Log Cabin Construction
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LOG CABIN CONSTRUCTION

By A. B. Bowman

Early American type cabin built of hewed timbers dove-tailed at the corners. The fireplace is of rocks that were quarried locally and the roof is of hand-made white oak shakes. (Photograph — U. S. Forest Service.)

MICHIGAN STATE COLLEGE :: EXTENSION DIVISION

EAST LANSING

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CONTENTS

Log Cabin Construction

A. B. BOWMAN*

Use of logs in building shelters dates back to the dawn of civilization; virtually all of the pioneer homes in this country were of that construction. With the advent of the circular saw in 1820 and a plentiful supply of lumber, a decided change occurred in structural taste. Log buildings went out of style and were largely forgotten; with them went the art of construction. A century passed before interest in log buildings revived; with this new interest came new methods and developments. It is the purpose of this bulletin to point out the new, as well as the "time-honored" avenues open to the cabin builder.

As a rule, those interested in log cabins prefer real logs to imitation ones, and so the greater part of this discussion will bear upon that type of construction.

Fig. 1. A well chosen cabin site commanding an excellent view. Peeled jack pine logs are being used. (Photograph by the U. S. Forest Service.)

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However, the use of slabs and manufactured products will be considered briefly.

PLANNING

Location

Selecting a cabin site is an important matter, demanding serious thought and careful field inspection. The following questions should be considered before deciding on a location:

(a) Is it beyond the reach of high water, or ice jams that plow ashore in storms?

(b) Is it protected from high winds or possible forest fires?

(c) Will gusts of wind force smoke down the chimney because of surrounding tree growth?

(d) Is a good water supply conveniently located?

(e) What can be done with the sewage?

(f) Can a restful view be obtained?

(g) Is the site accessible to roads, power lines, favorite activities?

(h) Are the surroundings such that it can be made attractive?

Design

Insofar as possible, the lines of a log cabin should follow a definite traditional trend. Primitive tools, heavy logs, and inadequate labor imposed hardships upon the pioneer that clearly affected the general shape and character of the building. Cabin architecture typical of earlier days includes:

(a) Roofs that are low and covered with wooden shingles or shakes.

(b) Broad rather than tall windows, set high, and containing small panes.

(c) Evidence of rough axe work if not the result of poor workmanship.

(d) Doors, hinges and latches in primitive harmony with the rest of the building.

(e) Stone foundations and fireplaces.

Few departures from these fundamentals are possible in a log cabin without marring its true architectural distinction (Fig. 2).

Plans

Many log buildings are erected each year without the aid of plans of any sort. Except for inexpensive structures this procedure is likely to result in costly mistakes. Many persons, too, have the erroneous impression that a floor plan is all that one needs in order to proceed with a construction job. Floor plans are very helpful in deciding upon the size and arrangement of rooms (Fig. 28), but, in themselves, are inadequate as a guide to the builder, or in estimating the quantity of materials needed, their size and kind. Elevations (upright views) are likewise necessary. To encourage the preparation of at least preliminary plans, three sample sets are shown in the APPENDIX, each representing a different style of log construction: Plan No. 1 shows the use of horizontal logs in a community building; plan No. 2, the use of split-logs in a farm dwelling; and plan No. 3, sprocket-type processed logs in a summer home. If the builder is unable to prepare a set of plans more or less resembling these, he would be wise to seek the services of an architect.

Fig. 2. An unusual design bordering on the ornate. The selection of tin roofing and stucco to accompany the rather attractive log work has largely destroyed the finer characteristics of the cabin. (Photograph by the U. S. Forest Service.)

It is commonly believed that log cabins, which can be made from rough products near at hand, are cheaper than other buildings similar in size, but using finished lumber. Were it not for the increased labor costs required to fashion rough timbers this would probably be true; in reality, little if any saving can be made. The United States Forest Service estimates that log cabins built in the national forests cost about 45 cents per cubic foot of space enclosed. This figure includes both labor and materials for cabins equipped with suitable fireplaces and porches. The cost of other well-constructed cabins may vary widely from that amount, depending on local conditions; in fact, it is impossible to arrive at accurate cost estimates without a knowledge of local prices.* A material list (see APPENDIX) is also essential to such estimates.

SELECTION AND PREPARATION OF LOGS

Choice of Species

It is sometimes possible to cut logs from the property selected as the cabin site. Usually such economies are obtained only at the sacrifice of natural surroundings, although in some instances the forest may be improved by the operation. In any event the builder is seldom justified in going long distances for some particular kind of timber or rock. The style of construction can usually be modified to make local products acceptable.

Where a choice of species exists, needle-bearing softwoods should be given preference because they ordinarily are more uniform in shape, lighter in weight and more easily worked than the broadleafed hardwoods. Both groups vary greatly in their ability to

Table 1.

Softwoods		Hardwoods		
Easy to work		Difficult to work		Easy to work
Durable (require no treatment)	Non-durable (require treatment)	Durable (require no treatment)	Non-durable (require treatment)	Non-durable (require treatment)
Cedar	Spruce	Black Locust	Red Oak	Ash
Tamarack	Hemlock	White Oak	Hickory	Basswood
Pine	Balsam Fir		Beech	Yellow Poplar
			Birch	Aspen
			Elm	Cottonwood
			Maple	Balm of Gilead

**Cabin log prices vary from about 2c to 10c per linear foot throughout the United States, with the average about 7c.*

Fig. 3. A well constructed horizontal log house of Norway pine. The appearance might have been improved by facing the foundation and chimney with native rock. (Photograph by the U. S. Forest Service.)

resist decay. The accompanying table classifies important native woods according to durability and ease of conversion into cabin logs.

Construction methods and site affect durability to a considerable extent. A well-constructed, well-aerated hemlock, fir or aspen cabin may outlast one of pine or tamarack by many years, if the latter were situated in a damp or shady place. It is possible also to use less durable woods in the upper courses of the walls, provided the sill logs (those in contact with the ground or on low foundations) are naturally durable or can be made so with a preservative treatment.

Size of Logs

Wall logs should average about 8 or 9 inches in diameter at the middle; larger logs are seldom attractive, while smaller ones do not appear nor actually are, substantial enough for permanent structures. Lengths should be cut long enough to extend from one corner to another or from opening to opening. If jutting ends are desired at the corners, an additional foot or two must be allowed (Fig. 3). For use in large cabins, logs should be cut just as long as the transportation facilities will permit. Even so, considerable splicing may be necessary. Short lengths, such as might be cut from scrubby, misshapen trees, can be used between the openings and small diameter material, if long enough and straight enough, for the rafters.

Time to Cut

The best time to cut and move logs is during the winter. At that time it is easier to obtain teams and labor, and also to haul the material out of the woods. Condition of the roads impedes work during the spring, and summer-cut logs are subject to early insect attacks (before the bark is removed), staining, and serious checking. They are also more difficult to peel.

Bark-Covered Logs

Experienced cabin builders do not favor bark-covered logs. They explain that the bark can be retained for a limited time only (because of insect activity between the bark and the wood), after which maintenance of appearance is difficult. Furthermore, the bark delays seasoning and encourages the growth of decay organisms. If a bark cover is preferred, cutting should be done late in the summer or in the fall, because at that time strong cellular tissue binds the bark and wood together. Adhesion may be further improved by removing a narrow strip of bark from each side of the log. Any shrinkage that occurs will open wide splits along the scored lines and thus relieve the tension elsewhere. When the logs are placed together to form the wall, the disfigurement will not be noticeable. Another method, and perhaps a more satisfactory one, is to secure the bark with large-headed nails, one for each square foot of bark surface.

Peeling

Bark peels easiest in the late winter or spring when a layer of weak, watery cells acts as the binding agency. A tighter and tighter bond is formed as the season advances until by fall there is little chance of peeling at a reasonable expense. Nevertheless logs that are peeled late in the season have a curiously pleasing appearance by reason of the numerous brownish streaks of bark scattered along the surface.

Under favorable conditions one man can peel from six to eight long logs per day, but if the bark is set, two or three represents a good day's work. A draw knife is the best tool for removing tight bark. On green timbers any sharp tool, such as an axe, spud or even a spade will do almost as well. Peeling the logs is often one of the most tedious jobs encountered in cabin building.

Seasoning

After cutting, or after cutting and peeling, the logs should be piled in a deck and allowed to season over the summer months; an entire year would give better results. If not given time to dry and shrink before the cabin is constructed, the logs will do so in the walls, thus causing cracks, ill-fitting joints and loose chinking. No practical treatment to prevent ultimate shrinkage has been discovered. Painting the logs with oil will slow down the process but not stop it completely. Seasoning of roof timbers is not so important as with wall logs, because they need not fit together as well.

Good air circulation is indispensable to proper seasoning. It may be helped appreciably by piling the logs so that the ends point in the direction of the prevailing winds. The logs should also be up off the ground, both to insure proper aeration and to prevent those on the bottom from rotting. Worthless logs laid crosswise to the pile will serve as a foundation but they

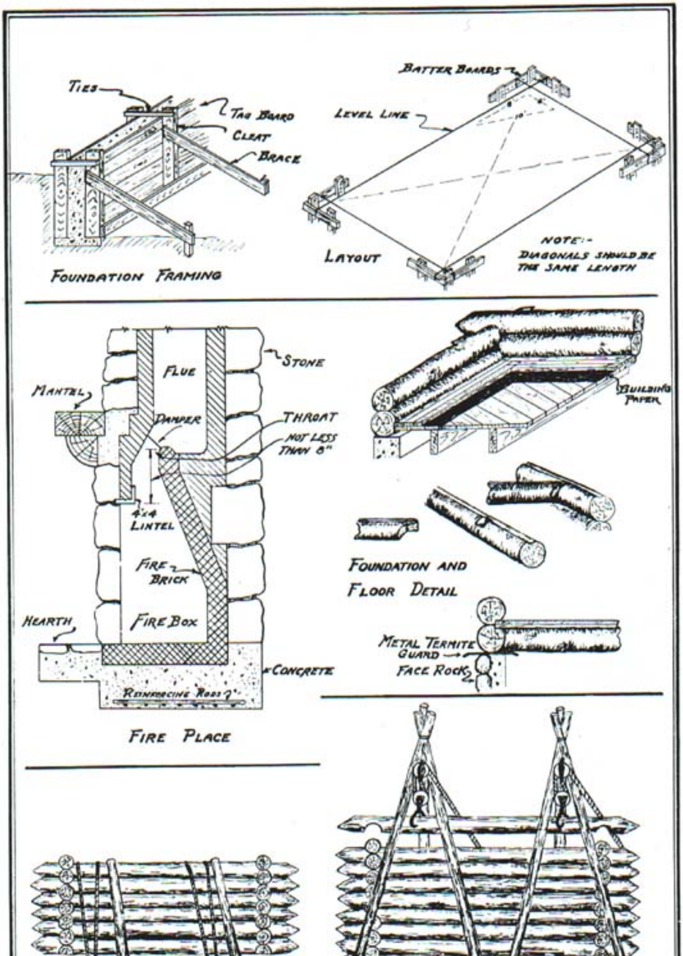
TIES
TAG BOARD
CLEAT
BRACE
FOUNDATION FRAMING
BATTER BOARDS
LEVEL LINE
LAYOUT
NOTE:-
DIAGONALS SHOULD BE THE SAME LENGTH
STONE
FLUE
MANTEL
DAMPER
THROAT
NOT LESS THAN 8"
4x4 LINTEL
FIRE BRICK
FIRE BOX
HEARTH
CONCRETE
REINFORCING RODS
FIRE PLACE
BUILDING PAPER
FOUNDATION AND FLOOR DETAIL
METAL TERMITE GUARD
FACE ROCK
CROSS-HAUL LOG LIFT
TEPEE LOG LIFT

Fig. 4.

should not be more than 6 feet apart, else the lower logs in the deck may develop a permanent crook.

