REGION ONE

HANDBOOK

CONSTRUCTION AND MAINTENANCE

OF

FOREST IMPROVEMENTS

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INTRODUCTION

This handbook is intended primarily for the use of the men in the field who actually do or superintend the doing of the construction and maintenance work on improvements. It is not intended to repeat in this handbook any instructions which are contained in the various manuals, such as the Trail Manual, Telephone Handbook, Telephone Trouble Book, and Road Manuals. This handbook is intended to be a working manual describing the better mechanical ways of doing things and including information of value in determining the kind of material most satisfactory for any particular job.

It is not assumed that the handbook includes everything that could be put in it. There are undoubtedly many things which could be included to advantage if they could all be thought of. With that in mind, the book is issued in loose-leaf form so that additions and corrections can be made from time to time. If any of you believe that a certain matter should be included, whether it be a detail of mechanical construction or a table of information, write it up in detail, illustrate your point if possible and then send it to the Regional Office. If the merit of your suggestion is apparent, it will be inserted in the handbook.

This handbook, as was said at the outset, is intended to be a help to the men in the field. The information has been accumulated from numerous suggestions by field men. The handbook will be just as serviceable and useful as the users make it. The first edition having become exhausted, this new revised edition is necessary.

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Construction and Maintenance

of Forest Improvements

Region One

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Note: The page numbers of each section will start with number 1, and letter symbols, as above, before the numbers, will indicate the section.

Amendments will bear the notations, at the lower left corner, "Paragraph amended" or "Paragraph added," and the date at the end of amended or new paragraphs, and the mark (*) before such paragraphs.

Errata: Unfortunately a few plates were incorrectly numbered and the error was not discovered until after the prints had been run. This should not cause any difficulty in the use of the book.

RANGER STATION IMPROVEMENT PLANS

SITE

The selection of the building site is perhaps just as important as the erection of the building according to sound construction standards. Whether the building is one of a group at ranger headquarters or stands alone at the intersection of two trails in the back country, its location must be chosen with care and considerable forethought. Sunlight, drainage, background, fuel, pasture and water supply must all be considered in their proper relationship one to another. In the Administrative Guide will be found instructions for the preparation of building site plans. The Service has in the past made so many too-evident mistakes in the location of buildings as well as in the selection of plans for them that it surely behooves all of us to be most critical in the consideration of the location of buildings to be constructed in the future. Just remember that a building once up is finally located for at least 25 years and that it must be lived with all of that time no matter how unhandily it may be located. For these reasons it is necessary that all ranger station improvement plans be approved by the Regional Forester and that changes in the plan shall not be made except with his approval.

Probably 95% of the stations which will be occupied in the future are already partially developed and little can be done to improve the station layout, where necessary, except as it becomes necessary to replace old structures which have served their usefulness. It is most essential that a well-thought-out plan of future development for such stations be in mind so that such future replacements may tend toward the general improvement of the whole station set-up. In those few cases where an entirely new station is to be started, it goes without comment that thorough consideration must be given to the location of every building in the general ensemble before the ground is disturbed.

As a rule such plans will be prepared by the Regional Office Landscape Architect cooperating with the Forest Supervisors and rangers. It will be the general practice to prepare a special design and plan for each of the major buildings at each site. These plans will be prepared by the architects working in the Regional Office. The use of standard plans will be confined to such structures as barns and garages at headquarters and to structures at temporary field stations.

The construction of any building at any location will not be attempted until after the location and building plans have been approved by the Regional Forester.

The type of construction, whether log or frame, will be settled at the time the improvement plan for the site is prepared. There is quite a bit of aversion to constructing log buildings for dwellings,

administration buildings, etc., at headquarters for the reason that it is difficult construction and adds materially to the cost of the structure to satisfactorily finish the interiors. Log walls are nice in summer cabins, hunting camps, etc., but the average housekeeper has a distinct aversion to them in yearlong homes because of the extra volume of work necessary to keep them clean. It has been found that a very satisfactory substitute for log buildings insofar as appearances are concerned is secured when the exterior walls of frame structures are covered with a sawed cedar shingle which has one surface scarified so that it resembles a split or hand-rived shake. The use of log siding is not considered desirable since buildings so finished have an artificial or counterfeit appearance.

For the many minor field stations log construction should be used where suitable house logs can be secured.

As a rule building plans prepared by competent architects are complete in every respect as to details of design, plan and specifications. Such plans will be followed without variation by the builder. When such plans cannot be satisfactorily interpreted in the field the Regional Office Improvement section should be asked for an explanation. Changes in approved plans will not be made except upon approval by the Regional Office.

BUILDING CONSTRUCTION

It is the plan of this handbook to discuss each phase of building construction in the order in which it occurs during the process of erecting the structure.

Frame construction will be described first and followed by log construction. Regardless of the type of structure every building will have a

Foundation

Laying Out Foundation

Probably the most convenient and handiest method of laying out a building foundation is by the use of "batter boards." These are placed outside the excavation lines and once properly set are permanent until the building is well under way. Having determined the location of the front line of the building and set two stakes the width of the foundation apart, then erect batter boards as shown by Fig. A.

The batter boards should be about six feet long and set back three feet from the building line. Stretch a chalk line from board to board directly over the two stakes. Cut a notch in the top of the batter board as a marker for the chalk line in case it is necessary to remove the chalk line for any purpose. There are several methods by which the other two corners of the building may be located and the

foundation properly squared. One of the simplest to use is to make a layout square with three 1"x6"-10' boards as illustrated by Fig. B.

Lay the corner of the layout square against a stake and line up one edge with the chalk line, then measure off with a tape the location of the opposite stake. Set up a batter board for the newly located corner and stretch a chalk line in place as before. Repeat the operation for the fourth corner and you are all set to start digging. Chalk lines can be removed while excavating is in progress and readily replaced whenever it is necessary to relocate the line of the foundation. Cellars should be excavated about one foot larger than the foundation all around so as to provide room to build the concrete forms.

If the batter boards are set so that the chalk lines are level all around, it will greatly simplify the leveling of the concrete work or excavation at all times. With the chalk line in place, tight and level, all that is necessary is to measure down from the string at any point to determine the correct elevations.

A level board should be provided as soon as the work is started. The material in the level board should be clear straight-grained fir or pine and the board should be kept in a dry place when not in use so that it will not warp or twist. By the use of the level board and a spirit level various parts of the excavation and foundation can be kept level at all times with the minimum amount of trouble.

The type of foundation for each building will be specified in the plan. Generally all foundations will be of concrete construction. Each concrete wall will have a footing course which shall extend down to firm bearing soil. It must not, under any circumstances, be placed on fill material. The footing course should be double the width of the wall it is to support and be at least six inches in depth. The footing should set at least two days before the wall forms are placed. The accompanying drawings illustrate the various methods followed in building foundation forms. For log structures the end walls should be from four to six inches higher than the side walls, so as to close the gap under the end log.

Forms

Finished concrete will have no smoother surface than the forms. For even fair foundation work, the form boards must be dressed on the inside and on both edges, so they will fit close and prevent leakage. The foundation forms should be centered on the footings and should be built of one-inch material, substantially constructed and tied together and braced to withstand the pressure of the concrete without being thrown out of alignment. Wood spacing blocks should be used to hold opposite form faces the correct distance apart, and wire ties passed around form studs and across the space between the forms to tighten the forms against the spacers and hold them in true alignment so that the finished wall will be straight and of even thickness. Wire ties

are tightened by twisting. Spacers must be removed as concreting progresses, otherwise a permanent blemish in the wall will result. Where anchor bolts are to be provided in concrete walls, they shall be carefully placed and supported in the form so they will set in the wall in true positions as shown on the plans. The forms shall be carefully constructed and all exposed surfaces of the foundation shall be even and smooth. If sufficient care is used in building the forms and in taking them down, practically all of the material can be used in constructing the building. Forms should be so designed that they can be taken down with the least amount of hammering, thus preventing possible injury to the concrete before it has thoroughly hardened.

The eight-inch shiplap specified for sheathing in the various bills of material should be used for the forms. Two by four material cut to the proper length for wall studding should be used for the form uprights. Sheathing should be nailed with 6d finish nails. When the forms are taken down in place of having to drive the nails back before they can be removed from the boards, they may be pulled through with a pair of pliers, saving time and material as well. Cellar window frames should be made and set in place in the forms. Cleats nailed on the back of the jambs will fix the frame securely in place when the concrete is poured. Recess pockets for cellar and porch girders should also be set in the form before the concrete is poured. Where buildings do not have cellars under them, ventilation boxes which will afterwards be covered with heavy wire screen must be placed in the form.

Concrete

The basic material of concrete is Portland cement - a staple product obtainable from practically all dealers in building materials. Cement is generally obtainable in cloth sacks or paper bags and occasionally in bulk. For convenience in handling or measuring, each sack contains one cubic foot (94 pounds) of cement.

Portland cement is a thoroughly dependable product. All of the standard brands produced by members of the Portland Cement Association are tested repeatedly and will produce good concrete when properly combined with the other materials necessary for a concrete mixture.

How Cement is Used to Make Concrete

Portland cement mixed with water forms a paste. When sand and pebbles are so mixed with this paste that every particle is coated, plastic concrete is obtained. This workable mass of cement, water, sand and pebbles, when placed into forms and allowed to stand, becomes hard like stone due to a process known as the hydration of the cement. When properly cured, concrete continues to harden for a long time after it has acquired sufficient strength for the work it has to do. This continued increase in strength is a characteristic of concrete, which differs from all other materials in that it grows stronger, never weaker, with age.

Strength, water-tightness and durability of concrete are controlled by the amount of water used per sack of cement. The inclusion of too much mixing water thins or dilutes the cement paste and weakens its cementing qualities. It is, therefore, important that the correct amount of mixing water be used to obtain concrete of the required strength and density according to the class of work for which it is intended.

TABLE I

Recommended Mixtures for Several Classes of Construction
(Intended primarily for use on small jobs)

Kind of Work	Gallons of Water to add to Each One-sack Batch			Trial Mixture For First Batch			MAXIMUM AGGREGATE SIZE
	DRY SAND AND PEBBLES	MOIST SAND AND PEBBLES	WET SAND AND PEBBLES	CEMENT	SAND	PEBBLES	
Fence posts, and other work of very thin sections. (Strength 4400 lbs. per sq.in. at 28 da.)	$4\frac{1}{2}$	3-3/4	$3\frac{1}{2}$	1	2	2	3/4
Water storage tanks, septic tanks, sidewalks, driveways, basement floors, steps, corner posts, piers, etc. (Strength 3300 lbs. per sq.in. at 28 da.)	$5\frac{1}{2}$	$4\frac{1}{2}$	3-3/4	1	2	3	1
Water-tight basement walls and pits, walls above ground, dipping vats, storage cellar walls, etc. (Strength 2700 lbs. per sq.in. at 28 da.)	$6\frac{1}{2}$	5	$4\frac{1}{4}$	1	$2\frac{1}{2}$	$3\frac{1}{2}$	$1\frac{1}{2}$
Foundation walls which need not be water-tight, mass concrete for footings, retaining walls, engine bases, etc. (Strength 2000 lbs. per sq.in. at 28 da.)	$7\frac{1}{2}$	6	5	1	3	5	2

Determining Proportions of Cement and Water

Table I gives recommended quantities of water to use per sack of cement for the different classes of construction. In mixing half-sack batches, use just half the amount of water indicated. The table also suggests proportions of cement, sand and pebbles for the first trial batch and gives maximum size of pebbles allowable. Note that with dry sand and pebbles more water is added than when the materials are in a moist or wet condition. This is true since the moisture present in damp aggregates is free to act on the cement.

The use of this table can best be explained by an example. Suppose it is desired to determine proper proportions for building a water-tight floor. The recommended mix for this class of work is one containing a total of $5\frac{1}{2}$ gallons of water per sack of cement. One cubic foot of moist aggregate contains approximately a quart of water. Consequently when the aggregates (sand and pebbles) are in a moist condition only $4\frac{1}{4}$ gallons need be added as the water which they contain is free to act upon the cement. When aggregates are dripping wet they contain even greater quantities of water and only 3-3/4 gallons are then added to a one-sack batch.

As a trial mixture for determining correct proportions of sand and pebbles for water-tight concrete, 1 sack of cement to 2 cubic feet of sand to 3 cubic feet of pebbles (1-2-3 mix) is recommended. It may be necessary to change the proportions of sand and pebbles slightly in order to obtain a smooth, plastic, workable mixture which will place and finish well. For example, suppose the addition of the recommended quantity of water for the trial proportions suggested gives a mixture that is too wet, add more sand and pebbles in the proportions of about two parts sand to three parts pebbles until the right degree of workability is obtained. On the other hand, if the mixture is too stiff with suggested proportions, use less sand and pebbles in the following batches. In this way the exact proportions for the job can be obtained.

The following recommendations (Table II) will prove helpful in arriving at best proportions of sand to pebbles. All measurements are based on moist sand. If sand is absolutely dry, a condition seldom encountered, use 25% less than quantities given in the table.

TABLE II

For coarse aggregates ranging from $\frac{1}{4}$" up to $\frac{1}{2}$", use approximately equal parts of sand and pebbles.

For coarse aggregates ranging from $\frac{1}{4}$" up to 3/4", use about three-fourths as much sand as pebbles.

For coarse aggregates ranging from $\frac{1}{4}$" up to $1\frac{1}{2}$", use about half as much sand as pebbles.

What Is a Workable Mixture?

A workable mixture is one of such plasticity and degree of wetness that it can be placed in forms readily, and that with light spading or tamping will result in a dense concrete. It should be neither too dry nor too wet. In a workable mixture there is sufficient sand-cement mortar to give good smooth surfaces free from rough spots, called honeycombing, and to bind the pieces of coarse aggregates into the mass so they will not separate out in handling.

In other words, there should be just enough cement-sand mortar to fill completely the spaces between the pebbles and to insure a smooth

plastic mix. Mixtures with a deficiency of mortar will be harsh, hard to work and difficult to finish. On the other hand, oversanding or the use of too much sand should be guarded against as it increases porosity, and reduces the amount of concrete that can be obtained with a sack of cement.

A good rule to follow is to so proportion the amounts of sand to pebbles as to obtain the greatest amount of concrete of a plasticity suitable to the character of the work. Under no circumstances vary the ratio of water to cement from the quantities given in Table I on page R-5.

Aggregates

Aggregates for concrete should be clean, hard and free from dirt, loam, clay or vegetable matter. These foreign materials are objectionable because they prevent adhesion between the cement and sound, hard particles of aggregates. Concrete made with dirty aggregate hardens very slowly at best and may never harden enough to produce a good quality of concrete.

Sand should be well graded, that is, the particles should not all be fine nor all coarse, but should vary from fine up to those particles that will just pass a sieve having meshes $\frac{1}{4}$" square. If sand is well graded, the fine particles help to occupy the spaces (voids) between the coarser particles, thus resulting in a dense concrete. Under those conditions, a given amount of cement paste will bind together a greater mass of aggregates, thus increasing the amount of concrete obtainable with a sack of cement.

Pebbles, crushed stone, or other coarse aggregates should be tough, fairly hard and free from impurities that are objectionable in sand. Stone containing a considerable quantity of soft, flaky, or elongated particles is not suitable for making concrete. Coarse aggregates should be well graded with sizes ranging from $\frac{1}{4}$" up to $1\frac{1}{2}$" or 2", the maximum size being governed by the nature of the work. In thin slabs or walls, the largest pieces of aggregates should never exceed one-third the thickness of the section of concrete being placed.

Bank-Run Materials

Bank-run gravel, the natural mixture of sand and pebbles as taken from the pit, is seldom suitable for concrete unless first screened to separate sand from pebbles. When thus separated materials may be recombined in correct ratio to give a workable mix as previously described. Most gravel banks contain either more sand or more pebbles than desirable; usually, there is too much sand. Money can generally be saved by screening out the sand and then recombining sand and pebbles in correct proportions.

Water

Water used to mix concrete should be clean, free from oil, alkali and acid. In general, water that is fit to drink is suitable

for concrete.

Accurate Measurement Essential

All materials, including water, should be accurately measured for every batch. A bottomless frame made to hold exactly 1 cubic foot, 2 cubic feet or any other convenient volume, serves as a measuring box for sand and pebbles. A pail marked off on the inside to indicate gallons and half-gallons is commonly used for measuring water.

Mix Thoroughly

Concrete may be mixed by machine or by hand. In either case, mixing must proceed until stones or pebbles are completely coated with a mortar of sand and cement.

Practically all standard batch-type machine mixers on the market will render satisfactory service and pay for their cost by saving labor and insuring more thoroughly and uniformly mixed concrete.

Hand Mixing

For hand mixing a tight floor or mixing platform is required and a platform should be constructed especially for the purpose. The method generally used for hand mixing is as follows: Spread the measured amount of sand out on the platform, distribute the required quantity of cement evenly on top of the sand and turn with square-pointed shovels until the mixture is uniform in color. At least three turnings are necessary. On the cement-sand mixture spread the measured amount of pebbles and mix thoroughly as before until the mass has the same even color throughout. A hollow is then formed in the center of the pile and the exact quantity of water poured into this depression, materials in the pile being gradually turned into the water with shovels and mixed until the cement, sand and pebbles have been thoroughly and uniformly combined and the mixture has the same color and plasticity throughout.

Placing

Concrete should be placed in the forms inside of 45 minutes. It should be deposited in 6-to 10-inch layers and thoroughly spaded. This compacts the concrete, releases air pockets, and works large particles away from the face of the forms.

The amount of cement necessary may be reduced a considerable amount by placing pieces of rock of convenient size in the form after the mixture is poured. Dropping the rocks into the form will cause them to be securely imbedded in the concrete, and spading the sides of the form will insure that they do not show in the wall after the forms are removed. The rock must be clean and free from all dirt or other foreign material.

Curing

Moisture is necessary for the proper hardening of concrete. If this fact is kept in mind, no difficulties will be encountered in the proper curing of concrete. Floors and walks are commonly given a covering of 2 or 3 inches of earth, straw or sand which is kept moist by sprinkling for 10 days. Wall sections are protected with moist canvas or burlap.

HOW TO FIGURE QUANTITIES

Quantities of Cement, Fine Aggregate and Coarse Aggregate
Required for One Cubic Yard of
Compact Mortar or Concrete
(See Table I, page 5, for quantities of mixing water)

MIXTURES			QUANTITIES OF MATERIALS				
Cement	F. A. (Sand)	C. A. (Gravel or Stone)	Cement in Sacks	Fine Aggregate		Coarse Aggregate	
				Cu.Ft.	Cu.Yd.	Cu.Ft.	Cu.Yd.
1	1½	-	15.5	23.2	0.86	-	-
1	2	-	12.8	25.6	0.95	-	-
1	2½	-	11.0	27.5	1.02	-	-
1	3	-	9.6	28.8	1.07	-	-
1	1½	3	7.6	11.4	0.42	22.8	0.85
1	2	2	8.3	16.6	0.61	16.6	0.61
1	2	3	7.0	14.0	0.52	21.0	0.78
1	2	4	6.0	12.0	0.44	24.0	0.89
1	2½	3½	5.9	14.7	0.54	20.6	0.76
1	2½	4	5.6	14.0	0.52	22.4	0.83
1	2½	5	5.0	12.5	0.46	25.0	0.92
1	3	5	4.6	13.8	0.51	23.0	0.85

1 sack cement = 1 cu. ft.; 4 sacks = 1 bbl. Based on tables in "Concrete, Plain and Reinforced," by Taylor and Thompson.

Materials Required for 100 Sq. Ft. of Surface for
Varying Thicknesses of Concrete or Mortar
(See Table I, page 5, for quantities of mixing water)

C - Cement in sacks
F.A.- Fine aggregate (sand) in cu. ft.
C.A.- Coarse aggregate (pebbles or broken stone) in cu. ft.
Quantities may vary 10 percent either way depending upon character of aggregate used. No allowance made in table for waste.

Proportion	1 - 1½			1 - 2			1 - 2½			1 - 3		
Thickness in Inches	C.	F.A.	C.A.	C.	F.A.	C.A.	C.	F.A.	C.A.	C.	F.A.	C.A.
3/8	1.8	2.7		1.5	3.0		1.3	3.2		1.1	3.4	
1/2	2.4	3.6		2.0	4.0		1.7	4.3		1.5	4.4	
3/4	3.6	5.4		3.0	6.0		2.5	6.3		2.2	6.8	
1	4.8	7.2		4.0	7.9		3.4	8.4		3.0	8.9	
1-1/4	6.0	9.0		4.9	9.9		4.2	10.5		3.7	11.1	
1-1/2	7.2	10.8		5.9	11.9		5.1	12.7		4.4	13.3	
1-3/4	8.4	12.6		6.9	13.9		5.9	14.7		5.2	15.7	
2	9.6	14.4		7.9	15.8		6.8	16.9		5.9	17.7	

Proportion	1 - 2 - 2			1 - 2 - 3			1 - 2½ - 3½			1 - 3 - 5		
Thickness in Inches	C.	F.A.	C.A.	C.	F.A.	C.A.	C.	F.A.	C.A.	C.	F.A.	C.A.
3	7.7	15.4	15.4	6.5	13.0	19.3	5.5	13.6	19.1	4.3	12.8	21.3
4	10.2	20.4	20.4	8.6	17.2	25.8	7.3	18.1	25.4	5.7	17.0	28.4
5	12.8	25.6	25.6	10.8	21.6	32.2	9.1	22.6	31.8	7.1	21.3	35.5
6	15.4	30.7	30.7	12.9	25.8	38.6	10.9	27.2	38.2	8.5	25.6	42.6
8	20.6	41.0	41.0	17.2	34.4	51.6	14.6	36.4	51.0	11.4	34.1	57.0
10	25.6	51.2	51.2	21.5	43.2	64.4	18.2	45.3	63.5	14.2	42.5	71.0
12	30.7	61.4	61.4	25.8	51.6	77.2	21.8	54.5	76.3	17.0	51.1	85.1

Mortar Materials Required for Concrete Masonry (8" Wall)

(NOTE: Amount of mortar required is subject to wide variation, depending upon wastage and how joints are made. The following figures represent general practice on the basis of 25% wastage and 3/8-inch mortar joints, the mortar joints being noncontinuous through the wall.)

For Ordinary Work

One sack cement, 1 cu. ft. lime and 6 cu.ft. sand will make mortar sufficient to lay up the following:
120 8x8x16" block, or
175 5x8x12" concrete building tile.

For Special Work

One sack cement, 10 lbs. lime and 3 cu. ft. sand will make mortar sufficient to lay up the following:
55 8x8x16" concrete block, or
75 5x8x12" concrete building tile.

HOW TO USE TABLES FOR CALCULATING QUANTITIES

Problem 1:

What quantities of materials are required for a monolithic concrete foundation wall 34 feet square, outside measurements, 12"

thick, 7' high, with a footing 12" thick and 18" wide, using a $1\text{-}2\frac{1}{2}\text{-}3\frac{1}{2}$ mixture in both the wall and footing?

Solution:

The wall contains 924 square feet of surface, 12" thick, deducting for duplication at corners.

Referring to table under $1\text{-}2\frac{1}{2}\text{-}3\frac{1}{2}$: mixture for 12" walls 21.8 sacks of cement are required for each 100 square feet of surface. Dividing 924 by 100 gives the number of times 100 square feet are contained in the total wall surface, and multiplying by 21.8 gives the total number of sacks of cement required. Similar calculations are made for the fine aggregate and the coarse aggregate in both the wall and the footing, noting that the width of the footing, 18", is $1\frac{1}{2}$ times the 12" thick.

$\frac{924 \times 21.8}{100} = 201.5$ sacks cement

$\frac{924 \times 54.5}{100} = 503.6$ cu. ft. fine aggregate

$\frac{924 \times 76.3}{100} = 705$ cu. ft. coarse aggregate

The footing contains 132 square feet of surface, 18" thick ($1\frac{1}{2} \times 12"$), deducting for duplication at corners.

$\frac{132 \times 21.8 \times 1\frac{1}{2}}{100} = 43.2$ sacks cement

$\frac{132 \times 54.5 \times 1\frac{1}{2}}{100} = 107.9$ cu. ft. fine aggregate

$\frac{132 \times 76.3 \times 1\frac{1}{2}}{100} = 151.0$ cu. ft. coarse aggregate

Total materials required for footing and wall: 244.7 sacks cement, 611.5 cu. ft. fine aggregate, 856 cu. ft. coarse aggregate.

Problem 2:

What quantities of materials are required for a 1.2 cement plaster coat, 1" thick on the lower four feet of the above foundation?

Solution:

Perimeter of foundation: 4 x 34' = 136'. This multiplied by height of plaster coat, 4', equals 544 square feet.

$\frac{544 \times 4.0}{100} = 21.8$ sacks of cement

$\frac{544 \times 7.9}{100} = 42.5$ cu. ft. sand

Construction Joints

The pouring of a concrete foundation should, if possible, be started early enough to insure its completion the same day and thus avoid construction joints between one day's work and the next. If it is necessary to stop work on a wall or foundation before it is finished, the concrete should be brought to a level in the forms and the surface prepared to receive the next day's work by roughening the surface with a trowel. Before concrete work is commenced the next day, the top surface of the hardened concrete must be cleaned. If too much water was used, a creamy scum will be found which must be cleaned off. Then coat the surface with a paste of cement and water just before the new concrete is applied.

Protecting Concrete

Heat hastens and cold delays the hardening of concrete. At a temperature of 80° F. concrete hardens rapidly, but the process of hardening is noticeably retarded at 50°, and at the freezing point it ceases.

Concrete in Winter

Small concrete jobs can be carried out in cold weather if due precautions are taken to guard against freezing. Such precautions consist of heating sand, gravel, and water before mixing and covering the forms with canvas and straw or dry earth or sand during moderately cold weather, or by placing lighted lanterns under the canvas during more severe weather. Ordinarily, the protection should be continued for three or four days after pouring and in all cases the forms should not be removed until after freezing weather is over. A definite plan for protection against freezing should be outlined and all necessary appliances and materials for carrying it out should be on the ground before concrete work is started during the winter months.

Removal of Forms

Forms must not be removed or "stripped" until the concrete has thoroughly hardened. The time required cannot be definitely stated as so much depends on the nature of the work and local temperature and weather conditions.

In summer weather, foundation forms can generally be stripped after two days and in colder weather from four to seven days. In removing forms, guard against chipping corners or otherwise injuring the exposed part of the wall. A wrecking bar is essential in this work.

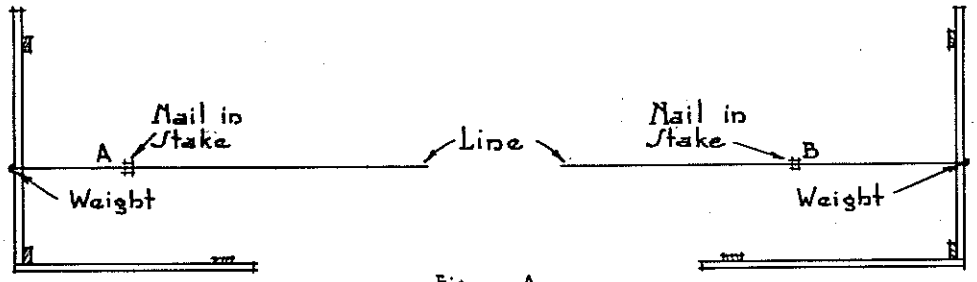


Figure A

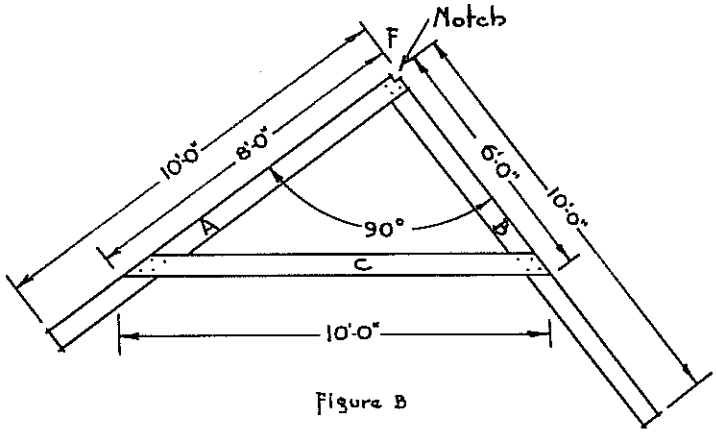


Figure B

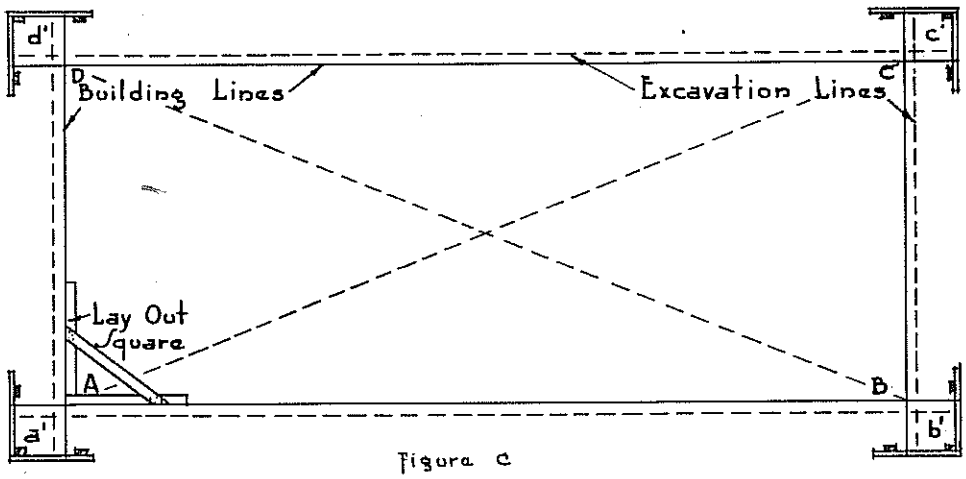


Figure C

METHOD of LAYING OUT FOUNDATION WITH BATTER BOARDS

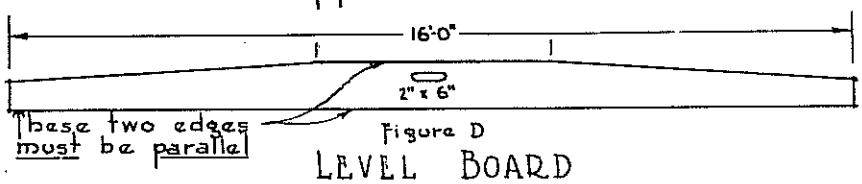
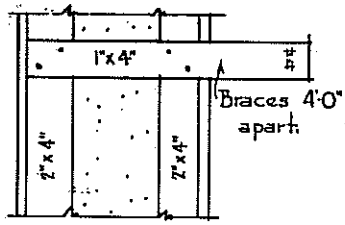


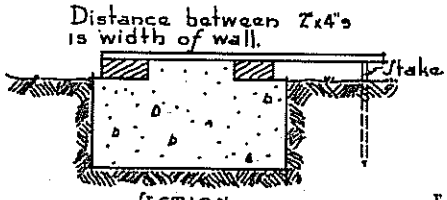
Figure D

LEVEL BOARD

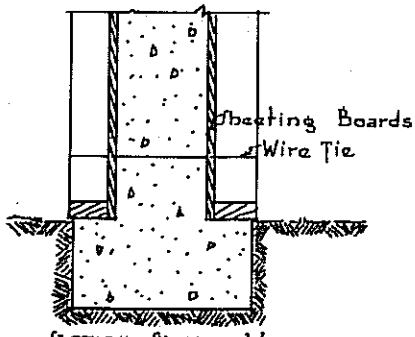
CONCRETE FORMS



PLAN



SECTION



SECTION SHOWING WALL

Figure A

FOOTING FORMS

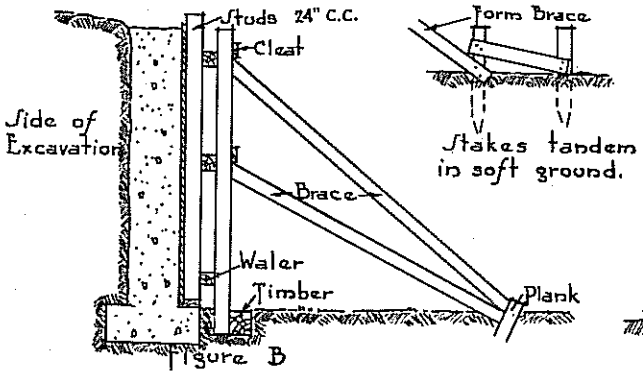


Figure B

CONCRETE FORM BRACED WITHOUT WIRE TIES.

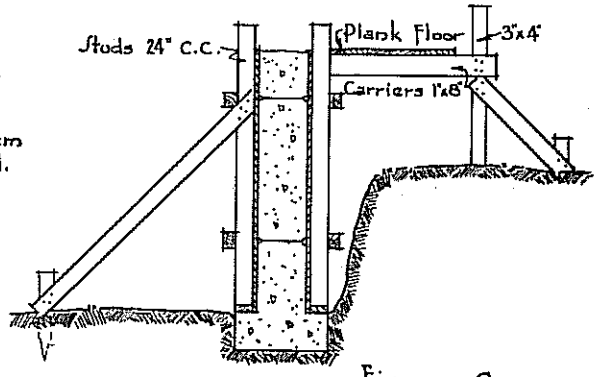


Figure C

RUNWAY FOR WHEELBARROWS

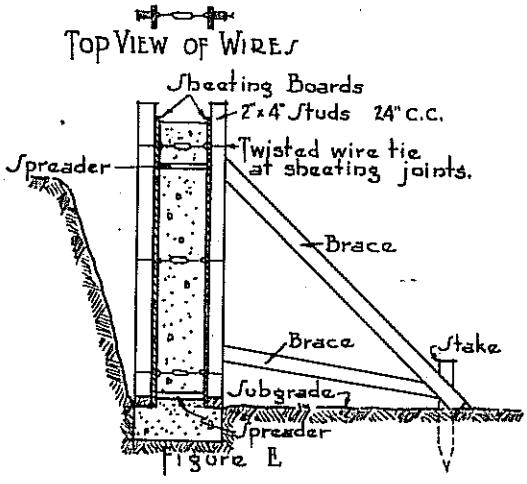


Figure E

WALL FORM WITHOUT WALERS USING STUD TIES IN PAIRS

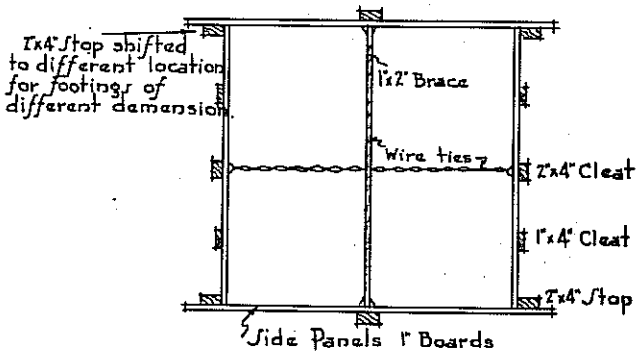


Figure F

FORMS FOR BOX FOOTINGS

MIXING CONCRETE

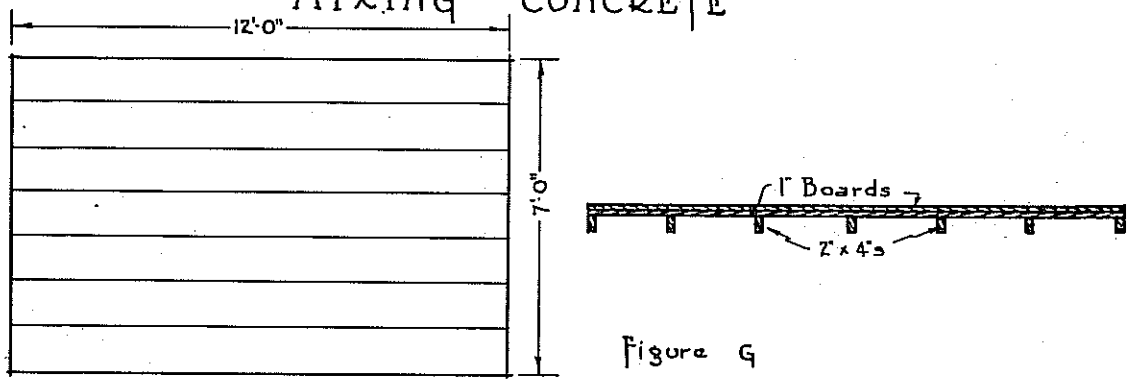
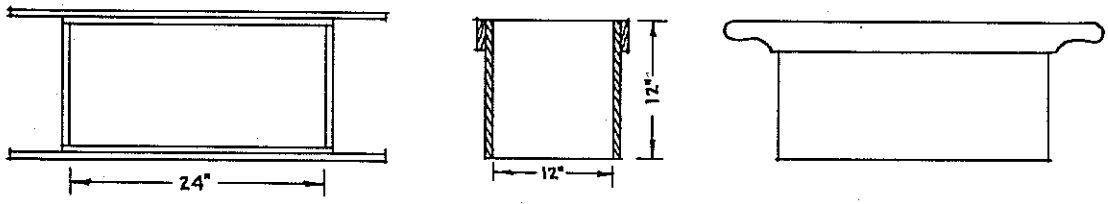


Figure G

MIXING PLATFORM



PLAN END VIEW SIDE VIEW

Figure H

BOTTOMLESS MEASURING BOX

Note – That 1 cu. ft. of cement, 2 cu. ft. of sand and 4 cu. ft. of pebbles do not make 7 cu. ft. of concrete but 4.5 cu. ft.

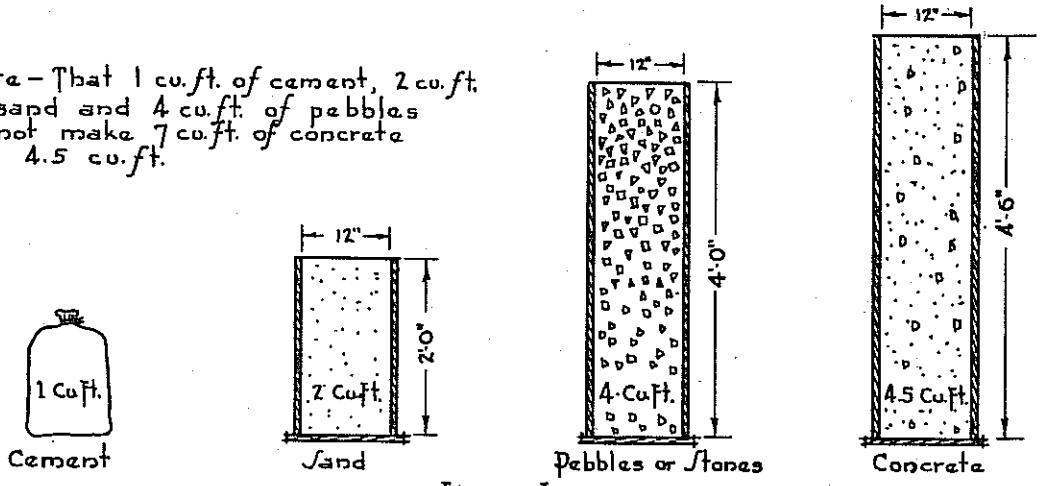


Figure I

CONCRETE MIXTURE

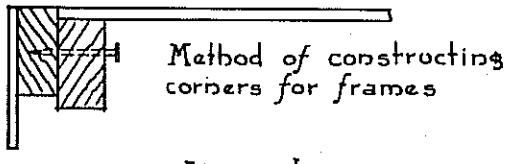


Figure J

FORM CONSTRUCTION

Form boards will absorb considerable moisture; as soon as they are removed, they should be well cleaned and piled in such manner that they will dry out without warping. The same treatment should be applied to the boards from the mixing platform, if they are to be used in the building.

Concrete Water Proofing

Where moisture seepage or dampness is apt to be prevalent, foundation walls may be painted with a preparation called "Atco Koncrete Koat" which will make the wall completely waterproof. This product is manufactured by the American Tar Company of Spokane, Washington.

To Make Smooth Concrete Wall Surface

If a smooth surface is required on a concrete wall, it should be rubbed down as soon as the forms are removed with a carborundum stone to remove all "fins" and irregularities. Porous spots or "gravel pockets" should be filled with cement mortar, after which the wall should be painted with a "cement wash" (cement and water mixed to the consistency of thick cream), rubbed in with a carborundum stone or a brick made of cement and sand. This will produce a smooth surface of even color. Such refinements are not warranted in plain foundation work but may be desirable in finishing porch columns or other work of that nature.

Back Filling

As soon as the forms are removed, the open trench on each side of the foundation wall should be filled with the excavated material and well tamped as the filling progresses. Back filling must be carried high enough to insure proper drainage away from the foundation.

Quantity Estimates

Sand, as it comes from the pit, will weigh around 3000 pounds per cu. yd. and gravel will weigh approximately the same. On this basis, we can say that a wagonload of either sand or gravel will equal 1 cu. yd. and can use the wagonload as a unit in estimating quantities needed and cost of delivery. However, the size of the wagon box or container should be roughly determined, and there must be a check to see that it is filled for each load while delivery is being made.

Based on the minimum requirements for four-room buildings, a cu. yd. of concrete will make about 18 lineal feet of foundation and will consist of approximately 6 sacks of cement, $\frac{1}{2}$ cu. yd. (1500 pounds) sand and 1 cu. yd. (3000 pounds) gravel.

Cost Estimates

The cost of concrete work will depend largely on transportation and labor charges and there is no basis for close estimates until these factors are known. Generally speaking, we can say that foundation costs will range from $1 per lineal foot under favorable conditions, to $2 per lineal foot under the other extreme.

Maintaining the Foundation

If properly constructed, a concrete or stone foundation should require very little maintenance. If cracks develop, an attempt should be made to keep water out of them. Heavy asphalt or pitch is better than mortar for filling cracks in cement walls and there are a number of preparations on the market which are recommended for this purpose. In calking cracks with these preparations, remove all surplus material from the adjoining surface.

Stone foundations should be kept pointed with cement mortar. Pier supports and underpinning should be inspected annually and repairs or renewals made when needed.

Guard against dirt and wash around the foundation. Keep bottom logs, sills, and floor joists at least 4" above the ground. Provide for free circulation of air under all floors. Properly screened ventilators are essential in all foundations and similar openings should be provided in well-chinked underpinning where pier supports are used. Replace decayed sills and keep floors level.

Sills and Anchor Bolts

Unless otherwise specified in the plans, sills, or bearing plates should be 2"x6", laid flat to an even bed and securely bolted to the cement foundation. For a small structure 10'x10', one anchor bolt in the center of each side will be sufficient; but for larger buildings, such as station houses and barns, there should be a bolt about 3' back from each corner and one intermediate bolt about midway between the corner bolts, or as specified in the plans. The bolts should be of 5/8" iron, 12" long. The bolts should extend 1" above the top of the sill and should be provided with washers. Nuts should not be tightened until the concrete is well set.

Drainage

On wet sites it will be necessary to provide suitable drainage around the outside of the footing course. This should consist of farm tile drains laid to drain with the ground slope, or may consist of a course of fairly large rock laid in a trench so as to provide a natural course for the water to follow around the foundation.

Concrete Floors

Concrete floors and walks should have a footing course of 4 to 6" of coarse gravel or crushed rock. Over this, spread a 1-2-3 mixture 3" thick which will be carefully troweled or floated until smooth. Be sure that floors slope toward the drain or door so that water will drain away. Large floor areas should be broken up into blocks 8 or 10 feet square and alternate blocks laid first. When partially set, the intermediate blocks can be placed. This method will help to keep the floor from cracking, which large areas have a tendency to do. U.S. Department of Agriculture Farmers' Bulletin No. 1480, "Small Concrete Construction on the Farm," will be a ready aid to those who have concrete jobs to do.

Chimneys

Substantial and safe chimneys are desirable in all buildings where stoves or fireplaces are used, but their construction may not be warranted in temporary buildings which will be used for only a short time, such as in timber sale operations or in temporary station buildings that are occupied only occasionally during the summer season. As a substitute for chimneys in such buildings, metal safety flues are considered satisfactory. If properly made and installed, they are fairly safe for a few years but they soon burn out and become a fire menace. Metal safety flues require constant attention during the entire period of use.

In extreme cases when cabins are occupied for a brief period, such as during construction work, reconnaissance, et cetera, a reasonable degree of safety may be maintained by the use of ordinary roof jacks. However, this is considered dangerous practice and should be discouraged, especially in timbered regions during periods when forest fires might result.

Chimneys for New Buildings

Although many kinds of chimneys are designed to fit various types of buildings, plain but substantial brick construction is all that we need consider. Concrete chimneys cast in place are used to some extent; but because of their tendency to crack and become unsafe, unless they are reinforced both vertically and horizontally, they are neither economical nor practical under the conditions which we must meet.

Specifications for Brick Chimneys

The walls of brick chimneys shall be not less than 4" in thickness, exclusive of flue lining. A standard-sized brick, laid flatwise, will meet this requirement. Bricks shall not be set on edge in chimney construction. These specifications contemplate a chimney approximately $16\frac{1}{2}$" square, outside measurement (two standard-sized bricks laid end to end, with spaces for mortar joints; see sketch).

The area inside the lining will be approximately 50 square inches, which is considered ample for stoves and ranges. All brick shall be laid in a full bed of mortar. The use of "buttered joints" in chimney work is specifically forbidden.

Chimney Foundations

In frame buildings, chimneys should be built from the ground up, or rest on basement walls. If there is no basement, the footing specifications for interior chimneys will be the same as those for foundation walls. The footing, which shall be not less than 5" thick, shall rest on firm bearing soil to insure against settling. A pit 26½ inches square should be excavated to the depth of the foundation footings and 5" of concrete of the specifications required for the foundation should be poured in the bottom. The quantities required are approximately ½ sack cement, 1 cu. ft. of sand, and 2 cu. ft. of gravel. If the soil is firm and if care is used in pouring, no forms will be needed. This will provide a footing extending 5" out from the brick work on all sides and should be smoothed with a trowel before the cement sets. Centering on the footing, the chimney should be built up without lining to within 12" of the first smoke pipe opening. The hollow center, up to and 2" above this point, should be filled with dry earth or sand. After laying brick, back fill and tamp over footing to a little above the ground surface to prevent collection of water around footing.

Chimney Lining

From a point 12" below the bottom of the first smoke pipe opening and extending to the top, all chimneys must be well lined with standard flue tile. The safety factor depends almost entirely upon the lining, and this operation is the most important in chimney construction.

Tile Flue Lining

Standard flue tile is widely used for lining chimneys and is available anywhere. It has a high rating in fire resistive construction and it is probable that the brick masons who will ordinarily be available for our work can build a better chimney at a lower cost if it is used. The rectangular lining 8½x8½", outside dimensions, will fit our standard chimney and should always be used. The sections are 2' long and are quoted at around 50¢ each. Sections of this lining are also made with openings to facilitate the entrance of the thimble. The opening is scored in the flue lining so that the disc can be removed without injury to the flue. Openings can also be made by chipping with a small chisel without breaking the tile if proper care is used. After the thimble is in place, all openings in both brick and tile should be carefully and thoroughly filled with mortar.

Tile flue lining shall start not less than 12" below the bottom of the first smoke pipe opening and shall extend 4" above the brick work at the top of the chimney.

As a support for the lining, the bricks should extend $\frac{1}{2}$" into the hollow inside of the chimney at the bottom of the first section of tile. The brick chimney should be built around each section of tile as it is placed and all spaces between masonry and lining shall be filled with mortar to the top of the brick work. Special care should be used in placing each section of tile and in sealing the joint with mortar.

Chimney Mortar

Chimney mortar should be made of cement, lime, and sand. Dry hydrated lime is preferable and should be used if available. When hydrated lime is not available, 1 cu. ft. of completely slacked lime putty may be substituted for 50 pounds of dry hydrated lime.

The following formula conforms to building ordinances and may be accepted without question:

2 parts Portland cement
1 part dry hydrated lime
6 parts clean, sharp sand (screened)

Mix cement and lime thoroughly while dry. Then mix with sand and add sufficient water to produce proper consistency. Do not use too much water. Mix the mortar in small batches in order that it may be used within 30 minutes after the water is added. The sand used in this mortar should pass a 12-mesh screen.

Height Above Roof

Chimneys shall be built at least 30" above flat roofs and at least 18" above the ridges of peaked roofs. Although it may, in some cases, be advisable to exceed them, these minimum requirements should ordinarily be satisfactory.

Thimble Construction

Smoke pipe intakes, sufficient to meet all future needs, should be provided when the chimney is built. Metal thimbles of the proper size should be securely set in the chimney walls with mortar as the work progresses. Seven-inch thimbles should be provided for the kitchen range but small or medium-sized heating stoves usually take a six-inch thimble. The top of all smoke pipe openings shall be at least 12" below wooden lath and plaster or other combustible ceiling or joists.

Chimney Flashings

Connections between chimney and roof should be carefully made by using the grade of flashing specified under metal work for shingle roof.

Specifications for Brick

For unexposed work, selected common stock brick will be satisfactory; but for all exposed work (above the roof) face brick #1 red pressed or equal should be used.

Unless care is used in handling brick, especially in hauling long distances, the waste will be enormous. Bricks will be broken and the corners chipped to such an extent that practically the entire lot may be unfit for use. Brick should always be packed in hay or straw for hauling. The waste in tile is even greater than in brick and the same precautions are necessary in handling.

Quantity Estimates

These estimates are based on the standard brick (approximately 8" long, 4" wide, and $2\frac{1}{2}$" thick) with mortar joints about $\frac{1}{2}$" in thickness.

Approximately 250 bricks and 3-3/4 cu. ft. of mortar will be required for each 10 lineal foot of lined chimney. For the unlined part (below the smoke pipe openings) $2\frac{1}{2}$ cu. ft. of mortar will be sufficient for each 10 feet of construction.

The 3-3/4 cu. ft. of mortar will require about 400 pounds of sharp screened sand, 65 pounds of dry hydrated lime, and 125 pounds of Portland cement.

Cost Estimates

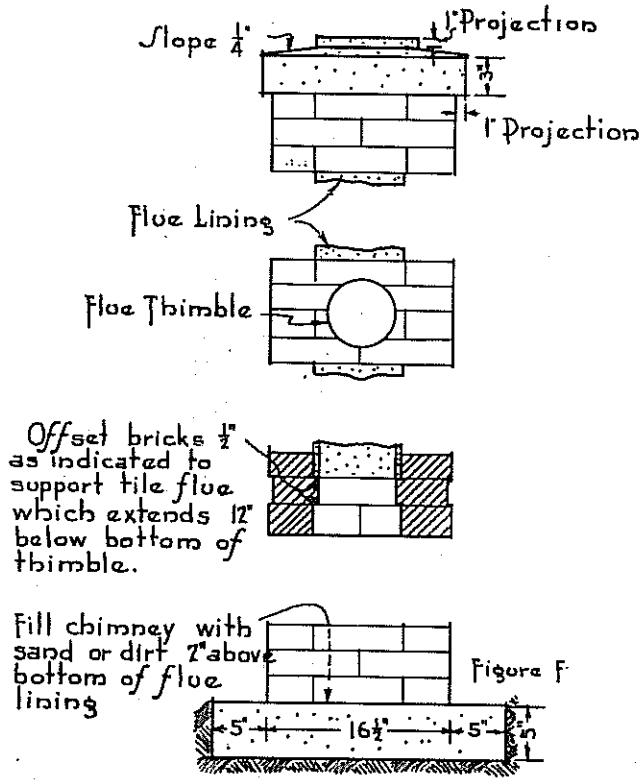
The cost of materials will vary considerably in different localities and final estimates must be based on quotations from local dealers, but rough estimates of chimney costs may be based on the following prices: Selected common stock brick, $14 per M; Good quality face brick, $20 per M; Cement, 85¢ per bag; Hydrated lime, 50¢ per 50-pound bag. The cost of sand at an unknown point cannot be approximated and must be obtained for each job.

Brick will weigh around 5800 pounds per 1000.

The average brick mason, with his helper, will lay about 500 bricks per day in chimney work, including the lining. If a tile lining is contemplated, the cost of tile should be obtained from a local dealer. The labor costs will be about the same as for mortar lining.

Maintenance of Chimneys

Chimneys must be kept in good draft and free from soot. The natural accumulation of soot must be kept well below smoke pipe openings. Chimneys should be cleaned from top to bottom and carefully inspected at least once each year. Chipped and broken mortar around chimneys and fireplaces should be replaced, cracks filled with fresh mortar and any needed repairs made in chimney cap or spark arrester.



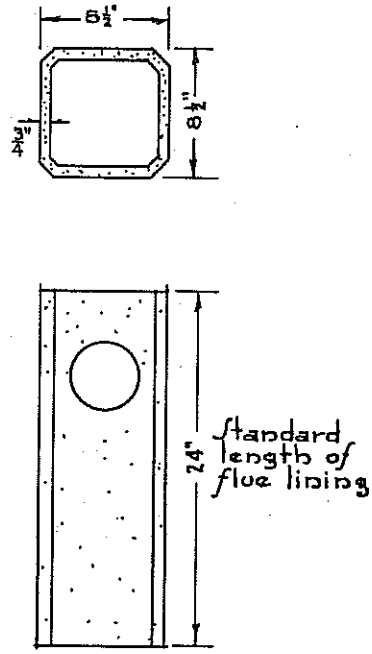
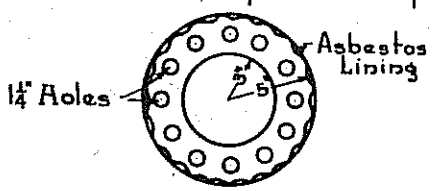
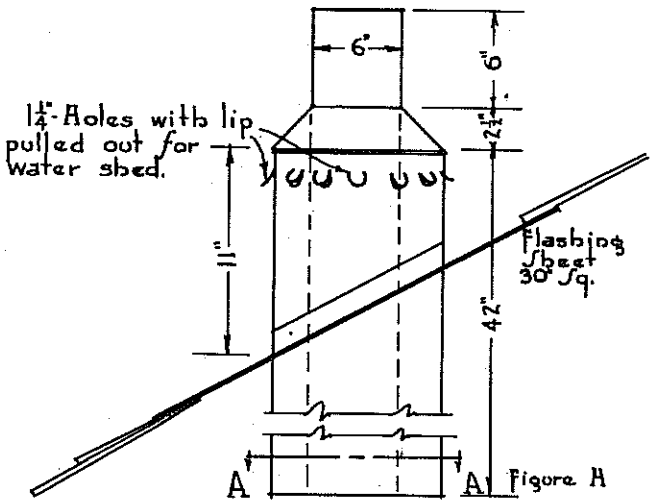


Figure G

CHIMNEY CONSTRUCTION DETAILS



SECTION A-A



DETAIL of ROOF JACK

24-Guage Gal. Iron

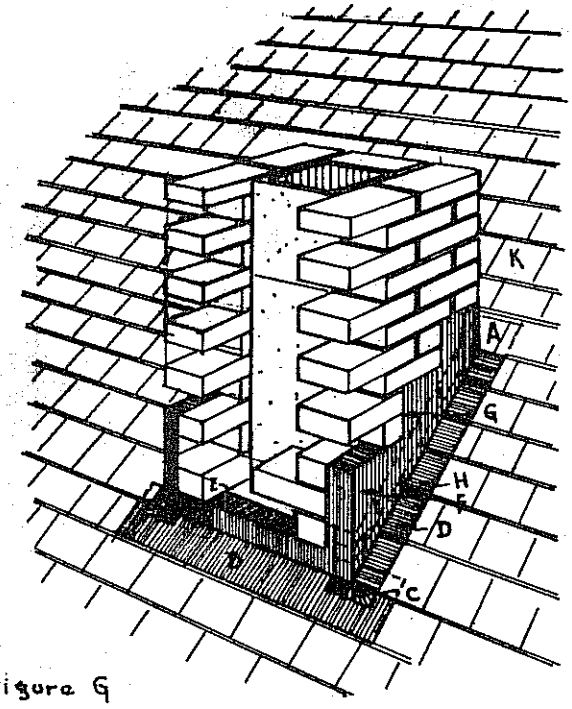
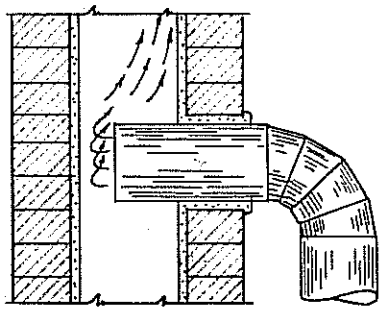


Figure 6

CHIMNEY & ROOF CONNECTION

Sheet metal A should have shingles K over it at least 4 inches. Apron B bent as at E with base flashings C, D, and H and cap flashings F and G, lapping over the base flashings provide watertight construction. When the chimney contains two flues the joints should be separated as shown.



WRONG Figure A

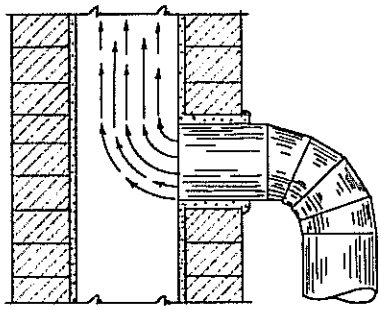


Figure B RIGHT

CHIMNEY CONNECTIONS

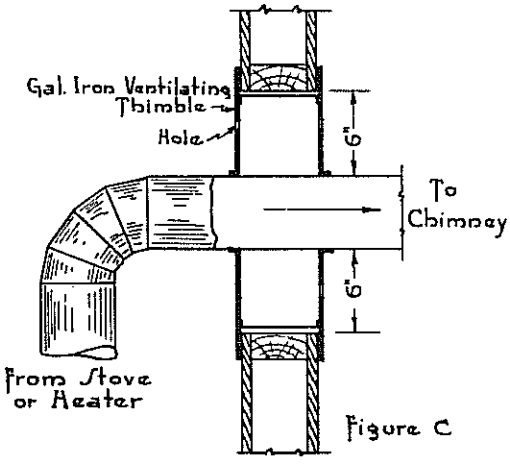


Figure C

PARTITION OPENING

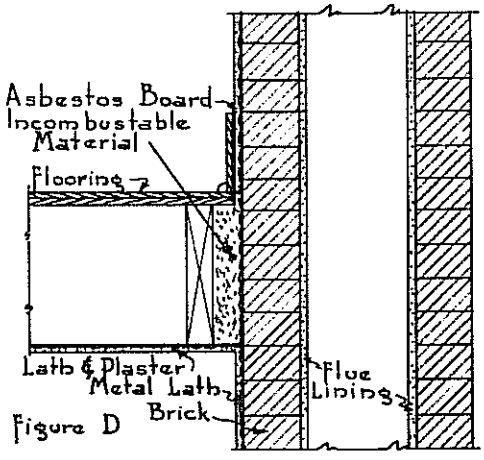
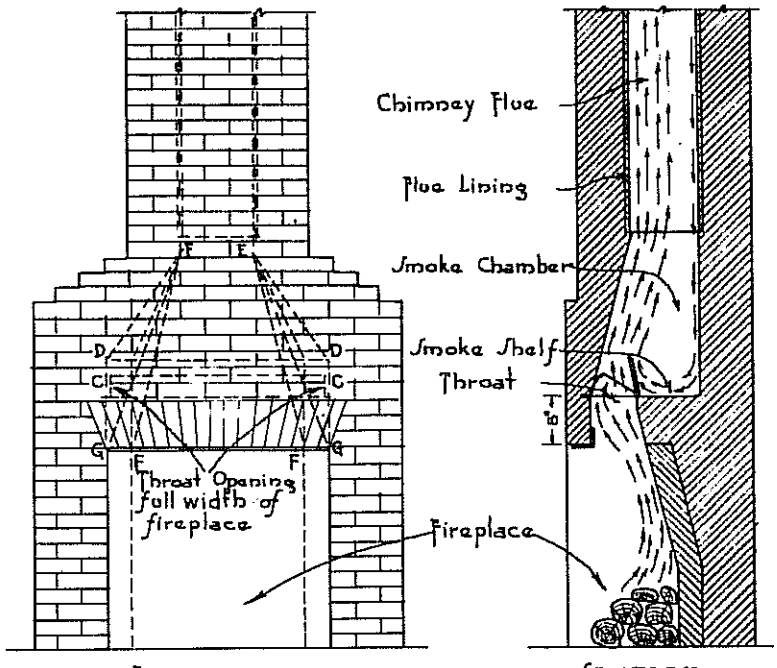


Figure D

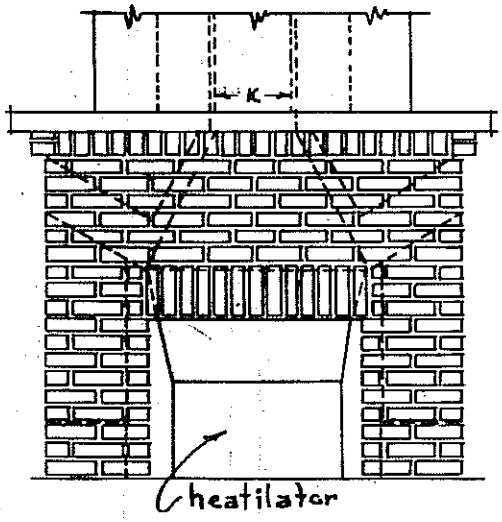
FLOOR & CHIMNEY CONNECTIONS.



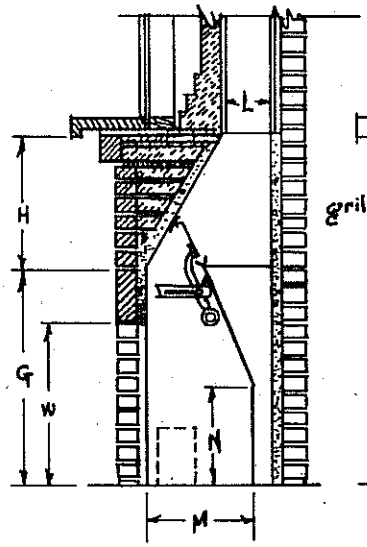
ELEVATION Figure E SECTION

FIREPLACE DETAILS

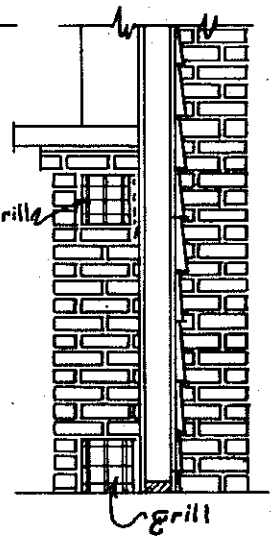
HEATILATOR FIREPLACE (const.)



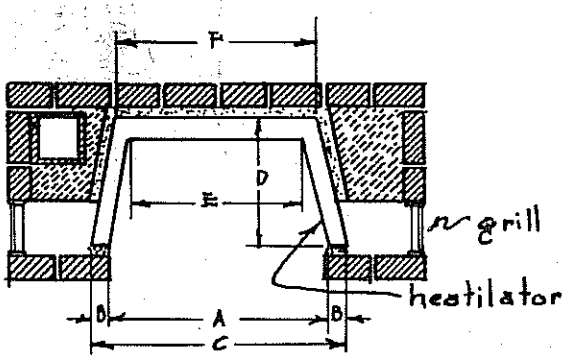
FRONT ELEVATION



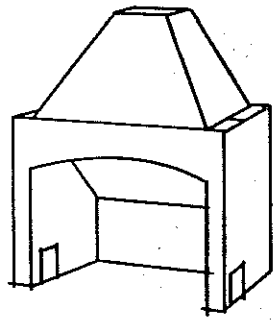
SECTION



SIDE-ELV.



PLAN



HEATILATOR UNIT

Note: The dimensions below are for the heatilator only — not finished fireplace.

Dimensions in Inches

Model	A	B	C	D	E	F	G	H	K	L	M	N	W
28H	28	3	34	18	20	25	32	16	12	8	15	14	25
34H	34½	3	40½	20	27	32	33½	20	12	8	17	15	26
39H	39	4	47	21	32	38	36	20	12	12	17	17½	28

The latter should be kept rigid at all times. Wind play will soon displace chimney cap and top course of brick.

Chimneys in Old Buildings

We have a number of dwellings and offices which have not yet been provided with satisfactory chimneys. In some cases, the type and use of such buildings will warrant the construction of a brick chimney, but because of the arrangement of the rooms or for other reasons it may not be practical to build it from the ground up as specified for new buildings.

If there are upstairs rooms which will permit frequent inspection of smoke pipe connections, the chimney may be supported by partition plates, although this is not good practice. In such cases, a ventilated thimble should be used to carry the smoke pipe through the second floor. This thimble should extend at least 2" below the ceiling and not less than that distance above the upper floor. Extra studding must also be provided to carry the additional weight.

Smoke pipe connections at the bottom of chimneys or above the ceilings of one-story buildings are dangerous, and for such structures the chimney, if not built from the ground up, must be supported by timbers resting on the floor.

If the chimney is not built from the ground up, the floor joists immediately under it must be blocked up in a substantial manner in order that the floor will carry the additional weight without sagging and these precautions must be taken in all cases, even if the chimney rests on partition plates.

A three-sided box of 2" lumber with the lower end resting on the floor makes a good support for a short chimney and the space may be utilized for storage by providing shelves or door. The support should be 16½" square with a cover of 2" material on the upper end which should be not less than 3 feet below the ceiling. On the top of the support, first place two layers of brick, laid solid, in thin layers of mortar. The chimney should be started on this base and lined throughout. The first 5" of the hollow inside should be filled with sand and the bottom of the smoke pipe opening should be 6" above this sand filling and not less than 18" below the ceiling. The chimney should be built to the required elevation of the dimensions, and in the manner specified for full length chimneys.

U. S. Department of Agriculture Farmers' Bulletin No. 1430 "Chimneys and Fireplaces (how to build them)," should be secured for additional information on chimneys.

FRAME BUILDING CONSTRUCTION

Standard plans for all kinds of buildings show the kind of construction and the class of material to be used. There are many

details of carpenter work, however, which cannot be shown on individual plans. An attempt will be made to cover most of these by description, and more clearly by illustration in this handbook. On any but the smallest job it will be advisable to employ a good carpenter. The mechanical results will more than pay for the additional wages paid a skilled workman.

Care of Materials

When lumber or any other material is delivered to the job it must be stored away with care so as to preserve it in good condition until needed. Lumber must be piled on skids or sills up off the ground and must be laid up in even piles, with the various sizes segregated so that it will not be necessary to paw over the whole pile in order to find any particular piece desired for immediate use. Door and window frames, and millwork, should be stored in a building if at all possible. Lumber should be piled under a cover of some sort so as to keep it from warping or getting wet. It won't hurt shingles and laths to get wet; in fact, they will lay better if a little damp. Wall board should be stood on edge and not laid flat.

Progressively there are seven separate steps or phases in the erection of a frame building once the foundation has been prepared.

Material

The frame or skeleton part of the structure is that upon which all other parts of the building are supported. Needless to say, the erection of the frame is the most important part of the job. Its members are all of material which is 2" in thickness and from 4" to 12" in width. Lengths depend upon the plan of the building. This material in the lumber trade is called "dimension" lumber and in this Region is usually sawed from fir and larch timber. It is graded and sold in accordance with the "Standard Grading Rules" of the Western Pine Association, and is divided into three grades - No. 1 dimension, No. 2 dimension, and No. 3 dimension. When buying this class of material it is customary to order it as follows:

25 pcs. 2"x8" - 16' S 4 S, No. 1 dim. F. & L.,

which being interpreted means you have ordered 25 pieces two inches thick, eight inches wide and sixteen feet long of fir and/or larch plank surfaced or planed on all four sides, which will usually be used for floor joist in a building. No. 1 dimension is the standard grade for use in practically all building construction. No. 2 dimension may be used in some cases where strength of material, straightness or imperfections of manufacture will not seriously weaken the structure in any way. It is entirely satisfactory where short lengths up to eight feet can be used, but should never be used for floor joist or studding in exterior walls that are more than eight feet in height. When a straight smooth wall is desired, such as in a dwelling where the finish is to be lath and plaster, only No. 1 dimension should be used.

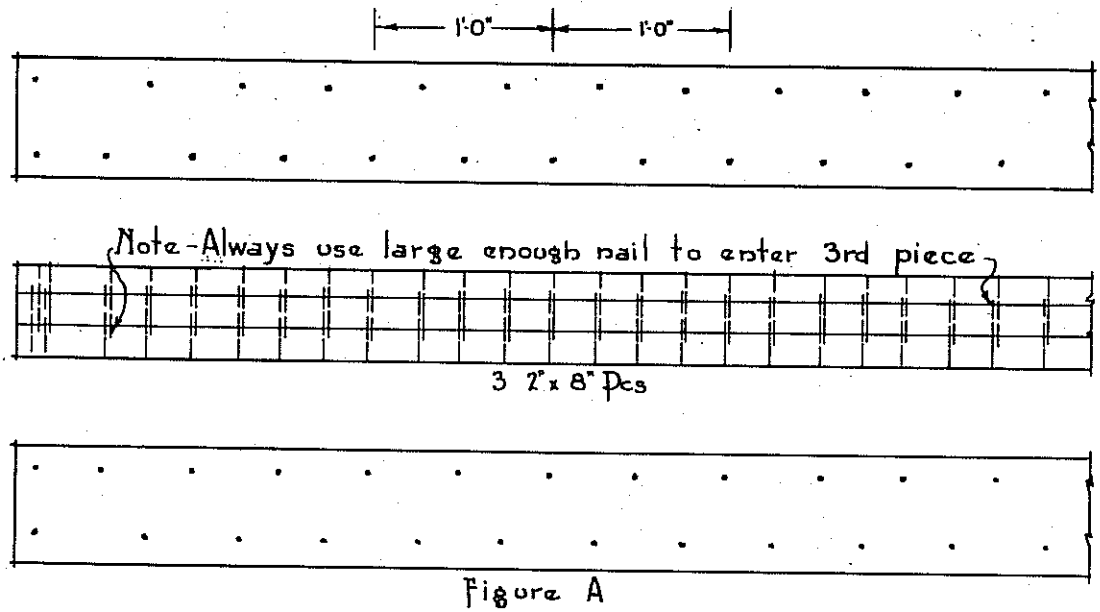


Figure A

PROPER NAILING FOR BUILT-UP GIRDERS

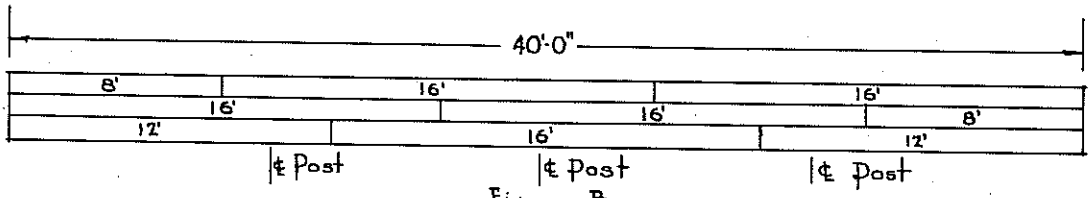


Figure B

Example using 6"x8" - 40'-0" with 2"x8"x16'
If longer lengths of material can be had they should be used

METHOD of SPLICING GIRDER

No Scale

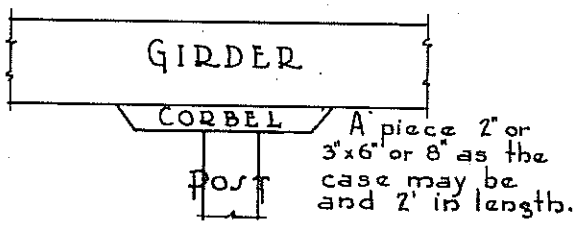


Figure C

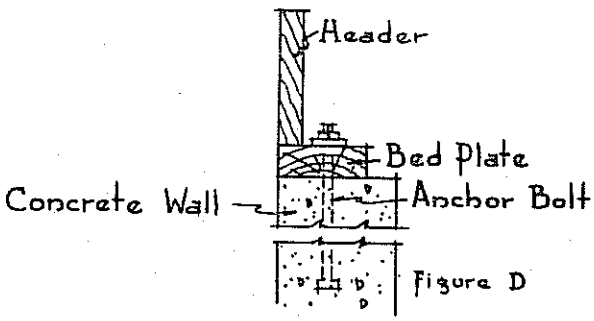


Figure D

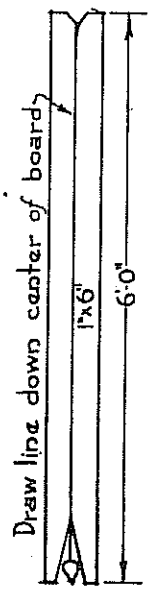


Figure E

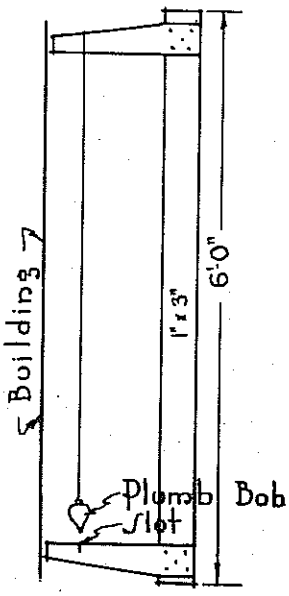


Figure F

PLUMB BOB FRAMES

Rough unsurfaced material is seldom used any more since such material as it comes from the saw is not uniformly of even thickness or width. For that reason it is the common practice to surface all dimension material before it leaves the mill. While it is the custom to designate dimension material by the standard widths of thicknesses in even inches, the actual sizes are as shown in the following table. And in computing lengths in cutting up material it is necessary to take the actual lumber dimensions into consideration rather than the descriptive dimensions.

Dimension S 4 S

2x4 to 1-5/8x3-5/8	3x10 to 2-1/2x9-1/2
2x6 to 1-5/8x5-5/8	3x12 to 2-1/2x11-1/2
2x8 to 1-5/8x8-1/2	4x4 to 3-5/8x3-5/8
2x10 to 1-5/8x9-1/2	4x6 to 3-5/8x5-5/8
2x12 to 1-5/8x11-1/2	6x6 to 5-5/8x5-5/8
3x4 to 2-1/2x3-5/8	6x8 to 5-5/8x7-1/2
3x6 to 2-1/2x5-5/8	8x8 to 7-1/2x7-1/2
3x8 to 2-1/2x7-1/2	

When purchasing material for standard plans it is essential that the lumber dealer be required to furnish material of these dimensions, since all plans are based on these dimensions. Dimension material is usually cut in 10-12-14-16-foot lengths, and some retail yards carry longer lengths. Lengths up to 24 feet can be secured on special order but they also cost more per board foot.

Framing

The erection of the skeleton or frame of the building starts on top of the foundation. The first step is to frame and place the long girder which usually, if the building has any width over 12 feet, extends from front to rear of the foundation. Its ends will be supported in "pockets" in the foundation since its top surface must be level with the bedplate of the box sill and its center will be supported on two or more posts not over 10 feet apart. It is usually made up of three 2"x8" pieces spiked together so as to form one continuous piece with joints broken at regular intervals to give it the maximum strength. It must be well nailed with 20d common nails placed along each edge and staggered. See accompanying illustrations.

The posts which support the center of the girder must be placed upon solid footing so that they will not settle under the weight of the building and thus throw the floors out of level. A block called a "corbel" should be placed between the top of the post and the girder as shown in the illustration.

Sills

The next step is to frame the box sill. This consists of a bedplate which is a 2x6 or a 2x8 which lies flat on the wall and is

bolted down, and a header which is the same size as the floor joist. The bedplate is laid out on the wall and the places for the anchor bolt holes marked and bored. The header is then spiked to the bedplate.

The bedplate should be laid on a layer of cement mortar about $\frac{1}{2}$" in thickness so that all unevenness of the wall top will be filled up and a tight joint secured between the sill and the foundation.

Floor Joists

After the box sill is in place, lay off with the square the location of the floor joists. These are usually spaced 16" from center to center. The center of the end joist is measured from the outside edge of the box sill. If the span of the building requires more than one length of joist and the ends of the joists are butted together in the center, the marks on each side will be in the same position, but if the joists are lapped together at the center then the center marks on one side must offset the thickness of the joist in order that the joists may be parallel to each other. The ends of the joists are nailed to the box sill with two 20d spikes. They are toenailed to the girder with 10d nails to hold them in place. If the joists are not straight they should be set with the bow or back up. The floor weight will soon straighten them out unless the bow is too much, in which case the piece should be discarded or used for short lengths. Floor joists should be doubled under all partitions. After the joists are all in place the bridging should be nailed in place. A spacer board should be laid across the center of the joist so that when the bridging is nailed in place the joist will be straight. Bridging is not essential for spans of 12 feet or less, or where a center support is placed under the center of the span. Bridging is usually either 1x3 or 2x2 material. It must be cut to the correct bevel and nailed at each end with two 8d nails. Methods of cutting bridging, and leveling floor joists are shown in the accompanying illustrations.

Subfloor

The main or first floor of nearly all buildings will have a false floor. This will be laid next and will be either one-inch sheathing or shiplap, and it should be laid diagonal to the floor joists. Boards 8" or less in width should have two 8d common nails at each joist. Wider boards should have three nails to each joist. Do not skip joists in nailing subflooring.

Walls

The accompanying illustrations show the correct methods to use in putting up the walls of a frame building. The soleplates or bedplates are first laid out and the spacing of the studding marked on them. The top plate should also be marked at the same time so that the marks on each coincide with the other. Soleplates are single and

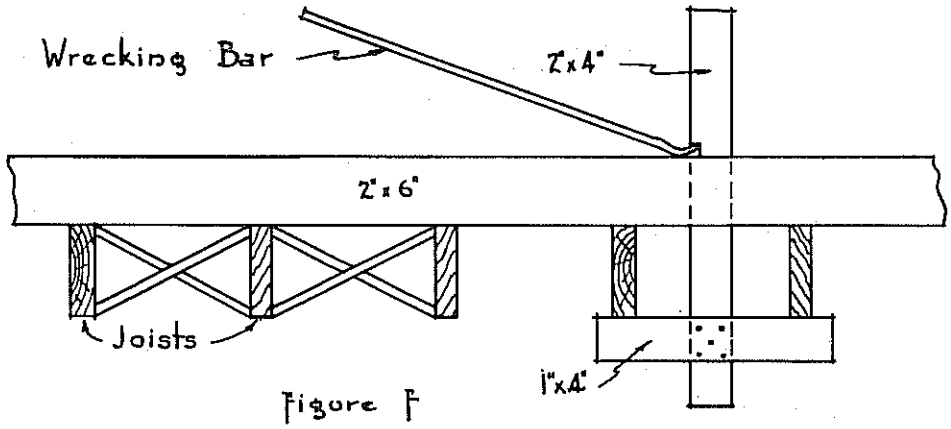


Figure F

METHOD of LEVELING JOISTS FOR BRIDGING

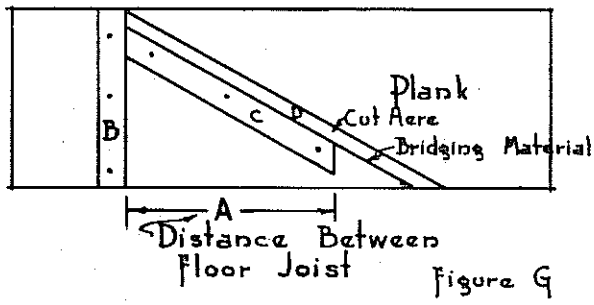


Figure G

METHOD of CUTTING BRIDGING

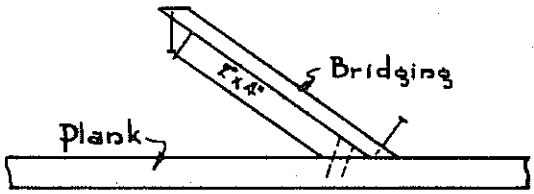


Figure H

METHOD of NAILING BRIDGING

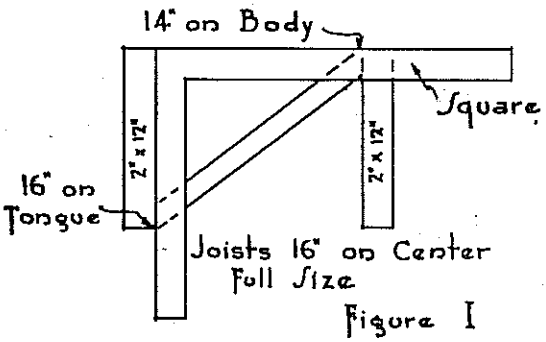


Figure I

METHOD FOR MEASURING & CUTTING BRIDGING BY USE of SQUARE ONLY

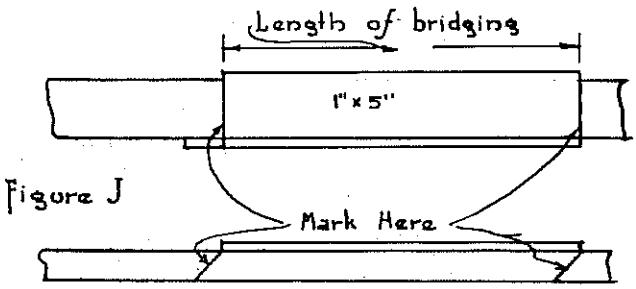


Figure J

PATTERN FOR BRIDGING

HOUSE FRAMING DETAILS

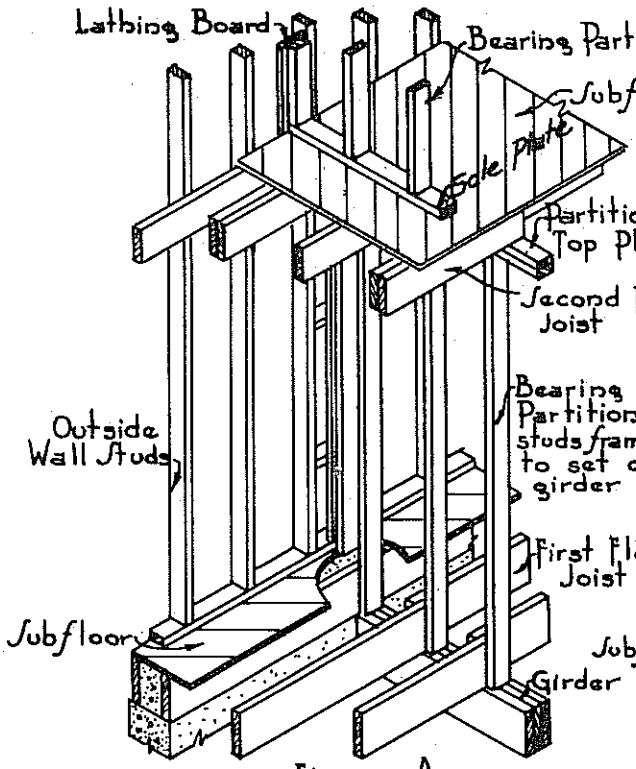


Figure A
Framing For Bearing Partition

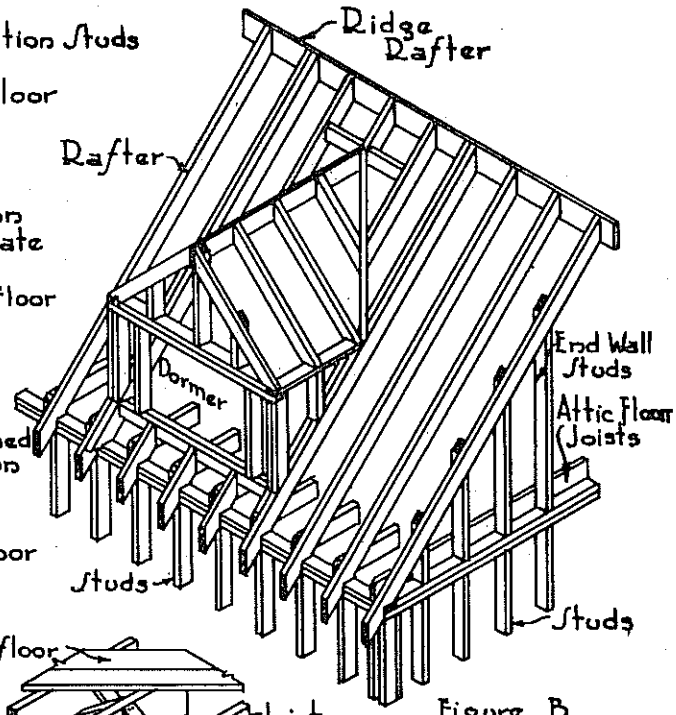


Figure B
Roof & Dormer Framing.

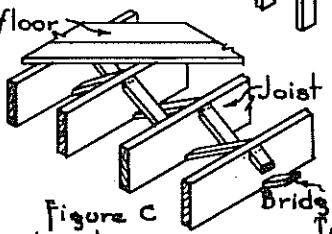


Figure C
Joist Bridging
Note: Bridging should be nailed at top only until after subfloor is laid.

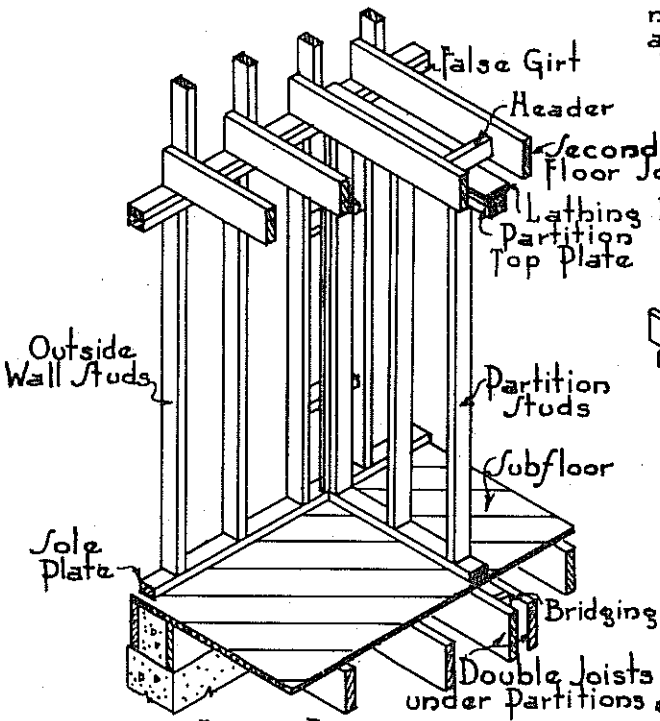


Figure D
Framing For Non-Bearing Partition

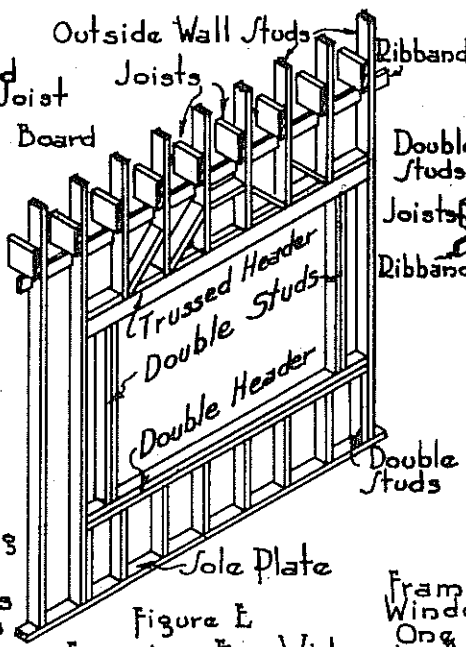


Figure E
Framing For Wide Window Openings

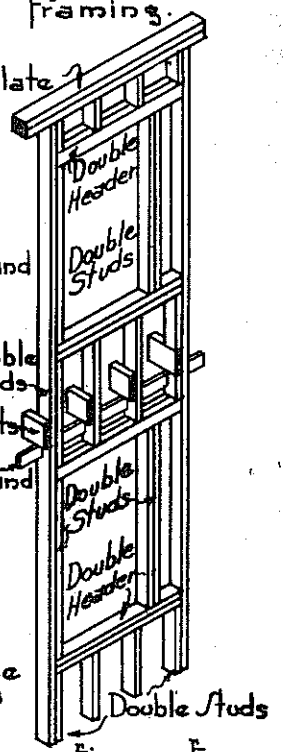


Figure F
Framing For Two Window Openings One above the other in Bearing Wall

HOUSE FRAMING DETAILS

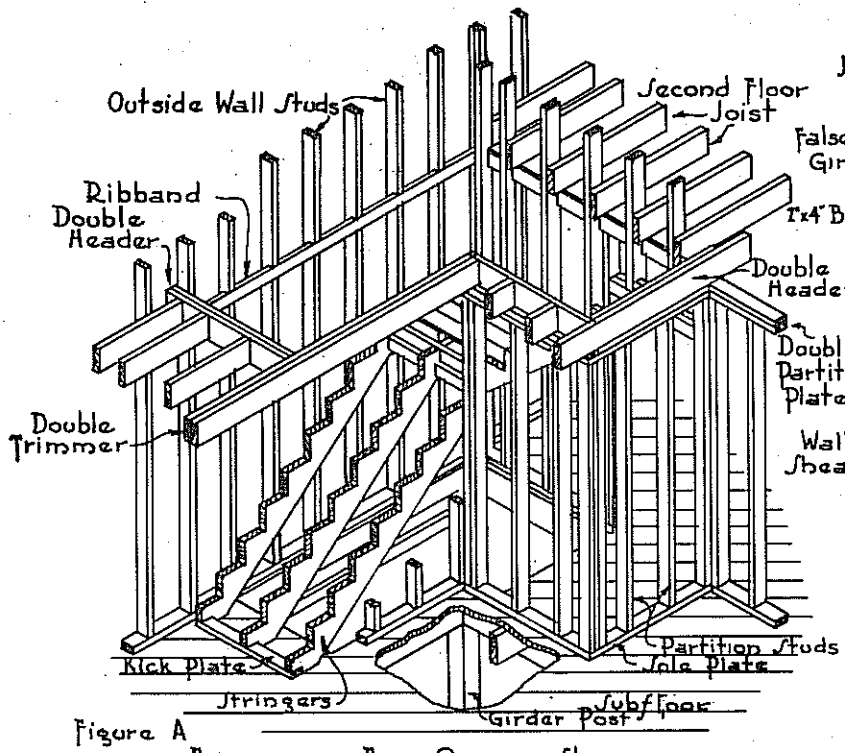


Figure A

Framing For Open Stairway

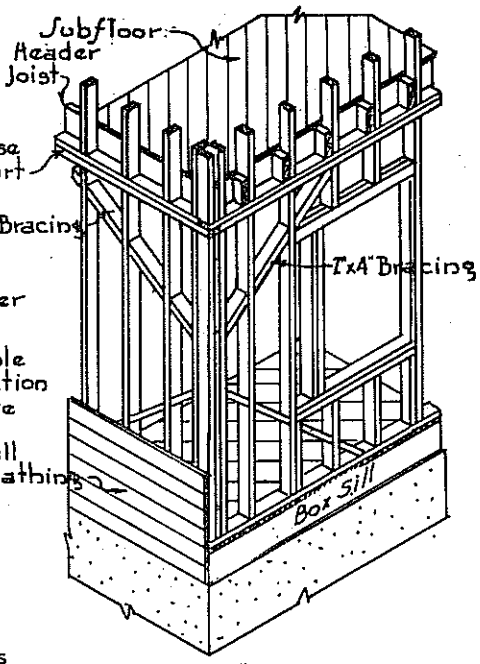


Figure B

Bracing By 2"x4" Between Studs. Sheathing applied Horizontally

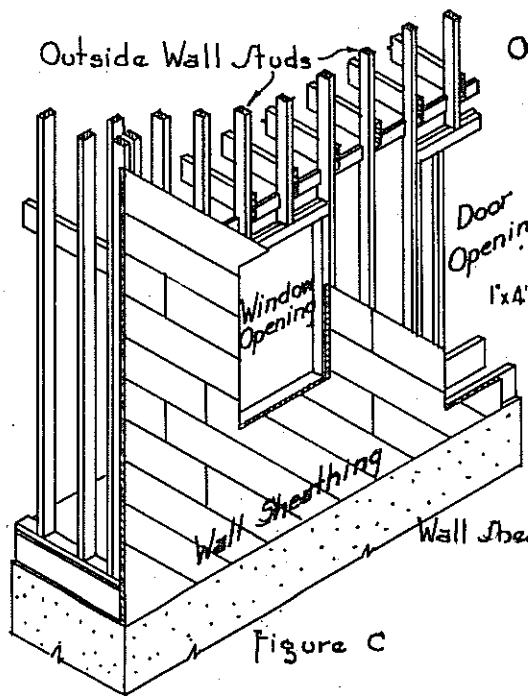


Figure C

Bracing Secured By Wall Sheathing Applied Diagonally

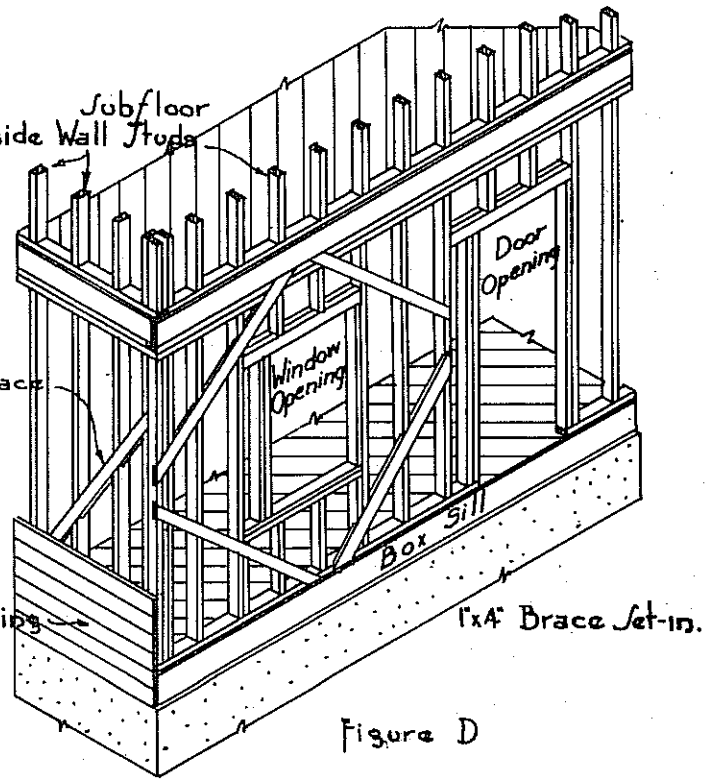


Figure D

Bracing with 1"x4" Mortised to Frame Sheathing Applied Horizontally

top plates are double. It is good practice to assemble all of one side wall or as much as can be raised handily on the floor of the building. In this way the studs can be nailed through the soleplate with two 20d nails instead of being toenailed as is necessary if the soleplate is nailed down first. Studding will be spaced 16", 18" or 24" center to center. The plate members should be as straight as it is possible to get them so that the wall will be straight after erection. It is customary to set a full set of studs in each wall and to cut out the openings afterward. Studs for a one-story building with an 8-foot ceiling will be cut 7'9" long.

Sway Bracing

One of the most important things about a frame wall is to have it properly sway braced. Where outside walls have a thickness of sheathing under the siding this is accomplished by laying the sheathing diagonal to the studding, starting at the bottom of each corner and breaking joint on the center studding of the wall. There should be two 8d common nails to each stud for each board 8" or less in width. Where the outside wall does not have the sheathing coat it is necessary to sway brace by putting in a 2x4 brace at each corner. There are two ways of doing this: by cutting the brace pieces between the studs and nailing carefully, or by putting in a full piece for the brace and cutting the studs. The latter is considered as being the best. Another way is to fit a piece of 1x4 or 1x6 into the face of the studs and corner post. This requires more work since the brace must be gained into each stud which it intersects.

When a section of the wall has been set up the soleplate should be lined up in place and nailed down with 20d nails on each joist. The next important step is to plumb the corner post and brace it. This must be accurately done. A plumb board should be used for this purpose. The use of a carpenter's spirit level is satisfactory but is not as accurate, on account of its short length, as a longer plumb board. A board 10 or 12 feet in length should be used as a temporary brace, nailed to the box sill on the outside and to the corner post at least 6 feet above the floor. Each corner of the building must be plumbed separately and all interior lines brought into the same plane as the sides of the corner posts.

Roof Framing

After the walls and partitions are in place, the ceiling or second floor joist, as the case may be, should be placed and the roof structure framed and placed. There appears to be a widespread impression that laying out a rafter for a roof is a mystical art to be approached with fear and trembling by the novice. As a matter of fact, roof framing is a relatively simple matter if a few fundamental facts are kept in mind. Practically all buildings for the Region are designed with a gable type roof which is the simplest form or type of roof. In the appendix will be found a fairly complete illustrated description of practical methods of roof framing. This discussion

and the illustrations were taken from a series of articles printed in the "American Builder," a monthly magazine for contractors and builders.

Rafters are normally spaced 16, 18, or 24 inches center to center, depending upon the span of the roof and the size of the rafter material. Two by four rafters should seldom be spaced more than 18" on very short spans. The standard roof pitch is one-third. In some few cases, where heavy snowfall is encountered, a one-half pitch roof may be used. Usually, however, it is more economical to properly brace a third pitch roof to carry the load than it is to build a one-half pitch roof. A ridge board need not be used since the proper spacing of the rafters can be secured by laying off a piece of sheathing with the proper spacing and temporarily nailing it to the rafters near the ridge as they are raised into place. A ridge board does not serve any particularly useful purpose, and it is usually much easier to nail two rafters together on the floor and then raise the assembled pair into place. The rafter should be toenailed to the plate at the heel or seat cut and spiked to the ceiling joist also. Eaves are usually 12, 18, or 24", depending upon the size of the building.

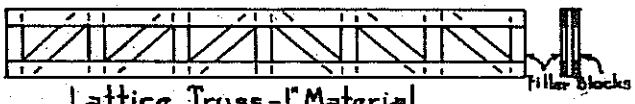
The rafter pair at each end of the building should be plumbed in line with the lower wall and all interior rafters made to conform. Rafter ties, sway bracing, et cetera, should be placed before the roof sheathing is put on.

If the side wall plates are lined up and the rafters carefully cut to pattern, the eave ends of the rafters should be in line. If they are not, it will be necessary to rim them down to meet the shortest length. As a general rule, roof sheathing should be laid tight. Exceptions to this rule are shown on individual plans. Also, as a general rule, a layer of tar paper will be placed between the sheathing and the shingles. The statement is sometimes made that tar paper will rot the shingles. There is absolutely no foundation in fact for any such statement. The tar paper serves several useful purposes. It is good heat insulation, which is desirable in all buildings. It is a secondary protection against leaks in the roof due to failure of the shingles, and it helps to exclude dust.

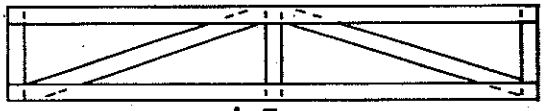
Cutting Materials

In cutting up dimension material it is customary practice to lay off and cut a pattern for each item. The pattern is then used to mark the rest of the material for that item. Dimension material is supposed to have both ends squared ready for fitting, but a considerable percentage of pieces will not be truly square, and for that reason it is necessary to check every piece before it is cut up. By following the plans carefully it is practicable to frame an entire structure before erection is started. When this is done, a frame building can be erected in a very short time.

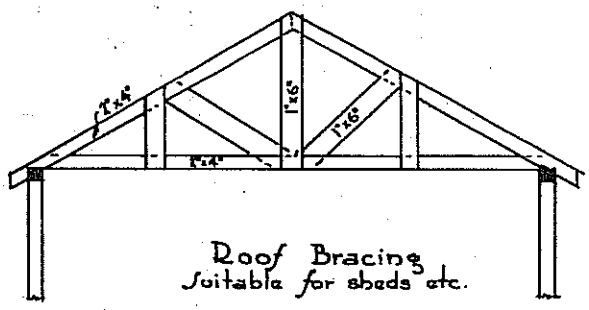
WOOD ROOF TRUSSES



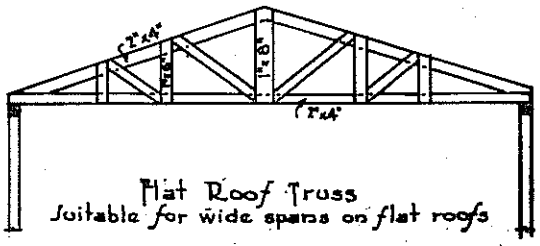
Lattice Truss - 1" Material
Used where vertical space is limited



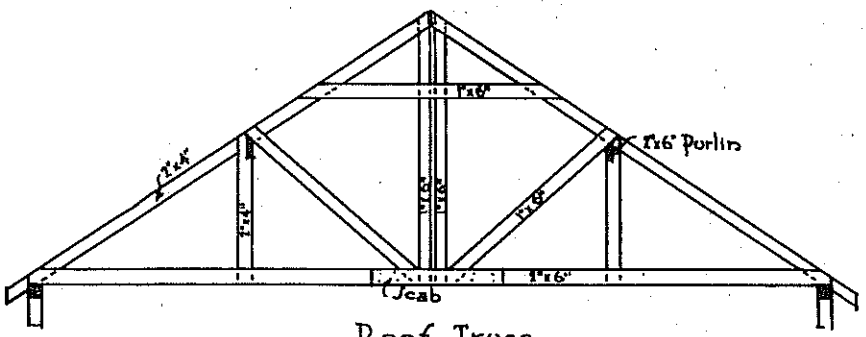
A-Truss
Requires more vertical space than Lattice Type.



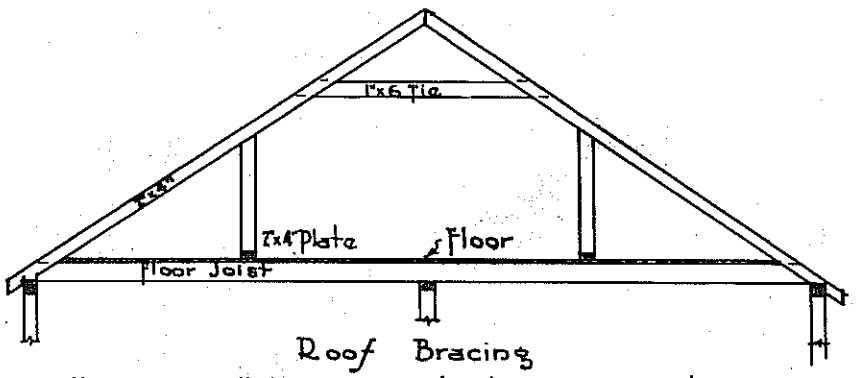
Roof Bracing
Suitable for sheds etc.



Flat Roof Truss
Suitable for wide spans on flat roofs



Roof Truss
Used where rigid roof is necessary and loft space is not to be utilized



Roof Bracing
Used in small house construction where loft space is desired. Vertical 2"x4" braces at each rafter serve as braces and second floor studding as well.

Siding

After the roof has been framed, the second step in construction of a frame building is the exterior wall and roof coverings. When a building, such as a ranger dwelling, is to be occupied during cold weather the exterior wall will have three thicknesses of covering: Shiplap next to the studs and laid diagonally for sway bracing, commonly called "sheeting" or sheathing; a layer of tar paper for wind and heat insulation; and the finish covering which will be some form of board siding, either 6" or 8" drop siding or rustic, or 8" bevel siding or cedar shakes. For those buildings where warmth is not an important factor, the exterior wall covering will be only one thickness, and, in some few cases, two thicknesses. The one thickness will usually be the same type of siding as described above, and it may be desirable in some buildings to put a layer of tar paper next to the studding under the siding as additional heat insulation secured for a very nominal cost. Wall sheathing should be nailed with 8d common nails and drop siding with 8d casing or 8d box nails, bevel siding with 6d finish nails.

Openings

The third step in frame construction is the placing of the window and door frames, which comes in between the laying of the wall sheathing and the siding. Usually it will be more economical to purchase ready-made frames which come knocked down ready to be assembled. All standard plans contemplate the use of the commercial product, except in those few cases where construction of the frame on the job may be deemed more practicable. The accompanying illustrations show the details of door and window frame construction and the method of setting them into the wall.

Windows and window frames are always designated by the size of the glass in the window.

Always give width first, length or height second, then thickness.

Sash means only one piece to fill opening.

Window means two pieces, upper and lower sash.

Orders for windows should state the number of lights in the windows, size of glass, thickness of sash, and whether check or plain rail. The difference between check and plain rail is illustrated in the accompanying sketches. Plain rail sashes are seldom used any more.

Window frames and windows are ordered separately. The frame will include the jambs, blind and parting stops, sill and outside casing. The sash, inside casing and inside window stop must be ordered separately. Windows are described as double hung or double run, because two sashes, one above the other, slide in parallel grooves past each other.

Frames for single sash, or sliding sash, are described as sash frames. Various kinds of sash are known as cellar sash, barn sash, and casement sash.

Cellar sashes have from one to four lights and are 1-3/8" thick.

Barn sashes have from 4 to 12 lights and are 1-1/8" thick for 4 to 6 lights and 1-3/8" thick for 8 to 12 lights.

When ordering cellar and barn sashes specify the number of lights per sash and the size, e.g.:

1, Barn sash, 6 light 10 x 12.

Casement sashes are usually ordered by the size of the sash rather than the glass. A millwork catalog should be consulted before ordering casement sashes.

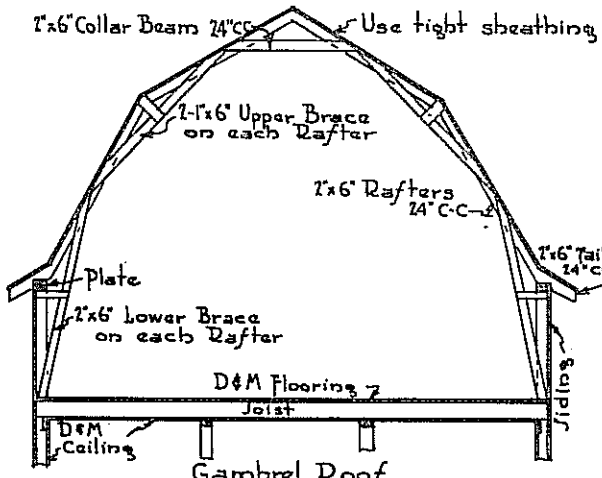
The proper way to assemble a door or window frame is to nail the head jamb to the two-side jambs and then nail the side jambs to the sill. Use 8d box nails. After this is done lay the frame with the inside edges upmost. Take a piece of 1x2 about 4 or 5' in length, lay it diagonally across one upper corner and nail one end about midway of one side jamb. Next, with the steel square laid in one corner, bring the frame square. Nail the other end of temporary cross brace. Check all four corners with the square to see that the frame is squared all around. Now saw off the projecting end of the cross brace flush with the outside of the jambs. Turn the frame over and nail the outside casings in place. Use 8d finish nails. The frame is now ready to set in the wall. The opening has been framed so as to be a little larger than the frame as it may not be exactly square. Center the frame in the opening and with the carpenter's spirit level see that the sill is level. Shims under one end may be necessary to bring the sill level. When this has been done the outside casing can be nailed to the sheathing or siding as the case may be. Use 8d finish nails. Shims should be placed behind door jambs about every two feet and the jambs nailed to the studding through the shims so as to give the jambs which carry the swinging door as much support as possible.

Interior door frames are not set until after the inside walls have been plastered or otherwise finished. Their construction is illustrated on the accompanying plates.

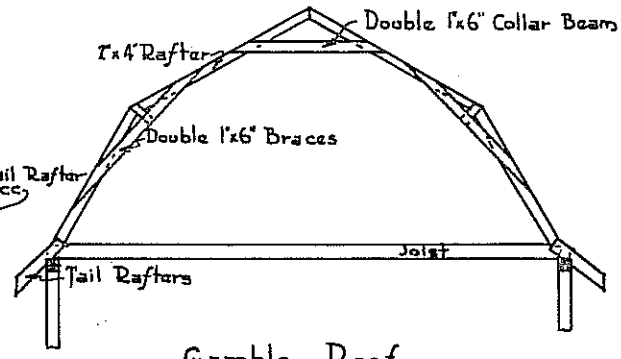
Exterior Walls

There are a large number of patterns of siding in use. For this Region, use will be confined to common drop siding, rustic, bevel, and lap siding. Drop siding has a tongue and groove joint, and the rustic has a shiplap joint. The standard drop siding is called pattern #106, while the same pattern in rustic is #105. Rustic is much easier to lay since it fits together easier than the tongue and groove pattern. Bevel siding is made in several different patterns, either tongue and groove,

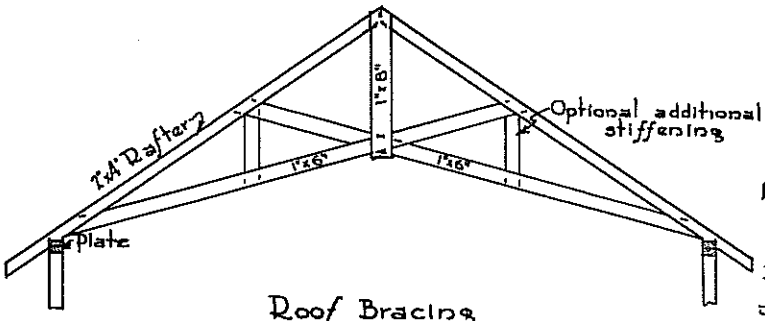
WOOD ROOF TRUSSES



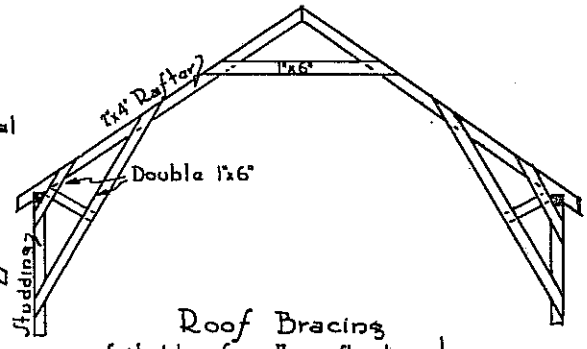
Gambrel Roof
For use where large amount of loft space is required



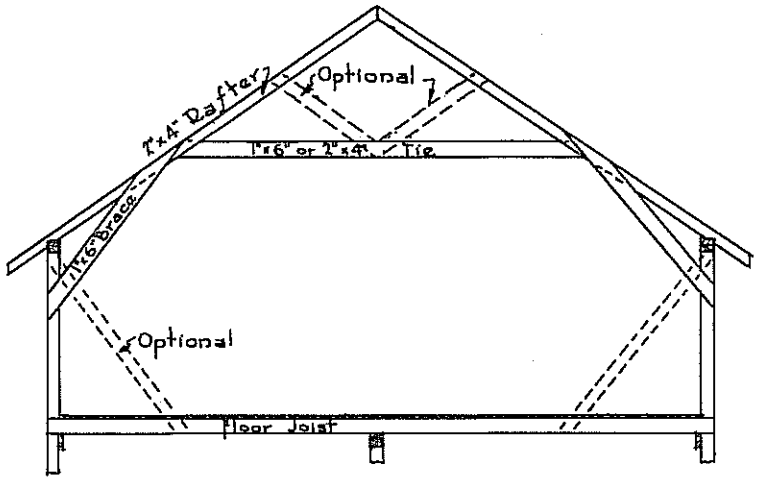
Gamble Roof
For use in lofts where moderate amount of loft is required



Roof Bracing
For Barn & Shed roof.



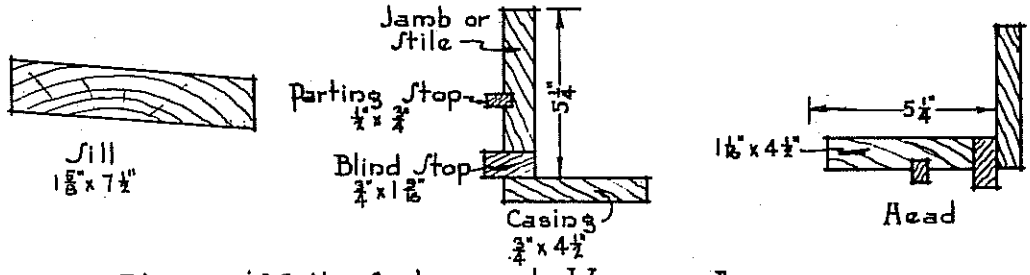
Roof Bracing
Suitable for Hay Sheds etc.



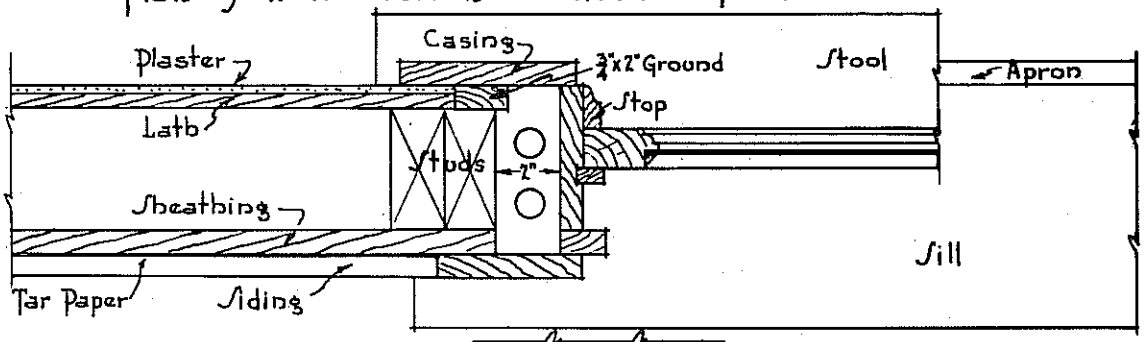
Roof Bracing
Used where second floor space is required

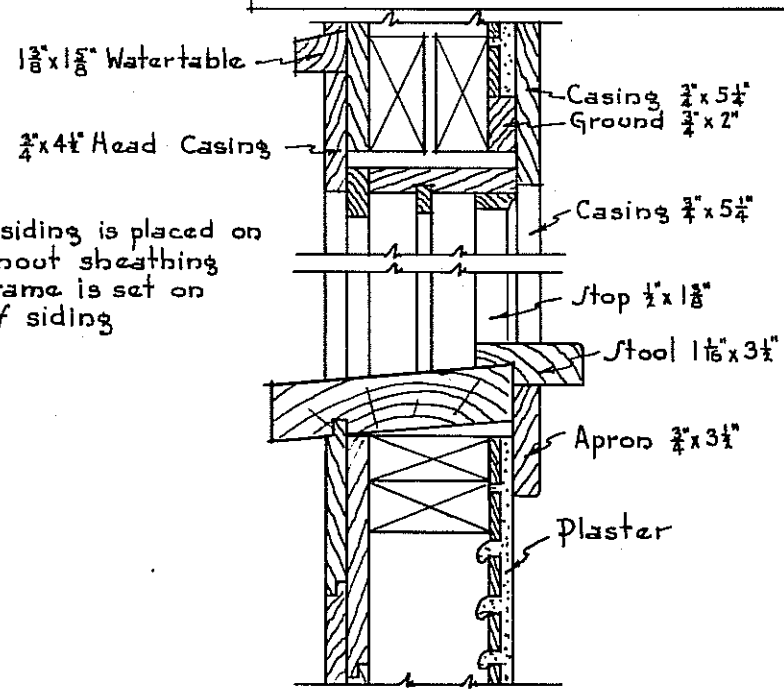
WINDOW FRAMES

Parts of a Window Frame as it comes from the factory



Plan of Wall Section at Window Frame





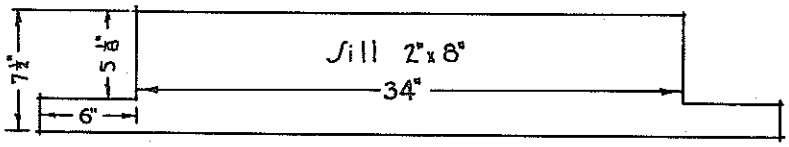
Note: If siding is placed on studs without sheathing Window Frame is set on outside of siding

A DOUBLE HUNG, CHECK RAIL WINDOW

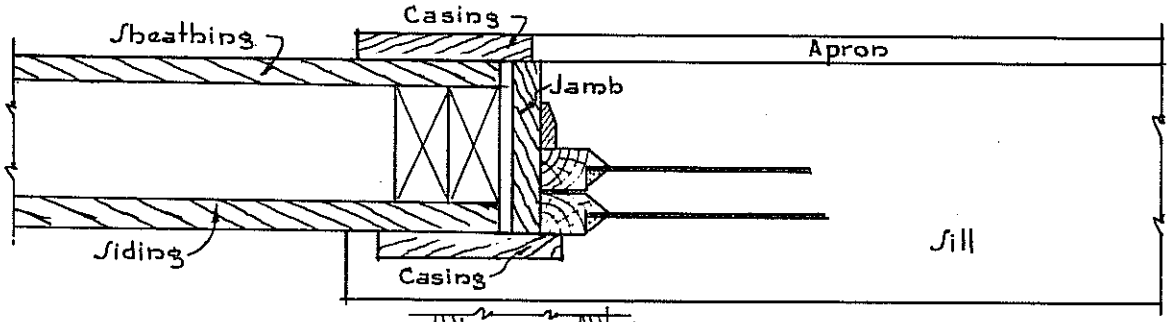
Sash 1 3/8" Thick

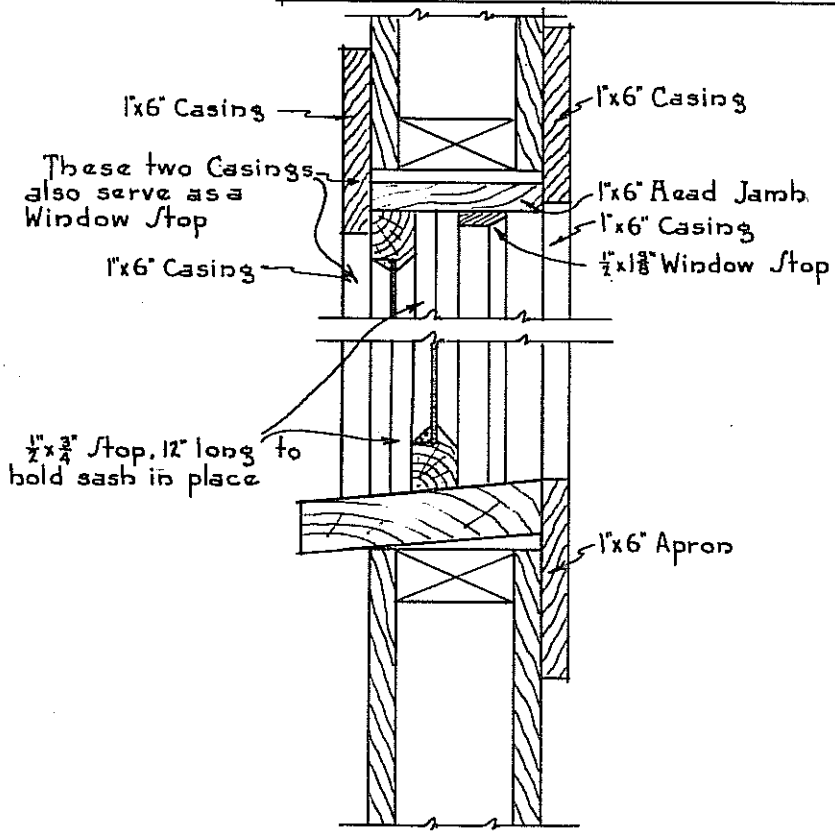
WINDOW FRAMES

A simple frame for plain rail sash and no weights
2 Sash, 6 light, 10"x12"



Make this cut so that sill will slope ½" to outside. Bevel side to match.

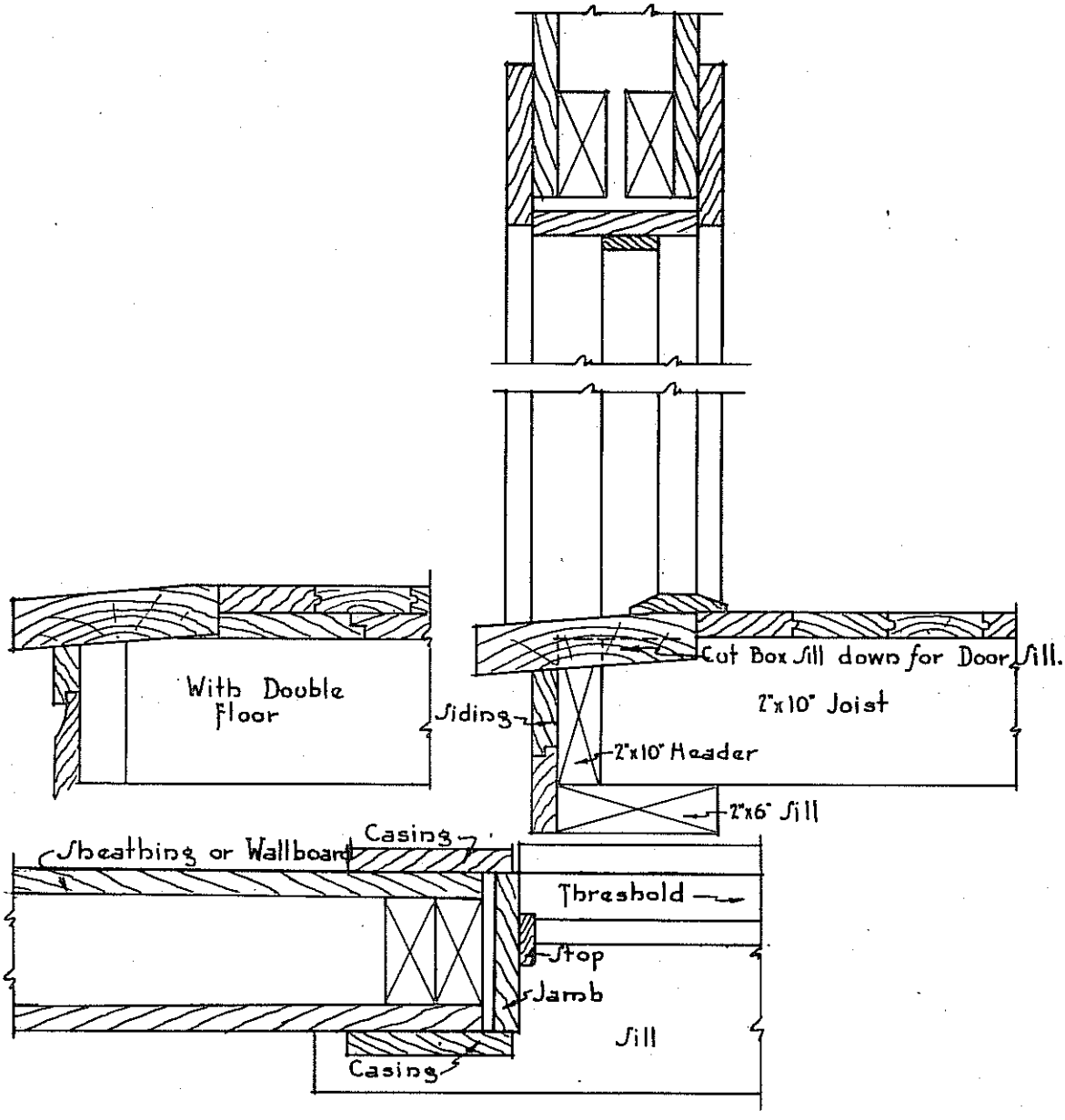


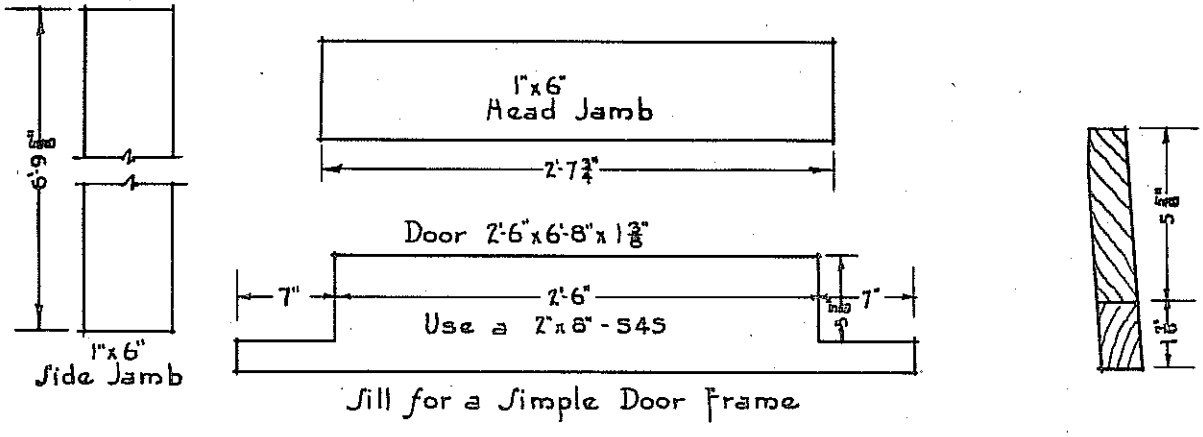


A DOUBLE HUNG, PLAIN RAIL WINDOW

Sash 1⅜" Thick

DOOR FRAMES





Sill for a Simple Door Frame

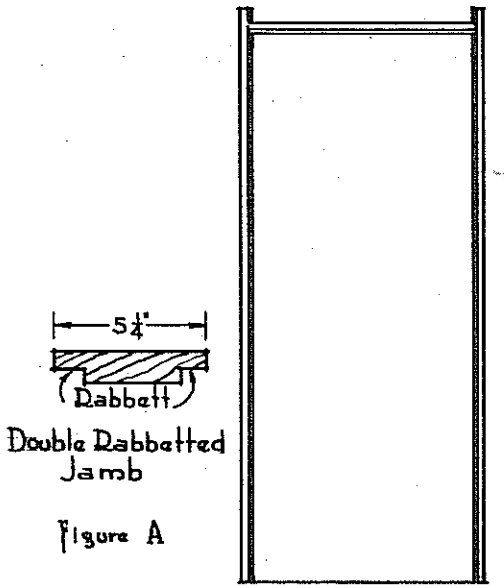


Figure A

INTERIOR DOOR FRAME

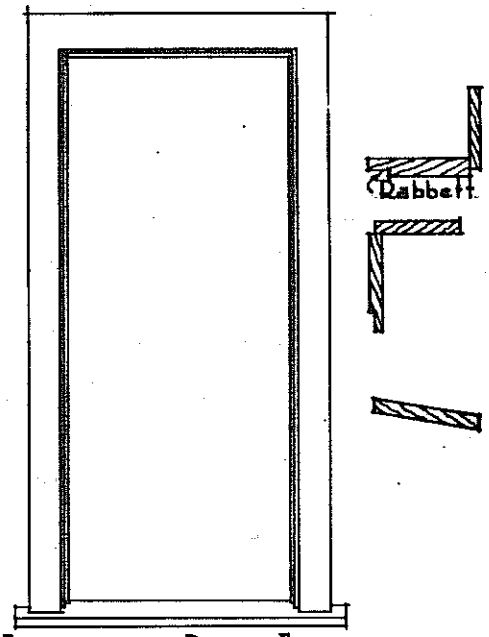


Figure B

EXTERIOR DOOR FRAME

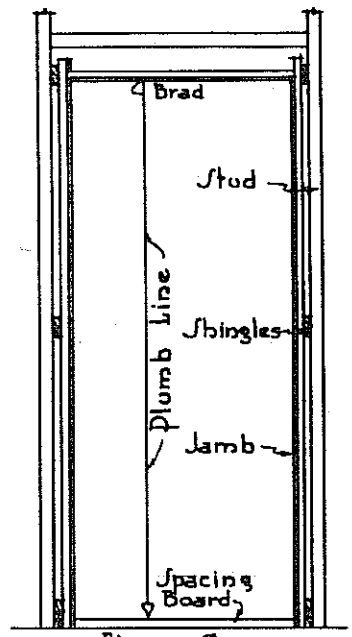


Figure C

SIMPLE METHOD FOR SETTING DOOR QUICKLY & ACCURATELY

Here is a method of setting and plumbing door jambs which I find to be very accurate. By using it, jambs can be plumbed both ways with one operation. Get a piece of board and cut to an exact fit between the jambs, at the top of the door. Mark the head-jamb and board on their edges and the same distance from either side. Drive a brad in the head-jamb on the mark. Next place this spacing board on the floor between the jambs and even with the wall on both sides of the opening. Now wedge the jambs, using shingles, until the plumb hang from the brad in the head-jamb registers over the mark on the spacing board. Tighten the wedges and nail and the job is done.

I also plumb outside door frames the same way except that I mark the sill of the door frame and do not use wedges but nail the casing.

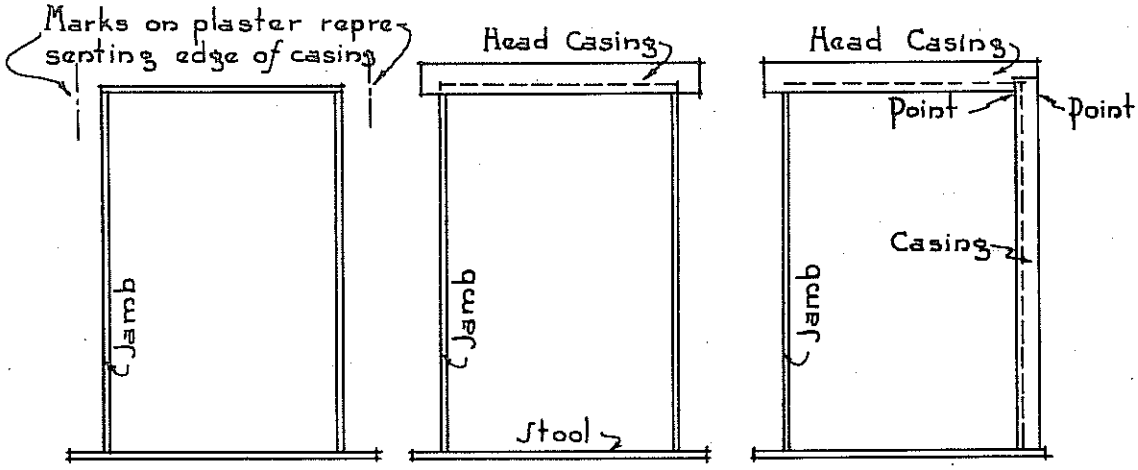
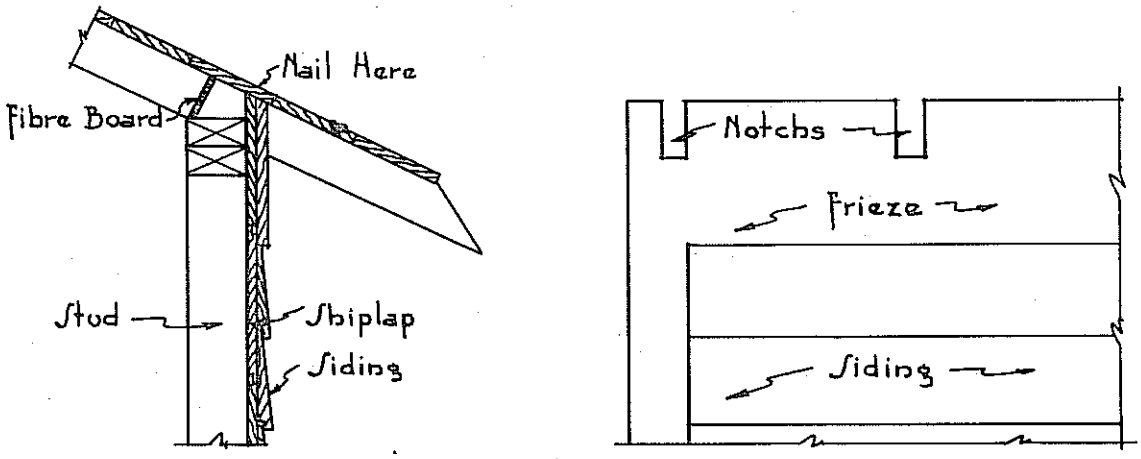


Figure D

METHOD of CASING DOORS & WINDOWS

This method keeps the Head Casing from being pulled away from the Side Casing by the nails.

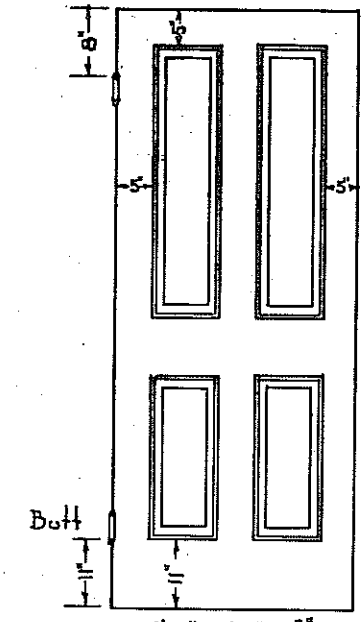


Section Figure E Elevation

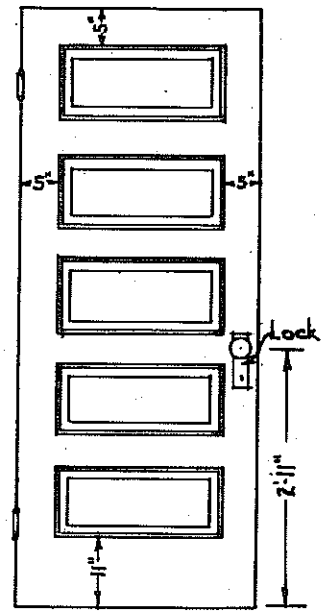
CORNICE DETAILS

Showing the Rafters notched into the Frieze Board making a weather-tight job.

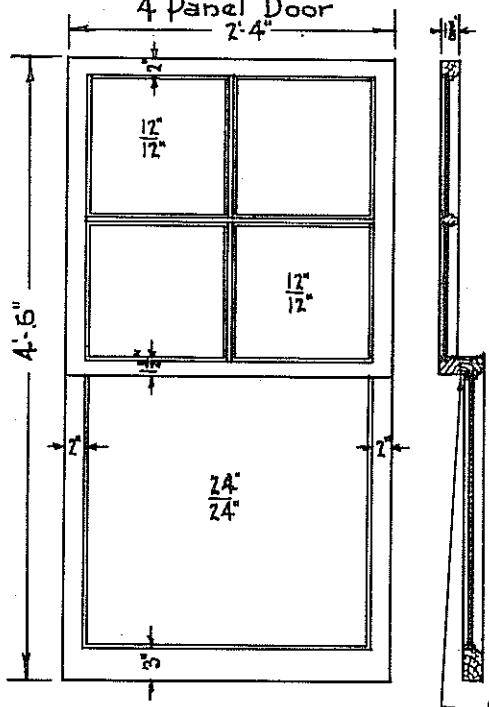
DOORS & WINDOWS



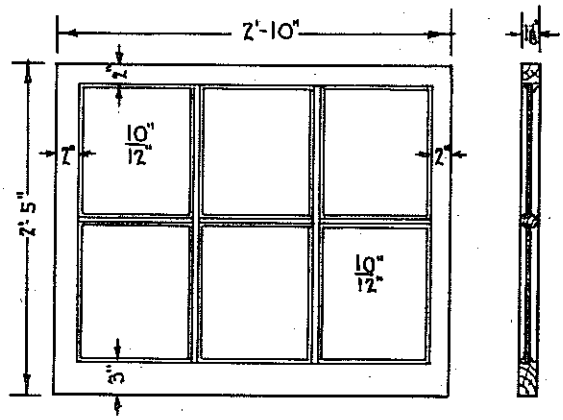
2'-8" x 6'-8" x 1 3/8"
4 Panel Door



2'-8" x 6'-8" x 1 3/8"
5 X Panel Door



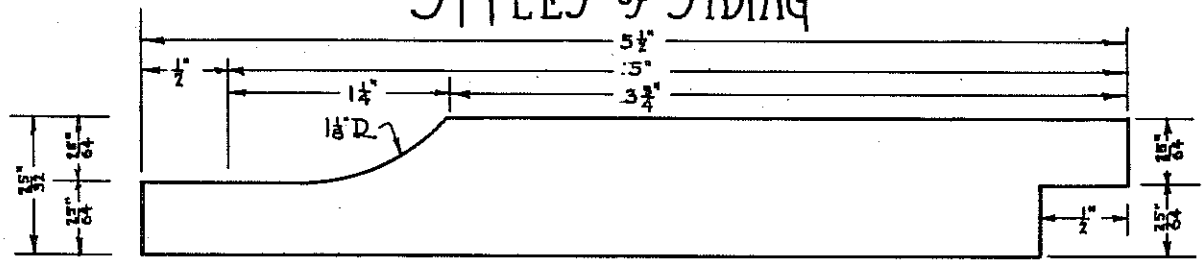
A Check Rail Window



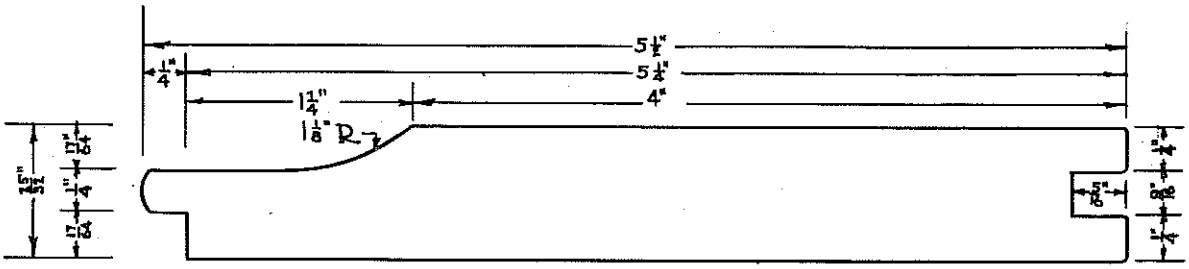
A Barn Sash

Note: Plain rail sash do not have this bevelled projection where upper sash laps over the lower one. They are smooth and even in thickness both sides like the barn sash shown above.

