

UNITED STATES DEPARTMENT OF AGRICULTURE  
FOREST SERVICE

A D O B E A R C H I T E C T U R E  
ITS DESIGN AND CONSTRUCTION

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# A D O B E   A R C H I T E C T U R E

## Its Design and Construction

### Prefatory Remarks

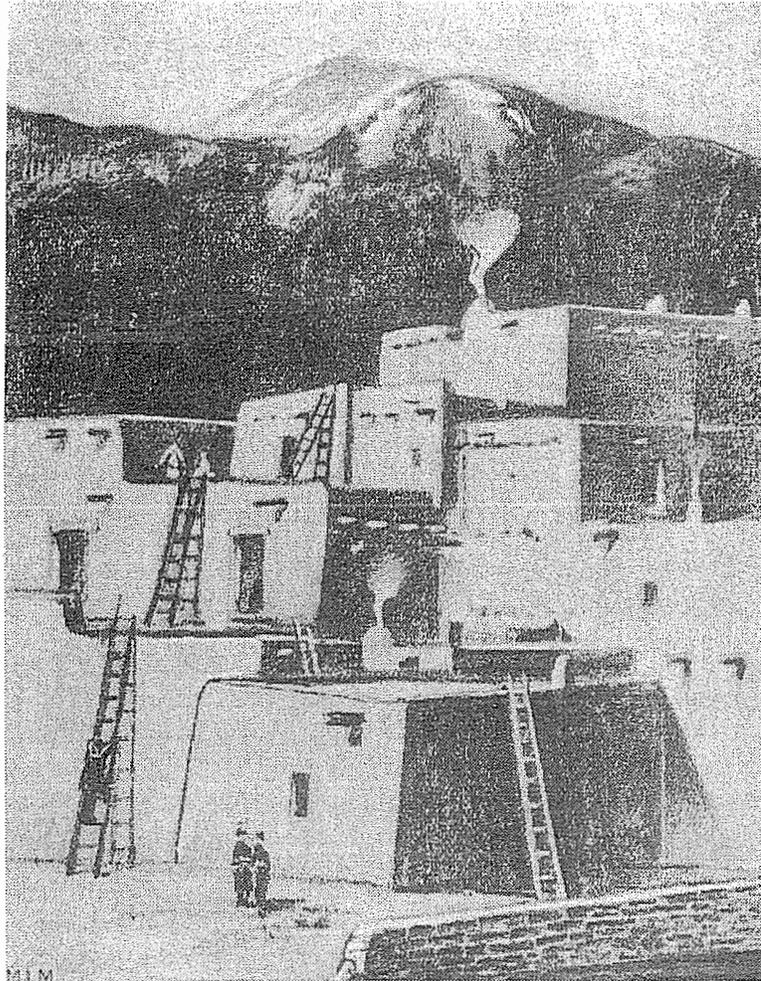
In the recent brochure entitled "The Architectural Trend of Future Forest Service Buildings" it was recommended that, where a traditional style of architecture exists, advantage be taken of it in designing Forest Service buildings.

Favorable opportunities of this sort do not present themselves very often. Invariably, the designer is confronted with the vexing problem of selecting an appropriate style of architecture, with the attendant difficulties of determining just what that comprehends. Due to the various interpretations placed upon the word 'appropriate', it may signify; 1) an elevational expression of the specific purpose or use of a building; 2) a style displaying that attribute and, at the same time, in harmony with the environment; 3) having both these qualities and, in addition, representative or typical of the Forest Service itself.

No single architectural style can successfully serve universally, be appropriate for the various environments of such a vast country as ours and, also, be unmistakably significant of one Federal agency, such as the Forest Service, in contradistinction to any other.

Nevertheless, certain Regions do possess a traditional architecture which is recognized as appropriate both by long association and the dominating influence it exerts upon present day structures.

The Pueblo style is in this category and, consequently, has been made the subject of a treatise for the assistance of the architectural designers of the several Regions of the Forest Service wherein its influence is felt.



THE PUEBLO . . . . . Penthouses  
Terraced facades or set-backs . . .  
Flat roofs or sun-decks . . .  
Plain wall surfaces without cornices  
Functional construction . . .  
Who called these features 'Modern'?

## ADOBE ARCHITECTURE

### Early Usage

Either adobe or a combination of adobe and local stone were used by the North American Indians as building materials in the southwestern sections of our country. Both present interesting studies in aboriginal construction.

The adobe, a prehistoric sun-dried brick construction, is made of indigenous loam, sand, or alluvial clay to which straw, tile chips, or other material is added as a binder. Adobe construction was well known in Egypt and Syria at an early date - The Children of Israel made bricks for the Egyptians at the time of Moses as shown by Pharaoh's command: "Ye shall no more give the people straw to make brick, as heretofore; let them go and gather straw for themselves." Exodus 6:7. Later, it was used to some extent in England.

The combination of adobe and stone masonry occurs in localities where, due to erosion, stratified stone outcroppings have broken down to such an extent that this material becomes available for building purposes through the simple effort of collecting it from the surface of the ground. Here, where an abundance of broken stone is in evidence on every hand, walls like those of Oraibi (fig. 1), but with somewhat less stone in proportion to the adobe, are very appropriate. Masonry of this sort affords many opportunities for effects of a very intimate and naive character.



Fig. 1. Oraibi, Arizona, most important of the Hopi villages. Combination of adobe and local stone.

Adobe structures are to be found in California, Arizona, and, to a greater extent, in Texas and New Mexico west of the Rio Pecos (fig. 2). Many early examples are still extant which appeal to the traveller and archeologist alike, because of their quaint and colorful simplicity as well as their historical interest.

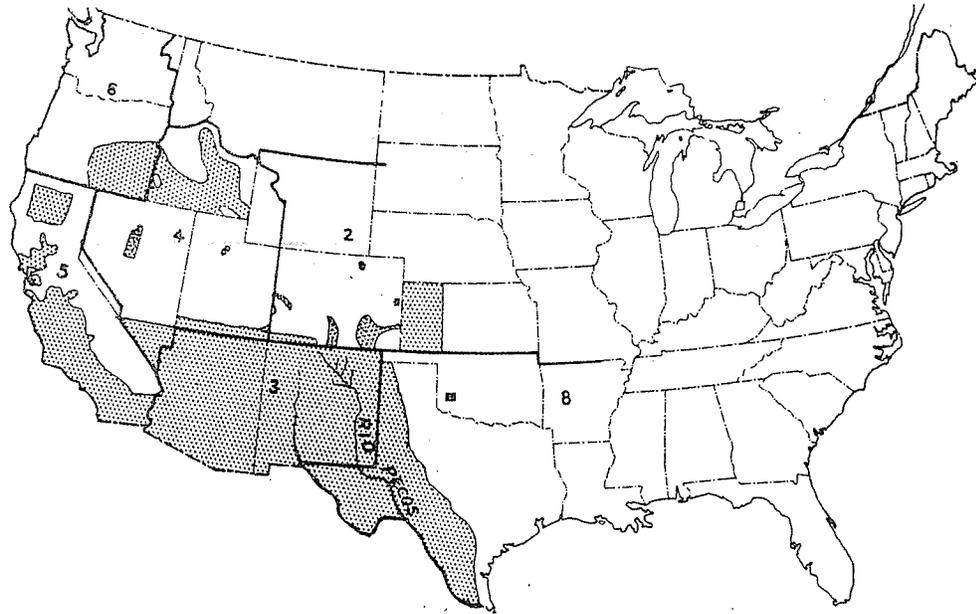


Fig. 2. The shaded portions represent the areas where adobe construction occurs and the numbers indicate the Forest Service Regions.

Adobe dwellings are of two kinds; the familiar one-story adobe hut and the multi-storied pueblo community or primitive apartment building, erected tier upon tier. The latter were originally without doors at grade; any now visible in the first story having been later additions. Entrance was had by means of exterior movable ladders to the roof of the first story with similar ones to the upper stories.

Indian pueblos or villages are very old and shrouded in historical interest. It is a well authenticated fact that a number of communal buildings, in use at the present time, notably those at Taos, were in existence and occupied long before the arrival of Columbus. They, therefore, represent a style of architecture more truly American than any other since introduced and patterned after familiar prototypes which may be found in Europe and Asia. So far as it has been possible to determine no foreign precedent is ever cited as the basis of the Pueblo style of architecture.



ACOMA - Silhouetted against the sky

## Historic Pueblos

At Albuquerque, Santa Fe, Taos, Acoma, Zuni, Laguna, Isleta, and elsewhere in New Mexico are innumerable ancient examples of this style. Of these, Taos, Acoma, and Laguna are outstanding. Taos is about 46 miles north of Santa Fe by motor, in the fertile valley of the Rio Grande, while Laguna is 75 miles west of Albuquerque, from which Acoma, 15 miles to the south, may be reached.

At first glance one would think that the pueblos occupied only sites dominating the landscape - the most picturesque locations of a picturesque land. This is not so, however. They are often extremely inaccessible, naturally well protected and apparently impregnable, and reached only with difficulty. This accounts for the reason why, until quite recently, the general public has known so little about some of the more important ones.

One of the most spectacular and inaccessible is that of Acoma, perched high on a lofty mesa of the same name. It offers a most scenic approach up the long, gradual slope of the valley, colorful with growing crops; up through groves of junipers to noble precipices patched with everchanging hues, and shadowed with mysterious recesses; up over sheer rocks and boulders until, passing through the towering portals of a vast canyon, may be glimpsed the cliffs and pinnacles of what appears to be a mighty citadel - this is Acoma.

The pueblo of Acoma with its sheer exterior back wall surmounting the edge of the precipitous cliffs, some 350 feet high, is triple terraced on the interior or plaza side like three giant steps. Access is had by means of an outside wooden ladder to the roof of the lower story, thence through a small trap door and down an inside ladder. The second and third stories are, each in turn, set well back from the face of the other. The upper roof levels are reached by narrow, steep odd-looking steps made in the top of the partition walls built at right angles to the facade. These walls extend down through the pueblo and divide it into separate individual compartments with no interior intercommunication with adjacent ones (fig. 5, page 5).

When one considers the fact that all the material used in constructing this pueblo - stone, adobe bricks, heavy wooden beams, some as long as 40 feet - had to be carried by hand up treacherous and precipitous paths, ending in stone steps cut out of the almost vertical, natural rock walls, one may well marvel at the stupendous task represented in the building of Acoma.

In sharp contrast to Acoma are the twin pueblos of Taos, which occupy a position close by the Rio Grande where the Indians still till their farms in the same primitive manner as their forefathers. The Sangre de Cristo Mountains, flanking the immediate background of Taos, offer no impression of rugged, savage grandeur but, on the contrary, breathe tranquility in their green forest-covered slopes. Peace and quiet reign here.

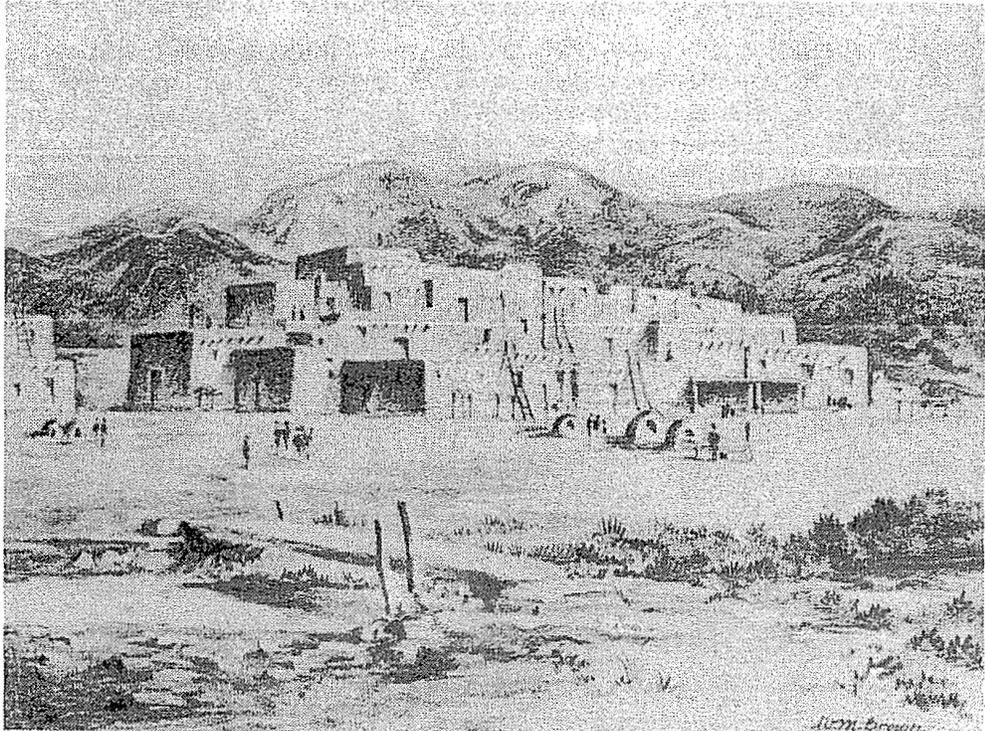


Fig. 4. The twin pueblos of Taos, showing the northern one.

Laguna, the last of the original examples to be built, represents the third and final type of adobe community, a pueblo or village consisting of detached one- and two-storied dwellings, but having no communal pueblo. Not being continually harrassed by the threat of attack, the location and type of construction were no longer dominated solely by the idea of protection as at Acoma.