CONSTRUCTION PRACTICES

Clearing

In endeavoring to save as much of the natural setting as possible the builder is often loath to dispose of certain trees and shrubbery that are certain to be damaged and in the way during the course of construction. Usually, the site can be landscaped much more effectively after the building is constructed than before, and at little cost if native shrubs are used. All dead trees within reach of the building should be felled at the outset to avoid possible accidents.

Layout

Having determined approximately the location of the building, the next problem is to "square" the corners. A square corner may be formed by measuring 8 feet in one direction and 6 feet in another in such a manner that a 10-foot span results across the diagonal (Fig. 4). When all corners are established, stakes and batter boards should be set to indicate the height of the foundation. String levels are frequently used in this work, although a better instrument can be devised by sticking a pin into each end of a carpenter's level (at a measured

Fig. 5. A well-constructed, well-lighted cabin suitable as a small school house. Heavier hardware for the door would have been more appropriate. (Photograph by the U. S. Forest Service.)

Fig. 6. A pleasing combination of materials distinguishing floor levels. Note the precautions taken to aerate the timbers beneath the main floor. (Photograph by Michigan Dept. of Conservation.)

distance from the top surface); then by leveling the instrument and sighting between the pins, equal elevations can be obtained with great accuracy. Strings can then be stretched between the points to indicate the foundation levels. Any foundation peculiarities should be considered at this time. Some construction methods require end wall logs to be above the side wall logs by the thickness of one-half log. Foundations at the ends of the building should, therefore, be that much higher.

Foundations

Piers and posts have proved satisfactory as supports for porches, but hardly so for main walls unless they rest on bed rock or unusually stable ground. Continuous foundations are generally necessary to bear the weight of log walls, prevent cold floors, and keep out small animals (Fig. 5).

Footings should go as deep as the soil is likely to freeze and spread out a few inches wider than the foundation wall. The wall itself should rise at least one foot above the ground, else the sill logs will be subject to excessive moisture and decay. Any exposed portions can be faced with rock or hidden with foundation plantings. One or two small openings should be left at opposite ends of the foundation so that the space beneath the floor can be aerated. These openings should be covered with screens during the summer and with shutters during the winter (Fig. 6).

Rock masonry is more appropriate for log walls than foundations of other materials and frequently is cheaper. The foundation, if made of rock, should be not less than 18 inches thick for proper stability. This permits the use of large and preferably flat rocks. Good masonry mortar can be made from one part of cement, three parts of sand, and one-tenth as much slaked lime as cement.

Various other foundation materials may be substituted for rocks if used inconspicuously. Cement building blocks can be laid rapidly and may be preferable to rocks as lining for a basement. Poured concrete is convenient to use in filling trenches although, if it must be extended much above the surface of the ground, forms will add to the complexity of the problem (Fig. 4). Concrete foundations seldom are more than 10 to 12 inches wide yet they demand sturdily braced forms to resist the powerful internal pressure exerted by the mix.

Good foundation concrete can be made with one part of cement, two parts of coarse, sharp sand and four parts of gravel. Thorough mixing is important; it should be continued until the batch is uniform in color. As long as a mix can be well-packed, the less water used the better. A fairly stiff mix will produce stronger concrete than a sloppy one. Under no conditions should the concrete be allowed to freeze.

It is often difficult to obtain suitable aggregates, especially sand. Any local sand that has produced durable concrete can usually be depended upon. A sand can be tested by rubbing it between the fingers; if it discolors them, too much clay or organic matter is present. Gravel can be washed to eliminate impurities; sand, ordinarily, cannot.

Horizontal Log Walls

Considerable time can be saved if the logs are sorted into several piles. There should be one pile of heavy logs for the bottom courses, another of crooked ones that must be cut into shorter lengths and still others of slim poles to form the upper courses and rafters. The logs should gradually diminish in size from the bottom to the top. Some of the very finest pieces should be set aside as roof members at the start.

The first course above the foundation (commonly called the sill) should consist of large durable specimens. They should be flattened on the underside to fit the foundation and notched on the inside to receive the floor joists (Fig. 23). The sills are sometimes fastened by anchor bolts embedded in the foundation, although many cabin builders consider this unnecessary.

As other courses are added they must be fitted along their entire length to the ones immediately beneath and tied into intersecting logs at the corners. There are various ways of doing this; perhaps the best, but by no means the best known, is the "cupping and grooving" method (Fig. 7). This method is characterized by a groove on the underside of each log and a semi-circular corner

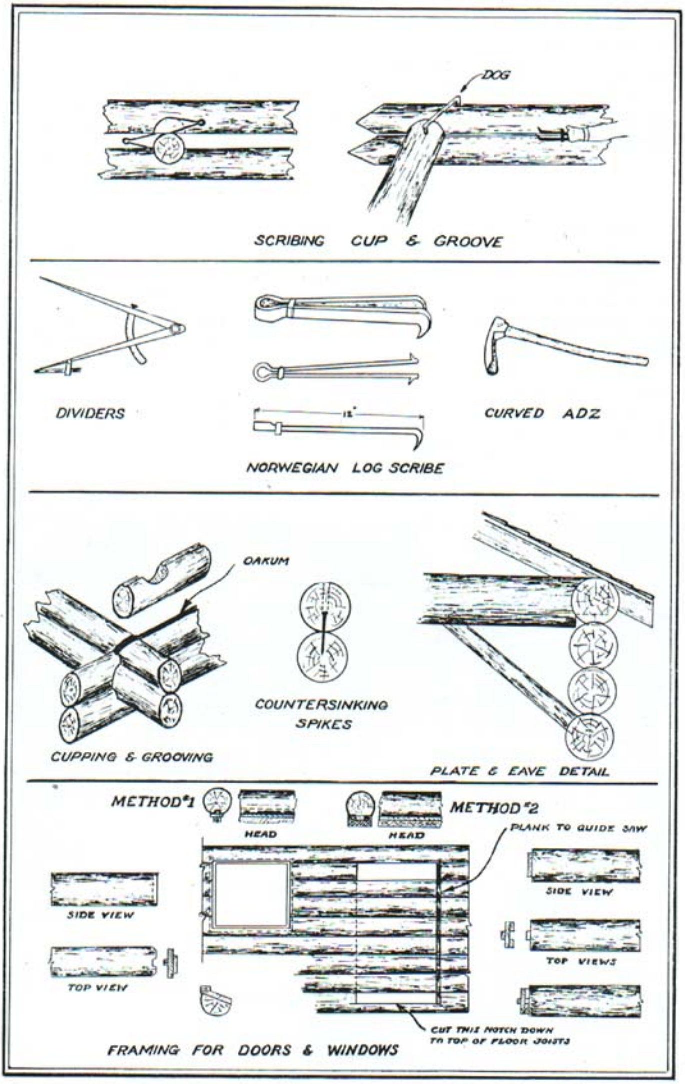
DOG
SCRIBING
CUP & GROOVE
DIVIDERS
12"
NORWEGIAN LOG SCRIBE
CURVED ADZ
OAKUM
COUNTERSINKING SPIKES
CUPPING & GROOVING
PLATE & EAVE DETAIL
METHOD #1
HEAD
METHOD #2
HEAD
PLANK TO GUIDE SAW
SIDE VIEW
TOP VIEW
SIDE VIEW
TOP VIEWS
CUT THIS NOTCH DOWN TO TOP OF FLOOR JOISTS
FRAMING FOR DOORS & WINDOWS

Fig. 7.

notch, which cups over or grasps the intersecting log in much the same manner as one's hand grips a railing. Compared with other methods, this one has several outstanding advantages—namely: (1) Time is saved in having to shape only one side (the underside) of the log; (2) a more waterproof wall and joint is produced; (3) oakum, where it is used, is better concealed than between flattened logs. Other horizontal systems of construction frequently are wanting in one or more of those respects.

In the "cupping and grooving" method the width and depth of each cut is defined by a large pair of wing dividers, or an instrument known as a Norwegian Log Scribe, the latter being made from a piece of spring steel and a link out of a small chain (Fig. 7). Scribing consists of drawing either of these instruments along the crack formed between one log and another immediately below, which already has been fitted and fastened into position. One must be certain to scratch a line on the underside of the top log both inside and outside of the cabin wall. These two lines define the width of the groove as will be seen when the log is turned over. It will be noted, too, that the greatest amount of material always has to be removed at the point where the logs ride in closest contact. For best results, two rules must be observed: first, the notch must be

Fig. 8a. Cutting grooves with curved adz and draw knife.

Fig. 8b. Notching logs with a heavy gouge.
(Photograph by U. S. Forest Service.)

roughly shaped before the logs can be brought sufficiently close to scribe the groove, and, second, the jaws of the instrument must be set slightly wider than the widest gap between the two logs.

The best tool for cutting grooves is a curved adz. Adzs cannot be purchased with curved blades, so they must be heated and curved to the desired degree for this work. They are dangerous tools in unskilled hands, but if the operator keeps the corners blunt they are relatively safe, without causing much loss in effectiveness. As an added precaution the operator should be provided with a pair of sheet iron shin-guards (Fig. 8a).

Axes have often been used to cut the grooves. An accomplished axeman can cut a very acceptable groove, but not so rapidly as with an adz. Gouges have also been used to a limited extent, but because they are slow to operate and tend to bite unnecessarily deep into a log, they usually are not recommended.

Once a log has been fitted to the satisfaction of the builder it is ready to be spiked into place. Many cabin builders choose this time to do their chinking. If so, they lay down a strip of oakum between the logs before spiking them together. Impregnated oakum should be selected instead of untreated fiber because it is more effective in repelling air and insects. It also imparts a pleasant "tarry" odor to the cabin. Even

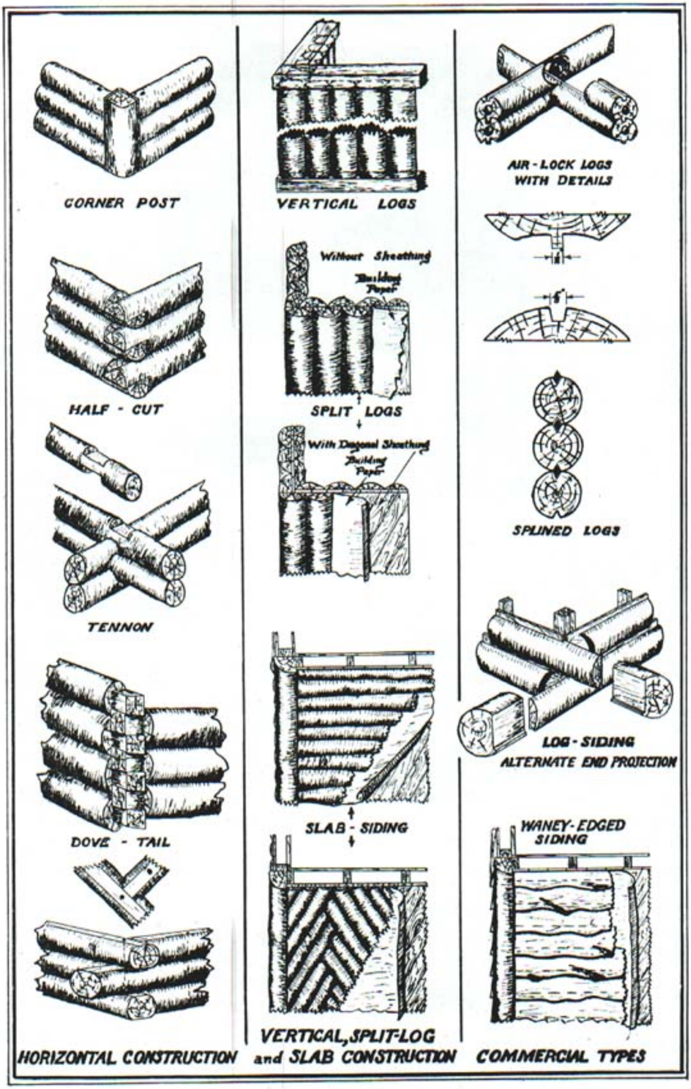
CORNER POST
VERTICAL LOGS
AIR-LOCK LOGS WITH DETAILS
HALF-CUT
Without Sheathing
Building Paper
SPLIT LOGS
With Diagonal Sheathing
Building Paper
SPLINED LOGS
TENNON
LOG-SIDING ALTERNATE END PROJECTION
DOVE-TAIL
SLAB-SIDING
WANEY-EDGED SIDING
HORIZONTAL CONSTRUCTION
VERTICAL, SPLIT-LOG and SLAB CONSTRUCTION
COMMERCIAL TYPES

Fig. 9.

so, the oakum should not show. Spikes, 10″ to 12″ long, should be used because of their great drawing power, although shorter ones can be substituted if properly counter-sunk. Counter-sinking largely overcomes the tendency of long spikes to turn over.

