in preventing settling or cracks, in walls. One method for determining the size, which is often used with most normal soils, is based on the proposed wall thickness. The footing thickness or depth should be equal to the wall thickness (fig 2-12). Footings should project beyond each side of the wall one-half of the size of the wall thickness. This is a general rule. The footing bearing area should be designed in relation to the load capacity of the soil. Local regulations often relate to these needs. This also applies to column and fireplace footings.

If the soil has a low load-bearing capacity, a wider reinforced footing may be required.

A few rules that apply to footing design and construction are:

- o Footings must be at least 6 inches thick; 8 inches or more are preferred.
- o If footing excavation is too deep, fill it with concrete never replace fill.
- o Use form boards for footings where soil conditions prevent sharply cut trenches.
- o Place footings below frostline.

- Reinforce footings with steel rods where they cross pipe trenches.

- Use key slot for better resistance to water entry at wall location.

- In freezing weather, cover with straw or heat the area.

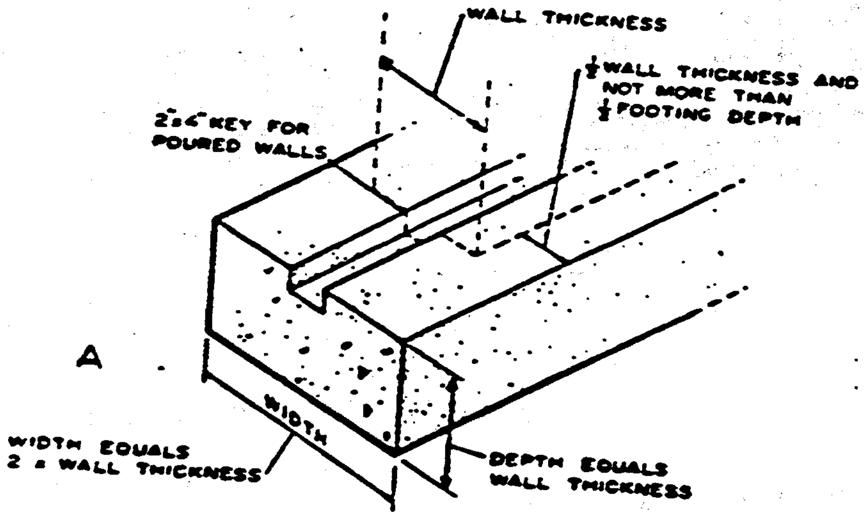


Fig 2-12. Typical concrete wall footing.

Wall foundations are solidly built all through their length when they are to support heavy loads or when the earth where they are built does not have supporting strength. These walls may be made of concrete, rock, brick, or cut stone, with a footing at the bottom figure 2-13. Because of the time, labor, and material required to build this type of foundation, it will be used in the theater of operation only when other types cannot be used.

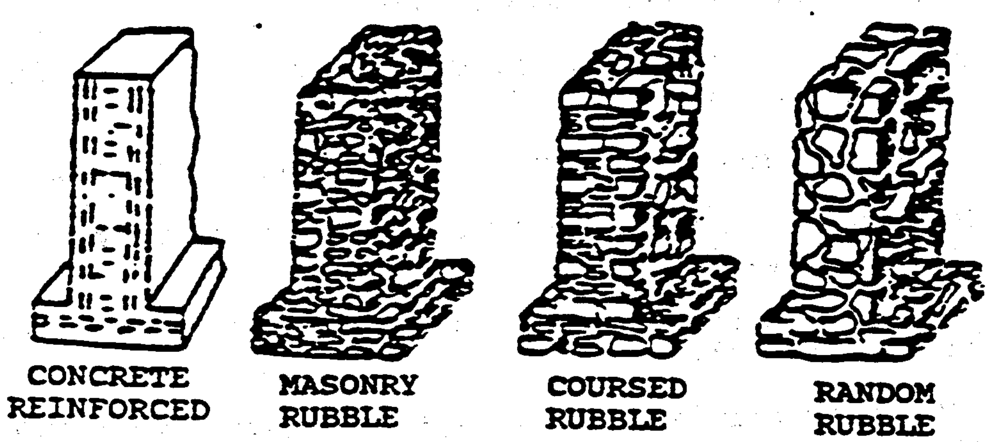


Fig 2-13. Types of wall foundations.

The various plan views of the foundation will furnish a lot of information that is needed in the construction of a building. In the plan view of the foundation, the footing width is designed by dash-lines and the wall width by an unbroken line. Figure 2-14 shows that the main foundation will be an 8-inch concrete block wall measuring 28 feet lengthwise and 22 feet crosswise. The lower portion of each lengthwise section wall will be 12 inches thick to provide a concrete ledge 4 inches wide for the support of the first floor joist end. A girder running through the center of the building will be supported at either end by two 4-inch x 12-inch concrete "pilasters" which will butt against the end foundation walls. Intermediate supports will be provided by two 12-inch x 12-inch concrete "piers" (columns), each supported on 18-inch x 18-inch spread footings, 10 inches deep. The dash-lines around the foundation wall indicates that these walls also rest on spread footings; those for the side walls will be 20 inches wide, those for the end walls 16 inches wide.

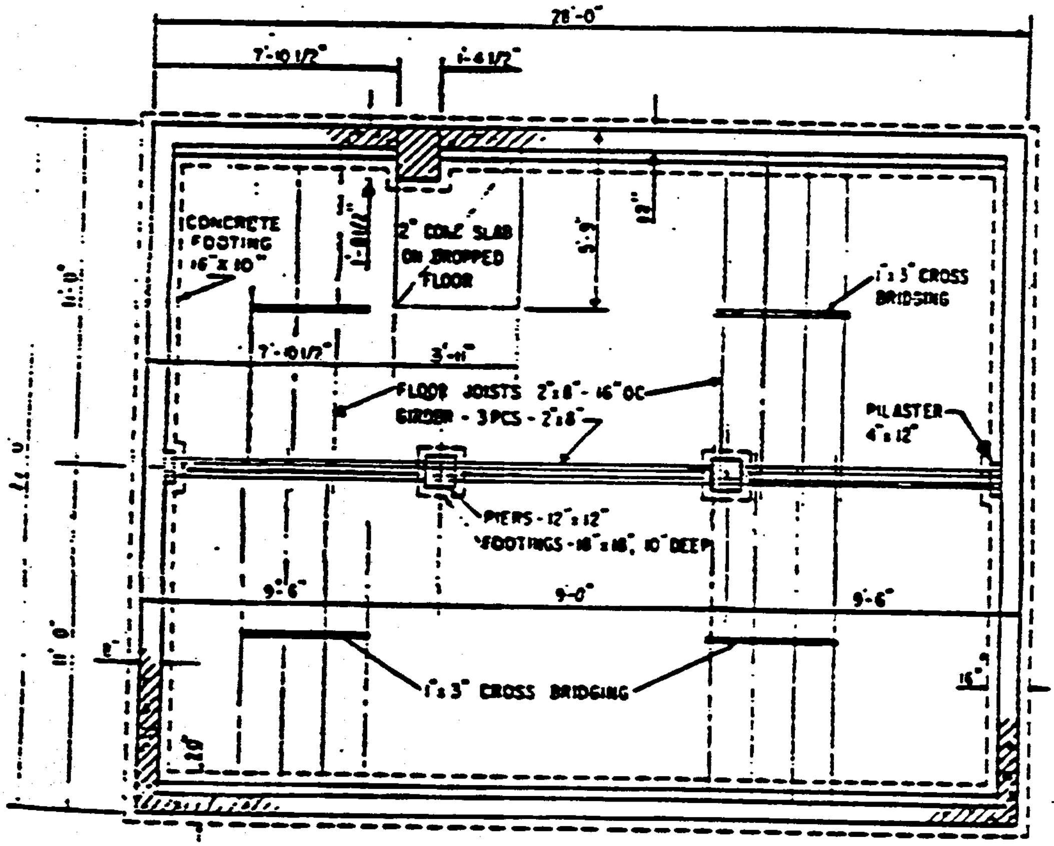


Fig 2-14. Typical wall foundation plan.

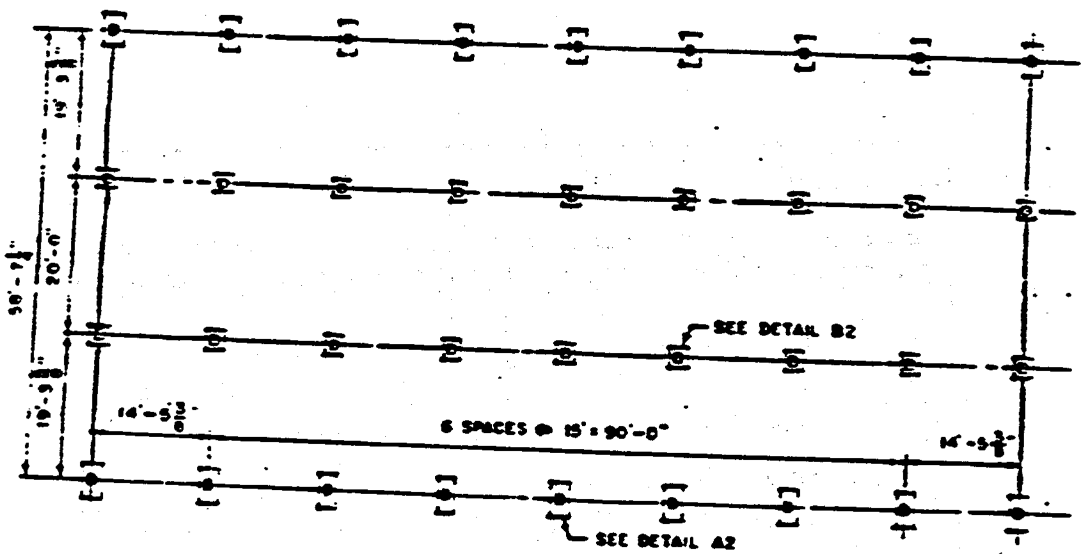
EXERCISE: Complete items 1 through 6 by performing the action required.

1. Column foundations will save both time and ______________ ________________________.

2. Which type of material is generally used to save time and labor when installing a column foundation?

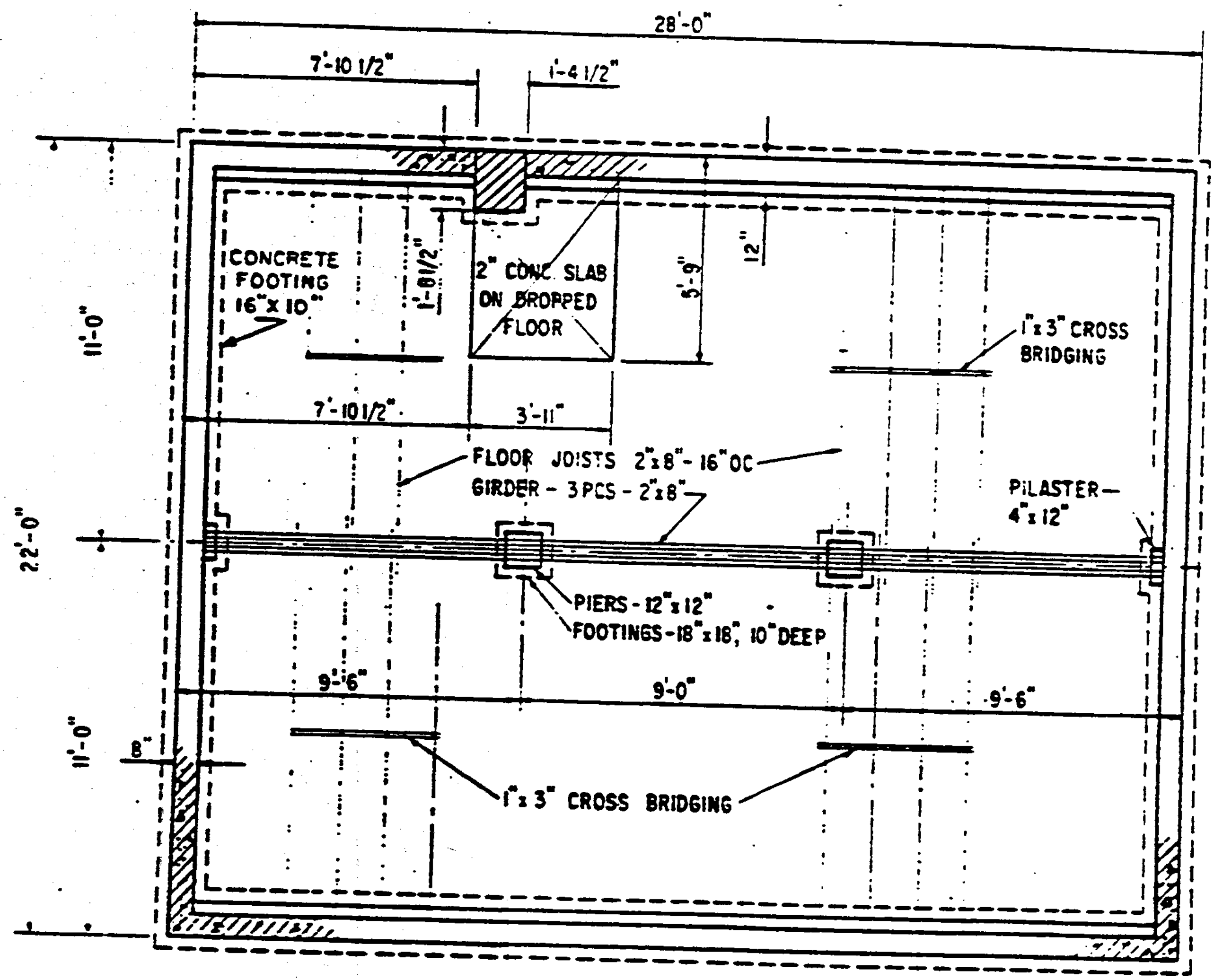
____

Note: Use the illustration below to answer item 3.



3. The illustration above is a ________________________ foundation plan.

__Note__: Use the illustration below to answer items 4-6.



4. How thick is the concrete wall? ________________

5. What is the girder made out of? ________________

6. Which type of foundation plan is shown in the illustration above?

____

FLOOR PLANS

Floor Plan Symbols

A floor plan is a cross-sectional view of a building. The horizontal cut crosses all openings regardless of their height from the floor. The development of a floor plan is shown in figure 2-15. Note that the floor plan shows the outside shape of the building; the arrangement, size, shape of the rooms, and the types of material. It also shows the length, thickness, width, location of the doors and windows, the thickness and character of the building walls at a particular floor. A floor plan also includes the type and location of utility installations, and stairways.

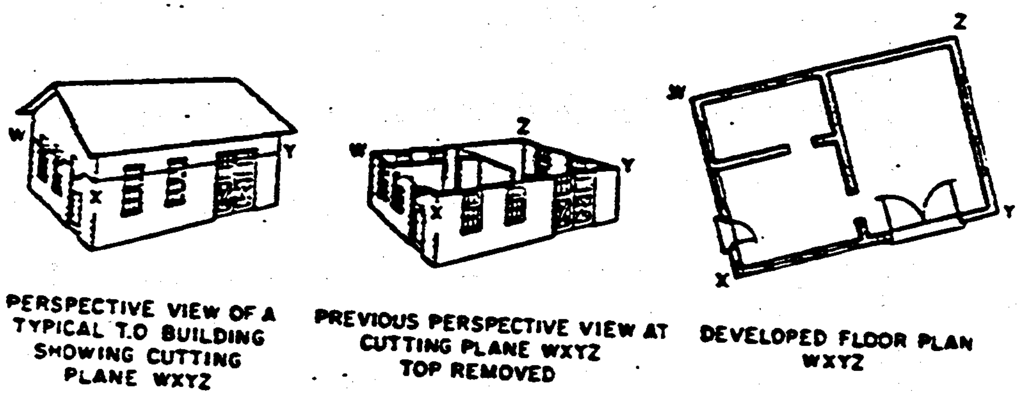


Fig 2-15. Floor plan development.

Architectural symbols on the construction plans are used to indicate the type and location of doors, windows, and any other features. The symbols shown in this lesson are used to represent the different materials, doors, windows and building parts that will normally be found on floor plans. To read the various floor plans, the builder must be able to recognize the different symbols and he must also know how several types of materials can be used in the same wall.

The architects usually do their best to follow all the accepted standards in representing materials, equipment, and parts of the buildings. There may be occasions when more than one symbol can be used. If this happens, the architect will note the symbol and what it represents in a legend on the plan.

The American National Standards Institute (ANSI) works with other trade groups and associations to standardize the procedures and symbols used in the construction field.

Material symbols show the types of material in the structure. Figure 2-16 illustrates the ones which are used for the more common types of materials found on a floor plan. The symbol selected will normally represent the material in some way whenever possible; however, it is not always possible to use a common characteristic of the material for symbols. The builder should know all the symbols of the material in order to accurately read construction prints, and should always check their meaning in the legend if he has any doubt. Figure 2-17 illustrates the symbols of materials that are most often used in combinations.

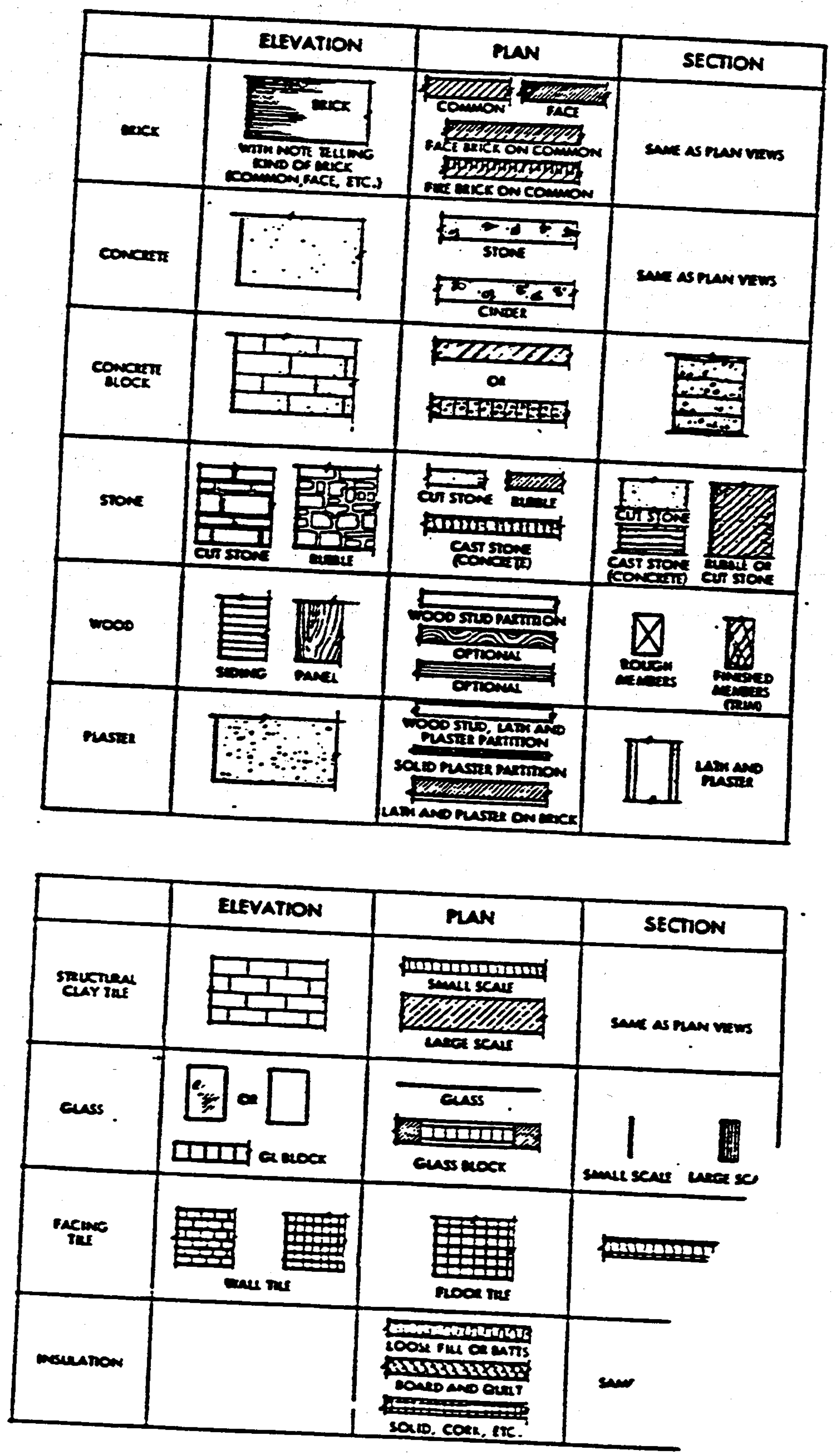


Fig 2-16. Typical material symbols for each view.

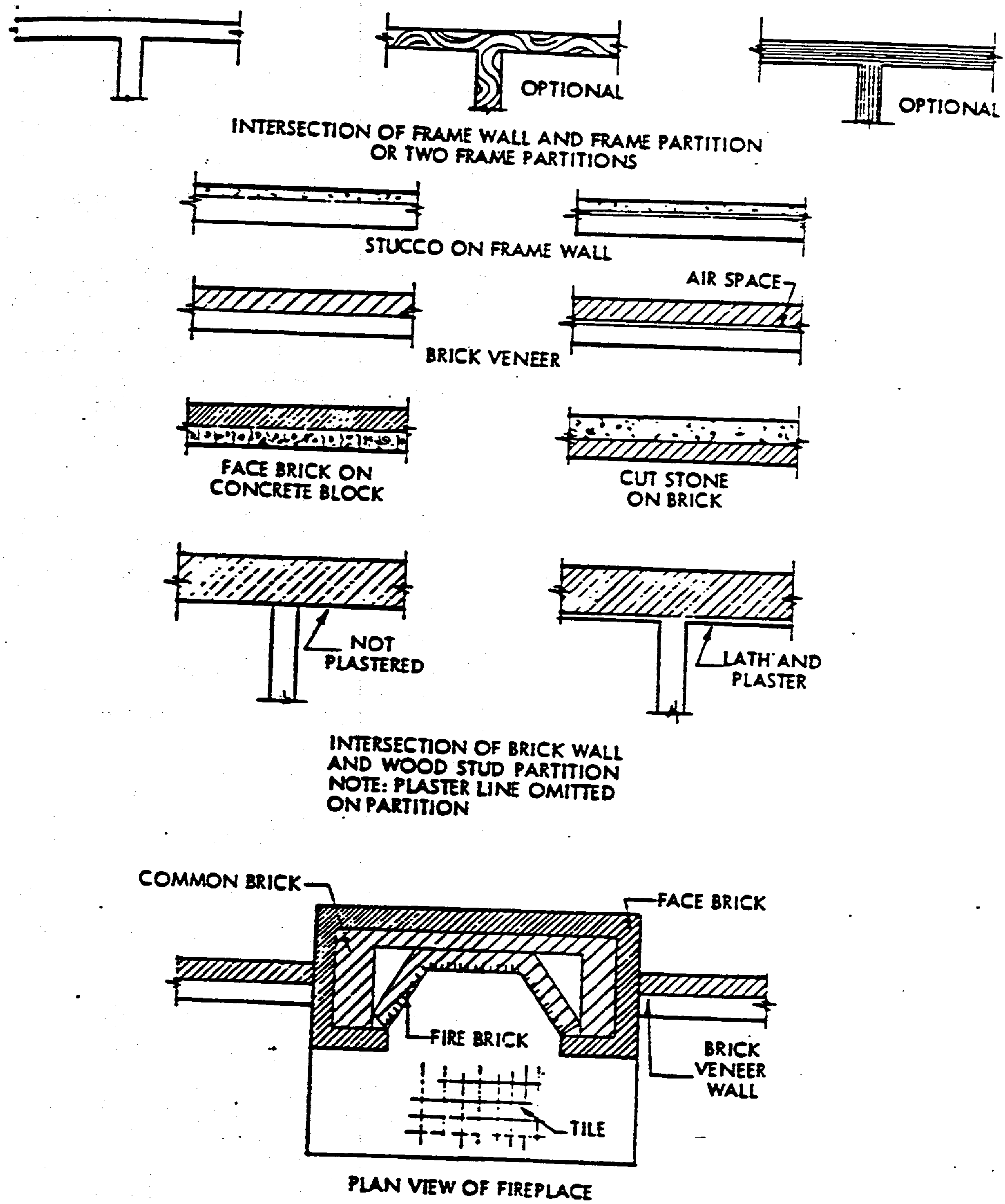


Fig 2-17. Material symbols used in combination.

Windows and doors are represented by symbols on floor plan and often the symbol is accompanied by either a number or a letter which refers to a particular window or door on the appropriate schedule. The schedule consequently will give various information such as the size, material, and the type of door or window.

Figure 2-18 shows both plan view and elevation view for five of the most typical windows set in a wood frame wall. The elevation view is included to show the relationship between the two views. The dash-line on the awning and casement window points to the side where the window is hinged. As an example, the casement window is hinged at the sides and swings out from the middle.

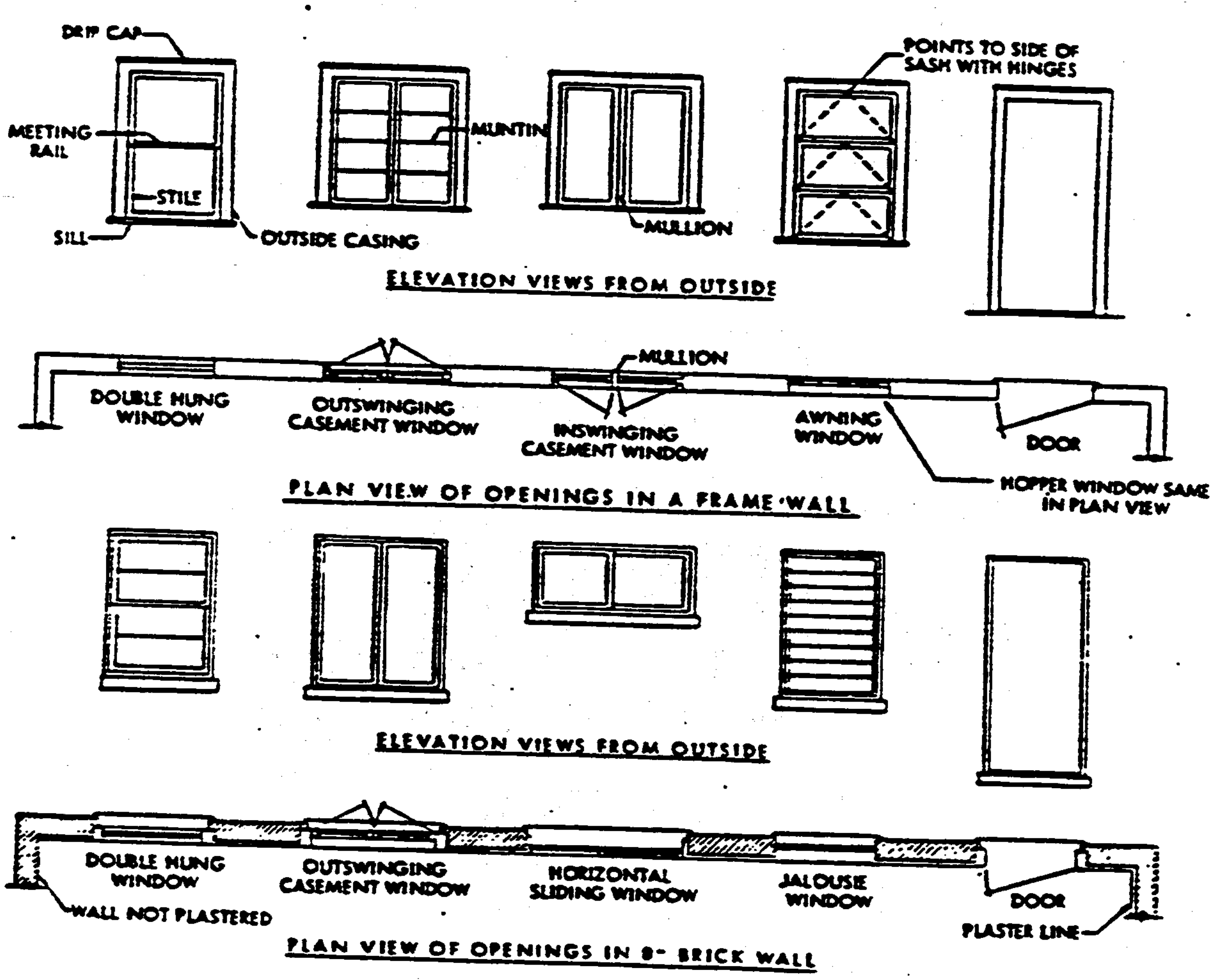


Fig 2-18. Typical window symbols.

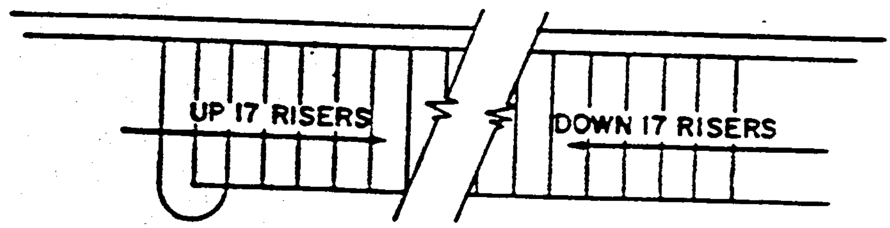


Fig 2-20. Plan view of stairway.

Specialized symbols used to show heating, air conditioning, plumbing, and electricity will be covered in study unit 4.

Floor Plan Abbreviations

The architect works on such a small scale that he does not have the space to letter all the information; therefore, he uses abbreviations whenever he can.

Because the person reading the construction print may be new and inexperienced, there is danger that he may not be able to understand the abbreviation. Most architects will use an accepted form of abbreviations, but if there is any doubt he will spell out the word completely. Sometimes abbreviations have more than one meaning. The abbriviation "FL" can stand for "floor" or "flush"; therefore, the builder must be very careful and make sure he understands all abbreviations fully. If there is any doubt, he should check with the architect for the correct meaning.

Table 2-1 contains most of the accepted abbreviations found on a floor plan. Specialized abbreviations used in conjunction with heating, air conditioning, plumbing, and electricity will be discussed in study unit 4.

Table 2-1. Floor plan abbreviations.

TERMS	ABBREVIATIONS
Acoustic	AC or ACST
Acoustic Tile	ACT or AT
Aggregate	AGG or AGGR
Aluminum	AL
Anchor Bolt	AB
Apartment	APT
Approximate	APX or APPROX
Architectural	ARCH
Area	A
Asbestos	ASB
Asphalt	ASPH
Asphalt Tile	AT
Basement	BSMT
Bath Tub	BT
Bathroom	B
Beam	BM
Bedroom	BR
Blue Print	BP
Book Shelves	BK SH
Brass	BRS
Brick	BRK
Bronze	BRZ
Broom Closet	BC
Building	BLDG
Building Line	BL
Cabinet	CAB
Calking	CK or CLKG
Cast Iron	CI
Cellar	CEL
Cement	CEM
Cement Floor	CEM FL
Cement Mortar	CEM MORT
Center	CTR
Center to Center	C to C
Center Line	C or CL
Ceramic	CER
Channel	CHAN
Cinder Block	CIN BL
Clear Glass	CL GL
Closet	C, CL or CLOS
Column	COL
Concrete	CONC
Concrete Block	CONC BLK
Concrete Floor	CONC FL or CONC FLR
Construction	CONST
Contract	CONTR of CONT

Table 2-1. Floor plan abbreviations (continued)

Copper	CPR or COP
Counter	CTR
Cubic Feet	CU FT
Cut Out	CO
Detail	DET or DTL
Diagram	DIAG
Dimension	DIM
Dining Room	DR
Dishwasher	DW
Double-Acting	DA
Down	D or DN
Downspout	DS
Drawing	DWG
Dryer	D
End to End	E to E
Excavate	EXCA or EXC
Expansion Joint	EXP JT
Exterior	EXT
Finish	FIN.
Finish Floor	FIN. FL or FIN. FLR
Fire Brick	FRBK
Fireplace	FPL or FP
Fireproof	FP or FPRF
Flashing	FL or FLG
Floor	FL or FLR
Flooring	FLG or FLR
Flush	FL
Footing	FTG
Foundation	FND
Frame	FR
Full Size	FS
Furring	FUR
Galvanized Iron	GI
Garage	GAR
Gas	G
Glass	GL
Glass Block	GLB or GL BL
Gypsum	GYP
Hardware	HDW
Hot Water Heater	HWH
I Beam	I
Inside Diameter	ID
Insulation	INS
Interior	INT
Iron	I
Jamb	JB
Kitchen	KIT or K

Table 2-1. Floor plan abbreviations (continued)

Landing	LDG
Lavatory	LAV
Leader	L
Length	L, LG, LGTH
Library	LIB
Limestone	LMS or LS
Linen Closet	L CL
Lining	LN
Linoleum	LINO
Living Room	LR
Louver	LVR or LV
Main	MN
Marble	MRB or MR
Material	MTL or MATL
Maximum	MAX
Medicine Cabinet	MC
Minimum	MIN
Miscellaneous	MISC
Mixture	MIX
Modular	MOD
Mortar	MOR
Moulding	MLD or MLDG
Nosing	NOS
Obscure Glass	OBSC GL
On Center	OC
Opening	OPN or OPNG
Outlet	OUT
Overhead	OH or OVHD
Pantry	PAN.
Partition	PTN
Plaster	PLAS or PL
Plate	PL
Platform	PLAT
Porch	P
Precast	PRCST
Prefabricated	PFB or PRFAB
Quarry Tile	QT
Random	RDM
Range	R
Recessed	REC
Refrigerator	REF
Reinforce or Reinforcing	RE or REINF
Revision	REV
Riser	R
Roof	RF
Room	RM or R
Rough	RGH
Rough Opening	RO or RGH OPNG

Table 2-1. Floor plan abbreviations (continued)

Rubber Tile	RBT or R TILE
Scale	SC
Schedule	SCH
Screen	SCN or SCR
Scuttle	S
Section	SEC or SECT
Select	SEL
Service	SERV
Sewer	SEW
Sheathing	SHT or SHTHG
Sheet	SH
Shelf and Rod	SK & ROD
Shelving	SH or SHELV
Shower	SH
Sink	SK or S
Specification	SPEC
Square Feet	SQ FT
Stained	STN
Stairs	ST
Stairway	STWY
Standard	STD
Steel	STL
Storage	STG
Switch	SW or S
Telephone	TEL
Terra Cotta	TC
Terrazzo	TZ or TER
Thermostat	THERMO
Threshold	TH
Toilet	T
Toungue and Groove	T & G
Tread	T or TR
Typical	TYP
Unfinished	UNF
Unexcavated	UNEXC
Utility Room	U RM
Vinyl Tile	VT or V TILE
Washing Machine	WM
Water	W
Water Closet	WC
Water Heater	WH
Waterproof	WP
Weather Stripping	WS
Wide Flangd	W or WF
Wood	WD
Wood Frame	WF

Reading Floor Plans

The first thing a builder will normally do with a set of prints is to become familiar with the layout of the building. This can be accomplished by studying the floor plan(s) of the building. Since the floor plan(s) can contain a maze of information, he will usually concentrate on the overall size, shape, and relation of rooms; as well as the use of any auxiliary space such as hallways, closets, and stairways.

The following are some basic rules that can be applied to reading floor plans.

* Floor plans are drawn to scale; therefore, all rooms and stairways will drawn so that they are in the correct relationship to each other.

* Floor plans are drawn to the same scale as the elevation drawings and they will be exactly related to each other. Doors and Windows shown on the floor plan will be the same in size and location as those on the elevation view.

* If a builder has more than one floor plan (two or more floors), then these floor plans will be related to one another. Partitions on the lower floor will support the floor load directly above. Stairways will start on one floor level and end on the floor above in the correct place. If a stairway is noted on one floor plan, then another floor plan for the other level must be available. The stairway will only be partially shown on either the first or second floor plans. If the first floor plan shows a set of stairs descending, then there must be a basement in the building.

* The building on a floor plan will normally be shown with the front view toward the bottom of the print.

Read the floor plan shown in figure 2-21 and note the features of the recreation building. Although the location of the utilities is given, you can disregard the details on utilities in this lesson. Basically, the lines with small circles show wiring for electrical outlets, while other appropriate symbols designate the plumbing fixtures. Complete information on reading the utility data and interpretation of the associated symbols are given in study unit 4.

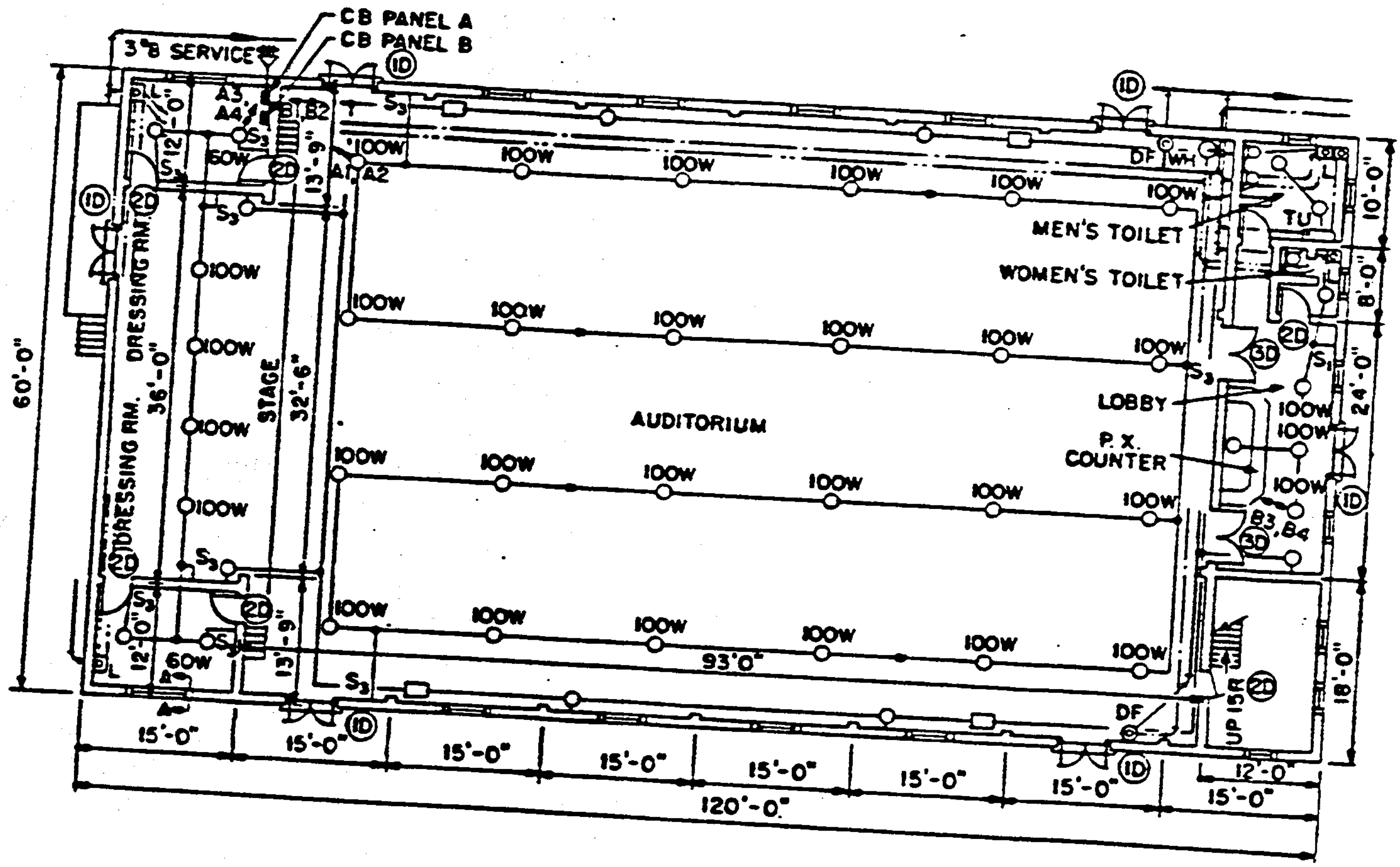
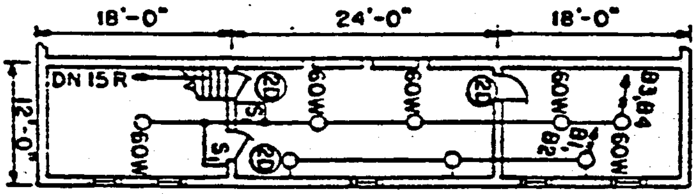


Fig 2-21. Typical floor plan.

By examining the floor plan, you can see that the interior or the building will consist of an auditorium, a lobby with a P.X. counter, a men's toilet, a woman's toilet, a projection room (fig 2-22) on the second level above the lobby, two dressing rooms and a stage. The stage may not be apparent but, by noting the steps adjacent to each dressing room you can see that there is a change in elevation. The plans give the dimensions of the areas specified. Note that all building entrances and/or exit doors are of the same type (1D) and that all windows are the double-hung type. All interior single doors (2D) are the same and two double doors (3D) open into the lobby from the auditorium. The projection room is reached via a 15-riser stairway located in a 12 by 18 foot room.

At the top of the stairway is a single door which opens into the projection room along the wall of the projection room that faces the stage (the inside wall which has three openings). Note that no windows are designated for the sides of the building where the projection room is located, but are indicated at the first floor level.



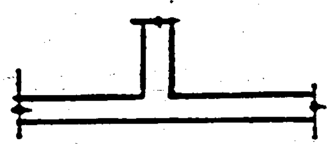
PROJECTION ROOM

Fig 2-22. Second floor plan.

EXERCISES: Complete items 1 through 26 by performing action required.

1. The symbol below illustrates a

____.



2. The symbol below illustrates a

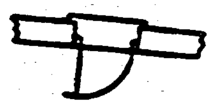
____.

3. What type of window symbol is illustrated?

____

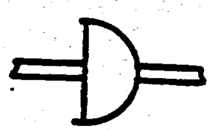
4. What type of door symbol is illustrated?

____



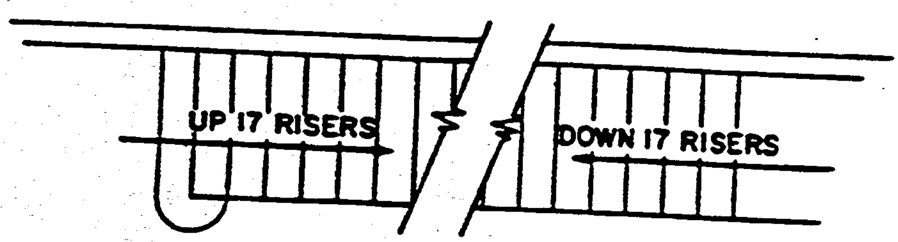
5. The symbol below illustrates a

______________________________________.



6. The symbol below illustrates a

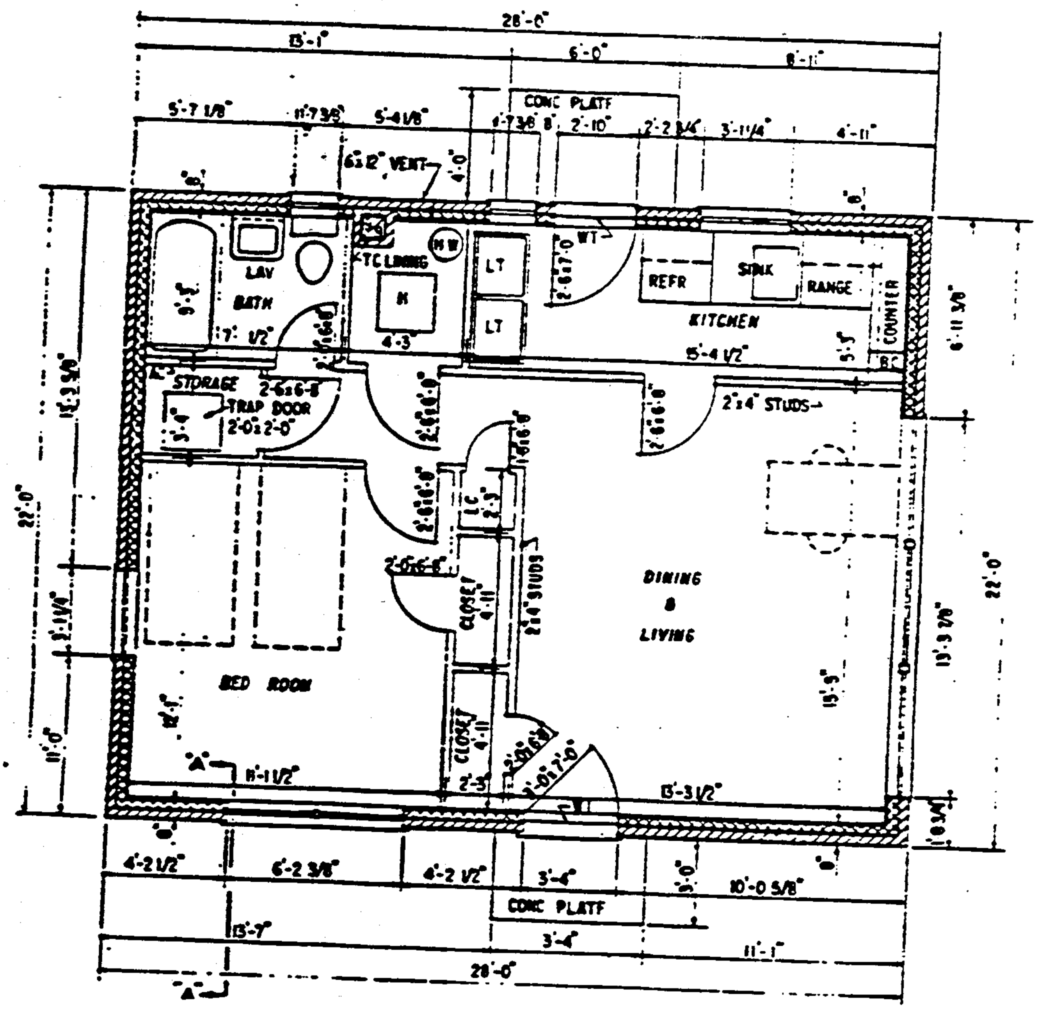
______________________________________.



Matching: For items 7 through 16, match the floor plan abbreviation in column 1 with its floor plan term in column 2. Place your responses in the spaces provided.