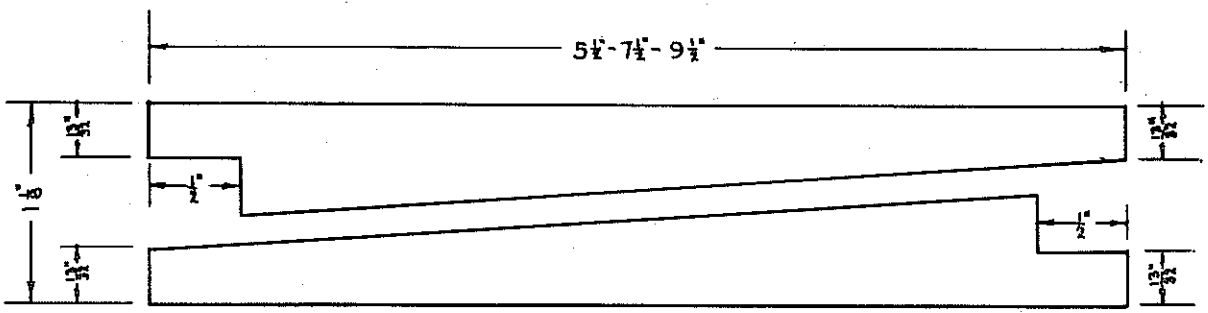
STYLES of SIDING



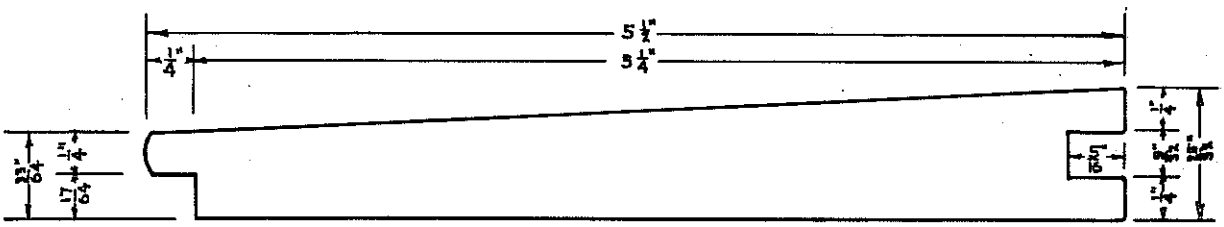
RUSTIC 105



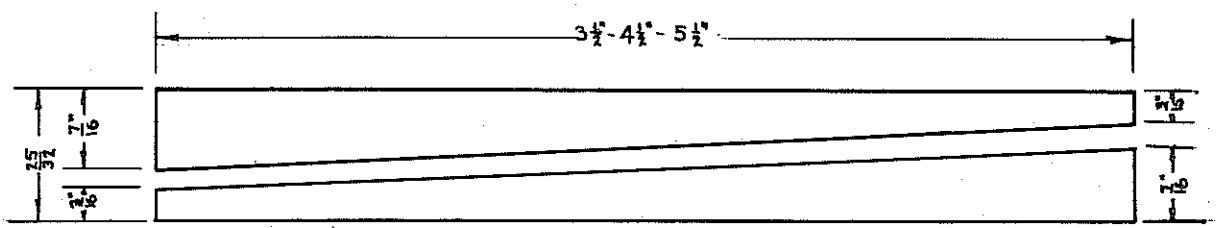
DROP 106



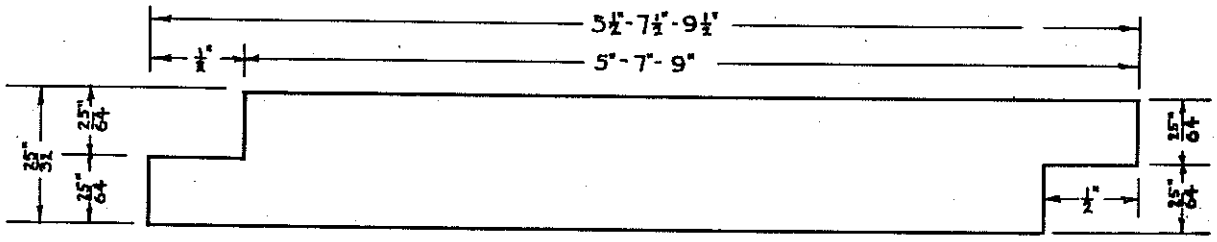
DOLLY VARDEN



BEVEL 124



BEVEL



SHIPLAP

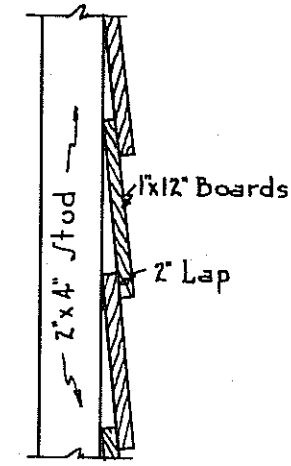


Figure A

BOARD SIDING

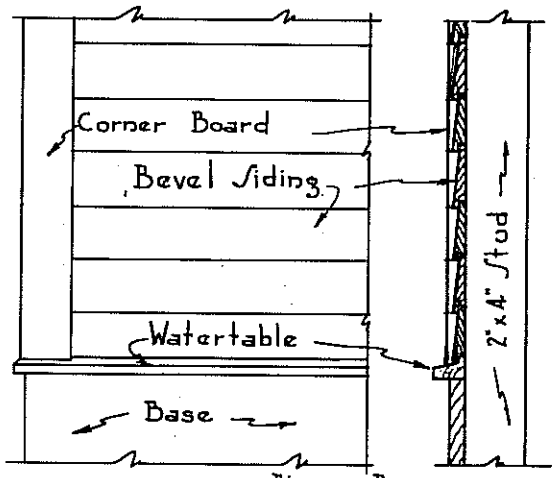


Figure B

METHOD of LAYING BEVEL SIDING

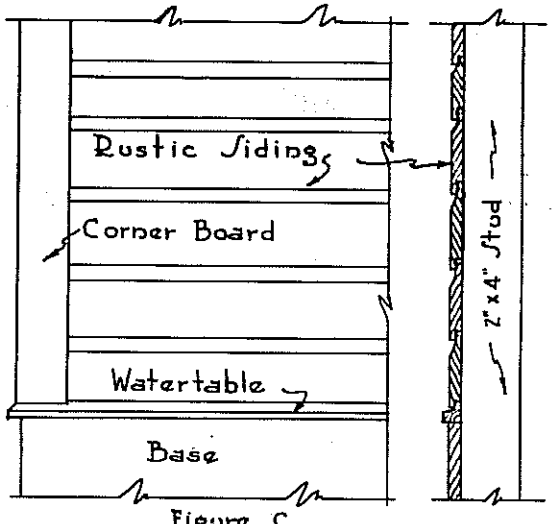


Figure C

PLAIN NOVELTY SIDING

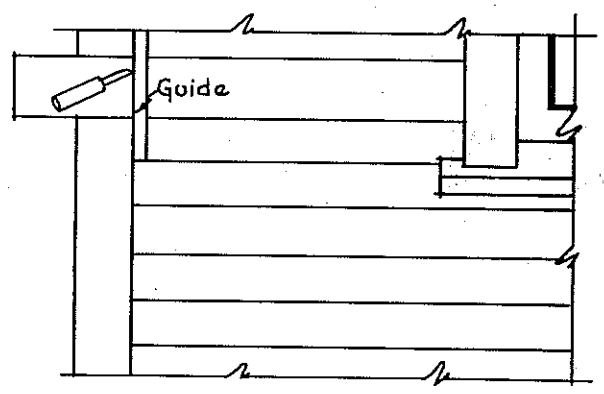
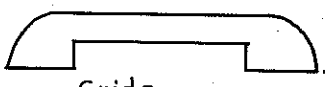
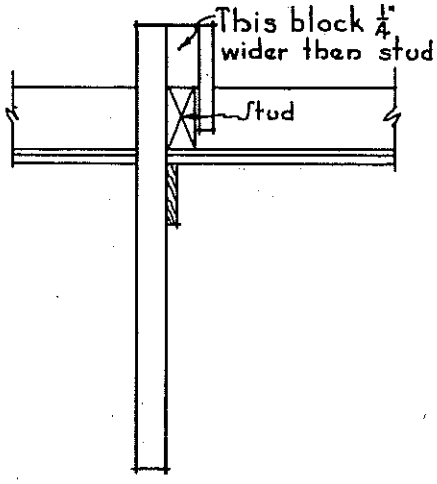


Figure D



Guide

PROPER METHOD TO MARK SIDING FOR CUTTING



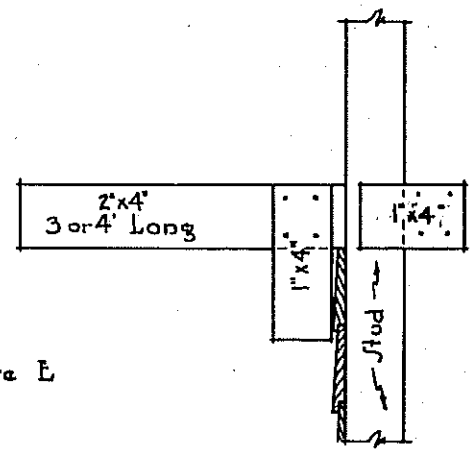


Figure E

SIMPLE DEVICE TO HELP APPLYING SIDING

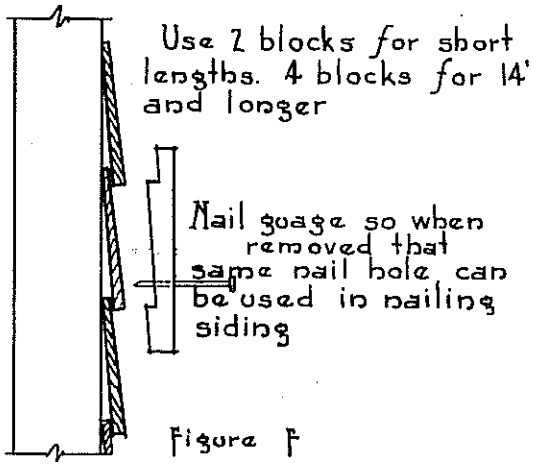
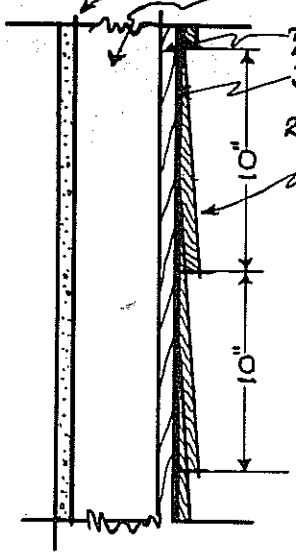
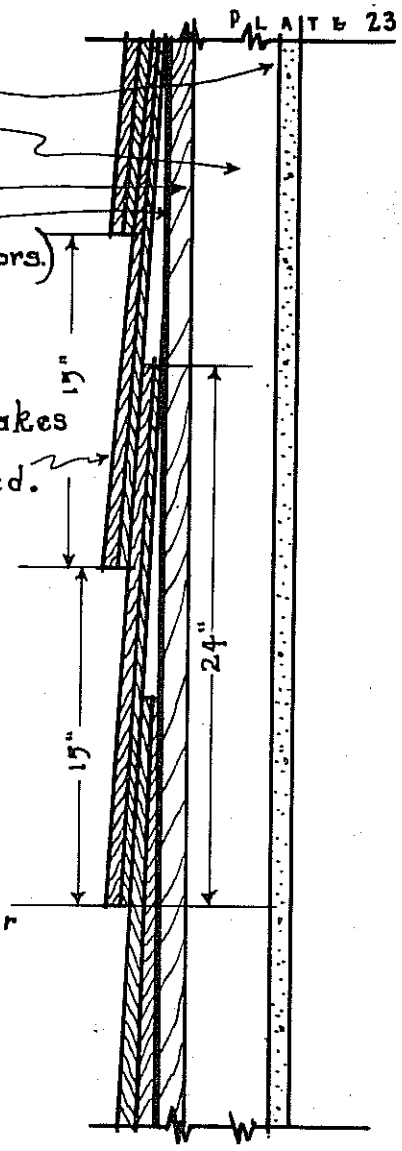


Figure F

SIDING GUAGE

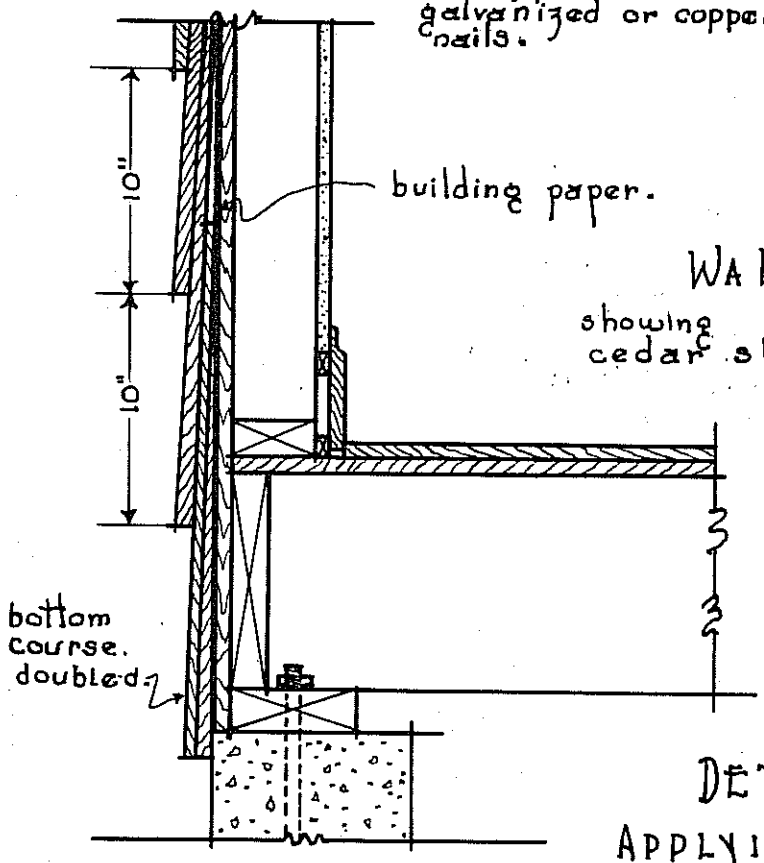


WALL SECTION
showing single coursed cedar shakes 10" to weather.



Note: shakes to be applied with a galvanized or copper nails.

WALL SECTION
showing double coursed cedar shakes 15" to weather.



SILL & WATERTABLE.

DETAILS FOR APPLYING CEDAR SHAKES

ROOFS

METHODS of LAYING SHINGLES

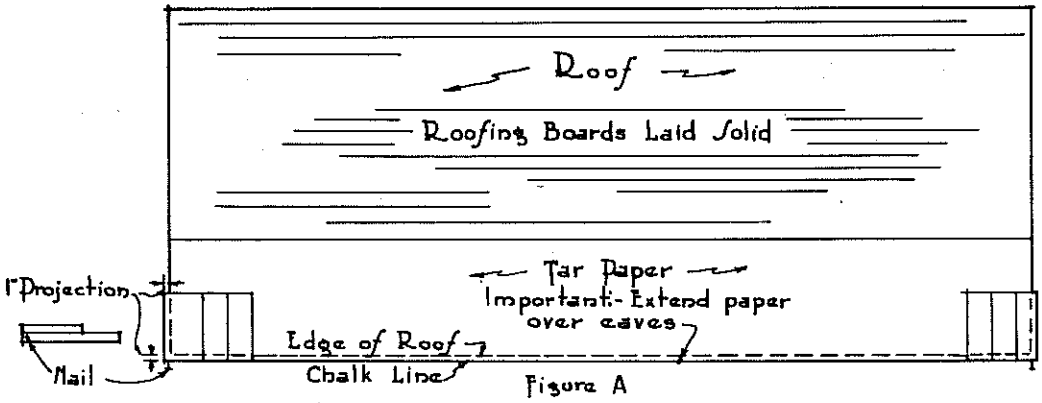


Figure A

To start first course use Chalk Line as indicated.

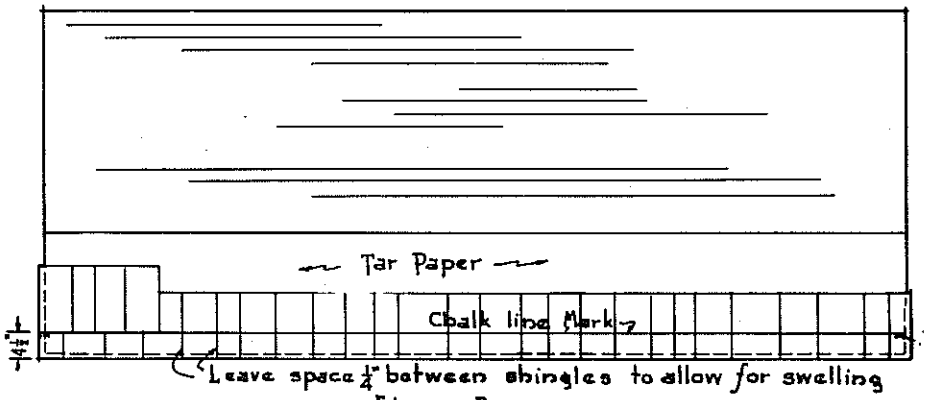


Figure B

For second course snap Chalk Line to indicate line of second course.

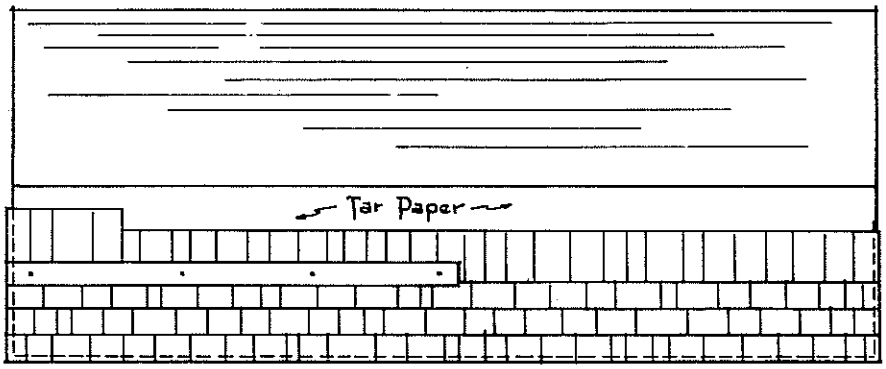


Figure C

The Straight Edge Method

Take a piece of 1"x4" or 1"x6" and any length (16' preferred) and toe nail in place. Butts of shingles can then rest on top of Straight Edge as shown

Lap all joints of Tar Paper at least 2"

SCAFFOLDING FOR ROOF

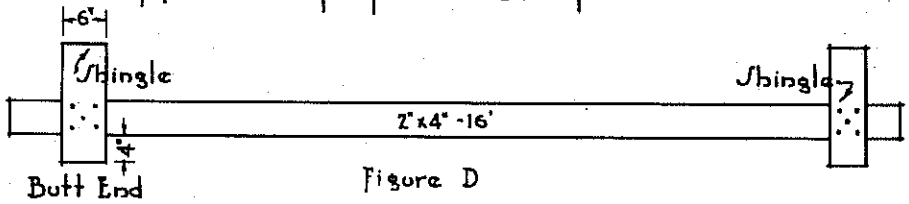


Figure D

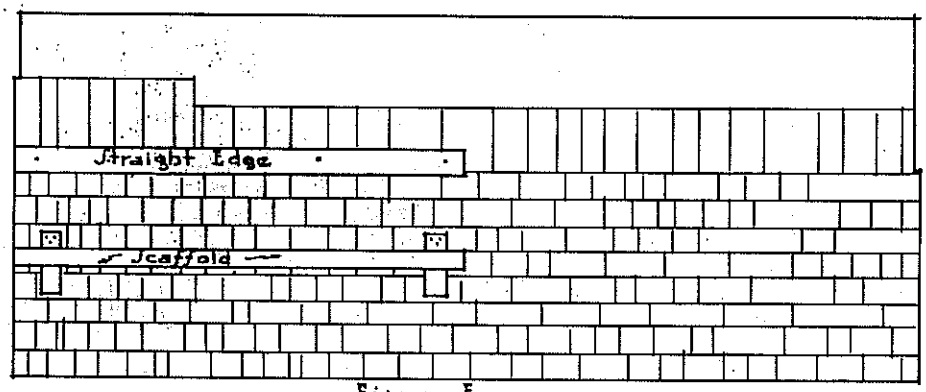
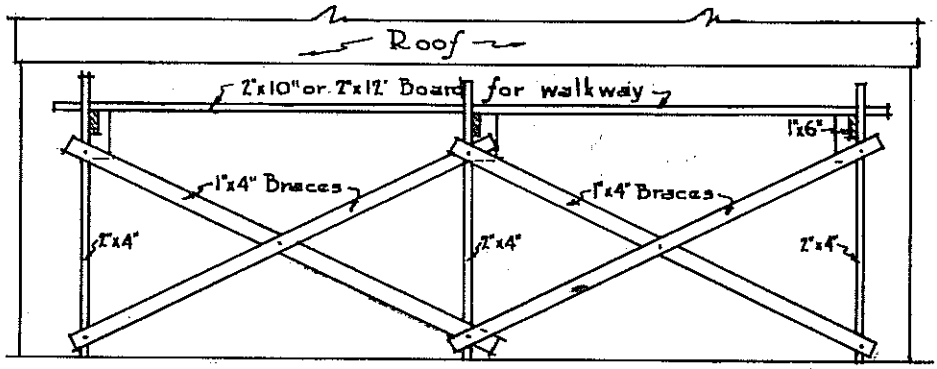


Figure E

The above shows how it is put on the roof and when finished can be taken down without harming roof.



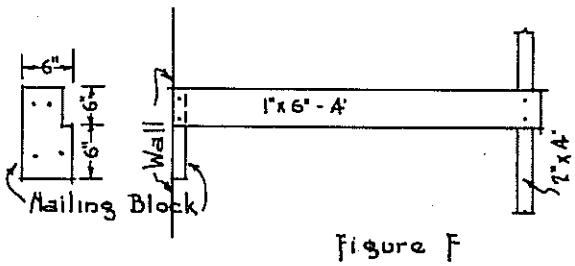
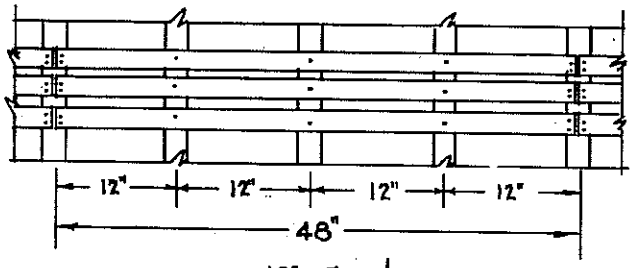
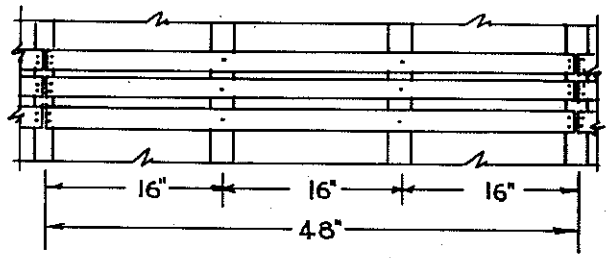


Figure F

WALL SCAFFOLDING



12" Centers



16" Centers

Figures A & B

WHY LATH ARE CUT IN 4 FT. LENGTHS

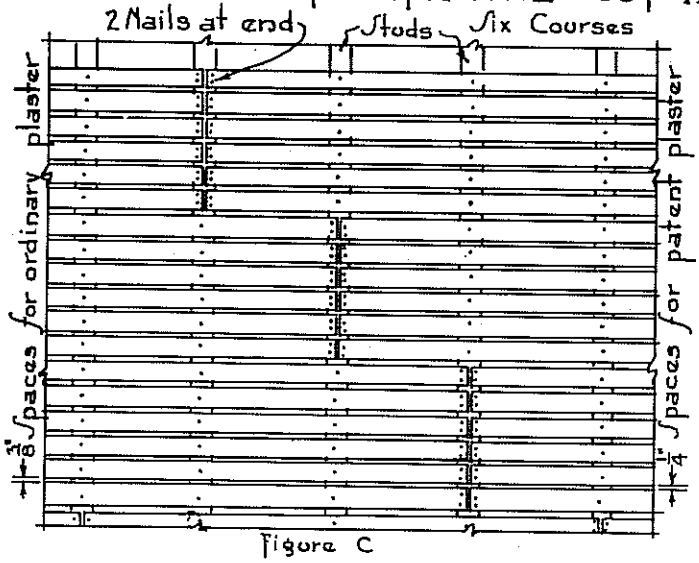


Figure C

METHOD of BREAKING JOINTS NAILING & SPACING

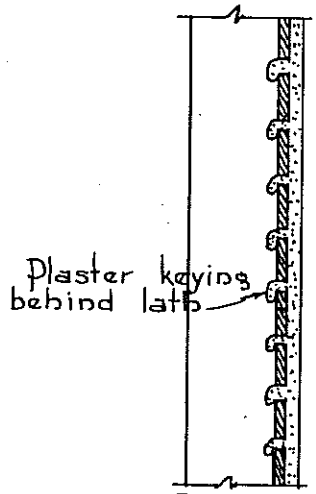


Figure D

SECTION

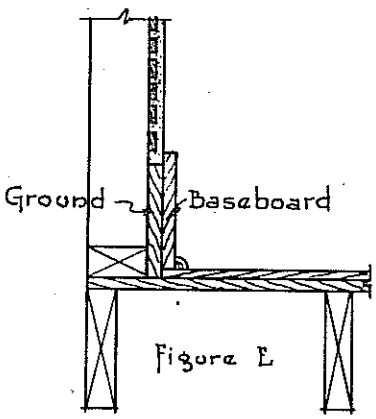


Figure E

PLASTER GROUND BEHIND BASEBOARD

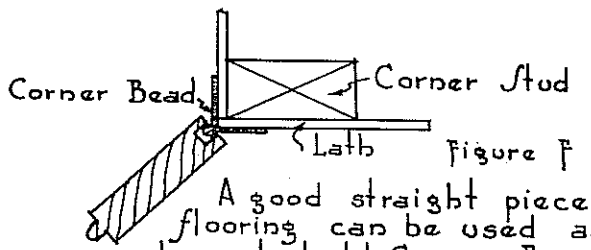


Figure F

A good straight piece of flooring can be used as shown to hold Corner Bead while nailing

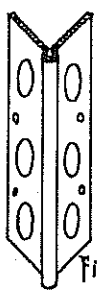


Figure G

Corner Bead

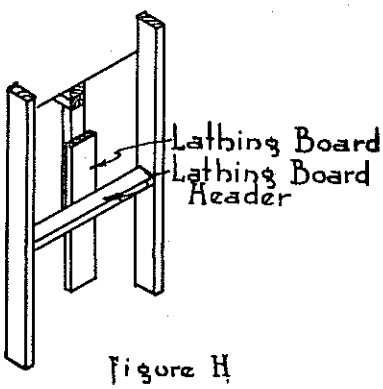
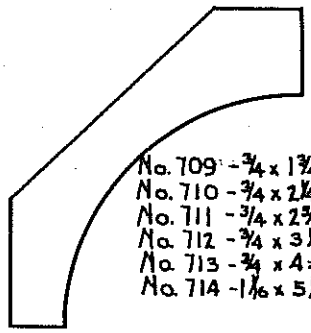


Figure H

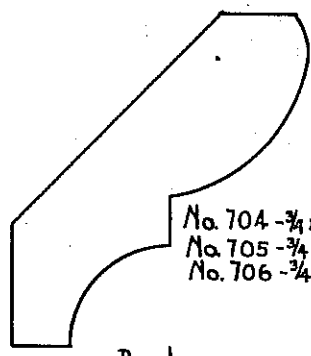
INSIDE CORNER BRACING

MOULDINGS



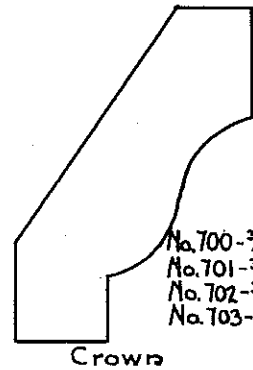
No. 709 - 3/4 x 1 3/4
No. 710 - 3/4 x 2 1/4
No. 711 - 3/4 x 2 5/8
No. 712 - 3/4 x 3 1/2
No. 713 - 3/4 x 4 1/2
No. 714 - 1 1/16 x 5 1/2

Cove



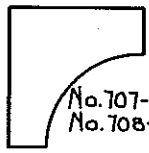
No. 704 - 3/4 x 1 3/4
No. 705 - 3/4 x 2 1/4
No. 706 - 3/4 x 3 1/4

Bed



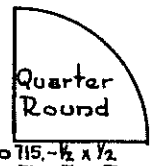
No. 700 - 3/4 x 1 3/4
No. 701 - 3/4 x 2 5/8
No. 702 - 3/4 x 3 1/2
No. 703 - 3/4 x 4 1/2

Crown



No. 707 - 3/4 x 7/8
No. 708 - 3/4 x 1 1/8

Cove

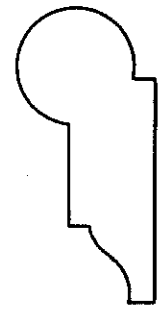


Quarter Round

No 715 - 1/2 x 1/2
No 716 - 5/8 x 5/8
No. 717 3/4 x 3/4

Bull-Nose Stop

No 729 - 1/2 x 1 1/8
No 730 - 1/2 x 1 3/8
No 731 - 1/2 x 1 5/8
No 732 - 1/2 x 1 7/8



Picture Mould.

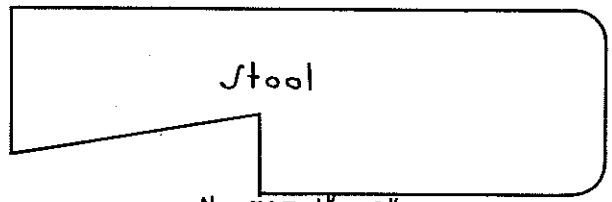
No. 749 - 3/4 x 1 3/4
No. 750 - 3/4 x 2 5/8

Lattice

No. 756 - 5/16 x 1 1/8
No. 757 - 5/16 x 1 3/8
No. 758 - 5/16 x 1 3/4

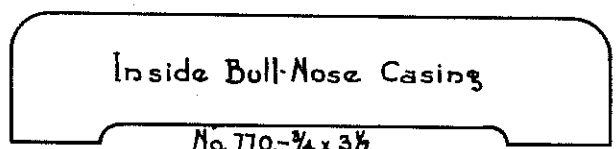
O.G. Stop

No. 733 - 3/8 x 7/8
No. 734 - 1/2 x 1 1/8
No. 735 - 1/2 x 1 5/8
No. 736 1/2 x 1 5/8
No. 737 1/2 x 1 7/8



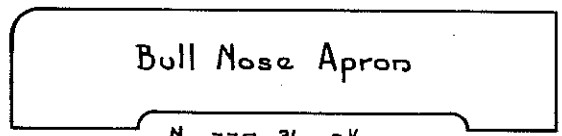
Stool

No. 765 - 1 1/16 x 3 1/2
No. 766 - 1 1/16 x 4 1/4



Inside Bull-Nose Casing

No. 770 - 3/4 x 3 1/2
No. 771 - 3/4 x 4 1/4
No. 772 - 3/4 x 5 1/4

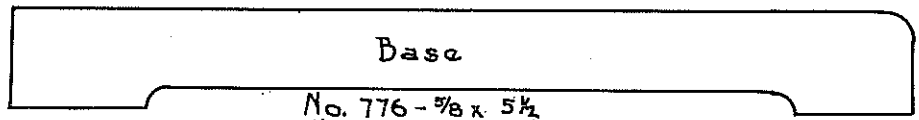


Bull Nose Apron

No. 775 - 3/4 x 3 1/2

Threshold

No 778 5/8 x 3 1/2



Base

No. 776 - 5/8 x 5 1/2
No. 777 - 5/8 x 7 1/4

shiplap or lap joint. For the amateur mechanic the shiplap or "Dolly Varden" pattern is the simplest and easiest to lay. The lap joint is the most difficult to lay sinceit is essential that the laps be accurately measured so as to keep the line of the siding parallel to the first or bottom course. Lap siding is simply one-inch boards laid like a shingle course, the upper board lapping the lower board one or two inches, as may be desirable. Styles of siding to use on any particular building are indicated on the plans in each case. The different patterns of siding described are shown on the accompanying illustrations.

In many settings where a rustic appearance is desirable, the use of manufactured shakes, 1/2"x24", for siding will be found satisfactory. These shakes are similar to a sawed shingle except that one side is scarified to represent a split shake surface. On small structures they should be laid single thickness, 10" to the weather. Fireman's cabins, garages, shops and other small structures may be sided in this way. On large structures they should be laid double thickness, 15" to the weather. When used for roof shingles, they should be laid 7" to the weather. One very excellent type is "Fitite Cedar shakes." They should be dipped in a hot mixture of 3 parts raw linseed oil and 1 part clear varnish before laying on the building.

Roofing

Roofs will be covered with either cedar shingles or shakes. Only in those cases where the estimated life of the building is believed to be only two or three years will building paper be used for roof covering. In the appendix will be found a table showing grades, sizes, and quantities of shingles per square of roof. A square is 100 square feet. Also a table giving the quantity of nails needed. Methods of laying shingles are shown in the accompanying illustrations.

Interior Wall Covering

The exterior walls being covered and the roof on, the fourth step is the interior wall covering. This will be of several different kinds, depending upon the kind of building, the purpose for which it is to be used, and the means of getting material to the job. Frame ranger dwellings will be lathed and plastered. Log ranger dwellings may be left natural log finish, or lathed and plastered, or covered with some form of wall board such as Masonite, fir veneer panelling, or knotty pine ceiling, as specified in plans. Other buildings will be finished as indicated on the individual plans for each building.

Lath and Plaster

Wood lath only will be used. They are 3/8" thick by 1½" wide and 4' in length. They are made from several different varieties of wood, but the most satisfactory to use is pine. Several grades are made, but for all our work only #1 pine lath should be used.

Application of Wood Lath

All exterior stud walls, wood furring, interior stud partitions, ceiling joists, stair soffits, shall be lathed with wood lath. Lath shall be spaced not less than $\frac{1}{4}$" nor more than 3/8" apart and shall be secured to each bearing with standard 3d common wood shingle nails, two (2) to each end and one (1) to intermediate bearings.

Lathing shall break joints every six laths, all put on horizontally. Under no circumstances shall lathing stop and form a long, straight, vertical joint nor be put on vertically to finish out at angles or corners; neither shall any lath run through and behind studding from one room to another. All corners must be made solid before lath is applied.

Grounds

All lathing and plastering shall be laid to not less than the following grounds:

3/4" for wood lath, 5/8" for brick or clay tile.

Wood Lath Defects

General - Probably 90% of the cracks in wood-lathed walls not due to building settlement are due to lath.

The principal causes of lath troubles are four:

(1) Inferior lath which expand and contract unduly, shearing the keys and cracking the plastered surface, or which contain sap that stains the plaster.

(2) Neglecting to wet the lath so that they will swell as much as they can before the plaster is applied.

(3) Failure to space the lath properly.

(4) Insufficient nailing.

How to detect: Cracks and buckles in the plaster coat running horizontally with the lath are always traceable to lath conditions. When plaster sounds hollow and loose when tapped but is hard, faulty spacing may be looked for, except im cases of dry-outs or oversanded plaster where the keys have fallen off for lack of strength.

Straight vertical cracks, either chip cracks or larger cracks, are often the result of failure properly to break joints in the lath. Settlement and shrinkage cracks are very liable to follow lath joints that are not properly staggered.

Lath stains on the surface of the plaster are due to sap, pitch, resin, oil, tar, or gum in the lath.

How to prevent:

(1) Quality of lath - Architects should specify No. 1 lath and also the kind of wood desired. White pine, balsam or spruce lath are preferable when they are to be had. Lath should be free from knots, sap, and bark. However, this is not the only test of a good lath, because many clear laths on the market today are of very inferior quality.

(2) Proper wetting - Wetting of lath before plastering is important in the prevention of plaster cracks due to the swelling, warping, twisting and buckling of wood lath. Wood lath should be wet the day before plastering and again an hour or so before plastering. Swelling lath exert tremendous pressure, which shears off the keys and causes the plaster to loosen and crack. This in time means a loss of bond, for the face side of wood lath has no bonding properties. This condition can be avoided only by using a good grade of lath and by swelling the lath to the limit before plastering, so that it will not swell afterward.

(3) Proper spacing - Lath should be spaced $\frac{1}{4}$" to 3/8" apart and should be so spaced at ends as well as at sides, as lath swells endwise as well as sidewise. Narrower spacing will not provide sufficient room for the lath to swell without pinching the plaster, and will result in weakened keys. A wider spacing, on the other hand, is unnecessary and is a waste of materials. Lath should be applied in groups of five to eight lath, which should be staggered; i.e., the ends of each group moved to the stud at right or at left of the group below.

(4) Proper nailing - Requires two lath nails at the ends of lath and one at intermediate studs, the nails driven home so as to hold the lath tightly against the stud.

Remedy: The only remedy for plaster failure due to bad lathing is to remove the parts of the wall that are defective and replaster.

Grounds are strips of wood usually placed at the floor or around openings for the purpose of assisting the plasterer in making a straight wall and in giving a place to which the finish of the room may be nailed.

Quantities

Fifteen hundred lath are required for 100 square yards of surface, and 10 pounds of 3d blued lath nails will lay them.

Plaster

To secure a good plaster job, employ the best plasterer available. Amateur plaster jobs are never satisfactory. The following rules in regard to plastering have been prepared by the United States Gypsum Company and are applicable in all cases.

General

Gypsum plaster is made by subjecting gypsum rock to heat (calcining) which process drives off a large percentage of the water of crystallization contained in the rock. When plaster is mixed with water on the job, it takes up the water that was expelled during calcination and recrystallizes.

From this it will be seen that the crystallization, or setting, of gypsum is a law of nature; plaster must set if conditions are satisfactory.

Following are nine general rules addressed to the mechanics. Their observance will avoid trouble and assure the best results in plastering.

Rule 1. Keep moisture away from the plaster before mixing. Moisture causes plaster to partially set. Therefore, plaster should be stored in a dry place, and circulation of air through the warehouse should be prevented. Do not pile plaster out-of-doors or on the bare ground or next to green walls. Do not allow plaster to stand dry-mixed with sand.

Rule 2. Have lath conditions right: Wood lath should be of good grade and should be properly spaced and nailed. Look out for dry lath. Wood lath are bound to swell when wet and if they are not swelled before plastering, they are likely to swell and buckle afterward. Therefore, wet the lath. It is better to do it the day before and again about one hour before plastering. It is specially important to wet wood lath over doors and windows, where the walls dry out very rapidly. Brick walls have great suction; sprinkle them well before plastering.

Rule 3. Use only clean water: Do not use stagnant water; water from wells or hydrants is best. Water from the barrel in which you wash your tools should never be used.

Rule 4. Look to your sand: Use only clean, sharp, well-graded sand, free from dirt, quicksand and frost.

Rule 5. Keep set-up plaster out of the mix: Set plaster causes quick-set. Clean the mortar box and tools after each gauging. Do not wash tools in the gauging water. Do not mix one gauging with another. Do not retemper plaster after it has commenced to set. Throw it away - it is time and money saved.

Rule 6. Mix material as needed: Apply mortar immediately after mixing and do not mix more material than can be handled in about one hour.

Rule 7. Caution regarding use of mechanical mixers: A mechanical mixer if closely attended makes excellent mortar; frequently, however, no attention is paid to condition of mixer and time of mix. Unless mixer is cleaned regularly, quick-set result; the plaster may stiffen in mixer, which continues to churn it about, breaking down the set. Mortar so treated never gains its normal hardness on the wall. Time of mixing will also vary, resulting in variable sets and walls of uneven strength.

The proper use of a mechanical mixer involves the following cycle of operation:

(a) Put in the approximate amount of water
(b) Put in approximately half the sand required
(c) Put in all of the plaster
(d) Put in the balance of the sand
(e) Clean at regular intervals

Rule 8. Keep green walls from freezing for 24 hours: After this length of time cold will not injure them. Be sure that frost is out of the base coat before applying the finish.

Rule 9. Keep plastered walls from drying out until set: Although this is the last rule, it is the most important, because dry-outs are the most frequent of all plaster troubles during the hot summer months. They appear as soft, chalky spots on the wall. Dry-outs can be cured - but it is much easier and cheaper to prevent them.

In dry, warm weather, all openings must be covered with canvas or muslin to eliminate circulation through the building while the plaster is drying.

Plaster is a mixture of sand or other fine aggregate with a binder of lime, gypsum (plaster of Paris) or cement, and hair or fiber. The customary method of application on a wood or metal lath base is to apply it in two or three coats. These coats consist of scratch coat. When applied to masonry the scratch coat is omitted.

The scratch coat is applied to the lath and forced through to form a key or clinch at the rear of the lath. This coat is made rich in lime and hair, as the strength of the entire plaster work depends on the holding properties of the scratch coat. Before this coat sets hard it is scratched, to form a key for the brown coat, from

which operation it derives its name.

The brown coat is applied to the scratch coat, and is the leveling or truing coat. It is floated up to within 1/8" of the finished surface or grounds, plumbed and rodded to correct any irregularities in the scratch coat. In the better grade of work plaster bands about 6" wide, called "screeds," are applied horizontally and vertically, about 6' apart, carefully plumbed and rodded, to form a guide for the body of the coat which is then floated up to the surface of the screeds.

The finish coat, also called the white coat, skim coat, sand finish, et cetera, is applied over the brown coat and brought to the face of the grounds. The amount of work required on this coat is one of the governing factors in the cost of the job. The longer it is worked with a trowel the harder and smoother it becomes, and in first-class work only expert mechanics should be employed on this coat.

The fine aggregate used depends on the coat and the finish desired. Coarse sand is used for the scratch and brown coats and also for "sand float" finish coats. Washed white beach sand is used for smooth finish, and marble dust for smooth hard finish coats. Hair, Manila fiber, jute, asbestos and wood fiber are used in the scratch and brown coats as a tie to hold the plaster together. Hair should be long, cattle or goat hair, free from grease.

Lime may be either lump (quicklime) or hydrated. Quicklime is a calcined material, the major part of which is calcium oxide or calcium and magnesium oxides, which will slake on the addition of water. Hydrated lime is a dry flocculent powder resulting from the mechanical slaking or hydration of fresh quicklime. Lime paste or putty is a material of workable consistency resulting from the slaking of quicklime or of a mixture of hydrated lime with water to a similar consistency. When made from quicklime it should be allowed to age under proper conditions.

Quicklime is sold in barrels of 180 and 280 pounds net weight. When slaked it increases in bulk two and one-half times more or less, depending on the grade of lime. A 180-pound barrel will make from six to seven cubic feet of paste.

Quicklime can never be used as such for structural purposes. It must always be slaked first. Since the method of slaking is an important factor in determining the quality of the finished product, the following directions are given:

Different kinds of lime vary considerably in the way in which they behave with water. A little supervision over the operation of slaking will amply pay for itself by insuring the production of the greatest possible quantity and the best possible quality of putty. To find out how to slake a new lot of lime, it is safest to try a little of it and see how it works. Since different lots of the same brand of lime vary somewhat, and since the weather conditions at the

time have a decided influence, it is wise to try a sample from each lot used, whether familiar with the brand or not.

In a bucket, put two or three lumps of lime about the size of one's fist, or, in the case of granular lime, an equivalent amount. Add enough water to just barely cover the lime, and note how long it takes for slaking to begin. Slaking has begun when pieces split off from the lumps or when the lumps crumble. Water of the same temperature shall be used in test and field practice. If slaking begins in less than five minutes, the lime is quick slaking; from five to thirty minutes, medium slaking; over thirty minutes, slow slaking.

For quick slaking lime, always add the lime to the water, not the water to the lime. Have enough water at first to cover all the lime completely. Have a plentiful supply of water available for immediate use - a hose throwing a good stream, if possible. Watch the lime constantly. At the slightest appearance of escaping steam, hoe thoroughly and quickly, and add enough water to stop the steaming. Do not be afraid of using too much water with this kind of lime.

For medium slaking lime, add the water to the lime. Add enough water so that the lime is about half submerged. Hoe occasionally if steam starts to escape. Add a little water now and then if necessary to prevent the putty from becoming dry and crumbly. Be careful not to add any more water than required, and not too much at a time. For slow slaking lime, add enough water to the lime to moisten it thoroughly. Let it alone until the reaction has started. Cautiously add more water, a little at a time, taking care that the mass is not cooled by the fresh water. Do not hoe until the slaking is practically complete. If the weather is very cold, it is preferable to use hot water, but if this is not available, the mortar box may be covered in some way to keep the heat in.

White coat - After the action has ceased, run off the putty through a No. 8 sieve. Add sand up to equal parts by weight, all of the hair required, and store for a minimum of two weeks.

Mason's mortar - After the action has ceased, add part or all of the sand required, and store for a minimum of 24 hours.

Hydrated lime is sold in standard 50-pound packages. One cubic foot weighs about 40 pounds, and it will make approximately one cubic foot of fairly stiff paste equivalent to similar paste made from quicklime.

Plaster of Paris is made from gypsum, a rock which consists of calcium sulphate combined with water. When heated until three-fourths of the water is driven off, it is known as calcined gypsum or plaster of Paris.

Gypsum plaster is calcined gypsum to which has been added from 10 to 15 percent of hydrated lime and other retarding material, making the setting time vary from one to six hours. It is sold as neat plaster when the sand has to be added at the job, or as prepared plaster when the proper proportion of hydrated lime, retarder, sand and fiber are already included. In this state it has only to be wet up and mixed before being applied.

Keene's cement is a calcined gypsum prepared under a special formula and will give a very hard, smooth surface when properly applied. It is used where a hard, sanitary surface is required and is usually finished to imitate wall tile.

The best grades of pure calcined gypsum are shipped in paper-lined wooden barrels that hold from 250 to 320 pounds net. Neat gypsum plasters come in burlap bags containing 100 pounds, or in paper bags of 80 pounds each. Ready mixed plasters are shipped in burlap bags of 100 pounds.

A three-coat plaster job will require about 26 hours for a skilled plasterer, and 18 hours for a helper, per hundred square yards of surface.

Using a gypsum plaster it will require about 1000 pounds of cement plaster per 100 square yards and 400 pounds finish coat per 100 square yards.

For a two-coat sand finish job use 10 bushels lime, 56 cubic foot sand, and 15 pounds of hair per 100 square yards of surface.

Wall Boards

In some cases and for some types of buildings it will be more satisfactory to use wall board for the interior wall covering. The number of such boards on the market is almost legion. It is believed that the product known as Masonite is as satisfactory as any, and it has the additional feature that it is entirely a wood product, which is not true of any other wall board on the market insofar as is known. The use of plywood should be more general for this purpose. It is the Forest Service policy to use only wood products in building construction insofar as is practicable. Wall board comes in sheets of varying sizes, but 4'x8' is the standard and is suitable for any 8' ceiling job. The manufacturer's instructions should be followed in applying it. When wall board is used in a room with not more than 8½' ceiling, excellent results can be had by running the panels around the room rather than up and down. One moulding like a chair rail around the room covers the horizontal joint; vertical strips on the walls are unnecessary.

In some cases, as in shops and warehouses, it will be more satisfactory to cover the walls with shiplap either 6, 8, or 10" width. On frame buildings where the outside wall is a single thickness of

siding, the shiplap wall covering should be put on diagonally in order to give the walls additional sway bracing.

Finish

For dwellings a standard pattern of bull-nose baseboard, casing, window stool, and so forth, will be used. Such material is illustrated in the accompanying sketches. Casings for openings may be ordered in sets, specifying the size and kind of opening, or it may be ordered in linear foot lengths, or by pieces of various lengths. "D" select pine is the proper grade to use.

For bunkhouses, offices, and so forth, door and window casings and mopboards may be plain dressed boards, #2 common or "D" select pine being the correct grade. Finish must be applied carefully in order to secure workmanlike job. A sharp, fine-tooth saw, a good mitre box, and careful measurements are essential to a good job. This requires applied mechanical skill which can only be secured through practice.

LOG BUILDING CONSTRUCTION

Most Forest Service buildings will be of log construction. Good axemen with considerable mechanical skill can construct log buildings of good appearance almost as cheaply as frame buildings can be erected. The material cost is much less for log buildings, but the labor cost is commensurately higher. Foundations for log buildings have the same specifications as those for frame buildings. Any building is only as good as the foundation on which it is built.

Logs

The selection of straight, smooth, even-sized logs is the prime consideration in starting the erection of a log building. Top diameters should be as uniform as possible, not less than 10" or more than 12". Taper should be as small as possible. Logs longer than 40' may require a smaller top diameter in order to keep down excessive diameter at the large end.

Logs should be cut in late fall or winter for two reasons. Logs cut in spring or summer peel easier but check to an undesirable degree while seasoning. Insect activity is dormant during the winter months and logs cut and seasoned during the winter are less liable to insect or rot fungus attack and damage. Logs should be cut, peeled, and laid up on skids well above the ground for at least six months before they are put into a building. This is not always practicable to do but it is a good rule nevertheless. The logs should be single decked with 2" or 3" between logs and each log should have the sweep or curve (if any) laid up so that the weight will tend to straighten it while drying. If skidding room is limited, the logs can be double decked but should have poles between each tier of logs. Unrestricted air circulation will aid

the seasoning materially. Cedar, pine, fir, or larch, in the order named, are the most desirable timbers to use. All knots, limbs, or bumps, should be trimmed off carefully at the time the log is peeled. Logs should be cut at least 2' longer than actually needed so that they can be trimmed evenly after they are in the building.

Logs should be carefully sorted before construction starts so that the best logs can be used in the front and more conspicuous sides of the building. If the logs are not even in size, the larger logs should be at the bottom of the wall.

The dimensions of a log building are the inside measurements from log to log. The outside dimensions will vary some with the size of the logs, hence the use of inside measurements. Logs should be cut at least 6' longer than the inside dimensions of the building. In erecting the walls of a log structure the logs in the wall will be kept even or plumb on the inside. The reason for this is that it is often necessary to finish the inside of the building and the difficulty of doing this is increased if the log walls are not straight. Logs will not be hewed on the inside.

Logs may be scribed and grooved by the Scandinavian method if the building is to be used yearlong. This method will be described in detail later. Log buildings for summer use only, or other structures such as barns, woodsheds, et cetera, should not be scribed. When logs are not scribed they should be fitted as close together as possible so as to keep the crack between the logs at a minimum.

Corners

The important item about log construction and upon which the appearance and stability of the structure is principally dependent, is the corner. There are several different types of corner construction in use and each of them has several variations due to local prejudice or individual ideas. The corner considered most satisfactory from every standpoint for Forest Service use is the round notch or saddle corner. This corner is selected for the standard for several reasons:

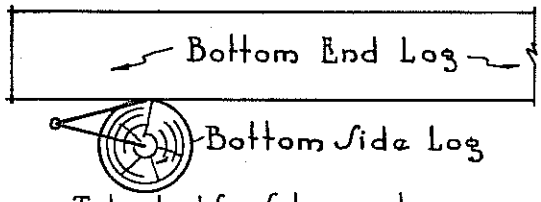
Appearance - It gives the most distinctive appearance as a log corner since the logs project beyond the corner and do not appear dubbed off as is the case with some other corners.

Mechanical - It is a good mechanical joint as it is self-locking and the logs immovable. It is relatively simple to construct.

Permanence - Since the material is all taken out of the under side of the upper log and the surface of the upper side of the bottom log is not disturbed, all moisture drains out of the corner and the wood is much less subject to decay because of moisture conditions.

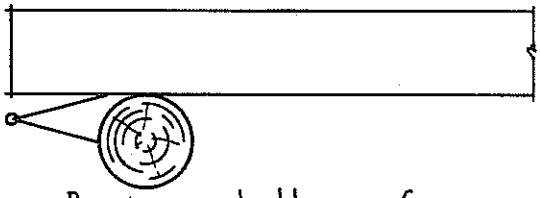
SADDLE CORNER

1



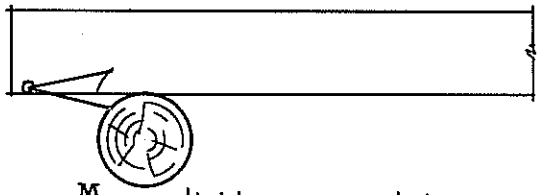
Take half of lower log diameter

2



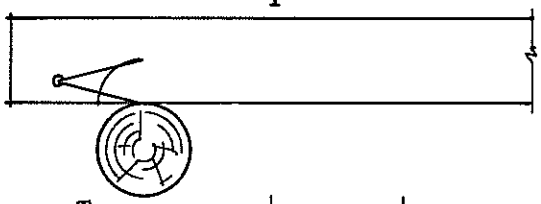
Begin on bottom of upper log

3



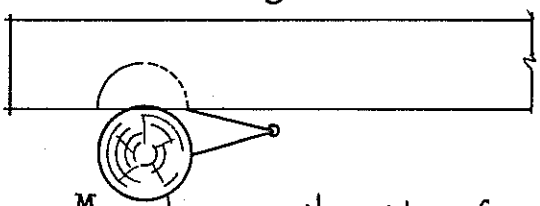
Move divider upward in circular motion

4



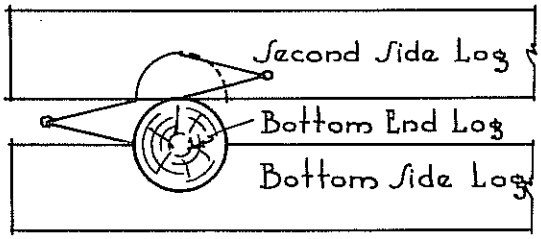
Top or quarter circle

5

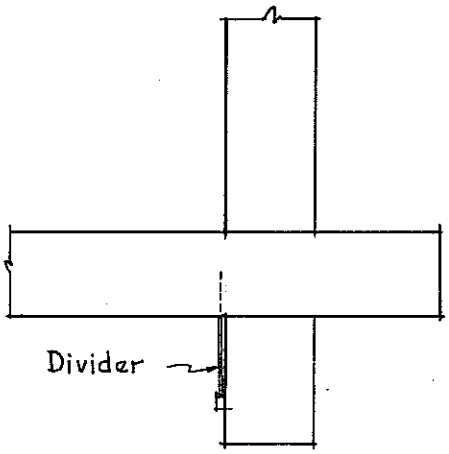


Move to opposite side of under log and repeat. Then repeat same operation on opposite side of upper log.

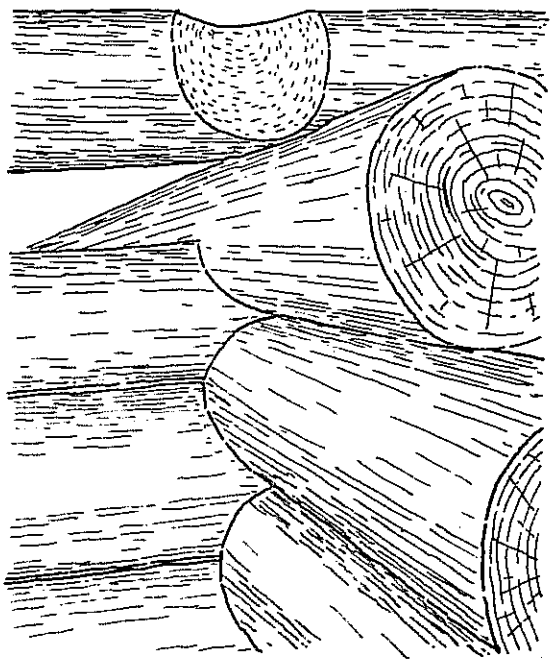
6



Take depth of space between 2 side logs then work as before.



Divider is held paralell to the under log. You should stand facing side of log to be marked so as to keep points of divider lined up perpendicular to each other.



Shrinkage - It is the outer area of the log circumference that produces most of the shrinkage which tends to open up the cracks in the logs. In the round corner one-half of this shrinkage is left in the corner and consequently the cracks will not open as much as if each log had been cut down to the heartwood as is the case with most other types of corners.

The tools necessary to make this type of corner to the best advantage are: A pair of log dogs, to hold the log in place; a pair of 12" wing dividers with pencil holding attachment; a sharp axe; a 2" gouge chisel with outside bevel; and a crosscut saw. The accompanying illustrations showing the various steps in framing the corner should be relatively easy to follow.

The two side logs are laid on the foundation and set in place. A face of two to three inches should be hewed on the under side of the bottom log to make it lay. The two end logs are then placed and accurately centered so that their inside edges are the exact dimension of the building apart. They should be dogged so that they will not move while being marked for the corner notch. The wing divider is now set for one-half the diameter of the side log. With the one leg of the divider resting upon the side of the under log and the other leg resting against the bottom of the upper log and directly above the lower log, start drawing the divider in an upward direction so that the lower leg follows the curvature of the under log and the upper leg makes a mark on the surface of the upper log which will be the intersection of the surfaces of the two logs when the notch has been cut from the upper log. Repeat this operation four times, when all four sides of the corner will have been marked. A little practice will soon make one adept at keeping the points of the divider perpendicular to each other at all times while making the marks.

After both ends of the log have been marked, turn it over on its back. It will be well to trace the divider scratch with an indelible pencil so that the mark for the notch can be more easily seen. Chop the notch out roughly with the axe and chip down as close as possible to the mark. Then take the gouge chisel and give it the finishing touches down to the mark. The notch should be cupped out just enough so that the weight of the log will come on the outside edges of the notch, thus assuring a tight joint.

When the next side log is rolled into place, the dividers will be set apart the width of the space between the top of the first side log and the bottom of the next side log, and the marking done as before.

If it is desired to have the upper log "ride" the lower log a little so that an especially tight joint between the two logs will be secured, the dividers should be set a little wider than the space calls for. This is also true if the logs are to be scribed.

Sufficient additional depth should be given the notch so that the log can be scribed for the groove.

While the form of corner described above is standard for Forest Service structures, other forms of corners in common use are described since it is often desirable to be able to furnish special use permittees and others with descriptions of how to make a log corner.

Dovetail or Box Corner

This is a good strong corner and with some experience can be made a good looking mechanical job. Axe work must be carefully done in order to secure a neat job. It has this undesirable feature, however, that the logs are apt to open up a wider crack because the corner is framed from the part of the log where the least shrinkage occurs. The logs being hewed down as they are to form the corner, the wood has a tendency to gather and retain moisture. This form of corner also detracts from the "loggy" appearance desirable in log structures. The accompanying drawings illustrate the practical methods of marking and framing this corner.

Flat or Plain Tenon Corner

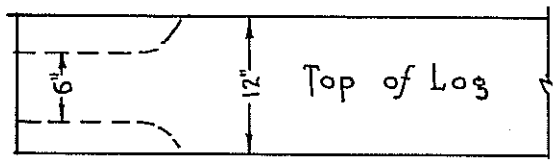
This corner is the one most commonly used in this locality. It is made in two forms. In one, only the bearing surfaces are framed, while in the other all four sides of the tenon are framed flat. It has this undesirable feature - that it is not self-locking as are the corners previously described. It is simple and easy to make and the most economical for temporary structures. The logs should be pinned as will be shown. For this type of corner all framing can be done on the ground before log is put on the building. Carefully done, it can be a neat looking job.

Upright or Groove-and-Tenon Corner

It is not known where this type of corner originated, but it is used to a considerable extent around the town of West Yellowstone, Montana, the west entrance to Yellowstone National Park. It has several very desirable features from a mechanical viewpoint. The weight of the building is carried on the full length of the logs at all times and does not rest on the corners as in other types of corners. It makes a tight wall at all times; the cracks will never open up. A good mechanic can frame the complete building on the ground before any logs are placed on the foundation, and then it can be erected in a very short time. Next to the round notch corner, it probably has the best appearance of any corner. It is not a difficult corner to construct, although it calls for considerable mechanical skill and accuracy. The accompanying illustrations will show how it is framed. Door and window joints should be framed just the same as the corner logs except that only one side is grooved and the door side left smooth or rabbeted out as may be desired. If logs are reasonably dry, from 3" to 4" should be left at each corner for settling. In

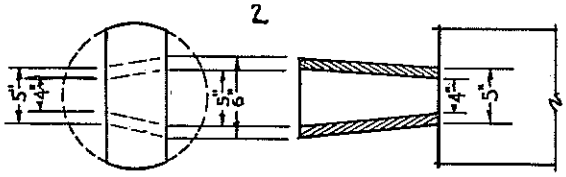
DOVETAIL OR BOX CORNER

1



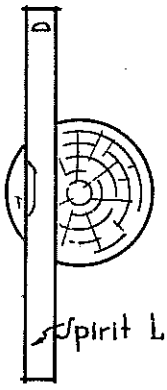
Hew flat at dotted line

2



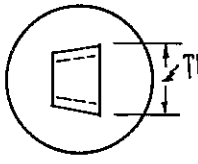
Mark as shown and cut to dotted lines. Note that bearing surface of tenon has a 2 way bevel so that logs are locked in place

The demensions of the cuts given are indicative only. The depth or thickness of the tenon varies with the size of the log and the bottom may be deeper then the top cut or vice-versa. The tenon is not always in the center of the log

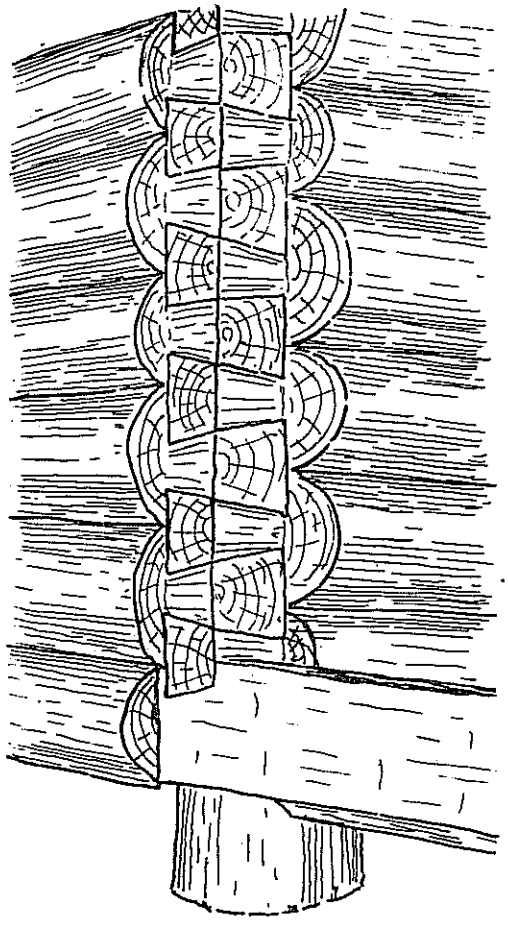


Log is dogged in place, then use Spirit Level to mark and cuts at start.

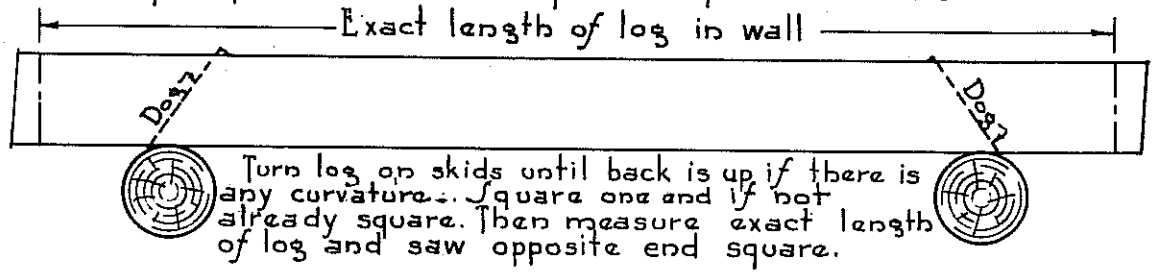
3



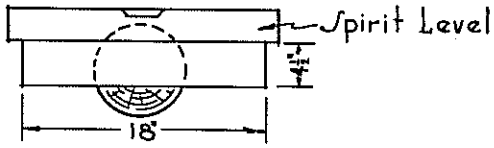
This depth varies with size of log.



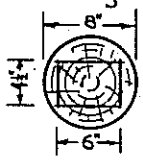
FLAT CORNER OR PLAIN TENON CORNER



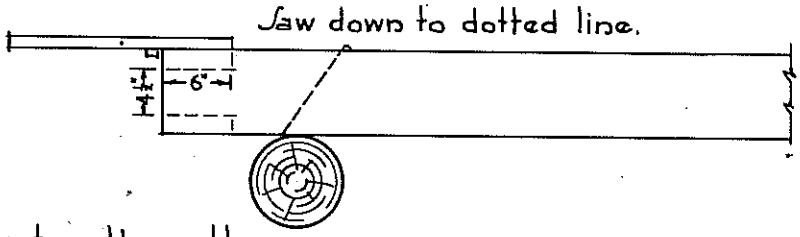
Turn log on skids until back is up if there is any curvature. Square one end if not already square. Then measure exact length of log and saw opposite end square.



Having determined the average thickness of the "tenons" from the average top and butt diameter of the logs, prepare a piece of board about 18" long and the same width as the tenons are thick. Drive a nail through the center of the board and into the center of the log. Now put the level on top of the board. Move the board until it is perfectly level and then mark a line on the log at the top and bottom edge of the board. For 16' logs, 8" or 10" the board should be about 4½" wide. Now go to the other end of the log and do likewise.



Having marked the top and bottom of the tenon cut, now mark the sides. Use the plumb side of the level or a square to do this. The width of the tenon will depend on the logs. For 8" to 10" logs, 6" to 7" will work out.

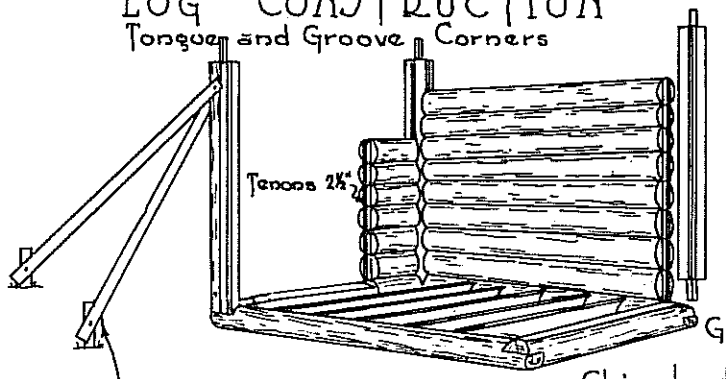


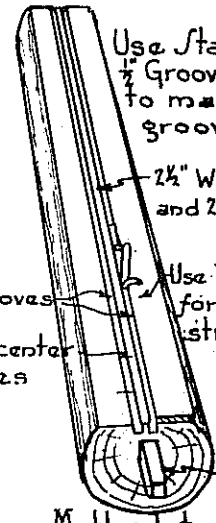
Nail a 1"x1" cleat on the pattern board to make this mark.

Make saw cuts on each end, then cut chip off and smooth up surface again. Turn log over and do other side. Then frame out the sides of the tenon and the log is ready to go on the wall. Some fitting between corners will undoubtly be necessary, but if logs are fairly straight and smooth very little should be needed.

LOG CONSTRUCTION

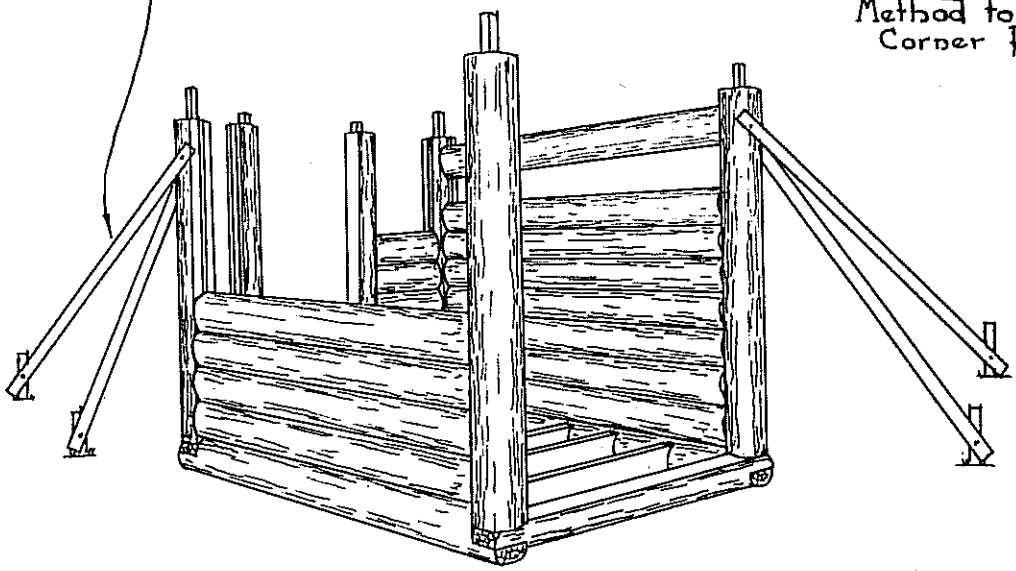
Tongue and Groove Corners

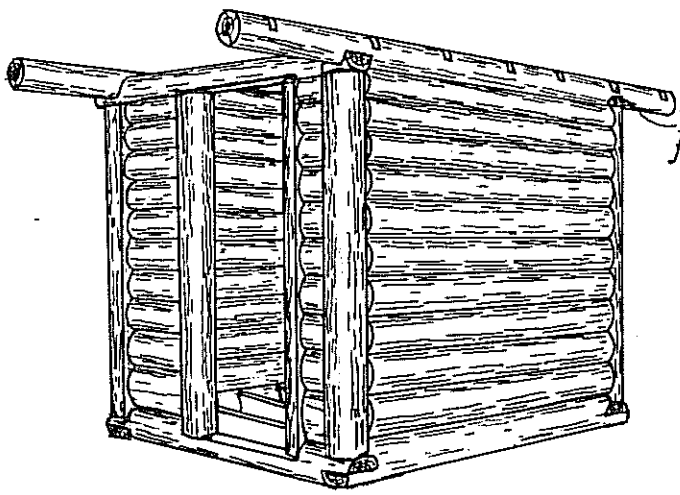




Method to groove Corner Post

Plumb and brace posts first.



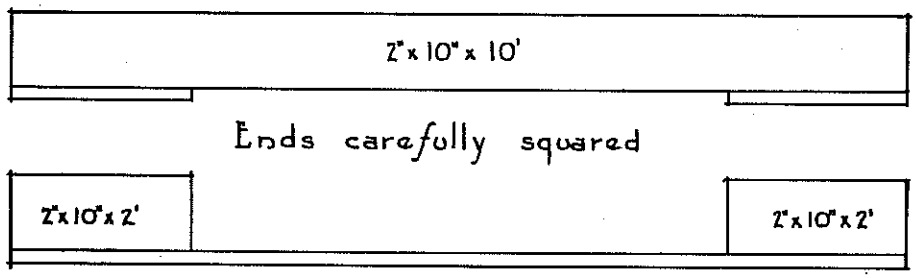


Leave 2" to 4" for settling.

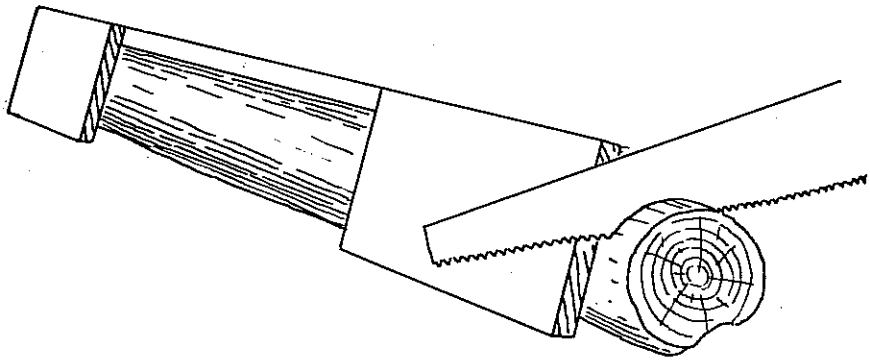
LOG CONSTRUCTION

Mitre Boxes

To saw a log square

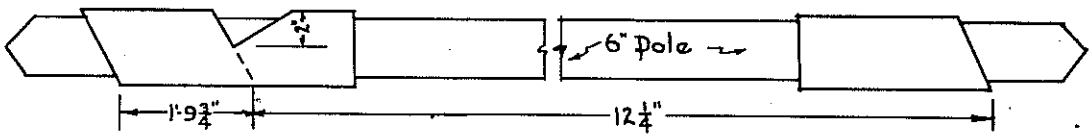


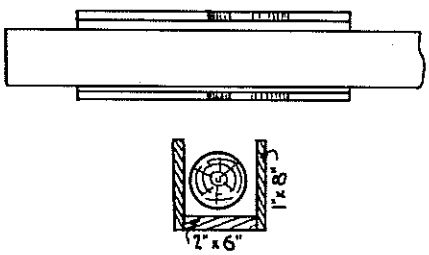
With this miter box you can saw any log or pole exactly square at either end.



To Frame Pole Rafters

$\frac{1}{3}$ Pitch roof, width of building 20', Eave 18"
Rafter $12\frac{1}{4}$" Eave 1'-$9\frac{1}{2}$" = 13'-$9\frac{3}{4}$"





Make each box separate and then fasten to the top of a log or on the floor the correct distance apart as shown. Lay the pole in the box, back down if any; dog it fast and then saw to the pattern. This is much faster than marking each pole separately and every rafter will be the same.

For Pole Rafters, line and hew upper surface to get a face and a good even bearing for boards.

LOG CABIN CONSTRUCTION

Two methods of framing floor joist when sawed material is available

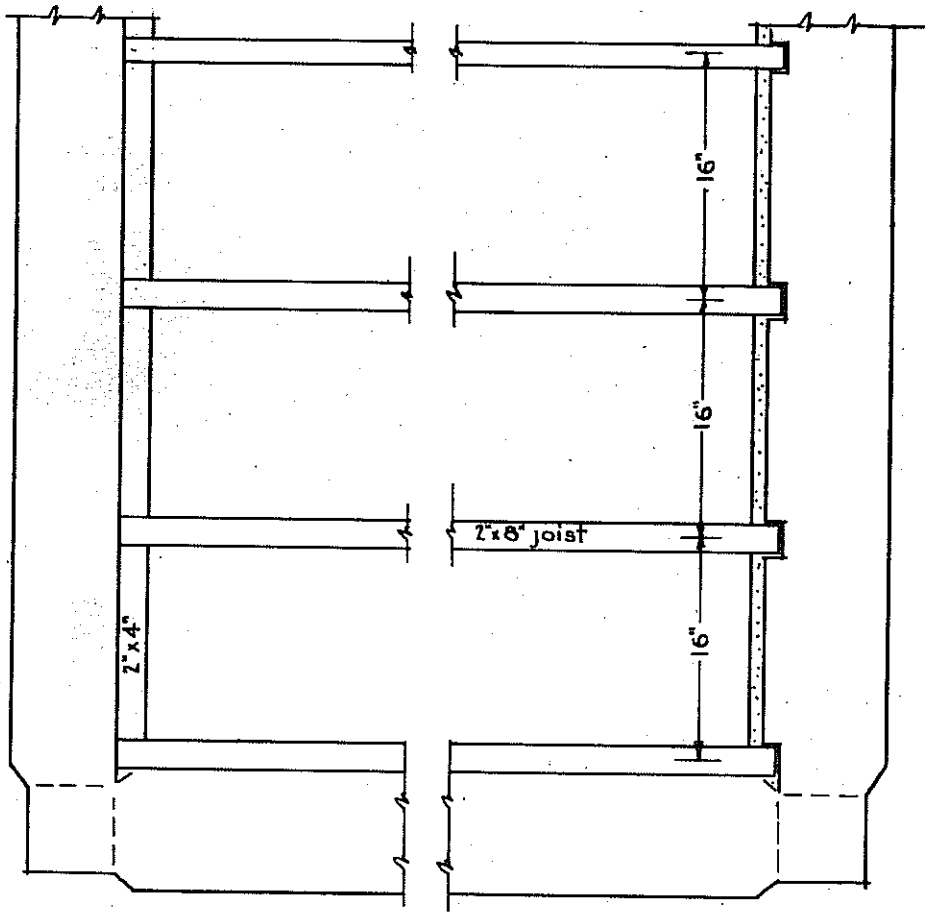


Figure C

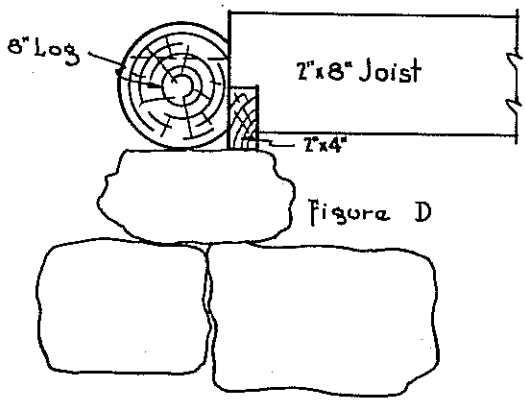


Figure D

Rock Piers at Corners and Center Bearings

Raw Sill Log flat on inside face and spike 2"x4" to the log as bearing for the joist.

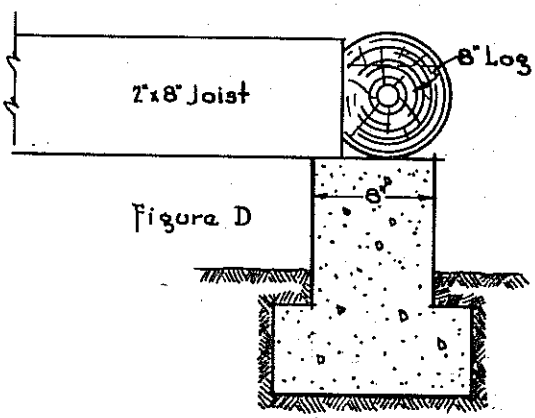
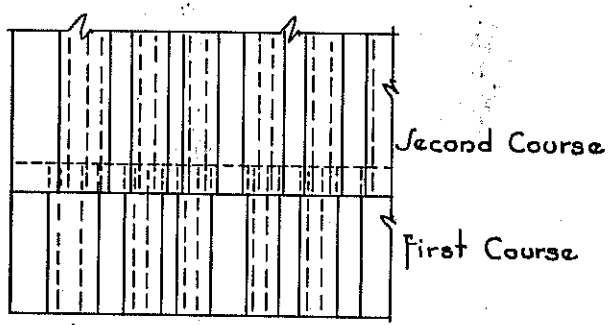
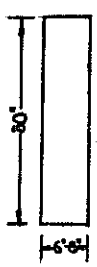


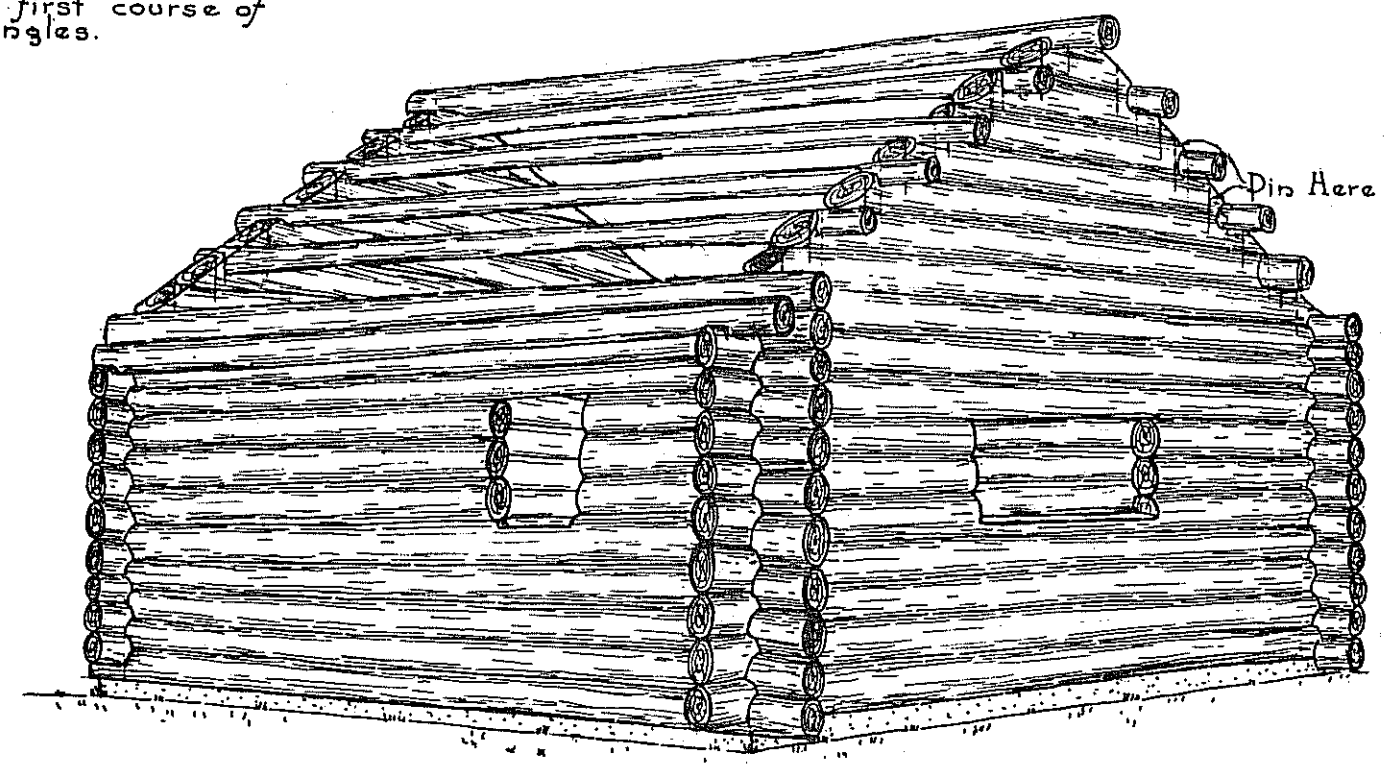
Figure D

When Concrete Wall is used, joist may rest on wall. Saw notchs on inside face of Sill Log.



Shakes in each course are laid the same as the first course of shingles.





FRAMING POLE RAFTER ROOF
FOR SHAKE ROOF

LOG CONSTRUCTION

Scribed Log Walls

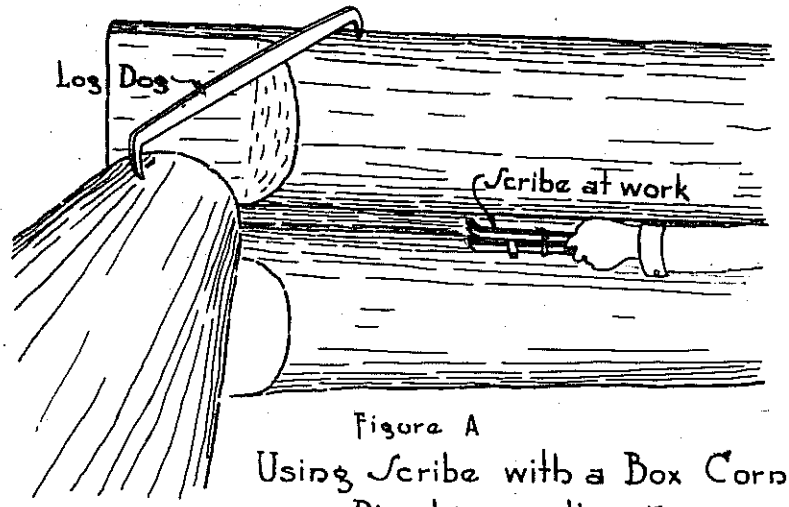


Figure A

Using Scribe with a Box Corner

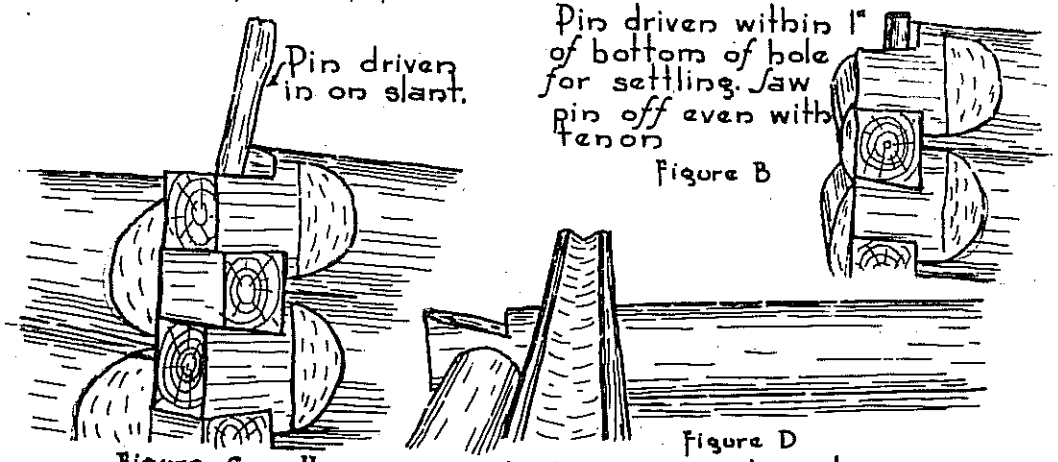


Figure B

Figure C

Figure D

How groove looks when cut out.
Do not take out any more than absolutely necessary to make a tight fit.

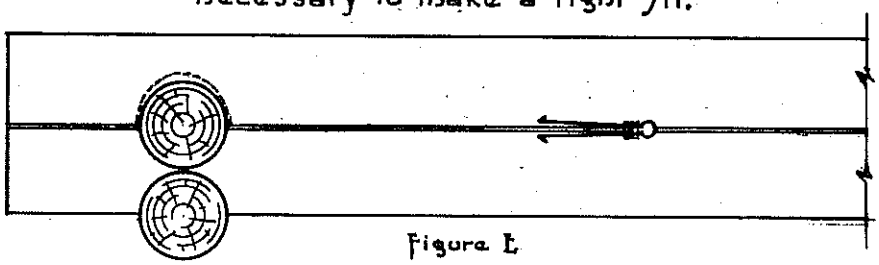


Figure E

Using Scribe with round notch.
Mark and cut out notch as for ordinary wall. Then dog log into place and scribe making additional mark as shown by dotted line to deepen notch.

LOG CONSTRUCTION
Framing Partitions

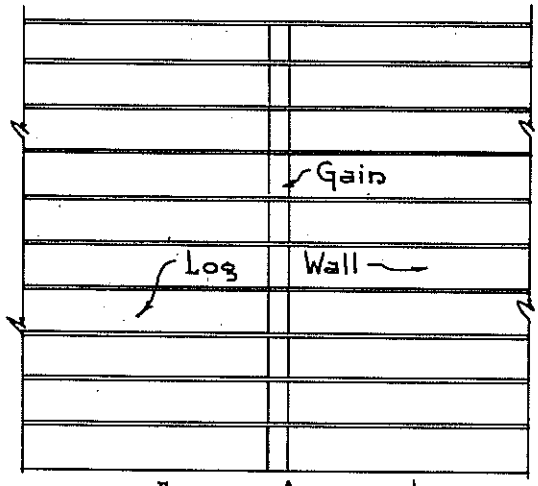
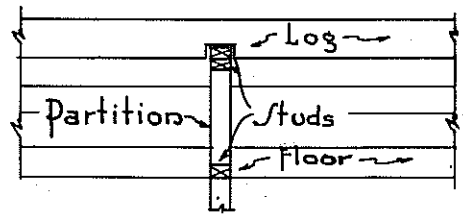


Figure A



Cut a gain 2" in depth and the width of a 2"x4" ($3\frac{5}{8}$") into the face of each log before it is finally placed. Then set stud of partition in the notch but <u>do not nail</u>.

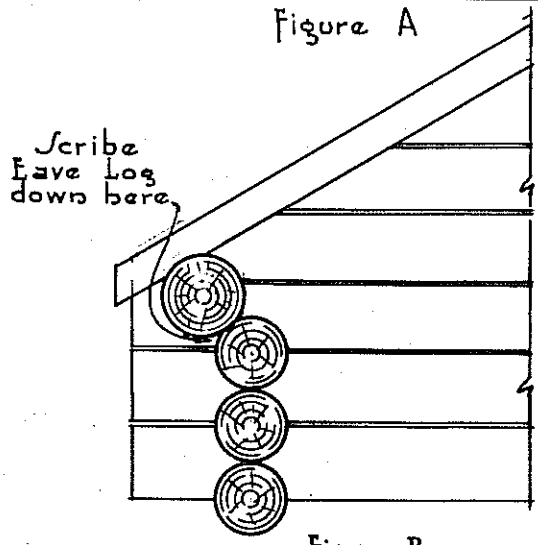


Figure B

Method of construction of Eave Log in heavy snow country

LOG CABIN CONSTRUCTION

Framing Poles for Floor Joist.

Put these in before second round of side logs are put in.

Make two saw cuts across log. Then chisel out half way to make gain for end of joint. If you dont want the saw cuts to show, cut the mortise out with chisel.

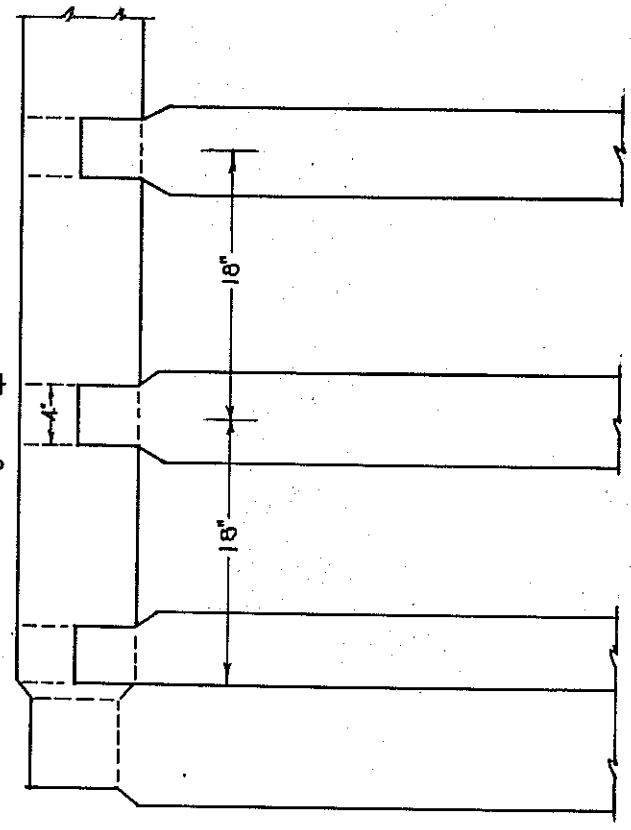


Figure E

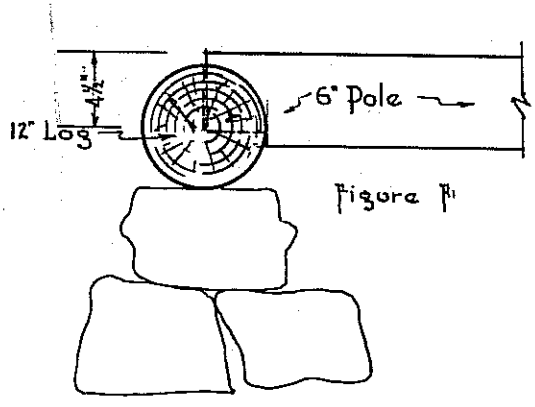


Figure F

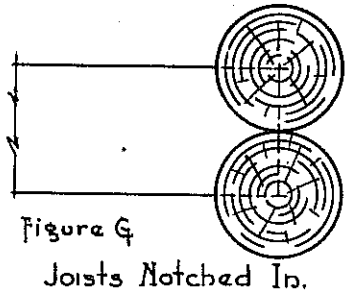
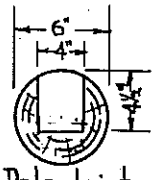


Figure G

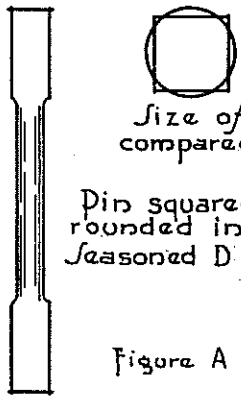
Joists Notched In.
Tops of floor joists should be as much below top first end log as possible.



Frame Pole Joists to same thickness at each other.

LOG CONSTRUCTION

Pinning of Logs



Size of square pin compared to round hole.

Pin squared at ends and rounded in middle section
Seasoned D Fir preferred

Figure A

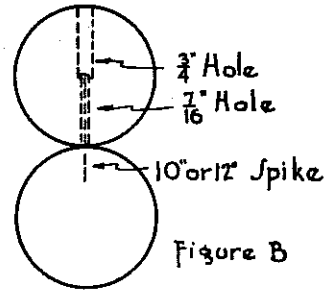
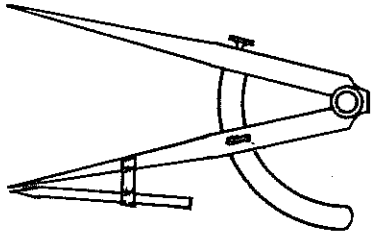


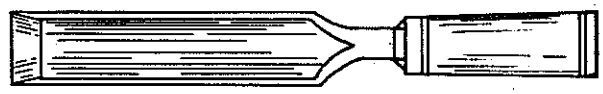
Figure B

Bore 3/4" hole 1/2 way through top log then bore 7/16" hole through remainder of log. Then drive a 10" or 12" spike down as shown. Wall can then settle without interference from spike.

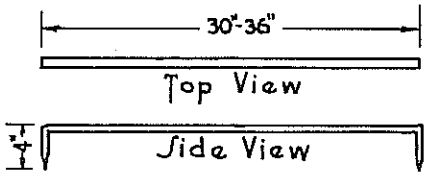
TOOLS



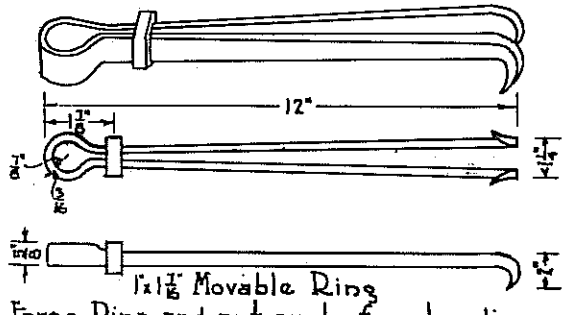
Divider



2" Gouge Chisel



1/2" Iron Dogs

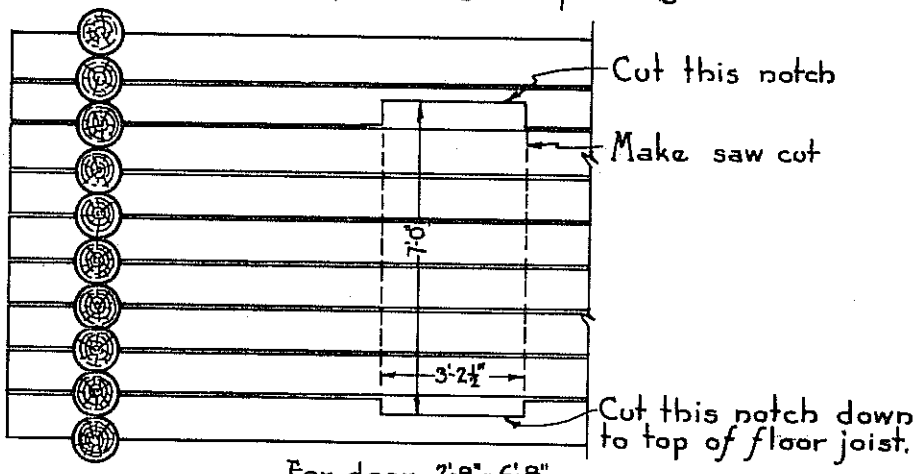


Forge Ring and put on before bending end up

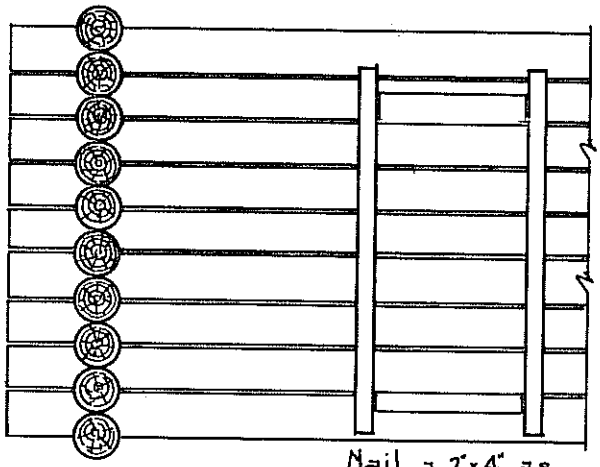
Norweign Log Scribe

LOG CONSTRUCTION

Framing Openings



For door 2'-8" x 6'-8"
Figure A



Note: Openings will usually be from 6½" to 7" wider than door or window sash.

Nail a 2"x4" as straight edge to cut logs down.
Figure B

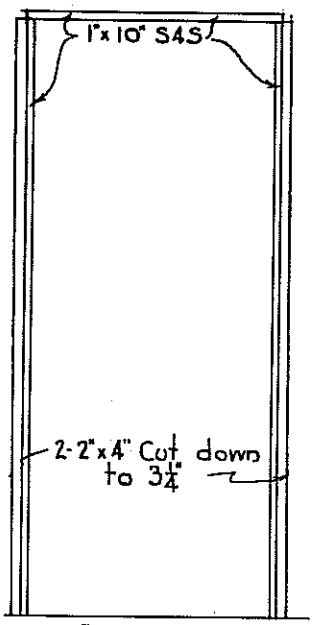


Figure C

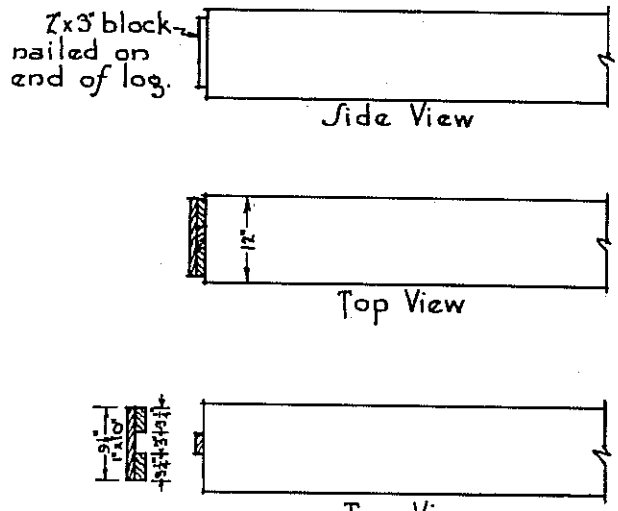


Figure D

FALSE JAMB

LOG CONSTRUCTION

Framing Openings-Cont.—

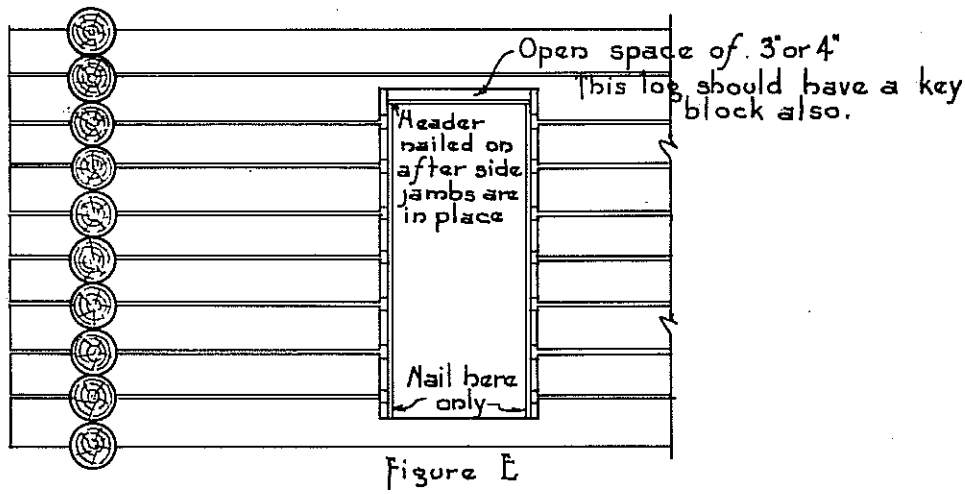


Figure E

False jamb in place, nailed to bottom log only. Nail header after side jambs are in place. Logs are free to settle yet the false jamb to which finish frame is attached is held securely in place. Nail casings to false jambs, and not to the logs.

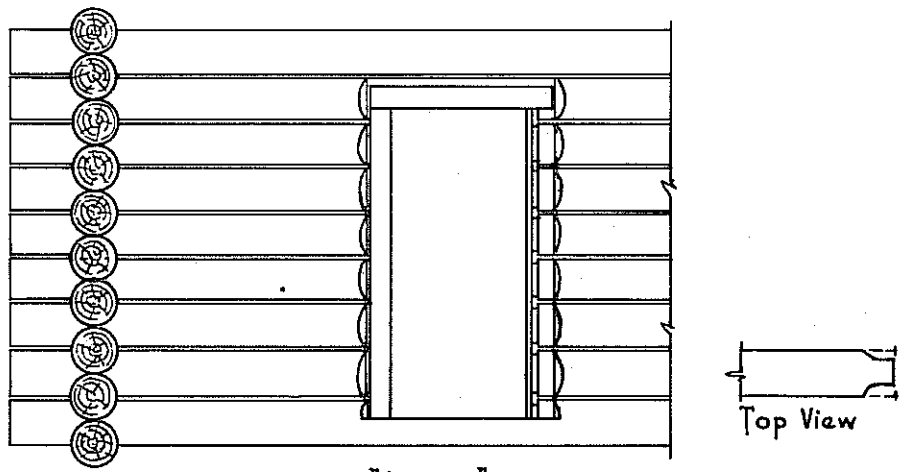
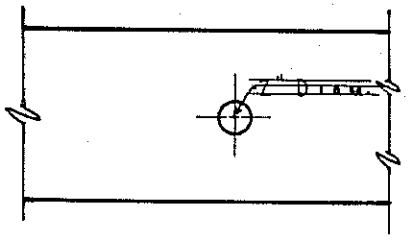


Figure F

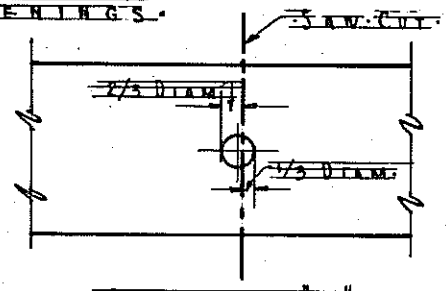
Showing logs cut back for casings.

TYPICAL · LOG · CONSTRUCTION ·

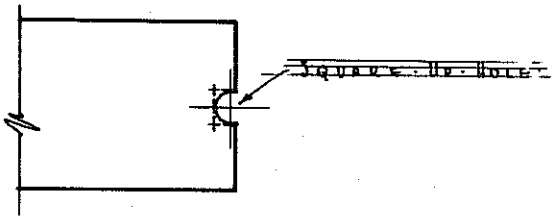
FRAMING · OPENINGS ·



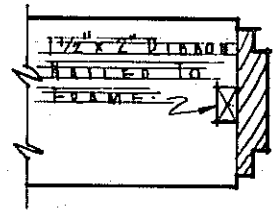
DETAIL "A"



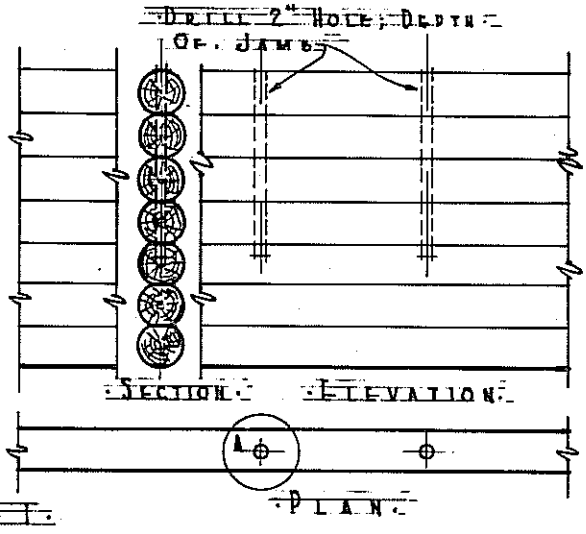
DETAIL "B"



DETAIL "C"

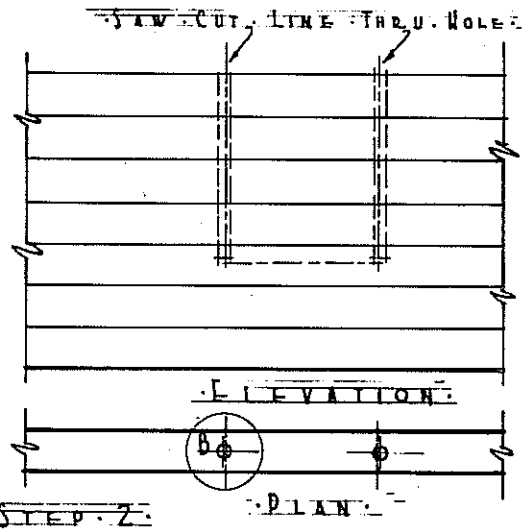


DETAIL "D"



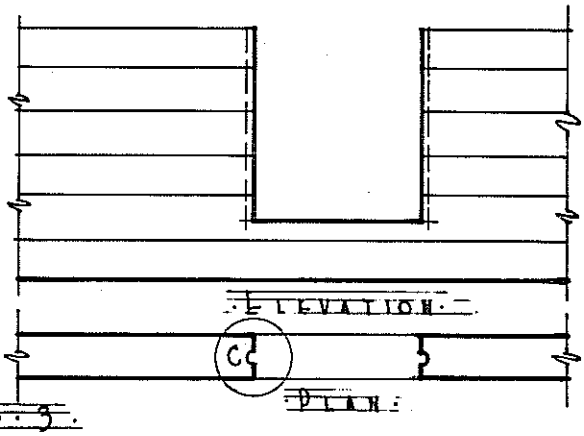
STEP 1

NOTE: HOLE TO BE BORED AS EACH LOG IS PUT IN PLACE

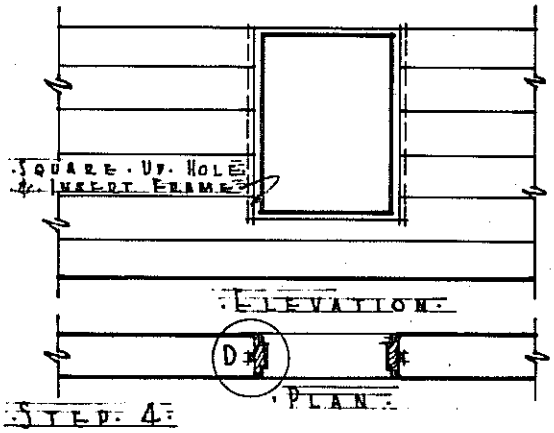


STEP 2

FRAME TO BE INSERTED BEFORE TOP LOG IS PUT IN PLACE



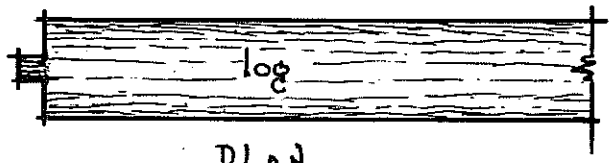
STEP 3



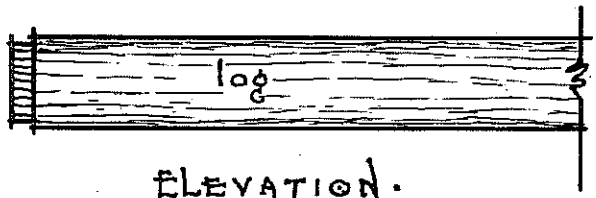
STEP 4

- LOG CONSTRUCTION

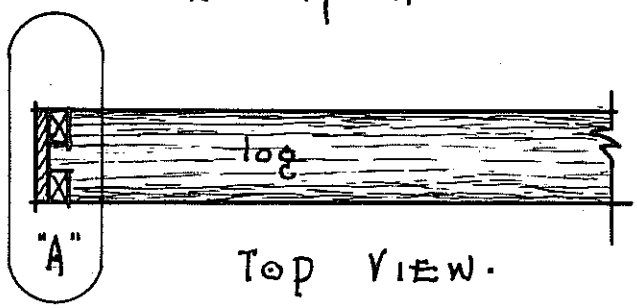
Framing Openings. (cont'd.)



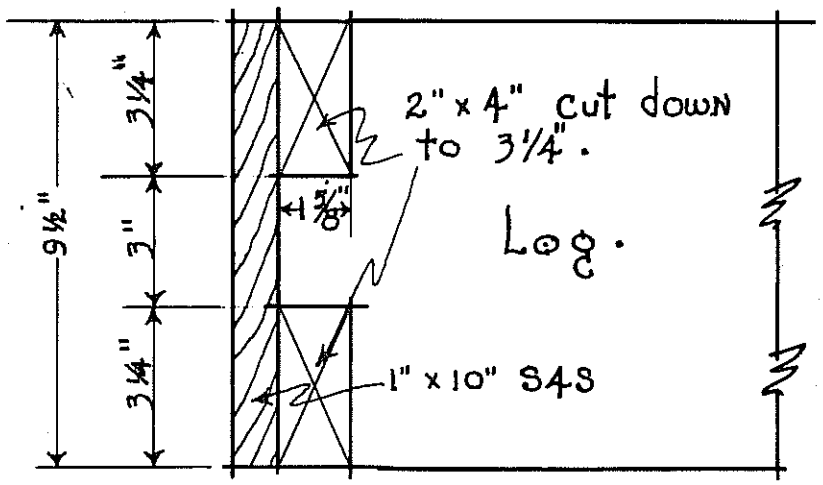
PLAN.



ELEVATION.



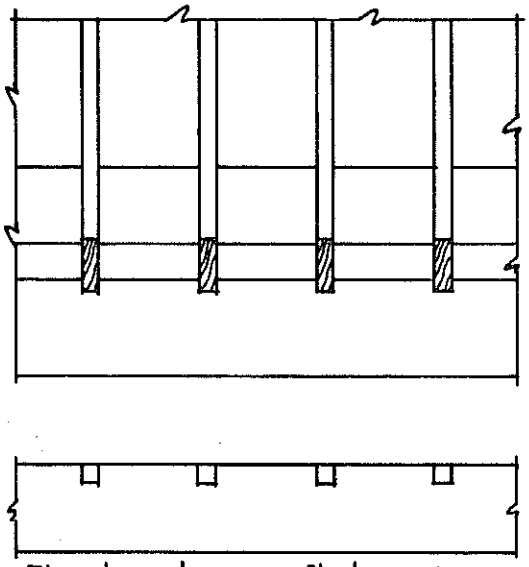
TOP VIEW.



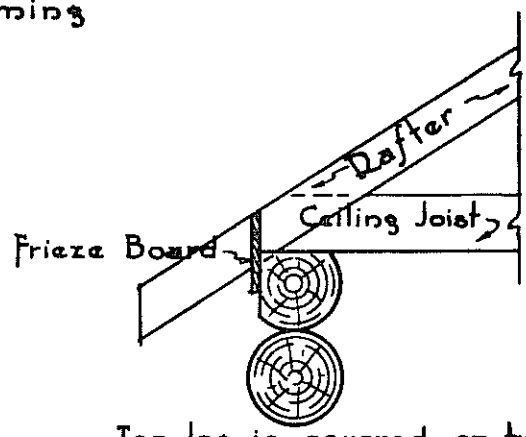
- DETAIL AT "A" -

showing false Jamb construction to allow for log settlement & shrinkage.

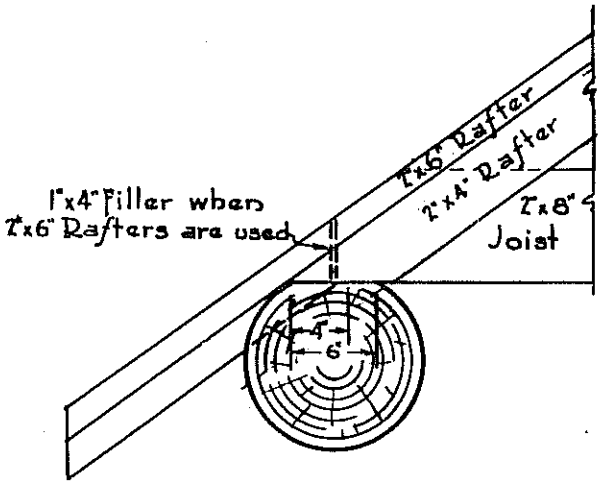
LOG CONSTRUCTION
Roof Framing



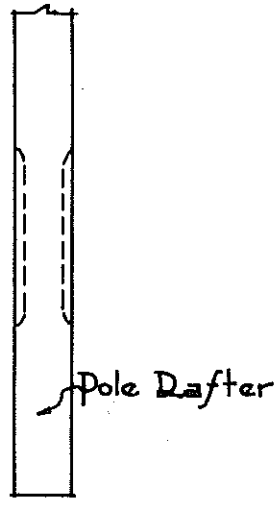
The top log is flatened on top and roof seats are notched down.



Top log is squared on two sides to make regular plate for roof rafter and ceiling joist.



Hew top of log down to average width of 6", then notch down for each rafter. Be sure rafter cut makes a snug fit.



With a Pole Rafter notch will need to be wider but rafter should be flattened a little where it fits into notch.

about six months the cap log will come down that much. The same is true over openings also.

Aside from the corner construction, the other details of log building construction are much the same for any type of corner and will be discussed separately, disregarding the type of corner used.

Floor Joists

In a log building the floor joists should be put in as soon as the first round of logs is in place. They should be notched into the first side log, or, if the building has a concrete foundation, can be set on the top of the foundation as in a frame building. In order to give the ends of the joist sufficient bearing on the wall it will be necessary to either notch the ends into the side log or else hew it off on the inside. The simplest way is to cut out the notches before the log is rolled into place. Pole joists should be 4" to 6" in size and hewed straight on the upper side to provide level bearing for flooring. A number of ways of framing floor joists are illustrated in the accompanying pictures.

Wall Logs

In laying up the successive rounds of logs in the wall, several details must be watched and kept lined up. The corners should be kept nearly level with each round. This can be determined by measuring up from the level of the floor joist from time to time. A variation of an inch in height will not cause any difficulty. The main idea is to come out level at the top log. The height of the corners is regulated in two ways: By increasing or decreasing the thickness of the tenon of the log at the corner, and by reversing the top and butt ends of the logs in the wall.

The face of the logs must be kept plumb on the inside of the building and in the same vertical plane. Some use a spirit level for plumbing the wall, but after the first two or three logs are up a plumb board is much more accurate because of its greater length. Of course, it is possible to secure a 6' or 8' spirit level, but they are not usually available for our work, and anyone can make a plumb board in a few minutes.

The logs should be pinned together with either a wooden pin or a large spike as illustrated. The spike method is the easiest and quickest to put in and is just as satisfactory as the wood pin. The logs should be pinned on each side of an opening and about two feet back from each corner. On small structures where alignment of the walls is not so important, pinning may be eliminated. On larger buildings it is essential in order to maintain the logs in alignment and to prevent individual logs from springing out of place in the wall as sometimes occurs under various circumstances.

Where it is necessary to use logs which have a decided curve or sweep, they should be put in the wall with the bow or back up, and may be straightened by making saw cuts in the curve on the under side of the crooked log from a half to two-thirds through near the center.

Chinkless Log Cabin Construction

The method of construction used is an old idea used in the building of log structures in Scandinavian countries, which does away with the method of chinking and mudding so prevalent in many of our buildings of this type. It consists of grooving the underside of each log in each tier or round so that it saddles the log beneath, making a close joint its entire length. The marking of the groove is accomplished by a tool, which, for the purpose of convenience we shall call a cabin scribe. (Also called a drag.)

The scribe used is a tool about 12" in length, made preferably of 3/8" square steel or iron bent in much the same manner as the spring in a steel trap; the two ends are turned down in two fingers about 1¼" and sharpened with a flat surface on the inside of the point toward the loop. These points should diverge to be about 3/4" at the points. The loop should be hammered out thin to provide spring so that the points may be spread or closed easily. A ring is welded around the two halves of the tool, which, when slipped up or down, makes it possible to adjust the points and prevent further spreading while tool is actually being used. A link out of a small chain slipped over the logs before points are turned will serve the purpose also. A chip or any small piece may be forced between to hold the points from springing together. In using the tool, the log to be fitted is framed at the ends and fitted down to within about 2" of lower log at the widest crack. If logs are too close, it is difficult to do a good job of scribing. The scribe is then adjusted at the widest crack between them so that when holding the tool parallel to the interstice the lower point of the scribe will ride on the surface of the lower log and upper point will scratch the upper log. The upper log is marked in this manner on both sides of the wall. The tenon on the corners is also marked with the scribe, set as described. The log is then turned over, the tenons worked down and a V-shaped groove to the lines cut in the remaining portion of the log.

The V-shaped groove should be cut deep enough in center to always permit the outer edge of the groove to rest on the lower log. The smaller the groove the better chance to obtain a close fit. I mean that one should take off the least possible amount that will permit of a close fit.

An ordinary double-bitted axe is used for this purpose. The principle of the scribe is based on parallel lines and it can readily be seen that if there is a hump on the lower log there will be a gouge from the upper one. When carefully done the space remaining

is so small as to be negligible. Where an air-tight wall is desirable, a strip of plumber's rolled oakum should be laid on the bottom log before the upper log is dropped into place. Dry moss also makes a good filler for this purpose.

Door and Window Openings

As soon as the first round of logs and the floor joists are laid, spot the location of each door and window opening and mark permanently on the inside face of the logs. Cut out the door opening and chop the notch down to within an inch of the true line. Leave the finishing until you are ready to set the frame so as to preserve the surface of the wood in good shape. Also determine the height of the opening above the floor line and mark that also on the bottom log so that it can be referred to from time to time and the necessary cuts in the top log over the opening can be made before it is put in place. When the log in the wall that carries the window sill is reached, the cuts for the window must be made the same as for the doors.

The logs should not be cut out of the openings between the bottom and top of the opening until the log work of the building has been completed and the roof put on. It is very desirable that the building be allowed to settle and dry out for several weeks before this is done even if the logs are well seasoned. This is not always possible because of the necessity of getting the job done promptly. When the last log over the opening is reached, it should be notched out the same as the bottom log before it is put in place. Also saw-cuts at least half the depth of the next log should be made as a start in cutting out all the logs for the opening. When the time arrives to cut out the logs in the opening, spike a 2x4 along the line of the opening to follow as a straight edge in making the saw cut. It will also hold the logs until the false jamb can be placed in the opening.

It has long been the common practice to put in false jambs to hold the ends of the logs in place. A 2x8 or 2x10 was spiked to the logs. This works all right but it has the objectionable feature that the logs next to the opening are held from settling as they dry out and consequently the false jamb causes the cracks in the logs to open up. If the logs are well seasoned and the building has been allowed to settle, nailing the false jamb to the ends of the logs will not prove too unsatisfactory, especially on smaller buildings where appearance is not so essential. Where an excellent job of workmanship is desirable a false jamb may be used, prepared and set in as shown in the accompanying illustrations. It is essential that space be left above the jamb for logs to settle.

Width of the jambs will vary with the size of the logs in the building. For logs which average 12", the jambs should be 10" material, and for logs 10" or under, 8" material should be used. It will be necessary that the logs on each side of the opening be cut

down flush with the opening jambs so that the casing will fit properly and flush with the jambs.

Roof Logs

Roofs on log buildings may be framed in several different ways, depending upon the kind of material available and the appearance desired. With a shingle roof, the frame, whether of sawed material or round poles, will be framed in the same way as the roof on a frame building. The only difference is that the top log on the wall must either be framed to make a seat for the rafters, or it must be notched out to receive the rafters. Both methods are illustrated. The gable ends may be run up with logs, which is most desirable for appearance's sake, or they may be framed similar to the gables in a frame structure.

With a shake roof, rafters are not used, but roof logs running parallel to the side walls are placed at intervals for the shakes to rest upon. Shakes are usually made 30" in length so that the roof logs are spaced at 24-inch intervals. The gable logs are run up at the same time as the roof logs, and the two are framed together.

The facing or hewing of round timbers so as to have one or two sides surfaced flat for framing purposes requires some skill with the axe and a good mechanically-trained eye. There are a number of mechanical aids to the work which should be used by anyone engaged in doing any form of log construction work.

The carpenter's spirit level, the steel square, chalk line and chalk are necessary for laying off the lines to be followed in hewing a timber. Lay the log to be framed up on skids or horses, dog it in place with iron dogs, and with the level and square lay off the desired dimensions on each end of the log. The level will insure that lines on each end are parallel to each other. Then with the chalk line snap lines from end of the log which connects similar points on each end. After this has been done, the axe and broadaxe, with the good mechanical eye, will do the rest if skillfully handled.

For framing the ends of timbers square and for cutting pole rafters the work is greatly simplified if the mitre box in various forms is used to guide the saw.

For measuring lengths use a steel tape for accuracy, or a board pattern cut the exact length desired.

Second Floor Joists

For a 1½-story or 2-story building it is necessary to put in floor joists at the proper height. This is done by notching into the wall log about half way so the ends of the joists will set into the side wall.

Patterns should be set independent of the log walls and not nailed to the logs as this would prevent the walls from settling

Finishing Log Walls

If the logs in log constructed buildings are either scribed or are very carefully fitted together, it will seldom be necessary to put in chinking. However, wherever this may appear to be necessary, it is better practice to use small poles which will run the full length or nearly the full length of the wall. This makes a much more satisfactory looking job and is easier to put in than the split chinking. It always has been a considerable problem with log structures to devise some method by which the plaster daubing in the outside wall, or the inside, too, for that matter, can be held in place. Some have driven shingle nails into the log two or three inches apart from one end of the crack to the other. The plaster used has also been mixed with considerable hair in it on the basis that probably the hair would help the plaster to hang together. Others have tried nailing small strips, like a piece of window stop, on the lower log to hold the plaster. This has appeared unsightly and has detracted from the general good appearance of the building to which it has been applied. Another scheme that has been used has been to tack narrow strips of ½" mesh wire screen, or window guard, as it is called, into the crack. This has perhaps been about as successful as any method which has been contrived. Another method which has worked with considerable satisfaction was to lay a layer of moss on each log before the next log was laid down. The moss projecting beyond the crack presented a surface which would tend to hold the plaster in place.

The most satisfactory material of all those experimented with is a product called "Atco Plastic Fibre Seal." This is a tar and oil product which is applied to the cracks between the logs and elsewhere with a pressure grease gun leaving a one-half inch nozzle and a trigger release. Logs should be laid as tightly together as possible and must be dry when the seal is applied. It should be heated to a temperature of about 65° F to handle properly. It is important and difficult to apply the proper quantity of the material. About 1/4" in thickness gives good results, which allows the material to "give" as the logs contract and expand, insuring a permanent joint. If the material is applied in any less amount, it does not have body enough to stick together. It has a greater power to stick to the log than to itself. The material "Atco Plastic Fibre Seal" can be secured from the American Tar Company, N. 109 Erie Street, Spokane, Washington. The cost is very reasonable especially when purchased in quantities of 50# or more.

Shake Roofs

In some situations it may be more economical to use split shakes for the roof covering than to pack in sawed shingles, or it may be considered more harmonious design to use split shakes. Shakes are usually made from cedar but may be made from any wood which is straight-grained, free from knots, and splits easily. They are usually cut 30" in length and average from six to eight inches in width, with a thickness of one-half inch. The length may be varied to suit the spacing of the rafter logs of the building, since the spacing will vary with the pitch of the roof and the size of the gable logs.

Shakes are laid in double courses with a lap of six inches between courses. Each shake should lap the shake beneath it from $1\frac{1}{2}$" to 2". (See illustration.) It will take approximately 120 shakes per hundred square feet of roof space to be covered and from $2\frac{1}{2}$ to 3 pounds of 6d box nails to lay them. Use galvanized nails as ordinary wire nails rust out very quickly.

HARDWOOD FLOORS

The use of vertical grain fir for flooring has not proved to be as satisfactory as might be desired. In fact, it has been found that maple or oak can be secured and placed at even lower cost than the vertical grain fir. Those hardwoods make a much more satisfactory floor, and it will be the general policy to use them in ranger dwellings and offices and other structures where a good floor is considered desirable. No. 2 maple, 25/32"x$2\frac{1}{4}$"xR.L., or select quartered red oak, 13/16"x$2\frac{1}{4}$"xR.L. are most suitable for dwellings and offices.

The Proper Nails to Use for Hardwood Flooring

It is very essential that the proper nails be used in laying hardwood flooring to prevent splitting the tongue and bruising the face. For the best results the following are recommended: 3d finish nails for 3/8" thick, used 9" apart; 8d cut flooring nails for 13/16" thick, used 16" apart; 10d cut flooring nails for 1-1/16" thick, used 16" apart.

The 3d is a wire nail and on account of the small gage and medium length is best adapted to thin flooring.

The 8d and 10d are steel-cut nails, manufactured especially for laying hardwood flooring and are being used by up-to-date contractors and floor layers. These nails are the same thickness from point to head and have two smooth sides which are set parallel with the tongue, eliminating the strain from the narrow part of the tongue. They are wedge-shaped in width, which puts the entire strain lengthwise of the tongue. The rough edges give these nails drawing and holding qualities not contained in any other nail, and after being driven their entire length they remain in position, producing and maintaining a perfectly tight joint.

The nails should be driven at an angle of 45 to 55°, and the first nail or two driven in the piece of flooring should be "toe-nailed" toward the preceding piece to which it joins.

PAINTING

As a general rule all frame buildings should be repainted every three or four years.

The following is the standard color scheme for Region One:

Ranger District Headquarters

Frame buildings, board siding
Body, white - no trim.

PAINTING

As a general rule all frame buildings which have been painted should be repainted every three or four years. If this rule is followed, one coat of paint each three or four years will keep the surface in acceptable shape. If the repainting is let go much longer it will usually require a two-coat job to restore the surface to a satisfactory condition.

Buildings which have a rough sawed, natural finish or are covered with shakes or shingles and have been stained with logwood oil or linseed oil should probably also be re-stained every three or four years. Our experience with this type of exterior finish is not yet sufficiently extensive to show any definite conclusions as to the life of the stain.

Roof stains are applied solely for the purpose of giving the roof of the structure a constrasting color with the body color of the building. Their value as a preservative is very questionable. The renewal of roof stains is governed solely by the desire to maintain a satisfactory color. Architects are of the opinion that the faded and mottled appearance of the green stain commonly used in the region has a more satisfactory effect than does the uniform solid color just after application.

Color Scheme

When new buildings are erected the specifications on the plans will show the color scheme to be used. It is expected that this color scheme will be followed in future maintenance unless approval for a change has been secured. When new buildings are added to a group already painted the color of the new structures will conform to the exterior of the old buildings. As nearly as may be, all buildings will conform to the following general scheme of coloring.

Ranger Stations (District Headquarters)

Exteriors

All frame buildings with smooth siding which are to be painted. White, unless otherwise specified. The entire exterior, except roofs, and including trim, doors and window sash will be painted white.

Roof, may be stained moss-green.

Porch floors (wood) painted light pearl or dust color.

Porch ceilings, white.

All frame buildings with rough sawed siding, shakes or shingles.
Natural color. Apply one coat of the following formula.

Clear logwood oil----------10 gallons
Raw sienna in oil---------- 1/16 " (1-lb.)
Mix the color in a small amount of logwood oil, stirring until smooth and then stir into the larger body. Stir frequently and thoroughly. Apply with a four-inch brush as much as the wood will absorb. Apply evenly.

All exterior trim to be painted with the same formula.

Doors and window sash to have one coat of clear spar varnish over logwood oil.

Roofs may be painted with logwood oil or left natural.

Porch floors (wood) will be either one coat of hot linseed oil or painted a very light brown.

Porch ceilings, oiled only.

All log buildings.
Give logs a thorough cleaning and apply one coat of the logwood oil formula.

All window and door trim to have logwood oil.

Doors and window sash to have one coat of clear spar varnish over logwood oil.

Roofs may be painted with logwood oil or left natural.

Porch floor (wood) will have either one coat of hot linseed oil or painted a very light brown.

Ceilings, oiled only.

Interiors

Dwellings - plastered walls, living rooms, dining rooms and bedrooms.
One coat of "Caseine" or cold-water paste paint. (Trade names, "Texolite" or "Luminall".)
Colors, ivory, cream, light tan or buff, and gray.

Kitchens and bathrooms, semi-gloss enamel on wall size and undercoat.
Colors, white or ivory.

For best light refraction, ceilings should be white or pale ivory.

Doors, sash, trim and baseboards, semi-gloss enamel over prime coat and undercoat.
Colors, white or pale ivory.

Knotty pine or plywood walls, natural finish.
One coat Fullers floor preservative and one coat white shellac; or, first coat boiled linseed oil thinned with turpentine (2 parts oil, 1 part turpentine); second coat clear white shellac; third coat, semi-gloss varnish rubbed down.

Interior log walls should be treated the same as knotty pine finish.

Hardwood floors, oak or maple, should be sanded smooth. The most satisfactory finish on the market now is believed to be "Bruce" floor finish filler and "Bruce" tuf-lustre. Follow manufacturer's instructions. "Fullers" floor preservative #5865 has been found to be very satisfactory.
When floors have to be painted, use a good brand of floor paint.
Colors, light pearl, dust, light tan, buff or golden brown. Dark colors are taboo.
Do not lay linoleum on hardwood floors in dwellings.

Administration buildings or offices, bunkhouses, warehouses and similar structures.
Plastered walls, same as dwellings.
Ceilings with insulation tile or plaster board. Apply Caseine, cold-water paste paint.
Colors, white or pale ivory.

All doors, sash and trim to be finished natural. First coat boiled linseed oil (2 parts oil, 1 part turpentine); second coat clear white shellac; third coat semi-gloss varnish rubbed down.

Knotty pine or plywood walls finished same as wood work.

Warehouse and shop interior walls and ceilings to have one coat of aluminum paint.

Hardwood floors will be treated as in dwellings. They have not proved satisfactory in offices and bunkhouses and the use of linoleum in these buildings is strongly recommended.

Warehouse floors should be treated with hot linseed oil as needed.

Interiors of barns, sheds and garages may be left natural, painted with aluminum paint, or a coat of clear logwood oil.

Guard Stations

The painting or staining of the exterior and interior of all buildings at guard and other temporary or overnight stations should conform in general to the color scheme for buildings at ranger district headquarters.

The color of yard fences, flag poles and radio antenna poles should conform to the color scheme of the building group of which they are a part.

Lookout Houses (frame)

Exterior, will be painted white to provide the maximum visibility.

Interior, walls and underside of shutters will be painted or stained a dark green as it has been found that this color offers the most protection to the lookout's eyes.

Paints - Exterior

Results secured by the use of ready-mixed paints purchased under the Federal specifications have been very disappointing. For that reason the use of ready-mixed paints on any but small, isolated jobs is to be avoided.

On all new jobs the prime coat should be aluminum. There have been some complaints about the ability of the aluminum paint to stick to the wood. Every complaint investigated developed either one or both of two errors in application. Use of ready-mixed aluminum paint intended for application to metal surfaces or improper spreading of the paint. The aluminum paint must be brushed to the point where there is no piling-up of the aluminum particles. If the paint is the least bit too thick on the wood, it will not properly adhere. The correct product and the proper mixture is as follows:
2 lbs. aluminum paste, "Alcoa Albron"
1 gal. very long oil varnish.

For the second coat on new jobs, use the following formula:

100 lbs. white lead, all purpose soft paste
1-1/2 gal. pure linseed oil, boiled
1-1/4 gal. pure turpentine
1/2 pint liquid drier.

This formula will make about six gallons of paint and cover about 700 square feet of surface to the gallon.

For the third coat on new jobs, use the following formula:

100 lbs. white lead, all purpose soft paste
3 gals. pure linseed oil, boiled
1/2 pint liquid drier.

This formula will make about 6-1/4 gallons of paint and will cover about 700 square feet to the gallon. When color is to be used, the color paste should be added to this coat.

On repaint or maintenance jobs, use the second coat and third coat formulas.

Logwood oil stain

This is a comparatively new product and it has been found to give very satisfactory results where natural wood colors or shades of tan or brown are desired. It is very easy to apply and simple to mix. The clear logwood oil has but very little color and it is desirable to use suitable amounts of raw sienna, burnt sienna or burnt umber, in order to secure the desired shade. The colors should be used in the paste or ground in oil form as it is much easier to handle than is the dry powder.

The formula generally used on ranger station buildings with rough sawed siding is as follows:

10 gal. clear logwood oil
1/16 gal. (1-lb.) raw sienna in oil

This formula gives a fairly good sunburned effect.

Another formula used which gave a darker finish is as follows:

10 gals. clear logwood oil
1/16 gal. (1-lb.) raw sienna in oil
1/32 gal. (1/2-lb.) burnt umber in oil
1 tablespoon burnt sienna in oil

One coat of this formula is sufficient. The oil should be brushed out so that the wood will take all that is put on without any "wet" spots.

Yard Fences and All Gates

If built of surfaced sawed materials, paint white.

Flagpoles

At headquarters paint white. At field stations leave natural color.

Bridges

Dark red bridge paint.

Instructions for Using and Mixing Paints

Exterior Work: How to Measure and Estimate a Surface to be Painted:

To correctly estimate, one must know that a square is a hundred square feet, and that a square yard is nine square feet. He must then ascertain the actual dimensions of the surface to be painted. He must estimate the number of square feet there are in the surface and the amount of labor and material required to do the work, whether one, two, or three coats. He must know on which side of the work he will have to double and treble the measures; that is, where the work must be measured two or three times to arrive at the amount and time necessary to paint it. After he has taken all these points into consideration he is ready to make an intelligent estimate. However, all rules for measuring a surface to be painted will fall short of the desired results if good judgment is not used.

No definite rules can be furnished which will give bases for arriving at the actual amount of labor necessary on work which is difficult to handle. The following rules, however, will answer in the ordinary construction work in the National Forests:

To Measure the Building

Take a tape line and begin at one corner of the building, measuring all of the same height together. Multiply this with the height of the building, commencing with the outer edge of a cornice and running to the lower edge of the baseboard, adding from 1 to $1\frac{1}{2}$' for the edges of weather-boarding. This will give the number of square feet in the building. To measure a gable, take length of base, multiply by one-half of the height from the square to peak or comb of the roof. This will give the number of square feet in any gable. This is, of course, all called "plain work" when painting, and extra measurements allowed for two or three-story work.

For wall work, measure solid; no windows or doors deducted.

Staving, or wainscoting cornices, shingle gables and dormer windows, $1\frac{1}{2}$ to double measurements.

Veranda railings and columns, measure solid.

Veranda ceilings, beaded and rafter finish, double measurements.

Veranda, plain - measure floor and ceiling, allowing for the brackets and columns.

Verandas that have heavy columns and rails - measure floor, ceiling, and the entire veranda solid.

Columns, rails, lattice and turned work - double measurement.

Outside blinds - three measurements; usually done by the pair.

Lattice work - two and one-half to three measurements.

Picket fence - three measurements.

Roof Work

Roofs are measured solid except coping, which is extra if painted a different color.

Inside Measurement

Inside work is measured solid on both doors and windows. Ordinarily three inches allowed on each square opening for tracing the edges. Base, never less than one foot.

Stair rail and balustrade three times.

(a) Example for ascertaining the number of square feet in a house.

Width of front	40 feet
Width of rear	40 feet
Length of one side	50 feet
Length of other side	50 feet
	180 feet
Multiply by height	30 feet
	5400 square feet

(b) Example for ascertaining the number of square feet in a roof.

Multiply length by distance from comb of roof to gutter, then multiply by two to get number of square feet in both sides.

Covering Capacities

It is impossible to state definitely how many square feet a gallon of paint will cover. The table on the following page is given

as a guide:

1 gal. paint	Surface Lumber Sq.Ft.	Rough Lumber Sq.Ft.	Shingles Sq.Ft.	Iron Sq.Ft.
1st coat	500	300	100	600 to 800
2nd coat	500	350	200	600 to 800
3rd coat	600 to 700	400	250	600 to 800

These figures are approximate, as spreading capacity is governed by the conditions of the surface.

When ordering paint, order a trifle more than is required by the table.

When packed, a case of six gallons of paint weighs approximately 100 pounds. A gallon of paint weighs 15 to 18 pounds, according to color and quality.

To mix, pour portion of oil into another can, stir the balance with a flat paddle to an even consistency, then add the balance of oil, stirring continuously. It would be better to pour the paint from one can to another, back and forth, to more thoroughly and evenly mix it. Stir paint every few minutes while using, as heavy pigments, like lead or zinc, settle.

Relative Merits of Reducers and Thinners

Turpentine with its sweet odor, high solvent action and wonderful oxidizing value has always taken first place among the volatile liquids used for thinning paints. Wood turpentines produced from the distillation of fine-cut, fat pine, or from the destructive distillation of stumpage and sawdust, has been refined in some cases by the elimination of odor and toxic effects to such purity that they are equally as good as the purest grades of gum turpentine, and their use is bound to increase in the paint industry.

The painter and manufacturer have come to understand that certain grades of asphaltum and paraffin distillates are equally as satisfactory as turpentine for use in paints for exterior purposes. Those volatile oils which are distilled from crude oil, either with a paraffin or asphaltum base, and possessed of flash point, color and evaporative value, approximating similar constants of turpentine, are as often used by painters, and in some cases almost replace turpentine in exterior paints. A little additional drier added to paint thinned with these materials will cause oxidation to take place in the proper time.

Prominent master painters have shown that benzol, a product obtained from coal tar (different from benzine, a product obtained from the distillation of petroleum), is a valuable thinner to use in the reduction of paints for the priming of resinous lumber such as cypress and southern yellow pine or other timbers possessing this

characteristic. The penetrating and solvent value of benzol is high, and it often furnishes a unison between paint and wood that is a prime foundation to subsequent coating, preventing the usual scale and sap exudation which often appears on a painted surface. Because of the great solvent action of benzol this material should never be used in the second and third coating. These facts should be borne in mind where wood of a refractory nature to paint composes the structure to be painted.

Exterior Painting - Cautions

1. Be sure the character of the lumber is understood as to its absorption of the paint, and if you desire satisfactory results, see that the paint is reduced as thin as possible according to the conditions.

2. See that the surface to be painted is thoroughly dry and in proper condition to receive the paint.

3. Do not paint immediately after rain storms, heavy dews, fogs or in frosty weather.

4. Do not follow too closely after the carpenter. Siding which has been wrapped in bundles for several days exposed to the weather is often wet on the inside.

5. Do not apply shellac too thickly to knots and sappy places. Have it thin and brush well into the knots or other wet places that require shellac.

6. Where light shades of paint are to be applied, use white or very light colored shellac.

Owing to the cellular or spongy nature of wood, or in some cases the old paint over which a coating is applied, absorption of oil and turpentine takes place as long as the oil remains liquid. This absorption is naturally greater with a slow-drying raw oil assisted by the penetrating action of turpentine, then with quick, surface-drying boiled oil, and consequently adds greatly to the life of the wood. At the same time, one of the important points to receive careful attention is that the oil be so regulated to different surfaces as to fully satisfy them without, on the one hand (leaving an extremely oily surface void of sufficient pigment) and on the other hand, a dry coat of pigment from which the oil has been so far abashed as to leave insufficient binder to insure durability.

Priming - Exterior

It is bad practice to prime a building from a carpenter's scaffold. It is best to have the entire building ready to prime at one time so that the same mix of paint can be used. Cover knots and sappy spots with shellac. The sap is as injurious to paint as water.

Prime with the kind of paint you will use afterward. New woods take little oil, old dry woods more. Do not prime with ochre, it dries too hard. Aftercoats do not unite with it, and it is almost impossible to repaint successfully over ochre priming. If you are painting over old paint, get the surface clean. If you paint over dirt, the dirt will come off and the paint with it. Get off all of the old paint you can by scraping or by using a stiff brush, or broom, or sandpaper.

Putting on the Paint

Begin at the top and paint from side to side a strip about four feet wide across the side of the house. Then paint the next strip below that. This avoids laps and joins edges while the paint is yet fresh. Under no circumstances paint in vertical strips.

Brushing Out

Brush out well and remember that three thin coats are better than two thick ones. The cost is a little more but worth it in the long run. Turpentine may be used for thinning on interior work, but should be used sparingly for exterior work.

Linseed Oil

Boiled oil dries quicker than raw, but the raw oil is considered better for painting. If you feel sure of the weather and don't fear dust, use the raw material.

Brushes

Leave your brush in the paint if it is to be used again shortly. If not to be used for a week or two, wipe the brushes off and place in linseed oil. For the next job, soak thoroughly in turpentine or benzine, shake out dry and hang up by the handle.

How Much Paint to Use

It depends, of course, upon whether you paint two or three coats. For new work, three coats are considered best for the good of the building. A gallon of good paint covers 250 square feet for three coats; or 300 square feet where only two coats are used. To get the square feet, measure the ground line and multiply by the average height. Select your colors and measure the building for each color separately. Count window casings as if they included windows; window blinds, double each side. Columns, piazza, and all irregular parts, double.

Reduce the paint according to the absorbing property of the wood. It must be thin enough to both satisfy and fill the surface, and not leave an excess of pigments on the surface. The reduction must be made with oil according to the character of the surface.

Where hard, close-grained woods are to be painted, a large percentage of oil must necessarily be used to open the pores of the wood and permit of greater penetration. The main point in priming is to satisfy all of the surface, thus leaving a uniform condition.

When Not to Paint

There are certain times of the year when outside painting should not be done if satisfactory results are to be expected.

If painting is done too early in the spring, the surface is apt to be full of frost and moisture and the pores closed. This produces uneven absorption. On the side of the building exposed to the heat of the sun the pores will open to a greater extent than on the protected side of the building. All paints and oils are much heavier in cold than warm weather, and if applied under a low temperature, there is apt to be too heavy a coat over a contracted surface which will crack through exposure under the summer heat.

Do not paint after a frost or in early spring when the frost is leaving the ground, filling each part of the building with dampness. Paint should never be applied too heavily to the surface. It sets and dries very rapidly when exposed to the direct rays of the sun and is apt to blister, especially on old wood.

Remember the tints absorb, while white reflects heat, and when it is too hot to paint with white, it is also too hot to paint with tints. This should not be taken as an argument against summer painting, but merely as a precaution against work on extremely hot surfaces.

In spring painting, follow the sun with your work. In summer painting, allow the sun to follow you. Switch your work according to the time of day. Do not paint while the plastering is drying out. Remember there are from 80 to 90 gallons of water used in each 100 yards of plastering, most of which is due to escape some place. If the building is tightly closed, or is being dried by heating, the moisture will be driven out through the side, causing it to break away plaster or paint. Do not paint buildings having damp basements without first removing the cellar windows so as to permit a free circulation of air, thus drying out the under part of the building; otherwise, the dampness will be driven up through the house between the siding and the plastered wall and be attracted to the surface through the siding.

Do not paint near fresh mortar beds; the heat, moisture and fumes will be absorbed by the oil in drying, causing it to break out and destroy its life. Do not paint in sultry weather or in a heavy, wet atmosphere, as the moisture from such conditions penetrates the surface to such an extent that it takes several days of good drying weather for the building to again be in condition to receive paint. Do not paint during or immediately following after a fog or dew. In

a few hours, lumber absorbs more dampness in this kind of weather than from heavy rains. Moisture from heavy fogs or dews penetrates lumber to a greater depth than from any other source.

Old Work - One Coat

Exterior Painting: Where the paint has stood for two or three years, and one coat is to be given over a shade similar to the one already on the building, the surface should be thoroughly cleaned with a wire brush or broom, then thoroughly dusted. It is sometimes necessary to wash the building with sponge and water to remove the smoke and dirt which otherwise will work up through the paint changing the color and causing lack of uniform shades. It is almost impossible to brush dirt streaks out, and the only way to get the work in condition for painting is to first wash the surface with water. Allow time for the surface to dry; then, if the wear of the paint is found to be uniform, one coat, mixed to a good consistency with a full oil reduction and sufficient turpentine to assist the working, will make a satisfactory job. If, however, upon examination, the paint is found to be weather-beaten or worn off in spots on the exposed parts of the building, it will have to be touched up on these exposed portions, and a coat of paint applied to the entire surface to even it up; otherwise, there will be spots when the paint has dried, usually making an unsatisfactory job.

If the paint has not worn down to the wood, and it is only worn off to the undercoats which are solid, mix the paint to a thin consistency with a good linseed oil; go over the exposed portions of the building with a smooth, even coat. As soon as hard-dry, give the entire surface a coat of paint, mixed to a good consistency as before directed. The paint should dry out even, thus making satisfactory work.

Since all portions of a building do not have a uniform exposure, it is very hard to find a surface where one coat will produce satisfactory results over the entire building. On the most severely exposed portions, the paint will naturally show more wear than on the protected parts. The exposed parts should, therefore, be touched up or painted over to even them up with the less exposed portions.

Blistering

Where paint blisters, the cause is usually attributed to dampness; wet or unseasoned lumber, or wet plastering. In old buildings, bad roofs, leaky gutters, broken-down spouts, and wet basements are the usual causes of blistering. Where the blister is caused from dampness from wet plaster, the blister will be full of discolored water which stains the paint when it breaks and upon removal of the point of the blister, it will be found that there is very little, if any, paint or oil left in the grain of the wood. If a coat of oil paint is applied over a heavy coat of ochre priming

which has dried hard and flinty, it will often cause the two to blister badly when exposed to the heat of the sun. This result is due to the paint not penetrating into the hard surface, thus leaving an excess of oil in the ochre coat.

Where ochre is mixed dry with oil, it is impossible to thoroughly incorporate the two, and when applied sometimes masses up in small blisters. The under part will be found dry, and the paint can be powdered. This is caused by the dry ochre lying on the surface, absorbing all the oil and leaving nothing to satisfy the wood.

Repainting Blistered Wood

To successfully repaint blistered wood, the character of each kind of blister must be understood. Study the cause of the trouble and repaint the surface accordingly. If water or dampness is the cause, the paint for retouching should be mixed with a full oil reduction to satisfy the bare wood. If from fat oil, the mixture should contain sufficient turpentine to penetrate the surface which this oil reaches. If from nondrying oil, the surface must be first washed with turpentine to remove the grease, then touched up with paint mixed with part turpentine to assist in penetrating to a good depth. For ochres and like surfaces, the same reduction is applied for touching up as for a burned surface. On old woodwork, where the paint has blistered from an excess of oil, reduce the paint mixture as above. This will penetrate through the old paint and give a good foundation. Then repaint, but spots are bound to show to a certain extent.

Window Sash

Break sashes loose so that they can be worked without trouble. Scrape off all loose paint and putty; then sandpaper. If the putty is soft or broken away, it is best to remove all of it and not attempt to patch up broken places. Apply a heavy coat of paint in the groove where the putty has been removed. The paint used on sash should be of a heavier consistency than that used on the body of the building. If the surface is in good condition (not badly weather-beaten), the paint should be mixed as planned. Before applying this finishing coat, however, reputty the sash where necessary. (If the putty is to be painted, it is best to do this some days before dressing, in order that the putty may become set.)

Veranda Columns and Rails

Be sure that the surface is dry. Scrape and sandpaper loose paint from veranda columns and rails before applying the first coat. Fill the cracks and nail holes with paint. See to it that there is no mildew on the base skirting boards or lattice work caused by dampness underneath the porch. Knife putty into cracks and nail holes before applying finishing coat. Use the same paint as for the body of the building, and brush out well on the round columns and turned work.

Veranda and Porch Floors

Sweep the floor clean; also remove dirt from cracks so that the paint can be brushed into them. Paint applied heavily on floors will not dry solid, and will soon scuff up. Be sure there is no dampness coming from underneath, as such conditions will invariably result in blistering and peeling, caused by improper hardening. On old floors that have been kept well painted, one coat is often sufficient. When they are badly weather-beaten, they should receive a coat of paint of good consistency, mixed with two-thirds oil and one-half turpentine well brushed out. When hard-dry, putty the cracks, nail holes and seams; then apply the coat of heavy consistency, mixed with the same proportions of oil and turpentine. The floors and steps should not receive the finishing coat until all of the other painting has been completed.

Staining Shingles

While it is not usually considered necessary to color roofs, it may sometimes be desirable to do so. A good grade of commercial stain should be used for the purpose, or the following formula may be used:

1 gal. linseed oil
2 lbs. graphite
3 lbs. mineral green

This will give a satisfactory color which is not likely to fade or spot very much.

For a good job, shingle stain should be applied before the shingles are put on the roof. This is done by dipping the butt end of each shingle in the stain at least seven inches. In this way the stain is applied well above the joint or lap when the shingle is placed on the roof. One gallon of stain will dip about 1000 shingles.