The other methods of construction differ mainly in the type of corner mortise used (Fig. 9). Virtually all of them resort to flattening the log surfaces, which is unfortunate in view of the tendency of flattened surfaces to collect water. Some of them, the corner post and the half-cut methods in particular, can be worked out rapidly, but this means little if, after the work is finished, sound construction, tight-fitting joints and a pleasing appearance are lacking. Corner post construction is neither highly regarded for its appearance nor is it very substantial. The half-cut mortise looks good on paper, but in the actual fitting there is an immediate necessity to fill a square notch with a round or semi-circular log end. An unfilled hole invariably results. Another method failing to measure up to present-day expectations is the dove-tail joint. Its interlocking features may have had advantages years ago when spikes were scarce but it is hardly worth the extra effort today. What is more, none of these methods permits projecting ends at the corners, which is generally conceded to be a desirable feature.

To insure a relatively level top course, butt and top ends of the logs must alternate. Crooked logs often present a problem inasmuch as they tend to make the courses uneven. They can be straightened by turning the bow up and cutting from one-half to two-thirds through the diameter. It is also possible to cut them into shorter

Fig. 10. An attractive combination of vertical and horizontal logs. Extreme knottiness produces a very unusual effect. The general appearance would be vastly improved by shingling the roof.

Fig. 11. A "split-log" cabin of modest design. The building would be much more attractive with a shingled roof and gabled end, a more suitable door, a porch, and a bit of shrubbery around the foundation. (Photograph by University of Wisconsin.)

lengths and splice the parts together although the results are somewhat more conspicuous. The topmost, or plate logs, should extend to the edge of the eaves on the gable ends; they should also be notched to receive the rafters and beveled to fit the roof boards. Log partitions should be carried upwards at the same rate as the outside walls. In no instance should they start from an unsupported part of the floor because the weight would certainly cause the floor to sag.

Vertical Log Walls

In upright pole construction, the sill and plate logs, together with the corner posts, form a frame within which the other poles are placed. The sill logs should be hewed flat enough to provide a good base for the standing poles, and yet have a slight outward pitch for shedding storm water. The vertical poles must be trimmed at the base to match this slope and also along the sides. When finally placed in position, toe-nailing should be on the sides so that the spikes will be hidden by adjoining uprights. Vertical construction is most frequently found in small, low buildings (Fig. 10). It makes good use of short, tapering timber and requires a minimum of labor, but despite this it is not very popular, possibly because there are already too many vertical lines in a wooded setting (Fig. 10).

Split-Log Walls

The so-called "split-log" cabin is not actually made out of split logs but rather from logs that have been sawed in half lengthwise. These pieces are usually set upright with the sawed surfaces face to face although they need not necessarily be arranged in that manner (Fig. 11). Many interesting patterns are possible by occasionally turning them horizontally, or in herringbone fashion over restricted areas (Fig. 4). As a rule, the faces are separated simply with building paper although greater rigidity is possible by adding a layer of diagonal sheathing. Each half should be edged lightly to permit close fitting. Details of the method are illustrated in Fig. 9 and House Plan No. 2 (Fig. 32).

The unique features of this style of construction, aside from those of any upright pole walls, are:

(a) A wall of more uniform thickness is obtained.

(b) The addition of building paper seals the wall against infiltration of air more effectively than is possible by any other method.

(c) This style is better adapted to shedding water than other systems. Unusual protection can be given to the sill logs by extending the outside facing and building paper over them (Fig. 32).

(d) Difficulty with chinking is avoided in that none is needed.

Offsetting these favorable factors is the general antipathy toward upright construction and the tendency of cut faces to bulge upon seasoning. The latter difficulty can be remedied by running each piece through a jointer prior to placement. Solid nailing is indispensable. One spike every two feet will suffice, if driven at a slight angle.

Slab Walls

Slab construction calls for the presence of a sawmill, not merely to supply slabs but liberal quantities of lumber as well. Studding and other structural timbers are just as necessary in this as in any type of frame house. Slabs, in themselves, are merely low grade by-products and consequently should neither be difficult nor expensive to obtain. Only those of fairly uniform thickness will do; poorly matched material will show undesirable bulges and sawed ends. Each piece must be edged to a certain extent before a good fit can be secured (Fig. 12). It is not satisfactory to nail the slabs directly to the studding; better construction calls for a layer of sheathing, building paper and then slabs (Fig. 9). Because this method leaves the interior unfinished, matched and surfaced knotty lumber might be selected as paneling. It harmonizes with the rustic exterior better than insulation board or plaster and is little, if any, more expensive. If greater insulating qualities are desired, sawdust might be packed between the studding.

Log Siding Walls

Unlike most other kinds of siding, log cabin siding can be nailed directly to the studding, thus eliminating a layer of sheathing (Fig. 9). It is usually rounded on the weather side although some firms

Fig. 12. Ordinary beveled siding has been used in this cabin to accentuate the door and window framing. Exclusive use of slabs would not have produced the same effect. The owner obviously has failed to protect the woodwork against decay organisms inasmuch as the rear portion of the cabin is resting directly on the ground and permits no aeration under the floor. (Photograph by U. S. Forest Service.)

market a hewed timber pattern that is very interesting. At a distance, a cabin finished in log siding certainly gives the impression of real logs but at close range there is no mistaking its identity. Even so, this class of material has a definite place in log cabin construction—especially where real logs are not available—or for remodeling old buildings. The cost is only slightly more than that of ordinary lumber.

Processed Log Walls

Commercially prepared logs usually are artificially rounded and have interlocking features that will insure a good fit when in place (Fig. 9). In addition, centers of the logs may be hollowed to permit a reduction in weight, concealed wiring, and to provide a possible insulation advantage. This group of products carries out the rustic motif on the interior of the building whereas log siding generally does not.

Processed logs have certain advantages over real logs:

(a) There is no period of waiting for the logs to season.

(b) Cost of assembling is reduced.

(c) The finished cabin generally fits perfectly.

Whether these factors offset the artificial appearance and the higher cost of materials, as compared with using raw products near at hand, can be decided only by the individual concerned.

Roof Supports and Roofing

A gable roof is best suited to log construction; it is simple and minimizes the occurrence of troublesome ridges, hips, corners and valleys. The roof seldom should have more than "one-third" pitch;* "one-quarter" or less is better. Roofs with more slope are generally favored by builders in regions of heavy snowfall—however, not for log cabins. By the use of heavy timbers, adequate to bear the weight of 20 pounds per square foot occasionally exerted by snow loads, the cabin roof can be kept low, thus simplifying both the construction and the heating problems.

The chief qualities sought in roof timbers are strength and straightness. The strength imparted to a structural unit by any given timber depends on the timber's resistance to bending and rupture (stress at proportional limit). Since different woods vary in this respect (Table 2), specifications for different roof timbers should vary.

The suggested average dimensions that follow apply to the woods listed as "fairly strong" in the table. If weaker woods are used, the cross-sectional area should be proportionately larger. Generally, the diameter of a beam, expressed in inches, should be about one-half the span in feet.

Fig. 13. Structural details of a horizontal log house. Rafters for the main roof lean against the wall.

**The pitch of a roof is the relation between the height of the ridge above the plates and the width of the building.*

Table 2. Relative Strengths of Common Woods (air dry).

Species	Stress at Proportional Limit* (lb. per sq. in.)	Relative Strength
Northern white cedar, balsam poplar, hemlock, black spruce, basswood.	5,000– 6,000	Very weak
Aspen, cottonwood, balsam fir.	6,000– 7,000	Weak
Tamarack, white pine, ponderosa pine, jack pine, Norway pine, elm, red maple, white oak.	7,000– 9,000	Fairly strong
Douglas fir, southern yellow pine, old growth ash, beech, red oak, sugar maple.	9,000–11,000	Strong
Birch, second growth ash, hickory.	11,000–13,000	Very strong

**Stress at Proportional Limit is defined as the load a timber can bear without suffering any injury. Timbers can stand greater stresses than those designated in the table for limited periods but will not recover completely.*

Similarly, ridgepoles and purlins (those timbers that parallel the ridgepole) should be no less than one-third of their respective spans. No such rule of thumb applies to rafters but they should rarely be less than 4 inches in diameter at the middle, or more than 6.

The raising and installation of roof timbers should take place in the following order: ridgepole, purlins, beams, struts, rafters. The ridgepole is usually the most difficult to lay, sometimes requiring a sparpole equipped with a block and tackle, or, if a splice is necessary, a temporary tower. The same applies to raising purlins. Both timbers should extend beyond the gable end sufficiently far to sup-

Fig. 14. Attractive log work in a U. S. Forest Service ranger station. The structure features a full basement and ample porch space. It might have been much more attractive had the foundation been constructed of material similar to the fireplace.

Fig. 15. A well-appointed small log cottage. Note the width of the eaves and the unusual method of supporting the porch roof. (Photograph by U. S. Forest Service.)

port the eaves. They should be squared where they rest upon the walls and a square notch should be cut to receive them.

Over any long spans the ridgepole and purlins must be supported from below. Struts or trusses perform this function. They should be so arranged as to distribute the weight toward the outer walls insofar as possible (Fig. 22). Unseasoned timbers may have to be propped up with temporary posts until the stiffening process overcomes the tendency to sag. Knee braces, set at an angle of 45°, are often used to support the beams. Their value generally is more aesthetic than strengthening.

Rafters may override or simply meet the ridgepole. They also depend on the purlins and plate log for support, imbedding themselves in the latter and projecting far enough beyond to form the eaves, or, perhaps, a porch roof. Inasmuch as their chief function is to provide anchorage for the roof boards they should not be too widely spaced—never more than 3 feet apart. Furthermore, they must present a smooth surface on top. Long straight-edged boards are useful in leveling the rafters.

Roof Covering — A serviceable cabin roof might consist of, first, a knotty grade of pine sheathing, second, a layer of asphalt building paper, third, a coating of roofing tar, and, last, wooden shingles or shakes—all materials laid in the order mentioned. Bright new lumber will help to keep the interior light, while the building paper and tar give added security against leaks. Wooden shingles or shakes are considered more appropriate than composition ones and are usually longer-lived. Roofing paper alone, tin or decorative composi-

Fig. 16. Splitting out shakes with a shake-maker's froe. (Photograph by the U. S. Forest Service.)

tion shingles are out of place in rustic cabin construction.

Shakes differ from shingles in size and manner of production. Instead of being sawed out of a block of wood they are split out with a shake-maker's froe (a tool resembling a meat cleaver, but having a vertical handle (Fig. 16). It is impracticable to attempt splitting them out of anything but large bolts of straight-grained durable woods. Cedar, pine and white oak are most preferred. Shakes are larger than shingles and have no taper. For this reason longer nails are needed to secure them.

Zinc nails outlast the ordinary type by many years and prevent the shakes or shingles from becoming loose and blowing away. Eighteen-inch shingles are commonly laid 5½" to the weather and spaced one-eighth inch apart. This practice can hardly be followed in laying shakes, although some provision for expansion joints and adequate overlap must be observed to avoid buckling and leakage.

Fireplaces and Chimneys

There are many ideas as to what constitutes a good fireplace. Numerous designs appear in magazine articles, sales literature and elsewhere; only a few can be mentioned here. In general it is agreed that the fireplace should be constructed of native stone, it should ably assist in heating the cabin and it should occupy a prominent place in the interior.