Adobe represents a logical solution of the building problem in a section of the country where protection from the heat of the sun always has been a primary consideration because the heavy sun-dried bricks, laid in walls several feet in thickness, ensure coolness in summer and warmth in winter. This type of construction is indigenous to our great Southwest where it still exerts a predominating architectural influence as evidenced by many buildings recently erected in both Santa Fe and Albuquerque.

## The Pueblo Style

The primitive simplicity of adobe buildings permits of their unlimited adaptability to basic settings, whether perched in several storied tiers on a lofty mesa or as a pueblo in a sheltered valley.

Noteworthy, from the standpoint of advanced principles of design in connection with ancient, so-called primitive, adobe construction may be cited the following facts which, ordinarily, receive little attention and still less recognition.

The terracing of facades by setting back each story from the next one below, plain wall surfaces without cornices, flat roofs instead of sloping ones, and provisions for a crude method of air-conditioning, are some of the characteristic features of which the origin is often erroneously accredited to much more recent architecture.

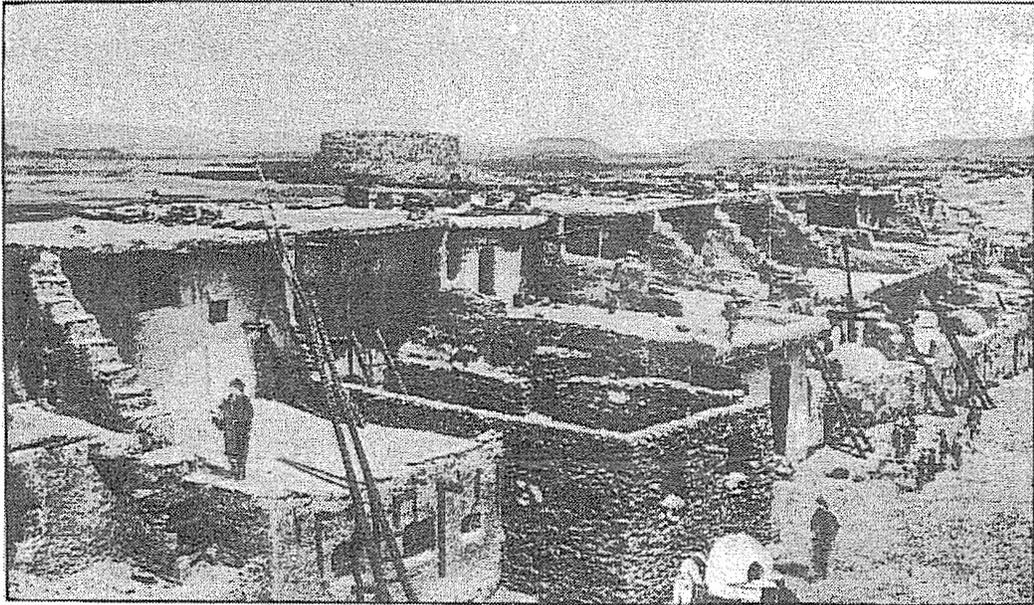


Fig. 5. Pueblo of Acoma and the Enchanted Mesa beyond

Adobe structures belong to a purely regional type of architecture, commonly known as the Pueblo Style and are distinguished by their naive simplicity, the pleasing effect of which is frequently enhanced by colorful exteriors.

The adobe dwelling is not only one of the simplest to build but, also, it is as habitable as any for the locality with which it is associated. Box-like in shape, with the ground as its floor, it is built of adobes laid in a cement of their own mud; roofed

with peeled juniper, pine, or fir poles or vigas, and cross-branches called latillas, supporting a thatchwork of smaller interwoven branches and, finally, a thick layer of adobe.

From this basic unit there is an endless range of more complex, multi-storied possibilities possessing all the modern comforts and conveniences and, at the same time, simple, dignified, and charming in character.

In this style it is imperative to avoid sharp corners or exactly straight lines and surfaces in the exterior treatment to maintain the true plastic character of adobe. On the other hand, too much freedom or license in line or surface is equally incorrect and not characteristic of the best prototypes.

By substituting both better methods and materials the defects commonly found in the crude adobe construction employed by the native Indians may be avoided.

#### Making Adobe Bricks

Adobe, unlike ordinary bricks, is an unburned mud product, molded in pieces and then sun and air dried. Its manufacture is a very simple process. The term 'adobe' is derived from the Spanish word 'adobar' which means to knead.

Most clayey loams are suitable material for adobe. Earth having an excessively high content of either clay or sand should not be used. The former condition develops shrinkage cracks in drying while the latter lacks sufficient bonding material to prevent crumbling. Very good material may be obtained by mixing soils having both qualities in the proper proportions.

Either on or near the site of the proposed structure, a crater-like mound of earth is made. Then, after pouring water into it, it is puddled to a plastic consistency by the workmen, or 'adobero', tramping bare-footed throughout the mass or,



Fig. 6. A typical adobe dwelling

better still, by hoeing to ensure a more thorough mixture. Then, a 1-1/2 or 2-inch thick layer of straw or chopped hay, preferably of short lengths, is spread over the top and the entire mass again kneaded to uniformly distribute this binder. To prevent the straw from working to the bottom it should not be added until the material has been well puddled. Upon the latter, together with the thoroughness with which the puddling is done, largely depends the reduction of cracks which occur during the sun-drying process and the ultimate strength of the material. The quantity of straw varies with different soils, but approximately one and a half bales should be used to every thousand finished bricks of average size - 4 x 8 x 18 inches.

The addition of manure in lieu of clean straw, a common native Mexican practice, is detrimental and very appreciably reduces the strength of the bricks. This custom, prevalent in certain localities, is due to ignorance and is not substantiated by actual tests made upon the adobes, as the unit bricks are commonly known.

Where a satisfactory prairie sod, having a thick growth of tall stiff grass is available in 4- or 5-inch layers, it may be plowed and puddled without the addition of straw.

In large projects, where vast numbers of adobes are required, homemade horsepower mixers may be used to advantage. Mechanical, revolving concrete mixers, if available, afford greater efficiency, convenience, and increased production.

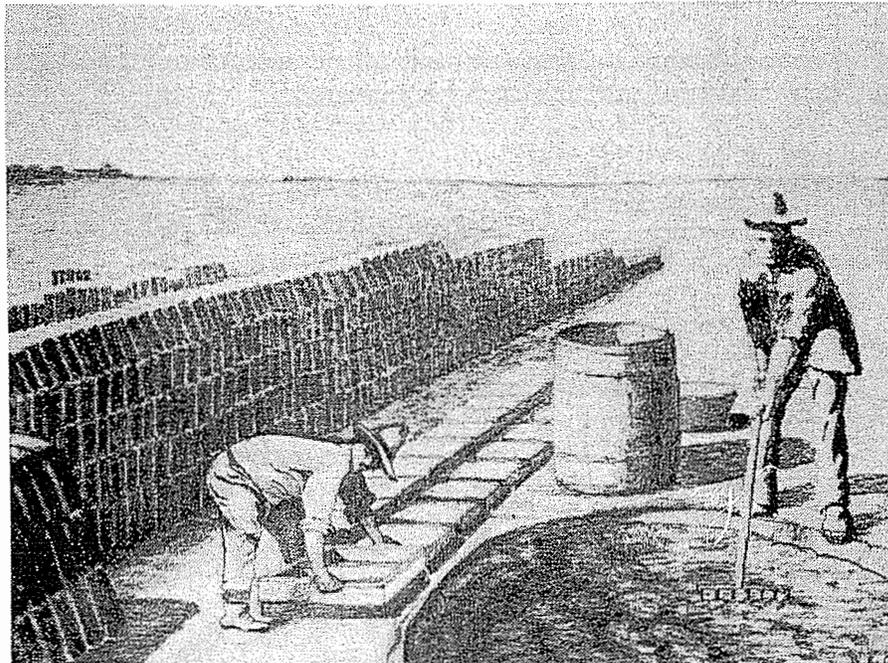


Fig. 7. Making adobe bricks

A relatively level, convenient site, over which straw or sand is strewn to prevent the bricks from sticking to the ground, is selected as the molding floor. The prepared mud is conveyed from the puddle in wheel barrows and shoveled or forked into the wooden forms, called 'adoberos'. Figure 7, page 7, shows one of these being emptied.

After tamping by hand, using care to fill all the corners, the top surface is leveled with the hand and then the form, holding two or four bricks, is lifted, washed of any loose mud and is ready for the next batch. If it does not lift easily it may be loosened from the bricks by lightly tapping. Metal-lined forms are used very often to facilitate the molding because there is not the same tendency for the mud to stick to them as there is with the wooden ones.

Within a few days the bricks are ready for curing which consists of standing them on edge in a manner to ensure approximately equal exposure of both sides to the sun and wind. After ricking them in this fashion several times, they are piled and, if necessary, covered with boards for protection from the rain, then allowed to cure for several weeks by continued drying in the sun.

Bricks should not be made when the weather is unsuitable for drying. Where there is any likelihood of freezing, which causes them to disintegrate, they should be covered in advance for protection.

Brick sizes vary considerably. They are generally 4 or 5 inches thick by 8, 10, or 12 inches wide, and 16, 18, or 20 inches long, depending upon the thickness of the walls in which they are to be used. For the purpose of ordinary construction the bricks should develop a crushing strength of about 350 pounds per square inch, which is more than sufficient for the average two-story structure.

Usually, for convenience, several men work together. Ordinarily, a skillful workman can prepare 200 adoberos or 400 adobes per 8-hour day, at a cost of about 4 cents each, plus 1 cent additional for ricking. While this price is relatively cheap, due to the large size of the bricks, other factors enter into and affect the cost of their production and erection; notably that most building contractors are neither accustomed nor organized to make adobes. In spite of any statement to the contrary, it still remains a fact that adobe construction is economical only where the property itself yields the material for the adobes, and when they are made in advance by unskilled, hence cheap, Mexican or Indian labor.

## Curing Adobe

The primitive methods employed in mixing the adobe are not thorough enough to ensure exact uniformity of texture or bricks of regular sizes and shapes. These inequalities not only reduce their strength but have a very direct and important bearing upon the permanence of the protective cement plaster coating, applied subsequently as an exterior finish, which necessarily varies considerably in thickness in order to obtain relatively smooth exposed surfaces.

Excessive variation in thickness affects the coefficient of expansion and contraction of the cement plaster, causing cracks which admit moisture between it and the adobe proper, with the result that it later peels and falls off. Again, the lime in lime mortar, if erroneously used in laying the bricks, or the lime in stucco, sometimes applied as an exterior protective coating, reduces the strength of the adobe, thereby causing it to weaken and disintegrate.

## Laying Adobe Walls

Only thoroughly dry, well-seasoned adobe bricks should be used. They should be laid with wide joints of similar adobe mortar, not only for convenience and economy but mainly because they both possess the same coefficients of expansion and contraction. The adobe walls should be allowed to cure over a protracted period before applying any plaster in order to obtain the most satisfactory results. The length of time should not be less than three months, particularly if erected in midsummer, due to settlement approximating 1 inch to every 10 feet of height.

The exterior masonry foundation walls, extending down to the frost line, should be continued as a base course to a height of at least 8 inches above the finished grade, upon which, after applying a coat of hot asphalt to its top surface, the adobe should start. Particular care should be taken to place the adobe back from the face

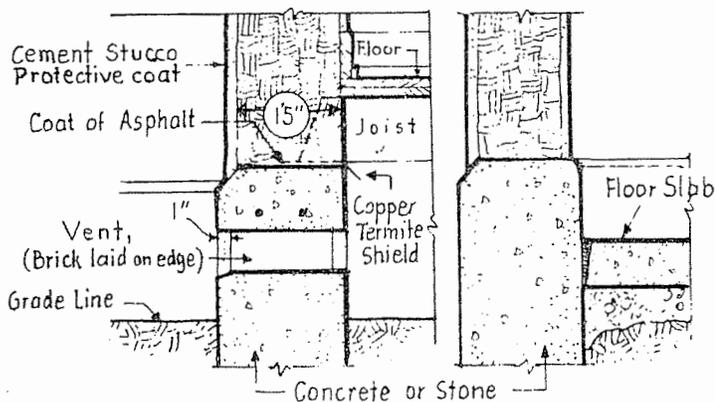
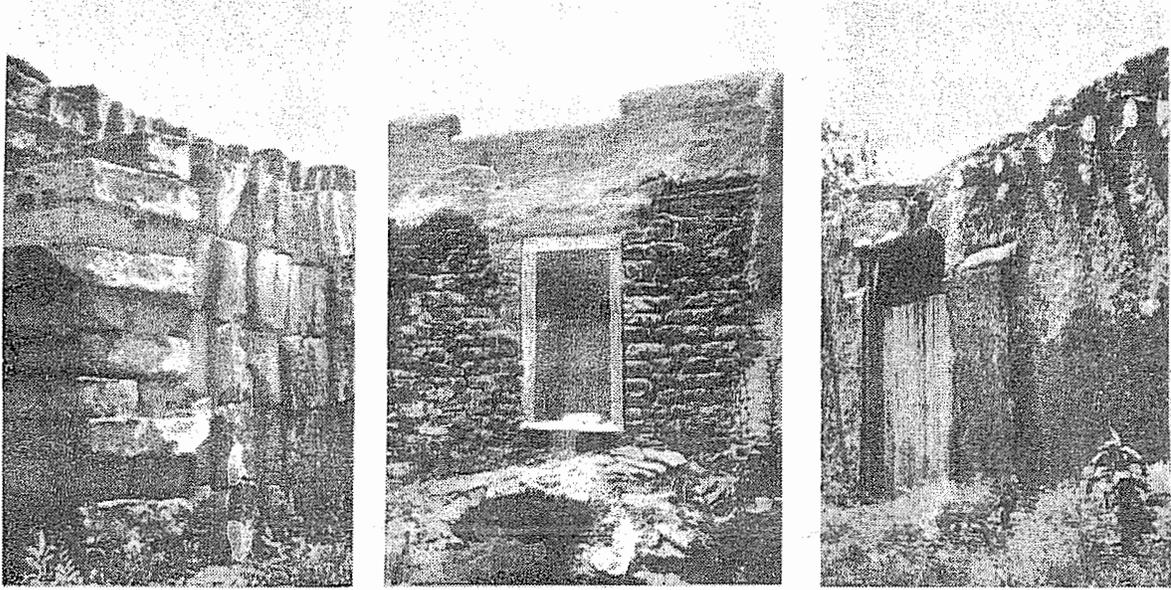


Fig. 8. Wall section, A; alternate, B.

of the cement base far enough to allow for the finished exterior cement plaster or stucco to stop without projecting beyond it, as in fig. 8 A. Under no circumstance should the cement plaster extend to grade because dampness or frost causes it to disintegrate very rapidly.