Column 1 ABBREVIATIONS	Column 2 TERMS
7. ______________, APT	a. Water Closet
8. ______________, BT	b. Shelving
9. ______________, CONC	c. Construction
10. ______________, FBRK	d. Overhead
11. ______________, OC	e. Firebrick
12. ______________, PL	f. Approximate
13. ______________, RF	g. Threshold
14. ______________, SHTHG	h. Bath tub
15. ______________, TH	i. Platform
16. ______________, WC	j. Sheathing
	k. Rough
	l. Thermostat
	m. Basement
	n. Concrete
	o. Water Counter
	p. Roof
	q. Plate
	r. Apartment
	s. On Center

Note: Items 17 through 24 refer to the floor plan illustrated below.



First Floor Plan
Scale 1/4"=1'-0

17. How many doors permit entry or exit to the house?

____

18. How many bedrooms are there in the house?

____

19. What are the dimensions of the kitchen?

____

20. What is the total number of closets in the house?

____

21. What are the dimensions of the dining/living room?

____

22. How many windows are in the plan?

____

23. As you enter the kitchen from the living room, on what side of the room is the sink located?

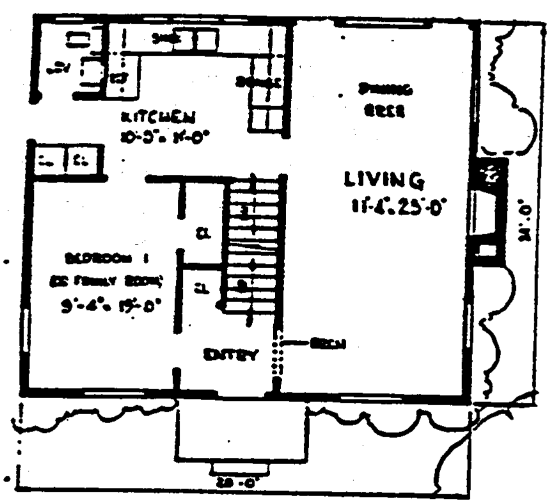
____

24. What auxiliary space can be found next to the right side of the range?

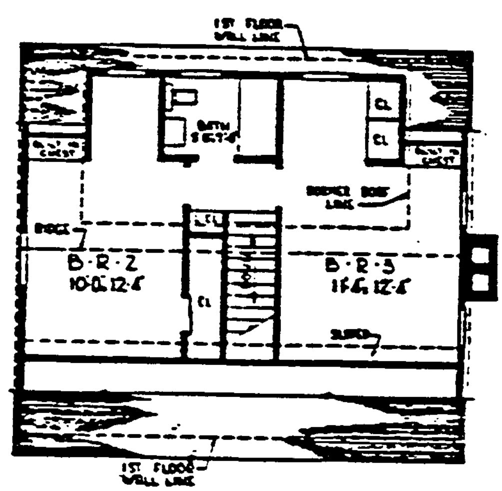
____

<u>Note</u>: Use the illustration below to answer items 25 and 26.

25. How many stories are in the house as shown by the floor plan(s) below?



FIRST FLOOR



SECOND FLOOR

26. What may you safely assume when you see a set of stairs running down on a first floor plan?

____

ELEVATION DRAWING

Elevation Symbols

Elevation drawings are the exterior views of a structure and they may be taken from the front, rear, or left side. Being projections on a vertical plane, they show a picture-like view of the structure as it actually is and not as it would appear to the eye. The basic function of elevation drawing is to be used, and where the doors and windows are to be located.

Elevation drawings also have a wide variety of symbols that will represent the different types of materials, doors, windows, and other features of a structure.

The symbols used by the architect on the elevation drawing will normally be of a standard type accepted in the trade. Most of the symbols used are standardized; however, occasionally the architect will use a non-standard symbol. When a non-standard symbol is used, the architect will note what that symbol represents.

Material symbols used on elevation drawings are similar to the material symbols found on floor plans. The symbols will represent the material in the same way when possible. If there is any question about what a symbol represents, then the architect should be contacted to explain its meaning.

Figure 2-23 shows some of the more common material symbols used on elevation drawings. You should note that some materials may have more than one symbol and some symbols look very much alike. This can and does cause a lot of confusion if the builder is not careful. Make sure that the drawing is checked for any notes about material symbols that the architect may have included.

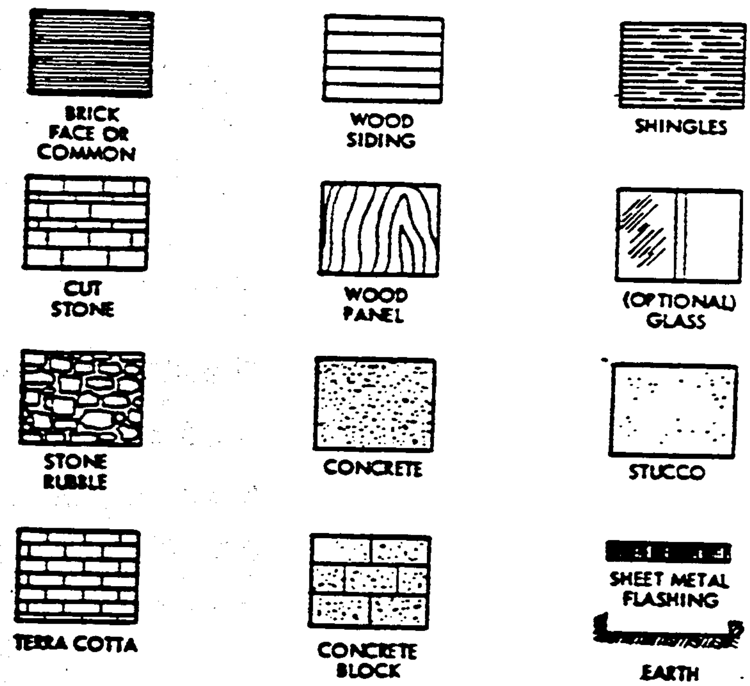


Fig 2-23. Material symbols.

Elevation drawings will show windows and door symbols as they appear in the walls in their exact locations. A door or window schedule number or letter may appear by the symbol so that additional information can be found on the appropriate schedule.

Figure 2-24 shows some of the most common types of windows found on an elevation drawing. The plan view of the window is included to show the relationship between the two views. Note that the dash lines on the casement and awning windows point to the side where it is hinged.

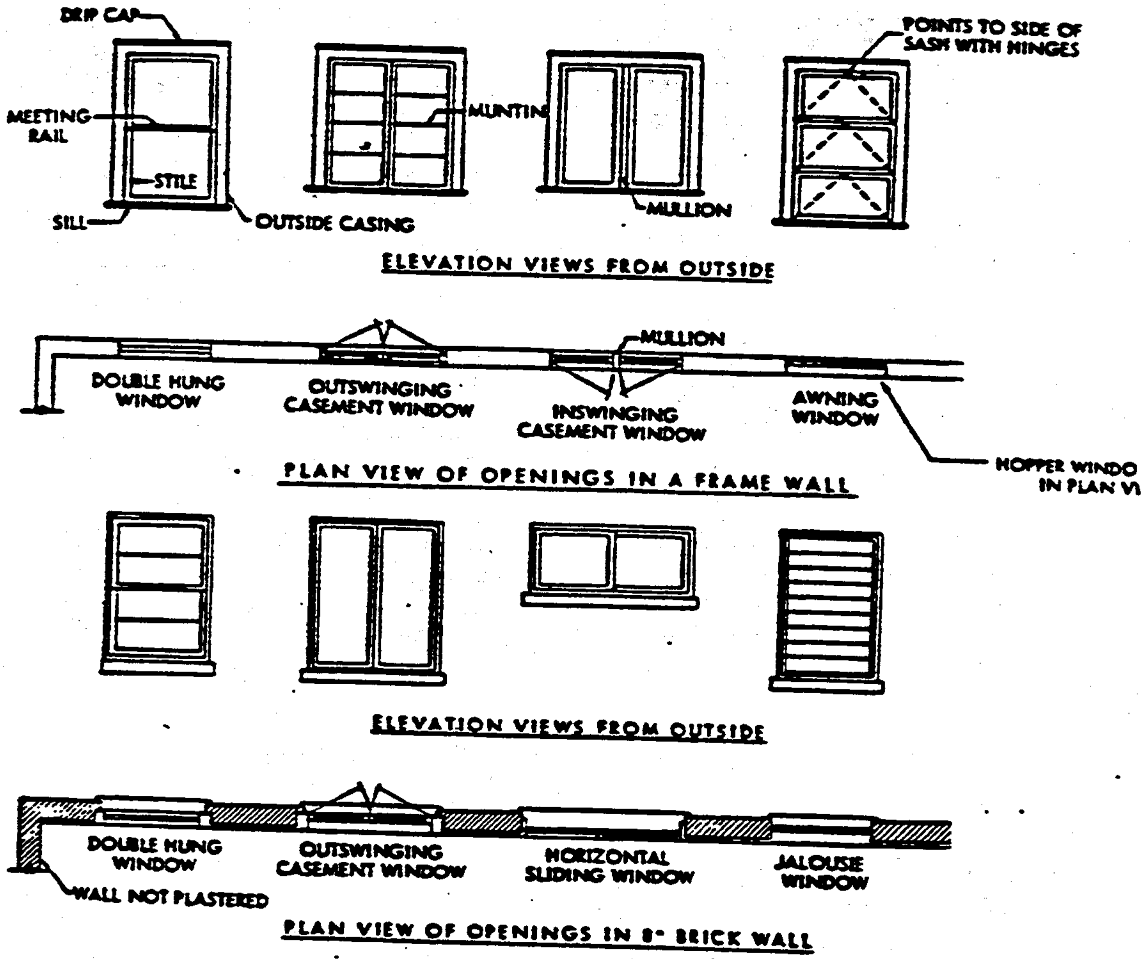


Fig 2-24. Typical window symbol on elevation drawing.

Figure 2-25 illustrates some of the most common door symbols that will be on elevation drawings. Doors in traditional pattern are usually the panel type (fig 2-25, A). They consist of stiles (solid vertical members), rails (solid cross members), and filler panels in a number of designs. Glass upper panels are combined with raised wood or plywood lower panels.

Flush doors (fig 2-25, B) consist of thin plywood faces over a framework of wood with a woodblock or partical board core. Wood combination doors (storm and screen) will occasionally be shown on elevation views (fig 2-25, C). Panels which include screen and storm inserts are normally located in the upper portion of the door.

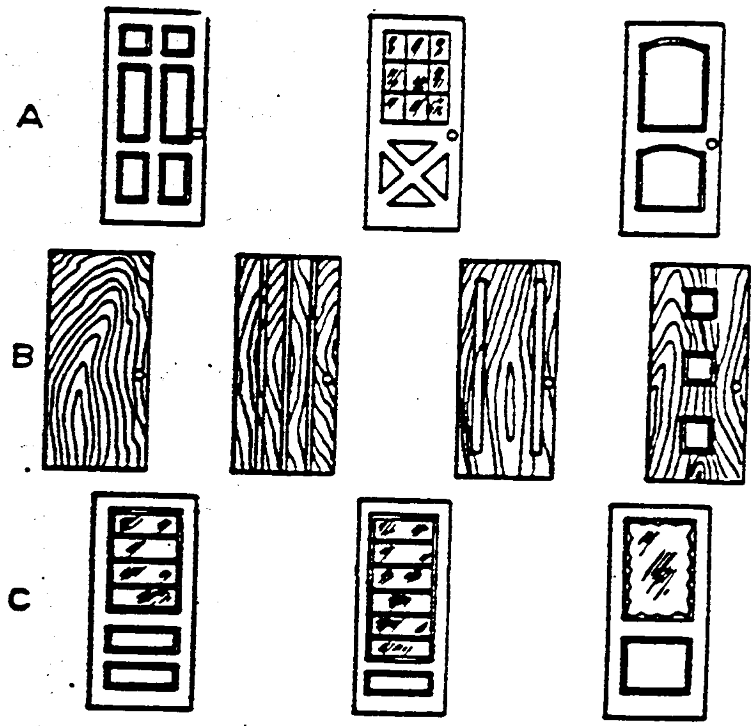


Fig 2-25. Typical door symbols: A, panel; B, flush; C, combination.

There are many things that can be shown on elevation drawings to help a builder locate certain items. Utility outlets and fixtures can be shown to locate their position in the building; however, the utility symbols will not be discussed in this lesson. Many items such as gutters, downspouts, metal flashing, chimneys, or any other distinguishable feature will be shown on themselves, and therefore, need no symbols.

Elevation Abbreviation

Elevation drawings will also use standard abbreviations. As noted in lesson 3, which contains floor abbreviations, elevation drawing abbreviations are used when the architect does not have enough space to letter all of the information. If you have any doubt an abbreviation, you should check with the architect.

Table 2-2 contains most of the accepted abbreviations used in an elevation drawing. Many of the abbreviations are the same as those used on a floor plan. Utility drawing abbreviation will be covered in study unit 4.

Table 2-2. Abbreviations used on elevation views.

TERMS	ABBREVIATIONS
Aluminum	AL
Asbestos	ASB
Asphalt	ASPH
Basement	BSMT
Bevel	BEV
Brick	BRK
Building	BL
Cast Iron	CI
Ceiling	CLG
Cement	CEM
Center	CTR
Center Line	C or CR
Clear	C or CLR
Column	COL
Concrete	CONC
Concrete Block	CONC BLK
Cooper	CPR or COP
Corner	COR
Detail	DTL or DET
Diameter	DIA or O
Dimension	DIM
Divided	DIV
Door	DR
Double-hung Window	DHW
Down	DN or D
Down Spout	DS
Drawing	DWG
Drip Cap	DC
East	E
Elevation	EL
Entrance	ENT
Excavate	EXCA or EXC

Table 2-2. Abbreviations used on elevation views.

TERMS	ABBREVIATIONS
Floor	FLR or FL
Foot to Foot	FT
Foundation	FND
Full Size	FS
Galvanized	GALV
Galvanized Iron	GI
Guage	GA
Glass	GL
Grade	GR
Grade Line	GL
Height	HGT or H or HT
High Point	H PT
Horizontal	HOR
Inch or Inches	IN
Insulating (Insulated)	INS
Length	LGTH or LG or L
Long	LG
Louver	LVR or LV
Low Point	LP
Masonry Opening	MO
Metal	MET or M
Molding	MLD or MLDG.
North	N
Number	No. or #
Opening	OPG or OPNG
Outlet	OUT
Outside Diameter	OD
Overhead	OH or OVHD
Panel	PNL
Plate Glass	PG or PL GL
Plate Height	PL HT
Radius	R
Revision	REV
Riser	R
Roof	RF
Roof Drain	RD
Roofing	RFG
Rough	RGH
Saddle	SDL or S
Scale	SC
Schedule	SCH
Section	SEC or SECT
Sheathing	SH TH or SHTHG
Sheet	SHT or SH
Shiplap	SHLP

Table 2-2. Abbreviations used on elevation views.

TERMS	ABBREVIATIONS
Siding	SDG
South	S
Specification	SPEC
Square	SQ
Square Inch	SQ IN.
Stainless Steel	SST
Steel	ST or STL
Stone	STN
Terra Cotta	TC
Thick or Thickness	THK or T
Typical	TYP
Vertical	VERT
Waterproofing	WP
West	W
Width	W or WTH
Window	WDW
Wire Glasswood	W GL
Wood	WD
Wrought Iron	W I

Reading Elevation Drawings

As stated earlier, an elevation drawing is an exterior view of a structure and may be taken from the front, rear, right, or left side. The front, rear, right side, and left side elevations of a building are shown in figure 2-26. Elevation views can show many things including exterior materials; height of doors, windows and rooms; the type and solpe of the roof; and the surrounding ground level. On an elevation view for a single story building, the floor level is located in reference to the surrounding ground level or finished grade as shown in figure 2-26. Additional floors above the first floor are located by dimensions between finished floor surfaces. If the sides of the building are not identical, an elevation for each side must be drawn. If you had access to a plan, you could see that the dimensions may be placed on an elevation view if it is not possible to show them on a plan view.

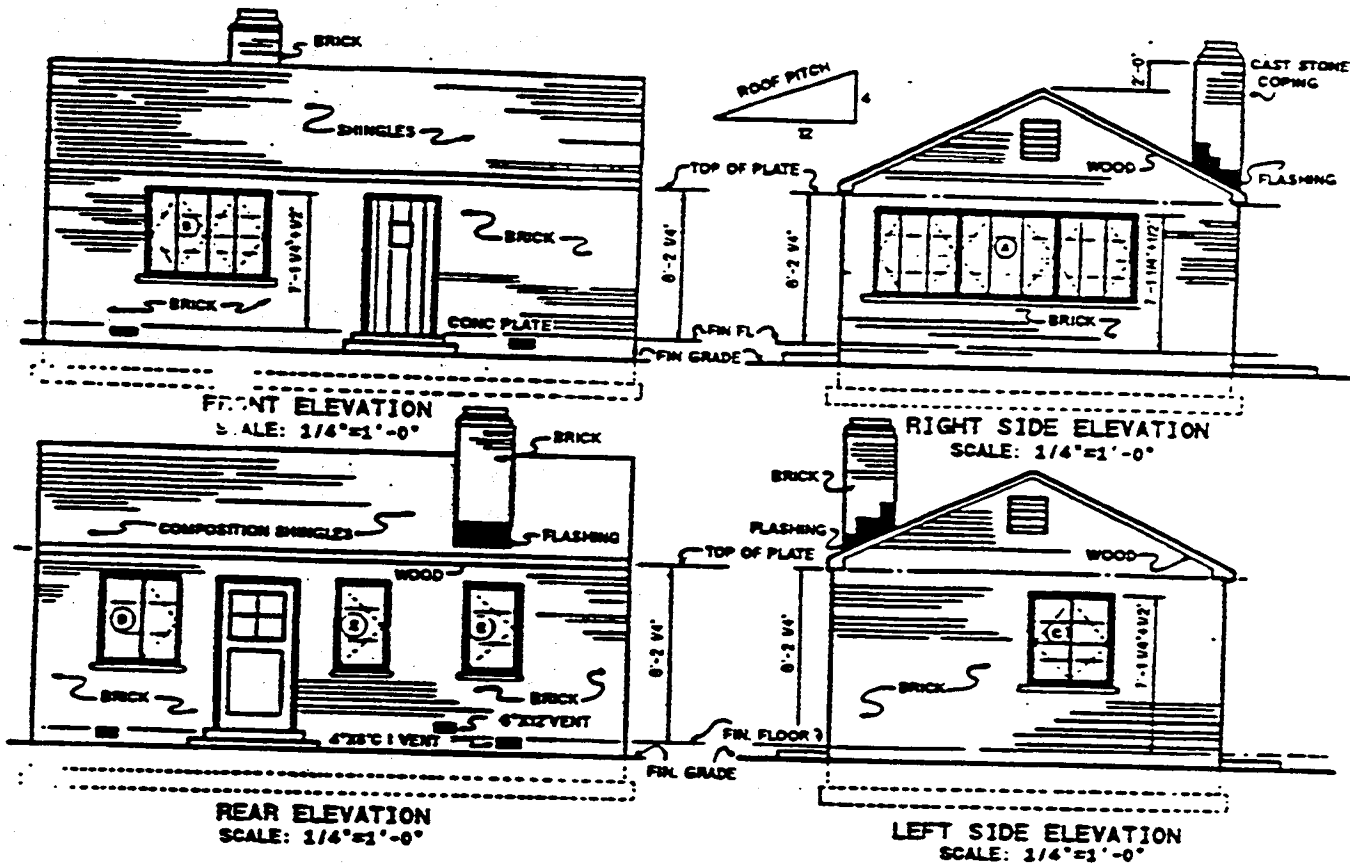


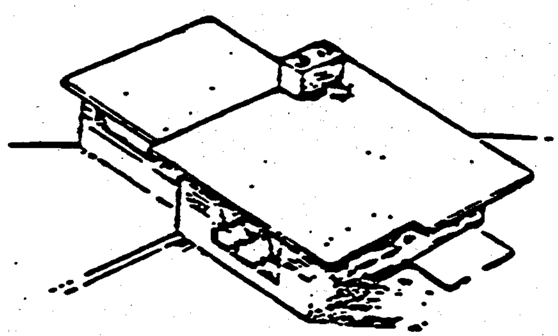
Fig 2-26. Typical elevation view of a building.

The centerline symbol of alternate long and short dashes in an elevation indicates the finished floor lines. Foundation below grade are shown by the hidden line symbols of short evenly spaced dashes. Note in figure 2-26 that the footing and foundation are shown below grade. Many times the elevation view will give the dimension between the finished floor level and the finished ceiling level for that floor, or as shown in figure 2-26, the top of the wall plate. Figure 2-26 also shows the dimensions from finished floor to the top of the door and window.

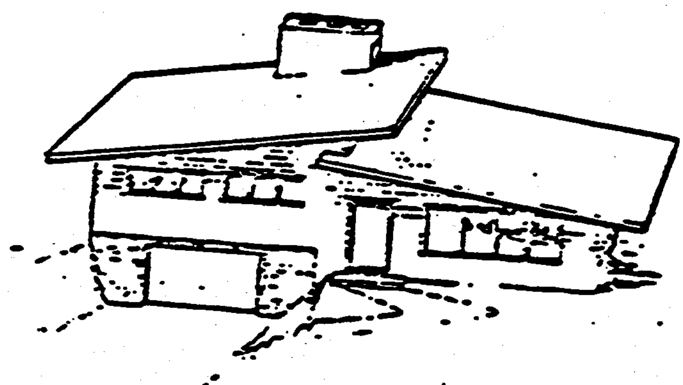
The primary objective of a roof in any climate is to keep out the rain as well as the cold or heat; however it also serves an artistic purpose. This is quite apparent by the different types of roofs found on buildings.

The architectural style of a house often determines the type of roof and roof slope which are best suited. A contemporary design may have a flat or slightly pitched roof; a rambler or ranch style an intermediate slope; and a Cape Cod Cottage a steep slope. Generally, however, the two basic types are called flat or pitched, defined as (a) flat or slightly pitched roof in which roof and ceiling supports are furnished by one type of member, and (b) pitched roofs where both ceiling joists and rafters or trusses are required.

a. Flat or low-pitched roofs, usually known as shed roofs, can take a number of forms, two of which are shown in figure 2-27.



A



B

Fig 2-27. A, flat roof; B, double low-pitched (shed) roof.

b. There are several types of pitched roofs. Perhaps the simplest and most common of these is the gable roof (fig 2-28, A). A variation of the gable roof, used for Cape Cod or similar style houses, includes the use of shed and gable dormers (fig 2-28, B). A third style in roof design is the hip roof (fig 2-28, C).

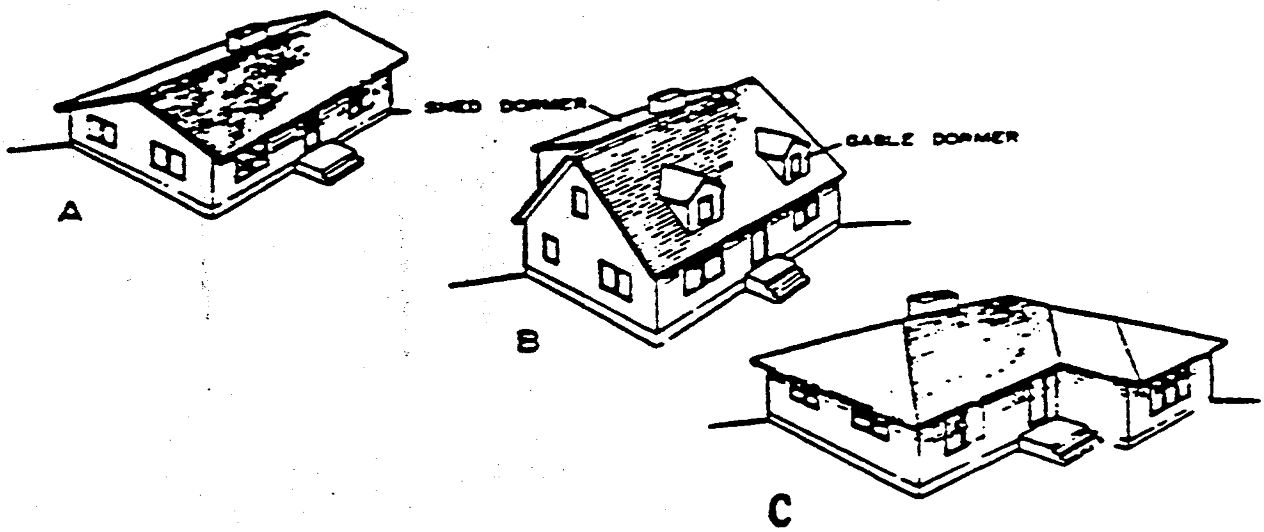


Fig 2-28. A, Gable roof; B, Gable with dormer; C, Hip roof.

c. Combinations of the various types can be used together. The gable and valley roof (fig 2-29) is a combination of two gable roofs intersecting each other. Many times a combination of hip roof intersecting with gable roof may be used (fig 2-30).

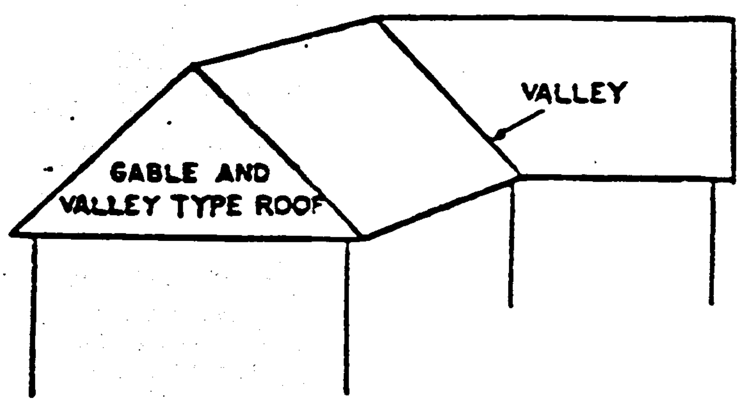


Fig 2-29. Combination gable and valley roof.

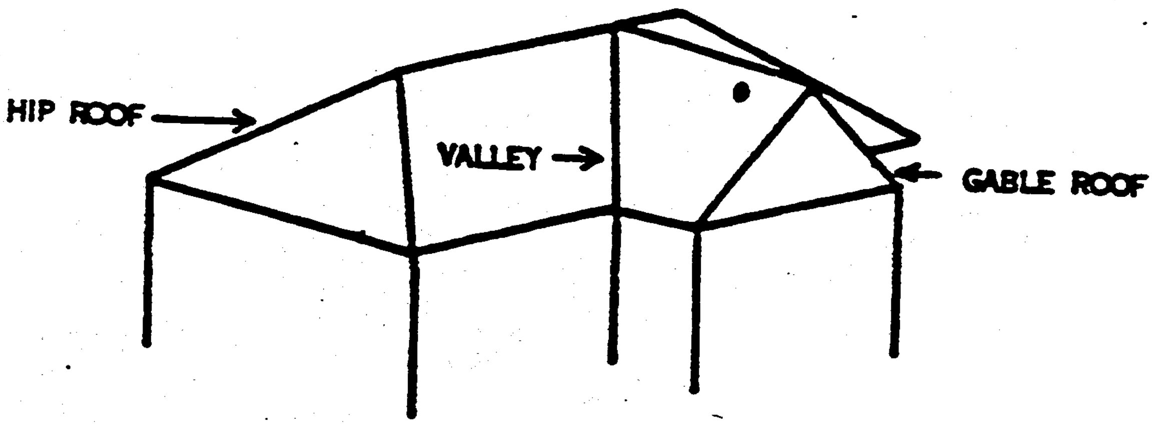


Fig 2-30. Combination hip and gable roof.

The slope of a roof is very important when the snow weight and the rain run off are considered. The slope of pitch of the roof is generally expressed as the number of inches of vertical rise in 12 inches of horizontal run. The rise is given first, for example 8 in 12. The run will always be expressed as 12. Figure 2-31 shows some of the different slopes that can be found on buildings. They range from a 4 in 12 to a 24 in 12 slope.

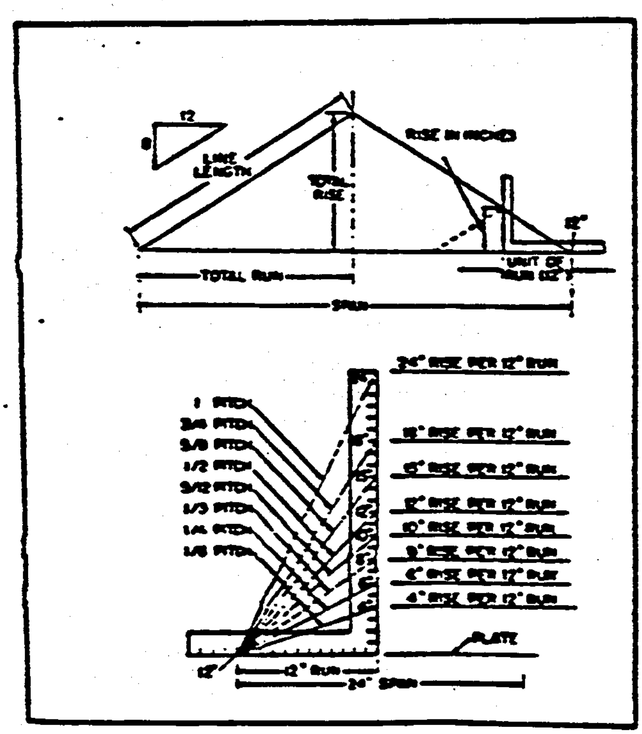


Fig 2-31. Determining roof slope.

The roof slope or pitch will normally be indicated on an elevation view by a triangle with a numerical ratio of rise to run (fig 2-32). This triangle will usually appear next to the roof line of the building in the elevation view.

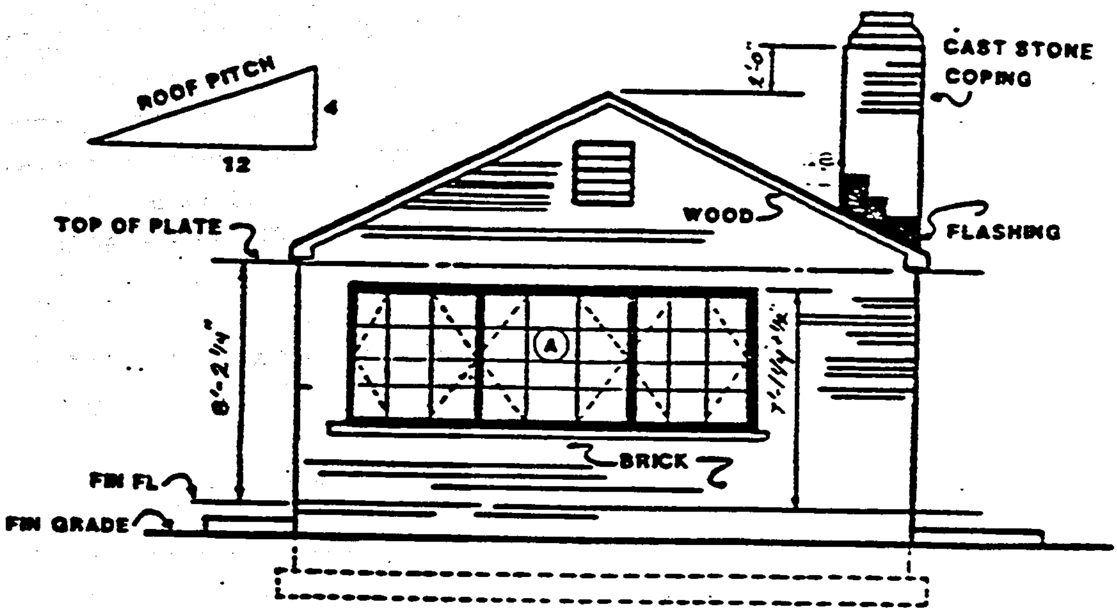


Fig 2-32. Roof slope indicated by a triangle and numerical ratio.

Elevation drawings will contain a lot of information about windows, doors, and other types of openings. Horizontal locating dimensions will not be included on the elevation drawing; therefore, openings are located by reference to the floor plans.

Windows will appear in their exact location on an elevation view. Symbols used to represent the most common types were shown in lesson 4. The most common types are double hung, casement, awning, horizontal sliding, and jalousie. Elevation views will show where a window is hinged by the use of dash-lines.

Sometimes a window may be coded with a number or a letter. this refers the builder to a window schedule. The window schedule can contain such information as size, rough opening, and also shows the relationship between a coded window and a window schedule.

WINDOW SCHEDULE				
MARK	SIZE	TYPE	QTY	REMARKS
W-1	2'-8 3/4"x4'-0"	WD. GLIDING	7	BB GLASS
W-2	4'-10"x4'6"	WD. DBL.HG.	1	BB GLASS

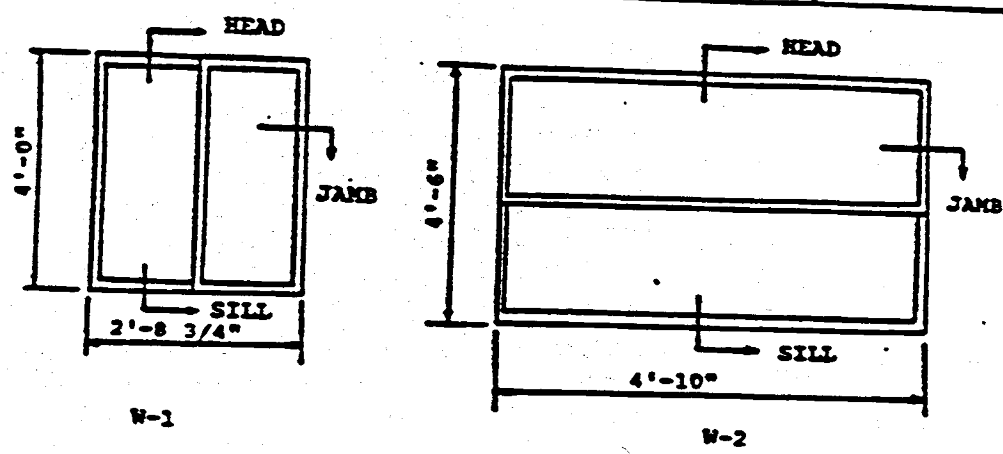


Fig 2-33. Window Schedule.

Sometimes the glass size will also be shown in an elevation view of windows. If a window glass contained a number 32/20, this would indicate a glass 32 inches wide by 20 inches high. If only one size is given for a window containing more than one glass, then they are all of the same size. The window schedule will not normally give the size of the glass to be used.

Elevation drawings will also show the doors in their correct location, and of what type or style they will be. The symbols for the doors have been covered in lesson 3, but as a rule there are three basic types; flush, panel, or combination. The flush door is a plain rectangle, (unless there is a glass opening in it), sometimes with irregular lines to help distinguish it from a panel door. The panel door will be drawn to highlight the panels and/or glass. The swing of the door will not be indicated on an elevation view. The floor plan will show this information.

Door schedules can also be used in conjuction with the door symbols shown on an elevation drawing. Door schedules can contain the same information as that found on a window schedule. Figure 2-34 shows a typical coded door schedule and its relationship to four flush doors identified as D-1, D-2, D-3 and D-4. Door D-1 is a wooden door with a solid center, D-2 is a wooden door with a hollow center. They are both or the same size.

DOOR SCHEDULE				
MARK	SIZE	TYPE	QTY	REMARKS
D-1	3'-0"x6'-8"	WD.SOL.CR.	1	
D-2	2'-8"x6'-8"	WD.SOL.CR.	2	
D-3	3'-0"x6'-8"	MET.HOL.CR.	3	1HR FIRE RATING
D-4	2'-8"x6'-8"	MET.HOL.CR.	1	3HR FIRE RATING

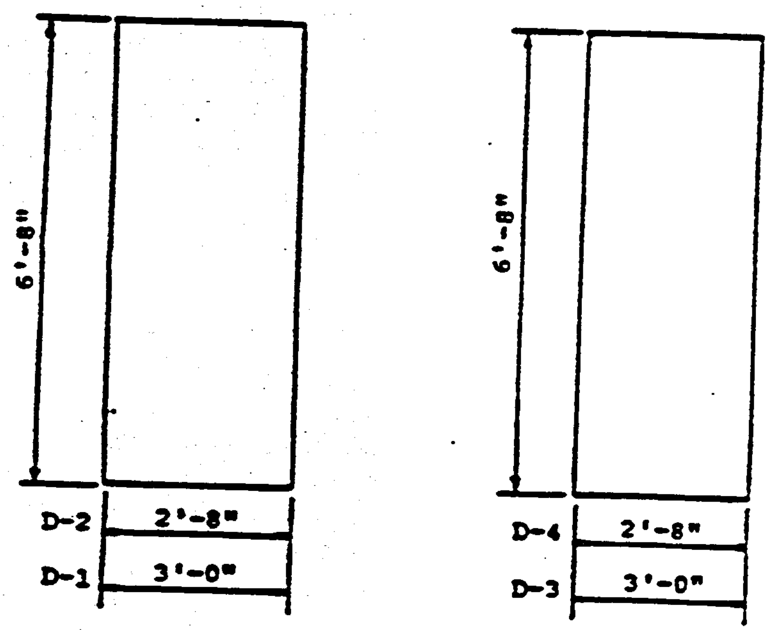


Fig 2-34. Door Scedule.

If glass is to be used in the door, the same numerical system will be used as the one used in the windows. A glass panel in either a flush panel door which measures 10 inches in width and 18 inches in length would be indicated by the numerical symbol 10/18 in the glass panel.

There may be many other openings shown on an elevation view. These are usually ventilation openings used to ventilate the foundation or attic. They will be drawn to resemble their final appearance and are self explanatory. Figure 2-35 shows an example of an attic louver used to ventilate attic space.

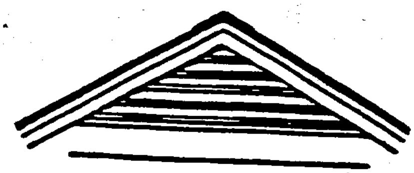


Fig 2-35. Typical roof ventilation louver.

On the elevation view of a building, the exterior finish will be shown by using various material symbols and notations. Outside wall siding can be various types of materials such as grooved plywood, shingles of wood, asphalt, or asbestos, cement or any size wood siding. The outside finish can also be made of brick, stone, or concrete block. A combination of the previously mentioned materials can also be used. Since many of the material symbols closely resemble each other, it is important to read the architect's notes for the exterior finish materials used. Figure 2-36 shows an example of a combination of exterior or finish materials used on a single house. The front elevation shows V-Groove siding over Cedar Shingles. Even if the builder could not understand the material symbols, he would not have any problem determining the materials to use on the exterior of the house because of the architect's notation.

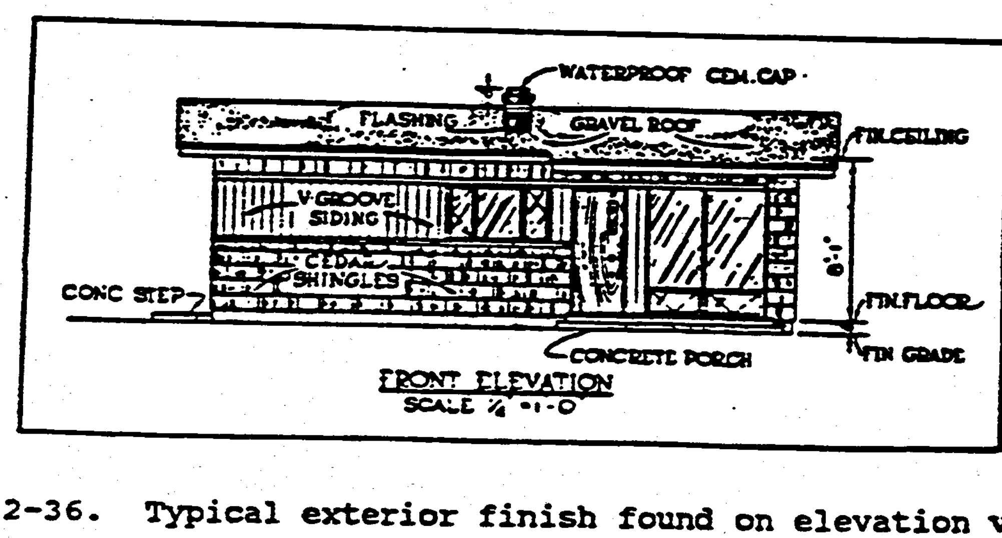


Fig 2-36. Typical exterior finish found on elevation view.

EXERCISE: Complete items 1 through 30 by performing the action required.

1. The symbol illustrated below is the symbol for a

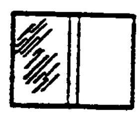
____.

2. What material is illustrated by the symbol below?

____

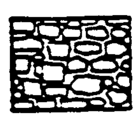
3. What material is illustrated by the symbol below?

____



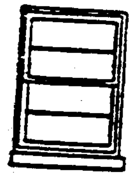
4. The symbol below represents what material?

____



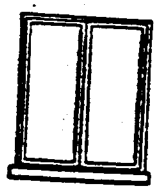
5. The illustration below is the symbol for a

____.



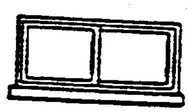
6. What type of window is illustrated by the symbol below?

____

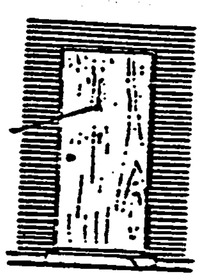


7. The illustration below is the symbol for a

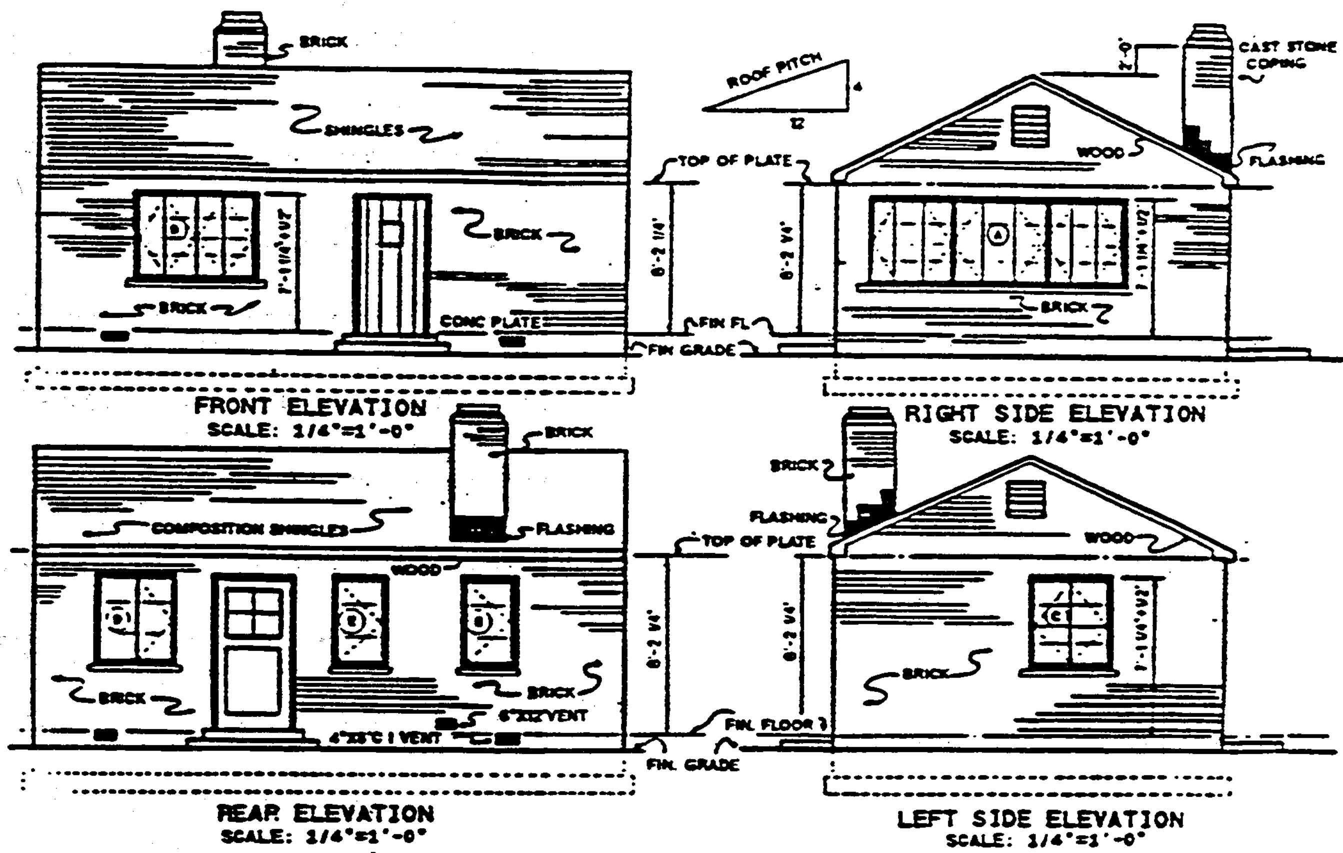
____.



8. The illustration below is the symbol for a ____________.



Items 9 through 20 refer to the illustrations below. Check your responses against those listed at the end of the study unit.



9. What type of roof is used?

____

10. What type of material is used to finish the roof?

____

11. What is the slope of the roof?

____

12. What is used to provide ventilation in the space under the roof?

____

13. What type of windows are used on the left side elevation view?

____

14. The windows in the rear elevation view are hinged on what side?

____

15. What type of door is used at the front entrance?

____

16. What type of door is shown in the rear elevation view?

____

17. What material is used on the outside finish of the house?

____

18. What provides ventilation to the space under the house?

____

19. Where is flashing indicated?

____

20. What kind of material is used for the top of the chimney?

____

Matching: Column 1 below lists elevation abbreviations. Column 2 lists elevation terms. Write in the matching term for the abbreviation. Compare your answer with the answers given at the end of the study unit.

Column 1 ABBREVIATIONS	Column 2 TERMS
21. ____________, E	a. Window
22. ____________, GL	b. Sheathing
23. ____________, COR	c. Length
24. ____________, N	d. Elevation
25. ____________, FND	e. Sheet
26. ____________, WDW	f. Glaze
27. ____________, SH	g. Width
28. ____________, LG	h. East
29. ____________, TC	i. Glass
30. ____________, EL	j. Column
	k. Foundation
	l. Number
	m. Corner
	n. Long
	o. North
	p. Each
	q. Top Center
	r. Elevation
	s. Flashing
	t. Terra Cotta

SECTION 3

STRUCTURAL INFORMATION

Introduction. A building project may be divided broadly into two major phases, the design phase and the construction phase. First, the architect conceives the building in his mind and sets his concept down on paper in the form of presentation drawings. Next the architect and the engineer, working together, decide upon the materials to be used and the construction methods to be followed. The engineer determines the loads which the supporting (structural) members will carry and the strength the members must have to bear the loads. He also designs the mechanical systems of the structure. The end result of all this is the preparation of architectural and engineering design sketches. The purpose of these design sketches is to guide the draftsmen in the preparation of the construction drawings. These construction drawings, plus the building specifications, are the chief sources of information for the builders responsible for the actual construction work. Most of the structural information needed by the builder actually comes from the different sectional views, detail drawings, and framing plans along with a set of construction prints. This study unit will concentrate on guiding you to find all the structural information on these plans, drawings, and details.