Interior Woodwork

Follow the manufacturer's instructions in using the materials specified.

Size

New walls should always be sized before applying wall paper, plastic paint, paint or kalsomine. A good size for general use can be made as follows:

1/2 gal. good hard-drying varnish
1/2 gal. turpentine
1 lb. finely powdered pumice stone

The pumice stone gives it the "tooth" over which the wall finish will cover better and produce a more solid appearance. Let

the size dry overnight before putting on the wall finish.

Any standard varnish size may be used with good results.

There is no regular or fixed rule for applying wall finish. It depends on the surface. If the wall is very smooth the directions given for mixing above, will make about the proper consistency; if rough or porous, it would, of course, absorb the wall finish rapidly. In such cases it is advisable to thin the wall finish by adding a small amount of water.

Interior Wall Finish

Use a good-sized flat wall or kalsomine brush. Coat the ceiling separately. Begin at the corner of building and work back and forth across the short way of the room. Do not try to cover a strip wider than two feet so as to always keep the edges from becoming dry. For side walls, begin at the ceiling line and coat across in narrow strips about twice the width of the brush. Use a sweeping, slanting, slightly curved motion of the brush. If correctly applied, and the wall is in proper condition, the different brushfuls will flow together and leave no brush marks. Do not expect good results if applied with a stiff brush.

Eggshell finish paint or plastic paint is to be preferred for new walls, unless otherwise specified in plans, but the eggshell finish must be applied with considerable care and skill if it is to look well.

Directions for Use of Kalsomine Wall Finishes

To each five-pound package of wall finish use one-half gallon (four pounds) of boiling water. The best way is to slowly pour the wall finish into the water as you would in making cornmeal mush, stirring as you pour, and keep stirring until the mixture is a smooth paste. It is a good plan to let the wall finish cool and then add a quart of cold water. Stir to an even consistency. You may rest assured of good results if the foregoing suggestions are closely followed.

Whitewash Formula

1 barrel of lime
5 pounds of glue
10 pounds of salt
1 gallon of vinegar (best proof)

The lime should be soaked at least overnight and will require about the same amount of water as lime. The vinegar should be added to the lime and water. In case the logs or boards are pitchy, a double amount of vinegar should be used. The salt should also be added with the water and vinegar. The stock that will be secured by

soaking the lime will be very thick, and for whitewashing rough boards or logs should be reduced to a consistency a little thicker than cream.

The thinning should be done with warm water to which the glue has been added, and thoroughly dissolved. For a bright green tint use one-half pound each of dry chrome yellow and Prussian blue for one bucket of whitewash.

Putty

All nail holes, cracks, et cetera, must be puttied in order to secure a smooth job. This should be done after the first or priming coat has been applied. When putty seems dry and hard add a few drops of linseed oil to it and work thoroughly in the hands. It must be thoroughly pliable to work properly.

Metal Roofs

If new galvanized iron, they should first be treated with a coat of Galvanized Iron Proparer.

In painting, follow directions for wood surface.

If old galvanized iron, before painting use a steel wire brush to remove all rust, dirt and scaly paint.

Interior Walls

Plastered walls should be kalsomined. Kalsomine is more desirable as it is easier to apply than paper. Directions for applying are given on the package. There are several good brands on the market. Cracks and holes in the plaster should be filled with plaster of Paris and allowed to dry before kalsomine is applied.

Wall boards - most wall boards may be left in their natural condition if desired. All of them can be painted or kalsomined as desired. When Masonite is used with log walls, it should be given a coat of sizing (two pounds chip glue dissolved in three gallons of boiling water) and two coats clear spar varnish.

Wood walls should be painted or treated the same as logs, depending upon the use for which the building is intended.

Wall Paper

Figuring number of rolls required.

A single roll of ordinary wall paper is 8 yards long by 18 inches wide; and a single roll of ingrain, felt or cartridge paper, is 8 yards long by 30 inches wide. A single roll of one-strip border is 8 yards long by 13 inches wide. A single roll of two-strip

border is the same length and width, and contains, therefore, 16 yards of border. Common wall paper is put up in double rolls; and ingrain, felt or cartridge paper is put up in triple rolls.

Prices are quoted on single rolls.

To determine the quantity of paper required to cover a room, divide the surface area (square feet) to be covered by 30, which will give a fairly approximate estimate of the number of single rolls of common paper required, with allowance made for trimming and matching.

If the paper is 36" wide, one-half the above number of rolls will be required.

If the paper is 30" wide, and 8 yards long, two-thirds of the above number will be needed.

As, for example, suppose that it is desired to find the number of single rolls of paper needed for a room 12'x15' with a 10' ceiling; also the number of rolls of border required.

The distance around the room is 54 feet. The wall surface, therefore, is 54x10=540. This area, divided by 30, gives 18 rolls of common paper needed.

If there were two doors and three windows of ordinary size in this room, an allowance of 20 square feet for each opening might be made. This would bring the surface area down to 440 square feet, with a corresponding decrease in the quantity of paper needed, to 15 rolls.

Since the distance around the room is 54 feet (or 18 yards) and a two-strip roll of border contains 16 yards of border, 1-1/8 rolls of border would be needed.

If the ceiling of this room was to be papered also, there would be 180 square feet of surface to be covered, which would require six rolls of common paper, or three rolls of 36" wide paper.

The waste to be allowed for trimming and matching will approximate one roll in every eight single rolls, the larger the pattern the greater the waste necessary for proper matching.

One gallon of paste should be allowed for each nine rolls of ordinary paper.

General Directions for the Use of Varnishes

The working qualities, flowing properties, as well as drying and hardening of all varnishes, are dependent upon atmospheric conditions. Varnish works best in a temperature of from 70° to 80° Fahrenheit. Good ventilation is necessary, but care should be

taken to see that no cold or warm drafts of air strike any freshly varnished surface. Always select the particular kind of varnish that is especially recommended for the work in hand.

The work to be varnished should be perfectly clean, dry and free from dust. A second coat of varnish should never be applied until the first coat is thoroughly dry and hard. Second coats are best applied over first coats after the latter have been sandpapered, mossed, or rubbed down to a dull finish. Keep the can tightly corked when not in use, to prevent evaporation. If the varnish appears to be thick or heavy-bodied, try it out first before cutting down. If reduction is necessary, add a very little pure spirits of turpentine. Too much turpentine will "kill" the gloss. Do not pour unused varnish back into the original container. If you do, trouble will follow.

Interior Woodwork

(Varnishing)

(a) New Work. See that wood is clean and smooth. Thin first coat of varnish with turpentine. Apply second and third coats as varnish comes from can, sandpapering between coats with 00 sandpaper if best results are wanted.

(b) Old Work. Wash with soap and water, sandpaper and apply coat of varnish.

Interior Floors

(a) For general use the most satisfactory finish for interior floors is a coat of linseed oil applied hot. This works equally well with either fir or maple floors. Take raw linseed oil, put it on the stove and heat it to the boiling point, then apply to the floor with a mop, giving the wood all it will take and no more. If any wet spots are left rub them dry with a piece of cloth. See that the floor is clean and free from stains before applying the oil.

(b) Yellow pine floors - new surface. Floor varnished should not be classed with general interior varnishes. Such varnishes should be similar to exterior varnishes in their power of resistance to destructive agencies. Do not use any varnish on a floor, except varnishes intended and labeled for floor use.

The floor must be perfectly clean and free from dust and dirt.

Fill all cracks and crevices with crack filler, working it in with a broad-bladed putty knife.

The first coat of varnish should be flowed on to a smooth, even film. Do not apply too heavily.

Allow at least 24 hours for the first coat to thoroughly dry.

Before applying the second coat, sand the entire surface with 00 sandpaper and dust carefully.

Flow on the second coat of varnish in a smooth, even film.

(c) Maple floors - new surface. Maple is a hard wood, and penetration will not be as deep as on yellow pine. It will, therefore, require slightly longer for the finish to dry. Where an oil or penetrating stain is used, it will not show as dark a finish on maple as on a softer wood. In all cases, however, the method of treatment is the same as that described for yellow pine.

(d) Hardwood floors. The general mode of treatment is the same as that prescribed for yellow pine floors.

If oak or other open-grained woods are used, they will require the application of a paste wood filler to make them ready for finishing.

See that the surface to be filled is clean and free from dust and dirt.

Thin the filler with turpentine or benzine to the consistency of thin varnish and apply with a brush. In five or ten minutes the filler will have "set" or become flat. Then with a cloth or wad of tow, rub filler across the grain, packing it into the pores, finally wiping the surface clean.

Apply no more filler at one time than can be wiped off as soon as it has set. Allow the filler to dry at least 24 hours. The surface can then be finished in the usual manner.

(e) Floors previously finished - to be revarnished. It is frequently necessary to refinish the portion of the floor where the tread of feet and abrasion have worn down the varnish coat, while the remainder of the floor may be in good condition.

Application: The floor should first be scrubbed and allowed to dry. Sandpaper the surface to be finished with 00 sandpaper, and dust carefully. Apply a coat of the floor varnish, flowing it on to a smooth, even finish. In most cases, but one coat is necessary.

In extreme cases, or where the abrasion of the surface has been unusually severe, two coats may be required, sanding the first coat lightly when dry.

If the entire floor surface is to be revarnished, follow the same general directions.

Note: It is not practicable to revarnish a floor that has been waxed, unless the wax is removed with either benzine or gasoline. After this is done, the surface should be washed with clean, warm water, containing a small amount of ammonia.

Also, bear in mind that if varnish is applied over a surface that has been cleaned with a nondrying oil, it will remain tacky indefinitely. The oil should be entirely removed by washing with benzine or gasoline.

(f) Wax finish. Douglas fir flooring will take a wax finish in fair shape. In addition, it is much cheaper than stains and varnish. The following are general instructions for waxing:

Secure prepared floor wax, which should be of soft paste consistency which will spread easily.

The surface must be clean and free from dust.

Apply the wax to the surface with a cloth. Allow to remain for a few minutes, then polish by rubbing briskly with a soft cloth.

For large surfaces, use a weighted floor-polishing brush.

If a more durable or brilliant finish is desired, apply a second coat in the same manner.

To Remove Paint, Varnish, Et Cetera, from Wood

Paint, varnish, and so forth, no matter how old and hard, may be softened in a few minutes so as to be easily scraped off by applying the following mixture:

Water glass, 5 parts
Soda lye 40° B. (27%) 1 part
Ammonia water - 1 part
Mix

Another compound for removing paint and varnish from wood or stone, without injuring the material is as follows:

Flour or wood pulp	385 parts
Hydrochloric acid	450 "
Bleaching powder	160 "
Turpentine	5 "

Board Sizing

A cheap sizing for rough, weather-beaten boards may be made by dissolving shellac in sal soda and adding some heavy body pigment. This size will stick to grease spots. Linseed oil may be added if desired. Limewater and linseed oil make a good heavy sizing but

it is hard to spread. They are usually used half and half but these proportions may be varied somewhat.

Removing Putty, Grease, Et Cetera, from Plate Glass

To remove all kinds of greasy materials from glass and to leave the latter bright and clean, use a paste made of benzine and burnt magnesia of such consistency that when the mass is pressed between the fingers a drop of benzine will exude. With this mixture and a wad of cotton go over the entire surface of the glass.

To Preserve Steel from Rust

Many steel tools, being exposed to the weather, are subject to rust. To preserve them from rust dissolve one part caoutchouc and sixteen parts turpentine with a gentle heat, then add eight parts boiled oil and mix by bringing them to the heat of boiling water. Apply to the steel with a brush, the same as varnish. It can be removed again with a cloth soaked in turpentine.

Heating Oil

When oil is to be heated for any purpose, the vessel containing the oil should always be placed in a larger vessel with water in it. Then if the oil boils over it will not catch on fire.

PRESERVATIVE TREATMENT OF TIMBER FOR IMPROVEMENT WORK

Preservative treatment, particularly of telephone poles, reenforcing stubs and fence posts, is rapidly coming to be standard practice in the Region. All treatment of such timber should be done by the open-tank method in the future, as it is more satisfactory than the dipping or brush methods.

The open-tank method of treatment is an impregnation process, and differs radically from a mere dipping process or a coating of the surface with preservatives. Merely dipping the timbers or giving them a brief immersion in a preservative is not economical because of the higher cost and the relatively slight increased value over surface treatments. A discussion of dipping and brush methods has, therefore, been purposely omitted from these specifications.

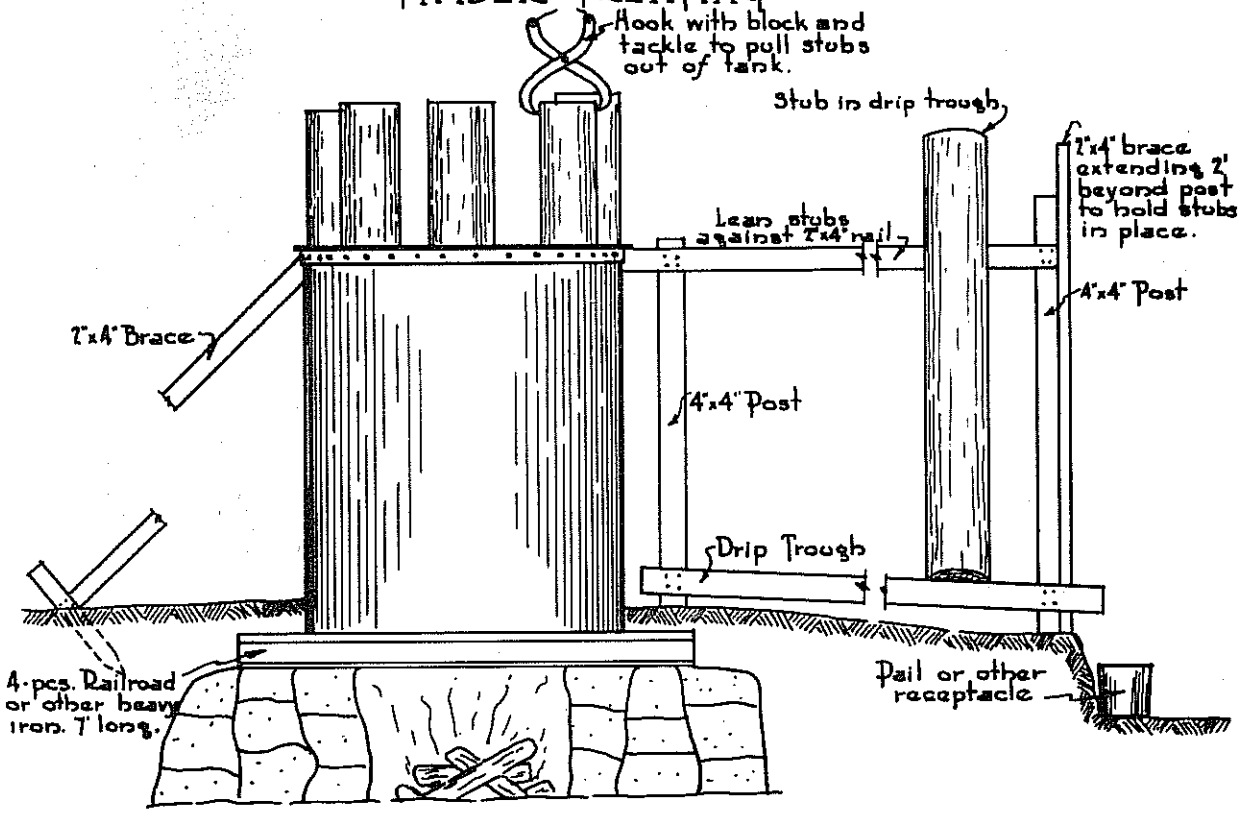
The use of preservatives, other than those mentioned, such as arsenic powder, the effectiveness of which has not yet been proved, is not authorized.

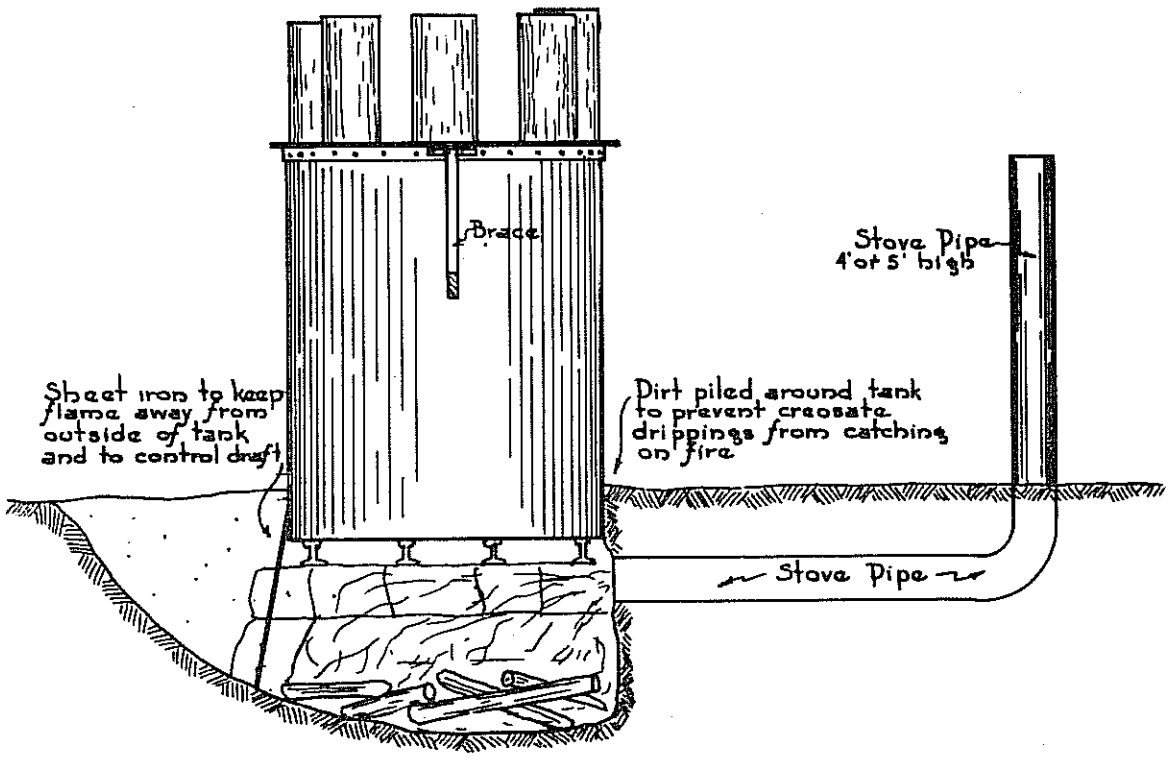
A strict adherence to specifications is absolutely necessary to obtain the full benefit of a preservative treatment.

Preparation of Timber for Treatment

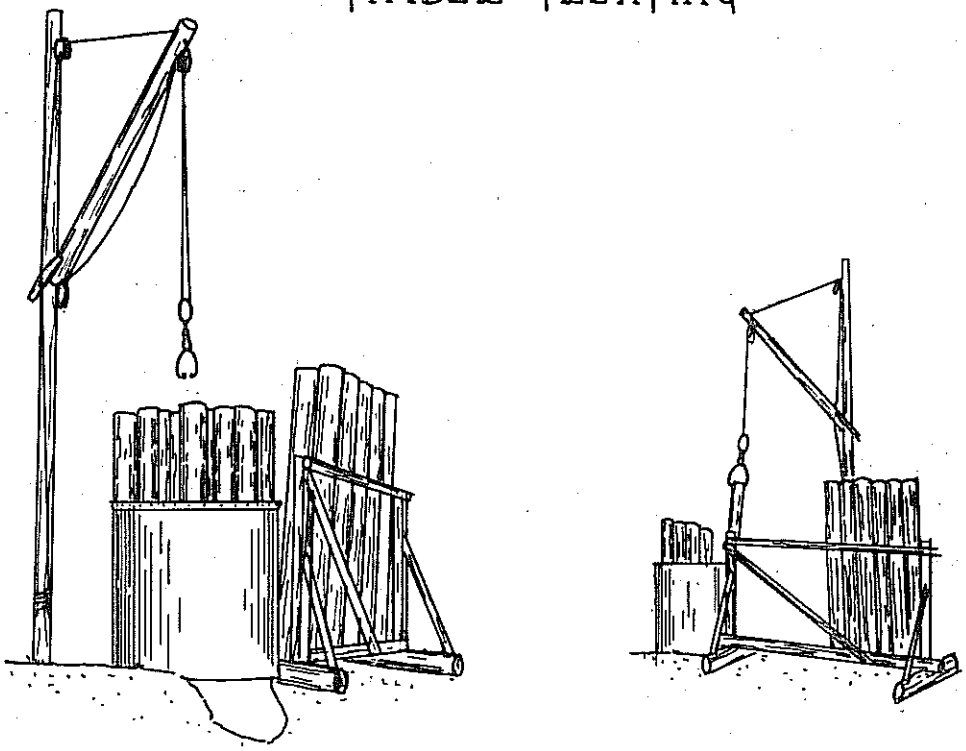
General: The poles, stubs and posts selected for treatment shall be manufactured from sound live or dead timber, reasonably straight and

TIMBER TREATING

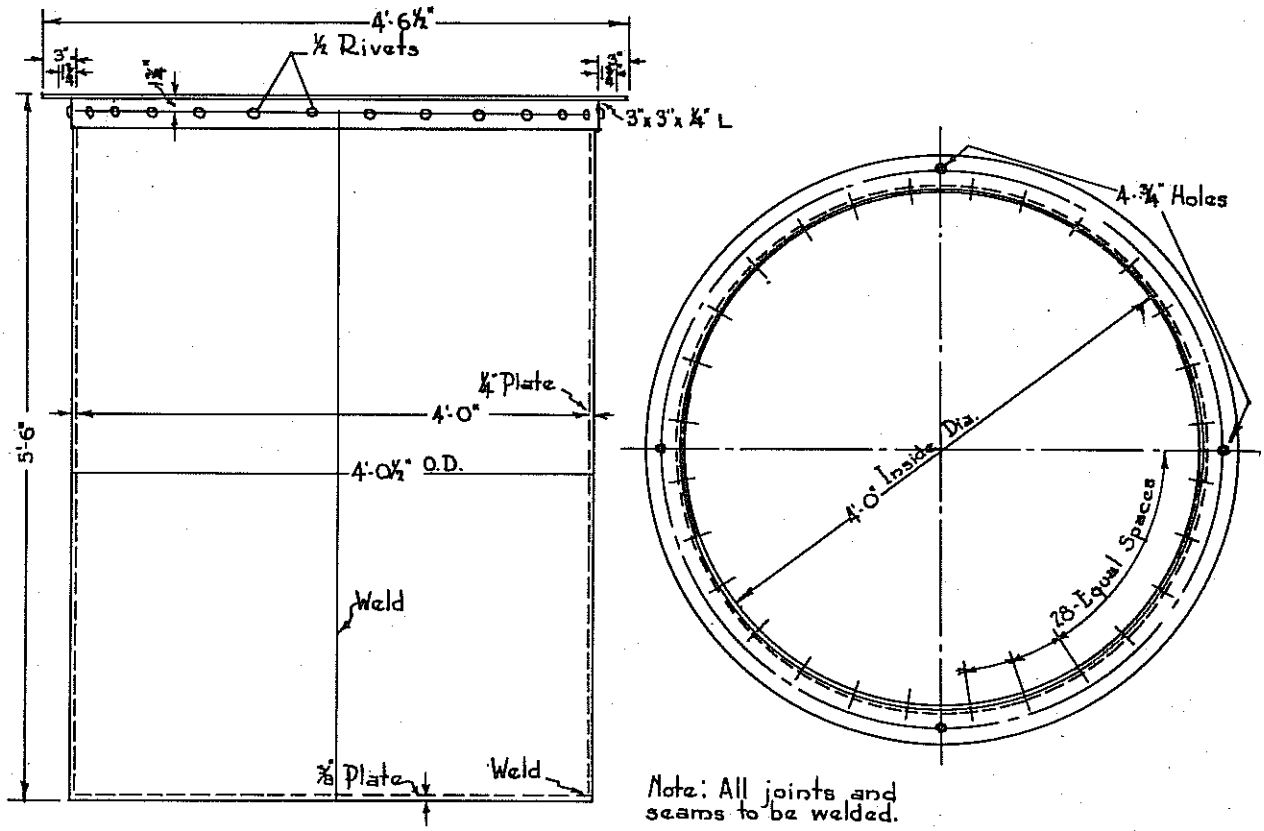




TIMBER TREATING



Views of Treating Plant



Note: All joints and seams to be welded.

Creosating Tank
Tank Steel

all knots closely trimmed. Unless fire-killed, dead timber is rarely sound enough for treatment. If decay has made a start, it is not always stopped by the application of a preservative in the open-tank process but may continue beneath the treated wood. Whatever kind of wood is used be sure that it is absolutely sound. Even a trace of rot or numerous large checks should be cause for rejection.

Cutting and Peeling: Cutting should usually be done in the late fall, winter or early spring. Summer-cut timber will check badly. Peeling will be facilitated by spring cutting. It is important that the butts or poles and stubs be sawed off square and the tops roofed with a slanting cut. (See Fig. 4, roofing of poles, and Fig. 30, roofing of stubs, in Telephone Handbook.)

All timber must be thoroughly peeled for the entire length at the time of cutting. Before treatment use drawknives to clean off all adhering inner bark from a point about 18" above the future ground line to the bottom end of the timber.

Seasoning: The material should be thoroughly seasoned before the preservative is applied. The moisture must come out of the wood to make room for the preservative. If only partly seasoned the wood is likely to check after treatment, thus exposing untreated areas to decay.

At the time of cutting, open-pile or stack the timber, leaving plenty of air space between the individual sticks. These piles should be made over dry ground and preferably under light shade. If the timber is summer-cut, pile out of the direct sunlight to prevent checking and casehardening as much as possible. Piling western yellow pine timbers in the hot sunshine immediately after peeling causes the pitch to harden on the peeled surface like a coating of shellac. Lodgepole pine is sometimes affected in the same manner. This "casehardened" surface generally retards seasoning and must be shaved off to get good penetration.

The length of the seasoning period varies with the weather conditions and the kind of wood. If open-piled in a good location, in favorable weather fence posts will season sufficiently in 60 to 90 days. Western red cedar posts which are purchased on the market are usually sufficiently seasoned for treatment at once.

The following periods are indicated as sufficient for poles and stubs of the different woods: Lodgepole pine and western yellow pine, six to eight months; Douglas fir, western red cedar and western larch, from eight to twelve months.

Preservatives

A creosote petroleum mixture consisting of 40% coal-tar creosote and 60% gas oil is the preservative which should ordinarily be used. This will be standard practice on the usual job where the

amount of timber treated will result in a considerable saving as compared with the use of straight creosote. In very small runs, use of the latter preservative may be justified.

In order to secure a solution of the mixed oils it will be necessary to purchase the creosote and the gas oil from different sources and prepare the mixture at the treating plant. As coal-tar creosote is very poisonous to wood-destroying fungi the reduction in toxicity through dilution with the nontoxic petroleum oil to as high as 60%, in order to cheapen the cost, is readily permissible.

None of the petroleum oils such as kerosene distillate, kerosene, gas oil and fuel oil, which are produced in the order named after gasoline has been removed through distillation of the crude at the refineries, are sufficiently toxic to be used alone. As diluents for coal-tar creosote, however, both gas oil and fuel oil have been used with great success. In experimental work it has been found that some of the heavier fuel oils do not penetrate well and that gas oil will give the best results in mixture with creosote.

Coal-tar creosotes vary considerably in quality but satisfactory results can be obtained from the best grades produced within the Region by the following companies:

Great Falls Gas Company, Great Falls, Montana.
Montana Power Company Gas Branch, Butte, Montana.

Large quantities of gas oil are produced at all of the Montana oil refineries and it costs only six to nine cents per gallon f.o.b. the shipping point. The Sunburst Refining Company at Great Falls is especially well equipped to supply this product in light metal barrels at the lowest prices. It will be advantageous in most cases to purchase the gas oil from this company. The other companies from which samples of gas oil have been secured and tested are:

Arro Oil & Refining Company, Lewistown, Montana.
Hart Refineries Company, with branch offices in Missoula and other cities.

Prices quoted in the coal-tar creosote f.o.b. the shipping point in 50-gallon iron barrels, are 25¢ per gallon by the Great Falls Gas Company, and 30¢ per gallon by the Montana Power Company Gas Branch, Butte. As a general rule orders for creosote and gas oil should be handled through Central Purchase.

With creosote at 25¢ and gas oil at 6¢ per gallon, a mixture of 40% coal-tar creosote and 60% gas oil will cost 13.6¢ per gallon, not including freight. Within a distance of from 100 to 200 miles of Great Falls or Butte the freight charges will vary from about 3¢ to 6¢ per gallon. On the longest haul which is likely to be made within the Region, the cost for freight will be from 12¢ to 14¢ per gallon.

An absorption of about five pounds of oil per cubic foot of wood impregnated should be obtained in the butt treatments, which will require about $1\frac{1}{2}$ gallons for a pole or stub treated $4\frac{1}{2}$ feet, and $\frac{1}{2}$ gallon for each fence post. The amount of preservative which will be used in treating a given number of pieces with a mixture of 40% creosote, and 60% gas oil can be estimated from these figures. In purchasing, an additional allowance must be made to cover the amount which will be left over in the tanks at the end of the operation. For example, in treating poles to a height of $4\frac{1}{2}$ foot the amount of oil needed in a tank 4 foot in diameter after allowing for the cubic foot of space occupied by the timber would be about 190 gallons, and this amount would fill the tank without the poles in it to a level of 2 foot. In a 3-foot tank about 100 gallons would bring the level of the oil up to the same height.

The Treating Plant

The operation of an open-tank treating plant requires one or two tight steel tanks, strong enough to hold the weight of the oil and timber, a simple hoisting tackle, a leaning trestle (if poles are to be treated), and small tools such as drawknives, axes, shovels, et cetera.

On projects where it will be necessary to handle a good deal of the preservative, a small rotary pump should be provided for use in filling and emptying the tanks.

The plan and specifications for a very durable tank of convenient size can be secured from this office. A photostat copy of the plan will be sent to Supervisors. A tank of this type (4 foot in diameter and $5\frac{1}{2}$ foot deep) can be constructed at a cost of about $80, and will hold about 20 poles measuring 8 inches in diameter at the butt. It is deep enough so that the level of the oil will be a foot or more below the top in giving timbers a butt treatment for $4\frac{1}{2}$ feet.

In setting up the plant the upright tanks should be set into the ground from one to two foot and mounted upon a solid foundation of cement or stone banked up with earth so as to form a crude fire box. Three or four substantial iron bars should be laid across the foundation to help support the tanks. It is not necessary to protect the bottom of the tanks from direct contact with fire. Three joints of stovepipe should be connected with the fire box to form a chimney. Some old sheet iron can be used for fire box doors, et cetera. A false bottom or wooden crate (wedged down) will keep the butts from sliding around and facilitate loading. The fire box should be roomy with a large heating space against the bottoms of the tanks and provision made for a good draft.

A very satisfactory outfit for the treatment of fence posts and small stubs can be installed at very low cost by cutting the heads out of two large gasoline storage barrels or steel drums

of 110-gallon capacity and using the drums for treating tanks. False bottoms to keep the butts from sliding about in the tanks can be made from the heads cut out, by riveting to them strips of buggy tire through which are projecting 3/4-inch screws.

These tanks may be set up over a trench in the ground and heated by a direct fire or mounted on a solid foundation as described above. If operated continuously, a large number of posts (depending on size) can be treated at a small plant of this kind.

The treating plant should be located where an accidental fire will not endanger any buildings. The creosote-petroleum oil mixture is not dangerously inflammable but carelessness in allowing the oil to boil over the sides of the tank may result in the loss of oil and timber. It is generally advisable to screen the flues, provide fire extinguishers and have a barrel or two of water on hand for fire protection purposes. A pile of sand and a shovel are even better than water.

Application of the Preservatives

The Open-Tank Process

In this method the timber is allowed to remain in the hot preservative for a period of from two to seven hours, during which the air and moisture in the wood are heated, expanded and partly driven off. The material is then allowed to remain in the preservative as it cools (single-tank method), or are changed quickly to a cool tank of the same preservative (double-tank method). In either case the cooling process causes a contraction of the remaining air and moisture in the wood structure and as a result additional preservative is drawn into the wood. The open-tank process is the most thorough method of treatment, and should be used throughout the Region.

Length of Treatment Required for Native Species and the Steps Involved

In the Single-Tank Treatment

1. The creosote and gas oil will be heated to a temperature of from 180°-190° F. The amount of preservative must be sufficient to submerge the lower 4½ feet of telephone poles or reenforcing stubs, and the lower 3½ feet of posts.

2. The timbers are placed in position in the hot oil or may be placed in the preservative at the time the heating process is begun.

3. A temperature as near as possible to 185° F. is to be maintained for from 2 to 7 hours, depending on the kind of wood being treated. (See time schedule specified below.)

4. Enough creosote and gas oil must be added to the tank once or twice during the hot bath to compensate for the

absorption of preservative in the wood. By keeping the oil at a uniform level the timbers will receive a uniform treatment for the desired length along the butt.

5. The fire is allowed to die down or is removed. The cooling of the preservative causes an additional penetration into the timber. This accomplishes practically the same result as the removal of the timber from the hot bath to a cold tank of creosote. The process, however, requires a somewhat longer time because the hot creosote cools slowly.

6. The timber will be allowed to remain in the cooling bath from two to fourteen hours, depending on the species to be treated. (See time schedule specified below for different species.)

7. The preservative must be kept as nearly as possible at a uniform depth during the cooling process, also in order to insure a good penetration at the butt for the length specified.

8. When the timber is removed the excess surface preservative should be drained off and the material placed in open piles. If the preservative has become cool enough to be only semiliquid, it should be warmed slightly in order to liquefy, before the timbers are removed.

Sample Daily Schedule (for an average run of fence posts):

11:00 a.m. - Start fire for heating preservatives. Place timbers in position in the tank.

2:00 p.m. - Preservative reaches a temperature of 190° F.

6:00 p.m. - Fire removed and preservative allowed to cool overnight.

8:00 a.m. - Timbers removed.

The above schedule should be varied to suit the species being treated and also to suit the convenience of the operator.

Schedule Indicating the Required Length of Treatment in Hot and Cooling Baths:

(a) Telephone poles and reenforcing stubs:	Hours in Hot Bath	Hours in Cooling Bath
Lodgepole pine (cut green and seasoned)	7	14
Lodgepole pine (fire-killed)	2	6
Western yellow pine	3	2
Douglas fir	7	14
Western red cedar	7	14

If crossarms are used, paint gains with hot creosote and also paint roofs of poles.

(b) Fence posts:

Lodgepole pine	(Same as for poles or stubs)	
Douglas fir	" " " " " "	
Western red cedar	" " " " " "	
Western yellow pine*	$2\frac{1}{2}$	$1\frac{1}{2}$-2
Cottonwood*	2	12

*Tops are to be given a short treatment in addition to the treatment for the butts. This can be easily given. After the butt treatment has been completed, the posts may be inverted in the preservative and allowed to remain while the preservative is being heated up for the second run. The posts should be removed when the preservative is being heated up for the second run. The posts should be removed when the preservative reaches 190° F. and a new run placed in the tank for the butt treatment.

The Double-Tank Treatment

1. The preservative will be heated to a temperature of from 180° to 200° F.

2. The timbers are to be placed in position in the hot oil, or when the operator has become accustomed to the work, time may be saved by placing the timber in the preservative at the time the heating process is begun.

3. A temperature as near as possible to 190° F. is to be maintained for from one to seven hours, depending on the kind of wood that is being treated.

4. Creosote and gas oil are added to the tank as in the single-tank treatment in order to keep the timbers submerged to a sufficient depth.

5. After being heated for the length of time required for different species the timbers are to be quickly transferred to the second tank containing oil, having a temperature of about 100° F. The "cold" bath should be warm enough to liquefy the oil thoroughly. A temperature of 100° F. will usually be sufficient for this purpose.

6. The timbers will be allowed to remain in the cold bath from one to fourteen hours, depending on the kind of wood that is being treated.

7. The absorption of oil by the timbers during the cold bath will lower the height of the oil in the tank. Care must be taken that enough oil is added to submerge the pole

and stub timbers to a depth of $4\frac{1}{2}$ feet and fence posts to a depth of $3\frac{1}{2}$ feet.

8. When the timber is taken from the cold tank the excess surface preservative should be drained off and the material placed in open piles.

Sample Daily Schedule (for an average run of fence posts):

7:00 a.m. - Start fire for heating preservative. Place material in tank.

10:00 a.m. - Oil reaches temperature 200° F.

2:00 p.m. - Timbers removed from hot bath to tank of cold preservative. (Temperature 100° F.)

2:00 p.m. - New run of timbers placed in hot preservative.

6:00 p.m. - Material of run No. 1 removed from the tank of cold preservative.

6:00 p.m. - Second run transferred from the hot bath to the cold tank and allowed to remain until the following morning.

If the tops of the posts are also to be treated, the above schedules must necessarily be modified.

Duration of Treatment

Poles and stubs will be treated in the hot and cold bath for the number of hours indicated in the columns headed "Hours in hot bath," and "Hours in cooling bath," under the above schedule (a). If two tanks are available, in treating poles and stubs it will generally be preferable to use both tanks for the hot bath, allowing the timbers to remain in the hot preservative while it cools off and thus save the extra handling and working over the hot tank.

In the treatment of fence posts by the double-tank method it will generally be possible to make two runs per day. If so desired, the length of time specified under schedule (a) may be reduced when using two tanks.

The following schedule is intended to indicate the approximate minimum time limits in the hot and cold bath which can be expected to give satisfactory results for posts when two tanks are used:

	Hours in Hot Bath	Hours in Cooling Bath
Lodgepole pine	$1\frac{1}{2}$	$2\frac{1}{2}$
Douglas fir	3	3
Western red cedar	3	3
Western yellow pine*	$2\frac{1}{2}$	$1\frac{1}{2}$
Cottonwood*	1	2

*Tops are to be given a short treatment in addition to the treatment for the butts. There are two methods of giving the top treatment. In one method the cold tank is made long enough to hold the posts lying full length. In this case, when the posts are transferred to the cold tank, they are entirely submerged in the oil. This results in a comparatively heavy absorption in the butts, which have been heated, but only a light absorption in the tops. Another method is to complete the butt treatment of the posts first, and then turn them upside down in the tank of hot oil and allow them to remain for a few minutes.

Penetration and Absorption

The time schedules indicated above are calculated to provide for a thorough treatment of the sapwood portion of round timber under average conditions, which will afford good protection for the entire stick.

A penetration of 3/4" to 1" is satisfactory. A minimum of 3/4" at the ground line (the critical point on a pole or stub) is required.

One piece of timber from each run should be tested to make sure that the required penetration is being obtained. Use an increment borer to determine this by taking out a core at the ground line, or bore a hole with a $\frac{1}{2}$" bit, then fill the hole with creosote and put in a creosoted plug.

The best treatment is the one which gives the greatest penetration with the least absorption of oil. The time schedules indicated should be taken as a guide but varied somewhat as conditions may demand after the penetration has been tested.

Lengthening the hot bath tends to increase the penetration without greatly increasing the absorption. Lengthening the cold bath increases the absorption. As a rule, if the absorption of the poles and stubs is found to be much more than $1\frac{1}{2}$ gallons or that of fence posts much over $\frac{1}{2}$ gallon of the preservative per piece, the cold bath should be shortened. The amount of absorption can be easily checked up by measuring the drop in the level of the oil in the tanks and allowing for any addition made; or by weighing a number of pieces before and after treatment.

Be sure to keep the level of the preservative well above the ground line point on the timbers during the entire cooling-off process.

During the heating period the temperature of the preservative must be kept as nearly constant as possible. A cheap high-temperature thermometer suitable for trying temperatures of the hot bath should be used in all treating work.

It will seldom be necessary to heat the preservative for the hot bath to a temperature of more than 205° F. If the timber to be treated is thoroughly seasoned, average temperatures of 180° F. to 190° F. will be sufficient. If there is any question about the timber being well seasoned, temperatures slightly above the boiling point of water are needed to further reduce the moisture content of the woods, consequently temperatures of 200° to 205° F. should be substituted in the schedules which have been outlined.

The maximum temperature of the hot bath should not in any case be allowed to go above 220° F. as excessive heating is likely to result in checks which will weaken the timber and also cause a considerable loss of the preservative through volatilization.

Records

In order that the experience gained from wood preservation work carried on in this Region may be available in the future, a systematic record should be kept during each operation showing the following data for each run:

1. Date
2. Run No. (1, 2, 3, et cetera).
3. Number of poles, posts, or stubs treated.
4. Average diameter (at ground line) and length treated.
5. Species.
6. Average number of annual rings per outer inch.
7. Penetration secured at ground line.
8. Absorption, gallons.
9. Maximum temperature of preservative.
10. Loading, firing and unloading schedule.

This record should be filed in the Improvement folder for the project at the Supervisor's Office.

Care of Timber After Treatment

The treated timbers should be handled in such a manner as to maintain an unbroken band of creosoted wood which will remain intact after they are set.

Do not allow sharp-pointed tools to be stuck into the treated butts.

Set poles and stubs so that the treated portion extends at least 12" above the ground line.

WATER SYSTEMS

Water systems will usually be one of two kinds, either gravity flow or forced pressure by pumping. Gravity flow systems are relatively simple to install, although there are a number of factors concerned which must be fully determined in advance of construction.

Source of Water Supply

Is it adequate, permanent, and pure?

Is the head sufficient to provide adequate pressure at point of use?

Point of Use

How much water required at point of use?
Number of persons - Av. 25 gal. per person per day?
Number of stock - 10 gal. per head per day?
Area of lawn and garden - estimate?

Having determined the volume of water needed per day and per hour during times of actual use, and the flow per hour and day of the source of supply, the next step is to plan the proper size of reservoir or intake needed and the length and size of pipe necessary to deliver the desired quantity of water. Such plans should be forwarded to the Regional Office for review by experienced engineers. It is mistaken economy to have the supply pipe too small, and this is especially true where the head is barely sufficient to insure a flow of water through the pipe. It is not believed to be good business for some field man to spend considerable time and effort in trying to figure out all the factors relative to the determination of proper size of pipe, et cetera, when an experienced engineer can do it in a fraction of the time and much more accurately. Information required is:

Horizontal distance, source of supply to point of use.
Difference in elevation between supply and point of use.
Volume of supply required at point of use. Give details in support of estimated quantity.
Nature of source of supply - spring, stream, or other. If a spring, is flow sufficient to supply current need or is a reservoir required to build up a reserve supply for periods of peak use?
A rough sketch or diagram illustrating the ground layout will be helpful in working out the specifications.

With power pressure water systems the source of supply is also usually at or near the point of use. The type of equipment will vary somewhat between shallow well and deep well situations. It is believed that for pumping plants the most satisfactory type of installation is the air pressure type of equipment. It obviates any danger from freezing, requires less attention to maintain pressure and insures a constant flow of pure fresh water, since no storage tank is necessary. These systems cost about 30 to 40% more than the type of plant which uses a storage tank for the water supply. The purchase of pumping plants will be made through the Procurement and Supply Division, in order that compliance with all engineering requirements may be secured. There are a number of different makes of such plants on the market and each one has its good points as well as some drawbacks.

In some locations it may be desirable to use a hydraulic ram for pumping the water supply. They are low in first cost and cost practically nothing to operate. With a ram it is necessary to have an elevated storage tank, since the ram works slowly but constantly and a considerable flow of water to work the ram is necessary. In recommending the use of a hydraulic ram the same information should be supplied as is wanted for gravity water systems.

Installation

Pipe lines must be placed well below frost line. This is seldom less than 30" and should average around 40". In long lines, drain valves, unions and tees with plugs must be placed at several places in order to facilitate draining for repairs, et cetera. One most essential thing is a record or diagram showing the exact location of all lines and various connections, so that any one unfamiliar with the location of the line may determine from the diagram just where the various parts are located. This should, of course, be included in the ranger station improvement plan.

Water Supply Pipes

Water is usually led to buildings through wooden or standard butt or lapwelded iron water pipe. The main pipe of the water supply should always have a stopcock, easy of access, just outside the buildings, so that water can be shut off quickly in case of a break in the pipe. This stopcock should also have a waste (Crane Company, #5632, Rough), so that when the water is shut off all water standing in the house pipes can be drawn off.

The following table gives information frequently needed in the preparation of estimates:

PROPERTIES OF IRON PIPE, STANDARD WEIGHT
BLACK OR GALVANIZED, WROUGHT, BUTT OR LAPWELDED

Size	Diameter Ins. Ext.	Diameter Ins. Int.	Thickness	Wgt. Per Ft. Lbs. Plain ends	Wgt. Per Ft. Lbs. Threaded and couplings	Threads Per In.	Proper Lgth. of thread to make a tight joint
1/2	.840	.622	.109	.850	.852	14	1/2"
3/4	1.050	.825	.113	1.130	1.134	14	1/2"
1	1.315	1.049	.133	1.678	1.684	11 1/2	9/16"
1 1/4	1.660	1.380	.140	2.272	2.281	11 1/2	5/8"
1 1/2	1.900	1.610	.145	2.717	2.731	11 1/2	5/8"
2	2.375	2.067	.154	3.652	3.678	11 1/2	11/16"
2 1/2	2.875	2.469	.203	5.793	5.810	8	15/16"
3	3.500	3.068	.216	7.575	7.616	8	1"
4	4.500	4.026	.237	10.790	10.889	8	1-1/16"

Note: Fluctuation on pipe prices prevents giving cost figures dependable for any length of time.

Surfaces

Black iron pipe is highly susceptible to rust. Often accumulation of tubercles or rust flakes on its inner surface destroys 50% to 70% of its carrying capacity. Stoppage frequently occurs. Rusts from inside are the greatest source of damage. Little good is accomplished by painting the outside.

Galvanized pipe gives much longer and better service. Its use is always advisable. Dipped or coated pipe is black iron pipe dipped or otherwise coated with a heavy paint such as asphalt or similar substance. The coating increases the life and durability of the pipe. The effectiveness of the coating depends upon the adhesiveness and thickness of the coating. Dependable pipe dealers do not strongly recommend the use of dipped pipe.

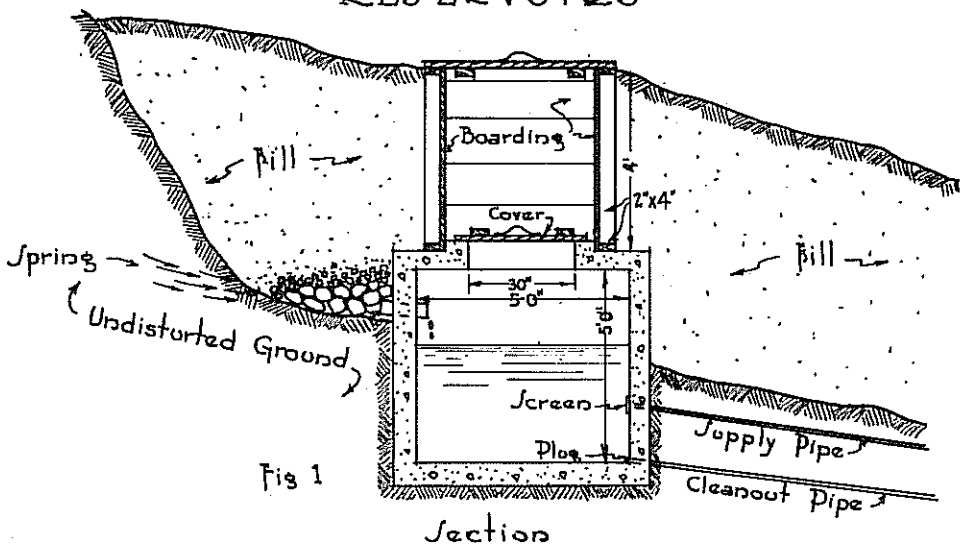
Size of Pipes

It is rarely advisable to use pipe smaller than 2" for mains from source of supply to point of distribution. Unions ordinarily should be inserted at 150-feet intervals in all pipe lines where silt is likely to be carried. Frequent use of unions in all branch pipe provides means for easy opening of piping in case of stoppage.

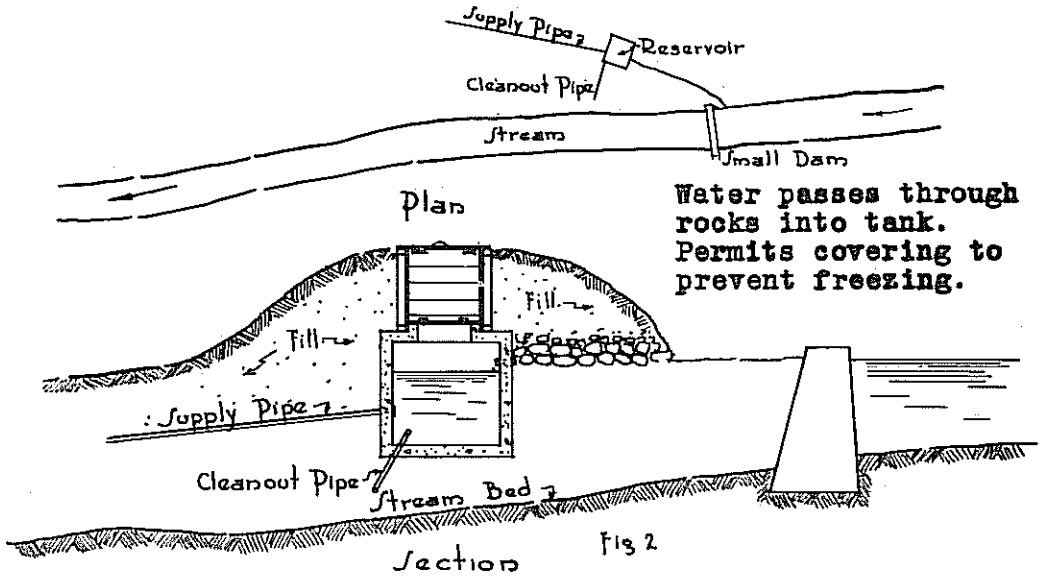
Pipes leading water from the main pipe to the fixtures should not be smaller than 3/4" diameter, unless water is delivered under very high pressure. Some form of reducers should be used to reduce the 3/4" diameter so as to accommodate the fittings of the fixtures.

The size of pipe is of major importance due to the loss of lead due to friction.

RESERVOIRS

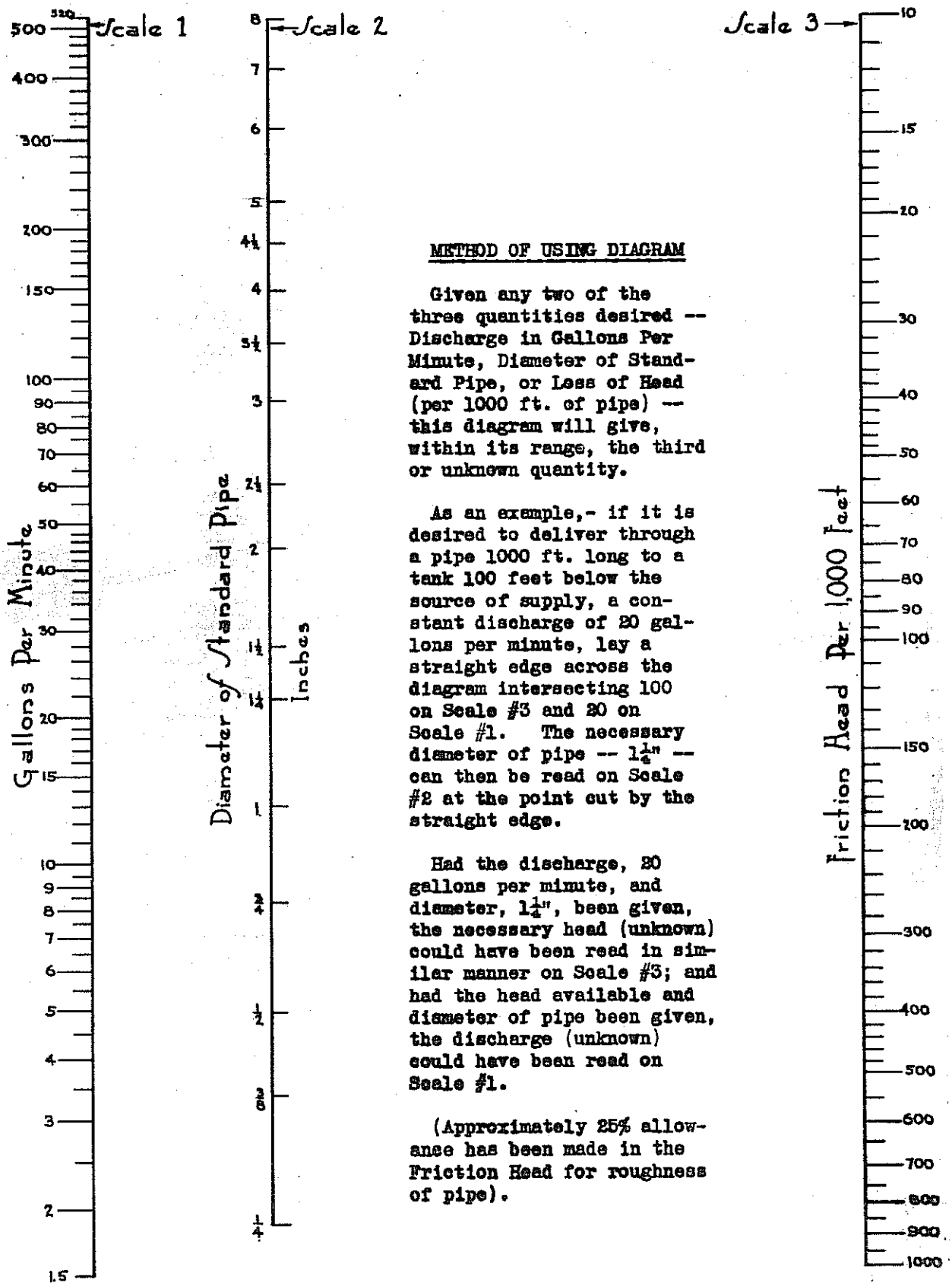


Where a spring leads into a reservoir which is subject to freezing, the reservoir should be covered with earth, as well as pipe, to below frost and loose stones placed at intake, so water can pass through to tank, thus preventing clogging. This also applies to small streams.



Where a stream is tapped, divert stream through large rocks into tank. This permits stream to enter tank under rocks and permits covering tank to prevent freezing; also permits a free flow of water. Surplus water at flood time follows main channel. If properly made this will not fill with sediment or become clogged. Most of sediment and trash goes down the main course of the stream bed.

FLOW OF WATER IN PIPES



METHOD OF USING DIAGRAM

Given any two of the three quantities desired -- Discharge in Gallons Per Minute, Diameter of Standard Pipe, or Loss of Head (per 1000 ft. of pipe) -- this diagram will give, within its range, the third or unknown quantity.

As an example,- if it is desired to deliver through a pipe 1000 ft. long to a tank 100 feet below the source of supply, a constant discharge of 20 gallons per minute, lay a straight edge across the diagram intersecting 100 on Scale #3 and 20 on Scale #1. The necessary diameter of pipe -- 1¼" -- can then be read on Scale #2 at the point cut by the straight edge.

Had the discharge, 20 gallons per minute, and diameter, 1¼", been given, the necessary head (unknown) could have been read in similar manner on Scale #3; and had the head available and diameter of pipe been given, the discharge (unknown) could have been read on Scale #1.

(Approximately 25% allowance has been made in the Friction Head for roughness of pipe).

HOW TO MEASURE THE FLOW OF WATER

The most common method of measuring the flow of water from a pump or stream is by constructing a weir. The weir consists of a rectangular notch cut in a dam across the stream or in the side of a box into which the pump discharges. The notch should be centered and its width should not be more than three-fourths the width of the box. It should be sufficiently wide, however, so that the water flowing over the lip will not be over 10" or less than 1" deep. The depth of water flowing over the weir must not be more than one-half the drop outside. The edges of the notch should be beveled on the side and top. A notch cut in a piece of flat tin or thin sheet iron, gives as good or better results than the beveled wood notch. The water back of the weir for three or four feet should have little or no motion.

Two to four feet back from the lip of the weir a post is set with its top exactly level with the lip. An ordinary rule set on this post serves to measure the depth of the water flowing over the lip. It is at this point that the water must have no current. The post is usually set near the edge of the pond.

Well Curbing

Material required to curb a square well 30" diameter, inside measurement, and 1' deep, with a 3" concrete wall:

Sacks Cement	Cu. Ft. Sharp Sand	Cu. Ft. Fine Gravel
.715	1.43	2.12

Same as above for round well 30" diameter, inside measurement:

Sacks Cement	Cu. Ft. Sharp Sand	Cu. Ft. Fine Gravel
.51	1.02	1.51

Example: To curb a square well 10' deep, 30" diameter, inside measurement, with a 3" wall, multiply the above figures by 10, which would require 7.15 sacks cement, 14.3 cubic feet sand, and 21.2 cubic feet gravel.

GALLONS PER MINUTE FLOWING FOR EACH INCH LENGTH OF WEIR, WITH THE GIVEN DEPTHS AT THE LIP.

Inches Depth	Gallons Per Min	Inches Depth	Gallons Per Min	Inches Depth	Gallons Per Min	Inches Depth	Gallons Per Min	Inches Depth	Gallons Per Min	Inches Depth	Gallons Per Min
1	3.06	2-5/8	12.96	4-1/8	25.47	5-5/8	40.50	7-1/8	57.78	8-5/8	76.95
1-1/8	3.60	2-3/4	13.86	4-1/4	26.64	5-3/4	41.85	7-1/4	59.31	8-3/4	78.66
1-1/4	4.22	2-7/8	14.85	4-3/8	27.81	5-7/8	43.29	7-3/8	60.34	8-7/8	80.28
1-3/8	4.86	3	15.75	4-1/2	28.98	6	44.64	7-1/2	62.37	9	81.99
1-1/2	5.58	3-1/8	16.74	4-5/8	30.24	6-1/8	46.08	7-5/8	63.99	9-1/8	83.70
1-5/8	6.30	3-1/4	17.82	4-3/4	31.41	6-1/4	47.43	7-3/4	65.52	9-1/4	85.41
1-3/4	7.02	3-3/8	18.81	4-7/8	32.67	6-3/8	48.87	7-7/8	67.14	9-3/8	87.21
1-7/8	7.33	3-1/2	19.89	5	33.93	6-1/2	50.31	8	68.76	9-1/2	88.92
2	8.64	3-5/8	20.97	5-1/8	35.28	6-5/8	51.75	8-1/8	70.30	9-5/8	90.72
2-1/8	9.45	3-3/4	22.05	5-1/4	36.54	6-3/4	53.28	8-1/4	72.00	9-3/4	92.43
2-1/4	10.26	3-7/8	23.13	5-3/8	37.89	6-7/8	54.72	8-3/8	73.62	9-7/8	94.23
2-1/2	11.97	4	24.30	5-1/2	39.15	7	56.25	8-1/2	75.24	10	96.03

It may be necessary to correct for rapid flow, or velocity of approach. This can be measured by timing sticks floating on the surface. The following table shows proper amounts to add to measured depths for different velocities:

Velocity of approach, in feet per second	.5	1	1.5	2
Addition to measured depth	1-16	$\frac{1}{4}$	5/8	1-1/2 inch

The use of the above table is made clear by the following example:

Suppose the notch is 60 inches wide and the rule shows the depth to be 6 inches. Then the total flow will be 60 x 44.64 = 2,678.4 gallons per minute.

PLUMBING

It is not within the scope of this booklet to attempt to make a plumber out of every Forest officer. The job requires considerable skill and mechanical knowledge and if the man responsible for the work has not enough natural talent or experience to do a fair job, a good plumber should be called in to do the job. Each building plan which includes any plumbing more than a kitchen sink has a detailed plan showing all the details of the plumbing job for that particular structure, and those plans; such as R-1 or R-4, can be used as a guide in other installations.

SEWAGE DISPOSAL

(Secure Farmers' Bulletin #1227)
(Sewage and Sewerage of Farm Houses)

Sewage disposal systems at ranger stations will usually be one of two types. Either the common cesspool or a septic tank will be used. Sewage should never be dumped into any stream of water or allowed to flow out in open ditches. In some locations the cesspool type may be used as it will be the most economical to install. This is simply a covered pit walled up with rock to keep the sides from caving in, and of sufficient size to allow the liquid contents to gradually seep away. They will work only in sandy, porous soils, and will have to be dug anew every few years. It is not a desirable method to follow but in some out-of-the-way places may be used.

The septic tank is the only satisfactory economical sewage disposal method at our command. Properly installed, the tank will last indefinitely and the sewage will be disposed of without any trouble or discomfort. All the septic tank does that the cesspool does not do is to liquefy the organic matter in the sewage and conduct the liquid into overflow areas where it drains away into the surrounding soil. There has long been an idea current among many people that the effluent from a septic tank is harmless and has been completely purified by bacterial action. This is far from the case as it has been found that various germs have passed from septic tanks and traveled many miles through porous soils. It is only a more convenient way of disposing of a nuisance.

There are several kinds of septic tanks in use, and perhaps the simplest and certainly the easiest to install are the iron tanks such as are made by the Kaustine Company of Perry, New York, the San-Equip Incorporated, of Syracuse, New York, and several others. A higher type, and for larger plants, is built of concrete and operated with automatic syphons, such as are made by the Kewanee Company of Kewanee, Illinois. There are also several different makes of chemical systems on the market which work very effectively. A statement of the needs for each job should be sent to the Regional Office and you will be advised as to the type of equipment which should be installed in each case. A copy of Farmers' Bulletin #1227

should be in every Supervisor's Office as a matter of information.

LIGHTING PLANTS

Wherever it appears desirable and where commercial power is not available, electric lighting plants may be installed at ranger stations. There are a good many different types of these plants on the market with varying qualities of performance. As a rule it will be desirable to install plants which generate a 110-volt alternating current and are automatic starting at the turn of a switch anywhere in the system. With such sets standard attachments of all kinds can be used, and it is not necessary to purchase lamps and attachments which have special voltage, as is necessary with direct current battery sets. The storage batteries require considerable attention and need to be renewed at regular intervals at considerable cost. The purchase of such sets and the wiring plan for each station must be approved by the Regional Forester before action is taken to make the installation. Plants will always be purchased through Procurement and Supply.

Where such plants are installed, the ranger will be required to pay such proportion of the operating cost of the plant as appears equitable. The installation of meters to measure the amount of current used in the dwelling and the total amount generated by the plant may be the most satisfactory method to use in order to do this.

MAINTENANCE

Station Premises

Untidy and littered station premises reflect on the official standing of the officer in charge. Keeping the premises free from rubbish and other debris is essentially a portion of the occupant's duties. Care must be exercised in the disposal of refuse from toilets and barns as well as the disposal of garbage. Saddles, harnesses, washtubs and other articles should not be hung on the exterior walls of dwellings or other buildings.

After being condemned as required, dilapidated and useless buildings, as well as broken-down corrals and log fences, should be torn down and disposed of.

Walks to be kept in good condition.

Depressions that develop into mudholes during wet weather must be filled up.

Dwellings

Foundations

Buildings must not be allowed to settle out of plumb through decay of underpinning or sills. Where underpinning or sills have been placed in contact with earth, they should be reset on piers or foundations of concrete or stone. Foundations should extend 10" or 12" below the ground surface in order that they may have a firm setting and not be affected by frost.

No earth is to be banked up to or over sills or underpinning.

Shallow gutters should be made around buildings to carry off surface water, where drainage is poor.

Floors

All floors should be kept level, firm and even.

Where unmatched flooring had been used and has developed large cracks and uneven condition, matched flooring should be placed over it at right angles with a layer of building paper between.

Roofs

Shakes or shingles only are to be used in replacing roofs on this class of buildings. The use of shingles is preferable.

All roofs are to be kept in a presentable condition. All defects must be repaired as soon as possible.

Chimneys and Flues

Where stovepipes or tiling pass through partitions, ceiling and roofs, a pipe guard casing with not less than a 2" air space between outer and inner casings is to be inserted. A stovepipe should under no circumstances be placed nearer than 6" to any woodwork and even at this distance it should have a shield. With metal roof jacks and flues frequent inspection is necessary to insure safety from fire.

Where such equipment becomes unserviceable or dangerous, it should be replaced with brick chimneys. (See standards for chimney construction, pages R-15 to R-19.) The value of the building must in all cases be weighed against the additional expense. This applies primarily to yearlong stations, but is desirable in all permanent structures.

Where roof jacks are used and caps extend through the roof, they must be made rainproof.

Accumulations of soot must be removed at least annually. Roof jacks must not be allowed to become clogged with dust and cobwebs in the ventilating space between the outer and inner jackets.

Doors and Windows

All doors should swing freely and easily and yet fit snugly in the jambs.

Damaged locks must be replaced.

Window sashes should move freely and not bind.

All broken panes should be replaced as quickly as possible and loose panes reputtied.

Roller shades should be kept in repair so they can be operated easily. Shades that become unsightly or badly damaged should be replaced as soon as possible.

Screens

Screen doors that sag are to be trued up and braced so they will fit snugly in the jambs. They must operate freely.

Springs are to be fitted so the door will remain tightly closed.

Galvanized wire mosquito netting is to be used for all doors and window screens when replacement is made.

Holes in the screen large enough to admit flies must be repaired.

All doors and window screens must be removed in the fall and stored in a dry place for the winter.

Interior Finish

Interior wood finish that has been stained should be brightened up with oil, since restaining blackens the wood.

Plaster should be tinted in accordance with standard color scheme. All cracks and holes are to be repaired before tinting. New plaster is to be finished with rough-sanded surface.

Wall board is to be tinted the same colors as plaster. Unless the room is of sufficient size to eliminate a checker-board effect, the binding strips are to be stained the same color as the wall board.

Barns

Building must not be allowed to settle through decay of underpinning of sills. Wooden piers to be replaced by concrete or stone. Sills and underpinning are to be kept from contact with earth.

Batten and chinking are to be kept in good repair. Mortar or stucco is to be used for pointing up.

Mangers and feed racks should be kept in good repair and all nails kept driven flush. A rodent-proof grain bin should be provided at each barn and kept in good repair.

The premises must be kept free from manure and other litter, especially bottles, and boards with nails in them.

Watering troughs must be kept clean of slime and moss.

Other Buildings

The foregoing applies equally to other buildings. All lightning protection installations must be kept in first-class condition.

Flags and Flagpoles

All flagpoles at headquarters stations are to be straight, firmly set, and painted white.

Pulley and halyard are to be kept in serviceable condition.

A small box with weatherproof top should be fastened near the foot of pole for the storage of the flag when not in use.

Outside Toilets

All outside toilets at headquarters stations must be flyproof and kept in a sanitary condition.

Roofs and sides of buildings are to be kept in first-class repair.

Good doors are to be provided for each building and should swing easily and freely.

Slacked lime or chloride of lime must be used frequently.

A shallow trench or gutter is to be made around the building to prevent surface water from running into the pit.

Yard Fences

Fences are to be kept in perfect repair.

Woven wire when used is to be kept tight.

Pasture Fences

When in use wire is to be kept tight.

Braces, poles, and posts are to be kept in alignment and be replaced as soon as they become unserviceable.

In high altitudes where snowfall is heavy, it may be necessary to take wire off the posts in the fall. This may be facilitated by driving two staples parallel and keying the wire between them with a nail. The wire should be securely fastened to a braced post every 15 or 20 rods.

Pole and log fences are to be kept in first-class repair. All unserviceable timber is to be replaced each year.

Gates

All gates must swing easily.

Patent automatic catches are to be used wherever possible.

All bars and wire gates where there is frequent use are to be replaced with swinging gates as soon as possible.

Gates that sag and drag on the ground must be trued up and braced.

Water

Wells must have curbings that will prevent surface water from running in and the ground given sufficient slope to carry off overflow from pump.

Covers must be tight to prevent the entrance of dirt and vermin as well as any overflow from pump. Two-inch tongue-and-grooved Douglas

fir should be used for this purpose, especially where the pump is set on the platform.

Head boxes on pipe lines should be kept in perfect repair and kept free from all moss or other accumulations. Covers and screens are to be kept vermin and dirtproof.

Cisterns should be cleaned at least annually, and semi-annually if possible. Springs should be cleaned frequently and should be fenced if necessary to keep out stock. Proper drainage should be provided.

Lookout Towers

To eliminate danger from fire that may be started in the surrounding timber or debris, a strip of all inflammable material is to be cleared from around the base of each tower.

All towers are to be thoroughly inspected each spring and all damaged timbers replaced. Loose bolts must be tightened or replaced. The wiring and grounds installed for lightning protection and all guy wires must be kept in first-class condition.

Rungs to ladders must be firm and have a factor of safety that will eliminate accidents due to their becoming loose or breaking.

Painting and treating of timbers to prevent decay must not be neglected.

Tool Caches

All tool boxes must have a strip cleared around them of all inflammable material. Usually this strip should not be less than ten feet. Each year all weeds and grass must be removed.

ADMINISTRATIVE SITE DEVELOPMENT AND IMPROVEMENT

Development of new ranger station sites will be carried out in accordance with plans prepared by the Regional Office in collaboration with the respective Forest. Insofar as is possible, landscape plans will likewise be prepared for the improvement of existing stations.

The following notes are intended to augment the plans submitted, as well as give definite information for use at those stations where it may not be possible to prepare detailed plans but where improvement work is to be undertaken.

Factors in Development

It should be understood that the term "Landscape Improvement" does not imply that the factors of efficiency and practicability of the lay-out are to be superseded by that of appearance. It is rather an attempt to create better efficiency in the normal functions of the station in the most pleasing manner and by utilizing natural existing features to the greatest advantage.

Practicability

The general plan of buildings, roads, walks, etc., should be such as to give a maximum of efficiency in circulation and use, with proper emphasis on their respective importances and functions.

The most practical solution is generally the one which most closely fits the existing conditions. Extensive grading, use of retaining walls and the like are not practical or desirable solutions where they may be reasonably avoided.

All areas have a definite importance in the general plan. Development should be compatible with this importance, neither exceeding or underestimating it.

Livability

Buildings should be located with definite regards to their function in the general scheme as regards prominence or privacy, views, prevailing winds, shade, sun, relation to other buildings of desirable or undesirable nature, etc.

Maintenance

Development should not exceed the capacity to maintain the grounds in a neat and orderly condition at all times. Lawn areas especially should be considered in respect to water supply, mowing, edging, fertilizing, etc. Trees and shrubs need considerable attention for two or three years after planting, but require little attention after that. Native materials tend to require less care.

Drives and courts require periodic care against weeds and rutting.

Appearance

Ranger stations should reflect a feeling of neatness, simplicity and livability. General development of the grounds should be made by judicious use of trees, shrubs and lawns. Such items as rockeries, pools, fountains, etc., are not desirable. Flower and vegetable gardens are permissible, but should be set apart and so located as not to detract from the general appearance of the grounds if neglected by occupants.

Plans

Reference to development and improvement plans should be made in accordance with the following classification. The term "Landscape Plan" commonly used in referring to the planting plan is erroneous and confusing. Strictly speaking, all plans listed are landscape plans since each pertains to some phase of landscape development.

1. Topographic Surveys

See the appendix of this section for special instructions prepared by Engineering for administrative and recreational site surveys.

2. Sketch Plan

This plan will be prepared by the Regional Office on the topographic survey basis, together with a visit to the site, and will be submitted for general discussion purposes relative to final development. This plan is not to be used for construction purposes unless specifically indicated on the plan.

3. Plot Plan

This plan will be prepared primarily for building and road location purposes, giving their locations and grade elevations in reference to the base line and bench mark which will be indicated on the plan and tied to one or more corners of the property. Using this plan, the buildings and roads will be staked out and checked on the ground.

4. Construction Plan

This plan will show locations and details of construction for roads, walks, fences, walls, etc. Standard details of construction (See Plates 1 to 17) are incorporated in this handbook and become a part of the construction plan where such details are indicated, unless otherwise specified.

5. Service Plan

The service lay-out, including power, telephone, water and sewer systems, will be shown on the approved plot plan. Any variations from this lay-out in actual installation are to be recorded on this plan in the field and returned to the Regional Office where this data will be incorporated in the construction plan. The completed construction plan will then be a permanent record of all installations and improvements.

Due to present-day complexity of underground service installations, combined with occasional personnel changes, it is essential that the service plan be accurate and up-to-date at all times.

6. Planting Plan

This plan will show existing trees and shrub masses, together with all proposed planting. Quantities of plants needed, with their scientific and common names, will be listed. (See "Plant Material" under "4. Planting," for all sizes, etc.)

Where scale permits, the general arrangement of individual plants will be shown.

This plan will also show the lawn-area boundaries and edging outlines to be maintained about shrub beds.

Construction Notes

1. Grading

Grading should be done in such a manner as to permit proper drainage of all areas without causing uncontrollable erosion. Grades should be as slight as possible and merge into natural grades easily. Terraces and angular sections to shoulders of cuts or fills are not desirable. (See Plates Nos. 2; 3; 4 for desirable grading sections.)

Stripping Topsoil

Where good topsoil exists on the site, it is desirable to strip all suitable earth from the area and pile in convenient places for subsequent replacement. Piles should not be greater than four feet in depth. Where piles are compacted by heavy equipment, they should be loosened several weeks in advance of replacement, especially if areas are to be seeded or planted the same season.

Rough Grading

This will consist of placing all subsoil from excavations and cuts in its final location. Allowance should be made for shrinkage in heavy fills and around building foundations and for replacement of topsoil layer.

Finished Grading

This will consist of replacing the topsoil layer over all rough-graded areas.

For lawn areas, the topsoil layer should preferably be six inches deep with four inches a minimum depth. Shrubbery beds should have a topsoil depth preferably of 18 inches with one foot a minimum depth. Where topsoil is nonfriable, a liberal application of well-rotted straw manure should be applied and worked into the soil. This will loosen soil, assist in retaining moisture, and act as a fertilizing agent.

Wherever possible, new grading should be allowed to settle thoroughly before planting or seeding. All lawn areas should be raked and rolled to an even grade before seeding to prevent subsequent settlement and irregularities of surface which are difficult to eliminate after lawn is established.

2. Drainage

All places requiring special drainage consideration should be anticipated at the time of grading and proper installations made at this time.

Gutters

Gutters should be as broad and shallow as circumstances permit to eliminate erosional tendency of water in constricted areas.

Where gradient permits, it is desirable to establish turf gutters. Where these occur in lawn areas, the broad, shallow gutter will be found to be much easier to maintain with less erosional tendencies. (See Figure 1, Plate 5.)

Where gutter area is restricted and on steep gradient, it will be necessary to use the paved type of gutter to prevent erosion. (See Figure 2, Plate 5.)

Catch Basins

Areas are often encountered which are either impossible or impractical to drain by open-gutter methods. Installation of catch basins is usually the most desirable solution.

A simple type of catch basin is shown in Figure 1, Plate 6A. This is suitable for installation in lawn or court areas

where heavy traffic is not encountered. The flush type of strainer renders it inconspicuous and offers no obstacle to mowing.

Where heavy traffic is encountered, the standard type of brick or concrete catch basin should be used.

Culverts

Culverts for receiving flow from roadside gutters should be of the type shown in Figure 2, Plate 6A.

Where culvert ends are conspicuous in the development, they may be treated as shown on Figure 1, Plate 6, depending on size of opening.

Eave Gutters

Gravel or paved type gutters should be provided under the eave drip to eliminate erosion. (See Figure 2, Plate 6.)

3. Lawns

Seed Mixtures

To best meet the varying conditions and requirements in Region One, differing seed mixtures are necessary.

For recommended mixtures, see Appendix "A" of this section of the Improvement Handbook. These mixtures have been worked up from information gathered from several sources. It is believed that there is chance for improvement of these mixtures for certain sites. Any comments on results obtained or suggestions toward improvement will be appreciated.

Germination

A properly prepared seed bed and use of high-quality seed are essential to a successful lawn.

Seed testing 95 percent in purity and 90 percent in germination is considered high quality.

Purchasing Seed

It is suggested that seed be requisitioned through the Division of Procurement and Supply to insure obtaining a high quality of seed. Unless purchased from a reliable seed concern, it is apt to be old, impure and of general inferior grade.

Rate of Sowing

From three to five pounds of seed should be sown per 1,000 square feet on clipped lawn areas and 40 to 50 pounds to the acre on unclipped areas, the relative amount depending on fertility of soil, moisture and time of sowing.

Time to Seed

Lawn areas should be seeded either in the fall or early spring to take advantage of natural ground moisture.

Fall sowing should be done before the middle of September to permit germination and substantial growth before severe weather sets in. Less seed is generally required then, due to tendency of plants to stool at cooler seasons.

Fall sowing also has the advantage of permitting grass to become established while weed seed is dormant, thus eliminating the usual competition of spring seeding.

Spring sowing should be done as early as the ground can be worked, usually between May 1 and June 1. Due to subsequent warm weather, there is a tendency for plants to grow spindly and consequently more seed is required at this time of year.

Sowing

Sowing should be done at a time when there is little or no wind. To insure even distribution, divide the seed and broadcast one-half each way of the lawn. After sowing, the ground should be raked lightly and rolled. Sprinkle lightly if the soil is dry. The ground should be kept moist until the seedlings are well rooted.

Seeding Banks

Where steep banks are to be seeded which are susceptible to erosion, a light layer of loose straw or hay applied immediately after seeding will assist materially in holding the earth until the grass can become established. The straw or hay should not be removed but allowed to remain to act as a mulch.

Fertilizing

For establishing lawns, a fertilizer that gives satisfactory results and one that is easily applied is a mixture of superphosphate, applied at the rate of 300 pounds per acre. Application should be made either early in the spring, as soon as danger of hard freezes is over, or in early fall prior to seeding.

For maintaining established lawns, bone meal and many special brands of lawn fertilizers are used. They should be applied in the early spring at the rate of 20 to 25 pounds per 1,000 square feet.

Fine, well-rotted manure applied in the late fall or early winter is beneficial. It should be sifted or well pulverized, as coarse manure may prove detrimental.

Mowing and Watering

The lawn should be mowed frequently during the growing season, gradually tapering off as the dry season approaches. Grass should not be cut closer than one inch to the ground at any time. During dry spells greater protection is afforded if the mower bar is raised to an inch and a half. Better winter protection is afforded if mowing ceases in time to permit a final growth of about two inches.

Coarse clippings from the mower should be removed. Fine clippings, as a result of frequent cutting, are beneficial and should be allowed to remain.

Watering may be done at any time, but perferably confined to the cooler hours or cloudy days when loss from evaporation is least.

Watering should consist of a good thorough soaking. Light sprinklings tend to encourage surface root growth which renders the grass extremely susceptible to drouth.

Watering with the hose nozzle removed is recommended as being more effective due to smaller loss from evaporation and quantity of water possible to apply in a given time.

4. Planting

Normal planting seasons are in spring and fall while material is in a dormant stage and ground moisture most plentiful.

Preparing Beds

Soil for planting beds should be prepared to a preferred depth of eighteen inches. Twelve inches should be considered as minimum. Where existing soil is of poor quality, it should be excavated and the bed refilled with a good soil rich in humus. Existing soil of fair quality may be improved sufficiently by spading in a liberal application of well-rotted manure several months before planting.

Where planting is to be done immediately, well-rotted manure should be applied and spaded into the top few inches of soil after planting is completed, care being taken not to disturb the plant roots.

Plant Material

The major portion of plant material to be used for ranger station planting will consist of native species. These may be successfully collected from local sources by careful selection and handling.

Large sizes in native materials should generally be avoided unless suitable moving equipment is available. Best results will be obtained by use of smaller sizes. For small, deciduous shrubs a desirable size would be from two feet to three feet; for large deciduous shrubs four feet to six feet; deciduous trees, one inch to two inches - diameter breast-high; for evergreen trees two feet to three feet height. Evergreen shrubs vary from prostrate to upright forms and of varying ultimate sizes so that it is difficult to indicate definite sizes. However, young plants should be selected so that a good portion of the root system may be obtained.

All native plants should be carefully selected as regards shape and exposure. They should be well-developed and as symmetrical in shape as possible. This necessarily implies a proper exposure. Plants growing under crowded shaded conditions are poorly shaped and when moved from these conditions to one of open sunlight and wind exposure invariably succumb to these conditions. This is the most important factor to consider in selecting native materials. See Plate 9.

Deciduous shrubs of smaller sizes may be moved with bare roots, but the roots should be kept moist while exposed to the air. However, it is recommended that all plants be moved with a ball of earth wherever possible to insure best survival. Deciduous trees and large shrubs must be moved with a ball of earth large enough to contain a good majority of the root system.

Both evergreen shrubs and trees must be transported with a ball of earth.

Where it is necessary to handle plant material with large balls of earth or where the soil is of a loose, crumbly character, moving can be facilitated by allowing the balls to freeze slightly. Only a few inches, depending on the size of ball, should be allowed to freeze. Complete freezing of the ball is harmful and may often cause loss of the plant. Plants can readily withstand ground freezing when unmolested, but are unable to do so when dug and balled.

Before planting, cut off all broken and damaged root ends with a clean, straight cut. Plate 11 shows the proper shape and proportional size of hole required in proper planting. Roots should be allowed ample room to be spread out in a natural position. To secure proper settlement of soil about the roots, fill the hole partially with loose earth, shake plant with a slight up-and-down motion, apply more earth and tamp firmly, repeating until hole is filled. Use only good, clean earth, avoiding stones, sod, sticks, etc. These tend to create air pockets, and it is essential to success that the earth come firmly in contact with all roots or about the ball.

Planting should not be attempted when the ground is frozen unless unfrozen material is available for backfill. Frozen earth does not respond to tamping, and its use results in air pockets and subsequent settling.

Depth to which plant is set should be the same as that at which it was originally growing, unless otherwise specified on the planting plans.

The earth about the base of the plants should not be mounded as this tends to turn water away from the roots. Planting beds should be left smooth and level. Individual plants should have a slight depression left about the base as shown on Plate 11.

Mulching

A loose layer of straw or straw manure of three inches to four inches depth should be spread around the base of shrubs and trees after planting to conserve soil moisture and protect the roots from alternate freezing and thawing. Such a mulch will also assist in keeping down weeds. Allow the mulch to remain until plant is well established, then spade into the soil.

Guying

Newly transplanted trees should be securely guyed against swaying until root system is firmly established. The swaying action tends to break off the tender new rootlets, thus preventing the tree from receiving proper nourishment, resulting in diminished vigor and eventual loss.

Guy wires should be kept taut at all times. See Plate 11A.

About three years is required for proper establishment of the root system.

5. Pruning

Pruning, at time of planting, is necessary to balance top wood with the root system capacity which has been retarded and reduced. Pruning should consist of removing all dead wood, cross branches and weaker shoots. The latter should be cut as near the ground as possible. The general shape of the plant should be retained.

All pruning should be done by clean cuts either close to the ground or to the nearest branch. Stubs are unsightly and offer a place for decay and insects to attack the plant. See Plates 10 and 11.

Evergreens should not be pruned. Tips of branches may sometimes be clipped to thicken foliage. In no case should the leader be cut or damaged.

Pruning may be done at any season, preferably while plants are dormant. It should be noted, however, that spring flowering shrubs form their buds in the fall, and for best flowering effect, should be pruned after blooming. Large cuts should be painted over with pitch or tar compound or ordinary lead paint. A black or gray color is preferred.

6. Construction Details

Roads

Roads and drives about ranger-station grounds should be constructed in accordance with standards for Class 5 roads, excepting alignment, grading sections, curbs and width. Variations as regards the above will be indicated on the construction plan and on Plates 4, 5A, 6, 6A, and 7.

For Class Five Road Standards, see "Regional Instructions for Forest Road Location," and "Forest Truck Trail Handbook."

Walks and Steps

Types and widths of walks will be indicated on the construction plan. Generally, the most suitable local material should be selected in determining the type. See Plates 8 and 8A.

Fences and Gates

Construction details for various types of fences and gates for ranger station grounds are shown on Plates 12, 12A, 12B, 12C, 12D, and 12E.

Gate Stops

See Plate 12D for detail showing method of holding drive gates open.

Cattle Guards

Construction details for cattle guards are shown on Plate 12F.

Retaining Walls

Construction details for "Dry Stone Retaining Walls" are shown on Plate 15.

Construction details for "Gravity Type Retaining Walls" are shown on Plate 15A

Ranger Station Sign Supports

Construction details for varying types of supports are shown on Plates 13, 13A, and 13B, together with suggestions for their proper selection. See also Sign Handbook.

Poster Display Supports

Construction details for suggested support structures are shown on Plates 14, 14A, and 14B.

Clothes Lines

Construction details for clothes lines and supports are shown on Plate 16.

Flag Poles

Proper proportions of poles and flags, together with construction details are shown on Plate 17.

APPENDIX "A"

To best meet the requirements of the Region in respect to climatic conditions, the following seed mixtures are recommended:

Clipped Lawns

1. For less arid conditions generally prevailing in the western portion of the Region:

Kentucky Bluegrass	75 percent (by weight)
White Dutch Clover	25 percent

2. For arid conditions generally prevailing in the eastern portion of the Region:

Canadian Bluegrass	75 percent
Red Fescue	15 percent
Italian Ryegrass	10 percent

Unclipped Areas

1. Less arid conditions (western):

Redtop	40 percent
Red Fescue	40 percent
Italian Ryegrass	20 percent

2. Arid conditions (eastern):

   a. Benchlands:

      Crested wheatgrass, Fairway variety.

   b. Fertile bottom lands:

      Buffalo grass. Note: Seeds sparingly - best propogated by small sods spaced 18 inches to 24 inches apart.

Rate of Sowing

From three to five pounds of seed should be sown per 1,000 square feet on clipped lawn areas and 40-50 pounds to the acre on unclipped areas. the relative amount depending on fertility of soil, moisture and time of sowing.

Specification

High-quality seed should test at least 95 percent in purity and 90 percent in germination.

APPENDIX "B"

E(L)
Surveys

Revised February 1937.

INSTRUCTIONS FOR ADMINISTRATIVE SITE SURVEYS

General

The engineer responsible for making the survey shall obtain from the landscape planner or the Forest Supervisor all necessary information on the location, area, and any special details that should be stressed, for the site to be surveyed. This shall include any adjacent area which is near enough to influence development of the site, and which shall be mapped to the same standards.

In making these surveys, it must be kept in mind that aesthetic values are paramount and for that reason no live trees shall be blazed. An absolute minimum of green foliage of any kind shall be cut. Avoid all cutting wherever possible. However, in cases where a property survey is required, the boundary lines may be trimmed out as narrow and neatly as possible, keeping always in mind the above instructions.

Survey

1. Instruments

On all property surveys the transit and steel tape graduated in feet and tenths of a foot will be used.

On the topographic surveys, the plane table and stadia or transit and stadia shall be used.

The Abney level and tape should not be used on the topographic survey, as this method is not sufficiently accurate.

The precision instruments required for this work should be requisitioned through the Forest Supervisor. These instruments can be furnished on short notice by the Regional Office on a rental basis. As the supply of these instruments is limited, and in order to avoid accumulating large rental charges, these instruments should be returned to the Regional Office through the Forest Supervisor for reassignment as soon as the work is completed.

2. Standards

a. Property surveys shall be made where the tract is to be acquired, or where, for administrative reasons, it is desired to accurately define the boundaries of tract. The boundaries of the tract shall be marked with

standard Forest Service iron posts or bronze tablets. For description of these markers, see "Monuments." In the majority of cases, property surveys will also be topographic surveys a nd, therefore, will be made to conform with Topographic Survey Standards listed below:

The meridian established by observation of Polaris shall control the property survey.

The angular error of closure of the tract shall not be greater than two minutes of arc.

A balanced survey shall be made, having not more than $\frac{1}{640}$ error of closure. The formula for computing the error of closure is as follows

$$\text{Error of closure} = \frac{\sqrt{(\text{Error in Latitude})^2 + (\text{Error in Departure})^2}}{\text{Perimeter}}$$

Use double-meridian distance method for computing the area.

b. Boundary surveys (not a topographic survey). On some areas, contiguous private property will not require a property survey because existing lines are sufficiently well known to eliminate administrative difficulties. There is need, however, for adequate posting of the boundary so that during construction and for other purposes, the confines of the area can be readily recognized.

This type of survey will be made with a Forest Service standard staff compass and 100-foot tape. The correct variation will be obtained from Isogonic Chart, recorded in the field notes and on the map.

The boundaries of contiguous private property shall be marked in the field with standard private land boundary signs, Form 1505, at points most easily observed such as roads, trails, etc. Where the tract is withdrawn as a public-service site, the engineer will be so instructed, and the boundaries shall be marked as above, except that Form 394A should be used. These signs can be obtained from the Forest Supervisor.

The boundary survey is not intended to be a part of the topographic survey of this area.

c. Topographic Survey shall be made, unless the engineer is otherwise instructed, in writing, by the recreational planner.

The accuracy required for the topographic survey is such that the map location of any point shall show correctly to the nearest foot in horizontal distance and the elevation of points where shots are taken to the nearest one-tenth foot.

The contour interval of the topographic map shall be one foot on slopes up to twenty-five percent, and five feet on slopes over twenty-five percent.

3. Suggested Method of Topographic Survey

There are three principal methods of making topographic surveys: (a) Triangulation, (b) Traverse, and (c) Strip or Gridiron. The method or combination of methods best adapted to the individual site should be selected.

To avoid the necessity of outfitting these small surveys with a variety of instruments, both vertical and horizontal control as well as sketching detail should be done either with a transit or plane table.

For this reason, all level lines should be confined to one-half mile in length (and will be double run) in tying to an authentic standard established bench mark of the United States Geological Survey, United States Coast and Geodetic Survey, or other organization. Where the distance exceeds one-half mile, an elevation as nearly to true elevation as possible should be assumed. All bench marks will be fully described in the field notes.

Make sufficient sketches in your notes so that they will be entirely clear to anyone who tries to use them. Write a note explaining your general method and procedure from beginning to end and attach to the field notes.

Each survey should have an "origin of coordinates" somewhere on the area. The same point should be the origin for both horizontal and vertical control and shall be one end of the reference base line.

Map

One map of the site shall be made in the field using scale 1" - 20' shall be used. Use either standard plane-table sheets or the type of mounted paper used for base map lay-outs.

Show length and bearings of all boundaries in cases where required. Show ownership of adjoining property. Also area of site in fractions of an acre, excepting city lots.

1. Buildings and Improvements

For existing buildings show all outside entrances and existing ground elevations at each corner, also first floor elevation. State

functions of buildings such as barn, residence, etc. Give type of structure such as log, shakes, siding, etc. Give color if painted. Show all existing recreational developments such as signs, stoves, tables, garbage pits, etc. Show all buildings located on adjoining property within 100 feet of the boundary of site. State type, condition and function as per above.

2. Highways and Roads

Show width of right of way, width of traveled surface or shoulder to shoulder and drain ditches for all highways and roads inside and adjacent to the site. Show elevation of ditches, both shoulders and center line at sufficient points to give a practical picture of the grade and drainage. Give approximate direction and distance in miles or fractions thereof to nearest towns.

3. Sidewalks

Indicate type (gravel, concrete, flagstone, etc.) width and condition.

4. Fences

Indicate type (buck, wire, pole, etc.) and condition.

5. Streams

Show actual width and high and mean-high water surface.

6. Shore Lines

Show present, mean-high and high water. Mean-high and high can be noted as feet below and above present level, if necessary.

7. Rock Outcroppings or Boulders

Show ledges, and rock outcroppings, extent and height. Also indicate glacial boulder deposits, gravel bars, sand beaches, etc.

8. Trails

Show location of all trails and give name, number and destination.

9. Telephone and Power Lines

Indicate type, ownership and location of all poles within the site or near enough to be of use or to affect the development of the site.

10. Trees

Show all prominent trees on the property. Give diameter breast-high, and name of species. Groups of trees and shrubs may be indicated by type lines. Indicate varying sizes and species separately; give average diameter; show and label open parks where there are no trees in same manner. Where grouping is resorted to, reference trees should be located 40 or 50 feet apart throughout the group. These reference trees should be tagged, using cardboard and shingle nails and spotted on the map. They shall be numbered consecutively and the numbers on the tag shall be identical with the corresponding number of the tree shown on the map. This is done to help the planner or landscaper orient himself on the ground.

11. Views

Show point or points from which the most attractive natural view or outlook is obtainable and indicate the direction and approximate extent or angle of view in degrees. Describe the outlook briefly. (As lake view, mountain view, etc.)

12. Winds

Indicate by arrows and notations the direction of prevailing winds both summer and winter. This information can usually be secured from the district ranger.

13. Sunlight

Indicate in notes if site is situated so that direct sunlight is restricted in either morning or evening and the extent as, partially, totally, etc.

14. Soil Conditions

Indicate whether sand, gravel, clay, etc., and approximately where dividing line is if more than one type is involved. Also indicate whether moist, marshy, arid, etc. Note such data on subsoil as can be determined from existing cuts, banks, or holes. Dig one or more test holes, in absence of other definite evidence.

15. Water Supply

Irrigation ditches, creeks, springs, reservoir, etc. Give direction and distance to any source referred to off the site from a known and identifiable point on the plat. Give general idea of quantity of water available and ownership from source to site. Locate underground supply lines if they occur on or near the site. Such data as can be obtained of natural underground water table from surrounding wells, if any, is highly valuable in estimating the depth necessary in possible well drilling.

16. Sewage Disposal

Locate sewage disposal lines, describe type as wood, tile, etc., septic tanks, or cesspools, if any. Give information on possible surface disposal outlets, depth, and extent of seepage bed, if any.

17. Title

Give name of Forest, name of site, location by legal subdivisions, scale, by whom surveyed, by whom platted approval, and date and acreage involved.

18. Elevations

State whether elevations are assumed or true. State datum, if possible. If assumed, give approximate elevations above sea level and show original bench mark or assumed elevation on the plat. If true elevations are used, describe point where take-off was made, such as United States Coast and Geodetic Survey bench mark at forks of road near Deep Creek (elevation 4,517.29 feet), Power Company bench mark near Quarter Corner, Section 1/12 T. 17 N., R. 5 W., M.P.M. (Elevation 3,621.45 feet.)

19. Meridian

Show true north meridian by arrow and give method of obtaining, such as from General Land Office section line, observation on Polaris or compass. Also give magnetic variation for the location of the site.

20. Subdivision Lines

Show all General Land Office lines on the plat where they pass through or form a part of the boundary thereof. Tie all surveys to a General Land Office corner or other definite monument such as Homestead Entry Surveys, Patented Mineral Claims, etc., if available within approximately two miles of site. These ties can be made with sufficient accuracy with compass and tape traverse, except in cases where a property survey is required.

21. Conventional Symbols

A list of symbols is attached and shall be used without exception.

22. Sample Map

See sample map attached for general idea of what is required.

Reference Base Line

A reference base line shall be established on the ground and shown on the map and be as convenient to the site of probable

intensive development as the engineer is able to determine. In cases where it becomes desirable, this base line may be moved after the building lay-out has been made by the landscape planner. It shall have a permanent monument established at each end consisting of a standard Forest Service iron post or Forest Service bronze tablet set in concrete. (See Monuments for description, etc.) This line must be long enough to be consistent with the degree of accuracy required, in no case less than 200 feet, and the ends shall be visible one from the other. The monuments shall be set with the top ten inches above the ground so as to be easily found.

Monuments

In the monumentation of landscape planning surveys, Forest monuments shall be set. These monuments shall be used to mark the "Reference Base Line" and where it is necessary they will be used to define the exterior boundaries of the tract, one monument being set at each angle point.

The Forest monuments to be used in this work consist of two types, the standard Forest Service iron post and the Forest Service bronze tablet. The post consists of a 1½-inch iron pipe, 30 inches in length. This pipe is flanged on one end and has a brass cap mounted on the other end.

The standard Forest bronze tablet consists of a three-inch disc with a 11/16 x 2-5/8-inch shank. These tablets should be cemented into drill holes in ledges, boulders, concrete blocks or other substantial objects. Either the iron posts or the tablets may be secured, properly marked, upon requisition from the Regional Office.

1. Marking

A key letter has been assigned to each Forest as shown on the attached index sheet. Each Forest has its own series of Forest monument numbers which begin with number one. When an order is received for monuments, six for example, and the last monument previously established on the Forest is number 22, then the monuments sent out will be stamped from 23 to 28, inclusive, with the additional marking on each monument of F.M. and the date. After the post is set, a cross (x) should be marked on the cap to indicate the exact monument point. Where monuments are set for corners of the tract, the numbers shall run in a consecutive series in a clockwise direction. Do not mark the elevation on the cap of Forest monuments as there is always a possibility that it might be mistaken for a United States Coast and Geodetic or United States Geological Survey bench mark. The elevation, however, must be recorded in the notes and on the plant. Should less monuments be required than was anticipated when the order was placed, or if for any reason more monuments are received than are actually set, they shall be returned to the Regional Office, Division of Engineering, in order that the office record may be corrected.

2. Witnesses

Witness trees and mounds will be omitted as they tend to detract from the natural beauty of the site.

3. Recording

The description of each monument will be recorded on a 4"x6" "Record Card," issued by the Regional Office. A facsimile of a sample card is attached. These cards, along with the field notes and maps of the site, will be sent through the Forest Supervisor's Office to the Regional Engineering Division. This Division will receipt for the information sent in.

SAMPLE RECORD CARD

F.M. L -21 - 1936	Monument	Flathead	Forest
Project	Big Fork Administrative Site Survey		
Method of Est.	Restoration of N.$\frac{1}{4}$ Cor. Sec. 36, T. 27 N., R. 20 W.		
By Whom	John Doe	Date	May 1936
Precision	Transit and Steel Tape	Elevation	3,020.19

Set standard Forest Service iron post with top 10 inches above ground, marked F.M. L-21, 1936 on brass cap.

(If bronze tablet is used, the following will apply:
Set standard Forest Service bronze tablet cemented in top of large boulder, marked F.M. L-21, 1936 on bronze cap.)

Located by restoration of N. 1/4 cor. of Section 36, T. 27 N., R. 20 W.

Elevation ran from Mountain States Power Company bench mark on spillway at Big Fork Power House.

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FOREST MONUMENT INDEX SHEET

Name of Forest	Key Letter	Name of Forest	Key Letter
Absaroka	A	Gallatin	M
Beaverhead	C	Helena	N
Bitterroot	D	Kaniksu	Q
Cabinet	F	Kootenai	P
Clearwater	G	Lewis & Clark	S
Coeur d'Alene	I	Lolo	T
Custer	J	Nezperce	W
Deerlodge	K	Saint Joe	Y
Flathead	L		

MAPPING

- Existing Contours (See Grading)
- Depression Contours
- B.M. 1120 — Bench Mark
- Triangulation Station
- O F.S.M. — Forest Service Monument
- Traverse Turning Point
- 182° 30' / 305.2' — Base Line

BOUNDARIES

- National Forest Boundary
- Adjacent National Forest Boundary.
- National, State or Province Line
- County Line
- Township Line
- Section Line
- Property Line

NATURAL FEATURES

- Lake Shore
- Stream or River
- Small Stream
- Intermittent Streams
- Spring
- Wet Meadow or Bottom Grassland
- Marsh
- Rock Out Crop
- 12" Y.P. — Existing Individual Tree (Give caliper and name)
- Aspen etc. — Existing Masses of Deciduous Trees & Shrubs
- Lodgepole — Existing Masses of Evergreen Trees & Shrubs

WORKS & STRUCTURES

- Barn — Buildings
- Pole — Fence (Indicate type- Buck, Pole, Wire, etc.)
- Gate
- Road
- Trail
- Ford
- Culvert
- Bridge
- Cattle Guard
- Railroad
- Railroad Tunnel
- Concrete Wall
- Dry or Masonry Stone Wall
- Riprap

WATER, PLUMBING, SEWERS

- Reservoir
- Canal or Ditch
- 6" — Pipe Line (Large Size)
- 1½" — Water Line (Small Size)
- 6" — Sanitary Sewer Soil Pipe
- 10" — Vitrified Sewer Tile
- 4" — Agricultural Tile
- ST — Septic Tank
- Gate Valve
- Check Valve
- Stop & Waste
- Line Drain
- Hose Connection
- Catch Basin
- Manhole

MATERIAL SECTIONS

- Brick
- Concrete
- Stone Masonry
- Wood - Finished
- Wood - Rough
- Iron
- Rock
- Gravel
- Sand
- Cinders
- Earth or Topsoil

PLANTING

- O Name — Proposed Tree
- Name — Tree to be Removed
- Name — Tree to be Moved
- Planting Bed (Circles indicate No. of Plants and Spacing)

GRADING

- Proposed Contours
- Existing Contours
- + 560.2 — Proposed Elevation

UTILITIES

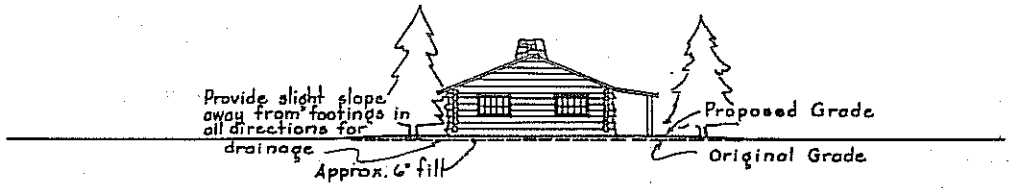
- Telephone - Overhead
- Telephone - Underground
- Electric Power - Overhead
- Electric Power - Underground

U.S. DEPT OF AGRICULTURE
FOREST SERVICE
REGION NO. 1
LANDSCAPE PLANNING

STANDARD SYMBOLS FOR LANDSCAPE IMPROVEMENT

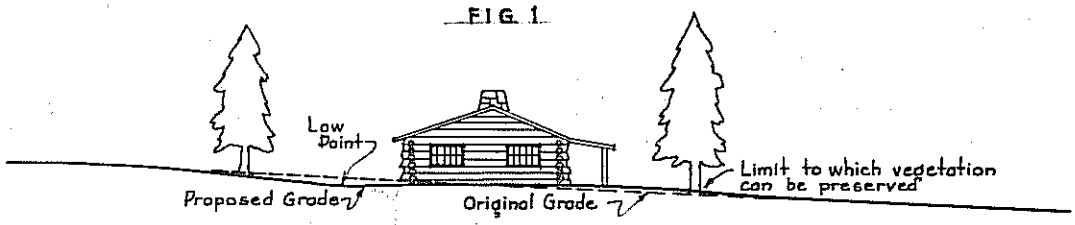
PLATE NO. 1

DRAWN BY Peterson DATE 12-27-35
CHECKED BY Peterson - 1-3-36
TRACED BY Coleman - 1-2-36
APPROVED BY [illegible] -



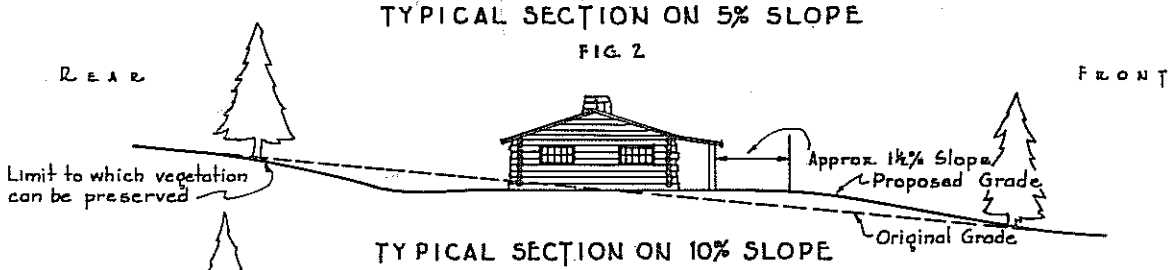
TYPICAL SECTION ON LEVEL GROUND

FIG. 1



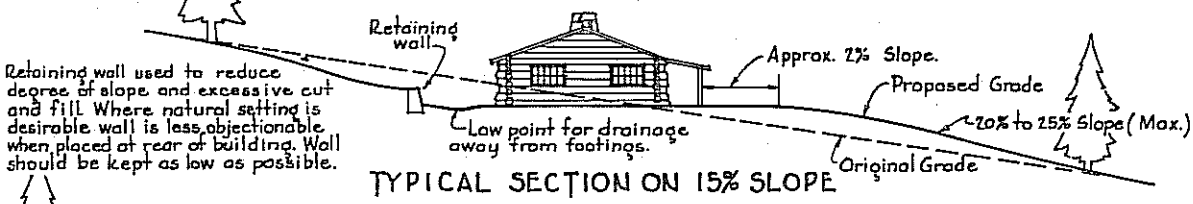
TYPICAL SECTION ON 5% SLOPE

FIG. 2



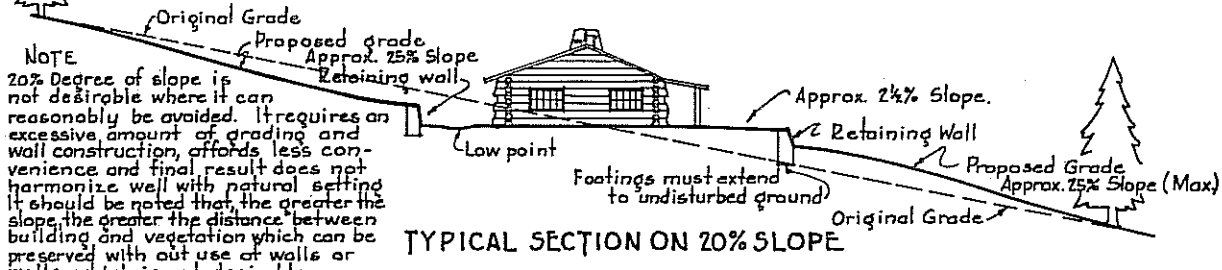
TYPICAL SECTION ON 10% SLOPE

FIG. 3



TYPICAL SECTION ON 15% SLOPE

FIG. 4



TYPICAL SECTION ON 20% SLOPE

FIG. 5

TYPICAL SECTION WHERE SLOPE IS TOWARD FRONT OF BLDG.

FIG. 6

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	GRADING SECTIONS FOR BUILDINGS WITH VARYING DEGREES OF SLOPE	PLATE NO. 2 DRAWN BY Peterson DATE 12-26-35 CHECKED BY Peterson - 1-3-36 TRACED BY Cunningham - 1-3-36 APPROVED BY [illegible]

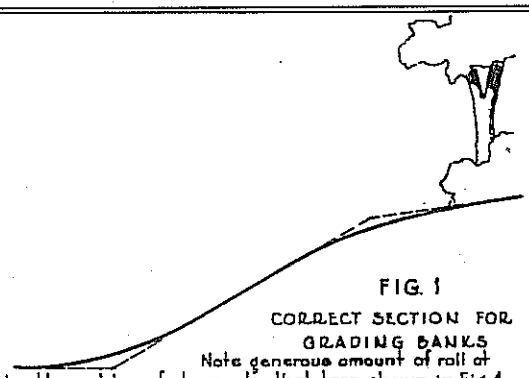


FIG. 1

CORRECT SECTION FOR GRADING BANKS

Note generous amount of roll at shoulder and toe of slope, also that tree shown in Fig 4 has been sacrificed, its eventual loss as shown in Fig 6 being anticipated at this time.

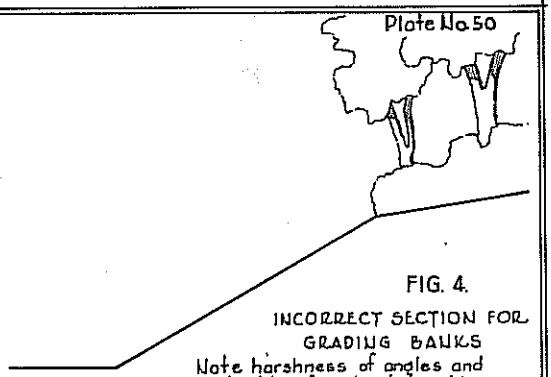


FIG. 4.

INCORRECT SECTION FOR GRADING BANKS

Note harshness of angles and unstability of angle at shoulder.

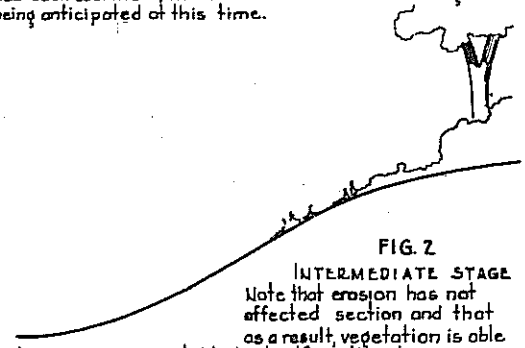


FIG. 2

INTERMEDIATE STAGE

Note that erosion has not effected section and that as a result, vegetation is able to spread and establish itself on the slope.

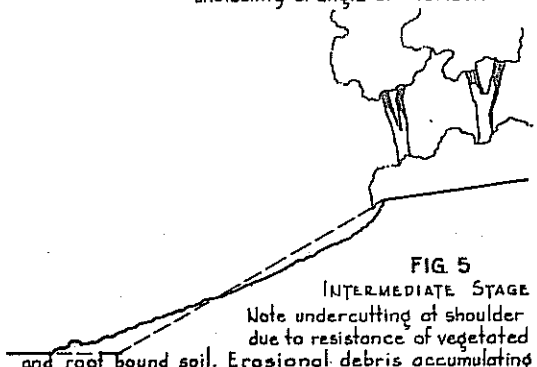


FIG. 5

INTERMEDIATE STAGE

Note undercutting at shoulder due to resistance of vegetated and root bound soil. Erosional debris accumulating at base of slope creating a perennial maintenance problem, especially along road side gutters. Vegetation unable to maintain foothold in shifting soil.

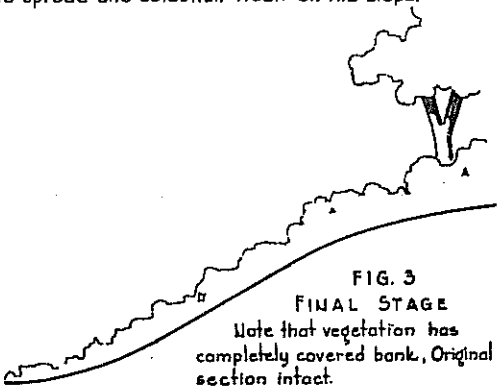


FIG. 3

FINAL STAGE

Note that vegetation has completely covered bank, Original section intact.

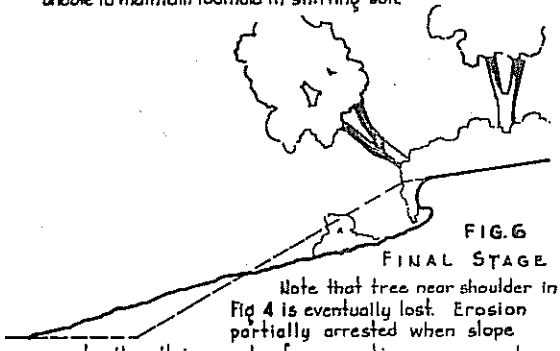


FIG. 6

FINAL STAGE

Note that tree near shoulder in Fig 4 is eventually lost. Erosion partially arrested when slope eventually attains angle of comparative repose and vegetation is able to establish itself. The appearance still remains highly undesirable. This stage represents a period several years later than shown in Fig 5

SKETCH SHOWING CORRECTLY GRADED BANK BEING REVEGETATED BY NATIVE SHRUBS AND VINES

Banks should not be graded steeper than the normal angle of rest for the particular soil encountered. A slope of 1 to 2 should, for most types of soil, be considered as maximum and used only where absolutely required. Where space permits, better stability and more natural appearance may be had by flatter slopes such as 1 to 4 and 1 to 5.

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	GRADING BANKS CUT SECTIONS	PLATE NO. 3 DRAWN BY PETERSON DATE 1-8-36 CHECKED BY PETERSON " 2-8-36 TRACED BY COUGHLAN " 1-16-36 APPROVED BY [illegible] " 2-19-36

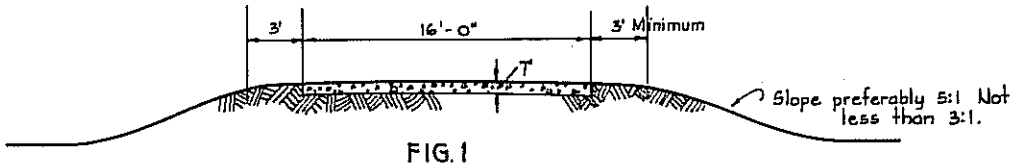


FIG. 1
FILL SECTION

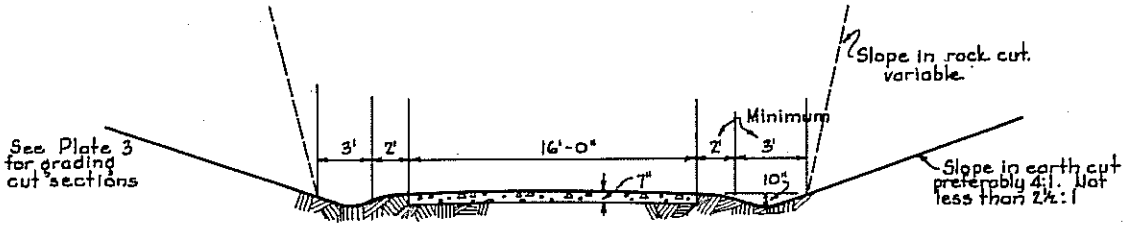


FIG. 2
CUT SECTION

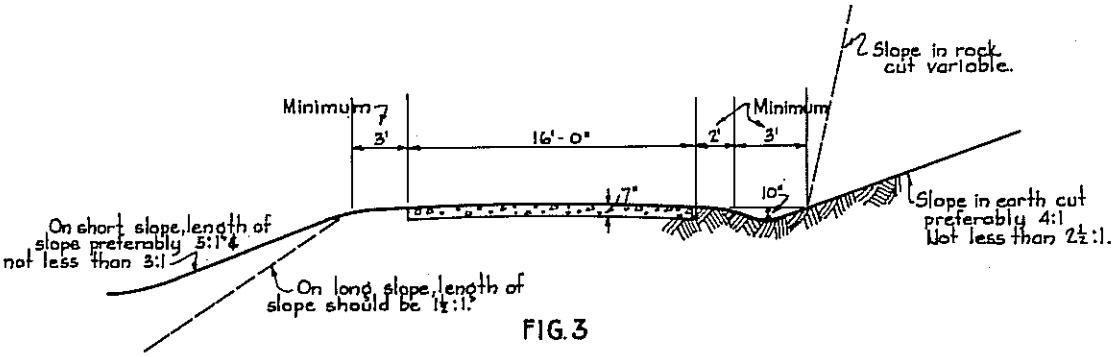


FIG. 3
SIDE HILL SECTION

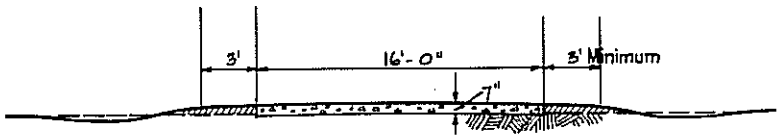
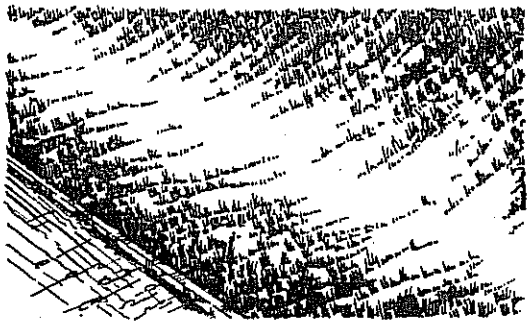


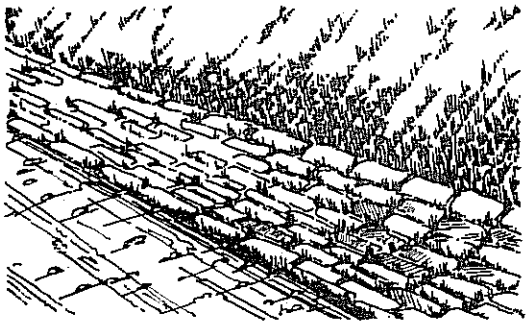
FIG. 4
TURNPIKE SECTION

Note: The above sections are based on construction standards for Class 5 Roads as established for Region 1. Variations in width of wearing surface as may be indicated on plans will not affect the standard of construction as regards wearing course, drainage etc. unless specifically indicated. Gutter and shoulder widths shown are minimum dimensions. Where conditions permit it is desirable to increase gutter and shoulder widths up to 5' or 6'.

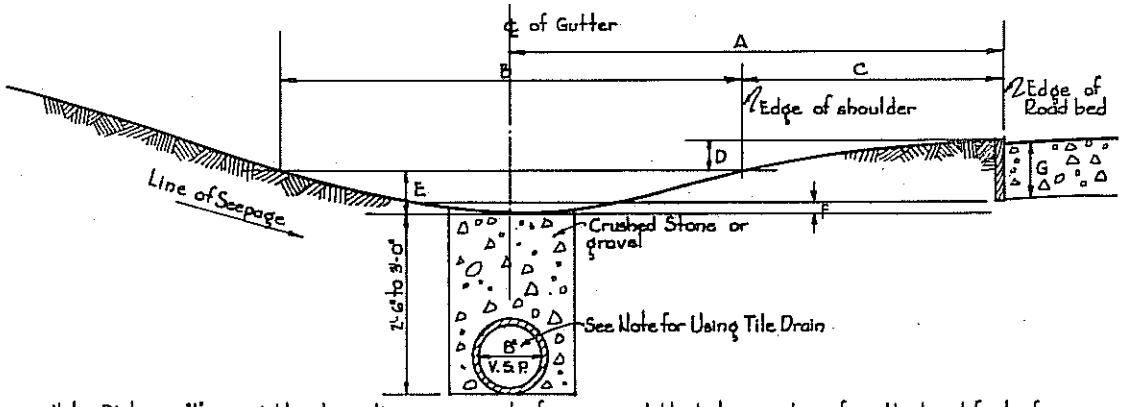
U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	DRIVEWAYS TYPICAL GRADING SECTIONS	PLATE NO. 4 DRAWN BY Peterson DATE 1-15-36 CHECKED BY Peterson " 2-8-36 TRACED BY Coughlan " 1-20-36 APPROVED BY [illegible] " 2-17-36



SKETCH SHOWING GRASS GUTTER



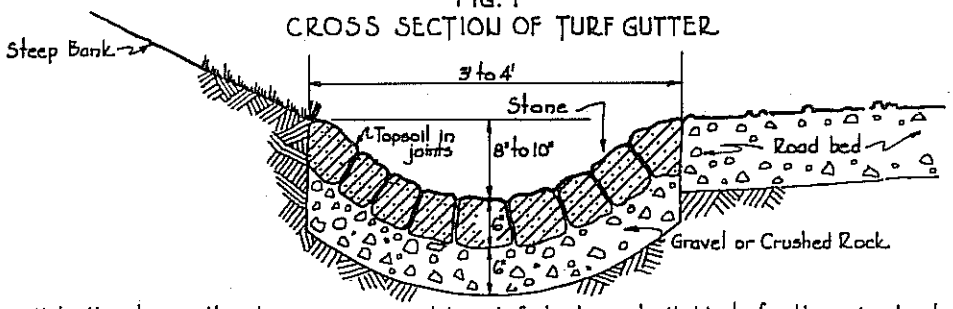
SKETCH SHOWING PAVED GUTTER



Note: Distance "A" is variable, depending on amount of space available between edge of road bed and foot of slope. Generally a distance of 7' to 8' is desirable - 5' about a minimum distance. This distance should remain constant along a given section of road except to avoid definite obstacles such as large rock or trees. Distances "B" and "C" will vary in proportion to distance "A". In general shoulder width "C" will be somewhat less than half the gutter width "B". Height of shoulder "D" should be from 3" to 4". Depth of gutter will vary with drainage conditions. Where surface drainage only is encountered and roadway is on gradient, depth "E" may be from 4" to 6". Where bank seepage must be intercepted, depth "E" should be increased to 8" or 10" or more, depending on depth of road material at "G" or until bottom of gutter is at least 2" or 3" below bottom of road bed, indicated by distance "F". Where seepage is extreme and gutter width and depth limited, an intercepting 6" vitrified tile drain should be laid under the center line of the gutter and trench backfilled with coarse gravel or crushed rock.

FIG. 1

CROSS SECTION OF TURF GUTTER

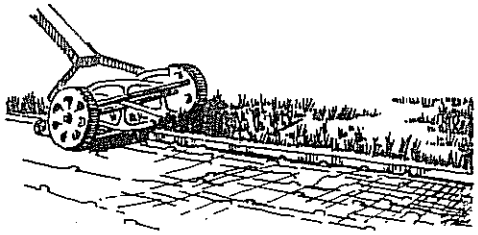


Note: Use stone gutter where erosion cannot be satisfactorily controlled by turf gutters, due to steep gradients, too narrow available space to carry required volumn of water, lack of ability to establish turf, etc. Bed stones on a 6" course of compacted gravel or crushed rock. Fill joints with topsoil and seed to bind soil and diminish harshness of stone. Note rounding of gutter shoulders into road surface and bank.

FIG. 2

CROSS SECTION OF PAVED GUTTER

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	TURF AND PAVED GUTTERS	PLATE NO. 5 DRAWN BY PETERSON DATE 1-22-36 CHECKED BY PETERSON " 2-8-36 TRACED BY COUGHRAN " 1-30-36 APPROVED BY [illegible] " 2-17-36



SKETCH SHOWING WOODEN CURB
AND METHOD OF TRIMMING
LAWN EDGE

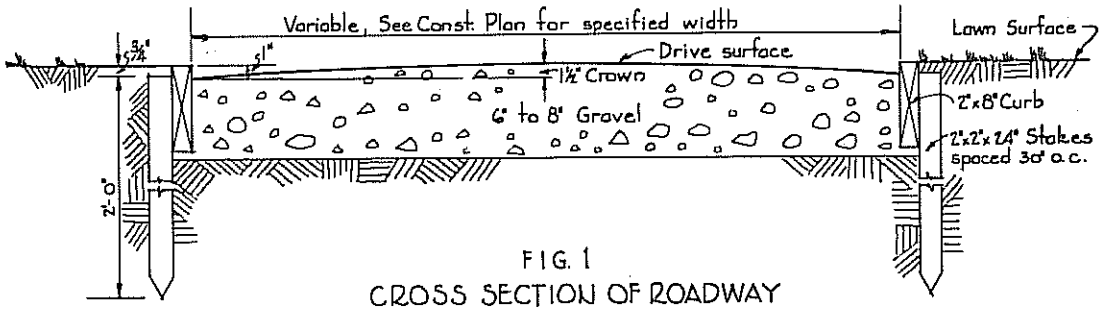
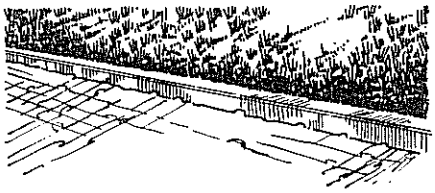
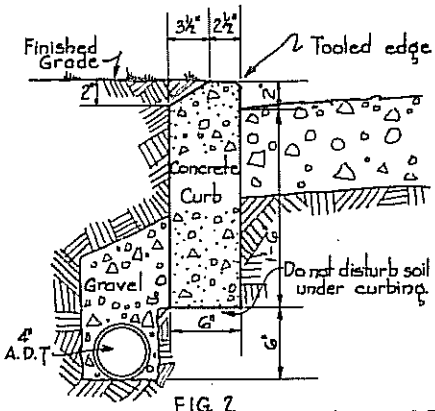


FIG. 1
CROSS SECTION OF ROADWAY
WOODEN CURB



SCALE
0' 1'

PERSPECTIVE OF CONCRETE CURB



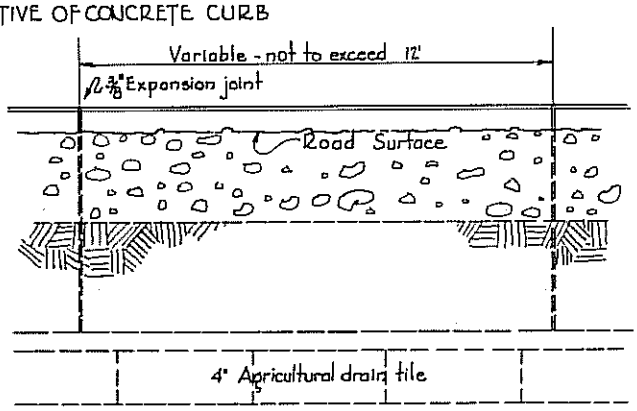


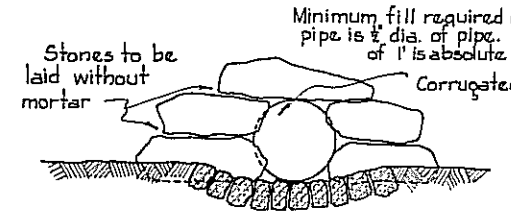
FIG. 2
SECTION

CONCRETE CURB

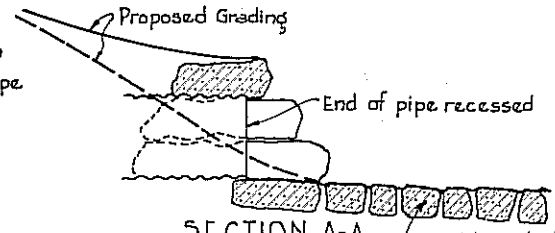
FIG. 3
SIDE VIEW

Note: Tile drain should be installed in heavy soils, or where ground water is apt to accumulate. This drain may be omitted in exceptionally porous and well drained soils. Note amount of curb which is allowed to show after completion of grading. Form and cast curb in place. Concrete mix 1:2:3. Due to harsh lines formed by this type of curb it is generally not desirable and should not be used unless specified.

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	CURBS WOOD AND CONCRETE	PLATE NO. 5A DRAWN BY Peterson DATE 2-3-36 CHECKED BY Peterson " 2-8-36 TRACED BY Chapman " 2-5-36 APPROVED BY [illegible] " 2-19-36

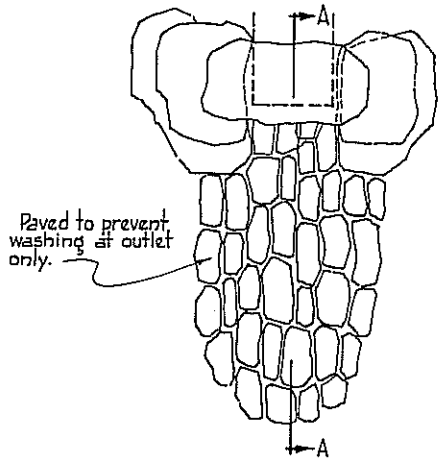


ELEVATION

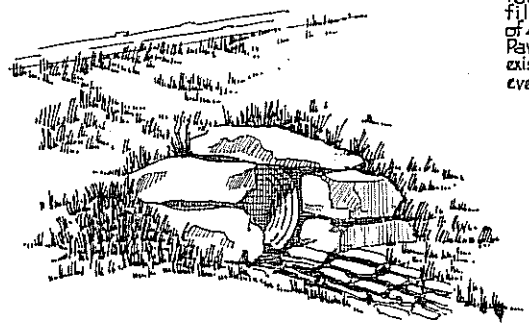


SECTION A-A

Paved to end of fill or to a distance of 4' on stable ground. Paving should meet existing grade on even slope.



PLAN

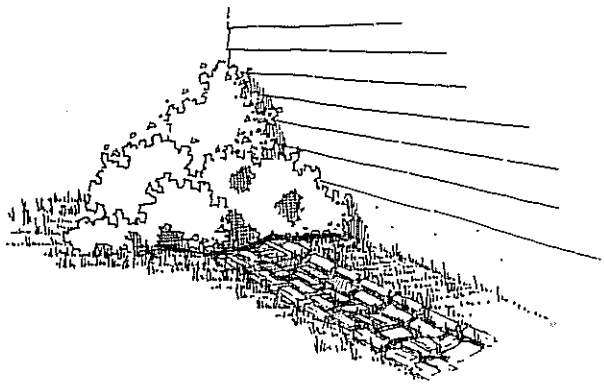


SKETCH

CULVERT ENDS FOR SMALL SIZE PIPES

NOTE: This method suitable for culverts up to 18" diam. Inlet end of culvert not paved unless a steep slope is required (See paving inlet to walled catch basin).

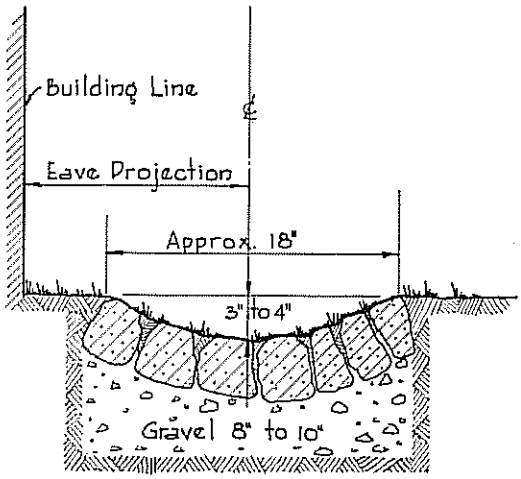
FIGURE 1



SKETCH

Used to prevent erosion under eave drip.
Eave gutters are not necessary where planting breaks eave drip

PAVED EAVE GUTTER



Stones to be covered with soil and sewed to lawn grass between joints.

SECTION

FIGURE 2

Revised 4-23-37

U. S. DEPT. OF AGRICULTURE FOREST SERVICE REGION ONE LANDSCAPE PLANNING	CULVERT END AND EAVE GUTTER	PLATE 6 DRAWN BY H.W.C. DATE 4-23-37 CHECKED BY C.M.B. " 4-26-37 TRACED BY H.W.C. " 4-23-37 APPROVED BY [illegible]

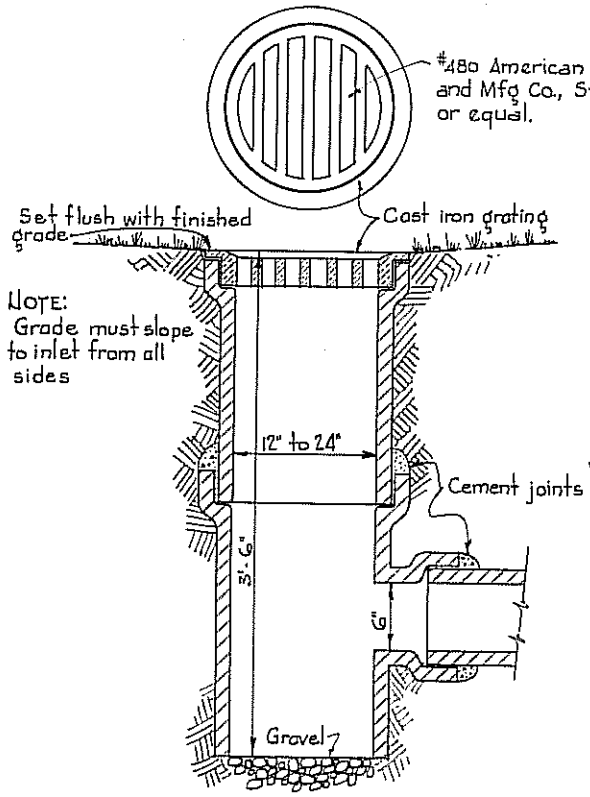
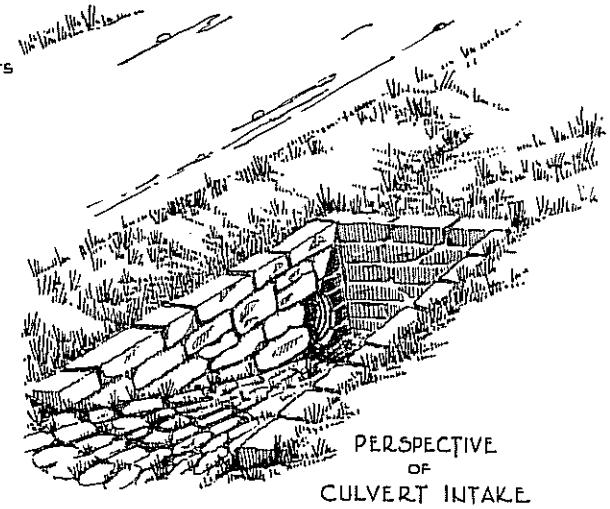


FIG. 1

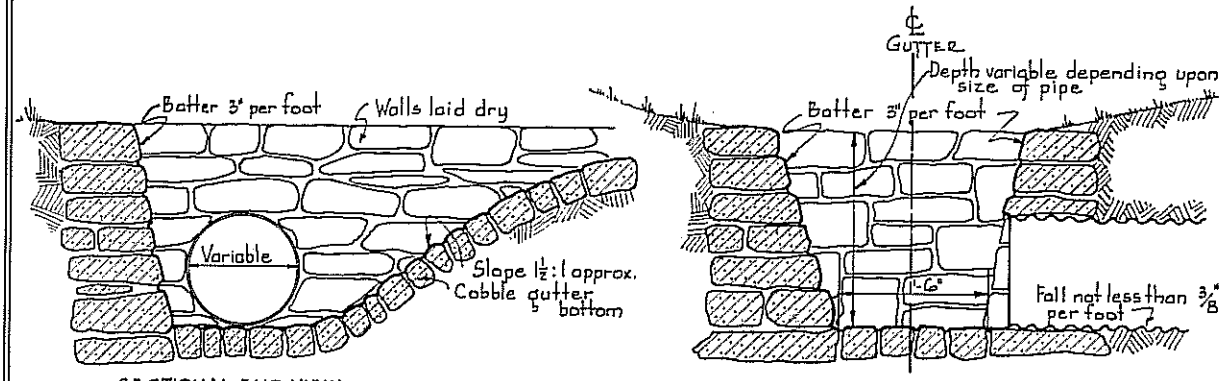
VITRIFIED SEWER PIPE CATCH BASIN

SCALE 3' 1' 0' 1' 2'

PERSPECTIVE OF CATCH BASIN



PERSPECTIVE OF CULVERT INTAKE



SECTIONAL END VIEW

SECTIONAL SIDE VIEW

FIG. 2

CULVERT INTAKE STRUCTURE

SCALE 2' 0' 1' 2'

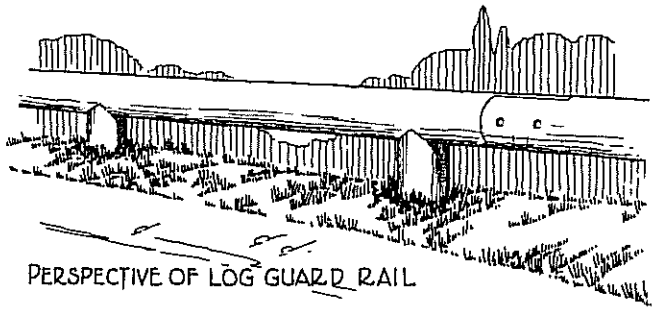
Note - Cover for pipe under roadbed not less than ½ diameter of pipe, minimum cover 12"

This type of culvert intake to be used on roadway cut sections where volume of water is too great to be carried in gutter to end of cut.

Revised 4-26-37

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	CATCH & BASIN CULVERT INTAKE	PLATE NO. 6A DRAWN BY PETERSON DATE 1-15-36 CHECKED BY PETERSON " 2-18-36 TRACED BY COUGHLAN " 1-22-36 APPROVED BY CPL " 2-17-36

Plate No. 54



PERSPECTIVE OF LOG GUARD RAIL

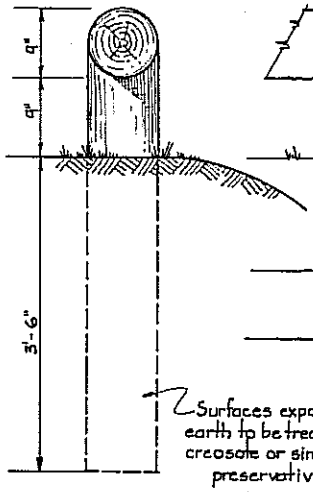


FIG. 3
SECTION

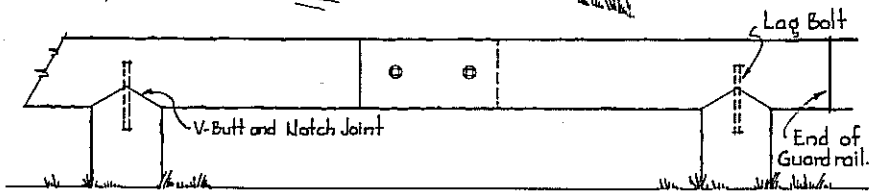


FIG. 1
ELEVATION

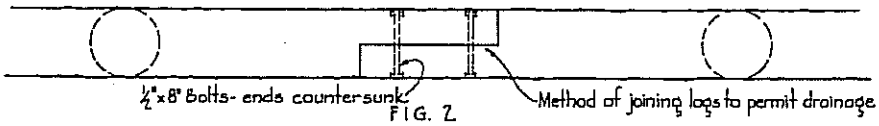
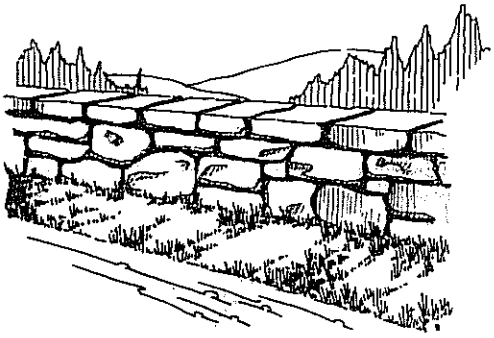


FIG. 2
PLAN VIEW

LOG GUARD RAIL

NOTE: All members to be of natural peeled logs.
Finish: Treat with hot linseed oil, unless otherwise specified.



PERSPECTIVE OF STONE GUARD WALL

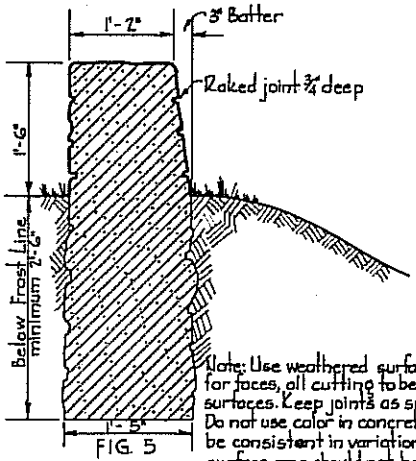
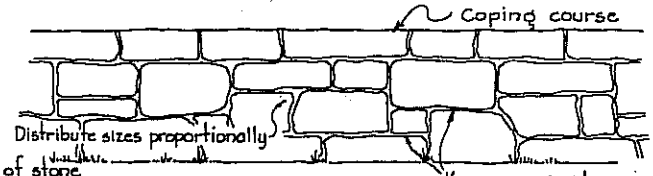


FIG. 5
SECTION



Note: Use weathered surfaces of stone for faces, all cutting to be made on interior surfaces. Keep joints as small as possible. Do not use color in concrete. Stones should be consistent in variation of sizes. Average surface area should not be less than 48 sq. in.

FIG. 4
FRONT ELEVATION

Keep coursing horizontal. Do not lay stones in a vertical or angular position.

STONE MASONRY GUARD WALL

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	ROADWAY GUARDS AND BARRIERS	PLATE NO. 7 DRAWN BY Peterson DATE 1-24-36 CHECKED BY Peterson " 2-8-36 TRACED BY Coughran " 1-30-36 APPROVED BY [illegible] " 2-19-36

Plate No 54 A

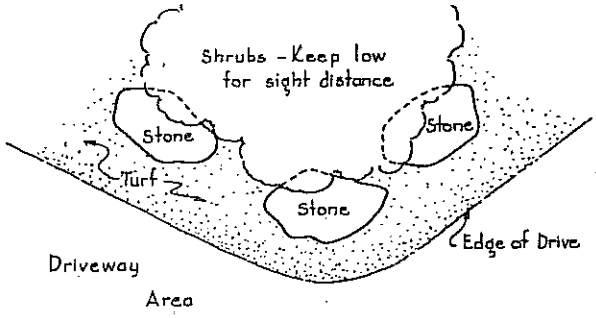
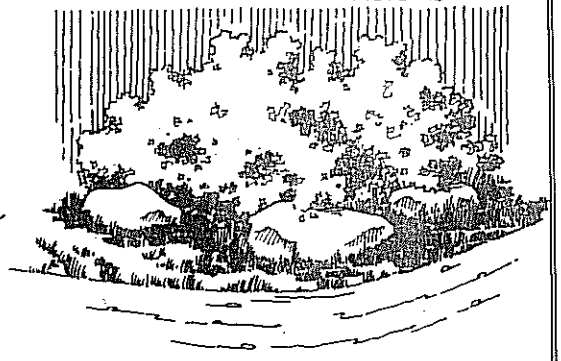


FIG. 1

STONE CORNER BARRIER

SHOWING ITS USE IN PREVENTING TRAFFIC FROM CUTTING CORNERS



PERSPECTIVE OF CORNER BARRIERS

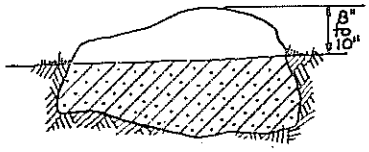


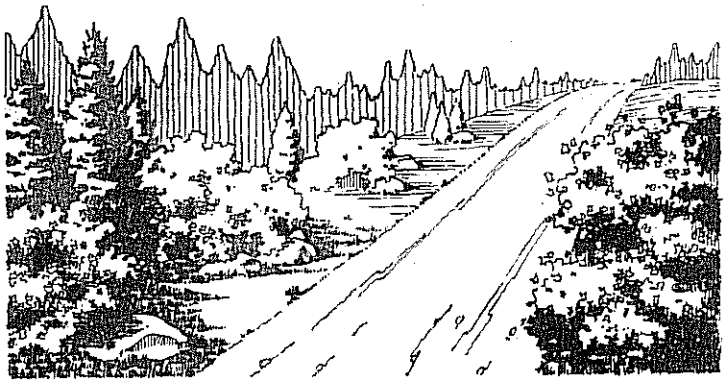
FIG 3

SECTION

SHOWING STONE PROPERLY SET IN GROUND

Stones should be set with their flatter surfaces parallel to the ground surface, avoiding sharp corners and points above ground for solid, natural appearance and to prevent removal. The distance stone projects, above ground should not be less than 8" or ordinarily more than 12".

DO NOT SET STONES IN A LINE OR SPACE EVENLY.
DO NOT PAINT STONES BUT PRESERVE THEIR NATURAL, WEATHERED APPEARANCE.