Two outstanding fireplace types

are in common use—the "circulating" fireplace and the ordinary one. Units of the former type consist chiefly of a fire box of boiler plate steel with an air circulating chamber surrounding it (Fig. 31). When properly installed, cold air is drawn into the circulating chamber through registers at the floor level, it then becomes heated in the compartment behind the fire box and is ejected through registers at a higher level. This feature is supposed to double the efficiency of a fireplace, but if small fans are installed to assist the circulation, efficiency is theoretically quadrupled. There is little doubt that the circulation feature adds materially to the heating capacity of the fireplace. Manufacturers claim that the price of such a metal chamber is largely offset by a saving in labor costs and the elimination of fire-brick and a dome damper.

The more common type of fireplace is based on principles of heat radiation rather than circulation. Figure 4 shows a fireplace of this kind having the essential features so related as to insure good draft conditions and heating efficiency. It will be noted that in order to throw the maximum volume of heat into a room the rear wall of the fire box is pitched well forward, enough so to provide space for a suitable smoke chamber at the base of the flue. The throat is formed at the same time. A rough relationship exists between the several parts. The depth of the flue should be approximately one-half the depth of the fire box and the throat about one-half that of

Fig. 17. A cut-rock, circulating fireplace. Registers are on the side. Individual rocks have been accentuated with an outline of black mortar.

the flue. The throat should have the same width as the fire box until it is above and out of range of the damper, then it should taper towards the flue at an angle of about 60° from the horizontal. Unless the throat and smoke chamber are correctly designed and smoothly finished, "smoking" invariably results. Another important relationship exists between the area of the fireplace opening and the area of the flue, the former should not exceed the latter by more than 10 times. The fire box should be well-lined with fire-brick to prevent the heat from breaking off rock fragments and showering them into the room. A damper should also be installed, not so much to control burning as to keep cold air, insects and small animals from gaining entrance by way of the chimney.

Except for the hearth, fireplace footings should go to the same depth as the main foundation. They consist, principally, of concrete and reinforcing steel upon which a layer of fire-brick is placed to form the base of the fire box. Support for the hearth need be nothing more than a ledge protruding from the main bulk.

The rockwork may be formed from cut or uncut stones (Fig. 17 and Fig. 18). Never should the two be mixed because there is a marked difference in appearance, owing to weathering. When rocks are used in their natural state, shapeliness is of first importance. Poorly shaped ones are difficult to balance and tend to slip. On the other hand, in cut rock fireplaces workability takes priority. Some rocks are extremely hard and difficult to split. The fine-grained, dark colored, igneous rocks make up the greater portion of this group. A good mason will recognize them on sight. The walls

Fig. 18. A natural rock fireplace artistically patterned.

Fig. 19. Partially completed fireplace showing the placement of corner stones, framing for the fire-box arch and scaffolding.

should be approximately one foot thick. This does not mean that the rocks need be a foot thick; any difference can be made up with poured concrete.

Several temporary forms and possibly one permanent one may be needed in constructing a fireplace. The permanent one usually consists of an angle iron lintel, placed to assist in supporting the rock mass over a square-mouthed fire box opening. A lintel is not necessary in an arched opening having a keystone; in this case the mass can be supported with a sturdy temporary form while the mortar is setting (Fig. 19). The same is true in shaping the rear wall of the fire box and the air passages of a circulating fireplace.

As the rockwork advances from one level to another, corner stones are always the first to be placed in position. Haywire and rock chips are often used to balance and hold them in place. The intervening area can be filled in after these keystones have been allowed "to set" in mortar over night. When the higher levels are reached, scaffolding and pulleys will have to be provided.

The rockwork should be well lined-up throughout; variations of as little as an inch or two are often noticeable. Long plumb levels, and drop lines, suspended from the roof, are indispensable in keeping it so. Adjacent logwork should be trimmed so that the ends may extend into the fireplace a few inches.

If the cabin is in the open the chimney should project at least two and one-half feet above the roof to insure good draft conditions; if nestled in a pocket of tall trees it may have to be several feet higher. Proper curvature of the chimney cap also may aid a sluggish fireplace to produce an upward draft on windy days (Fig. 30). This advantage should not be off-set by "tapping" a stove pipe from another heating unit into the chimney. A second flue, separated by the width of one brick, is much more satisfactory. A chimney flue can be formed by bending a piece of sheet metal to the proper size and using it as a form to support the surrounding masonry. It can be drawn upward as the work progresses. Such chimneys are less expensive than those that are lined with fire-clay tile, but are not so safe.

Flat stones make better hearths than do brick, tile, concrete or roofing slate. They should extend from one to three feet out in front, depending on the size of the fireplace, and should rest on foundations or suitable ledges rather than inflammable floor joists. Some are built on a level with the flooring, others are raised a few inches to

Fig. 20. Interior finished in knotty pine lumber. Note the odd character of the furniture, the massive hewed mantelpiece, and the level of the hearth.

Fig. 21. Logs and rocks blend together in any type of building. Both were obtained locally as were the cedar shakes in the roof.

harmonize with a slightly elevated fire box (Fig. 20). No pronounced advantage exists either way.

There is equally as much opportunity to exhibit originality in a fireplace as in the logwork. An odd design, an unusual mantelpiece, or a finish of dark-colored mortar setting off the individual stones creates a pleasing and variegated effect. Attachments, such as cranes or warming ovens, lend utility and antiquity.

Flashings

Flashings are used to prevent water from leaking into the cabin by way of ventilating pipes, chimneys, gutters or ridges. A flashing must either be bound around an object penetrating the roof tightly enough to preclude any chance of leakage at the bond, or it must extend into or under the fixture in such a way that water would be required to flow up hill in order to gain entrance. The former method is generally used around plumbing fixtures, the latter around chimneys.

Once a chimney has been brought to a level slightly above the shingles, a beveled piece of lumber is thrust into the mortar with the sharp edge uppermost. Upon setting, the lumber is removed and a flashing inserted in its place. If the flashing conforms with the indentation it will have a decided upward pitch thereby tending to conduct water away from the point. Above the chimney the flashing should be inserted under the shingles; below it, it should overlap them. To be doubly certain that no leakage will develop all joints and nail holes should be daubed with roofing tar. Gutter flashings should be laid before shingling, ridge flashings afterward.

Sheet lead and copper make excellent flashings, but because they are relatively expensive, galvanized iron or tin, with a lead coating, is generally substituted. In some instances, the substitution might take more visible form. An attractive ridge roll can be made from a log that has had a V-shaped notch, corresponding to the peak of the roof, cut along its entire length.

Windows

Modern log cabins can, and do, make one noteworthy departure from the early conception, namely in providing for better-lighted interiors (Fig. 5). Dark and gloomy interiors were no doubt as distasteful to the pioneers as they are to the present generation, but little could be done to remedy the situation so long as glass was expensive and difficult to transport. Not only are the windows more plentiful today but all types are to be found (Fig. 22).

Window openings either may be cut out of solid walls or formed by the use of short log lengths (Fig. 7). The latter policy permits more economical use of a limited supply of logs; the former, more uniform log courses. Insofar as possible they should be well spaced, of uniform shape and in conformity with the doorways. Opening sizes are usually governed by the dimensions of ordinary window sash, which, in turn, are governed by standard light sizes. Still, it is possible to have sash made up to almost any size at small extra cost. Small panes are more appropriate than large ones and are cheaper to replace if broken.

Frames adequate to accommodate the sash should be made up as units beforehand rather than attempting to build the frame work of a window into an opening. It is infinitely better to take up the slack between the frame and wall than between frame and sash. The simplest type of frame consists of four planks properly fastened at the corners and pitched at the top and bottom to shed water. A better type from the standpoint of tightness and ability to withstand the settling of logs is one that interlocks the frame with the walls (Fig. 7). It is considerably more difficult to build, yet should be worth the effort in valuable buildings.

Double-sash, side-sliding windows, being wide laterally and narrow vertically, harmonize well with the low lines of a cabin. They likewise require very little hardware and, inasmuch as the sash slides entirely within a framework there is no interference with curtains or furniture. However, if the sashes are fitted tight enough to keep out cold drafts, they become very difficult to move during damp weather. Where windows of this kind are installed, water drainage is obtained by drilling holes into the track at the sill level.

Windows that slide vertically are usually tall and require relatively high walls, hence they do not conform with log cabin architecture; only when arranged in groups do they lose this effect. They offer less resistance toward opening than the preceding type, but are relatively difficult to build.

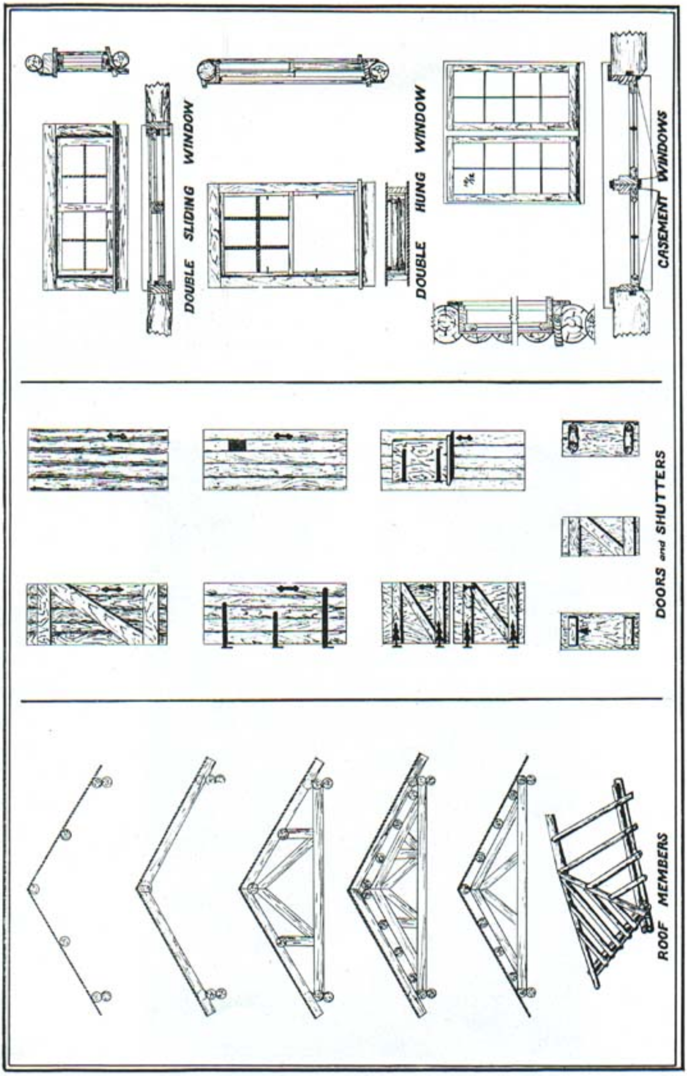
DOUBLE SLIDING WINDOW
DOUBLE HUNG WINDOW
CASEMENT WINDOWS
DOORS and SHUTTERS
ROOF MEMBERS

Fig. 22.

The style of window that seems to have the most desirable features and the least objectionable ones is the casement window. It is the easiest of all to operate and provides for maximum aeration. Inward swinging casements permit washing from the inside and installation of screens in the usual manner. On the other hand, they are likely to introduce water leakage problems unless carefully designed, and they may interfere with the placement of furniture if set too low. Casement windows also require more hardware than the other types, the minimum being a pair of hinges, a hasp, a flush bolt and an arm extension per sash.