SCALE AND DIMENSION

Print Scale

To manufacture an object in accordance with a designer's specifications, a builder or craftsman needs more information than that furnished by the scale drawings of its shape. The systematic description of shape must be accompanied by a systematic description of size. Height, width, and length of the object; size and location of its features; plus other important numerical details must be clearly stated. The system of lines, symbols, numerals, and dimensional notes furnishing this information is called dimensioning. Dimensions are numerical values, expressed in appropriate units of measure, that define the different parts of an object and establish its location.

The purpose of dimensioning is to give workmen on the job sufficient size data to enable them to proceed as easily as possible with the construction. You should not have to seek additional information by scaling the drawing or performing calculations; however, there may be times when it is necessary.

Measuring dimensions on a print is called scaling. Due to possible distortion of the print, scaling should be avoided as much as possible. When scaling is essential; however, be sure to check for accuracy by applying the scale you are using to one or more of the important dimensions normally shown on the print. The letters "NTS" on a set of drawings indicate that they are "NOT TO SCALE"; therefore, do not try to scale the drawing.

All construction prints found on the job are copies of an architect's plans and drawings, drawn to a scale.

Any map of the local area is an example of a drawing made to scale. All maps have been drawn to scale using some measure other than the original, such as miles per inch. When this is reproduced, one inch on the map will represent one mile on land; therefore, ten inches on the map is really ten miles.

Every line on a drawing will be reduced to the same amount of its true length so that all lines on the print are in exact relationship to each other. The scale usually found on construction prints is 1/4" = 1'-0". Many detailed drawings that require a larger amount of detail of the object will usually be on a scale of 1 1/2" = 1'-0" or larger. Figure 3-1 shows a first floor plan drawn to a scale of 1/4" = 1'-0"; however, the plan has been reduced to fit the page and therefore is no longer to scale. The builder must be very careful to look for any notes that have been added to a drawing.

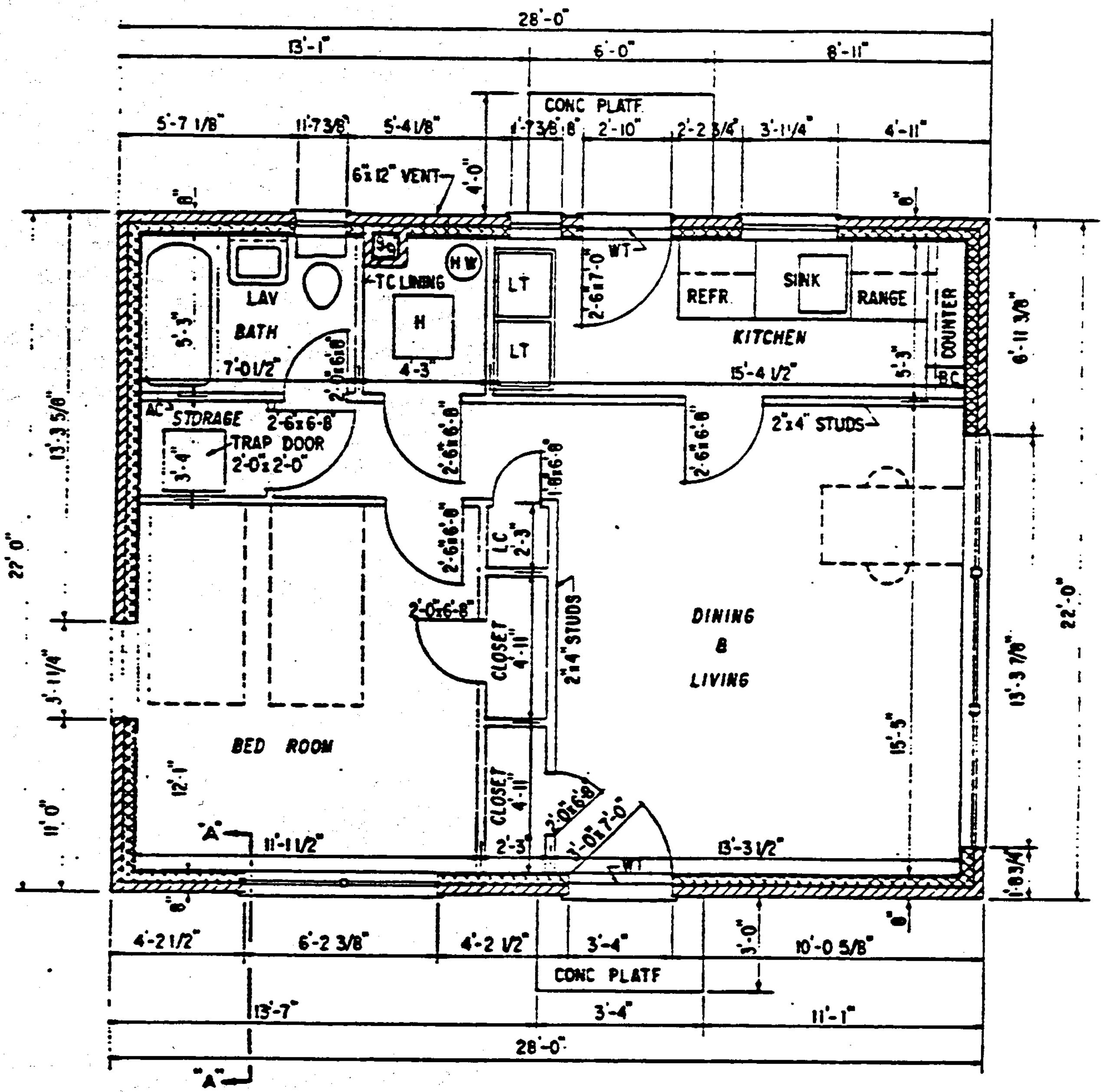


Fig 3-1. Typical floor plan scale.

On most military drawings the scale block (in the title block) will indicate the scale on the drawing either as a ratio (for example: 1/4 or 1:4 meaning 1 inch on the drawing equals 4 inches on the object, and 12/1 or 12:1 meaning 12 inches on the drawing equals 1 inch on the object) or as a graphic scale as shown in figure 3-2. If the same scale is not used on all parts of a drawing, the scale block may be marked "as noted" or left blank, and the scale noted underneath each part of the drawing. If graphic scales are used, several scales may be shown with numbers (fig 3-2) and the appropriate scale number noted alongside each part of the drawing. When reading drawings, always follow the dimensions specified on the drawing first, and use the scale on the drawing where no dimension is given. Because graphic scales are placed in or near the title block of the drawing, their relative lengths to the scales of the drawing are not affected if the drawing is reproduced or reduced or enlarged for prints. Do not measure directly on a print unless there is no other means of obtaining the dimensions. Often during the copying process the print will shrink. Other times the print may be reduced for ease of handling.

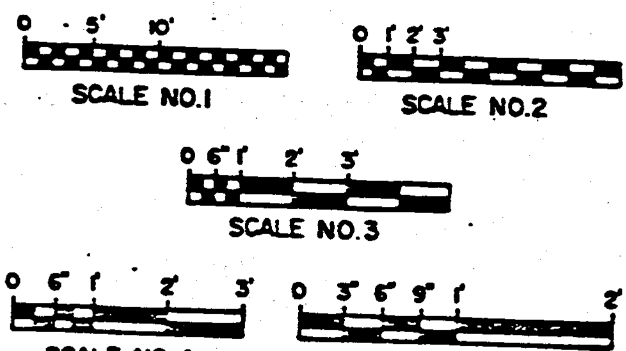


Fig 3-2. Graphic scales.

The architect's Scale

Construction prints should be measured only as a last resort. However, if the dimension cannot be obtained by other means, then the builder may have to measure the drawing to determine the needed dimension. The best tool to use in this case is the architect's scale.

An architect's scale is very similar to a ruler, except that it has six ruled edges with a total of ten different scales, plus one edge that is identical to the twelve-inch ruler with which you are familiar. Figure 3-3 shows a triangular architect's scale.

One of the four scales shown in figure 3-3 is labeled 1/4 which means that it is used to make a drawing at a scale of 1/4" = 1'-0". One foot, at this scale, will be equal to the length of 1/4 of an inch in the drawing.

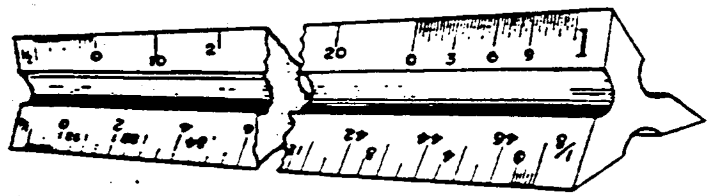


Fig 3-3. Triangular architect's scale.

Each of the scales listed will be found on an architect's scale, but their location may be different depending upon the manufacture of the scale. Also, each of the scales used in the drawing has its own ratio by which the actual size of the object in the drawing is determined.

Scale label	Scale	Ratio
3"	3" = 1' - 0"	1/4 size
1 1/2"	1 1/2" = 1' - 0"	1/8 size
1"	1" = 1' - 0"	1/12 size
3/4"	3/4" = 1' - 0"	1/16 size
1/2"	1/2" = 1' - 0"	1/24 size
3/8"	3/8" = 1' - 0"	1/32 size
1/4"	1/4" = 1' - 0"	1/48 size
3/16"	3/16" = 1' - 0"	1/64 size
1/8"	1/8" = 1' - 0"	1/96 size
3/32"	3/32" = 1' - 0"	1/128 size

Usually two scales that can be subdivided into each other will be found on the same edge. The scales will normally be grouped as follows; 3 and 1 1/2 scale, 1 and 1/2 scale, 1/4 and 1/8 scale, 3/4 and 3/8 scale, 3/16 and 3/32 scale, and the 16 scale or full scale on an edge by itself.

The scale is one foot long with an additional space on either end so that the units can be read in parts of a foot such as inches or a fraction of an inch. Figure 3-4 shows one edge of an architect's scale which has two scales. The 1" scale is read from left to right starting with the line marked "0" near the left end of the scale. From the "0" you can read 3 spaces which represents a distance of 3 feet to scale. The 1/2" scale is read from right to left starting at the right end of the scale (not shown).

You must pay particular attention that the correct numbers are used with the scale. The numbers used with the 1/2" scale are in a row near the edge of the scale. The 1" scale numbers are farther from the edge. The lines for the units have been extended so that you can tell the difference between the two scales.

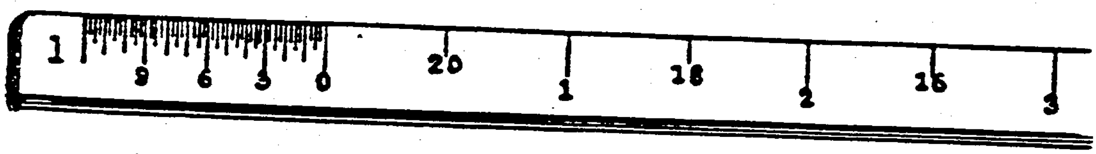


Fig 3-4. Typical 1" and 1/2" scales.

Measurements less than one foot can be read by using the space outside the line marked "0". These units are divided into parts representing one inch or fractions of an inch. The scale is placed so that when the distance is not an even number of feet, the amount in inches can be read directly from the subdivided units of the scale. Figure 3-5 shows four examples of how dimensions can be found using four different scales. First the scale used on the drawing must be determined; then that particular scale on the architect's scale is used to measure the missing dimension. Not all scales are subdivided into the same amount of units; therefore, care must be taken to determine what each unit represents. The 3" scale is subdivided into 96 units, each one represents 1/8 of an inch; the 1 1/2" and 1" scales are subdivided into 48 units, each one representing 1/4 inch; the 3/4" and 1/2" scales are subdivided into 24 units, each one representing 1/2 inch; the 3/8", 1/4" and 3/16" scales are subdivided into 12 units, each one representing 1 inch; and the 1/8" and 3/32" scales are subdivided into 6 units, each one representing two inches.

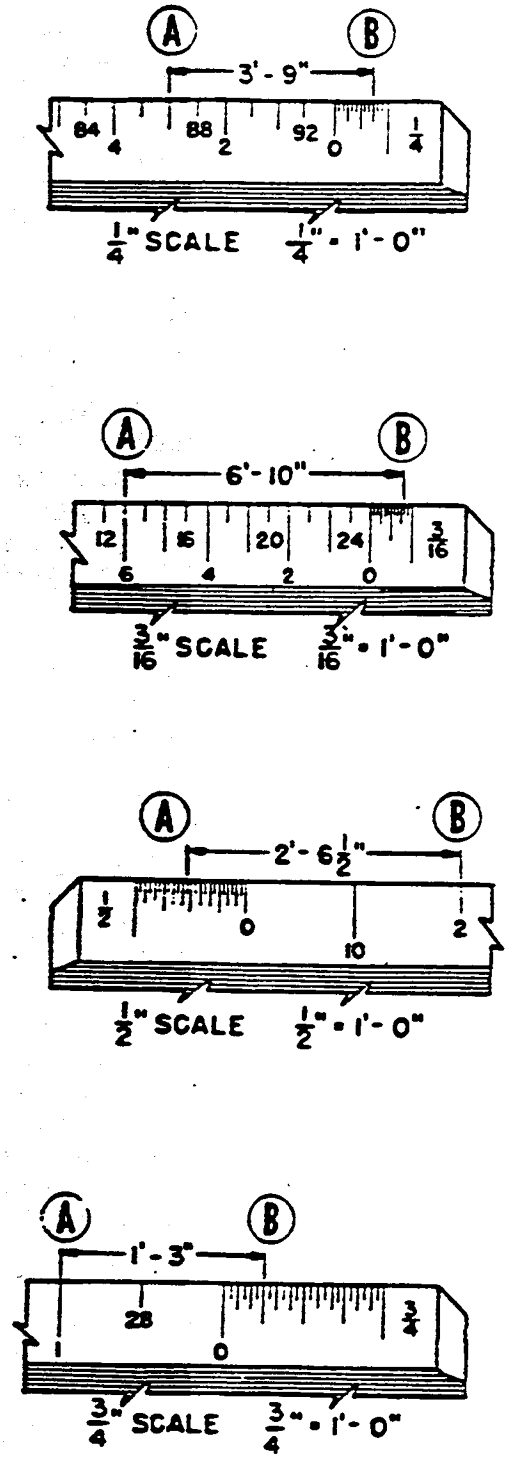


Fig 3-5. Scaling to find missing dimensions.

Checking Missing Dimensions

One of the items you should be most concerned with when reading construction prints is the dimensions. Dimensions on construction drawings will usually be given in feet, inches, and fractions of an inch. Any dimension less than a full foot is written as a simple inch dimension. For example, three inches will be written 3". All dimensions twelve inches or larger will automatically be changed to feet and inches. For example, 30 inches becomes 2'-6".

If a dimension is a whole number of feet, it will show zero inches. For example, an even seven feet is shown as 7'-0".

Feet are never shown as fractional feet. They will always be shown in whole numbers. Any fraction of a foot will be changed to inches. For example, five and one-half feet is written as 5'-6" (five feet, six inches). Any part of an inch will be shown as a fraction. Eight and three-eighths inches will be shown as 8 3/8". Any fraction on a construction print indicates a part of an inch.

Most architects use a standard dimension system; however, some architects may use variations or nonstandard dimensions. For example, instead of writing a nine-foot dimension as 9'-0", they may write it as 9^{0}, which means 9'-0". Sometimes an architect will show the finished room size by using this dimension system.

Many architects use a standard system for showing dimensions that are used in conjunction with exterior walls, interior partitions, and openings in walls. There are, though, some variations that a builder must be aware of and should keep a close look out for.

Usually the dimensions on construction prints are given to the edge of structural sections. Exterior walls will usually be measured to the outside face of the studs (fig 3-6, D). This is done because the stud walls are built and then the outside sheathing or finish is put on. However, some architects will show dimensions to the outside face of the sheathing (fig 3-6, A). Brick and concrete walls are always dimensioned to their outside edges (fig 3-6 B and C).

Figure 3-6 E shows the way veneer and frame exterior walls are dimensioned. Dimensions of both the outside face of the studs and of the outside edge of the veneer wall are given.

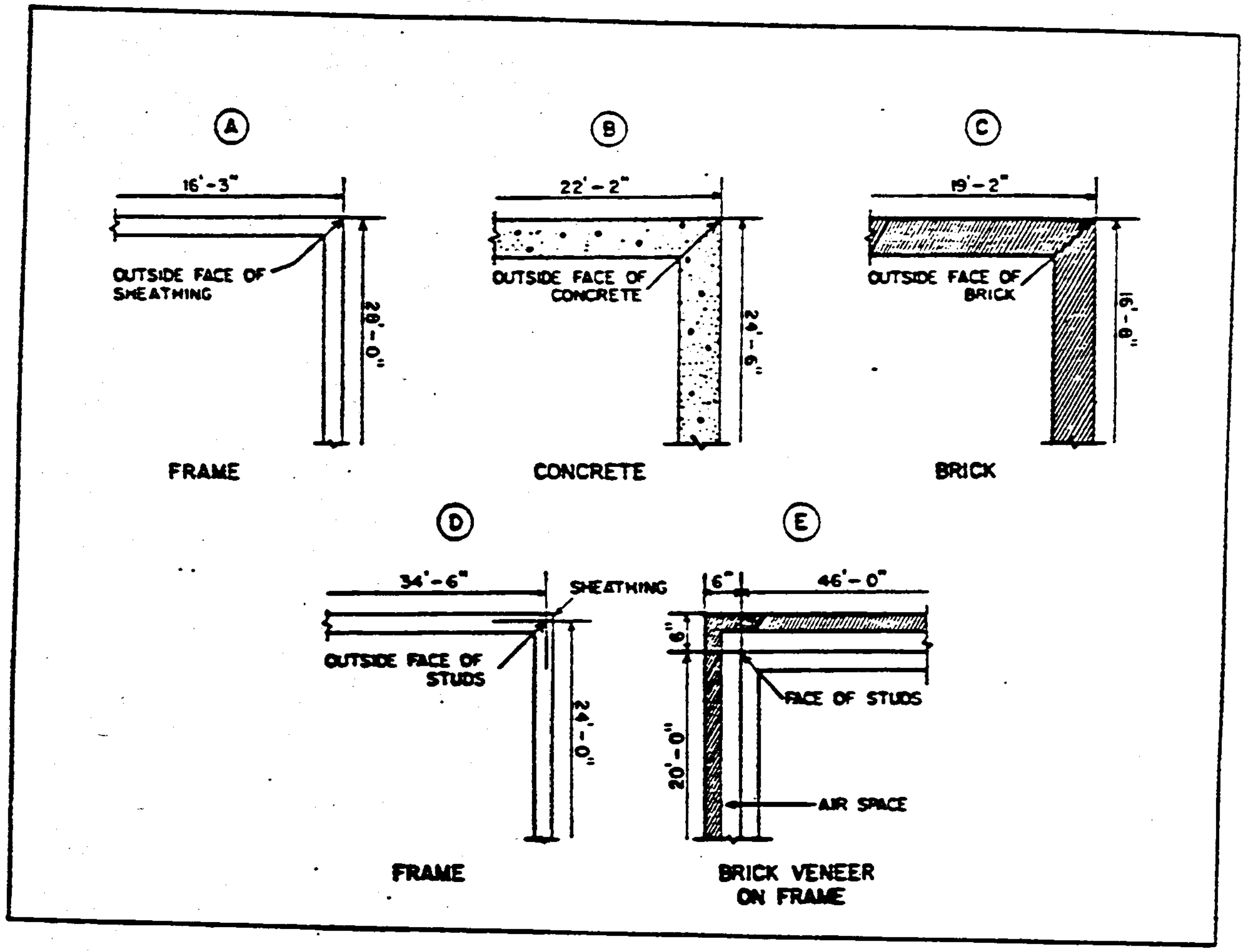


Fig 3-6. Exterior wall dimensions.

Interior wall partitions of brick or concrete will be dimensioned to their outside edges and the wall thickness will also usually be shown (fig 3-7 A and B). Interior frame wall partitions will normally be dimensioned to the center of the partition (fig 3-7, C). Some architects may show these dimensions all the way to the outside edge of the wall (fig 3-7, D).

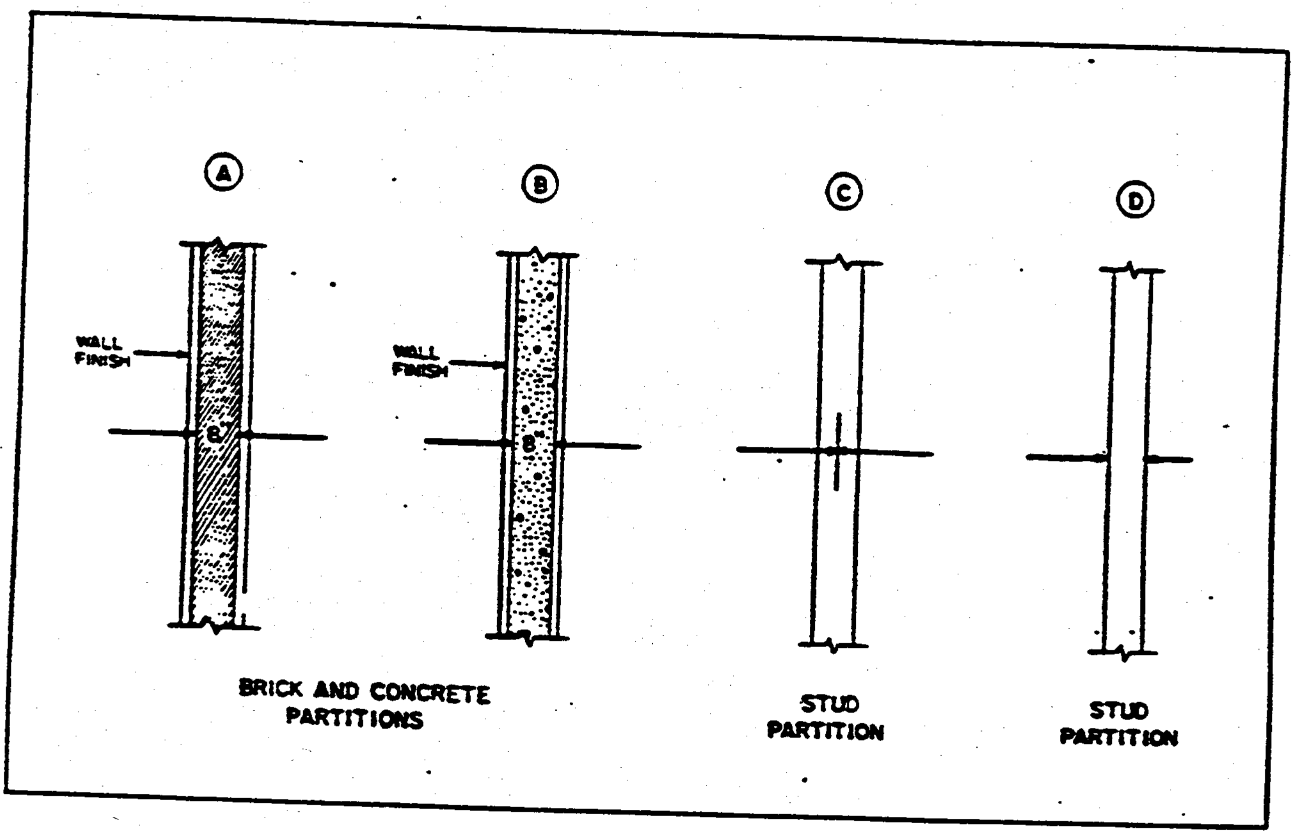


Fig 3-7. Interior wall dimensions.

Window and door openings in both frame and veneer exterior walls will be dimensioned to the centers of the openings (fig 3-8A). Brick and concrete exterior walls will show dimensions of door and window openings to the edge of the wall (fig 3-8B).

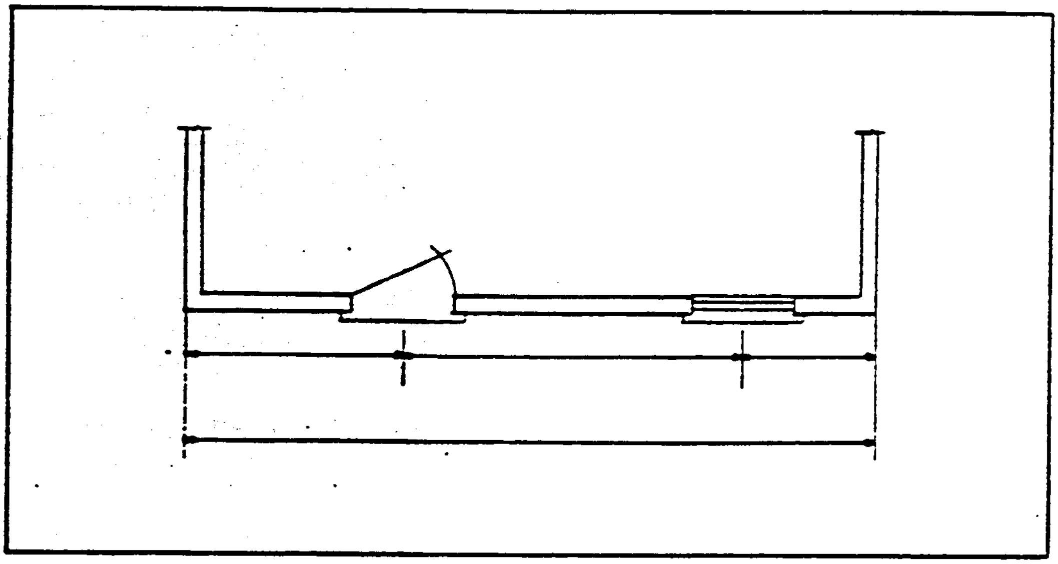


Fig 3-8a. Frame and veneer.

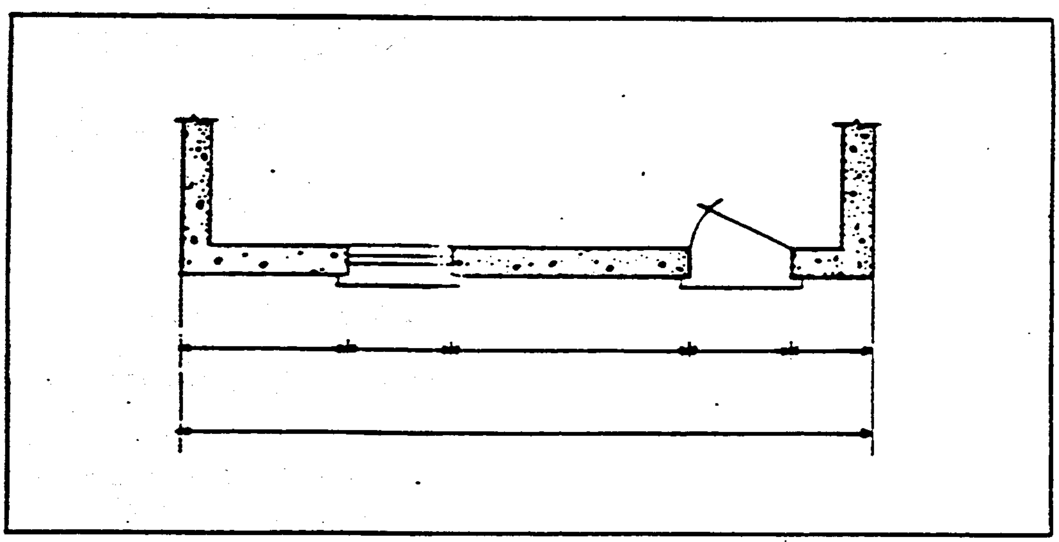


Fig 3-8b. Brick and concrete.

Many times when a dimension seems to be missing, it may in fact be located on some other print. Look on all views and/or parts of the prints that are associated with the building or structure. Usually the architect will give a dimension only once to save space.

Many dimensions can also be found by simple arithmetic. Simply by adding and/or subtracting other dimensions on the print, the missing one may be found. Figure 3-9 shows how a missing dimension can be found by using basic addition and subtraction. By adding the two dimensions given and subtracting them from the overall dimension, the unknown distance between A and B can be found.

$$\begin{array}{r} 3'\text{-}0" \\ +\ 4'\text{-}4" \\ \hline 7'\text{-}4" \end{array} \qquad\qquad \begin{array}{r} 16'\text{-}0" = 15'\text{-}12" \\ -\ 7'\text{-}4" \\ \hline 8'\text{-}8" \end{array}$$

The unknown dimension between A and B is 8'-8".

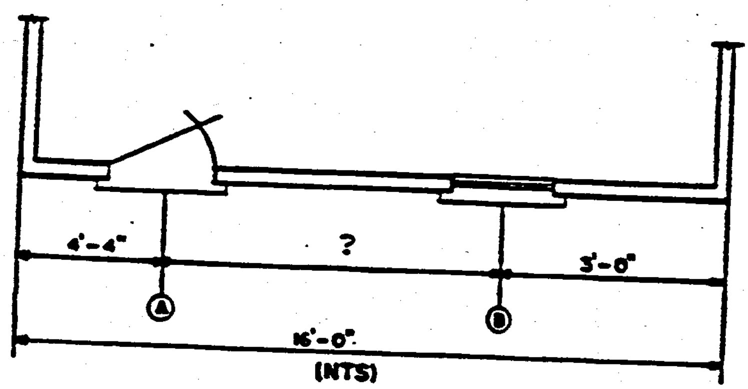


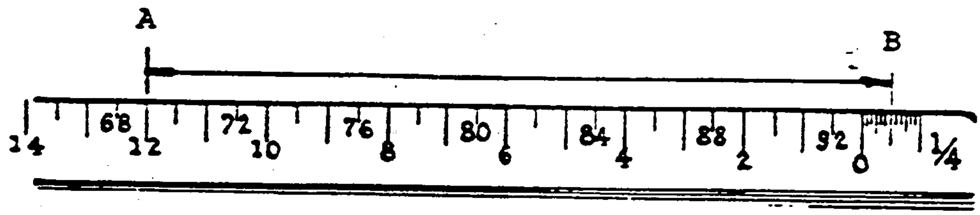
Fig 3-9. Finding missing dimensions.

EXERCISE: Complete items 1 through 9 by performing the action required.

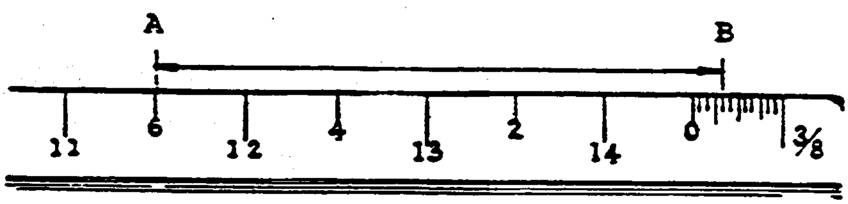
1. A scale of 3/4" = 1'- 0" means that 3/4 inches on the drawing presents ____________________ on the object.

Note: Identify the dimensions between points A and B on the illustrations below. Insert your answers in the blank spaces to the right of the numbers.

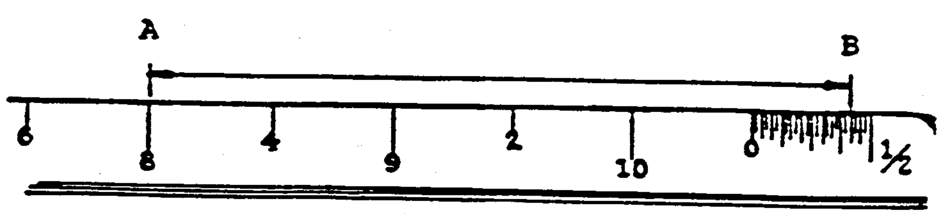
2. ______________________________



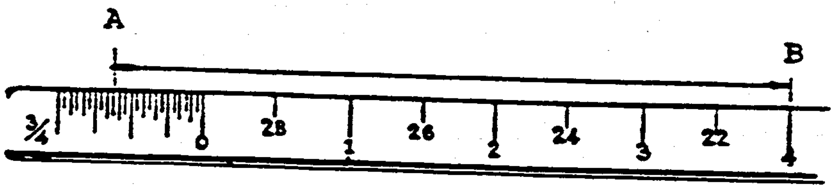
3. ______________________________



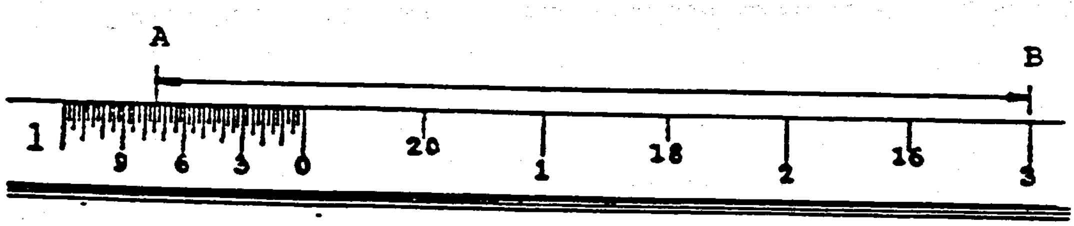
4. ______________________________



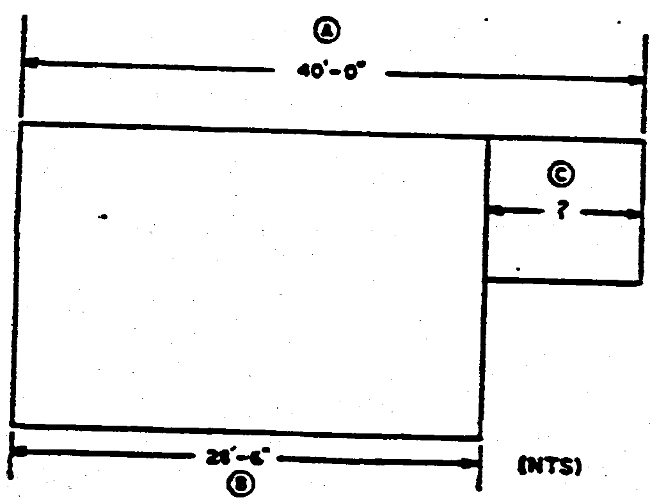
5. ______________________________



6. ______________________________

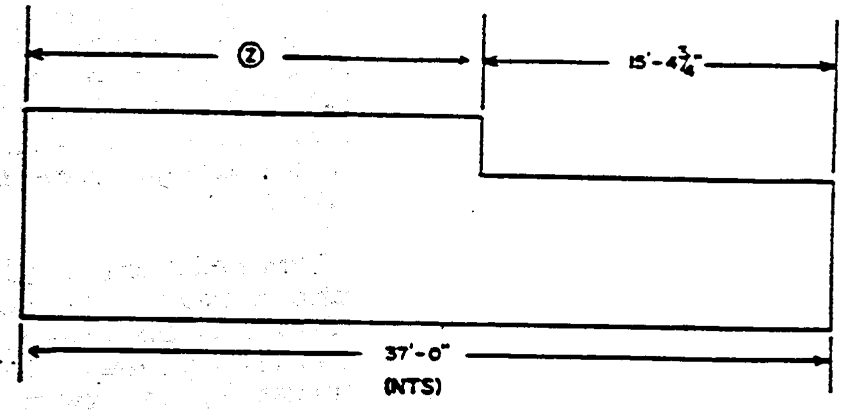


7. What is the unknown dimension of (C) on the illustration below? ________________



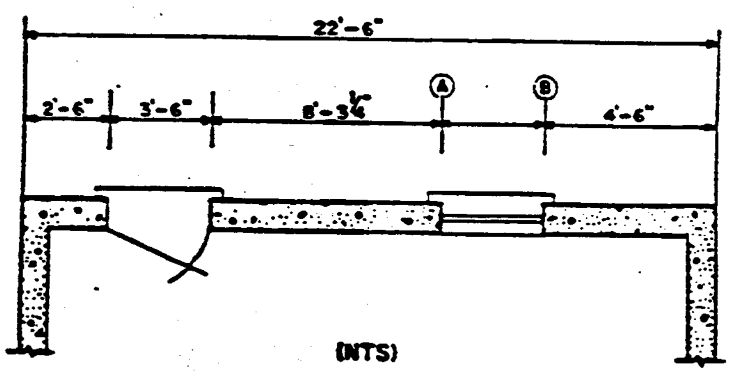
8. What is the unknown dimension of (Z) on the illustration below?

____



9. What is the unknown dimension between A and B on the illustration below?

____



Detail Scale

Detail drawing is indicated by a code or the notation "SEE DETAIL". This is used to call attention to the fact that more information is available about that specific part of the structure (fig 3-10). The detail may be located on the same sheet where the designated part is or it may be else where on another sheet. Many times, several details will be grouped on one sheet; however, when a detail is drawn, it will usually be placed on the same sheet so reference can be made to it without too much inconvenience to the builder.

After the detail drawing has been located, the builder must determine the scale used to show the detail. If the details are not too difficult to understand, they may be drawn to the same scale as the plan, elevation, or section views. Details that show structural information will normally be drawn at a larger scale so that the parts can be shown with more clarity. The architect can use any of the scales previously mentioned in lesson 1, depending on how large the view must be drawn, so that all the information can be seen clearly.

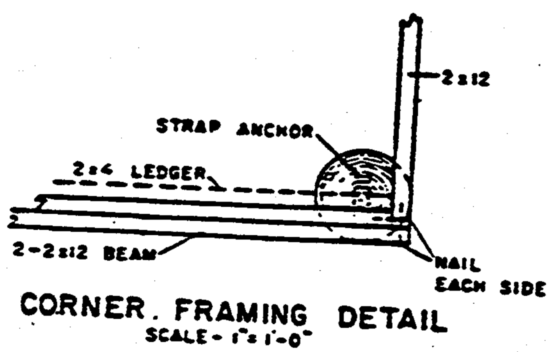


Fig 3-10. Detail drawing.

Figure 3-11 shows a detail drawing without any scale indicated. Occasionally, an architect will include a detail drawing for informational purposes only; thus the scale is not needed. The architect will indicate this by listing (No scale) under the detail title (fig 3-11).

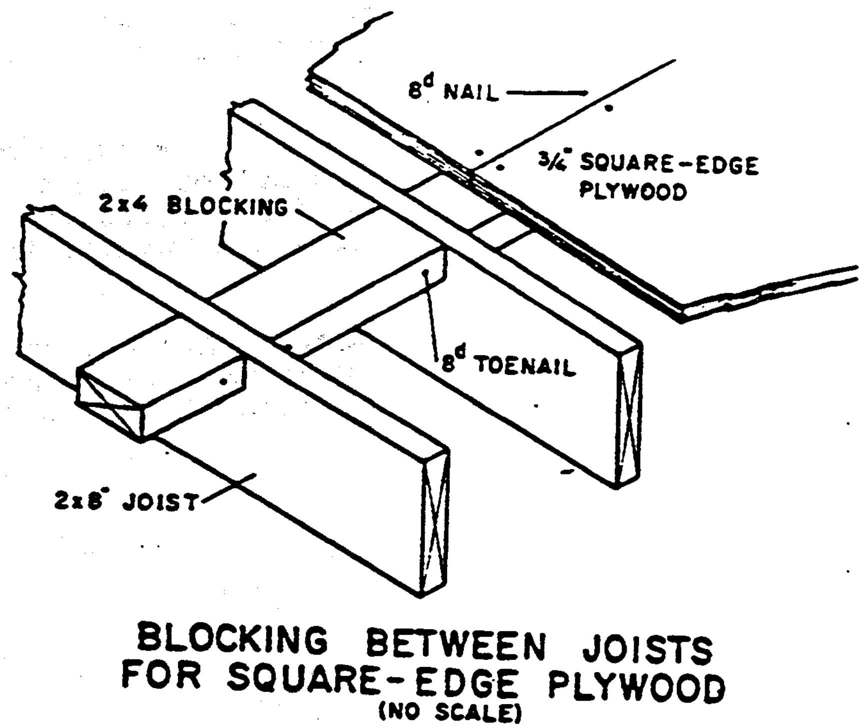


Fig 3-11. Detail without scale.

Many times an architect will use preferred scales when drawing details, because the builder using the prints carries a folding ruler which is divided into inches and sixteenths of an inch. Each 1/16 inch on the rule would equal one-inch on a detail drawn to 3/4" = 1'-0" scale. A list of preferred scales and their relationship to the measurements on a folding rule is shown below.

3/4" = 1'-0" scale - 1/16" on rule = 1" on detail
1 1/2" = 1'-0" scale - 1/8" on rule = 1" on detail
3" = 1'-0" scale - 1/4" on rule = 1" on detail
FULL SIZE scale - 1" on rule = 1" on detail

These scales are the preferred ones; however, an architect can be expected to use any of the scales available to him on his architect's scale. Therefore, a builder, when reading a detail drawing, must be very careful about the scale used.

Interiod Details

Interior detail drawings can consist of, but are not limited to, the following items: views of kitchen cabinets and all built-in items, cabinets and closets throughout the building, permanently attached items in the bathroom, interior trim, fireplaces, and stairways.

Most of the items shown in a detail will also be shown on a plan or elevation view elsewhere on the set of prints; however, they do not include enough information for the builder. Therefore, a detail drawing is furnished to give the builder this needed information.

Figure 3-12 shows two detailed elevation views of a typical kitchen. The drawings not only give the measurement of the cabinets, but also show where the sink, range, and refrigerator are to be located.

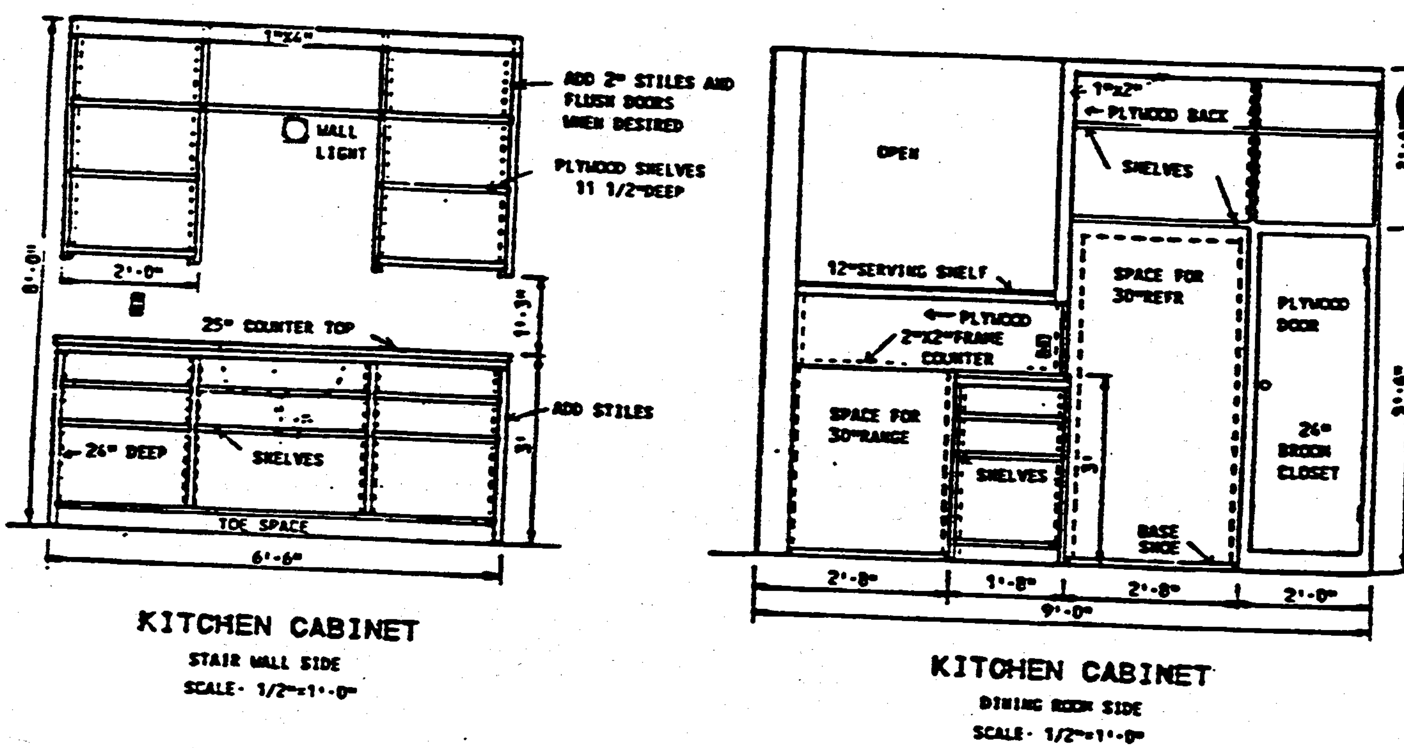


Fig 3-12. Kitchen detail drawing.

Figure 3-13 shows both a front view and a side view of a typical closet (wardrobe). By using the information provided on the detail, the builder would have very little trouble building the closet.

