A Field Guide to American Houses
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Structure

The Anatomy of American Houses

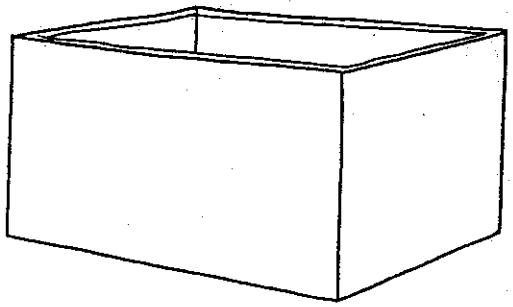
In addition to style (fashion) and form (shape), there is a third and somewhat more technical element that is useful for identifying and understanding American houses. This is structure, which can be defined as the several individual components of houses that give them their characteristic forms and styles.

All houses are composed of three basic structural units. First come walls, the vertical units that serve both to screen the interior spaces and to support the second basic unit, the roof, which shields the interior spaces from weather and completes the enclosure. In very simple houses—for example, tipis or modern A-frames—roof and wall may be a single unit. Far more commonly, each is made of different materials combined into separate structural systems. The most important materials and systems used for walls and roofs in American houses are described in the pages that follow. A house made up only of walls and a roof, with an entrance opening in the walls, can be a fully functional shelter. Many simple folk houses have little more. Most American houses, however, have added architectural details to the basic walls and roof, including some or all of the following components: windows, to provide light and ventilation to the interior; doors, to permit the entranceway to be closed against the weather; chimneys, to confine and eliminate smoke from interior fires; porches, partially exposed areas having roofs but lacking one or more walls; and, finally, decorative details, which function to enrich the external appearance of the house.

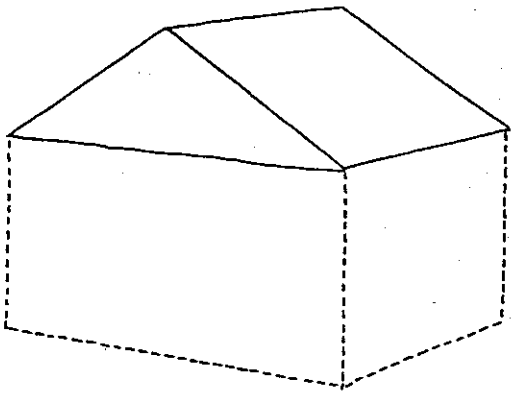
WALLS

The walls of houses have two separate and distinct functions; first, they provide support for the roof and for any upper floors that may be present; second, they screen the house interior from weather and intrusion. In some types of wall structure—for example, those made up entirely of stone or brick—the same materials serve both functions. In others the functions are separated: one material provides the structural support and another the screening. The most familiar example is the wood-frame house, in which vertical wooden members provide structural support while an exterior covering, or cladding, screens the interior. This first section describes the principal structural support systems used for walls of American houses. The principal cladding materials used with these wall structures are treated below.

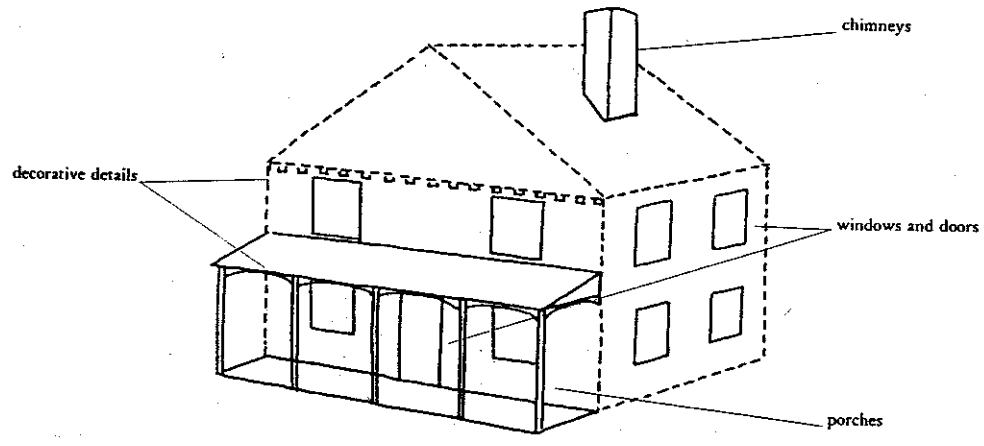
WALL FOUNDATIONS—Walls of very modest houses are sometimes built directly on the ground with little or no underlying foundation. Such walls rest on the surface soil, which makes a very poor base for most types of construction. Wooden walls tend to rot when in