Curing Adobes

Process of Erection  
Fig. 9

Old Weathered Wall

Any discoloration of the concrete base course may be removed by the application of a cement wash for its renovation whenever necessary.

Where concrete floors occur inside adobe buildings, such as warehouses, shops, and similar structures, a 6- or 8-inch high interior base should be provided to permit washing without injury to the wall finish (fig. 8 B, Alternate, page 9).

#### Protective Coatings

Adobe, when directly exposed to the elements with no protective coating, often noticeable in primitive Indian or Mexican dwellings, does not weather satisfactorily. Its preservation and economical maintenance requires a coat of exterior cement plaster or stucco, applied in the same manner as that used for interior plaster by stretching poultry wire over the face of the adobe to receive it.

To ensure a thorough bond between either the exterior stucco or the interior plaster and the adobe, several  $\frac{3}{4}$ -inch deep depressions may be made on the exposed face of each brick by striking them with the head of a hammer. Into these depressions an 8- or 10-penny barbed, zinc-coated nail is then driven at an angle, to which is attached No. 18 gage, one-inch mesh, galvanized iron wire netting, entirely covering the wall surfaces, (fig. 10, page 11).

For economy, the wire netting or metal lath may be omitted and reliance placed entirely upon the nails and the depressions in which they occur, together with the protruding mortar of the adobe

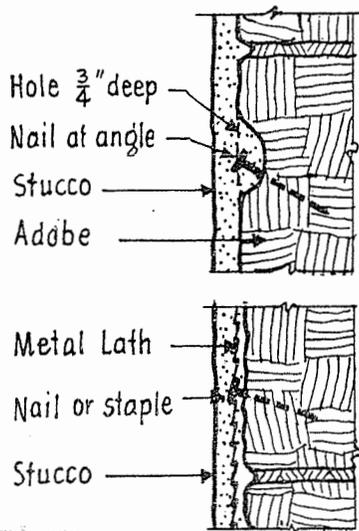


Fig. 10. Methods of applying stucco to adobe walls

joints for the necessary stucco bond. Under these circumstances, the nail heads should be kept flush with the face of the adobe to avoid interference with the trowel when applying the stucco finish.

Instead of 10-penny nails, two 1- or 1-1/4-inch staples may be driven into each adobe brick, which is equivalent to attaching the mesh on approximately 8-inch centers. The netting is furred out with the usual metal furring strips consisting of 3/8-inch round rods. Frequently, instead of rods, 3/8-inch wide, galvanized iron strips are used to hold the netting away from the surface of the adobe. Additional bond or key may be obtained by allowing the nail heads to project about 3/8 inch.

### Ceiling and Roof Construction

The ceiling joists, or vigas, invariably project at random distances beyond the outside faces of the exterior walls which support them and rest upon either a continuous reinforced concrete lintel or a wood wall plate. Ordinarily, the vigas are simply peeled pine or cottonwood poles, varying slightly in diameter and length.

Concrete lintels, being heavier than those of wood, are less satisfactory unless supported upon concrete posts to avoid imposing their weight directly upon the adobe walls. In this method of construction the adobe becomes merely a curtain wall. Unusual care should be exercised to prevent any moisture from the concrete, which contains lime water, from penetrating and ruining the adobe wall below it. To prevent this a layer of heavy, waterproof building paper should be placed over the top course of adobe brick directly under any such lintels.

The vigas support the wood ceiling boards, generally placed at right angles to them, upon which a 3-inch layer of dry earth, volcanic dust or cinders is placed as an insulation against heat and cold. A good grade of building paper should be laid over the ceiling boards to prevent the dirt insulation from sifting through. Celotex, or some similar material, may be used satisfactorily for insulation instead of the dirt (fig. 13 F, page 13). It is advantageous to similarly insulate the underside of the roof rafters as an added protection against heat and cold.

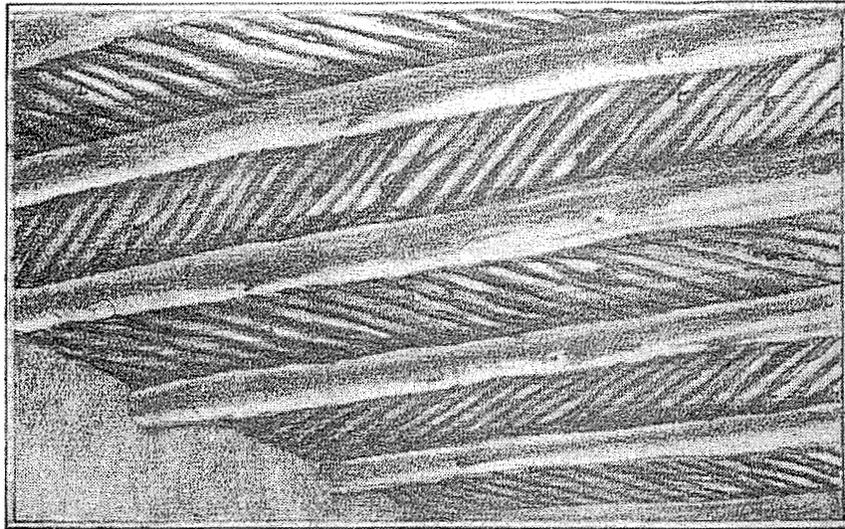


Fig. 11. Ceiling of latillas, or wood sticks laid herringbone across peeled pole joists.

Wood latillas,  $1\frac{1}{2}$  or 2 inches in diameter, either full round or halved and laid herringbone across the vigas, make a more primitive and interesting ceiling than flat boards (fig. 11).

Throughout the areas where adobe structures occur the climate is both dry and hot. Consequently, to ensure cool interiors in summer and warm ones in winter, the customary native building practice consists of combining the roof construction with that of the ceiling using adobe as an insulation. This very simple arrangement permits of low parapet walls.

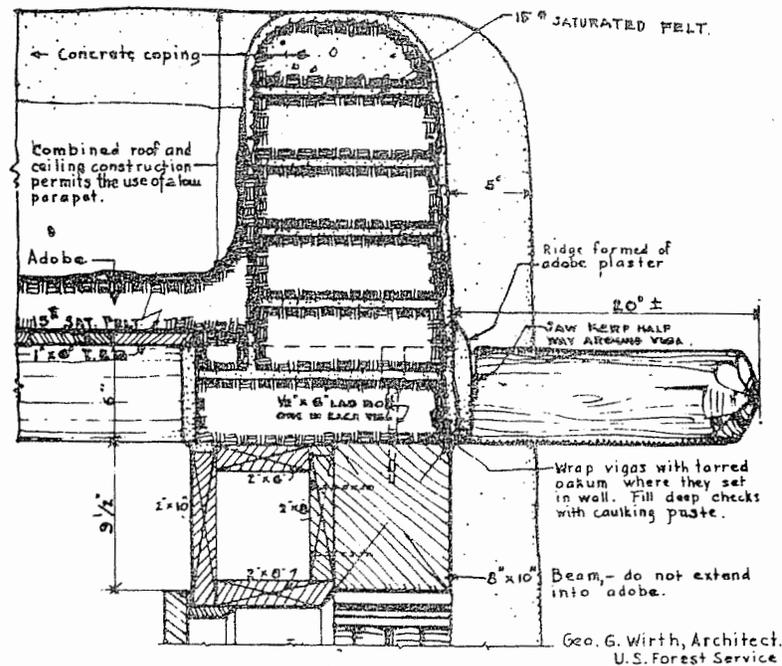


Fig. 12. Combined ceiling and roof, using adobe insulation.

Over the ceiling boards a layer of saturated felt is laid, then sifted adobe is deposited in a dry state allowing the necessary pitch for drainage. By means of a light-weight roller this roof material, having excellent insulation value, is compacted until it is sufficiently solid to walk upon. Over this a protective layer of felt is placed which is continued up the surrounding vertical parapet surfaces where it is carefully flashed at its intersection with the cement coating of the adobe (fig. 12, page 12).

In the poorer native Indian and Mexican adobe roof construction the material is exposed to the weather due to the omission of the protective layer of felt. It, therefore, requires frequent patching with plastic adobe after torrential rainstorms.

Well-ventilated air chambers, 2 or 3 feet high, between the ceiling and the roof, are much more effective for maintaining comfortable interiors. Openings in opposite walls, fitted with 4-inch diameter tile pipe projecting slightly beyond the exterior wall face, create a circulation of air adequate to provide the desired results (fig. 13 G).

### Outlookers

The outlookers or overhanging ends of the vigas, projecting from 2 to 3 feet beyond the face of the building proper in a truly functional manner, are subject to considerable checking on account of their exposure to the weather. This necessitates filling any cracks in them with hot asphalt. Tarred or oiled oakum packing should be carefully wrapped around the vigas for the full thickness of the wall, after which they are set in a bed of asphalt mastic or other caulking compound. Later, after the shrinkage of the vigas has occurred, additional caulking compound should be forcefully inserted into the exposed opening around them, at the face of the adobe wall, to ensure thoroughly weather-tight construction (fig. 13F).

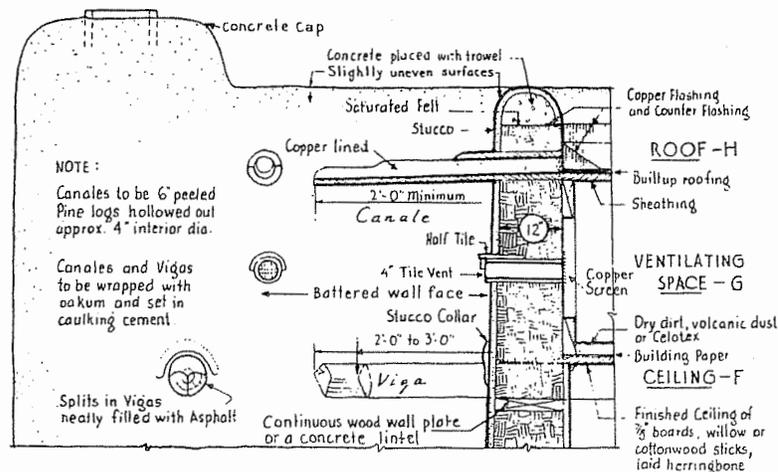


Fig. 13. Parapet wall showing canales, vigas, and air chamber.

A half-inch deep groove, if cut halfway around the top of the vigas and close to the exterior face of the wall, will divert any rain water from penetrating between the stucco finish and the adobe. Here, over the upper half of the vigas, the exterior plaster may be projected beyond the face of the wall to form a collar for the purpose of providing a watershed. These safeguards form excellent precautionary measures to prevent the rain water from seeping into the adobe walls at the vigas.

The appearance is greatly enhanced when the ends of the vigas, or rafters, which support both the ceiling and roof construction, vary in their projection beyond the wall face to indicate the varying lengths of natural wood poles and when spaced on slightly differing horizontal centers to avoid the mechanical uniformity common to skilled workmanship. These oddities conform more closely to local custom and early tradition. The extreme ends of the vigas are shaped with a very simple cross-cut of which there are a variety, and then painted with some bright color for a decorative effect.

#### Shrinkage of Adobe

The inherent shrinkage of adobe and the resulting settlement of the walls as well as the all-too-common practice of doing the carpentry before the shrinking has taken place makes it imperative to take these facts into account and to provide the necessary structural allowances.

The following are some of the precautions which should be observed.

1. By using structural concrete posts and lintels, in connection with which the adobe acts merely as a curtain wall as previously stated on page 11, settlement may be largely eliminated. While not in conformity with traditional adobe construction this more modern procedure eliminates many of the difficulties which otherwise occur.

2. It is important that both ends of the vigas rest upon similar construction; not one end on an adobe wall and the other on a frame partition. This, however, requires thick interior adobe bearing walls and accounts for their use in structures greater than one room in depth.

3. Wherever possible, cross-partitions should be erected in a manner to avoid superimposed loads; a simple matter with nonbearing partitions (fig. 14, page 15).

