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Stone Construction: A History and Primer

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Structures made of stone stand for very long periods of time—the Pyramids at Giza, the Parthenon, the Pantheon, Notre Dame cathedral, the Washington Monument. The weight, both figuratively and literally, of stone is what makes it enduring and gives the spaces it shapes a sense of permanence, but not all stone buildings are quite so monumental. Think of fieldstone fences meandering along edges of woods, old stone stairs worn into cradles for your feet, mossy headstones whose names and angels have melted into smears. The surface textures of pebbles tumbled in streambeds or the hollowed out ridges of sand blasted cliffs also capture stone's duality.

Buildings made of stone are assemblies of many pieces, yet the combined impression is of solidity and strength. Stone is a foundation for our homes, our barns, our steel beams; stone is the crust of our planet, keeping us safe above the molten core. Stone melts, drifts, grinds, settles, moves, and endures. Our use of stone to build is but a small section of history, but one we know first-hand.

History

The use of stone as a building material in America began before nationhood. The early colonists of the East Coast used what they could find and knew. Those from countries familiar with stonework quarried stone and used it near the site. Fieldstone found when plowing or digging earth shelters was dry-laid or fixed with lime mortar in simple thick walls (Rifkind 245). The abundance of timber in the colonies led to stone being relegated to the role of foundation material or outbuildings. By the mid- to late-1700s, the Georgian influence led to stone being used but stuccoed to present a refined exterior. Other decorative elements such as brick quoins or wood trim were faux painted to suggest more costly stones than were available. The faux stone of choice in interiors was marble.

The newly established nation of the early 1800s turned to the Federal style, a Democratic pattern based on Roman design. Buildings relied on brick with simple cut stone lintels and quoins. The shallow relief

Monte Sano (Chapman) Dairy—The 19th century limestone cooling barn of the dairy sits near a springhouse and bottling barn. Before the Gladstone Place Homeowners Association stabilized the stonework in 1995, the rubble interior of the wall was exposed (top). Stonemason Robert Ervin repointed the walls with a lime-based mortar and constructed a random cement cap to stop further weather deterioration. Photos by Diane Ellis.

Monte Sano (Chapman) Dairy—The preserved ruins of the roughly-coursed, undressed limestone walls illustrate the vernacular use of stone. The thick stone walls also helped the dairy maintain cool temperatures for their products. Photo by Diane Ellis.

and minimal design elements were popular in homes such as the Charleston houses, and stone was mostly decorative. Masonry work in America began to mature during the Greek Revival (1820-1860) when the temple became the ideal form to express nationalism. Smooth, fine joints, and intricate lintel and trim designs were worked with regional expressions. Plantation homes of the South echoed the stone columns of the North with stuccoed brick columns or painted wood (Rifkind 38).

Ashlar masonry was used for important public buildings while coursed or uncoursed cobblestone was still implemented for vernacular buildings and bridges. As larger building spaces became necessary, stone became the ideal support for heavy milled-timber structures. Ironically the brick mills of 1820-1860 rested on stone foundations. Machined, high-quality brick and stone led to construction techniques for vaults and domes, making stone structural again (Rifkind 258).

During the Early Victorian era (1840-1860) the influence of Gothic stone work and Italian Villas led to stuccoed towers inset with pebbles for texture or stone carved for tall chimneys and stone tracery for

stained glass windows, or left rough to imply ruins. The Victorian style (1860-1900) relied on Italianate heavy solidity with shadows and rusticated surfaces. The brownstone of urban areas included stone quoins, horizontal coursing, and balusters if not rusticated stone exteriors (Rifkind 62). Mixed in with the more streamlined stonework of later buildings were Victorian remnants of limestone rosettes, dark brick walls with Gothic stone arches, and richly carved doorway ornamentation.

Fire codes in urban areas led to greater use of structural stone, brick and terra-cotta blocks from 1860 to 1895 (Rifkind 193). The resulting style leaned toward a light sandstone, limestone, or marble revival of Chateau and Classical facades of the Renaissance. Steam power made the quarrying, cutting, and polishing of stone quicker and more readily available. Larger pieces of stone could be lifted into place onto metal (wrought iron and steel) reinforced structures. This technology led to stone façade pieces with metal reinforcement and structures. The result was thinner walls, more openings, and larger spans with less reliance on stone for structural strength (Rifkind 271).

In a revival of stone structures, Henry Hobson Richardson designed Romanesque public buildings during the 1880s. Heavy, solid, rugged stone and brick structures with low arches and dressed granite and brownstone enhanced the visual and tactile rough-hewn stability (Rifkind 194). Richardson's work also proved that stone could be structural and decorative simultaneously.

