



TECH TALK

This issue: Building Materials • Part I



Masonry by Charles W. Nelson

This is the first of two Tech Talk articles concerning building materials by Minnesota Historical Society Historical Architect Charles Nelson. This article can be considered a “primer.” In the January, 1988 *Interpreter*, Nelson will discuss problems of maintaining and treating building materials.

“Masonry” is defined in the *Dictionary of Architecture and Construction* by Cyril M. Harris (1975) as “the art of shaping, arranging, and uniting stone, brick, building blocks, and other materials to form walls and other parts of a building.” Virtually all buildings incorporate some type of masonry construction, whether it be a stone or concrete foundation, brick veneer walls, or terra cotta ornamentation. Preservation of these buildings requires a basic understanding of masonry types and their characteristics, technology and construction methodology, and proper maintenance and conservation treatments.

Let us begin with a brief overview of masonry types and technology found in the construction of Minnesota buildings.

Stone

The earliest material to be used is stone. It is obtained in two ways: from natural outcroppings or scattered deposits, and by the process of quarrying. Many early buildings were constructed of stone readily available near the building site. Along river valleys, limestone was prevalent, both in the gray Platteville and yellow Mankato/Kasota varieties. The stone was removed in natural layers, or strata, by the simple technology of picks and crowbars.

Early stonemasons were familiar with the properties of limestone and other sedimentary stone, and exercised care to “lay up,” or set, the stone in accordance with its “bedding plane,” i.e., its natural geological layering. If the bedding plane ran horizontally in the deposit, the stone was laid so that this bedding plane was also horizontal in the construction of the building wall. (When sedimentary

stone is not laid up in accordance with its bedding plane, i.e., when the bedding plane runs horizontally but the stone is laid vertically, problems will arise. This improper practice has been used by contractors when the original thickness of stone is not readily available and they are required



State Historic Preservation Office, MHS; photograph by Charles Nelson

Two limestone gate posts in St. Paul, built around 1885.

Editor’s note: TECH TALK is a bimonthly column for offering technical assistance on management, preservation, and conservation matters that affect historical societies and museums of all sizes and interests.

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to lay up the stone as a “vener,” or facing. When the stone is not in its bedding plane, it is at its weakest, will absorb moisture between strata, and will “spall”—fracture and lose its surface—as a result of thermal stress and weathering.)

Early stonemasons also were aware that certain stone types had more “weatherability”—able to withstand the effects of weather better than others—and they utilized each type in accordance with its properties. For example, Platteville limestone is prone to fracture along strata and so is more vulnerable to effects of weathering when used in above-grade, or

above-ground, construction. Kasota stone is more dense and has a higher resistance to weathering.

Another readily obtainable type of stone is fieldstone, found in many areas of the state affected by glaciers. In laying up fieldstone, adherence to bedding plane is far less critical.

Stones may be laid up in their natural

form, or broken and “squared,” or shaped, for proper fit with other stones in the wall. After milled lumber became available, fieldstone was used primarily in foundations, fireplaces and chimneys. There was a revival of fieldstone construction during the 1920s and ’30s, however, when it was recognized as a distinctive characteristic of the Rustic Style.

Quarrying, the industrial process of extracting stone from the earth, requires substantial effort and technology. In this process, stone is drilled, blasted, fractured or cut from the quarry face, and then shaped and finished for use in construction. Four examples of significant quarries that have contributed immensely to building construction in Minnesota are located at Kasota, Sandstone, Cold Spring/Rockville and Jasper.

State Historic Preservation Office, MHS; photograph by Charles Nelson



These men are using hammers and picks to break off slabs of limestone from a riverbank outcropping.

Brick

Brick is the second of the early masonry types to be found in Minnesota. Unlike the extraction of stone, brick-making requires a technological process to reach its final form. The primary ingredient in brick is clay, which is most often found in deposits in lowlands or river valley. Clay is soft, and may be supplemented with a binder; early brick often had straw as a binder. The clay is packed into molds and set aside to dry and stiffen; in this form, the brick is called “green.” After an appropriate time period, the green bricks are removed from the molds and stacked in a kiln to be fired.

The intensity of heat and duration of firing determines the strength and durability of the brick. The process is similar to baking bread; a brick has a protective outer layer, or crust, with a softer

State Historic Preservation Office, MHS; photograph by Charles Nelson



This wall of the J. Engesser House in St. Peter, built in 1888, is a good illustration of the kind of variety in design of which brick is capable.



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interior. It is important to remember that when the exterior crust is damaged or removed, the brick rapidly deteriorates. This is sufficient reason not to sandblast; sandblasting removes the crust and reduces the life expectancy of the brick. The colors found in bricks are the result of minerals in the clay deposits. When fired, the minerals go through a transformation to produce reds, yellows, and even purples.

Bricks are produced for a variety of applications in the building trade. "Soft-fired," or "common," brick makes up the cores of walls and exposed secondary facades. "Hard-fired," or "faced," brick is used on principal facades and surfaces where a crisp, durable image is desired. Yet another type of brick, often called "sewer brick," is used for paving or subterranean culverts. Brick may also be finished with a glazed surface to provide a sanitary, impervious surface for use in areas of food production such as meat-processing plants and creameries.

A masonry type closely related to brick is *terra cotta*. Its principal ingredient is also clay. The primary difference between brick and *terra cotta* is that *terra cotta* is not a load-bearing structural material. It is used primarily for facing, or veneer. It is often ornamental, having been made in molds and then fired in the same fashion as ceramics. *Terra cotta* also shrinks during the process of firing; the shrinkage must be compensated by enlargement of the original mold, allowing for the final proportions. *Terra cotta* is often glazed and pigmented. Like brick, if the glazing or outer skin is removed or damaged, the material will

rapidly deteriorate. Architects and builders made extensive use of *terra cotta* in their designs for Commercial and Prairie School style buildings, which were popular during the first decades of this century.