4. Over window and door frames an allowance of about 1 inch should be made in anticipation of the usual settlement.

5. Wood wainscoting may be used as a means of reducing the cracks which frequently occur in plastered walls (fig. 14)

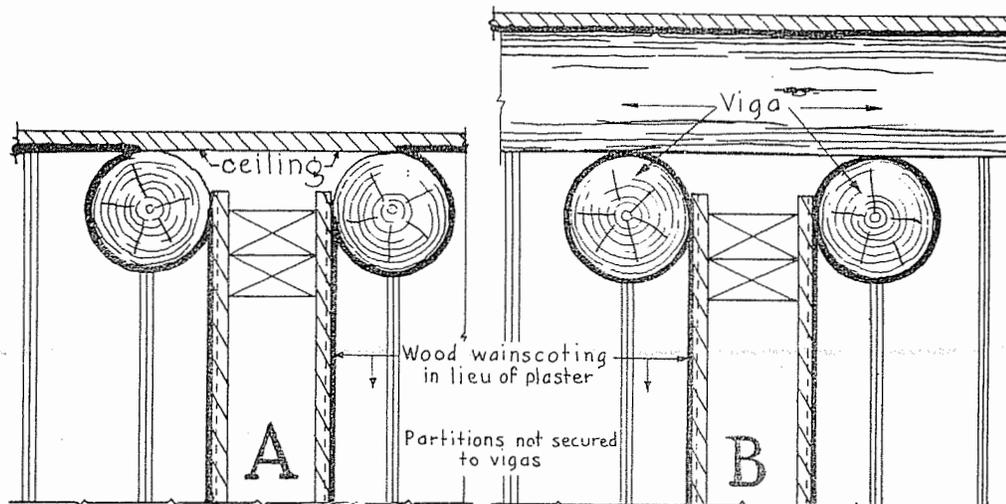


Fig. 14. Practical precautions against settlement and cracks:  
A, nonbearing partition; B, partition made nonbearing by transferring load.

Parapets, Copings, and Cornices:  
Their Design and Construction

Parapets are usually of modest height above the roof. Wavy effects and exaggerated curved crestings (fig. 15), reminiscent of decadent Spanish work, are not only in bad taste but give an impression of motion which is quite contrary to the repose typical of Pueblo architecture.

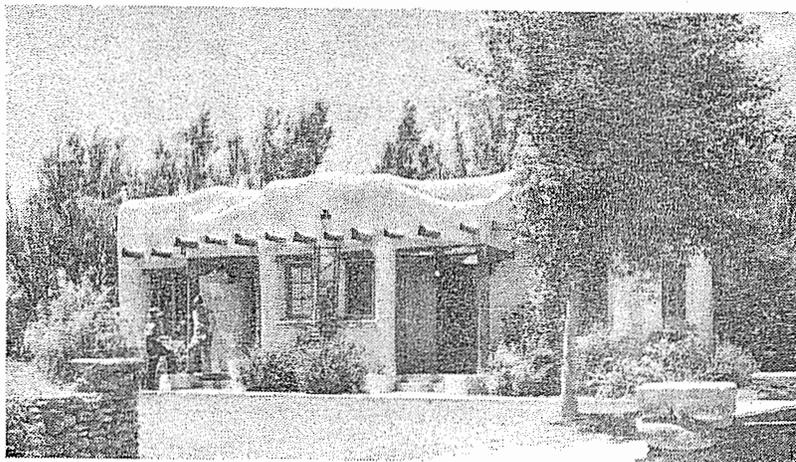


Fig. 15. Exaggerated parapet cresting.

Neither excessive height nor pronounced irregularity are characteristic of, or in accordance with, either tradition or good design. Their top surface should be rounded in a simple fashion and not be made exactly level or horizontal; but just irregular enough to appear to have been trowelled by hand.

The coping proper may be constructed of cement, brick, or tile. The former serves better than any other material because it lends itself more readily to irregular surfacing. No form work is required and, if a fairly dry mix is used, the rounded surface effects which are characteristic of the Pueblo style may be obtained without difficulty with an ordinary trowel. No concrete, however, should be erected until a layer of saturated felt has been placed over the top surfaces of the adobe walls, (fig. 13 H, page 13).

In certain localities, particularly Santa Fe and its environs, a very simple form of dull red brick coping is used in preference to any other material because it affords greater protection where it is most needed (fig. 16).

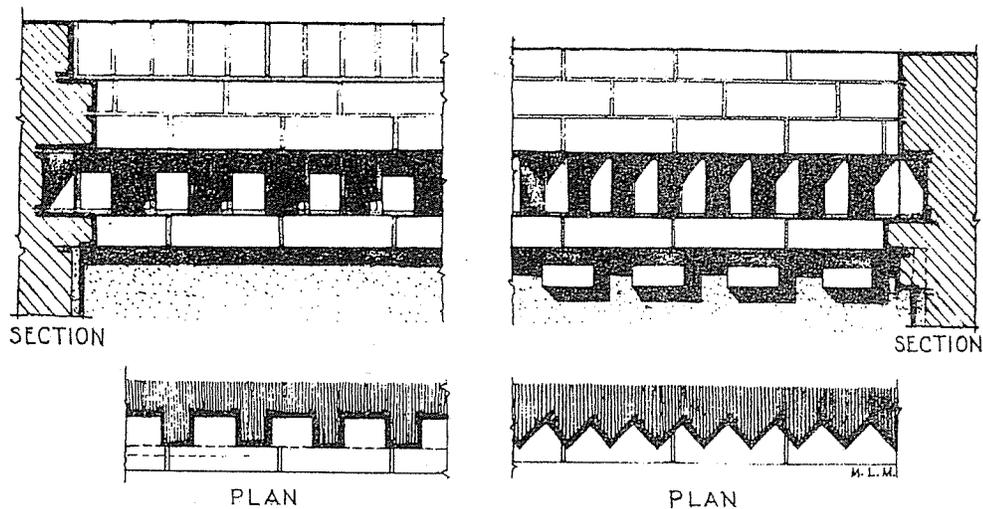


Fig. 16. Cornices of Santa Fe and its environs. Simple in pattern and of a dull red color in pleasing contrast with light pastel shade plaster work.

Many Mexicans and Indians still build roofs of adobe. However, they lack permanence because of the traditionally flat, unprotected surfaces do not long withstand heavy rains, and, therefore require continual repairing. Consequently, instead of adobe ordinary standard, ply-felt and slag roofs are used very often now-a-days.

The roofs of the original pueblos were surrounded on all sides by parapets and drained through spouts known as "canales" or hollowed out half wood poles. The overhanging portion, projecting like a gargoye, was shaped in a simple fashion for appearance. The waterway of a modern canale should be lined with sheet copper for greater permanence and thoroughly flashed at the inside wall face to ensure watertight connections. Today, the roofs of small buildings are very often surrounded by parapets on three sides only and sloped to the fourth, or open rear side, and thence drained to a hanging gutter having down-spouts (fig. 13 H, page 13).

Roof intersections with parapet walls are flashed and counter-flashed with cold rolled sheet copper in the usual, present-day manner by building it well into the horizontal joints of the adobe.

Seldom does anything appear above the flat roofs but the chimney, usually at a corner rather than free-standing (fig. 13 H, page 13), and then only as an elevated portion of a wall. They are built of adobe, surrounding a vitrified flue lining, with a concrete cap for weathering purposes as previously described for parapet copings.

### Cellars

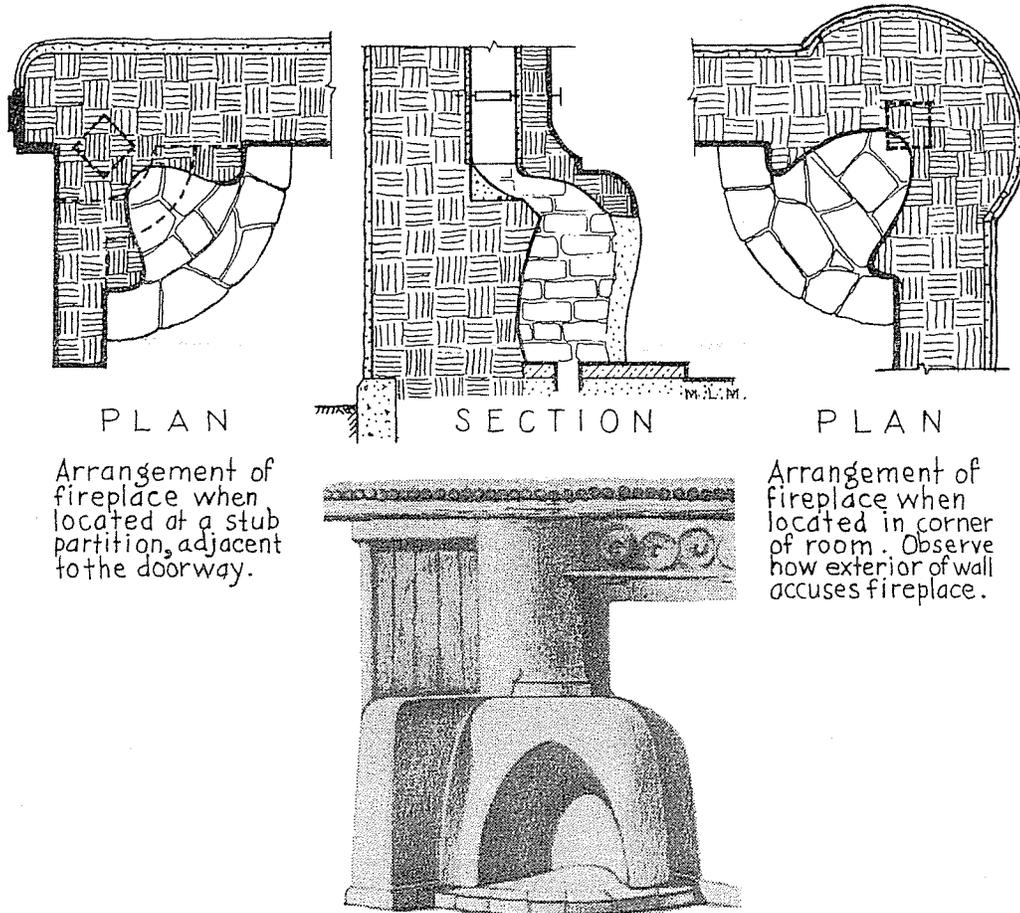
The original adobe structures possessed no cellars; the ground floors were built directly upon the earth itself. Door sills, being merely elevated thresholds over which one stepped from the outside ground to the inside dirt floor, acted as rain water retardents.

Only in the more recent buildings, due to a different mode of living, have cellars been introduced. Here, regular joist construction and wood floors are used. Consequently, where not excavated for basement purposes, any space between the first floor construction and the ground proper should have occasional openings in the foundation walls for ventilation, to avoid the dampness common to buildings having no cellars, and also to prevent decay in the floor construction from dry rot. At these vent holes a fine mesh, copper wire screen should be installed on the inside to stop the access of rodents (fig. 8 A, page 9).

### The Fireplace

The fireplace, unique in many respects, plays an important role in the Pueblo style. The annoying inconvenience of having to continually replace the fragments of burning wood, due to the fact that when pieces are placed horizontally they burn at the center first and then fall apart, led the Indians to stack the wood in an upright position. Consequently, the fireplace opening was shaped like a vertical parabolic arch instead of being a horizontal, rectangular one like those to which we are accustomed.

Because of the cold drafts around the doorway, often a low partition wall was built, 4 or 5 feet high, and the fireplace erected across the re-entrant angle and facing the room. If not located in this fashion the fireplace occupied some other corner but seldom was it placed on, and parallel with, one wall (fig. 17).



Arrangement of fireplace when located at a stub partition, adjacent to the doorway.

Arrangement of fireplace when located in corner of room. Observe how exterior of wall accusses fireplace.

Fig. 17. A native fireplace

### The Porch

The 'portale', or porch, occupies a conspicuous place in the Pueblo style as a retreat from the heat of the sun for both man and beast. In its most primitive form it consists of vertical poles supporting similar lintels and rafters thatched with branches for shade (fig. 18, p. 19).

In other instances, the porch roof was built of adobe and the ceiling of round sticks, while, today, the built-up roof of ply-felt and slag, as previously described, is very common.



Fig. 18. The primitive porch.

Later, the porch assumed the greater architectural importance of an arcade, as in the Palace of the Governors at Santa Fe (fig. 19).

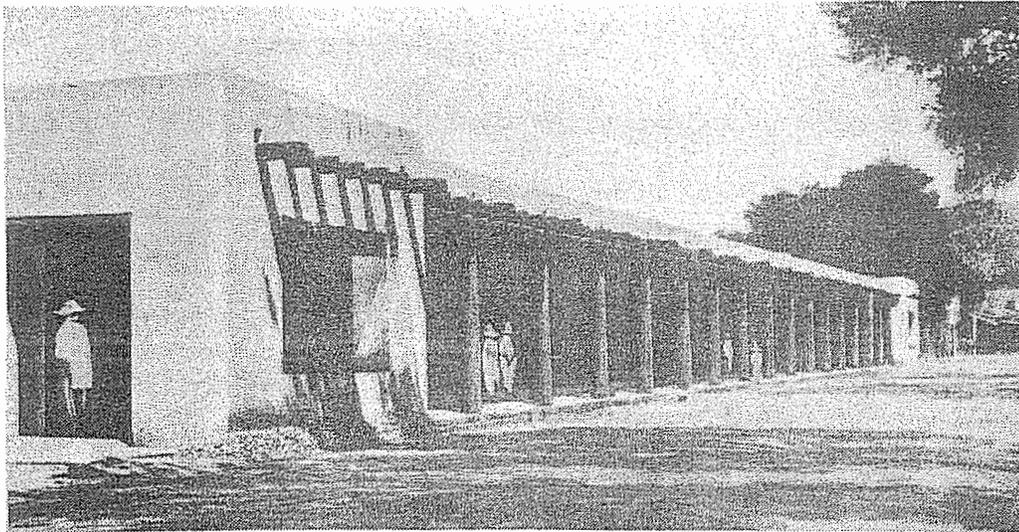


Fig. 19. The arcade, Palace of the Governors, Santa Fe, N.Mex.

