



## **THE HEXAGON (Ephraim Shay House) Harbor Springs, Michigan**

The Hexagon is a unique house designed and constructed in 1892 by inventor Ephraim Shay as his home in Harbor Springs, Michigan. Shay's principal invention, the Shay locomotive, ran on wooden rails over rough terrain, enabling Michigan's logging industry to reach previously inaccessible stands of timber and to expand into a year-round operation. Listed on the National Register, the Hexagon is the last remaining building in a complex that formerly included Shay's machine shop and the waterworks that he constructed for the town of Harbor Springs.

The first floor of the house is composed of a central hexagon surrounded by six hexagonal wings (*see figure 1*). Each wing originally contained one room, with windows in each elevation, permitting outside visibility in all directions from the center of the house. One large hexagonal room forms the second story. The house is of frame construction, sheathed on both the interior and exterior with 7/8" horizontal planks.

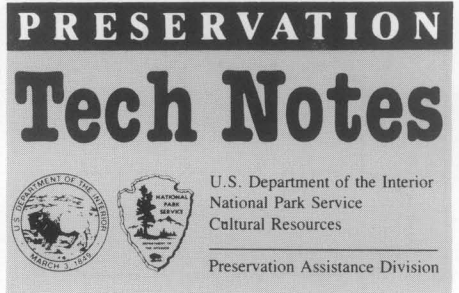
Stamped sheet metal covers the planks on the exterior and the interior of the Hexagon. Brick-patterned metal siding, accented by four bands of varying ornamental designs, covers the exterior elevations; the ornamental

window hoods are also sheet metal. On the interior, the walls and ceilings are also covered with stamped sheet metal (*see figure 2*). This extensive use of architectural sheet metal reflected the popularity of the product at the turn of the century. It provided a decorative and fire-resistant covering that was inexpensive, easy to install, and durable.

Until the mid-twentieth century, the house remained a single-family residence. Later, the building housed a dress shop and a basement tea room. In 1989, a new owner purchased the Hexagon, planning to rehabilitate it into offices. The building had not been substantially altered, and the new owner wanted to restore it to its original appearance.

### **Problem**

The house had been poorly maintained for several decades and, more recently, had been unoccupied. The asphalt shingle roof that replaced the original standing seam metal roof leaked badly, allowing water to penetrate into the wall cavities behind the stamped metal siding. Due to neglected repairs and cleaning, the original drainspout system failed to divert rainwater away from the house (*see figure 3*). In some places, rainwater



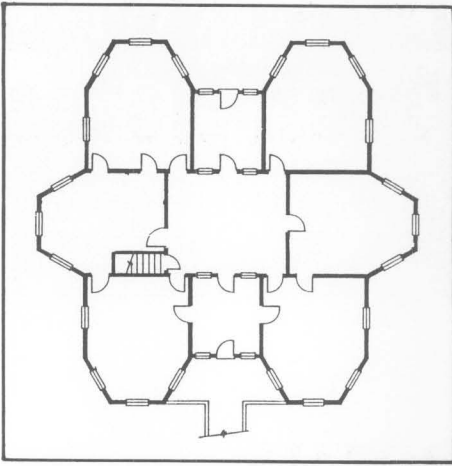
## **METALS:**

### **NUMBER 3**

## **In-Kind Replacement of Historic Stamped Metal Exterior Siding**

**Rebecca A. Shiffer**  
Mid-Atlantic Regional Office  
National Park Service

***Historic stamped sheet metal exterior siding should be replicated in-kind when deteriorated beyond repair.***



1. Windows in each elevation of the hexagonal wings offer views in every direction from the center of the house. This first floor plan of the Hexagon shows the new, post-rehabilitation uses. Drawing: Jeffrey Pascale, from plans by Richard Hiler.

ran directly down the exterior walls.

Although the original galvanized (zinc-coated) steel and zinc siding had been back-primed, long-term water infiltration caused the siding to corrode from the inside toward the face. The location of the building at Little Traverse Bay also contributed to the slow deterioration of the siding. In extremely deteriorated areas, the metal had been reduced to an easily breakable, crusty mass. An assessment of the exterior revealed that nearly 90% of the stamped siding had moderately or severely deteriorated to the point that replacement was required (see figure 4). Since only a small percentage of the siding was salvageable and all needed to be removed to facilitate other project work, the decision was made to replace all of the metal siding.