WALLS



ROOFS



ARCHITECTURAL DETAILS

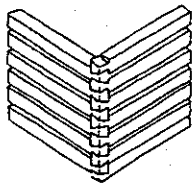
direct contact with damp earth, while masonry tends to be undercut by rainwater erosion of the soil beneath. For these reasons, most house walls are set upon foundations designed to protect them by raising them above the underlying soil. Simplest are wooden walls set upon wooden posts of some rot-resistant variety such as oak, cedar, or bois d'arc. (Sometimes the posts are, themselves, set directly on the ground surface, but more commonly with this and all other foundation systems, the soil is removed to a depth ranging from several inches to several feet and the base of the foundation is "buried" to provide firmer support.) Columns of brick or stone masonry known as masonry piers provide a similar supporting system for wooden walls, without the danger of rotting. On the other hand, failure of mortar joints can lead to equally serious problems that can be avoided by the use of monolithic piers, sometimes of metal but usually of concrete reinforced by steel rods.

The strong basal timbers of wooden walls can be supported by separated posts or piers; masonry walls, on the other hand, require continuous underlying support. In earlier masonry houses, soil has typically been excavated beneath the proposed wall and the first courses of stone or brick laid on the firm base of the trench. For additional stability, this underlying masonry wall is usually wider and of heavier materials than is the masonry of the overlying walls. When a basement is desired, some or all of the space between the exterior walls is excavated and the foundation walls constructed around the margins of the pit. Similar masonry wall foundations are also common beneath wooden walls, particularly in larger houses or in smaller houses requiring a basement. Foundation walls of masonry, like masonry piers, are subject to erosion and failure of the mortar joints and thus require periodic repair. This problem is avoided by monolithic concrete walls made of concrete beams poured in place and reinforced with internal steel rods. Such foundations first became common in the late 19th century; by the mid-20th century they had generally replaced wooden and masonry foundations beneath all types of wall construction. Note that in all the foundation systems mentioned so far, the internal floors and walls are supported by piers of wood, masonry, concrete, or metal even when the external walls have a continuous masonry or concrete foundation. One additional foundation system, developed in this century, eliminates these internal piers. In such concrete slab foundations, a relatively thin sheet of monolithic poured concrete underlies the entire house. This system completely eliminates floor framing and support at the first-floor level, and has become increasingly common since the 1950s.

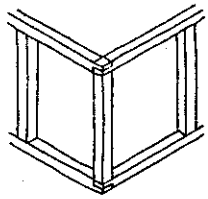
WOODEN STRUCTURAL SYSTEMS—Most American houses (probably well over 90 percent) use pieces of wood to support the upper floors and roof. Simplest are walls of horizontal logs, either left round or hewn square, which serve to provide both structural support and, when the cracks between the logs are filled with clay or other materials, weather screening as well. The principal structural support of a log wall is provided by the notched corners, where adjacent logs are in close contact. Several systems of log corner notching have been developed to strengthen this crucial junction. Simplest to construct but least rigid is the saddle joint; progressively more rigid are square, V-notched, and half-dovetail joints; while complex full-dovetail joints provide the strongest structure of all (see also the treatment of log houses on pages 82–3).

Far more common than horizontal log walls are those in which spaced vertical members provide structural support. Earliest is the Medieval post-and-girt system, imported