PERSPECTIVE OF CONTINUING STONE BARRIER

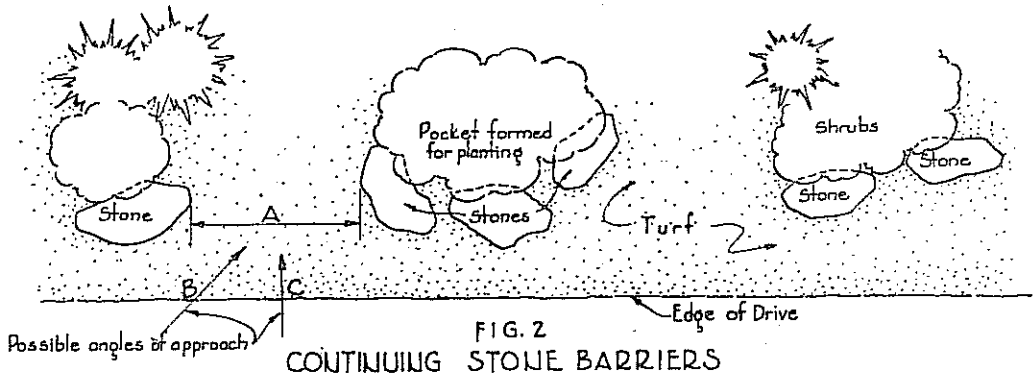


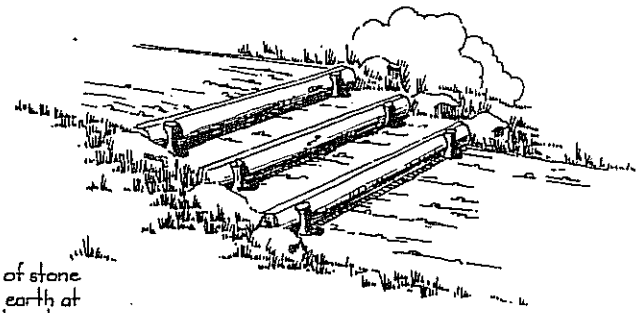
FIG. 2

CONTINUING STONE BARRIERS

SHOWING THEIR USE IN KEEPING TRAFFIC ON ROADWAY

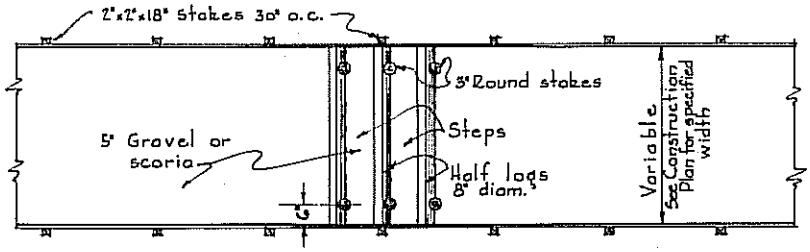
Note attempt to group stones in a natural manner and use of plant material to blend and soften outlines of stones. Use as large stones as can be handled by reasonable methods. Distance "A" will vary according to angle at which traffic is able to approach. The minimum distance of 4'-6" will be required to prevent access of automobiles only when the angle of approach "C" is possible. When approach is only possible from an angle such as "B" the distance between stones may be increased so that a space of not over 4'-6", which is perpendicular to the maximum angle of approach, is permitted.

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO 1 LANDSCAPE PLANNING	ROADWAY GUARDS AND BARRIERS	PLATE NO. 7A DRAWN BY Peterson DATE 1-29-36 CHECKED BY PETERSON " 2-8-36 TRACED BY COUGHLAN " 1-31-36 APPROVED BY [illegible] " 2-19-36



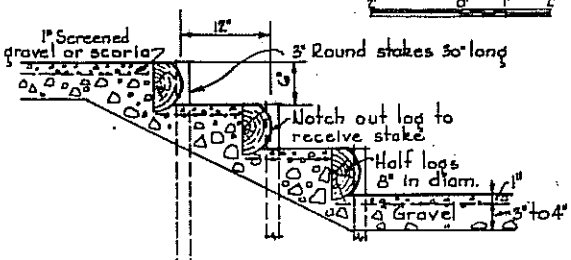
Note use of stone to retain earth at ends of treads

PERSPECTIVE

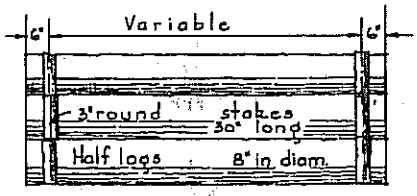


PLAN

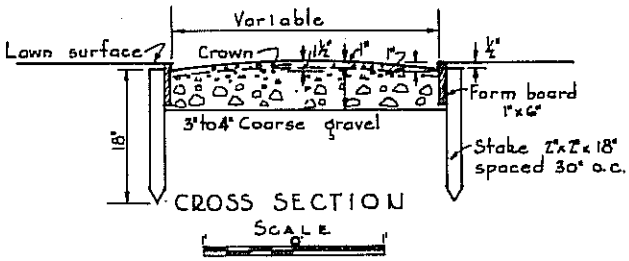
SCALE



LONGITUDINAL SECTION



ELEVATION

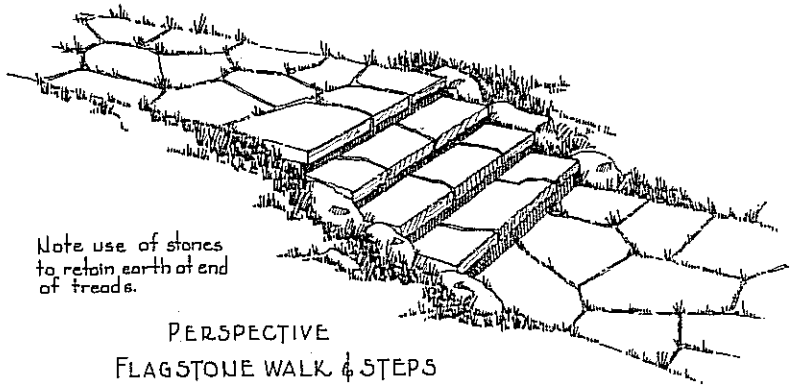


CROSS SECTION

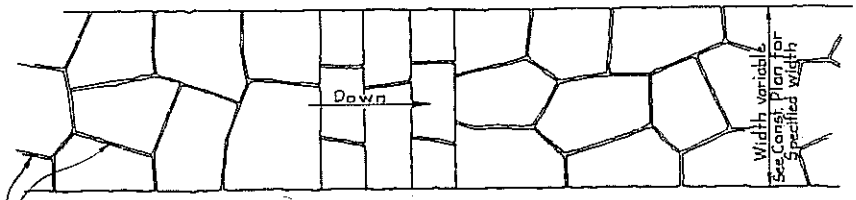
SCALE

Note: Log facings and stakes to be of natural peeled logs. Surfaces in contact with earth should be treated with creosote or similar preservative. Surface exposed to be treated with hot linseed oil unless otherwise specified. Top layer of gravel should be of material passing a ½" screen. Enough binding material should be incorporated in gravel to allow it to bind under foot traffic.

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	GRAVEL OR "SCORIA" WALKS & STEPS	PLATE NO. 8 DRAWN BY PETERSON DATE 1-16-36 CHECKED BY PETERSON " 2-8-36 TRACED BY COUGHLAN " 1-24-36 APPROVED BY [illegible] " 2-17-36



PERSPECTIVE
FLAGSTONE WALK & STEPS



NOTE: Joints between stones should be kept as narrow as possible, ½" width being most desirable.

FIG 1
PLAN VIEW

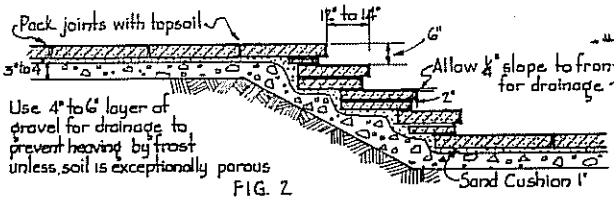


FIG. 2
LONGITUDINAL SECTION

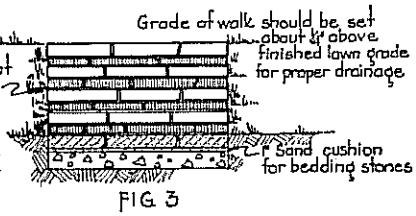
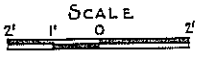


FIG. 3
FRONT ELEVATION OF STEPS

PERSPECTIVE OF STEPPING STONES



Note spacing of stones between centers. Where walks are to be used exclusively by men this distance may be increased to 2'-0".

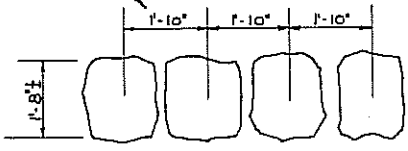


FIG. 4
PLAN VIEW

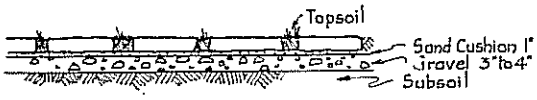


FIG 5
LONGITUDINAL SECTION

NOTE: Stones should not be less than 2½" in thickness or have a surface area of less than one square foot. Edges of walk should be build to a smooth, even line, avoiding segments on curves. Walks should not be laid on new fills until ground has been thoroughly settled naturally, or by compacting. Gravel base course should be thoroughly tamped before laying stone. Note proportion of tread and riser. These dimensions should be maintained for comfort and safety. Riser should rest on back portion of tread below. In long flights break the steps with 30" landings spaced at odd intervals of steps as 6-9-8, that is, alternating odd to even numbers. Excavate for entire width and length of stepping stone walk replacing topsoil between stones over base course.

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	STONE WALKS	PLATE NO. 8A DRAWN BY PETERSON DATE 1-22-36 CHECKED BY PETERSON " 2-8-36 TRACED BY COUNSMAN " 1-28-36 APPROVED BY [illegible] " 2-17-36

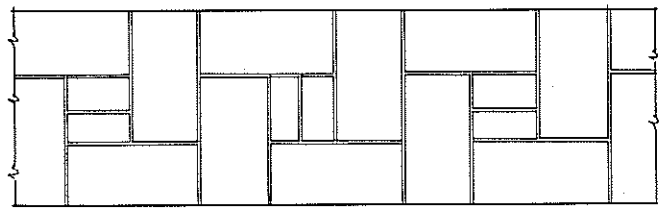


FIG. 1

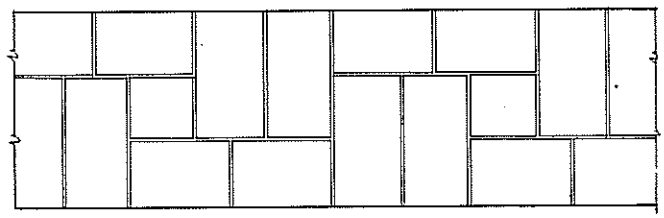


FIG. 2

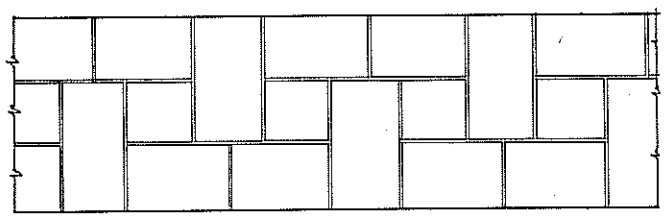


FIG. 3

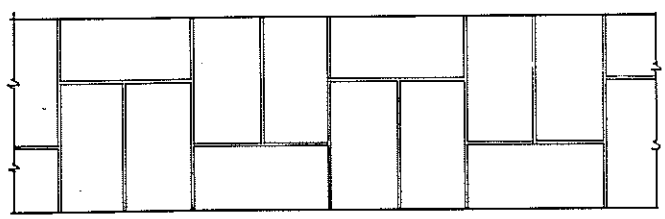
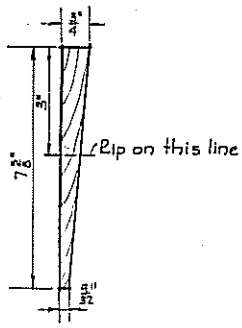
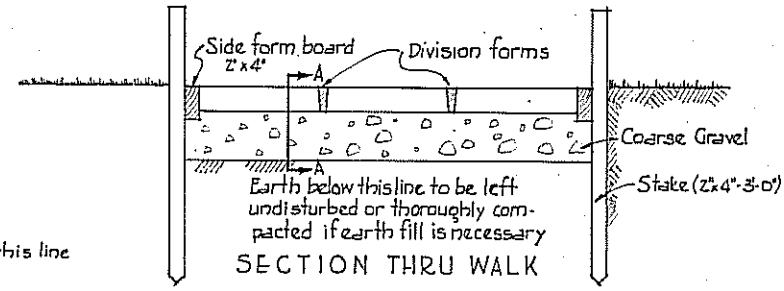


FIG. 4

DESIGN BY J.R.P. DRAWN BY H.W.C. APPROVED [signature] DATE 5/24/38 Division of Engineering APPROVED [signature] DATE 3/24/38 Acting Regional Forester	U. S. DEPARTMENT OF AGRICULTURE FOREST SERVICE DIVISION OF ENGINEERING REGION - ONE	CONCRETE FLAGSTONE WALK REPEAT DESIGNS 0 1' 2' 4' 6' PLATE 8B



DIVISION FORM BOARD



SECTION THRU WALK

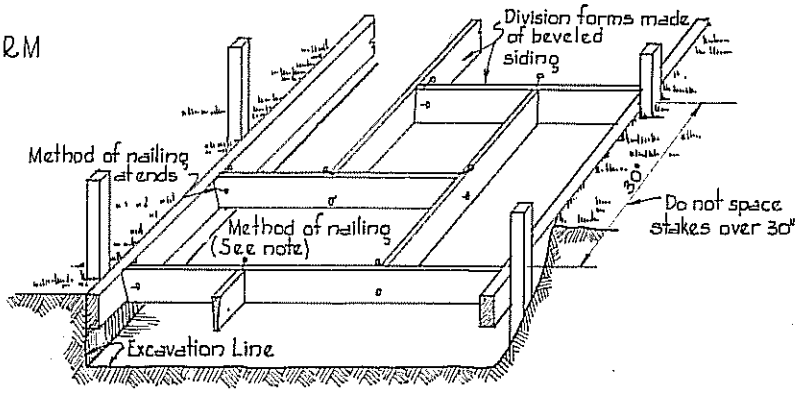
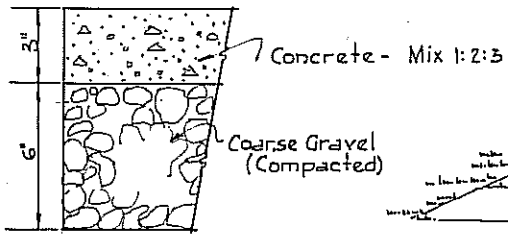


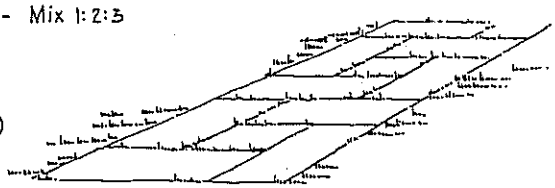
DIAGRAM SHOWING
METHOD OF SETTING FORMS

Gravel or cinders should be put in place and tamped before division forms are set. In setting division forms allow nails to protrude sufficiently so they may be withdrawn easily. When sufficient concrete has been poured to hold division forms in place lower nails should be removed. Oil forms thoroughly before pouring.
After removing forms pack openings with good top soil and seed.

SEE "CONCRETE - METHODS OF FINISHING"
FOR SURFACE TEXTURES



DETAIL "A-A"



SKETCH
OF COMPLETED WALK

DESIGN BY J.R.P. DRAWN BY H.N.C. APPROVED A.L.K.-C.H. DATE 3/4/38 Division of Engineering APPROVED F.E.T. DATE 3/24/38 Acting Regional Forester	U. S. DEPARTMENT OF AGRICULTURE FOREST SERVICE DIVISION OF ENGINEERING REGION - ONE	CONCRETE FLAGSTONE WALK FORM DETAILS 0 1' 2' 3' PLATE 8c

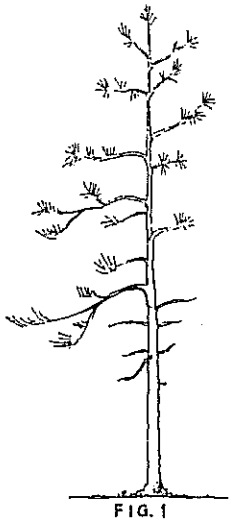


FIG. 1

EVERGREEN TREE GROWN IN A MASSED GROUP
Note undesirable texture & form. Such trees cannot be moved successfully due to extreme exposure change.

FIG. 2

EVERGREEN TREE GROWN IN AN OPEN, UNCROWDED SITE WITH FULL EXPOSURE TO SUN AND WIND. Note symmetrical shape and dense foliage. Most adaptable to moving.

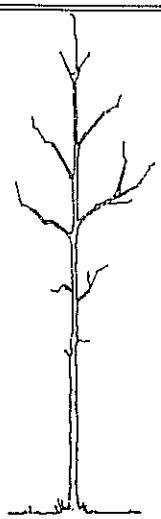


FIG. 3

DECIDUOUS TREE GROWN IN A MASSED GROUP. Note undesirable form and lack of lower branches. Trees of this type cannot be moved successfully due to exposure change.

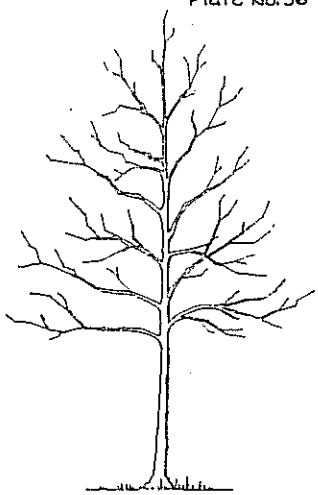


FIG. 4.

DECIDUOUS TREE GROWN IN AN OPEN UNCROWDED SITE. Note symmetrical development with lower branches intact. Ideally adapted to moving.

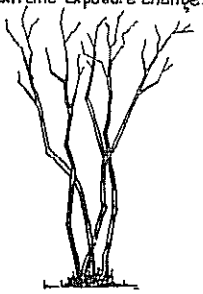


FIG. 5

DECIDUOUS SHRUB GROWN IN MASSED GROUP UNDESIRABLE FORM, DIFFICULT TO TRANSPLANT.

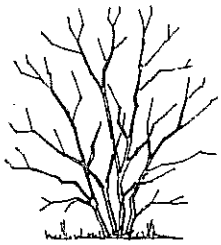


FIG. 6

DECIDUOUS SHRUB GROWN AS AN INDIVIDUAL PLANT. GOOD FORM AND ADAPTABLE TO MOVING.

Note: Recommended sizes for transplanting vary with species-See Text

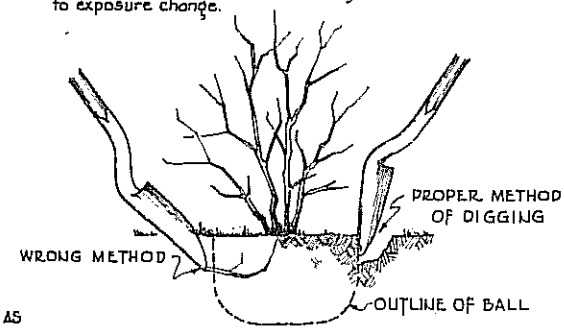


FIG. 7

DIGGING PLANTS WITH BALL OF EARTH
Note use of back side of shovel to cut earth from around ball before removing, leaving ball intact. Method at left breaks up soil in ball.

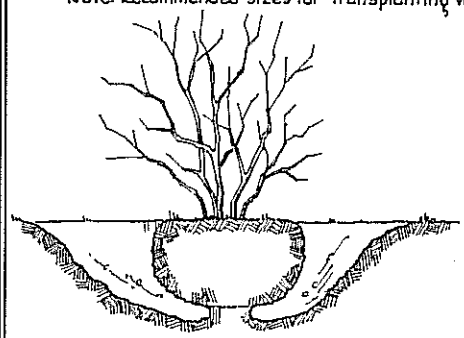


FIG. 8

PLANT DUG READY TO BE BURLAPPED. BREAK LOOSE AFTER WRAPPING.

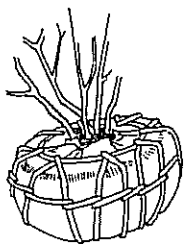


FIG. 9

SKETCH SHOWING A SATISFACTORY METHOD OF WRAPPING AND TYING. BALL. HANDLE BY BALL ONLY.

Note: Do not allow ball to be exposed to air longer than necessary or freeze harder than required for careful handling.

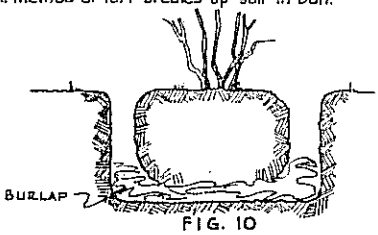
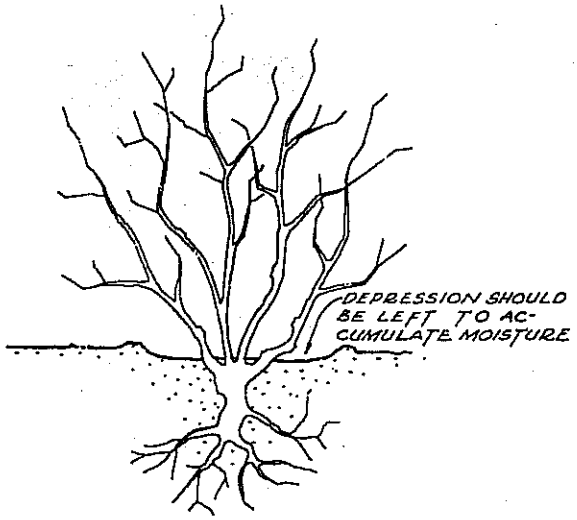


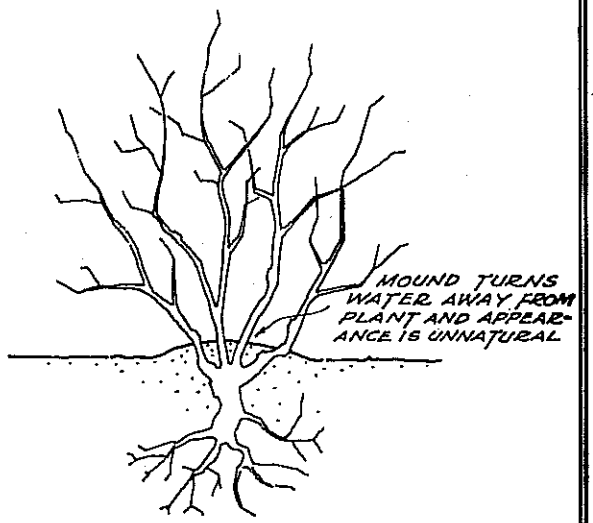
FIG. 10

PLANT IN NEW HOLE READY FOR BACKFILL. Do not remove burlap until plant is set, then cut away upper portion and press balance in bottom of hole. TAMP BACKFILL THOROUGHLY. If ball is broken or loose do not remove burlap from sides but backfill against it, then cut away the portion above ground.

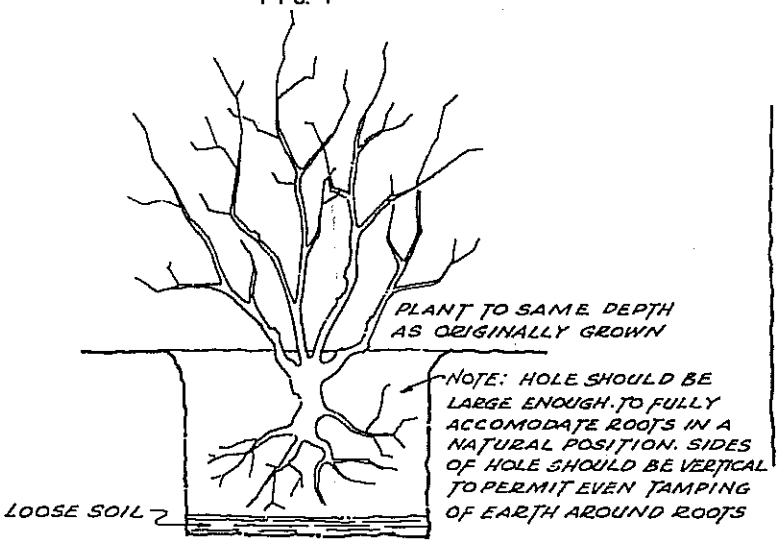
U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	TRANSPLANTING NATIVE TREES AND SHRUBS	PLATE NO. 9 DRAWN BY PETERSON DATE 1-13-36 CHECKED BY PETERSON " 2-8-36 TRACED BY COUGHLAN " 1-17-36 APPROVED BY [illegible] " 2-19-36



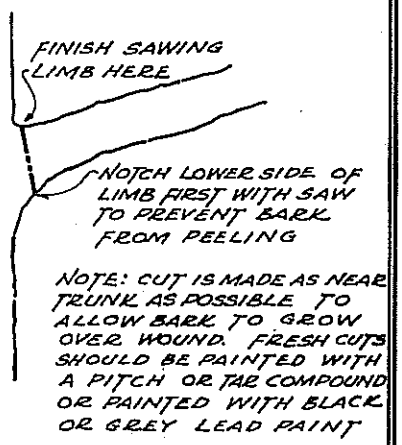
PROPER SHAPING OF SOIL ABOUT PLANT BASE
FIG. 1



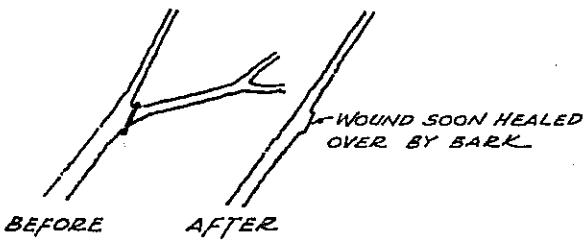
IMPROPER SHAPING OF SOIL ABOUT PLANT BASE
FIG. 2



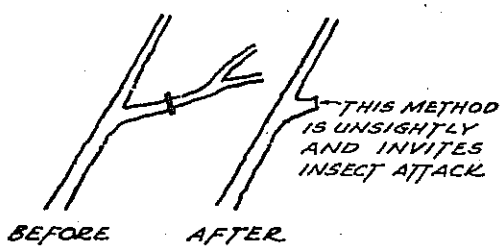
PROPER PLANTING METHOD
FIG. 3



PRUNING OF LARGE LIMBS FROM TREES
FIG. 4

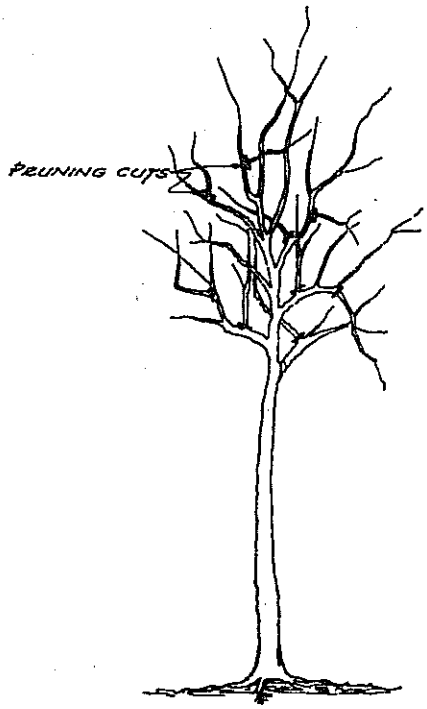


PROPER WAY TO REMOVE BRANCHES FROM SHRUBS
FIG. 5



WRONG WAY TO REMOVE BRANCHES
FIG. 6

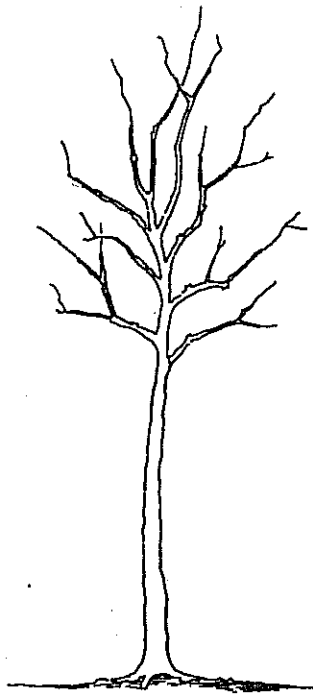
U.S. DEPT. OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	PLANTING DETAILS **PLANTING & PRUNING**	PLATE NO. 10. DRAWN BY COUGHLAN DATE 11-25-35 CHECKED BY PETERSON " 1-3-36 TRACED BY COUGHLAN " 11-25-35 APPROVED BY [illegible]



TRANSPLANTED TREE BEFORE PRUNING

HEAVY LINES DENOTE PRUNING CUTS

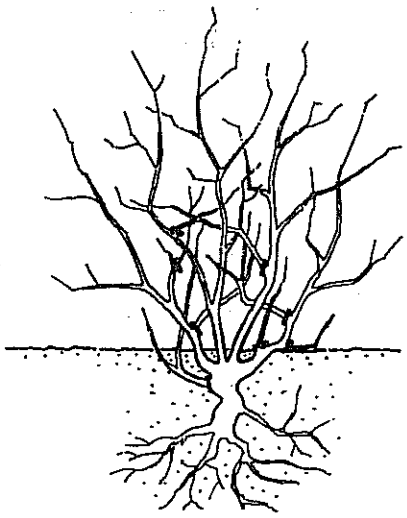
FIG. 1



SAME TREE AFTER PRUNING

SHOWING PROPER METHOD OF BALANCING HEAD TO ROOTS WHICH HAVE BEEN LOST OR DISTURBED IN MOVING. NOTE ORIGINAL OUTLINE HAS BEEN RETAINED.

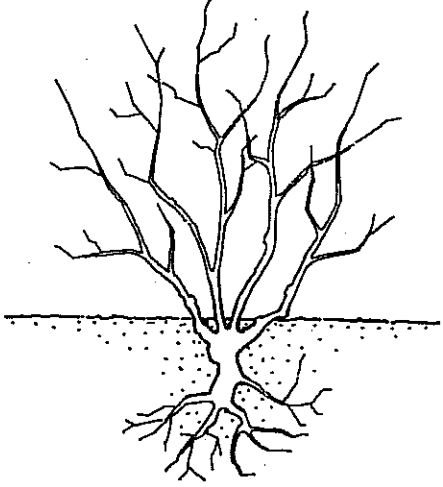
FIG. 2



TRANSPLANTED SHRUB BEFORE PRUNING

HEAVY LINES DENOTE PRUNING CUTS

FIG. 3



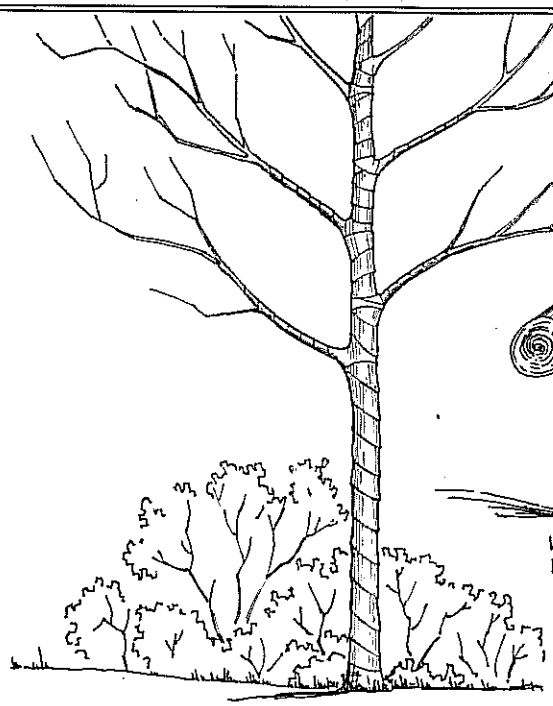
SAME SHRUB AFTER PRUNING

SHOWING PROPER METHOD OF BALANCING HEAD TO ROOTS WHICH HAVE BEEN LOST OR DISTURBED IN MOVING. ONLY STRONG SHOOTS HAVE BEEN RETAINED.

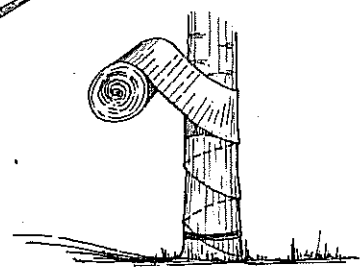
FIG. 4

U.S. DEPT. OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	CONSTRUCTION DETAILS **PRUNING OF TREE & SHRUBS**	PLATE NO. 11 DRAWN BY PETERSON DATE 11-26-35 CHECKED BY PETERSON " 1-3-36 TRACED BY COUGHLAN " 11-26-35 APPROVED BY [illegible]

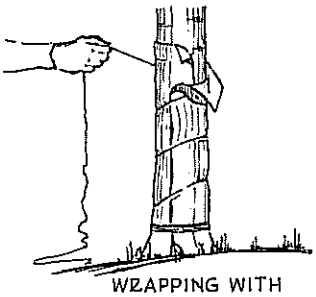
Plate 58A



SKETCH OF PROPERLY WRAPPED TREE

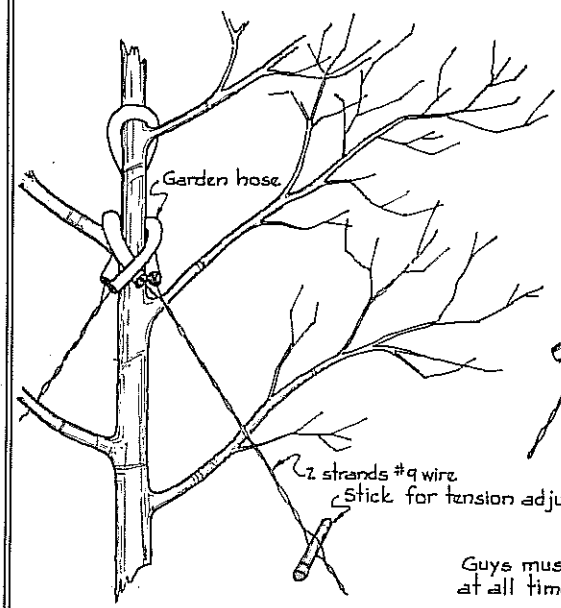


WRAPPING WITH BURLAP STRIPS



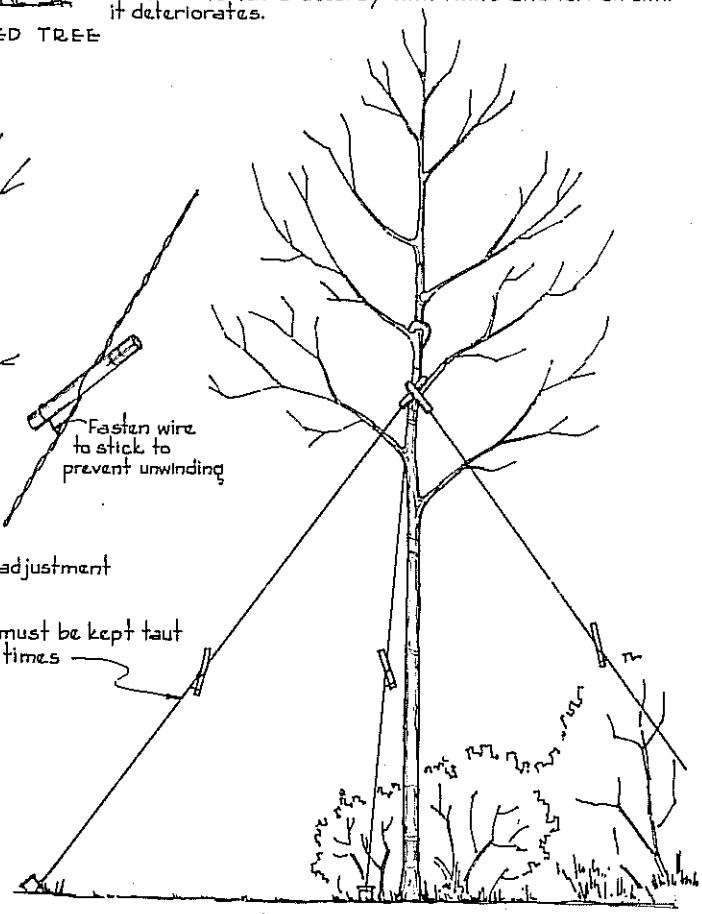
WRAPPING WITH BURLAP SACKS

The trunk and main limbs of all deciduous trees, over 4" in diameter should be wrapped with burlap after transplanting to protect tree from wind and sun scald, as the different exposure in the new location is often injurious. The burlap should be fastened securely with twine and left on until it deteriorates.



DETAIL SHOWING WIRES ATTACHED

Attach wire to tree approximately ⅔ of its height from the ground and protect tree from wire with piece of garden hose. Fasten wire to stake driven at a distance from tree so that the angle between wire and tree will not be less than 30°.
Stakes to be 2x4 or 3" round 30" long. Guy wires to be #9 gauge galvanized wire, doubled.
All trees over 5 feet in height should be staked and guyed 3 ways after planting to steady tree until roots are established.



SKETCH OF PROPERLY GUYED TREE

U. S. DEPT. OF AGRICULTURE FOREST SERVICE REGION ONE LANDSCAPE PLANNING	PLANTING DETAILS **GUYING AND WRAPPING**	PLATE 11A DRAWN BY C.M.B DATE 3-20-37 CHECKED BY J.E.P " 3-30-37 TRACED BY H.W.C. " 4-2-37 APPROVED BY [illegible]

Plate No. 59 A.

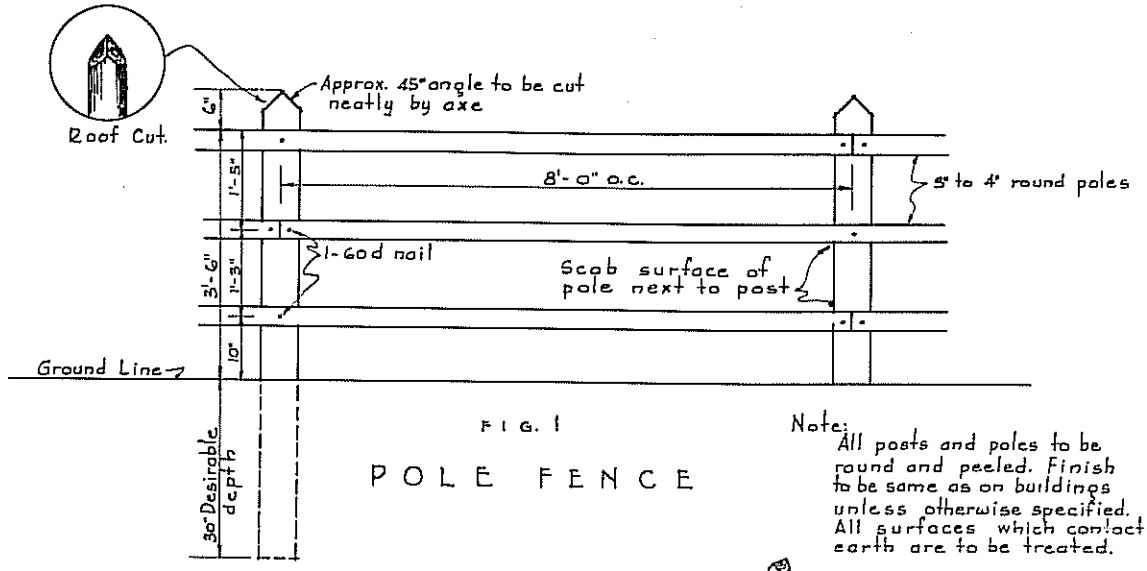
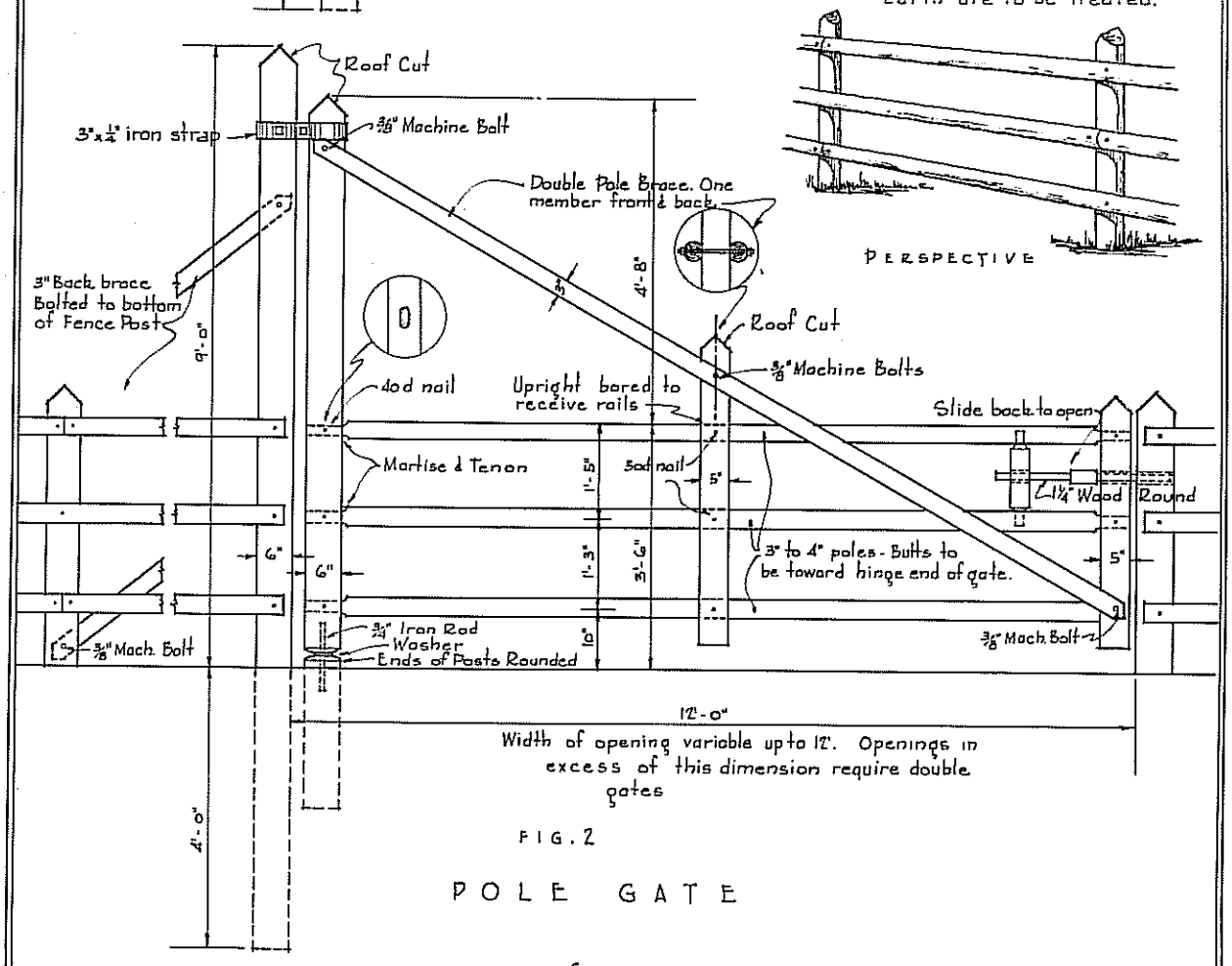


FIG. 1

POLE FENCE

Note: All posts and poles to be round and peeled. Finish to be same as on buildings unless otherwise specified. All surfaces which contact earth are to be treated.



PERSPECTIVE

FIG. 2

POLE GATE

SCALE 1" 0 1" 2"

Revised 4-27-37

U. S. DEPT. OF AGRICULTURE FOREST SERVICE REGION No. 1 LANDSCAPE PLANNING	FENCES & GATES FOR STATION GROUNDS	PLATE NO. 12 A DRAWN BY PETERSON DATE 12-16-35 CHECKED BY PETERSON " 1-3-36 TRACED BY COUNLAN " 12-18-35 APPROVED BY [illegible]

Plate No. 59 A.

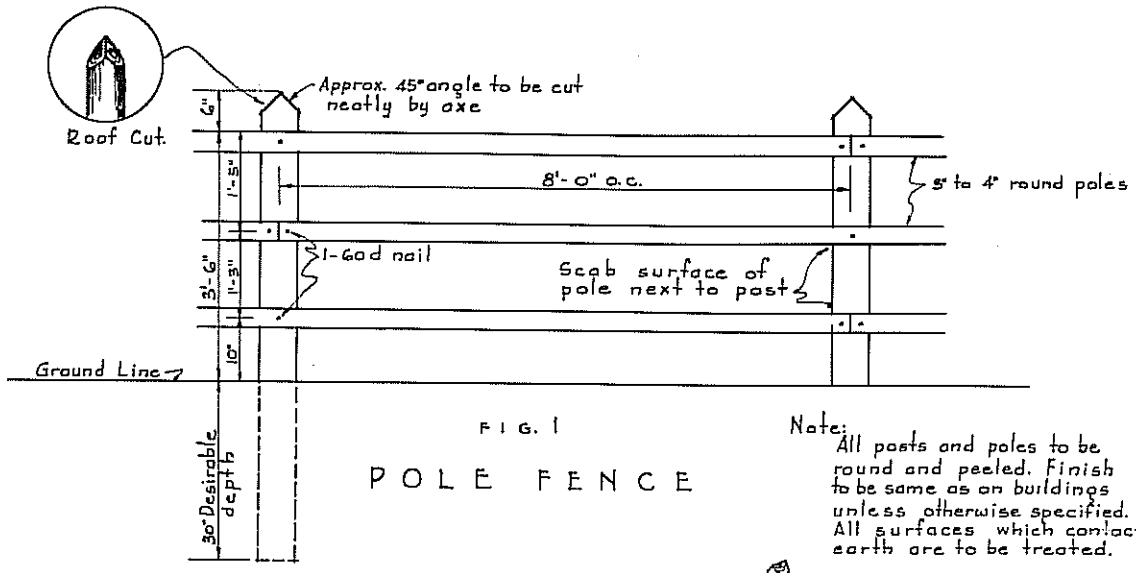
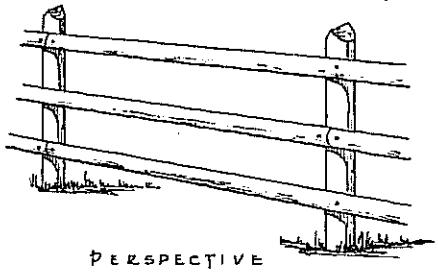


FIG. 1

POLE FENCE

Note: All posts and poles to be round and peeled. Finish to be same as on buildings unless otherwise specified. All surfaces which contact earth are to be treated.



PERSPECTIVE

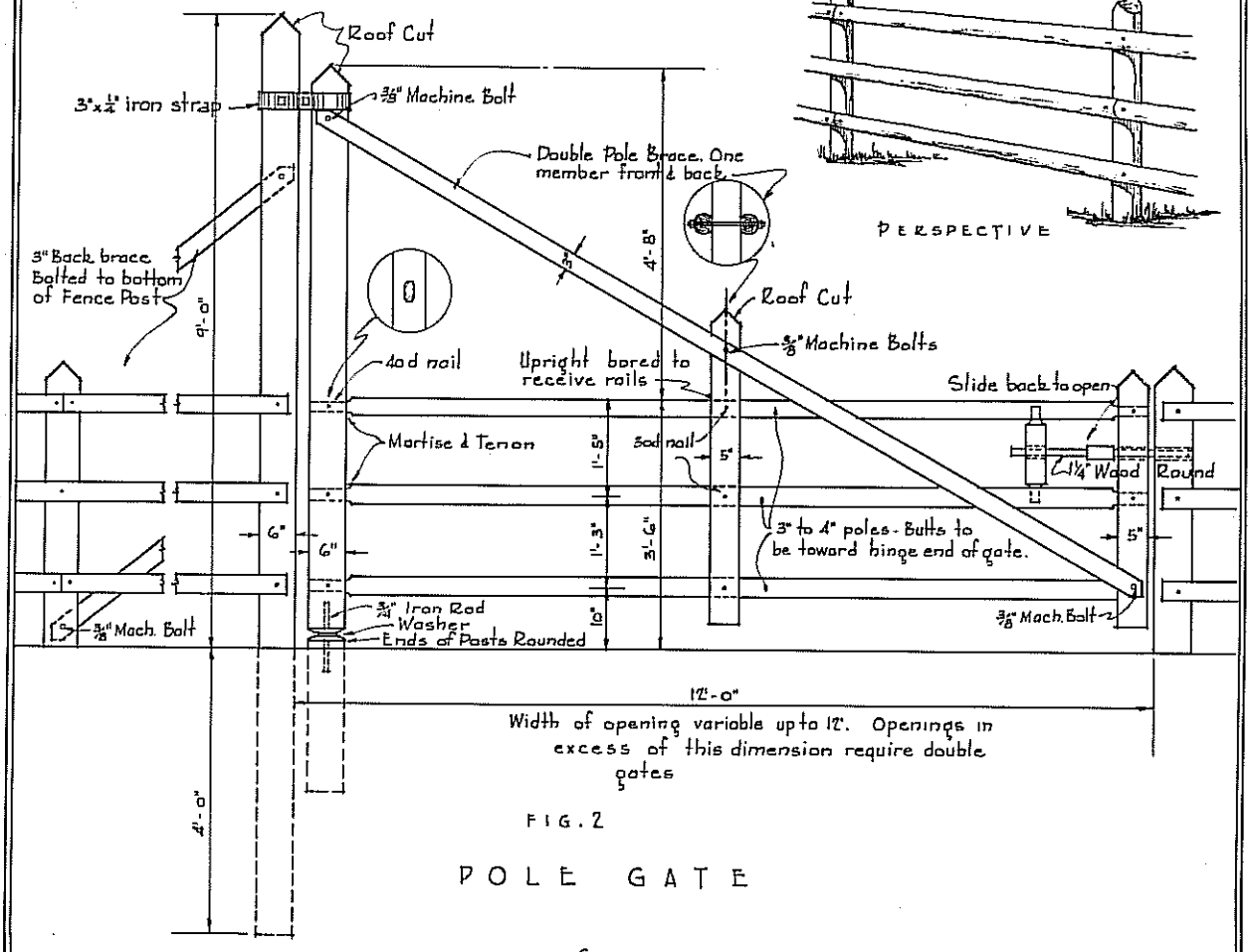


FIG. 2

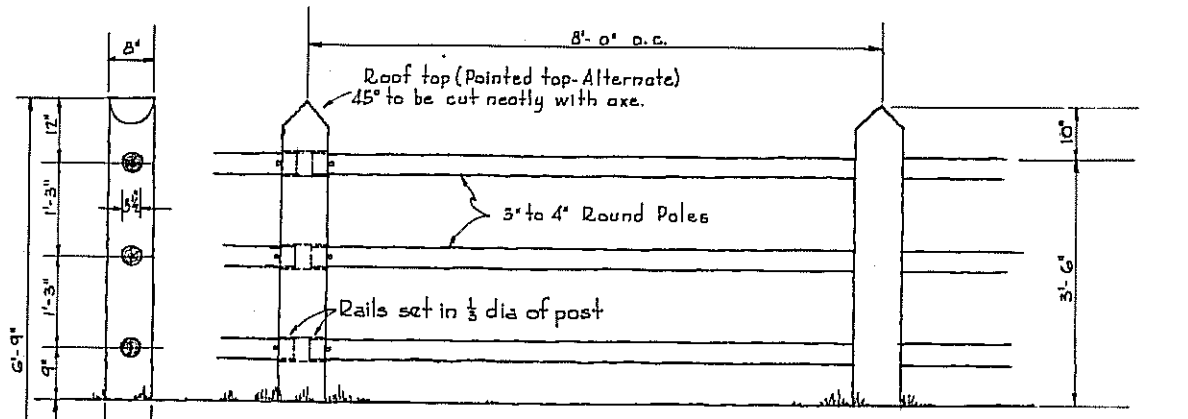
POLE GATE

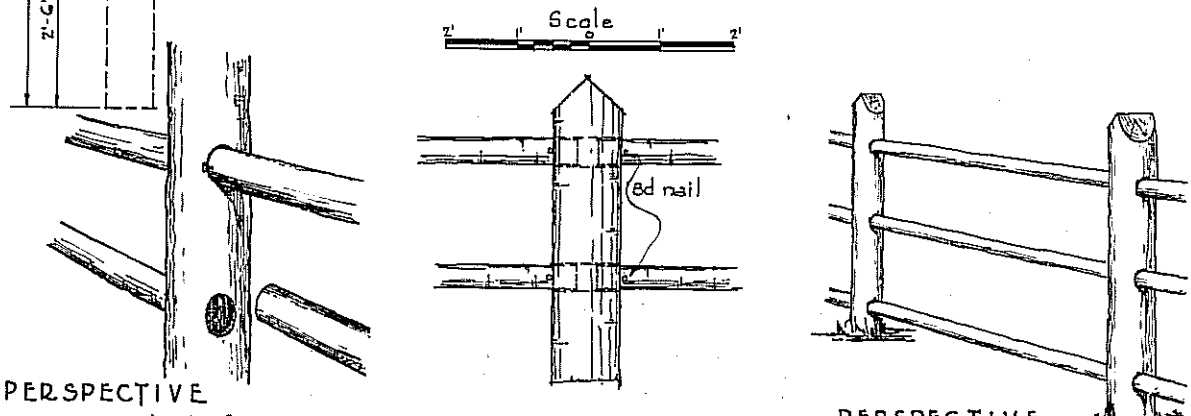
SCALE 1' 0 1' 2'

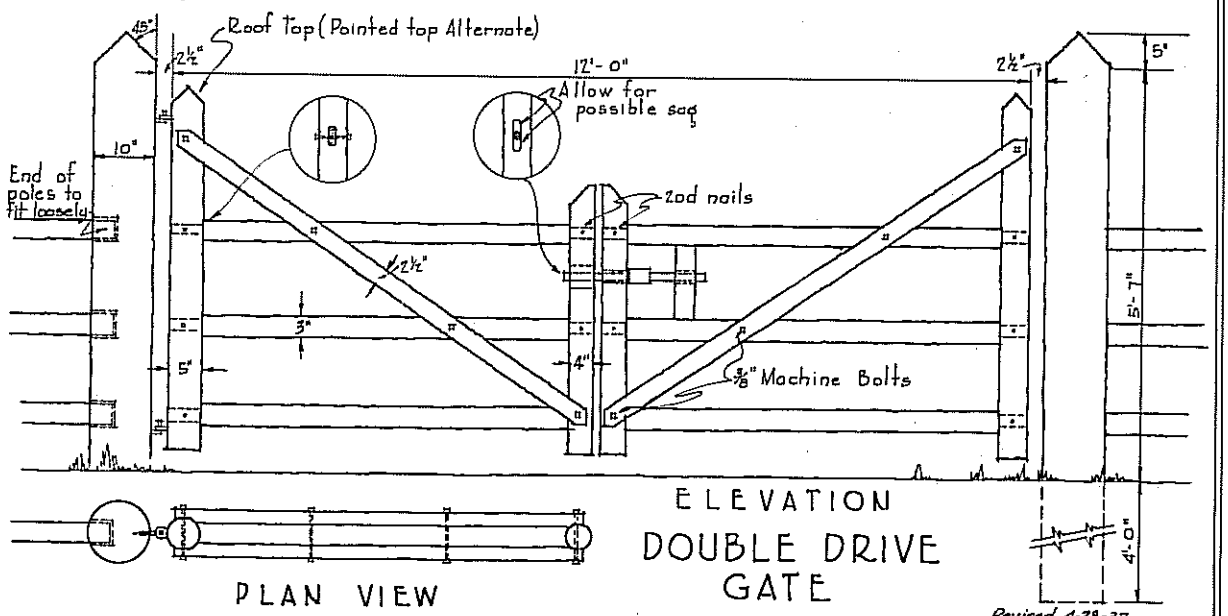
Revised 4-27-37

U.S. DEPT. OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	FENCES & GATES FOR STATION GROUNDS	PLATE NO. 12 A DRAWN BY Peterson DATE 12-16-35 CHECKED BY Peterson " 1-3-36 TRACED BY Coughlan " 12-18-35 APPROVED BY [illegible]

Plate No. 59B

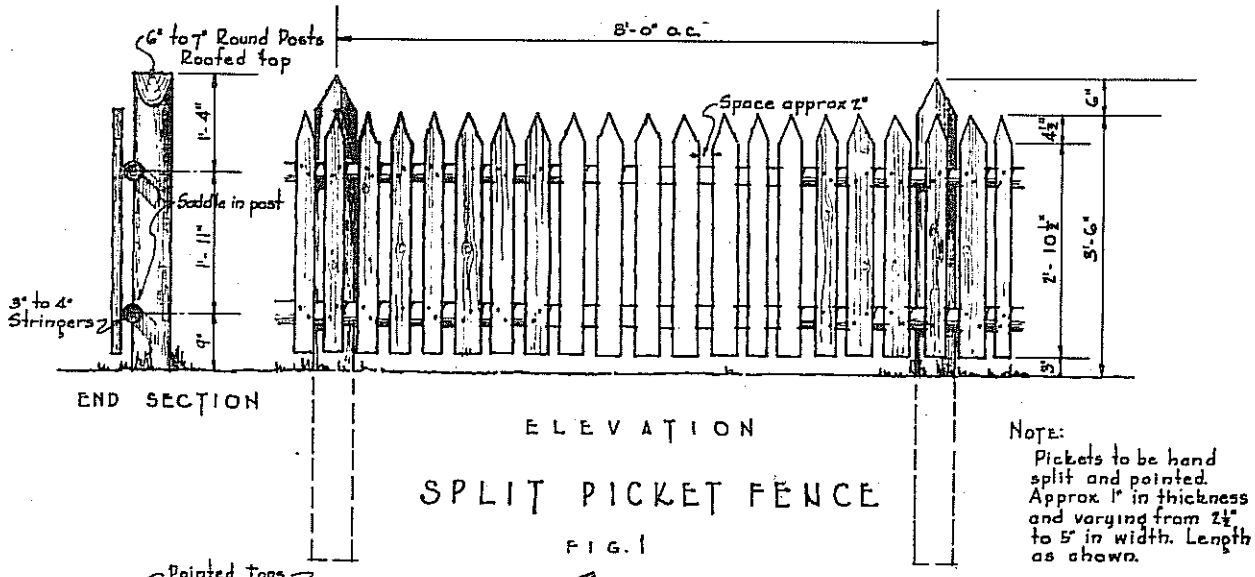






Revised 4-28-37

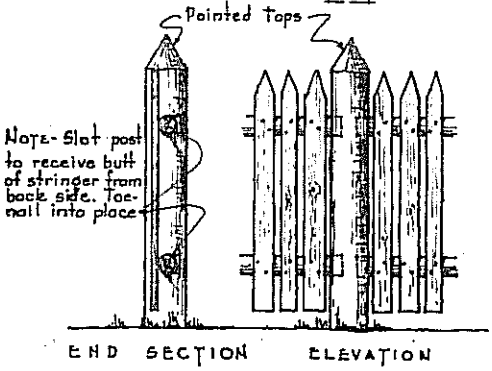
U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	FENCES & GATES FOR STATION GROUNDS	PLATE NO. 12 B DRAWN BY Peterson DATE 1-6-36 CHECKED BY Peterson " 2-13-36 TRACED BY Coughran " 1-11-36 APPROVED BY [illegible] " 2-17-36



SPLIT PICKET FENCE

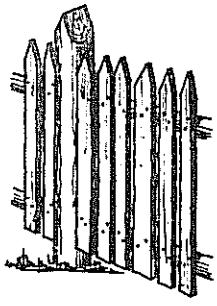
FIG. 1

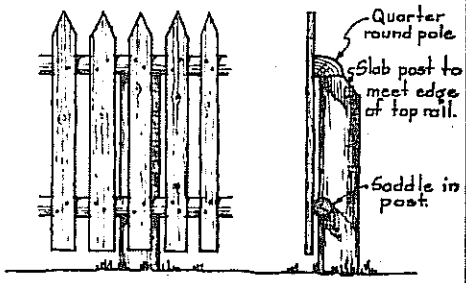
NOTE:
Pickets to be hand split and pointed. Approx 1" in thickness and varying from 2½" to 5" in width. Length as shown.



OPTIONAL DETAIL

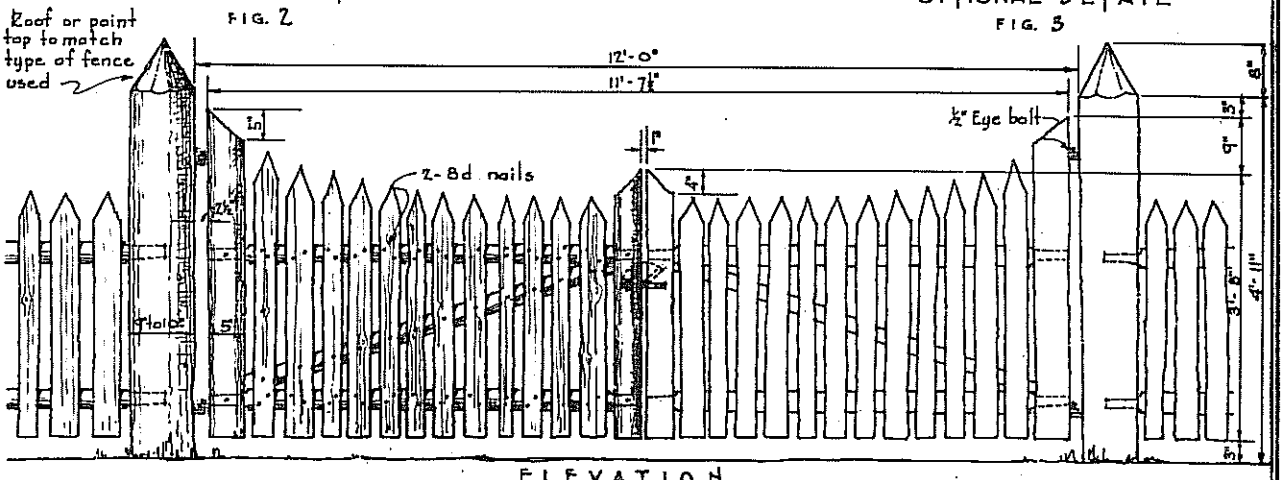
FIG. 2





OPTIONAL DETAIL

FIG. 3



SPLIT PICKET DRIVE GATE

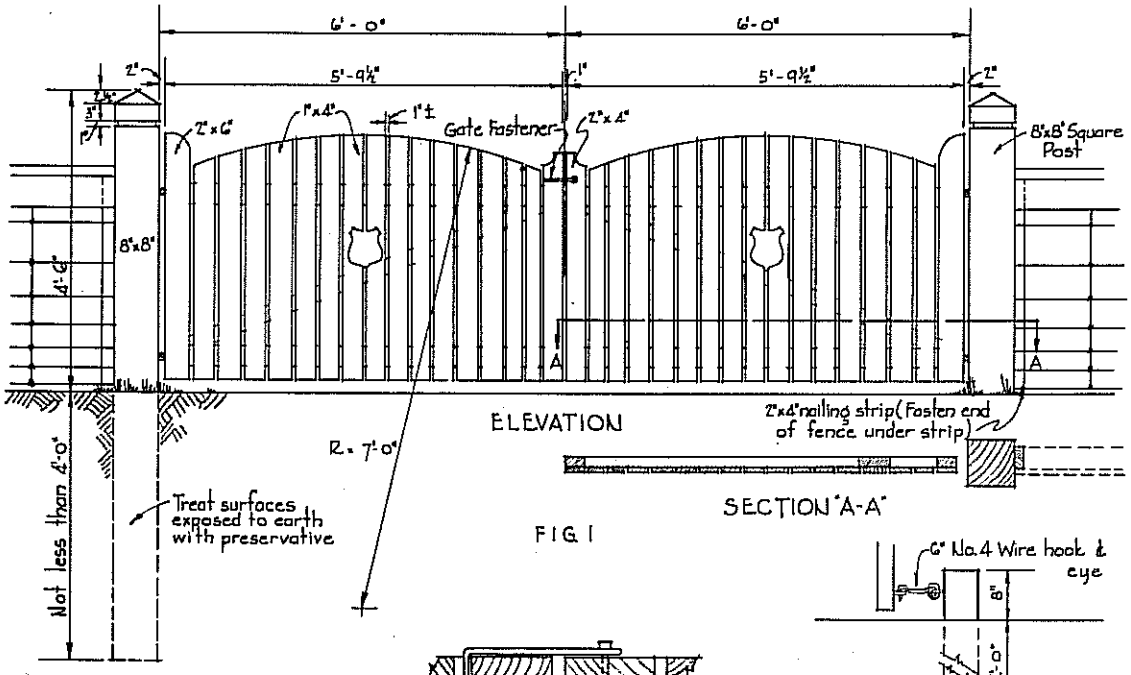
SCALE

U. S. DEPT. OF AGRICULTURE
FOREST SERVICE
REGION No. 1
LANDSCAPE PLANNING

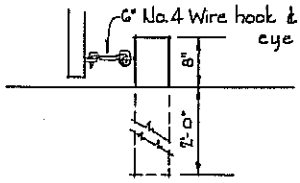
FENCES & GATES FOR STATION GROUNDS

PLATE NO. 12C
DRAWN BY Peterson DATE 12-20-35
CHECKED BY Peterson " 1-3-36
TRACED BY Counihan " 12-20-35
APPROVED BY [illegible]

Plate No. 59 D



PLAN VIEW
DETAIL OF GATE FASTENER



GATE STOP

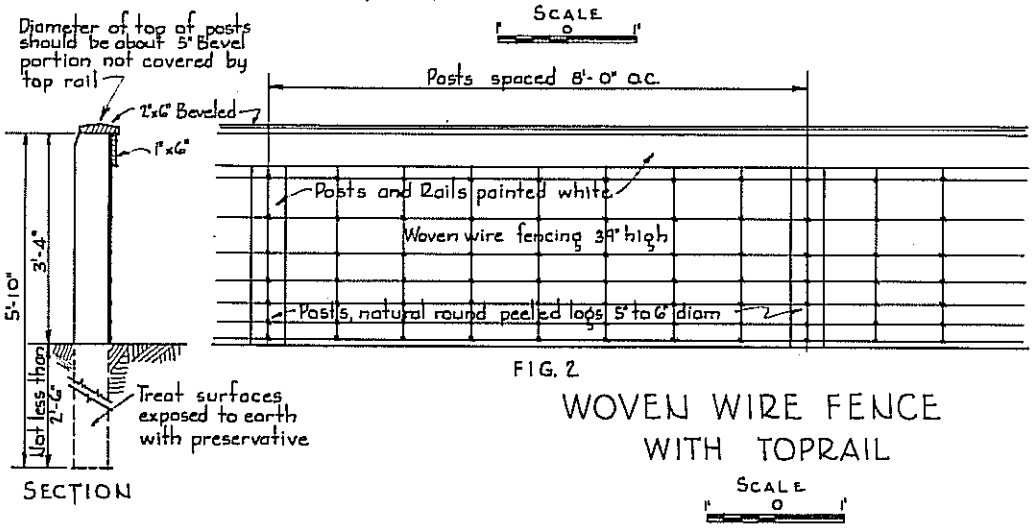
When open, gates should stand parallel to edges of drive and held in position by post with hook as shown

FINISH - 3 Coats White Paint

PICKET ENTRANCE GATE

TO BE USED WITH WOVEN WIRE FENCE

SCALE 1' 0 1'

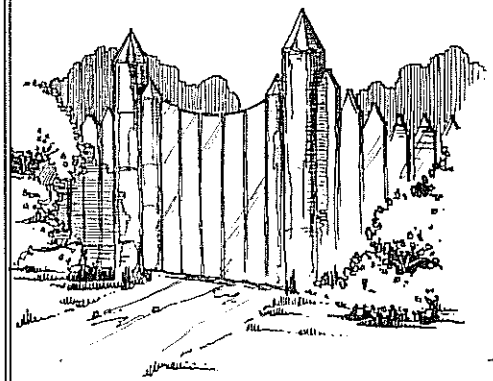


WOVEN WIRE FENCE WITH TOPRAIL

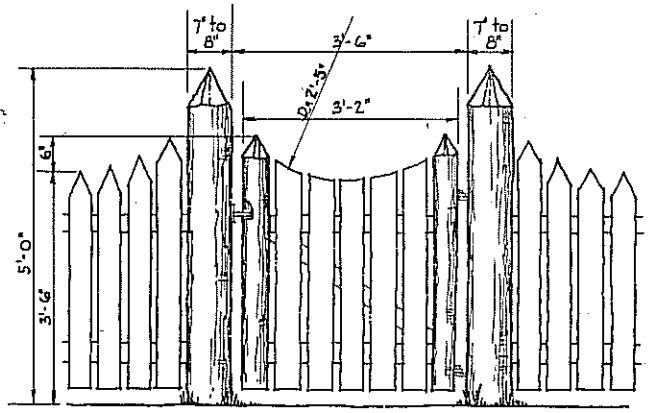
SCALE 1' 0 1'

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	GATES & FENCES FOR STATION GROUNDS	PLATE NO. 12 D DRAWN BY Peterson DATE 2-7-36 CHECKED BY Peterson " 2-15-36 TRACED BY Cousins " 2-15-36 APPROVED BY [illegible] " 2-19-36

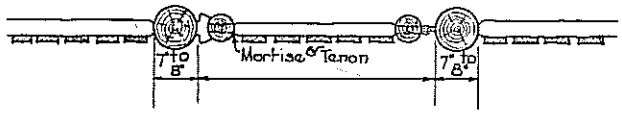
Plate No. 59E



·SKETCH·



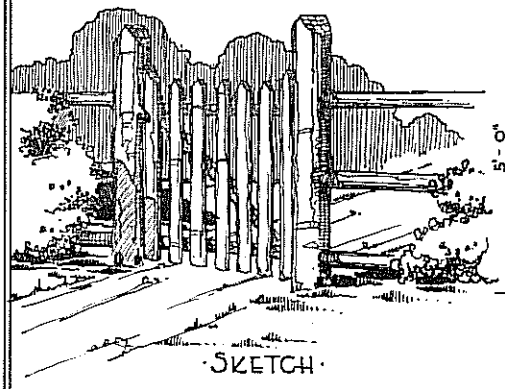
ELEVATION



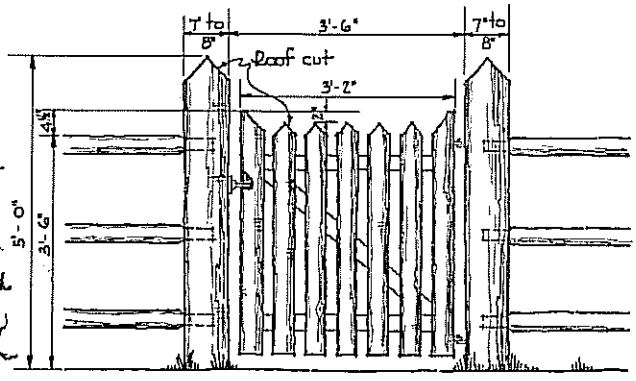
PLAN SECTION

SCALE 1' 0' 1'

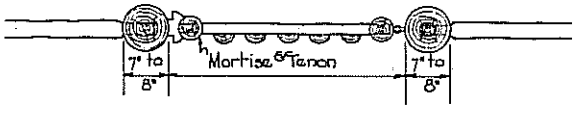
SPLIT OR SAWED PICKET WALK GATE



·SKETCH·



ELEVATION



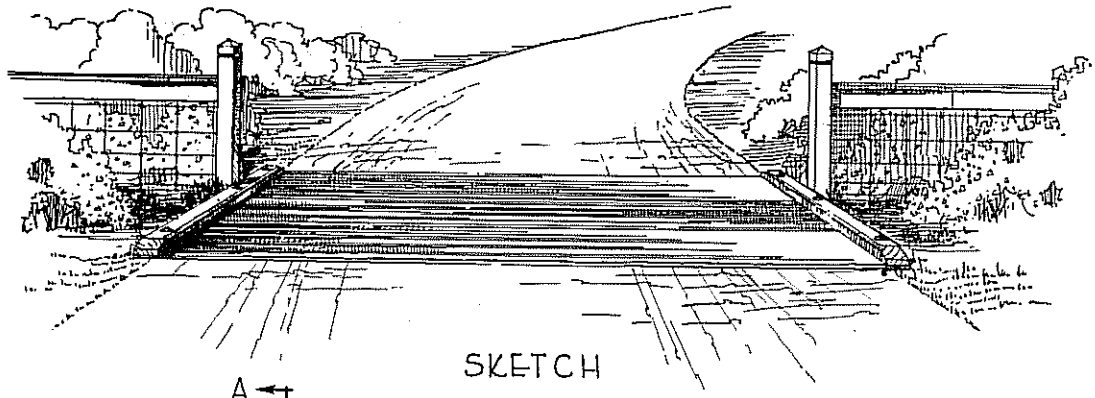
PLAN SECTION

SCALE 1' 0' 1'

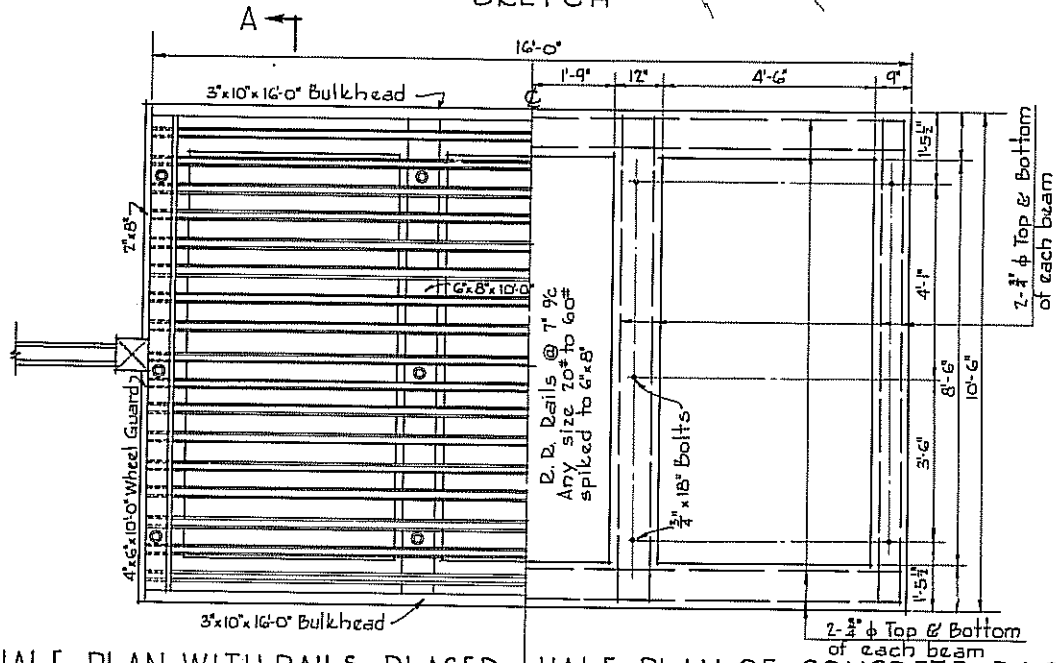
SPLIT POLE WALK GATE

Note: For latch & hinge details, see Plate No. 12E

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	WALK GATES	PLATE NO. 12E DRAWN BY Peterson DATE 2-7-36 CHECKED BY Peterson " 2-15-36 TRACED BY Coughran " 2-14-36 APPROVED BY [illegible] " 2-19-36



SKETCH



HALF PLAN WITH RAILS PLACED | HALF PLAN OF CONCRETE BASE

BILL OF MATERIAL

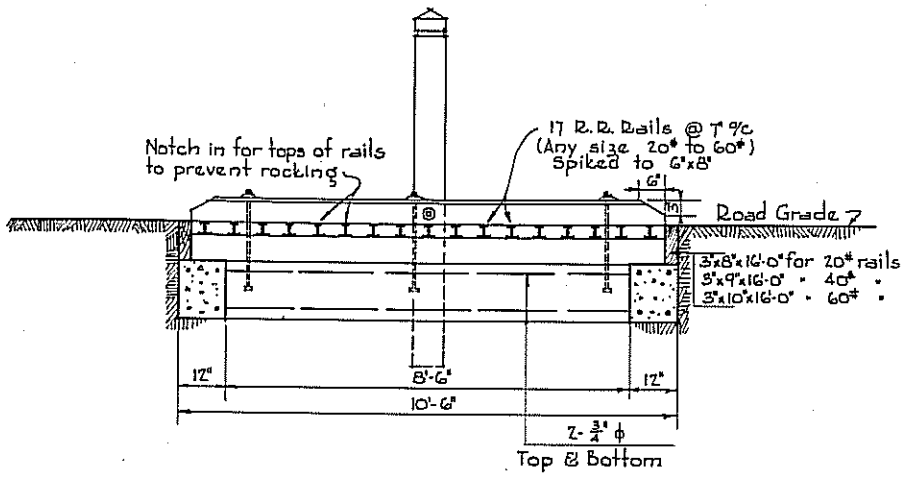
Concrete Mix 1:2:4

15 Sacks of cement
1.1 Cu. Yds. sand
2.2 " " gravel
17 R. R. Rails 16'-0" long
136 R. R. Spikes
8 - 3/4" ϕ Reinforcing bars 15'-9" long
16 - " " " " 10'-3" "
6 - 3/4" x 18" Machine Bolts
6 - 3/4" x 24" " "
2 - 3/4" x 16" " "

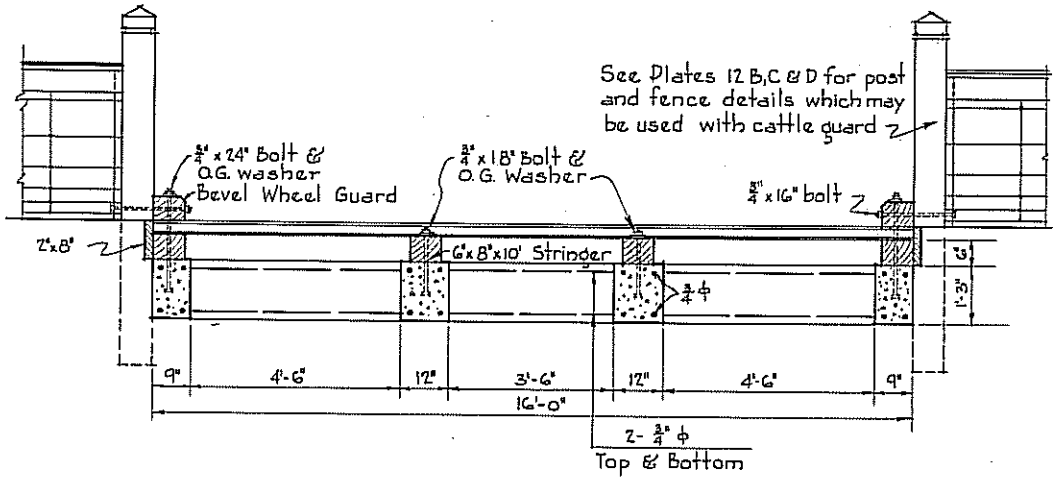
16 - O.G. Washers for 3/4" bolts
4 - 6"x8"x10' Rough (Stringers)
2 - 3"x - x16' " (Bulkheads See note)
2 - 4"x6"x10' S4S (Wheel Guards)
2 - 2"x8"x10' Rough (Bulkhead)

Note:
For 20# Rails use 4" x 1/2" R.R. Spikes
" 40# " " 4 1/2" x 1/2" " " "
" 60# " " 5" x 1/2" " " "

U. S. DEPT. OF AGRICULTURE FOREST SERVICE REGION ONE LANDSCAPE PLANNING	CATTLE GUARD FOR STATION GROUNDS	PLATE 12-F Sheet 1 DRAWN BY R.T.G. DATE 11-19-36 CHECKED BY C.M.B. " 4-24-37 TRACED BY H.W.C. " 4-15-37 APPROVED BY



SECTION A-A



ROADWAY SECTION

SCALE

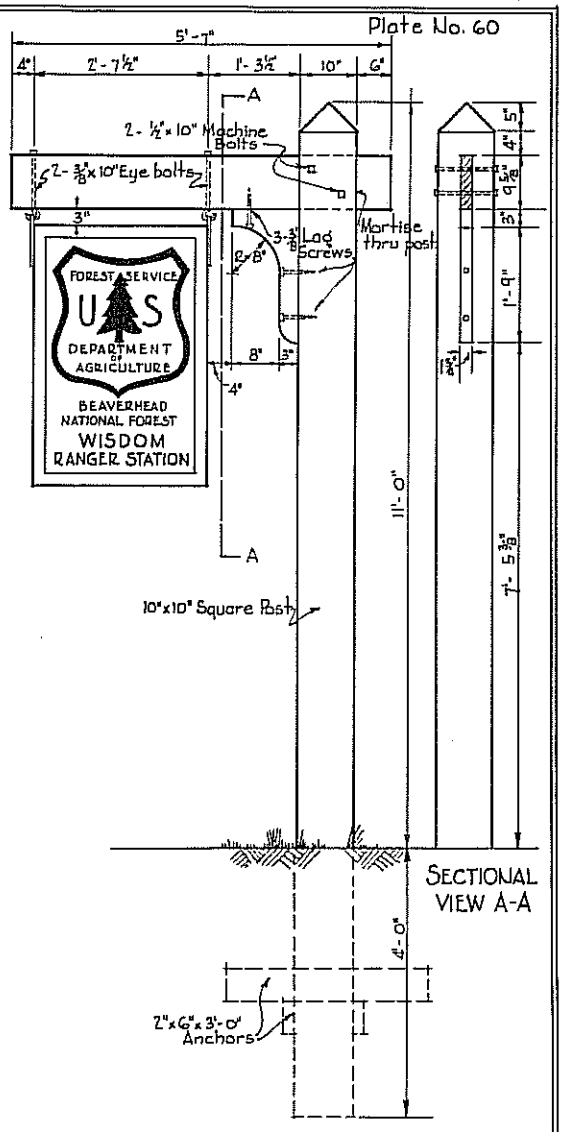
0 1' 2' 3' 4'

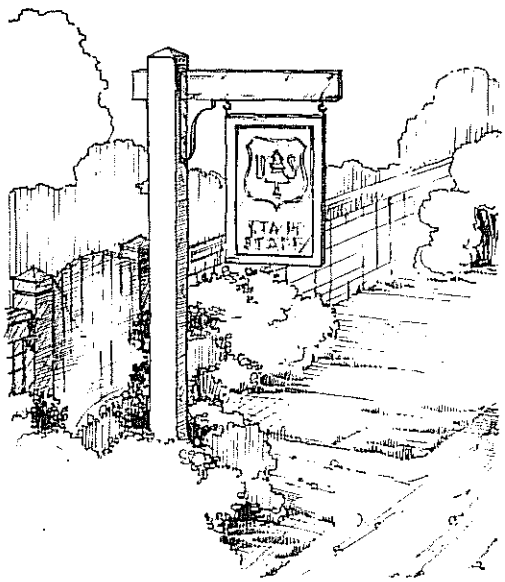
U. S. DEPT. OF AGRICULTURE FOREST SERVICE REGION ONE LANDSCAPE PLANNING	CATTLE GUARD FOR STATION GROUNDS	PLATE 12-G Sheet 2 DRAWN BY R.T.C. DATE 11-19-36 CHECKED BY C.M.B. " 4-24-37 TRACED BY H.W.B. " 4-16-37 APPROVED BY

Plate No. 60

Height of sign is variable, depending on ground elevation in respect to road. Height shown is for fairly level site. Raise if ground level is below road, lower if above, so that relation of height of sign to road is constant.

Portion of support above ground to be painted white. Portion in contact with earth to be treated with preservative.





SKETCH OF SIGN SUPPORT IN KEEPING WITH SETTING

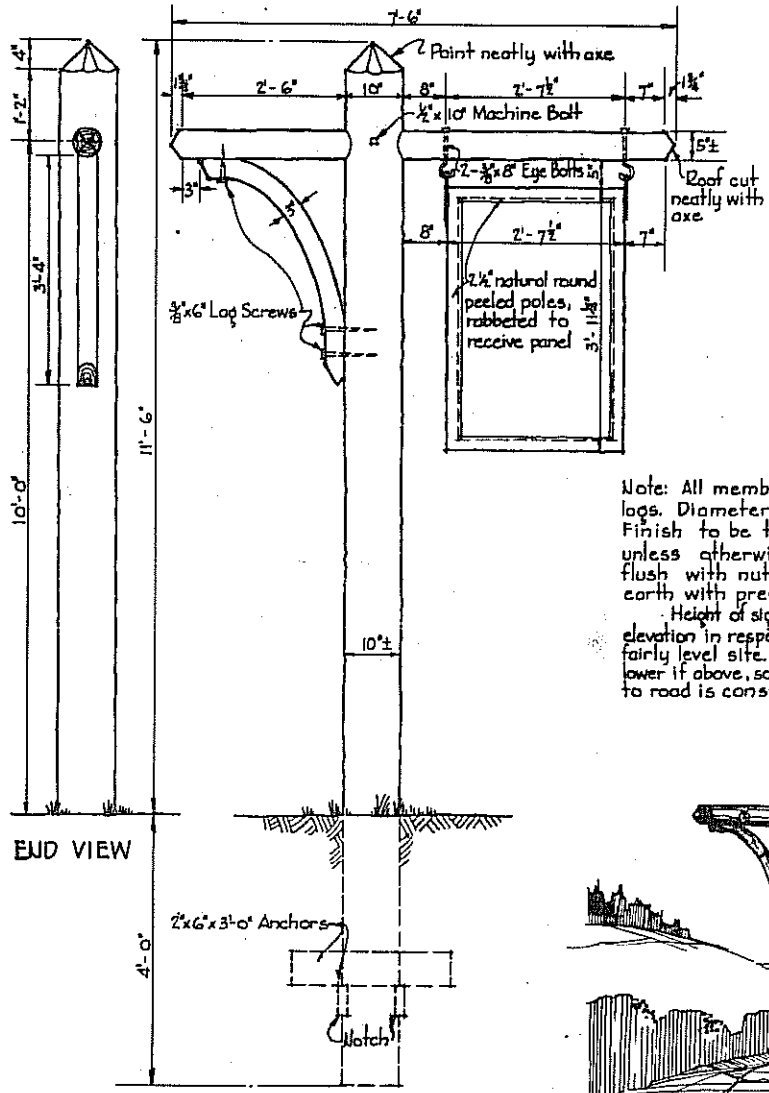
SIGN SUPPORT

SCALE 2' 1' 0 1'

TO BE USED WITH THOSE STATIONS HAVING WHITE EXTERIOR FINISH

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION No. 1 LANDSCAPE PLANNING	SIGN SUPPORTS FOR RANGER STATIONS	PLATE NO. 13 DRAWN BY Peterson DATE 1-24-36 CHECKED BY Peterson " 2-13-36 TRACED BY Coughlin " 2-6-36 APPROVED BY [illegible] " 2-19-36

Plate No. 60A



END VIEW

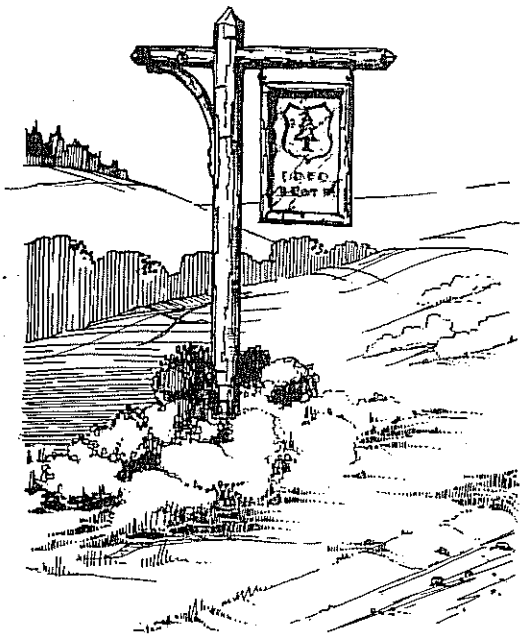
Note: All members are to be of natural peeled logs. Diameters indicated are approximate. Finish to be the same as that on buildings unless otherwise specified. Cut bolt ends flush with nuts. Treat portions exposed to earth with preservative.

Height of sign is variable, depending on ground elevation in respect to road. Height shown is for fairly level site. Raise if ground level is below road, lower if above, so that relation of height of sign to road is constant.

SIGN SUPPORT

SCALE

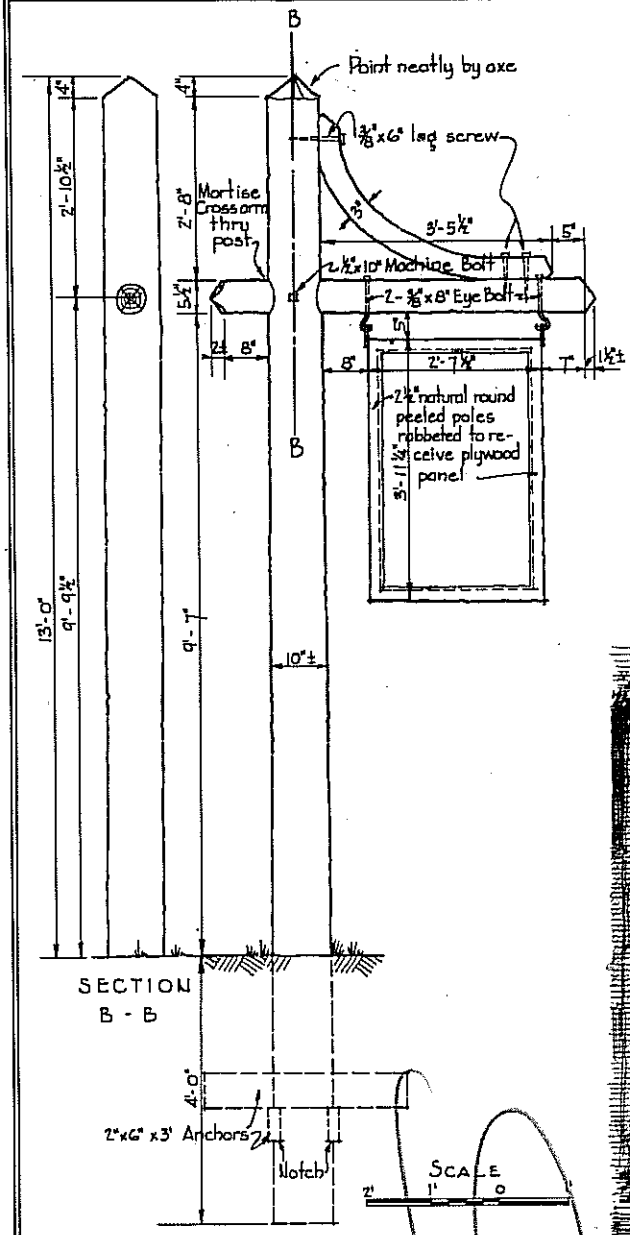
TO BE USED WITH THOSE STATIONS HAVING STAINED OR OILED EXTERIOR FINISH WHERE SITE IS OPEN AND HORIZONTAL LINES PREDOMINATE



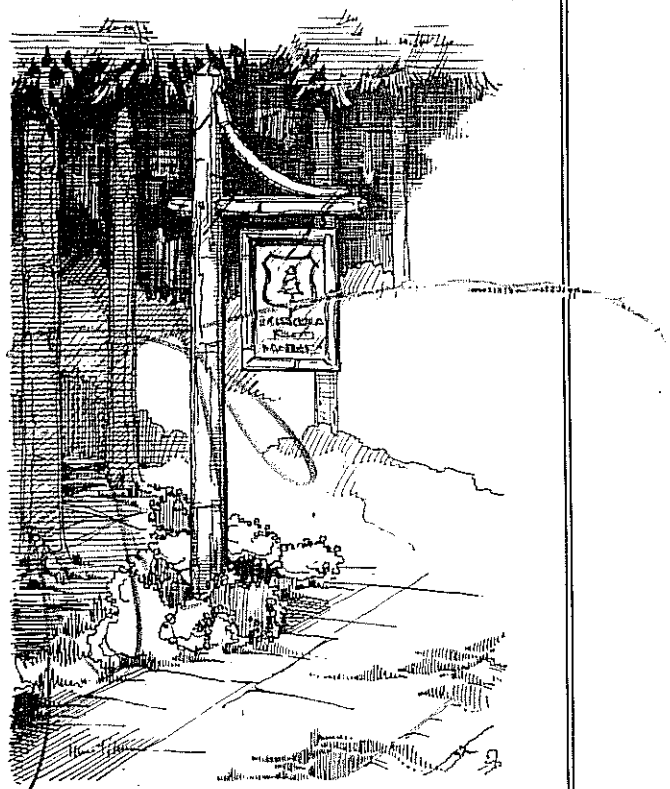
SKETCH OF SIGN SUPPORT IN KEEPING WITH SETTING

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION No 1 LANDSCAPE PLANNING	SIGN SUPPORTS FOR RANGER STATIONS	PLATE NO. 13A DRAWN BY PETERSON DATE 1-24-36 CHECKED BY PETERSON " 2-13-36 TRACED BY COUGHLAN " 2-6-36 APPROVED BY " 2-19-36

Plate No. 60 B



Note: All members are to be of natural peeled logs. Diameters indicated are approximate. Finish to be the same as that on buildings unless otherwise specified. Cut bolt ends flush with nuts. Treat portions exposed to earth with preservative.



SKETCH OF SIGN SUPPORT IN KEEPING WITH SETTING

SIGN SUPPORT

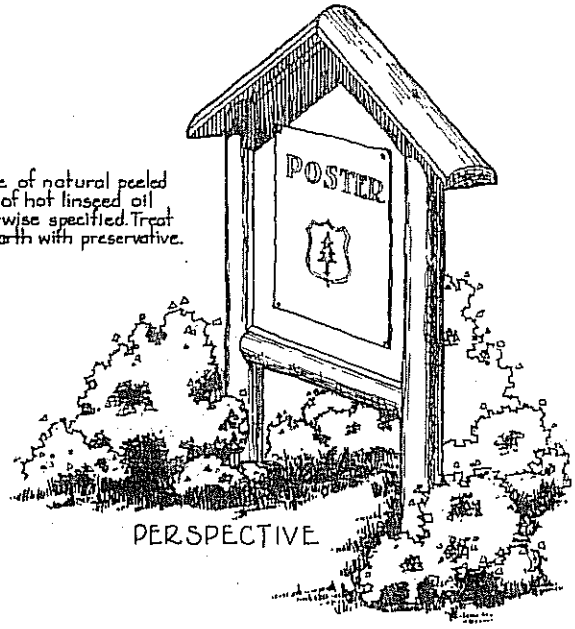
TO BE USED WITH THOSE STATIONS HAVING STAINED OR OILED EXTERIOR FINISH OR WHERE STATION IS NOT VISIBLE FROM SIGN LOCATION. THIS TYPE OF SUPPORT IS ADAPTED TO SITES WHERE SPACE IS LIMITED OR WHEN SITE IS CLOSE TO FOREST EDGE

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	SIGN SUPPORTS FOR RANGER STATIONS	PLATE NO. 13 B DRAWN BY PETERSON DATE 1-14-36 CHECKED BY PETERSON " 2-13-36 TRACED BY COUGHLAN " 2-6-36 APPROVED BY E.T. " 2-17-36

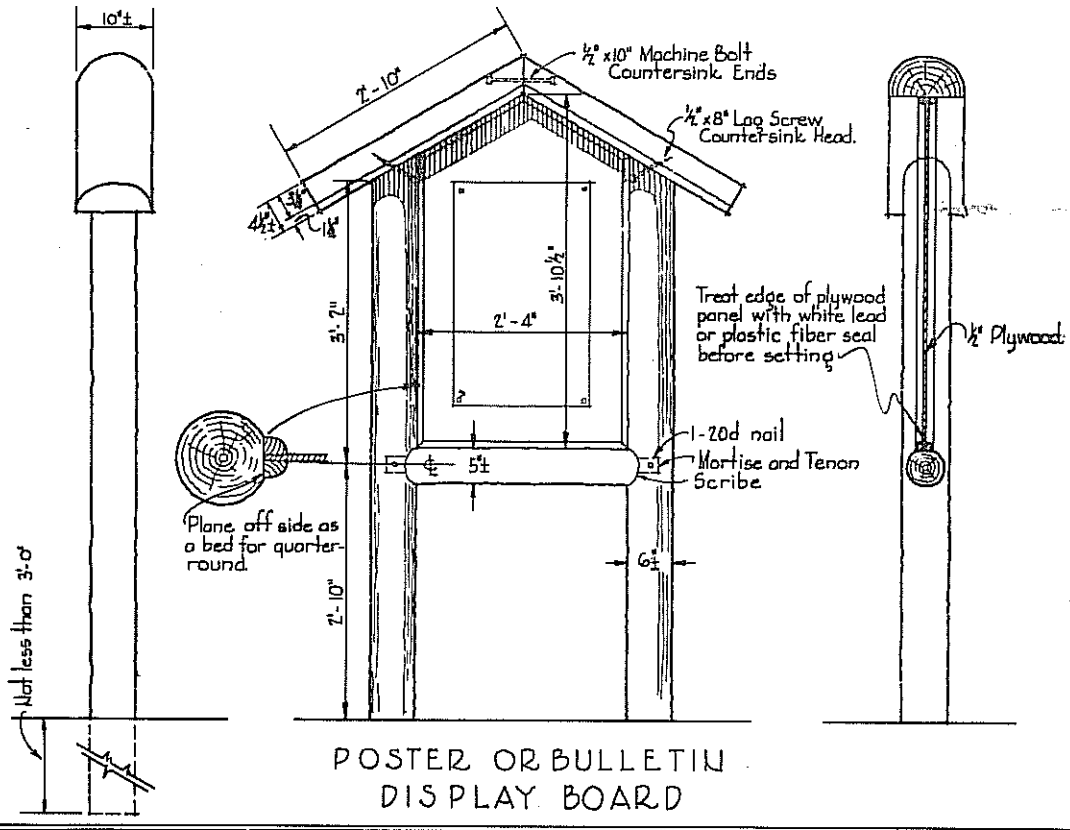
See Replacement Sheet

Plate No. 61

Note: All members to be of natural peeled logs. Finish to consist of hot linseed oil treatment unless otherwise specified. Treat portions exposed to earth with preservative.

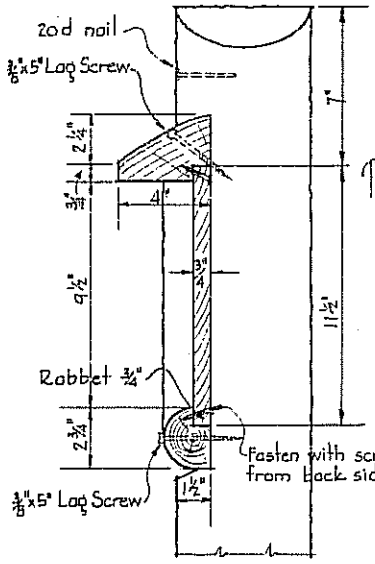


PERSPECTIVE

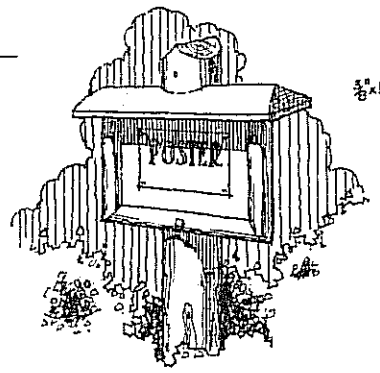


POSTER OR BULLETIN DISPLAY BOARD

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO 1 LANDSCAPE PLANNING	POSTER DISPLAY BOARDS & SUPPORTS	PLATE NO. 14 DRAWN BY PETERSON DATE 1-25-36 CHECKED BY PETERSON " 2-13-36 TRACED BY COUGHLAN " 2-7-36 APPROVED BY [illegible] " 2-19-36

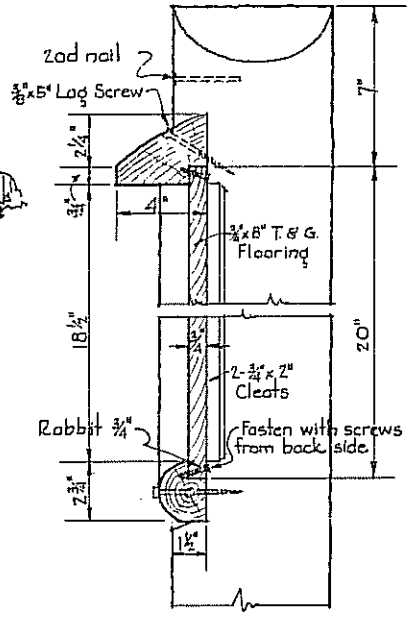


SECTION THRU SMALL BOARD



PERSPECTIVE

SCALE 6" 0 6"



SECTION THRU LARGE BOARD

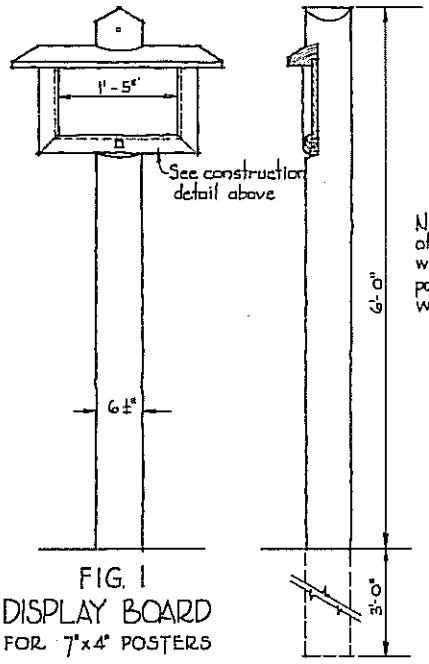


FIG. 1
DISPLAY BOARD
FOR 7"x4" POSTERS

Note: All members are to be of natural peeled logs, treated with hot linseed oil. Treat portions exposed to earth with preservative.

SCALE 1' 0 1'

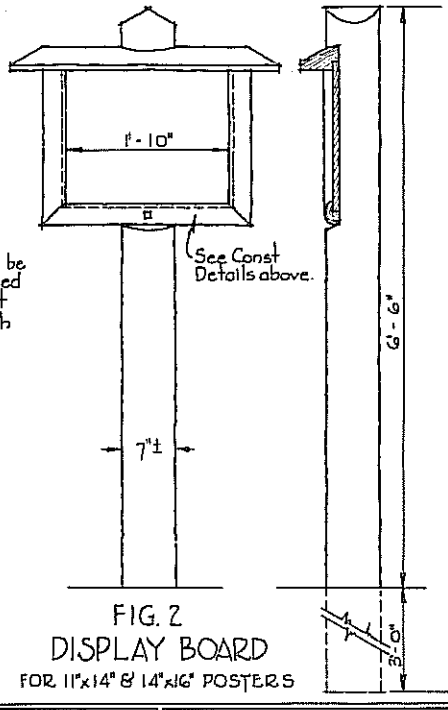


FIG. 2
DISPLAY BOARD
FOR 11"x14" & 14"x16" POSTERS

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	POSTER DISPLAY BOARDS & SUPPORTS	PLATE NO. 14A DRAWN BY Peterson DATE 1-25-36 CHECKED BY Peterson " 2-13-36 TRACED BY Coughman " 2-10-36 APPROVED BY [illegible] " 2-18-36

Plate No. 61B

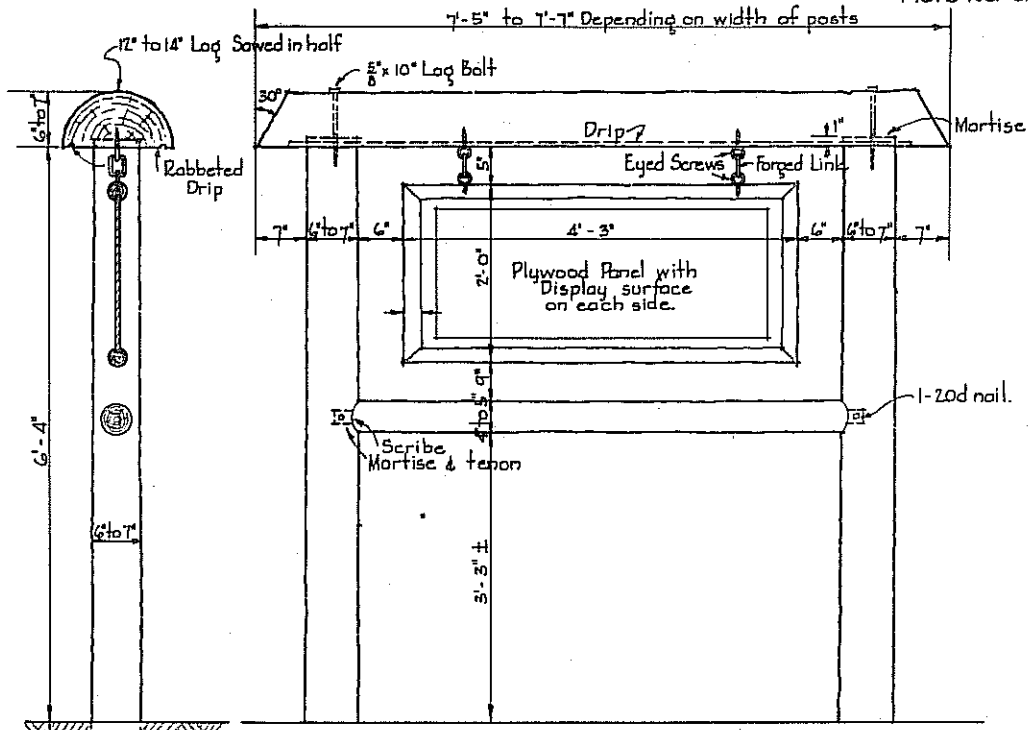
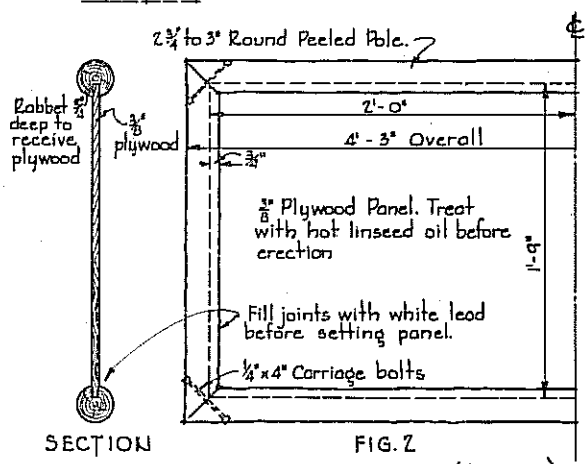


FIG. 1

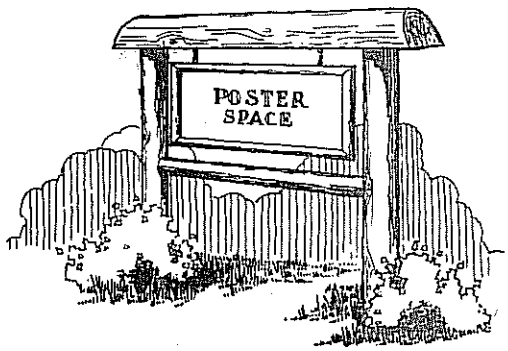
Note: Care should be taken in setting sign in respect to sight-distance on highways and to desirable views or vistas. Setting sign in the edge of low growing shrubs or the planting of a few about its base will add materially to its attractiveness and fitness to the sight. All members to be of natural peeled logs. Finish to consist of hot linseed oil treatment unless otherwise specified. Treat portions exposed to earth with preservative.



SECTION

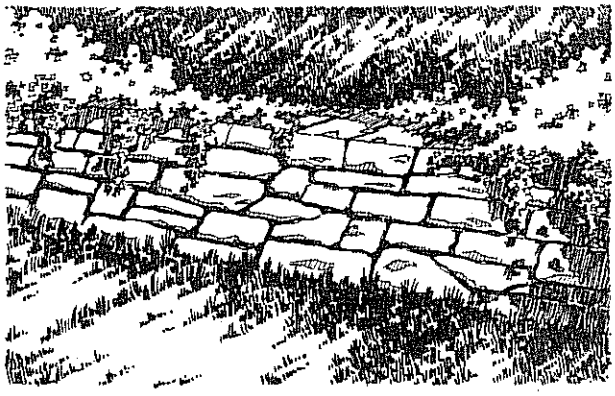
FIG. 2

DISPLAY BOARD (½ ELEV)



PERSPECTIVE

U.S. DEPT. OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	POSTER DISPLAY BOARDS & SUPPORTS	PLATE NO. 14B DRAWN BY PETERSON DATE 1-27-36 CHECKED BY PETERSON " 2-13-36 TRACED BY COUGHLAN " 2-11-36 APPROVED BY [illegible] " 2-19-36



PERSPECTIVE

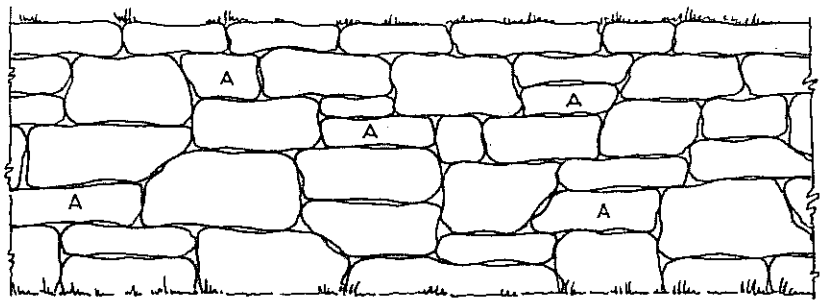
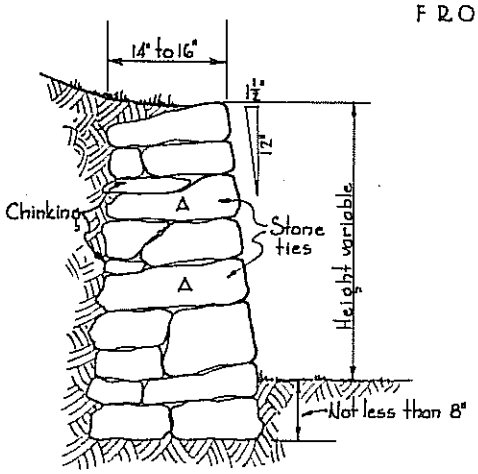


FIG. 1

FRONT ELEVATION



SECTION

Note: Back side of wall should be vertical or have a reverse batter from face. In no case should back side of wall be sloped in same direction as the face. Stones should be laid solidly in place with a slight tilt toward the bank. All chinking should be done at the back or interior of wall so as not to be visible from the face. All cutting of stones should be done on interior faces. Exposed surfaces should be natural, weathered surfaces. Tie-stones, marked "A" should be laid at frequent intervals to bind front and back of wall. Face of wall should have a batter of about 1½" per foot of height. Height of wall is variable but generally should not exceed 4'. Where walls of greater height are needed use reinforced concrete wall, shown on Plate 16, with stone facing. Where heavy, poorly drained soils are encountered, backfill behind wall should be of coarse gravel for drainage.

"DRY" STONE RETAINING WALL

SCALE 2' 1' 0 2'

U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	RETAINING WALL	PLATE NO. 15 DRAWN BY Peterson DATE 1-28-36 CHECKED BY Peterson " 2-8-36 TRACED BY Coughlan " 1-31-36 APPROVED BY [illegible] " 2-19-36

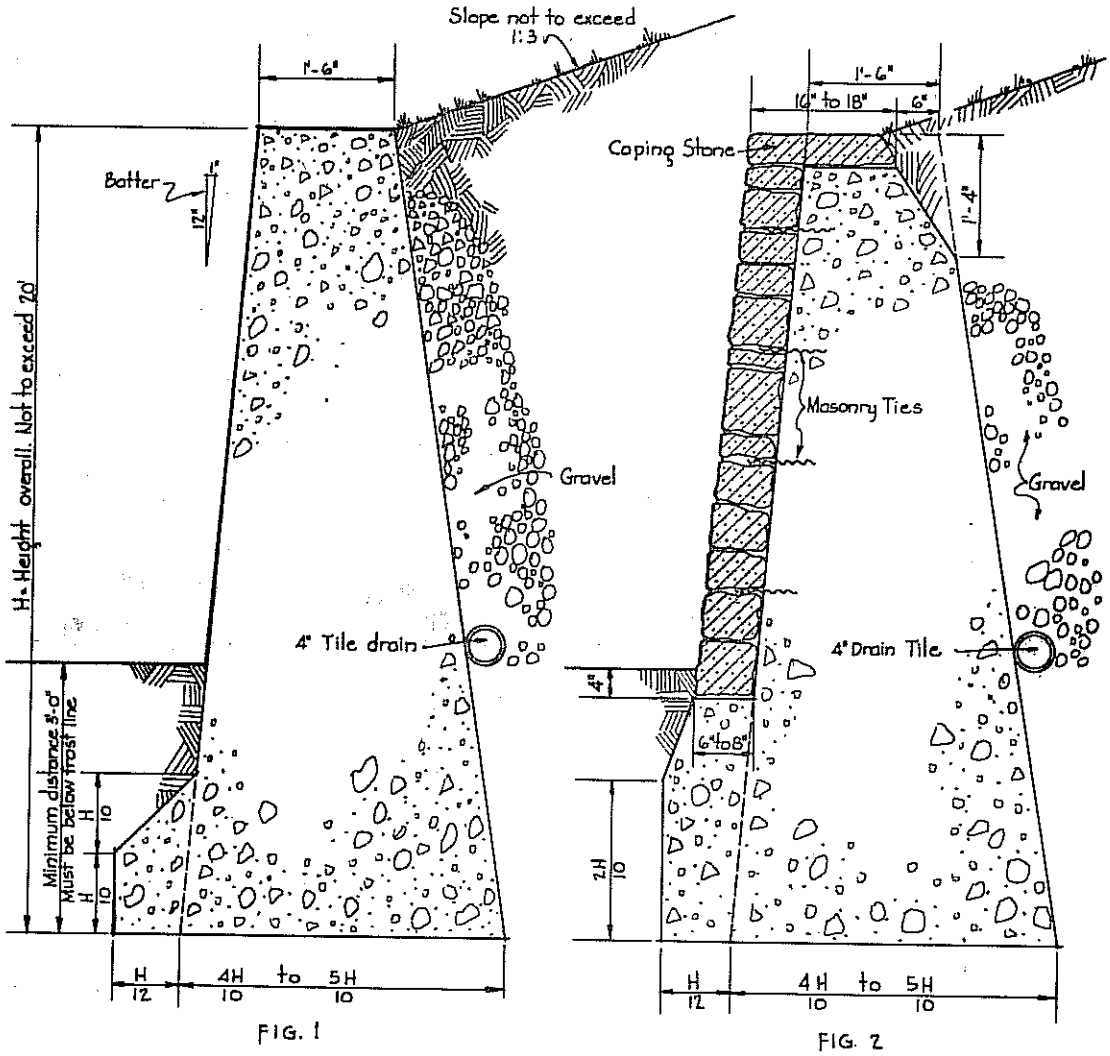


FIG. 1
SECTION

FIG. 2
SECTION

Note: To finish Concrete Face Retaining Wall, remove forms as soon as concrete has enough strength to sustain its own weight and rub with wooden float dipped in water and sand until form marks disappear. Ordinarily it is not desirable to plaster wall surfaces due to tendency to peel.

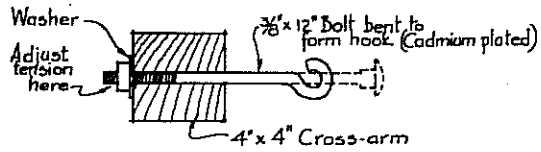
For Construction Details of Reinforced Concrete Retaining Walls see Forest Service Truck Trail Handbook 1933 page 429 Fig 410.

CONCRETE WALL STONE FACED WALL

GRAVITY TYPE CONCRETE RETAINING WALLS

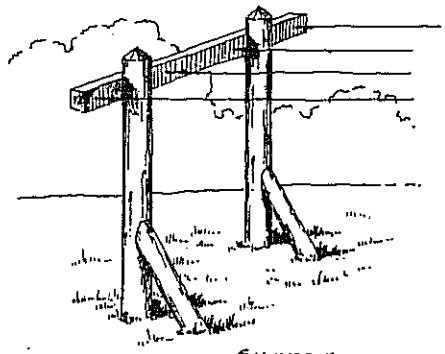
U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	RETAINING WALLS	PLATE NO. 15A DRAWN BY PETERSON DATE 2-5-36 CHECKED BY PETERSON " 2-13-36 TRACED BY COLEMAN " 2-13-36 APPROVED BY [illegible] " 2-19-36

Plate No. 63

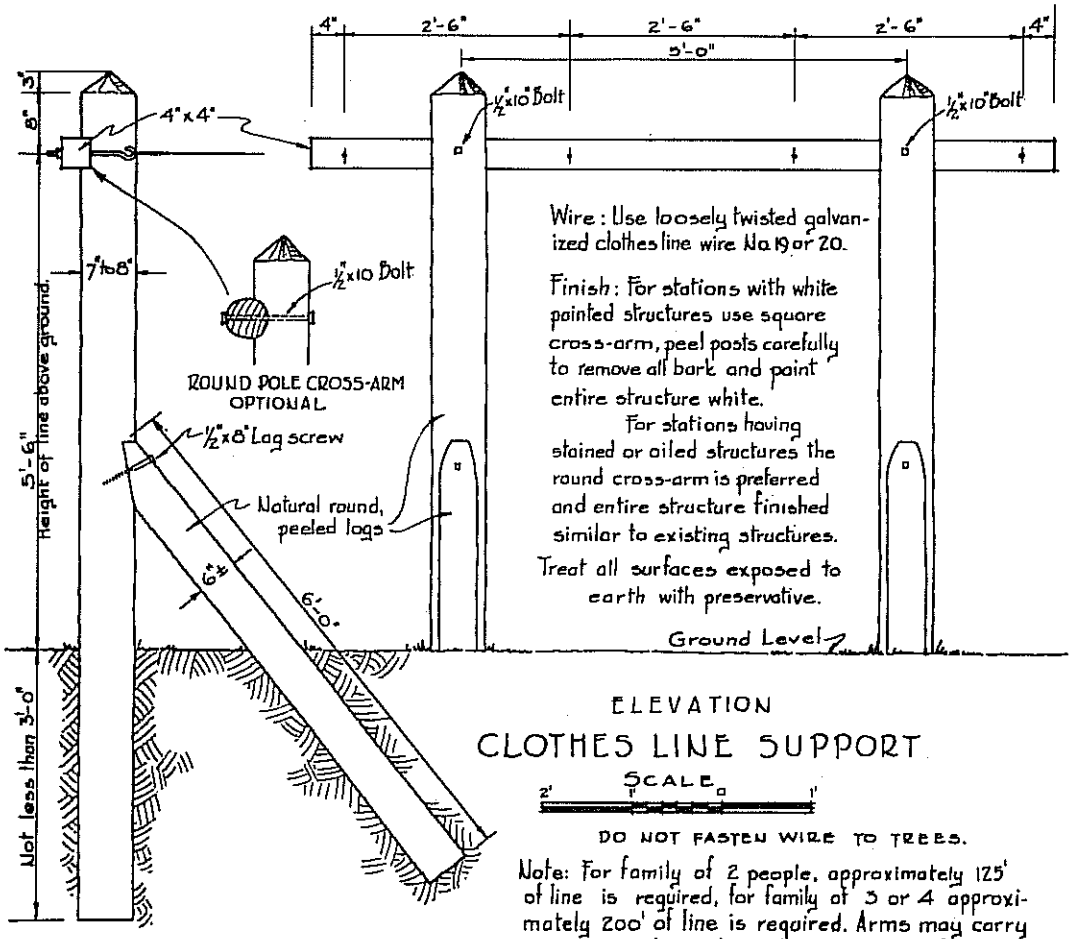


DETAIL OF HOOK

METHOD OF FASTENING WIRE TO HOOK



SKETCH



Wire: Use loosely twisted galvanized clothes line wire No. 19 or 20.

Finish: For stations with white painted structures use square cross-arm, peel posts carefully to remove all bark and paint entire structure white.

For stations having stained or oiled structures the round cross-arm is preferred and entire structure finished similar to existing structures.

Treat all surfaces exposed to earth with preservative.

SIDE VIEW

ELEVATION

CLOTHES LINE SUPPORT

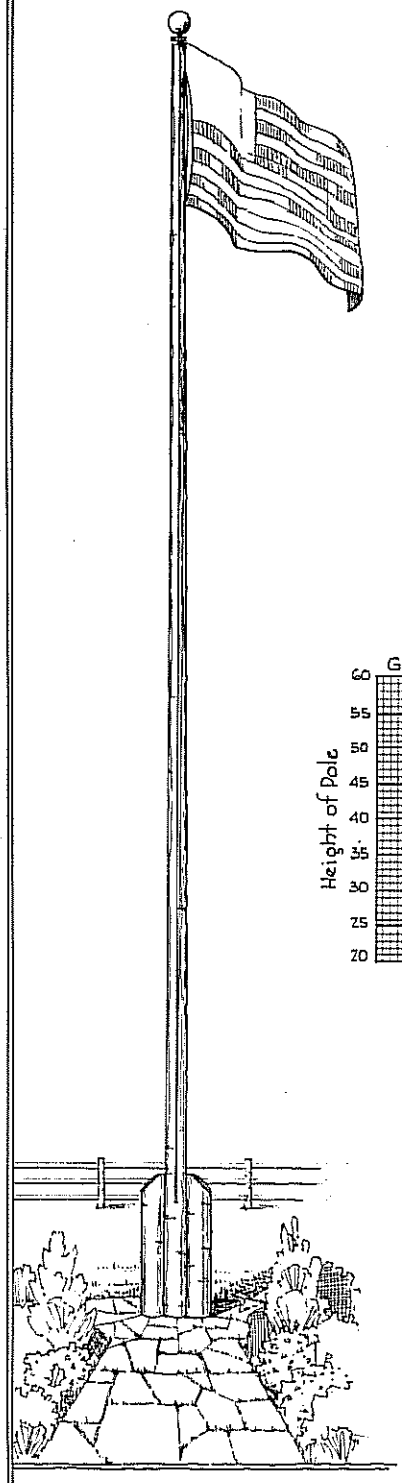
SCALE 2' 1' 0 1'

DO NOT FASTEN WIRE TO TREES.

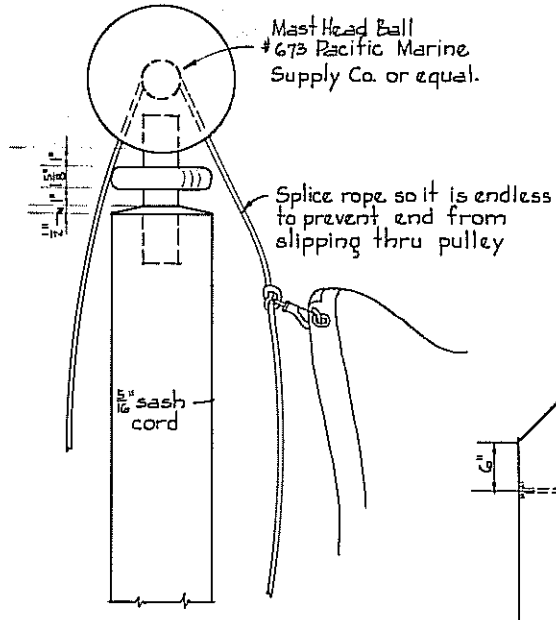
Note: For family of 2 people, approximately 125' of line is required, for family of 3 or 4 approximately 200' of line is required. Arms may carry 2, 3, 4 or 5 lines, depending on shape of space available. Where space is extremely limited use commercial folding clothes reel.

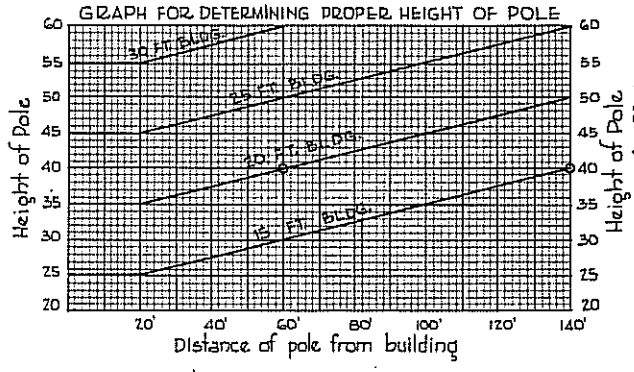
U.S. DEPT OF AGRICULTURE FOREST SERVICE REGION NO. 1 LANDSCAPE PLANNING	CLOTHES LINE SUPPORT	PLATE NO. 16 DRAWN BY PETERSON DATE 2-14-36 CHECKED BY PETERSON " 2-14-36 TRACED BY PETERSON " 2-14-36 APPROVED BY [illegible] " 2-19-36

Plate 63A



SKETCH

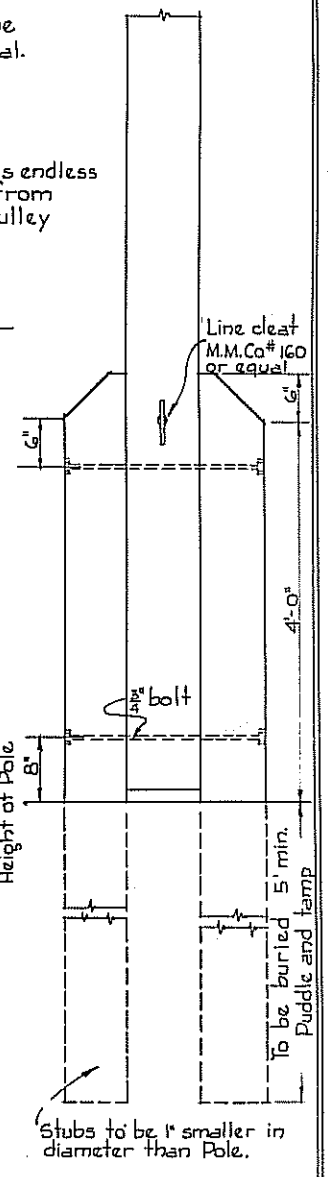




Example:
Pole set 60ft. from a 20ft. building
Height of pole = 40ft.

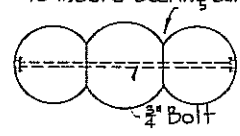
SCHEDULE FOR SIZE OF FLAG AND POLE				
HEIGHT POLE	SIZE FLAG	DIAM. BALL	DIAM BASE	DIAM TOP
25	3'-0"x5'-0"	6"	5"	3½"
30	4'-0"x6'-0"	6"	5½"	4"
35	4'-4"x5'-6"	7"	6"	4"
40	5'-0"x8'-0"	7	7"	4½"
45	5'-0"x9'-6"	8"	8"	5"
50	6'-0"x10'-0"	8"	8½"	5½"
60	6'-0"x12'-0"	8"	10"	6½"

Butt of stubs to be tank treated or given 3 coats of creosote
Pole to be finished the same as the exterior of the surrounding buildings
Mast Head Ball to be purchased thru "P&S.



ELEVATION

Poles should be flattened to insure bearing surface



PLAN

U. S. DEPT. OF AGRICULTURE FOREST SERVICE REGION ONE LANDSCAPE PLANNING	FLAG POLE FOR STATION HEADQUARTERS	PLATE 17 DRAWN BY H.W.C. DATE 4-13-37 CHECKED BY C.M.B. " 4-24-37 TRACED BY H.W.C. " 4-20-37 APPROVED BY "

LOOKOUT TOWER CONSTRUCTION

Lookout towers are built for three different uses. From 10 to 50 feet in height by 10' steps for supporting the standard L-4 lookout house in which the lookout lives. Over 50' in height for observation purposes on primary points. Light towers of any height for use along routes or at emergency points.

Towers up to 50' will be of wood construction with two types of cross bracing. Ten, twenty, and thirty-foot towers will be wood braced. Forty and fifty-foot towers will be cable braced. Towers over 50' will be steel construction. Light towers of the platform type will be wood braced up to 50' in height.

It is a pretty well settled fact that the simplest and cheapest way to build towers 30' or over in height is to assemble them on the ground and then raise the whole tower as a completed structure, putting in the stairways afterward and building the house after the stairs are in. Methods of cutting, fitting and assembling towers are detailed on the plans for each type of tower, as well as the mechanics of raising the tower after it is assembled.

The tower, if 40 or 50' in height, should be raised with two hoists. It can be done with one hoist but there is considerable danger of the tower falling while the hoist is being moved from one gin pole to the other, as the tower must be supported in the air at an angle of 45° while the change is being made. If two hoists are used the second hoist takes the lift at once as soon as the first hoist has raised the tower to its maximum lift, and the tower is kept moving until it is set on the foundation. The first hoist is also a great aid in taking the weight of the tower after it passes the center of gravity and commences to drop into place. This can be done by slacking off on a pair of double blocks by hand, but is not done so easily or uniformly.

The Spokane Warehouse has the hoist outfits set up in units as follows:

1 hoist
250 feet 1/2" steel cable
150 feet 1/2" " "
12 Crosby clamps
2 steel blocks, single for 1/2" cable
2 steel blocks, double for 3/4" rope
600 feet 1/2" rope
600 feet 3/4" rope

This is sufficient equipment to raise one tower, but for high towers the first five items should be doubled, and orders for hoisting equipment should specify if single or double equipment is desired. Only a limited number of these units are available and each Forest must schedule the use of this equipment so that it is returned to the warehouse in the shortest time possible or reshipped to some other Forest. If the

construction job is properly planned it should not be necessary for the hoisting equipment to be on the job more than two or three days at the most.

Raising the Gin Pole

It is usually necessary to use a short gin pole which can be raised by hand, to raise the heavy pole needed for raising the tower. After the heavy pole has been raised about 30° the hoist attached to it can be used to assist with the raising, or to do the whole job. Guy lines and hoisting tackle should all be in place before the pole is raised.

On those sites where there is standing timber available, it is advisable to spot trees to be used as gin poles and leave them standing until the tower is up. Trees should be guyed just the same as a gin pole when used for that purpose. The tower guys can be used to guy the gin pole until the tower is up. It is good practice to run the hoist rigging out to a stump or deadman and then take a good pull with the hoist and test out the gin pole before the tower is picked up.

Suggested List of Tower Tools and Equipment

1 - Necessary tools for any concrete work
1 - Hoist, hand, with anchor and hoisting cable
2 - Blocks, single snatch, 6x1 sheave
12 - Clamps, cable, 2-bolt or 3-bolt
2 - Wrenches, monkey, 10"
2 - Hammers, 4-pound single jack
1 - Hammer, 8-pound double jack
2 - Peavies, light weight
1 - Chest, carpenter's; tools complete; portable
1 - Slick, 3" socket, long-handled, chisel
1 - Chisel, 1½", made of heavy drill steel, 10" handle, for any heavy chiseling
1 - Bit, car, 13/16" with long twist, length overall 17", for 3/4" bolts
1 - Bit, car, 9/16" with long twist, length overall 17", for 1/2" bolts
1 - Brace, carpenter's, with long sweep
1 - Chain, log, 14' steel test, with grab and open-hook
1 - Block and tackle set, 1 single and 1 double wooden block, sheaves 3/4"x4", and 200' 5/8" rope. Have extra rope on hand also.

Steel Towers

Steel towers will be ordered through Procurement Division. Erection instructions are included with each set of material. A list of wrenches needed for the erection job includes:

Type of Wrench	Size of Opening	Armstrong Cat. No.	Williams Cat. No.
Construction	31/32" or		
"	1"	#226	#1206B
"	1-1/8"	#227A	#1207A
Engineers	7/16"	#1A	#1701
"	19/32"	#2	#1002
"	3/4"	#4-A	#1704
" double-end	11/16" and 7/8"	#1030	#1030
" " "	1" and 1-1/8"	#1735	#1735

These wrenches should be ordered at the same time that the tower is ordered so that they will be on hand in time for erection. One set to a forest would appear to be ample.

Guying

°Under no circumstances will steel towers be guyed. They are designed to withstand a gale of 100 miles per hour without guying, and to put guys on them would set up stresses which would be fatal to the tower. (Paragraph amended 8-12-38.)

Steel Tower Specifications

1. General

These specifications are based on many years of experience with lookout towers and similar structures, and in the light of this experience, towers, to be satisfactory, must conform to these specifications. The design and details of the structure have been made to meet the requirements of the Forest Service, and bids on towers differing in design or detail cannot be considered.

The bidder will be required to furnish all structural steel shapes; metal sash glazed with clear double-strength glass; sheet metal; rivets and bolts (number required plus 5 percent), including bolts for fastening down the cab flooring, landings and stair tread; anchor bolts and reinforcement bars for footings; and two base plates for 1" pipe with provision for attaching to corner angles of cab to make one or more complete towers as specified. The Government will furnish hinges and lock for cab trap door; ventilator base and ventilator; cast-iron floor register; iron pipe flagpole; lumber for cab floor, landings and stair tread; and cement and aggregates for tower and stair or ladder footings. All structural shapes and metal (including sheet metal) shall be completely fabricated so that it will not be necessary to do any cutting, bending, drilling, punching, or reaming in assembling the tower.

2. Material

Structural steel and rivets shall conform to U. S. Government master specifications F.S.B. #351a, "Steel, Structural for Bridges", Class A, "Structural Steel, Noncopper" and Class C, "Rivet Steel, Noncopper." Reinforcing bars shall conform to U. S. Government master

specifications F.S.B. #350a "Bars Reinforcement, Type B, Grade 1", and anchor bolts shall be type A, grade 1. Successful bidder will be required to furnish certified analysis showing chemical and physical properties of the run or runs of steel covering the material from which the towers are fabricated.

Sheet metal for roofing and siding shall be pure iron or copper bearing steel, 20 gauge.

Bolts for field connections shall be of mild steel with hexagonal heads and hexagonal self-locking nuts equivalent to those manufactured by the Dardelet Threadlock Corporation, 120 Broadway, New York, N. Y. Bolts shall be of such length that they will extend entirely through the nut but not more than 1/4" beyond. The threads shall be entirely outside the holes of the connected members. Metal siding and roofing shall be attached to structural shapes with 1/4" round-head brass bolts or machine screws. Three-eighths-inch carriage bolts shall be furnished for fastening down cab flooring, stair treads, and landings (which will be of two-inch lumber).

Metal sash shall be equal to Fenestra sash manufactured by the Detroit Steel Products Company. The sash on each side of the tower shall be composed of 18 lights and one-half of each sash shall be hinged so that the top part swings in and the bottom out. Provision shall be made for fastening the sash in any open position and locking it. The sash shall be weatherproof, so that no water can beat in through the sash or connections or between the sash and the cab structure. The sash shall be so constructed as to obstruct the view as little as possible. Plans of the sash and weatherproofing details shall be submitted for approval before fabrication is authorized.

3. Fabrication

All pieces shall be of sizes called for on the attached design drawings, shall be straight and true, and carefully cut to length. The punched holes shall be so accurately spaced that the tower will go together without the necessity of reaming the holes or of drifting or distorting the material.

As indicated on the accompanying drawings, the maximum length of members for towers with inside stairway will be approximately 22', and the maximum length of members for towers with ladders will be approximately 14'.

Unless otherwise stated, all punched holes shall not exceed the diameter of the bolt which it is to accommodate by more than 1/32 of an inch.

Unless otherwise stated on the accompanying design drawings, the following sizes shall be used for rivets or bolts for structural connections. The dimension given is for the width of the leg of the smallest angle through which the rivet or bolt passes.

Size of leg	Size of rivet or bolt
2-1/2" or wider	3/4"
2" and 2-1/4"	5/8"
1-3/4"	1/2"
1-1/2"	3/8"

The following minimum pitch and edge distance shall be adhered to:

Size of bolt or rivet	Minimum pitch	Edge Distance	
		For Sheared plate	For rolled or planed edges
3/4	2-1/2	1-1/4	1-1/8
5/8	2-1/4	1-1/8	7/8
1/2	1-3/4	1	3/4
3/8	1-1/2	7/8	5/8

All joints and splices shall be made in accordance with the details on the accompanying design drawings. The ends of all angles 1/8" thick (except stiffener strut splices) shall be bent together before punching as indicated on the attached details. The number of bolts for each joint is indicated on the attached drawings, the number in the circle indicating the number of bolts on each side of the joint as in the main leg members or the number of bolts in each end of each connecting member as diagonals and struts. All secondary struts bracing the main leg angles, all diagonal struts bracing the main struts laterally, and all landing members shall be connected with one bolt. All members passing each other shall be connected with at least one bolt, and ring fills shall be provided if these members do not pass in the same plane.

Splice angles, foot plates and gusset plates attached to the main leg members will be fastened by bolts, and each piece will be separately galvanized. The gusset plates shall be attached to the leg angles with four bolts each.

All angles shall have the vertical leg down and all unequal angles shall have the long leg vertical.

Landings are indicated on the attached drawings. Landings for towers with inside stairway shall be 2'6"x4'6" below the fifth landing, and as large as practicable above the fifth landing. Landings for platform ladder towers shall be 2'6"x3'6" below the fourth landing, and as large as practicable above the fourth landing. Seven-sixteenth inch holes shall be punched in the landing angles or struts approximately 6" apart for fastening down the landing plank.

Each leg angle will have two seven-sixteenth inch punched holes, one placed near the top (under the cab) and one placed near the bottom of the tower. The holes shall be so placed as to maintain the net section.

(These holes are to be used for making ground wire connections in insulating the towers from lightning.)

4. Shop Drawings

The successful bidder will be required to submit two sets of shop drawings for approval before fabrication is started. In case shop drawings covering similar towers have been approved the bidder may refer to these and no additional shop drawings will be required.

5. Galvanizing

After all the shop work has been finished, all structural parts of the tower shall be thoroughly galvanized by using the hot process.

The galvanizing shall consist of a heavy coating of prime spelter, evenly and uniformly distributed over all surfaces of the angle members, ladder runs, and metal cab parts. Spelter shall be applied in such a manner that it will not peel off in transportation or in the course of erecting the tower. Any spelter which peels, cracks or blisters under ordinary handling shall be prima facie evidence of poor workmanship and cause for rejection.

The bolts and nuts (except brass bolts) shall be galvanized by the hot process. Carriage bolts shall have standard threads which shall be carefully cleaned so that the nuts can be easily turned on the bolts. The threads of structural bolts and self-locking nuts shall be cut after galvanizing.

All galvanizing excepting that of the bolts and nuts may be subjected to the following tests:

A solution of sulphate of copper shall be made, using commercial copper sulphate crystals in water having a specific gravity of 1.185 at seventy (70) degrees Fahrenheit. The testing solution shall have a maximum temperature not exceeding seventy (70) degrees Fahrenheit or a minimum temperature of not less than sixty (60) degrees Fahrenheit. A sample piece galvanized shall be immersed in a standard solution, as above described, for one minute, and then removed, immediately washed thoroughly in water and wiped dry. This process shall be repeated. If, after the fourth immersion, there shall be a copper colored deposit on the sample, or if the zinc should be removed, the lot from which the sample was taken shall be rejected.

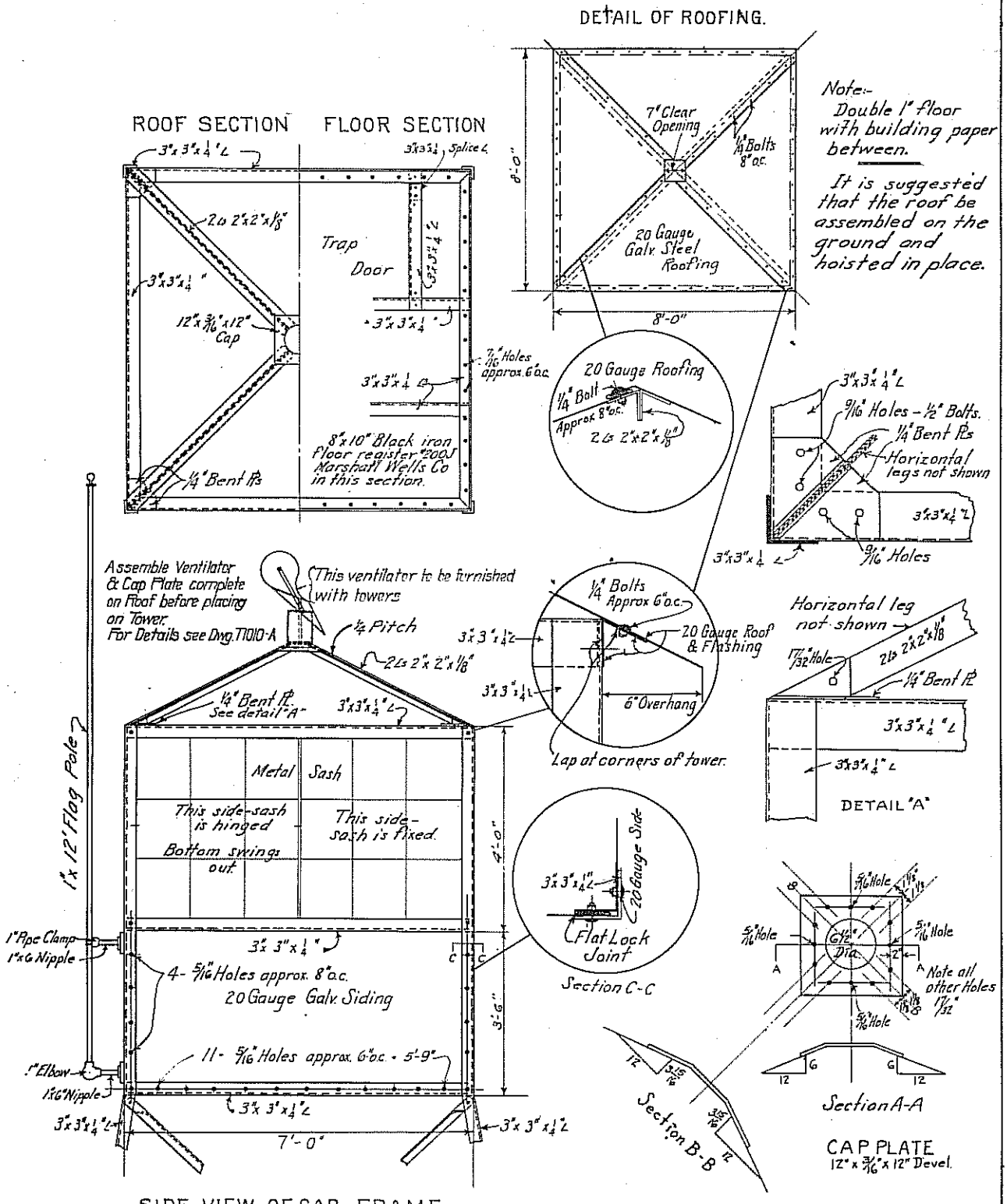
6. Marking

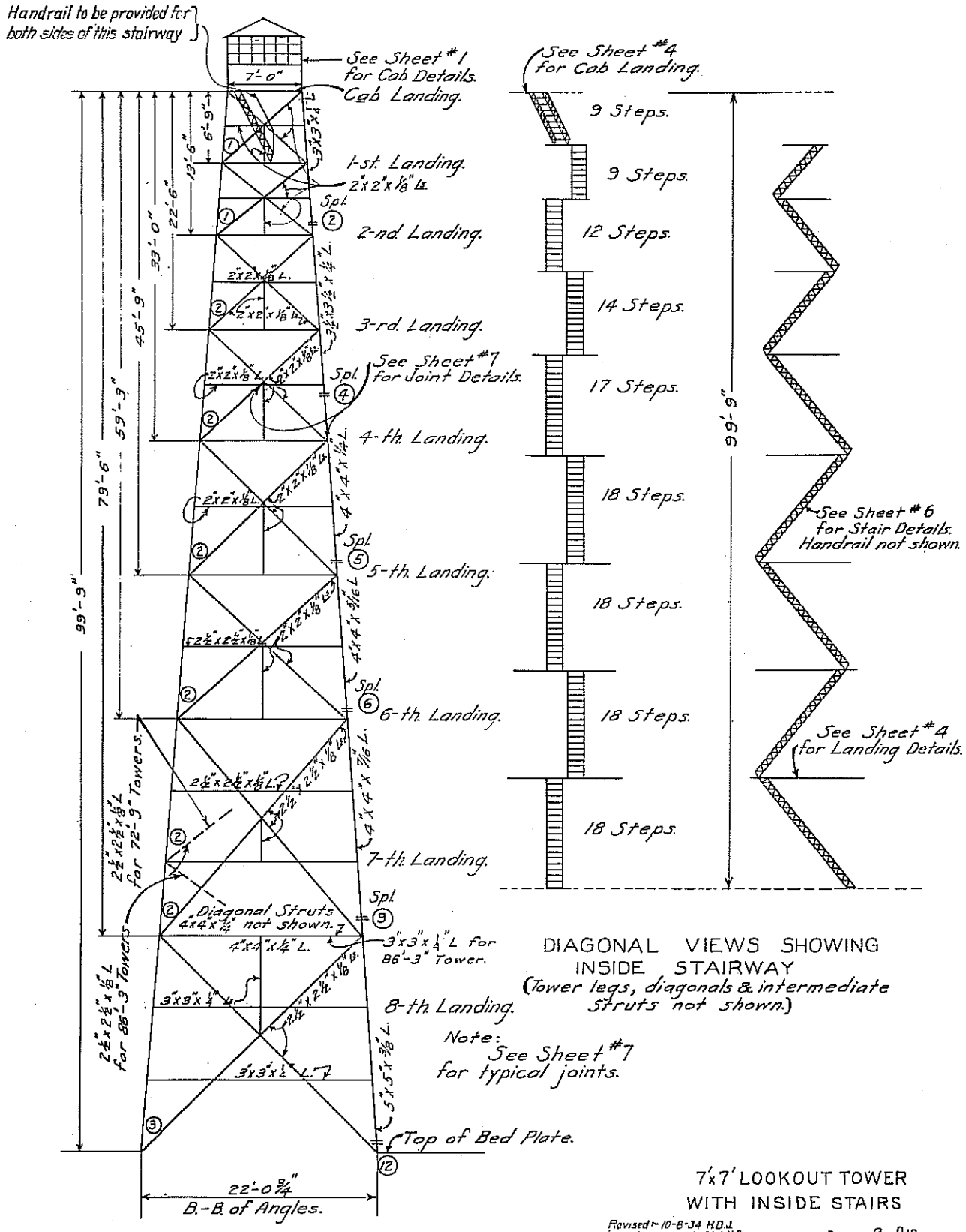
Each member shall be marked to indicate its position in the tower. The successful bidder shall mail to each destination two copies of an erection diagram of the tower which will show by the erection mark on the steel itself the position of each member and also the size bolts to use at each joint. The erection diagram may be included as a part of the shop drawings.