Doors and Shutters

There is wide latitude for individuality in choosing doors and shutters, provided the selection suggests ruggedness or antiquity rather than standard factory-made stock (Fig. 22). Special types, suitable for log cabins, may be obtained from some sash and door concerns, or they may be built on the premises. The home-made kind might very well consist of a layer of building paper between two

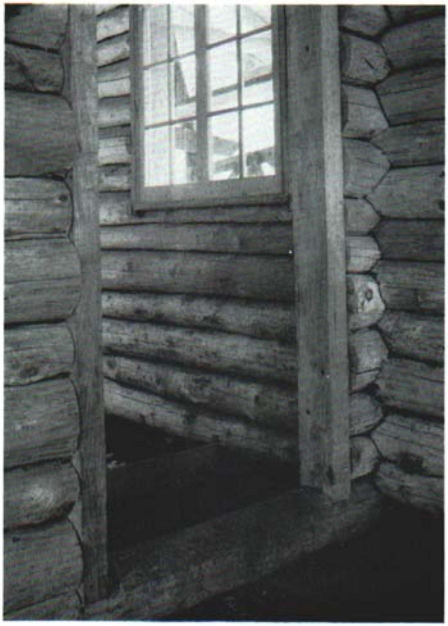

Fig. 23. Heavy hewed framing for the doors.

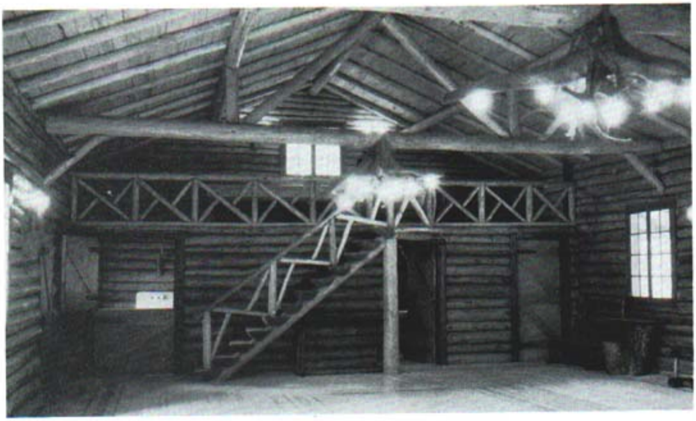

Fig. 24. Interior of a community cabin. Over any wide spans roof timbers must be braced. Note the rustic staircase, lighting fixtures and furniture.

thicknesses of tongue-and-groove lumber, all of which being held together with the familiar "Z"-type cross bracing. The appearance can be improved by studding one or both sides with large round-headed screws, or, for a more humble effect, with clinched nails.

Heavy hewed frames also go far in suggesting that antiquity of origin and sturdiness peculiar to log cabins (Fig. 23). The same can be said for the hardware. Many local blacksmiths can turn out all kinds of useful latches, hasps and hinges in black iron which harmonize with the rustic appearance of cabins. The old style gate hinge shown in Fig. 30 is an example of what can be done.

Staircases

Staircases of round and half-round timbers far surpass the usual plank type (Fig. 24). Where used, these staircases must rest upon foundations rather than unsupported parts of a floor. Insofar as possible, stairways going aloft should be directly above those going to the basement. The rise per tread should not exceed 8 inches, else the ascent will be uncomfortably steep.

Flooring

Wood flooring harmonizes much better with log-construction than other substances. Its chief competitors, stone and concrete, are too cold, although they have the advantages of being less expensive and more suitable for ground level floors. Cabin floors, as a rule, should be low, yet supporting timbers should clear the ground by several inches for proper air circulation.

Floor supports, or joists, may be round or squared; either way they must be notched into the sill log to obtain a good bearing on the foundation. It is better to saw out the notches before the sill log is laid than to chisel them out afterward, and also to bring the notches in conformity with standard joist spacing, which is 16 inches from center to center. In some instances, to allow more freedom of movement inside the building, it may be advisable to defer placement of the joists until the cabin approaches completion. If this is done, a middle foundation will probably be necessary to support the short joists that are brought from either wall, since it is impossible to crowd a full-length timber (one that will reach from one outer wall to the other) into the notches after all the wall logs are in place.

Joist sizes vary with the span and the load they are expected to bear, being seldom less than 2 by 8 inches in planks or 6 inches in the round. They should be brought to a perfect level to receive the sub-floor. This means that some have to be shimmed, others notched, and still others hewed down. The whole unit can be made more rigid with cross-bracing.

Sub-flooring is more effective when laid diagonally, than at right angles to the joists and is less likely to sag. Cheap, knotty lumber is adequate if it is of uniform thickness and fairly soft. Finish flooring may vary over a wide range of woods and lumber grades. Such softwoods as redwood, cypress and cedar are unsurpassed for exterior use, because of their great durability. Douglas fir, western larch and pine, when sawed to expose edge grain, are also very satisfactory. For the interior, hardwoods are preferred, because of their greater wearing qualities and appearance. They need not be more expensive either, if one selects moderately priced lumber grades. Third-grade maple, for instance, is cheaper than some grades of pine, and the mineral stain figuration, the cause of the degradation, is not at all undesirable in informal rooms and buildings. Standard tongue-and-groove flooring is nailed on the side, at an angle of about 45 degrees, and set with a punch. Use of a punch is important to prevent damage to the edge of the flooring. Modern flooring nails are flat one way, wedge shaped the other, and roughened to increase the holding power. This also minimizes the chances of splitting the tongue. They are superior to the old style 8d (8-penny) nail in every way, but unfortunately are not being used very extensively as yet. Squeaky floors are almost always the result of inadequate nailing.

To create an early pioneering effect floors may be made from plain wide planking and numerous large headed nails left purposely exposed. Floors of this sort frequently contain a considerable amount of flat grain, which tends to splinter and wear irregularly. The nails, too, are never so secure as when driven at a sharp angle. This difficulty can be remedied by the use of screws, counter-sinking them deeply. A glued wooden pin is finally driven into each hole giving the effect of a pioneer's "pinned floor".

Porches

Porches should be roomy and well-aerated. The main one, and it is agreed that a vacation cabin should have at least one, should face the center of interest. In case this would deny light to a room that is urgently in need of it, the interior design should be altered. Porches are easiest to construct and have a more unified appearance when the slope of the main roof can be extended to cover them. Extension of the main roof over a gable end is never very attractive, since the porch seems unnecessarily high. If a porch must be attached on that end, it is better to lower the roof by imbedding short rafters into the wall logs (Fig. 3).

Finishes and Preservatives

From the time the logs are peeled until the structural work is done, much of the woodwork will have weathered gray and dirty. Thorough cleaning is necessary before any kind of a finish can be applied. If the wood is merely dirty, a tri-sodium wash will suffice, but if it is weathered, scraping will be necessary. Finishing the log walls is desirable for two reasons, to provide a protective coat that will prevent dirt from becoming seated, and to increase the resistance to decay and discoloration.

Boiled linseed oil is a very popular interior finish. It is relatively cheap and will produce a soft, beautiful effect on clean wood. Ordinarily two or three coats are applied at intervals of from two to three weeks, followed by a coat of wax. When applying this finish, as with any other oily one, the log surfaces must be thoroughly dry. A cheaper, yet still satisfactory finish can be obtained with a single coat of linseed oil and turpentine, proportioned 3 to 1, to which a touch of chrome yellow paste is added. After that has dried, a coat of clear shellac and alcohol, equally proportioned, should be applied. This combination produces an oiled surface with a faint golden hue. Just enough sheen is imparted by the shellac to brighten the surface and make it easier to clean. There are also many excellent commercial preparations. If chinking is to follow the finishing coats, care should be taken to keep the shellac out of the cracks for it forms too hard a surface for most chinking compounds to grip. One should also remember that mortar will not adhere to a freshly oiled surface. In addition to the finishes just mentioned, brown creosote stains produce a nice effect on log exteriors, especially with contrasting chinking in the cracks (Fig. 25). They can be prepared from most of the heavier creosote oils by diluting with kerosene. Heavy black creosote oils are not satisfactory without dilution, because they have a lasting pungent odor and are too dark in color. For wooden pieces in contact with the ground and for those resting on low foundations the creosote should be applied in concentrated form. The best preservative treatment is to immerse the timber overnight in a strong creosote solution. Long metal or wooden troughs may be used to facilitate this operation. This method is far superior to brush applications.

Fig. 25. Treating the exterior with a creosote stain.

Insect pests, as well as decay organisms, are repelled by the preservatives. Some of them, notably powder post beetles, attack partially or even fully seasoned hardwood timbers. Porous woods such as oak, ash, and hickory are especially well-liked and can be ruined in a few years. Another group of insects capable of much destruction are termites.* They are especially active in southern and central United States; fortunately, climatic conditions are such that little damage is done in the west and the northern parts of the New England and the Lake States regions.

Several preservative formulas have recently been developed by the Western Pine Manufacturers Association to control these insects. They are known as Permatol "A, B, C, and D," "C and D" being used to combat termites and powder post beetles respectively. Permatol "C" consists of 5 pounds of tetrachlorphenol diluted with 13 gallons of some such penetrant spreader as Stoddard's Solvent Naphtha. Permatol "D" combines 3 pounds of 2-chlororthophenyphenol with the spreader. These solutions are colorless and penetrate well into the wood by brushing; they will not, of course penetrate a shellaced or varnished surface.

Whether some additional touch of color should be added to the woodwork of the cabin is largely a matter of individual preference.

**For the control of termites, see U. S. D. A. Farmers Bulletin 1472 "Preventing Damage by Termites or White Ants," or Michigan State College Extension Bulletin 193.*

The judicious use of a gay color on door and window-frames or shutters may impart a cheerful note, but added to log ends, frieze boards and other points is not considered good taste. For finishing work of this character, stains are better than paints because the grain of the wood is preserved. A stain effect can be attained by rubbing off the surplus of any paint or turpentine-linseed oil base containing coloring matter. Many shades of red, cherry, or orange are possible with burnt sienna. Shades of gray are made by mixing black paste with white lead in different proportions, although the "silver grey" of weathered pine cannot be accurately reproduced without a certain amount of erosion. Greens and blues are difficult colors to control, as they are quite apt to fade.

Chinking and Daubing

Few, if any, log cabins can be constructed tight enough to keep out drafts and insects without resorting to chinking or daubing in some form. Such time-worn chinking materials as moss, rags, and mud have proved neither lasting nor attractive. Only when held in place with strips of wood are they effective, and these increase the number of dust-catching ledges.

One of the most widely used of all chinking substances is oakum. Its popularity is due chiefly to the fact that it can be used in unseasoned log walls; in addition, it is easy to handle and moderately priced. It is not suitable for cabins having wide cracks unless used in connection with willow wands. Being of fibrous texture, it can be tamped compactly into place, even to the exclusion of air, and although the logs may shrink further apart, the oakum will still be serviceable by a little extra tamping. Well-fitted walls need nothing else. If the fit is not particularly good and the oakum shows, a secondary chinking may be desirable, both to improve the appearance and to reduce the fire hazard (oakum is rather inflammable). The logs should be given ample time to season before a secondary chinking is applied.

Hard mortars should never be used to chink unseasoned logs. Mortars that are basically cement, lime or gypsum harden quickly and permanently and so are not well-adapted to meet the hygroscopic action of wood. Swelling wood will push the mortar out of a crack or crumble it, and there will be no recession as shrinking takes place. Tests and experience have shown that unless hard mortars are given a backing of reinforcing materials, thus permitting them to get a more solid grip, they can be expected to crumble and fall out within a year or two. A mortar, composed of one part of cement and six of wood fiber plaster, when combined with a strip of metal lath, or a row of galvanized nails has staying qualities of considerable merit, yet, without the reinforcement, it cannot be recommended.

A commercially prepared product known as "caulking compound" will furnish very good results because; (1) it retains its plasticity for a long time, thereby being able to withstand the shrinkage and swelling of wood remark-

Fig. 26. Applying caulking compound with a pressure gun.

ably wėll; (2) it is easier to apply than the majority of chinking materials, since it can be loaded into and discharged from a pressure gun; (3) used in a gun, a narrow, even line is formed, thus not covering up the logwork unduly, and (4) it is available in many neutral colors, in cartridge form, or in bulk (Fig. 26). One gallon will fill a crack 275 feet long of average width and depth. It is more expensive than the chinkings previously mentioned, but if labor costs are considered, not excessively so.