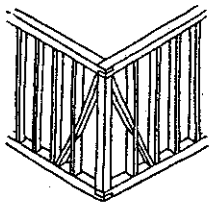
WOODEN



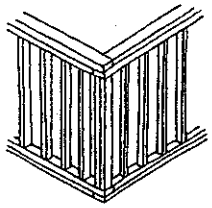
log



post-and-girt

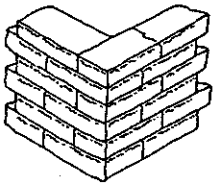


braced-frame

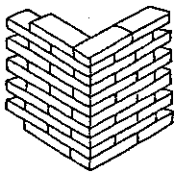


balloon or platform-frame

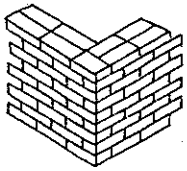
MASONRY



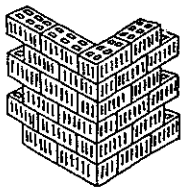
sod



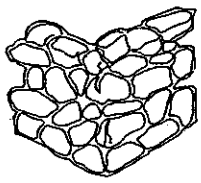
adobe (unfired) brick



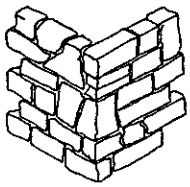
fired brick



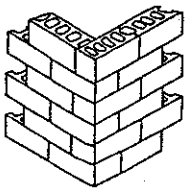
clay tile



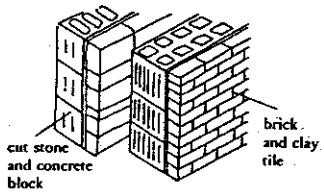
stone, uncut



stone, cut

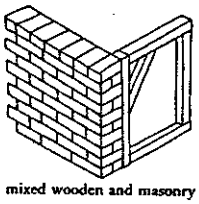


concrete block

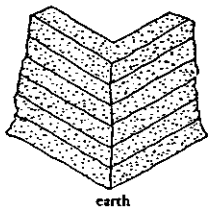


composite masonry, typical

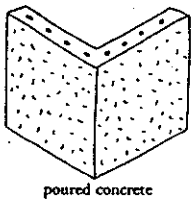
OTHER



mixed wooden and masonry



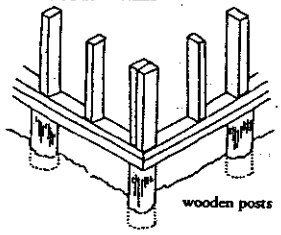
earth



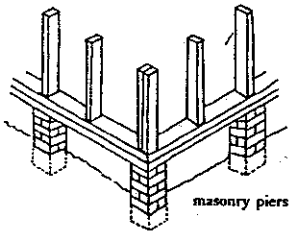
poured concrete

WALL STRUCTURAL SYSTEMS

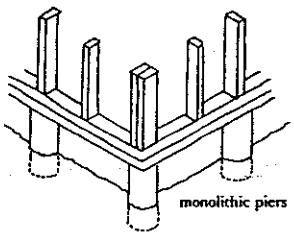
BENEATH WOODEN WALLS



wooden posts

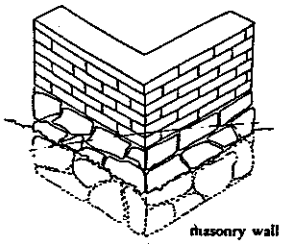


masonry piers

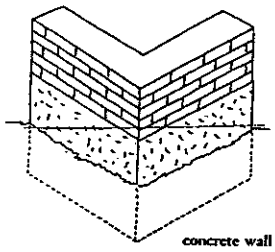


monolithic piers

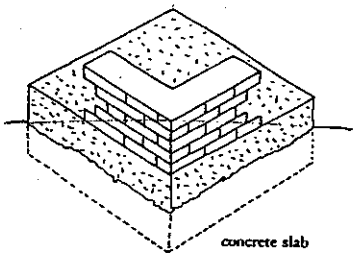
BENEATH WOODEN OR MASONRY WALLS



masonry wall



concrete wall

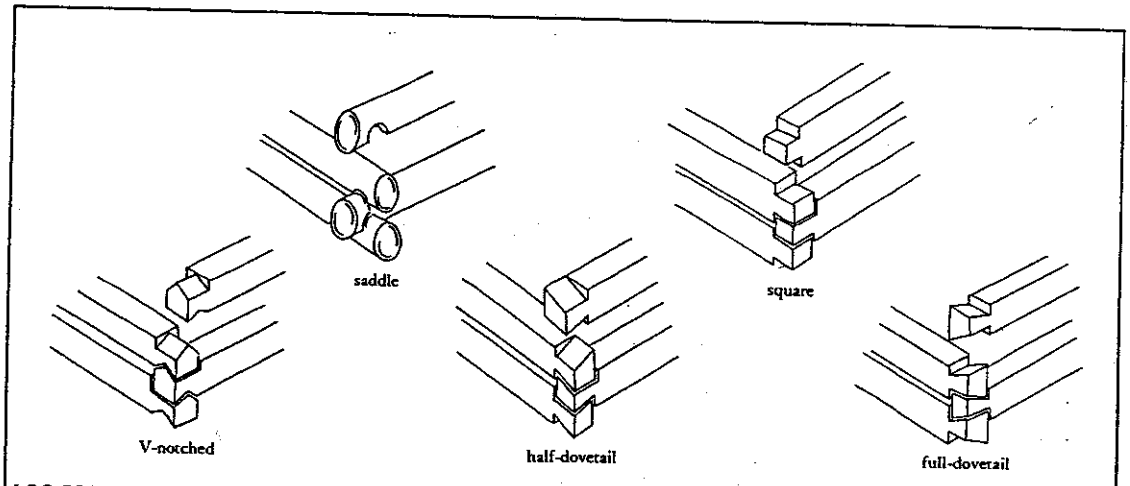


concrete slab

WALL FOUNDATIONS

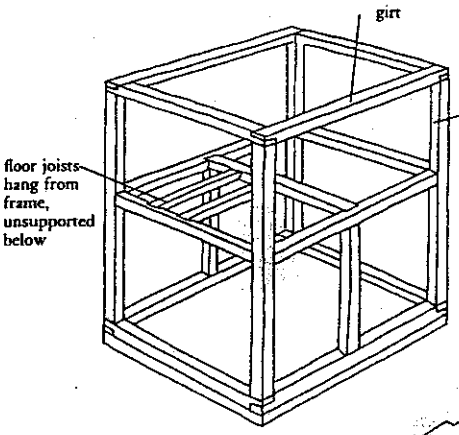
from England and France by the first colonists. In this system, upper loads are borne by heavy corner posts and widely spaced intervening posts; heavy cross timbers carry upper floors which are unsupported by the thin internal walls below. Typically, all structural joints in post-and-girt houses are laboriously hewn into interlocking shapes and held fast by wooden pegs. Post-and-girt houses dominated the English and French colonies and persisted until well after the American Revolution. In the early 19th century, however, the increasing abundance of commercially sawed lumber, together with the development of relatively inexpensive wire nails, led to a modification of the traditional post-and-girt system known as braced-frame construction. This system still employs heavy corner posts connected by heavy horizontal timbers, generally