7. Preparation for Shipment

All members that form one tower shall be put up in bundles, the bundles to be tagged with the tower number and with the proper erection mark. The bolts are to be boxed, all bolts necessary to put one tower together, with an excess allowance of 5%, being separately boxed.

Dwg No. T1001-A.





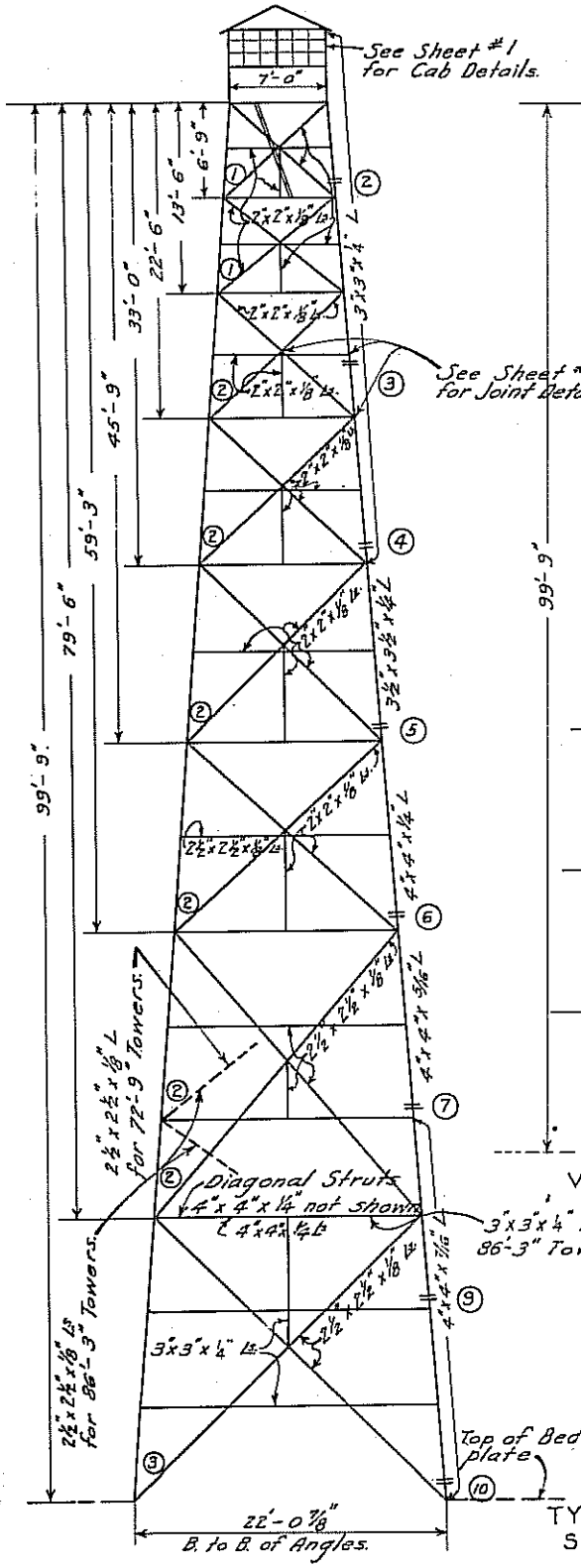
DIAGONAL VIEWS SHOWING INSIDE STAIRWAY
(Tower legs, diagonals & intermediate Struts not shown.)

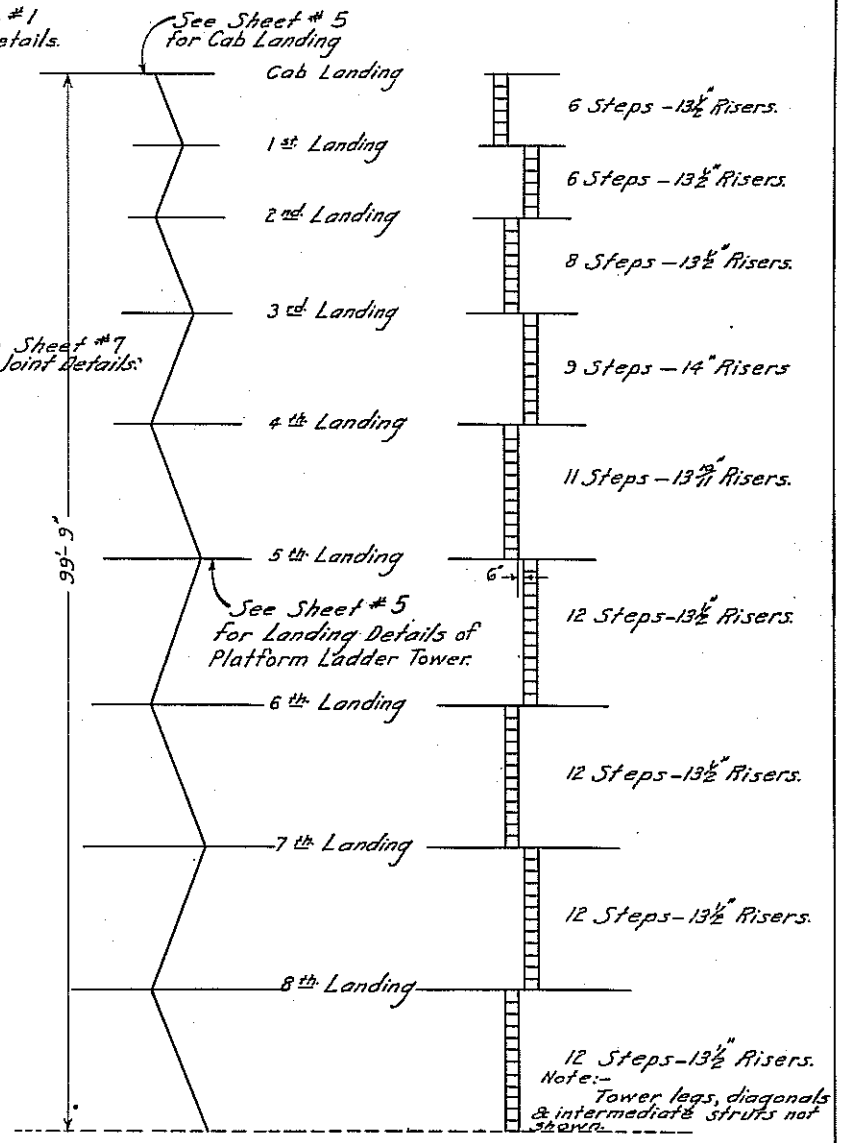
Note: See Sheet #7 for typical joints.

7'x7' LOOKOUT TOWER WITH INSIDE STAIRS

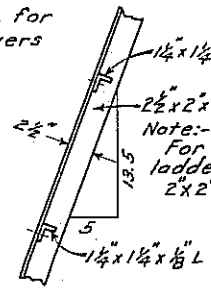
Revised - 10-6-34 H.D.J.
do 7-17-34 J.H.D.
Revised By: M.E.G. 1/18/33
9/10/32 W.I.D.

SHEET 2 of 10



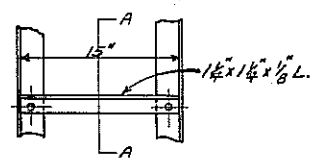


VIEWS SHOWING PLATFORM LADDER



Note:- For straight ladder use 2"x2"x1/8" L.

TYPICAL HALF SECTION A-A

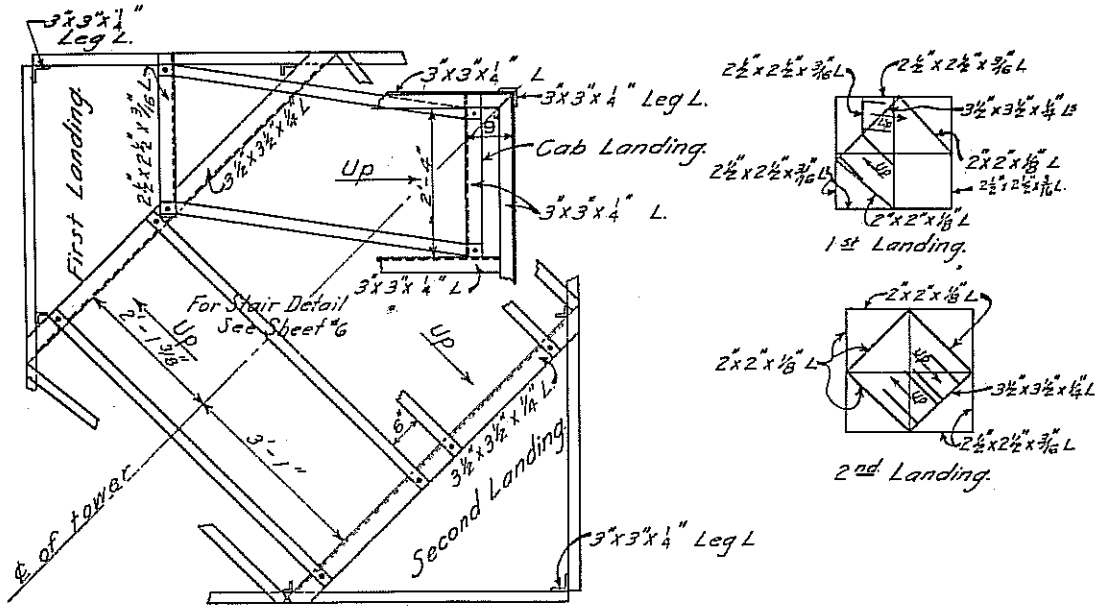


LADDER DETAIL BACK VIEW

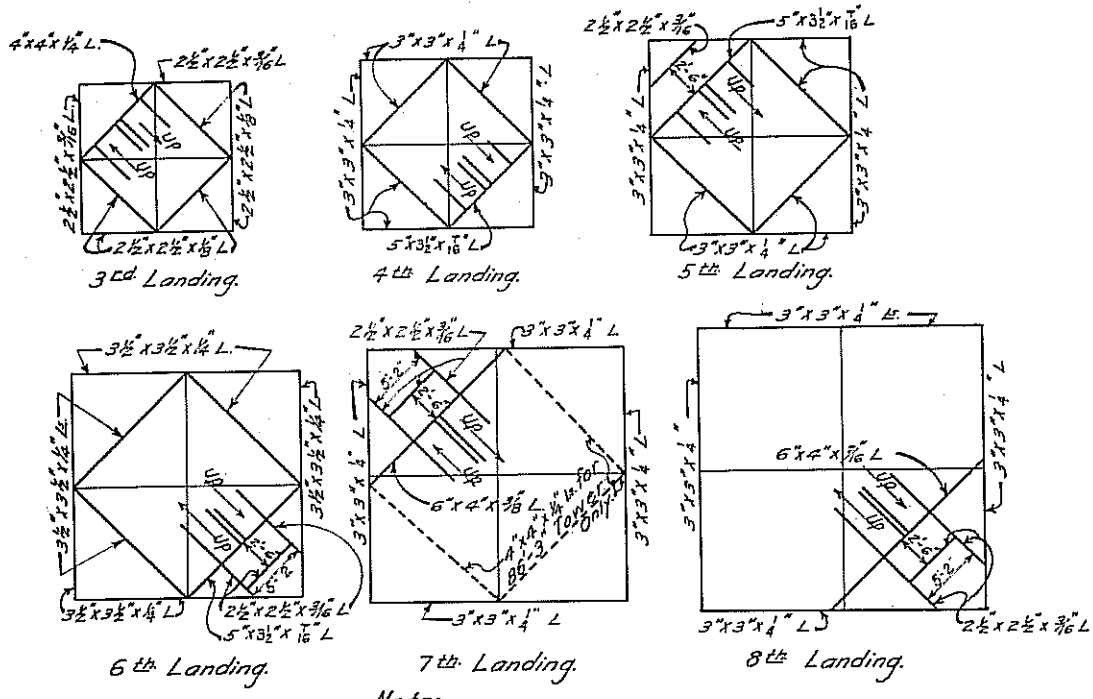
Note:- See sheet 9 of 9 for Landing & Girth Details for Straight Ladder Tower.

7'x7' LOOKOUT TOWER WITH PLATFORM AND STRAIGHT LADDERS

7/17/34 H.D.J.
1/18/33 H.E.G.
Revised 10/15/32 W.I.D.
9/10/32 W.I.D.



ENLARGED DETAIL VIEW OF CAB, 1-ST. & 2-ND. LANDINGS.



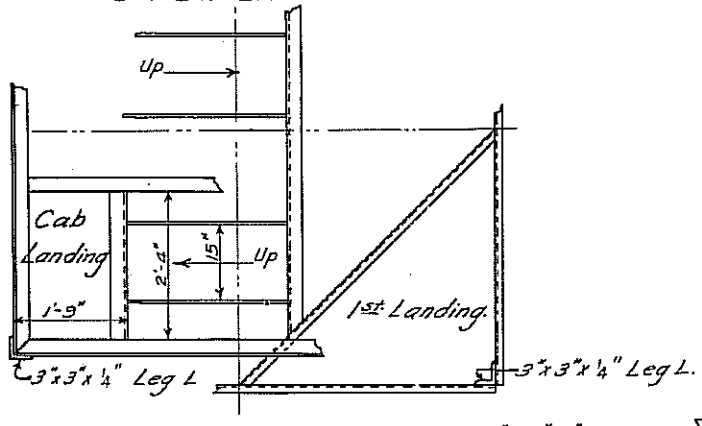
Note:
Guard railing for 6th, 7th and 8th landings see DRWG. T100G-A Sheet 6 of 9.

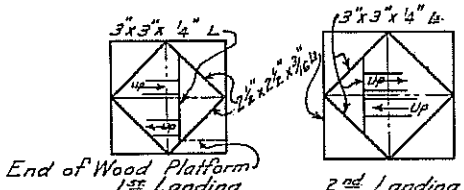
Note:
For 86'-3" tower all main struts @ 7th Landing are 4"x4"x1/4" L.

7'x7' LOOKOUT TOWER
LANDING DETAILS FOR
INSIDE STAIRS

Revised 10-9-34 H.D.J. Revised 7-17-34 H.D.J. SHEET 4 of 10
Revised: 8/10/32 W.I.D.; 1/16/33 M.E.G.; 9/2/33 W.I.D.; 5/4/34 L.T.B.

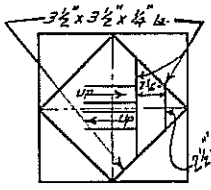
ENLARGED DETAIL VIEW OF CAB & 1-ST. LANDINGS.



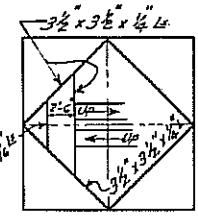


1st Landing
All others 2"x2"x 1/8" L.

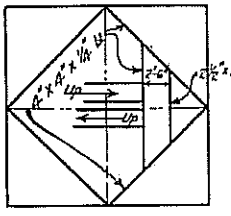
2nd Landing
All others 2"x2"x 1/8" L.



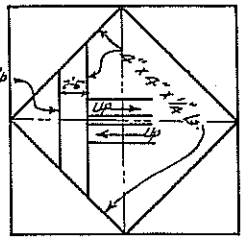
3rd Landing
All others 2 1/2"x2 1/2"x 1/8" L.



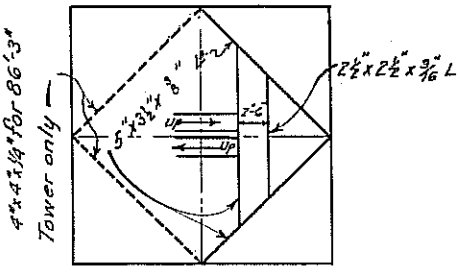
4th Landing
All others 3"x3"x 1/4" L.



5th Landing
All others 3"x3"x 1/4" L.

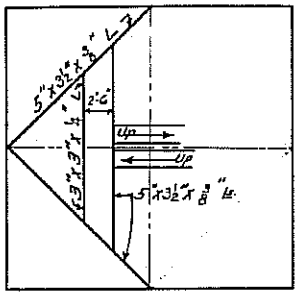


6th Landing
All others 3 1/2"x3 1/2"x 1/4" L.



7th Landing
All others 3"x3"x 1/4" L.

Note:- For 86'-3" tower all main struts at 7-th Landing are 4"x4"x 1/4" Ls



8th Landing
All others 3"x3"x 1/4" L.

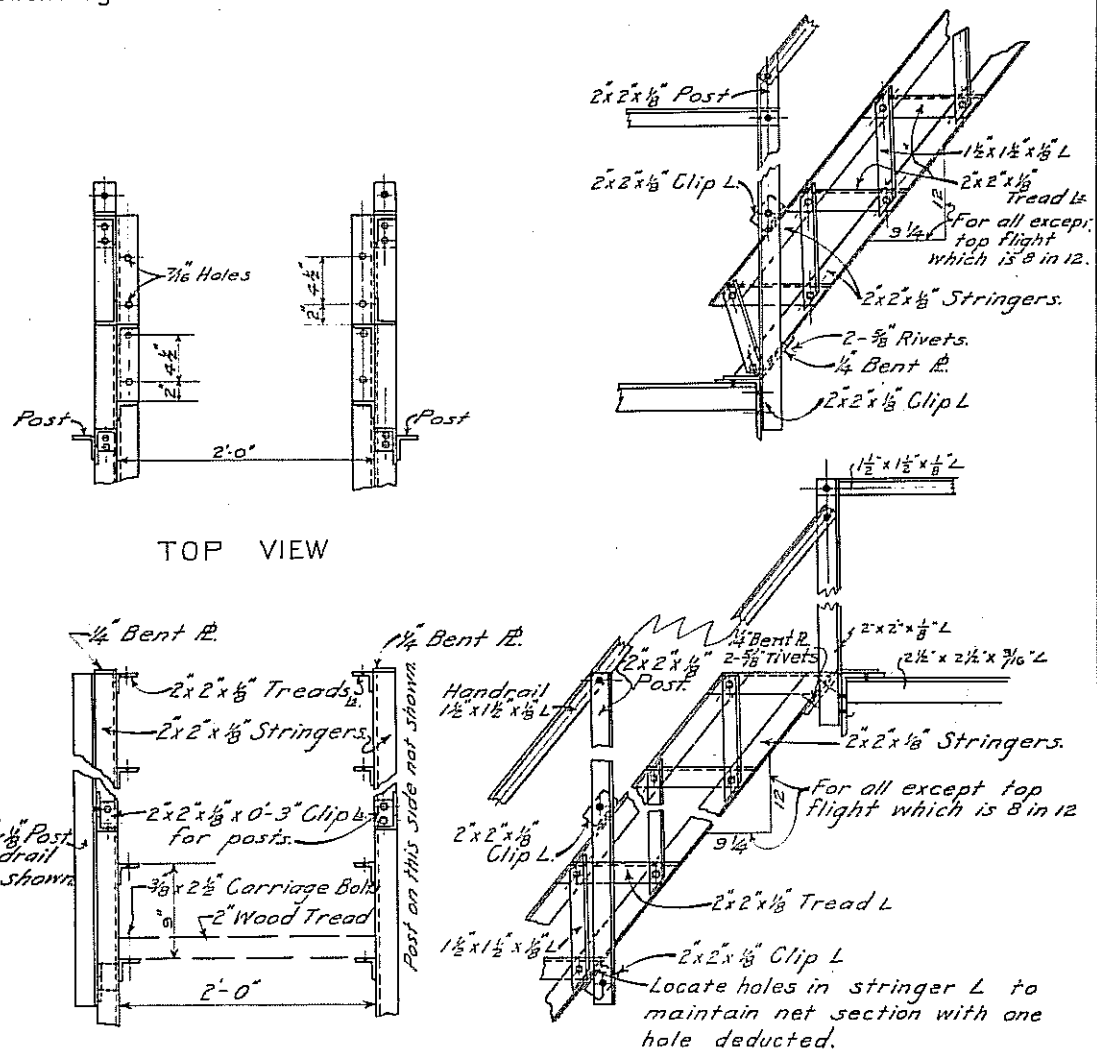
7'x7' LOOKOUT TOWER
LANDING DETAILS FOR
PLATFORM LADDER

Revised 10/26/32 W.I.D. 7/17/34 H.D.J.
9/10/32 W.I.D ; 11/14/33 H.E.G.

Dwg No. T1006-A

Note
Handrails required on both sides of all stairways

TYPICAL STAIR DETAIL AT LANDINGS

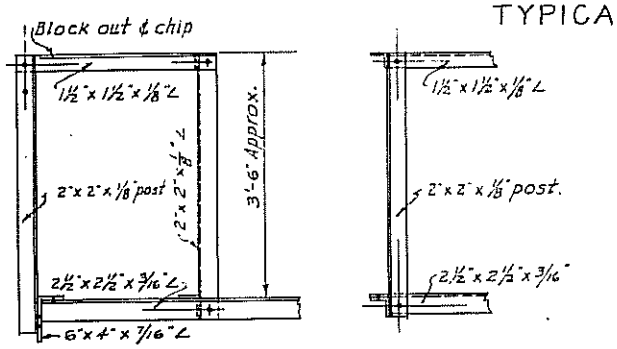


TOP VIEW

FRONT VIEW

SIDE VIEW

TYPICAL STAIR DETAIL



SIDE VIEW

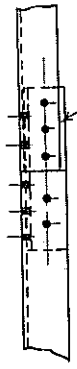
PARTIAL REAR VIEW

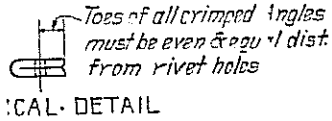
TYPICAL LANDING

7'x7' LOOKOUT TOWER
STAIR DETAILS

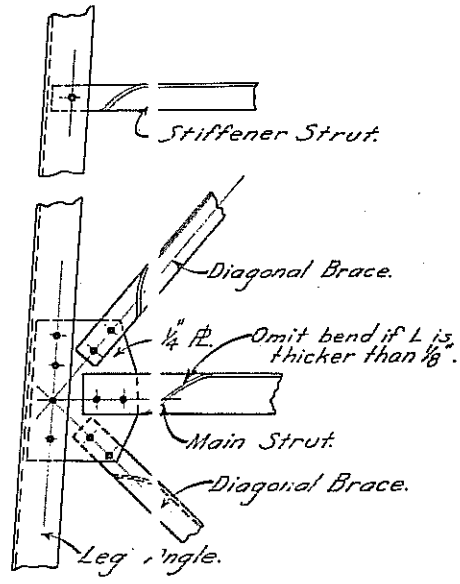
Revised 5/4/34 L.T.B. Revised 9/10/32 W.I.D. – 1/14/33 R.E.G. Revised 10-9-34 H.D.J.

SHEET 6 of 10



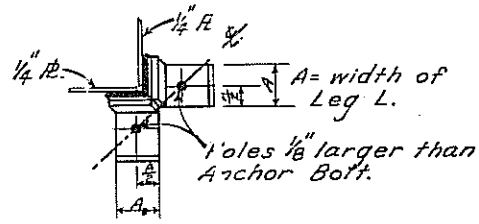


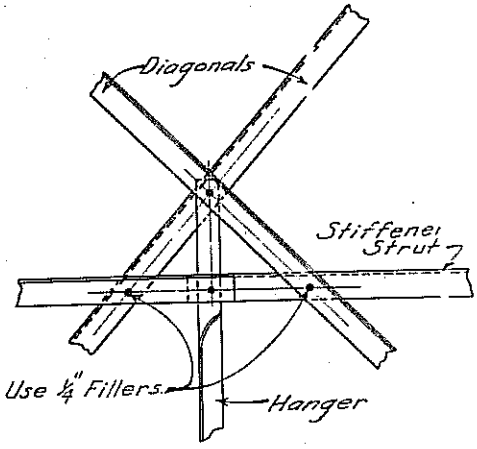
TYPICAL DETAIL OF CRIMP OF ANGLES

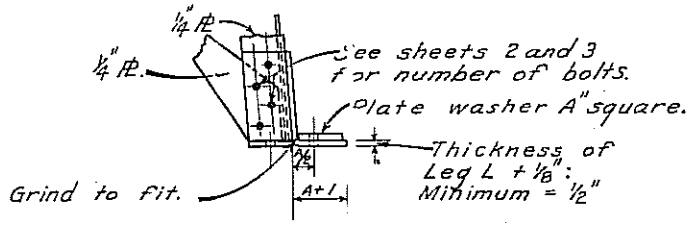


DIAGONAL AND STRUT CONNECTIONS TO LEG ANGLE.

TYPICAL SPLICE FOR LEG ANGLES.



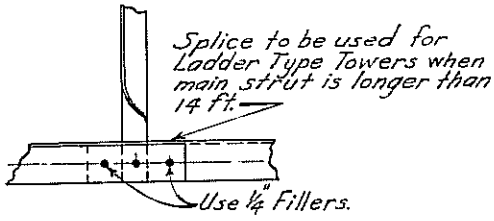




TYPICAL DETAIL OF ANCHOR PLATES

THICKNESS OF PLATE WASHER

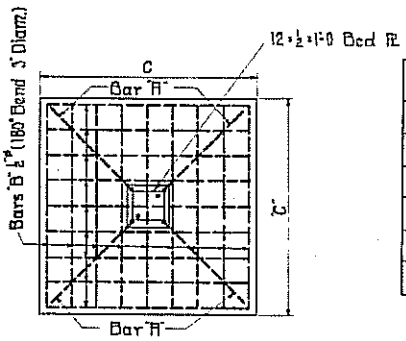
Ht. of Tower	Stair Type	Ladder Type
45'-9"	5/8"	1/2"
59'-3"	3/4"	1/2"
72'-9"	3/4"	5/8"
79'-6"	7/8"	3/4"
86'-3"	7/8"	3/4"
99'-9"	1"	7/8"



TYPICAL CONNECTION OF DIAGONALS, MAIN STRUTS, STIFFENERS & HANGERS.

7'x7' LOOKOUT TOWER
TYPICAL CONNECTIONS

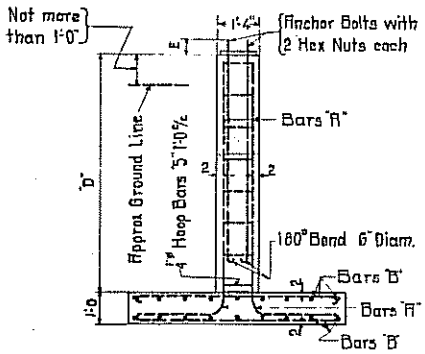
Revised 10-8-34 H.D.J.
Revised 1/4/35 M.E.G.
9/10/32 W.I.D.



DIMENSIONS OF ONE PIER FOR TOWER WITH INSIDE STAIRS

Height	A	B	C	D	E	Bars "A"			Bars "B"			Stirrups	Anchor Bolt Size	Cu. ft. of concrete
						No.	Dia.	Lg.	No.	Lg.	Spa.	No. Req'd		
45'-9	13'-10 7/8"	19'-8	5'-3	5'-3	3 3/4	4	1/2" ø	7'-10	16	4'-9	1'-7	6	3/4" × 5'-0	37
59'-3	15'-11 3/8"	22'-6 5/8"	5'-6	6'-0	4	4	5/8" ø	8'-10	20	5'-0	1'-3	6	7/8" × 5'-2	41
72'-9	18'-0 1/16"	25'-5 9/16"	5'-9	6'-6	4 1/4	4	5/8" ø	9'-6	24	5'-3	1'-0 1/2"	7	7/8" × 5'-7	45
79'-6	19'-0 1/4"	26'-10 13/16"	6'-0	7'-0	4 1/2	4	5/8" ø	10'-2	28	5'-6	11	7	1" × 6'-0	49
86'-3	20'-0 3/8"	28'-3 15/16"	6'-6	7'-3	4 3/4	4	3/4" ø	10'-8	32	6'-0	10 1/4"	7	1" × 6'-0	55
99'-9	22'-0 3/4"	31'-2 7/16"	6'-9	7'-6	5	4	3/4" ø	11'-2	36	6'-3	9 1/2"	7	1 1/8" × 6'-9	59

Note :- Lengths given are finished lengths



TYPICAL CONCRETE PIER

DIMENSIONS OF ONE PIER FOR TOWER WITH PLATFORM LADDER & STRAIGHT LADDER

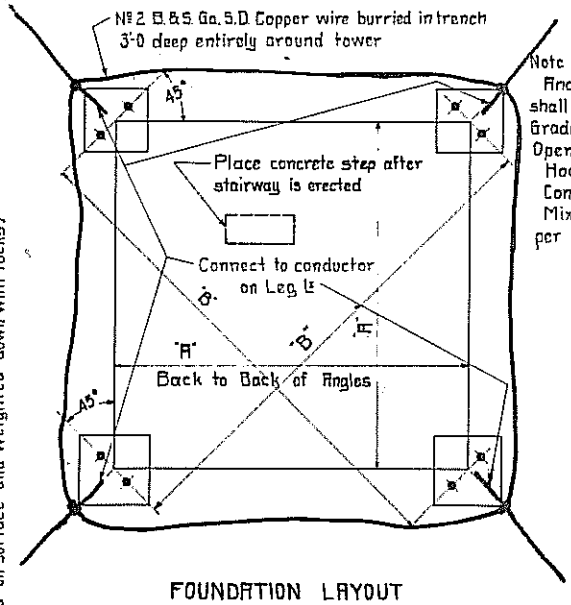
Height	A	B	C	D	E	Bars "A"			Bars "B"			Stirrups	Anchor Bolt Size	Cu. ft. of Concrete
						No.	Dia.	Lg.	No.	Lg.	Spa.	No. Req'd		
45'-9	13'-10 7/8"	19'-8	5'-0	4'-6	3 1/4	4	1/2" ø	7'-3	16	4'-6	1'-6	5	7/8" × 3'-8	33
59'-3	15'-11 1/4"	22'-6 1/2"	5'-3	5'-3	3 1/2	4	1/2" ø	7'-10	16	4'-9	1'-7	6	3/4" × 5'-0	37
72'-9	17'-11 13/16"	25'-5 3/16"	5'-6	6'-0	3 3/4	4	5/8" ø	8'-10	20	5'-0	1'-3	6	3/4" × 5'-2	41
79'-6	19'-0 1/4"	26'-10 13/16"	5'-8	6'-3	4	4	5/8" ø	9'-2	24	5'-2	1'-0 1/2"	7	7/8" × 5'-7	43
86'-3	20'-0 1/2"	28'-4 1/8"	5'-9	6'-9	4 1/4	4	5/8" ø	9'-6	24	5'-3	1'-0 1/2"	7	7/8" × 5'-7	45
99'-9	22'-0 7/8"	31'-2 5/8"	6'-0	7'-0	4 1/2	4	5/8" ø	10'-2	28	5'-6	11	7	1" × 5'-7	49

APPROX. SHIPPING WEIGHT COMPLETE TOWER

Height	Inside Stairs	Platform Ladder	Straight Ladder
45'-9	7000#	6000#	5800#
59'-3	9000#	7700#	7400#
72'-9	11300#	9900#	9300#
79'-6	12700#	11200#	10400#
86'-3	14700#	12900#	11900#
99'-9	17200#	15400#	13900#

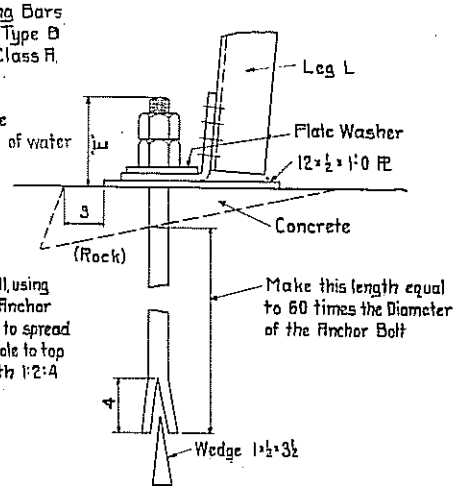
Paint ends of anchor bolts with one coat of red lead before erecting tower and with a second coat of red lead and a final coat of alummum after erection

No. 2 B.&S. Ga. S.D. Copper conductor extending diagonally from each corner of tower (Length of conductor to vary from 12'-0 in 3'-0 deep trench to 60'-100' if ground is too rocky to dig trench. In latter case conductor will be laid on surface and weighted down with rocks)



FOUNDATION LAYOUT

Note
Anchor Bolts & Reinforcing Bars shall conform to F.S. QQ-B-71, Type B Grade 1 (Deformed Structural) Class A. Open Hearth Steel.
Hoop Bars:- Type "A" Plain
Concrete:- Class "A" 1½ Severe Mix 1:2-3¼ (by volume) 6 gals of water per bag of cement



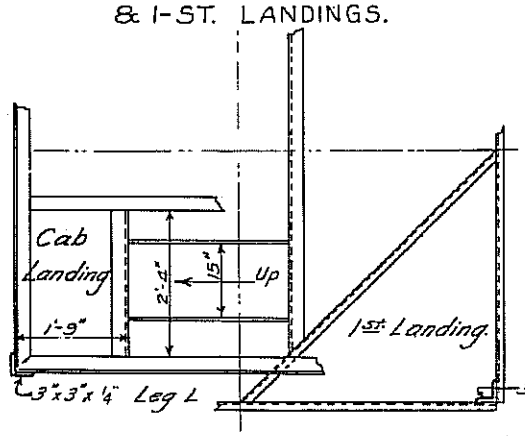
Fill holes about ¾ full, using neat concrete, Drive Anchor Bolt down on wedge to spread split end and fill hole to top Level of footing with 1:2:4 concrete

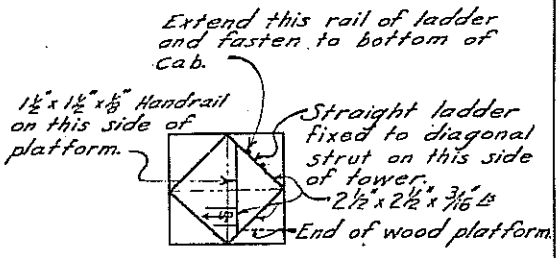
SETTING ANCHOR BOLTS IN ROCK

Revised by:- JD 6-8-34 & 10-9-34 H.D.J.

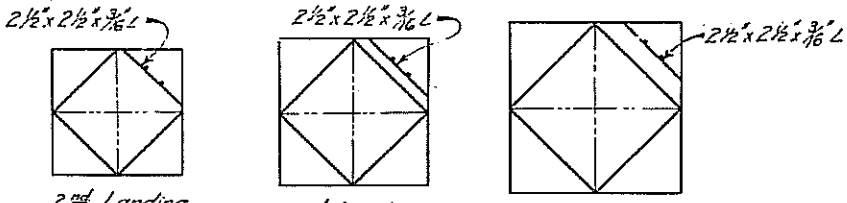
7'×7' LOOKOUT TOWER
FOUNDATION LAYOUT

ENLARGED DETAIL VIEW OF CAB & 1-ST. LANDINGS.





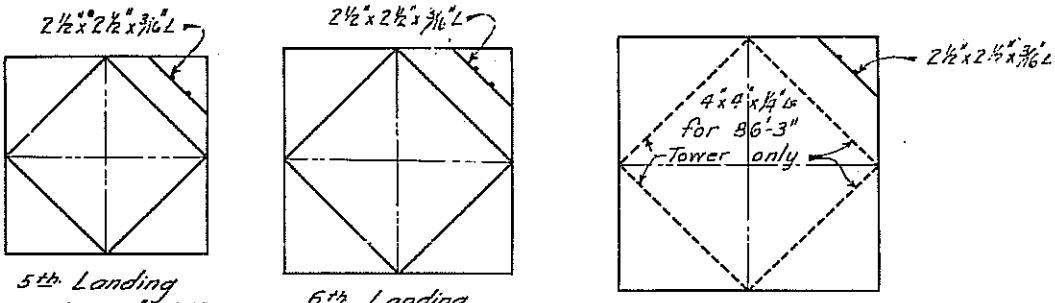
1st Landing of
All others 2"x2"x⅛" Ls



2nd Landing
All others 2"x2"x⅛" Ls

3rd Landing
All others 2½"x2½"x⅛" Ls

4th Landing
All others 3"x3"x¼" Ls



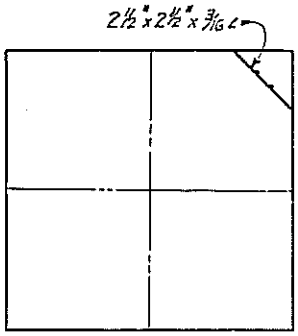
5th Landing
All others 3"x3"x¼" Ls

6th Landing
All others 3½"x3½"x¼" Ls

7th Landing
All others 3"x3"x¼" Ls

Note:- For 86'-3" tower all main struts at 7-th Landing are 4"x4"x¼" Ls.

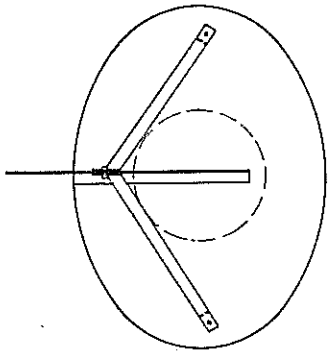
Note:-
Slope of ladder parallels slope of tower leg angle.

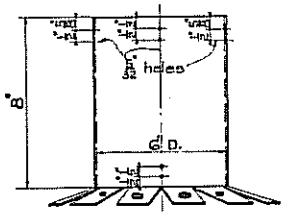


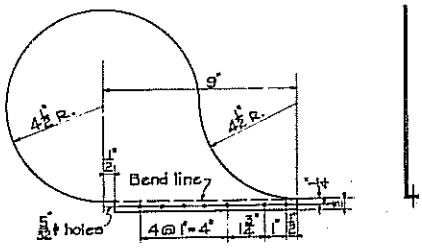
8th Landing
All others 3"x3"x¼" Ls

7'x7' LOOKOUT TOWER
LANDING & GIRTH DETAILS
FOR STRAIGHT LADDER

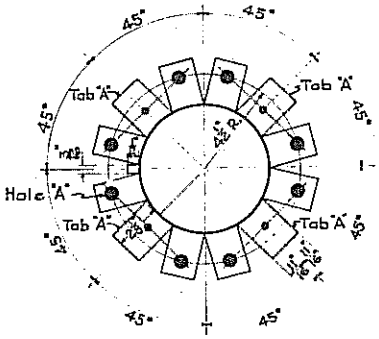
Revised: 7/17/34 H.D.J. 11/16/33 H.E.G. 10/25/32 W.I.D.



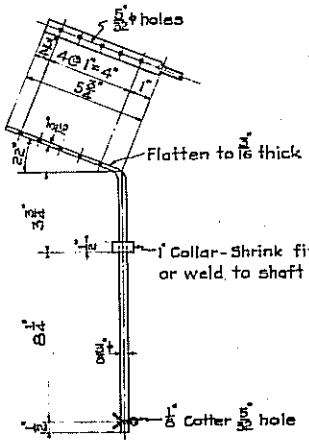




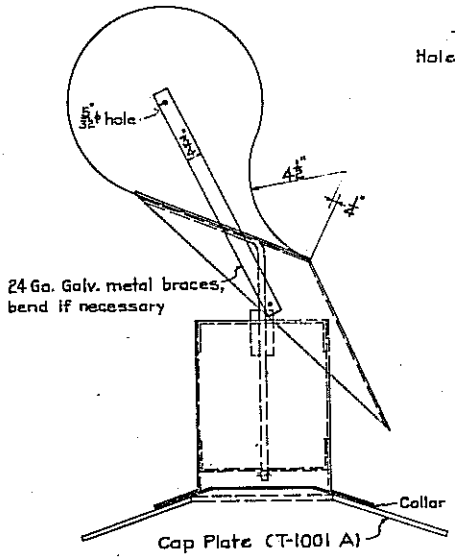
TEMPLATE FOR VANE
24 ga. Galv. Metal
1-Req'd.



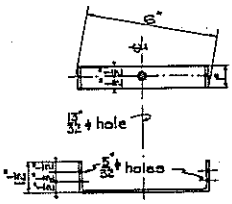
BASE OF STACK
24 ga. Galv. Metal
1 Req'd.



SPINDLE
1-Req'd.

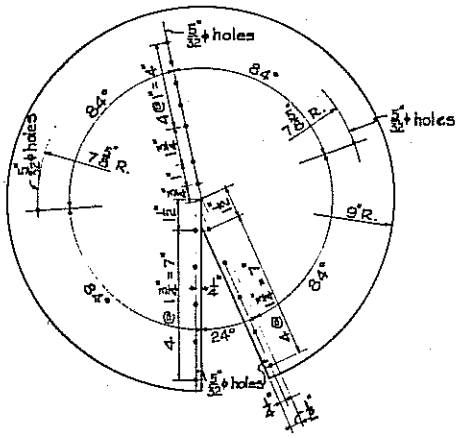


Cap Plate (T-1001 A)

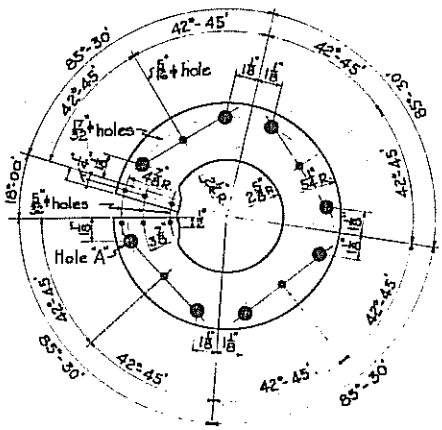


1"x1/8" BEARING PL's
3 Req'd.

Note:
Cone, Vane, Bearing PL's, Braces & Spindle to be riveted up complete with copper rivets



TEMPLATE FOR CONE
24 ga. Galv. Metal
1-Req'd.



TEMPLATE FOR COLLAR
24 ga. Galv. Metal
1-Req'd.

7'x7' LOOKOUT TOWER
DETAILS OF VENTILATOR

SHEET 10 of 10

1/5/35 H.D.J.-A.M.

TELEPHONE

CONSTRUCTION AND MAINTENANCE

Complete and detailed instructions for the construction and maintenance of Forest Service telephone lines will be found in the "Handbook, on Construction and Maintenance of the National Forests' Telephone Systems," 1925 edition, and the "Telephone, Trouble Book R-1," 1928 edition. There are a few special points which are not fully covered in these two books which will be defined and amplified here.

Line Load

A new method of figuring telephone line capacity has been devised. This system uses the decibel unit (db) as a measuring device. The logarithmic derivation of this unit is not essential in our use since for our work it can be considered simply as a unit of load. Each item of load is considered and then these units added to find the total line load. The db loss factors are as follows:

Metallic lines - loss per mile	- .0417	db loss or load
Grounded lines - " " "	- .2	" " " "
Each instrument on ringer	-1.0	" " " "
Switch	- .5	" " " "
Each spur line (This is in addition to its mileage load and phones)	-1.0	" " " "
Repeating coil	- .5	" " " "

Switchboard at a local exchange which has a repeater gives a gain of 5 db. However, very few of the usual local exchanges are thus equipped, generally a loss of one switch on a .5 db is the correct factor.

A line load of 31 db is standard. This means that the speech level should be comparable to ordinary telephone conversation in town. In case of an emergency the line can be loaded to 35 db and still maintain communication, but this is not advisable. When planning a new line it is better to plan for a 27 or 28 db load as this will allow the addition of several more phones without exceeding the db limit.

Standard Splice

The standard Western Union splice is standard construction on all Forest Service lines.

This splice consists of five long wraps with five close wraps on each end. Soldering splices in line wire is unnecessary, but care should be taken that the wires are clean, before the splice is made and that each turn is tight.

A more general use of the Fahnstock clamp in making copper to iron connections is desirable; outside connections on a pole are hard to solder, and unless soldered a galvanic action is set up

between the copper and zinc coating which will eventually build up a high resistance at the connection. For such connections use a #30 Fahnstock connector (copper to iron); tests made using this clamp show that the resistance in such connections is no greater than in a soldered copper to iron splice.

Railroad and Electric Line Crossings

All crossings should be underground as shown on page 49 of the Telephone Handbook.

Highway Crossings

Crossings over a highway, if practicable, should be at right angles, with a short crossing span; and the wire should be at least 20' above the road. Line should be dead-ended on both sides of road. If fastened to trees, span crossing road should have at least three feet of sag.

Lightning Protection

Line fuses are of no value against the initial lightning discharge. Their principal function is to give protection against damage that may arise from the telephone wire coming in contact with a high voltage circuit. Additional protection against lightning at stations other than lookouts, is best secured by installing a 975B air-gap sawtooth arrester on the pole to which the line is dead-ended before entering the building. This protector must be mounted in a weatherproof box. It is not necessary to cut the line wire when installing this protector. Merely run a No. 14, or larger, copper wire, either bare or insulated, from the line wire to one of the upper connections of the protector, with a similar wire from the lower connection to ground.

Vacuum arresters are standard for all inside installations. This protector must be mounted in a vertical position, with the tube end up, and must be placed at the point where the line wire enters the building; with a ground wire carried at once through a porcelain tube or loom to the outside of the building, and carried on porcelain knobs to a ground rod driven into the ground directly below the point where the wire leaves the building. At lookouts and other buildings having adequate lightning protection, the ground wire should be connected to the nearest lightning conductor. If this is done the ground rod can be dispensed with. With vacuum arresters the line wire will be attached to the top post and the ground wire to the bottom post.

(See handbook "Instructions and Specifications for Protection Against Lightning" - 1932)

Inside Wires

Use #20 B. & S. Flameproof telephone wire from the lightning protection to the instrument board. If there are only one or two

instruments at the station, a twisted pair can be used; if more, it is advisable to use a common ground wire, using #14 B. & S. insulated copper for this purpose. It is not necessary to keep the wires from the different instruments separate; they can be made up into a neat cable and fastened to the walls with insulated staples or nails.

It is optional whether the protection be mounted inside or outside the building. If outside, it must be mounted in a neat weatherproof box, but in any case it must be installed at the point where the wire enters the building, with a #14 R.C.S.B. ground wire carried on porcelain knobs to a ground rod driven into the ground directly below the protector. If it is not possible to drive a ground rod close to the building, attach the ground wire to a #10 copper wire, string along the ground to a point where a ground rod can be driven. If possible, bury this wire underground, but if on bare rock, lay loose rock on it to hold it down and protect it. Do not carry a ground wire from the lightning protector to ground on poles or trees.

Drop Wire

Do not attach the line wire directly to the building. Use a pole or tree not over 50' away. Dead-end the line wire to the pole or tree. Then run a drop wire of #14 R.C.S.B. copper wire to the building. Standard glass insulators and brackets or strain insulators should be used for dead-ending. For fastening the wire to the building, use either a Pierce Telephone wire holder or a Diamond insulated screw eye. The connection to the line wire should be soldered, but if this is not practicable, use a copper to iron Fahnstock clamp. In no event should a copper wire be connected to an iron wire unless soldered or attached by means of a clamp. Do not make attachment to the house under the eaves, where sliding snow may cause trouble; always carry the wire to the gable end.

Stubbing Poles

In setting stubs on lines along a road, the stub should be set on the side of the pole farthest from the road, except on curves, when the pull should be against the stub.

In crossing old burns it quite frequently occurs that there are a number of burnt snags from 4 to 6' in height, but none high enough to carry the line. In such cases the snag should be considered as a stub and a pole of sufficient height spiked to it, using 12" galvanized iron spikes with chisel point. By using this type of point and cutting across the grain, there is but little danger of splitting the pole, and the spikes can be driven without first boring a hole. After spiking, the pole should be further secured by wrapping with wire as shown in Fig. 7, page 32 of the Telephone Handbook.

Trouble Shooting

Fig. 81, page 92 of the Telephone Handbook, shows a method of testing the talking circuit of a telephone. In making this test the line wires are first disconnected from the instrument. A short piece of wire is then run from binding post L-1 to post L-2; this makes a complete circuit in the instrument. Then if the receiver is held to the ear, any sound made at the mouthpiece of the transmitter should be heard in the receiver. If the sound is heard, the talking circuit is in good order; if not, proceed to test out the different parts as described on page 103 of the Telephone Handbook.

Tree Line Construction

Use ladders rather than climbers for construction; they make for faster, more uniform and altogether better work. A light ladder that one man can handle with ease can be cheaply built on the job. Climbing trees all day with spurs is a hard job, and unless the trees are of uniform size, time will be wasted in adjusting the safety belt to fit each particular tree. In going through reproduction, using a ladder, trees can be used that could not be climbed using spurs.

The use of a pruning saw with sectional handle, such as is used in Silvicultural thinning work, will greatly facilitate the trimming of trees along the line. It will save much climbing as well as time.

Depth of Holes

On page 34 of the Telephone Handbook the depth of holes for 18 to 25' poles is placed at 4'. Practice on our lines has established the fact that in ordinary soil 3½' is ample, and if the soil is compact and hard to dig, 3' is enough.

Disconnect Switches

Where disconnect switches are installed for the purpose of disconnecting the telephone during periods when the station is not occupied, they should always be placed between the instrument and the protection.

1C or Adams Howlers

When these instruments were first installed, a 21W condenser having a capacity of 1 M.F. was placed in the circuit. This is the same condenser that is used in all Forest Service telephones to enable a ring to go through if a receiver is off the hook. With the receiver on the hook, the condenser is no load on the line; with the receiver off, it adds a load of about 16 milliamperes.

The coils in a telephone receiver are wound to a resistance of about 75 ohms, the coils in a 1C howler to 1000 ohms.

Therefore, the condenser used in a holwer circuit need not have as great a capacity as that used in the receiver circuit. For this reason the 1 M.F. condensers used in all howler circuits should be replaced with 21 AL condensers of 1/4 M.F. capacity, which will reduce the load from 16 to about 3 milliamperes.

Dispatchers' Desks

A special desk for use at district ranger's headquarters has been designed. This desk contains the switchboard and an operator's switchboard cord set, so that the dispatcher's hands are free at all times for writing notes or working over the fire map while talking. It is standard for all such stations on the fire Forests. It also has adequate space for all fire control records. The map is mounted on a movable easel so that it can be used either in a vertical or horizontal position. The cordless switchboards already in use can be dismounted and the front or key part mounted in the desk where the knife switchboard is shown. It is the intention that these desks be used exclusively for fire control dispatching. They are not intended to replace the regular ranger's desk or table. It may be desirable to put a desk phone on one switch so that the ranger and dispatcher may talk at the same time over different lines.

Switchboards

At some stations where there are a large number of lines coming through the station and the volume of traffic is constant and heavy, it may be advisable to install a regular switchboard of multiple type which will afford more than two switching circuits, as is the case with the cordless and the knife switch types. Situations of this character should be referred to the Regional Office for advice, and the proper type of commercial switchboard best suited to the case will be selected and supplied through Central Purchase.

Howler Signals

At some stations it will be necessary to install a loud signal that may be heard a greater distance than the ordinary bells can be heard. A telecode relay and auto horn can be hooked in the telephone circuit which will answer the purpose admirably, as shown in the accompanying diagram. It should always be disconnected when not actually needed, and especially at night.

Lookout Telephones

The standard telephone for use at lookout points is shown in the accompanying illustration. It will consist of a modified wall telephone with operator's breast transmitter and head receiver mounted on the Bosworth firefinder, as shown. It will be protected in accordance with the instructions for lightning protection at lookout points, the vacuum arrester and switch being installed under the floor of the house.

Pole Lines vs. Tree Lines

The Handbook of Telephone Construction states: "Tree lines will be used wherever practicable. Pole lines will be built only where (1) trees are not available on a feasible and practical route; (2) it is necessary to construct metallic circuit lines to eliminate electrical interference."

Since pole lines are generally more expensive to construct than tree lines and the setting of poles at intervals in tree lines generally increases the cost of the line, the question should be given serious consideration in planning construction and maintenance work and suitable instructions issued for each job which will insure against high costs due to the excessive use of poles. The following guiding principles should be kept in mind:

1. On general routing under average conditions the length of a tree line can be 40% longer and still be cheaper than a pole line. (On the other hand the cost of maintenance will be increased if the line is not routed along a trail.)

2. On lines where trees are generally available poles should not be set unless (a) it is clearly cheaper due to reduction of length of wire and amount of clearing; (b) changes in alignment between trees would be greater than about 45°; (c) span would otherwise be in excess of 200'. (In cases of necessarily long spans, the span on either side of the long span must be graduated in length for at least three spans so as to keep the slack from running to the long span.)

Static Filter and Amplifier

This filter and amplifier cannot be secured in manufactured form, therefore must be made up in Missoula. Requisitions should be submitted December 1 so the equipment can be made up during the winter. Requisitions should be accompanied by a statement covering the following points:

1. Name of telephone line and termini where filter and amplifier will be used.

2. Type of telephone to which amplifier and filter will be attached.

TELEPHONE LINE MAINTENANCE

Within the Forest the major purpose of telephone lines is to expedite fire control. Very few miles of our lines serve any other basic purpose. Three things are essential to fire control service:

1. That the line be free from grounds, either tree grounds, brush grounds, or grounds that result from direct contact with earth.

2. That sufficient line clearance is provided to make it impossible for stray animals to become entangled in the lines and break them.

3. That instruments are properly installed. Here, again, there are three essentials:

A. That there be an adequate ground. If necessary, an artificial ground should be developed.

B. That lightning protection should be adequate and so far as possible trouble-proof. For this reason the vacuum type of arrester is recommended.

C. That any switch arrangement at the point of installation be of the most simple nature.

With telephone lines, as with trails, there are certain things to avoid in the doing of maintenance work. Back tracking of men and too many men for the job serve no purpose except to run up costs. Poorly equipped men have the same effect. Unnecessary poles in the line run up the cost of maintenance, and whenever a tree will serve the essential needs of the telephone line, poles will not be set. Slavish adherence to span equalization beyond certain common sense limits serves no useful purpose, neither does alignment that is nice to look at. Neither does right-of-way clearing or brushing out which removes trees and other growth which could not possibly touch the line except under a snow load. (Snow load should be taken into account only on lines that are subject to winter use.) Do not allot money for expenditures that result in excesses in any of these items.

TELEPHONE REPAIR PARTS LIST

Wall Telephone - Kellogg #F-2884 has a 6-bar magneto

Ringer No. 78-G includes coils and frame without gongs and nuts, unless specified.
Ringer repair parts listed under "Extension Bell"
Receiver No. 41-A
Receiver cord No. 242
Switch hook spring contact assembly for 2884 tel.
Transmitter No. 64-L
Mouthpiece for No. 64-L transmitter, No. P-29779
Magneto (Generator) No. 75 - is a 6-bar magneto
Crank for No. 75 magneto
Spring contact assembly for No. 75 magneto
Induction coil, No. 28 C
Condenser, No. 28

Wall Telephone - Kellogg #F-2880 has a 5-bar magneto

Magneto (Generator) No. 53 - is a 5-bar magneto
Other parts the same as in the No. 2884 telephone

Short Base Wall Telephone - Kellogg #F-1983:

Parts the same as in the No. F-2884 telephone

Grab-a-phone - Kellogg

This set includes a No. 12 L Grab-a-phone and a No. F-1880 subset (magneto box) containing ringer and switch hook
Mouthpiece No. P-43963 for No. 12 L Grab-a-phone
Transmitter for No. 12 L Grab-a-phone
Receiver No. 50 A for No. 12 L Grab-a-phone
Diaphragm No. 1400 for No. 30 A receiver
Cord No. F-454-G Special 96"
Magneto box No. F-1880 G subset with No. 75 generator and 78 G ringer
Hook switch No. 110, includes spring contact assembly with Grab-a-phone hook
Generator (magneto) No. 75 - a 6-bar magneto
Spring contact assembly for No. 75 magneto
Crank for No. 75 magneto
Ringer No. 78 G - includes coils, frame with or without gongs and nuts as desired
Condenser No. 28

Portable Desk Telephone - Kellogg

Includes a No. 90 A desk stand and a No. 2415 desk set box
Receiver No. 41 A
Receiver cord No. F-6444 T R
Transmitter No. 64 L
Desk stand cord - 4 conductor No. F-666 D
Ringer parts - see "Extension Bell"
Mouthpiece for transmitter No. 64 L
Desk stand cord F-150 D
Generator (magneto) No. 75 is a 6-bar magneto
Spring contact assembly for No. 75 generator
Crank for No. 75 generator
Ringer No. 78 G, complete, including coils and frame with or without gongs and nuts
Induction coil No. 28 C
Condenser No. 28

Portable Field Telephone - Kellogg No. 1016

Receiver No. 14 A
Cap for No. 14 A receiver
Shell for No. 14 A receiver
Receiver cord No. 98 T R
Hook switch for Kellogg No. 1016 field set
Generator No. 53
No. 18 G ringer, complete, including coils, frame with or without gongs and nuts

Receiver No. 41 A - Kellogg

Receiver cap No. P-32307
" shell No. 27944
" diaphragm No. 1400
(Note: Diaphragms for Kellogg No. 41 and Graybar No. 143 A.W. receivers are interchangeable)

Magneto Generator - Kellogg No. 75 6-bar

3 No. P-13459 magnets
3 No. P-13462 "
Armature for No. 75 magneto - no code No.
Crank shaft for No. 75 magneto - no code No.
Other parts same as in No. 53 magneto

Magneto Generator - Kellogg No. 53 5-bar

1 No. P-29992 magnet
2 No. P-13459 "
2 No. P-13462 "
Armature assembly No. PC-12974
Contact spring assembly No. P-42687
Large gear wheel assembly No. P-3267
Small gear wheel assembly No. P-3273
Crank shaft (does not fit the No. 75 magneto) No. P-4500
Crank No. P-15911
Screws for fastening magneto in telephone
Machine screws - 1" #14-24, R.H. 4 required

No. 5 Howler - Kellogg

Diaphragm No. 1400
Coil - right - No. 47614
Coil - left - No. 47620
Horn for No. 5 howler, no code No.

Extension Bell - Kellogg No. 37 S G

No. 78 G ringer, includes coils and frame without gongs or nuts unless specified
Coil only - No. P-27382
Magnet No. P-12154
Gong No. P-30488
Nut for gong No. P-39400
Washer for nut No. P-46936
Clapper assembly No. P-12157
Pivot screw for clapper: No. P-2451 screw; No. P-2522 lock washer
Screws and washers for fastening frame to box: No. P-6121 screw; No. P-14762 washer

Wall Telephone - Graybar No. 1317 S

Ringer No. 38 B, includes coils and frame without gongs
Ringer gongs - No. 26 A
Gong nuts No. P-13695
Receiver No. 143 A W
Receiver cord No. 521
Switch hook assembly No. 143 Y
Transmitter No. 323 B W
" bracket No. 8 A
" mouthpiece No. P-94590
Induction coil No. 13
Magneto generator No. 48 A
Condenser No. 21 W
" strap No. P-43065

Portable Desk Telephone - Graybar

Includes a No. 1040 A L desk stand and a No. 300 N desk stand box
Transmitter No. 323 B W
Receiver No. 143 A W
Mouthpiece for transmitter No. 323 B W
Receiver cord No. 549
Desk stand cord No. 550 (is 5½' long)
Transmitter cord No. 547, 2 required
Generator (magneto) No. 48 A
Ringer (bell) No. 51 B G (2500 ohm)
Condenser No. 21 W
Condenser strap No. P-43065

Iron Mine Telephone - Graybar No. 1336 E

Receiver No. 143 A W
Receiver cord No. 364
Transmitter No. 1312
Mouthpiece for transmitter No. 1312
Magneto No. 48 C
Spring contact assembly for magneto No. 48 C
Switch hook assembly No. 143 J
Ringer No. 46 B including coils and frame, with or without gongs and nuts, as desired

Portable Telephone (leather set) - Graybar No. 1375 B

Hand set No. 1001 H
" " cord, 3 conductor No. 366
Magneto No. 29 D
Buzzer No. D-21141
Induction coil D-17624
Leather case P-139726

Portable Telephone (leather set) - Graybar No. 1375 B (con't)

Case mounting screws No. P-117156
Aluminum frame P-141455
Generator mounting screws No. P-123826
Top wood block No. P-135285
Line binding posts P-122936
Circuit diagram label, P-114789

Receiver - Graybar No. 143 A W

Receiver cap No. P-93519
" shell No. P-93518
" diaphragm No. P-95114

Magneto Generator - Graybar No. 48 A

Contact spring assembly for 48 A generator
Generator crank No. P-158950
Crank shaft No. P-139864
Collar for crank shaft No. P-113491
Large gear wheel and sleeve No. P-139889
Pinion (small gear) complete, including small gear wheel No. P-101493, spring No. P-42972, washer and cap No. P-42977
Armature No. P-156430
End magnets - 2 used - No. P-106117
Center magnets - 3 used - No. P-136790
Mounting bracket for holding magneto No. P-121710
Long screw for same No. P-42986
Nut for screw No. P-101556

No. 1004 A Hand Set - Graybar (aluminum portable telephone)

Special No. 131 W receiver per D-51129
" No. 244 W transmitter per D-51130
No. 32 induction coil
No. 39 A condenser
Vibrator spring contact assembly No. A 112375
Screws for shell No. P-17289 oval H.M. or 1/4x6/32 F.H. brass screws
Screws for cover cap No. P-97404 oval H.M. or 1/4x5/32 F.H. brass screws
Contact screw - is a #6-32 brass screw, 1/2" long overall and has a platinum point at one end; other end slotted for screw driver. H. A. Wilson Company, Newark, N.J. Cost approximately 50¢ each in quantity of 50.

1917 Model Army Field Telephone

This is now an "orphan" telephone; therefore, parts are difficult to get. Screw sizes for fastening

1917 Model Army Field Telephone (con't)

the aluminum frame to the box are as follows:
The following part substitutions may be made -

Transmitter	-	Transmitter for 1025 Kellogg Test Set
Receiver	-	Receiver " " " " "
Hand Set	-	Kellogg No. F-150 D
Condenser	-	" No. 20

1914 Model Army Buzzer Set

It is not possible to obtain parts for the 1914 Model Buzzer Telephone. If they cannot be repaired locally, send them in to the Regional Forester.

Note: Graybar No. 47A or 47B plug may be used. While this is not the same as the special plug originally furnished with these sets, it will fit the jack in both the 1917 and 1914 buzzer sets above mentioned. For lead wire, use ordinary electric light cord which may be connected to the 47 plug.

Iron Mine Telephone - Graybar No. 1336 J

Transmitter No. 312 W	
" mounting bracket	No. P-109455
Screws for same " "	No. P-13032
Transmitter mouthpiece	No. P-106561
Receiver	No. 144 A W
" cord	No. 384 (10½")
Condenser	No. 21 W
Ringer	No. 45 B G (2500 ohm)
Generator (magneto)	No. 48 C
" crank	No. P-158948
Switch hook	No. 143 J
Induction coil, inc.	No. 31
Wood case	No. P-112357
F.H.M. Mounting screws	No. P-117171

Howler Assembly - Graybar No. 1C

Horn for No. 1C Howler
Diaphragms No. P-95114
Coils No. P-90916
¼ M.F. Condenser No. 21 Y

EQUIPMENT AND MATERIAL LIST

TELEPHONES

Description	Purchase from	Approximate Cost	Wgt.
Wall telephone: 2500 ohm ringer; condenser in receiver circuit, 5-bar magneto; room for 3 dry cells in battery box.	Kellogg, F-2884, except 5-bar magneto.	$19.50	34#
	Graybar, No. 1317S	19.50	34#
Wall telephone: Same as above, except has 6-bar magneto. For heavy use on heavy loaded lines.	Kellogg, No. F-2884 with condenser in secondary (receiver) circuit.	22.50	26#
Short wall telephone: Does not have a battery box; otherwise same as item No.1	Kellogg, No.1809 Special, with a 5-bar magneto, 2500 ohm ringer and $\frac{1}{2}$ M.F. condenser in receiver circuit.	20.00	25#
Portable desk telephone: Includes (a) desk stand complete, (b) desk set box inc. 5-bar magneto, 2500 ohm ringer; has condenser in receiver circuit.	Graybar, No. 1040 AL desk stand, No. 300N desk set box. Kellogg, No. F-84 desk stand; No. 2371 desk set box.	20.00	20#
Portable desk telephone: Same as above except desk set box has a 6-bar magneto instead of a 5-bar	Kellogg, No. 90A desk stand No. 2415, desk set box with condenser in receiver circuit.	22.00	20#
Grab-a-phone: Consists of one-piece hand set, including receiver and transmitter, connected with a 96" cord to a magneto box including hook switch, 6-bar magneto, 2500 ohm ringer; has condenser in the receiver circuit.	Kellogg, No. 12 L Grab-a-phone, No. F-1880 magneto box and desk stand, cord No. F-454-G, special 96".	23.00	22#
Portable field telephone: Includes 2500 ohm ringer with bells, 5-bar magneto mounted in small wood box with transmitter on face.	Kellogg, No. 1016 test set.	21.00	18#

Description	Purchase from	Approximate Cost	Wgt.
Portable field telephone: Has 3-bar magneto, buzzer instead of bells mounted in leather case.	Graybar, No. 1330 E test set.	--	10#
Portable field buzzer telephone: Has no magneto or bells, uses buzzer for calling - not possible to receive calls.	Kellogg, No. 2731 Railway telephone.	--	8#
Dispatcher's desk telephone set: Complete, includes, (a) dispatcher desk telephone F.S. Type (Wonderphone) (b) magneto, includes a 6-bar magneto and 2500 ohm ringer in a suitable box. Note that the telephone set and magneto are purchased from different companies.	Universal High Power Tel. Co., Carlton & Eddy Sts., Seattle, Wn.	40.00	10#
	Kellogg No. 75 6-bar magneto and a 2500 ohm ringer mounted in a cabinet for a 2415 desk set box with 2 inside binding posts.	12.00	12#
New Kellogg "Grab-a-phone": No. 700 Masterphone, includes hand set and cradle with switch in base, cord 3 cond.		11.40	
No. 2415 Desk Set Box, having 6-bar magneto, 2500 ohm ringer induction coil, and condenser in receiver circuit, box to be wired for a 3 conductor cord.		16.10	
	Total	$27.50	
Graybar "Grab-a-phone" type telephone: 1 - 300N desk set box 1 - cradle desk stand for manual operation, including #B1A-3 hand telephone set #D3H cord, 5'6" long #50H apparatus blank		16.30	
		14.85	
	Total	$31.15	

MISCELLANEOUS EQUIPMENT

Extension bell: 2500 ohms.	Graybar, No. 127F extension bell. Kellogg, No. 57sg extension bell	$ 6.75	--

Description	Purchase from	Approximate Cost	Wgt.
Howler: for receiving howler signals. (Requires a $\frac{1}{4}$ M.F. condenser.)	Graybar, No. 1C Howler	9.00	$2\frac{1}{2}$#
Condenser: $\frac{1}{4}$ M.F. for use with the No. 1C Howler	Graybar, No. 21Y condenser	1.00	$\frac{1}{2}$#
Howler: for receiving howler signals. Includes howler and $\frac{1}{4}$ M.F. condenser mounted on wood base.	Kellogg, No. 5, with $\frac{1}{4}$ M.F. condenser	7.80	3#
Extra head phone receivers: for dispatcher's telephone (Wonderphone).	Kellogg, No. 65 100 ohm - 2 required	2.45 ea.	
	with #11 headband	.75 ea.	
Fahnstock connectors, No. 30 Specify: No. 30 for connecting No. 9 iron to No. 9 copper; No. 30 for connecting No. 9 iron to No. 9 iron.	Kellogg or Graybar	.10 ea.	
Repeating coil:	Kellogg, No. 17F Repeating coil	6.75	$6\frac{1}{4}$#
	Graybar, No. 77A repeating coil		
Line fuse: Foot-Pierson's W.B.G. fuse holder with a $\frac{1}{2}$ amp. fuse.	Kellogg	.75	4 oz.
Fuse: renewals for the above	Kellogg, fuse renewals for the W.B.G. fuse	.10	--
Vacuum lightning arrestor: Single pole	Graybar, G.E. No. 140057	1.50	2#
	Kellogg, Nat'l Elec. Specialty Co. No. 4 Vac-m lightning arrestor	1.85	2#
Vacuum lightning arrester: Double pole	Graybar, G.E.'s No. 1510809, vacuum arrester	2.50	$3\frac{1}{4}$#
	Kellogg, Nat'l Elec. Specialty Co. No. 3-B Vac-m lightning arrester	2.75	$3\frac{1}{4}$#

Description	Purchase from	Approximate Cost	Wgt.
Condensers: $\frac{1}{4}$ M.F. (.2 to .3) (Used with all types of howlers)	Graybar, No. 21 Y, requires mounting strap No. P-43065	1.00	6 oz.
	Kellogg, No. 20, requires mounting bracket No. PC 10638	1.00	6 oz.
$\frac{1}{2}$ M.F.: (used in receiver circuit Kellogg telephone)	Graybar, No. 21 AS, requires mounting strap No. P43065	1.00	6 oz.
	Kellogg, No. 28, has side ears for mounting	1.00	6 oz.
1 M.F.: (8 to 1.0) (Used in receiver circuit Graybar telephone)	Graybar, No. 21 W, requires mounting strap No. P43065	1.00	6 oz.
	Kellogg, No. 28, has side ears for mounting	1.00	6 oz.
2 M.F.: (for special use)	Graybar No. 21 D, requires mounting strap No. P43065	1.00	6 oz.
	Kellogg No. 53, has side ears for mounting	1.00	6 oz.
No. 14 B&S Ga. R.G.S.B.: (rubber covered single braid) copper wire. Comes in 500 coils. Specify either white or red (paraffin) finish.	Kellogg, Graybar or any electric dealer	4.00	14# coil
Porcelain tube: 5/6" x 3"	Kellogg, Graybar or any electric dealer	--	--
"Loom": 7/32" may be used instead of porcelain tube	Kellogg, Graybar or any electric dealer	--	--
Nailet knobs:	" "		
Friction tape: 3/4" wide, in $\frac{1}{2}$# rolls; 3/4" Blake (insulated) staples.	" "	.60 per lb.	
Rosin core solder: Kester's, comes in 1-lb. spools.	" "	.70 " "	
Solder flux: Allen's stick, 3/4" x 5" size	" "	.30 ea.	

Description	Purchase from	Approximate Cost	Wgt.
Ground rod: "Copperweld" is a copper covered, steel ground rod. NOTE: Order 1 ground rod clamp for each ground rod.	Jobbers Sup. Co. Pacific States Elec. Co. Kellogg, Graybar ½ x 6" "Copperweld" ground rod	.95	
Ground rod clamp: for use in connecting wire to copperweld ground rod.	Stocked by above companies. Specify ½" ground rod clamp with square headed nut	.25	½#
Ground clamp: for making connection to galvanized iron water pipe. No. A-1 Blackburn adjustable ground clamp. Type E All-in-one ground clamp.	Kellogg, Graybar	.15	4 oz.
Telephone extension arm: For portable desk telephone. When ordering specify for mounting on top, side or edge of a desk or wall.	Kellogg "Sperry's" Universal Arm No. 12	--	8#
Operator's breast transmitter set: 1 #145 Operator's plug ...$1.25 1 #325A " jack.. 1.25 1 #76L B.P. transmitter ... 3.75 6' cord for same ... 2.20 1 #65A receiver ... 2.45 1 #12 headband (#11 for double head receivers) ... .40 1 #28C induction coil .75 1 #1 M.F. condenser.. .85 $12.90	Kellogg	12.90	3#
Guy strand: standard 7-strand, Siemens; Martin: 5/16 breaking strength 6000#, 3/8 breaking strength 6900#.	Kellogg, Graybar, Roebling		210# per M ft. 275# per M ft.

Description	Purchase from	Approximate Cost	Approximate Wgt.
Guy clamp: standard 3-bolt clamp, medium Hubbard #7450-6", or Joslyn #1033-6"	Jobbers Sup. Co. Kellogg, Graybar		275# per C
Guy clamp, light, 3-bolt clamp - Joslyn #1031			155# per C
Guy rod: specify either Seyler No., thimble-eye guy rod or thimble-eye threaded anchor rod.	Jobbers Sup. Co. Kellogg, Graybar Specify size and length, 5/8"x6' or 3/4"x8'	$1.50 1.75	7# 12#
Square washers: for guy rods	Same firms as above. 4"x4"x1/2" square washer, galvanized. Has 1-1/8" hole	.10	2.1# ea.
Strain insulators: for use in dead-ending No. 9 iron wire and light guys. Is 1/2"x2½" with 5/16" hole.	Same firms as above. No. 500 strain insulators	67.00 per M	255# per M
Strain insulators: for use with 5/16 guy cable; is 2½"x3" with 3/8" hole.	Same firms. No. 502 strain insulator	182.00 per M	900# per M
Glass insulators: for use on wood brackets or crossarm pins.	Same firms. No. 16 Hemengray or equal glass insulators	91.00 in less than 200 lots 72.00 in lots 200 to 1000	1# ea.
Crossarm braces:	Same firms.		
1 7/32"x7/32"x22" for 4 or 6-pin crossarm		135.00 per M	1700# per M
1 7/32"x7/32"x26" for 8-pin crossarm		145.00 per M	1840# per M
1 7/32"x7/32"x30" for 10-pin crossarm		159.00 per M	2100# per M
Crossarm bolts: 10" long	Same firms.	Less than 82#	
Crossarm bolts: galvanized, 5/8 x10", Item 29		$10.70 per C for 100 9.75 per C over 100	

Description	Purchase from	Approximate Cost	Approximate Wgt.
Crossarm bolts: 12" long	Same firms.	Less than 92#	
Crossarm bolts: galvanized, 5/8 x 12", item 30		$12.05 per C for 100 10.95 per C over 100	
Carriage bolts: galvanized, 3/8 x 4", item 31, for attaching crossarm braces to crossarms.	Jobbers Sup. Kellogg, Graybar	2.55 per C Less than 100 2.30 over 100	15#
Crossarm washers: small, item 33, 2 x 2 x 1/8", with 11/16" hole.	Jobbers Sup. Kellogg, Graybar	15.30 per M Less than 100 13.90 per M over 100	
Lag screws: galvanized, 1/2 x 4", for attaching crossarm braces to pole.	Jobbers Sup. Kellogg, Graybar	3.75 per C Less than 100 3.40 per C over 100	
Crossarm pins: steel, Western Union type, 1/2 x 9½" with 3/4 hardwood top, item 35.	Jobbers Sup. Kellogg, Graybar	11.75 per C Less per C than 100 10.70 per C over 100	74#
Wood bracket: is 2 x 2-3/8 x 12" (larger than the one formerly used). Western Union No. 2555, wood bracket (Joslyn catalog).	Valley Mfg. Co. Woodburn, Oregon Jobbers Sup. Co. Seattle or Portland Kellogg, Graybar	.06 ea.	1100# per C
Wood tree pins: used for tree line construction.	Valley Mfg. Co. Woodburn, Oregon	.05 ea.	6 oz. ea.
Transposition bracket: No. 110 Pierce (with U bolts for No. 19J Joslyn) 3¼ x 4½" crossarms.			1.6# ea.
Double pole horn gap arrester: G.E. No. 2906818 G1.		8.00	10#

CROSSARMS

				Pin Spacing					Holes for Brace Bolts				
No. of pins	Length of crossarms	Size of crossarm	Diameter of pin holes	Between center pin holes	Between side pin holes	Between end pin holes and end of crossarm	Dia. of hole at center of crossarm for through bolt	Length of crossarm brace to use	Number of holes	Diameter of holes	Distance of hole from center of crossarm	Distance between center of holes	Approximate weight of crossarm. Fir.
4	5'	$3\frac{1}{4}$x$4\frac{1}{4}$"	1-17/32"	28"	12"	4"	11/16"	20"	2	3/8"	16"	32"	17#
6	7'	"	"	"	"	"	"	22"	2	"	18"	36"	24#
8	9'	"	"	"	"	"	"	24"	2	"	20"	40"	30#
10	11'	"	"	"	"	"	"	26"	2	"	22"	44"	37#

TOOLS

Description	Purchase from		Approximate Cost	Wgt.
Climbers: regular, eastern, Kleins #1901. Specify length of shank.	Kellogg,	Graybar	$4.05 per pr.	
Climbers: tree w/3" spur, Oshkosh. Specify length of shank. Are about the same as above climber, except that it has a 3" spur, set a little higher up on the shank.	"	"	5.50 per pr.	2#
Climber strap: sets of 4, including 2 bottom and 2 top straps, Oshkosh for either climbers.	"	"	2.10 set	2#
Lineman's belt: Klein's #5204-38.	"	"	5.04	2#

Description	Purchase from	Approximate Cost	Wgt.
Lineman's safety strap: Klein's #5250, 1" x 6'.	Kellogg, Graybar	$4.81	2#
Pliers: for use with #9 iron wire. Klein's #212-8 (8") has holes for twisting wire at connections.	" "	2.75	
Pliers: 6" long nose, Klein's #501-6.	Kellogg, Graybar	1.98	
Pliers: oblique cutting, Klein's #202-5, Swedish #526-5.	" "	1.50	
Connector: (combination wire and sleeve clamp) heavy, Klein's #132-15 is 11½" long, Red Devil #417-10 is 3/4" long.	" "	4.68 4.68	16 16# 17# per dz.
Connector: (combination wire and sleeve clamp) light, Klein's #132-12 is 9" long, Red Devil #424-9.is	" "		10# 10½# per dz.
Come-a-long: without pulley #1613-30, Chicago grip for stretching wire.	" "	2.20	2#
Screw driver: w/6" blade, Klein's #909-6.	" "	.45	
Test clips: #27 come 10 in a box, purchased by the box.	Kellogg Co. only	.08-3/4 ea.	
Special pruning saw: Specify with or without long handle.	Made by Famio Saw Works, Chico, Calif.	Price on application	

SWITCHBOARD EQUIPMENT

Building posts: single	Kellogg, #11	.05	½ oz.
Terminal strip:	"		
No. 41-bar 10 binding posts	#41	1.00	
No. 42-bar 20 " "	#42	1.40	
No. 43-bar 50 " "	#43	2.00	

Description	Purchase from	Approximate Cost	Wgt.
No. 20 tinned telephone wire: suitable for switchboard work. Insulation in 10 different colors.	Kellogg	$ .90 per lb.	180' per lb.
Knife switches:	"		
No. 707-S.P.S.T.		.20	
No. 708-S.P.D.T.		.32	
No. 709-D.P.S.T.		.35	
No. 710-D.P.D.T.		.50	
No. 711-3 P.S.T.		.60	
No. 712-3 P.D.T.		.90	
Switchboard keys: Note: If key is required for single mounting, when ordering, specify code number of key desired, mounted on a No. 1021 escutcheon for which there is no additional charge. If it is desired to have several keys mounted on one strip, specify the number of keys (giving proper code No.) on a No. 401 mounting strip with blanks for vacant openings. The mtg. strip is punched for 10 keys; therefore, if only 6 keys are desired, 4 blanks should be ordered, et cetera. If 5 or more keys are ordered, there will be no extra charge for the No. 401 mounting strip.	Kellogg Switchboard & Sup. Co.		
No. 1028 key: is a one-way locking key; breaks 2 and makes 2 contacts.		1.20	20 oz.
No. 1029 key: is a two-way key; locks in one position; nonlocking in the other position; breaks 2 and makes contacts each way.		2.30	22 "
No. 1030 key: is a two-way key; locks in each position; breaks 2 and makes 2 contacts each way.		2.30	22 oz.

Description	Purchase from	Approximate Cost	Approximate Wgt.
No. 1033 key: is a one-way nonlocking key; breaks 2 and makes 2 contacts.		1.60	20 oz.
Drops: regular switchboard drop. Has adjustable contact for code ringing, also night alarm contact. NOTE: Specify number of drops desired. This mounting (#410) is a 10-drop strip. Extra charge for mounting if less than 10 ordered; also, specify number plates, as "number plates 1 to 5," etc.	Kellogg No. 50 CO drop on No. 410 mounting	2.75 per mtg.	½ lb. per drop
Combined ringer drop and jack: has 2500 ohm ringer, small gongs, a drop and jack for standard plug.	Kellogg, No. 3M combined ringer drop and jack furnished 3 to strip	10.00 per strip	3#
Annunciator: for use on emergency switchboards at dispatcher installations.	Graybar, No. 3M Dixie annunciator, specify number of drops	1.50 per drop	61#
Plug: single conductor, for grounded circuit line.	Kellogg, No. 44 plug	.50	3 oz.
Cord: single conductor, for grounded circuit line.	No. 310 cord, 48" long	.80	2 oz.
Plug: two conductor, for metallic circuit line.	Kellogg, No. 108 plug Graybar, No. 47A plug	.75	3 oz.
Cord: two conductor, for metallic circuit line.	No. 304 cord, 48" long	.90	2 oz.
Cord weight: for use with either of the above cords	No. 9 cord weight	.40	1#
Jack: for use on either grounded or metallic circuit lines; has 3 contacts.	No. 25 jack	1.25	5 oz.

Description	Purchase from	Approximate Cost	Wgt.
Jack mounting strip: 1/8" bakalite, bored for 6 #25 jacks, spaced 2" between centers.	Kellogg	1.00	3 oz.

PREST-O-LITE SOLDERING OUTFIT

Purchase from Union Avenue Auto Service, 493 Union Avenue, Portland, Oregon; or Automotive Service Company, 908 E. Pine Street, Seattle, Washington.

The complete outfit includes the following parts:

1 M.C. Tank filled with gas, including key	$6.50
1 M.C. " Union No. A2345	.25
*1 3-lb. Reducing valve No. A3669, with gas cock assembly	7.75
1 Special M.C. tank handle assembly No. A5470; has reducing valve bracket with pigtail connection	2.25
6 Ft. No. Z118 rubber Prest-O-Lite tubing (hose)	.54
2 Hose bands No. A963, at 5¢ each	.10
1 Handle No. A3323	1.25
1 Head (burner) No. A3339 (make long pointed flame)	1.50
1 Head (burner) No. A3414 (make short bushy flame)	.75
1 Solder copper No. A3329	.75
1 Head for solder copper, No. SB3335	1.35
1 Friction lighter	.20
Extra tank key	.03
Tank refills, cost each	.95

*Note: The use of this valve will eliminate the fire danger caused by tubing breaks, due to excess pressure.

COMBINED DISCONNECT SWITCH WITH DISCHARGE GAP

This is a 30 amp. single pole, single throw, bottom fuse, mounted, knife switch. Discharge gap consists of 2 pieces of 5/8" copper rod, pointed at one end, soldered in fuse clips, with points 1/8" apart.

Purchase from Fouch Electric Mfg. Co., 105 N. 9th St., Portland, Oregon, - cost approximately $1.75 each.

Composition for use in treating emergency wire:

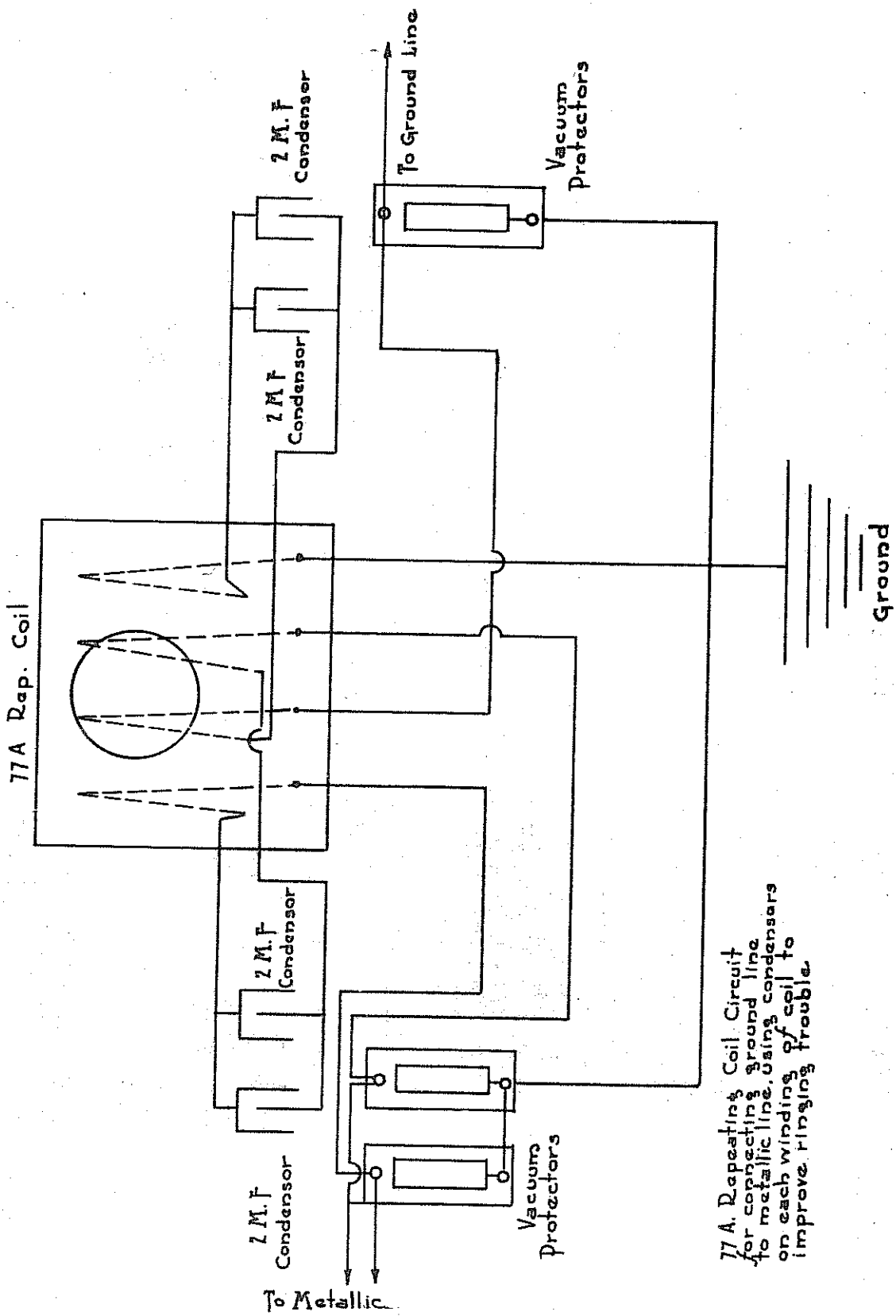
Use 2 parts Faultless A No. 1 wax . . . . . $ .45 per lb.
Use 1 part paraffin . . . . . .16 " "

Purchase from Kellogg or Graybar.

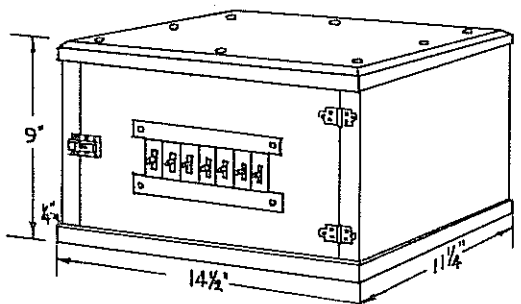
MISCELLANEOUS MATERIAL

2-1/2" #10 F.H. bright screws for Screwit knobs
1-1/4" #7 R.H. blue screws for baby knife switches
Lightning arrestors, extension bells
2" #10 R.H. blue screws for installing telephones

TELEPHONES
77A-Repeating Coil Circuit

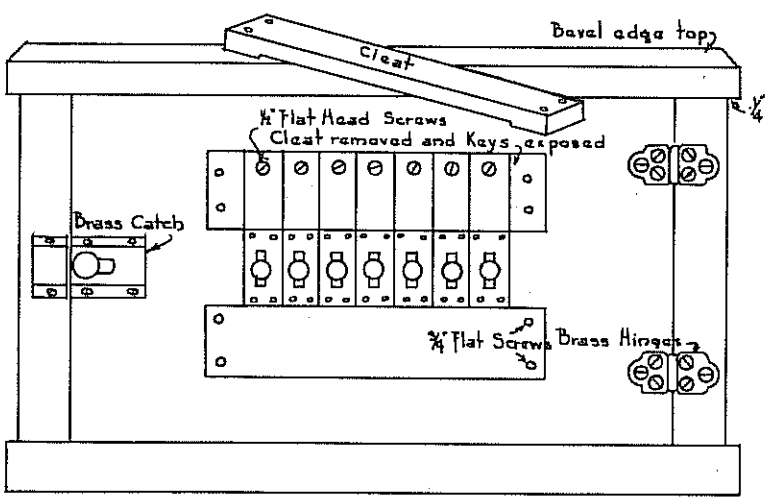


77 A. Repeating Coil Circuit for connecting ground line to metallic line, using condensers on each winding of coil to improve ringing trouble

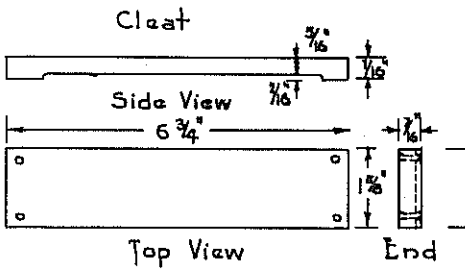


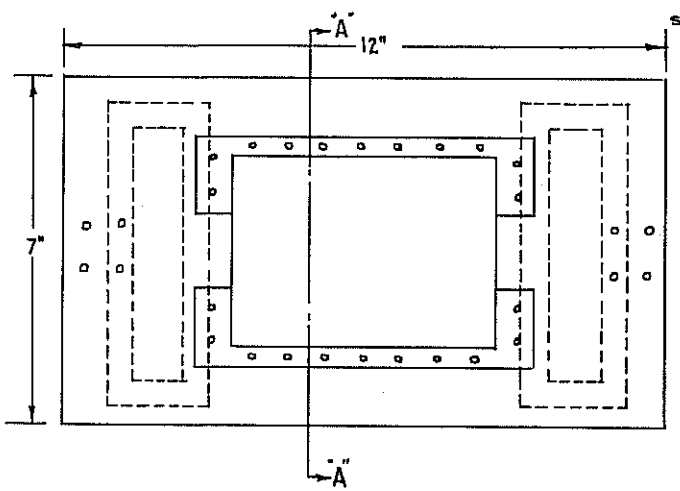
Cabinet

To be mounted on wall with 8"x10" brackets.
All screws used in this cabinet to be of brass.

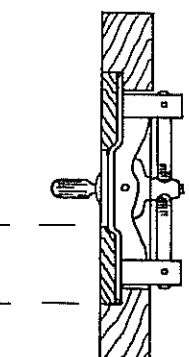


Showing Door in Place
Front View

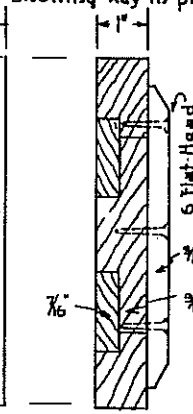




Door



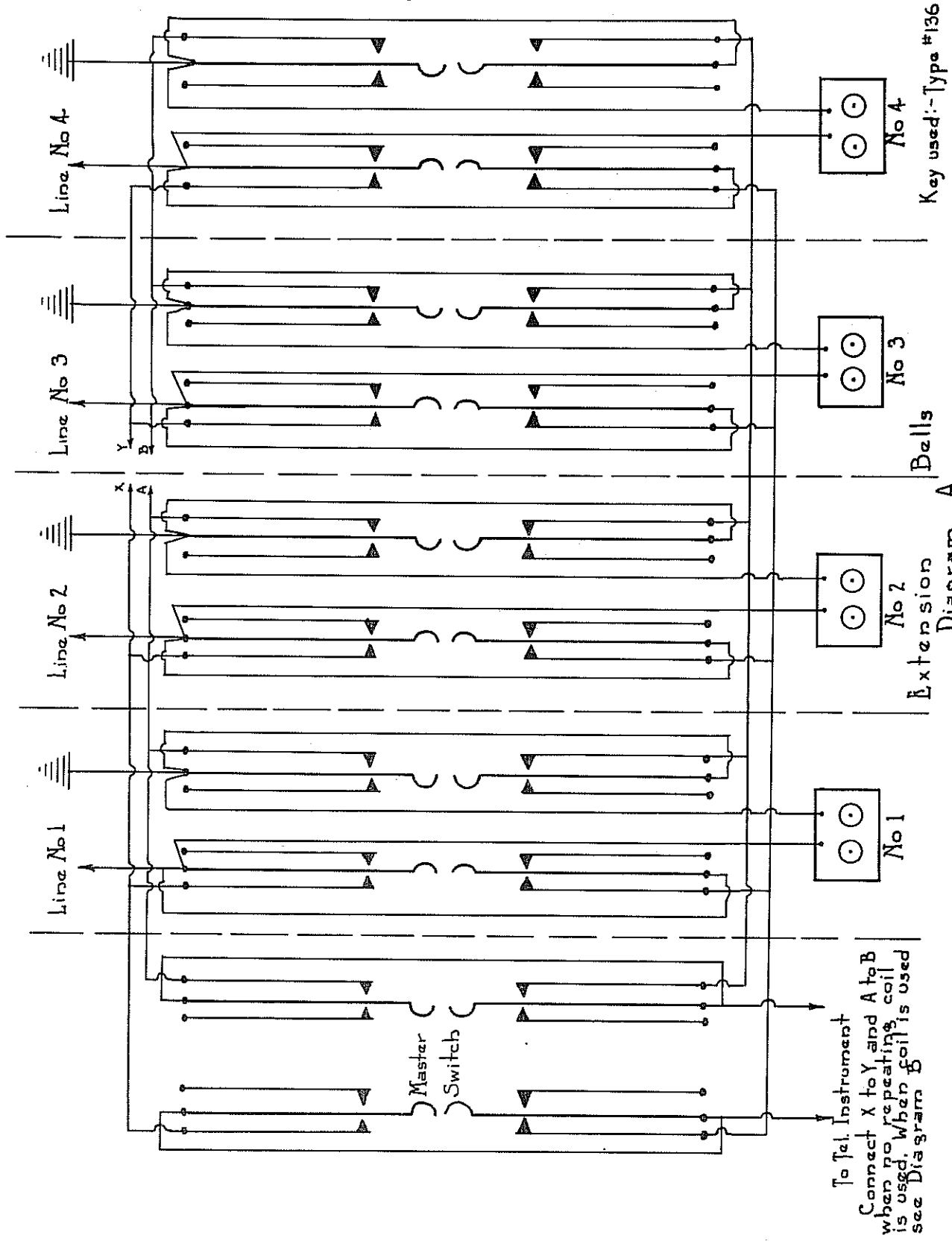
Door
Cross-Section showing key in place



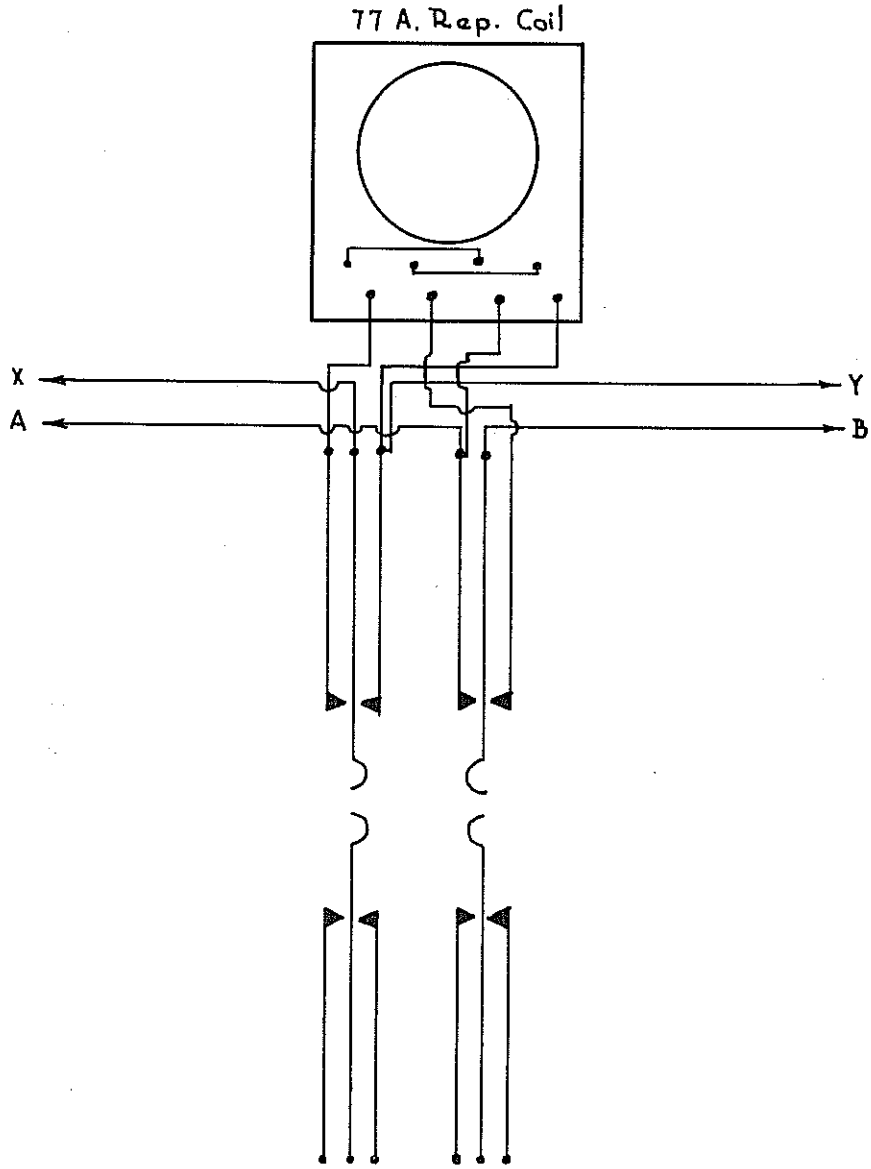
Cross-Section at "A-A"
Door

Cordless Switchboard

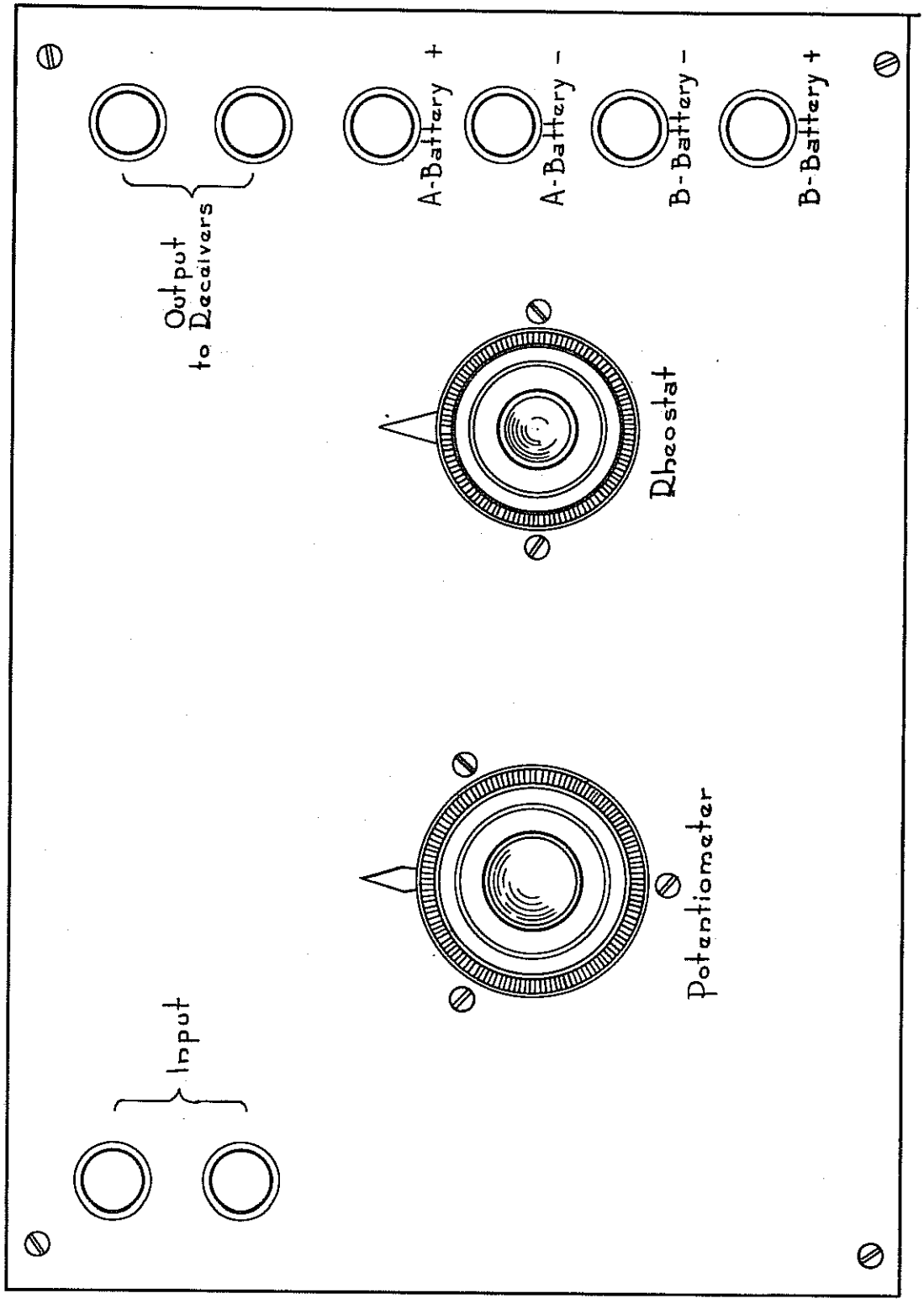
TELEPHONES
Cordless Switchboard Circuit
Diagram A



TELEPHONES
Cordless Switchboard Circuit
Diagram B
Key used #136 A

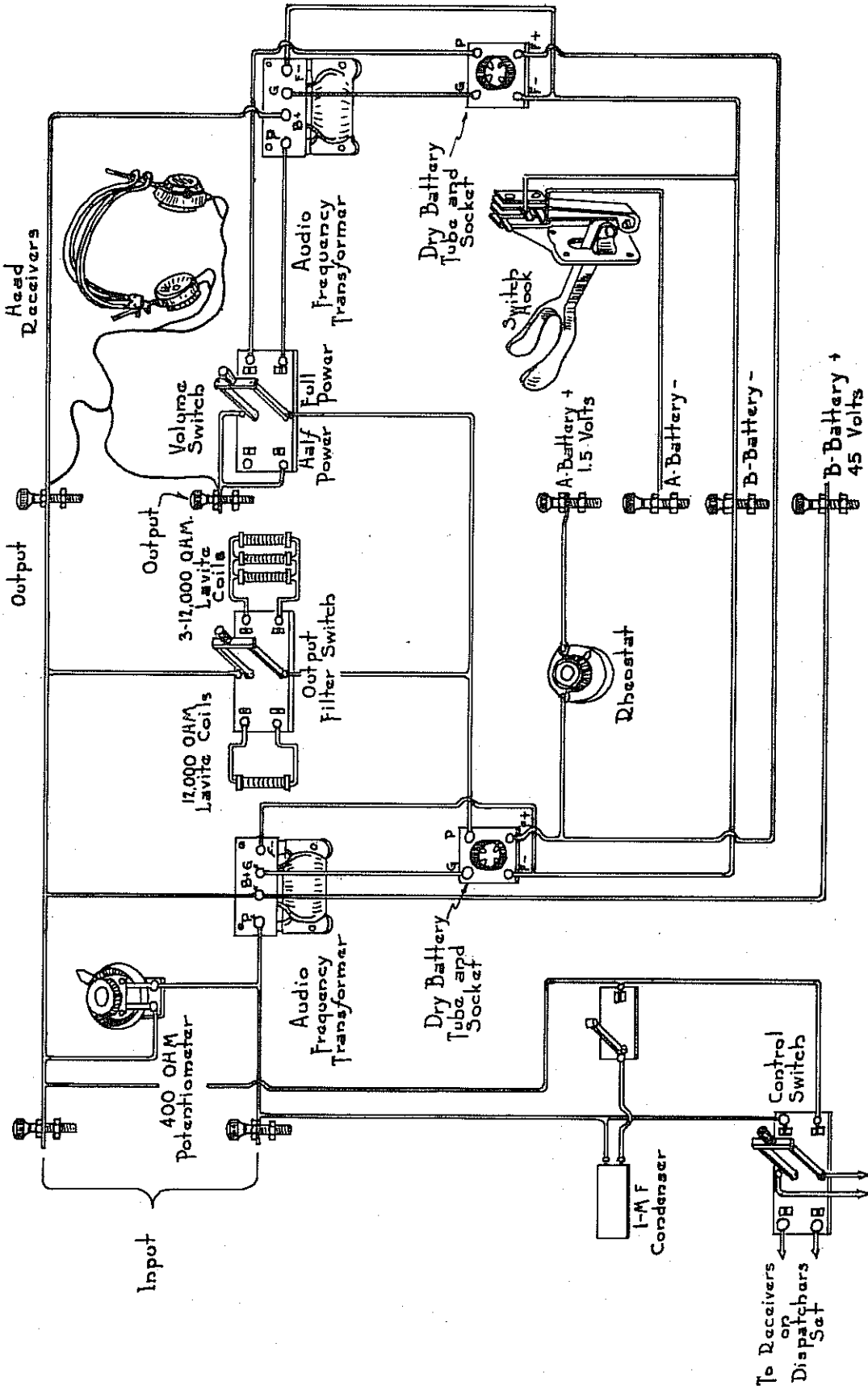


TELEPHONES



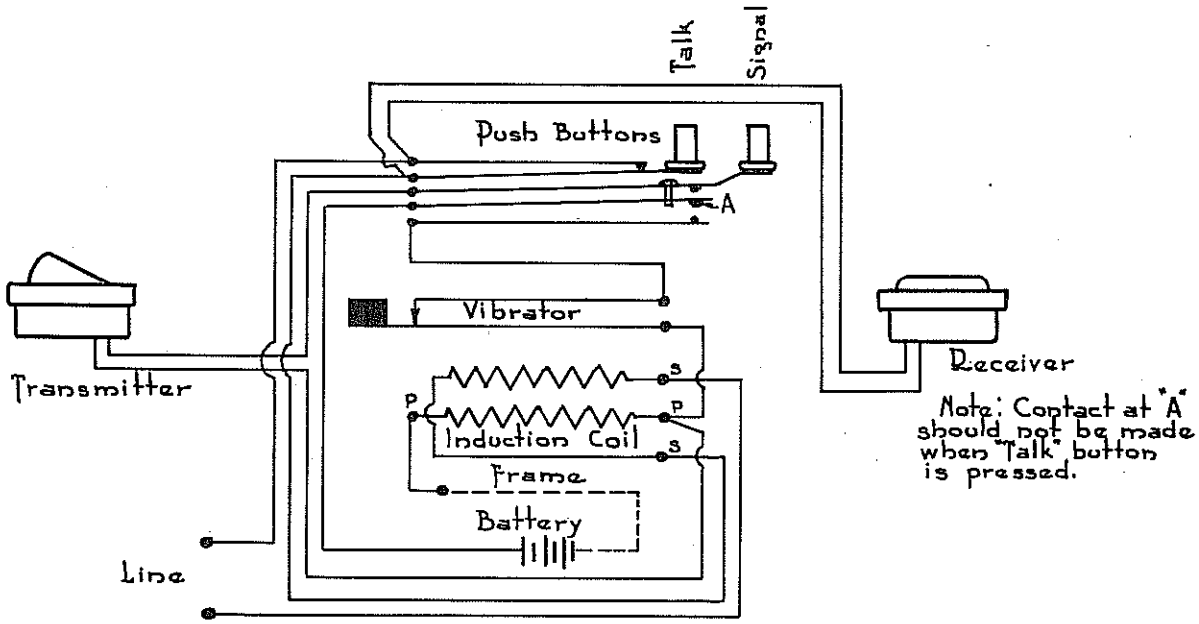
Static Filter & Amplifier

TELEPHONES



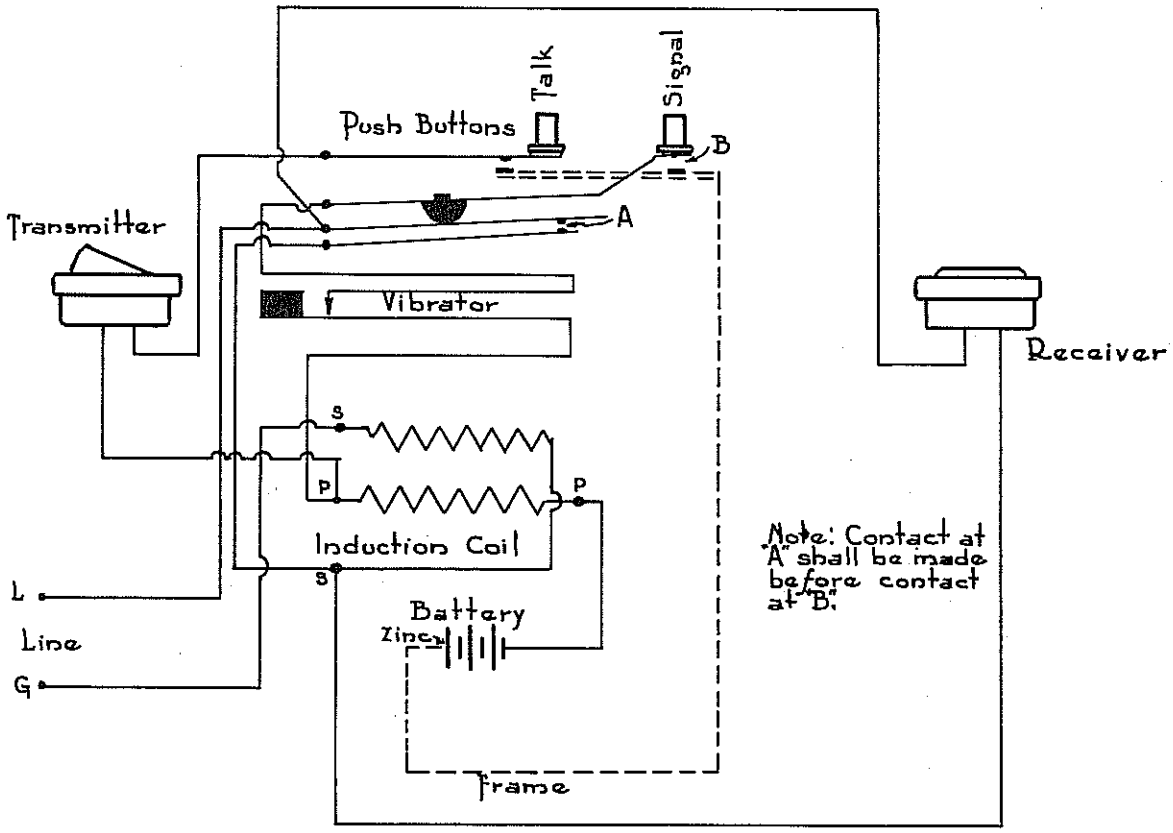
Static Filter & Amplifier

TELEPHONES
Adams Portable Telephone



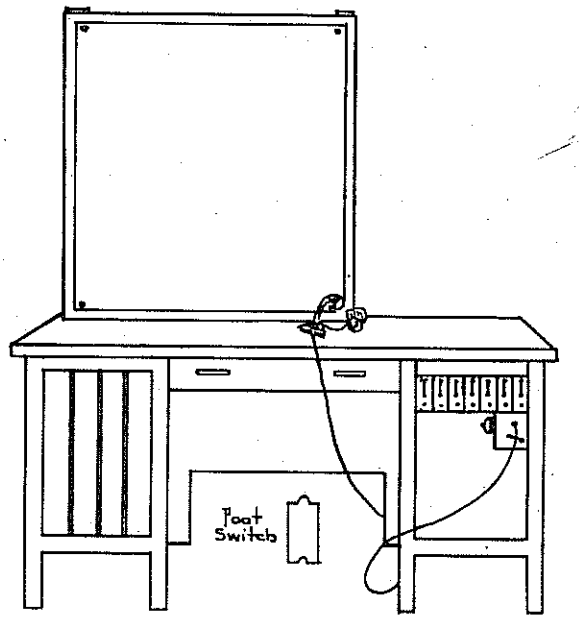
Wiring Diagram 1004-A Set

The Old Style Adams Portable Set
Necessary to press button to talk

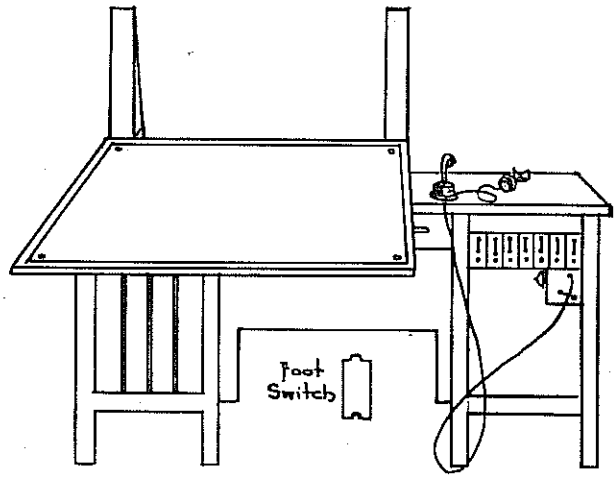


The Improved Adams Portable Set
Receiver across the line
Wiring Diagram Type 1004-A

TELEPHONES
Dispatchers Desk



Desk with Map Board Up



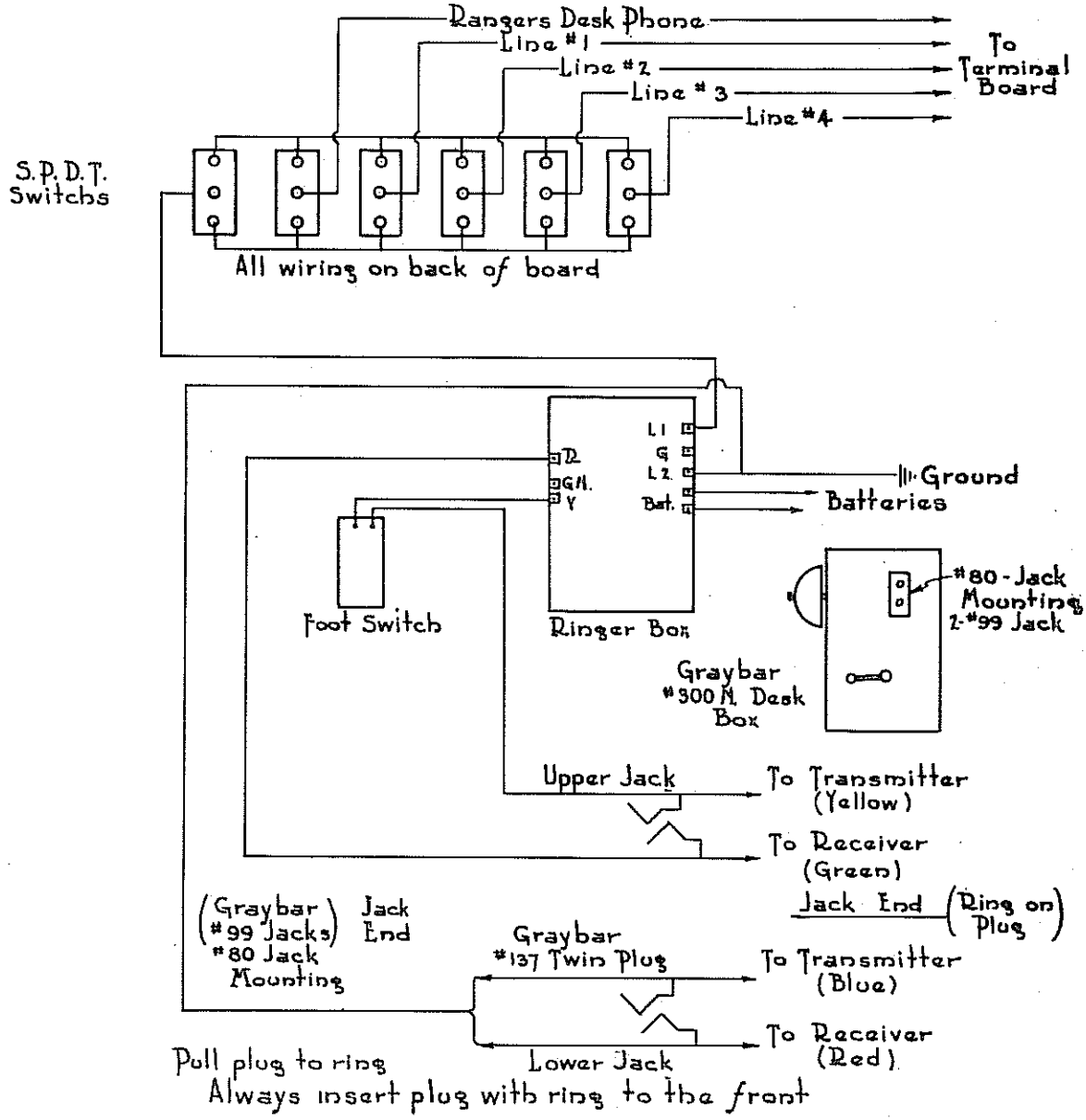
Desk with Map Board Down

TELEPHONES

Dispatchers Desk - Wiring Diagram

Materials

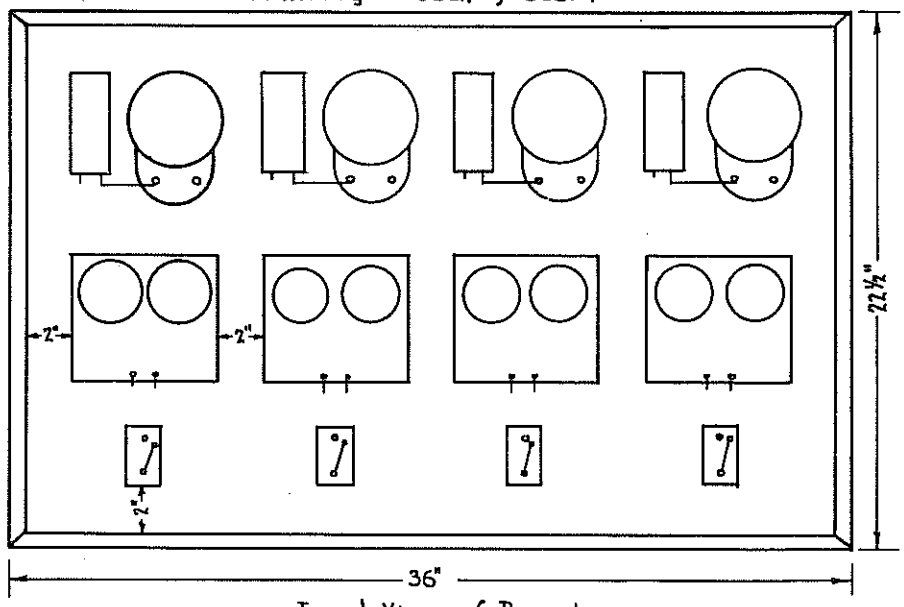
1-Box Telephone Ringer, Graybar		#300 N or equal
1-Jack Mounting	"	# 80
2-Jacks	"	# 99
1-Transmitter Breast Type	"	# 234
1-Receiver, Head Set	"	# 528
1-Attachment, transmitter	"	# 3
1-Plug Twin	"	# 137
1-Cord, Switchboard 6'	"	#L-4-E
1-Switch. Foot	"	# 1-B
6-Switchs. Baby Knife S.P.D.T.		



TELEPHONES

Terminal Switchboard

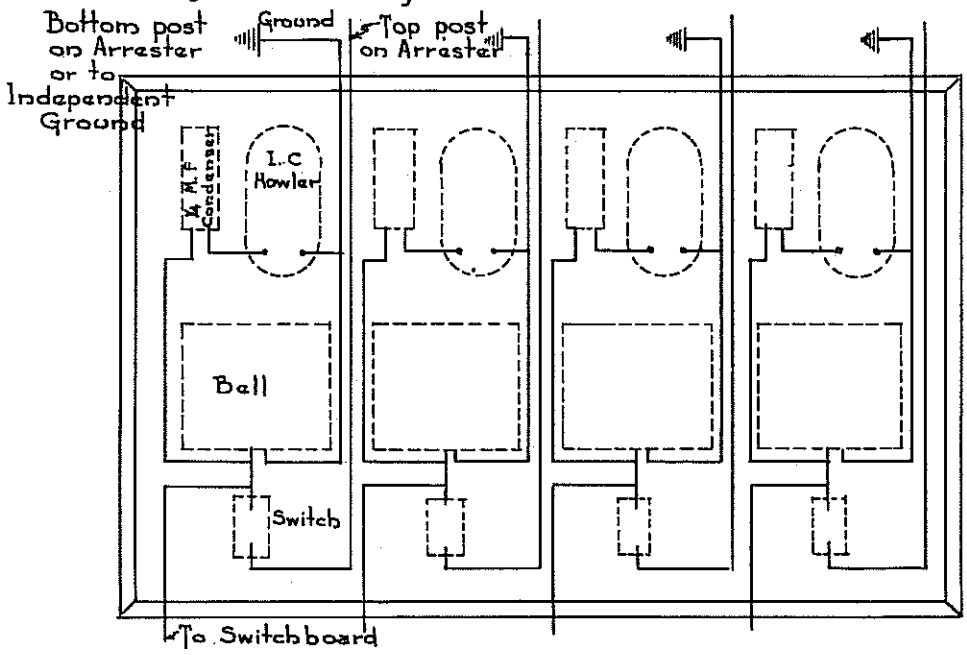
For use with Dispatchers Desk
All wiring on back of board



Front View of Board

Set instruments in place on board and bore ¼" holes

This board should be mounted on the wall well up out of the way. If properly wired it will seldom need to be disturbed. It can be fastened with heavy screws or one end can be hinged so that the wiring can be easily accessible



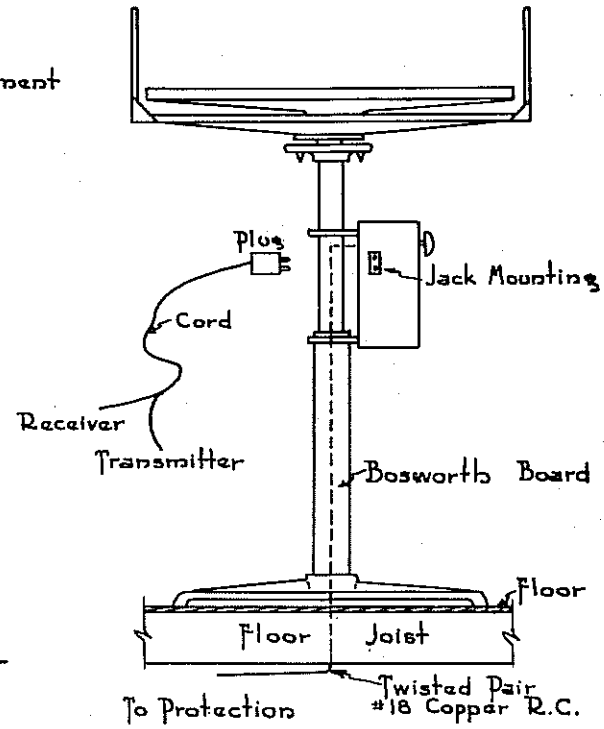
Rear View of Board showing Wiring Diagram

Use #20 B+S Flameproof telephone wire twisted pair for each line.
All splices on back of board must be soldered.

TELEPHONES
Lookout Telephones

Materials Needed

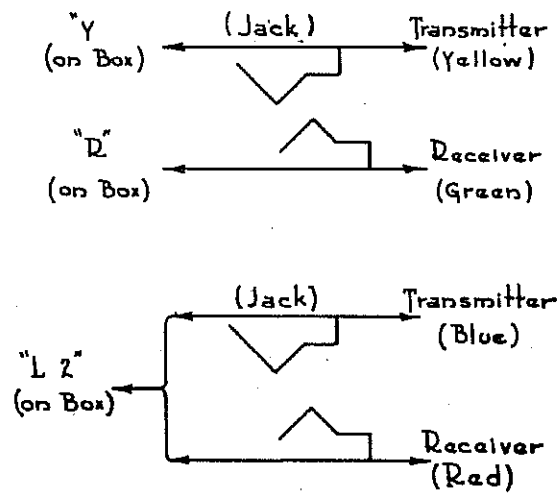
1-1317-3 Telephone, without Trans. or Rec.
1-Head Receiver #528 with #11 A Head Band
1-Breast Transmitter #234 with #3 B Attachment
1-Twin Plug #137
1-Jack Mounting #80
2-Jacks #99
1-Operators Tel. Cord #L4B (10'-0")



INSTRUCTIONS FOR INSTALLING LOOKOUT TELEPHONE

The telephone box will be clamped to the pedestal of the fire-finder. A small hole has been drilled in the pipe about 6 inches below the plate. The hole in the back of the telephone box should be placed opposite to the hole in the pipe. The lead-in wire (#18 copper twisted pair) should be threaded through the pipe and through a hole in the floor of the lookout house and brought out to the lightning protection and line wire at the outside edge of the house. Plenty of slack should also be left in the lead-in wire under the floor so that the base of the fire finder can be shifted without interfering with the telephone connection.

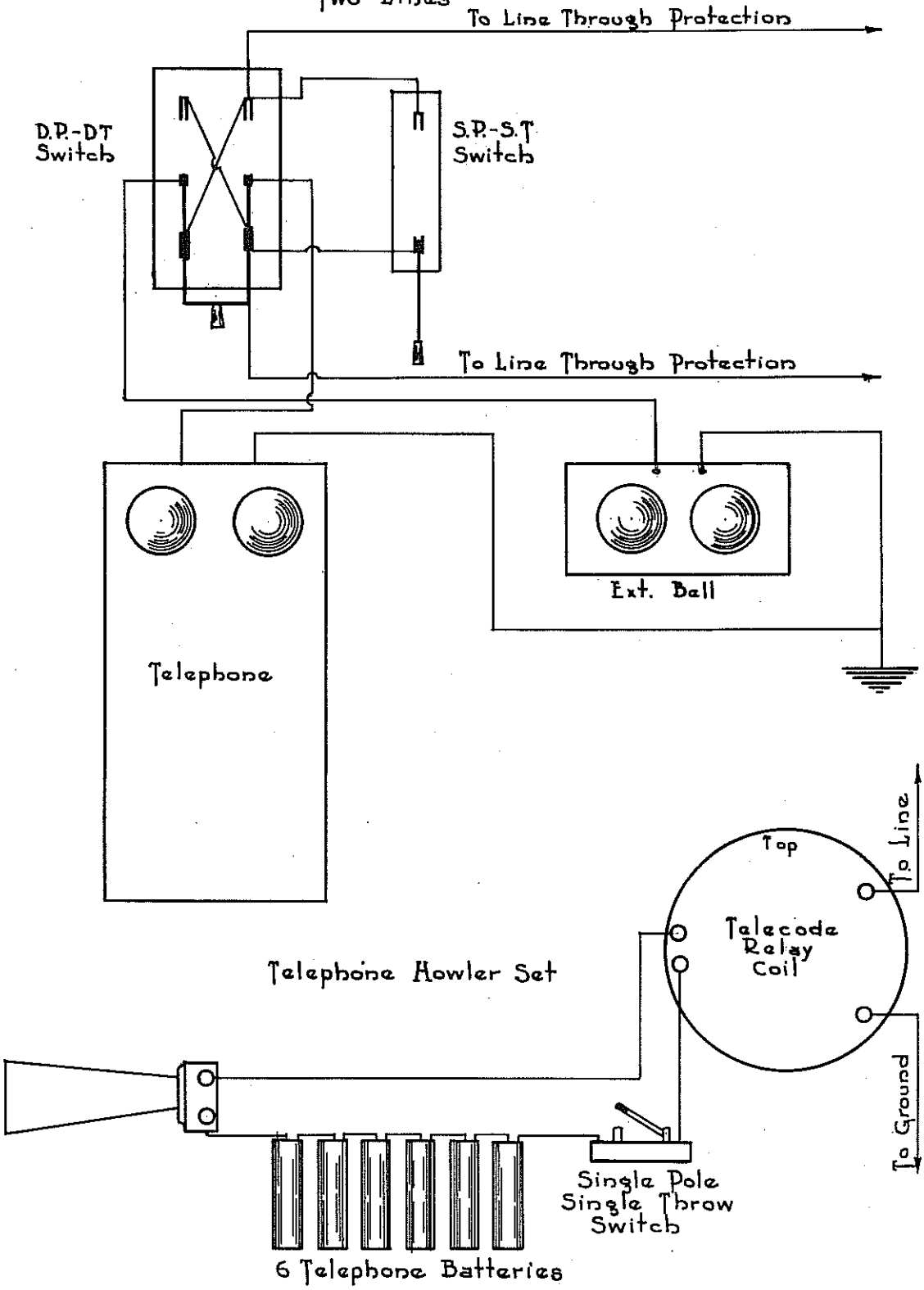
The jack mounting in the side of the telephone box and the twin plug at the end of the operator's cord take the place of the switch hook in the regular instrument. <u>The plug must be removed when the telephone is not in use.</u>



Wiring Diagram

TELEPHONES

Switching Station
Two Lines

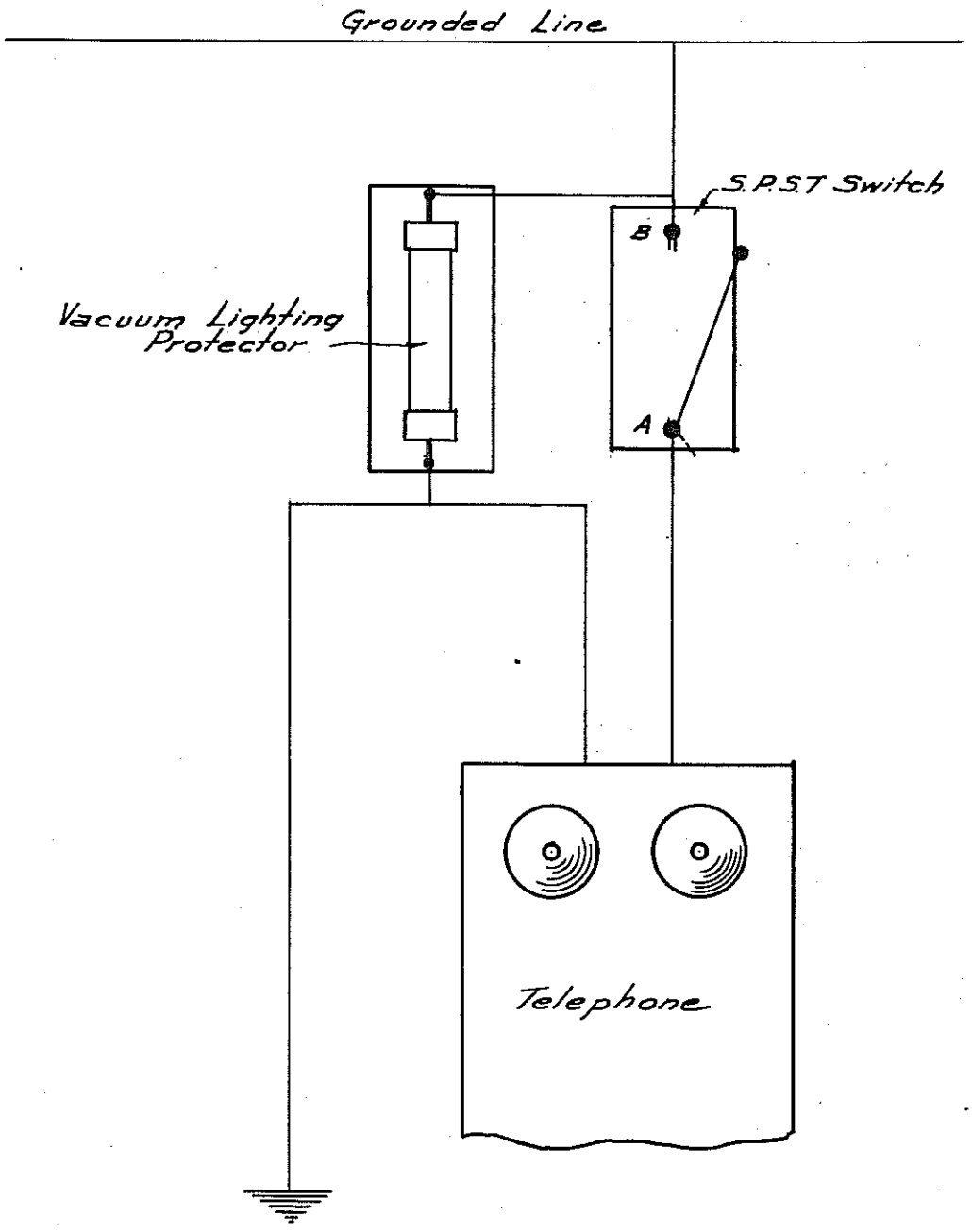


Material
1-Telecode Relay Coil. 2500 Ohms
1-Single Pole Switch
1-Klaxon Horn
6-Telephone Batteries

Note: More than one horn may be hooked up to the same set of batteries

0
Improvement

TELEPHONE INSTALLATION



TELEPHONES

STRINGING EMERGENCY WIRE

No. 50

Two men can string the wire to the best advantage,- one unreeling the wire, the other following behind to hang it up.

The use of a forked stick will help get the wire up high enough to clear game or stock.

Hang the wire on branches or limbs, but do not tie it to them.

Let the wire slide through the hand as it is unreeled and check each splice to be sure it is O. K.

Allow plenty of slack in the wire to provide for tree sway.

If necessary to cross a railroad track, put wire underneath rails.

In crossing a highway, the wire should be tied on each side, high enough to clear roadbed 20 ft.

Spans should not be over from 100 to 125 ft. long.

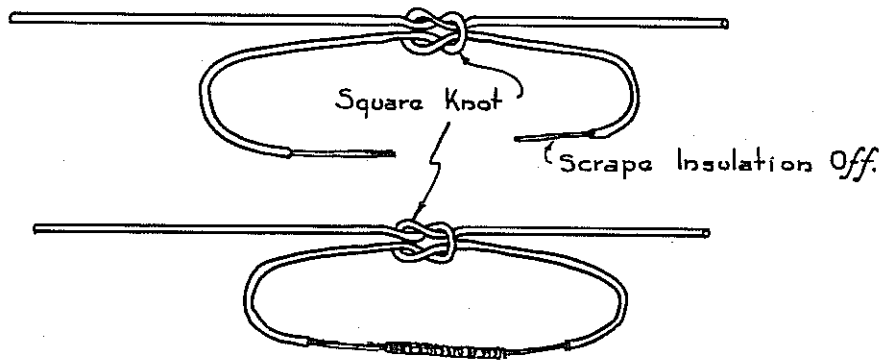
On trees or snags not having branches suitable for supporting the wire, wooden wedges about ⅛"x1"x8" may be driven into the tree, first cutting a perpendicular gash in the tree trunk.

When connecting to a No. 9 iron line, first dead-end the emergency by tying it securely with a square knot to an insulator or dead limb. Then bare and clean about 6" of the end of the emergency wire, make 8 or 10 tight wraps around the iron wire and tie the end back on itself to keep the wire from unwrapping.

To make connections in the emergency wire, first tie a square knot, as shown below. Then strip off insulation (taking care not to break strands), and make a regular line connection with 2 or 3 twists in the neck and 5 or 6 close wraps on each side.

With steel outpost wire, the ends should be tied after making the end wraps.

Tape the connection to avoid excessive line grounds.



Emergency Wire Connection

C.M.Allen. Apr.1930.

TELEPHONES

TELEPHONE GROUNDS

No. 13

Telephone grounds must be made in soil that is a good conductor, containing not only moisture, but some kind of an electrolyte. Soil that has in it considerable humus, as will be found in marshy ground, adjacent to a cesspool, or that receives waste water from a sink or camp, contains both the moisture and electrolyte necessary to make it a good conductor.

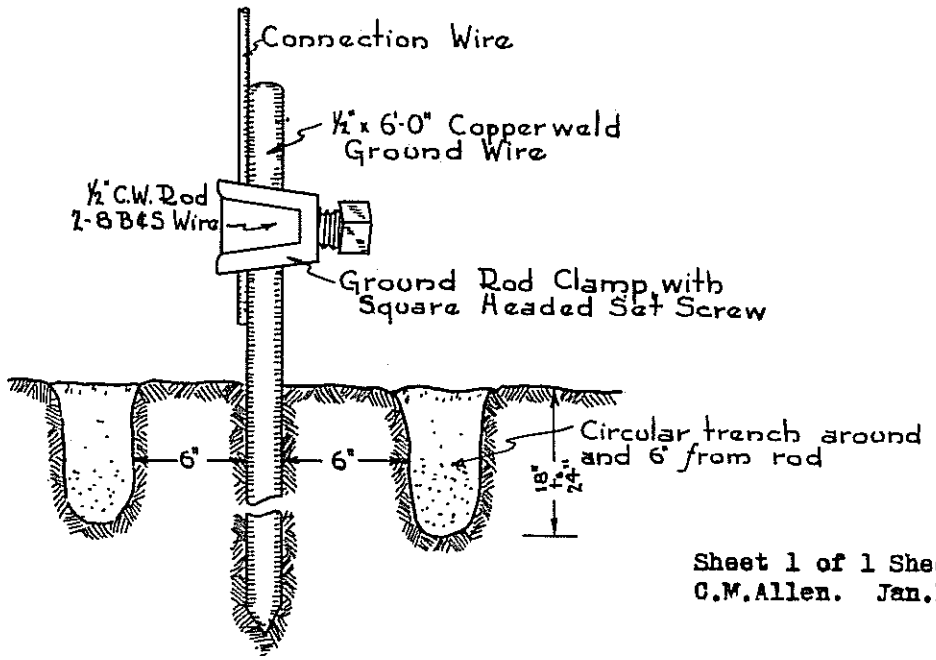
Eighty per cent of the resistance of a ground is in the soil within 6 or 8 feet of the ground electrode.

The diameter or surface area of an electrode has little to do with the ground resistance.

A galvanized iron water pipe, two or three hundred feet long, buried in soil as above described, usually makes the best ground; use a regular ground clamp for making connection with it.

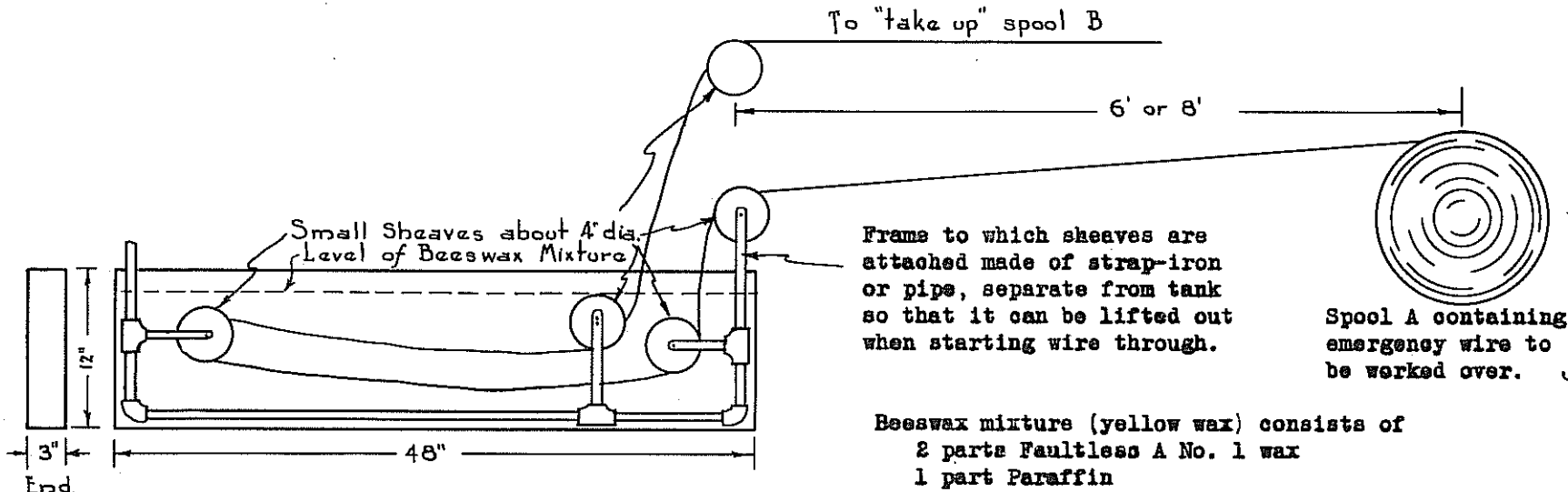
Following are instructions for making a ground when a water pipe is not satisfactory or is not available:

1. Use nothing but copper as a ground electrode,- either a copper wire about 8' long, No. 2 or No. 4 B & S gauge, or a ½"x6" copperweld ground rod. Use galvanized iron wire only as a temporary expediency.
2. When it is necessary to make a ground in soil that does not contain moisture and an electrolyte as described above, salt must be added. Rock salt contains more calcium chloride than ordinary salt and will last longer; if this is not available, use stock salt. Use about 50#, applied in a circular trench near the surface of the ground, as shown in the diagram, taking care to keep the salt from coming in direct contact with the electrode (ground rod or wire). In dry soil, add water occasionally, and renew the salt every two or three years.
3. If one ground does not give satisfactory results, a second ground made not less than 9 or 10 feet away, will usually lower the resistance from 30 to 40%. In very dry soil 3 or 4 grounds, separated as above, may be necessary. In every case where more than one ground is made, they should all be connected together.



Sheet 1 of 1 Sheets
C.M.Allen. Jan.1930.