In contrast to the exterior metal siding, the interior stamped ceilings and walls remained in good condition. All of the interior metal was retained, with only isolated areas requiring patching due to minor rust. In addition, the exterior window hoods had not deteriorated like the siding and only routine repairs were necessary for their retention.

### Solution

Five exterior sheet metal patterns required replacement: the brick pattern that covered more than half of the exterior, two ornamental band patterns, the wall corner pattern, and the molding that separated the ornamental bands from the brick pattern (see figure 5).

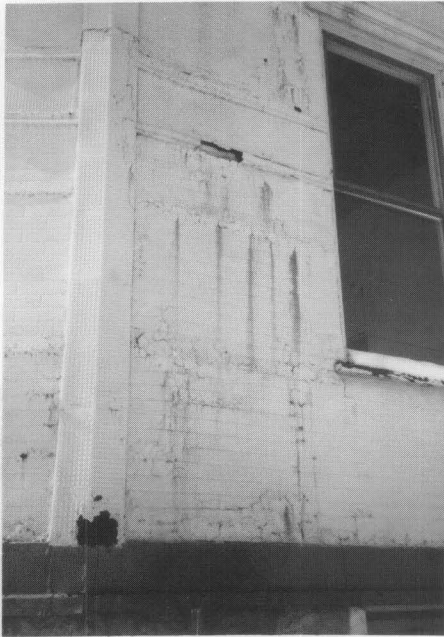
The owner decided to duplicate the 2 original siding because of its historical



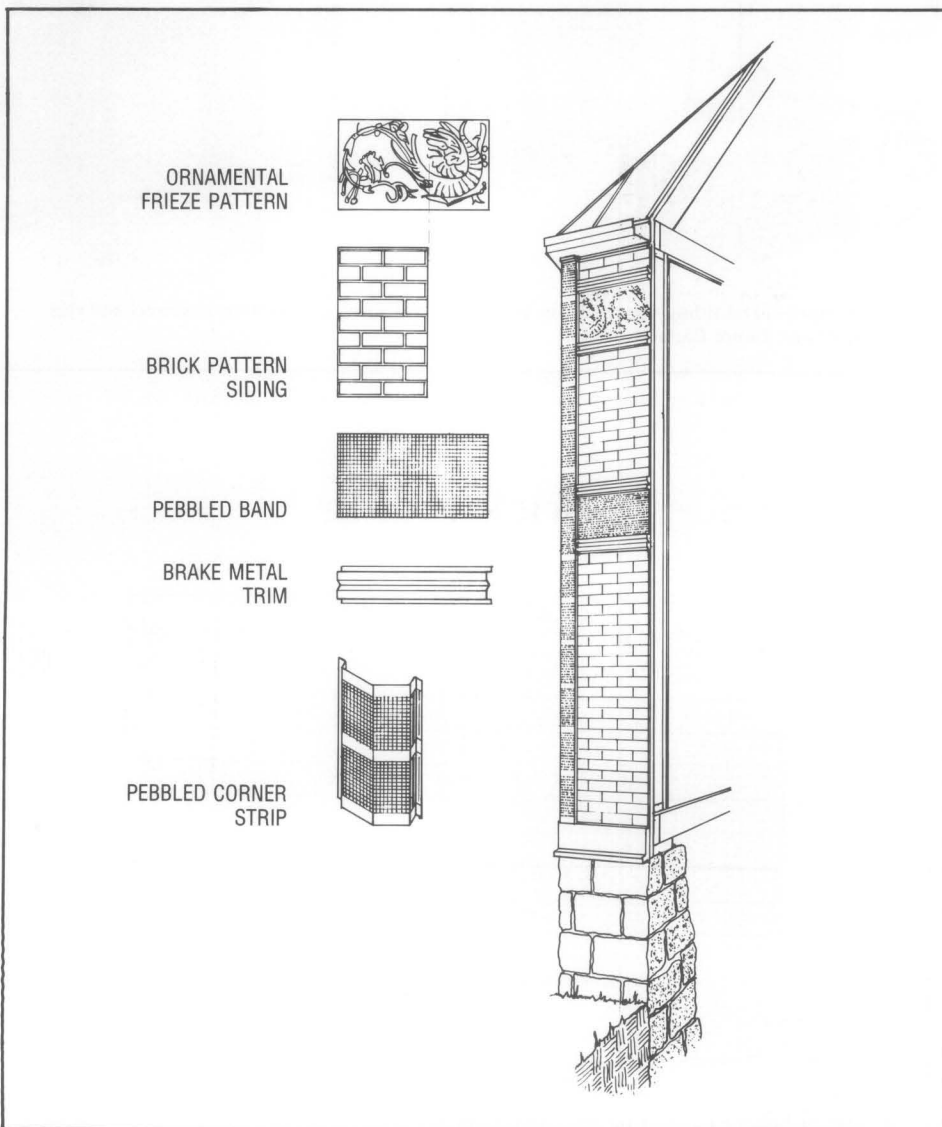
2. The walls and ceilings of each interior room are sheathed with stamped metal siding in a variety of decorative patterns. Photo: Brian Conway.