Asphalt emulsions, used in combination with such organic substances as wood fiber, or fine sawdust have been tried with varying degrees of success. One such product, known as "Atco Plastic Fiber Seal,"* has been used by the United States Forest Service very successfully. Like caulking compound it remains plastic (in a case-hardened condition) indefinitely, adheres well, except when spread upon a wet surface, and can be applied with a gun. The black color may be objectionable, but it can be changed to suit the taste, after a first coat of asphalt aluminum paint. Actually, with fresh, light-colored logs it serves about the same function as a black mortar outline around fireplace rocks. Care must be exercised in its application, for there is an inclination to produce stains.

Another compound of considerable merit is prepared from flake glue and fine sawdust. It has much the same characteristics as mortar in that it is troweled into place, sets up hard, and is economical to use for rough construction or wide cracks; however, it adheres better than does mortar.

**American Tar Company.*

ACCESSORIES

Furniture

Odds and ends of furniture will ruin the appearances of the interior of a log cabin as surely as any violation of the design, perhaps more so. If one wishes to buy furniture outright, nothing could be more appropriate than the "Early American" or "Colonial" pattern. It is simple, sturdy, moderately priced, and handsomely finished in any article from stools to double-decked beds. Rustic furniture also is attractive and possibly can be made by the cabin builder, provided he has the time and patience, as well as such simple tools as a ship auger, rasp, chisel, screws and glue pot. Particular attention should be given to the design, finish and solid joint construction. Joints are made tight in a socket by means of a small wedge in the cleft of a tenon. The design should be carried out conscientiously but not to the point of destroying comfortable qualities of the furniture. Cabin chairs and settees can be made as comfortable as more expensive pieces by properly shaping, padding or webbing the seats and backs.

Plumbing

The most economical way to dispose of sewage is through the septic closet comprising a septic tank, placed partly under that portion of the building where the closet is located, and a tight, well-vented stool having a large drop tube.* It is thus possible to have an indoor closet without running water and without danger of freezing, yet providing a means of disposal for lavatory and kitchen wastes. Closet, sink and materials for a septic tank need cost no more than $100; labor charges possibly may double this figure.

Standard waste fixtures with a running water system will run considerably higher. However, if the kitchen and bathroom are close together, materials and equipment should not exceed $200. This allowance will include a pumping unit (gas engine or electric motor), pressure tank, hot water boiler, water front for the kitchen stove, septic tank and the necessary sink and toilet fixtures. Labor cost may increase this expenditure to approximately $350. This estimate presumes there is a free supply of water from a nearby spring or stream. If a well must be driven, dug or drilled the cost may range from $25 to several hundred dollars more, depending on the level of the water table and the soil conditions encountered.

No water and waste system should be installed that cannot be adequately protected from freezing. Little harm can be done to such simple installations as a pitcher pump and septic closet; relatively more can go wrong with ordinary water and waste fixtures. The most necessary protective measures usually taken are: (1) drainage of the water system by means of a bleeder valve, and (2) the addition of some cheap chemical with a low-freezing point, such as salt brine or kerosene, to the traps; or, as an added convenience, frost-proof toilet fixtures

**For further information regarding water and waste systems see references on page 54.*

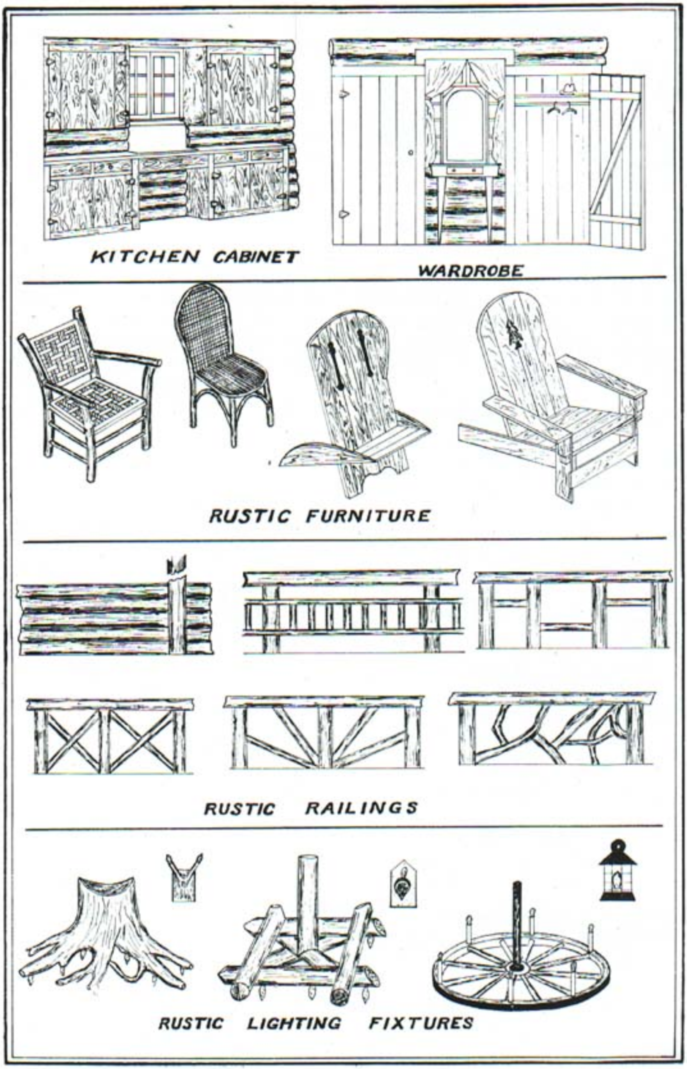
KITCHEN CABINET
WARDROBE
RUSTIC FURNITURE
RUSTIC RAILINGS
RUSTIC LIGHTING FIXTURES

Fig. 27.

might be obtained. Fixtures of this sort are characterized by having their traps and valves set well under ground. As a rule they are no more expensive than the ordinary kind, but, because of the slight demand, they must be ordered specially. Aside from the precautions taken to avert damage from freezing, provisions must also be made for adequate-sized vents (small ones are inclined to clog with frost during cold weather), a sufficient number of cleanouts, and tight caulking throughout. The services of a licensed plumber should be obtained for this work.

Electricity

If the cabin is within range of power lines satisfactory light and power is assured; if not, dependence may have to be placed in a home lighting plant. The most economical lighting plant practical for serving a small building delivers 6 volts, the same as an automobile generator. Current of this voltage cannot be delivered any great distance, usually not outside the building, and is capable of lighting only a limited number of bulbs. Small gasoline engine-operated plants of this type, together with the necessary wiring, need not cost more than $100. As a rule more satisfaction can be obtained from heavier duty plants supplying 32- or 110-volt current. Frequently the engine used to operate a pump can also be used to run the generator. If so, the generator should not be powered with less than a 1½ h.p. engine.

Concealed wiring has many advocates and if time can be taken to drill holes through the logs while the cabin is being erected, it may be worth the effort, however, careful surface wiring with non-metallic sheathed cable can be relatively inconspicuous, if the wires are "run" along the cracks instead of across them and if painted to harmonize with the background. The wiring should be done by a licensed electrician. A great fire hazard accompanies faulty installation and no insurance can be obtained until the wiring has been approved by a properly qualified inspector.

APPENDIX

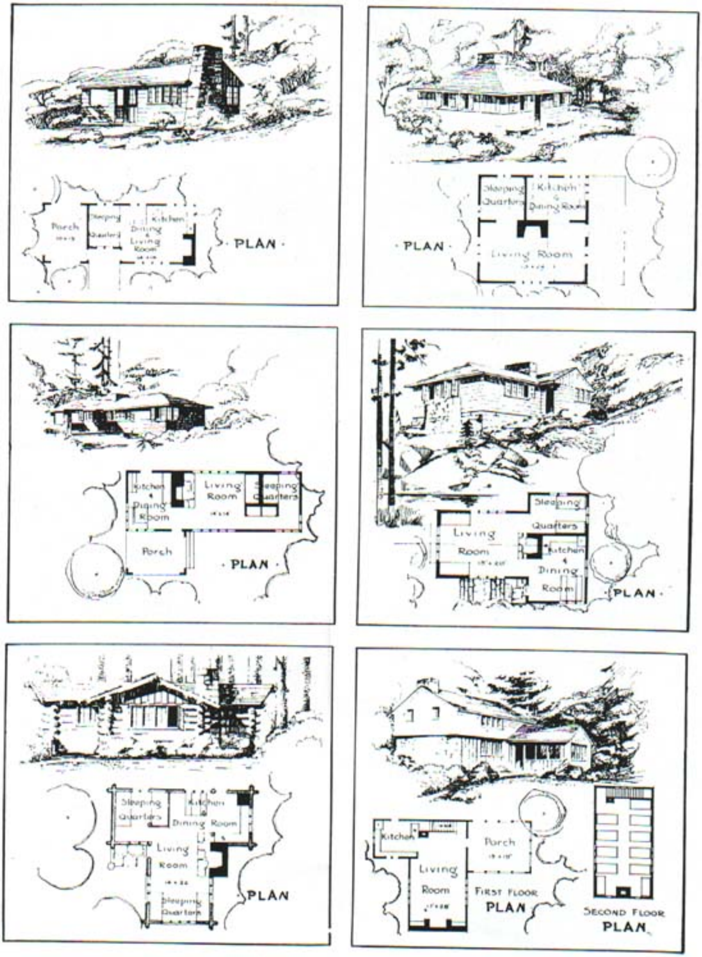

Fig. 28.

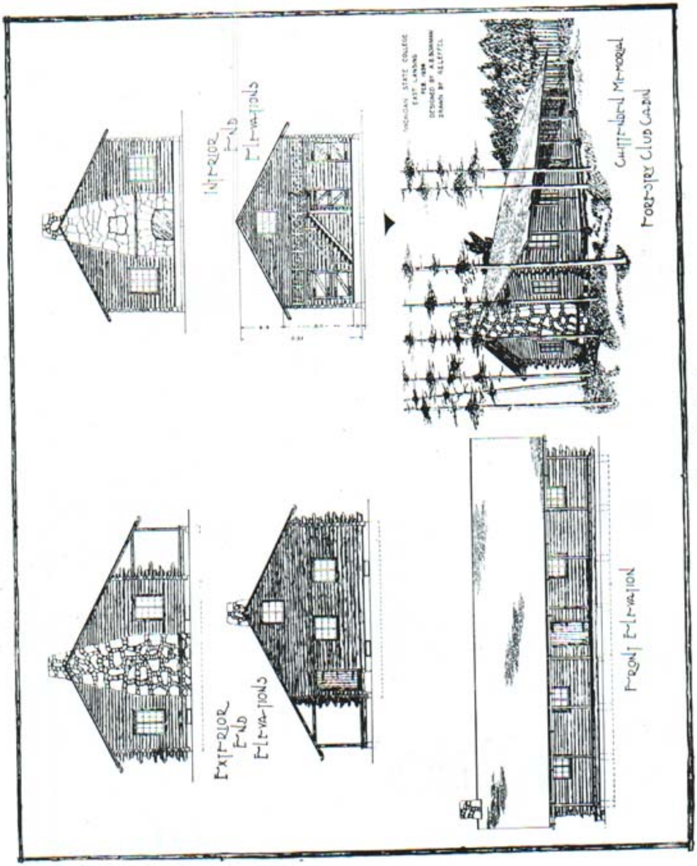
EXTERIOR END ELEVATIONS
INTERIOR END ELEVATIONS
CHITTENDEN MEMORIAL FORESTRY CLUB CABIN
FRONT ELEVATION

Fig. 29, Plan 1.