TREATMENT OF EMERGENCY WIRE



Tank made of about 16 or 18 gauge galv. iron, to be 3"x12"x48" used for heating beeswax (yellow wax) mixture.

Beeswax mixture (yellow wax) consists of
2 parts Faultless A No. 1 wax
1 part Paraffin

Ref.: Page 112 of the 1925 Telephone Handbook. Unless the entire spool of wire is heated to about 150 degrees, the immersion method of treatment, described on pages 112 and 115, will be unsatisfactory.

The method developed by the Chelan, including the use of a long tank fitted with pulleys attached to a frame as described above, has given excellent results. The beeswax mixture should be kept hot, just below the boiling point (about 200 degrees). The wire should be run through the tank slow enough to allow a thorough saturation of the cotton covering on the wire. The work should not be done in a cold room, and if the old spool of wire is first warmed, less time will be required in the tank. A mile of outpost wire will take from 3 to 4 lbs. of beeswax; two to three lbs. per mile for the small emergency wire. The wire is inspected as it passes from Spool A to the tank and all bad connections cut out, bare places taped, as described on page 112 of the Handbook.

NOTE: On account of the injurious effects of heat on the rubber insulation, rubber covered wires should not be left in the hot mixture longer than necessary to secure saturation of the braided covering. Be careful about overheating wax or letting it boil over and catch fire.

Sheet 1 of 1 Sheets
C.M.Allen. Jan.1930
Revised Dec.1930

TELEPHONES
Treatment of Emergency Wire

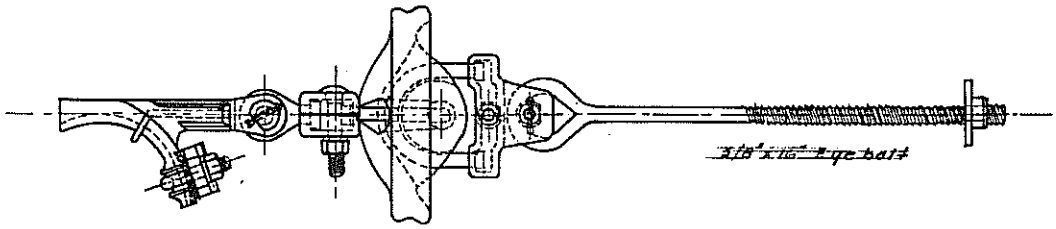
PLATE 79

TELEPHONE STRAIN INSULATOR

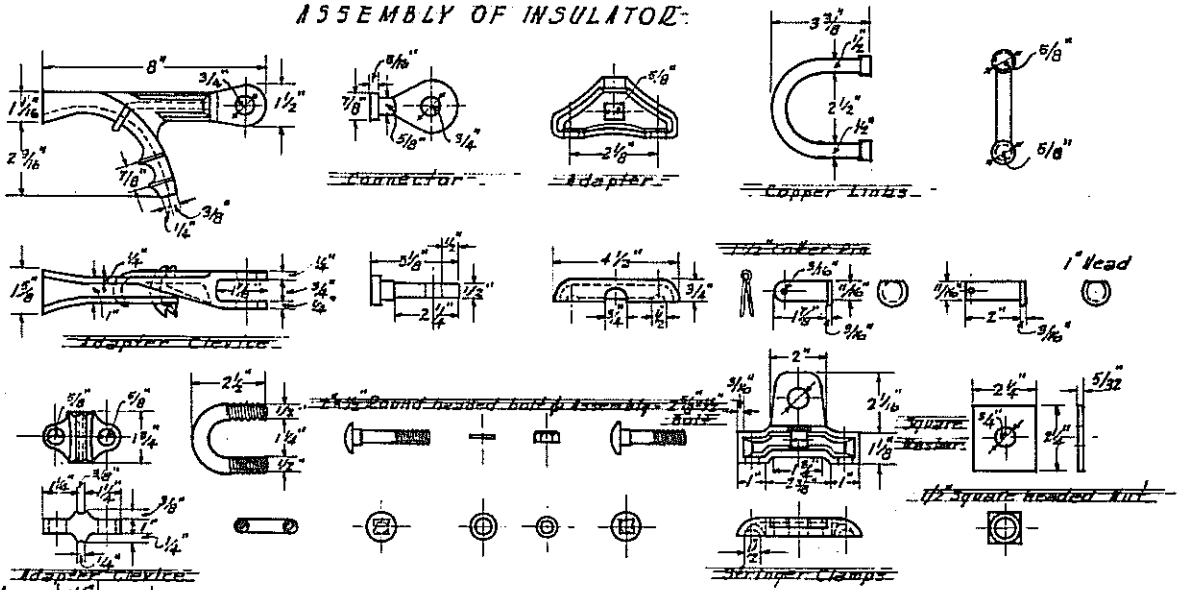
BILL OF MATERIALS

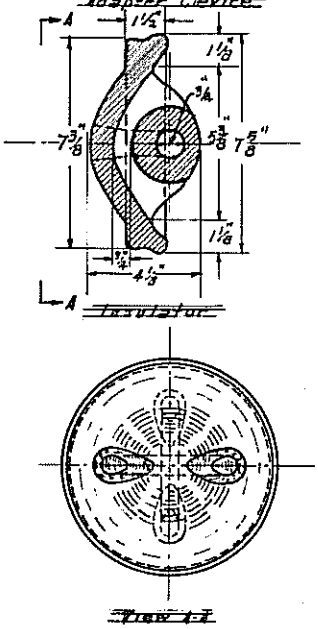
Insulator No. 12030 (Hewlitt)
Adapter, Clevice
Links, Copper
Connector, No. 5552
Eyebolt, 5/8" x 16"

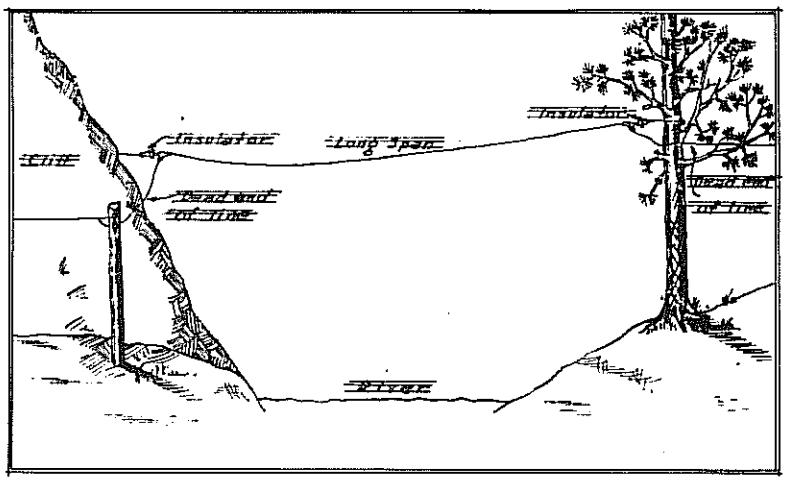
Washers, Square
Clamps, Stringer No. 10386
Adapter, No. 5480
P.O. S-13829 Graybar Electric Co.
P.O. S-14360 Graybar Electric Co.

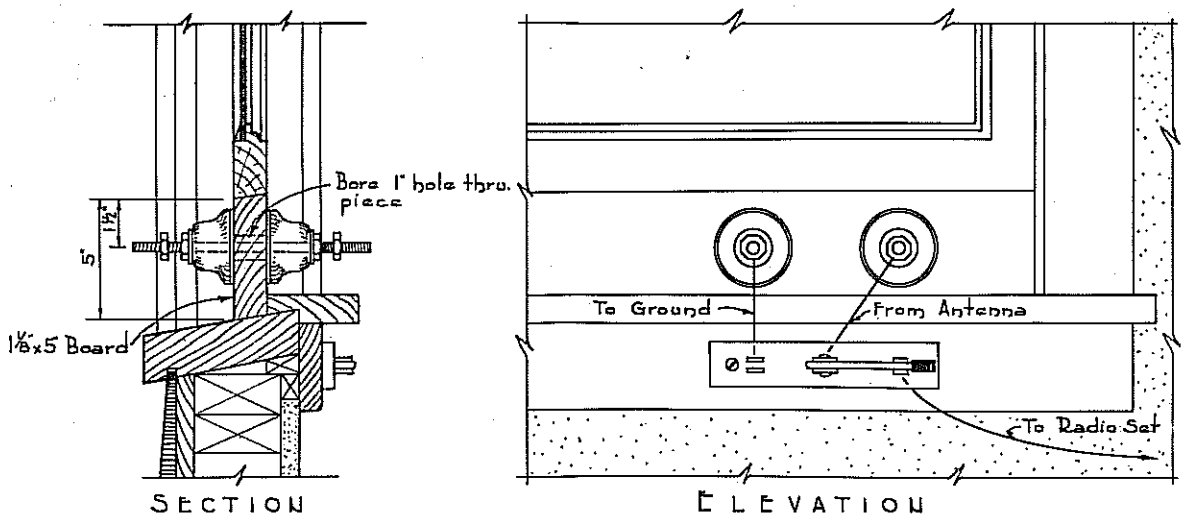


ASSEMBLY OF INSULATOR





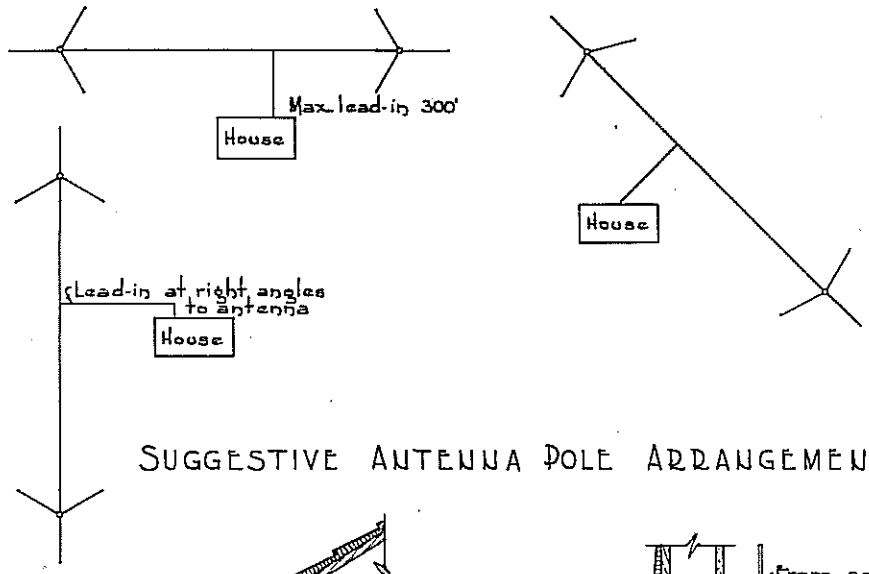




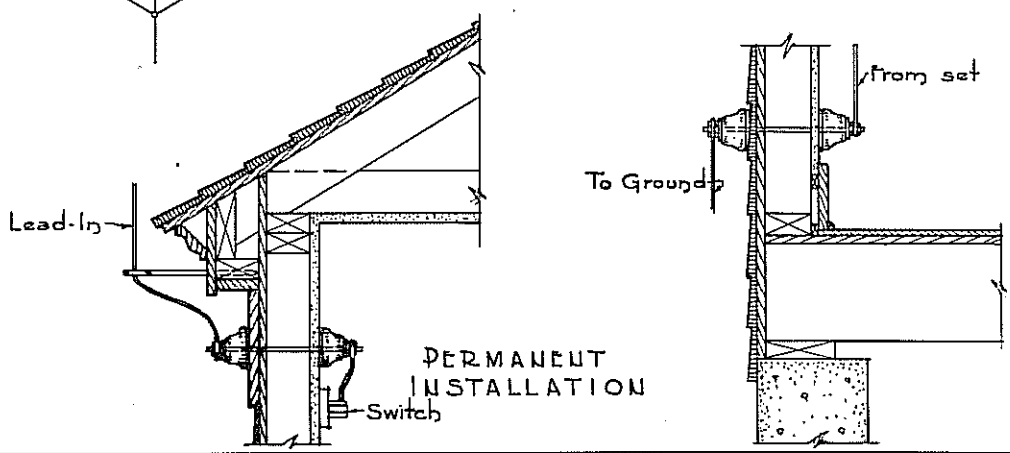
SECTION

ELEVATION

INSTALLATION OF PYREX LEAD-IN THROUGH WINDOW
TEMPORARY INSTALLATION

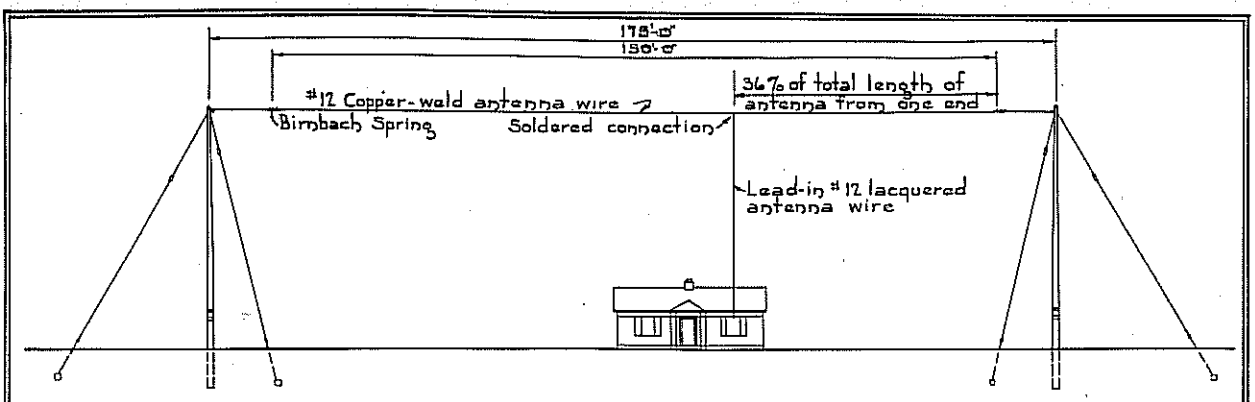


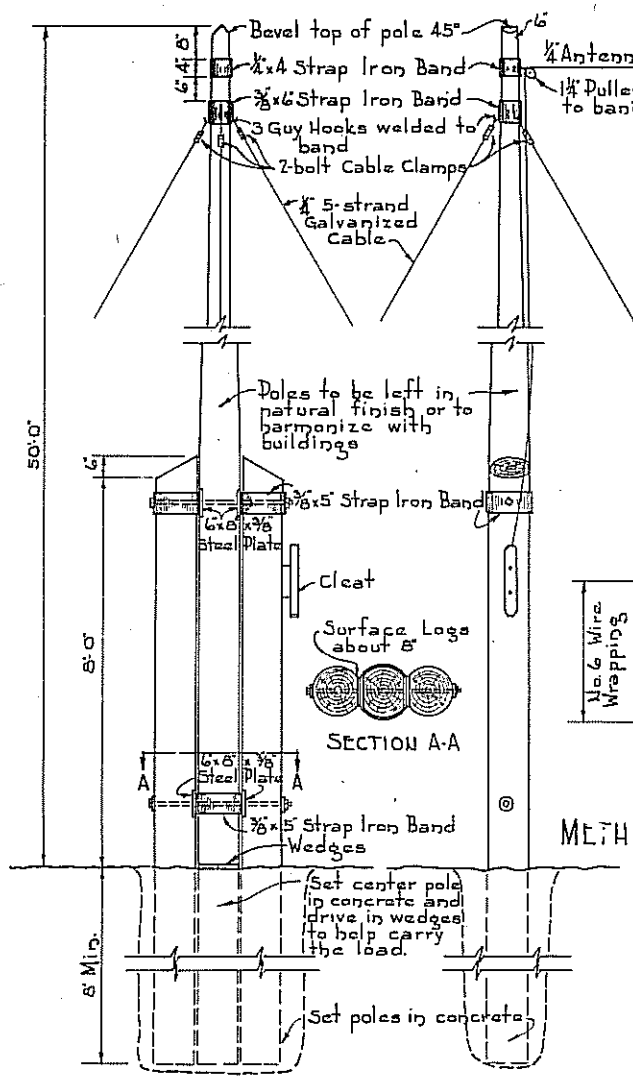
SUGGESTIVE ANTENNA POLE ARRANGEMENTS



PERMANENT INSTALLATION

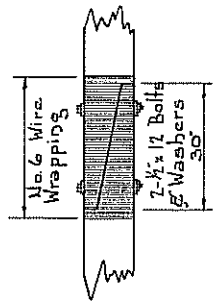
U.S. DEPT. OF AGRICULTURE FOREST SERVICE REGION ONE	**RADIO INSTALLATION** FOR FOREST SERVICE SHORT WAVE SETS ONLY	PLATE NO. 81 A DRAWN BY R.T. CHAPEL 9/30/36 CHECKED BY [illegible] TRACED BY R.T. CHAPEL 9/30/36 APPROVED BY [illegible]



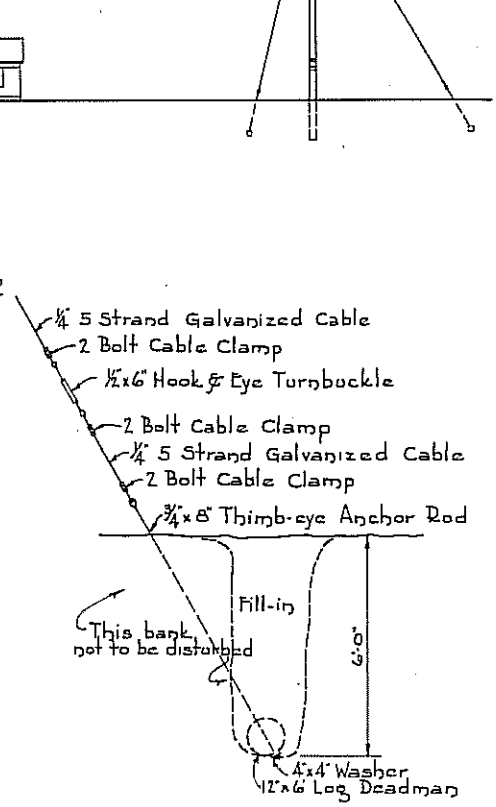


RADIO ANTENNA POLE

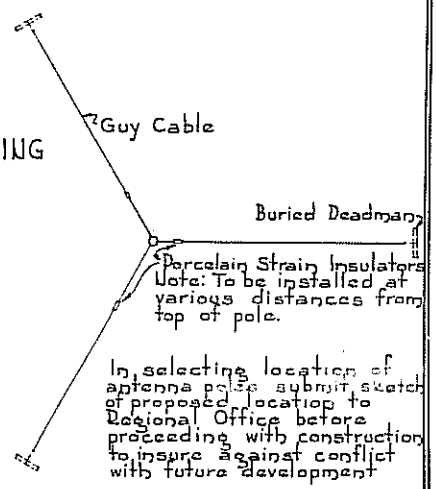
Scale 1/2"=1'-0"



METHOD OF SPLICING



METHOD OF ANCHORING GUY CABLE

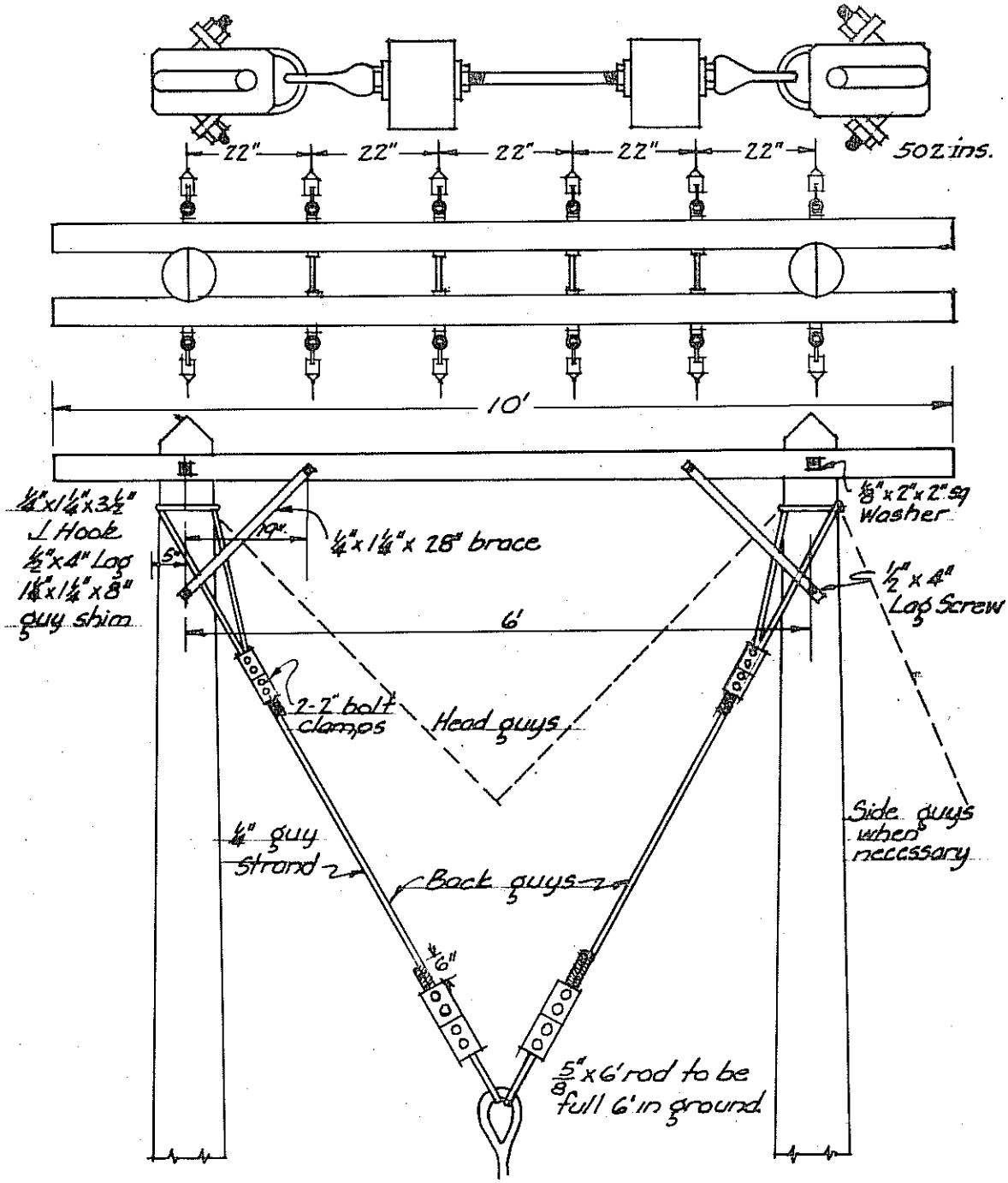


In selecting location of antenna poles submit sketch of proposed location to Regional Office before proceeding with construction to insure against conflict with future development

U.S. DEPT. OF AGRICULTURE FOREST SERVICE REGION ONE	**RADIO INSTALLATION** FOR FOREST SERVICE SHORT WAVE SETS ONLY	PLATE NO. 81 DRAWN BY R.T. CHAPEL 9/30/36 CHECKED BY LGR TRACED BY R.T. CHAPEL 9/30/36 APPROVED BY LGR

Plate No. 111

H TYPE CONSTRUCTION FOR LONG SPANS



METHOD OF "H" FRAME CONSTRUCTION FOR TWO OR MORE CIRCUITS. Use approved type connectors instead of sleeves on jumper wires where wanted for test purposes.

TRAIL CONSTRUCTION

(See Manual, "Trail Construction on the National Forests (1923)"
(See Finance-Administration section of the Administrative Guide)

The instructions on the bottom of page 4 of Form 600 MR-2, which may be secured from the Supply Depot, should be complied with on all trail work with the exception that the words, "Forest Supervisor" should be substituted for "Regional Forester" in the second paragraph.

Milepost Surveys

For two reasons it is desired that mileposts be established along all trails as rapidly as possible. The first reason is to obtain the actual surface distance traveled by pack trains which, for purposes of discussion, will be called "lineal distances." These lineal distances are needed in compiling trail construction costs and also obtaining packing cost data on a tonnage basis where such data are desired. The second reason is to obtain the horizontal locations of mileposts in unsurveyed country in order that they may be platted in their proper positions on administrative maps. Their chief value on such maps is for fire control purposes, particularly as an aid to lookout men and firemen in describing and finding small fires.

Field Survey Methods

When lineal distances between mileposts are desired, they are most conveniently obtained by using the wheel cyclometer. When horizontal distances between mileposts are desired, the most suitable surveying equipment is the topographic trailer tape, the improved Abney level, and the standard staff compass.

On many of the Forests a large percentage of lineal locations of mileposts has been established and only the horizontal position of these locations remains to be determined. On those Forests where no trail mileposts have been located, it is possible to make one survey obtain both lineal distances and horizontal positions. But this method is not recommended because there is too much chance for error and confusion in handling the complicated set of notes it would be necessary to keep. It would be much better practice to have the lineal distances between mileposts determined by the wheel-cyclometer method when the trail is constructed, and follow at some subsequent date with a compass-Abney-tape survey to obtain horizontal positions.

On trails that are free from switchbacks, short turns, and heavy grades, it is probable that horizontal distances between mileposts as obtained by a compass-Abney-tape survey will not vary greatly from lineal distances. Under such conditions the cyclometer-wheel survey may be eliminated, as the compass survey will

serve the two purposes; that is, provide both lineal distances and horizontal positions. It should be known, however, that the difference between lineal and horizontal distances does not vary over the horizontal degree of accuracy of one chain per mile. In doubtful cases, it will be well to test the degree of accuracy obtained by running between two mileposts both with a compass survey and cyclometer-wheel survey and compare the results obtained.

Trail Survey Finances

The cost of trail traverses and the establishing of mileposts should be charged to the subappropriation Forest Road Development, except in cases in which some particular refinement of survey makes such a charge unjustifiable. Ordinarily, the compass and chain survey of a trail and the tying in of mileposts on the map for fire control purposes should be considered as a legitimate part of the cost of the trail, and as such, properly a charge against F.R.D. funds. It was agreed at the Spokane Allotment Conference during the early part of 1928 that trail surveys are ideal contributed-time jobs for specially qualified men, and that so far as practicable, the surveys should be made by the use of such time without the necessity for a charge against F.R.D.

Instructions for Using Equipment

1. Cyclometer Wheel

Before starting on a survey trip, be sure the cyclometer is in good working order. Inflate the tire of the cyclometer wheel to a moderate pressure with a pump. Insert a pole of convenient size and length in the ferrules and secure with a nail or screw. The cyclometerer must be right side up and must always be pushed before the user. A slight compensating error may be found in all wheels but the error should in no case be more than 150 feet in one mile. To check the cyclometer, spin the wheel, multiply the number of revolutions per mile of the wheel on the cyclometer by 7.2 feet. The result, if compared with 5280 feet, will give the error. There should be approximately 733 revolutions per mile.

2. Improved Abney and Trail Tape

The Abney Manual contains ample information relative to care, precision, adjustments, etc., relative to the Abney level and trailer tape. (See also Circular N-99.)

Field Notes

In the past, it has been customary to keep a detailed set of log notes in connection with cyclometer-wheel measurements. It now seems advisable to supersede log notes by field notes kept in connection with Abney-compass-tape surveys for the determination of horizontal positions.

Circular E-99 gives sample field notes suitable for the trailer tape and Abney method. This form of notes may be kept in most any type of double-page field notebook, and the right-hand half of the notes should always be reserved for remarks and description.

Trail Sign System

Instructions for preparation of a trail sign plan will be found in the Sign Handbook.

Each trail in a forest system must have a project number which will appear on the office records, on all half-inch maps and atlas folios, and on all trail mileposts and trail signs in the field. Stock driveways constructed as such will not be numbered as a part of this system. For each forest, this series of numbers will start with "one" and be carried through to cover each and every trail in the system. In placing trail project numbers on mileboards or posts, the trail project number will invariably be placed above the figure used to indicate mileage.

Ordinarily, mile signs should be placed on all trails at a lineal distance of one mile apart. After the initial point (or initial points where more than one trunk trail crosses a forest) has been selected, mile signs should be placed in consecutive numerical order along the trail throughout its entire length. In like manner, mile signs should be placed along spur or branch-line trails at lineal-mile intervals. Each branch-line trail must have a numbering system of its own. Whether this numbering system is initiated at the point where the spur trail leaves the main trail, or whether it is carried on as a continuation of the numbering of the main-line trail will depend upon which method of numbering will best serve the forest needs. Foot trails not passable for horses should be so designated by the word "FOOT" on the sign or signs at their intersections with other trails.

When a trail crosses an area that has been surveyed by the G.L.O., all intersections of the trail with section lines should be marked with "Forest Service Crusier's Poster-Form 458". The distance in chains to the nearest section corner should be clearly indicated in the most permanent manner. Where trees are not available, well-set posts should be used. The position of these section line markers will not be shown by number or legend upon the maps. It will be sufficient to plot trail intersections with the section lines where they belong on the map with reference to the section corners.

Mile signs on all trails will be placed at all milepost positions regardless of whether or not other signs exist near any individual mile-sign position. For example, a mile-sign position may fall on or within a short distance from the intersection of the trail and section line, which is to be marked with Form 458. The mile sign should be placed in its proper position regardless of other signs; otherwise, if a mile

number is dropped, the continuity of the numbering system, which is desirable, is broken. There will be no objection to placing a mile-post sign and Form 458 on the same tree.

The Field Survey

Before the survey of any trail is started, the Supervisor should issue brief, written instructions outlining the methods and equipment to be used, how and where signs are to be placed, the initial and terminal points of survey, where ties are to be made, the degree of accuracy desired, and other factors deemed necessary to insure an adequate survey. (See Circular E-99.)

Under ordinary conditions, two men work to the best advantage with the compass-Abney-tape method. Unless otherwise specified all surveys should be made by the traverse method. Before starting, the correct magnetic declination should be determined and set off on the compass to be used. When H. E. surveys exist near where the survey is to be made, magnetic declinations suitable for compass work may be obtained from H. E. S. plats or notes.

All traverses should be initiated from and terminated on some established control point, such as a section corner, triangulation station, lookout station (which has been accurately located), or other point which is known to have been located to a degree of accuracy as hereinafter described. In no cases should "fly line" traverses, compass and pacing traverses, or other types of survey of a low degree of accuracy be used to determine the horizontal positions of mileposts which will eventually be printed on standard administrative maps.

In addition to the location of mile signs and ties to section corners, all obtainable information of value for map-correction purposes as outlines in Circular E-43 should be recorded in field notes.

To guard against personal errors, it is often advisable to have each chainman keep notes. The one set should be permanent, while the other need only be skeleton or check-notes of a temporary nature. Check-notes ordinarily consist only of bearings and distances, and are thrown away as soon as the survey is completed and they have been carefully compared with original or permanent notes. The two sets of notes should be compared at least once each day so that in the case of large discrepancies they may be checked on the way to or from camp. In order to localize errors, it is advisable to check the two sets of notes at 1/4 or 1/2-mile intervals. Experienced men can carry two sets of notes without any loss of time. Whether or not two sets of notes should be carried will depend upon the type of personnel available to do the work; sometimes when a very accurate and experienced man is assisted by an inexperienced man, check-notes may be of little value.

At the present time, as a general rule, the use of compass surveys for obtaining horizontal positions of mileposts should be limited

to areas that have not been covered by G.L.O. surveys. On areas surveyed by the G.L.O., where trail and section-line intersections are marked on the ground, the horizontal positions of mile-posts are not now so urgently needed. On these areas, cyclometer-wheel surveys for obtaining lineal distances that will make possible the setting of mile-posts in consecutive numerical order throughout the entire length of the trail will suffice. At some future time, after the horizontal positions of mileposts in unsurveyed country are completed, traverses through areas covered by the G.L.O. may be made by the compass and pacing method. On this type of survey, the horizontal position of mile-posts and information of value for map-correction purposes should be recorded and handled as required in Circular E-99.

Platting Traverses

In order to assist in detecting discrepancies and checking errors of closure as well as to furnish information urgently needed by the Supervisor, traverses should be platted as the survey progresses. The scale should be sufficiently large (2 to 4 inches - 1 mile) to allow accurate platting and show detailed information without crowding. It is realized that some members of the forest personnel will do their platting with ease on a 2-inch scale, while other members may have considerable difficulty in platting the same information on a 4-inch scale.

Driveway-Fire Lines

Specifications

Combination sheep driveway-fire line.

The following specifications are intended as a general guide to be followed in the construction of driveways through green-timbered or burned-over timber areas where the purpose of construction is to open a driveway which is designed to also serve as a fire line. Generally speaking, these specifications are intended to apply only on forests west of the Continental Divide, and on them construction not in accordance with the specifications should be undertaken only by special arrangement for the individual project made in advance with the Regional Forester.

Projects

Only those projects will be undertaken which will facilitate the handling of stock on ranges now being used or for which a demand can be foreseen within a reasonable time. The need for a fire line alone will not be considered as sufficient justification for construction.

Location

The location of the driveway should be chosen primarily with a view to making range resources more accessible. The location should be

definitely chosen by making a careful examination on the ground, and the center line of the driveway marked by stakes or blazes prior to the beginning of construction.

In selecting location on the ground two points should be kept clearly in mind at all times:

1. The suitability of the route for the purpose of moving and distributing sheep to the range.

2. The strategic location of the driveway with reference to its usefulness for -

(a) Stopping the advance of fire
(b) Serving as a position from which to meet fires by back-firing or otherwise
(c) A possible line of transportation in case of fire

Consideration of the foregoing points means that ordinarily driveway-fire lines will be confined to the crests of prominent ridges or divides or to broad expanses of relatively level land in more or less densely wooded country.

Width

In construction, driveway-fire lines will be held to a minimum width of 20 feet with a maximum of 30 feet. In open areas the boundaries may be posted to any desired width as specified under "Posting" below.

Sound green trees 5 inches or larger in d.b.h., will not be cut except where necessary to allow the passage of pack animals. They should be trimmed of all branches, green or dead, that a man standing on the ground can reach to lop off with an axe. Green trees of any size which show holes or rotten cat faces near the base and which would obviously ignite readily in case of fire, should be cut. Stumps will be left not more than 6 inches in height, lower in the case of very small material.

All dead snags on the driveways will be cut down and the portion of them which falls on the driveway will be bucked up and so far as practicable disposed of by burning. Tall snags outside of the line which are likely to fall across it or which are likely to carry fire aloft may be cut down, but need not be bucked up or further disposed of unless they fall across the line.

All windfalls on the driveways, whether rotten or sound, will be bucked up and so far as practicable disposed of by burning. Special effort should be made to clean up rotten wood.

All green poles and reproduction smaller than 5 inches d.b.h., will be cut down and disposed of as indicated under "Slash Disposal" below.

All brush more than 3 feet in height will be cut from the driveway and disposed of as indicated under "Slash Disposal" below. Huckleberry and other small brush and weeds which sheep may readily browse or tramp out, should not be cut.

Slash Disposal

The chief purpose of slash disposal on driveway-fire lines is to remove inflammable material.

As it is cut, all green slash or debris 4 inches or less in diameter will be piled or windrowed compactly near the center of the driveway and burned clean at the first safe opportunity. Special precautions will be taken to protect standing green trees in burning slash, and any trees seriously damaged by the burning will be cut down and the debris from them disposed of. Green tree trunks or parts of tree trunks larger than 4 inches in diameter will be left scattered on the driveway with their length parallel to the length of the driveway. In no case will they be windrowed along the sides of the driveway.

Parts of dead snags and windfalls which are bucked from the driveway will be carefully piled, either with the green debris or separately, and burned clean at the first safe opportunity.

Posting

Regular metal driveway posters for the center of driveways, Form 293, will be posted along the center line of the driveway at intervals of not more than 1/4 mile and closer together in open or burned country where there is any possibility of doubt as to the location of the driveway.

Blazing green trees on or along the driveway should be avoided.

Posters for the side limits of the driveway, Form 310, may be placed any desired distance outside of the cleared strip, should face the center of the driveway, and should be spaced sufficiently close to forestall any doubt concerning the location of the driveway limits.

Water signs should be used freely to show the distance and direction to water along the driveway.

TRAIL MAINTENANCE

The subject of trail maintenance is very well covered on pages 56 to 64 inclusive of the Forest Trail Handbook. Every trail maintenance

crew foreman or maintainer working alone should have a copy of this handbook in his possession and his superior should require him to be familiar with its contents.

These instructions are intended to supplement and amplify the handbook instructions. Each maintenance crew foreman or worker should be given complete written instructions and a map covering the projects to be worked on, the kind of work to be done, whether emergency, ordinary or extraordinary maintenance, and routine instructions in regard to camps, service of supply, etc. When telephone lines or other improvements are to be maintained by the same crew additional detailed instructions will be given the foreman in regard to them.

Organization

Probably the most important phase of trail maintenance is organization of the work. There are a number of different methods of organizing the work depending upon the type of the country and the location of roads within the area where the trails are located. What may be good organization of trail maintenance work in a district liberally supplied with roads will not be good in a district where there are few roads. Too much emphasis cannot be placed upon the need for more and wider use of the "gypsy" crew type of trail maintenance. For ordinary maintenance two men with pack horses, camping and working as they go is much more effective than when the men have to hike or ride long distances to get to some central camp. Men who are unwilling or unable to cook over a camp fire or to "bush whack" in a "leanto" tent have no business on the trail maintenance job. Rangers who do not consistently use this type of organization in trail maintenance, where it is applicable, must be prepared to defend with facts and "figgers" the scheme they do use.

Crews and methods recommended are as follows:

1. One man. Adapted to jobs where saw work is not essential. Can be effectively worked from lookouts on radiating trails up to four or five miles from point. Use horse when conditions permit.

2. Two-man crews.

(a) Quartered at ranger stations or other central camps and transported to and from trail intersections by use of trucks.

(b) Progressively moving with packstock equipment and food supplies with replenishment of supplies about every ten days. Ride stock when practical.

3. Three-man crews. Composed of one cook-packer and two other men. Adapted to interior regions where camp tender scheme entails undue

lost motion. Equipped with ample tools to handle any job encountered. Two or three weeks' supply of food. Three or four gentle horses or mules.

Plans

A district ranger cannot very well plan his work unless he has available adequate records which supply the information needed in the preparation of any work plan. The essential thing to know in trail maintenance planning is the location of the trails to be maintained, the length or mileage of each project and the probable kind of work which will be found on each project.

The instructions on page 3 to 4-I of the R-1 Administrative Guide provide for a trail plan map of the forest and for a detailed record of the individual projects.

With this record available the district ranger and his assistants, with their knowledge of trail conditions and the inspection records of the previous year, should be able to prepare a comprehensive plan for handling the trail maintenance job so as to get it done most effectively.

MAINTENANCE STANDARDS

Emergency and ordinary maintenance should be completed on all trails not later than July 31 of each year. Extraordinary maintenance is of course a season-long job and should be organized so that when emergency and ordinary maintenance has been completed, the same men proceed with the extraordinary maintenance work. In this way men are trained in the proper methods of doing the work and are provided with a longer employment period. Men used for trail maintenance should also be used on trail construction crews where possible.

In order that there will be uniform understanding among maintenance men as to the proper requirements of the work the district ranger and/or his alternate should spend from one to three days in actual work with the maintenance men. Only in this way can proper training in this kind of work be accomplished. Trail maintenance requires the application of a practical working knowledge of what to do and how to do it that can only be learned in the school of actual experience.

Trails will generally be maintained to the standard to which they were constructed. The detailed instructions in the Forest Trail Handbook are specific and adequate. Altogether too often good trails have become bad through poorly applied workmanship.

Drainage

One of the biggest faults of our trails is inadequate drainage. There must be constant follow-up inspection to see that maintainers

are putting in proper drainage by utilizing natural breaks in grade to form dips or turn-outs. Where natural breaks in the slope are not available, artificial dips can easily be put in. Wood water bars which require frequent replacement should be used as a last resort only.

Mud Holes

By careful scrutiny of a mud hole to establish the cause it will in nearly every instance be found possible to eliminate the mud hole permanently by the construction of ditches to drain the water away. The use of corduroy to cross mud holes is to be frowned on at all times. Only in exceptional cases will it be justified. Consider the use of nestable metal culverts with fills which can be made through the use of a wheel barrow. This makes a permanent job.

Bridges

The present trail system contains many unnecessary bridges. They should be eliminated as rapidly as they reach the condition where replacement is required. When it is necessary to ford small streams it will be found to be much more satisfactory amd economical to improve the ford by removing large rocks, filling in with small rocks, digging down the banks to better the approaches and to widen the ford and remove obstructions to the flow of the water below the ford in order to make the water shallower. In some cases the construction of a shallow rock dam below the ford which will hold the silt and small rocks coming down will soon establish a smooth bottom shallow ford, passable at all times.

Where bridges are unavoidable there must be careful inspection to see that all timbers are sound and securely fastened in place.

Signs

Instructions for the placement of trail signs will be found in the Sign Handbook. Trail maintainers will be instructed to replace signs where necessary and to report for replacement those signs which have been lost or destroyed.

MAINTENANCE CREW EQUIPMENT

Lists of equipment which are considered minimum for trail and telephone maintenance follow:

Two-Man Camp Equipment

Minimum Requirement

	Weight
2 Kapok beds with one wool blanket each	24#

Two-Man Camp Equipment (cont'd)	Weight
1 Tarp for fly silk, 8' x 12'	4#
2 Mantas	14
2 Cargo ropes	3
1 Tent, 5' x 7' silk	6
1 *Camp stove (Lang)	27
Total weight	78
Total weight less stove	51

* The stove is suggested in lieu of the dutch oven for the forests where open camp fires are not permitted by grazing permittees.

Two-Man Mess Equipment

Minimum Requirement

	Pounds	Ounces
One 10-quart canvas bucket	2	
One 10"-fry pan	1	
One 12"-fry pan	1	4
One 2-quart pail		8
One 4-quart pail		12
One butcher knife (short)		4
One 14"-steel pan (gold or similar)	3	
Three forks, table)		
Three knives, table)		
Three spoons, desert)	2	
One can opener)		
One 10"-dutch oven	9	8
One 8"-spoon, mixing		8
Three 9"-plates	1	8
Three bowls (soup)	1	4
Four sacks, lunch		4
Three yards dish toweling		8
One 3-quart coffee pot	1	
Total Weight	25	4

TRAIL MAINTENANCE OUTFIT

Minimum Requirement

Item	One-Man		Two-Man		Three-Man	
	No.	Wt.	No.	Wt.	No.	Wt.
Axe and sheath	1	5#	1	5#	2	10#
Pulaski			1	5#	1	5#
Saw, cross-cut 5½' and handles			1	7#	1	7#
Felling wedges			2		2	
Files, 6"			2	½#	2	½#
Hammer, 3#			1		1	
Files, 10"	1	½#	2	1#	3	1½#
Filing outfit			1	2#	1	2#
One pick mattock			1	6#	1	6#
Canteen, 2-quart	1	1#	2	2#	3	3#
First-aid kit	1	½#	1	½#	1	½#
Nails, 10d			50	2#	50	2#
Map of Work Program	1		1		1	
Pack sack or pack frames	1	2#	2	4#	3	4#
Lumberman's crayon	1		1		1	
Total Weight		9#		35#		41½#

TELEPHONE MAINTENANCE TOOL OUTFIT

Minimum Requirement

Item	One-Man		Two-Man		Three-Man	
	No.	Wt.	No.	Wt.	No.	Wt.
Telephone Climbers			1	5#	1	5#
Lineman's Safety Strap			1	2½#	1	2½#
Lineman's Safety Belt			1	8#	1	8#
Bar Digging, 6'			1	2½#	1	2½#
Shovel, long handle			1	4#	1	4#
Split Tree Insulators, pair			20	10#	20	10#
Staples, 3", gro.			½	3½#	½	3½#
#12 Wire			100'	9½#	100'	9½#
#9 Wire			100'	9½#	100'	9½#
Pliers, 8"			1	1#	1	1#

TELEPHONE MAINTENANCE TOOL OUTFIT (cont'd)

Minimum Requirement

Item	One-Man		Two-Man		Three-Man	
	No.	Wt.	No.	Wt.	No.	Wt.
Connectors			1	1½#	1	1½#
Telephone Axe			1	2#	1	2#
Telephone Test Set			1	4#	1	4#
Telephone Ground Rod #4 Copper Wire			1	1#	1	1#
Total Weight				64#		64#
Grand Total Weights		9#		99#		105½#

Telephone equipment to be included when dual maintenance is to be performed.

TRAIL CONSTRUCTION CREW EQUIPMENT

A decided tendency has been observed to oversupply trail crews with equipment, thereby adding to cost of transportation and camp preparation as well as tying up funds in stocks of unused or non-essential equipment.

A committee selected from representative forests has set up the following list as being adequate for trail construction purposes:

Tool Equipment List

Regional Standard for Trail Crews

	2-man	5-man	8-man
Axes, D. B., 3½-lb	3	4	5
Bags, man-pack, 5-gal. (only where needed)	1	1	1
Bags, water, 2½-gal.	2	2	3
Bars, crow (where needed)			
Chains, log, 12-ft. (where needed)			
Chest, medicine, crew	1	1	1
Crimpers, cap (where needed)			
Files, 8-in.	3	4	6
Files, 10-in.	2	4	6
Flags, U. S.	1	1	1

Tool Equipment List (cont'd)

	2-man	5-man	8-man
Grader, Beatty trail (where needed)...			
Grindstone and frame, Army			1
Hammers, claw	1	1	1
" falling, 4-lb.	1	1	1
Handles, axe		1	1
" mattock	1	2	4
" saw	2	2	4
Hooks, brush	1	1	1
Kits, timekeeper's	1	1	1
Level, Abney			1
Mattocks		1	2
Outfits, cobbler		1	1
" saw-filing	1	1	1
" smokechaser's, complete	2	2	2
Peavy		1	1
Picks, mattock	1	2	3
Plow, trail (where needed)			
Rasp, wood			1
Sacks, pack, Duluth #2, or pack frames	1	1	2
Saw, C. C., 5½-ft.	1	1	2
Shovel, L.H.R.P.....	1	2	2
Stone, carborundum, pocket	2	3	4
Wedges, falling	2	2	4

Mess Equipment

Basin, wash	1	2	3
Beater, egg			1
Board, wash	1	1	1
Boiler, 2-gal.		1	
" 3-gal.			1
Bowls, mixing, 6-qt.....			1
" soup, granite	4	4	10
Buckets, water, 10-qt., canvas	1	1	1
Can opener	1	1	2
Clocks, alarm	1	1	1
Collander			1
Cups, nested	4	7	10
Canvas, table top	1-5'	1-8'	1-8'
" " "			1-5'
Forks, meat			1
" table	4	8	10
Griddle, pancake		1	1
Kettles, 2-qt.	2	2	1
" 4-qt.	2	2	3

Mess Equipment List (cont'd)

	2-man	5-man	8-man
Kettles, 6-qt		1	1
Knives, butcher	1	1	1
" paring	1	1	1
" table	4	8	10
Nails, assorted - lbs	5	6	10
Oilcloth, white, 46" wide - yds	2	3	5
Pans, bread, medium	1	2	2
" " large			1
" dish	1	1	2
" dish-up, 1-qt	2	3	2
" " 2-qt	2	3	4
" " 3-qt			1
" fry, medium	2	1	1
" " large		2	2
Plates, enamel	4	8	10
Platter, meat			1
Pots, coffee	1	1	1
Sacks, cloth, lunch	6	12	15
Saw, meat		1	1
Screen, cheesecloth - yds	4	4	5
Shaker, salt		1	1
Sifter, flour, flat, 16" bottom			1
Spoons, dessert	4	6	8
" mixing		1	1
" table	4	8	10
Telephone, complete	1	1	1
Tins, pie	2	3	4
Toweling, dish, 50-lb. flour sacks	6	8	10
Tubs, wash	1	1	1
Turner, cake	1	1	1

Tentage

Flies, 10 x 12 ft	1	1	1
Tents, 10 x 12 ft	1	2	3

Bedding

Blankets, wool (6 thicknesses per bed)	12	30	48
Extra bed each crew for forest officer	1	1	1
Tarps	2	5	8

Stoves

Stoves, cook, Lang or sheep	1	1	1
Stovepipe, joints	5	5	5

Blacksmith Outfit

(To be furnished only on jobs where need is fairly constant)

	2-man
Anvil	1
Chisel, hot	1
Coal, sack	1
Drill, spoon	1
" steel, set	1
Forge, portable	1
Hammer, blacksmith, ball peen	1
" double jack	1
" flatter	1
" rock, 12-lb	1
" single, jack	1
" tool-sharpening	1
Hardie	1
Tongs	1

Nested mess outfits for the above units are the most desirable and should be used wherever possible.

RANGE IMPROVEMENTS

The technique of range improvement construction varies with each Forest or locality. Each has developed local problems without much reference to the experience of others. An attempt has been made to collect and illustrate here the best types of each class of improvement. These are set up as the standard which should be used in all cases. Variations which do not lower the standard of construction are always permissible.

Fences

There are six recognized types of fence construction in general use:

1. Buck pole
2. Buck wire
3. Rock buck
4. Pole and block
5. Wire on posts
6. Pole

The first two have been developed on eastern Forests in an endeavor to develop a fence which would stand up under heavy snow conditions. The rock buck fence is the result of a situation where post hole digging is almost impossible in places. The pole and block fence is used rather generally for corral construction. The "wire on posts" type is, of course, the most widely used of any kind of fence and the simplest to construct. Pole fences are built in various ways, but usually they consist of four-inch-by-18-foot poles spiked to posts set 16 feet apart. In a good pole country the poles may be long enough to cover two spans. It is good practice in high altitudes when only inferior poles are available to cut the material 16 feet, making a 14-foot panel.

Fence posts should never be set less than 18 inches in the ground. It is good practice to treat fence posts, juniper material excepted. The increased cost is more than justified by the increased life of the post.

The details of construction of the various types of fence are shown in the accompanying illustrations.

Corrals

Cattle and horse corrals must be substantially built and seldom less than eight feet in height. Gates must be free-swinging and strong. Stock is much easier to handle in good corrals, and there is less damage to its condition than in makeshift affairs. Such corrals should usually consist of three parts: A large, round-up corral; a small or working corral connected to the large corral by a chute or lane ten or twelve feet wide and 30 or 40 feet in length; a branding chute built along

one side of the larger chute and opening into both corrals will also usually be needed. The best corral material are poles wherever they can be secured. If sawed material is used, two-by-six or two-by-eight planks are necessary with posts set at eight-foot intervals. Sites selected for corrals should be dry and well drained in order that mud holes will not develop.

On the sheep range two types of corrals are needed. On those ranges where mixing of bands is probable and on driveways, separating corrals are needed. On other ranges simple counting corrals are all that are necessary. A separating corral, if carefully designed and laid out, will more than pay for itself in one day with a badly mixed bunch of sheep. Such corrals should slope uphill and away from the sun. Sheep will run better uphill or away from the sun. Fence adjacent to the chute entrance and the chute itself must be walled up solid or the sheep will not run if there are sheep in the adjacent pens.

Gates

The so-called wire gate so widely used in the barbed wire fence country is an abomination, a snare and a delusion. Nothing good can be said about it. At points where gates are necessary though seldom used, the wire makeshift may serve. Be sure that the gate posts are securely braced and that an adequate bail or tie for the gate is provided. The gate made of poles where it is required to remove from four to six to pass through a fence is equally as bad as the wire gate. This type is seldom closed.

Pole gates constructed as shown in the attached illustration will give long and satisfactory service and are standard for all cases where pole gates are desirable. The illustrated gate lacking the archway structure is intended for those places where minor entrances are desired. For board and wire gates, there are a number of good makes on the market which are more economical to purchase than to attempt to build them.

Water Development

There have been quite a variety of methods worked out for developing springs for watering stock on the range - some good, some poor, and some otherwise. Conditions at each site suggest variation in the mechanical scheme of development.

In some localities they cut down a big yellow pine, the bigger the better. A chunk 16 to 20 feet long is sawed off and then two-inch auger holes are bored into the center of the log in a diagonal direction from each side about 18 inches apart. Long slivers of pitch are cut, set afire and inserted in the holes or else kerosene is poured in each hole and set afire. In about 48 hours, sometimes longer, the log will be so well burned out that it is only a few hours' work to chop it out to the shape desired. Usually, however, it will be cheaper and better to construct water troughs from sawed material. Different types of plank troughs are shown. Material for plank troughs should be three-inch fir 12 to 16 inches in width.

Water troughs for sheep must be small in cross section and of considerable length so as to accommodate a band of 1,200 or 1,500 ewes and lambs when necessary. Usually, such troughs are built in 12- or 16-foot sections and placed in a long line one below another. Wherever water troughs are constructed and cattle or horses have access to them, they must be protected in such a manner that the troughs will not be broken or otherwise disturbed by the stock.

Water troughs should always be set upon a rock foundation, and usually it will be advisable to excavate a strip about four feet wide along the side of the trough and fill it with rock so as to eliminate the usual mud hole at such places.

Considerable success has been had in improving springs without putting in a trough, by laying a log across the outlet and creating a sort of dam to hold the water back. These are economical and simple to install.

Galvanized iron water tanks are available at moderate costs, and before going into plank construction the possibilities of buying iron troughs should be looked into. The Hudson Manufacturing Company of Minneapolis makes a tank two-feet-by-two-feet-by-eight-feet, weight 97 pounds, capacity 200 gallons, that sells for $14.00 in Missoula. They make a brace for their tanks that protects them against bursting on account of freezing. Round, iron tanks, diameter five and one-half feet, depth two feet, capacity 300 gallons, cost about the same as the oblong tank. They also make a sheep trough two feet wide, one foot deep and ten feet in length, capacity 130 gallons, weight 110 pounds for $14.00, f.o.b. Missoula. Other manufacturers make similar galvanized iron tanks.

Where it is necessary to use wells for water supply on the range, the use of windmills for pumping the water is preferred. These mills are now made automatic self-oiling and run through the season without any attention. Detailed information should be secured from reputable agents of standard makes.

In some cases, it will be necessary to construct earthen dam reservoirs to impound flood waters for stock watering. Sites for such dams must be carefully chosen and the dam constructed so that it will be permanent. Detailed instructions for the construction of such dams will be found in U. S. Department of Agriculture Bulletin No. 1358, "Range Watering Places in the Southwest." The recent handbook, "Design and Construction of Forest Service Dams" for Civilian Conservation Corps, issued in 1935, gives detailed information on earthen dams.

Miscellaneous Construction Hints

The plans under this heading as shown are self-explanatory. They were arrived at through experience on the ground and lean towards lower costs in construction and lower future maintenance without breaking down the standards set up.

Calking Wood Troughs

A calking compound is made of 25 pounds putty and one gallon paint ocher without oil, mixed thoroughly. This will be enough to calk about 100 linear feet of trough.

Freezing

A chunk of wood floating loose in a trough will often keep it from bursting, and can easily be left in the trough at all times.

SET-UP OF TOOLS RECOMMENDED

FOR TEN-MAN FENCING CREW

Axes, D.B., three-and-one-half-pound	8
Axes, S.B., three-and-one-half-pound	4
Bags, water, two-and-one-half-gallon	3
Chains, log, 12-foot	2
Files, ten-inch	6
Hammers, claw	2
Hammers, sledge, four-pound	1
Sacks, pack	3
Saw, C.C., or one-man	2
Saw, carpenter	1
Stone, carborundum, pocket	6
Grips, Buffalo	2
Pincers	2
Pliers, six-inch, side-cutting	4
Bars, digging	2
Shovels, L.H.	4
Bar, wrecking	1

Carpenter Tools

Brace	1
Expansion bit	1
Knife, draw	1
Square, carpenters'	1
Rule, carpenters', two-inch	1
Wrench, monkey, eight-inch	1
Handles, ax, D.B.	3
Handles, ax, S.B.	2
Handles, hammer	2
Pick	1

Reservoirs or "Tanks"

(See Department Bulletin No. 1358, "Range Watering in the Southwest," by M. W. Talbot.)

Stock Water Tanks (From Nevada N.F.)

Circular tanks for watering cattle may be installed where it is possible to deliver the tanks by wagon or cart.

Sizes of the tanks should vary to suit the carrying capacity of the range and storage facilities required. Storage capacity is gauged by the diameter of the tank.

Specifications

Twenty to twenty-four inches high (two-inch galvanized iron lead-in pipe). Not lighter than sixteen-gauge galvanized iron. Joints, seams and bottom well soldered. Upper rim supported by rolling tank material around 3/4-inch iron pipe. Two-inch connection in bottom for insertion or overflow or drainage pipe.

Tank placed on practically solid foundation of either rock, cement, or juniper posts (Juniperus utahensis) not less than four inches in diameter at the tip. The weight of the tank and water holds the tank in place.

Metal Trough Water Development

A modified method of installing metal troughs has been developed. This type of development is illustrated by the two enclosed plates. It may be more practical under some conditions to rest the sill logs on a few large rocks, rather than on numerous smaller rocks as shown in the illustration. If it is practical to do so, the sill logs should be creosoted, but this is not required if not practical.

There are several advantages of this type of development under certain conditions. In remote localities where posts and planks are not available and are difficult to transport, and logs and poles are available near at hand, the cost and labor of transporting posts and planks long distances can be avoided by using this type of installation. We are informed that this type of development is not so likely to settle and shift position in meadows and other areas of moist ground as is the type of development in which posts and planks are used.

SPECIFICATIONS FOR EARTHEN DAMS FOR STOCK-WATER RESERVOIRS

Earthen dams for stock-water reservoirs constitute a cheap method of water storage and in many cases the only means of providing adequate water. The selection of reservoir sites is a highly important matter and must be made with several important factors, in mind, such as:

1. Location with reference to feed area to be served.

2. Best possible drainage area with relation to vegetative cover, absence of silting material, etc.

3. The best possible soil conditions in the dam site itself and available for dam material. Heavy clay soils are most impervious to water.

4. Greatest storage capacity possible for minimum cost of dam construction.

5. Adequate spillway possibilities either natural or artificial.

6. The size of the drainage area above the dam is important. In most cases, areas from one to three square miles will be found adequate. Larger drainage areas mean expensive dams and enormous spillways.

The reservoirs should be of sufficient size and depth to provide ample storing facilities, but it is not intended to create lakes. I feel that in the past our efforts have been wasted to quite an extent by building small reservoirs that could not be expected to hold water for a great length of time. Based, however, on average conditions, we should with reasonable costs attempt to build reservoirs that will contain a minimum of four feet of water at all times.

Dam Construction

Earthen dams 20 feet high or less in good impervious material may be constructed without a cement core wall. Where porous soil is encountered, a 12-inch concrete core wall will be constructed through the center of the dam to prevent seepage and as a safety provision against burrowing mammals.

The first provision for the safety of an earthen dam is that the site or foundation be stripped of all vegetation down to mineral soil, usually by plowing, to insure a good bond when the fill is placed thereon.

The minimum width of the top of any earthen dam should not be less than six feet and this width can be used for dams up to eight feet in height. For dams above eight feet a good formula is, top width - maximum height of water in reservoir in feet + two feet;

for example, if the water in the reservoir is to be raised to a maximum height of 18 feet, the top width of the earthen embankment should not be less than $\frac{18 + 2}{2} = 10$ feet.

The slopes of earthen dams should be as follows: Upstream slope three feet horizontal to one foot vertical; downstream slope, two feet horizontal to one foot vertical.

When the dam is being constructed, the earth should be well compacted by driving teams over it. Pack slopes as well as along center. In other words, the upstream slope should be packed rather than depending on overcasting alone. To prevent the dam being low in center when settling of earth has taken place, it should be left high in the center.

The freeboard on earthen dams, or the distance between the maximum height to which water is to be stored and the lowest part of crest of dam should not be less than is shown in the following table. The width of the spillway and the elevation of spillway floor below the top of the dam to give the required freeboard for various heights of dams and drainage areas is also given:

Height of Dam (1)		Six to 12 Feet		12 to 18 Feet	
Maximum Height (2) Water Level		Four to 10 Feet		10 to 15 Feet	
Top of Dam to Maximum (3) Water Level (Freeboard)		Two Feet		Three Feet	
Drainage Area above Dam in Square Miles	Area of Spillway in Square Feet	Floor of Spillway Below Top of Dam	Width of Spillway in Feet	Floor of Spillway Below Top of Dam	Width of Spillway in Feet
1	12.5	4.50	5.0	5.50	5.0
2	16.5	4.75	6.0	5.75	6.0
3	21.0	5.00	7.0	6.00	7.0
4	25.5	5.00	8.5	6.00	8.5
5	31.0	5.25	9.5	6.25	9.5
6	35.0	5.35	10.5	6.35	10.5
7	39.7	5.45	11.5	6.45	11.5
8	45.0	5.45	13.0	6.45	13.0
9	49.0	5.50	14.0	6.50	14.0
10	52.5	5.50	15.0	6.50	15.0

(1) Height of Dam means the height between the lowest natural elevation of ground and lowest point on top of dam taken on the center line of dam.

(2) Maximum Height Water Level means maximum height to which water is permitted to rise in the reservoir.

(3) Freeboard means the distance between the maximum height of water level and the lowest point on top of dam.

Next to a good contact with the ground, the most important part of an earthen dam is the spillway, and this must be constructed of adequate size to handle flood waters without danger of the embankment being overtopped. Overtopping of an earthen dam without a core wall is certain to result in its failure, and should be avoided even if the dam is provided with a core wall.

It is not possible to predict accurately the required spillway capacity of dams without individual study of characteristics of the stream upon which the structure is to be built, but as a working guide the preceding table should be used which indicates the depth of the floor of the spillway below the top of the dam and the width of the spillway for drainage areas from one to ten miles in area.

To indicate the use of the table, take for example a dam ten feet high with a drainage area above it of three square miles. The table indicates that a two-foot freeboard is necessary for dams, between six and twelve feet high. The maximum permitted height of water in the reservoir will be 10-2 = 8 feet. The depth of the floor of spillway (distance from the top of dam) for drainage area of three square miles will be five feet and the width seven feet.

These small reservoirs are usually away from habitation and receive very little attention. This means that all construction and controlling devices should be of a character to require very little inspection. The spillway, which has to carry off all the flood water after the reservoir fills, is of great importance. The cause of the failure of a great many dams is due to the inadequacy of the spillway to carry off the flood, thus allowing the water to run over the top of the dam; or to some fault in the construction of the spillway, thus allowing water to run under or around it and cut out the dam if the spillway is on top of or very close to the dam. If there is a place away from the dam where a cut can be made for the spillway, this should be done and the spillway lined with rock or concrete if the ground is likely to wash badly. If it is necessary to construct the spillway on top or adjacent to the dam, it should be lined with concrete and should release the water at a sufficient distance from the dam to prevent erosion. It should be provided with an apron or cut-off wall to prevent the water from running under or around it. A concrete spillway on top of the dam should not be built until the earth fill has settled.

No timber should be allowed in earthen dams excepting for posts or braces for walks out to gates or valves.

In cases where soils are of an impervious nature, material for dams may be taken out of the reservoir proper, but care should be exercised where gravelly subsoils are encountered not to disturb the surface soils of the reservoir.

The availability of earth for the fill is of importance. Often the lakes or sites to be developed are located above timber line where sufficient earth cannot be obtained, and other materials and designs must be used. The cost of a dam increases rapidly with its height. Ordinarily under present conditions for small dams where earth is available, the cost of the earthen dams can be figured at an average of from 30¢ to 50¢ per cubic yard. Advantage should be taken of every opportunity to choose a long, grassy slope with a low gradient for the spillway to empty onto rather than to discharge it over a steep slope or one with sparse vegetative cover.

Protection of Dam

In order to protect the dam against trampling by livestock, all dams will be fenced with a substantial fence, well-constructed to withstand the unusual strain where livestock congregate.

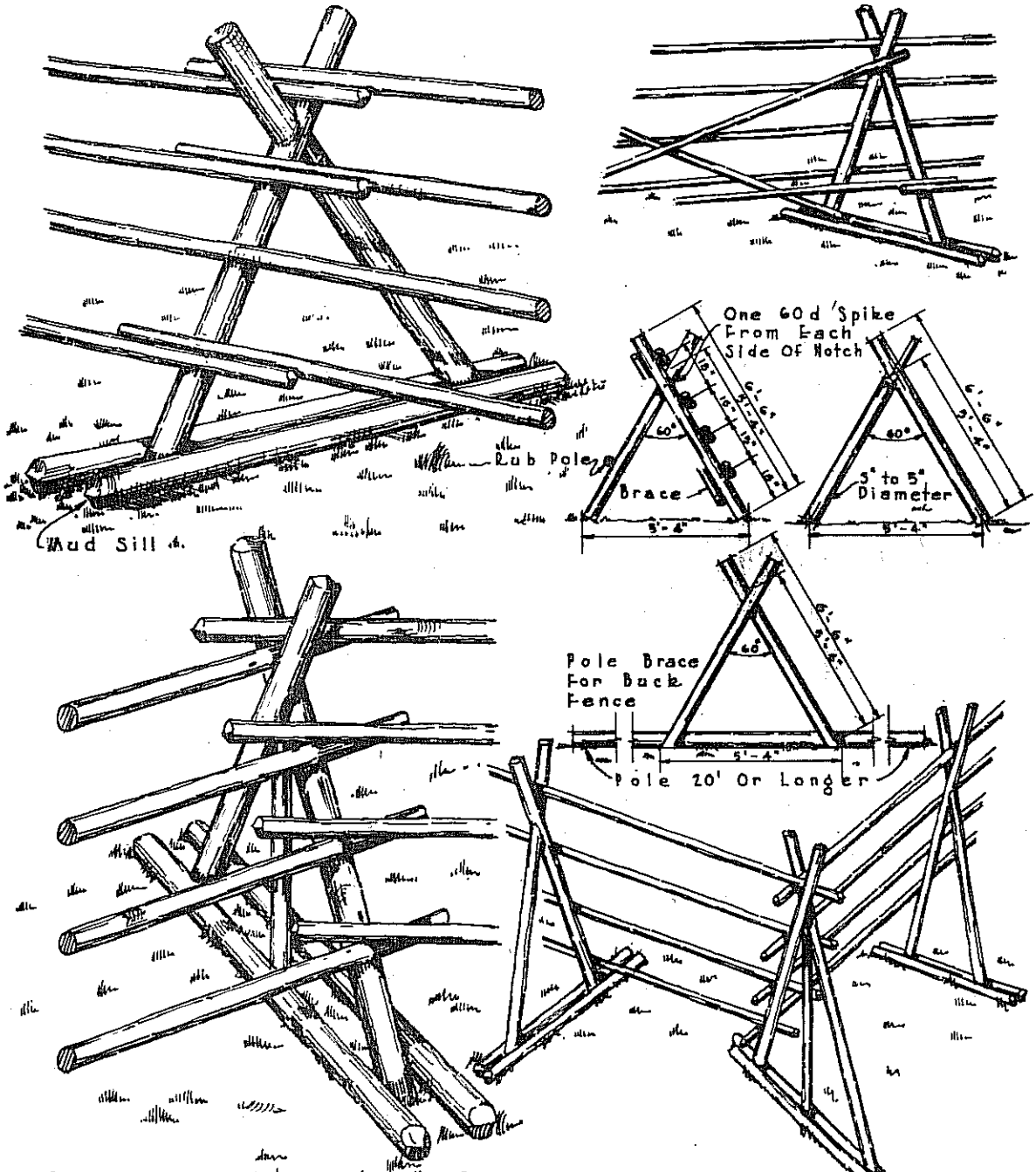
In all cases, some provisions should be made for planting native willows along the upper and lower slopes to provide protection to the dam and shade for livestock.

Satisfactory results can be secured by cutting rather large, but straight, willows, laying them flat on the ground and covering them with four to six inches of soil, allowing a few branches to protrude. The planting of willows along the shores of the reservoir in some cases may be of value and where the cost is small, this may be done.

Where a concrete core is not constructed and the dam is located in a rodent-infested region, occasional inspections should be made, and if it is found that rodents have been working on it, steps should be taken to correct the damage and eliminate it.

· RANGE · & · PASTURE ·

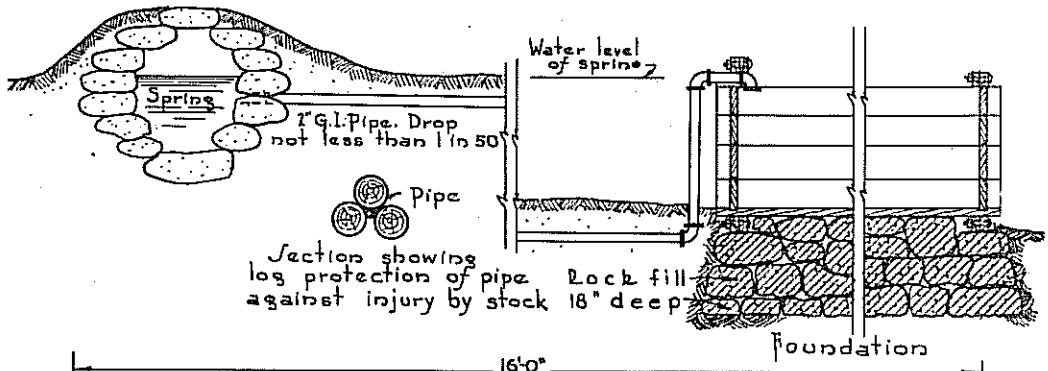
FENCES — BUCK POLE TYPE

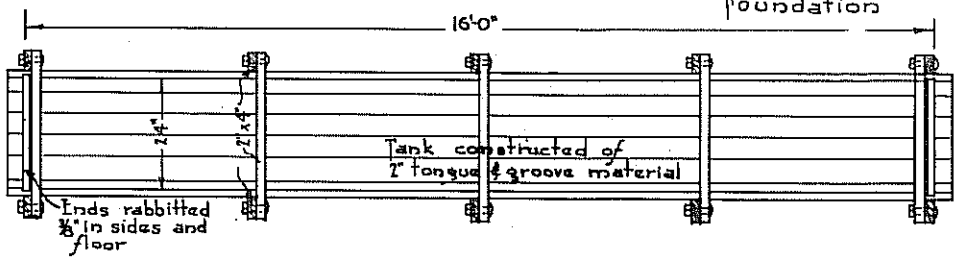


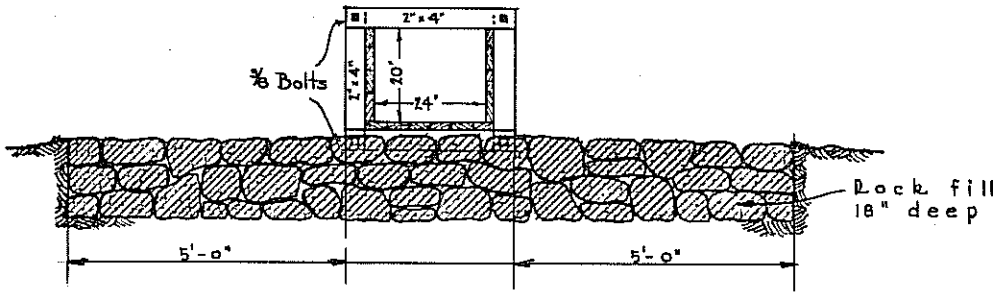
Bucks Shown With Mud Sills For Use On Swampy Ground. On Firm Or Dry Ground These Mud Sills Should Not Be Used.

Plan G-2

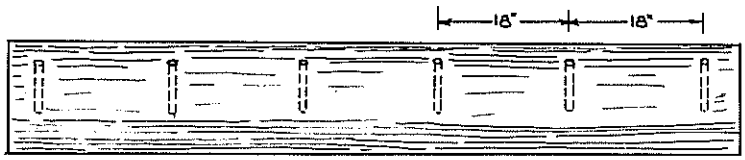
RANGE & PASTURE
Water Development







SECTION



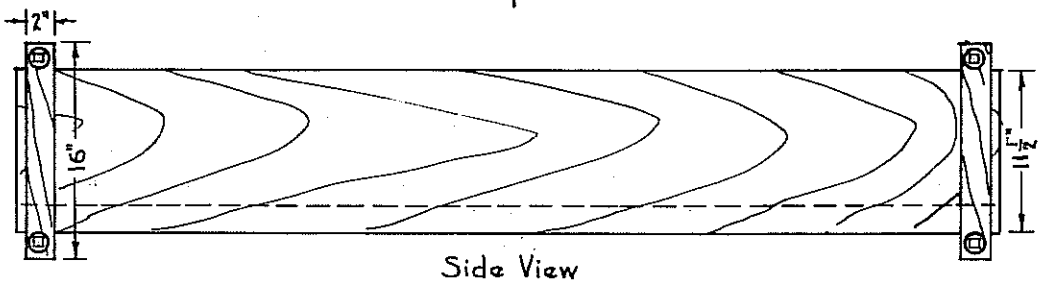
Holes bored in log every 18 inches.

Bore 2" holes to meet in center of log. Start fire in one side, with fat pitch or kerosine. Feed fire with slivers of pitch until it burns freely

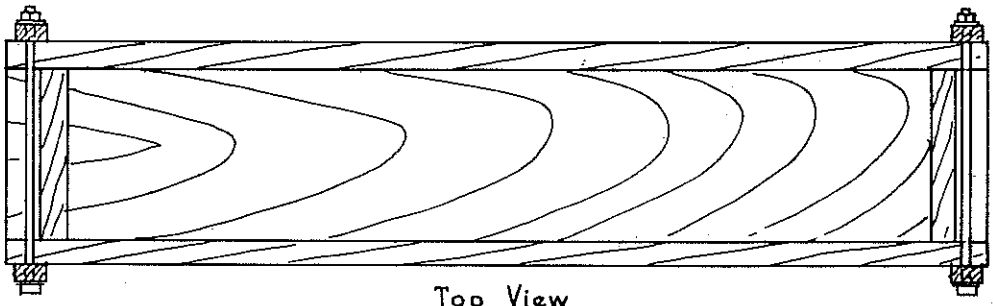
Burning Out Log Trough

Plan G-7

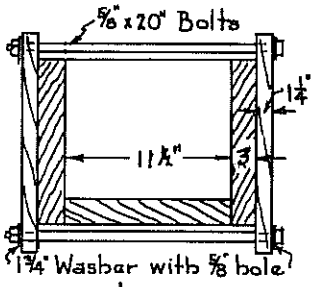
RANGE & PASTURE
Water Development



Side View



Top View



Section

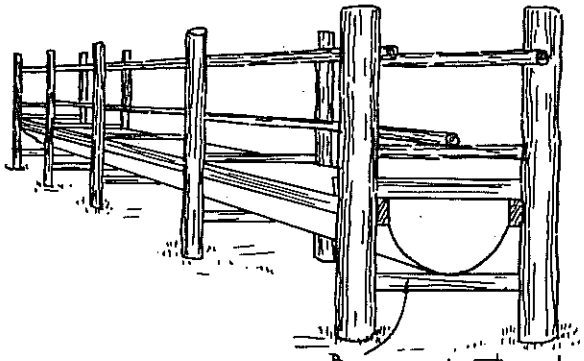
Material for Trough

3 - 2" x 11½" x 6'-0" Sides & Bottom
2 - 2" x 11½ x 9½" Ends
4 - 1¼ x 2" x 16" Stripes
4 - ⅝ x 20" Machine Bolts
8 - 1¾" Washers with ⅝" hole
2# 20d Spikes

Installation

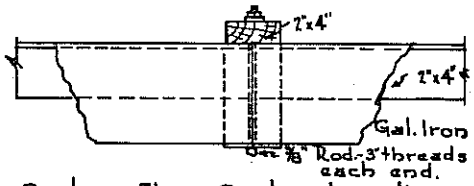
Note: It is not necessary that side and center rails be placed as shown below. Some use this design and others place two rails on each side. Some do not use a center rail.

Joint

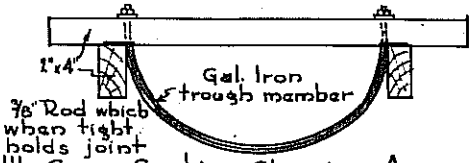


Plan G-8

Brace under trough should be at ground surface for sheep but higher for cattle.

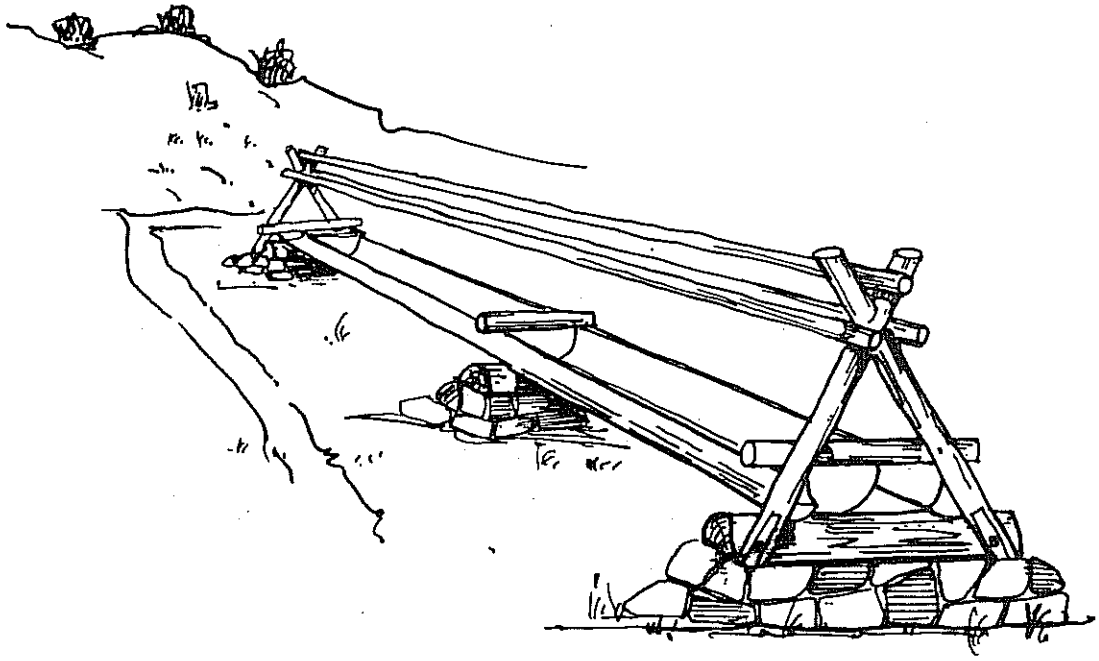


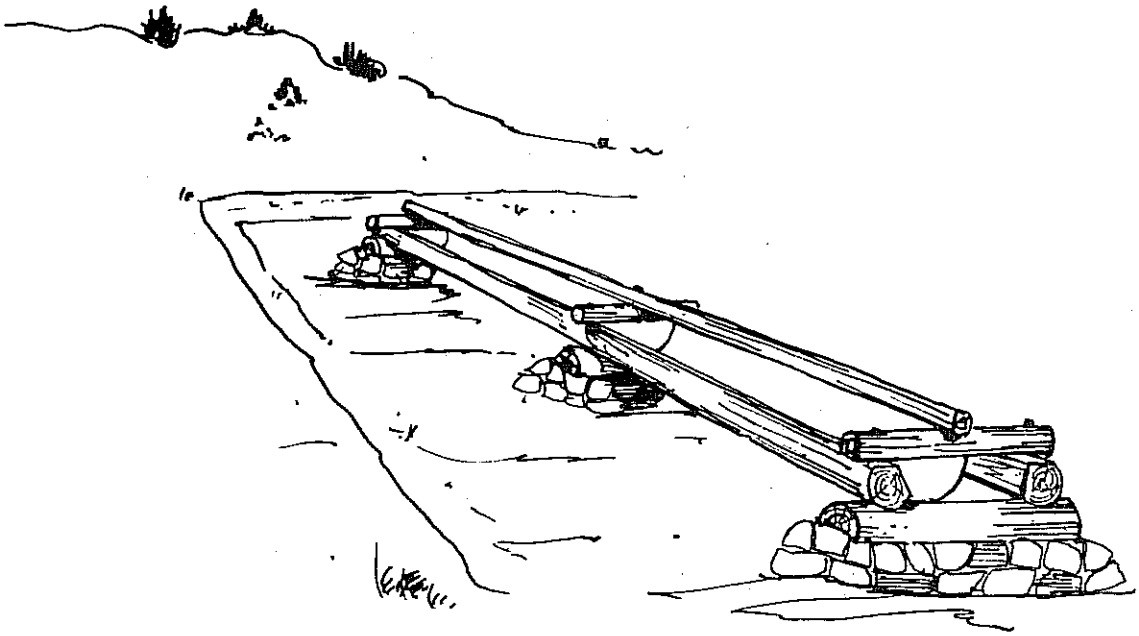
Section Thru. Center Lengthwise



Cross-Section Showing Assembly

· RANGE & PASTURE ·

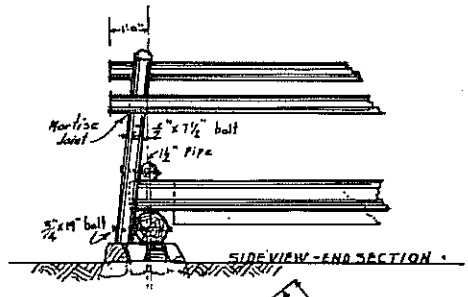


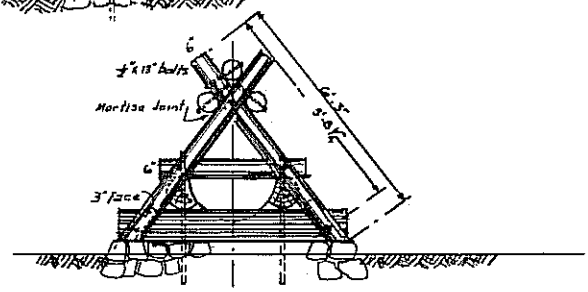


· METAL · TROUGH ·

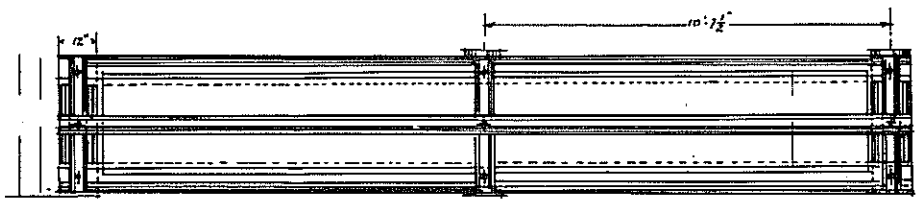
· RANGE · & · PASTURE ·

· METAL TROUGH ·

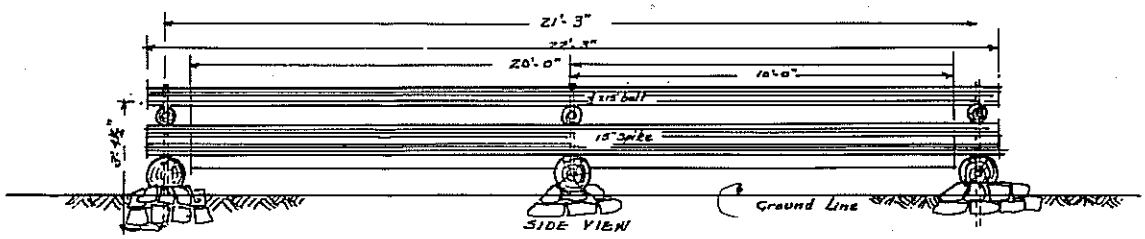




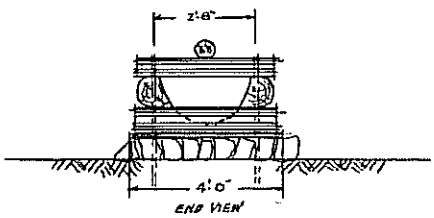
END VIEW



TOP VIEW

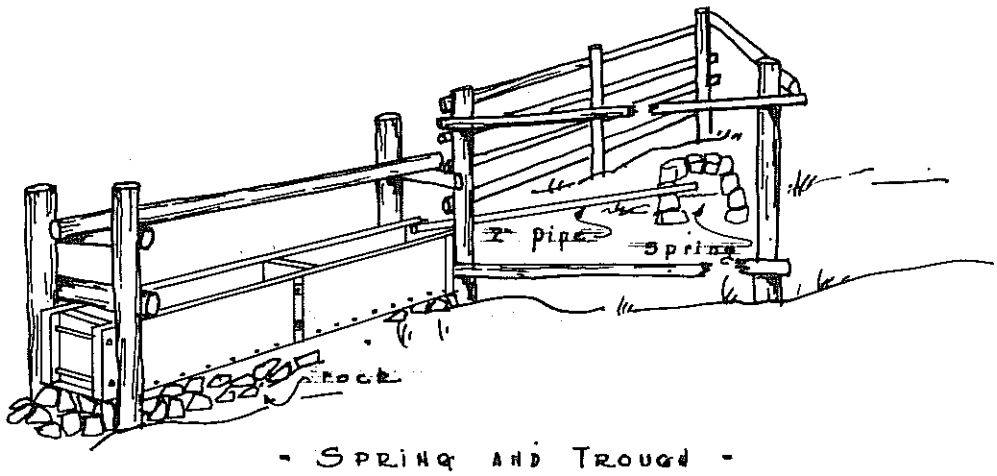


SIDE VIEW

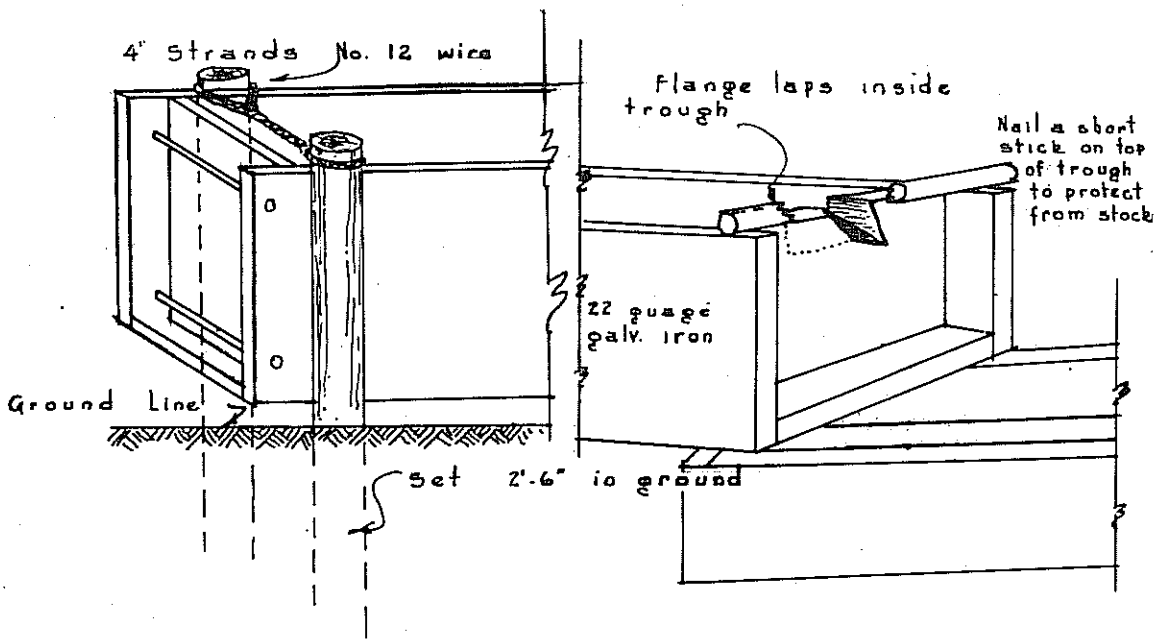


END VIEW

- RANGE - WATER DEVELOPMENT -

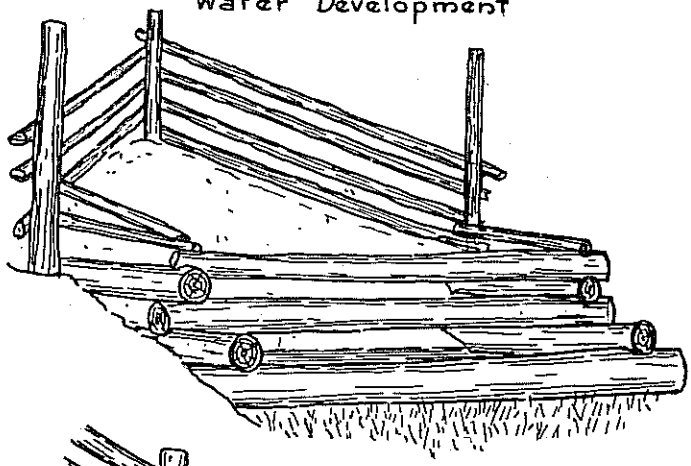


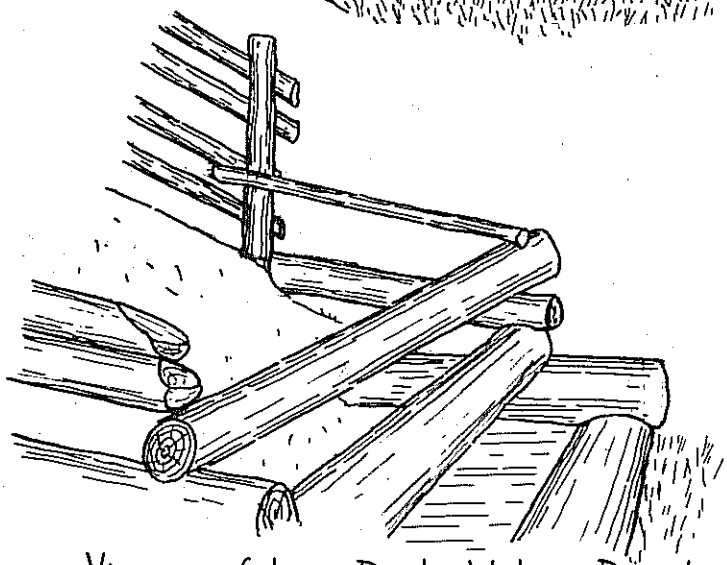
- SPRING AND TROUGH -



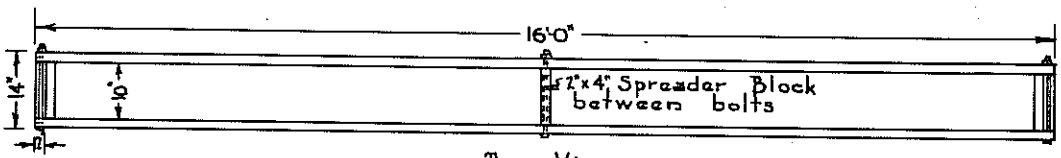
-TROUGH DETAILS-

RANGE & PASTURE
Water Development

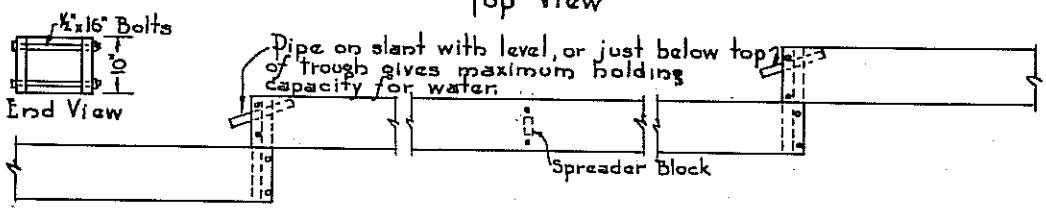




Views of Log Pool Water Development

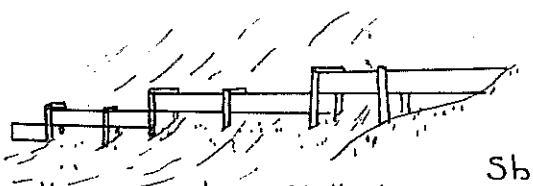


Top View



Side View of Series

Note: 11 troughs to a band of 1500 ewes with lambs gives adequate water supply



View on contour of hillside

Sheep Troughs

Plan G-9

Plate No. 94

RANGE IMPROVEMENTS

Water Development
Showing substitute for a pump head

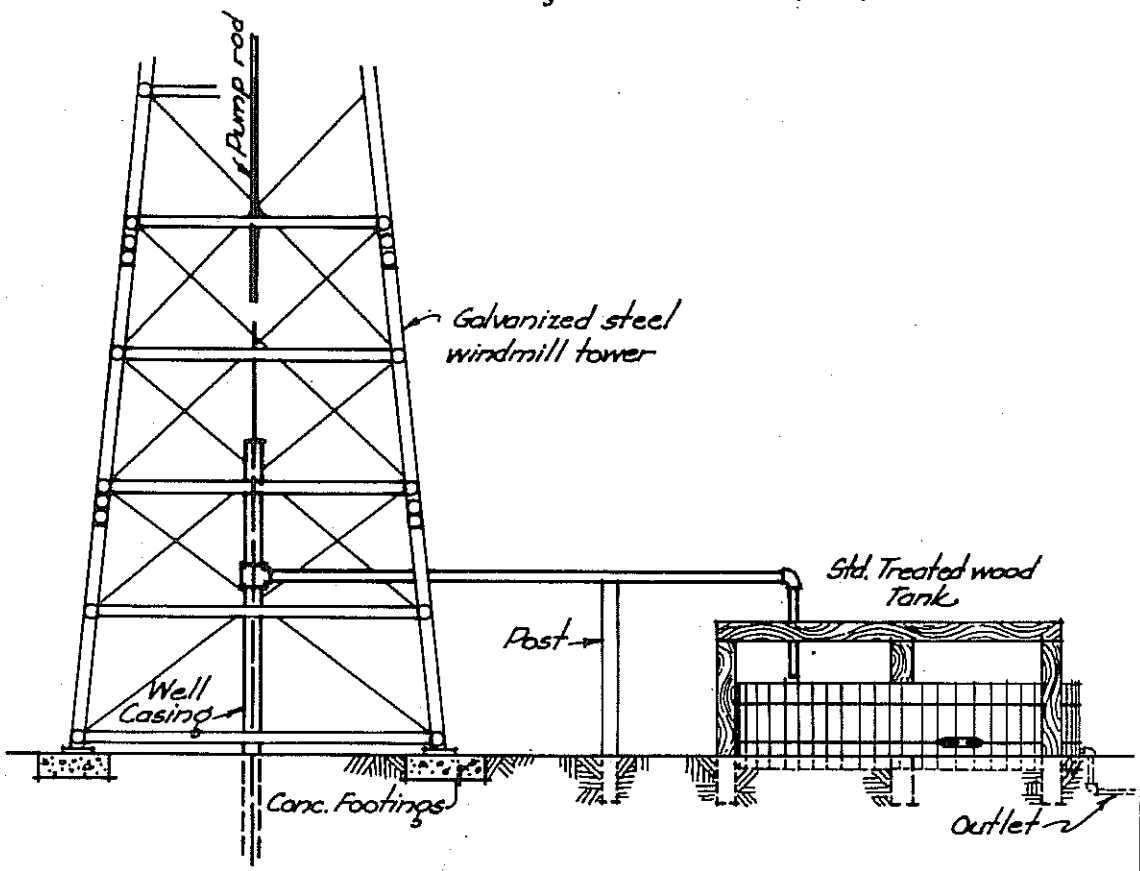
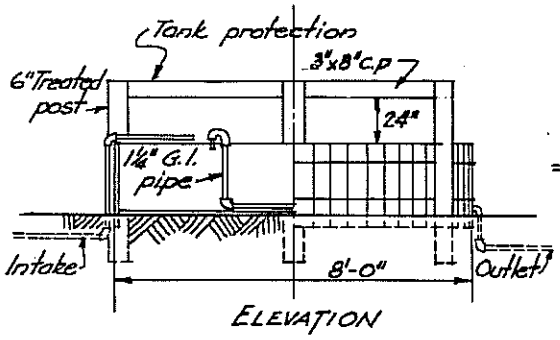


Plate No. 95



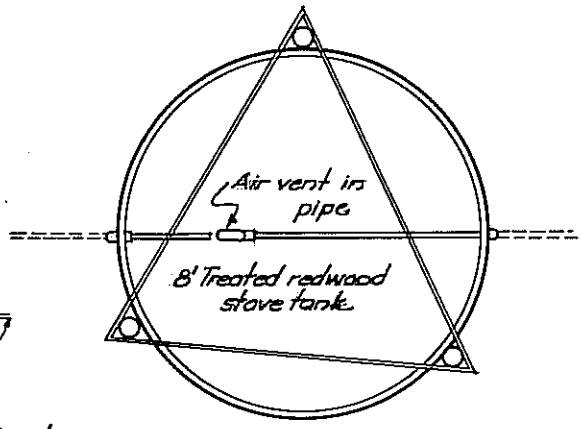


Fig. 1

STOCK TANK

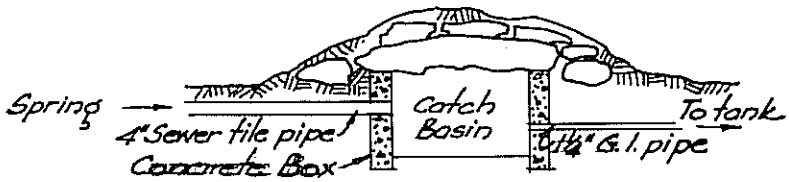
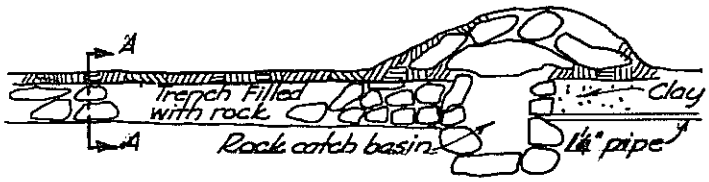
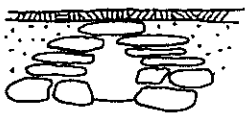


Fig 2





SECTION A-A

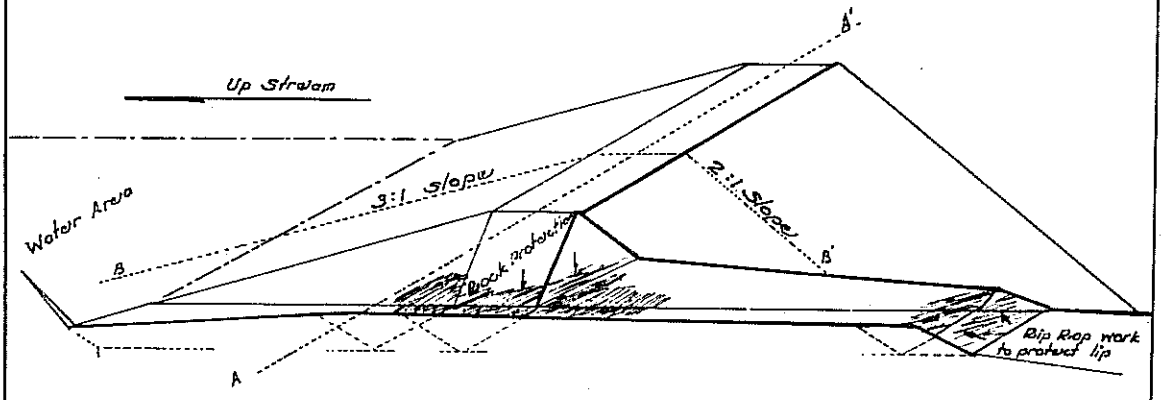
Fig. 3

DETAIL OF SPRING DEVELOPMENT

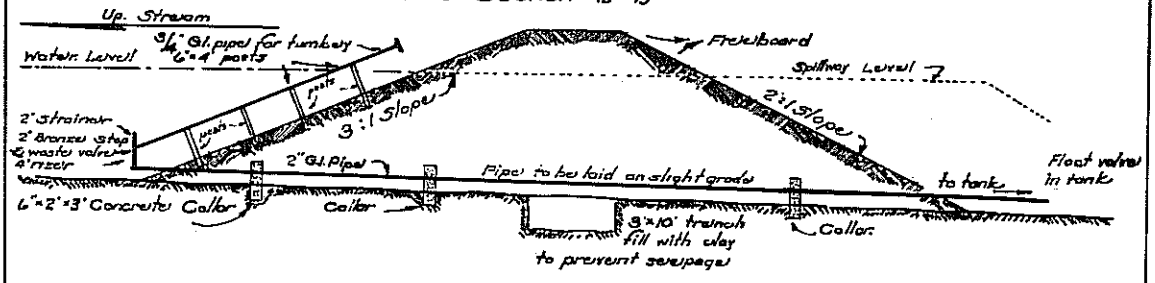
Plate No. 96

RANGE IMPROVEMENTS
RESERVOIRS

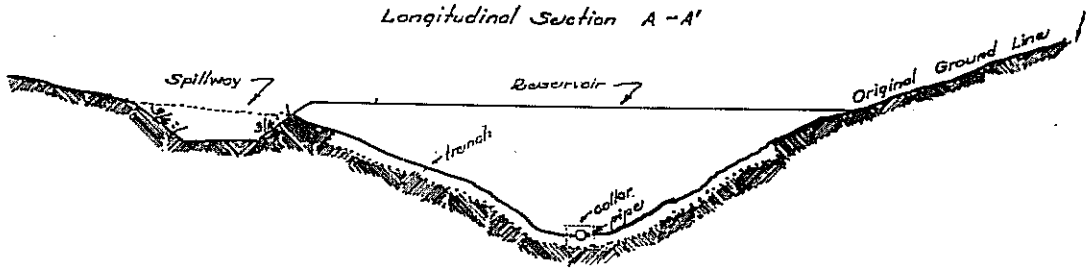
Block Diagram of Reservoir



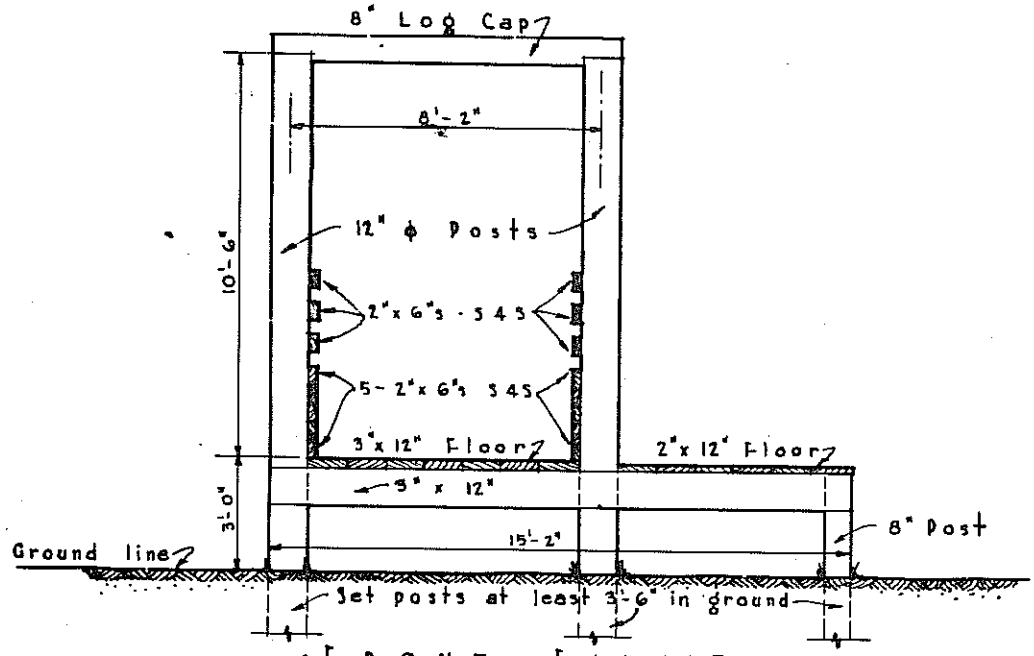
Cross Section B-B'



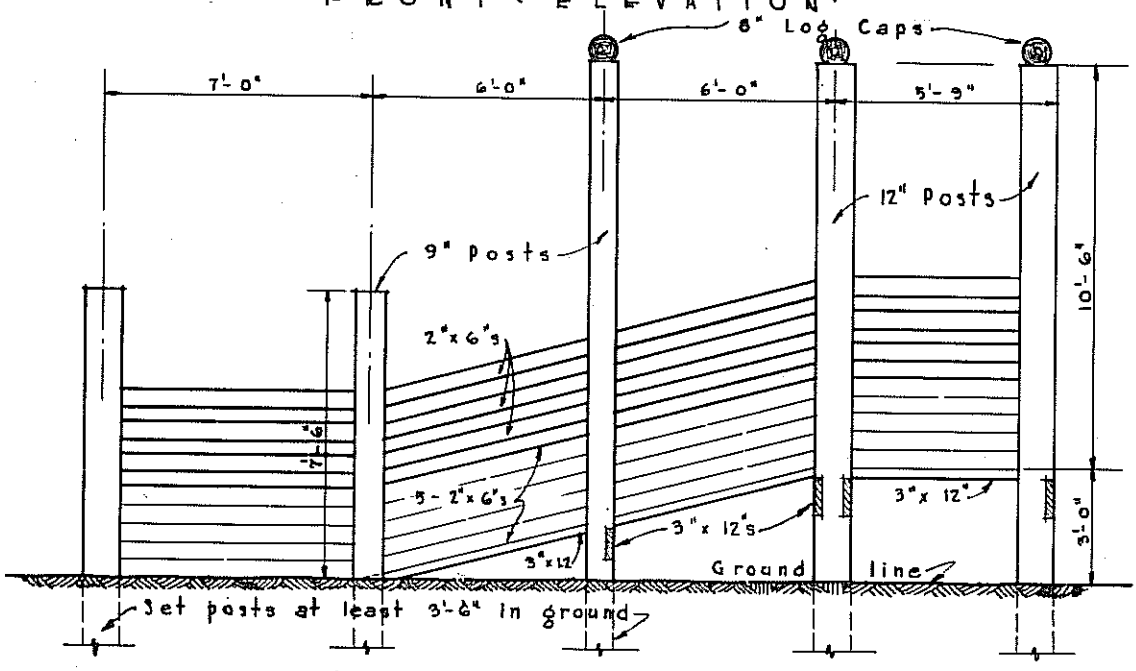
Longitudinal Section A-A'



RANGE IMPROVEMENT
STOCK LOADING CHUTE

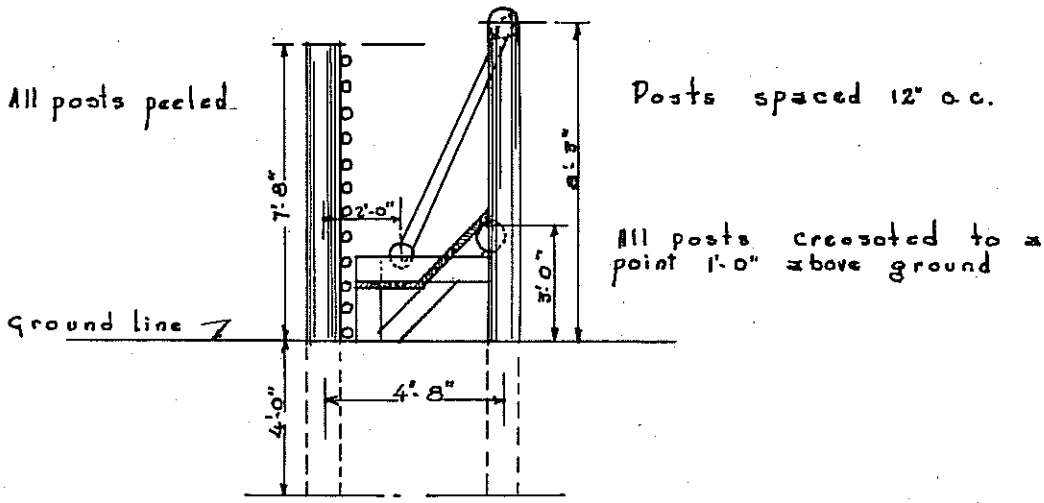


FRONT ELEVATION



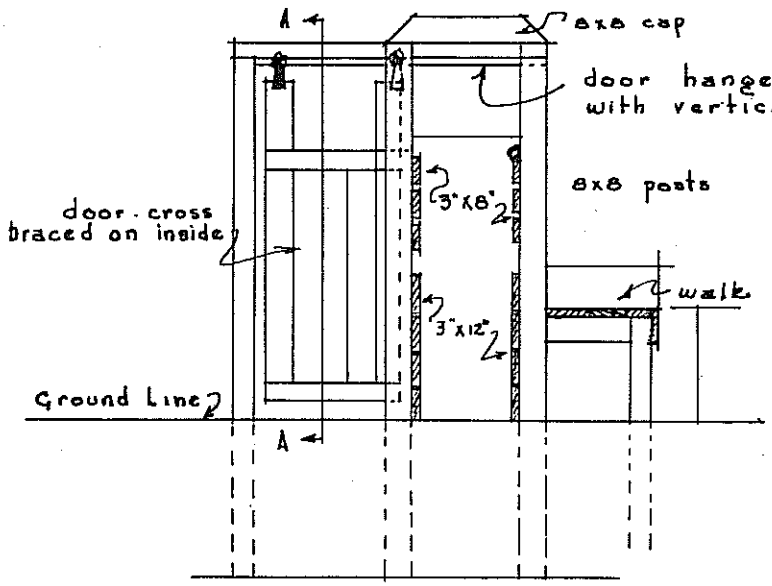
SIDE ELEVATION

· FEED · RACK · CONSTRUCTION ·

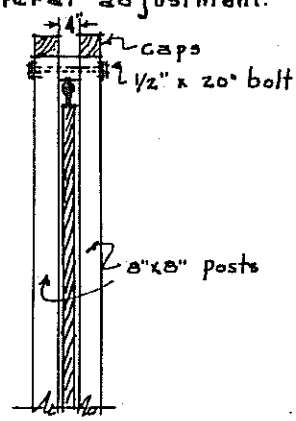


- SECTION ·

CHUTE

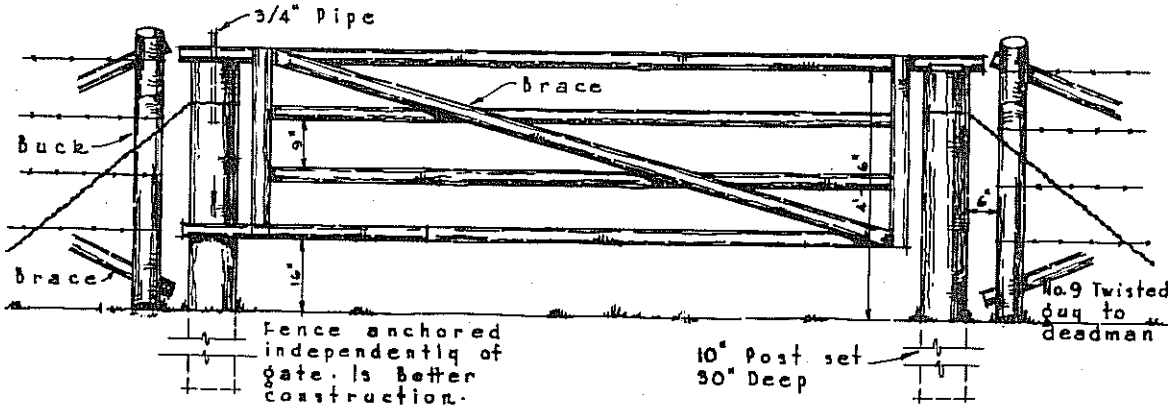


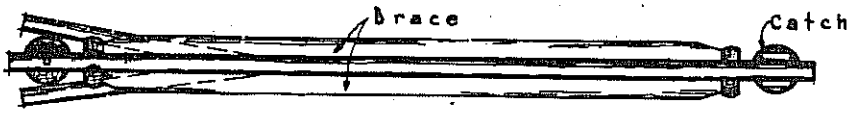
SECTION



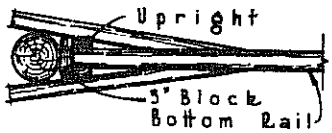
SECTION "A-A"

· GATE · CONSTRUCTION ·

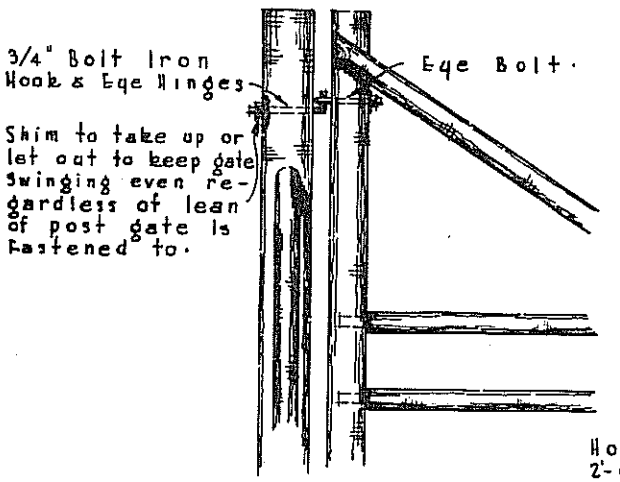


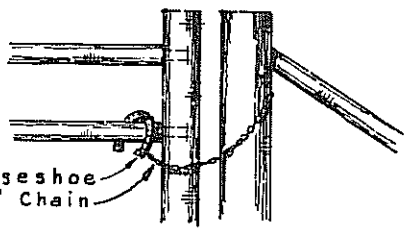


· PLAN ·



· DETAIL · OF · BOTTOM · HINGE ·
(Looking Up)

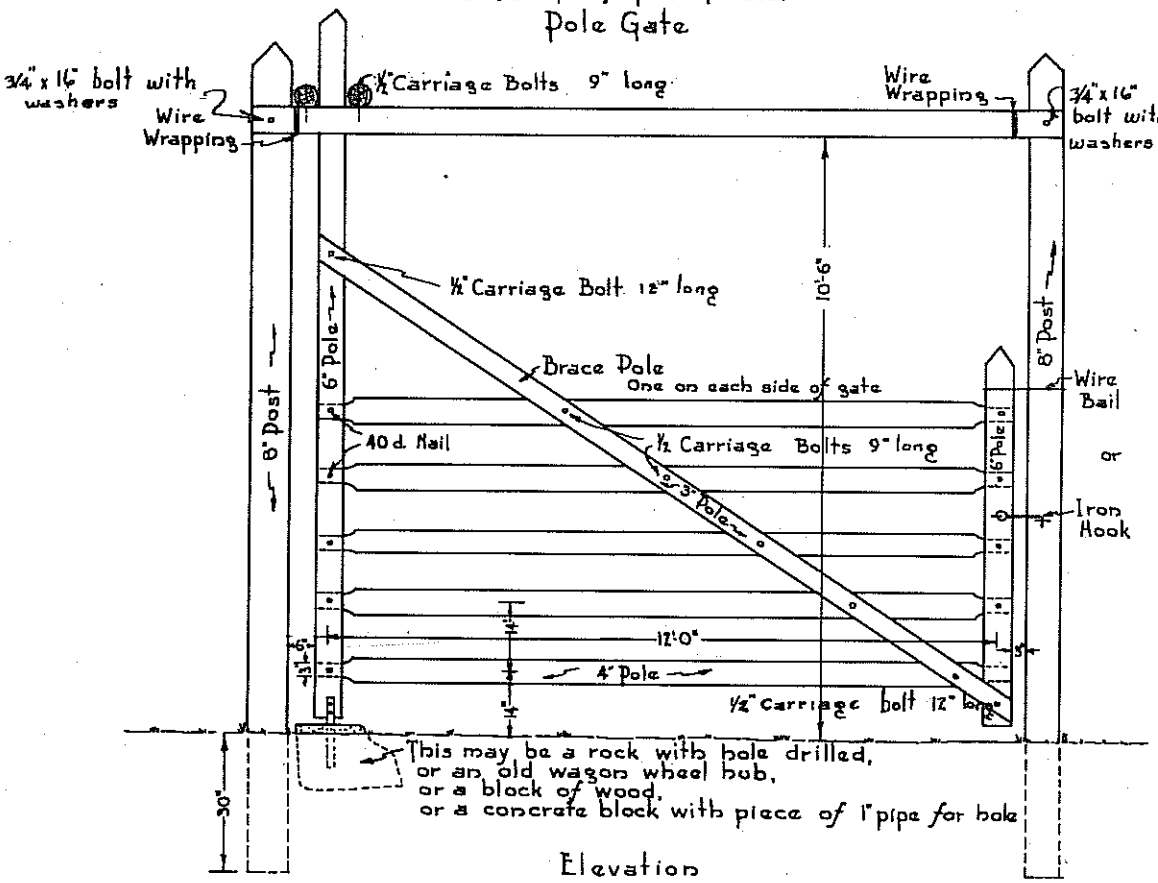




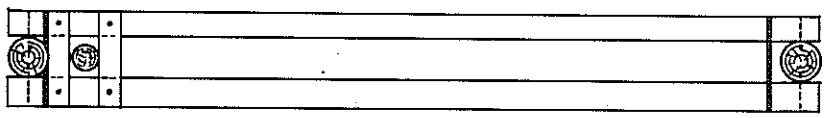
· DETAIL · OF · HINGE ·

· HORSESHOE · GATE · FASTENER ·

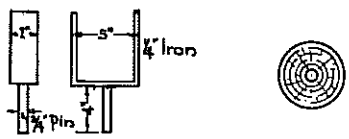
RANGE & PASTURE
Pole Gate



Elevation



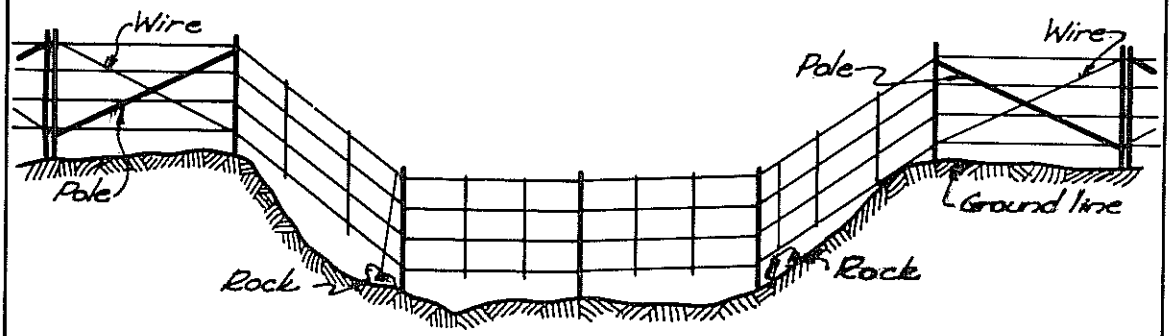
Top View



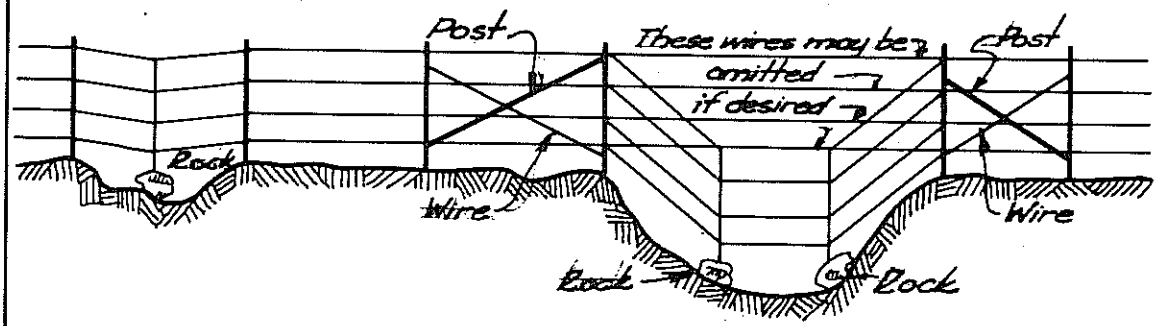
Stirrup for Gate Post or Bore a 11/16" hole and drive in a 3/4" pin

Plan G-1

Plate No. 101



Diagramatic Sketch
Showing Construction
across a wide Creek Bottom

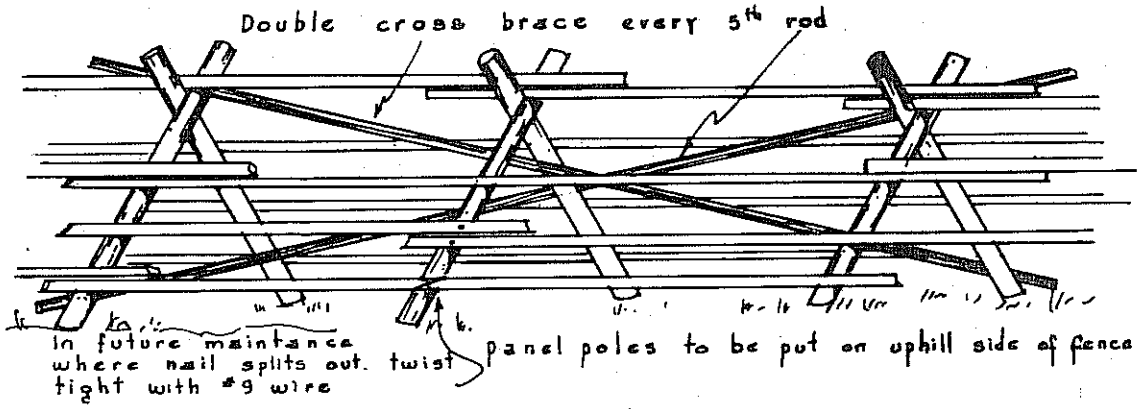


Diagramatic Sketch
Showing Construction
across a narrow Creek Bottom

RANGE & PASTURE FENCES

· RANGE IMPROVEMENT ·

BULL - FENCE

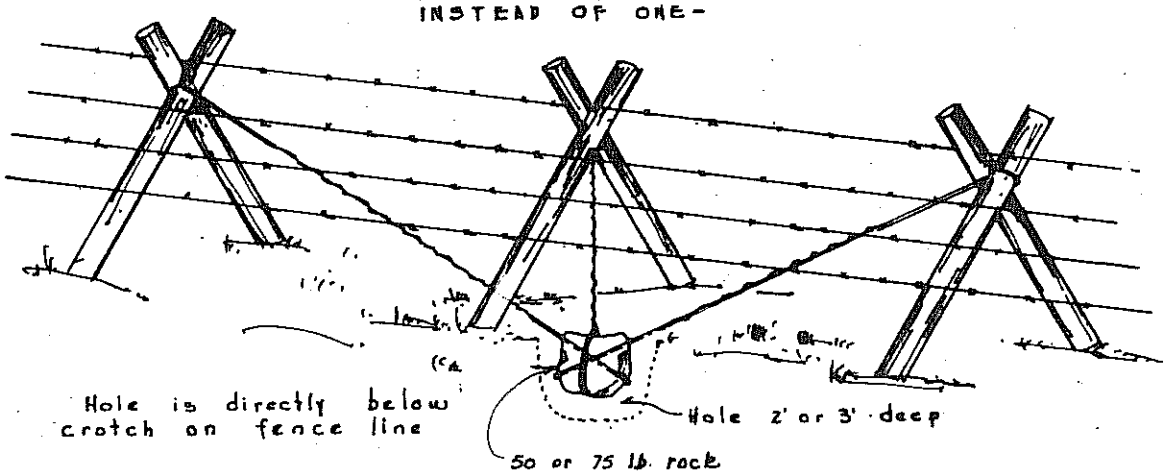


Two rub poles spaced 4' apart to keep cattle from getting hung up in fence.

Extra weight avoids windthrow also;

Anchor every 10 rods is usual way.

METHOD OF ANCHORING JACK LEG WIRE FENCE BY DIGGING ONE HOLE INSTEAD OF TWO - THREE POSTS ARE ANCHORED INSTEAD OF ONE -



RANGE & PASTURE

Fences - Buck Wire Type

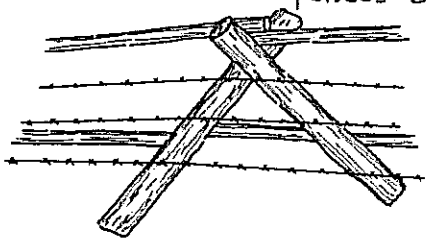


Figure A

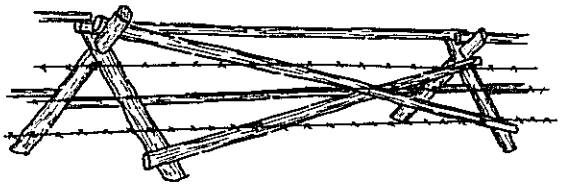


Figure B

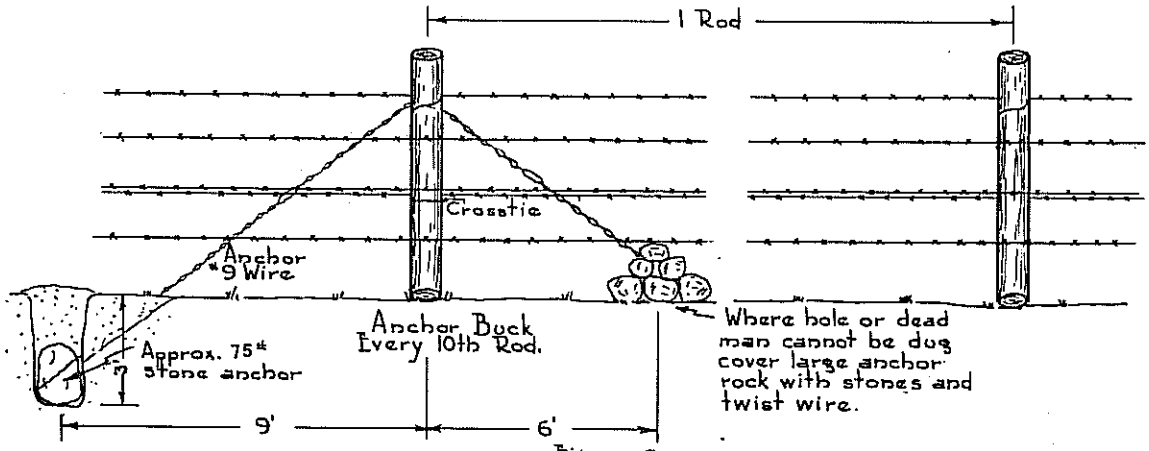


Figure C

Two Methods of Anchoring Fence Buck

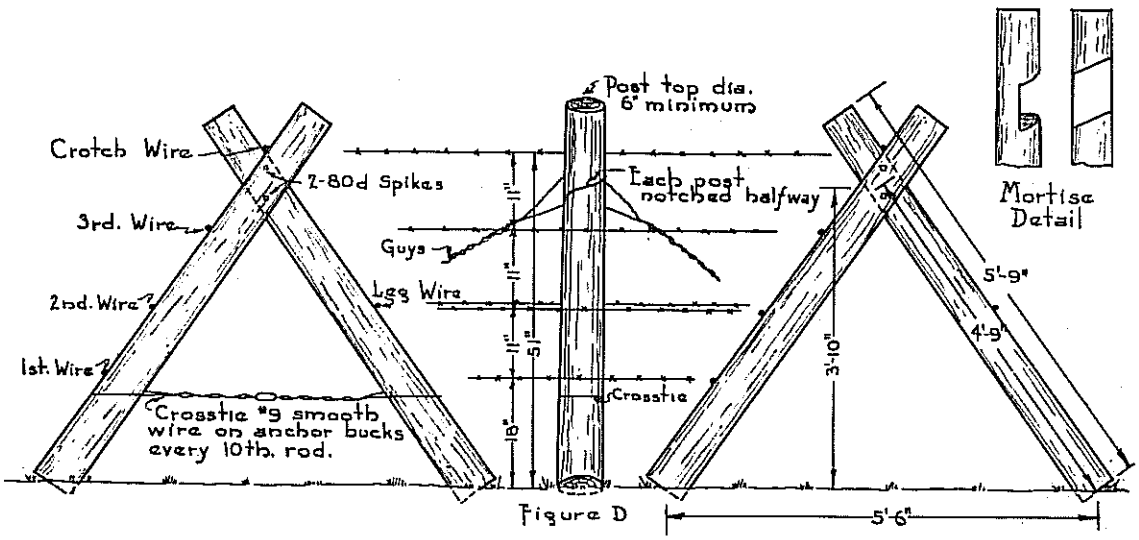


Figure D

Fence Buck Details

Plan G-4

RANGE & PASTURE
Fences

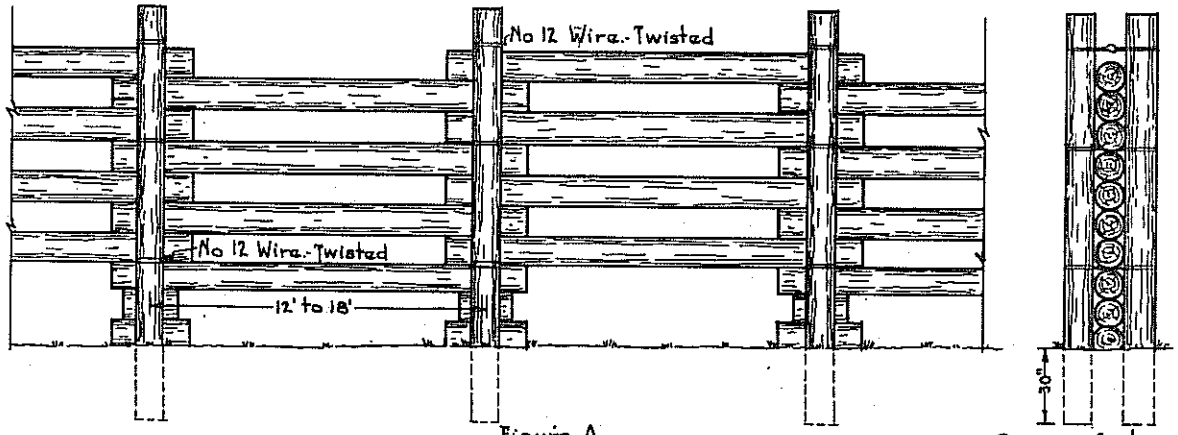


Figure A
Pole and Block Type
Often used for corrals

Cross Section

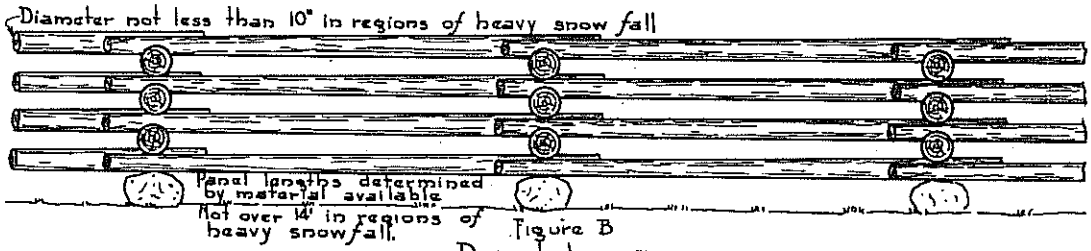


Figure B
Panel Log Type

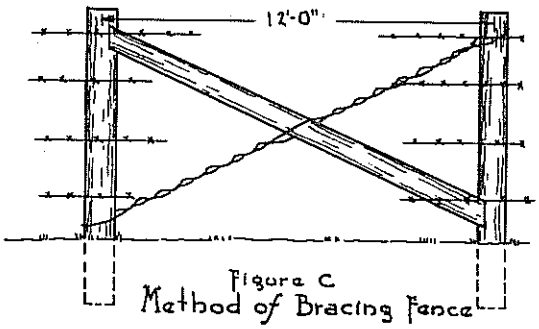


Figure C
Method of Bracing Fence

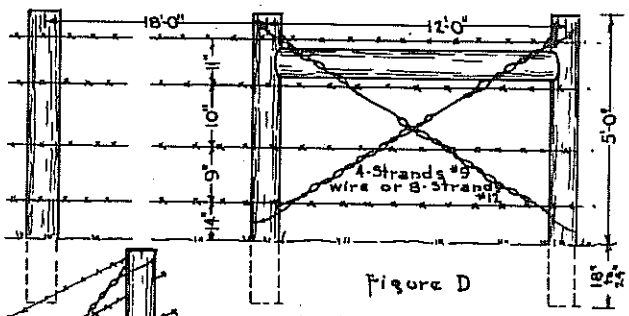


Figure D
Two Methods of Bracing Fence at Corners & Gates

Methods of Bracing Wire Fences

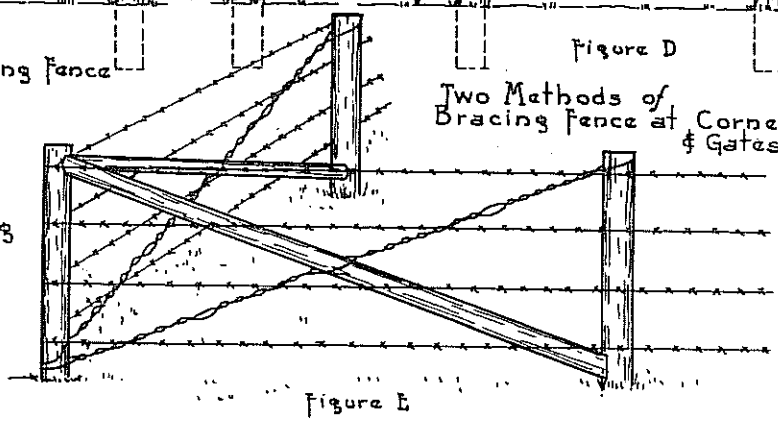


Figure E

Plan G-3

POST AND BRACE POLE SPECIFICATIONS FOR POST FENCES

See F. S. Manual NF-C9-2, page 2, "Range Improvement Standards" for special situations.

Wood Posts

All posts and brace poles shall be from sound, live or dead timber, straight, with all knots closely trimmed. All posts and brace poles must be peeled for the entire length.

Minimum post length - 6 feet 6 inches.
Minimum post diameter of top - 6 inches.

Corner and brace posts 8-inch top minimum. Brace poles 5-inch top minimum, notched into corner and brace posts.

If western redcedar split posts are used, these must be old-growth wood. Second growth is not acceptable. Round lodgepole, fir, juniper, ponderosa pine and split-butt larch are acceptable.

Depth set in ground - 2 feet.
Minimum height above ground - 4½ feet.
Spacing of posts - 16 feet.

One stay to each panel may be used.
Number of barbed wires (galvanized) - 4.
Three or five wires will be used only in exceptional cases. Through timber where poles are accessible, use poles on trees.
Where poles are not available, use wire on trees.
Wire will be stapled to post on the side from which the greatest pressure is expected.

Steel Posts

Minimum length - 6 feet 6 inches.
Type - steel rail type, galvanized. Weight 1.44 pounds per linear foot minimum.

Depth set in ground - 2 feet.
Minimum height above ground - 4½ feet.
Spacing of posts - 16 feet.
One stay to each panel may be used.

Treatment

All wood posts, except juniper and split-butt larch, will be butt treated with an approved creosote preservative to 2 feet 6 inches. Refer to page R-62.

RANGE & PASTURE
Fences-Rock Buck Type

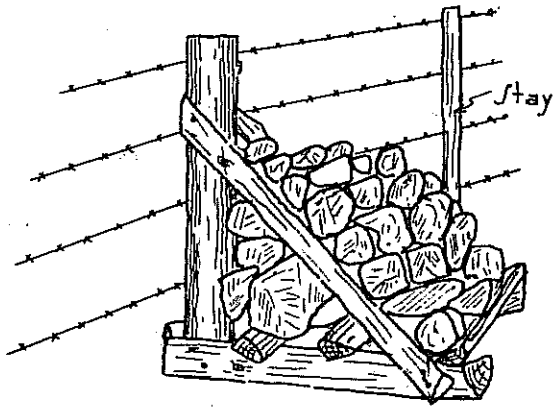


Figure A

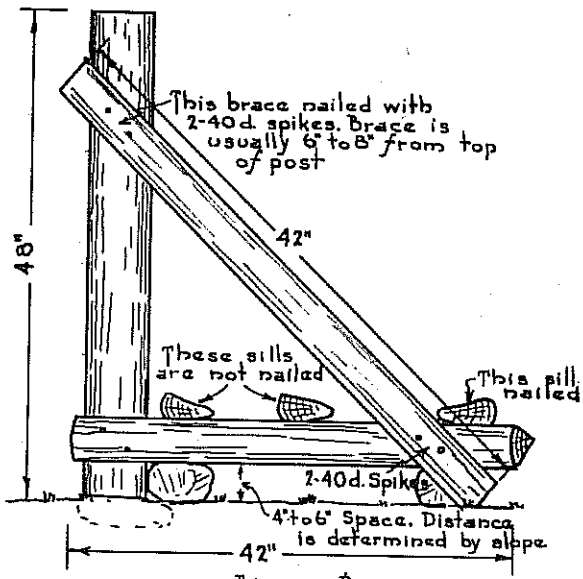


Figure B
Side View

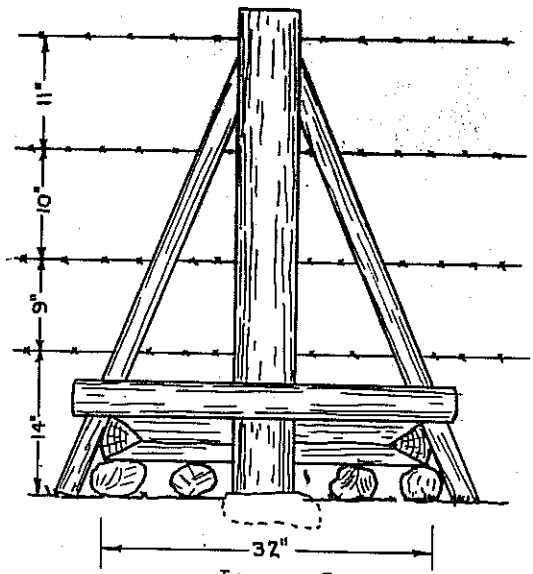
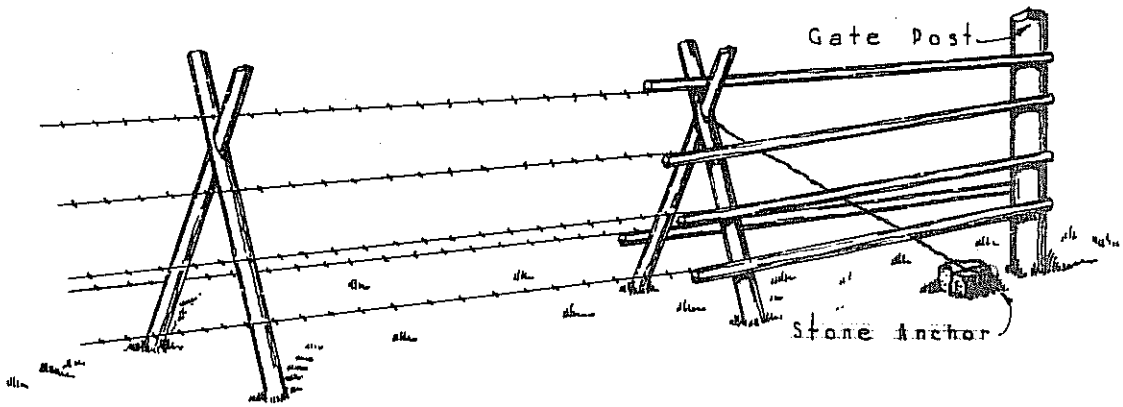


Figure C
Rear View

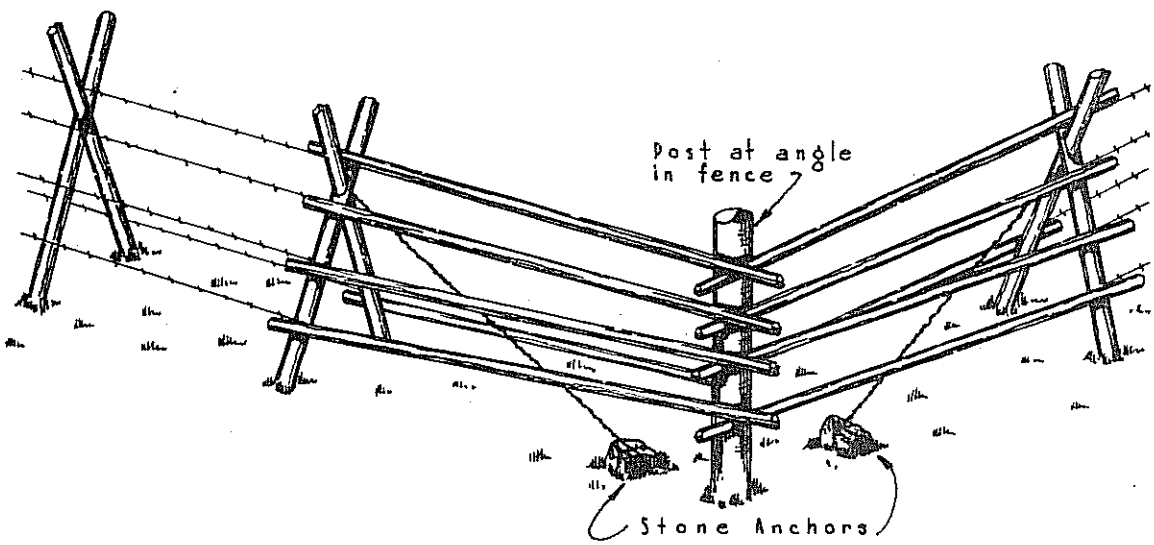
Plan G-5

·RANGE · & · PASTURE·

·BUCK · & · WIRE · FENCE · CONSTRUCTION·

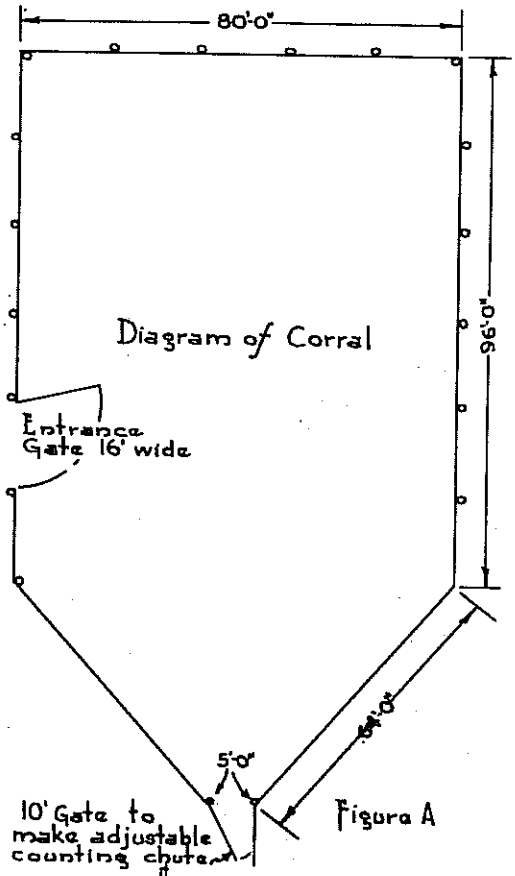


In buck and wire construction it is good practice to dead end the wire fence at gates and angles as illustrated, instead of placing a buck and wiring it to the gate post or corner post, or instead of ending wires at posts with raps around it, or instead of bracing one buck two ways at corners. This construction, as illustrated, leaves the wire fence independent of the posts in the ground, which, when rotted out and in need of replacement, can be easily done without fear of slacking the wires. The strain or pull on wires and brace anchors is always in a straight line in this construction.