Concrete

Concrete would be considered modern on the masonry timeline. (Concrete is cement plus an aggregate; cement is the bonding agent that hardens and bond the aggregate.) Cement and concrete date back to Roman times. It became a state-of-the-art, popular, building material early in the 20th century.

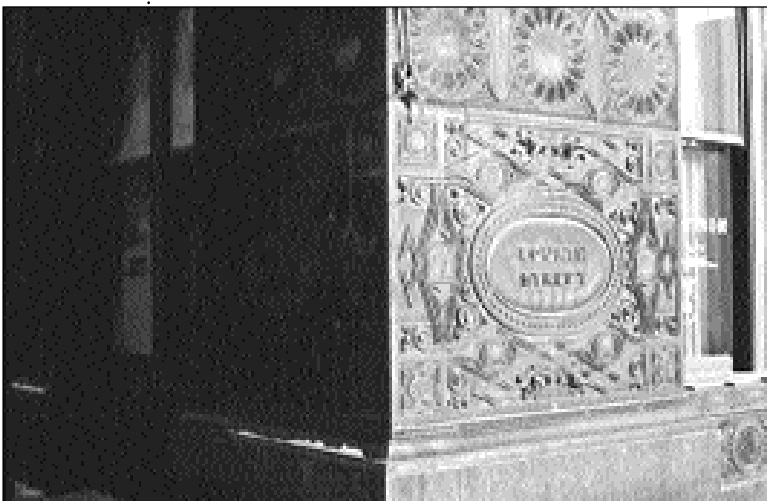
It had been used in the Civil War era as "grout" or "gravel wall" construction. In this form, a slurry of



This is an example of a poured concrete foundation, in a church built around 1910.

State Historic Preservation Office, MHS; photograph by Charles Nelson

The photograph below is a detail of the terra cotta cornerstone at the southwest corner of the Grain Exchange Building in Minneapolis, which was built in 1902. The inscription says, "Fourth Street."



State Historic Preservation Office, MHS; photograph by Charles Nelson

cement, lime and gravel was poured into slip forms that could be moved as the wall rose in height. For some reason, probably the ready availability of brick and wood, this concept was soon abandoned. This method was later used for poured concrete foundations at the turn of the century. With the addition of iron reinforcing bars, such construction became quite strong and durable. By the 1920s, reinforced concrete construction was common, and was used extensively in buildings and structures such as bridges and grain elevators.

Concrete also was produced in modular form as blocks of various sizes and textural finishes. Blocks were poured in forms, and after a short curing period were ready for use in construction. When they first appeared on the broad market, concrete blocks were considered "technologically fashionable" and were left exposed. Patterns made possible by molds allowed





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some blocks to resemble hewn stone while others presented a vivid array of color from a variety of aggregates. However, exposed concrete block soon fell from fashion and became the infrastructure of the walls, hidden beneath veneers and the “cladding,” i.e., the metal, wood siding or stucco. “Rusticated,” or “rock-faced,” block has experienced a revival within the last decade for use in historically sensitive new construction.

Clay tile

Hollow clay tile became a popular material for light-weight construction of walls and vaulted ceilings during the late 19th century. It is, for the most part, not a load-bearing material and is utilized in panel construction, to fill space between structural members such as posts and beams in a skeletal frame system. Some examples of exposed tile exist that date from the 1920s and '30s, but these are usually utilitarian structures such as garages or well-houses.

To provide protection from the elements and to give the wall a finish, plain concrete block and hollow tile was given a coating of “stucco.” Essentially a mortar slurry, stucco was applied like a durable plaster. It could be textured and pigmented and used as infill within the mock half-timber panels of a Tudor Revival cottage. It could convey the image of a southwestern adobe, it was essential to the Prairie School, and it was later used to conceal underlying deterioration and structural deficiencies.

Stucco may be textured into a variety of decorative patterns.



State Historic Preservation Office, MHS; photograph by Charles Nelson

Mortar

This discussion of masonry types would not be complete without a brief mention of mortar. The earliest mixture actually to be considered mortar was simply lime and sand, mixed with water to form a thick putty. Lime was obtained from burning limestone in kilns, then allowing the quicklime that resulted to slake by adding water to form a putty, then letting the putty cure for a specific period of time. The mixture formed a soft mortar that bonded with the masonry units in the wall, holding it in place while permitting it to expand and contract with changes in temperature and settlement. Being soft, however, this mortar was greatly susceptible to weathering and erosion. The solution to the problem was provided by adding a small portion of Portland cement to the mix.

However, the more durable the mortar became, the more rigid it became. The result was an undue stress on the masonry units, retarding their natural movement and causing them to fracture and spall within the confinement of the unresponsive mortar. Concurrently with the growing use of Portland-type mortars, masonry types with similar characteristics were developed to avoid this situation. Therefore, when repointing (replacing mortar) on an old building, one must become familiar with the properties of both the masonry type and the mortar, and take appropriate measures to assure compatibility.

NOTE: In the Tech Talk section of the January 1998 *Interpreter*, Nelson will tackle the challenges of maintenance and treatment of masonry.

Brief Glossary of Masonry Terms

Bedding plane	natural geological layering
Lay up	to place, or set
Spall	fracture, losing its surface
Squaring	shaping broken fieldstone to fit desired space
Veneer	facing
Weatherability	capacity of material to withstand the effects of weather