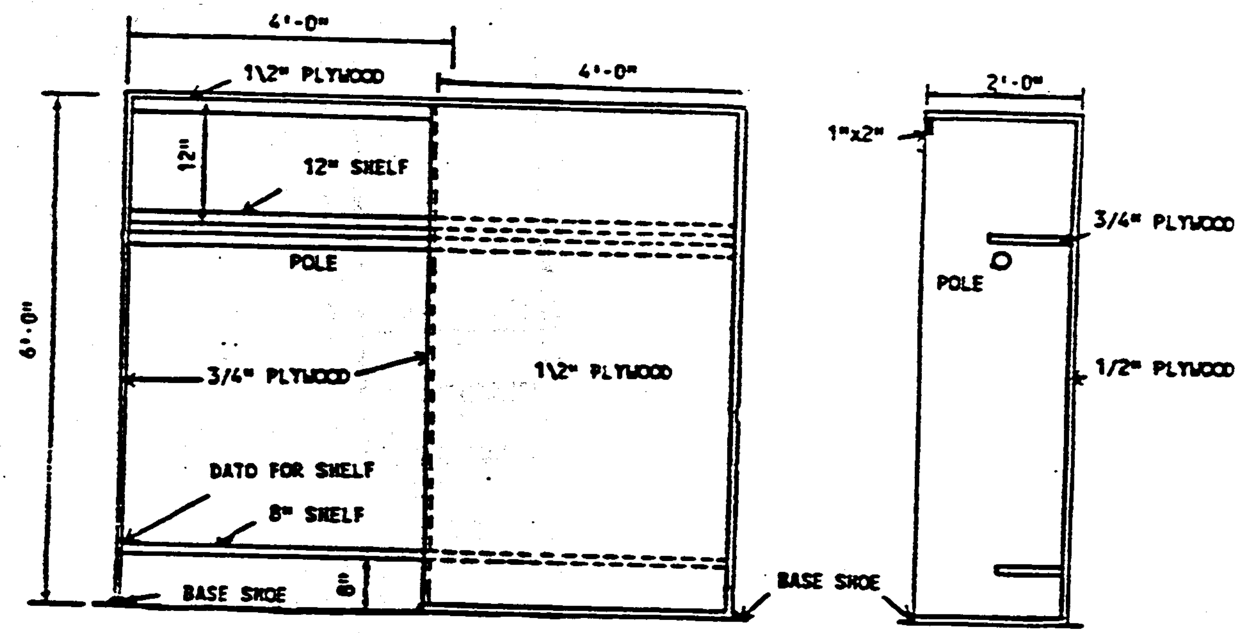


Fig 3-13. Closet detail drawing.

Figure 3-14 shows a typical bathroom detail drawing. From the detail a builder can determine the exact location of every fixture in the bathroom.

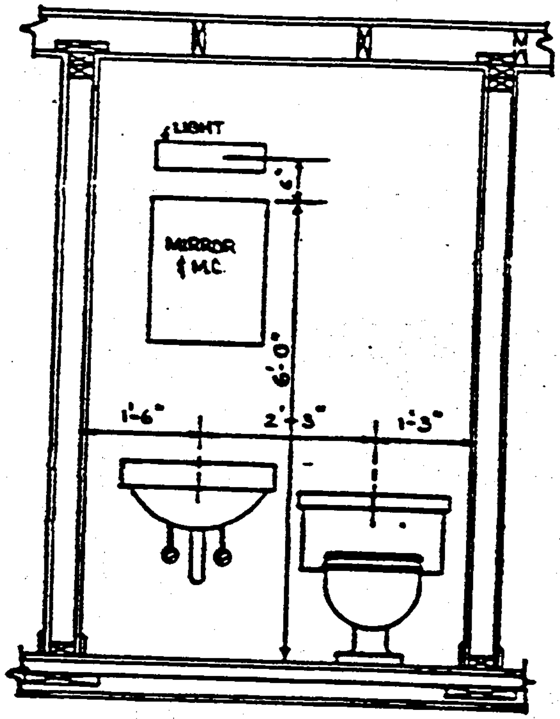


Fig 3-14. Bathroom detail drawing.

Figure 3-15 is a typical detail drawing that shows how the window trim must be applied. Figure 3-16 is a detail drawing of how the base molding is applied. Figure 3-17 is a detail drawing of the ceiling molding. None of the details are drawn to scale.

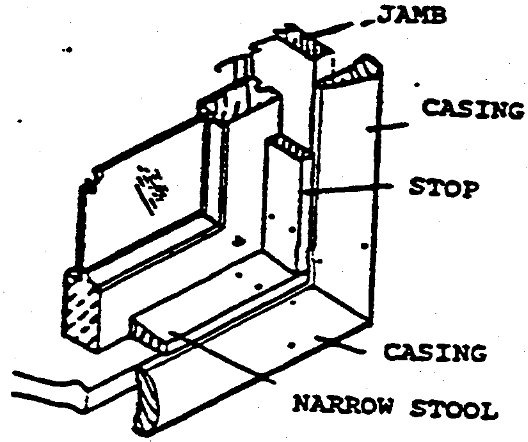


Fig 3-15. Detail drawing of window trim.

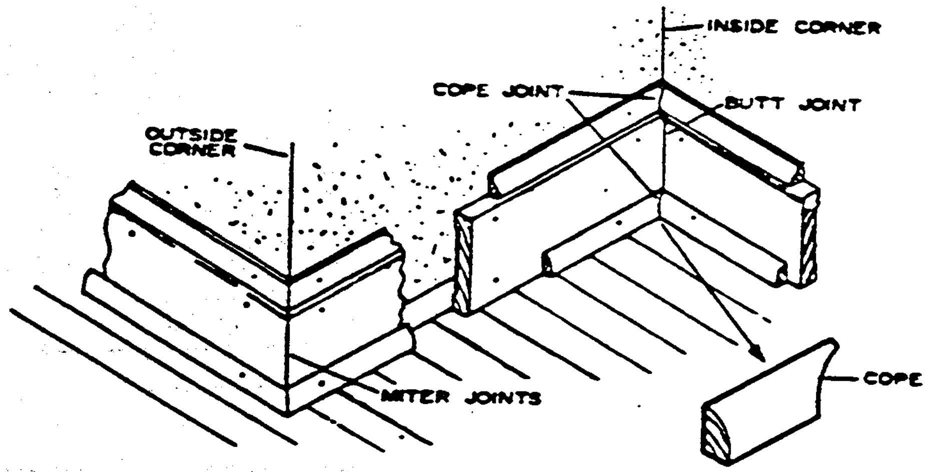


Fig 3-16. Detail drawing of base molding.

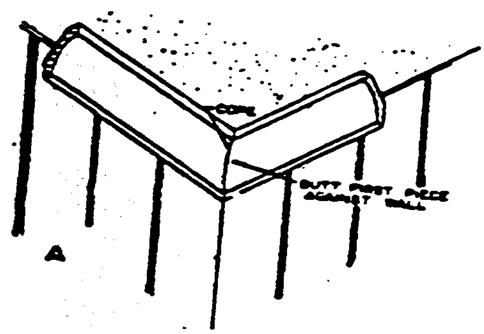


Fig 3-17. Detail drawing of ceiling molding.

A typical detail drawing showing a stairway and opening is illustrated in figure 3-18. The detail shown is not to scale; however, from it the builder can obtain a lot of information such as headroom, width of tread, height of riser, and total rise of the stairway that he will use to build the stairway.

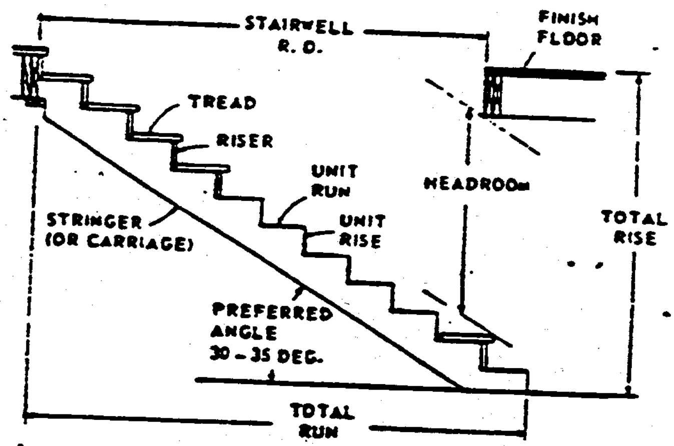


Fig 3-18. Stairway detail drawing.

Figure 3-19 shows a typical detail drawing of a masonry fireplace. The view presented is a sectional cut of a fireplace. Usually for a fireplace the complete set of details will consist of a section, plan, and elevation view because of the complexity of the construction.

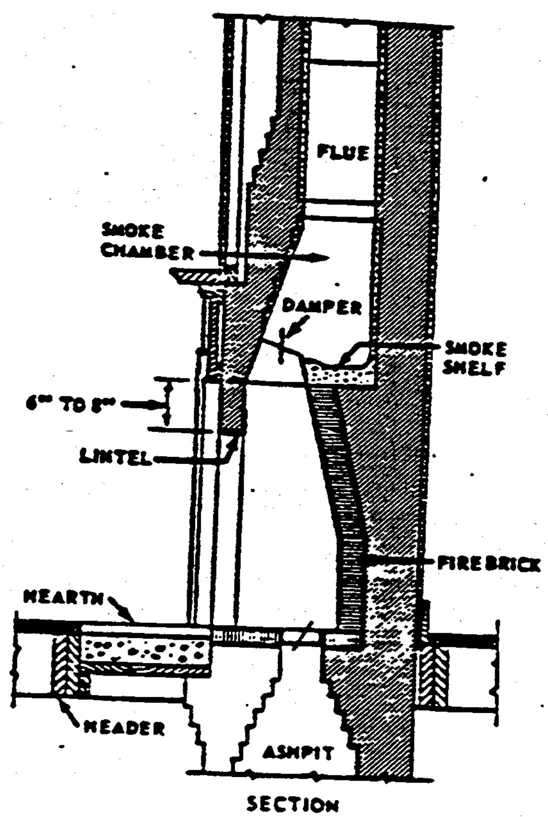


Fig 3-19. Fireplace detail drawing.

Exteriod Details

An exterior detail can be drawn of any object when the architect feels additional information is needed. We will not try to show every type of exterior detail drawing; however, we will show some of the objects that are normally drawn in detail.

- o <u>Cornice detail</u>. The cornice of a building is the projection of the roof at the eave line which forms a connection between the roof and sidewalls. In gable roofs it is formed on each side of the building, and in hip roofs it is continuous around the perimeter. Figure 3-20 shows a typical cornice detail drawn to 1" = 1'-0" scale.

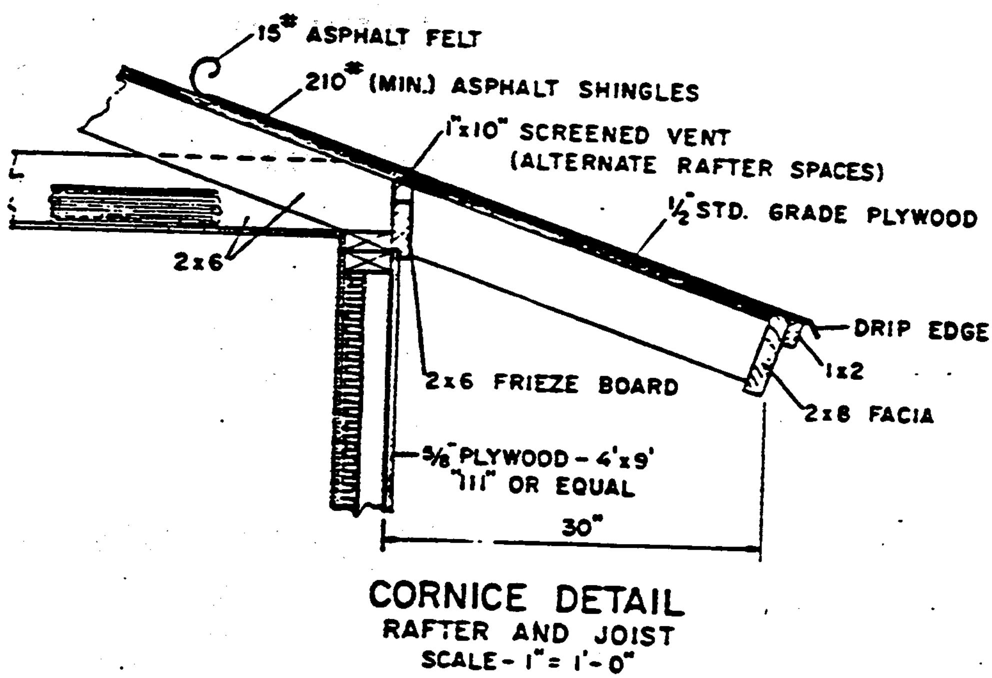


Fig 3-20. Typical cornice detail.

- o <u>Gable and overhang</u>. The gable end overhang is the extension of a gable roof beyond the end wall of the building. The detail will give the builder information about the types and sizes of materials needed and how far the overhang will extend beyond the end wall. Figure 3-21 shows a typical end overhang.

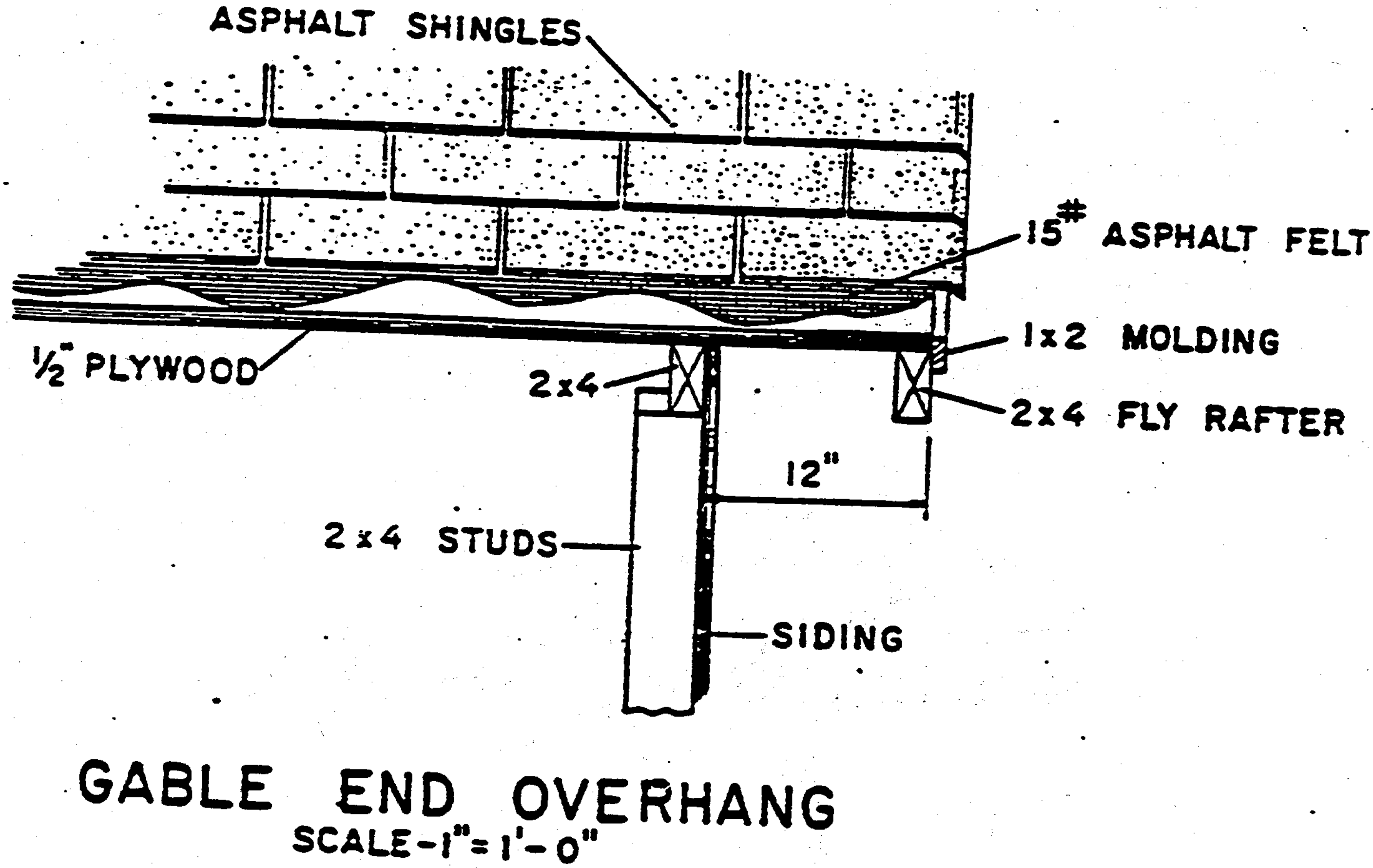


Fig 3-21. Typical gable end overhang.

o Vent pipe openings in roof. Normally all the openings in the roof will be shown in detail. Figure 3-22 shows a typical vent pipe detail.

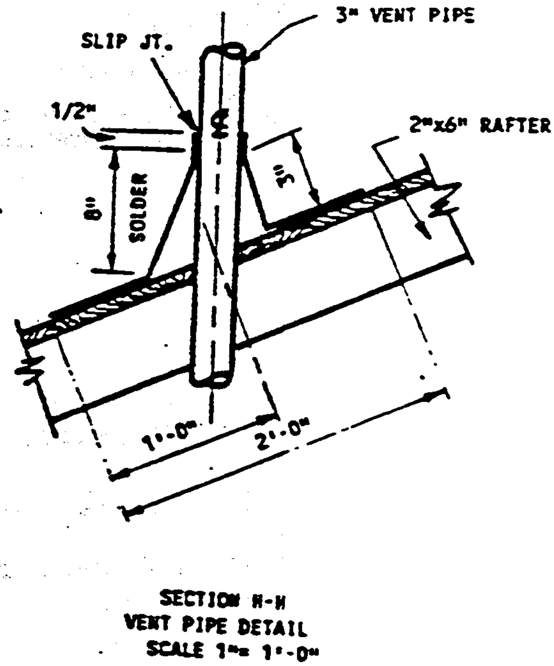


Fig 3-22. Vent pipe detail.

o Smokestack and chimney details. Openings for smokestacks (pipes, jacks) and chimneys will be shown in detail drawings so that the builder can provide an adequate opening in the roof. Additional information is usually provided which will show the exact size and location of the chimney or smokestack. Figure 3-23 shows a smokestack detail. Note the similarity between the smokestack shown in figure 3-23 and the vent pipe shown in figure 3-22.

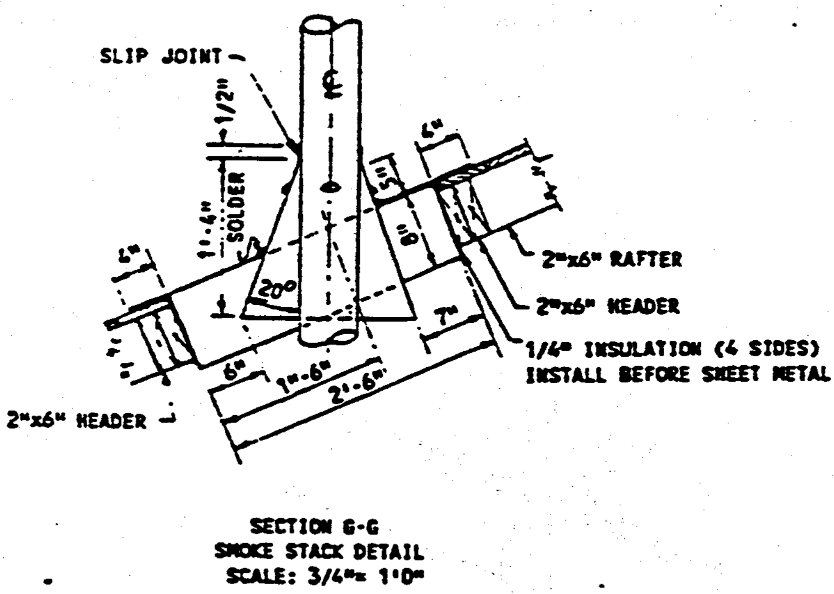


Fig 3-23. Smokestack detail.

o <u>Louver and ridge ventilator details.</u> Buildings with louvered or ridge ventilators will usually show details of the vents. Figure 3-24 shows a louver detail. A ridge ventilator detail is shown in figure 3-25.

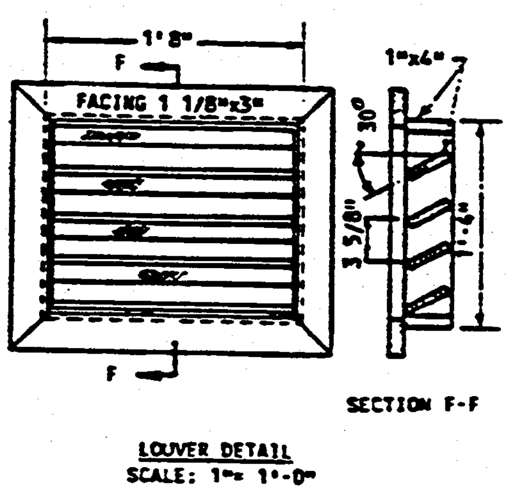


Fig 3-24. Louver detail drawing.

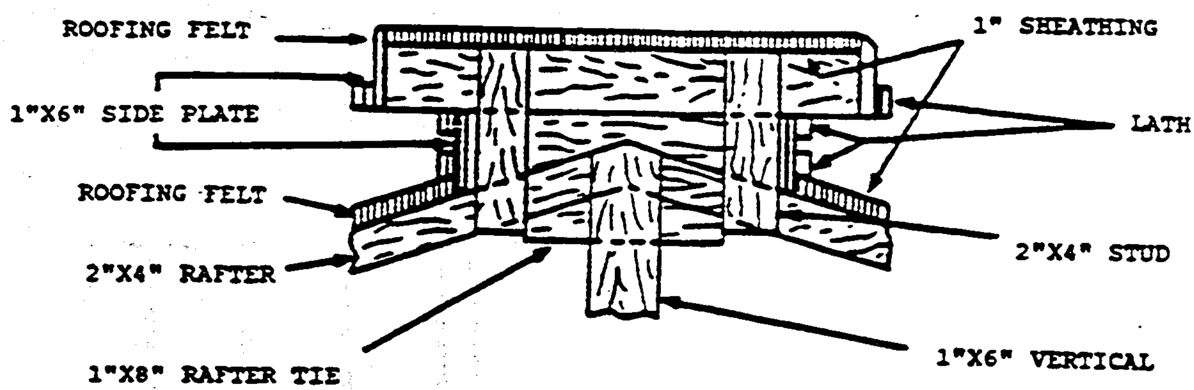


Fig 3-25. Ridge ventilator detail drawing.

o <u>Exterior stair/step details</u>. If a building has exterior stairs or steps, the architect will usually draw a detail showing the design and size of the stairs. A typical stair detail is shown in figure 3-26.

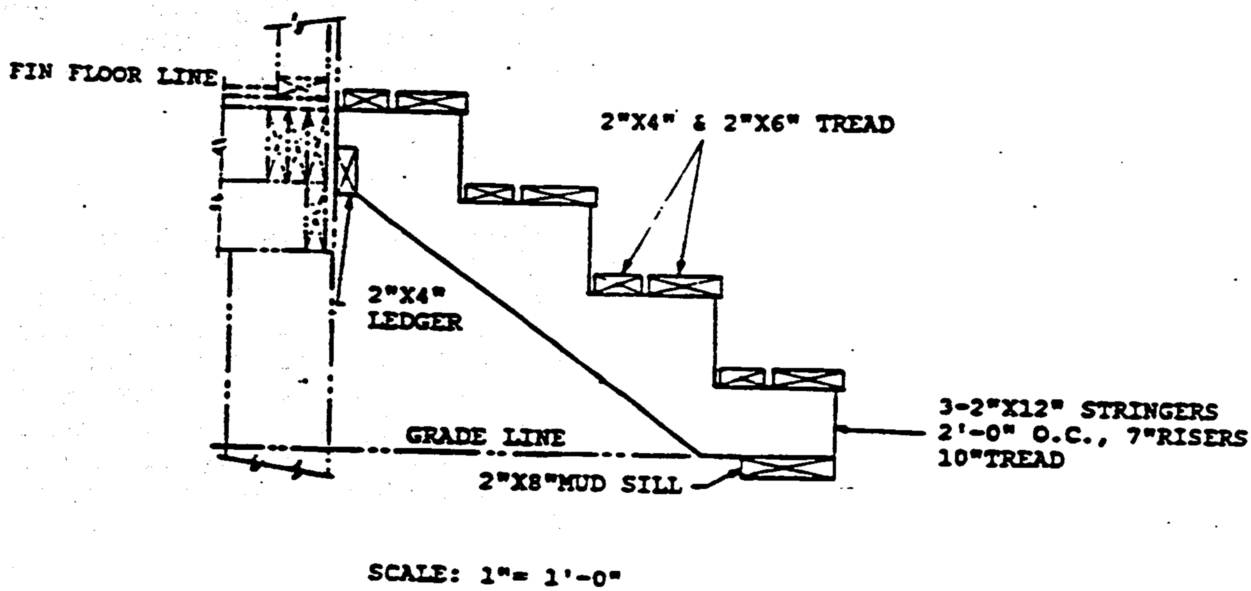


Fig 3-26. Exterior stair detail.

o Skirtboard detail drawing. Many buildings that have a post foundation will use skirting to fill in the space between the floor joist and the finished grade. The architect may choose to show a detail of how the skirtboard will be attached. Figure 3-27 shows a skirtboard detail drawing.

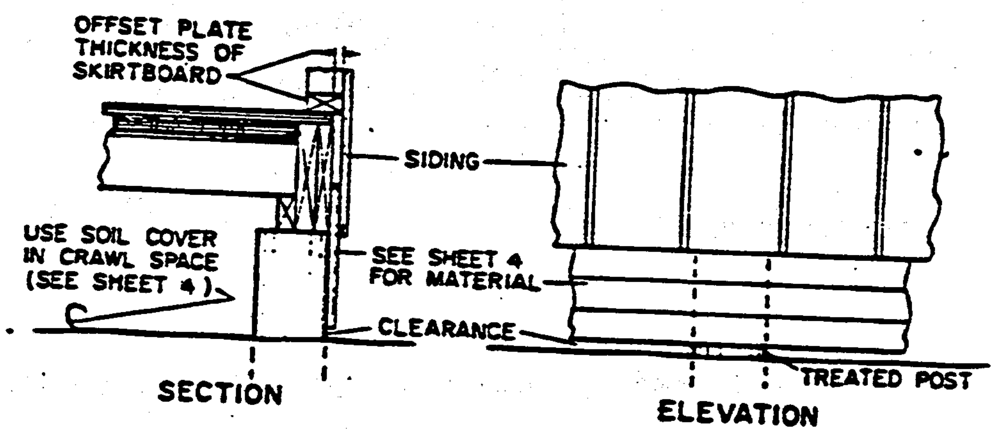


Fig 3-27. Skirtboard detail drawing.

This lesson has shown only a few of the many objects that can be drawn in detail by the architect. He or she may show by drawing in detail any unusual use of siding, a dormer, an unusual entranceway, or an unusual pattern of laying brick used for ornamental decoration.

Window and Door Details

Most windows and their frames are millwork items that are usually fully assembled at the factory. Window units, for example, often have the sash fitted, are weatherstripped, the frame assembled, and the exterior casing in place. Standard combination storms and screens or separate units may also be included. Since most windows come fully assembled, most construction prints in the business world will not show window details. However, this is not true on military construction prints. Usually all military construction prints will include detail drawings for every type of window used in the structure.

o <u>Double-hung window</u>. The double-hung window is perhaps the most familiar type of window. It consists of an upper and lower sash that slide vertically in separate grooves in the side jambs or in full-width metal weatherstripping. The top of the window frame is called the head. The sides of the window are called jambs. The bottom is called the sill. Figure 3-28 shows a double-hung window with four (4) details and the location from which the detail is taken. Figure 3-28A shows a cross section view of the head. Figure 3-28B shows a cross section view of the meeting rails. Figure 3-28C shows a cross section view of the side jamb (notice that the jamb section is a plan view, looking down). Figure 3-28D is a cross section view of the sill.

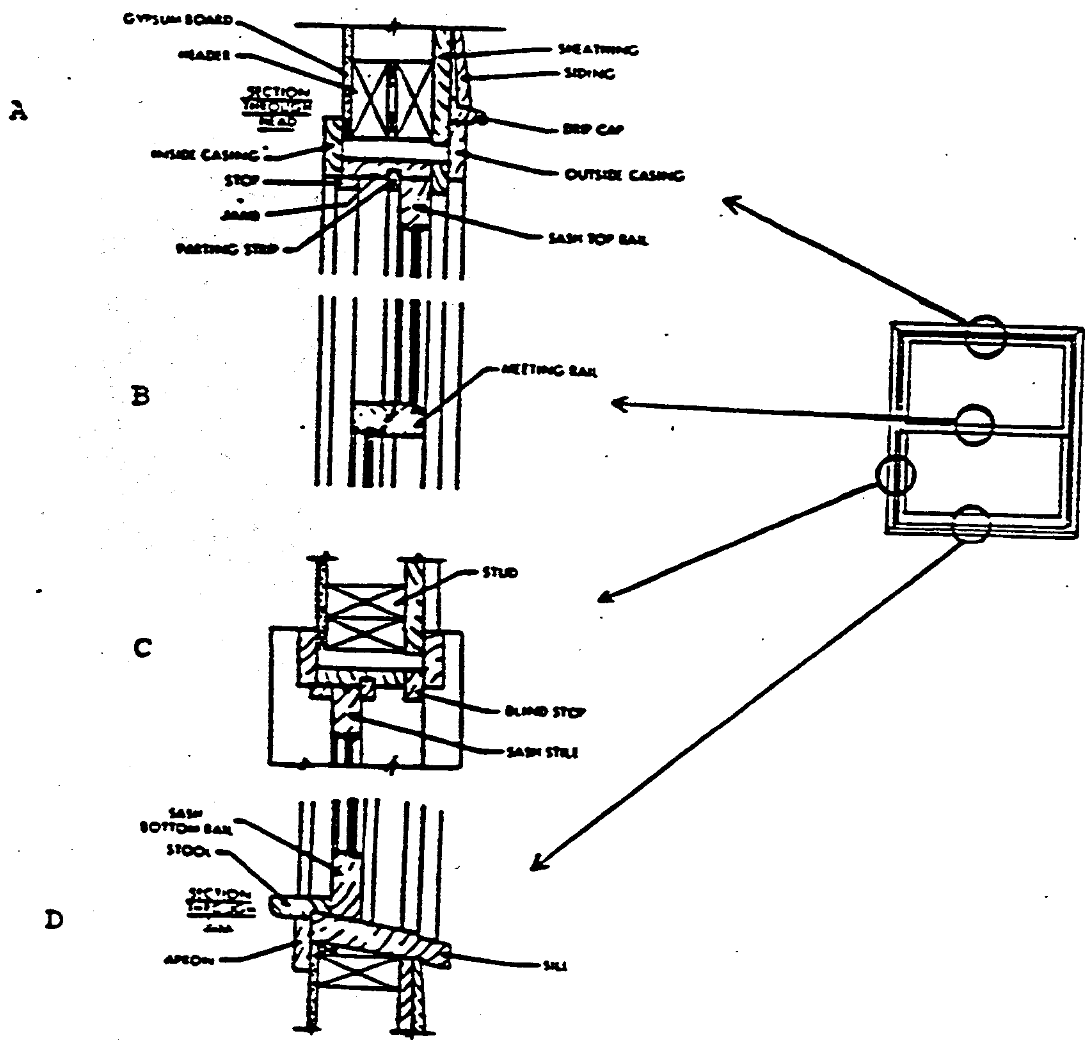


Fig 3-28. Double-hung window details.

o Casement windows. Casement windows consist of side-hinged sashes, usually designed to swing outward. Figure 3-29 shows an outswinging casement window with four detail views. View A is a sectional view of the head. View B is a sectional view (plan view, looking down) of the meeting stiles. View C is a sectional view of side jamb (plan view, looking down). View D shows a sectional view of the sill.

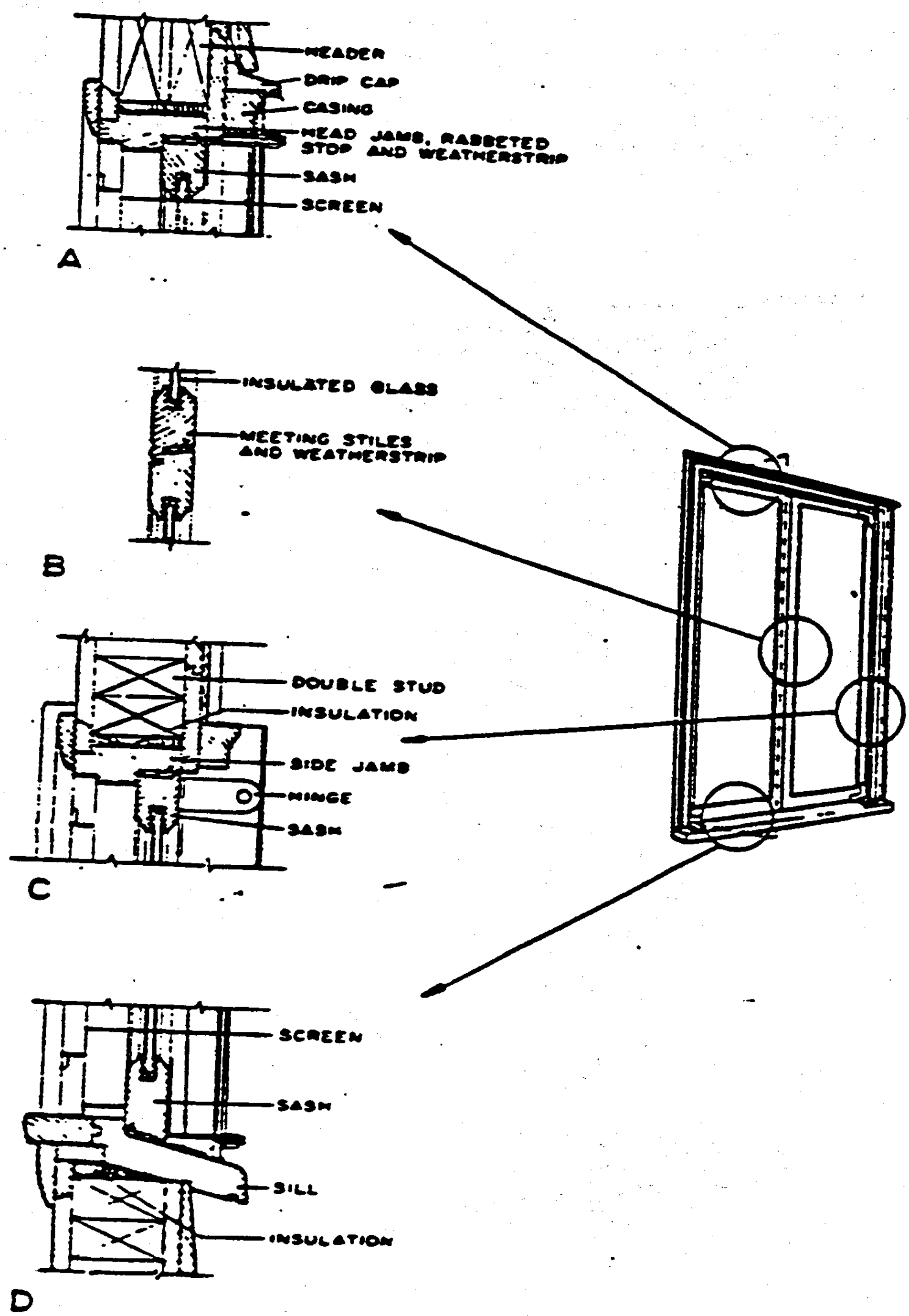


Fig 3-29. Casement window detail.

o Stationary windows. Stationary windows used alone or in combination with double-hung or casement windows usually consist of a wood sash with a large single light of insulated glass. A stationary window with two (2) detail views is shown in figure 3-30. View A shows a section view of the head, and view B shows a section view of the sill.

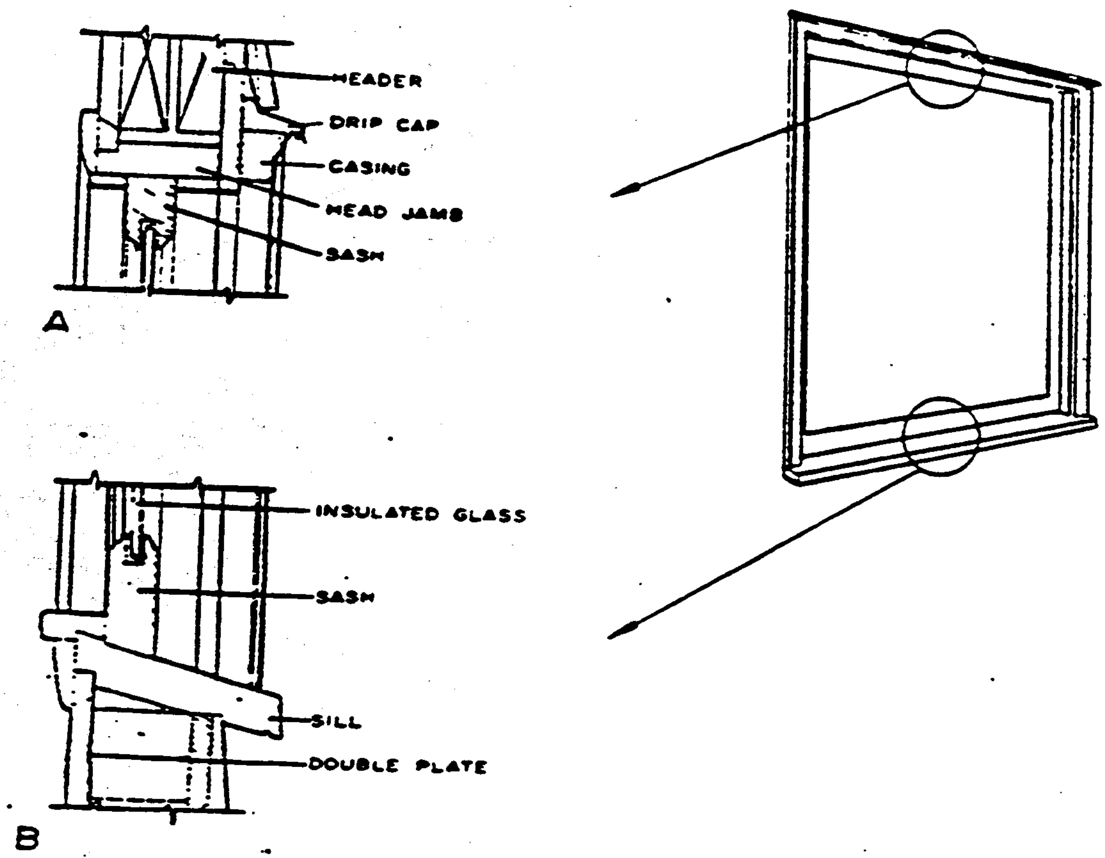


Fig 3-30. Stationary window details.

o Awning windows. An awning window unit consists of a frame in which one or more operative sashes are installed. The sashes of the awning type window are made to swing outward at the bottom. A similar unit, called the hopper type, is one in which the top of the sash swings inward. Figure 3-31 shows an awning type window with three (3) details and a typical combination of several awning windows in one unit.

View A of figure 3-31 shows a cross section view of the head. View B is a cross section view of the horizontal mullion between the top and bottom sash. View C is a cross section view of the sill. The phantom lines in views A, B, and C represent the swing of the hopper type window.

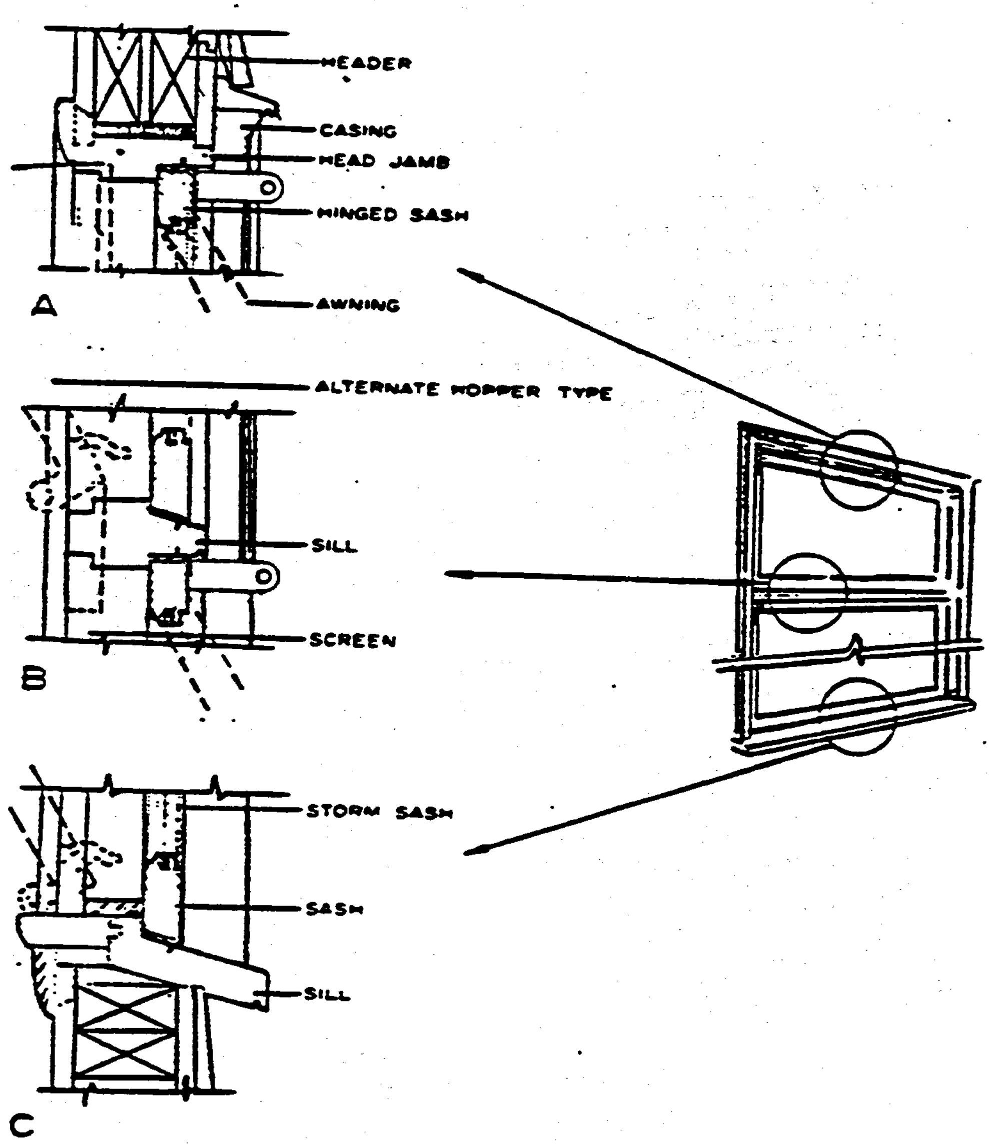


Fig 3-31. Awning window details.

Most doors and their frames used in commercial construction are preassembled at a factory and delivered to construction sites in the same manner as the windows which we discussed earlier. However, in military construction, the doors and their frames will usually be constructed on the job site. A door detail will be needed in order to accomplish this. Figure 3-32 shows a typical panel type exterior door and three door details. The head detail is shown in view A.

View C shows the sill detail which is taken directly below the head detail at the bottom of the door. Views A and C are taken from the left side of the door looking toward the right side of the door. The jamb detail shown in view B is a plan view, looking down. Notice that all three views show a combination storm door used with the exterior door.

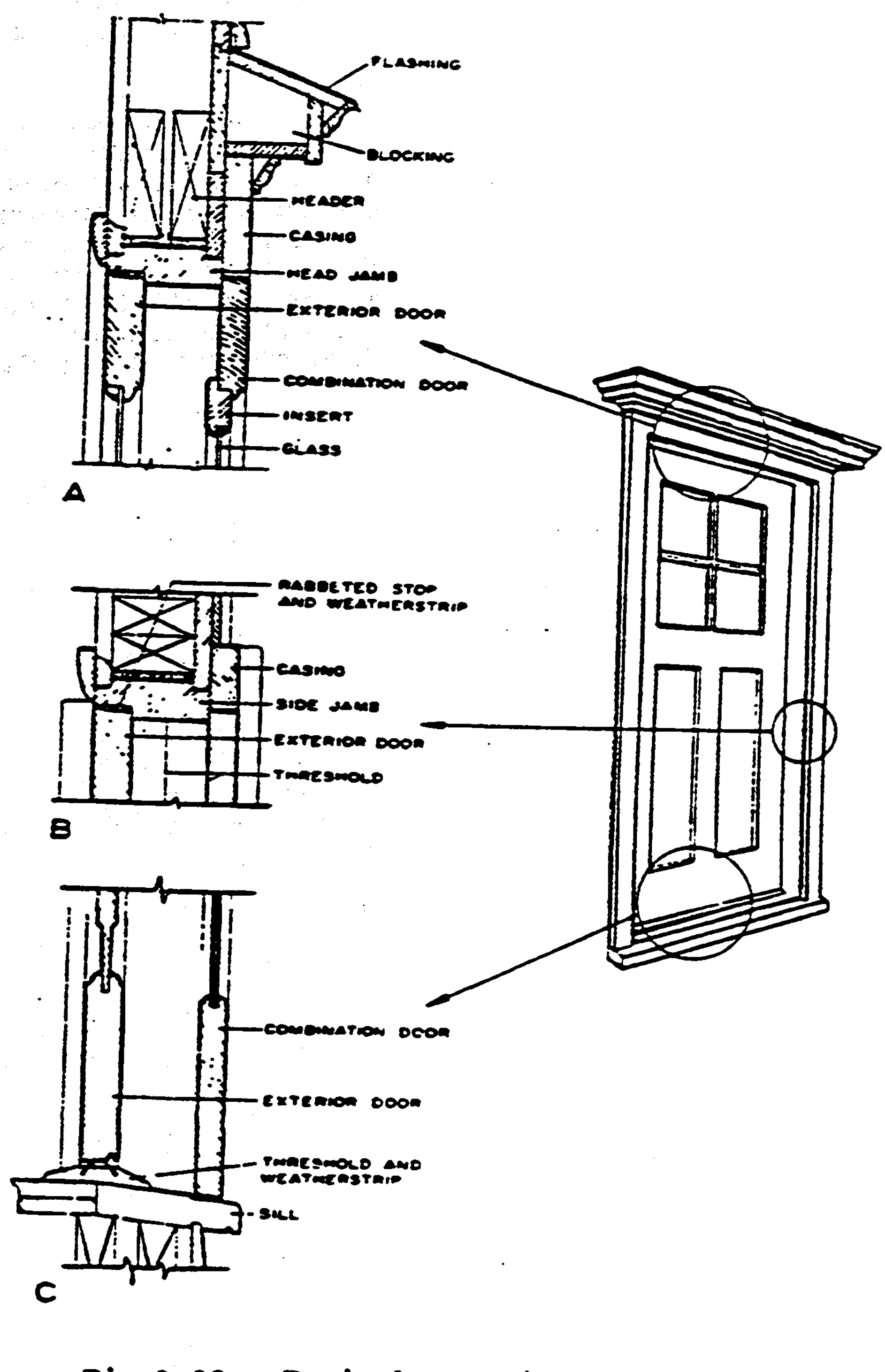
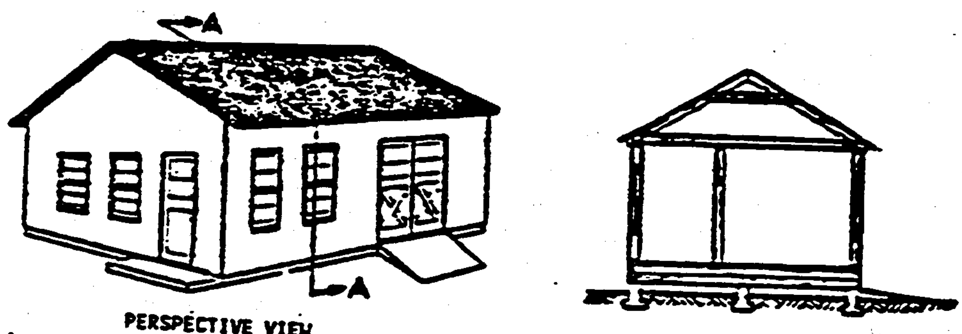


Fig 3-32. Typical exterior door details.