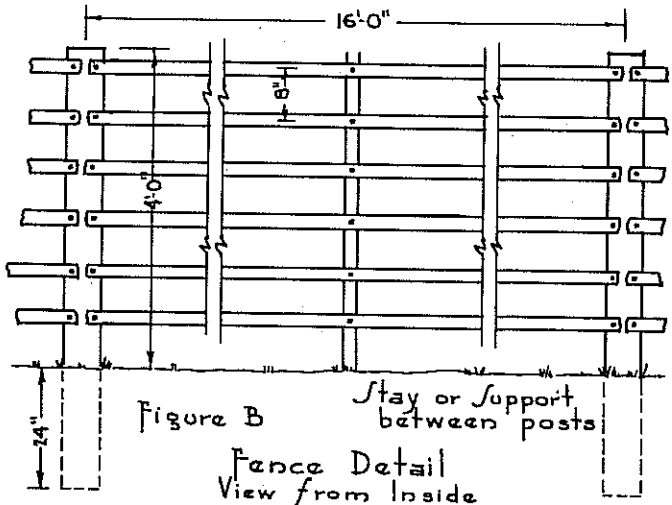


RANGE & PASTURE

Fences

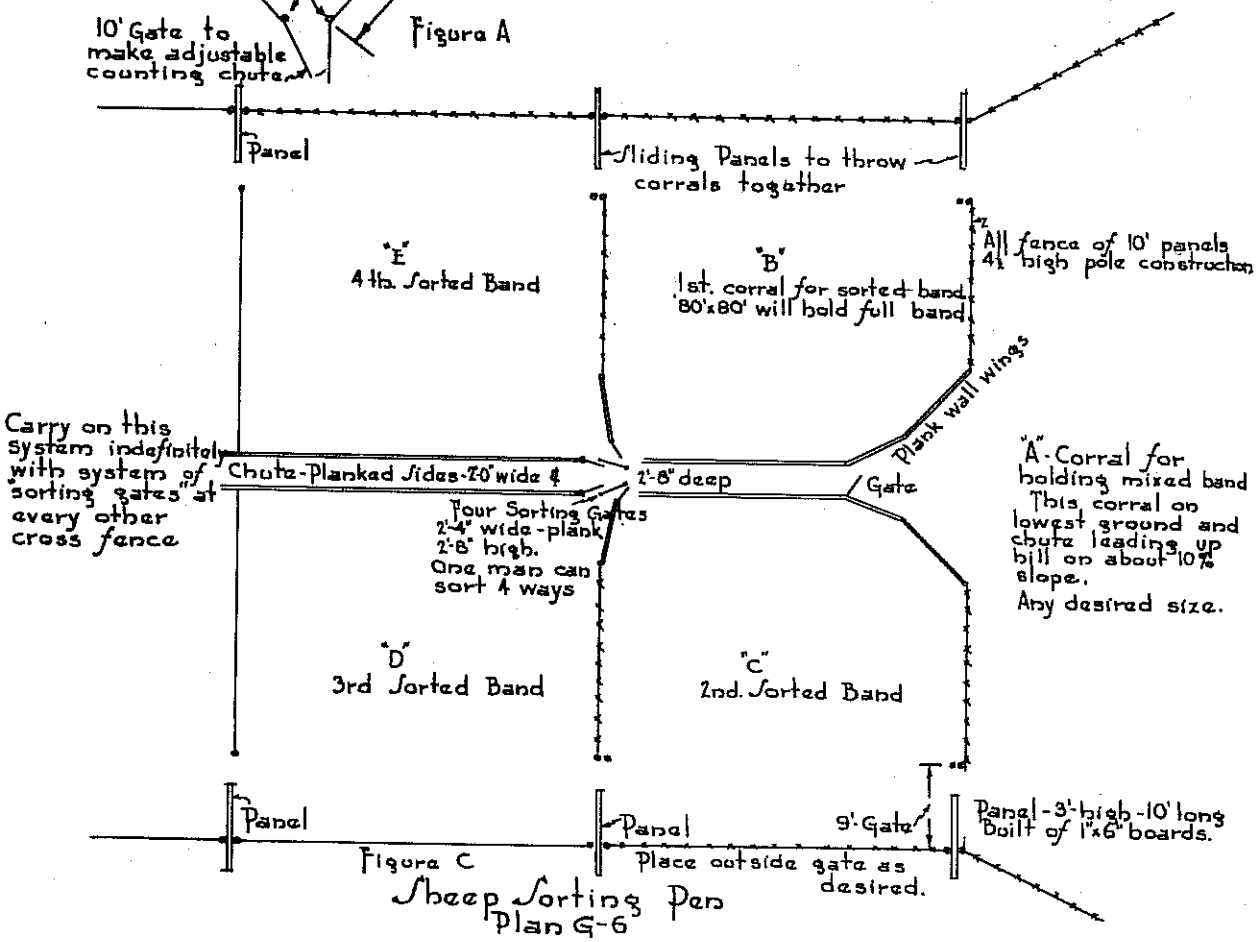


Sheep Counting Corral



Fence Detail
View from Inside

Minimum diameter of poles 2" at small end. All posts 6" minimum at small end.



Sheep Sorting Pen
Plan G-6

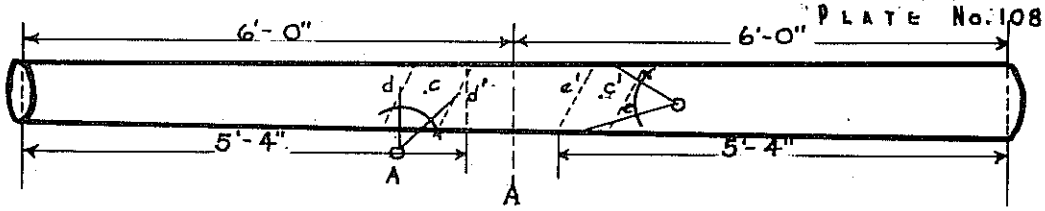
INSTRUCTIONS FOR MAKING FENCE JACKS

WITH SAW BUCK

The jack material is cut in 12-foot lengths. It may then be assembled at a central location along the proposed fence line, or the 12-foot lengths may be distributed to the approximate locations where they are to be used in the fence line. There is some question whether it is more convenient to make the fence bucks at a central location and then distribute them along the fence line with a team or truck, or to move the saw buck each time from place to place.

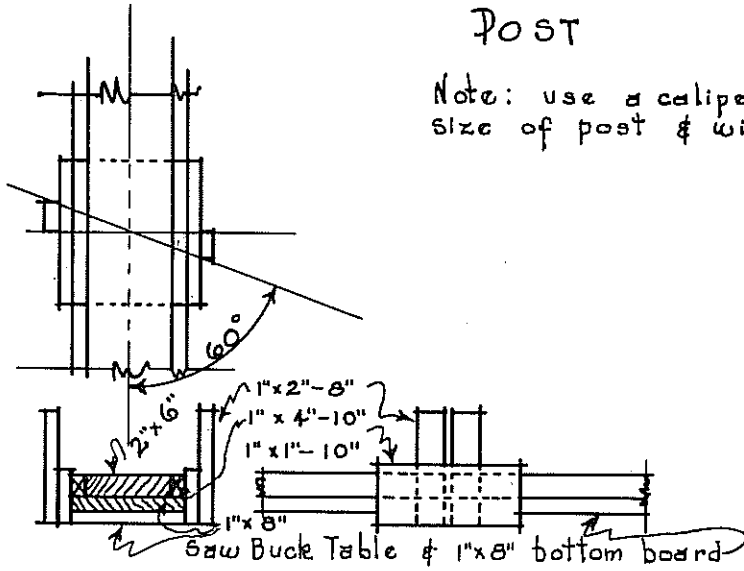
The method of using the saw buck is described below:

Lay the 12-foot log on the saw buck with its center near the middle of the saw buck. Then with a stick five-feet-four-inches long set slide for cuts d' and e'. After these cuts are made, take a caliper and measure diameter of log at c' and locate cut d'. Then caliper at c' and locate cut e'. Then cut post in two pieces at A. With an ax or slick chop out the two cuts and fit posts together. It is important that each pair of legs be used together or the notch will not be a tight fit. Nail with two 60d or 70d spikes.

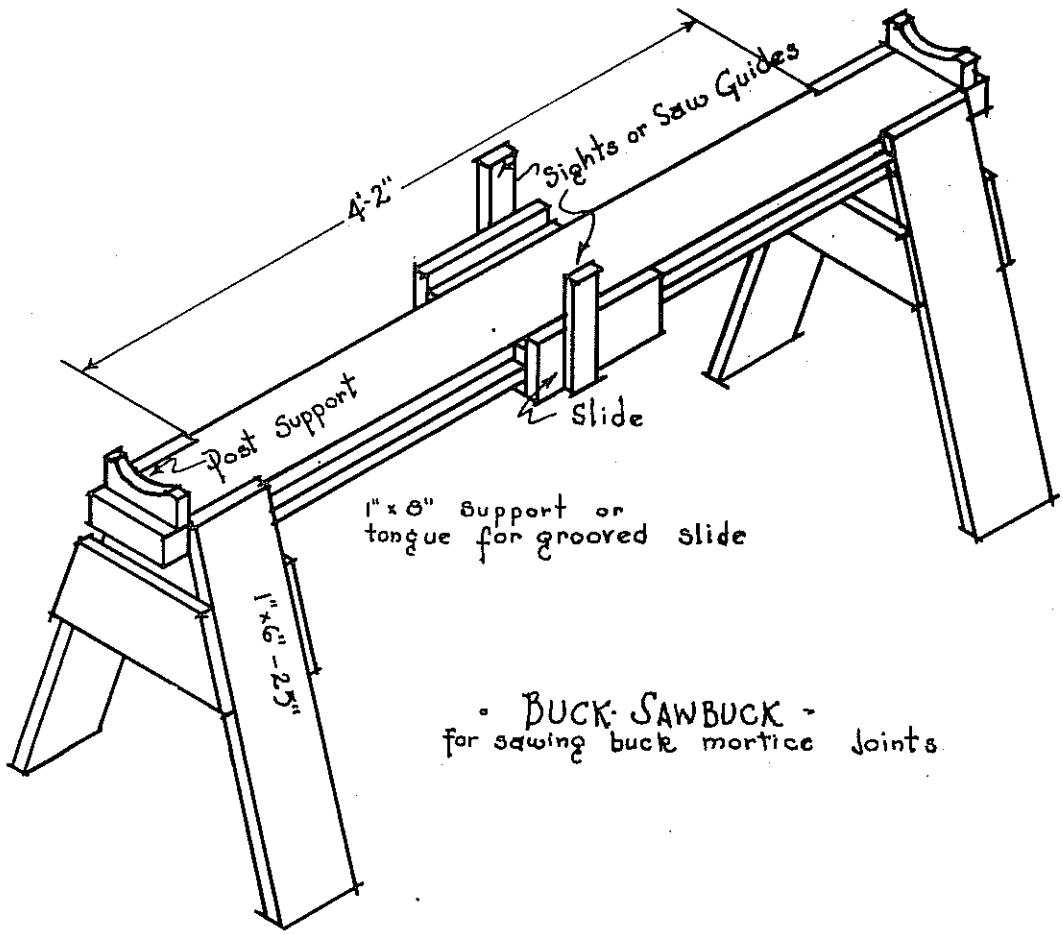


POST

Note: use a caliper to measure size of post & width of cut.

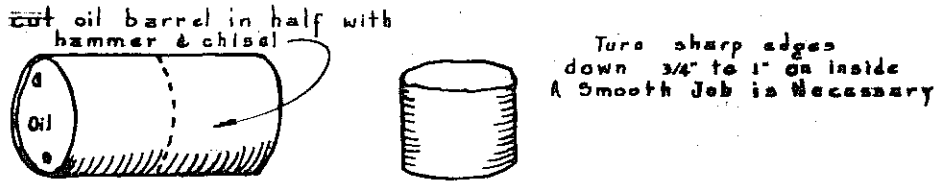


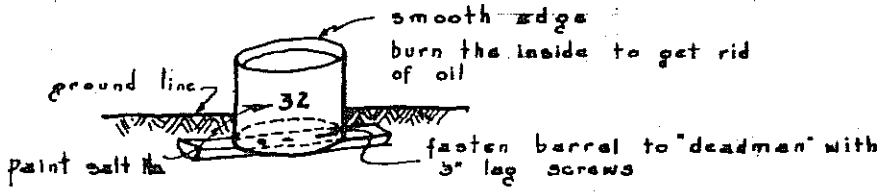
SLIDE AND SAW GUIDES



BUCK SAWBUCK -
for sawing buck mortice joints

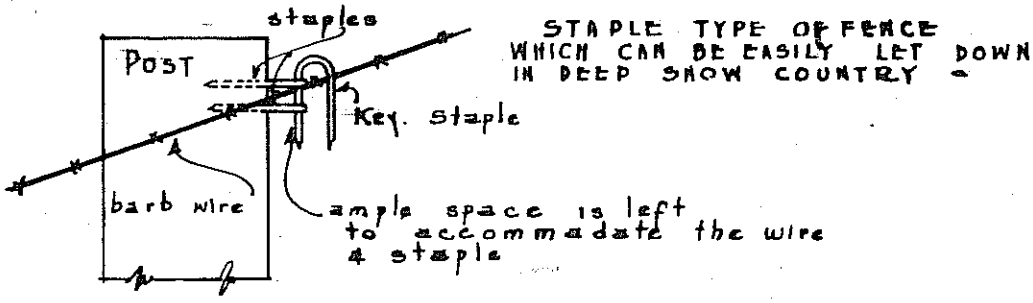
SALT BARRELS





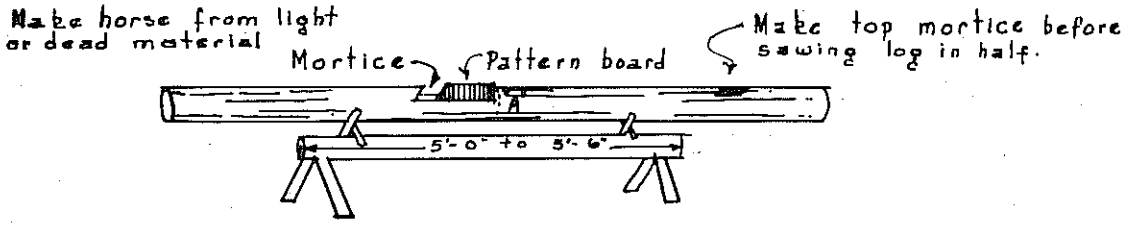
bottom of barrel 4" below ground

REMOVABLE FENCE



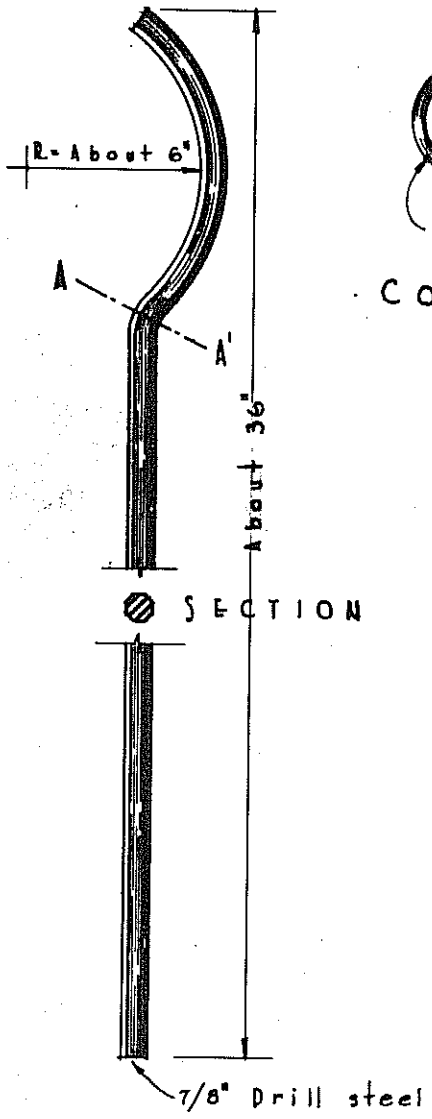
Replace key staple when the wire is let down. to be used again

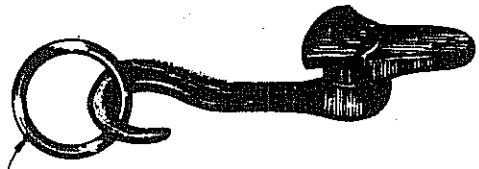
JACK LEG FRAMING HORSE



Place pegs in horse so jacks to be made will not pinch saw when double jack is cut at "A"

RANGE IMPROVEMENT
FENCE BAR & WIRE GRASP





1¼" ring to slip bar thru to point A-A' or a short chain with with swivel could be used.

COMMON WIRE GRASP

The wire grip is slipped over bar handle to "A". The loop in end of bar is placed around fence post and grip attached to wire. The handle is then swung around post and acts as a lever in pulling the wire taught, usually 1/4 turn will tighten wire. The advantage is quick application of gripping the wire, the ordinary wire stretchers usually being a tangle of ropes and pulleys.

APPENDIX A

HANDSAWS

There are many different kinds of saws, but the handsaws which are of most interest in our work are rip and crosscut. There are a number of other forms of classification of saws but they are of no particular interest to us. Ripsaws are usually 28" and 26" in length, and the teeth are either 5, $5\frac{1}{2}$ or 6 to the inch. Crosscut saws run in lengths from 24" to 30", the average being 26"; the number of teeth ranges from 7 to 11 per inch - the smaller number being used for rough work such as framing dimension lumber, and the finer, or 10 to 11 to the inch, being used for finish work where a very fine edge is necessary. The cutting edge of a handsaw is a series of little notches all of the same size. On a crosscut saw each side of the tooth is filed to a cutting edge like a little knife. On a ripsaw each tooth is filed straight across to a sharp, square edge like a little chisel. The set of the saw is the distance the teeth set out beyond the side surfaces of the blade. The teeth are set to prevent the saw binding and the teeth choking up with sawdust. In setting, the teeth are bent alternately, one to one side and the next to the other. The face of each crosscut tooth is slightly steeper than the back, making an angle with the line of the teeth about 66°. The ripsaw face is at right angles to the line of the teeth; its cutting edge is at right angles to the side of the blade. The angle of each tooth covers 60°.

Filing Saws

Saw filing, when properly done, consists of five separate operations: (1) regulating, (2) jointing, (3) setting, (4) filing, (5) side dressing.

The saw should be placed in a suitable clamp, where it will be held so tight that there will be no vibration. If the teeth have become irregular and it has become necessary to joint considerable from the points, first regulate them by filing square across every tooth, filing back on the large ones, bringing them nearly to a point, making them all the same size. If the teeth be all of a size the grooves at their base will be in a line parallel with that of their points the whole length of the saw. In regulating, it is well to look at their bases as well as at their points. The pitch of the tooth should also be watched while regulating. When a saw comes from the factory its teeth are all uniform in size, length, bevel, pitch and set. After being sharpened a few times by an inexperienced person its appearance will become decidedly irregular. It is then necessary to joint the saw. This is done by laying a flat file lengthwise on the teeth, using the fingers as a gauge on one side; then beginning at the butt end run the file lightly along the teeth; do not tip the file. Continue the operation until the teeth are even or with a slight crown in the center. If teeth be too stubby to set, give them shape with a three-cornered

file. In jointing, take off the smallest amount possible, making all teeth the same length as the shortest tooth. After the teeth are made even by jointing they need to be set. This means that every tooth will be bent over a little to give sufficient clearance for the blade in the cut. This setting for a handsaw is about half its thickness. This is usually done most uniformly by using a small lever tool called a hand set, which can be purchased for this purpose.

You are now ready to file. Place the saw in the clamp as for jointing but with the handle to the left. Begin to file at the butt end. For handsaws place the three-cornered file between two teeth, inclining it toward the smaller or tapered end of the saw, in this case to the right. File both teeth at once with one or more strokes of the file; work down the whole saw. This will file one side of each tooth; to complete the job, turn the saw around so that the butt is to the right, inclining the file toward the tapered end, in this case to the left; work down the length of the saw.

Note: When making the backstroke with the file do not drag it over the teeth; raise the hands, bring the file back and then make a sharp forward stroke.

Great care must be used to file each tooth just enough to bring it to a sharp point and no more. If any tooth is filed too much it will be shorter than the others and will take no part in the cutting. Reflection of light from the jointed points of a tooth will show when it approaches a point. Good eyesight is essential to good saw filing. Good light is very helpful. It can be had by seating the filer to face a window having a north exposure.

A ripsaw should be filed straight across the front of the teeth with the file handle lowered from two to three inches, giving a bevel on the top of the teeth that lean away from the filer. The accompanying illustrations will help you to understand how this is done.

After the saw has been filed, lay it on a board and run the flat side of the file gently along the side of the teeth on both sides. This is called side dressing and assures that the teeth are evenly aligned from end to end.

FILES

Files are of various shapes and kinds, depending upon the kind of work for which they are to be used. They are classed as: slim taper, taper, square, blunt band, mill, flat bastard, half round, round, and rasps.

The fineness of a file is graduated in accordance with its length. For filing handsaws a slim taper or a regular taper 6 or 7" in length is the proper size. For filing crosscut saws an 8" mill

TOOLS

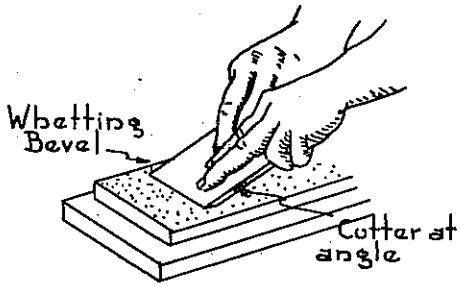


Fig 11

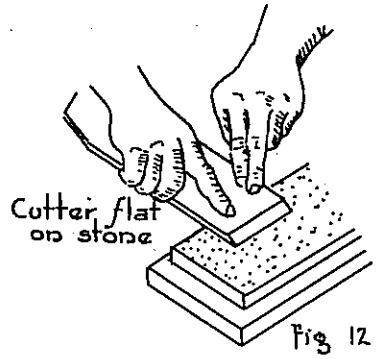


Fig 12

Method of Whetting Plane Iron on Oil Stone after Grinding

As in figure 11, grasp firmly in the right hand with palm downward, pressing down with left hand near cutting end to give rubbing pressure. Rub to and fro nearly the length of the stone. Never use an undulating motion, as this will produce a round edge, necessitating frequent grinding. After whetting the bevel side turn iron over and hold perfectly flat on the stone, as in figure 12; give it two or three strokes to remove any wire edge.

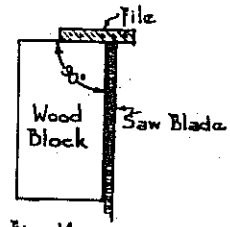


Fig 14
A safeguard against jointing one side high.

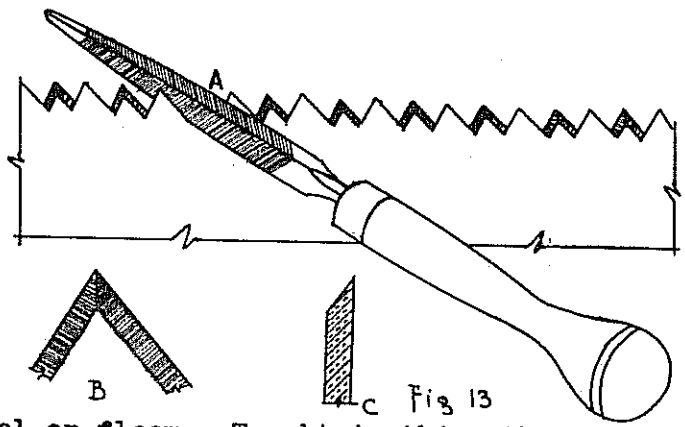


Fig 13

Bevel or fleam. To obtain this, the file is supposed to be horizontal to the perpendicular of the side of the saw, and on an angle of about 45° longitudinally with the length, measuring from the file line toward heel. The figure shows a 5-1/2-point crosscut saw showing the same amount of fleam front and back. This saw is best suited for work in soft wood, and where rapid, rather than fine work is required. A, shows the position of the file; B, an exaggerated view of shape of point; and C, an end view of point.

file is used. In using a file or wood rasp, it should always be remembered that the file must not be dragged back across the material, since this tends to damage the file more than the forward motion when it is cutting the material.

SANDPAPER

Sandpaper consists of a tough paper covered with finely crushed abrading material, which comes in sheets 9x11" and in sizes, or grit numbers as it is called, from #0000 to #3. The sizes generally used for finishing work are Nos. 1 and 2 for fairly coarse work and No. 0 for fine finish work.

CHISELS

A chisel consists of a flat, thick piece of steel, one end being ground to an acute bevel to form a cutting edge, and the other end provided with a wooden handle. There are a number of varying classifications of different kinds of chisels, but the ones with which we are particularly concerned are known as a paring chisel, a firmer chisel, a framing or mortise chisel, and a slick.

The paring chisel is a light duty type which is used for fine carpentry work and is manipulated by the hands and is not driven with a mallet or hammer. The firmer chisel comes in sizes from a quarter to two inches. It is a more substantial tool than the paring chisel and is used for ordinary framing work by carpenters. It can be driven either by hand or by blows with a wooden mallet. Never use a hammer to drive a chisel. The framing or mortise chisel is a heavy tool adapted to severe strain, as in framing where deep c cuts are necessary. The slick is any chisel having a blade wider than 2"; it is usually made with a long blade and handle and is used for heavy framing work such as in the construction of log cabins.

The chisels are classified according to their length, as butts $2\frac{1}{2}$ to $3\frac{1}{4}$", pocket 4 to 5", mill 8 to 10". The handles are classified as either tang or socket. With the tang handle the end of the chisel, similar to the end of the file, projects into the wood; with the socket the end of the wood projects into the rounded-out end of the chisel.

PLANES

There are many different types and varieties of planes for various uses. The ones in most common use are the jack and smoothing planes. The jack plane, as its name implies, is intended for heavy, rough work. The smoothing plane is used to finish off the surface after the jack plane has done the rough work.

Never lay a plane down with the blade underneath. Always lay your plane, when not in use, on its side if you wish to preserve the cutting edge. The wrong way and right way to hold and use a

plane are illustrated in the accompanying pictures.

BORING TOOLS

Boring tools are generally of four different kinds. Auger bits are classified as solid center or Irwin, Russell Jennings, Ford patented, and farmers' or common. They are also classed as single twist and double twist in accordance with the form of the auger. The single twist type is for boring deep holes, and the double twist type for fine work. Ship augers are made with the single twist and with extra long shanks for deep holes. Lighter types of augers are used with a tool called a brace, and the heavier and longer types are used with a wooden handle or a boring machine. Auger bits usually run in sizes from 4/16 to 16/16, the graduations in size being by 1/16 of an inch. Larger sizes up to 2" are in steps of 1/8 inch. An expansion bit is handy to use, since any size hole from 5/8 to 1-3/4" may be bored.

SHARPENING CHISELS AND PLANE IRONS

Use an oil stone or the fine side of a carborundum stone. In applying chisels and plane irons to the stone, the tool is held face up with both hands. The edge is rubbed back and forth with a sliding rotary motion on the face of the stone, the angle generally being a little above 60°; after 10 or 12 rubs it is turned over and rubbed flat on the face side. This operation is continued until the blade has a fine edge.

Only a very fine, thin oil should be used on oil stones. Remember that the bevel on a chisel blade must be kept as near the shape the manufacturer gave it as is possible.

THE STEEL SQUARE

The steel square is probably the most important tool in general use for any sort of carpentry work and many other kinds of work as well. That its importance and accuracy are not appreciated sometimes, is evidenced when some one is observed using the square to pry open a box or for some other use for which it was not intended. The square is divided into four parts: the body, which is the longer and wider member; the tongue, which is the shorter and narrower member; the face, which is the sides visible, both body and tongue, when the square is held by the tongue in the right hand, the body pointing to the left; the back which is the sides visible, both body and tongue, when the square is held by the tongue with the left hand, the body pointing to the right. The square in most general use has a body 24" in length by 2" in width and a tongue 16" in length by 1½" in width.

Other forms of squares are called try-squares, try and mitre squares and bevel squares. Each has its own particular use. The large steel square is generally used for all kinds of framing work,

TOOLS

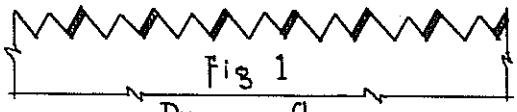


Fig 1

Proper Shape

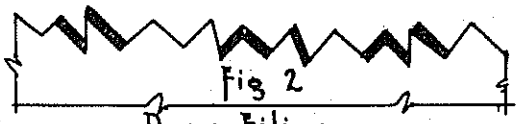


Fig 2

Poor Filing

Appearance of teeth of new and old saws, showing distortion of teeth due to improper filing.

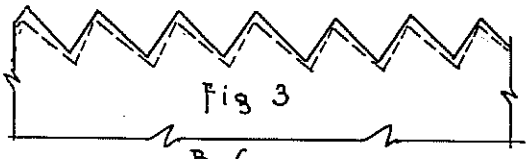


Fig 3

Before

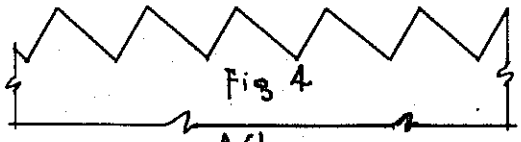
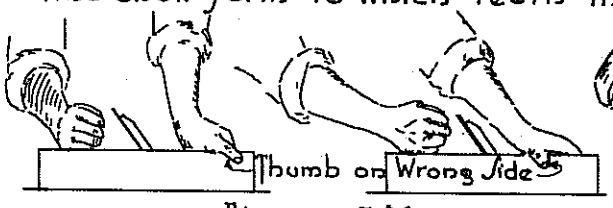


Fig 4

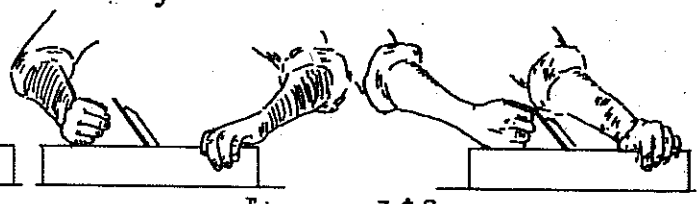
After

Appearance of teeth before and after jointing. In Fig 3 the dotted line show form to which teeth must be filed.



Figures 5 & 6

The Wrong Way



Figures 7 & 8

The Right Way

The above shows the wrong and right methods of holding the plane. The left-hand thumb should not be placed on the right side of the plane because the position of the hand will become awkward at the end of the stroke, and the motion of the plane restricted. Try holding the plane both ways and see how much easier it is to work when it is held the right way, as in figures 7 and 8.

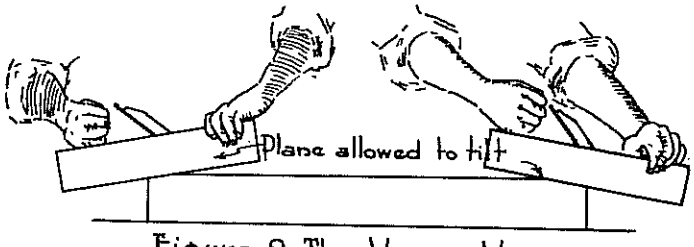


Figure 9 The Wrong Way

Figure 10 The Right Way.

The above shows the wrong and right methods of beginning and ending the stroke. When the plane is allowed to tip, as in figure 9, too much wood will be taken off at the ends so that the cut will not be true. To prevent this, press down with left hand in beginning the stroke and with right in ending the stroke, as in figure 10,- the object being to keep the face of the plane in contact with the wood during the entire cut.

and the try and mitre squares are used for such fine work as is involved in finishing and the making of cupboards, tables, et cetera.

A GLOSSARY OF BUILDING TERMS

Apron - A plain or moulded piece of finish below the stool of a window, put on to cover the rough edge of the plastering.

Astragal - A small semicircular moulding, sometimes plain and sometimes ornamented.

Baluster - Small spindles or columns usually forming the body part of a railing.

Barge-Board - The board under the verge of gables. Also called verge board.

Base Moulding - The mouldings immediately above the plinth of a wall, pillar or pedestal.

Base - A board running around a room next to the floor to properly finish between floor and plaster. Same as baseboard.

Batten - Small scantlings or small strips of boards used for various purposes. Small strips put over the joints of sheathing to keep out the weather.

Batter - A term used by bricklayers, carpenters, et cetera, to signify a wall, piece of timber or other material, which does not stand upright but inclines from you when you stand before it. When on the contrary, it leans forward, toward you, it is said to overhang.

Beam - A piece of timber, iron or other material, placed horizontally to support a load over an opening, or from post to post.

Brace - In carpentry an inclined piece of timber used in trussed partitions or in framed roofs in order to form a triangle, and thereby stiffen the framing. When a brace is used by way of support to a rafter, it is called a strut.

Bridging - A method of stiffening floor joists and partition studs by cutting pieces in between.

Butt-Joint - Where the ends of two pieces of timber or moulding butt together.

Casement - A glass frame which is made to open by turning on hinges affixed to its vertical edges.

Conduit - A channel that conveys water or fluids, a drain or sewer. In electric work, for carrying wires as a protection and for safety.

Cornice - The upper division of the entablature of a column, the highest projecture; that which crowns a wall.

Dormer - A window belonging to a room in a roof which consequently projects from it with a valley on each side.

Eaves - The margin or lower part of the roof hanging over the wall.

Facade - The whole exterior side of a building that can be seen at one view. The principal front.

Fascia - Pieces of lead, tin or copper, let into the joints of a wall so as to lap over gutters. Also pieces worked

around dormers, chimneys and any rising part to prevent leaking.

Framing - The rough timber work of a house, including the flooring, roofing, partitioning, ceiling and beams thereof.

Furring - Nailing on thin strips of board to level a surface for lathing, boarding, or to form an air space.

Gain - Cutting the joist to receive a timber, or cutting the joist to notch on top of the girder.

Grounds - Pieces of wood imbedded in the plastering of walls to which skirting and other joiners' work is attached. They are also used to stop the plastering around door and window openings.

Gutter - The channel for carrying off rain water.

Hanging Stile - Of a door, is that to which the hinges are fixed.

Headers - In carpentry, the large beam into which the common joists are framed, in framing openings, for stairs, chimneys, et cetera.

Headway - Clear space or height under an arch or over a stairway, and the like.

Hip Roof - A roof which rises by equally inclined planes from all four sides of the building.

Hips - The exterior corners of a roof where two slopes, at right angles with each other, come together.

Jamb - The side-post or lining of a doorway or other aperture.

Joist - Timber to which the boards of a floor or the laths of a ceiling are nailed. It rests on the wall or on girders.

Lattice - Any work of wood or metal made by crossing laths, rods or bars and forming a network.

Lean-to-Roof - A roof with only one set of rafters, falling from a higher to a lower wall.

Light - A division or space in a sash for a single pane of glass; also a pane of glass.

Lintel - Horizontal piece over a door or window opening, of any material, used for appearance or support of wall above, or both.

Mitre - To join two pieces at an angle.

Muntins - Small divisions separating panes of glass in a window.

Newels - The upright posts at the start of the stairway, usually receiving the stair rail. On landings and top of staircase for the same purpose.

Plan - A horizontal section of the walls of a building; as indications on a horizontal plane, of the relative positions of the walls and partitions with the various openings, such as windows and doors, recesses and projections.

Plate - A piece of timber on top of a wall giving support and bearing to the ends of rafters.

Plinth - The block that receives the casings and base of a door opening. In a wall the term plinth is applied to the projecting base or water table, generally at the level of the first floor.

Purlins - Those pieces of timber which support the rafters to prevent them from sinking.

Rail - The horizontal board in any piece of framing or paneling.

Ribbon - The term usually applied to a small strip notched into the studding to support the second floor joist.

Ridge Board - The highest horizontal timber in a roof to which the rafters are framed.

Roof Pitch - The proportion obtained by dividing the span by the height.

Scarfing - The joining and bolting of two pieces of timber together traversely so that the two appear as one.

Screeds - Long, narrow strips of wood put on horizontally along a wall and carefully faced out of wind, to serve as guides for plastering the wide intervals between them.

Scribing - Fitted woodwork to an irregular surface.

Shoe - The lowest member of a baseboard making the finish against floor.

Sills - Are the timbers on the ground which support the posts and superstructure.

Soffit - The lower horizontal face of anything, as, for example, of an entablature resting on and lying open between the columns, or the underface of an arch where the thickness is seen.

Stile - The upright piece in framing or paneling.

String Board - A board placed next to the well-hole in wooden stairs, terminating the ends of the steps. The string piece is the piece of board put under the treads and risers for a support and forming the support of the stair.

Tail Trimmer - A trimmer next to the wall, into which the ends of joists are fastened to avoid flues.

Trimmers - Double or triple joists or timbers for framing an opening in the floor. Support for headers.

Valley - The inside meeting point of roofs sloping at right angles with each other.

Wainscot - To line with boards or panels.

Water Table - A slight projection of the lower masonry or brickwork on the outside of a wall a few feet above the ground as a protection against rain.

APPENDIX B

PRACTICAL ROOF FRAMING

(By John T. Neufeld in the "American Builder")

The Mysterious Steel Square

The general impression seems to be that there is some mysterious thing about the steel square that if a person knows it he will be able to do any kind of roof framing. Perhaps it works like a slot machine, put in the coin and out comes the information.

It is true that the steel square is a wonderful tool, but it is also true that the usefulness of the steel square is based on very simple mathematical rules, and therefore what the carpenter needs first of all is a knowledge of the principles of roof framing. Perhaps it would be even more to the point to say that the carpenter needs to understand the mathematical principles by which the framing of roofs is figured.

The steel square will lose much of its mystery if we understand arithmetic. The purpose for these articles has been and will be to teach the why of the methods and rules of roof framing and not simply to give a set of so-called rules and short cuts. The man that understands the principles will develop his own rules and methods.

The Best Method

Other letters and requests have brought the idea that there should be one best method of obtaining the lengths and cuts of rafters. Many, too, believe that their particular method is the only one that is of any use. I would answer these that the important thing is to learn the principles of roof framing and then develop the methods that are best suited for their particular work. In these articles different ways or methods of arriving at solutions will be given and explained. Get the good points in favor of each and you will benefit by them.

The Pitch of a Roof

Very often the most simple things cause the most confusion. It seems that this is true with the subject of "pitches" in roof framing. There seems to be an endless amount of confusion on this point among beginners in roof framing, partly because of the fact that there are several methods of expressing the pitch of a roof.

By the "pitch" of the roof we mean the slant or slope of a roof, or, expressing it the other way, the proportionate degree of rise that the roof has. This degree of rise or the proportion of rise is usually expressed as the rise compared to the span, that is, we would call a roof having an 8-foot rise and a 24-foot span,

a one-third pitch roof, because the rise is one-third of the span.

This method of expressing the pitch of the roof comes to us from the customs of early builders. They expressed their degree of pitch by comparing the total height of the roof with the width of the roof and then called a roof where the height of roof was one-half of the width, a one-half pitch roof, or where the height of the roof was one-fourth of the width of the roof, it was called a one-fourth pitch roof. The ordinary pitches are one-fourth, one-third, and one-half, (and perhaps a few others) but these three are the most common.

At the present time we use this method of expressing the pitch of a roof; but we also use another method whereby we compare the rise of the rafter to the run of the rafter. This we usually express by giving the amount of rise in inches per foot of run. Thus a rafter has a 6" rise per foot run or an 3" rise per foot run, et cetera. Both of these methods of expressing the pitch of roof are easily understood by themselves, but when it is desired to change one method to the other, we find some difficulty.

To illustrate this we will assume that the building has a one-third pitch and that it is desired to express this as a certain amount of rise per foot run. For a one-third pitch the rise is one-third as much as the span, therefore, for every foot of the span we would have one-third of 12 equals 4" of rise; but the run is only one-half of the span and we wish to express the rise per foot of run. If the rise is 4" per foot of span, then it also is 4" for every 6" of run, or 8" per foot run.

A simple rule to follow here is to multiply the pitch expressed as a ratio of the rise of the span by 24. Take, for example, the problem worked above. A one-third pitch roof has a rise per foot of run equal to one-third times 24 equals 8". To illustrate this further, we shall work out a few more examples:

For a one-fourth pitch the rise per foot run is 1/4x24 = 6".

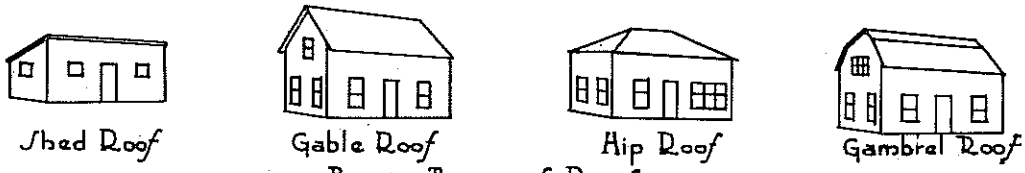
For a one-half pitch the rise per foot run is 1/2x24 = 12".

For a two-thirds pitch the rise per foot run is 2/3x24 = 16".

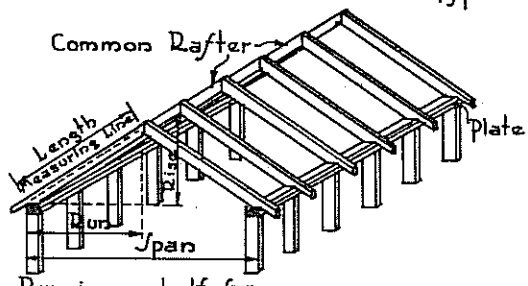
The pitch of the roof is also expressed by the number of degrees of the angle that the rafter makes with the horizontal. For example, we may have a 30° roof, a 35° roof, et cetera. This method, however, is not commonly used, but no doubt will be used to a certain extent in the future.

In order to compare the three methods of expressing the pitch of a roof, on the following page we have a table of comparative pitches:

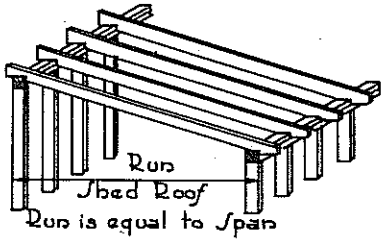
ROOFS



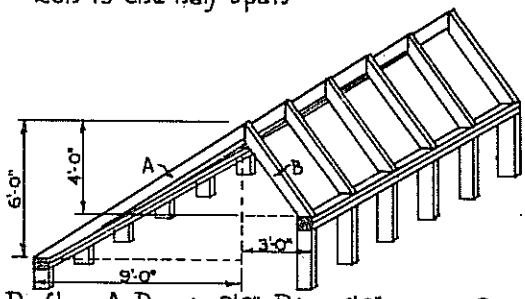
Basic Types of Roofs



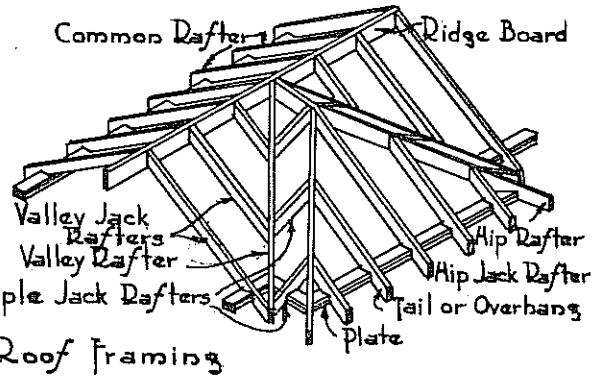
Run is one-half Span



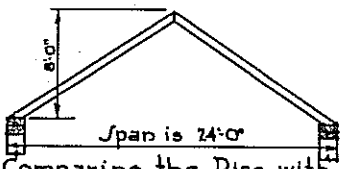
Run is equal to Span



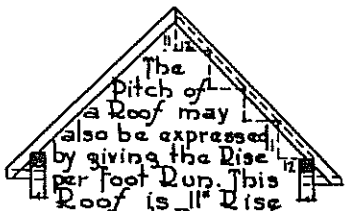
Rafter A Run is 9'-0" Rise 6'-0"
Rafter B Run is 3'-0" Rise 4'-0"

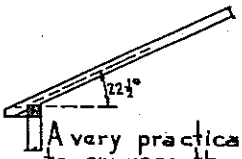


Terms Used in Roof Framing



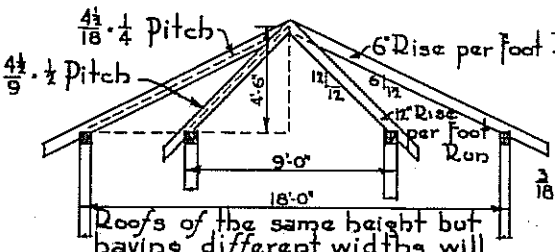
Comparing the Rise with the Span gives the Pitch. For this roof the Rise is $\frac{1}{3}$ the Span. This is called a $\frac{1}{3}$ Pitched Roof



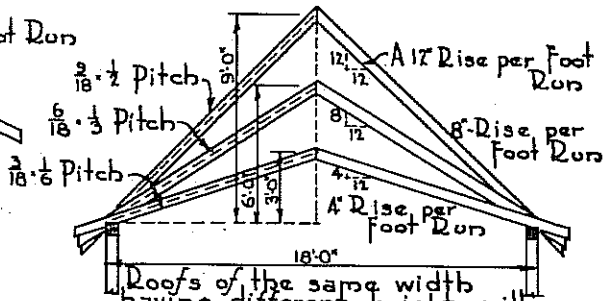


A very practical way to express the pitch of a roof is by degrees

Three Ways of Expressing the Pitch of a Roof



Roofs of the same height but having different widths will also have different pitches



Roofs of the same width having different heights will also have different pitches.

Rise Span	Rise Per Foot Run	Degrees
1/6	4	18° 26'
1/4	6	26° 34'
1/3	8	33° 41'
3/8	9	36° 52'
5/12	10	39° 48'
11/24	11	42° 31'
1/2	12	45° 00'
5/8	15	51° 20'
2/3	16	53° 08'
3/4	18	56° 19'

Finding Length of Rafters

It is the intention to show side by side the various methods of finding the length of rafters. Four methods are illustrated in the drawing on the following page. These are designated as follows:

"Scaling the length."
"Stepping off the length."
"Figuring by square root."
"The length per foot run method."

Scaling the Length of Rafters

A very simple and yet practical method is to scale the length of rafters on the steel square. This is illustrated first in our drawing. Generally the number representing the run of the rafter is taken on the square and the number representing the rise is taken on the tongue; thus in the example the run of rafter number 2 is 9', and the rise is 6'. Therefore we scale the distance between the 9 and the 6 on the square. The distance is 10 and 19/24; here each inch represents one foot and each twelfth of an inch represents one inch. We should therefore use a rule divided into twelfths. Usually a steel square has one edge graduated into twelfths.

Stepping Off the Length with the Square

In the second part of the drawing we show how the length of a rafter may be stepped off with the square. First the rise per foot run must be known. In the example given the rise is 10" per foot run. The illustration shows how a measuring line is drawn along the center of the rafter or rather through the point coinciding with the edge of the plate, from which all measurements are usually taken. The measuring line helps the beginner to avoid such mistakes as shown in the illustration at the lower right-hand corner of the following page.

Apply the square along the rafter so that the numbers 12 and 10 come on the measuring line (or the edge of the rafter may be

used). The square is moved forward once for every foot of run. This is very similar to laying out the stringer of a flight of stairs. When applying the square a mark is always made at the point where the 10 on the tongue falls, then the square is moved forward until the 12 coincides with this mark. It can readily be seen that it requires accurate work.

Figuring by Square Root

This method is quite accurate but not used very much because of the difficulty that most mechanics have with extracting the square root of a number. We shall therefore not dwell on this method very long but shall mention the principles involved so as to give those that know square root the benefit. The third part of our drawing shows how the run, rise and length of a rafter form a right triangle. To find the length of the long side of a right triangle we square both sides and add the sum of the squares together, then we extract the square root from this sum and the answer is the length of the long side. To find the length of the rafter we square the run and also square the rise; then we add the products together and extract the square root; the answer is the length of the rafter. See example on following page.

Length Per Foot Run

The "length per foot run" of a rafter varies with the pitch just as the length of the rafter varies. The length per foot run must be figured out by the square root method as shown in the illustration, but it is not necessary to figure these lengths out every time a rafter is figured. The length per foot run for the various pitches can be figured out and put in table form, this table to be used for calculating rafter lengths. The tables of all kinds can be found in handbooks or on special steel squares called "framing squares." To find the length of the rafter using such a table the length per foot run is multiplied by the run taken in feet. Example:

> What is the length of a rafter for a building 28' wide with a 9" rise per foot run?

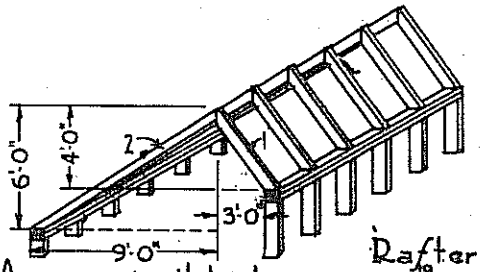
Solution:

> The run is 1/2 of 28 equals 14'.
> Table gives the length per foot run as 15". Length is 15 x 14 equals 210" or $17\frac{1}{2}$'. The table illustrated also gives the pitch by degrees.

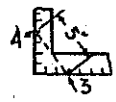
A Study of the Hip Roof

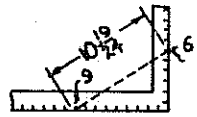
The first figure, in the accompanying illustration, illustrates an ordinary hip and valley roof. Fig. 2 shows this same roof in plan or as it appears when looking directly upon it.

ROOFS

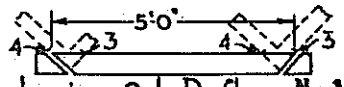


An uneven pitched roof solved by scaling

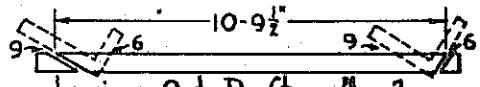




Rafter No 2 scales $10'\text{-}9\frac{1}{2}''$ as $\frac{19}{24}$ represent $\frac{19}{24}$ feet $= 9\frac{1}{2}''$
Rafter No 2 scales 5'-0"

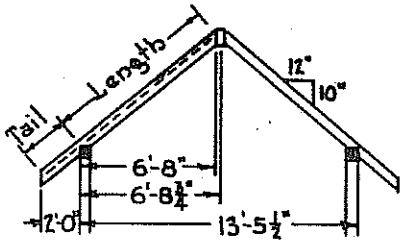


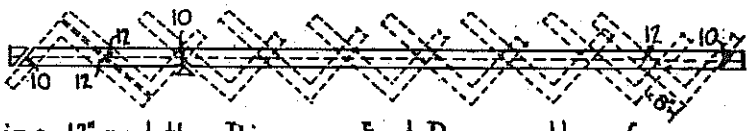
Laying Out Rafter No 1



Laying Out Rafter No 2

Solving for Length of Rafter by Scaling



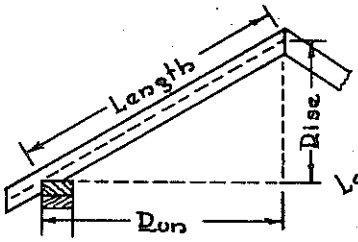


Using 12" and the Rise per Foot Run on the Square we apply the square twice for the 2 feet Run of Tail. Then we mark for the seat cut using the same numbers.

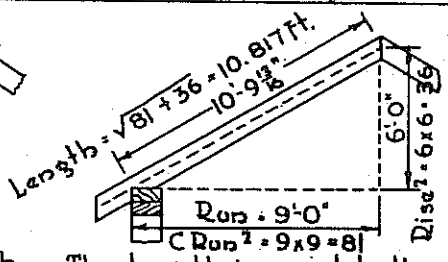
We continue to lay off the length of the Rafter applying the Square once for every foot of Run.

For the extra 8" the square is moved forward only 8" as shown.

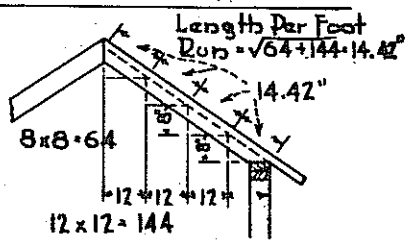
Solving for Length by Stepping off with the Steel Square.



The Run Rise and Length of a Rafter form a Right Triangle.



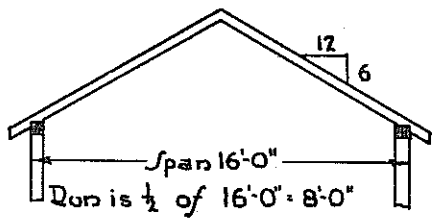
The length is equal to the Square Root (Run squared plus Rise squared)



Length of Rafter is 14.42 + 4 = 57.68 = 4'-9 11/16"

Square Root and the Length per Foot-Run in Roof Framing

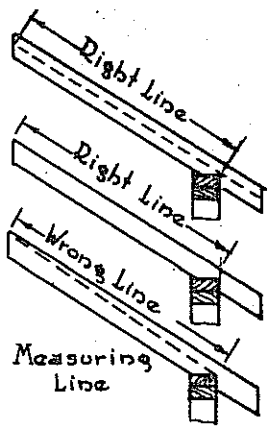
PITCH			LENGTH PER FOOT RUN	
RISE SPAN	RISE PER FOOT	BY DEGREES	IN INCHES	IN FEET
1/8	3	14° 02'	12.37	1.03
1/6	4	18° 26'	12.65	1.054
5/24	5	22° 37'	13.00	1.083
1/4	6	26° 34'	13.42	1.202
7/24	7	30° 15'	13.89	1.158
1/3	8	33° 41'	14.42	1.202
3/8	9	36° 52'	15.00	1.25
5/12	10	39° 48'	15.62	1.302
11/24	11	42° 31'	16.28	1.356
1/2	12	45° 00'	16.97	1.414
13/24	13	47° 17'	17.69	1.475
7/12	14	49° 24'	18.44	1.536
5/8	15	51° 20'	19.21	1.601



Run is ½ of 16'-0" = 8'-0"

Length Per Foot Run = 13.42" (See Table)

Length is 13.42" x 8 = 107.36" = 8'-11 3/8"



Using Tables to Solve for the Length of the Rafter

Again as with the common rafter we emphasize that we must be familiar with the different parts and we must also understand the principles on which the rules are based before we can do good work in framing a hip roof.

The Different Parts

A is the plate on which the rafters rest. This is of importance to us as its upper outside edge is the line from which the measurements are taken.

B is the ridge board which is generally made from a piece of material of the same thickness as the rafters only a little wider. The ridge board is not always used and in many cases, particularly in small buildings, is not necessary.

C is the common rafter; a rafter extending from the plate to the ridge board and not connected to any other rafter.

D is the hip rafter. This rafter forms a hip or ridge in the roof, usually extending from the corner of the building to the ridge. (There are six hip rafters in the illustration.)

E is the valley rafter. This is similar to the hip only that it forms a valley or depression in the roof in place of a ridge or hip.

F is the jack rafter, sometimes called hip jack. This rests on the plate at its lower end and frames to the hip rafter at its upper end.

G is the valley jack which frames to the valley at its lower end and to the ridge at its upper end.

H is the cripple rafter. This frames to the valley rafter at its lower end and to the hip rafter at its upper end.

In the lower figure we are looking down upon the roof and the dimensions that we get from this plan give the actual length of the run of the various rafters but not the lengths of the rafters.

We have learned from foregoing chapters that if we know the run and the rise of a rafter we can easily find the length.

The length of the various other rafters has a definite relation to the run of the common rafter, and the run and rise of the common rafter is the base from which the run and also the length of the other rafters are calculated.

The Length of the Hip Rafter

Finding the length of a hip rafter may be compared to finding the length of the diagonal of a box.

In Fig. 3 is shown a box with a width and length of 6' and a height of 2'6".

A school boy would find it easy to get the lengths of the different diagonals. He would first find the length of the diagonal of the bottom of the box from A to B, and then he would find the diagonal of the box from A to C. He might also find the length of the diagonal from C to D. He would use "square root"; however, we are sometimes afraid to use square root too much, for fear of being called down. We shall start with a simpler method.

If we compare a part of a hip roof with this box we shall have the following dimensions:

A is the corner of the building.
B to C is the total rise of the roof.
D to B is the run of the common rafter.
A to B is the run of the hip rafter.
A to C is the length of the hip rafter.
Compare figures 3, 4 and 5.

With the help of a square we may now find the length of the hip rafter without any calculations.

Lay the first square flat on the bottom of the box as shown. Each edge of the bottom is 6'. If we measure across between 6 on the tongue and 6 on the blade we find the length from A to B which is the run of the hip rafter. This is nearly 8-6/12 or $8\frac{1}{2}$". Therefore the run is $8\frac{1}{2}$' or 8'6".

Another square may be placed with the blade along the run of the hip and the tongue along the rise. The run is $8\frac{1}{2}$' and the rise is $2\frac{1}{2}$'. We measure between the points $8\frac{1}{2}$ on the blade and $2\frac{1}{2}$ on the tongue and find the length of the diagonal that stands for the length of the hip rafter. This distance is 8-10/12", therefore the length of the hip rafter is 8-10/12' or 8'10". By this method of measuring across the square we may find the length of rafters to a fair degree of accuracy; however, care should be taken in measuring. Steel squares usually have one side graduated into twelfths of an inch. If we take inches for feet, then twelfths of inches on the square represent inches on the rafter.

Another method that is more commonly used for finding the lengths of hip rafters is the "Length Per Foot Run Methods." In this method we use the foot run of the common rafter as basis.

The hypotenuse of a right triangle whose sides are each 12" is 16.97" long. We see from the illustration (Figs. 3 and 5) that the run of the hip rafter forms the hypotenuse of a triangle whose sides are the run of the common rafter and the length of the plate. (In the illustration this is the length of the plate from the corner of the building to the first common rafter.)

ROOFS

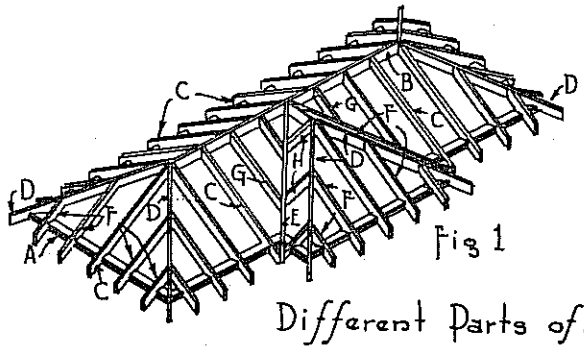


Fig 1

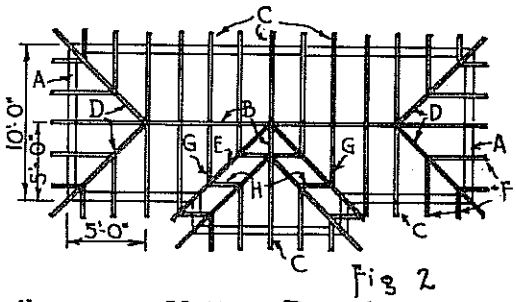


Fig 2

Different Parts of a Hip and Valley Roof

A-Plate
B-Ridge
C-Common Rafter
D-Hip Rafter
E-Valley Rafter
F-Hip Jack Rafter
G-Valley Jack Rafter
H-Cripple Jack

Figure 1 is an Isometric view of a Hip Roof. This same roof is shown in Plan in Figure 2. A plan view is always helpful in solving a roof problem.

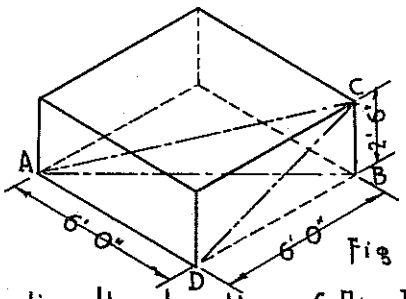


Fig 3

Finding the lengths of Hip Rafters may be compared to finding the diagonals of a cube.

Let DB be the Run of Common Rafter
Let DC be the Length of Common Rafter
Let AB be the Run of Hip Rafter
Let AC be the Length of Hip Rafter

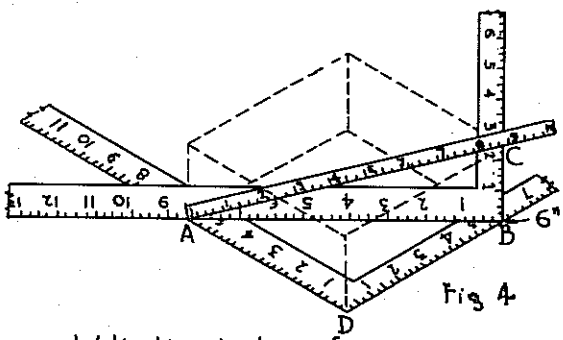


Fig 4

With the help of Squares and Ruler the lengths of the diagonals may be scaled as shown above.

Compare also this box figure with the illustration of a corner of a Hip Roof in the next illustration.

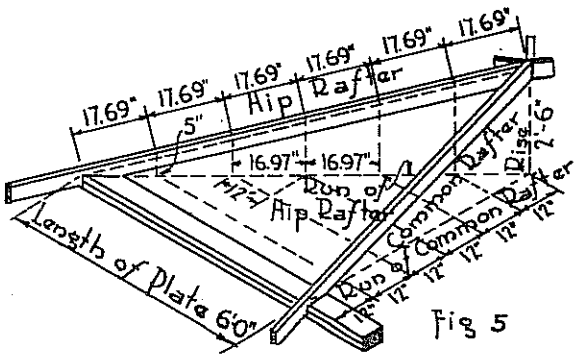


Fig 5

This illustrates what is meant by "Run of Hip" and "Length Per Foot Run" of Hip.

Note: The length per foot run is per foot run of Common Rafter

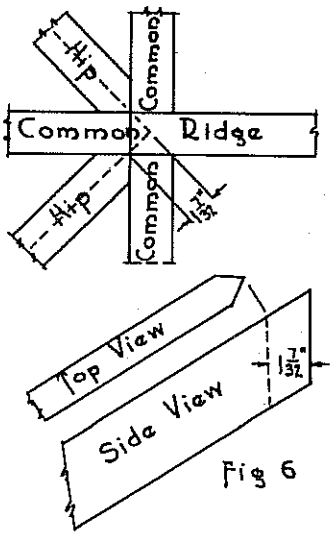


Fig 6

Showing how the deduction from the ridge is made.

If we take only one foot of run and one foot of length of plate, we have a right triangle whose sides are each 12" long and whose hypotenuse is 17" or, more accurately, 16.97".

The long side, or hypotenuse, in this case, is a portion of the run of hip rafter corresponding to one foot run of common rafter. Therefore, we say that the run of the hip is always 16.97" for every foot, (12") run of common rafter, if the roof is of an even pitch.

The hip rafter always has the same rise as the common rafter, therefore the rise for each 17" of run of hip is the same as the rise per foot run of common. In this problem the rafters have a rise of 5" per foot "run of common rafter" or 5" for every 17" of "run of hip."

To get the length of hip rafter per foot run of common rafter take 17" on the blade of the square and 5" on the tongue. This is usually stated thus: "Run of hip on blade, rise of hip on tongue." The distance between these two points is 17-2/3". This is the length of hip rafter per foot run of common rafter. This length can be figured more accurately thus: Length of hip rafter per foot run equals the square root of (the sum of the squares of 16.97 and 5), written thus:

$$\sqrt{16.97^2 + 5^2} = 17.69"$$

In practice we usually take this length per foot run from tables in handbooks or from the steel squares. The common rafter in this problem has a six-foot run and therefore there are also six such lengths for the hip rafter, as can be seen in the illustration. The total length of the hip rafter, therefore, is 6 x 17.67" = 106.14" = 8'10-1/8".

In Fig. 6 is shown a small framing detail taken at the point where the hip rafter meets the ridge. This is a view in plan and shows the upper ends of the rafter as seen from above.

The length of hip just found is to the center point "O." As the hip rafter does not extend to this point we must deduct a small amount from the length. On a horizontal plane this is 17/32" and is deducted as shown in the lower part of the illustration.

Problems

Some tables give the length per foot run for various pitches expressed by the rise per foot run. Other tables give the length per foot run for various pitches expressed in degrees. The following are taken from such tables:

Rise per Foot Run	Length per Foot Run	
	Common	Hip
6"	13.65"	18.00"
8"	14.42"	18.76"
9"	15.00"	19.21"

Pitch by Degrees	Length per Foot Run	
	Common	Hip
30°	13.86"	18.33"
45°	16.97"	20.78"
55°	20.92"	24.11"

Find the length of common and hip rafter for a roof
A - with 6" rise and 8' run
B - with 8" rise and 14' run
C - with 9" rise and 16½' run
D - with 30° pitch and 10' run
E - with 45° pitch and 9' run
F - with 55° pitch and 13'6" run

Answers

A. Common rafter 13.65"x8 = 109.2" or 9'1-3/16"
Hip rafter 18.00"x8 = 144" or 12'0"

B. Common rafter 14.42"x14 = 201.88" or 16'9-7/8"
Hip rafter 18.76"x14 = 262.64" or 21'10-5/8"

C. Common rafter 13.86"x16.5 = 247.5" or 20'7½"
Hip rafter 19.21"x16.5 = 316.97" or 26'4-15/16"

D. Common rafter 13.86"x10 = 138.6" or 11'6-5/8"
Hip rafter 18.33"x10 = 183.3" or 15'3-5/16"

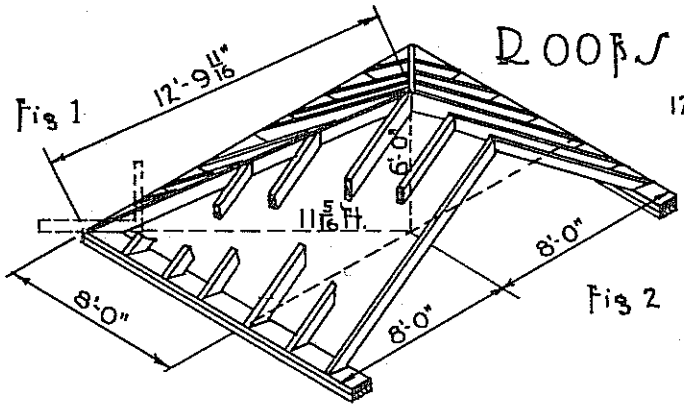
E. Common rafter 16.97"x9 = 152.73" or 12'8-3/4"
Hip rafter 20.78"x9 = 187.02" or 15'7"

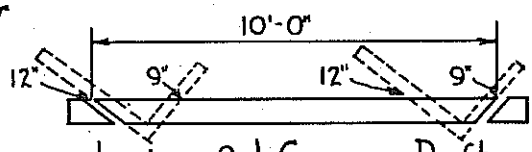
F. Common rafter 20.92"x13.5 = 282.42" or 23'6-7/8"
Hip rafter 24.11"x13.11 = 316.08" or 26'4-1/16"

Details of the Hip Rafter

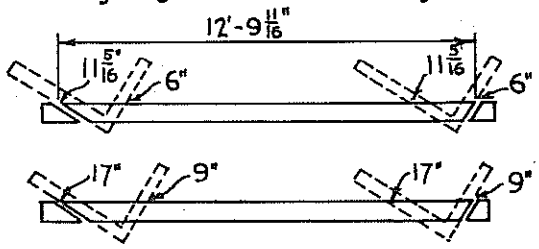
There are a few bothersome technicalities connected with the cutting of the hip rafter. These points have to be considered very carefully, otherwise the rafter is apt to be too long, or too short, or the cut may not fit exactly.

ROOFS





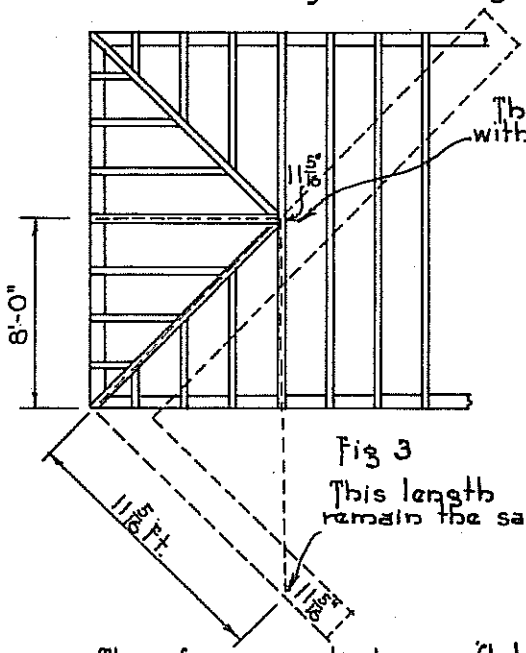
Laying Out Common Rafter

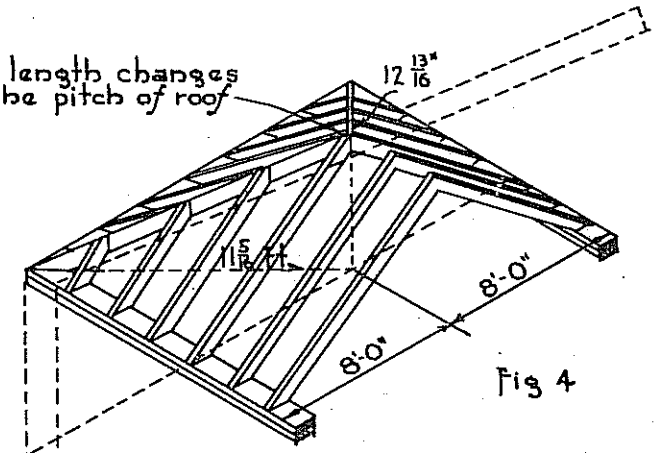


Laying Out Hip Rafter

One end of Hip Roof. The Rise per Foot Run is 9".
The Run of Roof is 8'-0". Total Rise is 8'x9" = 72"
Length per Foot Run of Common Rafter is $\sqrt{12^2+9^2} = 15.00"$
Length of Hip per Foot Run of Roof is $\sqrt{17^2+9^2} = 19.21"$

Method of Obtaining the Side Cut Shown Below.

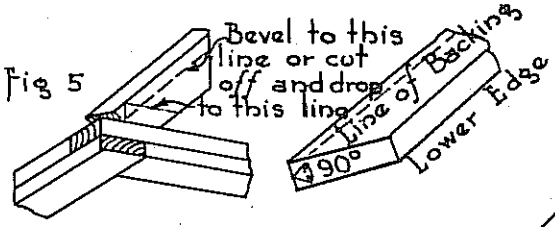




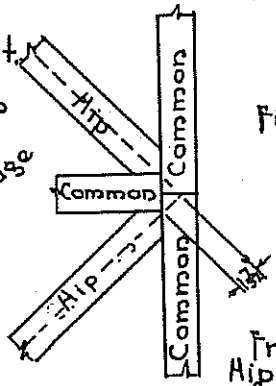
This length remain the same

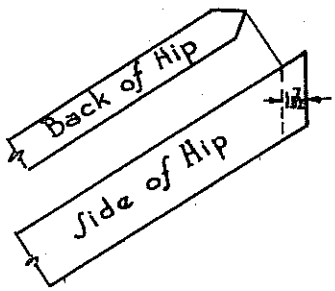
11 5/16" The length of the Hip Rafter taken on the blade of the Square and the Run of the Hip Rafter taken on the tongue of the Square gives the numbers for the side cut of the Hip Rafter.

The Square applied on a flat roof in the position that would give the numbers for the side cut.



A Convenient Way of Finding the Backing Line of the Hip





From the length of the Hip Rafter ½ the thickness of the Common Rafter must be deducted.

The proper way to measure this is shown above.

The roof illustrated has a pitch of 9" rise per foot run. In Fig. 1 of the accompanying illustration, the length per foot run is figured out by square root. This, however, is not necessary to do every time, as there are plenty of tables that give the length per foot run for all pitches. Knowing the length per foot run the length is found by multiplying by the total run. Thus the length of common rafter is 15"x8 = 120" or 10'0".

The length per foot run of hip is 19.21" and the length is 19/21"x8 = 153.68" or 12'9-11/16".

Laying Out the Rafters

There are two ways of marking for the plumb and seat cut of the common rafter. We may take the total run and the total rise of the rafter which in this case would be 8 and 6 on the square. We may also take the rise per foot run and 12 which represents one foot run on the square, which would give the numbers 12 and 9. The application of the square to the rafter is shown in the illustration.

For the laying out of the hip rafter we also have two sets of numbers to use. The total run of the rafter and the total rise will give the cut, which in this case is 11-5/16 and 6. The application of this is shown in the second illustration. The rise per foot run is 9" and the number representing the run of the hip per foot run of common rafter is 16.97" or say 17"; therefore, the numbers 17 and 9 will give the plumb and seat cuts.

The Side Cut of the Hip

If we assume a flat roof as shown in Fig. 3, of the accompanying illustration, the side cut for the hip is a 45° cut. It always remains a 45° cut with the side of the rafter; however, as the pitch of the roof changes the line on the back of the rafter which describes the side cut changes. A square is shown applied to the roof so that the blade coincides with the run of the hip and the tongue along a line at right angles to the hip. The length of this line from the corner of the roof up to where it coincides with a line extended from the line of the common rafter is the same as the run of the hip rafter. The length on the blade of the square is the same as the length of the hip rafter, therefore we have the rule as follows:

"Take the total length of the hip on the blade of the square and the total run on the tongue of the square and apply this to the back of the hip for the side cut, marking along the blade. The side cut for this hip rafter is marked by taking 12-13/16 on the blade of the square and 11-5/16 on the tongue marking along the blade."

The length per foot run taken on the blade and 17" on the tongue give the same bevel.

The Gambrel Roof

Historians tell us that the Dutch people were the first to develop the roof that we now know as the gambrel roof. They found it necessary to make their roofs rather steep because of the heavy snow. This required the use of long timbers and as long timbers became scarce they looked for some other methods to accomplish their needs. Thus they started to cut off the upper ends of the rafters, making the upper part of a little less pitch and making the rafters out of two pieces.

They kept the lower part as long as possible, leaving the part that had the less pitch as the shorter part so that there would not be too much chance for snow to lodge. They did not go to the extreme, as we so often see it in the gambrel roof of to-day, of having the upper part almost flat. This, too, was given a fairly steep pitch.

In our present day one may see every type of roof in one single town, regardless of what the climate of that locality may be, and we also find that many of the roofs look out of place. Sometimes it seems that there is more unity and harmony in a city flat district where the real estate dealer has built the most room on the smallest possible lot, than there is in the suburban district where every one has tried to work out his own peculiar ideas in his house, with no regard for locality.

Let us proceed to frame our gambrel roof, assuming that it is in the Northern States.

The architect has indicated the pitch of the roof by giving the run and the total rise of each set of rafters. Fig. 3, in the accompanying illustration, shows how the rise per foot run and the length of rafter "A" are obtained. The length of this rafter could also be found by taking the numbers 4 and 6 on the square and measuring between these two points, or it could be figured out by square root. The length of this rafter is the square root of (4 squared + 6 squared), equals the square root of 16 + 36, equals square root of 52, equals 7.211' or 7'2½".

Fig. 4, in the accompanying illustration, shows how to mark for the cuts for rafter "A." The pitch of roofs of this kind is sometimes given in degrees. The cuts are then made according to the degree given. This simplifies the work very much.

Rafter "B" is shown figured out in detail on the drawing. The cuts for the end studs may also be marked by using the same numbers on the square as for the rafters. It is well in this connection to note that the cut for the end stud is the same as the cut at the upper end of the rafter to which it frames.

The cut for the collar beam is the same as for the rafters.

ROOFS

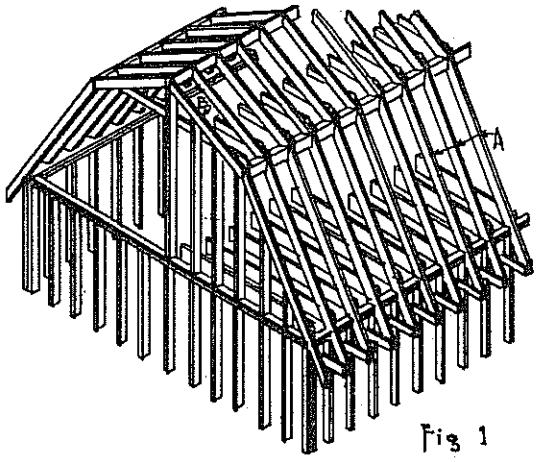


Fig 1

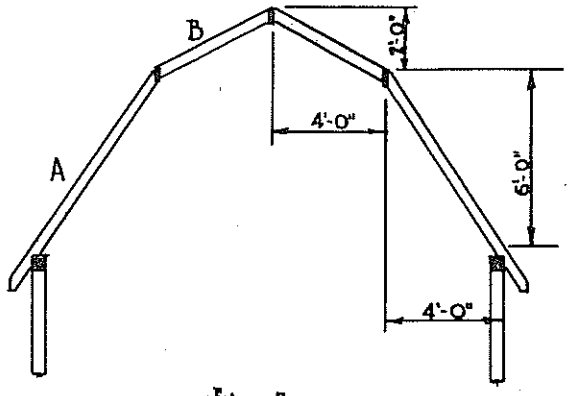
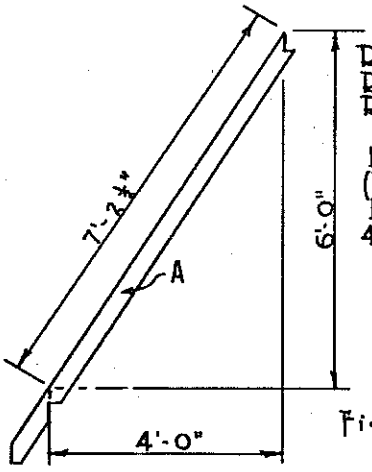
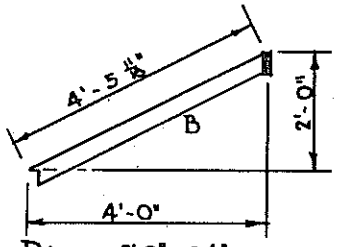


Fig 2



Rise is 6'-0" = 72"
Run = 4'-0"
Rise per Foot Run
= 72" ÷ 4 = 18"
Length per Foot Run
(from table) 21.63"
Length of Rafter
4 x 21.63" = 86.52" = 7'-2½"

Fig 3



Rise = 2'-0" = 24"
Run is 4'-0"
Rise per Foot Run 24 ÷ 6 = 6"
Length per Foot Run is
13.42 (from table.
Total Length = 4 x 13.42 = 53.68 = 4'-5 11/16"

Fig. 5

As the Rise is 6" in 12"
the numbers 6 and 12
give the top and bottom cut.

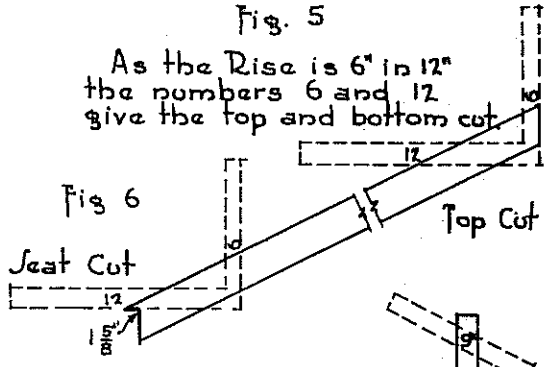


Fig 6

As the Rise is 18" in
12" the numbers 18
and 12 are used to
lay out the top and
bottom cut.

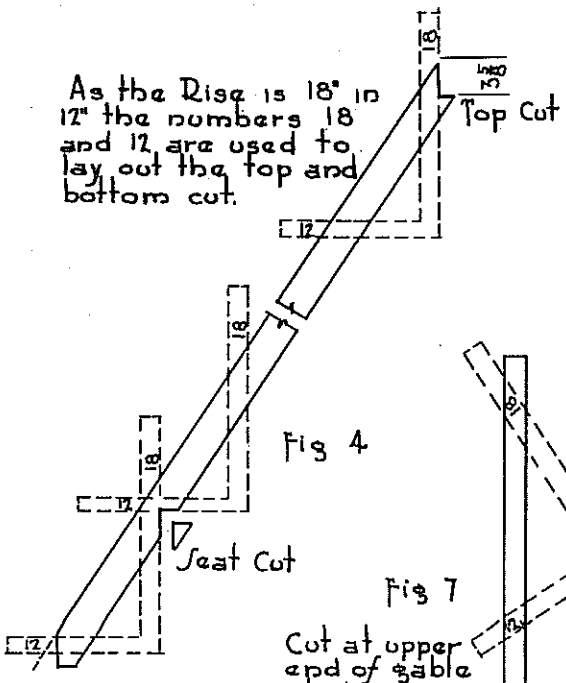


Fig 4

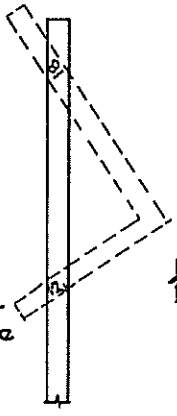
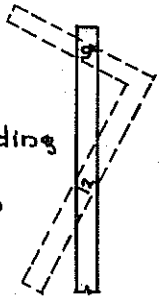


Fig 7

Cut at upper
end of gable
studding



Cut at upper end
of gable studding

Fig 8

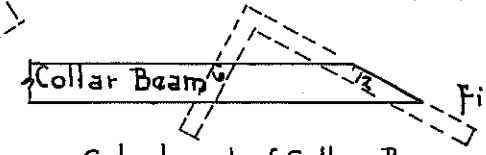


Fig 9

Cut at end of Collar Beams.

RAFTER - TABLE

Width of Building	1/4 PITCH			1/3 PITCH			1/2 PITCH		
	Run	Rise	Rafter Length	Run	Rise	Rafter Length	Run	Rise	Rafter Length
10	5'-0"	2'-6"	5'-7"	5'-0"	3'-4"	6'-0"	5'-0"	5'-0"	7'-1"
11	5'-6"	2'-9"	6'-1¾"	5'-6"	3'-8"	6'-7¼"	5'-6"	5'-6"	7'-9¼"
12	6'-0"	3'-0"	6'-8½"	6'-0"	4'-0"	7'-2½"	6'-0"	6'-0"	8'-5¾"
13	6'-6"	3'-3"	7'-3"	6'-6"	4'-4"	7'-9½"	6'-6"	6'-6"	9'-2¼"
14	7'-0"	3'-6"	7'-9¾"	7'-0"	4'-8"	8'-4¾"	7'-0"	7'-0"	9'-10¾"
15	7'-6"	3'-9"	8'-4½"	7'-6"	5'-0"	9'-0"	7'-6"	7'-6"	10'-7¼"
16	8'-0"	4'-0"	8'-11¼"	8'-0"	5'-4"	9'-7¼"	8'-0"	8'-0"	11'-3¾"
17	8'-6"	4'-3"	9'-6"	8'-6"	5'-8"	10'-2½"	8'-6"	8'-6"	12'-0¼"
18	9'-0"	4'-6"	10'-0½"	9'-0"	6'-0"	10'-9¾"	9'-0"	9'-0"	12'-8½"
19	9'-6"	4'-9"	10'-7¼"	9'-6"	6'-4"	11'-5"	9'-6"	9'-6"	13'-5¼"
20	10'-0"	5'-0"	11'-2"	10'-0"	6'-8"	12'-0¼"	10'-0"	10'-0"	14'-1¾"
21	10'-6"	5'-3"	11'-8¾"	10'-6"	7'-0"	12'-7¼"	10'-6"	10'-6"	14'-10¼"
22	11'-0"	5'-6"	12'-3½"	11'-0"	7'-4"	13'-2½"	11'-0"	11'-0"	15'-6¾"
23	11'-6"	5'-9"	12'-10¼"	11'-6"	7'-8"	13'-9¾"	11'-6"	11'-6"	16'-3¼"
24	12'-0"	6'-0"	13'-5"	12'-0"	8'-0"	14'-5"	12'-0"	12'-0"	16'-11¾"
25	12'-6"	6'-3"	13'-11½"	12'-6"	8'-4"	15'-0¼"	12'-6"	12'-6"	17'-8¼"
26	13'-0"	6'-6"	14'-6¼"	13'-0"	8'-8"	15'-7½"	13'-0"	13'-0"	18'-4½"
For 12" Eave add 1'-1½"				For 12" Eave add 1'-2¼"			For 12" Eave add 1'-5"		
For 18" Eave add 1'-8"				For 18" Eave add 1'-9½"			For 18" Eave add 2'-1½"		
For 24" Eave add 2'-2¾"				For 24" Eave add 2'-4¾"			For 24" Eave add 2'-9¾"		

Problems

1. Assume a roof similar to the one given in the illustration with the following dimensions:

   Run of lower rafter, 5'0"
   Run of upper rafter, 4'6"
   Rise of lower rafter, 6'3"
   Rise of upper rafter, 3'0"
   Find the lengths and cuts for the rafters

2. Assume a roof with the following dimensions:

   Lower rafter, 16" rise per foot run, with a run of 8'0"
   Upper rafter, 7" rise per foot run with a run of 5'6"
   Find the lengths and cuts for the rafters

Answers

1. Rise of lower rafter is 6'3", or 75"
   Run of lower rafter is 5'0"
   Rise per foot run is 75 ÷ 5 = 15"
   Length per foot run from tables is 19.21"
   Length of rafter is 19.21x5 = 96.05"
   To change to feet we divide by 12. This gives 8' and .05"
   The .05" may be changed to sixteenths of an inch by multiplying by 16. This gives .05x16 = .80. This is 8/10 sixteenths, or in other words, almost one-sixteenth of an inch.
   As the rise per foot run is 15" the numbers 15 and 12 on the square give the cuts for the rafters and the studs and collar beams.
   The upper rafter has a rise of 36"
   The run is 4'6", or $4\frac{1}{2}$'
   The rise per foot run is 36 ÷ $4\frac{1}{2}$ = 8"
   The length per foot run is 14.42"
   The length of the rafter is 14.42x$4\frac{1}{2}$ = 64.89"
   The numbers for the cuts are 12 and 8

2. Lower rafter has 16" rise per foot run
   The length per foot run is 20" (from tables)
   Length of rafter is 20"x8 = 160", or 13'4"
   The cuts are 12 and 16
   Upper rafter, 7' rise per foot
   Length per foot is 13.89"
   Length of rafter is 13.89"x$5\frac{1}{2}$ (the span) = 76.395", or 6'4-3/8"
   The cuts are 12" and 7"

APPENDIX C

WOOD SHINGLES

Summary of Sizes, Packing Rules, Running Inches and Shipping Weights
(See Note No. 1) (See Note No. 2)

Grades	Shingle Thicknesses (Green)	Approximate Bundle Thickness, Inches Green	Approximate Bundle Thickness, Inches Dry	Random Widths Max.Min.	No. of Courses per Bundle	No. of Bundles per Square	No.Running Inches Per Bdl.	No.Running Inches Per Sq.	Shp'g. Wgts. Per Sq.
No.1-24"(Royals)	4 Butts-2"	$6\frac{1}{2}$ /7	6-1/3 /$6\frac{3}{4}$	14"to4"	13/14	4	499	1996	192
No.1-24"(" sidewalls)	4 Butts-2"	$6\frac{1}{2}$ /7	6-1/3 /$6\frac{3}{4}$	14"to4"	13/14	3	499	1497	144
No.1-18"(Perfections)	5 Butts-$2\frac{1}{4}$"	8-1/8	7-7/8	14"to3"	18/18	4	666	2664	158
*No.1-16"(Perfects 5X)	5 Butts-2"	8	$7\frac{3}{4}$	14"to3"	20/20	4	740	2960	144
No.2-24"(16" Clear)	4 Butts-2"	$6\frac{1}{2}$ /7	6-1/3 /$6\frac{3}{4}$	14"to3"	13/14	4	499	1996	192
No.2-18"(12" Clear)	5 Butts-$2\frac{1}{4}$"	8-1/8	7-7/8	14"to3"	18/18	4	666	2664	158
No.2-16"(12" Clear)	5 Butts-2"	3	$7\frac{3}{4}$	14"to3"	20/20	4	740	2960	144
No.3-24"(10" Clear)	4 Butts-2"	$6\frac{1}{4}$/$6\frac{3}{4}$	6 / $6\frac{1}{2}$	14"to3"	13/14	4	499	1996	192
No.3-18"(8" Clear)	5 Butts-$2\frac{1}{4}$"	7-7/8	7-5/8	14"to3"	18/18	4	666	2664	158
No.3-16"(8" Clear)	5 Butts-2"	$7\frac{3}{4}$	$7\frac{1}{2}$	14"to$2\frac{1}{2}$"	20/20	4	740	2960	144

No.1 and No. 2 Grades Dimensions	Shingle Thicknesses (Green)	Widths (Green)	No.of Courses per Bundle	Additional Cross Shingles	No.of Bundles per Square	No.Pieces per Bundle	Shp'g. Wgts. Per Sq.
24"x6"	4 Butts-2"	6"	14/14		4	84	192
24"x6" (sidewalls)	4 Butts-2"	6"	14/14		3	84	144
18"x5"	5 Butts-$2\frac{1}{4}$"	5"	16/16	8	4	136	158
18"x6"	5 Butts-$2\frac{1}{4}$"	6"	17/18	8	4	113	158
16"x5"	5 Butts-2"	5"	18/18	8	4	152	144
16"x6"	5 Butts-2"	6"	19/20	8	4	125	144

Note No.1 - A small amount is allowed for shrinkage from green to dry wood. See grading rules for specific grade measurements, and also note third column, this table.

Note No.2 - No definite number of random width shingles are packed in a bundle; minimum contents is determined by actual running (combined width of shingles laid side by side) inches of wood contained.

Note No.3 - A "square" is 100 square feet of roof or wall surface

*Standard for Forest Service roofs.

Covering Capacities in Square Feet of the Various Sized Shingles
Square Pack

Size of Shingles		No. Bdls. per Sq.	Number of Inches Exposed to the Weather															
			4"	4½"	5"	5½"	6"	6½"	7"	7½"	8"	8½"	9"	9½"	10"	10½"	11"	11½"
1 Square of 16" -5/2 will cover on	Roofs	4	80	90	100	square feet:			greater exposure not recommended									
	Sidewalls	4	square feet			110	120	130	140	150	greater exposure not recommended							
1 Square of 18" -5 /2¼" will cover on	Roofs	4	70	80	90	100	square feet:			greater exposure not recommended								
	Sidewalls	4	square feet				110	120	125	135	145	155.	greater exposure not recom.					
1 Square of 24" -4 /2" will cover on	Roofs	4	square feet				80	90	95	100	greater exposure not recommended							
	Sidewalls	3	square feet				60	65	70	75	80	85	90.	95	100	105	110	115

Formula for Figuring Covering Capacities per "Square"

Formula:

(Total number of courses in both ends of bundle) x 18½ (Running inches in each course) x (Number of bundles in square) x (Number of inches exposed to weather) = Number of Square Feet that 1 Square will cover.

For Example:

Find covering capacity of 1 sq. 16" shingles exposed 5" to the weather: $\frac{(20 + 20) \times 18.5 \times 4 \times 5}{144} = \frac{14800}{144} = 102$ sq.ft.

(4 bdls. 16" = 1 sq. at 5" exposure)
(4½ " 16" = 1 sq. at 4½" ")
(5 " 16" = 1 sq. at 4" ")

Nails Required Per "Square"*

Size of Shingles	3d Nail 1¼" long	3½d Nail 1-3/8" long
16-inch - 5/2"	3 lbs. 5" exp.	
18-inch - 5 /2¼"		3 lbs. 5½" exp.

Size of Shingles	4d Nail 1½" long	5d Box Nail 1-3/4" long
24-inch - 4/2"	3 lbs. 7½" exp.	
Reroofing with Wood Shingles		Approx. 4 lbs.

*Quantities required vary slightly according to distance shingles are exposed to the weather.

Reroofing Over the Old Roof with Red Cedar Shingles

Thousands of home-owners are cutting their fuel bills and gaining a warmer house by reroofing right over the old roof with Red Cedar Shingles.

Scientific tests have proved the high insulation value of Red Cedar so the double roof provides maximum insulating value.

Red Cedar Shingles are rot-resisting and lend themselves as no other roofing material in this class can to the method of reroofing over the old roof.

Do not forget that in reroofing over the old roof proper nails are just as important as with a new roof. Use 5d box nails 1-3/4" long for all thicknesses and see that they are heavily coated with pure zinc by the hot dipping process, or use pure copper.

The appearance of the roof of the home is actually improved and reroofing in this manner has the following advantages:

(1) Saves the labor and expense of removing the old shingles or roofing.
(2) Avoids litter and dirt and the trouble and cost of cleaning them up.
(3) Retains protection for house while job is in progress.
(4) Increases insulation against heat and cold.
(5) Adds vastly to home comfort.
(6) Effects great savings in fuel bills.

Proper Weather Exposure

Roofs

After years of experience, it is recommended that not over 1/3 the length of a shingle should be exposed to the weather - to expose more to the weather does not furnish adequate protection.

Since shingles are manufactured in lengths of 16", 18", and 24", and since the grading rules permit 1" variation in length, the maximum weather exposure for a 16" shingle is 5", for an 18" shingle 5½", and for a 24" shingle 7½".

Walls

For sidewalls it is recommended that not over 1/2 the length of the shingle be exposed to the weather.

Allowing for the variation in lengths again, the maximum weather exposure for a 16" shingle is 7½" on the sidewalls; for an 18" shingle 8½"; and for a 24" shingle 11½".

If greater exposure on sidewalls is desired up to 2/3 the length of the shingle, undercoursing with low grade shingles is used. Exposures up to a maximum of 16" in 24" shingles, 12" in 18" shingles, and 11" in 16" shingles are thus obtained. In double coursing the upper course should be butt-nailed with copper nails.

Why Shingles are Packed by the Square

Red Cedar Shingles are sold by the square.

The square is a modern unit of measurement and means that a square of shingles laid at the prescribed exposure to the weather will cover a space 10'x10', or 100 square feet.

On the Pacific Coast where the trees grow so large, it was originally found impractical to cut wide shingles up into several small ones, so it was necessary to pack them "random widths." Architects immediately approved the appearance of random widths as it did away with uniformity. It followed that it was impossible to fit the random width shingles perfectly in each course, so that the rules make allowances and specify that the courses must average not less than $18\frac{1}{2}$" of wood.

The amount of lineal or running inches of wood in a square is found by the following formula:

Total number of courses at each end of bundle	X	18.5 or net amt. of wood in each course	X	number of bundles in square

Lineal or running inches in one square of XXXXX would be found as follows:

40x18.5x4 or 2960 running inches. See table on pages A-19 and A-20.

The Proper Nail

The heartwood of Western Red Cedar is naturally highly resistant to decay and when employed as shingles for roofs or sidewalls it is essential to use nails which will last as long as the shingles.

Just as the chain is no stronger than its weakest link, so is a shingled roof no more enduring than its nails.

When ordinary wire nails are used, moisture soon reaches the nail and the process of rusting begins. A small pocket is formed which harbors moisture and facilitates the rusting process. In time the nail heads become rusted off and the shingles are torn loose under the attack of wind and weather.

If the proper nails are used, however, the shingles will be held securely and give service and protection throughout their natural life.

Numerous experiments have conclusively proved the wisdom and economy of high grade nails and maximum service may be assured by using hot-dipped zinc coated cut nails, hot-dipped zinc coated steel and copper nails, or pure copper or zinc nails.

FACTS ABOUT LUMBER

Lumber as it comes from the saw is roughly classed as "boards," "dimension," or "timbers."

Boards have a nominal thickness of 1", and may be any width in an even number of inches or any length from 8' to 20' in 2' divisions.

Dimension has a nominal thickness of 2 or 3" and may be any width in even inches or any length from 8 to 24' in 2' divisions.

Timbers have a nominal width and thickness of 4" and up in even numbered dimensions and lengths from 8 to 24'.

All lumber is sold on the basis of the sizes and board foot contents as it comes from the saw. Usually boards and dimension are dressed or surfaced, very little rough material being used. The principal reason for this is that the rough material is not uniform in size and it is necessary to dress it so that the dimensions of all pieces of a given size will be uniform, which is essential for good carpentry. Most of the lumber used in Region One is cut under Western Pine Association rules, and the following lists of sizes of various kinds of lumber are quoted from those rules.

S 4 S means the piece is surfaced on both sides and both edges.
S 2 S means the piece is surfaced on the two sides and the edges are rough.
S 1 S 1 E means that one side and one edge are surfaced.

Inch common boards and finish.
S 2 S, to 25/32" thick.
S 4 S, to 25/32" thick and 3/8" scant of nominal width.

Nominal Width	Actual Width
2"	1-5/8"
4"	3-5/8"
6"	5-5/8"
8"	7-1/2"
10"	9-1/2"
12"	11-1/2"
14"	13-1/2"

Shiplap - Thickness 25/32"
Face, 1" less than nominal width
Lap, 1/2"

Drop siding and ceiling
Dressed and matched, or S 2 S and C.M.
(C.M. means center matched)

1x3	equals	25/32x2-1/4	face
1x4	"	25/32x3-1/4	"
1x6	"	25/32x5-1/4	"
1x8	"	25/32x7-1/4	"
1x10	"	25/32x9-1/4	"
1x12	"	25/32x11-1/4	"

Thick Common and Finish
Dressed and Matched (D and M) or S 2 S and C.M.

$1\frac{1}{4}$	equals	1-5/32	(sometimes called	5	quarter)
$1\frac{1}{2}$	"	1-13/32	"	" 6	"
2	"	1-13/16	"	" 8	"

Face width 3/4" less than nominal

Lath, 4' lath is 3/8" thick and $1\frac{1}{2}$" wide

Dimension, S 4 S	3x4 to $2\frac{1}{2}$x3-5/8
2x4 to 1-5/8x3-5/8	3x6 " $2\frac{1}{2}$x5-5/8
2x6 " 1-5/8x5-5/8	3x8 " $2\frac{1}{2}$x$7\frac{1}{2}$
2x8 " 1-5/8x$7\frac{1}{2}$	3x10 " $2\frac{1}{2}$x$9\frac{1}{2}$
2x10 " 1-5/8x$9\frac{1}{2}$	3x12 " $2\frac{1}{2}$x$11\frac{1}{2}$
2x12 " 1-5/8x$11\frac{1}{2}$	

Timbers, S 4 S	
4x4 to 3-5/8x3-5/8	6x8 to 5-5/8x$7\frac{1}{2}$
4x6 " 3-5/8x5-5/8	8x8 " $7\frac{1}{2}$x$7\frac{1}{2}$
6x6 " 5-5/8x5-5/8	

Under the Western Pine Association rules, Ponderosa pine (yellow pine) and Idaho white pine are graded as follows:

B Select and Better or 1 and 2 Clear
C Select
D Select
No. 1 Common
No. 2 "
No. 3 "
No. 4 "
No. 5 "

There are several variations under these general rules, but it is not advisable to quote them here or to give the details of the grading rules. For our building construction purposes, "D" Select is satisfactory for finish material and No. 2 Common for sheathing, shiplap, siding and flooring. No. 3 Common may be used

for sheathing, but it carries a certain amount of loose knots and knot holes, which might not always be desirable when a good appearing wall is desired.

These same grades are frequently used also in grading boards manufactured from larch, fir, and other species.

Dimension material is generally made from fir and larch and is graded as No. 1 Dimension and No. 2 Dimension. The latter should only be used in rough unfinished jobs and where strength is not a factor in the construction.

	Approximate Weight
White pine surfaced lumber	1700 lbs. per M bd.ft.
Ponderosa pine	1750 " " " " "
Fir and larch	2400 " " " " "
Cedar	1400 " " " " "

The following table gives the board foot contents of different sizes of boards and dimensions:

End Dimensions Inches	Length of timber - feet							
	10	12	14	16	18	20	22	24
	Contents - board feet							
1 x 2	1-2/3	2	2-1/3	2-2/3	3	3-1/3	3-2/3	4
3	2-1/2	3	3-1/2	4	4½	5	5-1/2	6
4	3-1/3	4	4-2/3	5-1/3	6	6-2/3	7-1/3	8
5	4-1/6-	5	5-5/6	6-2/3	7½	8-1/3	9-1/6	10
6	5	6	7	8	9	10	11	12
7	5-5/6	7	8-1/6	9-1/3	10½	11-2/3	12-5/6	14
8	6-2/3	8	9-1/3	10-2/3	12	13-1/3	14-2/3	16
10	8-1/3	10	11-2/3	13-1/3	15	16-2/3	18-1/3	20
12	10	12	14	16	18	20	22	24
14	11-2/3	14	16-1/3	18-2/3	21	23-1/3	25-2/3	28
16	13-1/3	16	18-2/3	21-1/3	24	26-2/3	29-1/3	32
18	15	18	21	24	27	30	33	36
20	16-2/3	20	23-1/3	26-2/3	30	33-1/3	36-2/3	40

End Dimensions Inches	Length of timber - feet							
	10	12	14	16	18	20	22	24
	Contents - board feet							
2 x 3	5	6	7	8	9	10	11	12
4	6-2/3	8	9-1/3	10-2/3	12	13-1/3	14-2/3	16
6	10	12	14	16	18	20	22	24
8	13-1/3	16	18-2/3	21-1/3	24	26-2/3	29-1/3	32
10	16-2/3	20	23-1/3	26-2/3	30	33-1/3	36-2/3	40
12	20	24	28	32	36	40	44	48
14	23-1/3	28	32-2/3	37-1/3	42	46-2/3	51-1/3	56
16	26-2/3	32	37-1/3	42-2/3	48	53-1/3	58-2/3	64
3 x 4	10	12	14	16	18	20	22	24
6	15	18	21	24	27	30	33	36
8	20	24	28	32	36	40	44	48
10	25	30	35	40	45	50	55	60
12	30	36	42	48	54	60	66	72
14	35	42	49	56	63	70	77	84
16	40	48	56	64	72	80	88	96
4 x 4	13-1/3	16	18-2/3	21-1/3	24	26-2/3	29-1/3	32
6	20	24	28	32	36	40	44	48
8	26-2/3	32	37-1/3	42-2/3	48	53-1/3	58-2/3	64
10	33-1/3	40	46-2/3	53-1/3	60	66-2/3	73-1/3	80
12	40	48	56	64	72	80	88	96
14	46-2/3	56	65-1/3	74-2/3	84	93-1/3	102-2/3	112
6 x 6	30	36	42	48	54	60	66	72
8	40	48	56	64	72	80	88	96
10	50	60	70	80	90	100	110	120

End Dimensions Inches	Length of timber - feet							
	10	12	14	16	18	20	22	24
	Contents - board feet							
6 x 12	60	72	84	96	108	120	132	14
14	70	84	98	112	126	140	154	168
16	80	96	112	128	144	160	176	192
8 x 8	53-1/3	64	74-2/3	85-1/3	96	106-2/3	117-1/3	128
10	66-2/3	80	93-1/3	106-2/3	120	133-1/3	146-2/3	160
12	80	96	112	128	144	160	176	192
14	93-1/3	112	130-2/3	149-1/3	168	186-2/3	205-1/3	224

If figured on the basis of a nominal width of 4 inches, about one-fifth more siding and flooring is needed than the number of square feet of surface to be covered, because of the lap in the siding and matching. On the basis of a nominal width of 6 inches, about one-sixth more than surface area will be needed.

Sizes of Windows and Doors

A double hung window consists of two sashes, one above the other. The lower sash is a little larger than the upper but the window frame is made four inches wider and six inches longer than the size of the glass. For instance, for a window with glass 30" x 24" the size of the opening would be 34" x 54". The outside dimension of the window frame would depend upon the thickness of the material used for the sill and jambs. This is roughly $2\frac{1}{2}$" x 2-3/4".

Windows are always figured according to the size of the glass desired and in an even number of inches. Whether a sash has one light or more, the outside dimension of the sash is not affected except that a two-light sash is one inch wider than any other.

Barn sash and cellar sash are four inches wider and five inches longer than the glass dimension. For instance, a barn sash for a six-light 10 x 12 sash is 34" x 29".

Doors come in two grades--No. 1 and No. 2--and are made either of fir or pine. Exterior doors are of many different patterns, but are usually 1-3/8 or 1-3/4 inches thick. Interior doors are usually 5 X flat panel, meaning 5 cross panels (see illustration), and are 1-1/8, 1-3/8, or 1-3/4 inches thick. Sizes are always given as width X height X thickness.

Door frames are ordered for the size door wanted. When ordering door and window frames for log buildings, be sure to specify the thickness of the wall as the width of the sill, as jambs will vary according to the thickness of the logs.

NAILS

COMMON

Size	Length, In.	Gauge No.	Aver. No. in 1 Lb.
2d	1	15	876
3d	1¼	14	568
4d	1½	12½	316
5d	1-3/4	12½	271
6d	2	11½	181
7d	2¼	11½	161
8d	2½	10¼	106
9d	2-3/4	10¼	96
10d	3	9	69
12d	3¼	99	63
16d	3½	8	49
20d	4	6	31
30d	4½	5	24
40d	5	4	18
50d	5½	3	14
60d	6	2	11

SMOOTH BOX

Size	Length, In.	Gauge No.	Aver. No. in 1 Lb.
3d	1¼	14½	635
4d	1½	14	473
5d	1-3/4	14	406
6d	2	12½	236
7d	2¼	12½	210
8d	2½	11½	145
9d	2-3/4	11½	132
10d	3	10½	94
12d	3¼	10½	88
16d	3½	10	71
20d	4	9	52
30d	4½	9	46
40d	5	8	35

FINISHING

Size	Length, In.	Gauge No.	Aver. No. in 1 Lb.
2d	1	16½	1350
3d	1¼	15½	807
4d	1½	15	584
5d	1-3/4	15	500
6d	2	13	309
7d	2¼	13	238
8d	2½	12½	189
9d	2-3/4	12½	172
10d	3	11½	121
12d	3¼	11½	113
16d	3½	11	90
20d	4	10	62

CASING

Size	Length, In.	Gauge, No.	Aver. No. in 1 Lb.
2d	1	15½	1010
3d	1¼	14½	635
4d	1½	14	473
5d	1-3/4	14	406
6d	2	12½	236
7d	2	12½	236
8d	2½	11½	145
9d	2-3/4	11½	132
10d	3	10½	94
12d	3¼	10½	87
16d	3½	10	71
20d	4	9	52
30d	4½	9	46
40d	5	8	35

SPIKES

Flat Head, Diamond Points

Length, In.	Diameter In.	Aver. No. in 1 Lb.
6	9/32	9
7	5/16	7
8	5/16	5
8	3/8	4
10	3/8	3
12	3/8	2½

FENCE STAPLES

Size, In.	1	1¼	1½	1-3/4	2
Gauge Nos.	9	9	9	9	9
Average No. per Lb.	108	87	72	65	58

POSTS AND STAPLES REQUIRED FOR ONE MILE OF BARBED WIRE FENCING

Posts Spaced Apart, Ft.	8	10	12	16½	20	25	30	33
No. of Posts	660	528	440	320	264	211	176	160
Lbs. of 1¼ in. Staples	8¼	6-3/4	5½	4	3-1/3	2-2/3	2¼	2

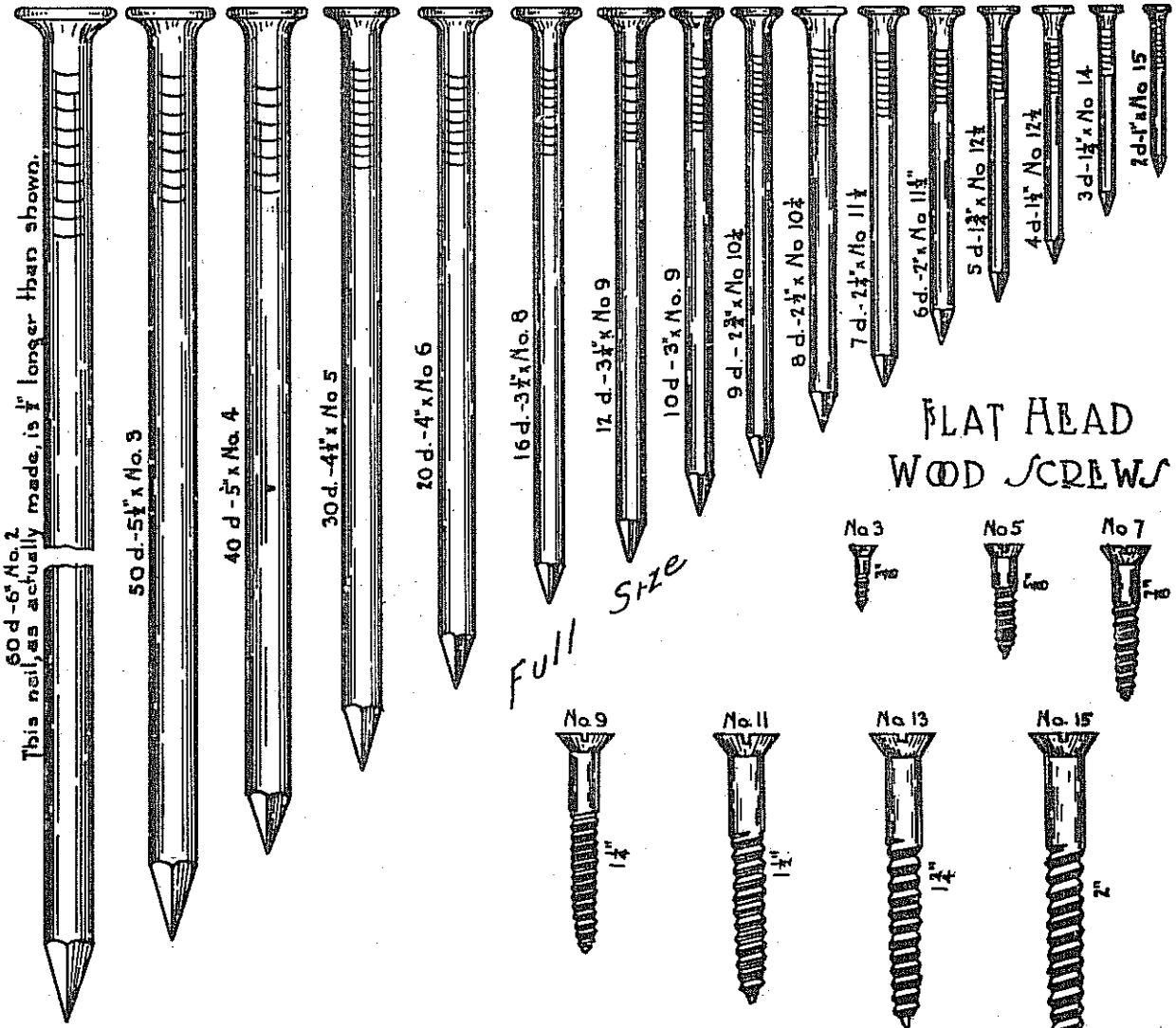
Kinds and Quantities of Wire Nails Required for Carpenter Work

Sizes and kinds of material	Nailings	Nails: Trade Names	Length	Size Gage	No. to Lb.	Pounds per M. B. ft. on centers as follows Inches: 12	16	20	36	48
1 by 4	2	8d common	2-1/2	10¼	106	62	48	40	24	19
1 by 6	2	8d common	2-1/2	10¼	106	42	32	27	16	18
1 by 8	2	8d common	2-1/2	10¼	106	31	26	20	12	10
1 by 10	2	8d common	2-1/2	10¼	106	25	20	16	10	8
1 by 12	3	8d common	2-1/2	10¼	106	31	24	20	12	10
2 by 4	2	20d common	4	6	31	106	82	65	41	33
2 by 6	2	20d common	4	6	31	71	55	46	27	22
2 by 8	2	20d common	4	6	31	53	41	35	20	16
2 by 10	3	20d common	4	6	31	64	50	42	25	20
2 by 12	3	20d common	4	6	31	53	41	35	20	16
3 by 4	2	60d common	6	2	11	200	155	131	77	62
3 by 6	2	60d common	6	2	11	133	102	87	51	41
3 by 8	2	60d common	6	2	11	100	77	65	39	31
3 by 10	3	60d common	6	2	11	120	93	79	46	37
3 by 12	3	60d common	6	2	11	100	77	65	39	31
Shingles	2-4	3d common	1-1/4	13	429					
Base, per 100 lin. ft.	2	8d finish	2-1/2	12½	189		1			
Lath	2	3d common	2-1/2	10¼	106		48			
Ceiling, 3/4 by 4	1	8d finish	2-1/2	12½	189	18	14			
Ceiling, 1/2 by 5/8 by 4 in.	1	6d finish	2	13	309	11	8			
Finish, 7/8 by 4 in.	2	8d finish	2-1/2	12½	189	35	27			
Finish, 1-1/8	2	10d finish	3	11½	121	29	22			
Flooring, 1 by 3	1	8d floor brads	2-1/2	10	99	44	34			
Flooring, 1 by 4	1	8d " "	2-1/2	10	99	33	25			
Flooring, 1 by 6	1	8d " "	2-1/2	10	99	22	17			

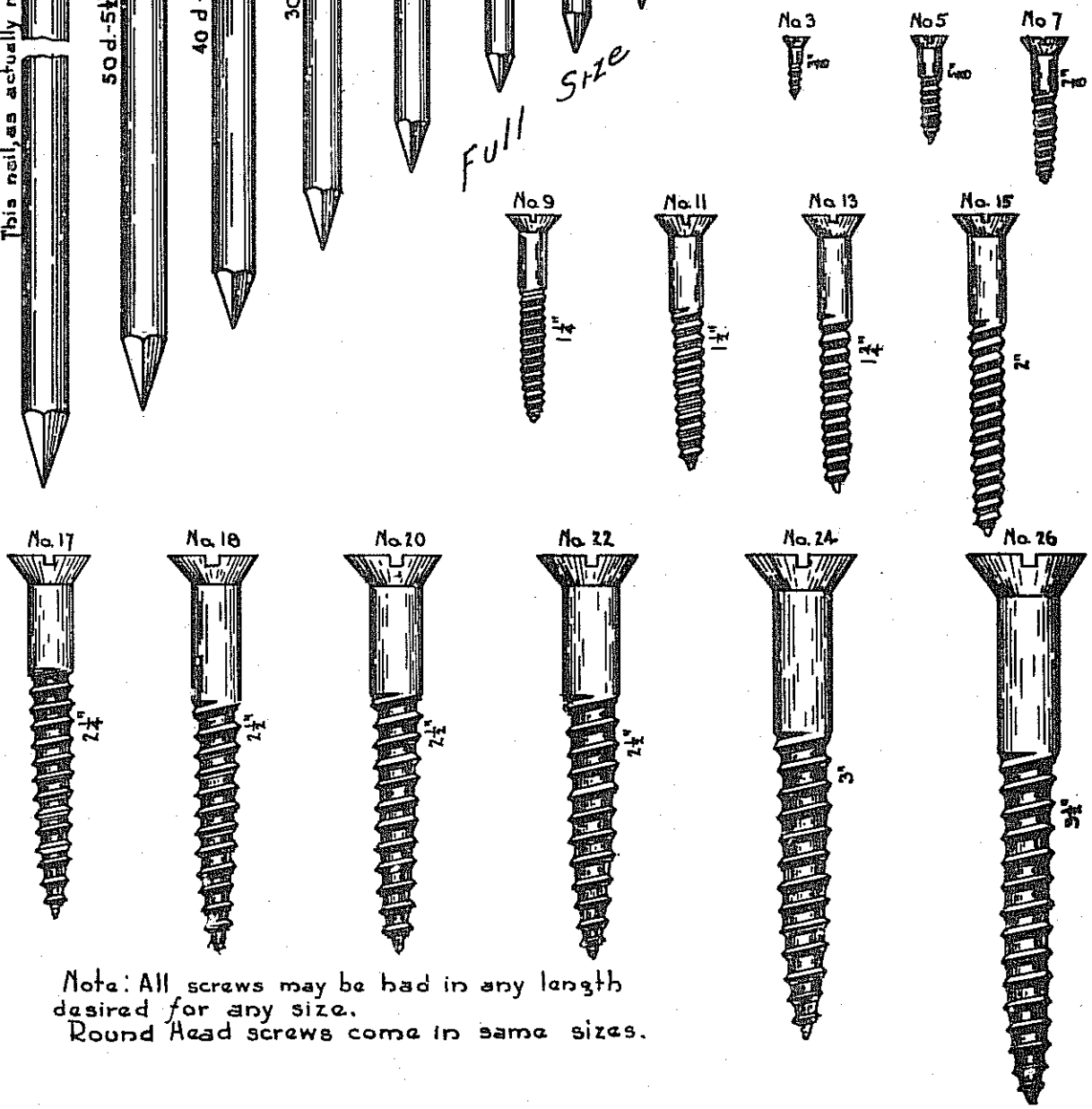
Kinds and Quantities of Wire Nails Required for Carpenter Work (con't)

Sizes and kinds of Material	Nailings	Nails: Trade Names	Length	Size Gage	No. to Lb.	Pounds per M. B. ft. on centers as follows inches: 12	16	20	36	48
Framing, 2 by 4 to 2 by 16 . .		(20d common	4	6	31	20	15	13	8	6
		(16d common	3-1/2	8	49	10	8	$6\frac{1}{2}$	4	3
		(10d common	3	9	69	8	6	5	3	3
Framing, 3 by 4 to 3 by 14 . .		60d common	6	2	11	30	25	20	12	9
Siding, drop, 1 by 4	2	8d casing	2-1/2	$11\frac{1}{2}$	145	46	35			
Siding, drop, 1 by 6	2	8d casing	2-1/2	$11\frac{1}{2}$	145	30	23			
Siding, drop, 1 by 8	2	8d casing	2-1/2	$11\frac{1}{2}$	145	23	18			
Siding, bevel, 1/2 by 4	1	6d finish	2	13	309	11	8			
Siding, bevel, 1/2 by 6	1	6d finish	2	13	309	7	$5\frac{1}{2}$			
Siding, bevel, 1/2 by 8 . . .	1	6d finish	2	13	309	$5\frac{1}{2}$				

STEEL WIRE NAILS



FLAT HEAD WOOD SCREWS



Note: All screws may be had in any length desired for any size.
Round Head screws come in same sizes.

Manila

Is about 25% stronger than Sisal and while there is practically no difference in the weight of these two fibers when made up, Manila is far superior in point of durability and will work in water and weather which Sisal will not withstand.

The working strain of Manila rope is about two-thirds of the breaking strain.

Sisal

Sisal fiber is of a porous nature and absorbs water and dampness very quickly, which greatly lessens its strength and durability and soon rots and ruins it. It should not be used in sections of the country near the great waterways. Its use is chiefly among farmers and cattlemen, as it is cheaper than Manila and answers the purpose for halter shank, lines, traces, and all general tying work, as well as the fence purposes, sometimes for hay carriers.

Approximate Weight and Strength of "Cloverleaf" Manila Rope

1/4 Diam. In.	Circumference, In.	No. Feet in One Pound Ft.	In.	Length of Coil in Fathoms	Weight Coil, Lbs.	Breaking Strength Estimated Lbs.
1/4	6-Thread	55	2	415	50	620
5/16	9-Thread	33	4	300	50	1000
3/8	12-Thread	26	8	220	50	1275
7/16	1-1/4	19	0	200	65	1875
1/2	1-1/2	13	2	165	75	2400
5/8	2	8	1	135	100	4000
3/4	2-1/4	6	6	135	127	4700
13/16	2-1/2	5	5	135	153	5600
7/8	2-3/4	4	7	135	180	6500
1	3	3	9	125	204	7500
1-1/8	3-1/2	2	9	125	271	10500
1-1/4	3-3/4	2	4	125	317	12500
1-1/2	4-1/2	1	8	125	453	17000
1-3/4	5-1/2	1	2	125	632	25000
2	6		11¼	125	815	30000

*Approximate Weight and Strength of Sisal Rope

Diam. In.	Circumference, In.	No. Feet in One Pound Ft.	In.	Weight, Coil, Lbs.	Breaking Strength Estimated Lbs.
1/4	6-thread	42	6	50	490
5/16	9-Thread	31	6	50	750
3/8	12-Thread	24	0	50	985
7/16	1-1/4	18	6	65	1230
1/2	1-1/2	13	2	75	1700
5/8	2	8	1	100	2700
3/4	2-1/4	6	6	127	3350
13/16	2-1/2	5	5	153	4000
7/8	2-3/4	4	7	180	5000
1	3	3	9	204	6000

*Note - A safe working strain is 50% of the breaking strength.

Double Galvanized Telegraph and Telephone Wire of the Highest Electrical Qualities

Number Birmingham Wire Guage	Diam. In.	Wgt. in Lbs. Per Mi.	Put up in Bdls. of	Approximate Breaking Strength in Pounds			Average Resistance in ohms at 68° F.		
				E.B.B.	B.B.	Steel	E.B.B.	B.B.	Steel
4	.238	811	1/4 mi.	2433	2676	3000	5.98	7.15	8.32
6	.203	590	1/3 "	1770	1947	2183	8.14	9.83	11.44
8	.165	390	1/2 "	1170	1287	1443	12.43	14.87	17.31
9	.148	314	1/2 "	942	1036	1162	15.44	18.47	21.62
10	.134	258	1/2 "	774	851	955	18.80	22.48	26.16
11	.120	206	1/2 "	618	680	762	23.54	28.15	32.76
12	.109	170	1/2 "	510	561	629	28.53	34.12	39.70
14	.083	99	1/2 "	297	327	366	49.00	58.58	68.18

The values given in this table are averages of a very large number of tests of wire of the various grades manufactured during a period of many years. They are within the limits of the specifications of all the large consumers of telegraph and telephone wires.

The average breaking strength is three times the weight per mile for E.B.B. wire.

The average breaking strength is three and three-tenths times the weight per mile for B.B. wire.

The average breaking strength is three and seven-tenths times the weight per mile for steel wire.

The mile-ohm = weight per mile X resistance per mile.

Hard Copper Telegraph, Telephone and Transmission Wire Sizes, Weights and Strength

Number B.& S. Gauge	Diam. in In.	Area in Circular Mls.	Weight in Pounds Per Mile	Breaking Strength in Lbs.	Resistance in International ohms per mile 75° F.
1	.289	83521	1336	3680	.1258
2	.258	66564	1065	3011	.1579
3	.229	52441	839	2430	.2004
4	.204	41616	666	1964	.2525
5	.182	33120	530	1590	.3174
6	.162	26240	420	1280	.4005
7	.144	20740	332	1030	.5050
8	.128	16384	262	820	3.49
9	.114	12996	208	656	4.39
10	.102	10404	166	531	5.49
11	.091	8281	132	425	6.90
12	.081	6561	105	339	8.70
13	.072	5184	83	268	11.01
14	.064	4096	65	213	13.94
15	.057	3249	52	170	17.57
16	.051	2601	42	136	21.95

Note: In handling hard-drawn copper wire great care must be taken to avoid kinks, bends, scratches, or cuts.

In making soldered line joints use the least possible heat necessary, as the copper softens easily and loses strength in consequence.

Crapo Galvanized Steel Strand Guy Wire
7 Wires Twisted into a Single Strand

Diameter Inches	Size of Wire	Weight Pounds Per 1000 Ft.	Std. Single and Double Galvanized Strength Pounds	Siemens-Martin Double Galvanized Strength Pounds
5/8	6	813	11600	19100
1/2	8	517	7400	12100
7/16	9½	399	5700	9350
3/8	11	296	4250	6950

(Continued)

Crapo Galvanized Steel Strand Guy Wire
7 Wires Twisted into a Single Strand

Diameter Inches	Size of Wire	Weight Pounds Per 1000 Ft.	Std. Single and Double Galvanized Strength Pounds	Siemens-Martin Double Galvanized Strength Pounds
5/16	12	205	3200	5350
1/4	14	121	1900	4250
3/16	16	72.9	1150	3150
5/32	17	51.5	870	1900

Diameter Inches	Size of Wire	Weight Pounds Per 1000 Ft.	High Strength Strand Double Galvanized Strength Lbs.	Extra High Strength Strand Double Galv. Strength Lbs.
5/8	6	313	29600	42400
1/2	8	517	18800	26900
7/16	9½	399	24500	20800
3/8	11	296	10800	15400
5/16	12	205	8000	11200
1/4	14	121	4750	6650
3/16	16	72.9	2850	3990

Coil or Cable Chain

Common or Proof. This grade of chain is made from open hearth basic steel. Compared with B.B. and B.B.B. chain, it is longer in the link, welds not as long lapped or as strong. Furnished self-colored.

Size, inches	3/8	7/16	1/2	5/8	3/4
Approx. links per foot . . .	10	9	8	6-1/2	6
Outside length, inches . . .	2-1/8	2-1/4	2-1/2	3-3/8	3-7/8
Outside width, inches . . .	1-1/2	1-11/16	1-7/8	2-1/4	2-11/16
App. wt. 100 ft., lbs. . . .	155	200	260	400	590
Proof test, lbs.	3600	4500	6500	9500	13500
App. break strain, lbs. . .	7200	10000	13000	20000	28800

B.B. Made of high grade open hearth steel. This is a closer link chain than the common grade, and greater care is exercised in its manufacture, making a good, strong chain for general use. Furnished self-colored.

Size, inches	1/4	5/16	3/8	7/16
Approx. links per foot . . .	13-1/2	12	11	9-1/2
Outside length, inches . . .	1-7/16	1-7/8	1-15/16	2-3/16
Outside width, inches . . .	15/16	1-1/8	1-7/16	1-9/16
Approx. wt. 100 ft., lbs. .	80	115	160	210
Proof test, lbs.	1650	3000	4000	5500
Approx. break strain, lbs. .	3800	6600	8000	11500

B.B.B. Only the highest grade of open hearth chain steel is used in the manufacturing of B.B.B The chain is closer link chain than the above grades and has heavier and stronger welds. Made only by the most experienced workmen. Furnished self-colored.

Size, inches	3/8
Approx. links per foot . . .	11-1/2
Outside length, inches . . .	1-7/8
Outside width, inches . . .	1-7/16
Approx. wgt. 100 ft., lbs. .	166
Proof test, lbs.	4500
Approx. breaking strain, lbs.	9000

Loading Chain

Genuine Tri-Weld. Guarantees the greatest possible degree of safety of any chain made. Combines greatest strength with least possible weight. Made of refined Tri-weld steel, tough and fibrous. Thoroughly welded extra long lapped self-locking swelled weld. Close and narrow links. Polished finish. This chain measures 1/32" oversize.

Size, inches	1/4	9/32
Approx. links per foot . . .	17	16
Proof test, lbs.	2500	2800
Average breaking strain, lbs.	6000	7200
Safe working load, lbs. . .	1375	1540
Weight 100 ft., lbs.	90	100

Log or Binding Chain

B.B. Grade. Self-colored. One round and one grab hook. Swivel in center.

Diameter, inches	5/16	5/16	3/8	3/8
Length, feet	12	16	12	16
Approx. weight each, lbs.	14	17	20	27

Passing Link Chain

Straight wide links. Cannot kink. Especially adapted for agricultural and general utility purposes.

Furnished in Bright, also Parkerized (rustless) finish.

Size, Nos.	2/0	4/0
Size material, inches	3/16	7/32
Inside length, inches	7/8	7/8
Inside width, inches	15/32	1/2

Links per foot	14	14
Weight 100 feet, lbs.	33	45

(100 feet in a package)

HOW TO LAY LINOLEUM

1. Handling Linoleum - In cold weather, linoleum becomes brittle, and if roughly handled or unrolled when cold, is apt to crack. Care should be taken, therefore, never to drop rolls of linoleum. And when laying in the winter months, linoleum should be kept in a warm room for at least 48 hours before it is unrolled. Be sure to cut the string and loosen the roll, when the linoleum is delivered. When laying linoleum, see that the room where the work is being done is kept at a temperature of at least 70° F.

2. Damp Floors - Never lay linoleum on a damp floor, either wood or concrete. See that the floor is not at any time likely to become damp from below. Moisture in a floor causes mildew or mould, disintegrates the paste and cement, and will in time injure the linoleum.

3. Basements - Make it a rule not to lay linoleum in basements. It is almost impossible to eliminate moisture from a basement floor. Persons laying linoleum in basements, therefore, do so at their own risk.

4. On Wood Floors - When wood floors dry out the cracks always tend to open up, and if cemented directly the linoleum is unable to hold the boards together; hence, is very likely to break along these cracks, and thus be seriously damaged. For this reason cementing the linoleum over a lining of deadening felt is always advisable on wood floors.

5. Water Glass Cements - In cementing linoleum, adhesives containing sodium silicate (water glass) must be avoided. This chemical compound attracts moisture. When wet it saponifies the oxidized linseed oil in the linoleum, causing the material to disintegrate.

6. Strong Soaps - One should be cautioned never to use strong soaps or soap powders, containing abrasive filler, free caustic alkali, or alkali in the form of alkaline salts. Such soaps are injurious to linoleum. Use only lukewarm water (not hot), and one of the approved soaps, such as Linseed Oil soap, Ivory soap, Amber Oil soap, Larkin's Vegetable Oil soap, et cetera.

Laying Linoleum on Wood Floors Without Felt, Paste, or Cement

Those who buy inexpensive printed linoleums may not be willing to pay the extra cost of having their floors put down with paste and cement over a lining of deadening felt. Others in rented homes or in offices held on short lease, may not consider it advisable to go to the expense of having their linoleum installed as a permanent floor.

In some cases, therefore, it becomes necessary to lay the linoleum on the floor without fastening. This method of laying is open to many serious objections, especially when the work is not skillfully done. The linoleum may develop bulges and buckles after it has been on the floor a short time, and the workman has to go back to the job to retrim the linoleum and smooth it out. Some merchants report that their men have had to return for retrimming as many as six times on a single job.

It is to eliminate all this extra trimming and trouble that the "cementing over felt" method has been investigated, developed, and finally recommended as standard. But where, for any reason, it is decided to lay linoleum without cementing, the following suggestions are offered:

Materials Required - In addition to the linoleum which is selected, you will need a linoleum knife and a hammer. Some layers find a small block plane very useful in trimming the seams and edges of the linoleum.

Condition of Base - See that the wood floor is dry and well seasoned. Remove all protruding nails and trim off knots so that the floor is perfectly smooth and even. If there are wide cracks, fill them with crack filler or narrow strips of wood. Sweep the floor clean with a broom.

This preliminary preparation of the wood base is especially important, because in time linoleum will conform to all the inequalities of the floor. And if the floor is left uneven or loose boards are not nailed down tightly, the linoleum will not only become uneven, but is likely to check and break.

Cutting the Linoleum - Remember the caution about handling linoleum in cold weather. Unroll it only after it has been kept in a warm room for 48 hours.

Take precise measurements of the floor and be careful not to cut the linoleum too scant at any point. If possible, the lengths of the linoleum should run crosswise to the direction of the boards, as it will thus take up any slight inequalities to better advantage. However, always endeavor to cut the linoleum to the best advantage.

Let Linoleum "Grow" - After linoleum has been rolled tightly for several weeks or months, it is bound to expand or "grow" for some time after it is laid flat. Where there is heavy traffic, and the floor is much used, it may take only a week or so for the linoleum to stretch. In most residences, however, it takes from two to four weeks to overcome the "growing" tendency.

It is necessary, therefore, to allow for expansion when the linoleum is not cemented firmly in place. This tendency to expand is taken care of in the following manner:

Laying the Linoleum - First, remove the quarter-round floor moulding around the baseboard. Cut the linoleum scant at each end just so the edge will be covered by the quarter-round moulding when it is replaced. Along each side wall do not place the linoleum tight against the baseboard, but just as at the ends, leave a space of $\frac{1}{4}$ to $\frac{1}{2}$". Along all seams butt the edges of the linoleum carefully against each other, matching the pattern accurately.

After all the linoleum strips are in position, replace the quarter-round moulding. Do not nail the latter to the linoleum or permit it to bind the linoleum at any point. The nails should be driven through the moulding, straight into the baseboard. Laid in this manner, the linoleum has an opportunity to expand under the edge of the quarter-round moulding.

The linoleum should be given plenty of time to expand. If a buckle or bulge develops, it must be smoothed or rolled out, and if necessary, the end or edge of the linoleum under the quarter-round moulding cut back a trifle.

Do not brad the linoleum at any point, until after all the "growing" is finished. Many linoleum layers make the mistake of bradding linoleum in one or two places during the expansion period. This should never be done. Linoleum cannot expand properly if even one or two brads are used.

If possible, heavy furniture should be kept off the floor during this time, as it prevents expansion. If such furniture must be used in the room, move it from one part of the room to another every few days. Give every foot of the linoleum a chance to expand.

In many cases no further fastening will be necessary. The quarter-round moulding will be all that is required to hold the linoleum in place. This is especially true in private houses. If not necessary, do not brad the linoleum.

Fitting Around Pipes and Projections - The layer who does not fit his linoleum neatly around radiator pipes, waste pipes, et cetera, is not a good workman. Wherever possible, insist that gas stoves, kitchen ranges, or any other movable equipment be disconnected so the linoleum can be laid underneath.

Fastening the Linoleum - Where it is necessary to fasten the linoleum to wood floors, use No. 18 3/4" wire brads. Do not use carpet tacks. The brads should be set in 1/8" to 1/4" from the edge or seam and should be spaced about 4" apart around the edges and 3" apart on seams. The brad should be driven down until its head is lost in the surface of the linoleum.

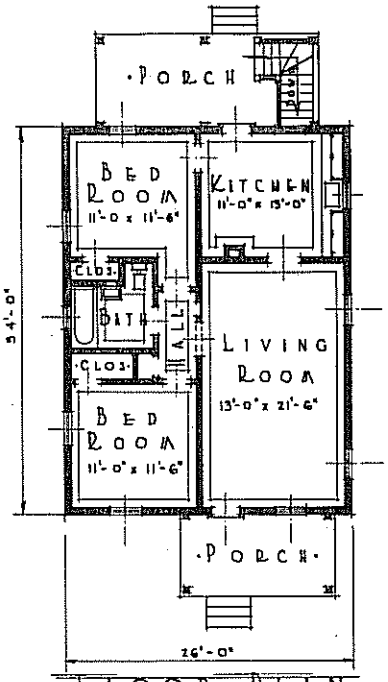
If it is desired to leave linoleum cemented to the floor, consult the dealer from whom it is purchased as to the method of laying with cement. For a good job the work must be carefully done.

BUILDING PLANS

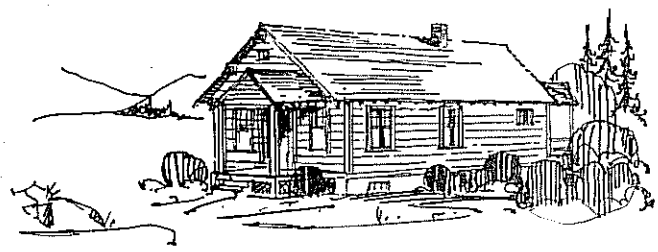
(Pages 6-I & 7-I Administrative Guide)

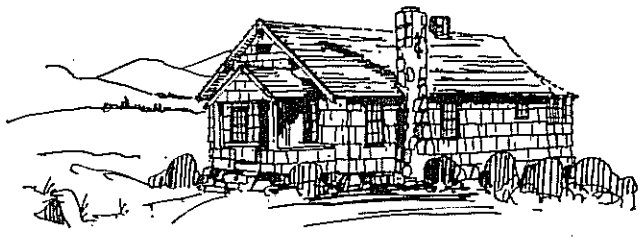
The building plans shown by the following illustrations (except lookout houses and towers) are examples of what has been done in designing structures for erection at ranger headquarters and temporary stations. They are shown as suggestions to help field men prepare their recommendations as to the type of structure desired at any particular site. It is not desirable or good practice to adhere to a policy of standardization of design for the principal buildings at a ranger station. In each separate situation it is desirable to rearrange floor plans to fit the ground and to modify or change the exterior appearance of the structure to fit the surroundings.

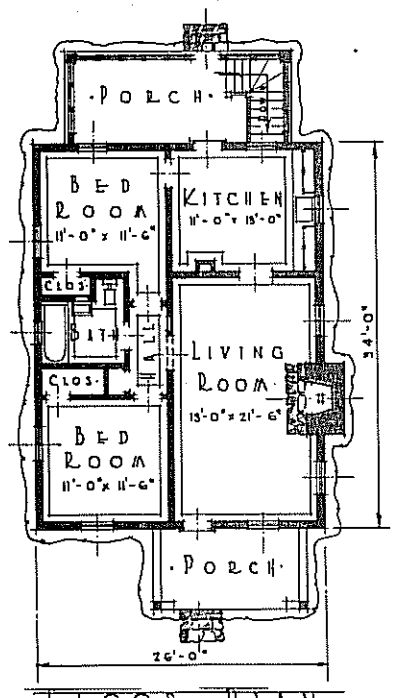
Requests for plans for a building should designate the exact site upon which the structure is to be erected if it is not at a ranger station, with an approved improvement plan. The purpose the building is to serve and the general arrangement of the floor space with the amount needed for each activity to be served should also be stated. It requires from one to three weeks to prepare the detailed plans for a building after the type of design and general arrangement have been decided upon. Ample time should therefore be allowed for the architectural work when requests for plans are made.