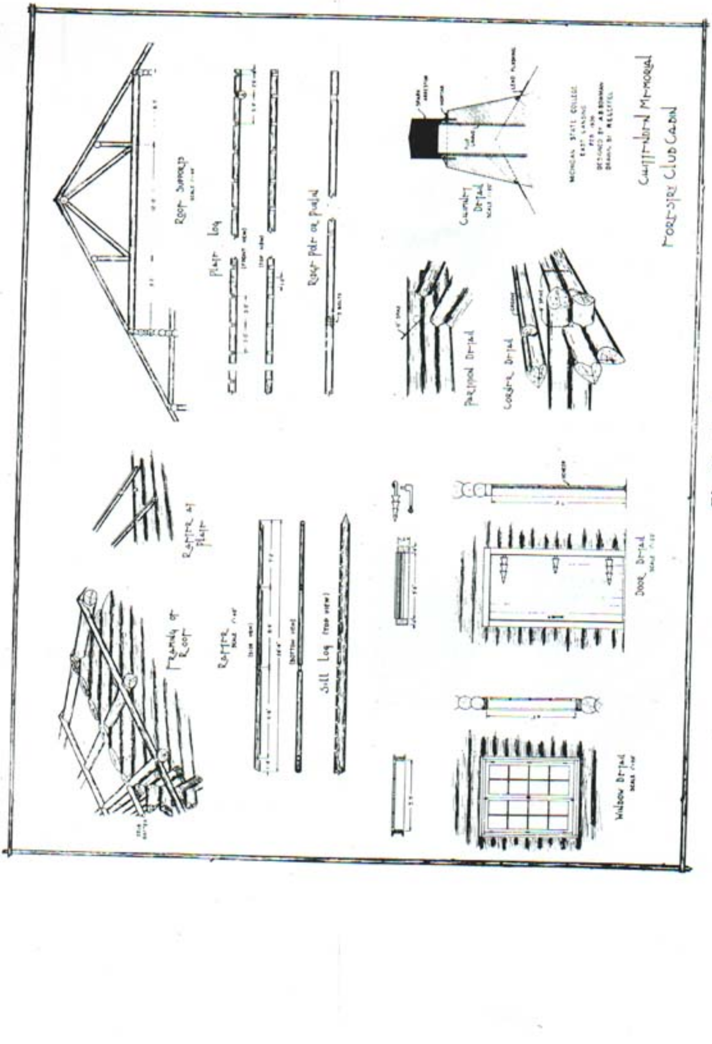

Fig. 30, Plan 1.

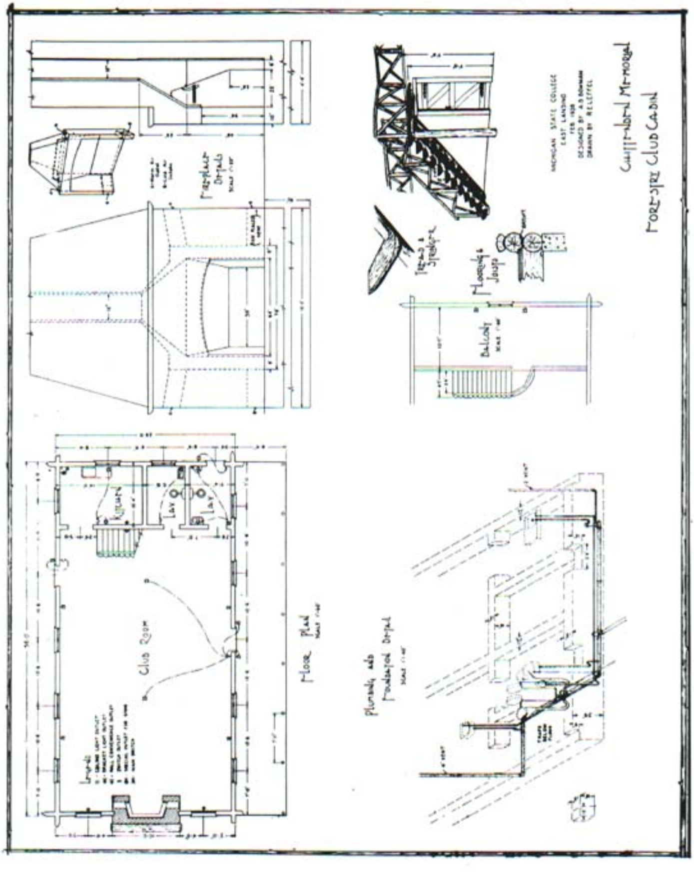
Club Room
Floor Plan
Balcony
Michigan State College
East Lansing
Chittenden Memorial
Forestry Club Cabin

Fig. 31, Plan 1.

MATERIAL LIST

FOR

HORIZONTAL LOG CLUB CABIN (56 X 28)

A. ROUND TIMBERS:	Materials and Size	Quantities
Wall logs (softwood)	Max. 12" butts / Min. 6" tops	
	30' to 32' long	50 pieces
	20' long	24 pieces
	16' long	32 pieces
	12' long	61 pieces
	10' long	70 pieces
	8' long	136 pieces
Roofs (hardwood)		
Ridge pole & purlins	32', av. diam. 10"	6 pieces
Beams	28', av. diam. 12"	2 pieces
Rafters	26', av. diam. 6"	22 pieces
Rafters	18', av. diam. 6"	22 pieces
Balcony beams	10', av. diam. 6"	16 pieces
Stairway (hardwood)		
Stringers	14', av. diam. 10"	2 pieces
Treads	12', av. diam. 12"	5 pieces
Post	8', av. diam. 8"	1 piece
Railing: posts & grips	av. diam. 4"	80 lin. ft.
Railing: braces	av. diam. 2"	100 lin. ft.
Door frames (hewed hardwood)	4" x 8" x 8'	14 pieces
	4" x 8" x 6'	6 pieces
	1" x 4" x 8'	25 pieces
	1" x 4" x 8'	14 pieces
	1" x 4" x 6'	6 pieces
B. ROUGH TIMBERS AND LUMBER:		
Joists (main floor)	2" x 12" x 14' spaced 18" apart	72 pieces
Joists (porch)	2" x 8" x 18' spaced 24" apart	13 pieces
Sub-flooring, 1" stock, any widths & lengths		1900 bd. ft.
C. SURFACED LUMBER:		
Roof sheeting (Y.P. No. 3)	1" x 6" x 12'	3100 bd. ft.
Balcony sub-flooring (Y.P. No. 3)	1" x 6" x 12'	300 bd. ft.
Door stock (Y.P. No. 3)	1" x 6" x 12'	350 bd. ft.
Door plywood (clear fir)		220 sq. ft.
Window framing (Y.P. or fir No. 2)	2" x 8" x 14'	8 pieces
Window framing (Y.P. or fir No. 2)	2" x 8" x 12'	5 pieces
Window framing (Y.P. or fir No. 2)	2" x 10" x 12'	5 pieces
Window framing (Y.P. or fir No. 2)	1¼" x 2½" x 8'	20 pieces
Window framing (Y.P. or fir No. 2)	1¼" x 2½" x 10'	32 pieces
Window stops (Y.P. or fir No. 2)	1" x 6" x 16'	8 pieces
Window stops (Y.P. or fir No. 2)	1" x 6" x 12'	5 pieces
Flooring, outside (softwood)	1¼" x 2½"	500 sq. ft.
Flooring, inside (hardwood)	¾" x 1½"	1900 sq. ft.
Cabinet stock (hardwood)	1" x 6"	150 bd. ft.
Cabinet plywood paneling fir	¼" stock	150 lin. ft.
Ridge roll (cypress or cedar)	1" x 6" x 12'	120 lin. ft.
D. SPECIAL LUMBER AND OTHER PRODUCTS:		
Eavestroughing (redwood)		130 lin. ft.
Threshhold (oak)		12 lin. ft.
Shingles (cedar or cypress) 18" long		28 squares
Building paper (asphalt, 3-ply) 8 rolls		4000 sq. ft.
Oakum		400 lbs.
Roofing pitch		100 lbs.
Caulking compound (brown)		25 gal.
Window sash 9" x 12", 8-light casement		16
Window sash 9" x 12", 6-light casement		10
Screens to match		13
Screen door 84" x 42"		1
Screen door 84" x 36"		1

E. HARDWARE: Materials and Size	Quantities
Cabinet door hinges (butterfly) 3"	6 pairs
Cabinet door catches	6
Cabinet drawer pulls	3
Window sash butt hinges 3"	39 pairs
Window flush bolts 2½"	26
Window catches	13
Door hinges (strap iron or bronze casting) with eye and bolt holes	19
Door false hinges (without eye)	19
Door hinge pins	19
Door thumb latches	6
Door key locks	3
Door bolt locks	3
Bolts—	
Door hinge bolts (hexhead) ¼" x 5½" (Dutch door)	12
Door hinge bolts (hexhead) ¼" x 4"	40
Anchor bolts ¾" x 16"	12
Other bolts ¾" x 12"	4
Other bolts ¾" x 10"	10
Other bolts ½" x 8"	24
Washers to match	
Screws—	
Door studding screws (round headed) 1¼"	6 gross
Lag screws (furniture & wall lights) ¼" x 5"	2 gross
Screws (flathead) 2½"	1 gross
Screws (flathead) 1½"	1 gross
Screws (flathead) ¾"	1 gross
Spikes—	
Spikes, 12" long	3 kegs
Spikes, 10" long	2 kegs
Spikes, 8" long	2 kegs
Nails—	
Casing nails, 6d	1 keg
Casing nails, 8d	1 keg
Common nails, 40d	1 keg
Common nails, 16d	1 keg
Common nails, 8d	1 keg
Finishing nails, 8d	½ keg
Finishing nails, 6d	½ keg
Shingle nails (zinc-coated)	1 keg
Brads (assorted)	5 lb.

F. MASONRY:	
Foundations (no basement)	
Cement	105 sacks
Sand	8 cu. yd.
Gravel	16 cu. yd.
Scrap lumber for framing	
Fireplace—	
Cement	45 sacks
Sand	3½ cu. yd.
Gravel (for fireplace foundation only)	3 cu. yd.
Rocks (selected)	25 cu. yd.
Firebrick	120
Heatilator (with fans) No. 62	1
Flue lining, 12" x 18" x 2'	9
Slate roofing (for hearth)	24 sq. ft.
Flashing (sheet lead or tin)	24 sq. ft.
Spark arrester screen, rods & roof	1
Mortar coloring (chocolate brown)	10 lb.
Reinforcing iron (in footings)	120 lin. ft.
Metal sheeting (over heatilator insulation)	60 sq. ft.
Railroad iron andirons	2
Half-round mantel piece plank, 11' long	1

G. FINISHES: Materials and Size	Quantities
Linseed oil	11 gal.
Turpentine	6 gal.
Chrome yellow paste	1 pt.
White lead	1 pt.
Burnt sienna paste	1 qt.
Shellac	8 gal.
Alcohol, denatured	7 gal.
Creosote oil, heavy (sill and joists)	5 gal.
Creosote oil stain, medium (2 coats on outside)	35 gal.
H. WIRING AND FIXTURES IN CABIN:	
60 amp. entrance switch, 110/220 v., 3-pole, with meter trim	1
Lighting panel and cabinet, 110/220 v., solid neutral, 6-branches with fuses, surface mounting	1
Romex cable, 2-wire, No. 14	750 ft.
4″ x 12″ junction boxes	2
4″ oct. outlet boxes	22
Gem switch boxes, m. c.	7
Tumbler switches, s. p.	7
Tumbler switch plates	7
Duplex conv. receptacle	5
Duplex conv. receptacle plates	5
Single conv. receptacle	3
Single conv. receptacle plates	3
Romex staples	300
Switchless sockets	26
Pull chain switch sockets	17
Outside lanterns	4
Bulbs, 25-watt flame tapers	4 doz.
Stump chandelier (6 to 7 ft. root spread)	2
Wall fixtures, double prong	2
Wall fixtures, single prong	5
Iron straps $1\frac{1}{2}$″ x 30″ (to support chandeliers)	2
Tape, friction and rubber	6 rolls
I. PLUMBING IN CABIN:	
Water system—	
Pipe, $\frac{3}{4}$″	40 ft.
Pipe, $\frac{1}{2}$″	50 ft.
Tees, $\frac{1}{2}$″ x $\frac{3}{4}$″ x $\frac{3}{4}$″	2
Tees, $\frac{3}{4}$″ x $\frac{3}{4}$″ x $\frac{3}{4}$″	2
Tees, $\frac{3}{4}$″ x $\frac{1}{2}$″ x $\frac{1}{2}$″	1
Elbows, $\frac{3}{4}$″	4
Elbows, $\frac{1}{2}$″	2
Nipples, $\frac{3}{4}$″	7
Nipples, $\frac{1}{2}$″	2
Drain valves $\frac{3}{4}$″	2
Bowl	2
Frostproof toilets	2
Sink	1
Urinal	1
Sewage—	
Fixture waste pipe $1\frac{1}{2}$″	30 ft.
Vent pipe (cast iron) 2″	24 ft.
Sewage pipe (cast iron) 4″	60 ft.
Adjustable P traps $1\frac{1}{2}$″	4
Brass collars $1\frac{1}{2}$″	4
Elbows 2″	2
Nipples, 2″	2
Reducing collars 4″ x 2″	1
Roof flanges, 2″	1
Roof flanges, 4″	1
Elbows, 4″	1
Cast iron T Y, 4″ x 3″	1
Tee branch 4″	2
Plug, 4″	4
Tee branch with side inlet, 2″, 4″	2
Tee branch tapped for $1\frac{1}{2}$″ pipe, 4″	3