Modern heating and cooling no longer needed to rely on thick walls to help maintain temperatures, and thinner walls were ultimately

"Kildare"—The O'Shaughnessy home has a foundation of rusticated limestone. The first-floor facade is a combination of a variation on broken range ashlar finished with patent-hammering and painted brick quoins. Photo by H. Cross.

cheaper. So, by the early to mid-1900s the use of stone was mostly in facades and ornamental applications. The exceptions occurred in the Arts and Crafts movement and the Prairie School, which emphasized a link to nature with materials and form. Bungalow pier foundations of cobblestones or boulders tied Arts and Crafts homes to the land and made use of local craftsmen. The Prairie School, epitomized in Frank Lloyd Wright's Fallingwater, emphasized smooth, layered stone and lighter colored horizontal coping. Early American Colonial, a revival of the 1960s, brought back some vernacular stone use, but on a smaller scale in homes and community facilities (Rifkind 100-101).

Stone bungalow along Oakwood Drive—Low heavy arches of porch and unraised foundation maintain a connection to the earth appreciated by Arts and Crafts builders. Photo by H. Cross.

Concrete (block and poured) replaced the need for stone structural elements. Stone and brick facings are still used where the solid impression of stone lends a building presence at a high cost, especially for industrially polished granite, marble, and travertine. Concrete forms can easily be textured, colored or mixed to look like stone and, due to the public's unfamiliarity with natural stone, usually passes for the real thing (Rifkind 293).

2335 Brandon—A later stone bungalow which incorporates broken range and random range ashlars as well as brick around wall openings and tile on the porch and stairs. Photo by H. Cross.

Geology

The use of stone as a building material in Northern Alabama rests on the underlying geologic structure and the availability of stone. Madison County lies on the Cumberland Plateau of the Appalachian Plateau and has a geologic profile of hard sedimentary rock from the Paleozoic era (Daniel 3; Malmberg 7). The movement of the Appalachian Mountains led to the up folds (anticlines) and down folds (synclines) of rock layers that produced local valleys and mountains. These "wrinkles" of rock were easily fractured and exposed softer rock to the elements. The eroded and fractured tops leveled off into plateaus and revealed layers of rock on their sides.

The composition of Madison County stone reflects its early beginnings as a seabed. Most of the local sedimentary rock is composed of calcium, carbon, silica, sand, or clay. This organic, underwater formation led to a wide range of hardnesses, layers, colors, and compositions of stone. The major types of rock found in Madison County reflect this range of qualities.

Limestone is an organic sedimentary rock that is composed of basic calcium and carbon bonds. Its smooth light grey to tan surface makes it an ideal building stone. The Tennessee River Valley is especially known for its limestone. Sandstone is composed of sand, clay, or silica. It ranges from hard to soft and contains easily seen grains of mineral. It is the most prevalent stone in Madison County and most commonly used for stonework.

Dolomite is a calcium and magnesium carbonate which ranges from cream to black in color. It is not structurally strong but does contain veins of crystallized elements in saddle, or curved, patterns. Conglomerate stone is a hard mix of fragments, silica, and calcite formed underwater. This stone ranges in composition and characteristics depending on the area. It often contains fossils and a mix of all other local stone. Shale is thin, built-up layers of silt or clay formed in moving water like a stream or river. Cleaved into sheets and layers, shale is non-structural but can be used for paving.

Local builders easily transported or found stone for their building needs for vernacular projects. The geography of the Cumberland Plateau made transport of large rocks or cut stone for bigger building projects

difficult until 1821 when the Canal Big Spring linked with the Tennessee River (Malmberg 13). Stone quarries took advantage of this transportation route for thirty years and then used the railroad for transportation of stonework, brick, and terra cotta building materials.

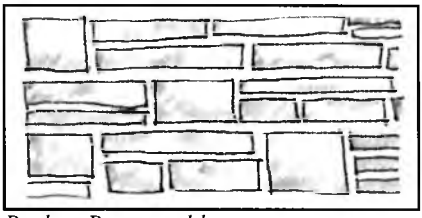
Construction

The construction of stonework or masonry is defined as "stone, brick, or similar elements installed so that the weight of a unit bears on the one below, typically with mortar in the joints between the units" (Bucher 285). Prior to the 20th century this often meant stonework. It now implies both stone walls and stone veneers over backing. The backing is an inferior or cheap material used for structure behind the exposed face stone. Backing can be rubble, fieldstone, concrete block, poured or cast concrete, or a frame wall with sheathing (Phillips 21). In any case it must be structural and able to be linked to the stone veneer.