Section Views

A section shows how a structure looks when cut vertically by a cutting plane. It is drawn to a scale and details a particular construction feature that cannot be clearly shown in the general drawing. The section provides information on height, materials, fastening, support systems, and concealed features. Section drawings are used to give a clear view of the interior or hidden features of the object which normally cannot be clearly observed in conventional outside views.

As mentioned in study unit 1, lesson 3, a section view is obtained by cutting away part of an object to show the shape and the construction at the cutting plane. The most common position of the cutting plane is through the longest dimension, or main longitudinal axis and parallel to the front view. The cutting plane will be identified by a double set of letters such as A-A, B-B, etc. The actual view of the section after it has been cut will also be identified by the same set of letters. Figure 3-33 shows a typical section view and how the cut was made through the building.



TYPICAL SMALL BUILDING SHOWS CUTTING PLANE A-A AND SECTION DEVELOPED FROM THE CUTTING PLANE

Fig 3-33. Development of a section view.

Foundations (both wall and column) will normally have section views included on a set of construction prints. Section views of the foundation will show the shape of the footing(s), materials used, size of materials used, and any unusual features about the foundation. Figure 3-34 shows a typical column foundation plan with the architect's note to see section view A on sheet 3 of the construction prints. This is the typical way an architect will let the builder know about a section view that will give the builder the needed information. Section A is shown in figure 3-35.

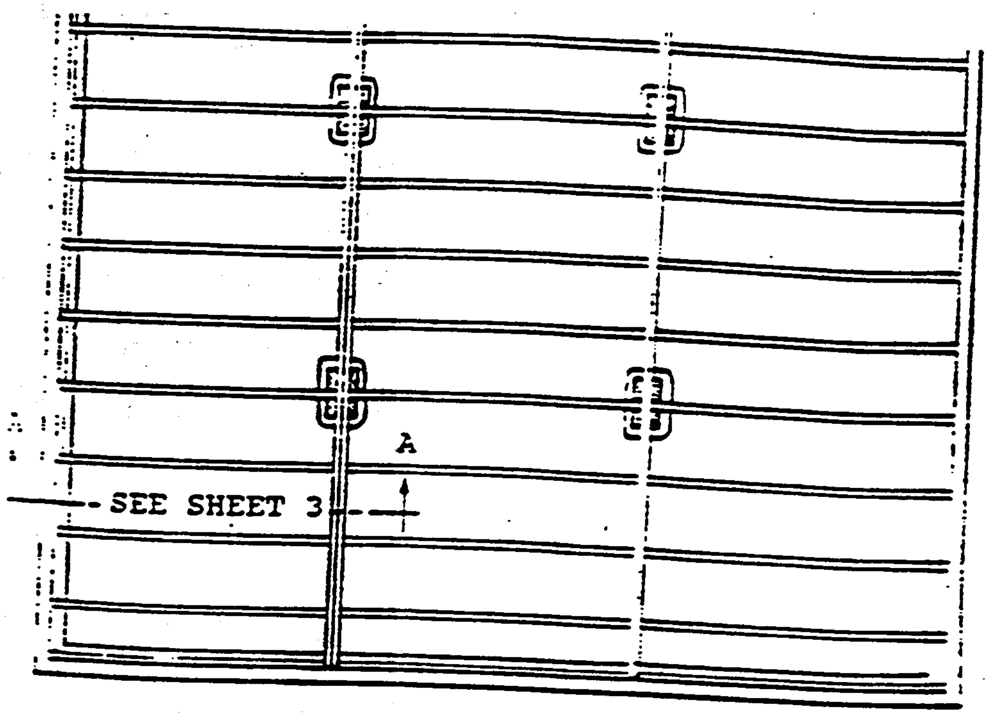


Fig 3-34. Foundation indicating the section views that are available.

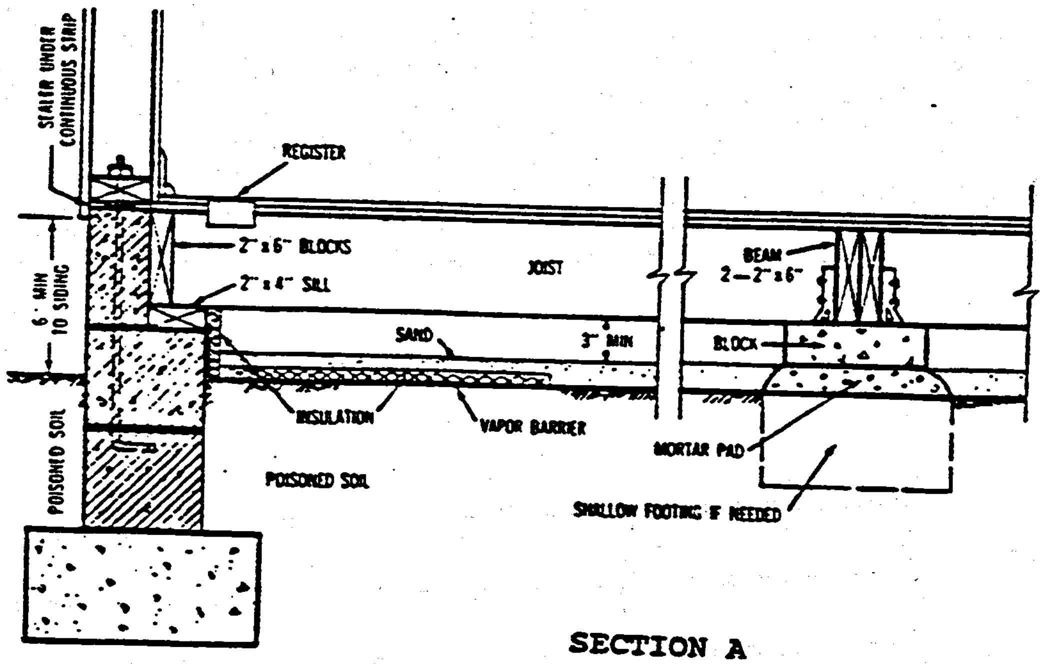


Fig 3-35. Section view of a column foundation.

Figure 3-36 shows a typical section view of a wall foundation. Note that the architect gives information about the materials used in the foundation, this includes the construction of the floor and wall.

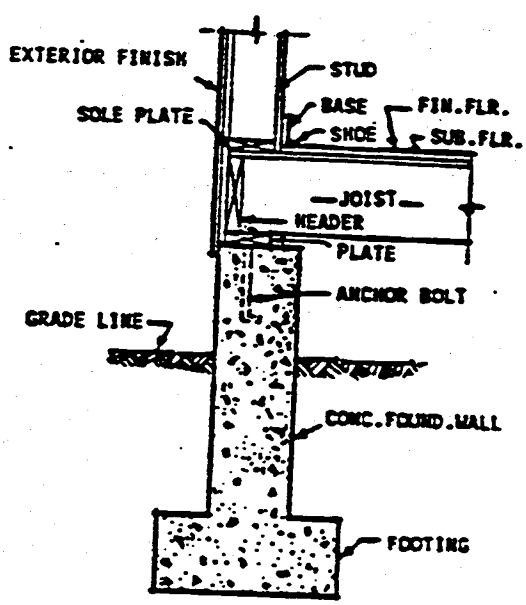


Fig 3-36. Typical section view of a wall foundation.

The wall section view is of primary importance to construction supervisors and to the craftsmen who do the actual building. The wall section shows the construction of the walls as well as the way in which structural members and other features are joined together. Since most wall sections extend vertically from the foundation to the roof, they will contain information not only about the wall, but also about the roof and foundation. Figure 3-37 shows a typical wall section view. Notice the large amount of structural information included on the section view illustrated. Information about exterior finish on both the wall and roof are shown, the wall will have shingles for exterior finish and plaster for interior finish material.

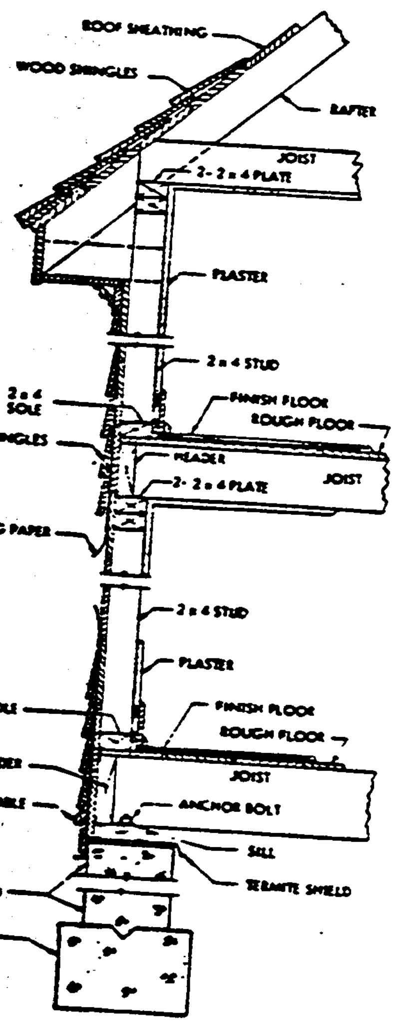
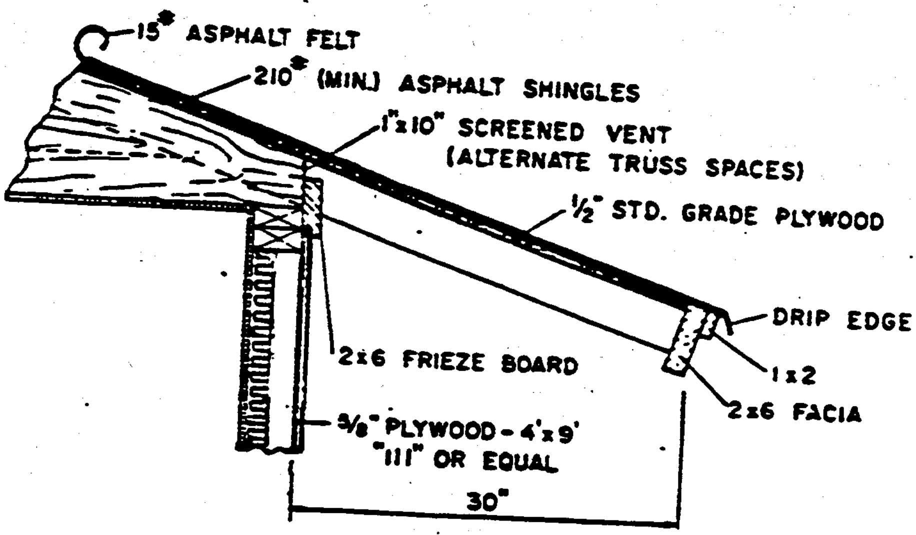


Fig 3-37. Typical wall section view.

EXERCISE: Complete items 1 through 20 by the performing action required.

1. The detail drawing illustrated below is drawn to

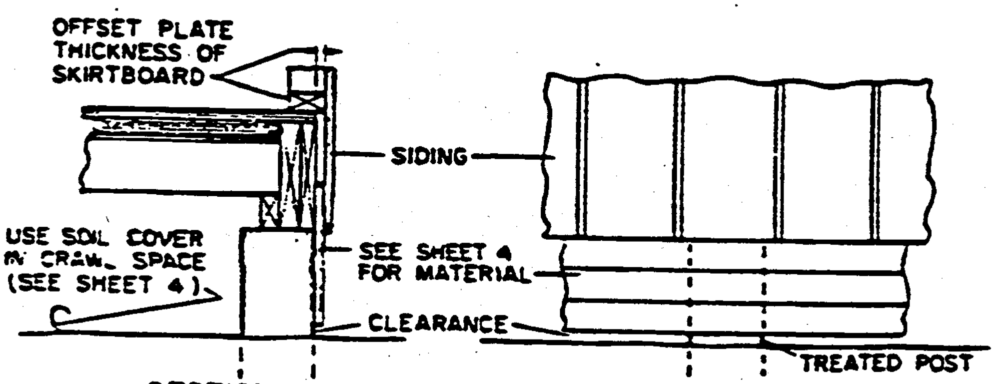
_________________ scale.



CORNICE DETAIL
TRUSS
SCALE - 1" = 1'-0"

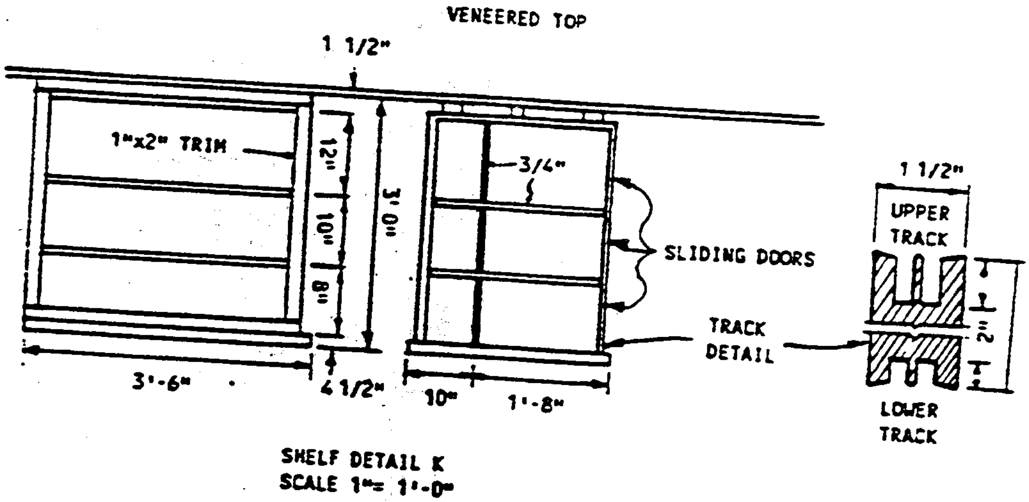
2. What scale is used on the detail drawing illustrated below?

____

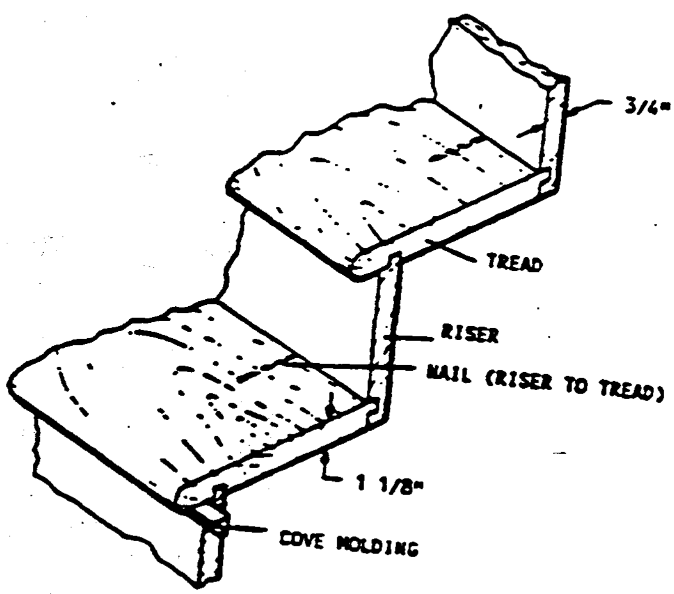


ALTERNATE SKIRTBOARD DETAIL
SCALE - 3/4" = 1'-0"

3. The illustration below is an example of a detail drawing of a ______________________________.

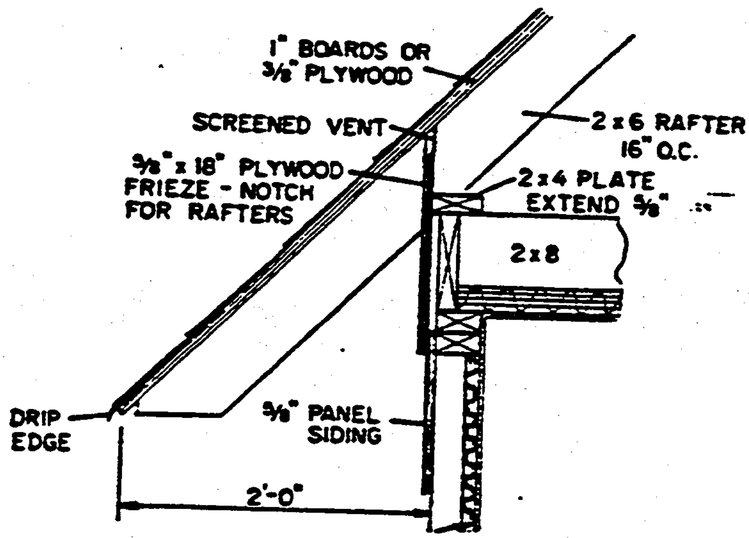


4. The illustration below is an example of a ______________ detail drawing.

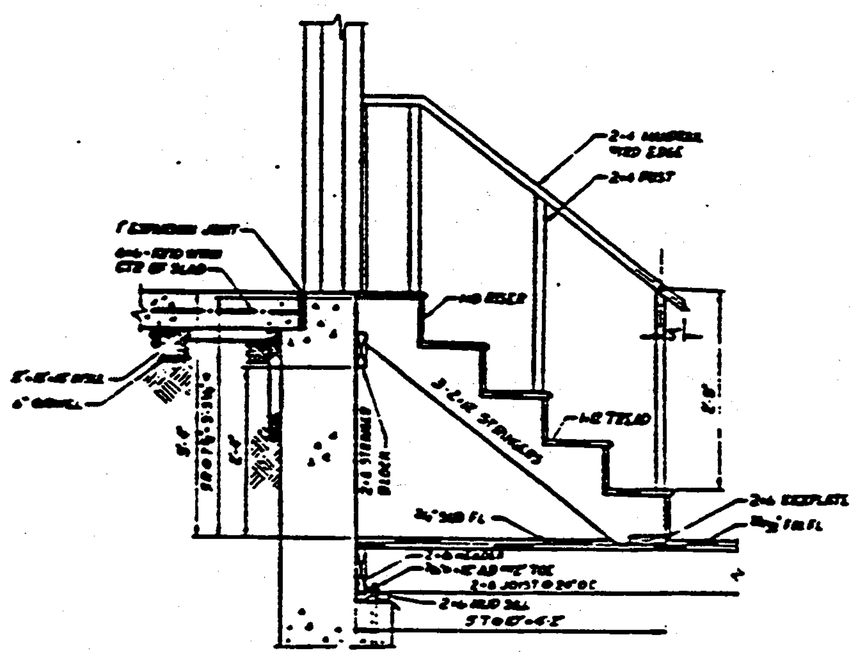


5. What exterior detail is illustrated by the drawing below?

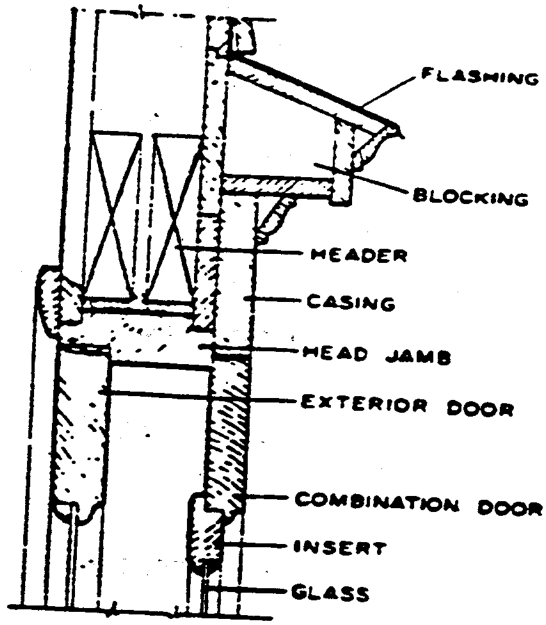
____



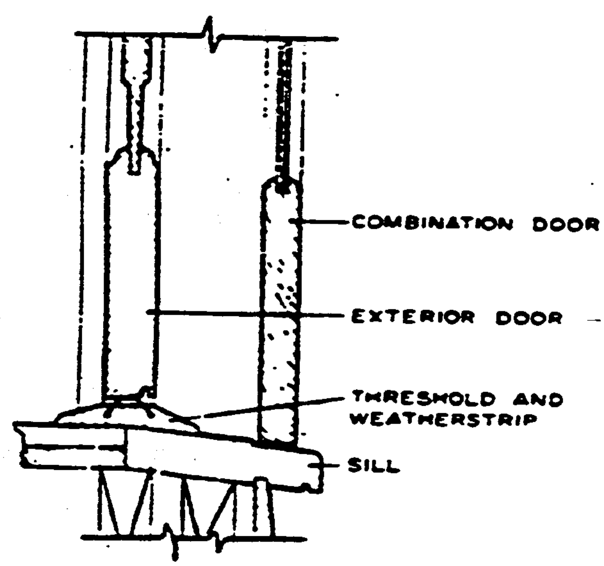
6. The illustration below is an example of an exterior ______________ detail drawing.



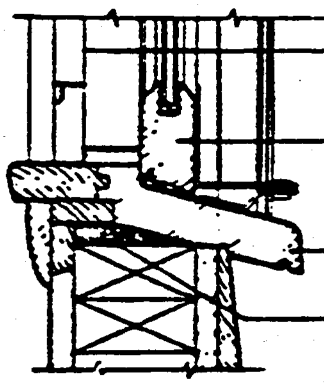
7. The illustration below is a head detail for a ______________________________.



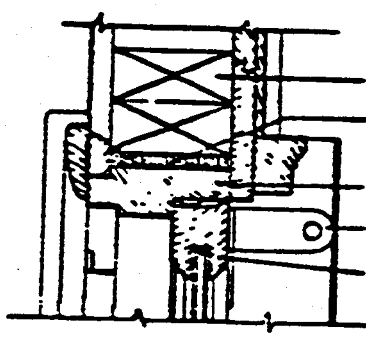
8. The door detail illustrated below is a detail drawing of the door ______________________________________.



9. The drawing illustrated below is a detail of a ______________________ sill.



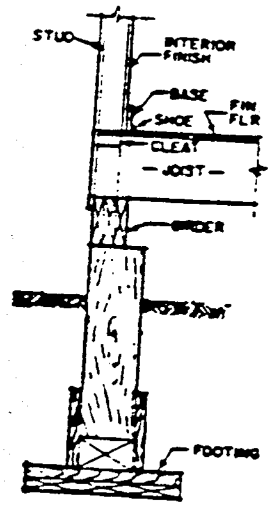
10. The illustration below is a detail of a window ______________________.



11. What type of section view will give information about the size and shape of footings?

____

12. The illustration shown below is an example of a ______________________________ view.



13. Foundation section views could show both column foundation and ______________________________ views.

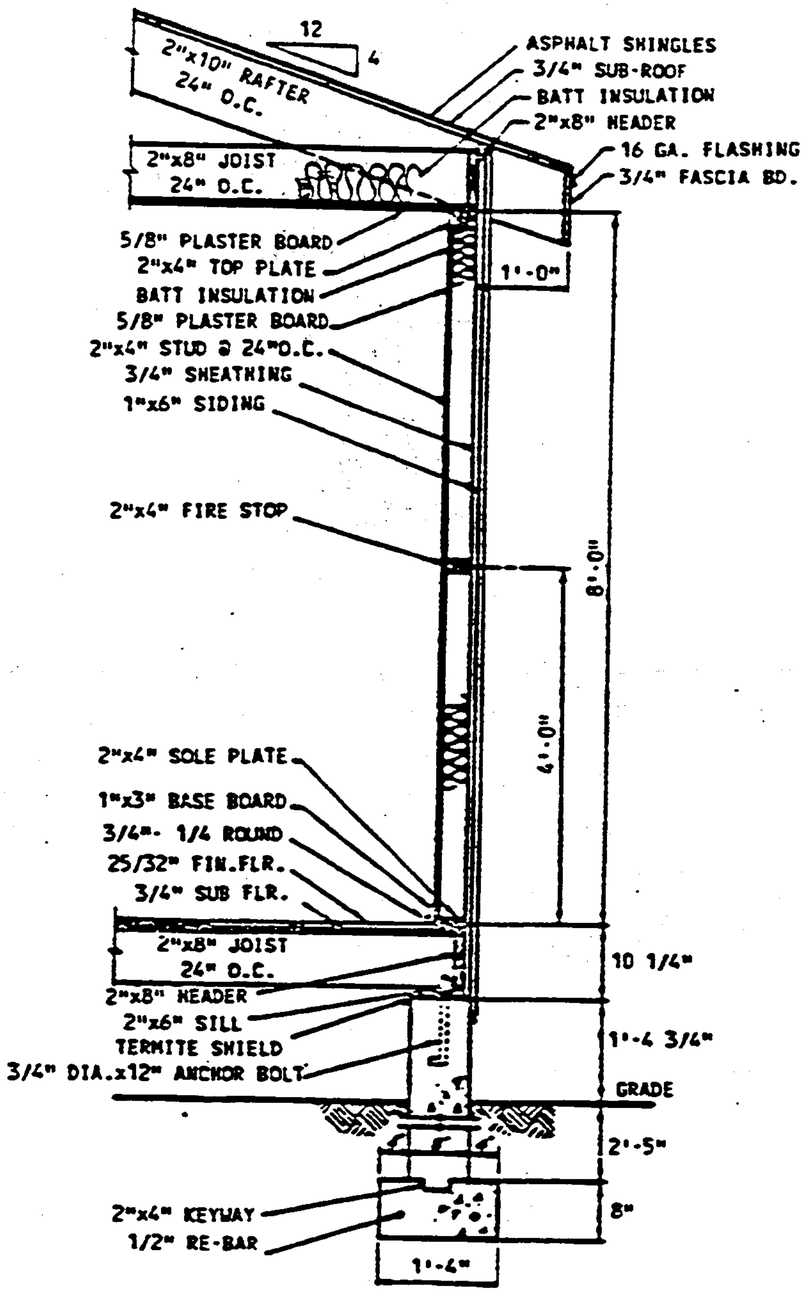
14. What type of section view will give information about the exterior finish?

____

15. What section view would give a builder information about the finish used on the roof?

____

Note: Items 16 through 20 pertain to the illustration below.



16. What type of material is used for the outside wall sheathing?

____

17. What size are the floor joists?

____

18. What type of material is used on the inside wall?

____

19. What size is the material used to finish the floor?

____

20. What type of shingles are to be used on the roof?

____

FRAMING PLAN

Floor Framing Plans

Framing plans show the size, number, and location of structural members which form the building frame work. Separate plans may be furnished for floors, walls, and roofs. Framing plans for floors are basically plan views of the girders and joists. The size and spacing of the joists, the size and number of girders, and the bridging are noted on the plan. A typical floor framing plan is shown in figure 3-38. By reading the floor framing plan, you learn that the girders will be made up of three 2"x 6"s (or three 2" x 8"s for 20-foot spans). The joists will be made up of 2" x 6"s and are to be spaced at intervals of 3 feet (2" x 6" at 3"-0" O.C.) with bridging. The joist lengths are joined at the girders with 2"x 6" x 2" – 0" foot splices. Note that there are two types of footings indicated (type C and type D). Detailed views of footings, joists, girders, or foundations may be shown on the framing plan if the architect feels additional information is needed.

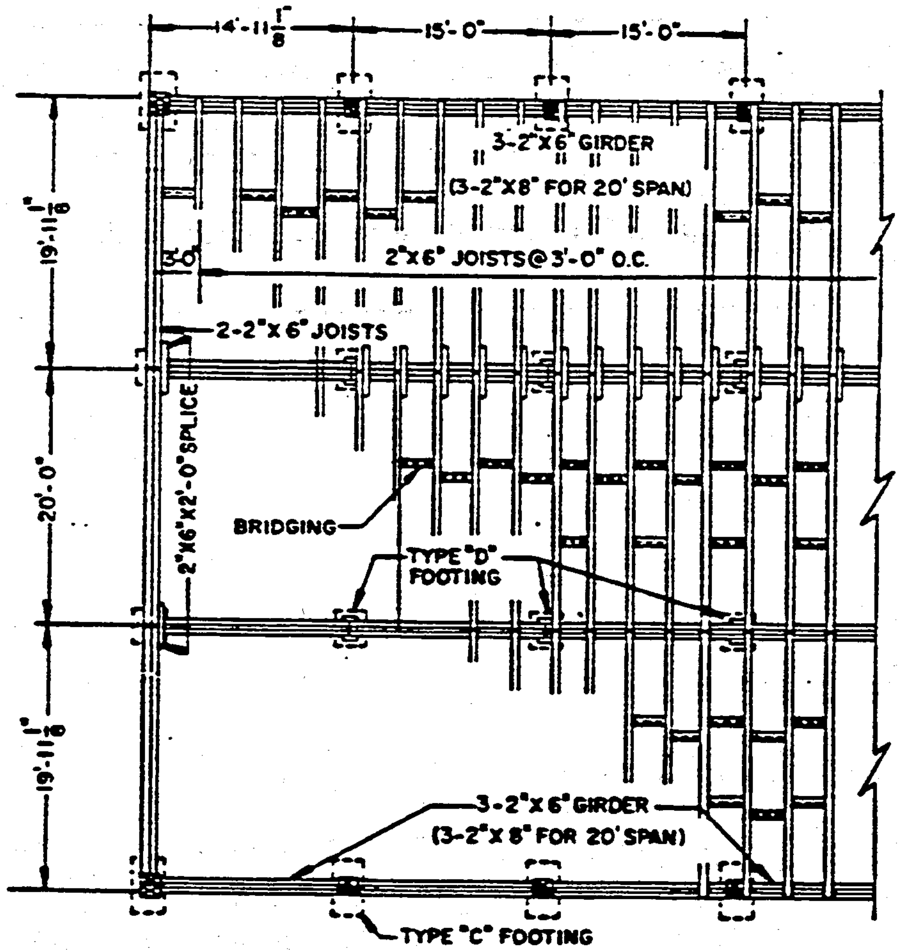


Fig 3-38. Floor framing plan.

Roof Framing Plan

Framing plans for roofs are very similar to floor framing plans and impart the same basic type of information. Normally shown is the size and spacing of rafters, ridgeboard, bearing walls, any roof openings, and other structural members in the roof as noted by the architect. Figure 3-39 shows a typical roof framing plan for a gable roof with a slope of 6 and 12 (6 inches of rise for every foot of run). After reading the plan, you can determine that the rafters will be 2" x 6"s spaced 18 inches on center. A ridgeboard made up of 2" x 8" stock will be used in the roof. The framing plan also indicates an opening for a chimney. The rafters will extend 1 foot beyond the edge of the building.

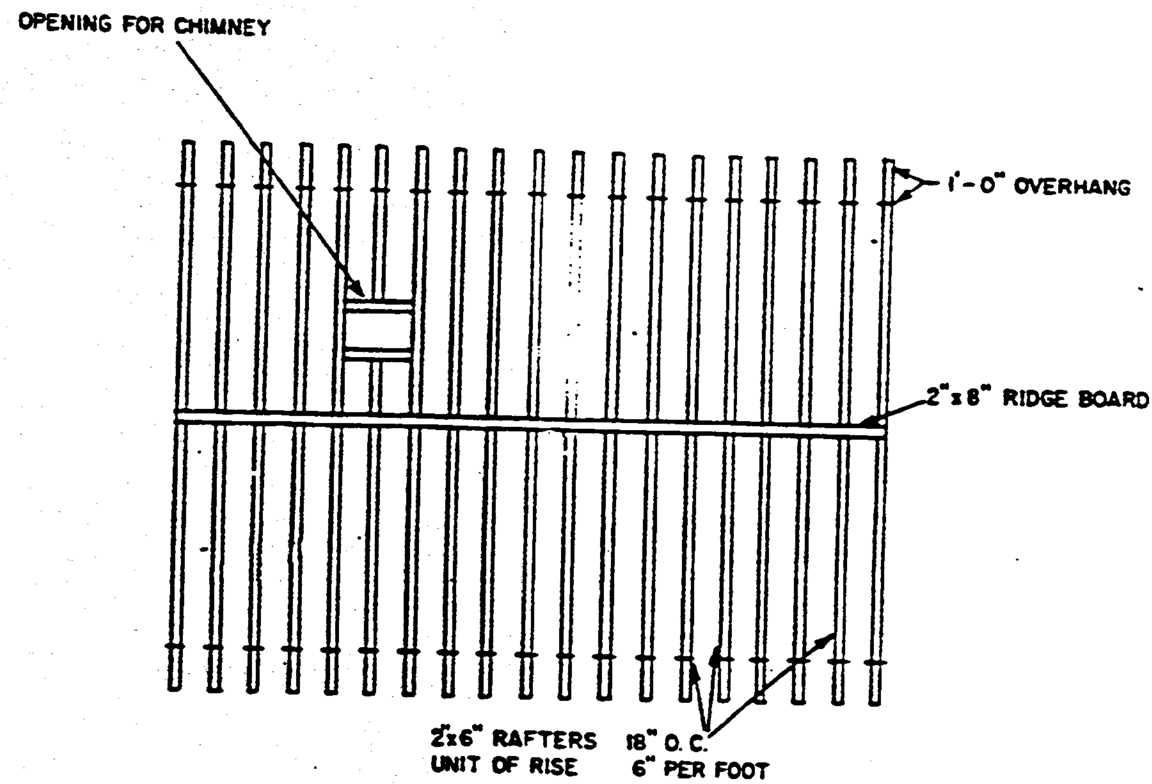
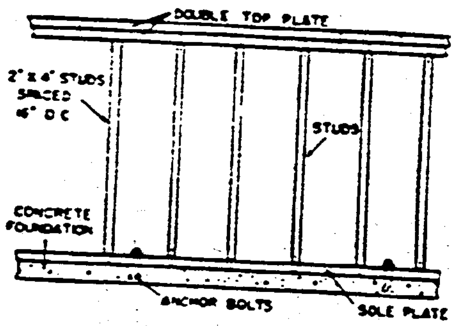


Fig 3-39. Roof framing plan.

Wall Framing Plan

Wall framing plans (also called wall framing details) present information about the size and location of studs, diagonal bracing, cripples, trimmers, headers, fire blocks (girts), plates, and corner posts. The door and window framing can also be shown in a wall framing plan. Figure 3-40 shows both a typical wall framing plan and a detailed drawing that shows where wall framing members are located. Notice that the framing plan gives not only the size of the studs, but also gives the on-center spacing at 16". Wall framing plans can be as simple as the one illustrated in figure 3-40 or they may be very complicated. Their complexity will depend upon the amount of information that the architect is trying to include on the plan.



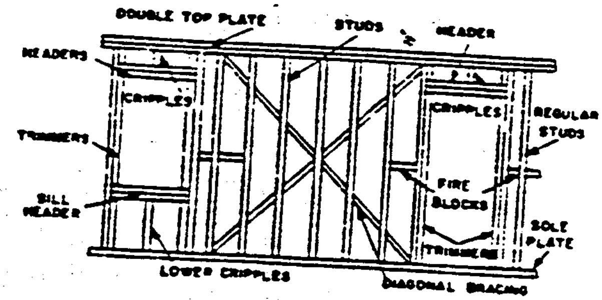


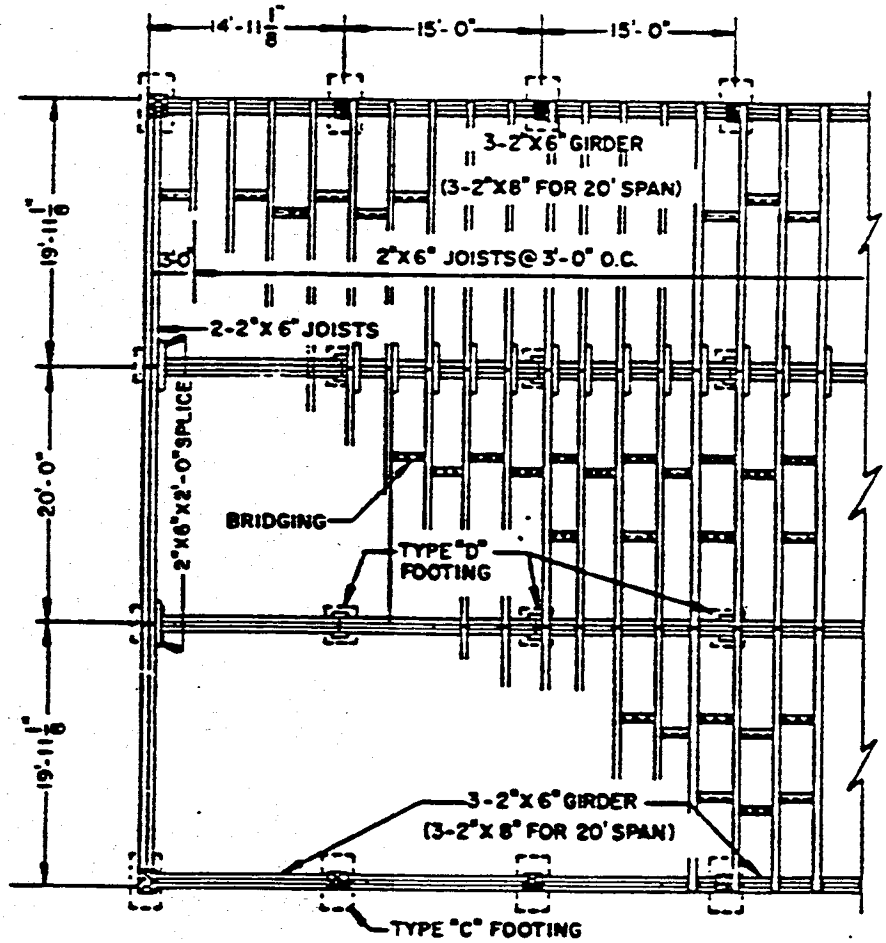
Fig 3-40. Typical wall framing plan.

EXERCISE: Complete items 1 through 7 by performing the action required.

1. What plan would show the size and spacing of the joists, the size and number of the girders, and the type of bridging used?

____

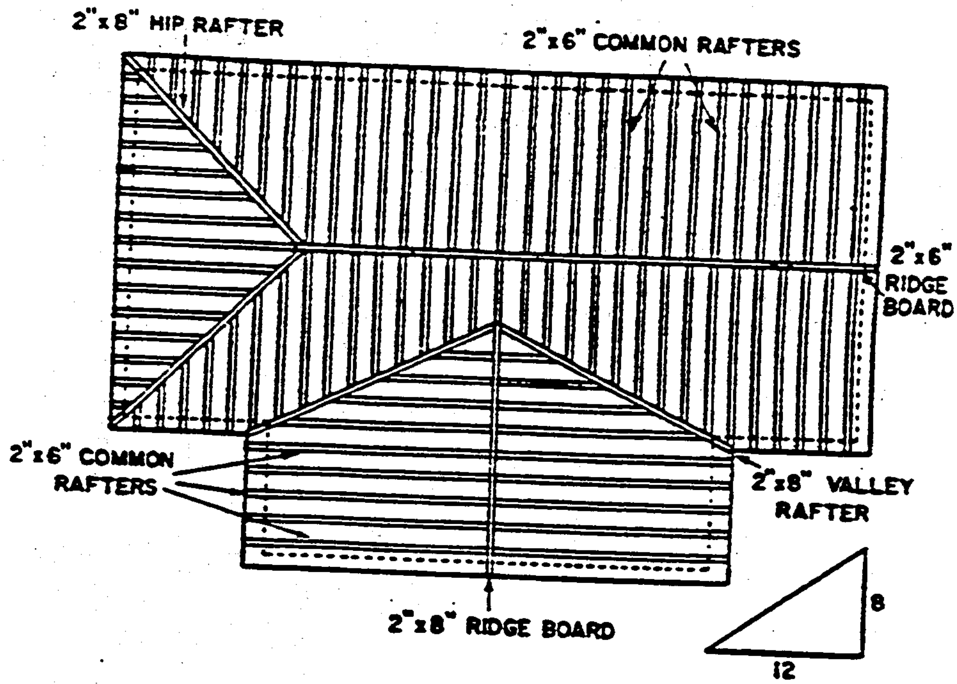
2. llustration below is an example of a ______________ ______________ plan.



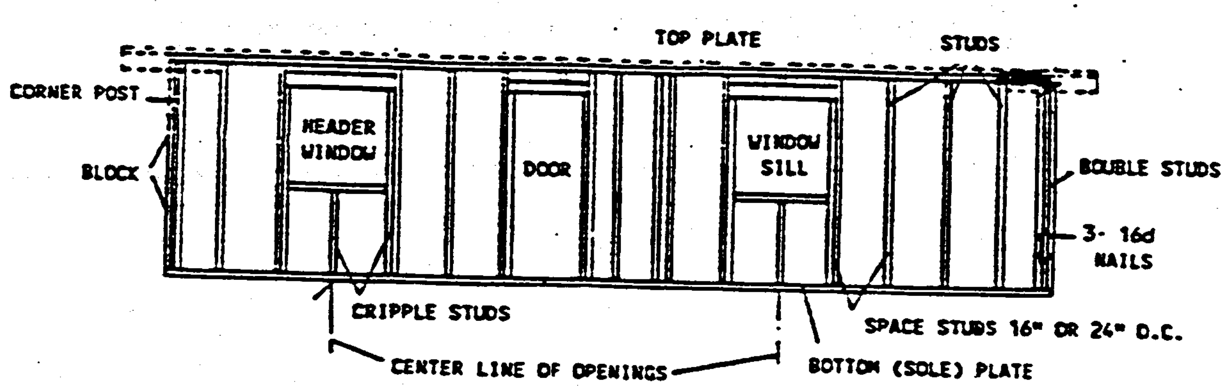
3. What framing plan would show the size and spacing of the rafters?

____

4. The following illustration is an example of a __________ __________________________________ plan.



Note: Use the illustration below to answer items 5 through 7.



5. The illustration is an example of a____________________ __________________________ framing plan.

6. What size nails are to be used to fasten the studs to the sole plate?

____

7. The stud spacing is to be either____________________ or ____________________ inches on center.

TYPES OF FRAME CONSTRUCTION

Platform Framing

There are four principal types of frame construction which are used today in the construction of light structures. They are platform (also called western), balloon, braced, and plank and beam. A brick veneer structure is also considered a frame structure because the internal or supporting structure is entirely of wood framing. Solid masonry construction such as brick or concrete block will not be discussed because of the limited use of masonry construction in the theater of operations. Braced frame, plank, and beam construction will not be discussed either. This lesson will concentrate on the platform and balloon framing methods which are the most widely used in the theater of operations.

The platform (also called western) frame is the most commonly used method in military construction. It is distinguished by the floor platforms independently framed as shown in figure 3-41, the second and third floors supported by studs one story in height. Framing of this type is fast, safe, and allows for extensive use of short materials.

Interior partitions and exterior walls are framed with material of the same length, thereby insuring proper balance in case of any shrinkage.

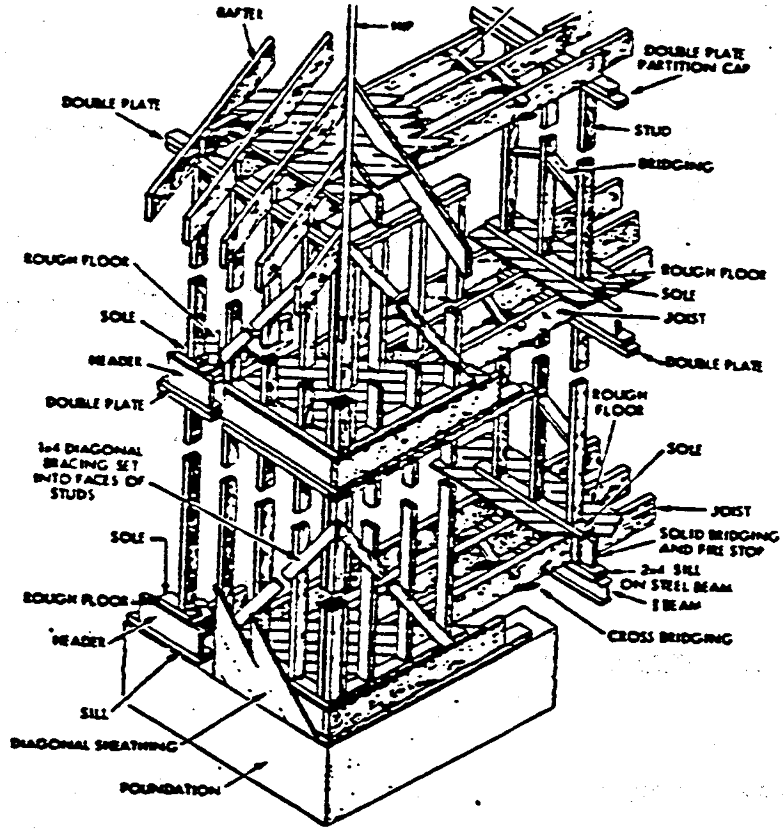


Fig 3-41. Platform (western) frame construction.

Because each floor is framed separately, the subfloor is laid "story by story" before the wall and partition studs are raised (fig 3-42). The studs are fastened to a sole plate that in turn is fastened through the subfloor to the floor joists. It is very difficult to install service pipe or wiring in these walls after they have been covered.

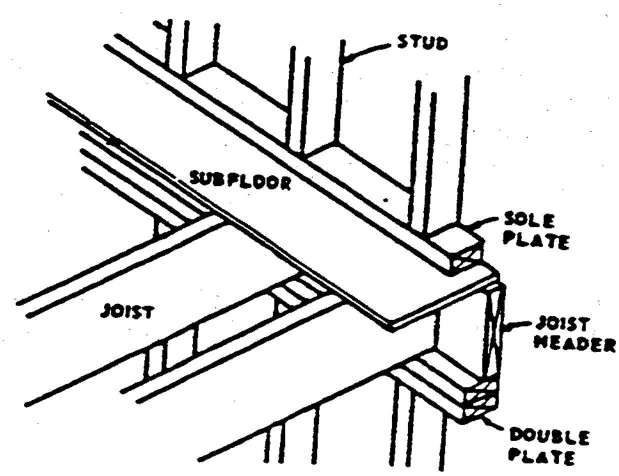


Fig 3-42. Method of framing upper-floor joists and studs in platform framing.