It was in the porch motif, almost exclusively, that vent was given to a display of decoration, albeit very modestly, in the form of crudely shaped carved wooden columns, caps, and lintels (Plate 1, Appendix), which were playfully enriched with some simple form of gouged surface ornament (fig.20,p.20). The carved bracket, whether simply a single one like a column cap or in the more complex form of a corbelled series as wall supports under either interior ceiling beams or overhanging balconies, the carved bracket

displays the influence of familiar Spanish prototypes, many of which they resemble. They possess a naive charm which is characterized by bold, crude workmanship rather than any architectural refinement.

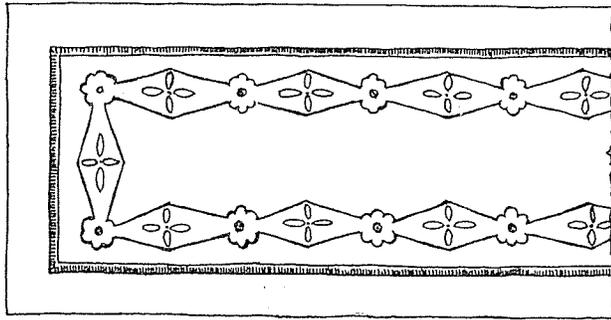


Fig. 20. Gouged decoration

The pergolas, being detached, stood in front of communal pueblos, as still evidenced at Taos and elsewhere. The pole supports were used to hitch horses and cattle while riders and owners relaxed and talked, sheltered from the sun.

### Windows and Doors

It is interesting to note that the somewhat small apertures of the early Indian structures were sometimes glazed with thin sheets of transparent mica set in crude wooden frames. Window frames and sash may be of the casement type and glazed in conformity with the common practice employed in dwellings of other architectural styles.

The exposed flat surfaces at window openings, not covered and protected by the wood sills, should not consist of stucco turned from the vertical wall surface in and under them. Due to the increased exposure of such horizontal surfaces to the weather, they may be of concrete for greater permanence. Where the natural grey concrete does not harmonize with the general color scheme, it may be painted to agree with the exterior woodwork (fig. 21 C).

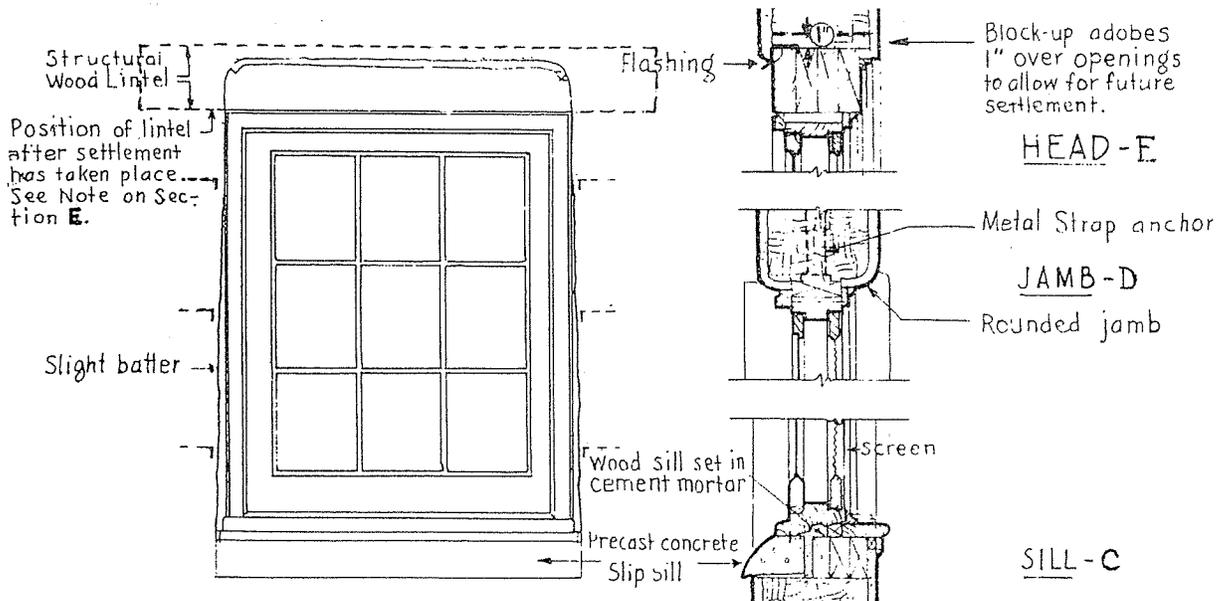


Fig. 21. Window details

Either wood jamb blocks or metal strap anchors (fig. 21 D, p.20) should be built into the adobe walls to secure the window and door frames rigidly in place. Metal strap anchors should have a hole punched in the vertical portion to receive a bolt for securing either a wood jamb nailing block or the finished frame itself. The door frames usually have just a plain rounded edge or molded rope pattern staff mold.

The adobe over the openings is supported by structural wood lintels, back of the exposed or face ones, which should be built into the walls a distance sufficient to obtain a substantial bearing on each jamb. It is of the utmost practical importance that they be set about 1 inch higher (fig. 21 E, p. 20) than the frames to allow for settlement in the adobe upon which they rest at the jambs. Furthermore, face lintels should be set in from the exterior wall surface for the thickness of the stucco and be thoroughly metal flashed along the top edge. Faces of wood lintels over window, door, and porch openings are usually rough-surfaced or adzed - often being gouged out with semicircular cuts for ornamentation, either as an over-all treatment or in the form of some very simple pattern.

Slab doors or panelled ones of a Spanish pattern are the most common types which have been found satisfactory in design and of a pleasing character to agree with the Pueblo style.

#### Surface Coatings and Colored Washes

A great variety of exterior protective surface coatings, ranging from colored washes, bituminous products\*, and oil paint to mud and plaster, are used with varying degrees of success. White or colored washes, although cheap and easily applied, are neither water-proof nor permanent. The traditional coloring used by native Mexicans and Indians is obtained from clays excavated from natural deposits usually found near the site. They vary in color with different localities and include tierra blanca or white, tierra vallita or cream, tierra rosa or pink, and tierra colorada or red. When applied in delicate, pastel shades they lend that particular charm to the exterior plaster work which is so characteristic of the Pueblo style.

The bituminous preservative treatments include coal-tar, cold-pitch asphalt, and coal-tar paint. Equal parts of cement and kerosene are mixed and added to four parts of coal-tar, by volume; they are then stirred to the consistency of paint and applied by brush to the adobe surfaces after having primed the latter with several coats of thin water-gas tar. While these materials are very effective preservatives, they are not recommended from an architectural standpoint because their blackish color is very displeasing.

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\*Bituminous treatments are not recommended from an architectural standpoint of surface treatment.

White or colored washes are decorative and attractive when new but, although cheap and easily and quickly applied, they are neither durable nor waterproof.

A mud mortar, composed of one part sand to two parts of clay mud, is commonly used. Due to its rigid adherence to adobe, it forms an excellent foundation for the final surface painting.

For buildings in which consideration is given to architectural design, cement plaster is found to offer the best media by which to protect the adobe, increase its durability and, at the same time, improve the external appearance. This material should be applied in at least two coats and, for first-class work, it is advisable to use three coats in order to completely fill the surface irregularities as well as the recesses between the adobe bricks. Each undercoat should be heavily scored to insure a thorough bond for the succeeding one.

By dashing the first coat upon the adobe with either a brush or a broom, it adheres more firmly than if applied with a trowel. The subsequent coats may then be trowelled to a reasonably smooth finished surface in the customary manner. Textured or slightly undulating finished surfaces provide a variety of pleasing effects, of which the best known and most popular is the so-called 'Mission'.

Within reasonable limits the absence of mechanically perfect plastering is highly desirable for the most artistic treatment of exterior surfaces. The adobe style is unique in this respect, being a material in which mass symmetry is sought instead of exactness of form; flowing outlines in preference to rigid or exactly level ones; rounded in place of sharp, true, and even corners and edges and, above all, battered exterior wall surfaces instead of absolutely vertical ones.

Lime stucco possesses good adherence and is reasonably permanent but does not have the durability of cement mortar to withstand wind and rain erosion, or continued dampness. The addition of lime paste ensures less likelihood of cracking.

To prevent the stucco from drying too rapidly care should be exercised not to apply it until the walls are thoroughly dry and, also, to wet them completely before any stuccoing or plastering is done. Finally, spraying the finished surfaces with water or covering them with wet bagging ensures their drying very slowly which is essential if the possibility of cracking is to be reduced to a minimum.

Lime stucco consists of one part lime putty to three parts of sand, by volume, whereas cement stucco consists of similar proportions of Portland cement and sand with the addition of thor-

oughly slaked lime paste. If, in lieu of lime paste, ten pounds of hydrated lime are added for each bag of cement the material can be worked much more easily.

Interior plastering frequently consists, in native or low-cost dwellings, of a clayey mud coating, similar to that previously described for the exterior surfaces. For greater durability and better appearance, a skim coat of lime or cement mortar is required.

Ordinarily, for better class buildings, the interior plastering consists of three coats of lime mortar or standard commercial plaster applied over metal lath according to the usual practice.

A variety of textured surfaces, colored in delicate tints of either the previously mentioned natural pigment colors or else commercially prepared mortar stains, may be employed to increase the beauty and character of both the interior and exterior plastering. A 4-foot high dado or base, painted in either a contrasting color or a darker shade of the same color as that used on the walls, is a characteristic feature of many exterior color schemes.

While the interior and exterior woodwork of the early adobe structures was commonly left natural or merely stained, the subsequent influence of the Spaniards has led toward an array of brilliancy by means of colorful wall tiles, bright-colored paints, and decorative fabrics.

When the colors of the exterior plastering are new, adobe buildings possess a very theatrical appearance in the brilliant sunlight of the Southwest. Later, when somewhat faded with age, they assume a subdued, mellow charm and appear to be an integral part of the landscape itself; a rare aesthetic quality seldom achieved anywhere in other styles of architecture.

#### The Spanish Influence:

Up to this point the discussion of adobe architecture has been confined entirely to the Pueblo style as the result of adhering to the early Indian prototypes.

Throughout the Southwest where adobe construction prevails its architectural design is not limited to the Pueblo style common to New Mexico and southern Colorado but, in Texas, Arizona, and California, it has been influenced chiefly by the Spaniards who overran these regions.

This influence has affected both the plan and elevation. The former is typified by the introduction of the patio having the building/s opening upon three sides of it and the fourth enclosed by a wall, thus ensuring a pleasant, shaded, and quiet retreat from the heat of the sun.

In arid and semiarid areas the flat adobe roof, similar to that of the pueblo, was originally and, in many instances, still is used. Later, however, low-pitched roofs, covered with Spanish roll tile, were introduced as an architectural variation. Plain, plastered exterior wall surfaces, invariably free of any embellishment and with slightly undulating surfaces delicately tinted with color, are characteristic. Only in the ecclesiastical buildings, the Spanish missions, was there any tendency to indulge in more elaborate architectural features.

*W. Ellis Groben*  
W. ELLIS GROBEN,  
Architect  
U. S. Forest Service.

November 15, 1940

## APPENDIX

### The Pueblo Style

#### Using Modern Materials and Methods

Unless the adobes are made locally to save transportation charges and by unskilled labor considerably in advance of the time when they will be needed at the building, as previously explained on page 8, their use is not economical but, on the contrary, more costly than almost any other suitable masonry.

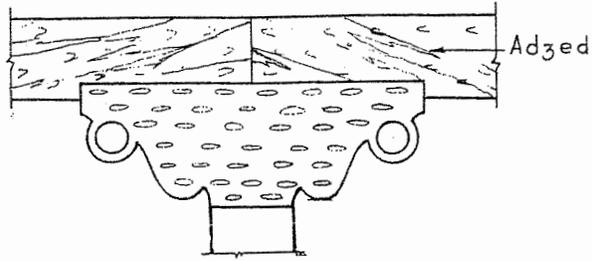
Therefore, for modern, multistoried buildings in which thin exterior walls are imperative or where speed of erection is a factor, economy dictates the substitution of native stone, kiln-burned brick, cinder concrete block, hollow tile, or concrete in place of adobe. Except in very isolated locations, any of these materials may be obtained conveniently and without delay.

The advisability of protecting adobe from erosive deterioration by a cement plaster or stucco coating, thereby concealing the actual construction, facilitates building in the Pueblo style without the traditional and sincere use of adobe. While conforming strictly to the Pueblo style in elevational design, this procedure offers a practical solution of the structural limitations of the adobe itself.

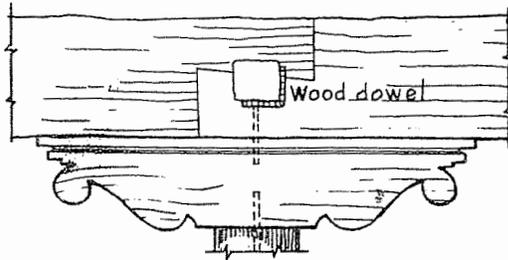
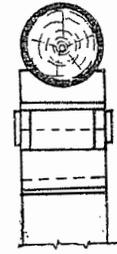
Some recent multistoried buildings, which externally appear to be built entirely of adobe, have been erected in the customary manner of modern construction with steel or reinforced concrete columns and floor slabs, using adobe only for the spandrels or curtain walls and as a veneer over the more rigid structural portions.