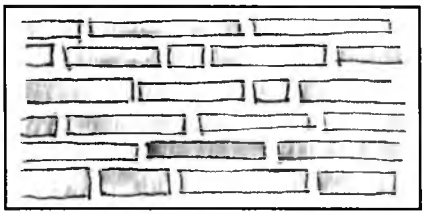
5607 Panorama—This rubblework fence in front of a stone/frame house incorporates found shapes as well as stone roughly cut for the top two courses of jagged, pointed projections.
Photo by H. Cross.

The configuration of stone, whether a veneer or an integral part of the wall, in masonry construction is named according to the type of stone or finish of stone that makes up the courses. As in brickwork, courses are the horizontal layers delineated by bands of mortar. Not all stonework, however, is evenly coursed. Due to the irregular shapes and cuts of stone, the coursing can be irregular or nonlinear.

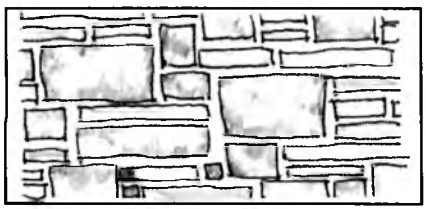
Rubblework—also called cobweb rubble, random, or mosaic—contains irregular stone left in the shape it was found. Think of stone that is rough and crude like a fieldstone fence or stone that is applied on a backing for a rustic feel around a prefabricated fireplace enclosure (Phillips 144). Variations of rubblework are known as fieldstone and cobblestone. These types use large mortar joints between the stone for irregularity and are built in natural forms that are usually wider at the base and taper upward. Cobblestone is a bit more refined and selected for shape and then used as a veneer over a backing material (Phillips 74, 109).



Broken Range ashlar pattern



Coursed ashlar pattern



Random Range ashlar pattern

Stone that has been squared, given a high-quality finish, and set with thin lines of mortar is termed ashlar. The term ashlar can also be applied to fired clay and masonry tiles (Phillips 19-20). Ashlar is mostly used as a veneer or surface finish due to its relatively small bearing surface versus its large face surface. Ashlar is commonly laid in three configurations: broken range, where the heights of the stone pieces vary; coursed, where all stone pieces are the same height; and random range or broken ashlars, which contain irregularities in courses and height.

Dressed stone involves more labor and allows many different effects from a single type of stone. Granite, gneiss, marble, porphyry limestone, and sandstone are the stones most commonly dressed by a mason. The surface finish, regardless of the stone's shape, provides variation in patterns, shadows, reflections, weathering, impressions, age, height, strength, and effect. The mason forms a finish for dressed stone by 1) hand or machine sawing, 2) rubbing with abrasives, 3) hewing with an ax or pick (soft stone), 4) hammering with an ax or hammer (hard stone), or 5)

chiseling with a mallet or hammer (soft stone) (Phillips 159).

The patterns achieved by these methods also carry names. Broached is a series of parallel grooves. Brush hammered is a stipple effect done on granite and hard limestones that employs a stiff wire brush. Crandelled surfaces are pebbled and soft and usually incorporate imperfections and existing pebbles in sandstone. Patent-hammering produces parallel short grooves that are broken into irregular lengths. A pointed stone has shallow grooves made with a pointed tool. A rock face or pitch face has no finish except for the cuts made to the edges of the stone to make it pitched or cut true for easier laying. Vermiculation displays what looks like worm tracks over the stone's surface. Rustication emphasizes a naturally rough surface by carving a small beveled margin around the face and edge of the stone. Any polished stone surface is said to be machined.

By the 1870s imitation stone block offered a cheaper alternative to hand dressed stone (Phillips 53). The most common example was a concrete block with one face finished to look like rusticated stone. These rockfaced "stones" provided a uniform structural unit for foundations which still looked like natural stone from a distance. Entire sturdy and fireproof outbuildings could also be built from these blocks. Quoins, the corner reinforcements necessary with smaller stone or brick construction, also took advantage of manmade rockface stones which were lighter and less expensive than professionally dressed stone options.

Today almost any type, style, or dressed stone surface can be imitated by concrete and admixture combinations. These created stones are hung on steel frames and mortared with expansion joints and caulk. The pure mass and weight of stone that limited the height of stone buildings, is easily distributed over the surface of a structure through the use of veneers. The buildings still have the illusion of solidity of stone to convince the public that they are sturdy and strong. The desire to see stone on a building, however thin a surface, belies our need to touch and trust materials that only time and nature can produce.

Heather Cross, an instructor of Freshman Composition at UAH and a technical editor at TRW, has always collected stones and drags her fingertips along rough walls.

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