with hewn joints. But within this heavy skeleton, loads are carried not by widely spaced and equally massive intervening posts and cross members, but by light, closely spaced vertical studs nailed between the horizontal timbers. Internal walls constructed entirely of light studs also now become strong bearing walls which help support the floors and roof above. This system takes its name from diagonal corner braces used to give lateral stability to the wooden framework. Note, however, that such braces are by no means unique to the system, but are common in all types of wooden framing.

By the early 19th century, braced frames were replacing post-and-girt construction throughout the former English colonies of the Atlantic seaboard; in this region braced-frame houses persisted well into the 20th century. Westward migration from these states also made this a common mode of construction throughout the country during the 19th century. By the time of the Civil War, however, another still more simplified method of frame construction was coming to dominance in the rapidly developing midwestern states. This was the balloon-frame system, begun in Chicago in the 1830s. This system eliminated altogether the tedious hewn joints and massive timbers of braced-frame and post-and-girt construction, for balloon-frame houses are supported entirely by closely spaced two-inch boards of varying widths (two-by-two, two-by-four, two-by-six, two-by-twelve, etc.) joined only by nails. Corner posts and principal horizontal members are made of two or more two-inch boards nailed together. As in braced-frame houses, the principal supporting members are the closely spaced two-by-four or two-by-six vertical studs of both the exterior and key interior walls. This system allowed both cheaper and more rapid construction by eliminating the need for skilled hand-hewing of the principal

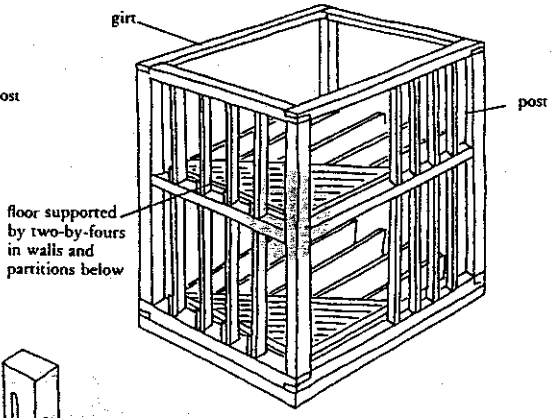


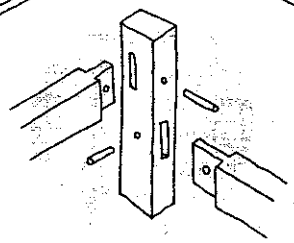
LOG CORNER NOTCHING SYSTEMS

POST-AND-GIRT
heavy timber frame
with hewn joints



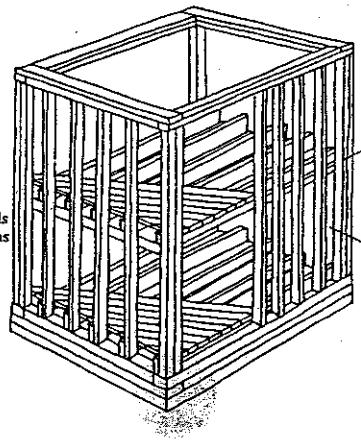
BRACED FRAME
combination of heavy timber frame with hewn joints and two-by-fours for floor support