The platform frame is preferred for one-story structures since it permits both the bearing and nonbearing walls, which are supported by the joist, to settle uniformly.

Main components of a platform frame are as following:

- Wall studs. Studs are the closely spaced vertical members of partitions and outside walls. Their purpose is to support the weight of the upper floors and to provide a framework for exterior and interior finishes.

- Plates. A top plate is a horizontal member of a partition or frame wall. It serves as a cap for studs and support for the joists. The sole plate (bottom plate) serves as a rest for the studs.

- Bracing. Diagonal braces are permanent parts of a building which serve to stiffen the walls, keep the corners square and plumb, and prevent the frame from being distorted. The common types of bracing which you will use are let-in, set-in, and block bracing.

- Joists. Joists are laid edgewise to support the floor boards.

- Rafter. The ribs are run from hip, or ridge, to eaves in the roof.

- Sill. Sills are horizontal members that either rest upon or form the foundation of the house.

- Sheathing. Sheathing is generally applied diagonally to assist in strengthening the structure.

All of the aforementioned components are illustrated in figure 3-41.

Balloon Framing

The major characteristic of the balloon frame shown in figure 3-43 is the use of studs extending from the sill (sole) plate to the rafters. Also, the joist ends are supported by ledge (or ribbon) boards and are nailed to the studs as shown in figure 3-44. The ribbon board is let into (seated in) the stud to form a rigid support for the joist. The balloon frame offers the advantages of speed and economy of construction as compared to the braced frame method. The continuous studs facilitate easy installation of service pipe, conduit, etc., without cutting through plates and weakening the structure. Corner braces for this frame are lighter than in the braced frame and are let into the outside edges of the studs.

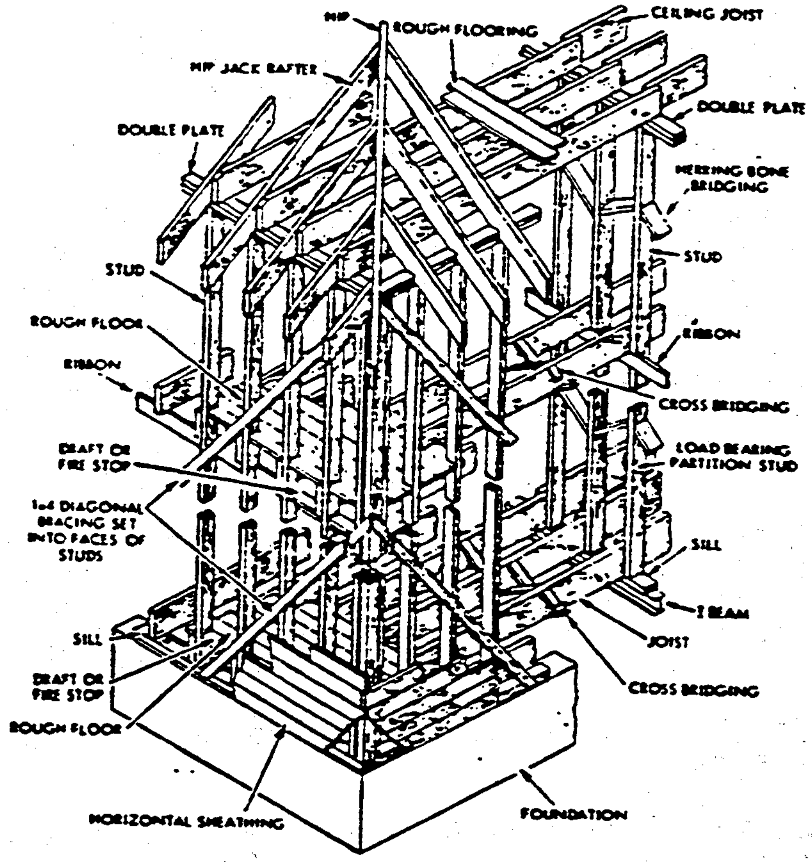


Fig 3-43. Balloon frame construction.

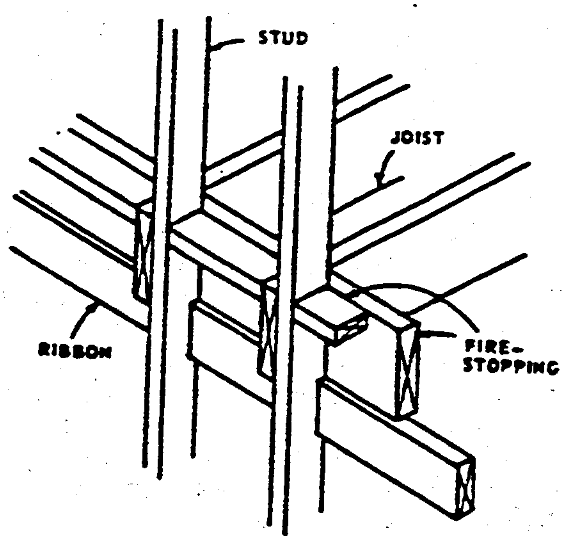
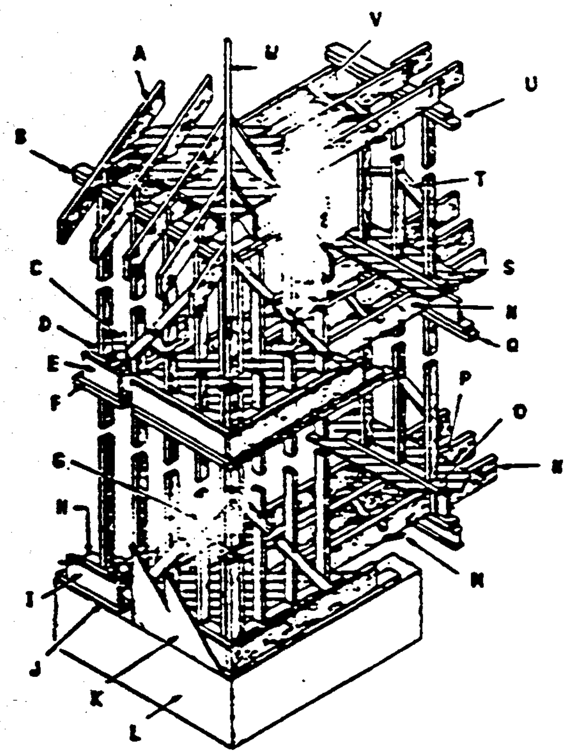


Fig 3-44. Method of supporting upper floor joist ends in balloon framing.

EXERCISE: Complete items 1 through 8 by performing the action required.

Note: Use the illustration below to answer items 1-8.

1. The illustration shown is an example of ____________ framing.



2. In what location on the illustration would you find bridging?

____

3. In what location on the illustration would you find a joist?

____

4. At which location would you find a diagonal brace?

____

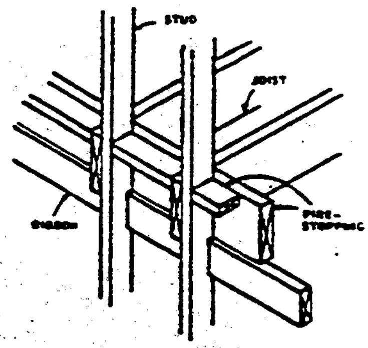
5. Which location indicates diagonal sheathing?

____

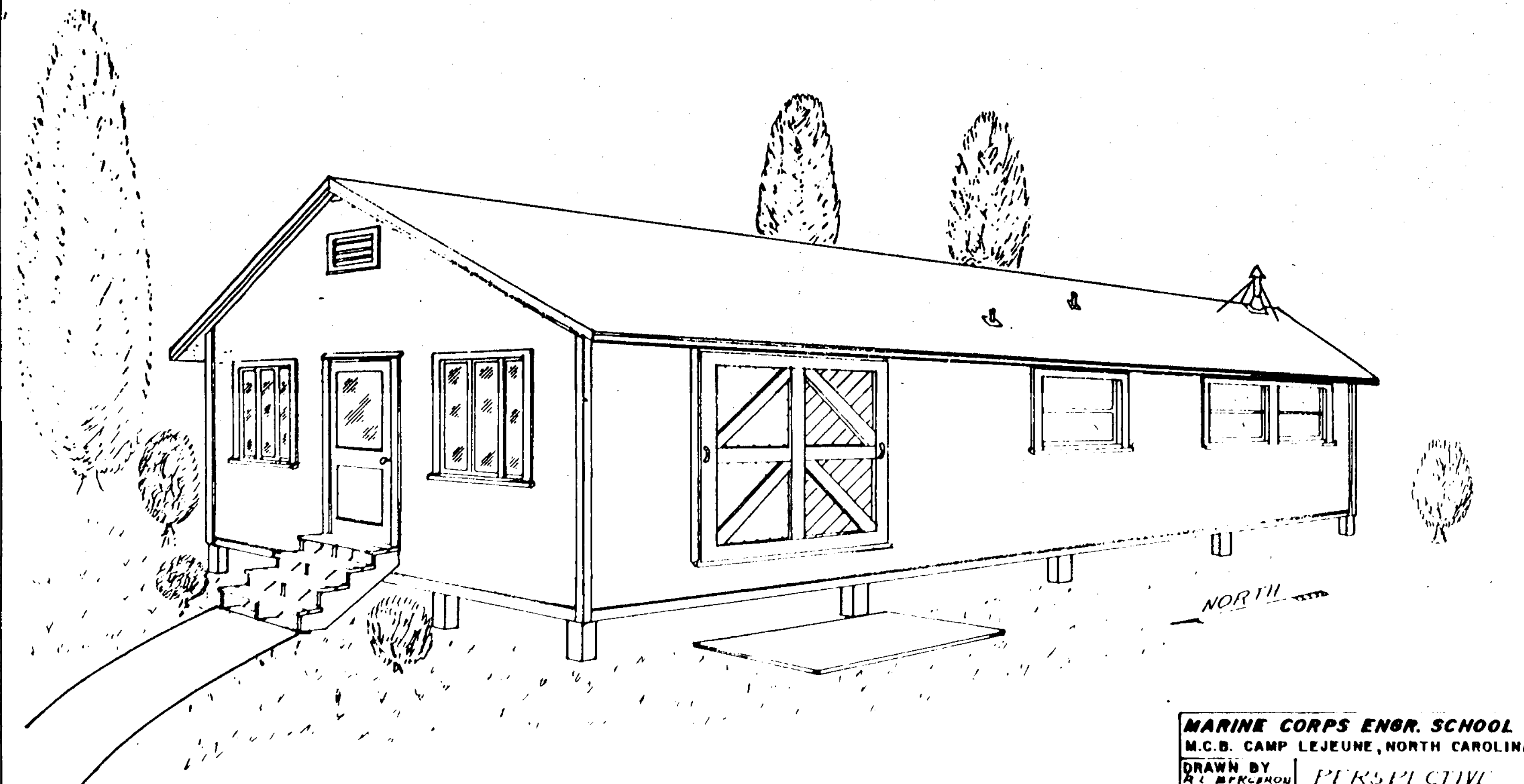
6. Which location indicates the header?

____

7. The illustration below is an example of ____________ frame construction.



8. The major difference between platform and balloon frame construction is that in balloon framing the studs run from the ______________ plate to the ______________ ______________.



MARINE CORPS ENGR. SCHOOL
M.C.B. CAMP LEJEUNE, NORTH CAROLINA

DRAWN BY [illegible]	PERSPECTIVE
CHECKED BY F A W	TEST BUILDING NO 1
APPROVED BY	SCALE NOT TO SCALE
	DWG. NO. [illegible]
DATE 10 NOV 19[illegible]	SHEET NO. [illegible]

INDEX SHEET

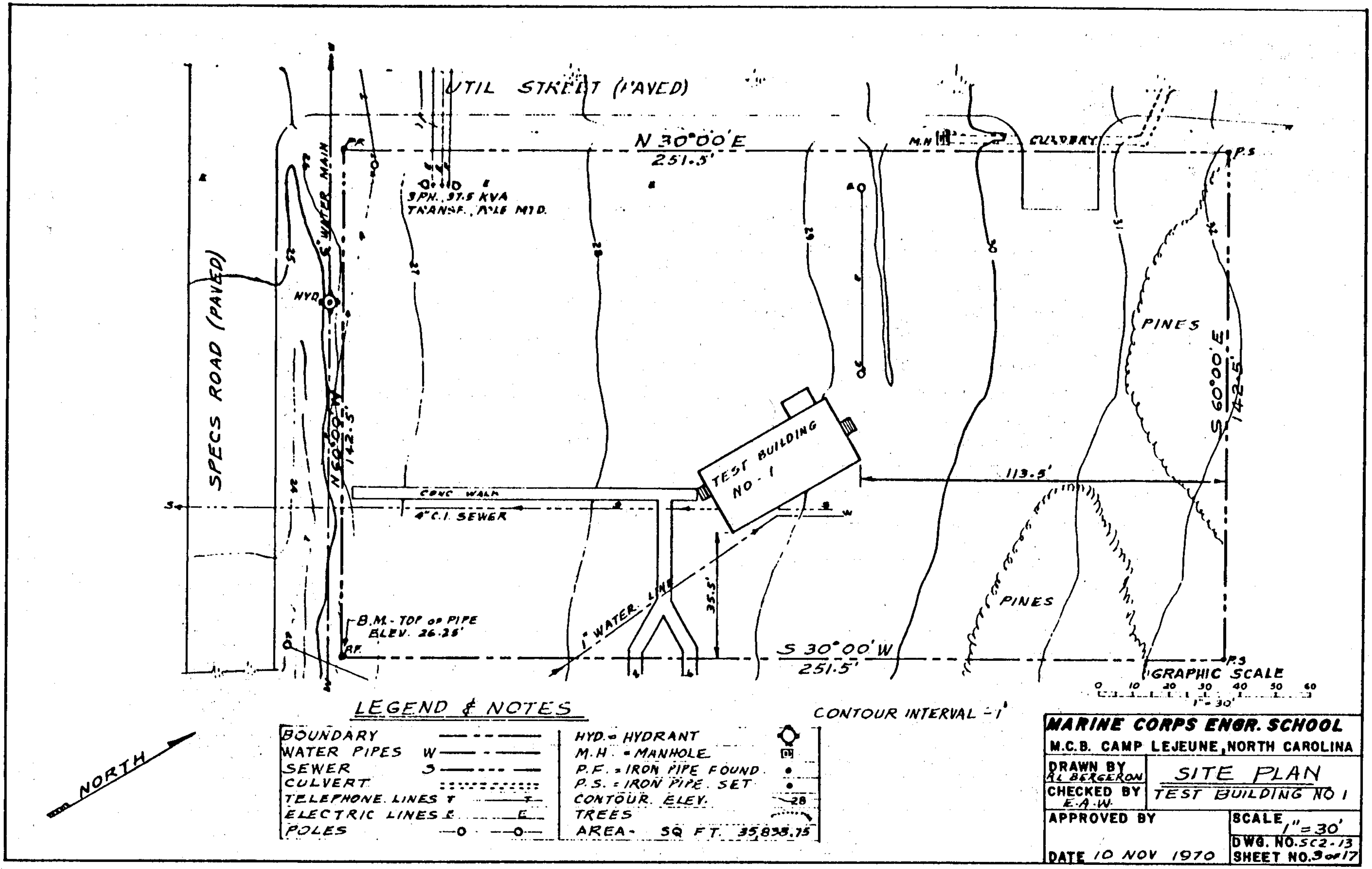
ARCHITECTURAL		STRUCTURAL		MECHANICAL	
DRAWING	SHEET NO.	DRAWING	SHEET NO.	DRAWING	SHEET NO.
PERSPECTIVE	1 OF 17	SITE PLAN (ENGR)	3 OF 17	ELECTRICAL PLAN	16 OF 17
INDEX SHEET	2 OF 17	FOUNDATION PLAN	4 OF 17	PLUMBING PLAN	17 OF 17
FLOOR PLAN	5 OF 17	TRUSS DETAIL	12 OF 17		
ELEVATIONS	6-9 OF 17	CABINET DETAILS	15 OF 17		
STANDARD DETAILS	10-11 OF 17				
DOOR DETAILS	13 OF 17				
SHOP DETAILS	14 OF 17				

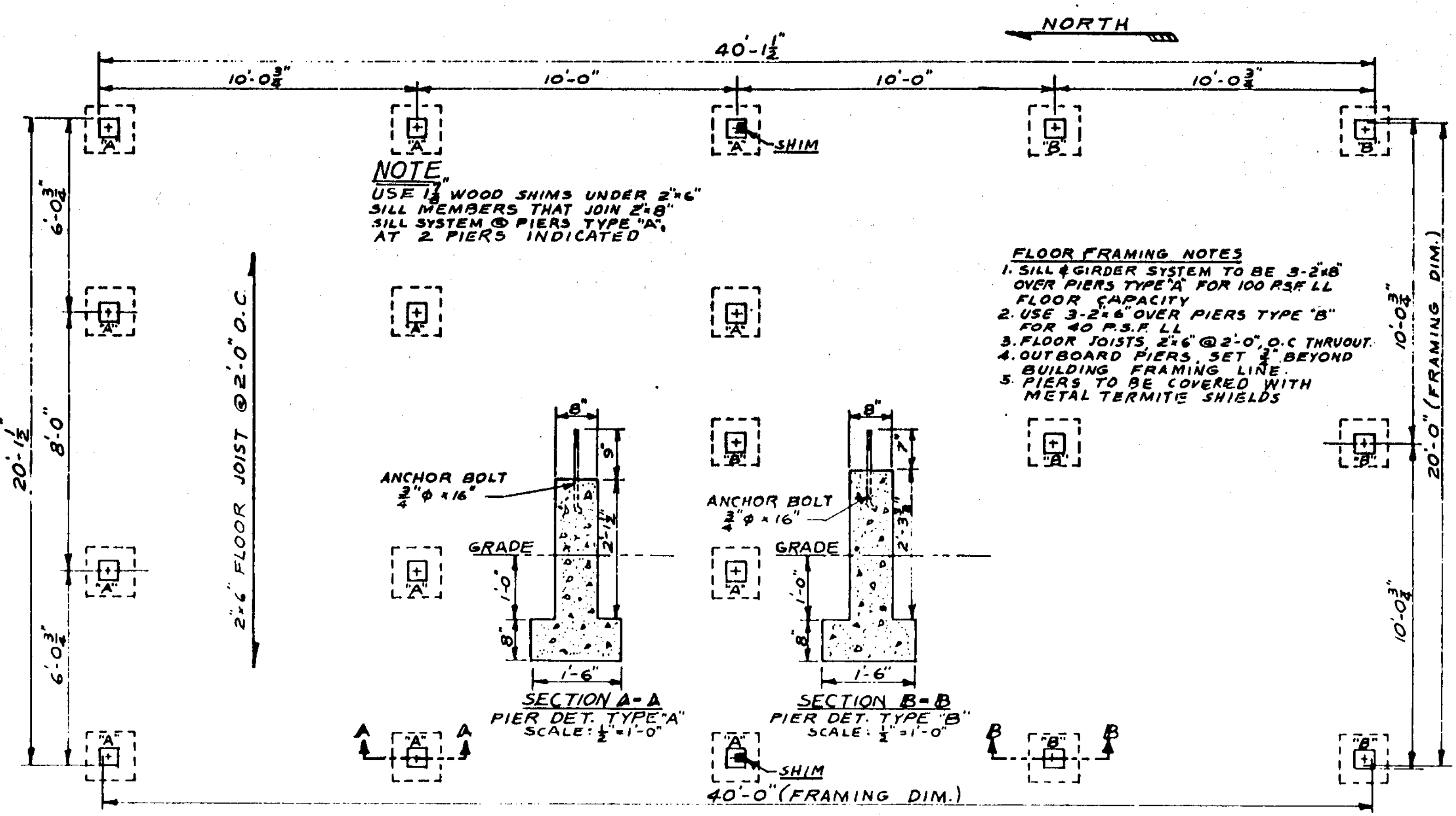
LEGEND & SYMBOLS

ARCHITECTURAL	ELECTRICAL	PLUMBING
CONCRETE	LIGHT FIXTURE	COLD WATER
WALL BOARD (GYPSUM)	FLOOR OUTLET	HOT WATER
FLEXIBLE INSULATION	CONVENIENCE OUTLET	WASTE LINE
STRUCTURAL MEMBER	SWITCH	CLEANOUT
NON-STRUCTURAL MEMBER	3-WAY SWITCH	GLOBE, HOSE
PLYWOOD	LIGHTING PANEL	SAFETY VALVE
SCREEN, (INSECT)	SAFETY SWITCH	ELBOW
GLASS	2-WIRE SYSTEM, W/G	TEE
	3-WIRE SYSTEM, W/G	GATE VALVE
	HOME RUN & CIRCUIT NO.	

MARINE CORPS ENGR. SCHOOL		
M.C.B. CAMP LEJEUNE, NORTH CAROLINA		
DRAWN BY R.L. BERGERON	INDEX SHEET	
CHECKED BY E.A.W.	TEST BUILDING NO. 1	
APPROVED BY		SCALE NONE
DATE 10 NOV 1970		DWG. NO. SC2-13 SHEET NO. 2 OF 17

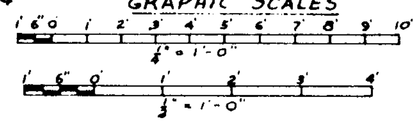
P-MCBCL 1144


UTIL STREET (PAVED)
SPECS ROAD (PAVED)
N 30°00'E
251.5'
S 30°00'W
251.5'
N 60°00'W
142.5'
S 60°00'E
142.5'
P.F.
P.S.
M.H.
CULVERT
3PH. 37.5 KVA
TRANSF., POLE MTD.
6" WATER MAIN
HYD.
CONC WALK
4" C.I. SEWER
TEST BUILDING
NO - 1
113.5'
35.5'
1" WATER LINE
PINES
PINES
B.M. - TOP OF PIPE
ELEV. 26.25'
GRAPHIC SCALE
0 10 20 30 40 50 60
1" = 30'
CONTOUR INTERVAL - 1'
NORTH
LEGEND & NOTES
BOUNDARY
WATER PIPES W
SEWER S
CULVERT
TELEPHONE LINES T
ELECTRIC LINES E
POLES
HYD. = HYDRANT
M.H. = MANHOLE
P.F. = IRON PIPE FOUND
P.S. = IRON PIPE SET
CONTOUR ELEV. 28
TREES
AREA - SQ FT. 35,853.75
MARINE CORPS ENGR. SCHOOL
M.C.B. CAMP LEJEUNE, NORTH CAROLINA
DRAWN BY R.L. BERGERON
CHECKED BY E.A.W.
APPROVED BY
DATE 10 NOV 1970
SITE PLAN
TEST BUILDING NO 1
SCALE 1" = 30'
DWG. NO. SC2-13
SHEET NO. 3 of 17
P-MCBCL 1144



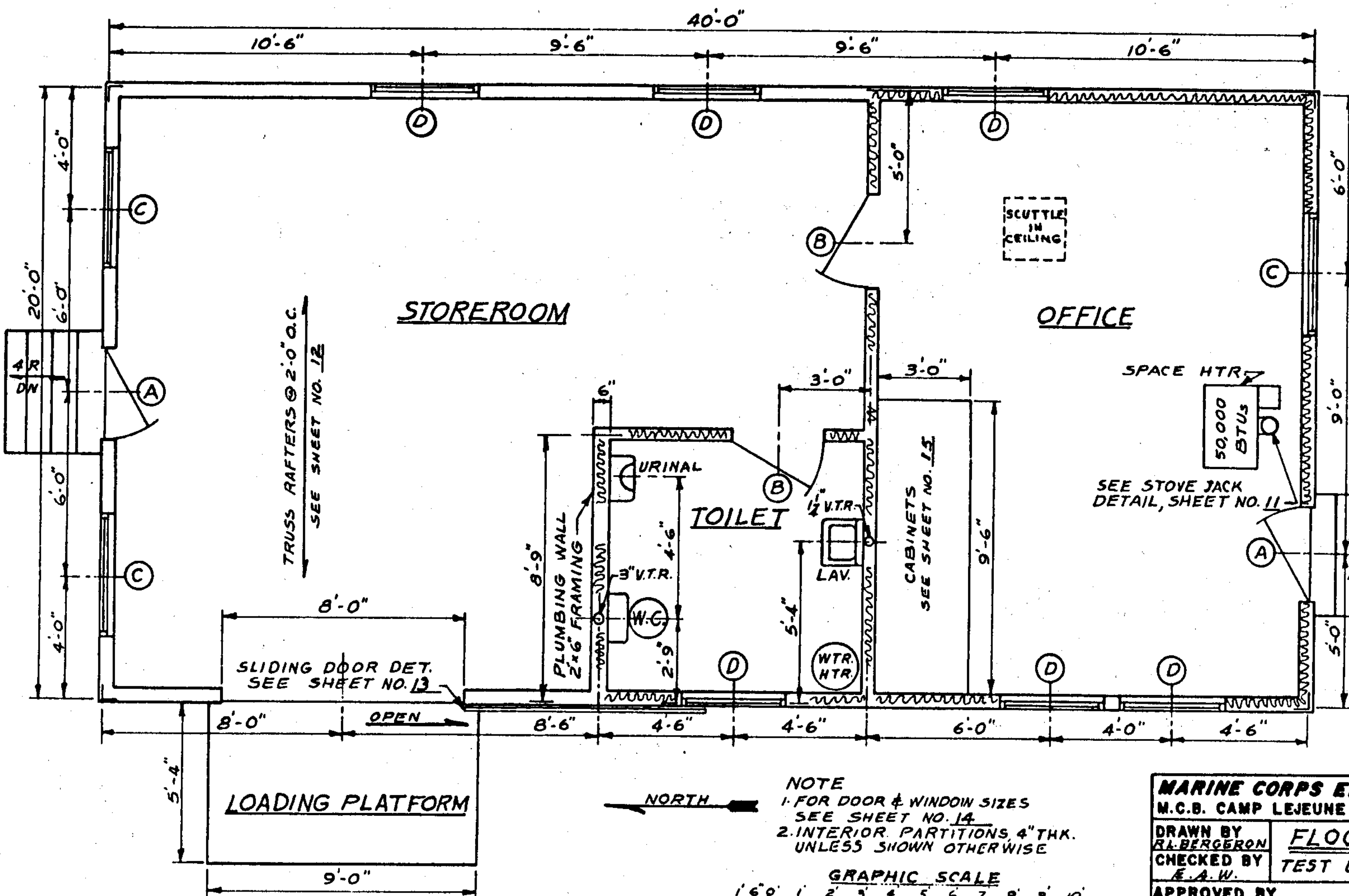
FOUNDATION PLAN
SCALE: 1/4"=1'-0"

GRAPHIC SCALES



MARINE CORPS ENGR. SCHOOL M.C.B. CAMP LEJEUNE, NORTH CAROLINA	
DRAWN BY R.L. BERGERON	FOUNDATION PLAN
CHECKED BY E.A.W.	TEST BUILDING NO. 1
APPROVED BY	SCALE AS SHOWN
DATE 10 NOV 1970	DWG. NO. SC2-13 SHEET NO. 4 of 17

P-MCBCL 1144

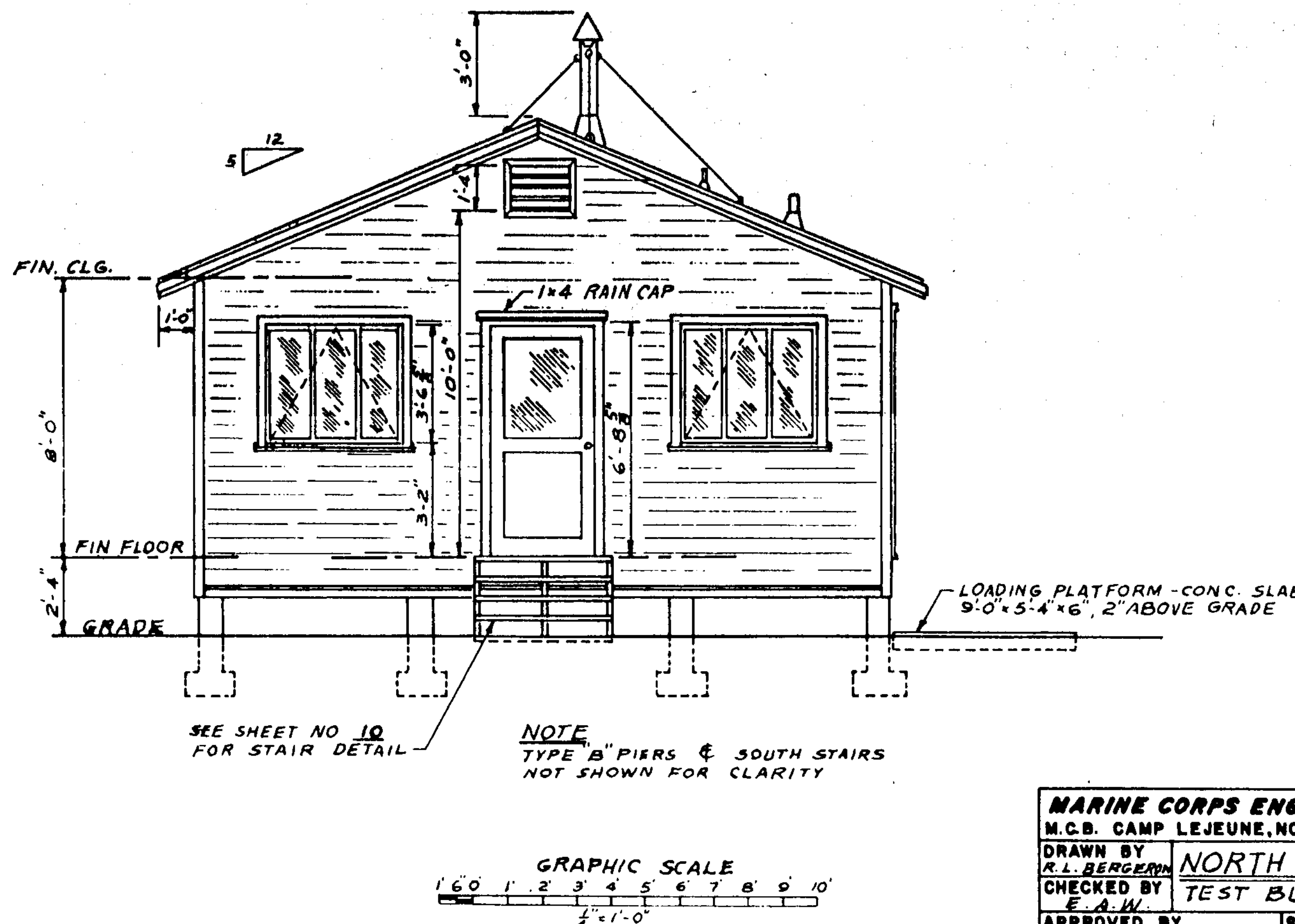


NOTE
1. FOR DOOR & WINDOW SIZES SEE SHEET NO. 14
2. INTERIOR PARTITIONS 4" THK. UNLESS SHOWN OTHERWISE

GRAPHIC SCALE
1'6" 0 1' 2' 3' 4' 5' 6' 7' 8' 9' 10'
1/4" = 1'-0"

MARINE CORPS ENGR. SCHOOL M.C.B. CAMP LEJEUNE, NORTH CAROLINA	
DRAWN BY R.L. BERGERON	FLOOR PLAN
CHECKED BY E.A.W.	TEST BUILDING NO. 1
APPROVED BY	SCALE 1/4" = 1'-0"
DATE 10 NOV 1970	DWG. NO. SC2-13 SHEET NO. 5 of 17

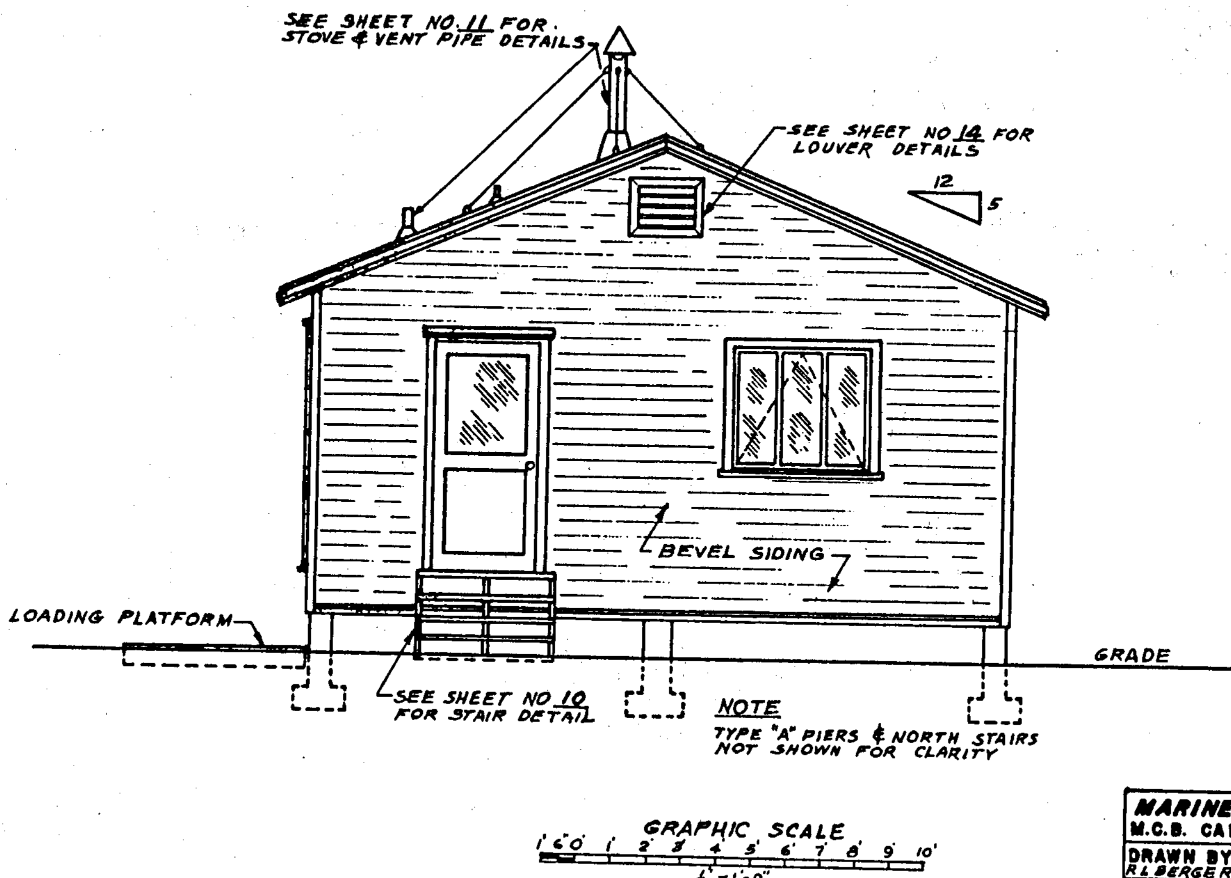
P-MCBCL 1144



MARINE CORPS ENGR. SCHOOL
M.C.B. CAMP LEJEUNE, NORTH CAROLINA

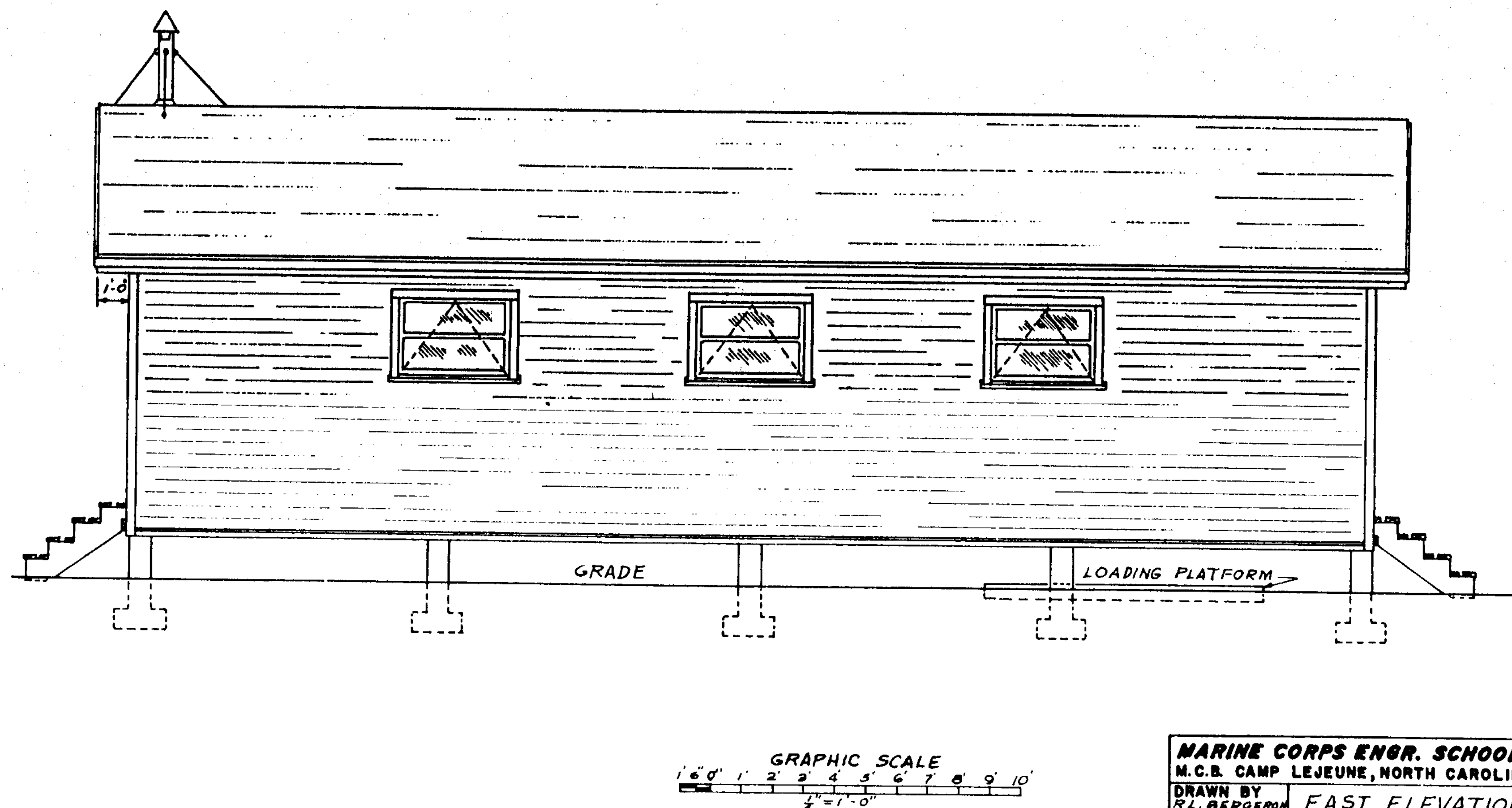
DRAWN BY R.L. BERGERON	NORTH ELEVATION		
CHECKED BY E.A.W.	TEST BUILDING NO 1		
APPROVED BY		SCALE 1/4" = 1'-0"	
DATE 10 NOV. 1970		DWG. NO. SC2-13 SHEET NO. 6 of 17	

P-MCBCL 1144



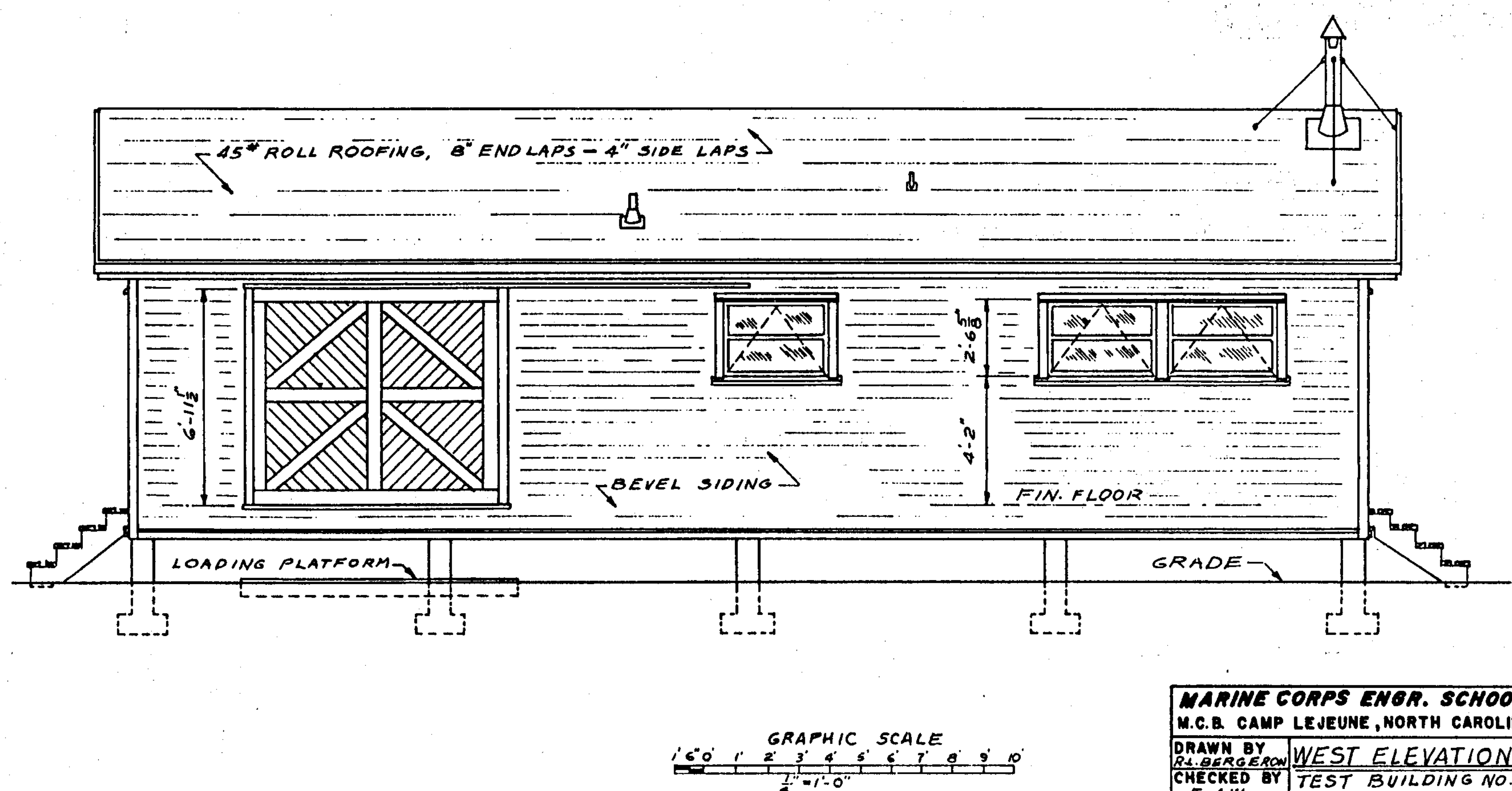
MARINE CORPS ENGR. SCHOOL M.C.B. CAMP LEJEUNE, NORTH CAROLINA	
DRAWN BY R.L. BERGERON	SOUTH ELEVATION
CHECKED BY E.A.W.	TEST BUILDING NO. 1
APPROVED BY	SCALE 1/4" = 1'-0"
DATE 10 NOV 1970	DWG. NO. SC2-13 SHEET NO. 7 OF 17

P-MCBCL 1144



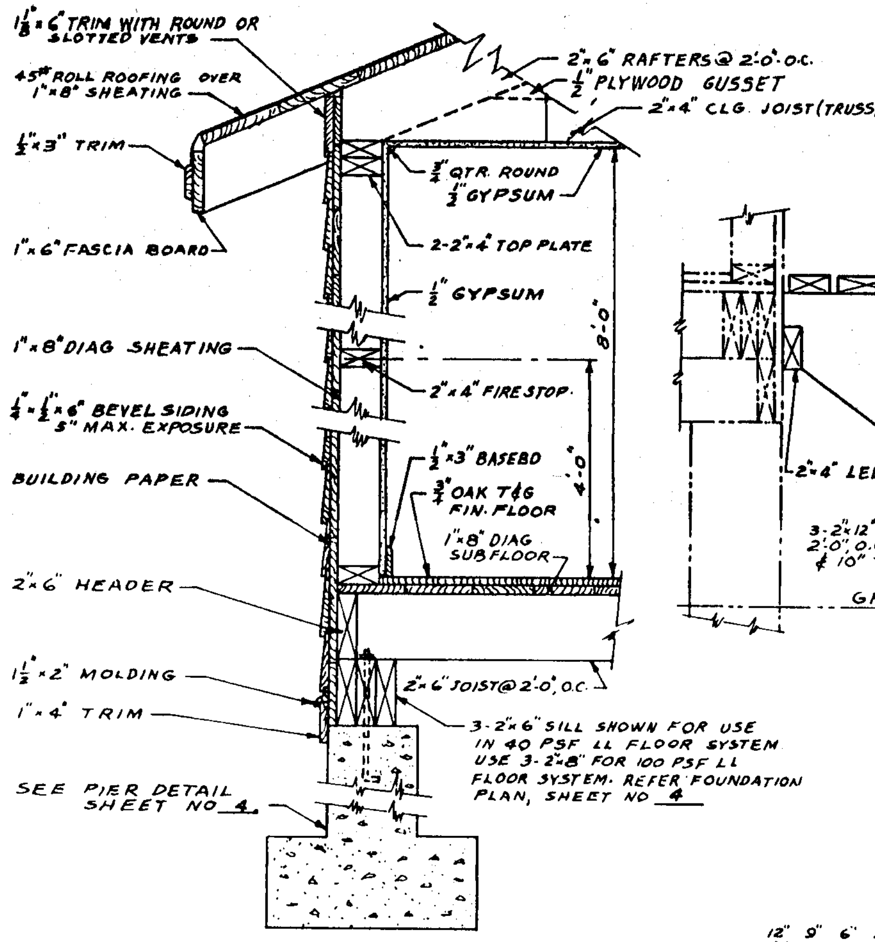
MARINE CORPS ENGR. SCHOOL M.C.B. CAMP LEJEUNE, NORTH CAROLINA	
DRAWN BY R.L. BERGERON	EAST ELEVATION
CHECKED BY E. A.W.	TEST BUILDING NO. 1
APPROVED BY	SCALE 1/4" = 1'-0"
DATE 10 NOV 1970	DWG. NO. SCE-13 SHEET NO. 8 OF 17