In simulating adobe construction by using other building materials such as hollow tile and brick, often the substitution is very noticeable because the final appearance is that of the ordinary stuccoed surface rather than adobe. Due to lack of efficient supervision, the plasterers are allowed to apply the cement stucco coating in the form of a perfectly smooth finish, thereby failing to obtain the true character and artistry of adobe - its crude, irregular, undulating surface effect.

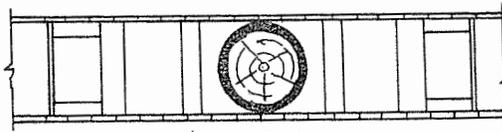
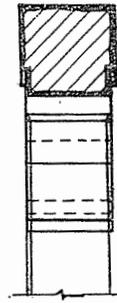
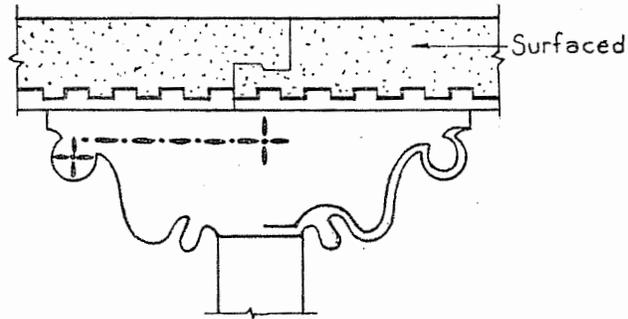
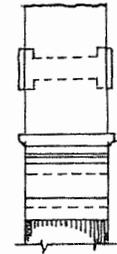
The following plates show several interesting examples which, despite their having been designed in the Pueblo style, have been constructed entirely of modern materials, the particular kind being designated in each instance.



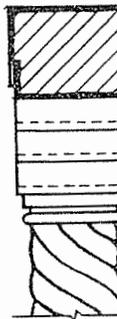
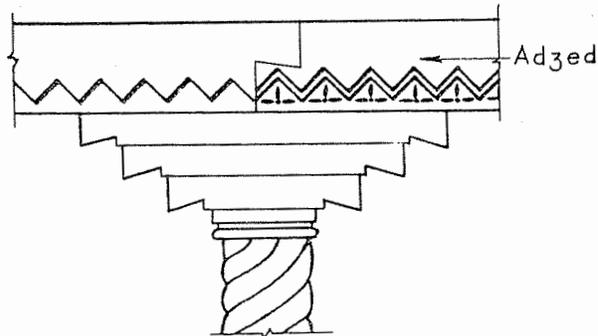
Bolster cap - Spanish influence



More primitive native cap



Typical Plan

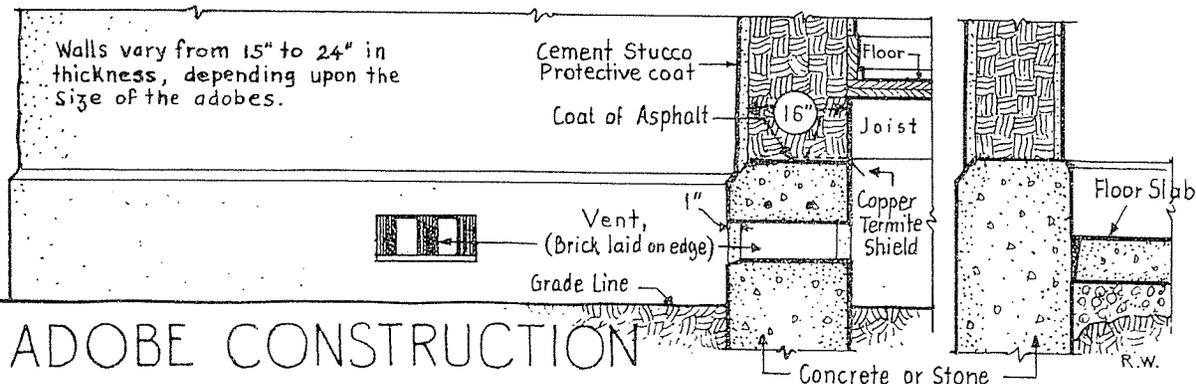
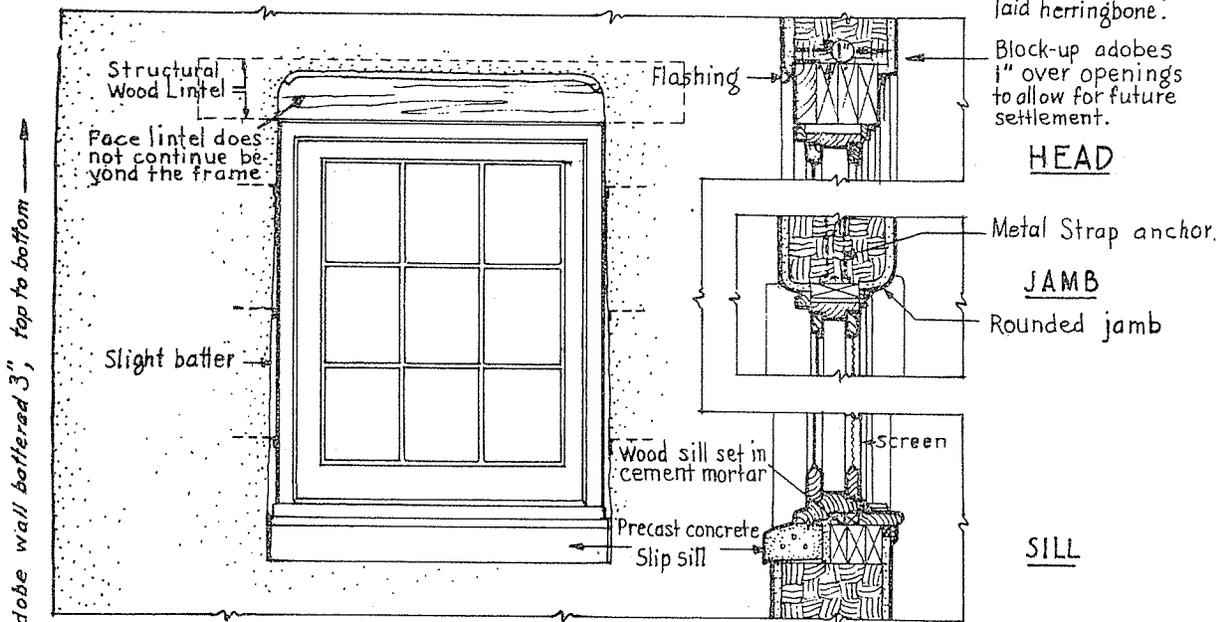
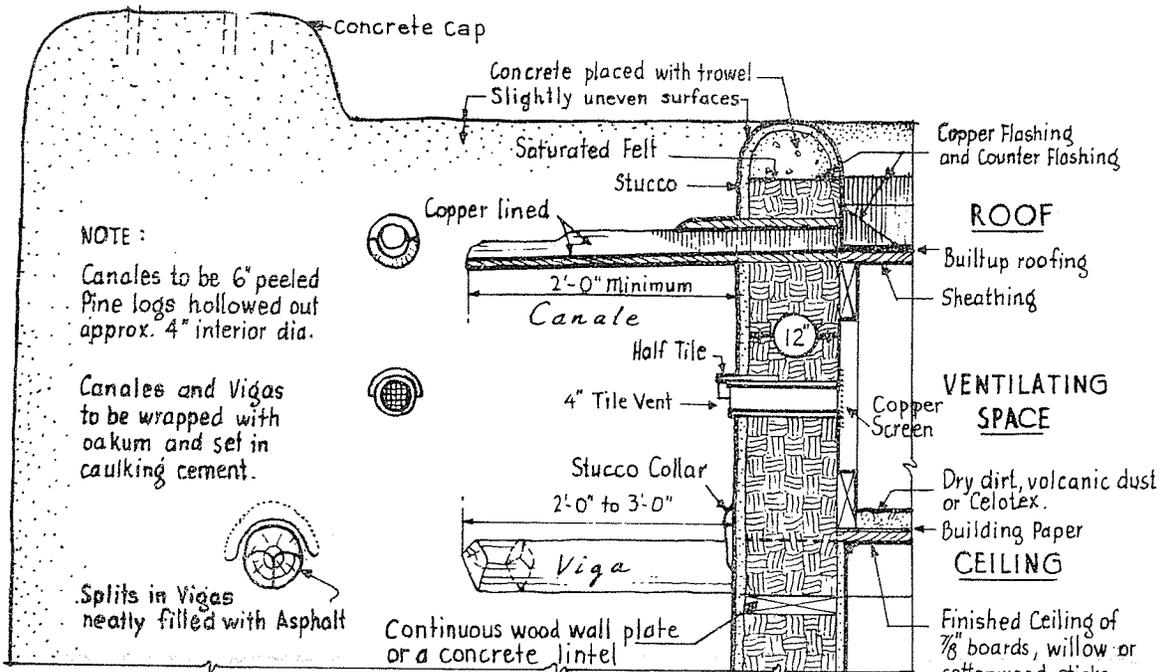


# WOOD COLUMNS, CAPS AND LINTELS

Wall brackets similar to half elevation  
All columns are round in plan

*W. Ellis Krohn,*  
Architect.

M.L.M.



# ADOBE CONSTRUCTION

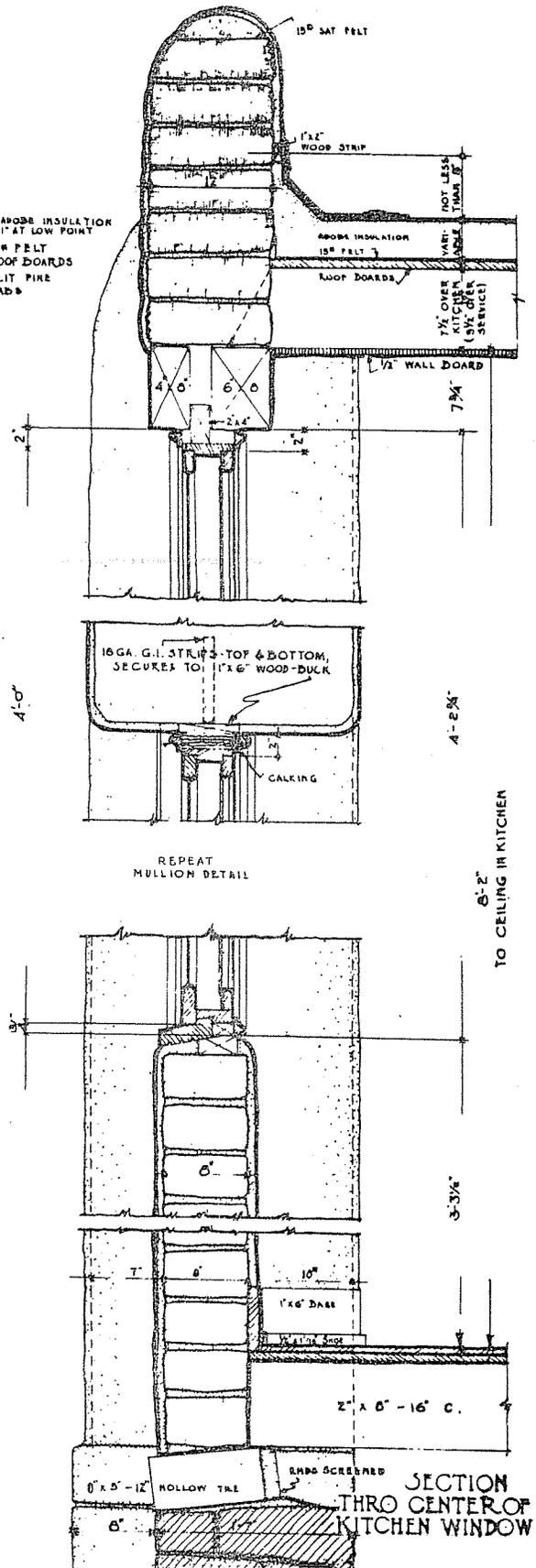
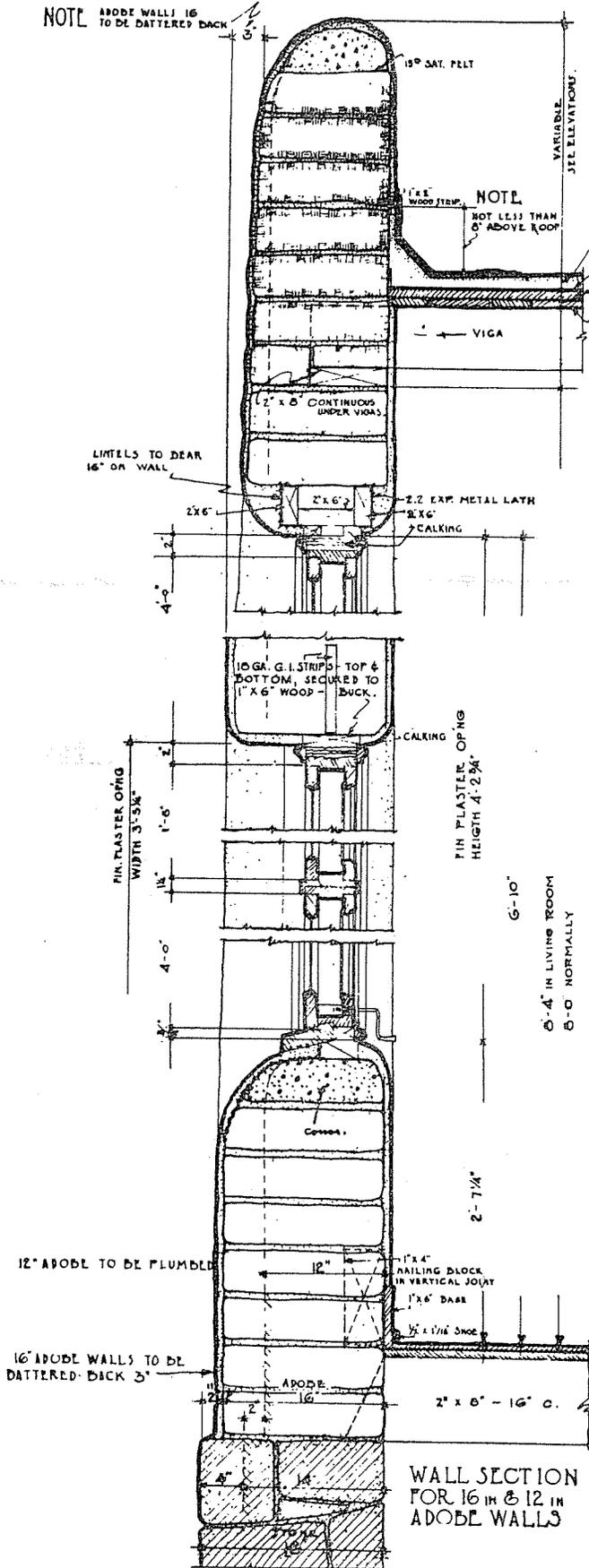
## DETAILS OF PIMA NURSERY