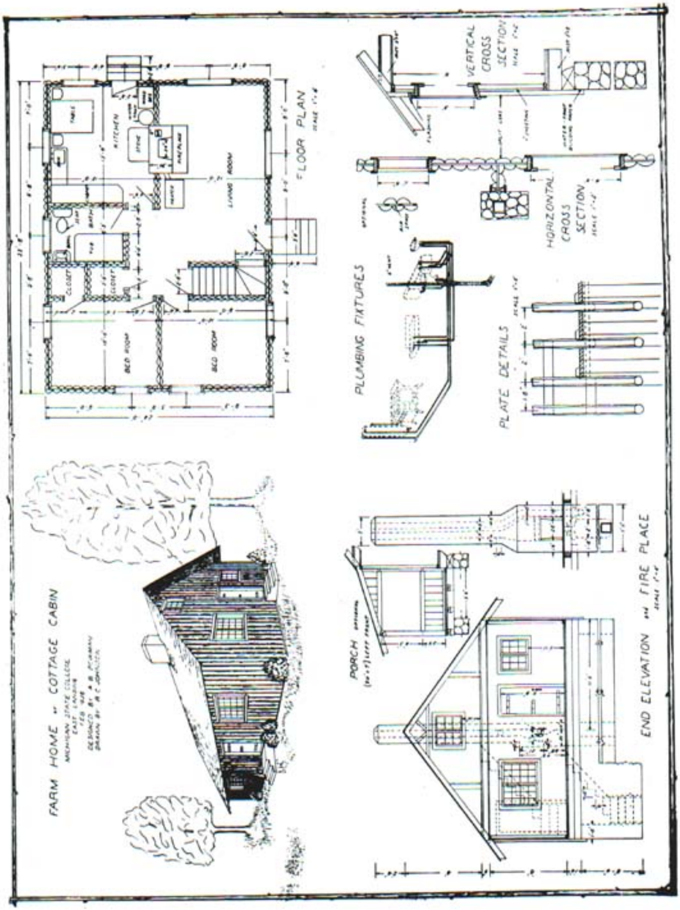
FARM HOME or COTTAGE CABIN
FLOOR PLAN
KITCHEN
LIVING ROOM
BED ROOM
BED ROOM
CLOSET
CLOSET
VERTICAL CROSS SECTION
HORIZONTAL CROSS SECTION
PLUMBING FIXTURES
PLATE DETAILS
PORCH
END ELEVATION and FIRE PLACE

Fig. 32, Plan 2.

MATERIAL LIST
FOR
SPLIT-LOG HOUSE (33 X 24)

Material	Quantities Without Porch	Quantities for Porch (20 x 7)
A. Split Logs and Timbers:		
Split logs (edged) 6′ long	120 sq. ft.	130 sq. ft.
Split logs 8′ long	1600 sq. ft.	
Split logs 10′ long	790 sq. ft.	
Split logs 12′ long	220 sq. ft.	
Split logs 14′ long	180 sq. ft.	
Split logs 16′ long	290 sq. ft.	
Total	3200 sq. ft.	130 sq. ft.
B. Rough Timbers:		
Sill log, 4″ x 8″, (from log)	180 lin. ft.	
Sill and plate, 2″ x 4″	250 lin. ft.	
Stringers (round 7″ stock, 20′ long)		60 lin. ft.
Floor joists (2″ x 8″ x 12′) 42 pc. or	672 bd. ft.	
Ceiling beams (round 6″ x 24″) 15 pc. or	360 lin. ft.	
Roof rafters (4″ min. dia. 18′) 26 pc. or	468 lin. ft.	80 lin. ft.
Posts (6″ diam. 8′ 0″) 4 pc. or		24 lin. ft.
C. Milled Lumber:		
Dimension—		
Window framing, plate & sill, (2″ x 8″ No. 2 fir or Y. P.)	650 bd. ft.	
Window framing, stair horses, (2″ x 10″ No. 2 fir or Y. P.)	120 bd. ft.	
Window framing (3″ x 3″ No. 2 fir or Y. P.)	70 bd. ft.	
Window framing (2″ x 6″ No. 2 fir or Y. P.)	100 bd. ft.	
Inch stock—		
Roof sheeting (matched) (1″ x ¼″ No. 3 Y.P.)	1300 bd. ft.	200 bd. ft.
Sub-flooring, wall sheeting (1″ x 6″ No. 4 Y.P.)	2300 bd. ft.	280 bd. ft.
Finish flooring (1″ x 6″ D-M fir)	1200 bd. ft.	160 bd. ft.
Flash boards (1″ x 4″ No. 2 fir or Y.P.)	800 bd. ft.	
Window & door stop (1″ x 6″ fir or Y.P.)	220 bd. ft.	

Material	Quantity	Optional Quantity
D. Special Material:		
Ceiling, ½″ insulation board		750 bd. ft.
Trim, ¼″ rd. 1″ stock	500 lin. ft.	
Shingles	12 squares	2 squares
Ridge roll	38 lin. ft.	
Threshhold	6 lin. ft.	
Building paper (waterproof) 6 rolls	3000 sq. ft.	1 roll 500 sq. ft.
Windows:		
8″ x 10″ 6-light casement sash	18	
8″ x 10″ 12-light casement sash	4	
Screens and storm windows to match		11
10″ x 12″ 3-light casement sash	4	
Doors:		
Exterior (2′ 8″ x 6′ 8″ x 1¾″) 4-light, 10″ x 14″	2	
Interior (2′ 8″ x 6′ 8″ x 1⅜″)	2	
Interior (2′ 6″ x 6′ 8″ x 1⅜″)	4	
Interior (2′ 0″ x 6′ 8″ x 1⅜″)	2	
Combined storm and screen (2′ 8″ x 6′ 8″ x 1¾″)	2	
Screen door (2′ 8″ x 6′ 8″ x 1¾″)		1
Porch screens (4′ x 4′)		5
Porch screens (4′ x 3½′)		4
Kitchen cabinet—cabinet stock 1″ stock (fir)	100 bd. ft.	
plywood panel ¼″ stock (fir)	100 bd. ft.	

Material	Quantity	Optional Quantity
E. HARDWARE:		
Cabinet—		
Butterfly hinges $2\frac{1}{2}''$	8 pairs	
Drawer pulls	3	
Clasps	8	
Window—		
3″ butt hinges	24 pairs	
Clasps	11	
Flush bolts	22	
Doors—		
4″ butt hinges	10 pairs	
Outside door locks and knobs	2	
Inside door locks	8	
Screen door latches	2	1
Screen door spring hinges	2 pairs	1
Nails, screws and bolts—		
8d nails, common	2 kegs	
16d nails, common	1 keg	
20d nails, common	1 keg	
40d nails, common	50 lb.	
8d nails, casing	25 lb.	
6d nails, finish	1 keg	
Shingle nails	50 lb.	
Screws, $\frac{3}{4}''$, 1″ and $1\frac{1}{2}''$	1 gross each	
Bolts, $\frac{1}{2}''$ x 8″	2 doz.	
F. FINISHES:		
Linseed oil	8 gal.	
Turpentine	5 gal.	
Shellac (clear)	5 gal.	
Alcohol (denatured)	5 gal.	
Creosote oil (heavy) sills butts	7 gal.	
Creosote oil stain (medium brown)	15 gal.	
Various paints and white lead for trim.		

G. MASONRY:

	No basement	2/3 basement
Foundations—		
Rock (shapely material)	25 cu. yd.	50 cu. yd.
Sand	3½ cu. yd.	5 cu. yd.
Cement	15 sacks	30 sacks
Lime	3½ sacks	7 sacks
Fireplace—		
Rock	15 cu. yd.	20 cu. yd.
Sand	2 cu. yd.	2½ cu. yd.
Cement	12 sacks	15 sacks
Lime	2½ sacks	3 sacks
Flue (8" x 12")	14 lin. ft.	
Firebricks	140	
Flue (8" x 8")	22 lin. ft.	
Flashings (tin or lead)	15 sq. ft.	
Damper (dome)	1	
Coloring (chocolate)	5 lb.	

H. PLUMBING:

Water pipes and connections—	
Pipe, ½"	100 ft.
Pipe, ½"	30 ft.
Tees, ¾" x ¾" x ½"	7
Tees, ¾" x ¾" x ¾"	2
Elbows, ¾"	2
Reducing elbows, ¾" x ½"	2
Boiler elbow, ¾"	2
Nipples, ¾"	8
Nipples, ½"	8
Couplings, ¾"	4
Unions, ¾"	4
Faucets, ½"	7
Sewage pipes and connections—	
Cast iron TY 3" x 3"	2
3" combination lead bend and iron ferrule	1
Plug 3" (trap screw)	1
Cast iron pipe 3"	5'
Cast iron pipe 2"	10'
3" cross with 2 1½" branches	1
Pipe 1½"	30'
Elbows 1½"	2
Traps 1½"	2
Unions 1½"	2
Tees 1½"	1
Fixtures—	
Toilet seat	1
Bowl	1
Tub 30" x 60"	1
Sink and drain board 18" x 48"	1
Hot water tank	1
Hot water jacket	1
Water pump (power)	1

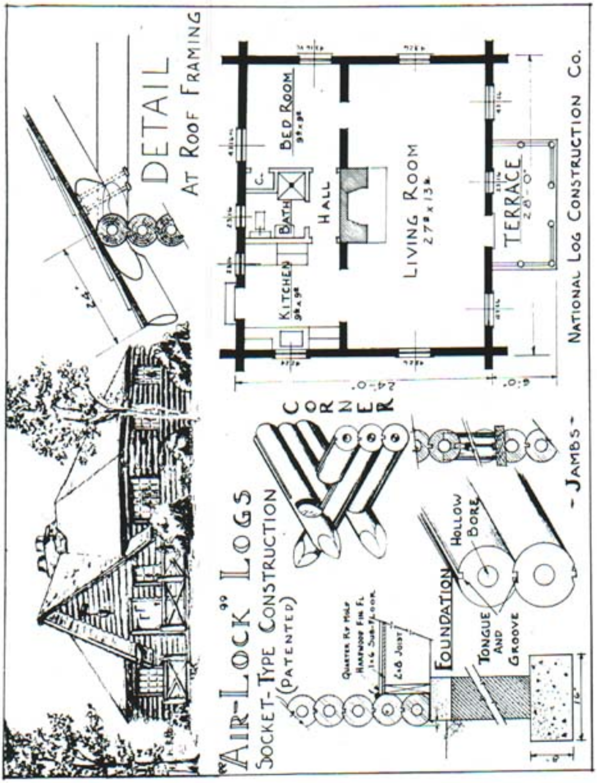

Fig. 33, Plan 3.

Courtesy of National Log Construction Co., Grayling, Mich.

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