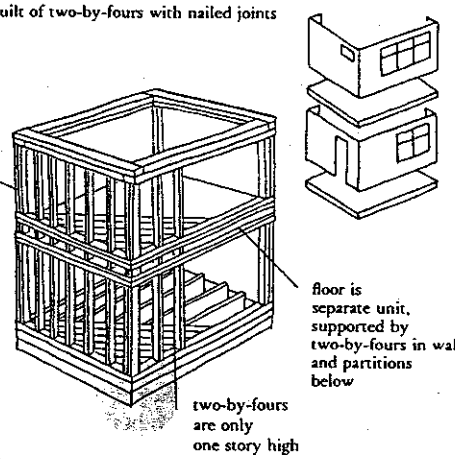


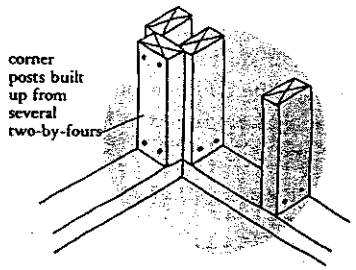
typical hewn-and-pegged joint

BALLOON FRAME
built of two-by-fours with nailed joints



PLATFORM FRAME
built of two-by-fours with nailed joints





typical nailed joint

WOOD-FRAMING SYSTEMS

wall timbers. With slight modification it remains the dominant method of American house construction today. The most common modification, known as platform framing, relates primarily to the wall studs and flooring. In balloon-frame construction, the studs are continuous from foundation to roof and the floors are hung upon the studs. In platform framing the floors are constructed as independent units, like thin, flat platforms; the shorter wall studs are then erected upon these platforms to support the overlying platform or roof. This system is both simpler and more rigid than balloon framing, which it has largely replaced through this century.

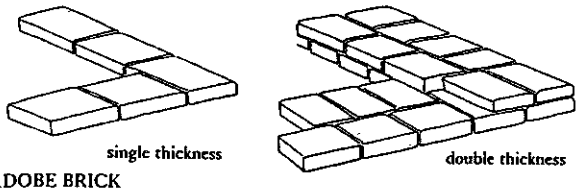
MASONRY STRUCTURAL SYSTEMS—Although wooden framing has always dominated American house construction, European immigrants to the New World brought with them an intimate knowledge of masonry techniques as well. Indeed, in colonial times, just as today, masonry houses far outnumbered those made of wood throughout most of western Europe. (For this reason first-time visitors from Europe are always surprised to find the United States to be a land of wooden houses). Although making up only a few percent of American houses, those with masonry walls show almost all variations of masonry building technique. Spanish colonists brought traditions of building in uncut stone and unfired adobe brick. The English, French, and Dutch had elaborate techniques of building with harder, fired brick and cut stone, as well as more modest folk traditions of building with sod (blocks of earth held together by grass roots) and uncut stone. These traditions tended to dominate certain regions during the colonial period; most persisted through the 19th century and a few survive even today. Within the last fifty years, 20th-century technology has added two more masonry materials to the traditional repertoire: hollow, fired clay tiles and hollow concrete blocks. These new materials are as strong as fired brick or stone, but are both lighter and cheaper. They have thus come to dominate 20th-century masonry construction, either alone or combined with an exterior layer of brick or stone to make composite masonry walls.

OTHER STRUCTURAL SYSTEMS—Only a very small fraction of one percent of American houses rely on structural systems other than wood or masonry. A few houses, mostly built in colonial times, used both wood and masonry in combination for structural walls.* Typically, end-chimney bearing walls were of masonry, the other walls of post-and-girt frames. In another variation, favored in the French colonies, the first-floor walls were of masonry and the overlying floor was post-and-girt.

Wooden and masonry walls are both composite, that is, they are made up of many small units linked together to make a wall system. Walls can also be of massive or monolithic construction, where only one or, at most, a very few units make up the entire wall. The simplest such walls are made of earth, either mixed with water to make mud and then built up in layers, or pressed into layers while only slightly damp (rammed earth). Such walls are found in both European and Native American folk houses, but are rare in post-colonial America. Somewhat more common are monolithic walls of poured concrete, usually reinforced with iron or steel rods. Such walls can either be poured in place or pre-cast and then transported to the building site. They are common in 20th-century commercial buildings but are only rarely found in houses, most of which date from the late 19th and early 20th centuries.