P-MCBCL 1144

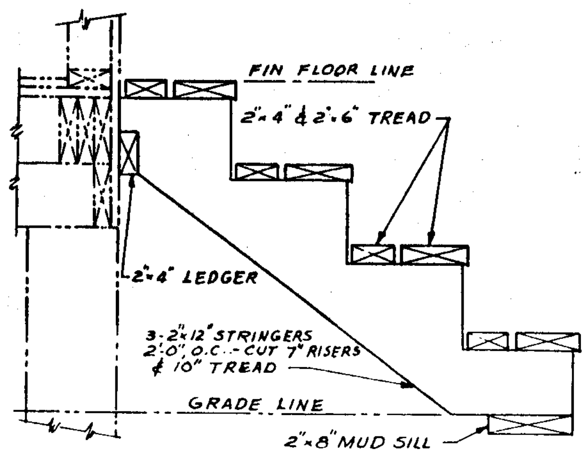


MARINE CORPS ENGR. SCHOOL M.C.B. CAMP LEJEUNE, NORTH CAROLINA	
DRAWN BY R.L. BERGERON	WEST ELEVATION
CHECKED BY E.A.W.	TEST BUILDING NO. 1
APPROVED BY	SCALE 1/4" = 1'-0"
DATE 10 NOV 1970	DWG. NO. SC2-13 SHEET NO. 9 of 17

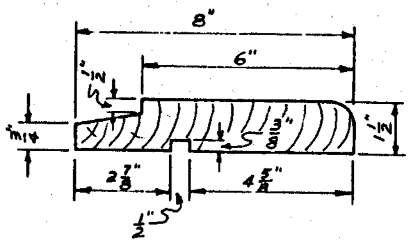
P-MCBCL 1144



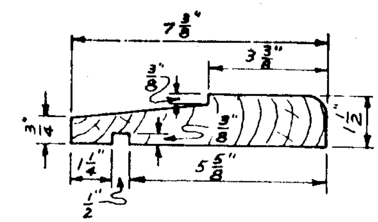
TYPICAL WALL SECTION
SCALE: 1" = 1'-0"



STAIR DETAIL
SCALE: 1" = 1'-0"

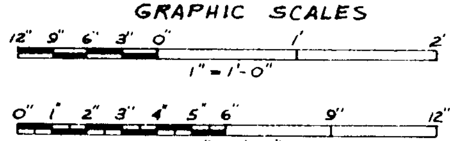


SLIDING DOOR
SILL DETAIL
SCALE: 3" = 1'-0"



SILL DETAIL
SCALE: 3" = 1'-0"

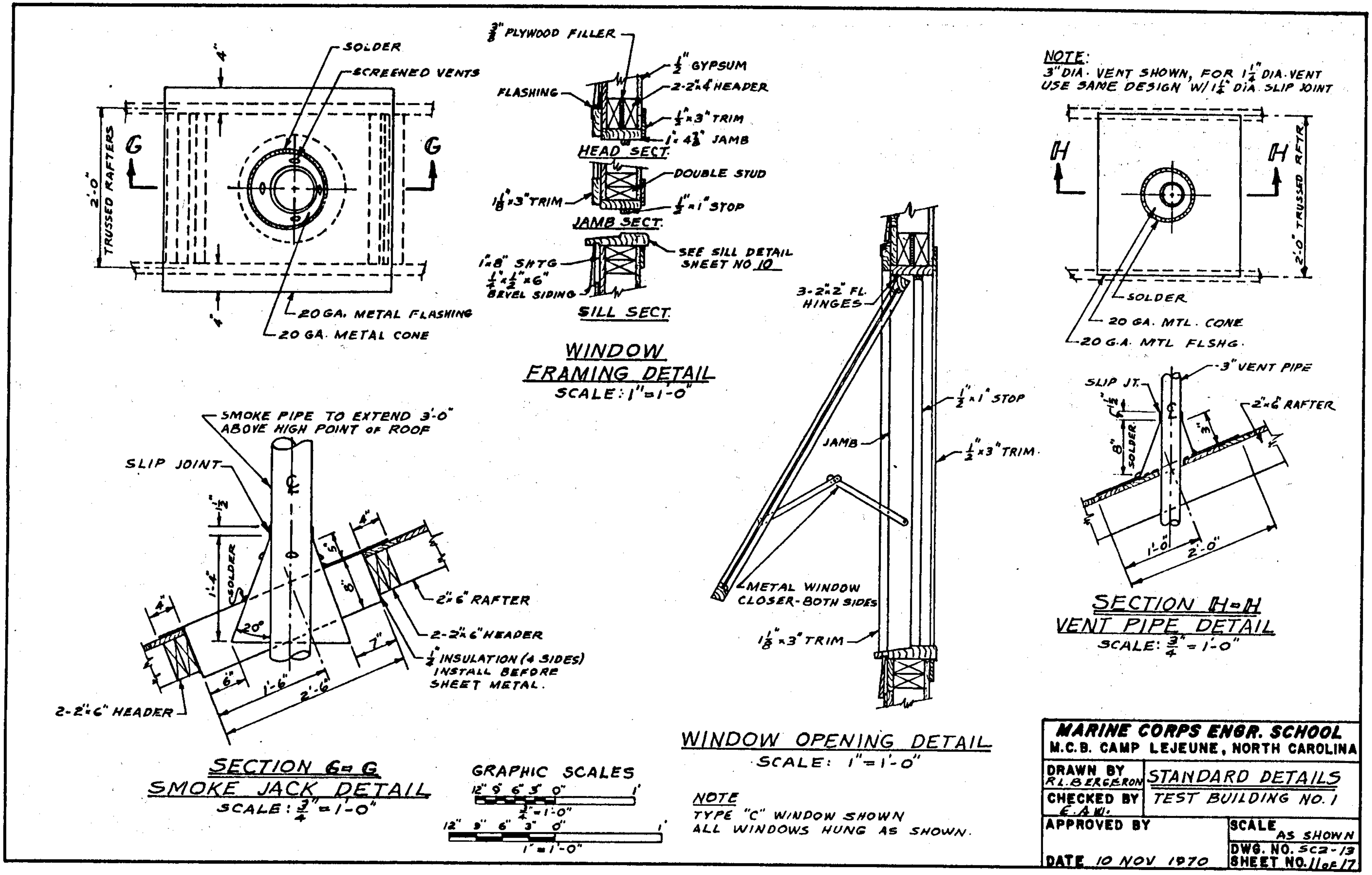
GRAPHIC SCALES

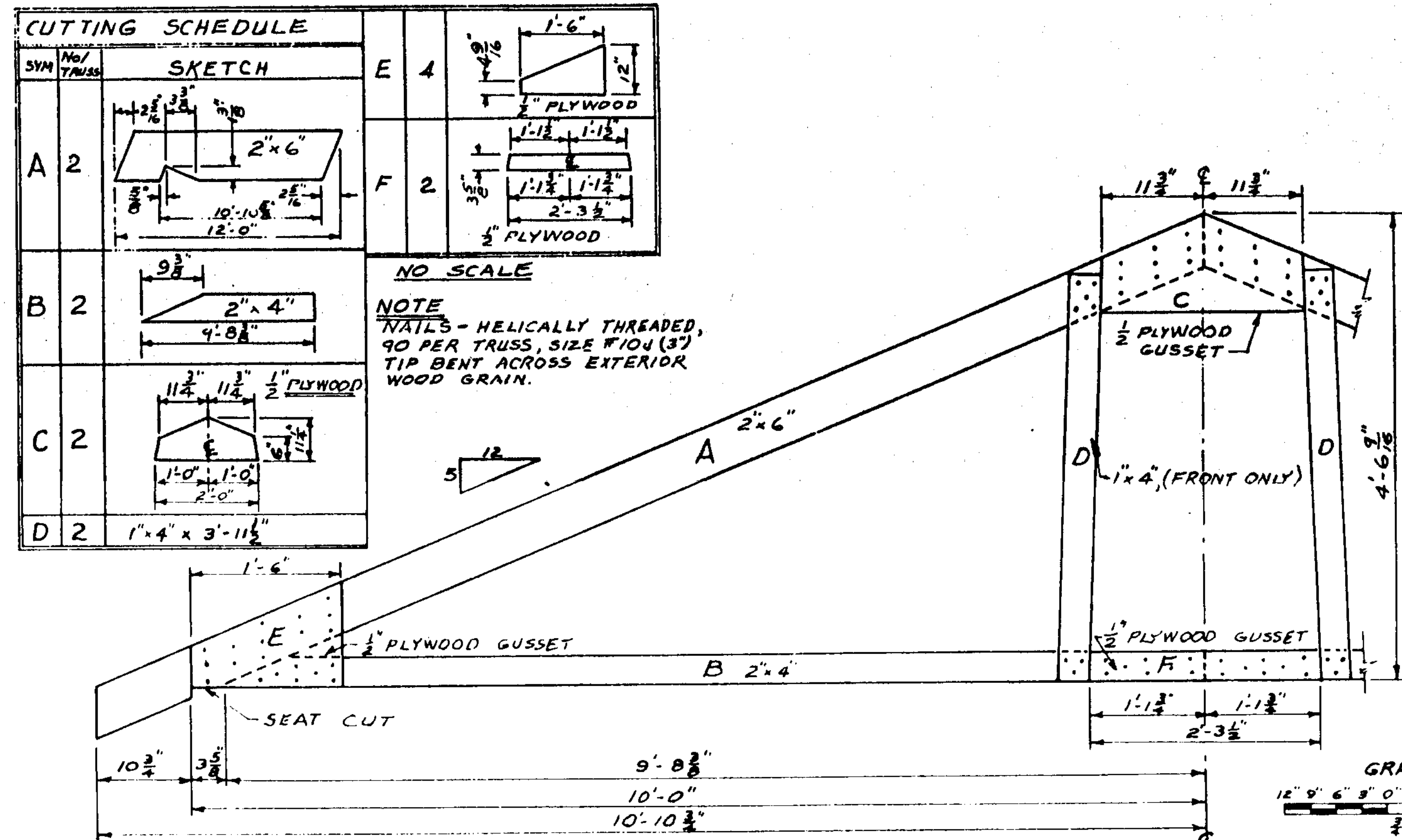


MARINE CORPS ENGR. SCHOOL
M.C.B. CAMP LEJEUNE, NORTH CAROLINA

DRAWN BY R. L. BERGERON	STANDARD DETAILS
CHECKED BY E. A. W.	TEST BUILDING NO. 1
APPROVED BY	SCALE AS SHOWN
DATE 10 NOV 1970	DWG. NO. SC2-13 SHEET NO. 10 OF 17

P-MCBCL 1144


SOLDER
SCREENED VENTS
2'-0" TRUSSED RAFTERS
G
4"
20 GA. METAL FLASHING
20 GA. METAL CONE
3/8" PLYWOOD FILLER
FLASHING
1/2" GYPSUM
2-2"x4" HEADER
1/2"x3" TRIM
1"x4 3/8" JAMB
HEAD SECT.
DOUBLE STUD
1 1/8"x3" TRIM
1/2"x1" STOP
JAMB SECT.
SEE SILL DETAIL SHEET NO 10
1"x8" SHTG
1/4"x1/2"x6" BEVEL SIDING
SILL SECT.
WINDOW FRAMING DETAIL
SCALE: 1"=1'-0"
NOTE:
3" DIA. VENT SHOWN, FOR 1 1/4" DIA. VENT USE SAME DESIGN W/1 1/4" DIA. SLIP JOINT
H
2'-0" TRUSSED RFTR.
SOLDER
20 GA. MTL. CONE
20 G.A. MTL FLSHG.
SMOKE PIPE TO EXTEND 3'-0" ABOVE HIGH POINT of ROOF
SLIP JOINT
SOLDER
1'-4"
20°
4"
5"
8"
7"
6"
1'-6"
2'-6"
2"x6" RAFTER
2-2"x6" HEADER
1/2" INSULATION (4 SIDES) INSTALL BEFORE SHEET METAL.
2-2"x6" HEADER
SECTION G-G
SMOKE JACK DETAIL
SCALE: 3/4"=1'-0"
GRAPHIC SCALES
12" 9" 6" 3" 0" 1'
3/4"=1'-0"
12" 9" 6" 3" 0" 1'
1"=1'-0"
3-2"x2" FL. HINGES
JAMB
1/2"x1" STOP
1/2"x3" TRIM
METAL WINDOW CLOSER-BOTH SIDES
1 1/8"x3" TRIM
WINDOW OPENING DETAIL
SCALE: 1"=1'-0"
NOTE
TYPE "C" WINDOW SHOWN
ALL WINDOWS HUNG AS SHOWN.
3" VENT PIPE
SLIP JT.
SOLDER
8"
3"
2"x6" RAFTER
1'-0"
2'-0"
SECTION H-H
VENT PIPE DETAIL
SCALE: 3/4"=1'-0"
MARINE CORPS ENGR. SCHOOL
M.C.B. CAMP LEJEUNE, NORTH CAROLINA
DRAWN BY R.L.BERGERON
STANDARD DETAILS
CHECKED BY E.A.W.
TEST BUILDING NO. 1
APPROVED BY
SCALE AS SHOWN
DWG. NO. SC2-13
SHEET NO. 11 of 17
DATE 10 NOV 1970
P-MCBCL 1144



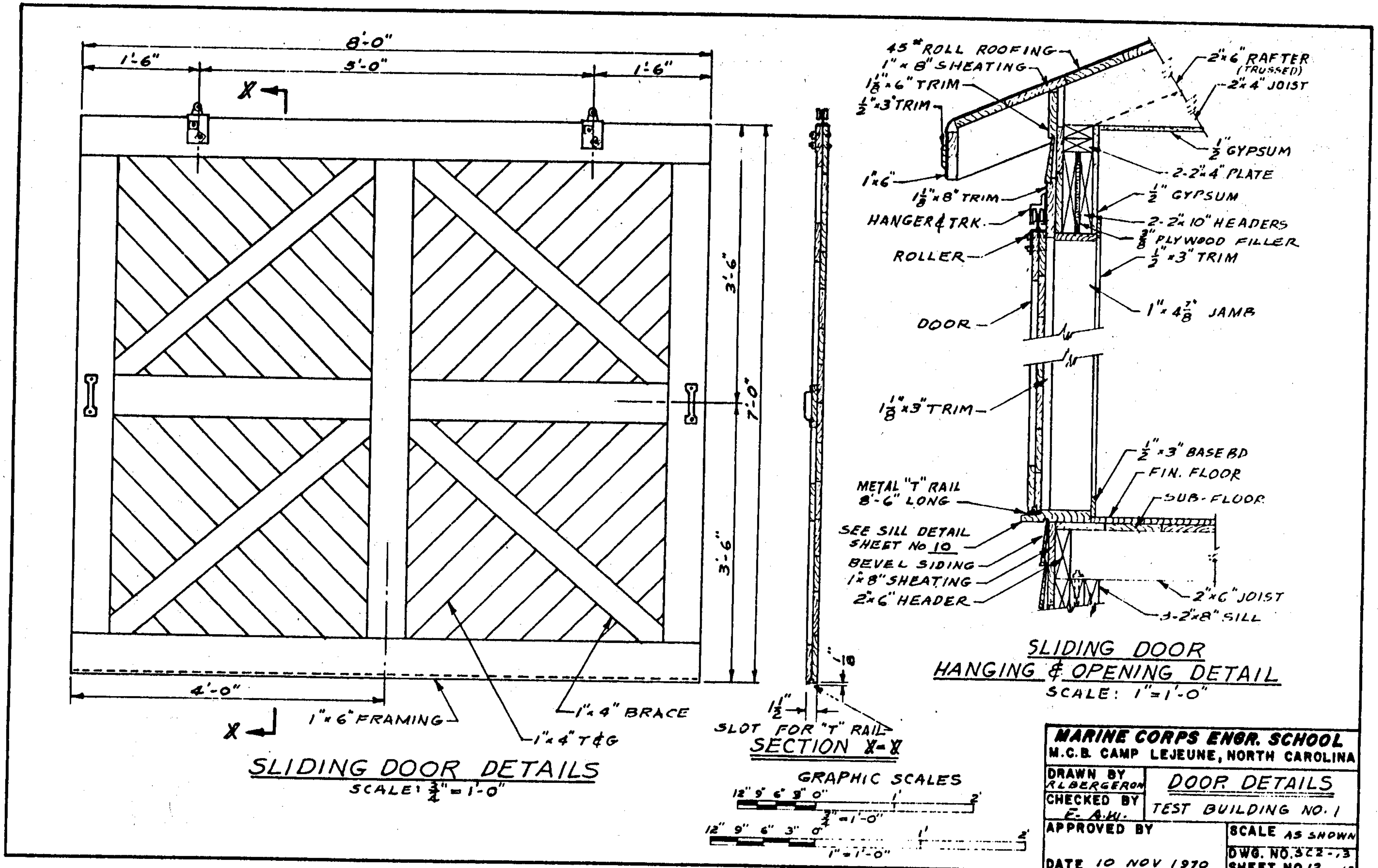
SPECIFICATIONS

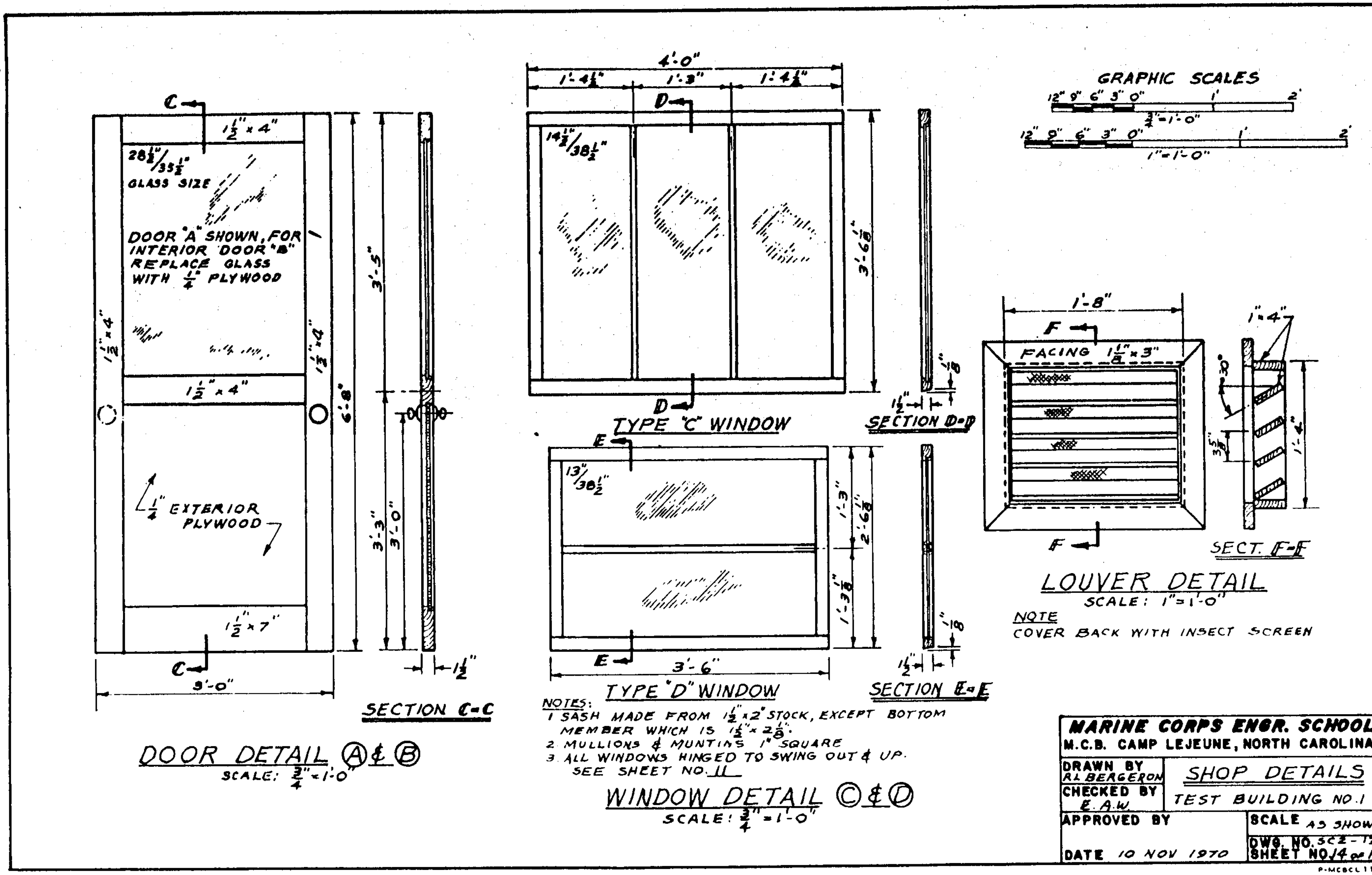
1. TRUSSED RAFTERS, SPACED 2'-0" O.C., 19 REQUIRED, FOR GABLE ENDS, USE 2"x4" STUD FRAMING FROM TOP PLATE TO 2"x6" RAFTER.
2. LUMBER - No. 1 S.Y. PINE OR DOUGLAS FIR.
3. ALL GUSSETS - 1/2" PLYWOOD.

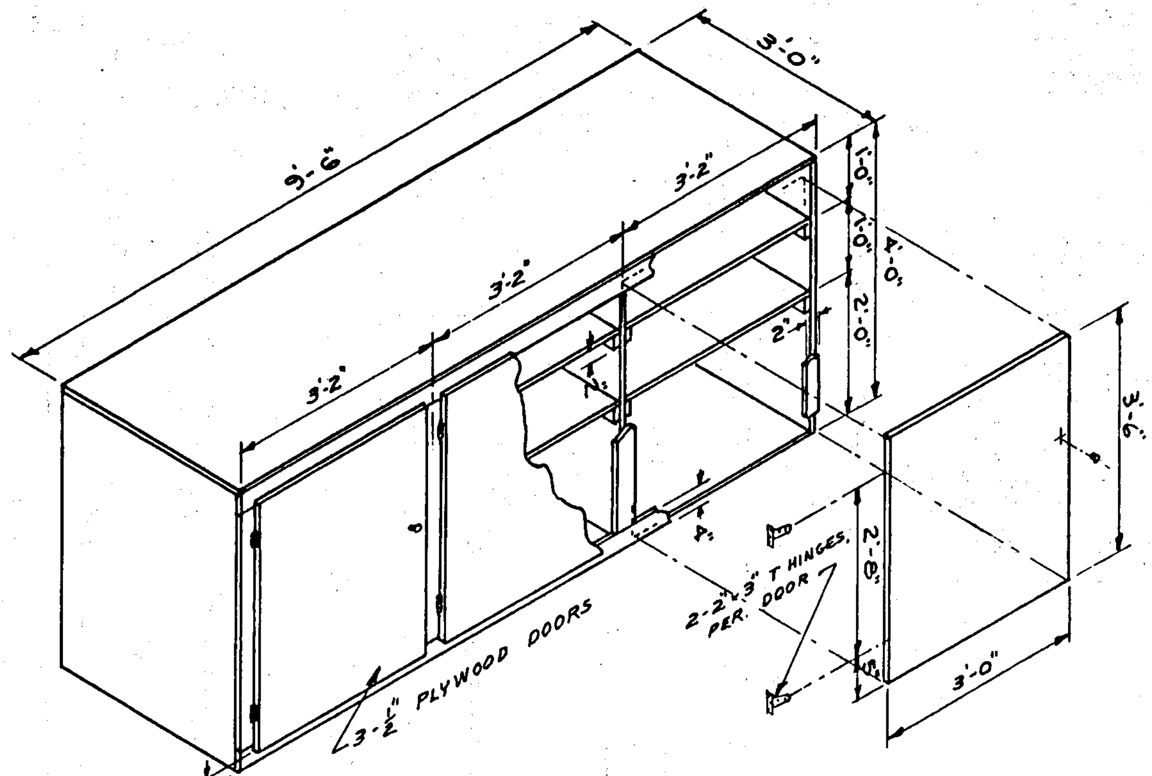
MARINE CORPS ENGR. SCHOOL
M.C.B. CAMP LEJEUNE NORTH CAROLINA

DRAWN BY R.L. BERGERON	TRUSS DETAIL
CHECKED BY E.A.W.	TEST BUILDING NO. 1
APPROVED BY	SCALE 3/4" = 1'-0"
DATE 10 NOV 1970	DWG. NO. SC2-13 SHEET NO. 12 of 17

P-MCBCL 1144


8'-0"
1'-6"
5'-0"
1'-6"
3'-6"
7'-0"
3'-6"
4'-0"
X
1"x6" FRAMING
1"x4" T&G
1"x4" BRACE
SLIDING DOOR DETAILS
SCALE: 3/4"=1'-0"
1 1/2"
10
SLOT FOR "T" RAIL
SECTION X-X
45# ROLL ROOFING
1"x8" SHEATING
1 1/8"x6" TRIM
1/2"x3" TRIM
1"x6"
1 1/8"x8" TRIM
HANGER & TRK.
ROLLER
DOOR
1 1/8"x3" TRIM
METAL "T" RAIL 8'-6" LONG
SEE SILL DETAIL SHEET No 10
BEVEL SIDING
1"x8" SHEATING
2"x6" HEADER
2"x6" RAFTER (TRUSSED)
2"x4" JOIST
1/2" GYPSUM
2-2"x4" PLATE
1/2" GYPSUM
2-2"x10" HEADERS
3/8" PLYWOOD FILLER
1/2"x3" TRIM
1"x4 7/8" JAMB
1/2"x3" BASE BD
FIN. FLOOR
SUB-FLOOR
2"x6" JOIST
3-2"x8" SILL
SLIDING DOOR
HANGING & OPENING DETAIL
SCALE: 1"=1'-0"
GRAPHIC SCALES
12" 9" 6" 3" 0" 1' 2'
3/4"=1'-0"
12" 9" 6" 3" 0" 1' 2'
1"=1'-0"
MARINE CORPS ENGR. SCHOOL
M.C.B. CAMP LEJEUNE, NORTH CAROLINA
DRAWN BY R.L.BERGERON
CHECKED BY E.A.W.
DOOR DETAILS
TEST BUILDING NO. 1
APPROVED BY
DATE 10 NOV 1970
SCALE AS SHOWN
DWG. NO. 322-13
SHEET NO. 13 OF 17


DOOR DETAIL Ⓐ & Ⓑ
SCALE: 3/4" = 1'-0"
C
1 1/2" x 4"
28 1/2"/35 1/2" GLASS SIZE
DOOR "A" SHOWN, FOR INTERIOR DOOR "B" REPLACE GLASS WITH 1/4" PLYWOOD
1 1/2" x 4"
1/4" EXTERIOR PLYWOOD
1 1/2" x 7"
3'-0"
6'-8"
3'-5"
3'-3"
3'-0"
1 1/2"
SECTION C-C
4'-0"
1'-4 1/2"
1'-3"
1'-4 1/2"
D
14 1/2"/38 1/2"
3'-6 1/8"
TYPE "C" WINDOW
SECTION D-D
E
13"/38 1/2"
1'-3"
1'-3 1/8"
2'-6 1/8"
3'-6"
TYPE "D" WINDOW
SECTION E-E
NOTES:
1 SASH MADE FROM 1 1/2" x 2" STOCK, EXCEPT BOTTOM MEMBER WHICH IS 1 1/2" x 2 5/8".
2 MULLIONS & MUNTINS 1" SQUARE
3 ALL WINDOWS HINGED TO SWING OUT & UP. SEE SHEET NO. 11
WINDOW DETAIL Ⓒ & Ⓓ
SCALE: 3/4" = 1'-0"
GRAPHIC SCALES
12" 9" 6" 3" 0" 1' 2'
3/4" = 1'-0"
1" = 1'-0"
1'-8"
F
FACING 1 1/8" x 3"
1" x 4"
30°
3 5/8"
1'-4"
SECT. F-F
LOUVER DETAIL
SCALE: 1" = 1'-0"
NOTE
COVER BACK WITH INSECT SCREEN
MARINE CORPS ENGR. SCHOOL
M.C.B. CAMP LEJEUNE, NORTH CAROLINA
DRAWN BY R.L. BERGERON
CHECKED BY E.A.W.
SHOP DETAILS
TEST BUILDING NO. 1
APPROVED BY
SCALE AS SHOWN
DATE 10 NOV 1970
DWG. NO. 5C2-13
SHEET NO. 14 of 17
P-MCBCL 1144



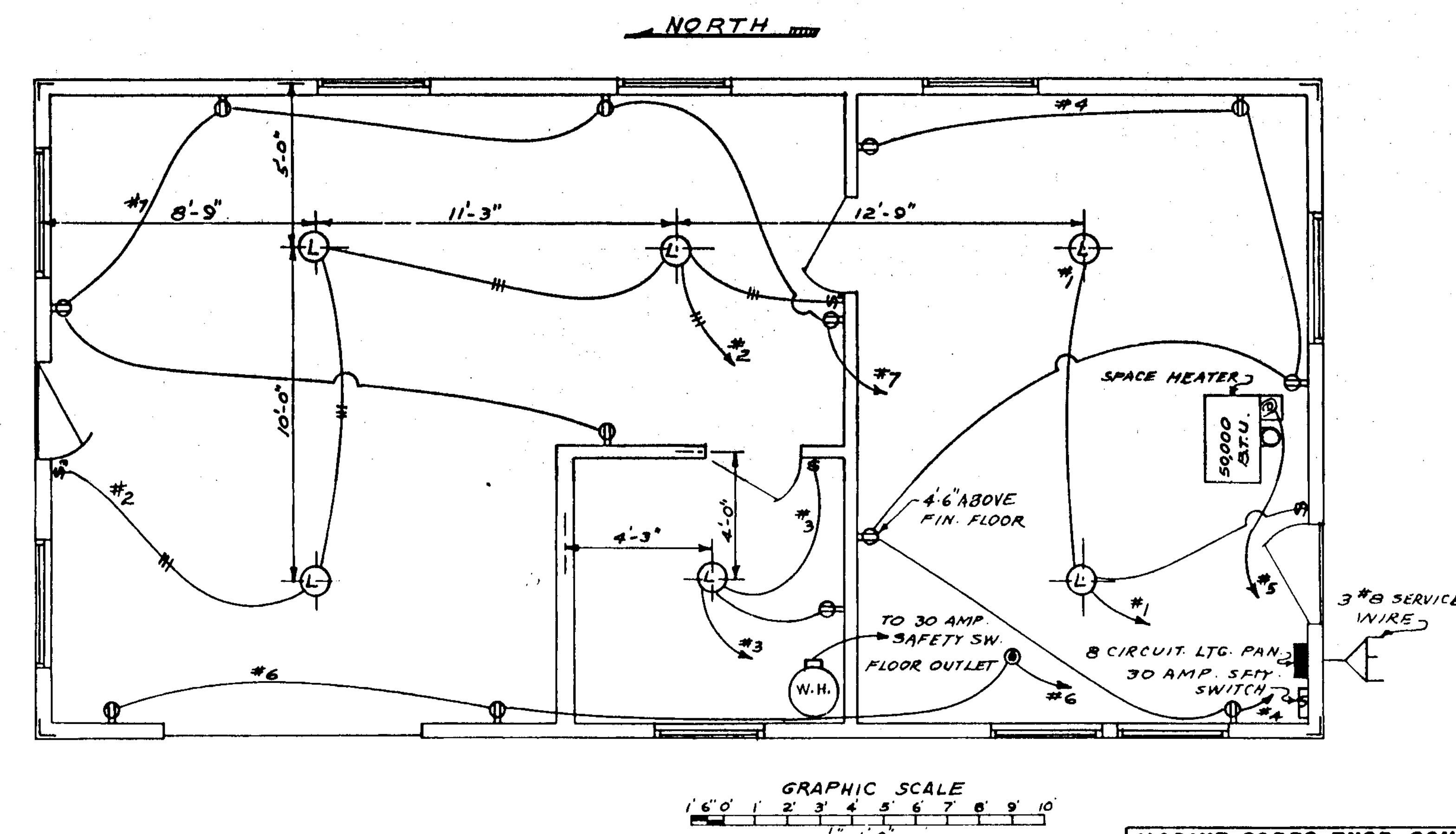
ENTIRE CABINET CONSTRUCTED OF
$\frac{3}{4}$" PLYWOOD, EXCEPT DOORS.

ISOMETRIC
EXPLODED VIEW

GRAPHIC SCALE
1' 6" 0' 1' 2' 3' 4'
$\frac{1}{2}$" = 1'-0

MARINE CORPS ENGR. SCHOOL	
M.C.B. CAMP LEJEUNE, NORTH CAROLINA	
DRAWN BY R.L. BERGERON	CABINET DETAILS
CHECKED BY E.A.W.	TEST BUILDING NO. 1
APPROVED BY	SCALE $\frac{1}{2}$" = 1'-0"
DATE 10 NOV 1970	DWG. NO SC2-13 SHEET NO. 15 OF 17

P-MCBCL 1144



WIRING

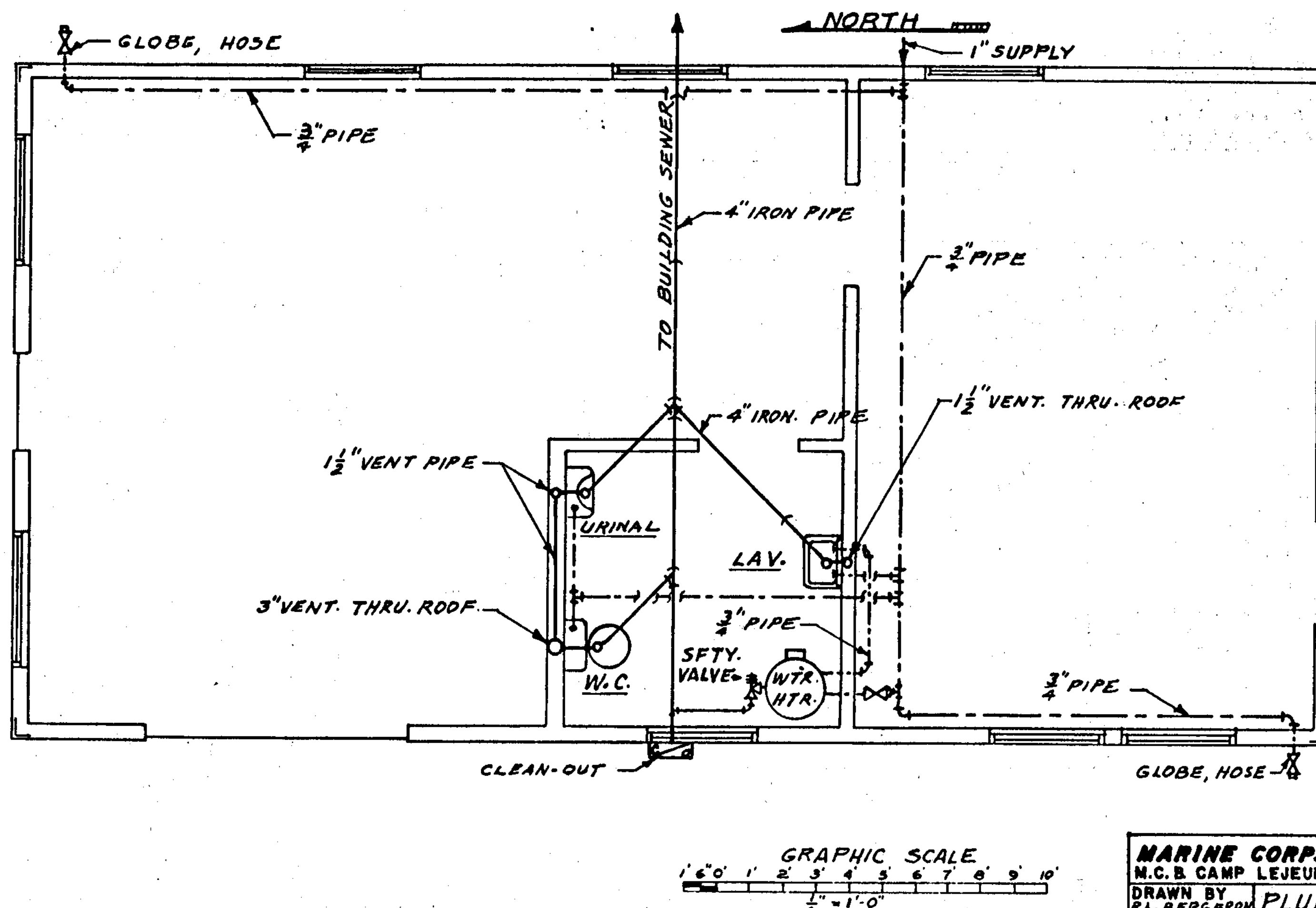
1. INTERIOR WIRING TO BE #12/2 WITH GROUND, SHEATED CABLE
2. HOT WATER HTR TO BE #10/2, W/G

NOTES

1. CONVENIENCE OUTLETS TO BE LOCATED 12" ABOVE FINISHED FLOOR.
2. SWITCHES, (LIGHTS) LOCATED 4'-0" ABOVE FINISHED FLOOR.

MARINE CORPS ENGR. SCHOOL M.C.B. CAMP LEJEUNE, NORTH CAROLINA	
DRAWN BY R.L. BERGERON	ELECTRICAL PLAN
CHECKED BY F.A.W.	TEST BUILDING NO. 1
APPROVED BY	SCALE 1/4" = 1'-0"
DATE 10 NOV 1970	DWG. NO. SC2-13 SHEET NO. 16 of 17

P-MCBCL 1144



MARINE CORPS ENGR. SCHOOL M.C.B. CAMP LEJEUNE, NORTH CAROLINA	
DRAWN BY R.L. BERGERON	PLUMBING PLAN
CHECKED BY E.A.W.	TEST BUILDING NO. 1
APPROVED BY	SCALE $\frac{1}{4}$" = 1'-0"
DATE 10 NOV 1970	DWG. NO. SC2-13 SHEET NO. 17 OF 17

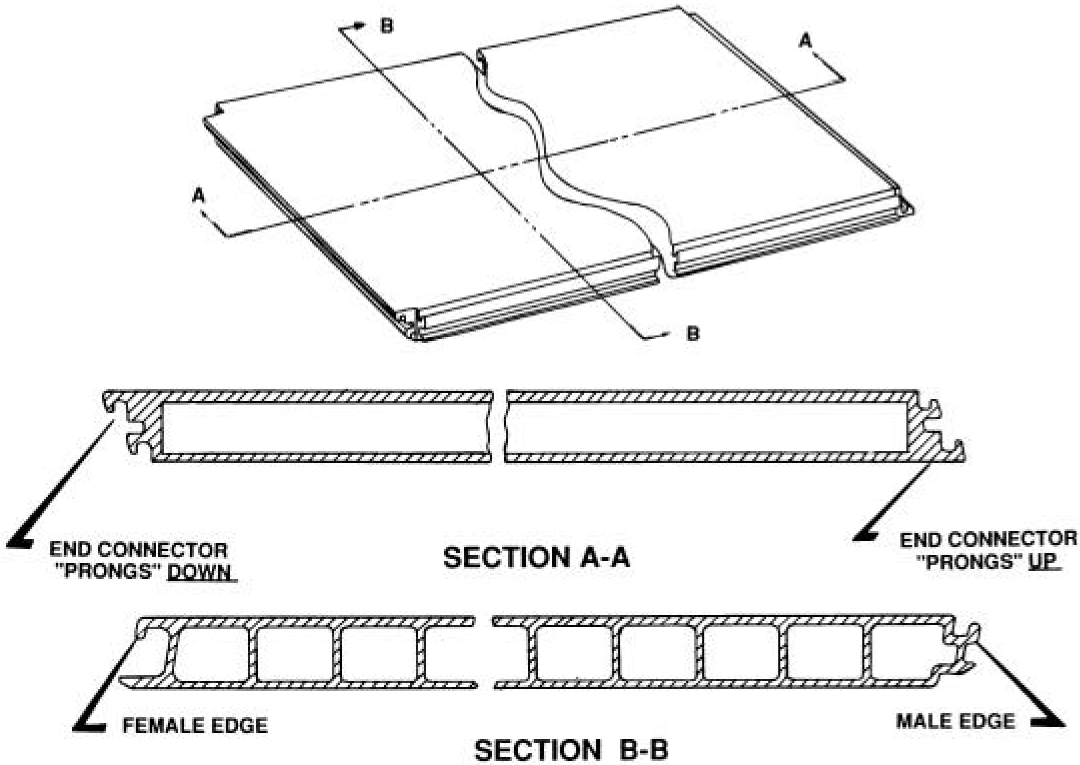
P-MCBCL 1144

REFERENCE TEXT

AM-2 AIRFIELD LANDING MAT AND ACCESSORIES

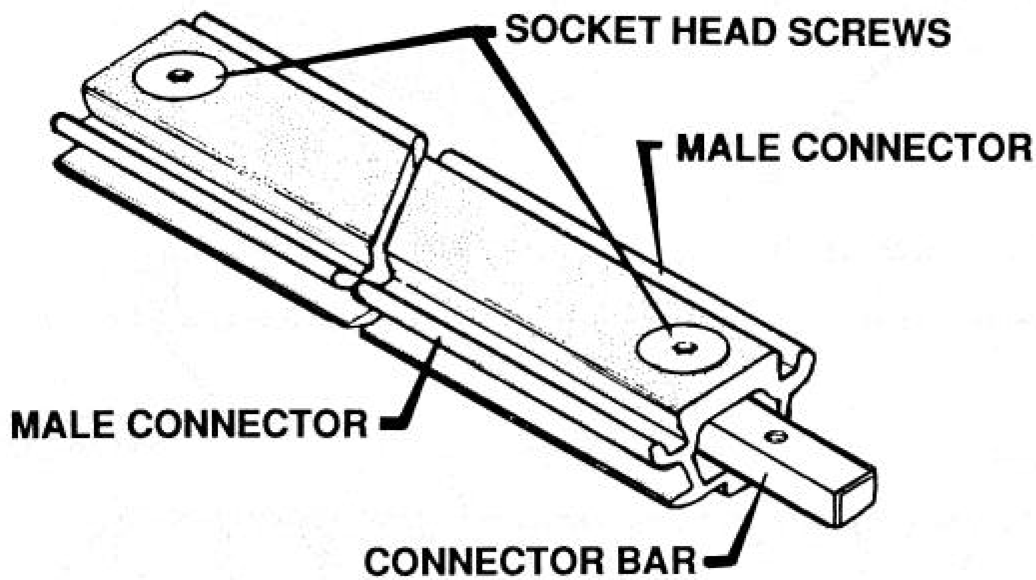
MARINE CORPS ENGINEER SCHOOL
MARINE CORPS BASE
CAMP LEJEUNE, NORTH CAROLINA

<u>AM - 2 MAT</u>



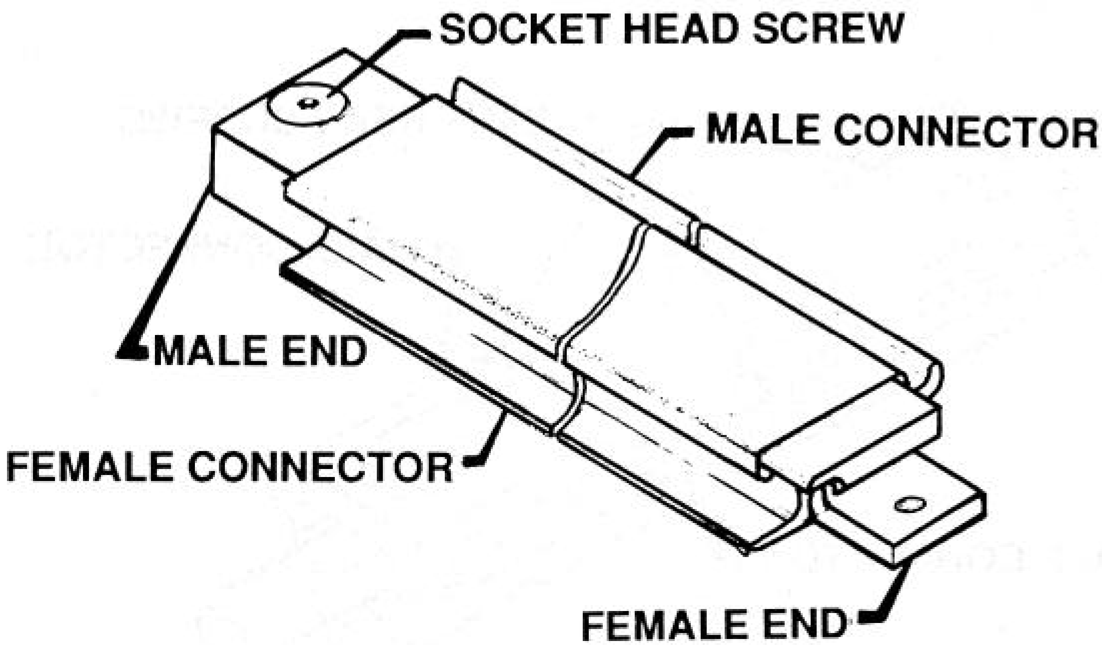
(1) Weight (Full length mat) 144 lbs	
(2) Weight (half length mat)	77 lbs
(3) Length (full mat)	12 ft
(4) Length (half mat)	6 ft
(5) Width (full & half)	2 ft

STARTER KEYLOCK



1. A starter keylock is a very narrow mat used to decrease surface Instillation time by approximately ½. Previous mat instillation methods required assembling the runway at one end, and working to the other. The starter keylock is installed in the middle of the intended surface, and enables two mat laying teams to start together and work simultaneously toward each end. Starter key locks are available in 3 foot, 9 foot, and 12-foot lengths for providing staggering joints in matting patterns. The starter keylock is coated with a non-skid surface. The starter keylock has male edges on both sides of the matting piece.

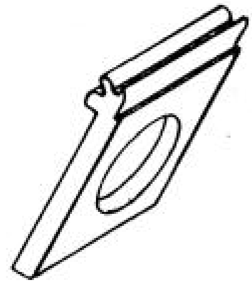
TYPICAL KEYLOCK



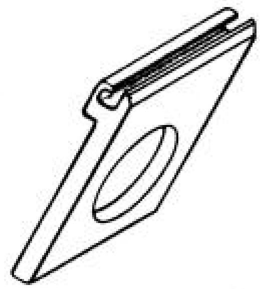
1. A typical keylock is inserted every 100 feet in the pattern to permit the easy removal of sections of mat for repair or replacement.

2. Typical key locks are available in 3 foot, 9 foot, and 12 foot lengths to provide staggering of the joints of matting patterns. The typical keylock is coated with a non-skid material. Typical key locks have a male edge, and a female edge, and are inserted just as a full of half mat section.