SAFFORD, ARIZONA

See photographs, Plate IV

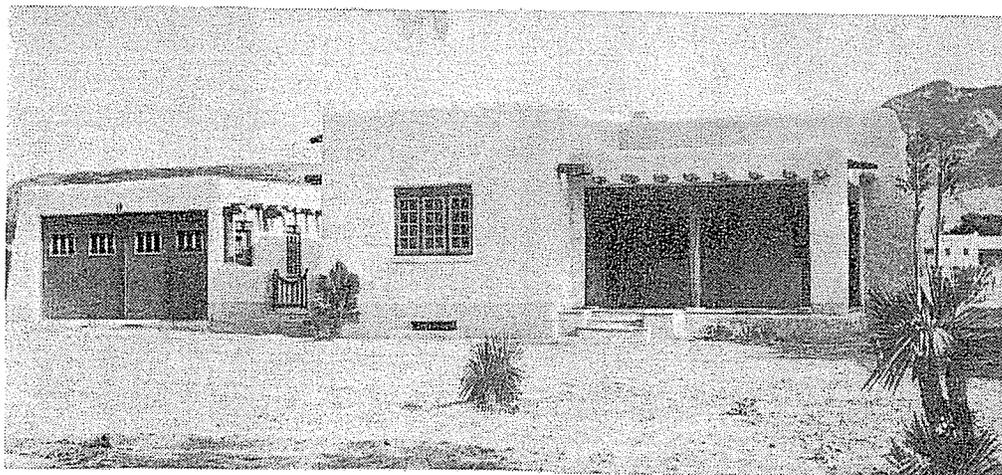
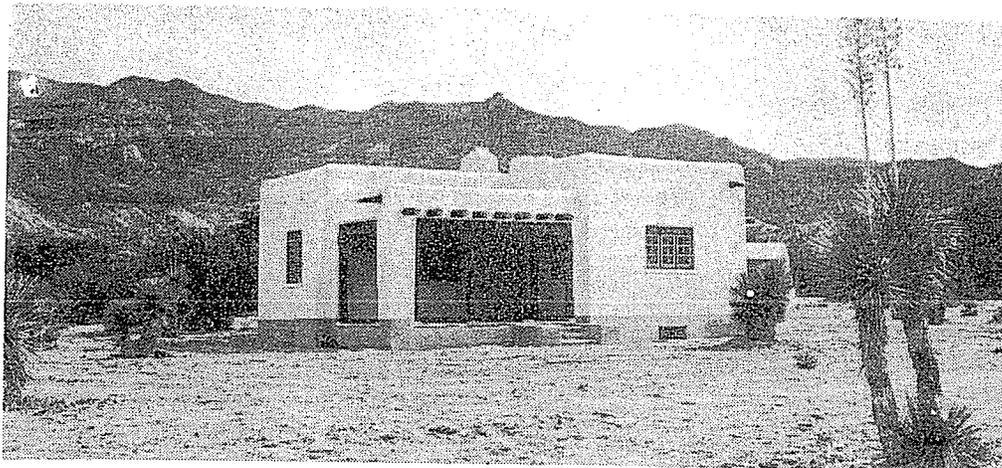
## WALL SECTION ALTERNATE (Concrete Floor Slab)

NOTE ADOBE WALLS 16 TO BE DATTERED BACK



G. G. WIRTH, FOREST SERVICE ARCHITECT

# ADOBE CONSTRUCTION DETAILS



W. ELLIS GROBEN, CONSULTING ARCHITECT  
U.S. FOREST SERVICE

RESIDENCES, PIMA NURSERY

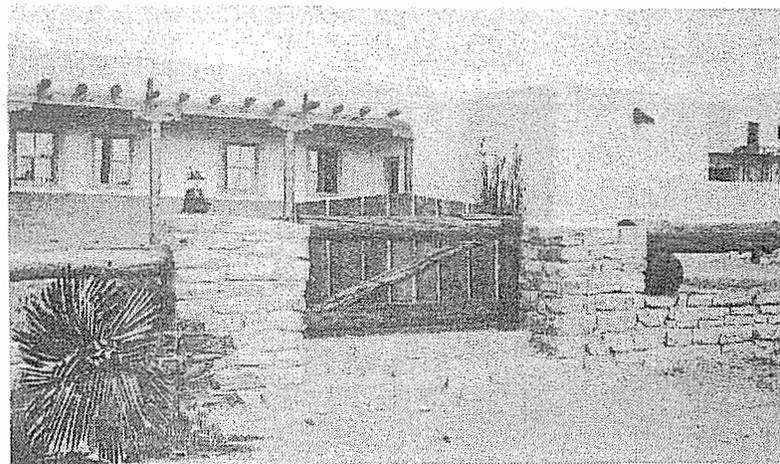
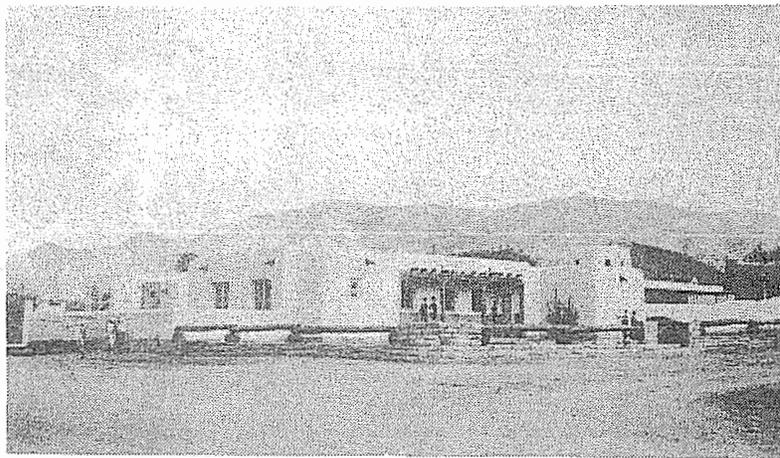
S C S

SAFFORD, ARIZONA

BUILT OF ADOBE

For construction details, see PLATES I AND II

PLATE IV



G. G. WIRTH, FOREST SERVICE ARCHITECT

RANGER STATION DWELLING

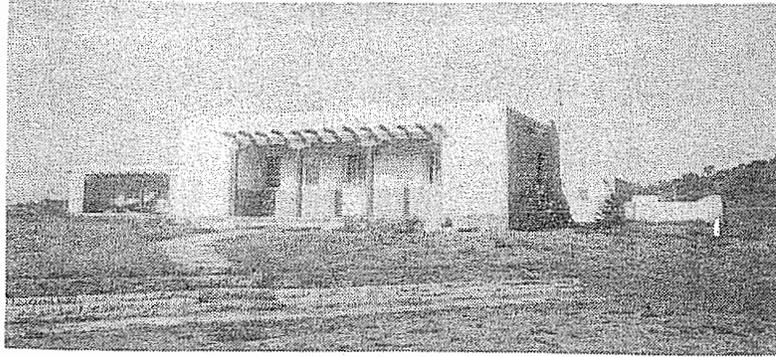
MAGDALENA, N. M.

CIBOLA NATIONAL FOREST

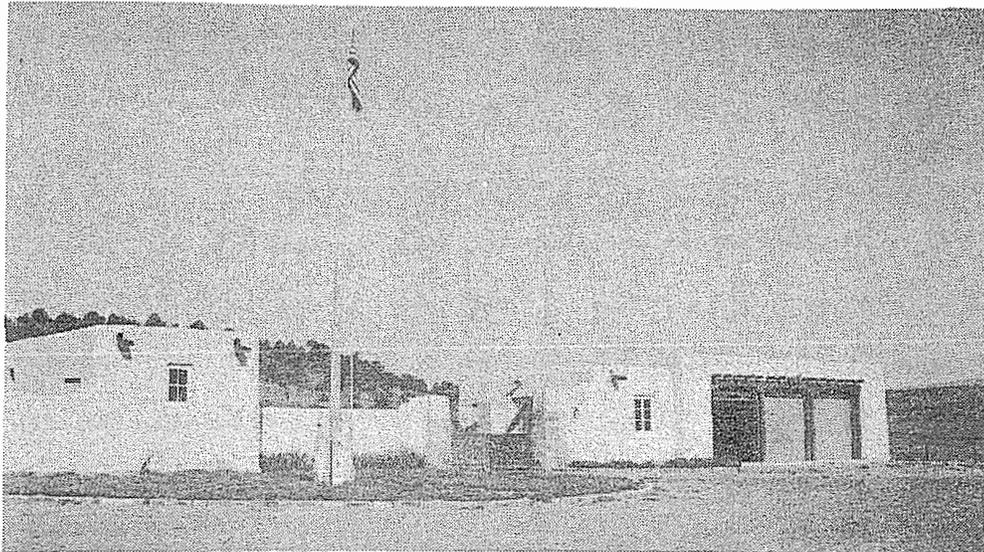
REGION 3

BUILT OF ADOBE

PLATE V



OFFICE BUILDING



UTILITY BUILDING



DWELLING

G. G. WIRTH, ARCHITECT  
U. S. FOREST SERVICE

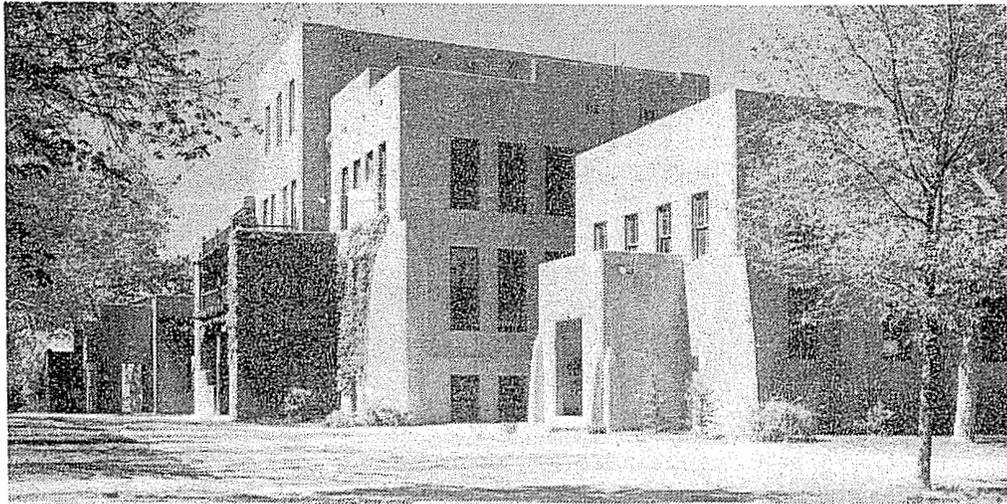
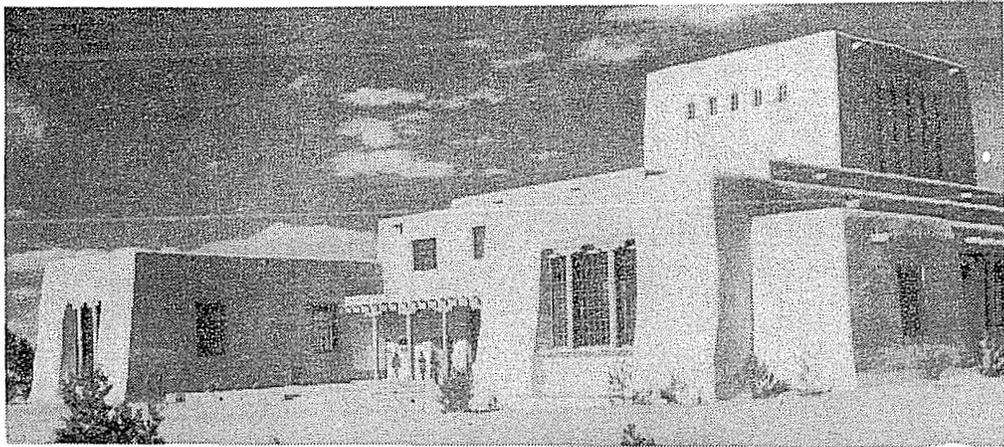
CAPITAN RANGER STATION

CAPITAN N. M.