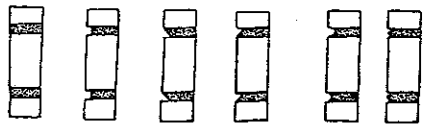
* Note that many houses have exterior wall *claddings* of both wood and masonry. Houses with true structural walls of both materials are, however, extremely rare.

MASONRY STRUCTURAL SYSTEMS

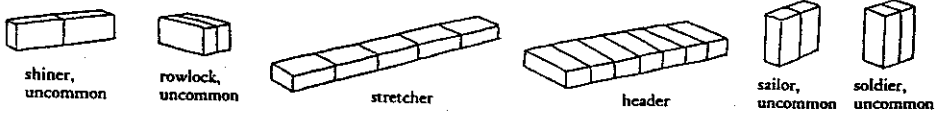


ADOBE BRICK

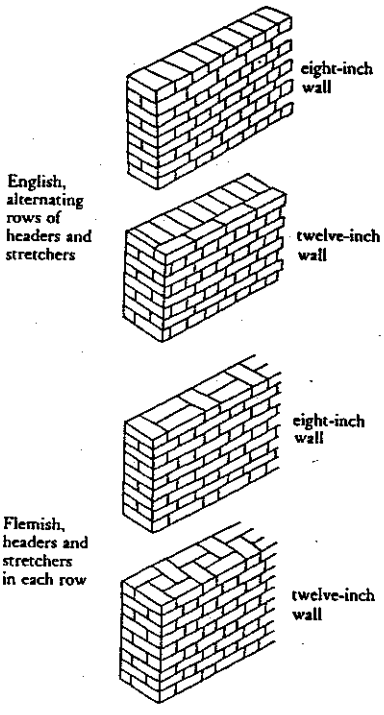
MORTAR JOINTS



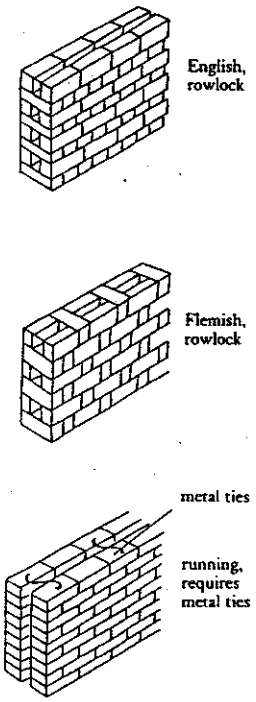
POSITION IN ROWS (COURSES)