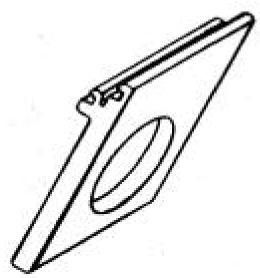
EDGE CLAMPS AND STAKES



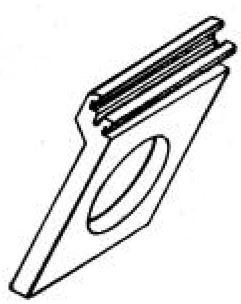
Type I. Edge clamp anchors female edge of mat.



Type II Edge clamp anchors male edge of mat.

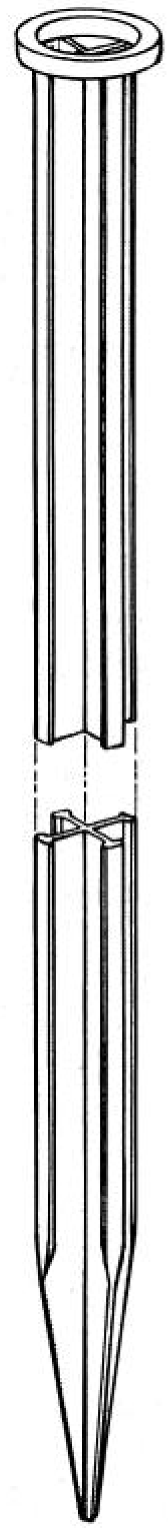


Type III Edge clamp anchors down-turned edge of mat.

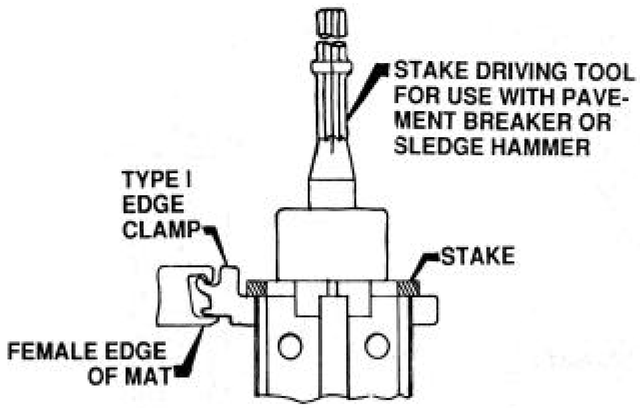


Type IV Edge clamp anchors up-turned edge of mat.

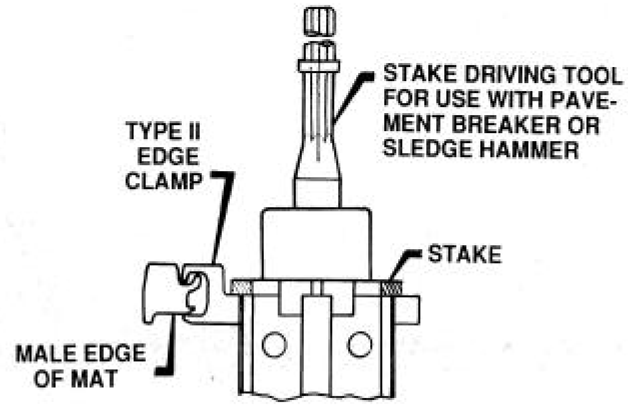
NOTE: Short locking bars are used to secure type III, and type IV edge clamps to the matting.



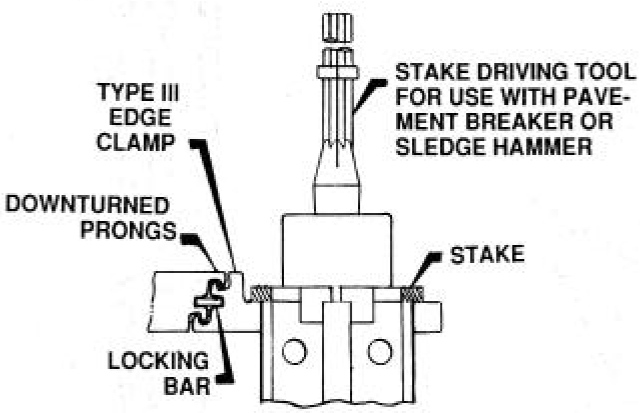
STAKE



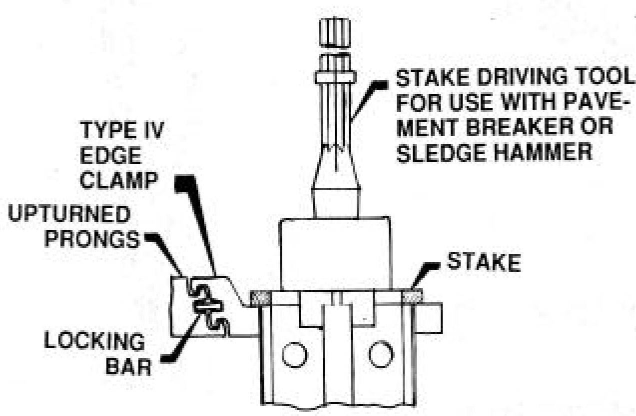
ANCHORING FEMALE MAT EDGE USING TYPE I EDGE CLAMP

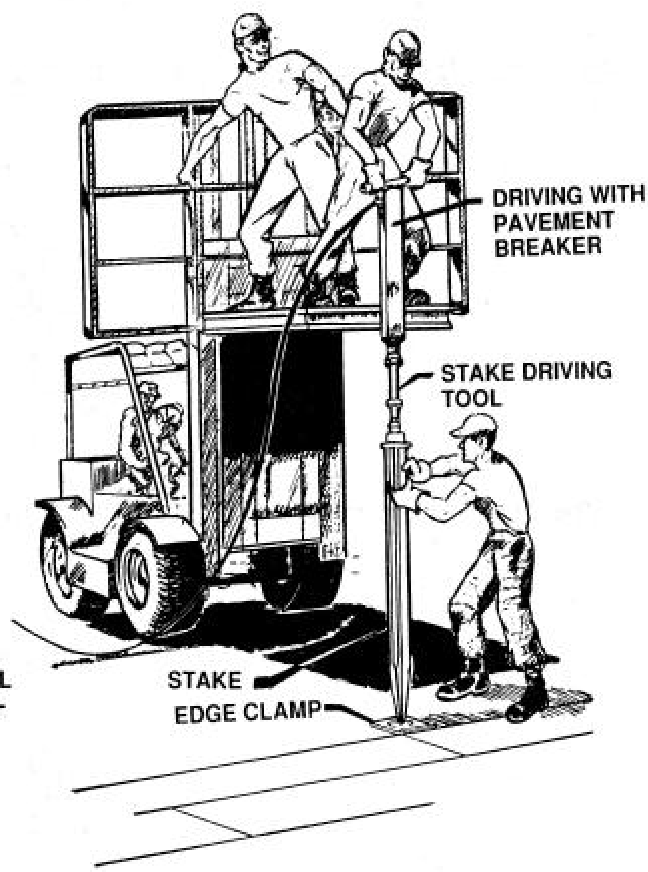


ANCHORING MALE MAT EDGE USING TYPEII EDGE CLAMP



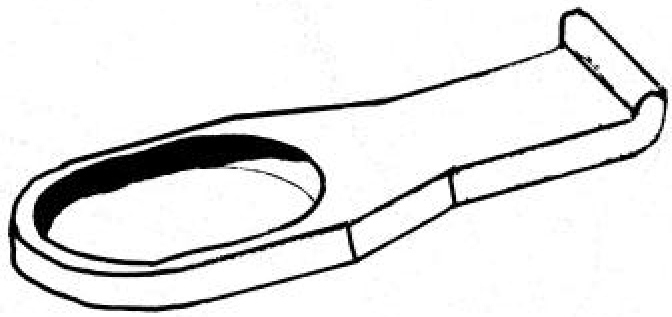
ANCHORING EDGE WITH DOWNTURNED PRONGS USING TYPE III EDGE CLAMP

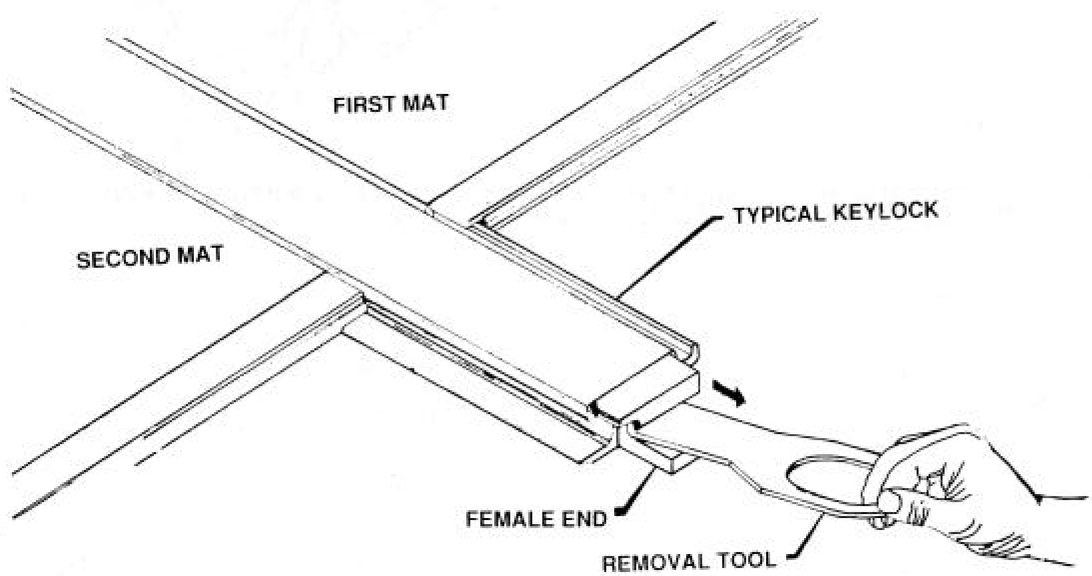




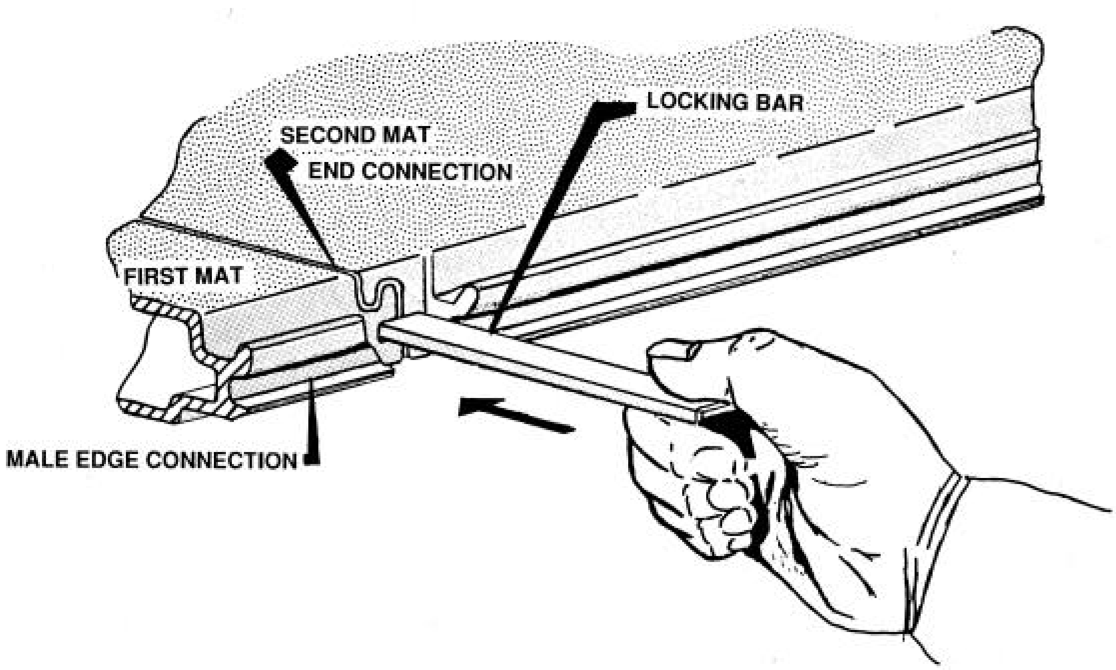
ANCHORING EDGE WITH UPTURNED PRONGS USING TYPE IV EDGE CLAMP

TYPICAL KEYLOCK REMOVAL TOOL





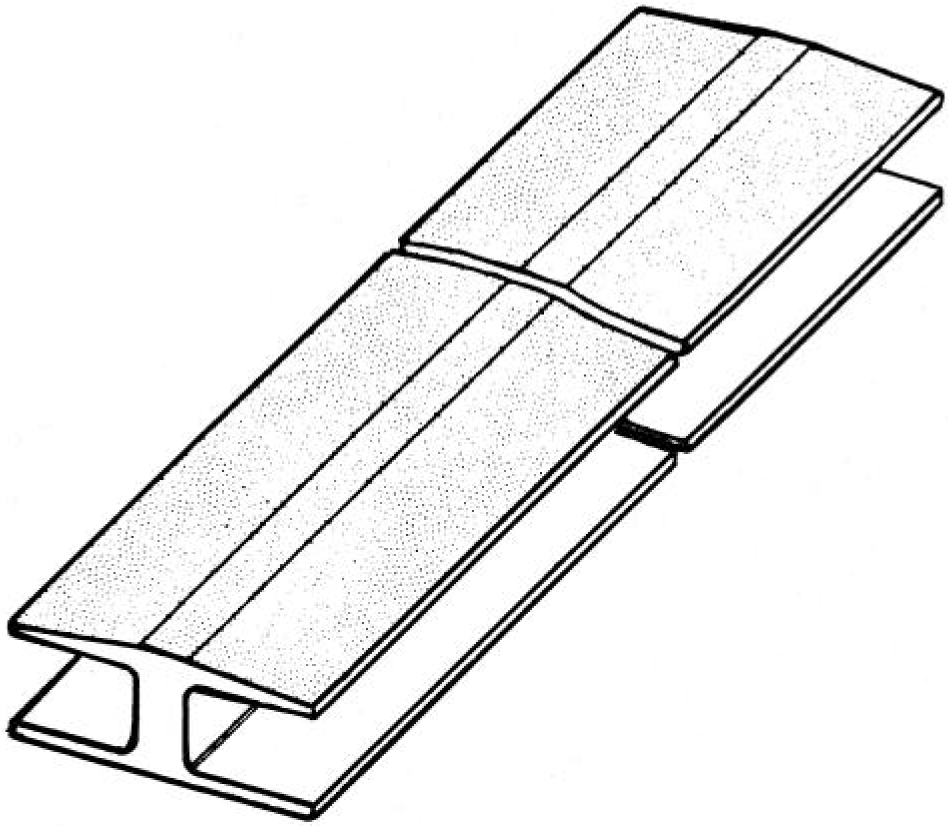
LOCKING BAR



1. Locking bars are used to join sections of AM-2 matting. Locking bars must be inserted into each adjoining matting section.

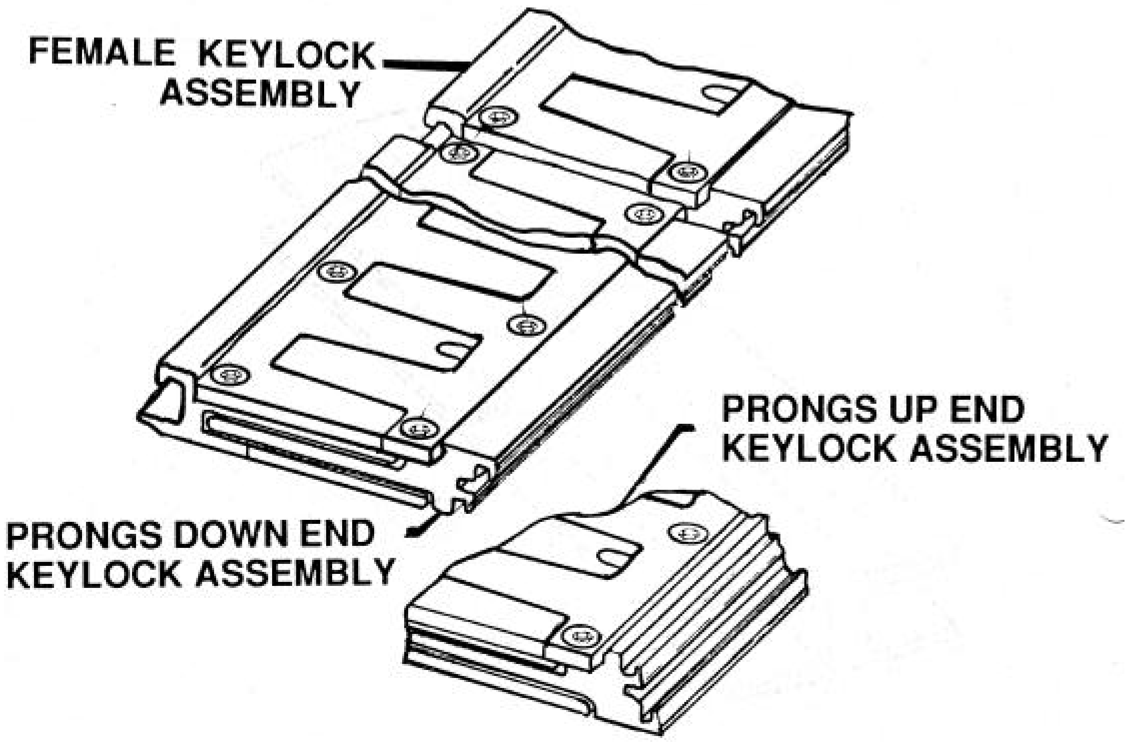
Length	24 inches
Width	5/8 inches
Thickness	3/16 inches

90 DEGREE CONNECTOR (H –TYPE)



1. The 90 degree connector is used to join two matting patterns that are adjacent at a 90-degree angle such as the runway and taxiway. It is also used to join additional matting or ramps to the ends of the runway where a catapult guide rail is installed. Connectors are 12 feet long aluminum “H” sections which allow relative movement and slight misalignment between the adjoining sections of matting.

ADJUSTABLE 90 DEGREE CONNECTOR



1. The adjustable 90-degree connector is used to join two matting patterns that are adjacent to each other at a 90-degree angle, such as the main runway and a taxiway. This connector is also used to join additional matting or mat end ramps to the ends of the runway where a catapult guide rail is installed. Connectors are 12 feet long, aluminum sections, which can be adjusted in width from 6 ½ inches to 9 ½ inches to facilitate the joining of two adjacent matting sections.

DEMOLITION ORDER
SERIAL NO_______

COPY NO____OF___

From____________
____
(Authorized Commander)

1. Demolition Guard Commander
2. Demolition Firing Party Commander
3. Retained by the Authorized Commander
4. ____________________________________

PART I

1. Demolition Target Details:

a. Description ____

b. Location (grid coordinate) _____________________________________

c. Target nickname, number or codeword ____________________________
(All orders are to be prefixed by target identifying nickname, number or code word.)

d. Technical Instructions ____

2. Executing Units:

a. Demolition Guard ____

b. Demolition firing party ____

3. Orders to the demolition commander

a. the demolition target is to be prepared to State of Readiness ___________________ by:____________DTG

b. ☐ All other orders will be issued to you by the Demolition Guard commander. Record their receipt in Part II

c. ☐ There is no Demolition Guard. You are to act as instructed in paras 5,6, & 7, recording the orders received in Part II.

(Only one box is to be crossed)

4. Orders to the Demolition Guard Commander

Your responsibilities are detailed in para iv. You are to act as instructed in paras 5, 6, & 7, recording the orders received in Part II.

5. Demolition is to be fired:

a. ☐ Immediately upon being prepared.

b. ☐ Upon receipt of codeword in para 8c by radio.

c. ☐ Upon receipt of the order from the Authorized Commander or his Liaison Officer personally.

d. ☐ (Other orders) ____

6. Emergency Firing Orders

a. ☐ You will not fire the demolition except as ordered in para 5.

b. ☐ You will fire the demolition on your own initiative if the enemy is in the act of capturing it.

(Only one box is to be crossed)

7. Orders other than for firing will be given:

a. ☐ By the Authorized Commander personnally

b. ☐ By the Authorized Commander's Liaison Officer personally.

c. ☐ By radio.

d. ☐ (other means)

8. Codewords

Action to be taken	Codeword
a. Change from State 1 (SAFE) to State 2 (ARMED)	
b. Change from State 2 (ARMED) to State 1 (SAFE)	
c. Fire the demolition now.	
d. Para 3b cancelled, para 3c applies.	
e. Para 3c cancelled, para 3b applies.	
f. Para 5c cancelled, para 5b applies.	
g. The Authorized Commander is changed to ______________________________________	
h. ______________________________________	
i. ______________________________________	

9. Authorized Commander

Signature ________________________ Rank/Name __________________________

Appointment _____________________ Date/Time Group ____________________

PART II

10. Changing State of Readiness:

a. Time estimated by Firing Party Commander to change from State or Readiness 1 (SAFE) to State of Readiness 2 (ARMED) is ________minutes.

b.

State of Readiness Ordered	Originator	Date/Time Group of:	
		Receipt of Order	Change Completed

11. Handover and Takeover of Demolition Target:

	Rank, Name and Unit	Signature	Date/Time Group of
Transferring Commander			
Accepting Commander			

12. Record of Other Changes to Part I (if any)

Detail	Date/Time of Receipt

13. FIRE THE DEMOLITION NOW

Signed ____

(Rank, Name, Unit) ____

(Date/Time Group) ____

(or enter date/time group of receipt of codeword in para 8c)

PART III

14. Demolition Report

a. Bridge

Estimated width of gap __________

No. of spans down ______________

b. Road/Runway/Railway

No. of craters ____________

Diameter/Depth ____________

c. Other target ____

d. Mines Laid: _________ AT mines ____________ AP mines ____________

Sketch

Signature _______________________ Rank/Name/Unit ______________________

NATO-CONFIDENTIAL on completion		+ NATO-RESTRICTED
OTAN-CONFIDENTIEL une fois remplie		+ DIFFUSION
VS-VERTRAULICH AMTLICH GEHEIMGEHALTEN		+ VS-NUR FUR DEN DIENSTGEBRAUCH
nach Ausfullen		Ab AlarmmaBnahme

OBSTACLE FOLDER
CARNET D'OBSTACLE
SPERHEFT

Type of obstacle		
Type d'obstacle		
Art der Sperre		

CLASS	CATEGORIE	DRINGLICHKEIT
1. ++ Preliminary 2. ++ Reserved	1. ++ Preliminaire 2. ++ Demanoeuvre (1)	1. ++ Sofort-Massnahme 2. ++ Reserviet

Serial number								Target no.					
Numero d'ordre								Dispositif No.					
Laufende Nummer								Objektnummer					

COPY NO.	EXEMPLAIRE NO.	Ausfertigung

NOTE Anmerkung

\+ When blank
Si laisse en blanc
Wenn unausgefullt

++ Strike out item not applicable
Rayer la mention inutile
Nicht zutreffendes streichen

(1) Delete the term NOT used
Barrer la mention NON utilisee

NATO-CONFIDENTIAL on completion
OTAN-CONFIDENTIEL une fois remplie
VS-VERTRAULICH AMTLICH GEHEIMGEHALTEN
nach Ausfullen

(1) Photograph of Target Photographie de l'ouvrage Fotografie des Sperrobjekts

DESCRIPTION	DESCRIPTION	BESCHREIBUNG

Indicate direction of view | Indiquer direction de prise de vue | Richtung, aus der das Objekt gesehen wurde einzeichnen

MAP NAME AND SCALE	NOM ET ECHELLE DE LA CARTE	KARTENBEZEICHUNG UND MAS-STAB

GRID REFERENCE OF TARGET	COORDONNEES DU DISPOSITIF	KOORDINATEN DES OBJEKTS

NATO-CONFIDENTIAL on completion
OTAN-CONFIDENTIEL une fois remplie
VS-VERTRAULICH AMTILICH GEHEIMGEHALTEN
nach Ausfullen

(1a) LOCATION OF TARGET AND PRESTOCK POINT	EMPLACEMENT DU DISPOSITIF ET DU CENTRE DE RATTACHEMENT (PRESTOCKAGE)	LAGE DES OBJEKTS UND MUNITIONS-LAGERPLATZ

Map of scale 1:250,00 showing target and prestock point and route between them.

Indicate nearest telephone/pick up point (if any) into the AUTOKO network (Corps trunk communications system).

SCALE	ECHELLE	MABSTAB
	1: ……………………..	

Page 4 Annex A, STANAG 2123 is Blank

NATO-CONFIDENTIAL on completion
OTAN-CONFIDENTIEL une fois remplie
VS-VERTRAULICH AMTILICH GEHEIMGEHALTEN
nach Ausfullen

(1B) LOCATION OF TARGET	EMPLACEMENT DU DISPOSITIF	LAGA DES OBJEKTS

(Map of scale 1:50,000 showin target and adjacent targets)

SCALE	ECHELLE	MABSTAB
1: ………………..		

NATO-CONFIDENTIAL on completion
OTAN-CONFIDENTIEL une fois remplie
VS-VERTRAULICH AMTILICH GEHEIMGEHALTEN
nach Ausfullen

(2) SUPPLY OF EXPLOSIVE AND STORES FOR TARGET	APPROVISIONNEMENT DU CHANTIER DU DISPOSITIF	VERSORGUNG MIT SPRENG UND ZUNDMITTELN SO-WIE GREAT FUR DAS OBJEKT
1 - PRESTOCK POINT	CENTRE DE RATTACHEMENT (PRESTOCAGE)	MUNITIONSLAGERPLATZ

NAME	NOM	NAME

LOCATION: See maps Pages 3, 5, 7	EMPLACEMENT: Voir cartes pages 3, 5, 7	LAGE: Siehe Karten Seite 3, 5, 7
2 - TRANSPORT REQUIRED	VEHICULES NECESSAIRES	ERFORDERLICHER TRANSPORTRAUM

NUMBER / NOMBRE / ANZAHL …………………………		
TRUCKS OF	CAMIONS de	LKW je
……………………. TONS / TONNES / TONNEN		

3 – ROUTE: See maps pages 3, 5, 7	ITINERAIRE: Voir cartes pages 3, 5, 7	WEG: Siehe Karten Seite 3, 5, 7
4 – Approximate travel DISTANCE from Prestock Point to Target:	DISTANCE approximative entre centre de rattachement (prestockage) et dispositif:	Ungefaehre ENTFERNUNG vom Munitionslagerplatz zum Objekt.

……………………….. Km

5 – Explosives and stores required: See page 12, 13, 14, 15	Explosifs et materiels necessaires: Voir page 12, 13, 14, 15	Erforderliche Sprengmittel u. Gerat: Siehe Seite 12, 13, 14, 15
6 - Storage location of additional barrier material	Lieu de stockage des accessories de mise en oeuvre supplementaires	Lagerort zusatzlicher Sperrmittel

MAP NAME AND SCALE	NOM ET ECHELLE DE LA CARTE	KARTENBEZEICHNUNG UND MASS-STAB

GRID REFERENCE	COORDONNEES	KOORDINATEN

NATO-CONFIDENTIAL on completion
OTAN-CONFIDENTIEL une fois remplie
VS-VERTRAULICH AMTILICH GEHEIMGEHALTEN
nach Ausfullen

(2a) LOCATION OF PRESTOCK POINT	EMPLACEMENT DU DEPOT DE MUNIION	LAGE DES MUNITIONS LAGERPLATZES

(Map of scale 1:50,000 showing location and route.)

SCALE	ECHELLE	MABSTAB
	1:…………………………..	

NATO-CONFIDENTIAL on completion
OTAN-CONFIDENTIEL une fois remplie
VS-VERTRAULICH AMTILICH GEHEIMGEHALTEN
nach Ausfullen

(2b) LAYOUT PLAN OF PRESTOCK POINT	PLAN DU DEPOT DE MUNITION	LAGE DES MUNITIONS LAGERPLATZES

(Sketch (scale about 1:50,000 showing entrance, route, storehouses (igloos) in which explosives and materials are stocked, etc..)

SCALE	ECHELLE	MABSTAB
	1:…………………………..	

NATO-CONFIDENTIAL on completion
OTAN-CONFIDENTIEL une fois remplie
VS-VERTRAULICH AMTILICH GEHEIMGEHALTEN
nach Ausfullen

(2c)

Instructions for opening ammunition storage vault door
Directives pour l'ouverture de la porte du depot de munitions
Anweisung fur das Offnen der Sperrmittelhaustur

NATO-CONFIDENTIAL on completion
OTAN-CONFIDENTIEL une fois remplie
VS-VERTRAULICH AMTILICH GEHEIMGEHALTEN
nach Ausfullen

(2c)

Instructions for opening ammunition storage vault door
Directives pour l'ouverture de la porte du depot de munitions
Anweisung fur das Offnen der Sperrmittelhaustur

NATO-CONFIDENTIAL on completion
OTAN-CONFIDENTIEL une fois remplie
VS-VERTRAULICH AMTILICH GEHEIMGEHALTEN
nach Ausfullen

Key for ammunition storage facility
Clefs pour la soute de munitions
Schlussel fur das Munitionslagerhaus

The bearer of this document is authorized to enter the ammunition site and pick up from Bunker No. …………. The barrier material for target No. …………….
Le titulaire du present document est habilite a acceder au lieu de stockage des munitions et aprendedans la soute no. ………… les accessoires necessaires a la mise ouevre de l'obstacle no. …………..
Der Inhaber dieses Dokuments ist berechtigt den Sperrmittellagerort zu betreten und aus dem Bunker Nr. ………… das Sperrmaterial fur die Sperre Nr. ………. zu entnehmen.

If the keys are not kept in this obstacle folder their location is to be marked clearly here:
Si les cles ne seront pas conservees dans le present carnet d'obstacles, indiquer ci-apres l'endriot de conservation exact:
Werden die Schlussei aurbewahrt ist der genaue Ort hier anzugeben:

NATO-CONFIDENTIAL on completion
OTAN-CONFIDENTIEL une fois remplie
VS-VERTRAULICH AMTILICH GEHEIMGEHALTEN
nach Ausfullen

(2d) EXPLOSIVES, STORES, MINES REQUIRED	EXPLOSIFS, MATERIELS, MINES NECESSAIRES	BEDARF AN SPRENG UND ZUNDMITTELN GERAT, MINEN

TARGET NO.	DISPOSITIF NO.	OBJEKT NR.

PRESTOCK POINT	DEPOT DU MUNITION	MUNITIONS - LAGERPLATZ

	ITEM (English)	DESIGNATION (Francais)	ART (Deutsch)	Menge Amount Quanite	Total Wt Poins total Gesamtgewich
(1)	(2)	(3)	(4)	(5)	(6) (Kg)
1	EXPLOSIVES	EXPLOSIFS	SPRENGMITTEL		
A	Cratering charges	Expl. Progressifs	Trichter sprengladungen		
B	High explosives	Expl. Brisants	Pi-Sprengmittel Brisanzspreng		
C	Plastic explosives	Plastique	Sprengmasse formbar		
D	Shaped charges	Charges Creuses	Hohlladungen		
E	Cutting charges	Charges coup.	Schneidladungen		
2	ACCESSORIES	ARTIFICES	ZUNDMITTEL		
A	Safety fuze	Meche Lente	Anzundschnur		
B	Detonating cord	Cordeau Detonant	Sprengschnur		
C	Non electric detonators	Detonateurs pyro technique	Sprengkapseln		
D	Electric detonators	Detonateurs electrique	Sprengkapseln elektrisch		
E	Prime cap	Detonateur D'amorce	Sprengkapsel-zunder		
F	Booster cap	Renforcateur	Sprengschnurkapsel		
G	Blasting Machines (exploder)	Exsploseur	Zundmaschine		
H	Cable electric (2 wire)	Fil electrique (2 fils)	Zundkabel (zweiadrig)		

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VS-VERTRAULICH AMTILICH GEHEIMGEHALTEN
nach Ausfullen

	ITEM (English)	DESIGNATION (Francais)	ART (Deutsch)	Menge Amount Quanite	Total Wt Poins total Gesamtgewich
(1)	(2)	(3)	(4)	(5)	(6) (Kg)
3	TOOLE	OUTILLAGE	WERKZEUG		
A	Quarrying bar	Barres a mine	Brechstange		
B	Shovels	Pelles	Schaufeln		
C	Picks	Pioches	Kreuzhacken		
D	Saws	Scies	Saegen		
4	STORES	MATERIEL	GERAET		
A	Nails	Pointes	Naegel		
B	Wire	Fil de fer	Draht		
C	Timber	Planches	Bohlen		
5	MINES	MINES	MINEN		
A	Mines AP	Mines AP	SchaBbwMi		
B	Mines AT	Mines AC	PzAbwMi		
C	Fuzes	Allumeurs	Zuender (Minen)		
	TOTAL WEIGHT	POIDS TOTAL	GESAMTGEWICHT		

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(2d) EXPLOSIVES, STORES, MINES REQUIRED	EXPLOSIFS, MATERIELS, MINES NECESSAIRES	BEDARF AN SPRENG UND ZUNDMITTELN GERAT, MINEN

TARGET NO.	DISPOSITIF NO.	OBJEKT NR.

PRESTOCK POINT	DEPOT DU MUNITION	MUNITIONS - LAGERPLATZ

	ITEM (English)	DESIGNATION (Francais)	ART (Deutsch)	Menge Amount Quanite	Total Wt Poins total Gesamtgewich
(1)	(2)	(3)	(4)	(5)	(6) (Kg)
1	EXPLOSIVES	EXPLOSIFS	SPRENGMITTEL		
A	Cratering charges	Expl. Progressifs	Trichter sprengladungen		
B	High explosives	Expl. Brisants	Pi-Sprengmittel Brisanzspreng		
C	Plastic explosives	Plastique	Sprengmasse formbar		
D	Shaped charges	Charges Creuses	Hohlladungen		
E	Cutting charges	Charges coup.	Schneidladungen		
2	ACCESSORIES	ARTIFICES	ZUNDMITTEL		
A	Safety fuze	Meche Lente	Anzundschnur		
B	Detonating cord	Cordeau Detonant	Sprengschnur		
C	Non electric detonators	Detonateurs pyro technique	Sprengkapseln		
D	Electric detonators	Detonateurs electrique	Sprengkapseln elektrisch		
E	Prime cap	Detonateur D'amorce	Sprengkapsel-zunder		
F	Booster cap	Renforcateur	Sprengschnurkapsel		
G	Blasting Machines (exploder)	Exsploseur	Zundmaschine		
H	Cable electric (2 wire)	Fil electrique (2 fils)	Zundkabel (zweiadrig)		

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	ITEM (English)	DESIGNATION (Francais)	ART (Deutsch)	Menge Amount Quanite	Total Wt Poins total Gesamtgewich
(1)	(2)	(3)	(4)	(5)	(6) (Kg)
3	TOOLE	OUTILLAGE	WERKZEUG		
A	Quarrying bar	Barres a mine	Brechstange		
B	Shovels	Pelles	Schaufeln		
C	Picks	Pioches	Kreuzhacken		
D	Saws	Scies	Saegen		
4	STORES	MATERIEL	GERAET		
A	Nails	Pointes	Naegel		
B	Wire	Fil de fer	Draht		
C	Timber	Planches	Bohlen		
5	MINES	MINES	MINEN		
A	Mines AP	Mines AP	SchaBbwMi		
B	Mines AT	Mines AC	PzAbwMi		
C	Fuzes	Allumeurs	Zuender (Minen)		
	TOTAL WEIGHT	POIDS TOTAL	GESAMTGEWICHT		

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(3) DEMOLITION ORDER and/or MINEFIELD RECORD do not complete until after laying the minefield
ORDER DE MISE DE FEU et/ou FEUILLE DE RENSEIGNEMENTS a completer apres realisation de champ de mines
SPRENGBEFEHL und/oder MINENSPERRNACHWEIS ernst nach dem Anlegen der Minensperre vollstandig ausfullen

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(3a) SPECIAL TECHNICAL INSTRUCTION	CONSIGNES TECHNIQUES PARTICULIERES	TECHNISCHE EINZELANWEISUNGEN
1. Time required for preparing and charging	Temps necessaire pour preparation chargement	Zeitbedar fur die Vorbereitung zur Sprengung

Hours	Heurs	Std	Minutes
…………………….			…………..

2. Time required for passing from state of readiness 1 (SAFE) to 2 (ARMED)	Temps necessaire pour passer de l'etat de preparation 1 (NON AMORCE) a 2 (AMORCE)	Zeitbedar fur Anderung der Zundbereitschaft von 1 (GESICHERT) in 2 (ENTSICHERT)

Minutes

3. Personnel required for preparing and charging	Personnel necessaire pour preparation et chargement	Personal fur die Vorbereitung zur Sprengung

NCO	S/Officer	Uffz	……………….
Men	Hommes	Mannsch	………………..

4. Personnel required for firing	Personnel necessaire pour mise de feu	Personalbedarf fur Zundtrupp

NCO	S/Officer	Uffz	……………….
Men	Hommes	Mannsch	………………..

5. Organization of work (attached if necessary)	Organisation du chantier (si necessaire)	Arbeitsplan (falls erforderlich)
6. Drawings and sketches See pages 19, 21	Plans et croquis Voir pages 19, 21	Zeichnungen und Skizzen Siehe Seite 19, 21

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7 <u>Mines</u>	<u>Mines</u>	<u>Minen</u>
a) Nuisance mines + MUST + MUST NOT Be laid + See sketch page 24	Des mines de harcelement + DOIVENT + NE DOIVENT PAS etre posees + Voir croquis page 24	+ MUESSEN + MUESSEN NICHT verlegt werden + Siehe Skizze Seite 24
b) THERE IS (A) + LARGE + NO minefield near (give location and reference of minefield record)	+ IL EXISTE + IL N'EXISTE PAS un champ de mines important a proximite (indiquer l'emplacement et documents de reference)	+ ES IST EINE + ES IST KEIN groBere Minensperre in der Nahe (Angaben ueber Lage und diesbezuegliche Minensperrnachweis)
+ Strike out words not applicable	+ Rayer la mention inutile	+ Nicht Zutereffendes streichen

English	Francais	Deutsch
Translation of notes on the sketch page 24	Traduction des inscriptions parlees sur les croquis page 24	Ubersetzung der Anmerkungen auf der Skizze Seite 24

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(3b) SKETCH OF TARGET	CROQUIS DE L'OUVRAGE	TRENN SCHNITTSKIZZE

Plan and sections of the target showing lines of cut and demolition chambers (in one language only)

Plan et coupes de l'ouvrage montrant sections de rupture et fourneaux (inscriptions on une seule lange)

Zeichnung und Teilzeichnung mit Angabe der Trennschnitte und Sprengkammern (nur in einer Sprache)

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English Translation of notes on the sketch page 19	Francais Traduction des inscriptions parlees sur les croquis page 19	Deutsch Ubersetzung der Anmerkungen auf der Skizze Seite 19

(3c) SKETCH OF CHARGES	CROQUIS DE CHARGEMENT	LANDUNGS-SKIZZE

Plan and sections showing details of chambers, lines of cut and location of charges, giving quantities of explosive, method of ignition etc.
(in one language only)

Plan et coupes detailles des fourneaux profils de rupture, emplacement des charges, avec indication des quantites d'explosifs, amorcage, etc.
(inscriptions on une seule lange)

Zeichnung und Teilzeichnung mit Sprengkammern, Trennschnitten, Ladungsanbrigung mit Angabe der Ladungsmenge und Zundungsart
(nur in einer Sprache)

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English Translation of notes on the sketch page 21	Francais Traduction des inscriptions portees sur les croquis page 21	Deutsch Ubersetzung der Anmerkungen auf der Skizze Seite 21

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(3d) SKETCH OF IGNITION SYSTEM	SCHEMA DE MISE DE FEU	ZUNDLEITUNGS-SKIZZE

Sketch showing firing circuits and firing point
(in one language only)

Croquis montrant les circuits de mise de feu et le point de mise de feu
(inscriptions on une seule lange)

Skizze der Zundleitungen (Hauptund Reservezundung) und der Zundstelle
(nur in einer Sprache)

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(3e) MINEFIELD IF APPLICABLE, OR PROTECTIVE MINES	CHAMP DE MINES OU CHAMP DE MINES DE PROTECTION SUIVANT LE CAS	MINENSPERRE FALLS VORHANDEN ODER SICHERUNGS-MINENSPERRE

Personnel and time required for laying mines	Personnel et temps necessaire pour la pose des mines	Krafte u. Zeitbedarf f. das Verlegen von Minen

Men	Hommes	Mann		Hours	Heurs	Std	Minutes
……………….				…………………			………

Sketch of planned minefield. When laid draw on page 24 and fill out minefield record on page 16
(in one language only)

Croquis du champ de mines prevu. Si realise encrire a la page 24 et remplir la fenille de reseignements page 16
(inscriptions on une seule lange)

Skizze der geplanten Minensperre. Wenn angelegt auf Seite 24 eintragen und Minensperrnachweis ausfullen Seite 16
(nur in einer Sprache)

(4a)

TURN-OVER/TAKE OVER OF TARGET		Target No.	
REMISE/REPRISE DU DISPOSITIF		Dispositif No.	
UBERGABE/UBERNAHME DER SRERRE		Objektnummer	

Type of target	
Type d'obstacle	
Art der Sperre	

Grid reference		Date/Time Group	
Coordonnees UTM		Groupe date/heure	
UTM-Koordinaten		Datum/Zeit-Gruppe	

State of readiness at the time of turn-over/Take over	
Etat de preparation au momont de la remise	
Zundbereitschaft bei Ubergabe/Ubernahme	

Work still required to complete barrier or to prepare demolition target
Travaux restant effectuer jusqu a l'achevement
Noch auszufuhrende Arbeiten bis zur Fertigstellung

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Ammunition/equipment to be turned-over/taken-over
Munition/materiels a remettre
Zu ubergebende/ubernehmende Munition/Gerat

Barrier document will remain at:
Les documents seront gardes par:
Sperrunterlagen verbieiben:

Relieved Commander
Responsible de la remise
Ubergebender

Last Name		Rank	
Nom		Grad	
Name		Dienstgrad	
Unit		Signature	
Unite		Signature	
Einheit		Unterschrift	

Relieved Commander
Responsible de la reprise
Ubernenmender

Last Name		Rank	
Nom		Grad	
Name		Dienstgrad	
Unit		Signature	
Unite		Signature	
Einheit		Unterschrift	

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(4b)

TURN-OVER/TAKE OVER OF TARGET		Target No.	
REMISE/REPRISE DU DISPOSITIF		Dispositif No.	
UBERGABE/UBERNAHME DER SRERRE		Objektnummer	

Type of target	
Type d'obstacle	
Art der Sperre	

Grid reference		Date/Time Group	
Coordonnees UTM		Groupe date/heure	
UTM-Koordinaten		Datum/Zeit-Gruppe	

Relieved Commander
Responsible de la remise
Ubergebender

Last Name		Rank	
Nom		Grad	
Name		Dienstgrad	
Unit		Signature	
Unite		Signature	
Einheit		Unterschrift	

Relieved Commander
Responsible de la reprise
Ubernehmender

Last Name		Rank	
Nom		Grad	
Name		Dienstgrad	
Unit		Signature	
Unite		Signature	
Einheit		Unterschrift	

Copy for the unit handing over
Exemplaire pour l'unite remettante
Ausfertigung fur dir ubergebende Einheit

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(5) DEMOLITION ORDER **(IF FIRED)**	COMPTE RENDU DE DESTRUCTION	MELDUNG UBER DURCHGEFUHRTE SPRENGUNG

a.

TARGET NO.	DISPOSITIV NO.	OBJEKT NR.	

b.

MAP REFERENCE	COORDONNEES	KOORDINATEN	

c.

Demolition was fired at	Le mise de feu a ete faite a	Die Sprengung erfolgte

Date / Time	Date / heurs	Datum / Zeit
……………………… / …..…………………….		

d.

Extent of damage (1) In case of a bridge	Resultats obtenus (1) Case d'un pont	Umfang der Zerstorungen (1) im Falle einer Brucke

Width of gap ……………… meters	Largeur de breche …………….. meters	Weite der Unter-breacung ……………… m
No. of spans down ……………..	No. de travees detruites ……………………..	Anzahl der herbge-fallenen Strecken ……………………………

(2) In a road or runway size, depth, and location of craters	Sur une route ou piste: Dimensions, profondeur et emplacement des entonnoirs	Auf einer StraBe oder Rollbahn: GroBe, Tiefe und Lage von Trichtern

(3) Mines laid, type and number	Mines posees, type et nombre	Anzahl und Art verlegter Minen

(4) Any other details	Autres reseignements	Sonstige Anmerkungen

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(5) SKETCH showing effect of demolition and location of mines (if applicable)	CROQUIS montrant les effects de la destruction et emplacement du champ de mines (s 'il y a lieu)	SKIZZE uber das AusmaB der Zerstorungen und Lage der Minen (wenn verlegt)

Date / Time	Date / Huers	Datum / Zeit

Name	Nom	Name	Rank	Grade	Dienst-grad	Unit	Unite	Einheit

TO	DESTINATAIRE	AN		SIGNATURE	UNTERSCHRIFT

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Notes:
1. Pages 3; 7-12; 14 can be detached from the target folder and handed to the soldier detailed to pick up the barrier material.
2. The commander of the closing/executing unit will use pages 29/30 to report results to his immediate superior.

Remarques:
1. Les pages 3; 7-12; 14 peuvent etre retirees du carnet de dispositif de destruction preparee et remise au responsible de l'enlevement des explosifs.
2. Le chef du detachement de protection/de mise a feu emploiers les pages 29/30 pour faire rapport a son chef immediat.

Anmerkungen:
1. Die Seiten 3; 7-12; 14 konnen dem Sperrheft entnommen und dem Soldaten ubergeben werden, der die Sperrmittel abholt.
2. Dass Ergebnis ist vom Fuhrer der schlieBenden/auslosenden Einheit/Teileinheit mit Seite 29/30 an den unmittelbaren Vorgesetzten zu melden.

TARGET folder completed by:	CARNET d'ALLERT etabli par:	Sperrheft aufgestellt Durch:

Name	Nom	Name	Rank	Grade	Dienst Grad	Designation	Fonction	Dienststellung

Signature	Unterschrift		Date	Datum

Name	Nom	Name	Rank	Grade	Dienst Grad	Designation	Fonction	Dienststellung

Signature	Unterschrift		Date	Datum

Folder reviewed by	Carnet controle par	Sperrheft gepruft

Name	Rank	Designation	Date	Signature

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