LINCOLN NATIONAL FOREST  
REGION 3

BUILT OF ADOBE, TAKEN FROM THE SITE

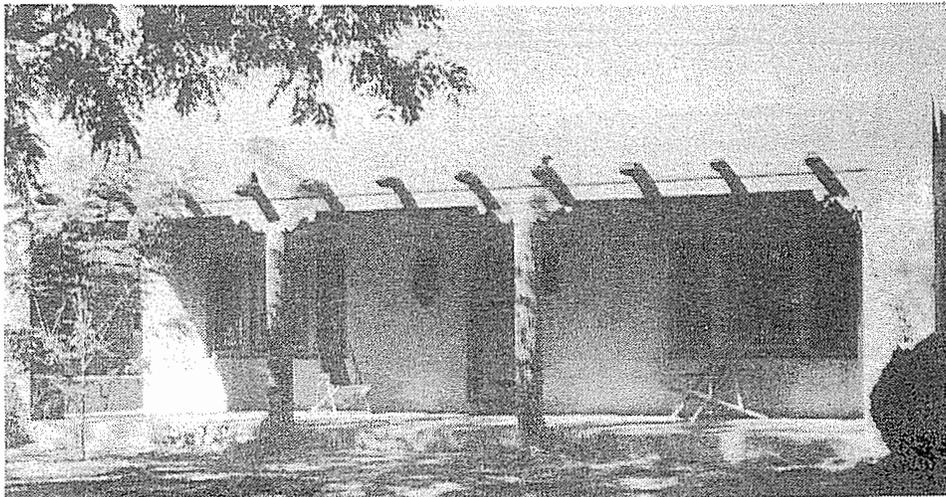
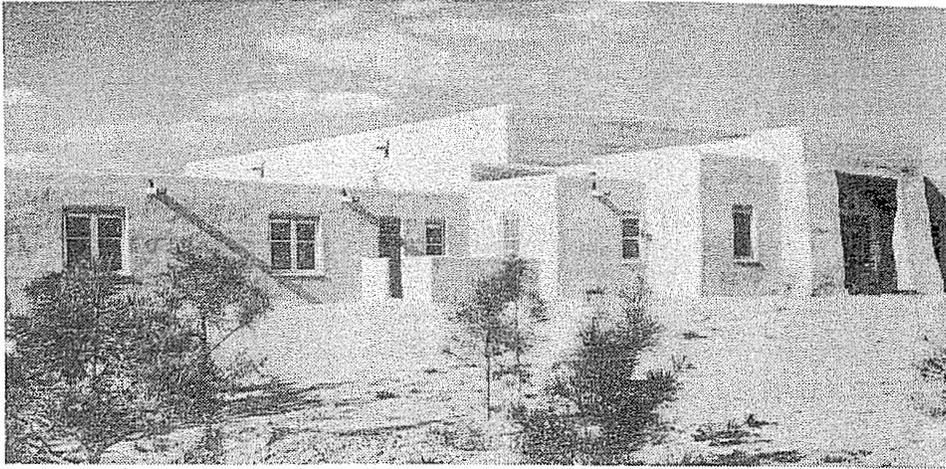
PLATE VI



BUILDINGS OF THE UNIVERSITY OF NEW MEXICO  
ALBUQUERQUE, N. M.

BUILT OF ADOBE

PLATE VII

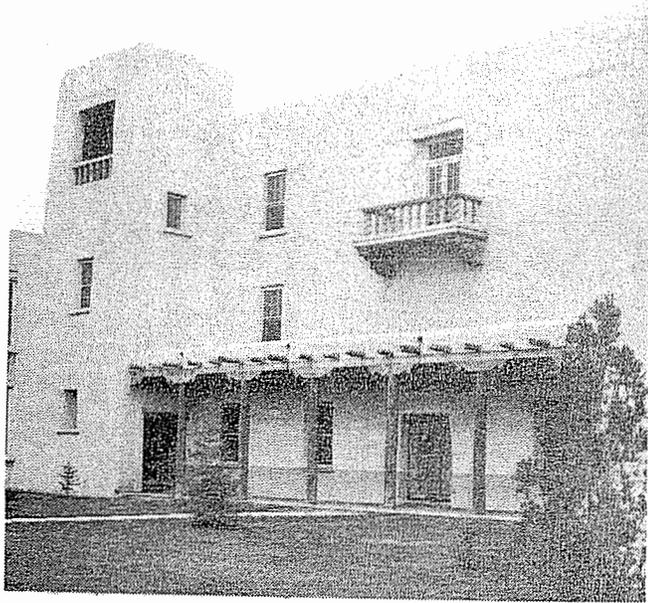


BUILDINGS OF THE UNIVERSITY OF NEW MEXICO

ALBUQUERQUE, N. M.

BUILT OF BRICK

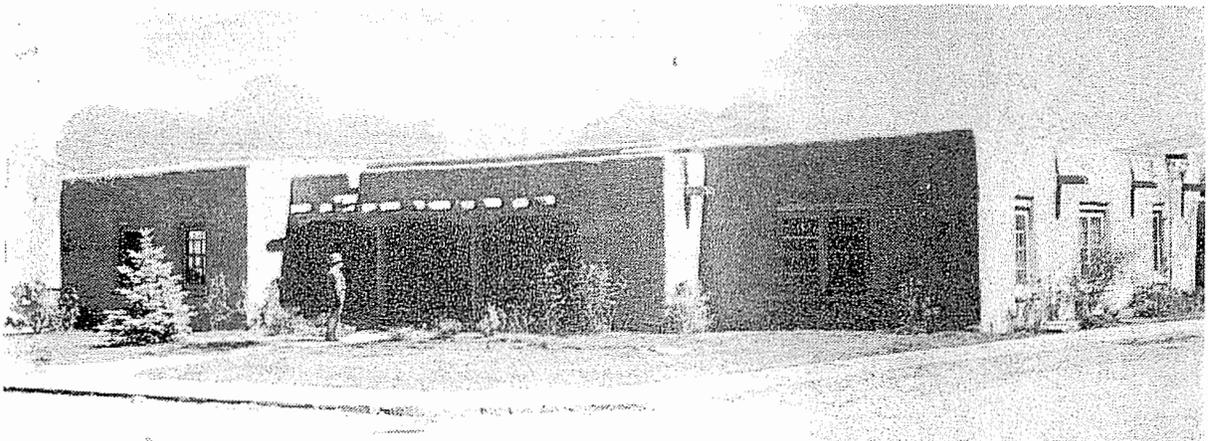
PLATE VIII



ADMINISTRATION BUILDING  
UNIVERSITY OF NEW MEXICO  
ALBUQUERQUE, N. M.

Built of kiln burned  
brick laid up to a full-  
sized metal profile to  
simulate the Pueblo  
style.

JAMES G. MEEM.  
ARCHITECT

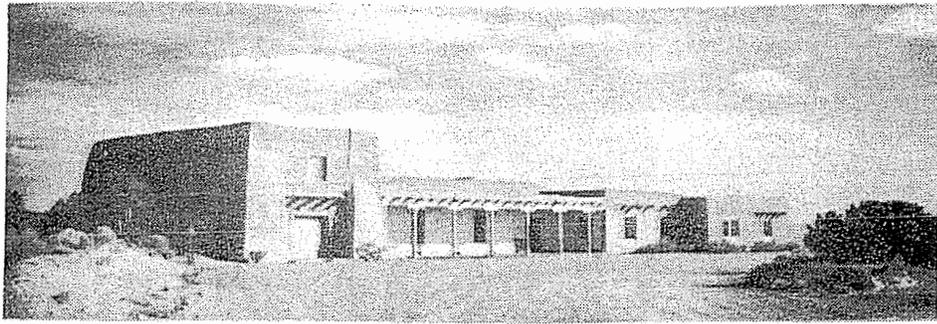


FOREST SUPERVISOR'S OFFICE BUILDING

TAOS, N. M.

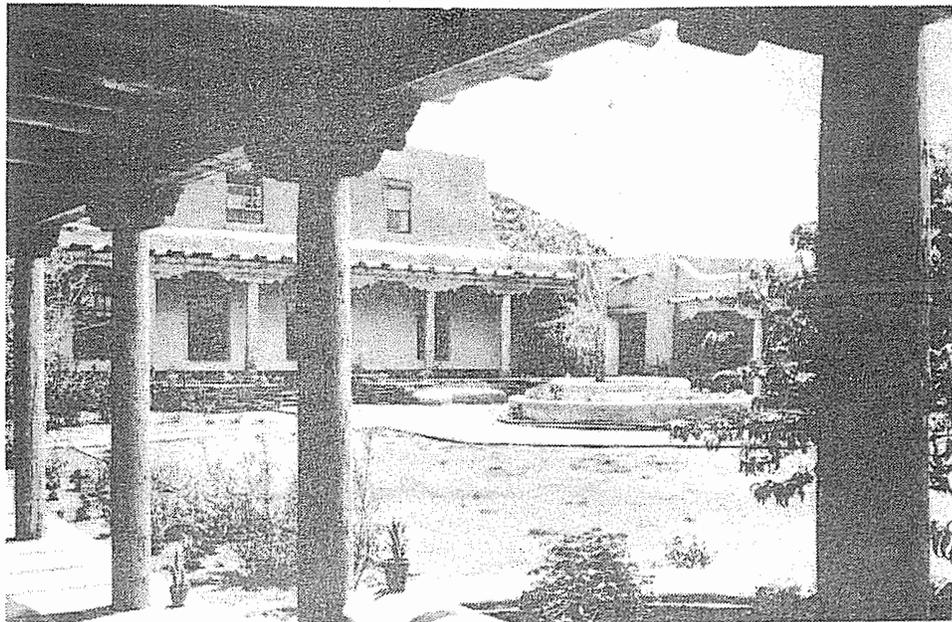
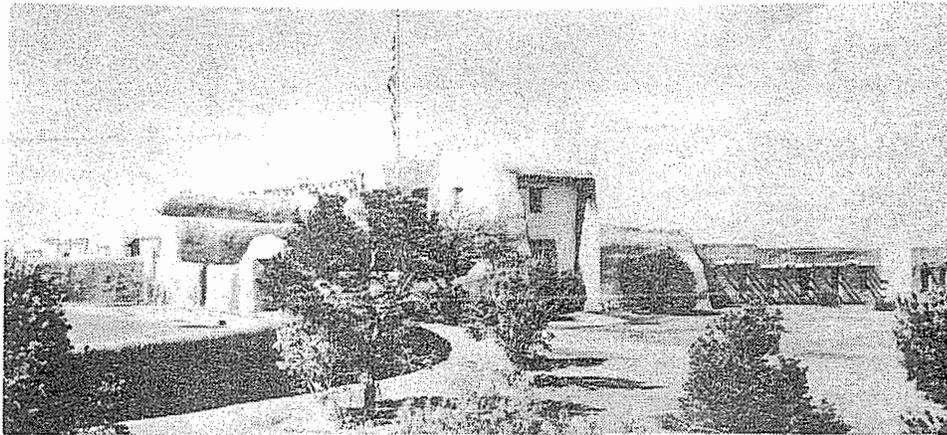
BUILT OF ADOBE

PLATE IX



JAMES G. MEEM, ARCHITECT

LABORATORY OF ANTHROPOLOGY  
Santa Fe, New Mexico



ADMINISTRATION BUILDING

DEPARTMENT OF THE INTERIOR, SANTA FE, N. M.

PATIO, SHOWING SPANISH INFLUENCE

BUILT OF ADOBE



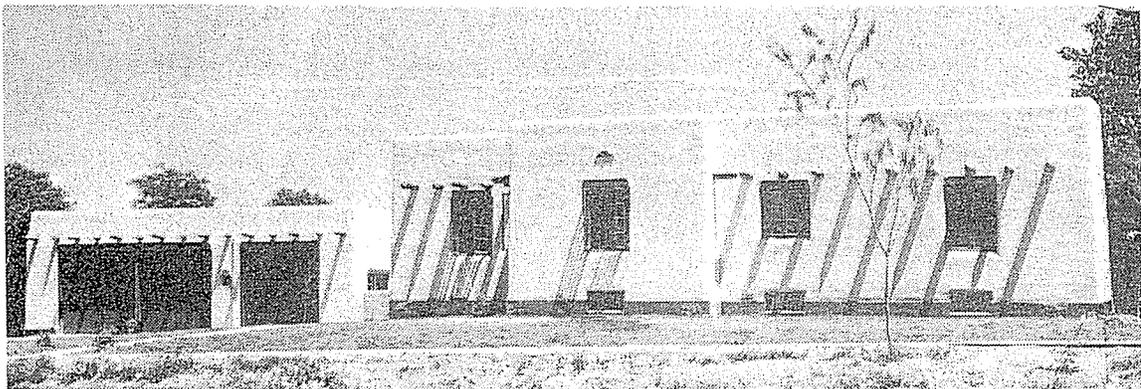
OFFICE BUILDING LA VETA, COLORADO  
SAN ISABEL NATIONAL FOREST  
ADobe

W. E. JACKSON  
U. S. F. S. ARCHITECT



RANGER STATION SAGUACHE, COLORADO  
COCHETOPA NATIONAL FOREST  
BRICK, STUCCOED

W. E. JACKSON  
U. S. F. S. ARCHITECT



RANGER STATION LA VETA, COLORADO  
SAN ISABEL NATIONAL FOREST  
BRICK, STUCCOED

W. E. JACKSON  
U. S. F. S. ARCHITECT

BUILDINGS IN THE PUEBLO STYLE

REGION 2

PLATE XI