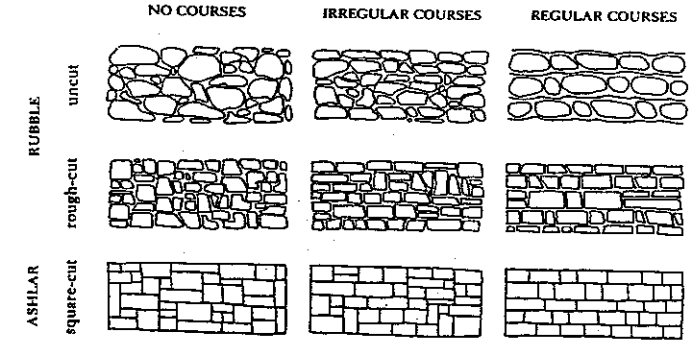
BONDING SYSTEMS, SOLID WALL



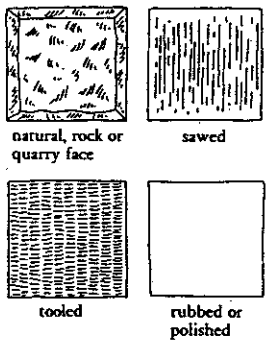
BONDING SYSTEMS, CAVITY WALL



FIRED BRICK



TYPICAL ASHLAR FINISHES

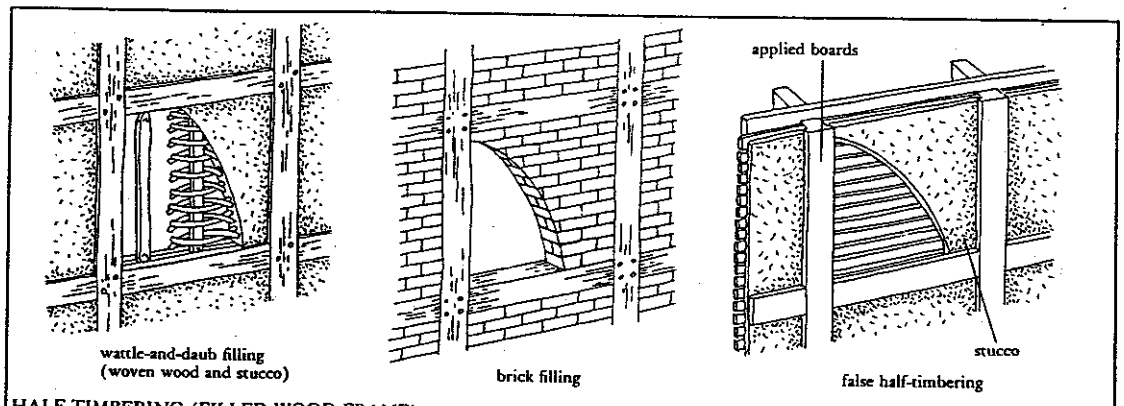


STONE

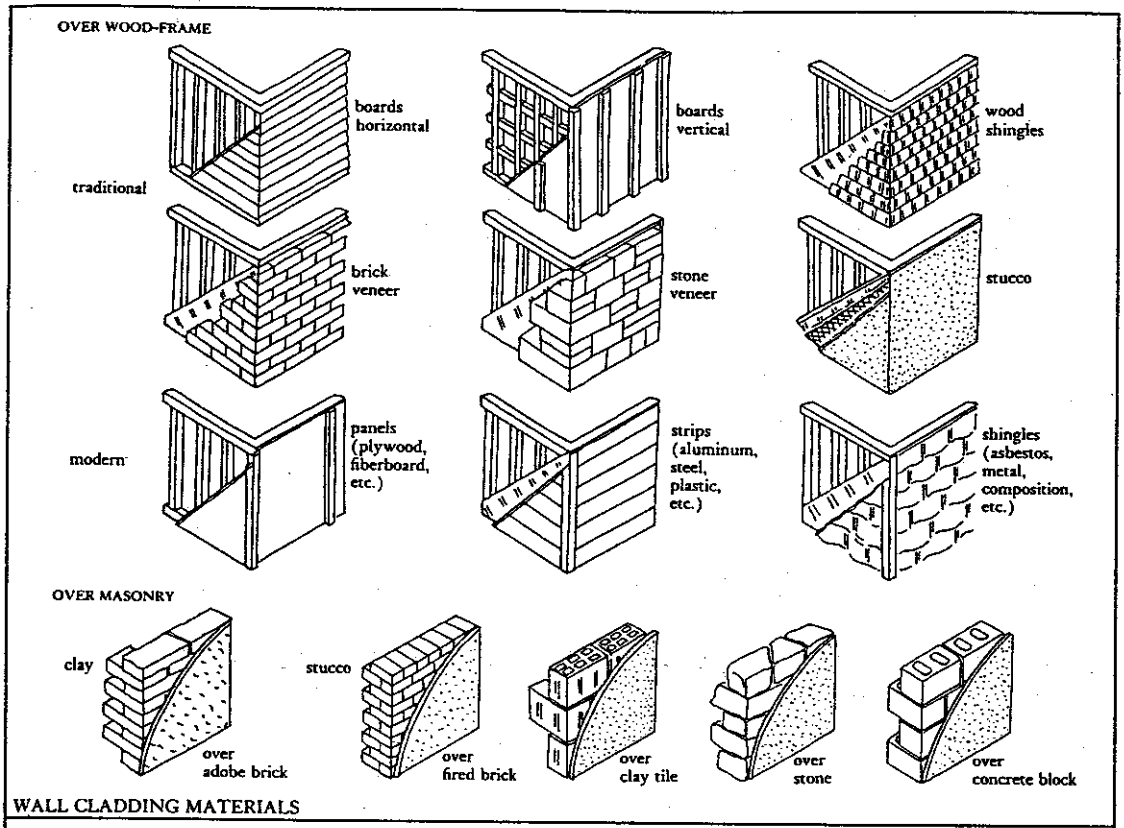
WALL CLADDING—Relatively few systems of wall structure are immediately evident from looking at the exteriors of houses. In masonry walls the structural units of stone or brick *may* be exposed, but equally commonly they are covered with a protective and decorative layer of stucco which masks the underlying structure. As a further complication, wood-frame buildings are often covered with an external layer of brick or stone, which gives them a superficial resemblance to masonry construction. These cladding materials can, however, provide clues to the underlying structure, which is almost always evident on close examination of foundations, basements, and attics.