FLOOR PLAN

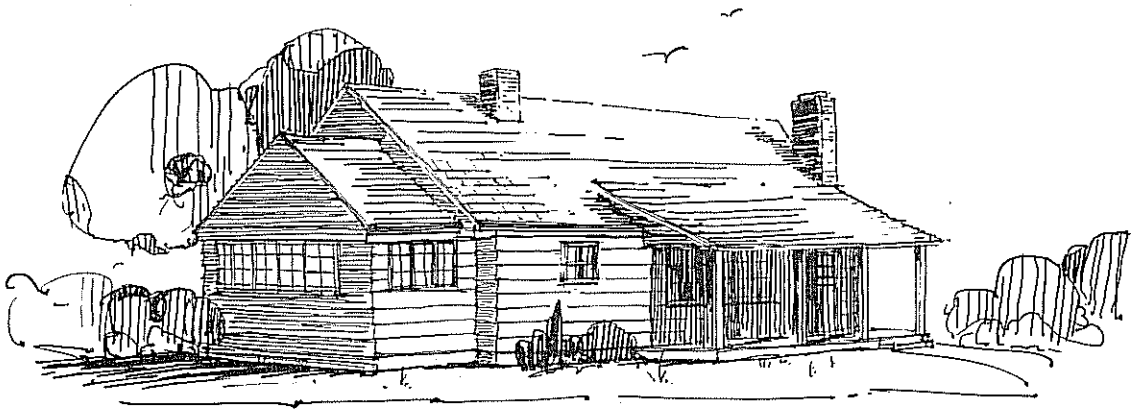


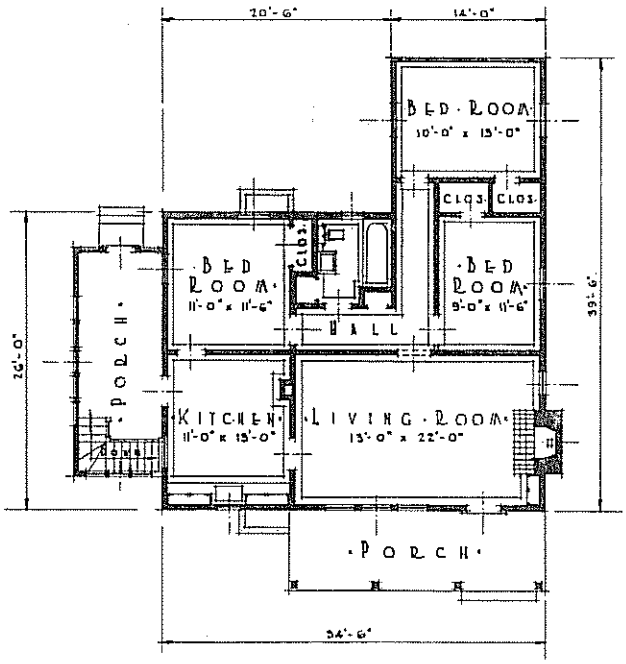




FLOOR PLAN

RANGER RESIDENCE PLAN R-1





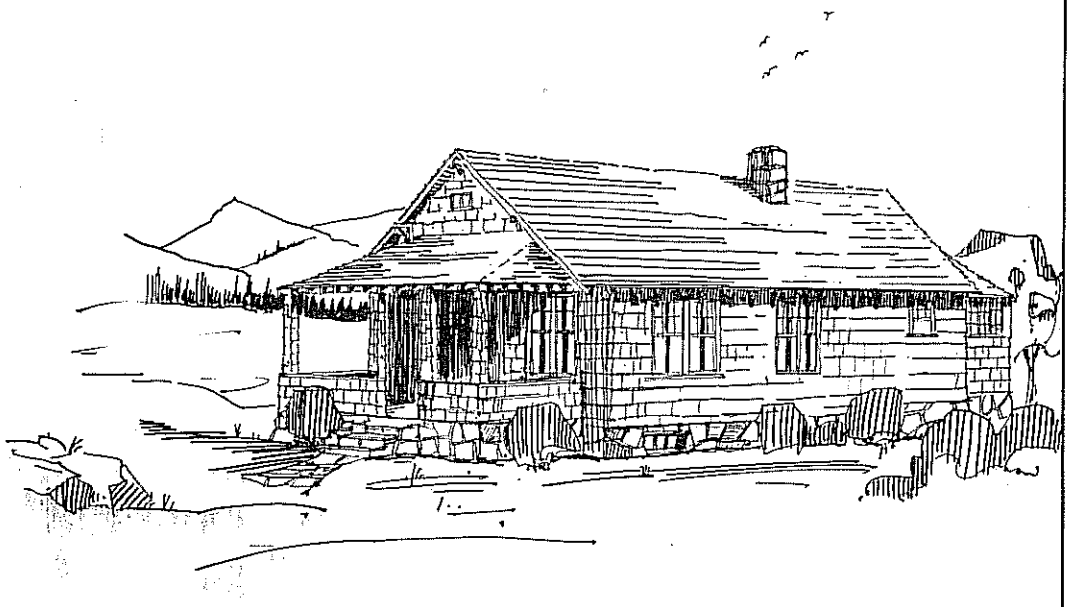
FLOOR PLAN

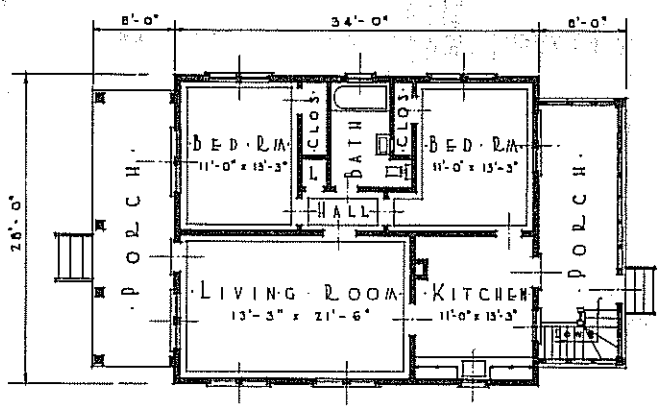
RANGER RESIDENCE

PLAN R-1

REMODELED

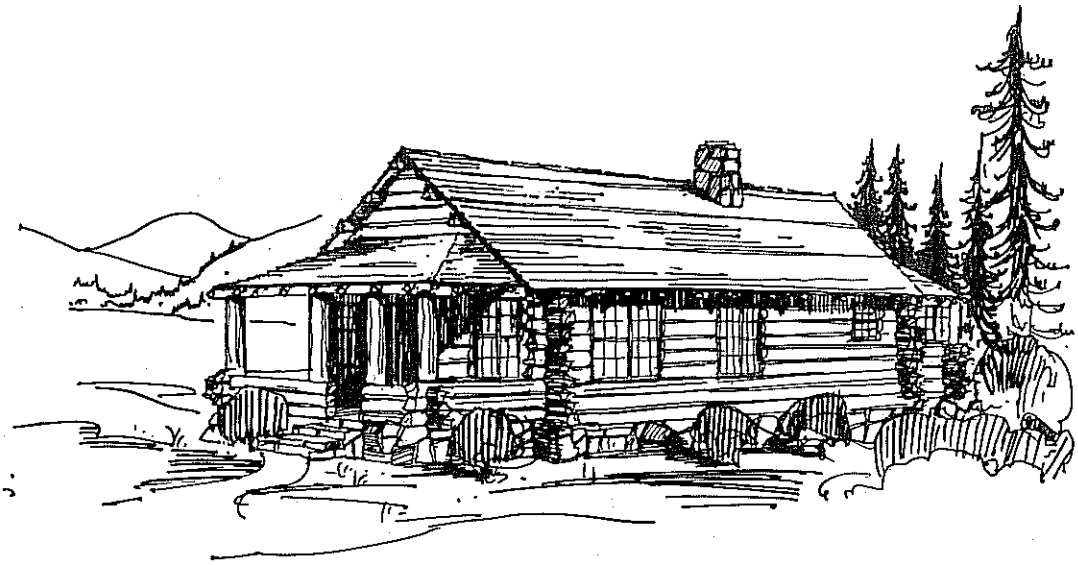
DRAWN BY [illegible]

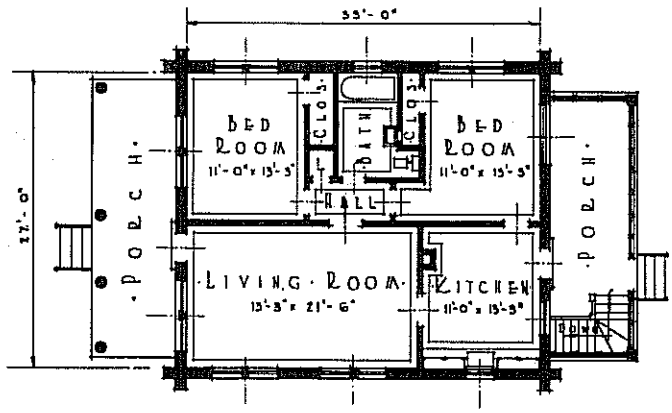




FIRST FLOOR PLAN

RANGER RESIDENCE PLAN R-7

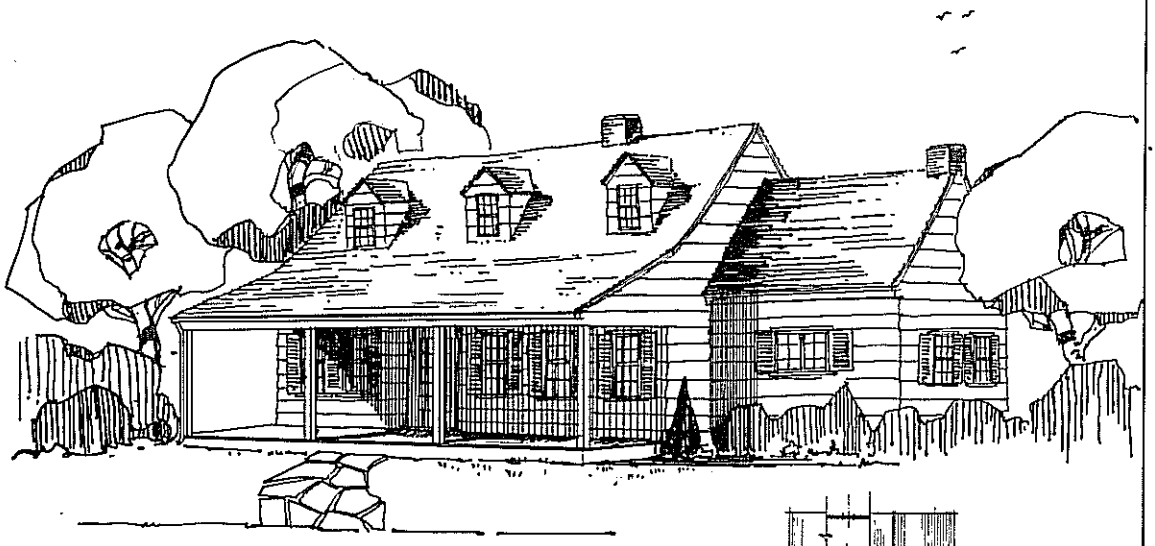


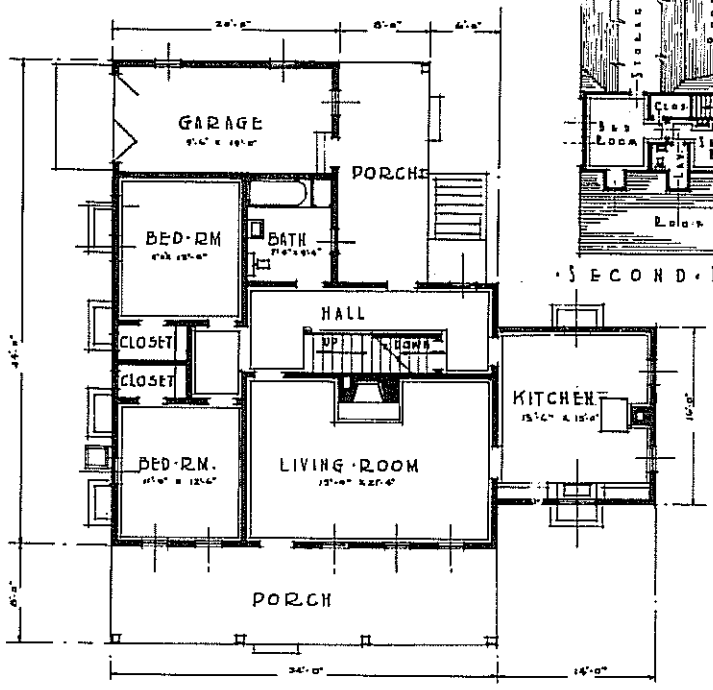


FIRST FLOOR PLAN

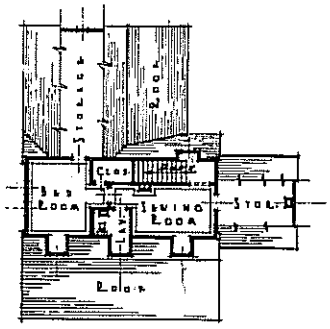
RANGER RESIDENCE PLAN R-8

W. J. Fox Jr. & W. B. McDaniel.





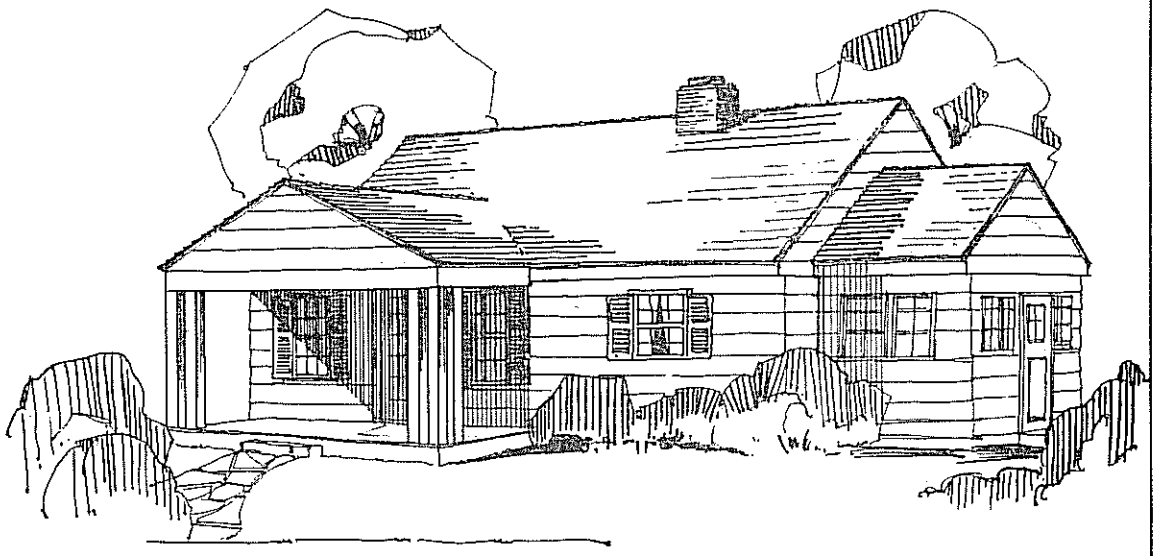
FIRST FLOOR PLAN

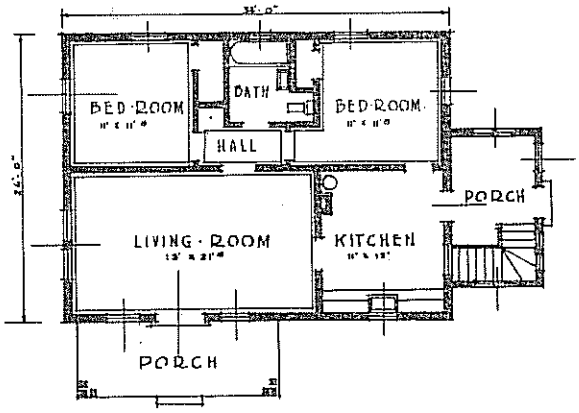


SECOND FLOOR PLAN

RANGER RESIDENCE PLAN R-9

DRAWN BY W. J. FOX JR.





FIRST FLOOR PLAN

RANGER RESIDENCE PLAN R-10

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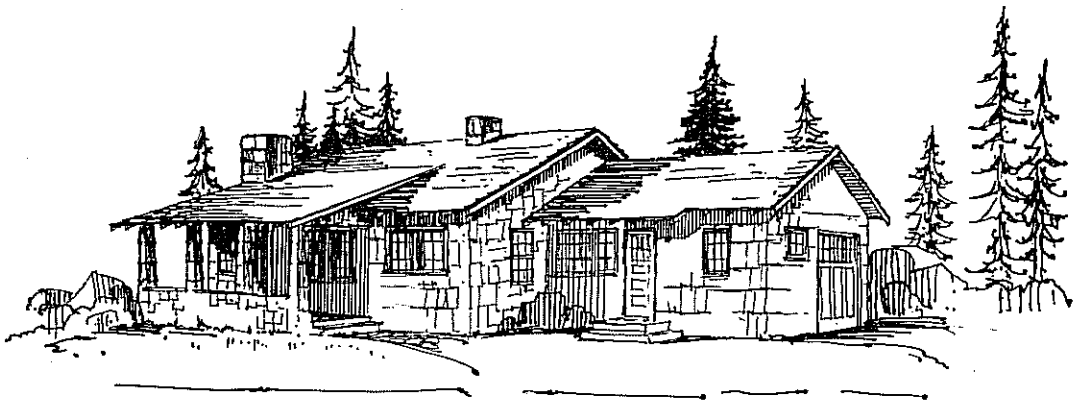
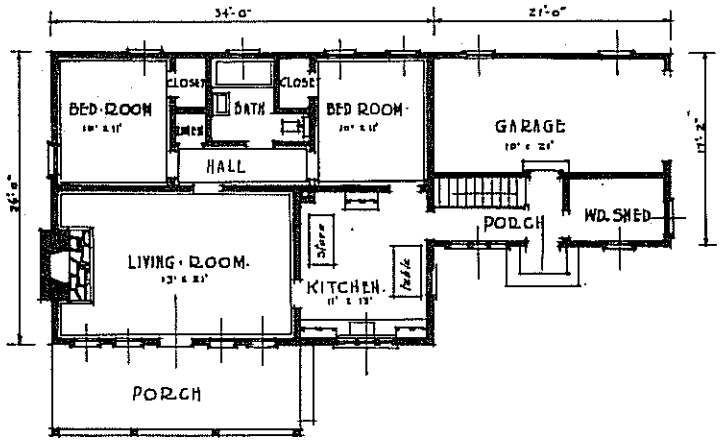
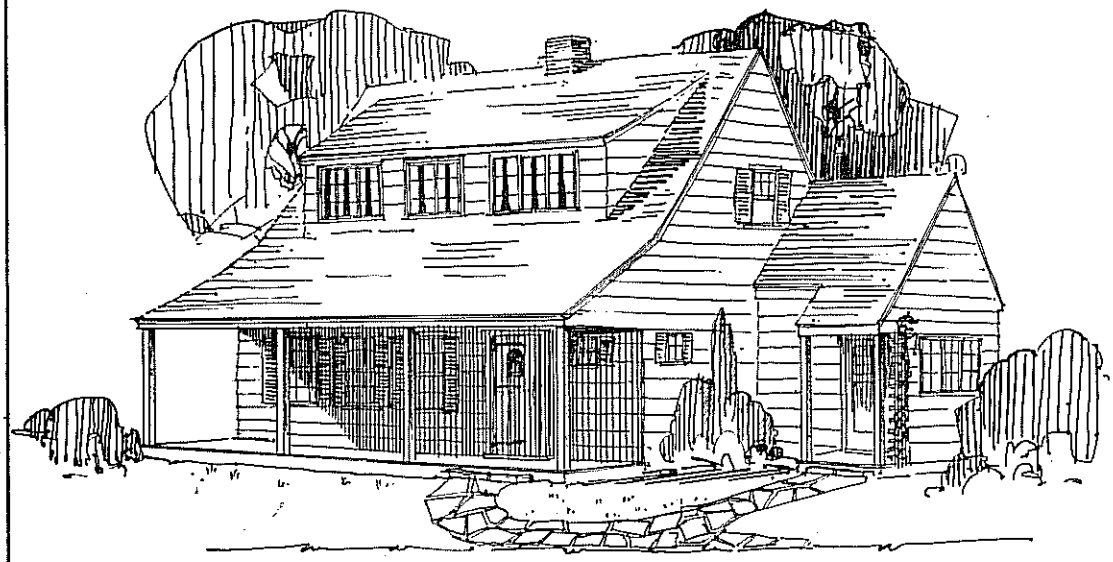


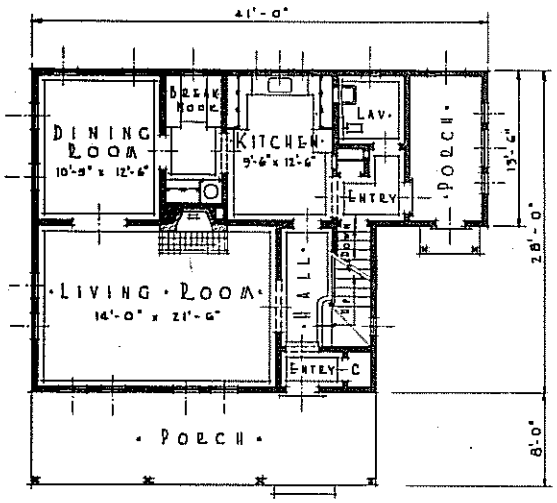


FIRST FLOOR PLAN

RANGER RESIDENCE PLAN R-11

DRAWN BY - W.J. FOX JR.





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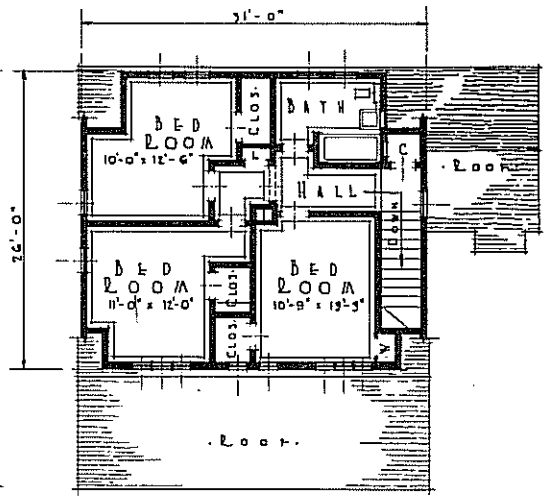
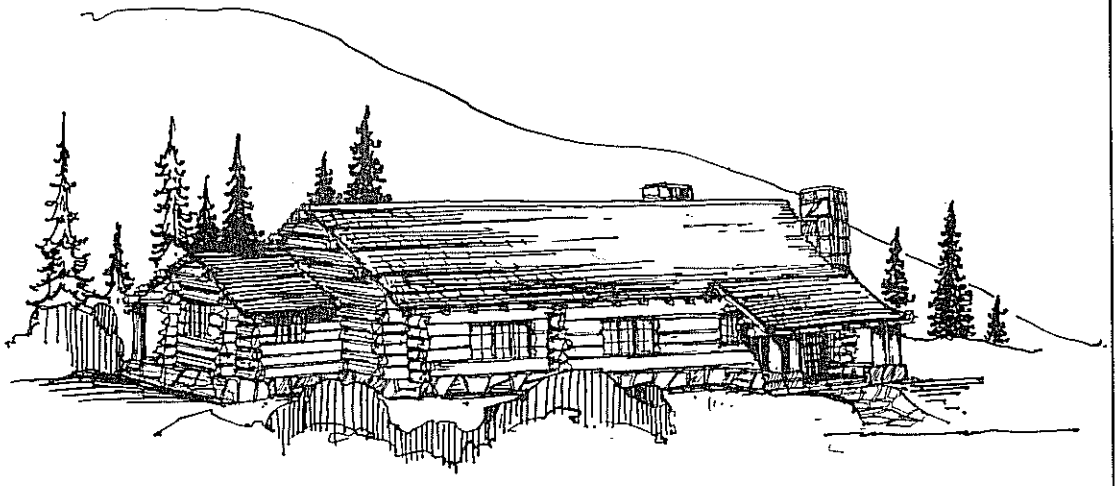
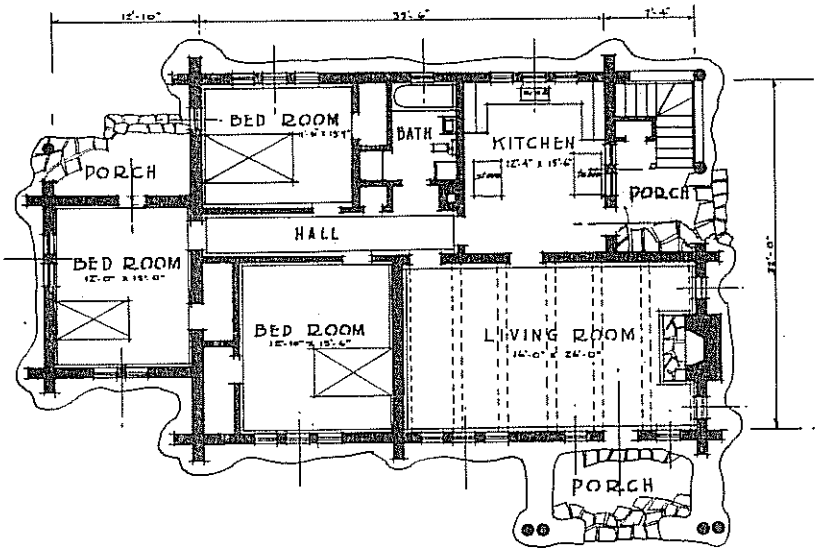


SECOND FLOOR PLAN

RANGER RESIDENCE PLAN R-12

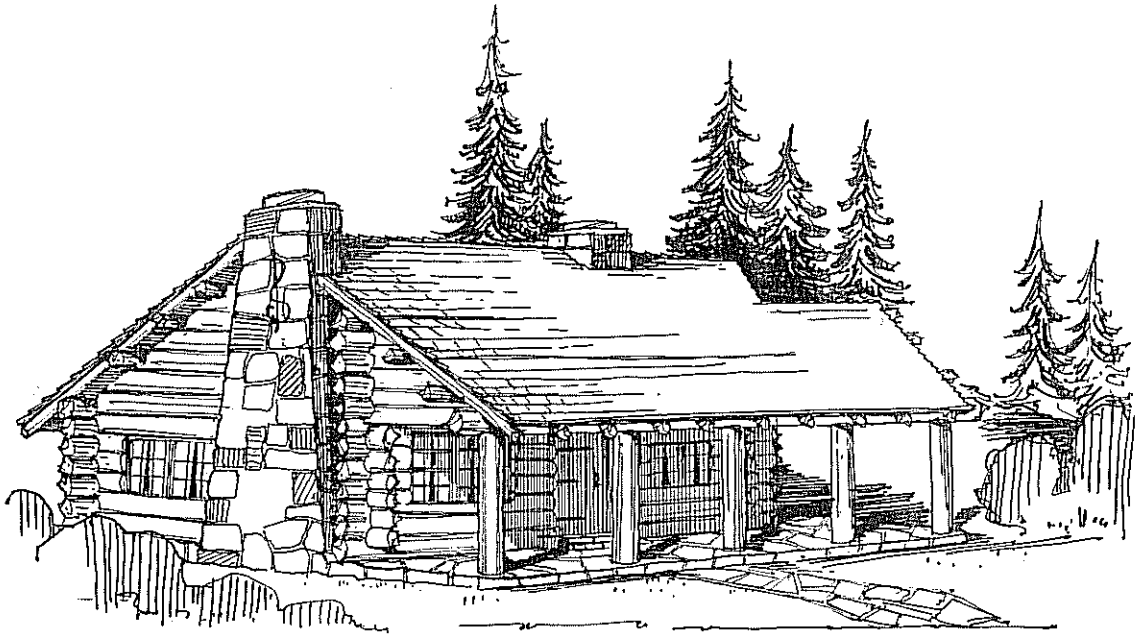


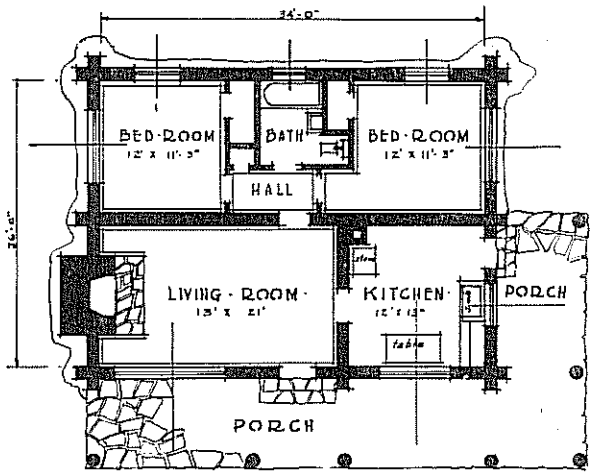


FIRST FLOOR PLAN

RANGER RESIDENCE PLAN R-13

DRAWN BY: W.J. COX JR.

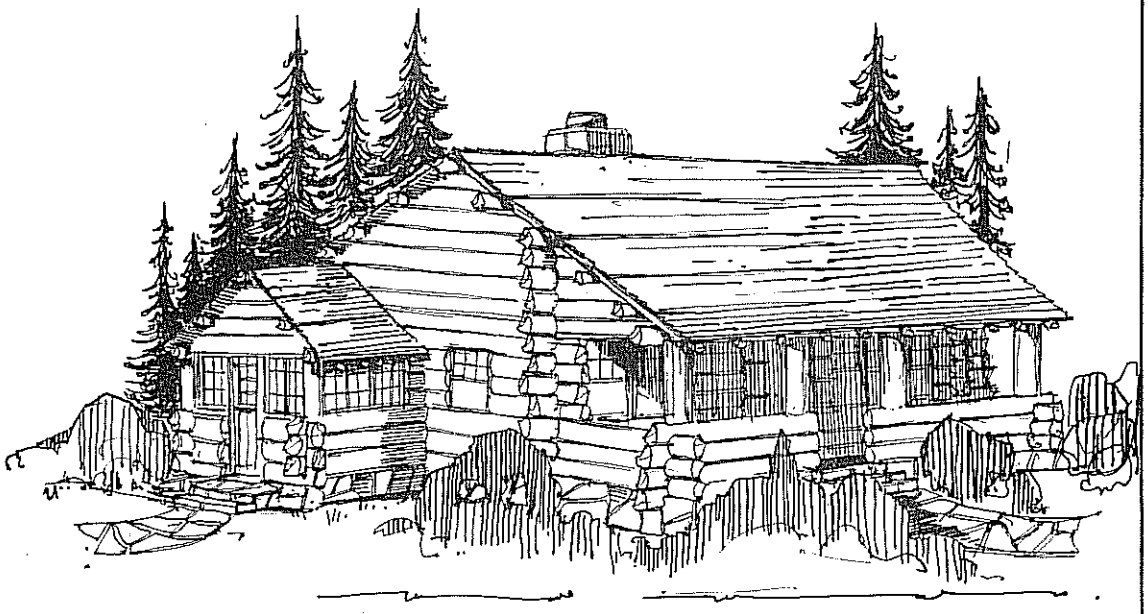


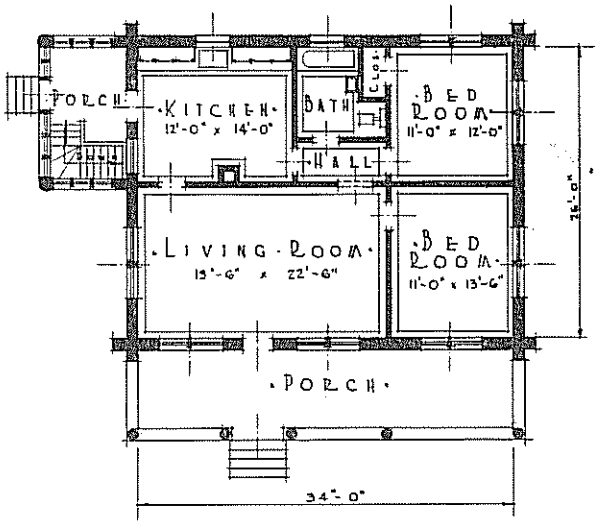


FIRST FLOOR PLAN

RANGER RESIDENCE PLAN R-14

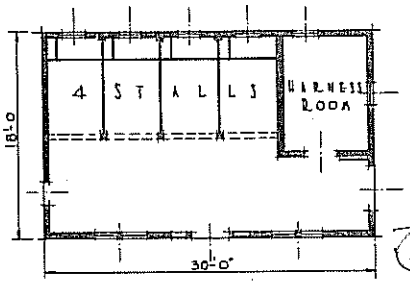
DRAWN BY W.J. FOX JR.





FLOOR PLAN

RANGER RESIDENCE PLAN R-15



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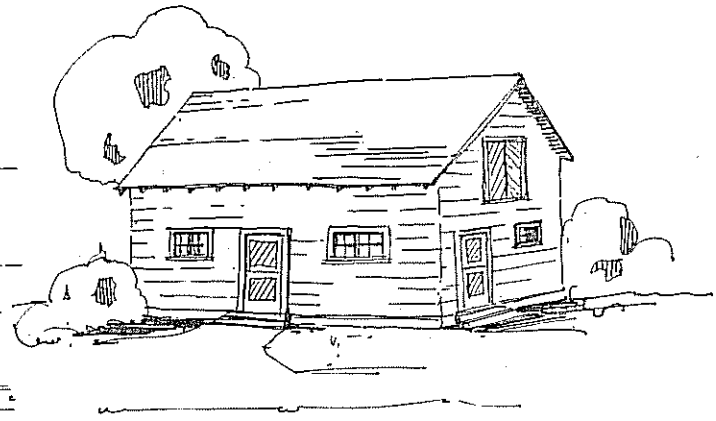
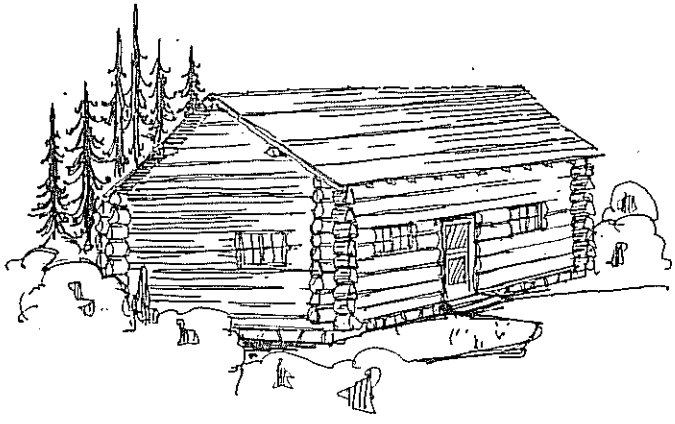
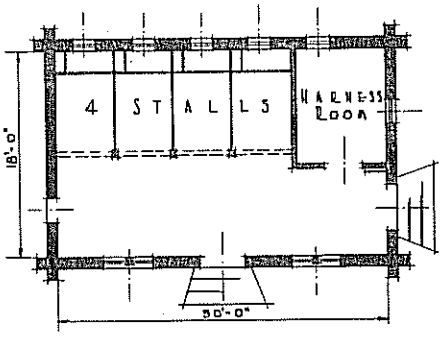


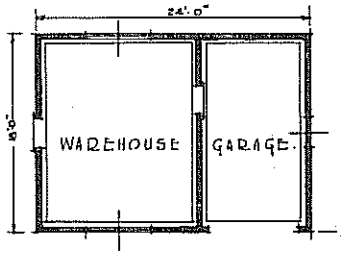
HORSE BARN PLAN B-1



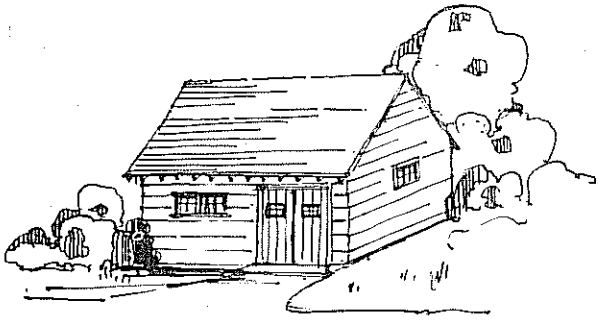


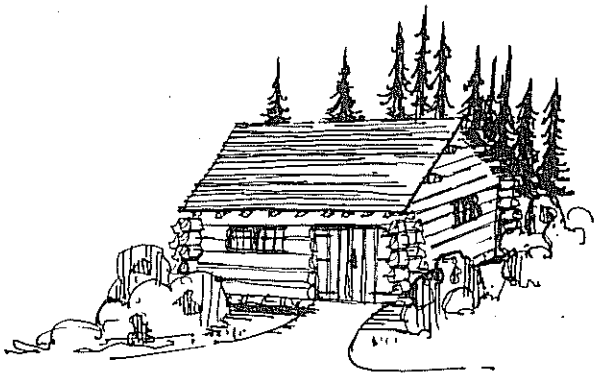
FIRST FLOOR PLAN

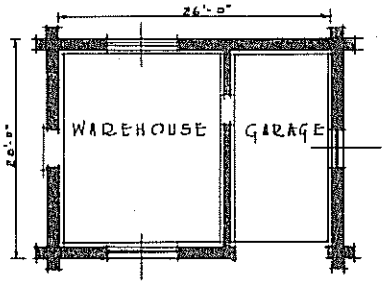
HORSE BARN PLAN B-1-A



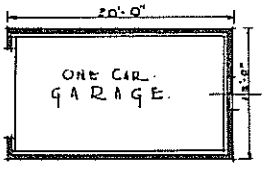
PLAN · B-5



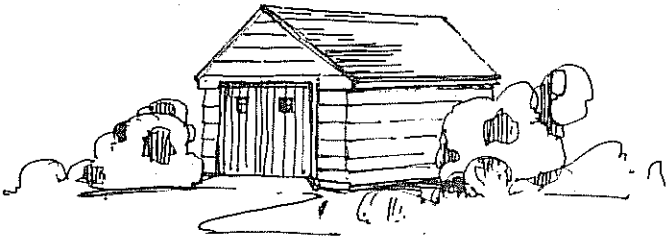




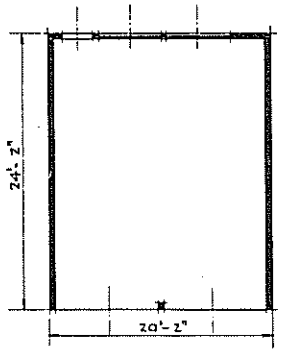
- PLAN - B-6

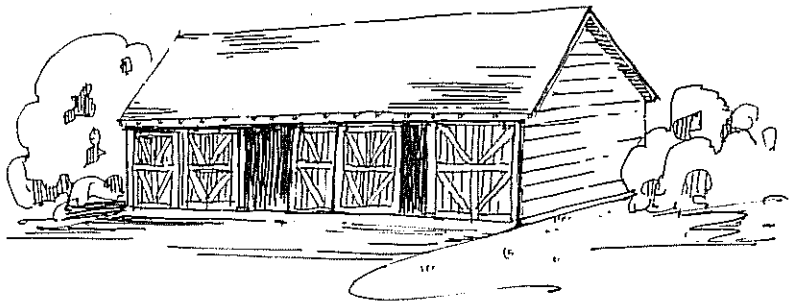


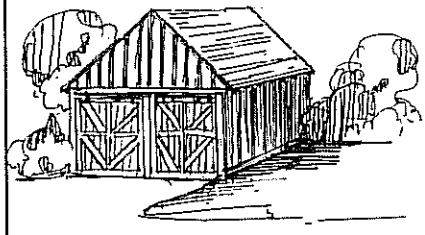
PLAN B-2



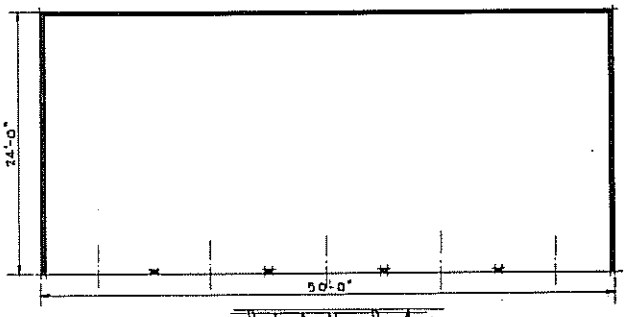
·GARAGES · · · PLANS·B·2·5&6·







PLAN B-3



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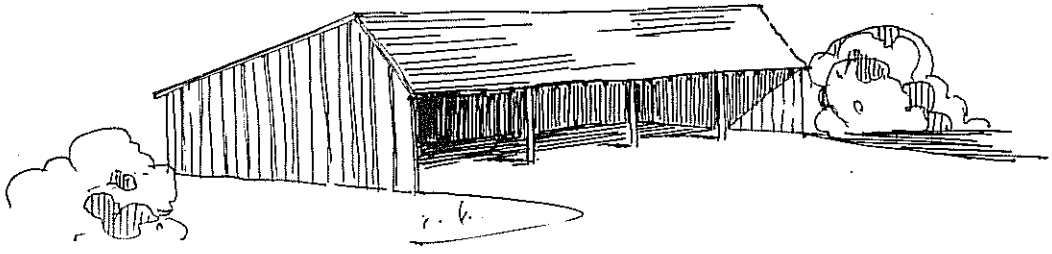
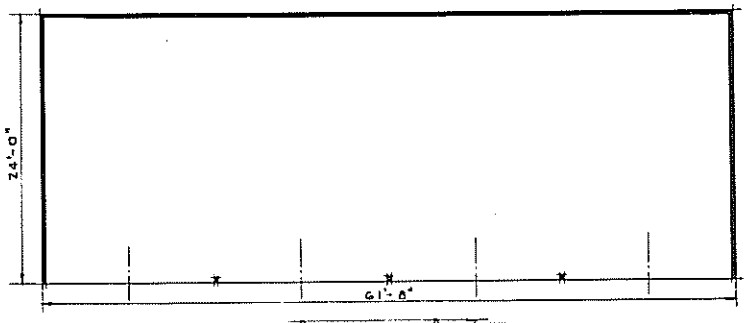
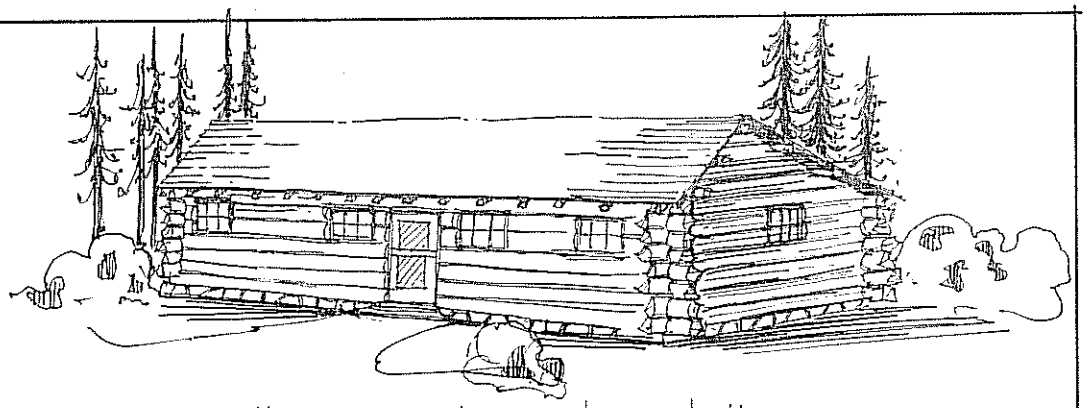
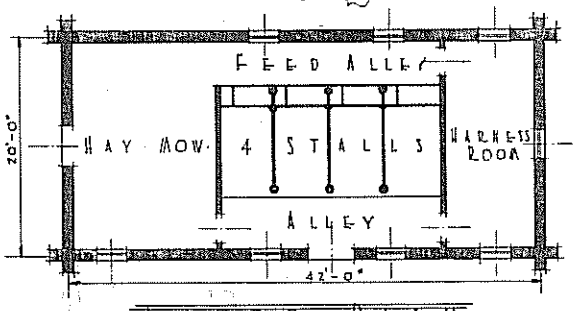




PLAN B-7

GARAGES . . . PLANS B-3, 4 & 7

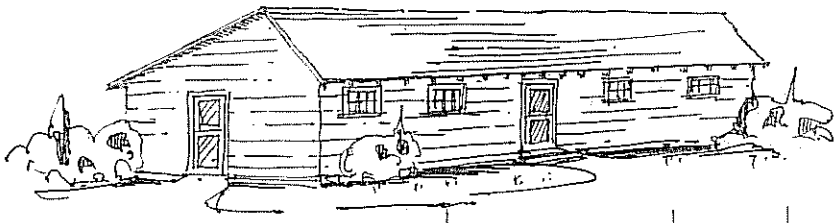


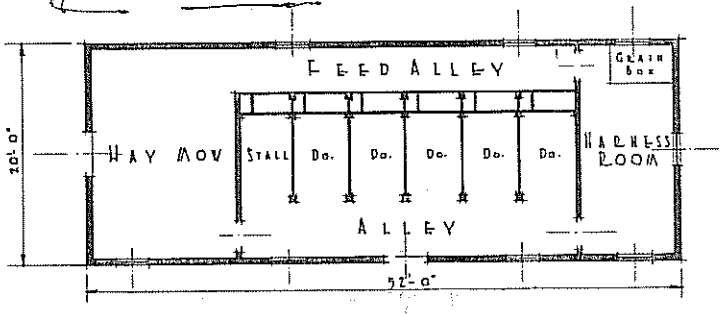


PLAN B-9 SAME AS B-10 EXCEPT FRAME CONSTRUCTION.

FLOOR PLAN

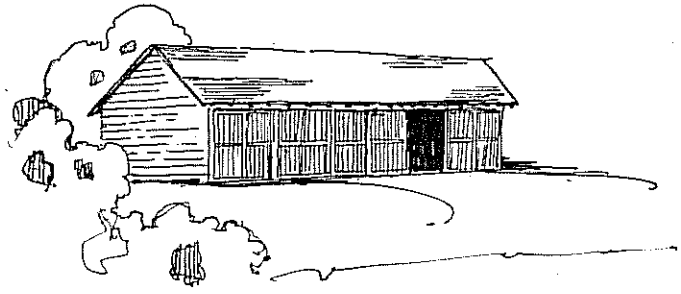
HORSE BARN PLAN B-10

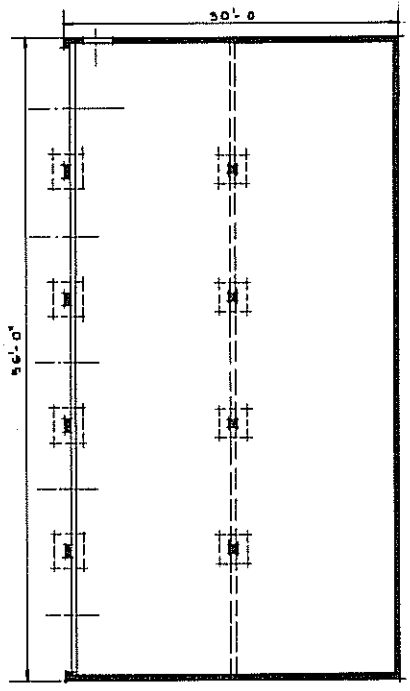




FLOOR PLAN

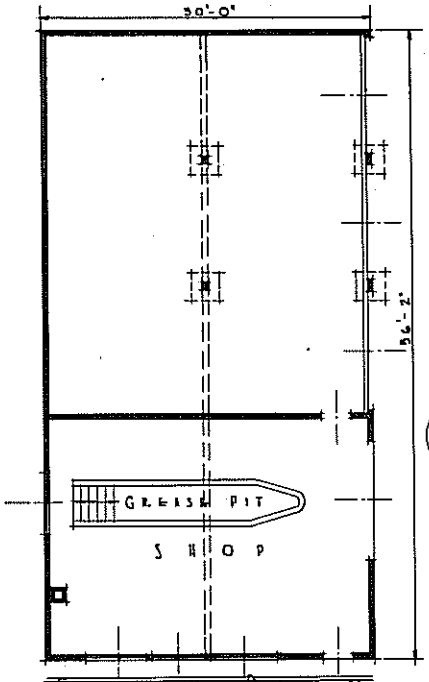
HORSE BARN PLAN B-9A





FLOOR PLAN

GARAGE PLAN B-11



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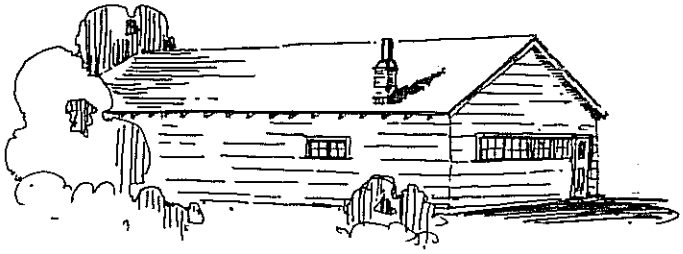

GARAGE PLAN B-12

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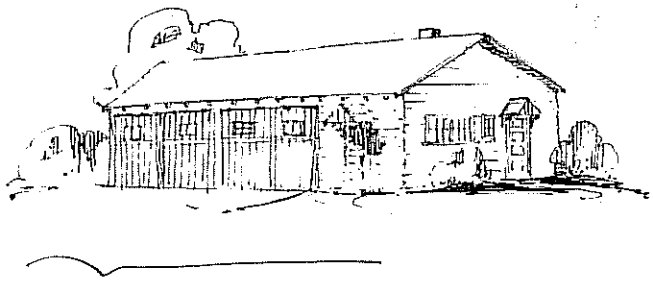
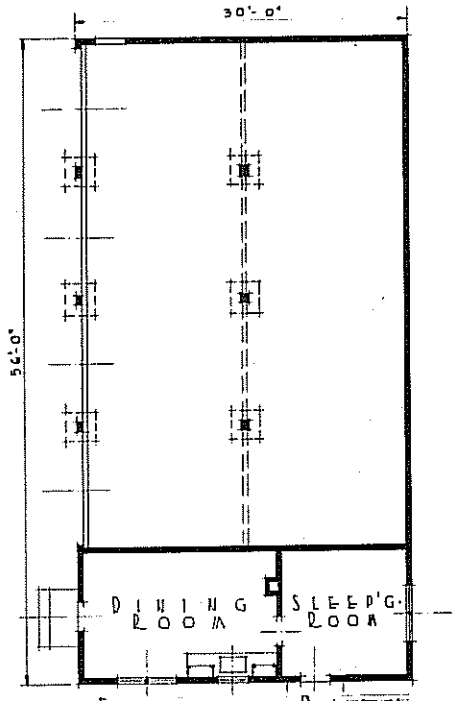
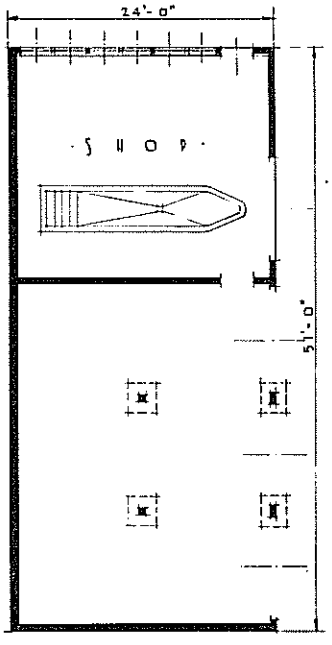




FLOOR PLAN

GARAGE . . . PLAN B-11-A



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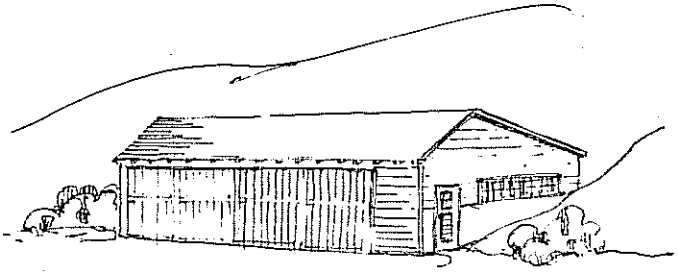
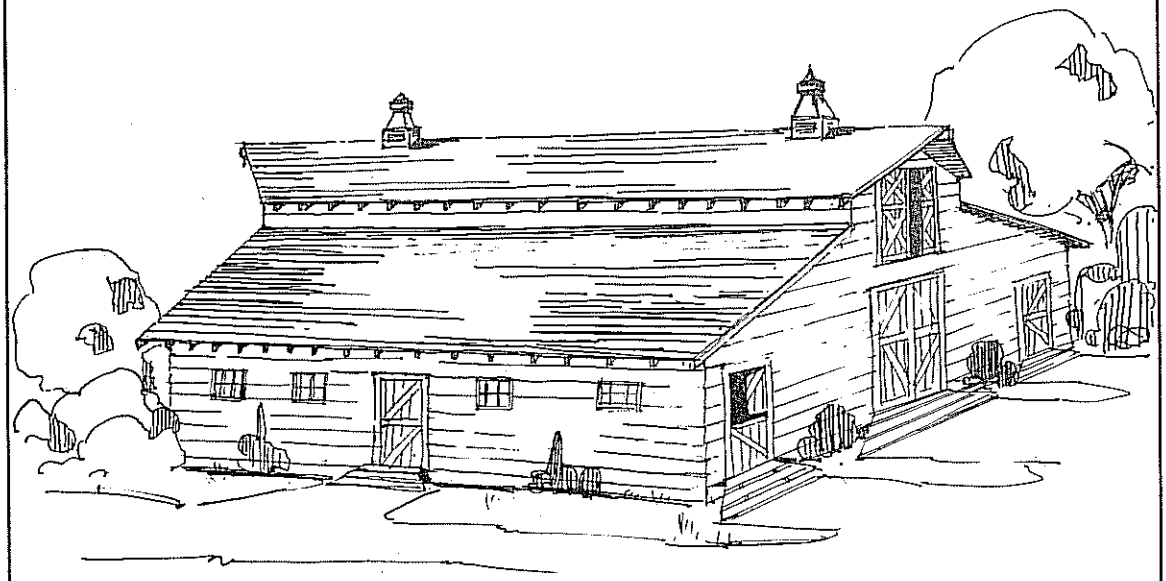
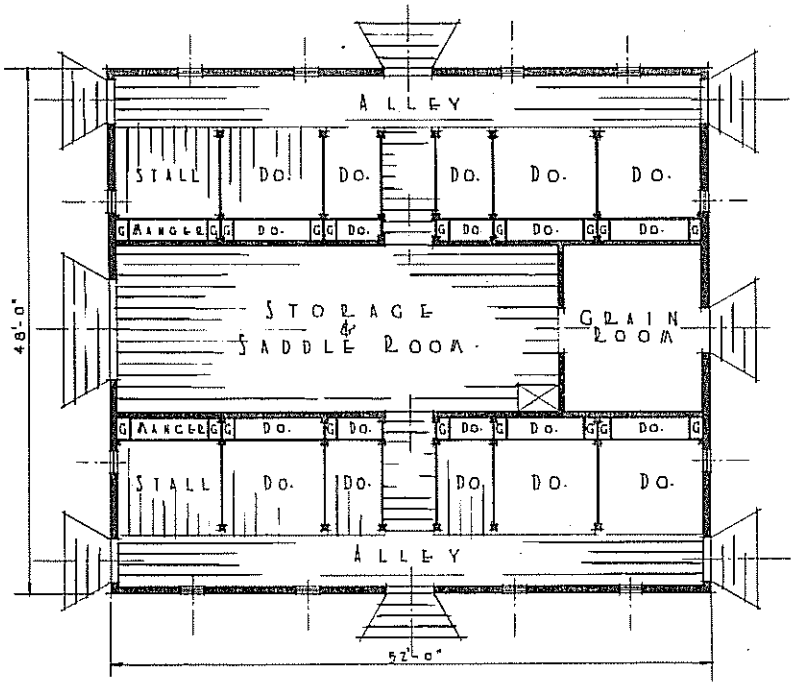


GARAGE . . . PLAN B-12-A

Drawn by W. J. Fox & W. A. Daniel

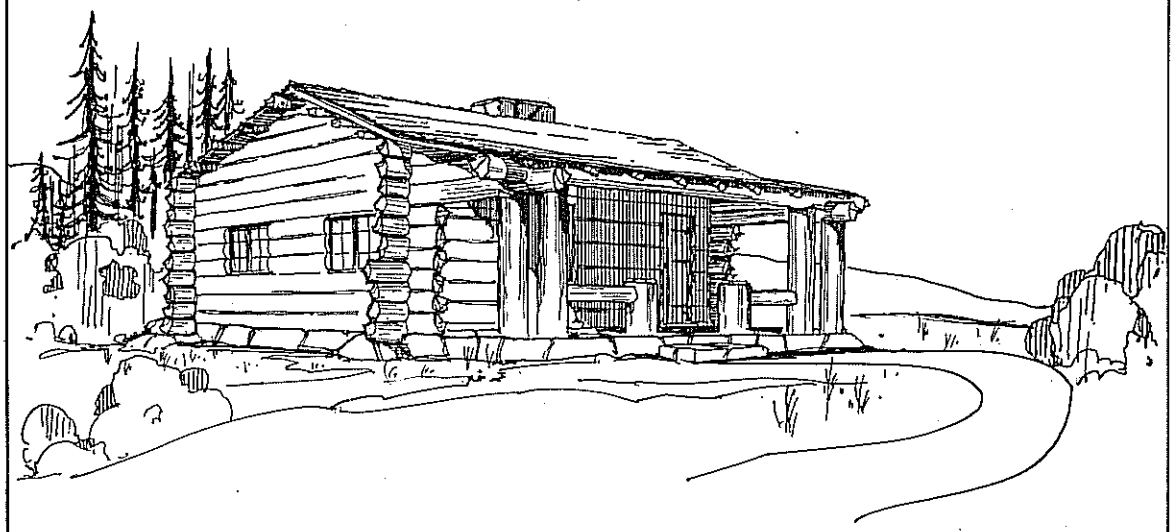


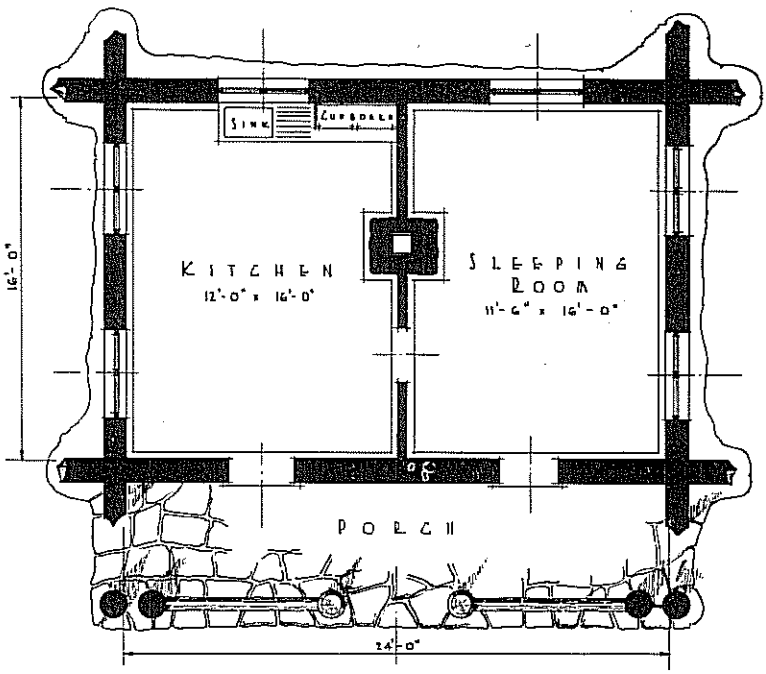


FLOOR PLAN

HORSE BARN PLAN B-13

Drawn by [illegible]

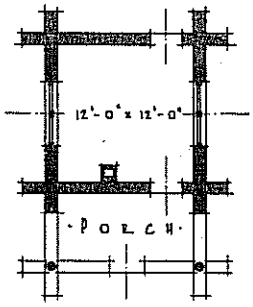




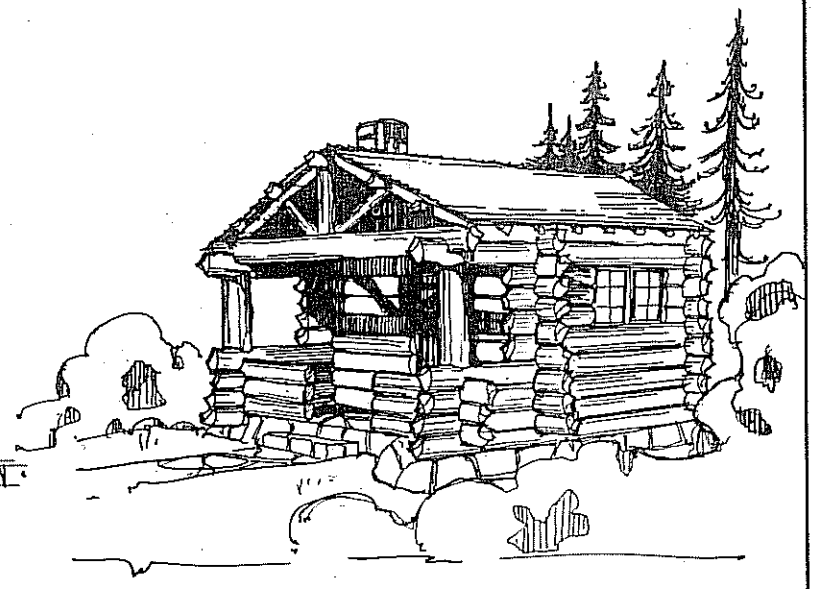
FLOOR PLAN

CABIN PLAN C-4

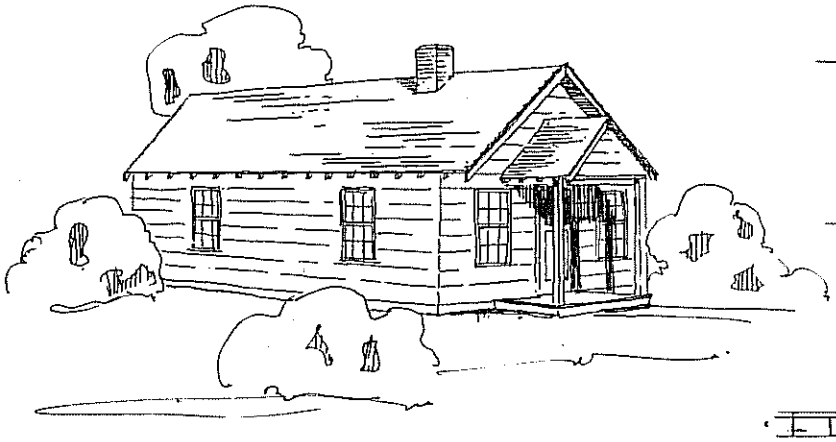
Drawn by [illegible]

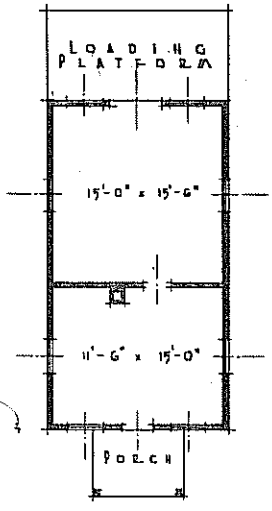


FLOOR PLAN



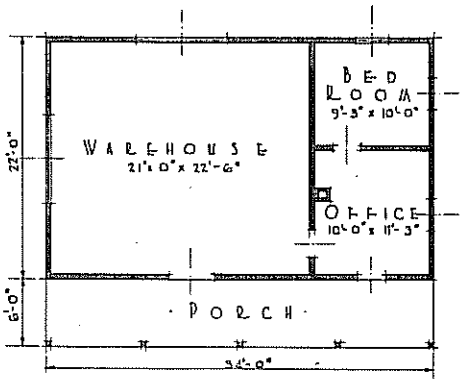
CABIN PLAN C-17

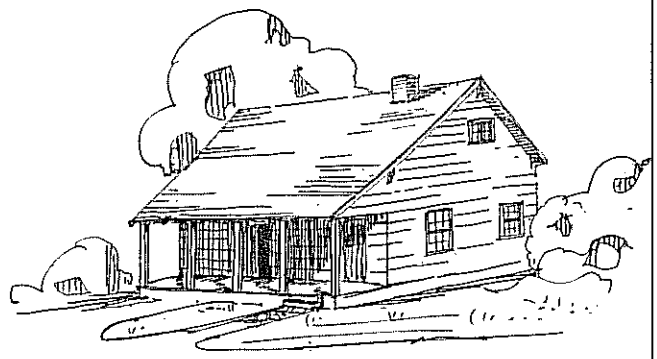




FLOOR PLAN

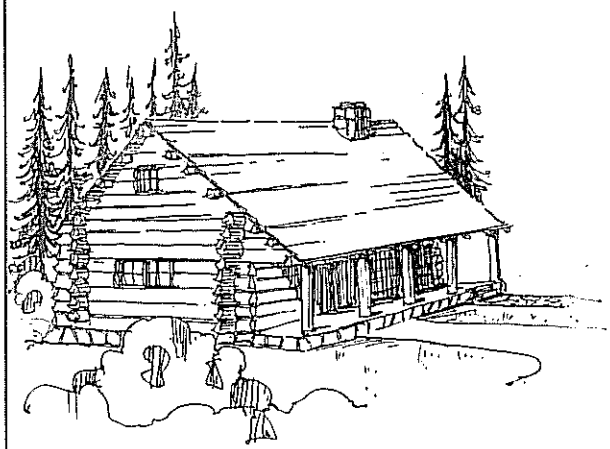
CABIN PLAN C-7

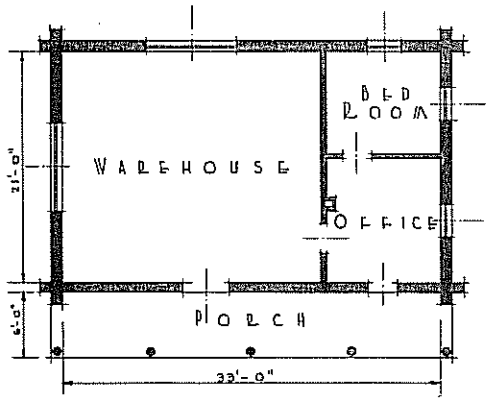




FLOOR · PLAN

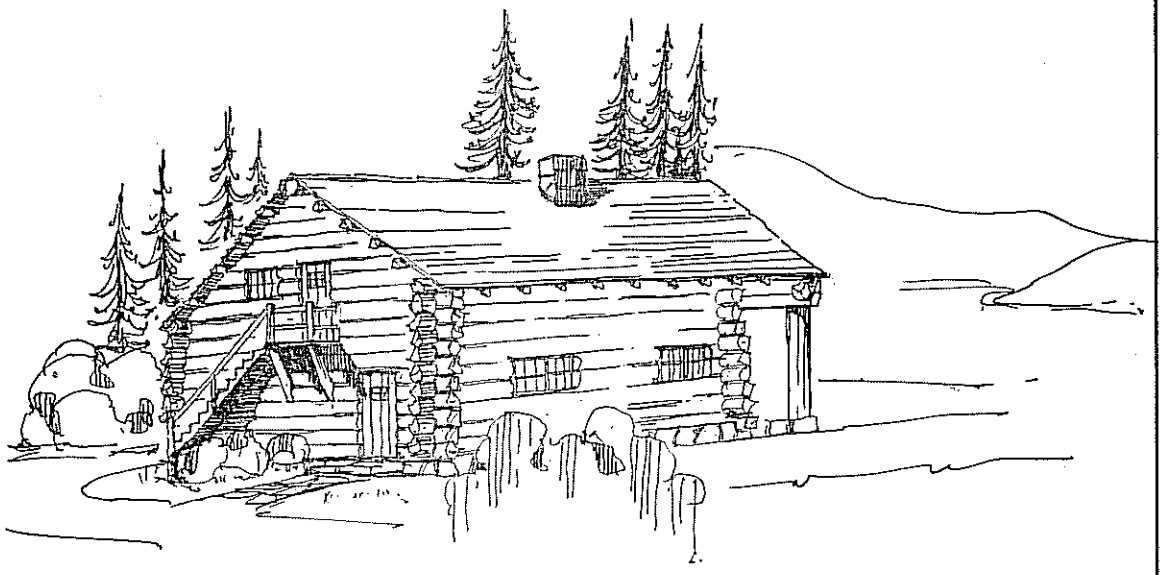
WAREHOUSE & OFFICE ··· PLAN · C-10

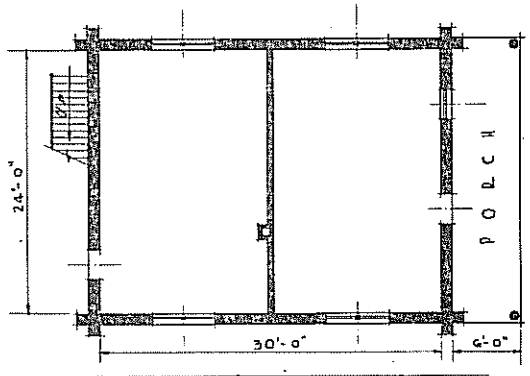




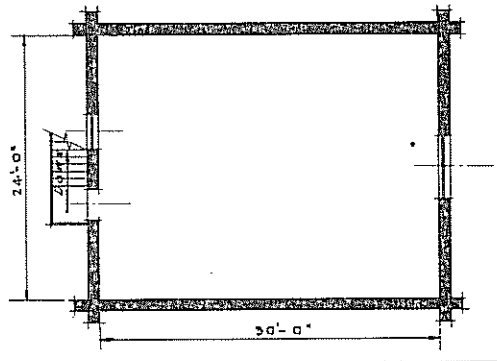
FLOOR · PLAN

WAREHOUSE & OFFICE ··· PLAN · C-11



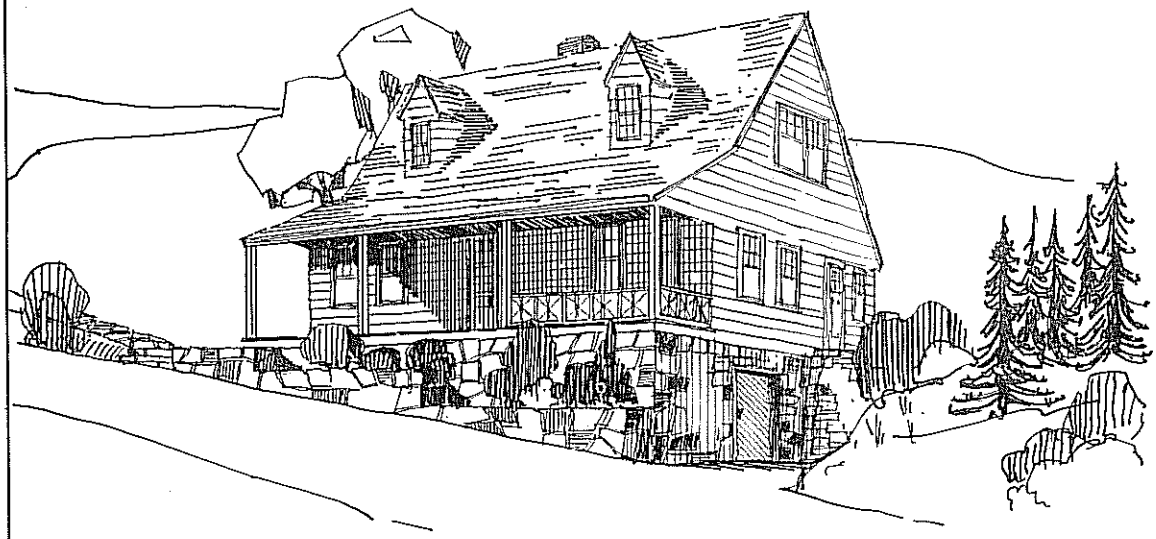


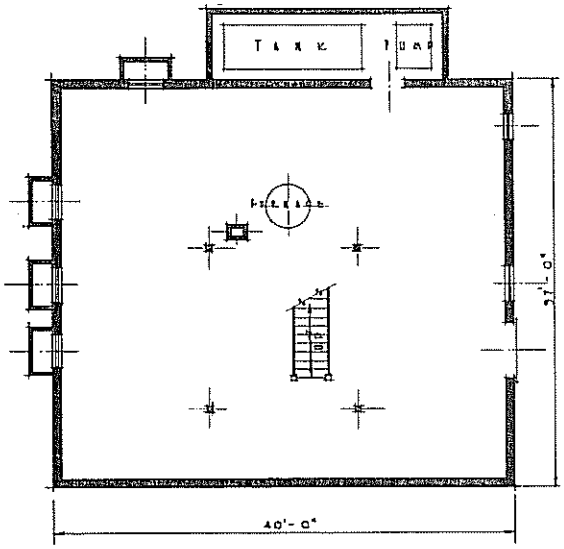
FIRST FLOOR PLAN



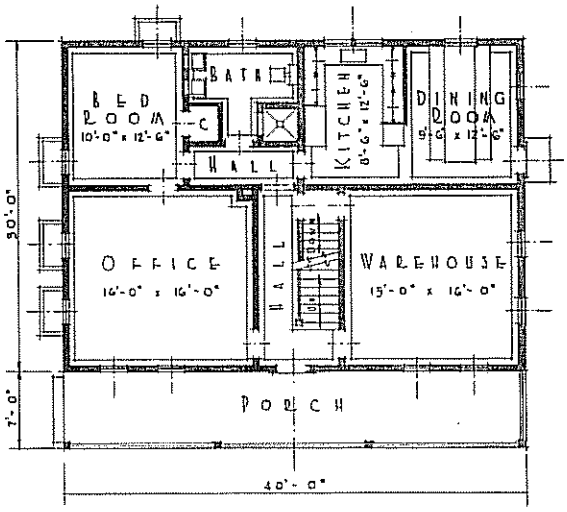
SECOND FLOOR PLAN

BUNK HOUSE ... PLAN C-12



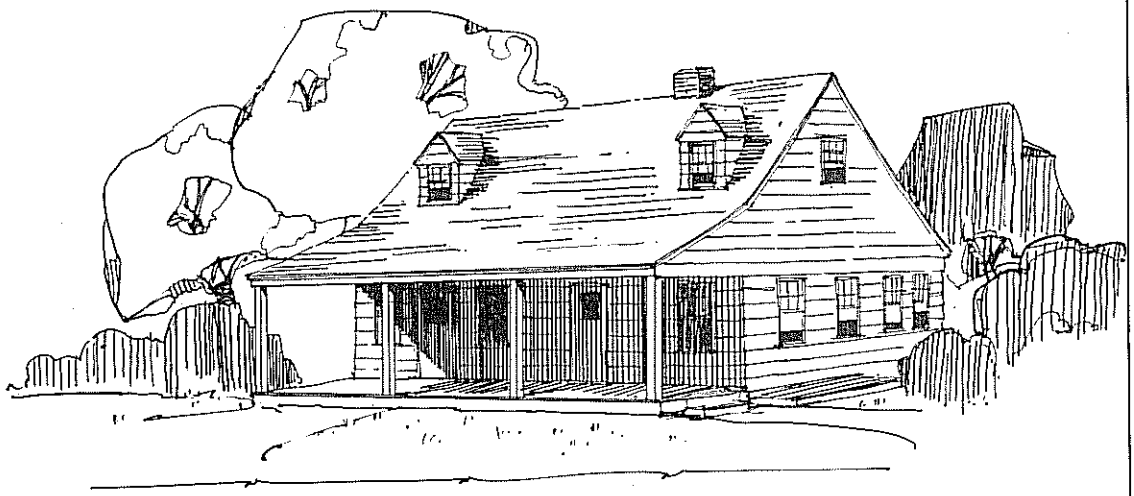


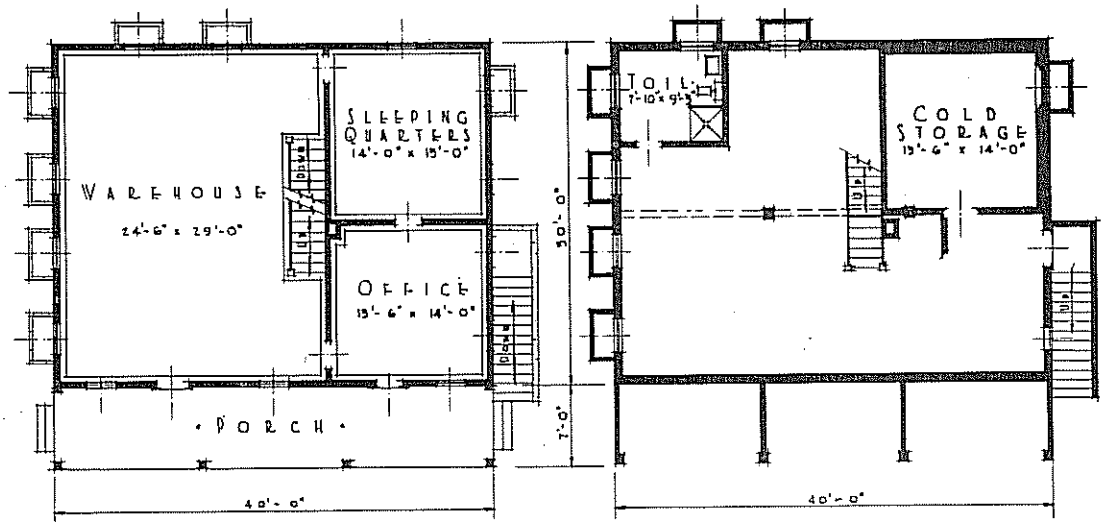
BASEMENT PLAN



FIRST FLOOR PLAN

ADMINISTRATION BUILDING PLAN C-18

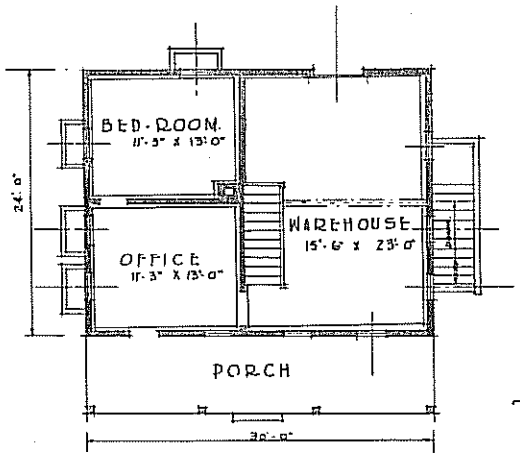


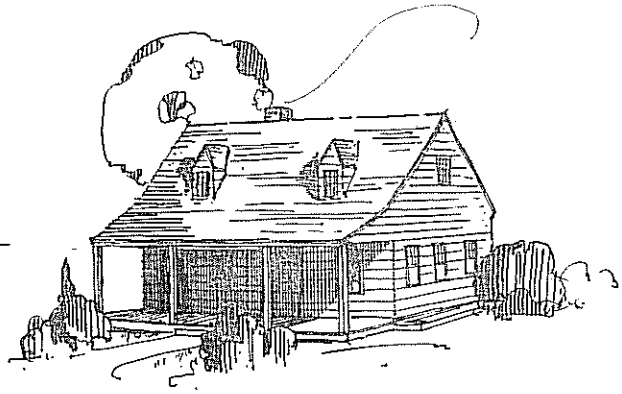


FIRST FLOOR PLAN

BASEMENT PLAN

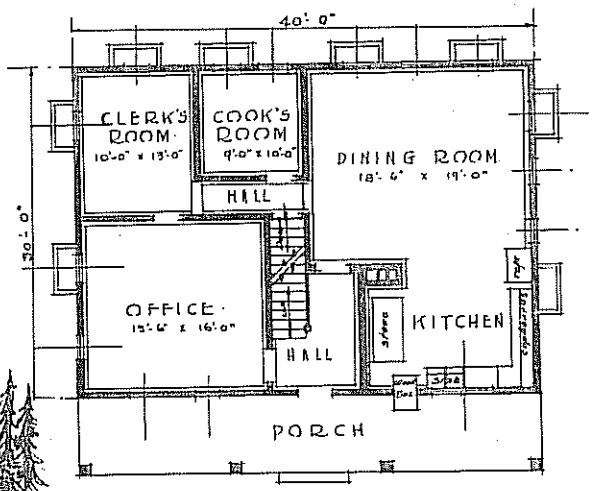
ADMINISTRATION BUILDING --- PLAN C-19



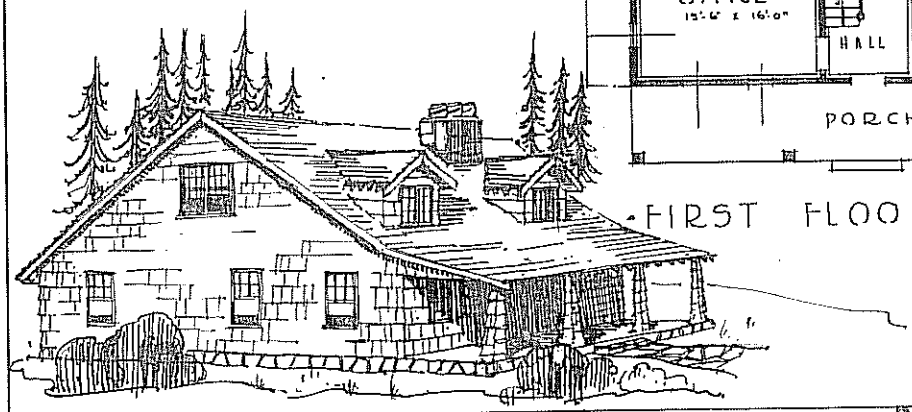


FIRST FLOOR PLAN

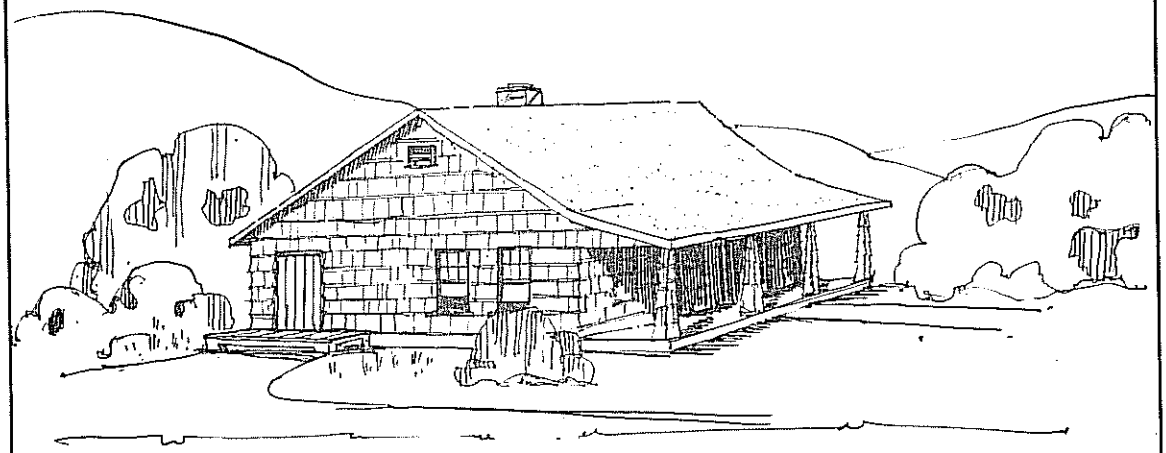
ADMINISTRATION BUILDING PLAN C.20

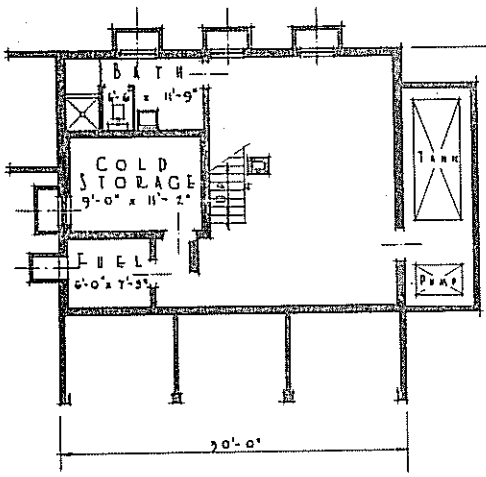


FIRST FLOOR PLAN

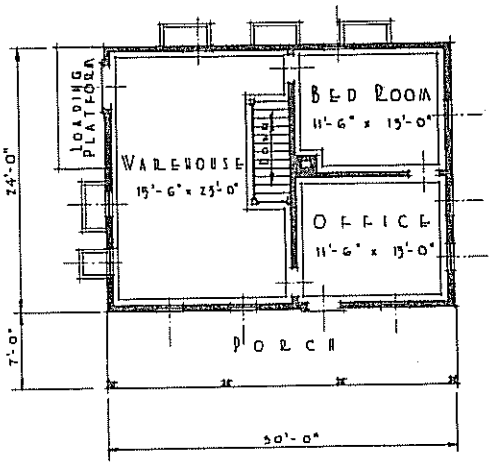


ADMINISTRATION BUILDING PLAN C.21



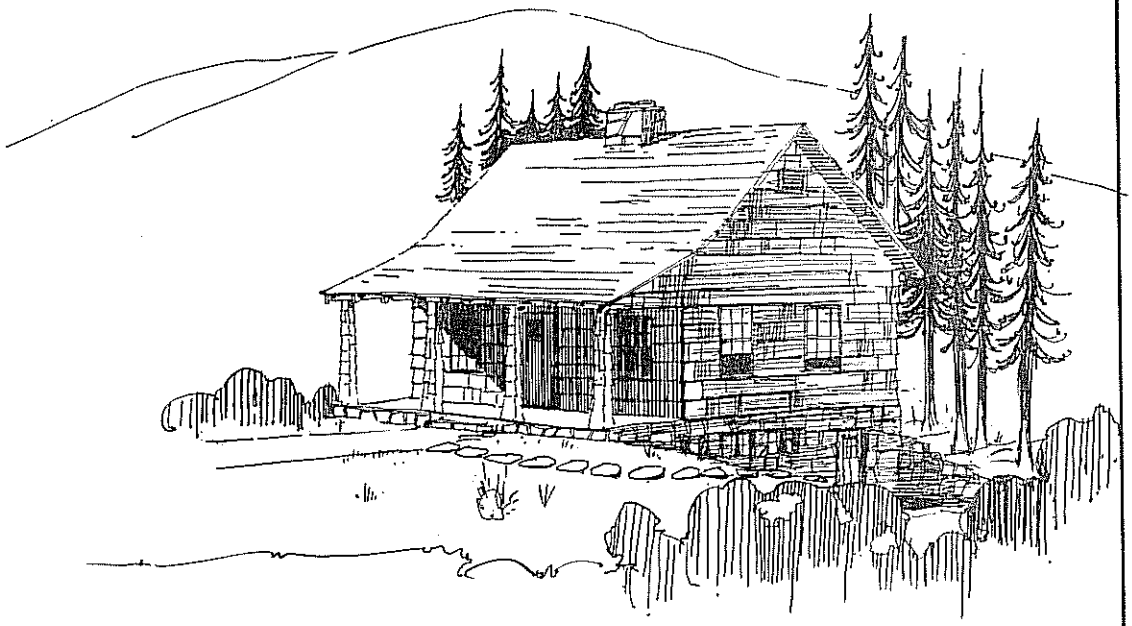


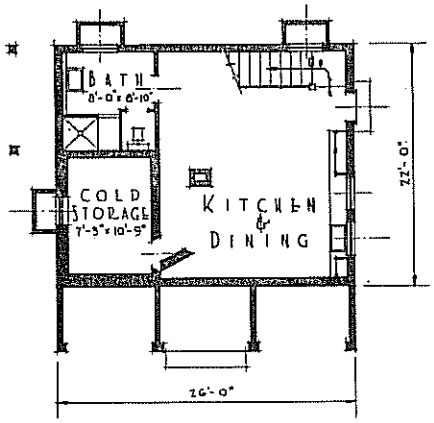
BASEMENT PLAN



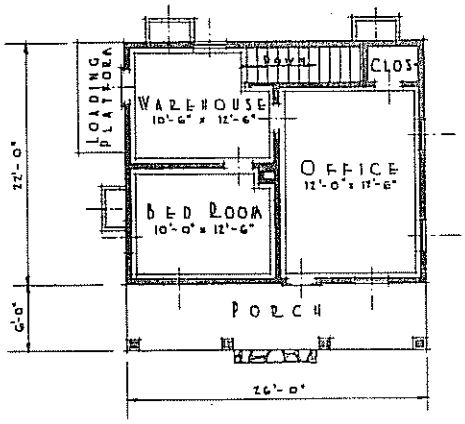
FIRST FLOOR PLAN

ADMINISTRATION BUILDING PLAN C-22



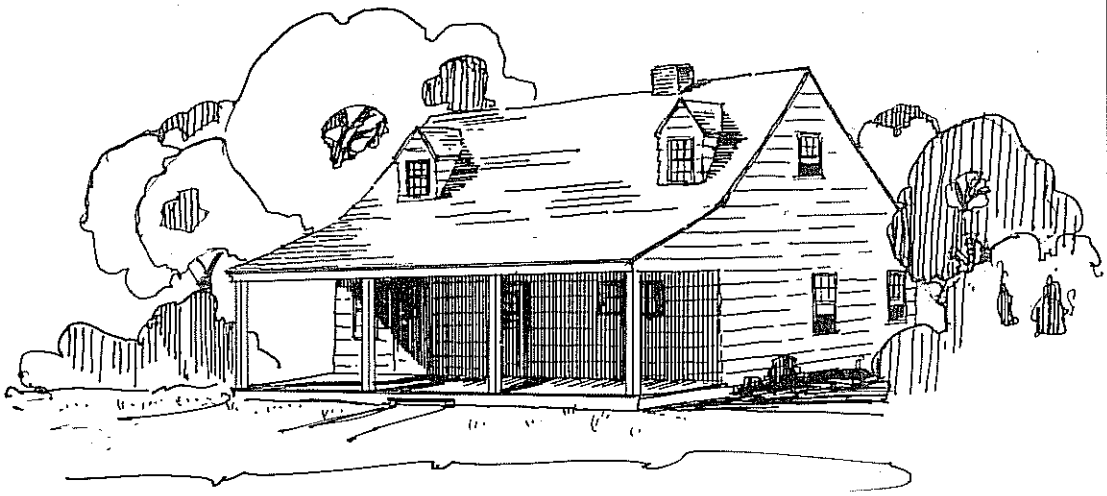


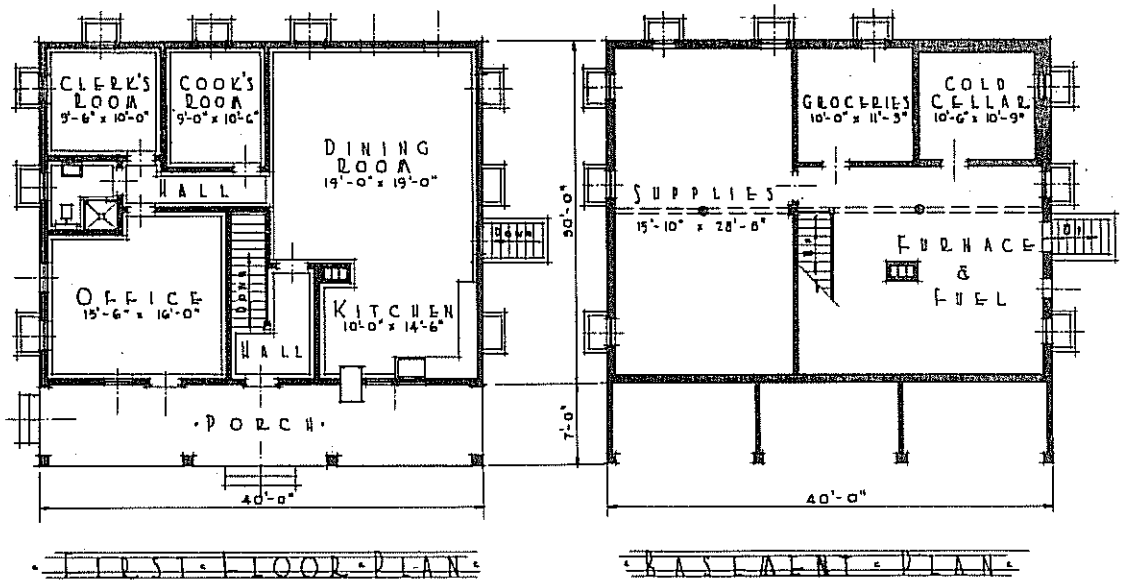
BASEMENT PLAN



FIRST FLOOR PLAN

ADMINISTRATION BUILDING PLAN C23

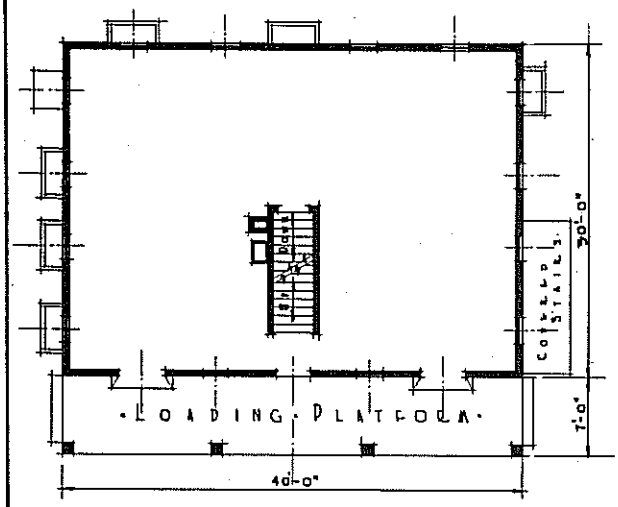




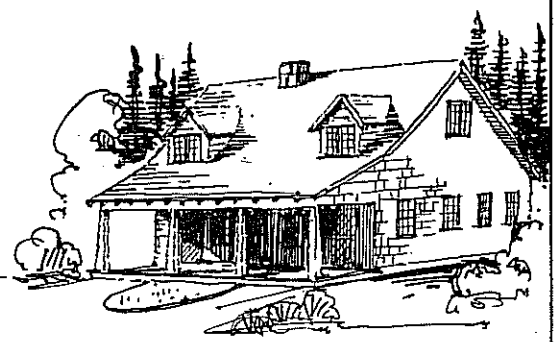
FIRST FLOOR PLAN

BASEMENT PLAN

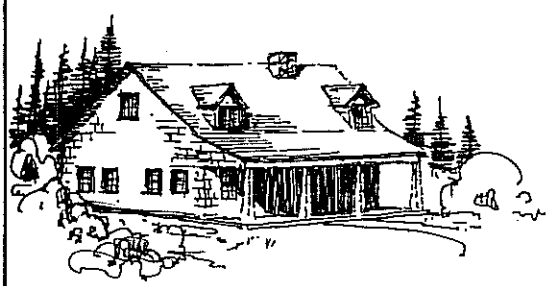
ADMINISTRATION BUILDING PLAN C24

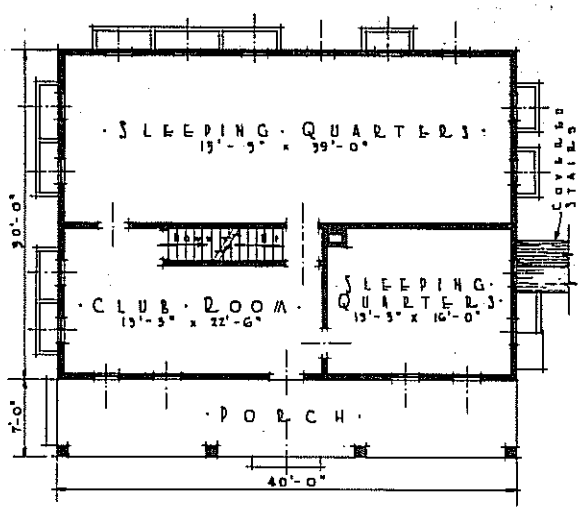


FIRST FLOOR PLAN



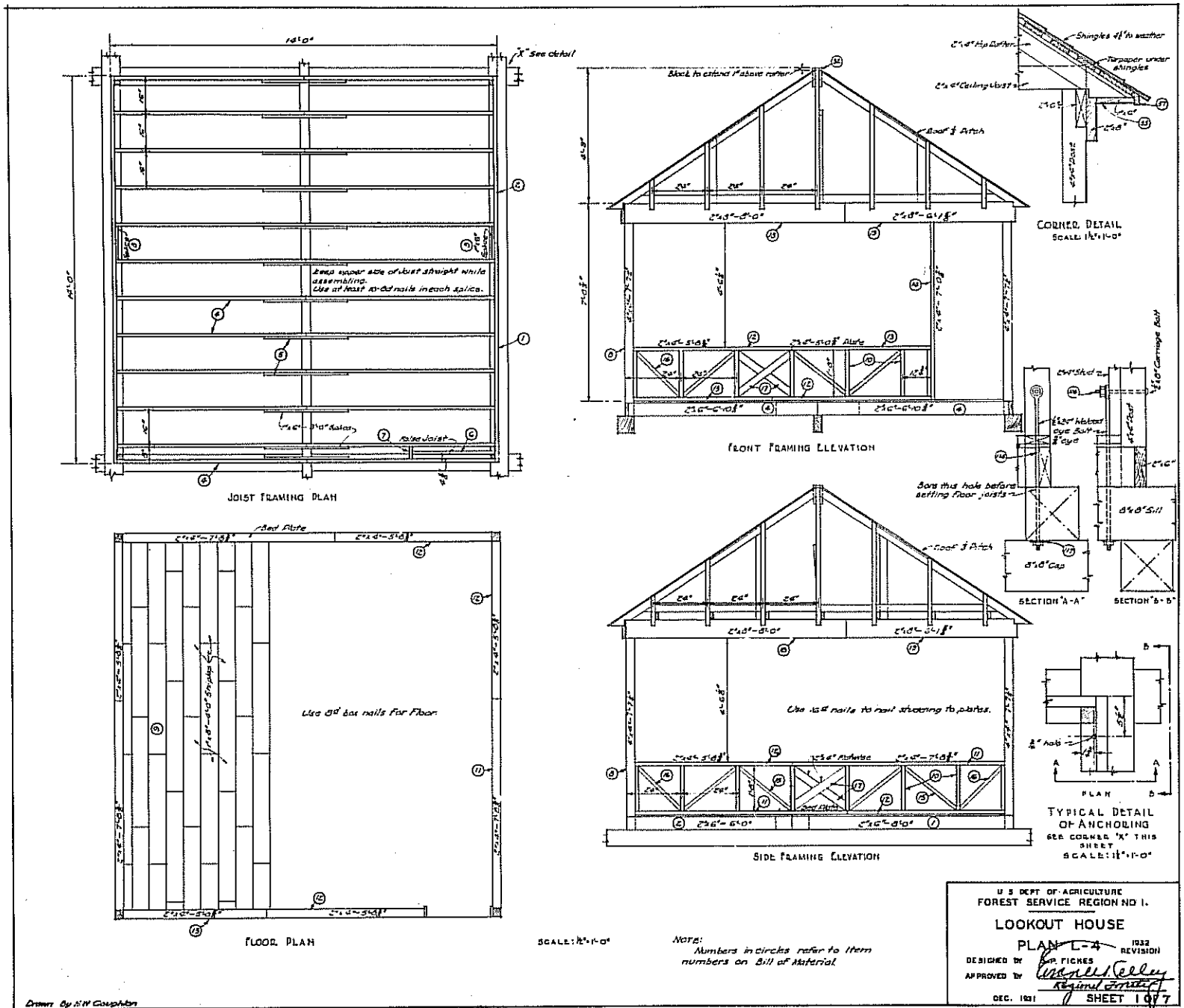
WAREHOUSE PLAN C-25





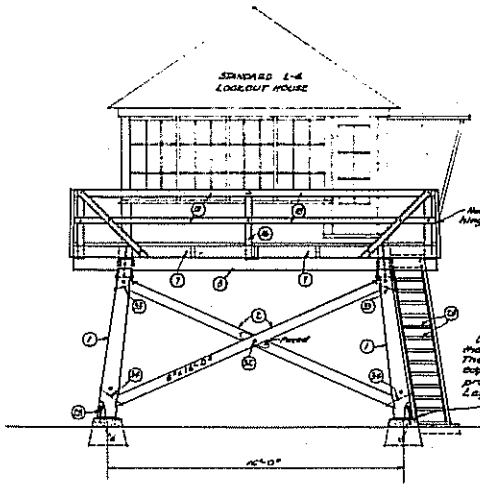
FIRST FLOOR PLAN

BUNK HOUSE PLAN C-26



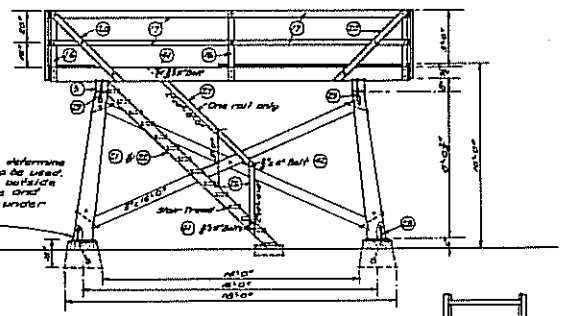
14'-0"
"X" See detail
Keep upper side of joist straight while assembling.
Use at least 10-8d nails in each splice.
False Joist
JOIST FRAMING PLAN
Bed Plate
Use 8d box nails for Floor.
FLOOR PLAN
Block to extend 1" above rafter
Roof ¼ Pitch
FRONT FRAMING ELEVATION
Use 16d nails to nail studding to plates.
SIDE FRAMING ELEVATION
Shingles 4½" to weather
Tarpaper under shingles
CORNER DETAIL
SCALE: 1½"=1'-0"
Bore this hole before setting floor joists
8"x8" Sill
8"x8" Cap
SECTION "A-A"
SECTION "B-B"
PLAN
TYPICAL DETAIL OF ANCHORING
SEE CORNER "X" THIS SHEET
SCALE: 1½"=1'-0"
SCALE: ½"=1'-0"
Note:
Numbers in circles refer to Item numbers on Bill of Material.
U S DEPT OF AGRICULTURE
FOREST SERVICE REGION NO 1.
LOOKOUT HOUSE
PLAN L-4
1932 REVISION
DESIGNED BY
APPROVED BY
DEC. 1931
SHEET 1 OF 7
Drawn By H.W. Coughlan

Note:
All logs and poles to be peeled. All bolt holes and contact surfaces to be treated with creosote before assembly. Tower House and Platform to be painted. Bolts to be purchased standard, threads on all long bolts to be run down approx. 4"



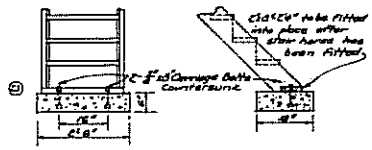
FRONT ELEVATION

Before running Concrete piers determine the diameter of base of Leg to be used. Then slope top of Pier ½" from outside edge of Leg to permit drainage and prevent moisture collecting under Leg.

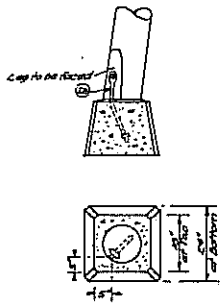


SIDE ELEVATION

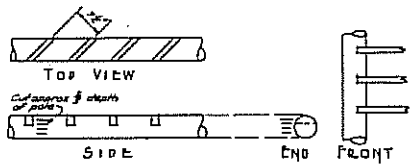
Note:
If round material is used for tower platform frame, the pieces need to be faced on top side only and dapped at bearing point on under side.
The 6"x8" post will be only 7½" so that sills must be dapped a sufficient depth on top to allow joist to fit perfectly.



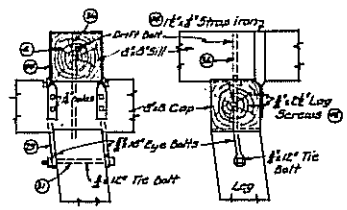
DETAIL OF FOOTING FOR STAIR HORSE



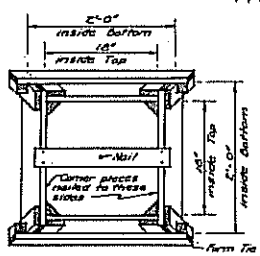
PIER DETAILS



Note:
This method of making stair horses may be used. Poles approx. 7" in diameter are used. The cuts for treads are sawed approx. ½ the depth of the pole by using an improvised miter box, the 1½" chip is chiseled out and the tread spiked into cut



DETAIL OF LEG TOPS

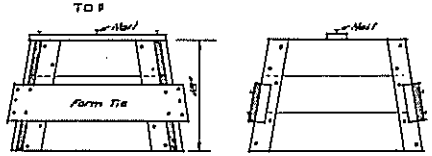


TOP

MATERIAL LIST FOR FORMS

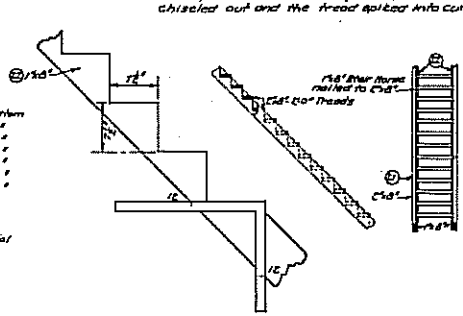
8 pcs.	1x6	1"x2 Cam	2x3	Cut 1'-3" Run 1'-11" Bottom	
8 "	"	"	"	"	1'-4" x 2'-2" "
8 "	"	"	"	"	2'-1" x 2'-8" "
8 "	"	"	"	"	1'-6" x 1'-8" "
8 "	"	"	"	"	1'-8" x 1'-10" "
8 "	"	"	"	"	1'-10" x 2'-0" "
8 "	"	"	"	"	2'-0" x 2'-6" "
32 "	1x2	"	"	"	16"
16 "	2x2	"	"	"	6"
16 "	2x2	Diagonal Strip			16"

(Pier forms to be furnished on special requisition only)



FRONT SIDE

PIER FORMS



STAIR DETAILS

Note: Numbers in circles refer to item numbers on material list

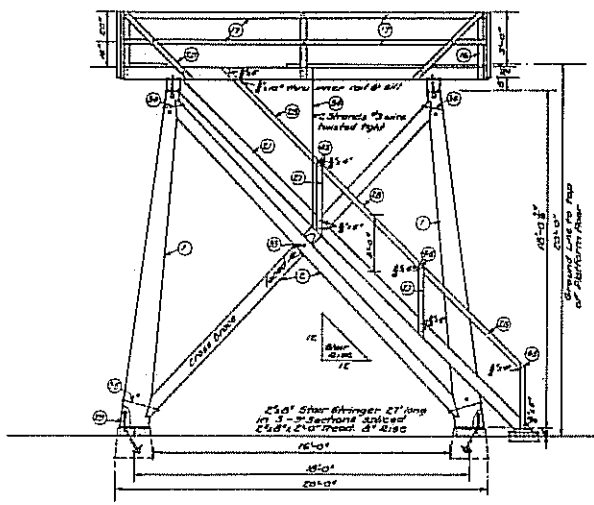
U. S. DEPT. OF AGRICULTURE
FOREST SERVICE REGION NO. 1
LOOKOUT TOWER WITH LIVING QUARTERS
FOR USE WITH PLAN L-4
PLAN T-10

DESIGNED BY C. R. FICKES & J. B. HALM
APPROVED BY [signature]
Acting Assistant Regional Forester

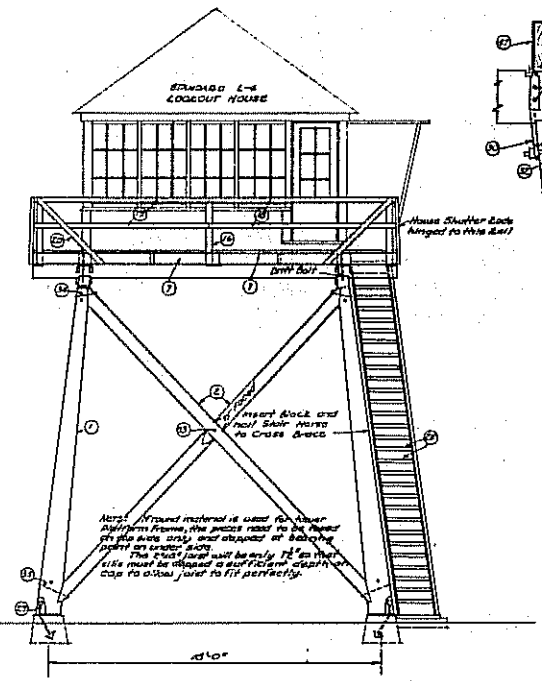
FEB. 1933 SHEET 1 OF 2

Drawn by H. N. Campbell

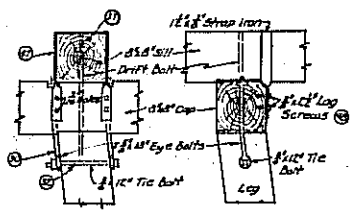
NOTE:
All logs and poles to be peeled. All bolt holes and contact surfaces to be treated with creosote before assembly. Tower House and Platform to be painted. Bolts to be purchased standard, threads on all long bolts to be run down approx 4".
Before pouring concrete piers determine the diameter of base of Leg to be used. Then slope top of pier ½" from outer edge of Leg to permit drainage and prevent moisture collecting beneath Leg.



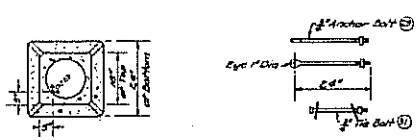
SIDE ELEVATION



FRONT ELEVATION

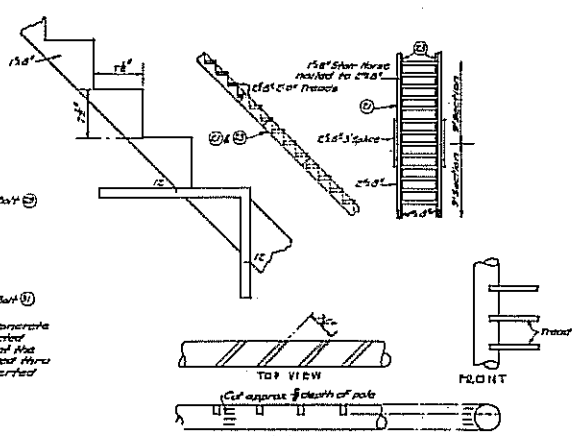


DETAIL OF LEG TOPS



Note: Anchor bolt is set in concrete on a slant. After tower is erected bolt is bent to meet the face at the foot of the leg. A hole is bored thru the leg and the bolt is inserted and drawn up snug.

PIER DETAIL



This method of making stair horses may be used. Poles approx. 7" in dia. are used. The cuts for treads are sawed approx. ⅝ the depth of the pole by using an improvised miter box. The 1⅛" chip is chiseled out and the tread spliced into cut.

STAIR DETAILS

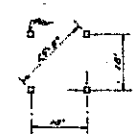
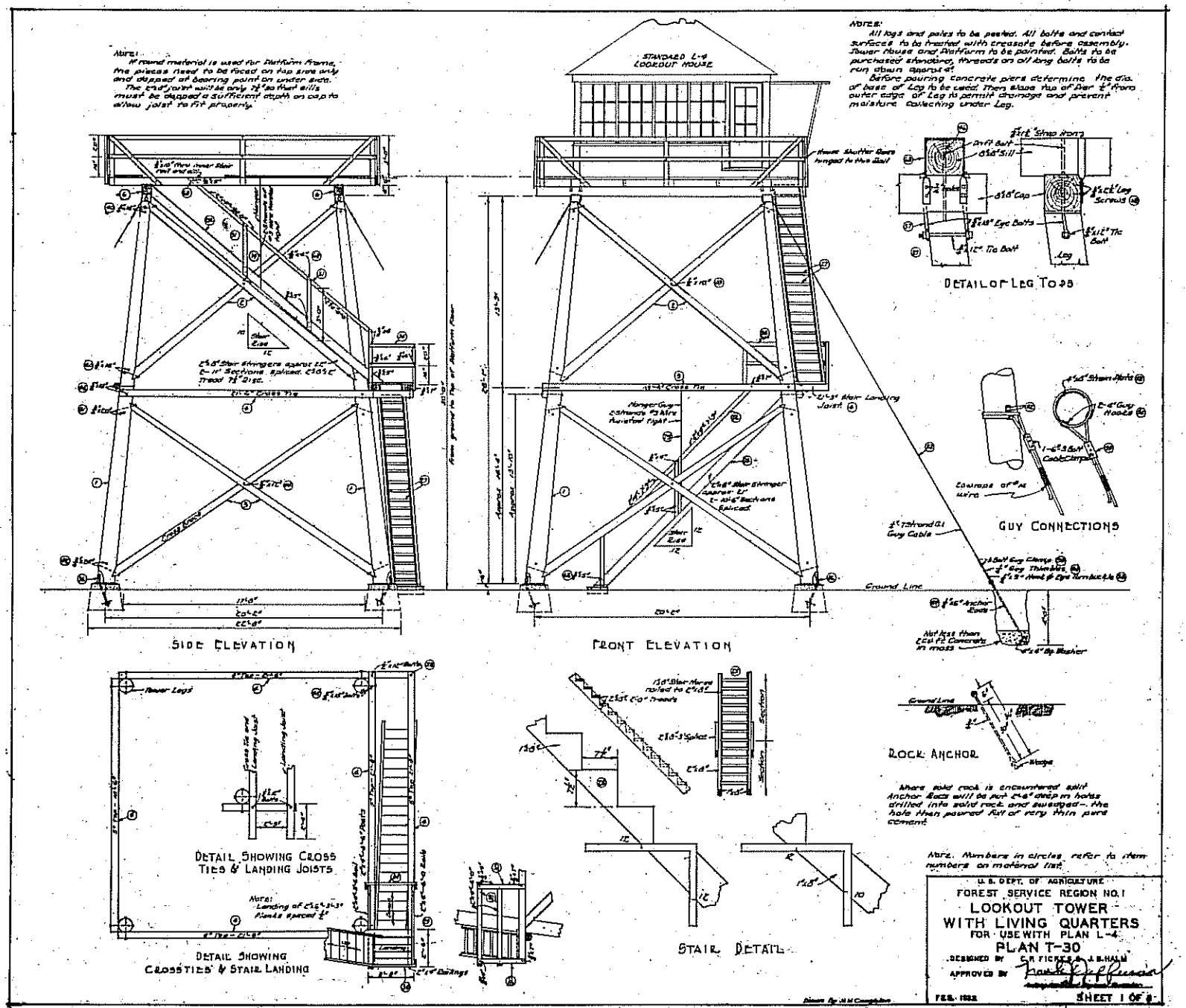


DIAGRAM FOR STAKING PIERS

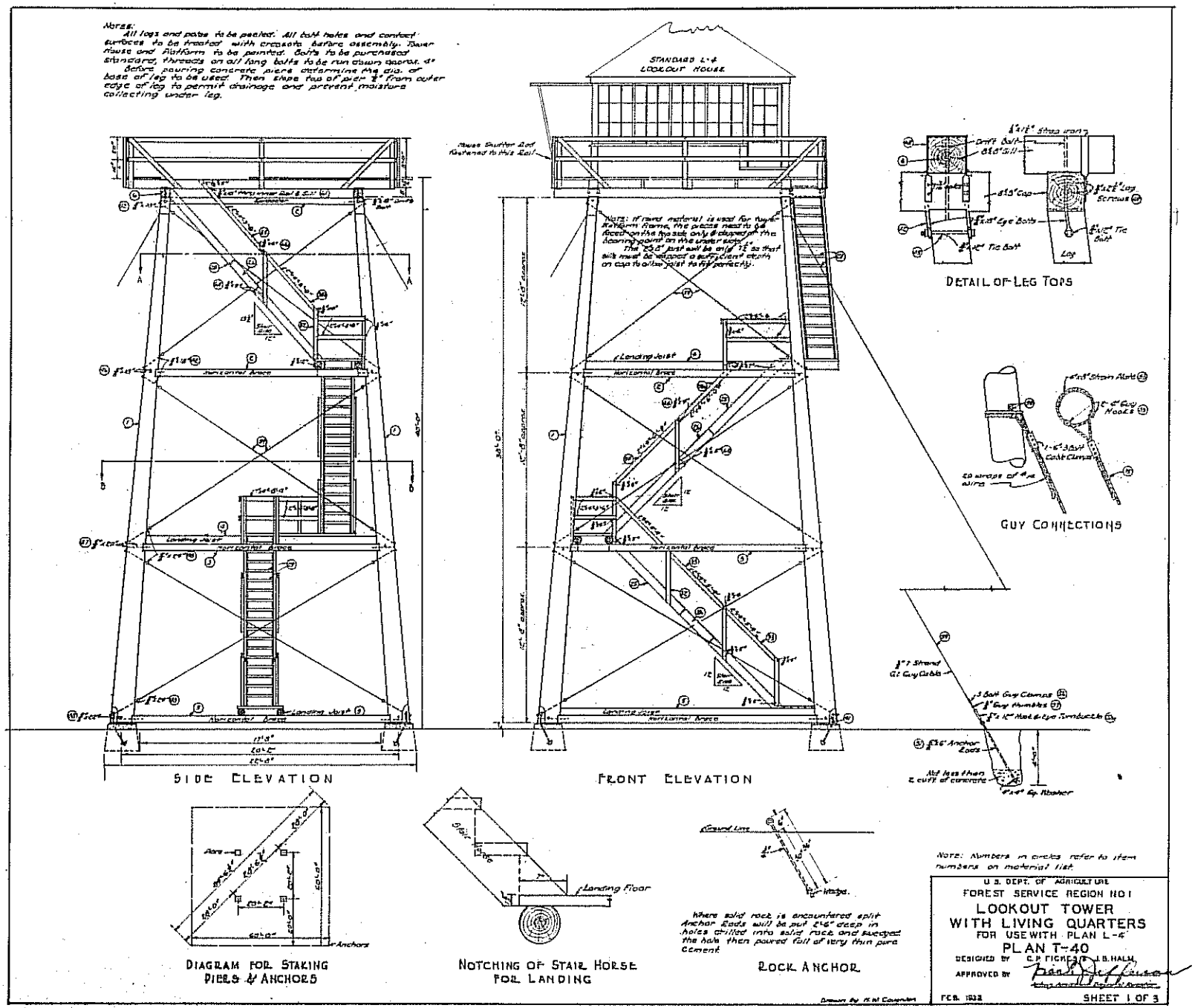
Note: Numbers in circles refer to item numbers on material list.

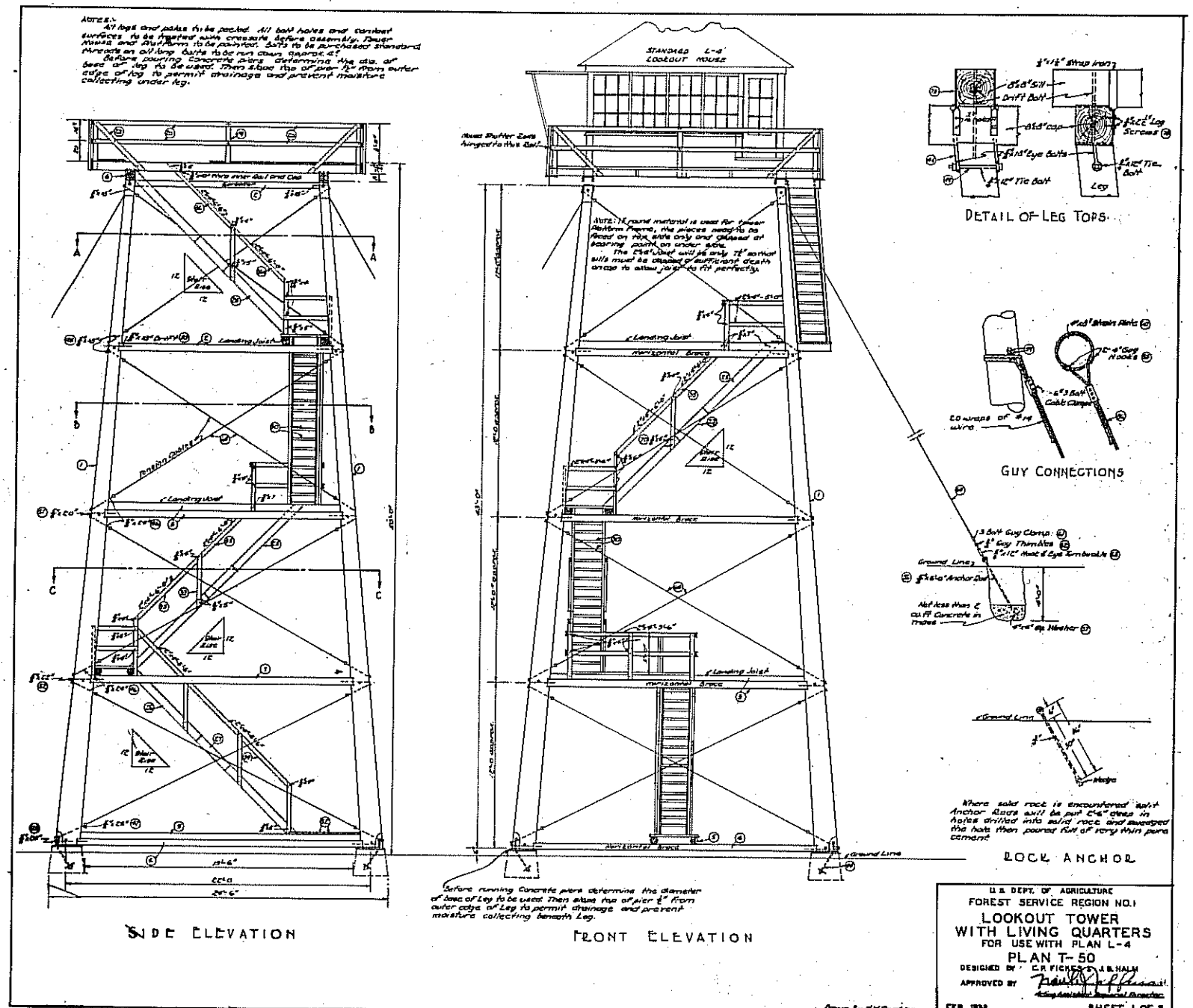
U. S. DEPT. OF AGRICULTURE
FOREST SERVICE REGION NO. 1
LOOKOUT TOWER
WITH LIVING QUARTERS
FOR USE WITH PLAN L-4
PLAN T-20
DESIGNED BY C. R. FICKES & J. B. HALM
APPROVED BY [signature]
Acting Assistant Regional Forester
FEB 1932
SHEET 1 OF 2

Drawn By H. W. Carpenter

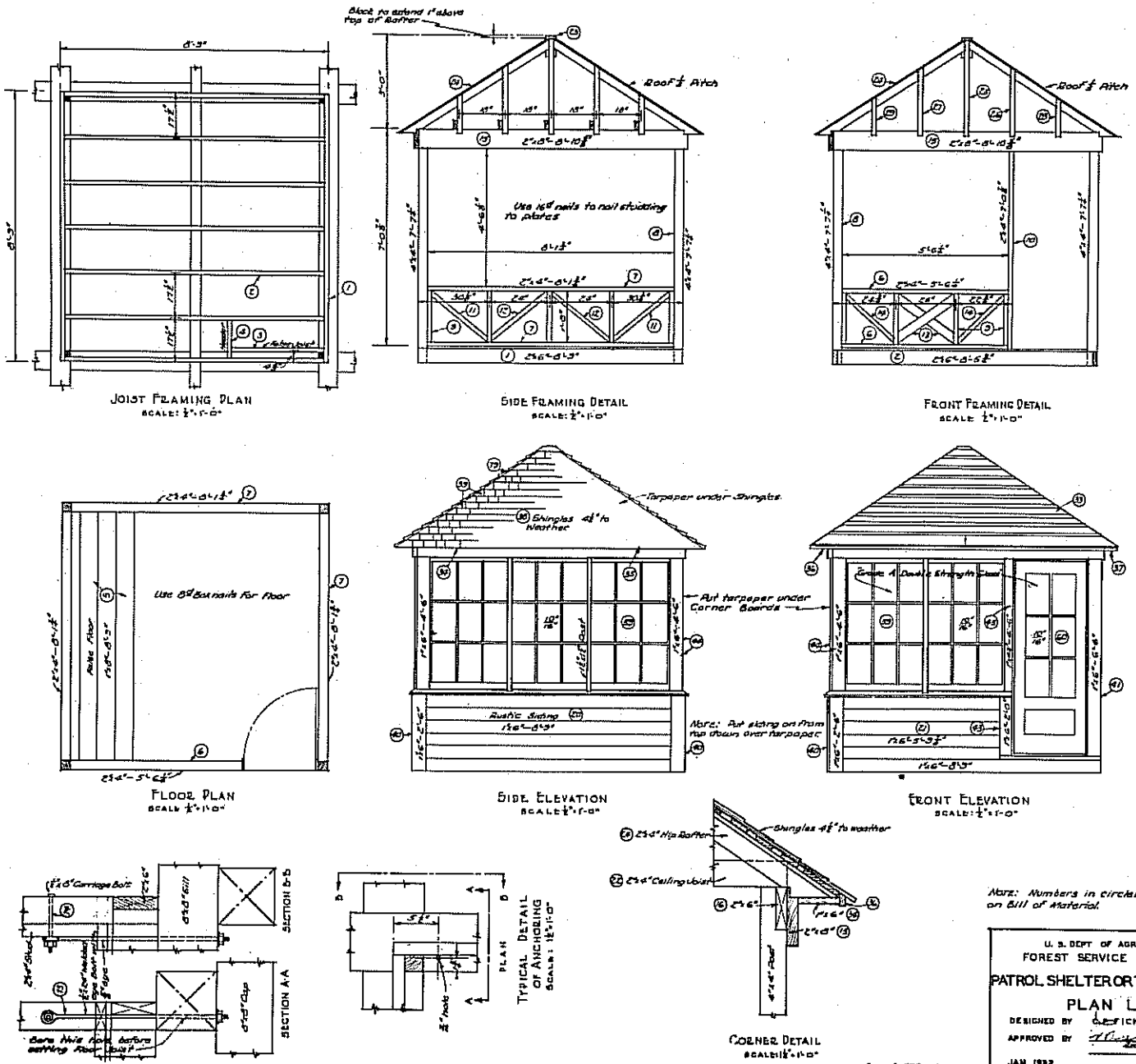


NOTE:
If round material is used for Platform Frame, the pieces need to be faced on top side only and dapped at bearing point on under side.
The 2"x8" joist will be only 7½" so that sills must be dapped a sufficient depth on cap to allow joist to fit properly.
NOTES:
All logs and poles to be peeled. All bolts and contact surfaces to be treated with creosote before assembly. Tower House and Platform to be painted. Bolts to be purchased standard, threads on all long bolts to be run down approx 4".
Before pouring concrete piers determine the dia. of base of Leg to be used. Then slope top of Pier ½" from outer edge of Leg to permit drainage and prevent moisture collecting under Leg.
STANDARD L-4 LOOKOUT HOUSE
SIDE ELEVATION
FRONT ELEVATION
DETAIL OF LEG TOPS
GUY CONNECTIONS
ROCK ANCHOR
DETAIL SHOWING CROSS TIES & LANDING JOISTS
DETAIL SHOWING CROSSTIES & STAIR LANDING
STAIR DETAIL
Ground Line
Note: Numbers in circles refer to item numbers on material list.
U. S. DEPT. OF AGRICULTURE
FOREST SERVICE REGION NO. 1
LOOKOUT TOWER
WITH LIVING QUARTERS
FOR USE WITH PLAN L-4
PLAN T-30
DESIGNED BY C. R. FICKES & J. B. HALM
APPROVED BY
FEB. 1932
SHEET 1 OF 8


Notes:
All logs and poles to be peeled. All bolt holes and contact surfaces to be treated with creosote before assembly. Tower House and Platform to be painted. Bolts to be purchased standard, threads on all long bolts to be run down approx. 4"
Before pouring concrete piers determine the dia. of base of leg to be used. Then slope top of pier 1/2" from outer edge of leg to permit drainage and prevent moisture collecting under leg.
STANDARD L-4 LOOKOUT HOUSE
Landing Joist
Horizontal Brace
SIDE ELEVATION
FRONT ELEVATION
DETAIL OF LEG TOPS
GUY CONNECTIONS
DIAGRAM FOR STAKING PIERS & ANCHORS
NOTCHING OF STAIR HORSE FOR LANDING
Landing Floor
Ground Line
Wedge
Where solid rock is encountered split Anchor Rods will be put 2'-6" deep in holes drilled into solid rock and swedged the hole then poured full of very thin pure cement.
ROCK ANCHOR
Note: Numbers in circles refer to item numbers on material list.
U. S. DEPT. OF AGRICULTURE
FOREST SERVICE REGION NO 1
LOOKOUT TOWER
WITH LIVING QUARTERS
FOR USE WITH PLAN L-4
PLAN T-40
DESIGNED BY C. P. FICHES & J. B. HALM
APPROVED BY
FEB. 1932
SHEET 1 OF 3


NOTES:-
All logs and poles to be peeled. All bolt holes and contact surfaces to be treated with creosote before assembly. Tower Houses and Platform to be painted. Bolts to be purchased standard threads on all long bolts to be run down approx. 4".
Before pouring Concrete piers determine the dia. of base of leg to be used. Then slope top of pier 1/2" from outer edge of leg to permit drainage and prevent moisture collecting under leg.
STANDARD L-4 LOOKOUT HOUSE
Note: If round material is used for tower Platform Frame, the pieces need to be faced on top side only and dapped at bearing point on under side.
The 2"x6" Joist will be only 7 1/2" so that sills must be dapped a sufficient depth on cap to allow joist to fit perfectly.
Landing Joist
Horizontal Brace
Tension Cables
Stair Rise
Ground Line
Before running Concrete piers determine the diameter of base of Leg to be used. Then slope top of pier 1/2" from outer edge of Leg to permit drainage and prevent moisture collecting beneath Leg.
SIDE ELEVATION
FRONT ELEVATION
DETAIL OF LEG TOPS
Drift Bolt
Tie Bolt
Leg
GUY CONNECTIONS
Ground Line
Where solid rock is encountered split Anchor Rods will be put 2'-6" deep in holes drilled into solid rock and swedged the hole then poured full of very thin pure cement
ROCK ANCHOR
U.S. DEPT. OF AGRICULTURE
FOREST SERVICE REGION NO. 1
LOOKOUT TOWER
WITH LIVING QUARTERS
FOR USE WITH PLAN L-4
PLAN T-50
DESIGNED BY C.P. FICKES & J.B. HALM
APPROVED BY
Acting Assistant Regional Director
FEB. 1932
SHEET 1 OF 3

THIS STRUCTURE TO BE USED FOR PATROL STATIONS AND FOR ALL TOWER HOUSES ON T-1 AND T-2 TOWERS.



JOIST FRAMING PLAN
SCALE: ½"=1'-0"

SIDE FRAMING DETAIL
SCALE: ½"=1'-0"

FRONT FRAMING DETAIL
SCALE: ½"=1'-0"

FLOOR PLAN
SCALE: ½"=1'-0"

SIDE ELEVATION
SCALE: ½"=1'-0"

FRONT ELEVATION
SCALE: ½"=1'-0"

TYPICAL DETAIL OF ANCHORING
SCALE: 1½"=1'-0"

CORNER DETAIL
SCALE: 1½"=1'-0"

Note: Numbers in circles refer to items on Bill of Material.

U. S. DEPT OF AGRICULTURE
FOREST SERVICE REGION NO. 1.

PATROL SHELTER OR TOWER CUPALO

PLAN L-6 — 1932 REVISION

DESIGNED BY C. F. FICKES

APPROVED BY [signature]
Regional Forester

JAN., 1932

SHEET 1 OF 5

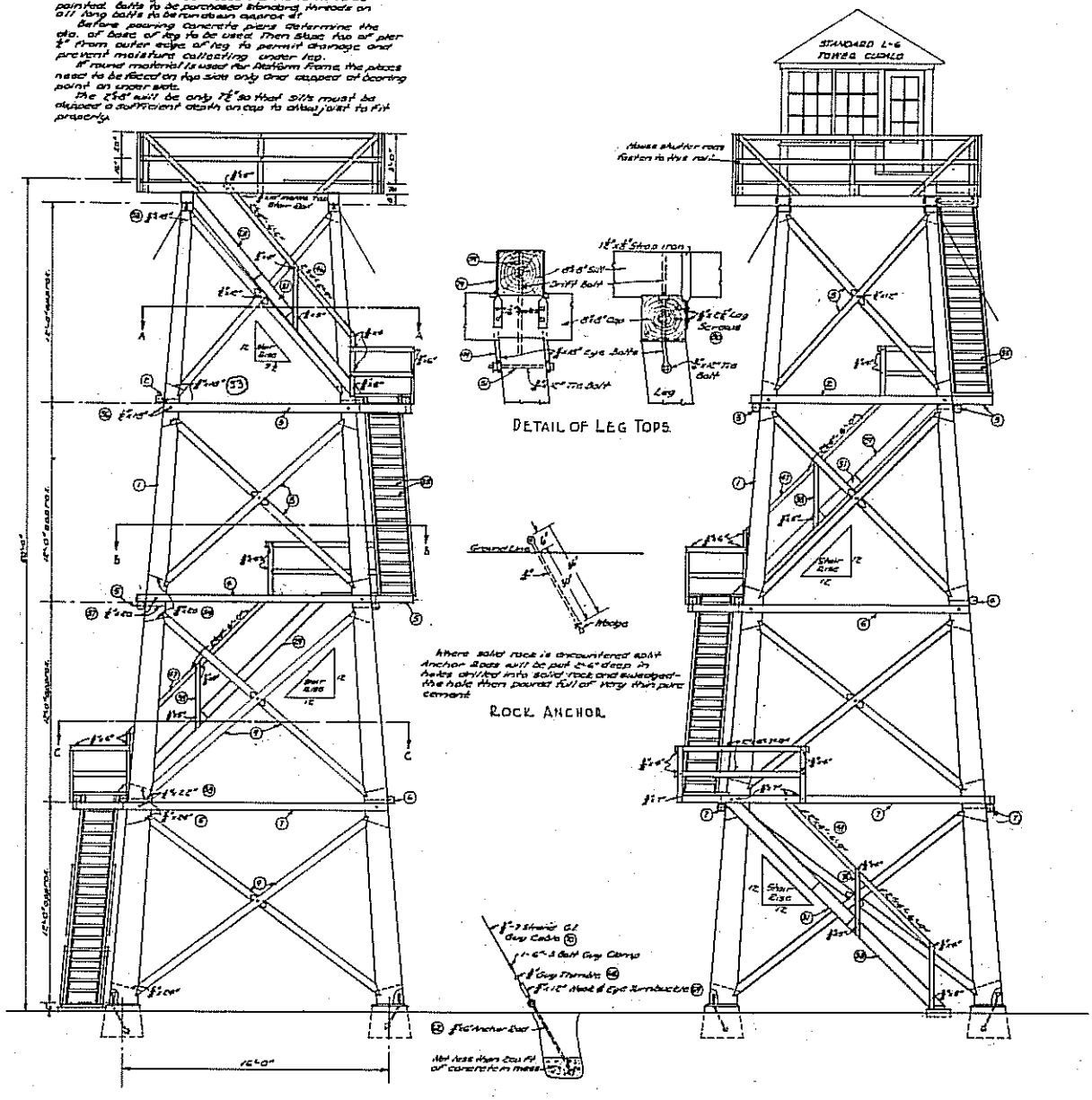
Notes:

All legs and poles to be peeled. All bolt holes and contact surfaces to be treated with creosote before assembly. Tower House and Platform to be painted. Bolts to be purchased standard threads on all long bolts to be run down approx 4".

Before pouring concrete piers determine the dia. of base of leg to be used. Then slope top of pier 2" from outer edge of leg to permit drainage and prevent moisture collecting under leg.

If round material is used for Platform frame the pieces need to be faced on top side only and dapped at boring point on under side.

The 2"x4" will be only 1½" so that sills must be dapped a sufficient depth on cap to allow sill to fit properly.



DETAIL OF LEG TOPS.

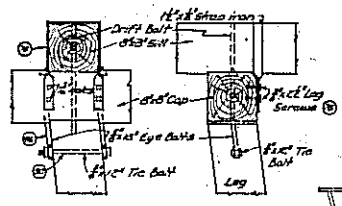
Where solid rock is encountered split Anchor Bolts will be put 2'-6" deep in holes drilled into solid rock and swedged. The hole then poured full of very thin pure cement.

ROCK ANCHOR

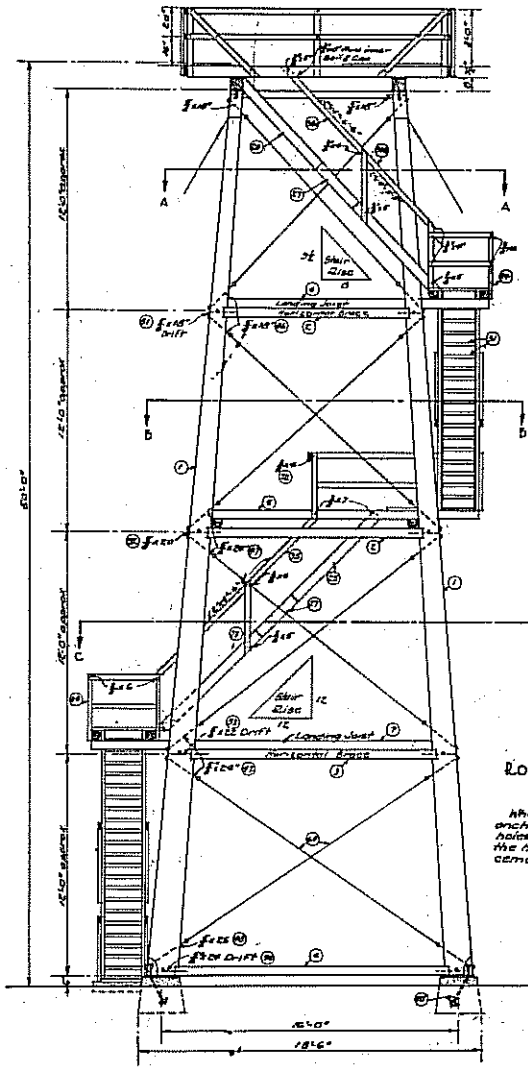
U. S. DEPT. OF AGRICULTURE
FOREST SERVICE REGION NO. 1
LOOKOUT TOWER
WITH CUPALO
FOR USE WITH PLAN L-6
PLAN T-1
DESIGNED BY C. R. FICKES & J. B. HALM
APPROVED BY
MAR. 1932
SHEET 1 OF 4

Notes: All legs and poles to be peeled. All bolt holes and contact surfaces to be treated with creosote before assembly. Tower House and Platform to be painted. Bolts to be purchased standard threads on all long bolts to be run down approx. 4". Before pouring concrete piers determine the dia. of base of Leg to be used. Then slope top of pier 2" from outer edge of Leg to permit drainage and prevent moisture collecting under Leg.

If round material is used for Platform frame, the pieces need to be faced on top side only and dapped at bearing point on under side. The 2"x8" joist will be only 7½" as that sills must be dapped a sufficient depth on cap to allow joist to fit properly.



DETAIL OF LEG TOPS



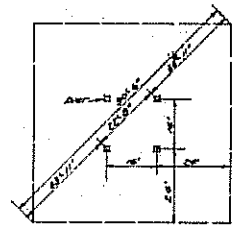
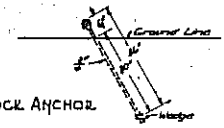
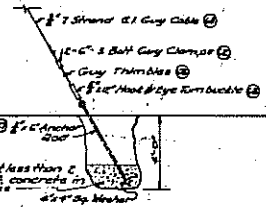


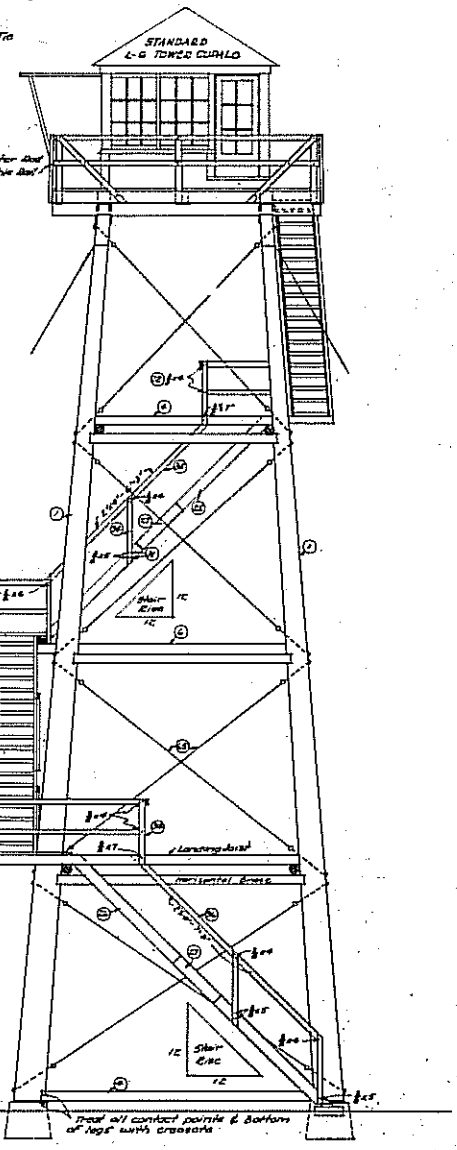
DIAGRAM FOR STAKING PIERS & ANCHORS



ROCK ANCHOR

Where solid rock is encountered split anchor rods will be put 2'-6" deep in holes drilled into solid rock and extended the hole then poured full of very thin pure cement.





U. S. DEPT. OF AGRICULTURE
FOREST SERVICE REGION NO. 1

LOOKOUT TOWER WITH CUPALO

FOR USE WITH PLAN L-6

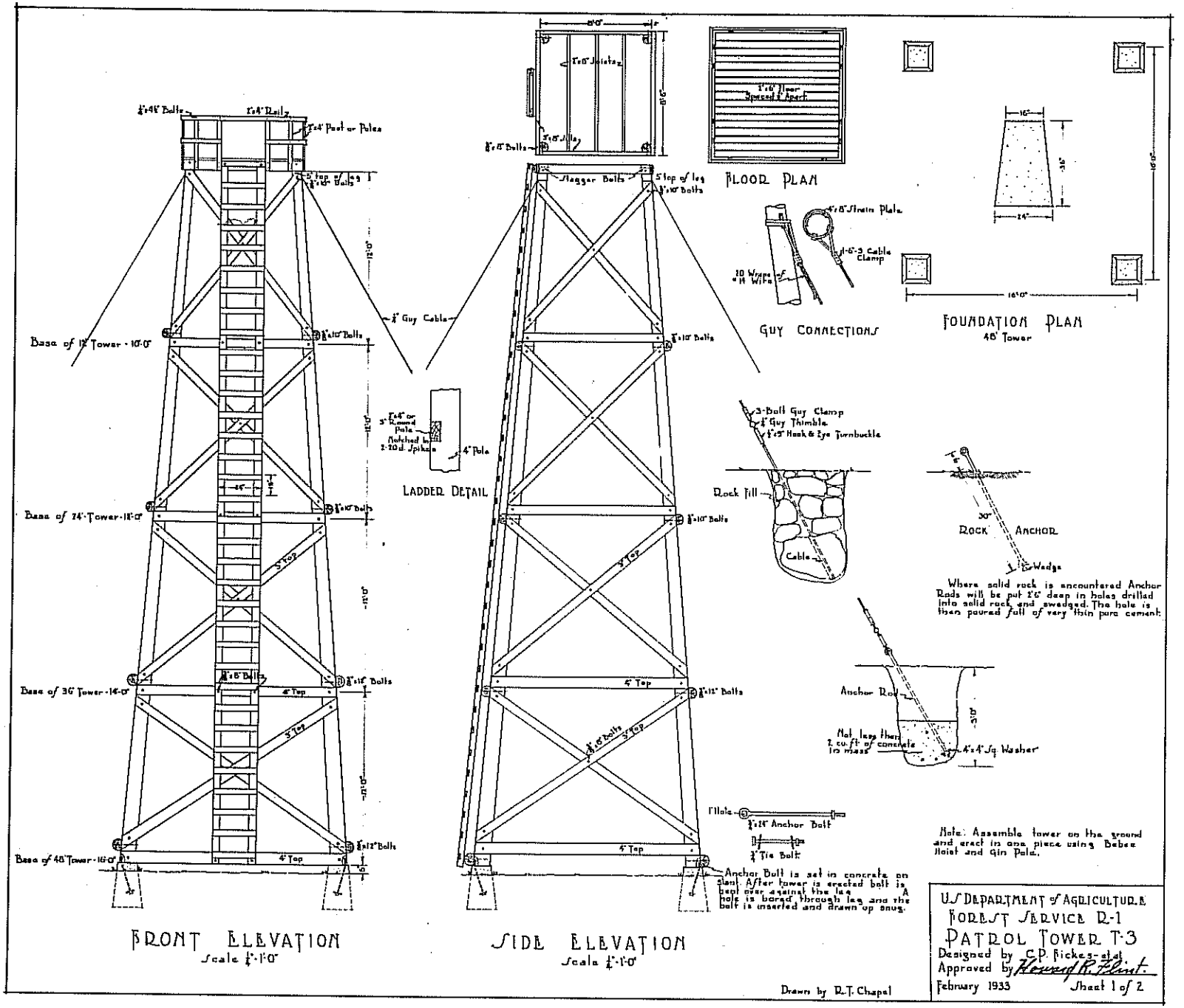
PLAN T-2

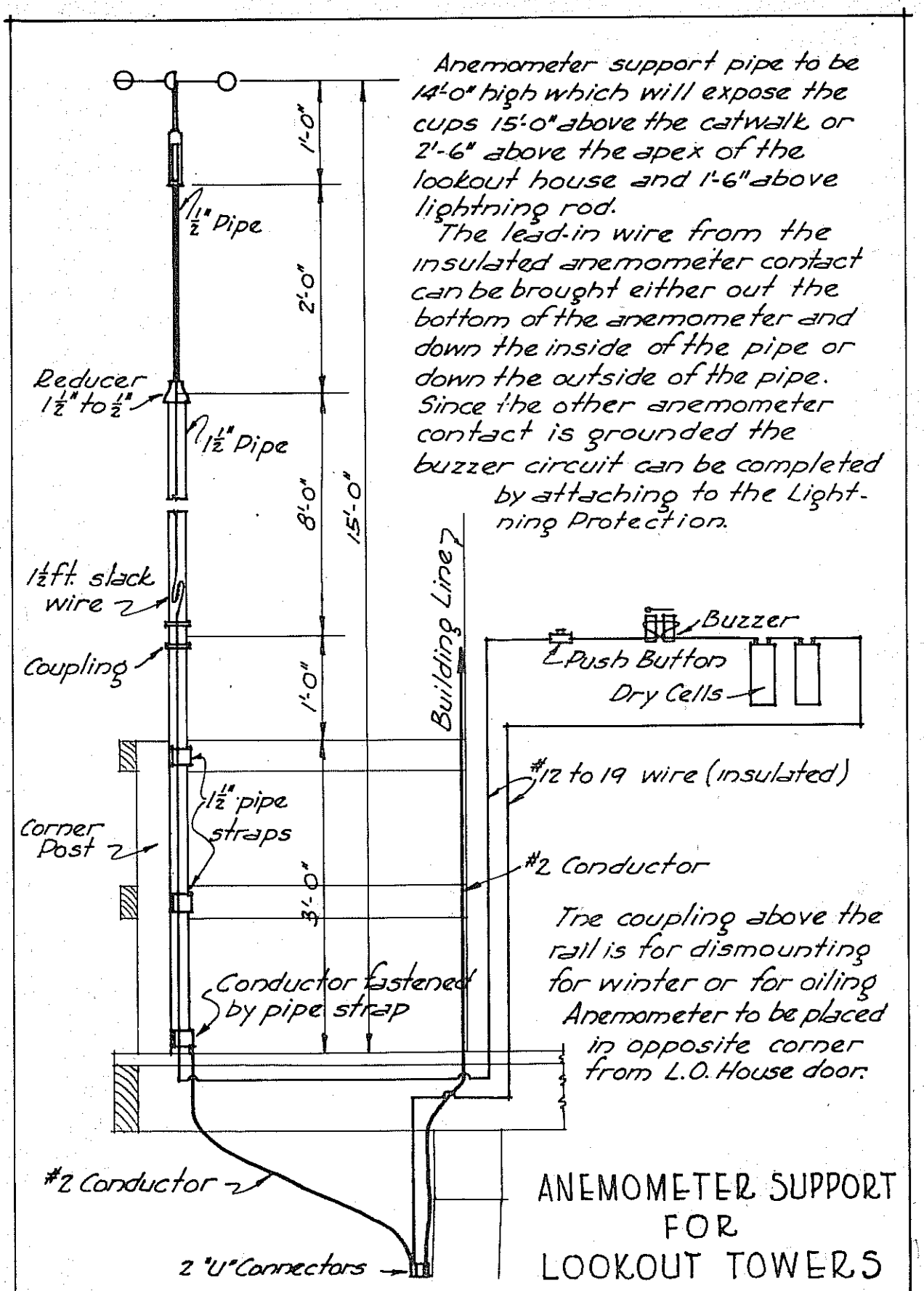
DESIGNED BY C. P. FICKES & L. B. HALM

APPROVED BY

FEB. 1932

SHEET 1 OF 5


Base of 12' Tower - 10'-0"
Base of 24' Tower - 12'-0"
Base of 36' Tower - 14'-0"
Base of 48' Tower - 16'-0"
FRONT ELEVATION
Scale 1/4" = 1'-0"
SIDE ELEVATION
Scale 1/4" = 1'-0"
FLOOR PLAN
GUY CONNECTIONS
FOUNDATION PLAN
48' Tower
LADDER DETAIL
ROCK ANCHOR
Where solid rock is encountered Anchor Rods will be put 2'6" deep in holes drilled into solid rock and swedged. The hole is then poured full of very thin pure cement.
Anchor Bolt is set in concrete on slant. After tower is erected bolt is kept over against the leg. A hole is bored through leg and the bolt is inserted and drawn up snug.
Note: Assemble tower on the ground and erect in one piece using Beber Hoist and Gin Pole.
Drawn by R.T. Chapel
U.S. DEPARTMENT of AGRICULTURE
FOREST SERVICE R-1
PATROL TOWER T-3
Designed by C.P. Ficke & et al.
Approved by Howard R. Flint
February 1933
Sheet 1 of 2



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