All wood-frame houses *must* have external cladding. Traditionally the cladding is also of wood, either boards or shingles; since these materials are rarely applied to masonry walls, they indicate an underlying wooden frame. It is usually difficult to tell the exact system of wood framing unless some of the cladding is removed (although, again, a careful examination of wall openings, foundations and attics may reveal the underlying framing). Such modern cladding materials as plywood or fiberboard panels, metal or plastic strips, or asbestos, asphalt, metal, or shingles are also seldom applied to masonry walls, and thus indicate an underlying wood frame. As noted earlier, brick or stone veneers may be difficult to distinguish from solid masonry, except that veneers are far more common; thus the first suspicion should be that *any* house showing external masonry—particularly if constructed in this century—has a veneered wooden frame. An additional clue is that most brick veneers use only a running (stretcher) bond, since no headers are necessary to lock together the multiple rows required in a solid brick wall. Stucco walls can be the most enigmatic of all, for stucco finishes are commonly applied to both wood-frame and masonry buildings. Simple tapping to see if the walls sound hollow will sometimes distinguish between underlying wood or masonry. Likewise, areas of thin or failing stucco may reveal the structure beneath.

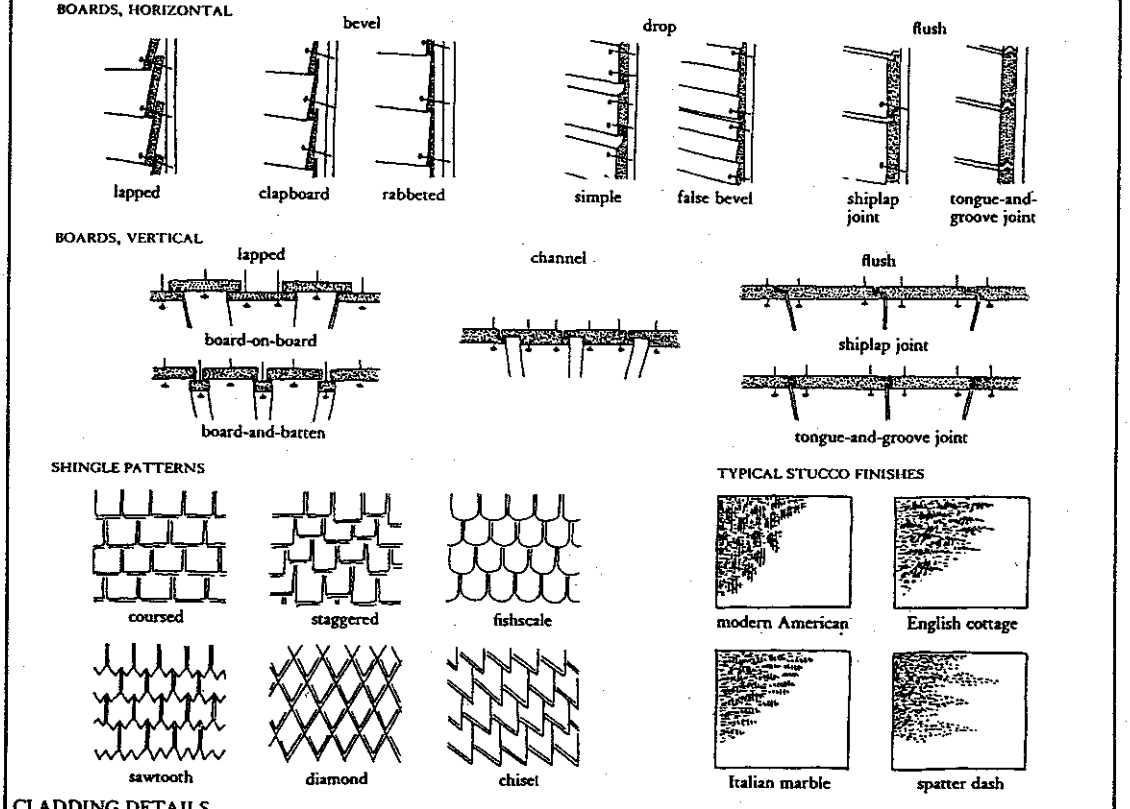
HALF-TIMBERING (FILLED WOOD FRAMES)—American wood-frame houses normally have cladding added to the exterior of the frame as a continuous covering that conceals the underlying structure. European framed houses of post-and-girt construction have, since Medieval times, commonly used another system of wall enclosure in which the spaces between the heavy supporting timbers are *filled* rather than covered. Such fillings normally leave the sides of the supporting timbers exposed and are known as half-timbered construction. The most frequent filling material is clay (daub) which is usually applied over a lath of short wooden sticks or woven basketwork (wattle). Brick or stone are also commonly used as filling materials; these are generally covered with stucco and thus



HALF-TIMBERING (FILLED WOOD FRAME)



WALL CLADDING MATERIALS



CLADDING DETAILS