3. Stamped metal siding simulating brickwork covered most of the exterior of the house. Pebbled corner pieces and several ornamental bands added decorative details. Deteriorated drain spout and original plank wall sheathing are at right. Photo: Richard Hiler.



4. Rust stains indicate where corrosion, caused by water infiltration, are breaking through the metal from the rear. Rust and separation are also evident at seams between sheets of stamped metal. Inspection determined that nearly 90% of the stamped metal siding had to be replaced. Photo: Richard Hiler.



5. Five different sheet metal patterns were used to cover the exterior wall. Drawing: Timothy Buehner.

significance and its important contribution to the appearance of the building. Although historical investigation failed to identify its original manufacturer, a sheet metal manufacturing company in business in the midwest since the turn of the century was identified as a possible source for replacement stamped metal siding.

Photographs of the original siding and sample sections of all five patterns were sent to the sheet metal company. The brick pattern matched one of the company's old stock designs, while the other four could be replicated as custom work. Of the four custom pieces, three required stamping and the fourth could be formed on a brake press.

### Manufacture of Stamped Metal Siding

After being awarded the contract, the sheet metal company proceeded first with making the cast-iron die sets that were needed for four of the five sheet metal patterns used on the exterior of the building. Two different approaches could be used to make the die sets. Where samples of the historic design have survived in relatively good condition, as with the case of the Hexagon, they can be cleaned and repaired to serve as a three-dimensional model for the casting of the dies. Since the cast-iron will shrink in casting as it cools from a liquid to a solid (approximately 3/16" per foot), the new die set will create a pattern that is slightly smaller than the original.

This approach, however, is cheaper than the second alternative: creating a model that is 1-1/2% larger than the original, to compensate for the shrinking that will occur when the casting cools. This method may be necessary where the historic pieces are too deteriorated for use as a model; where the historic pattern is missing altogether; or where a precise match is required (such as when only selective pieces on a wall require replacement). In such cases, a drawing of the design to be replicated is first produced, increasing the dimensions to correct for the eventual shrinkage. Then a three-dimensional model of the drawing is constructed in clay, plaster, or wood. Next a cast-iron mold of the model is produced from which the male-female die set used in the actual stamping process is created.

After each die-set for the Hexagon was ready for use, it was placed into a special press, with the female half set onto a cast-iron bed on the floor and

the male half attached to a large, cast-iron hammer, known as a gravity drop hammer, hanging above the press bed. A sheet of metal was then placed over the die on the cast-iron bed, and a press operator released the hammer to drop onto the bed, stamping the design into the metal by the force of the meeting of the die-set (see figure 6).

Each of the stamped designs was reproduced in the same metal used to make the original. The stock brick pattern was stamped into 28-gauge galvanized steel sheets measuring 28" by 60" (see figure 7). Galvanized steel is often used for exterior installations, due to its resistance to corrosion. Moreover, galvanized steel is strong enough to produce very stiff sheets of stamped siding in large sizes that can cover a fairly large area with minimum nailing support.

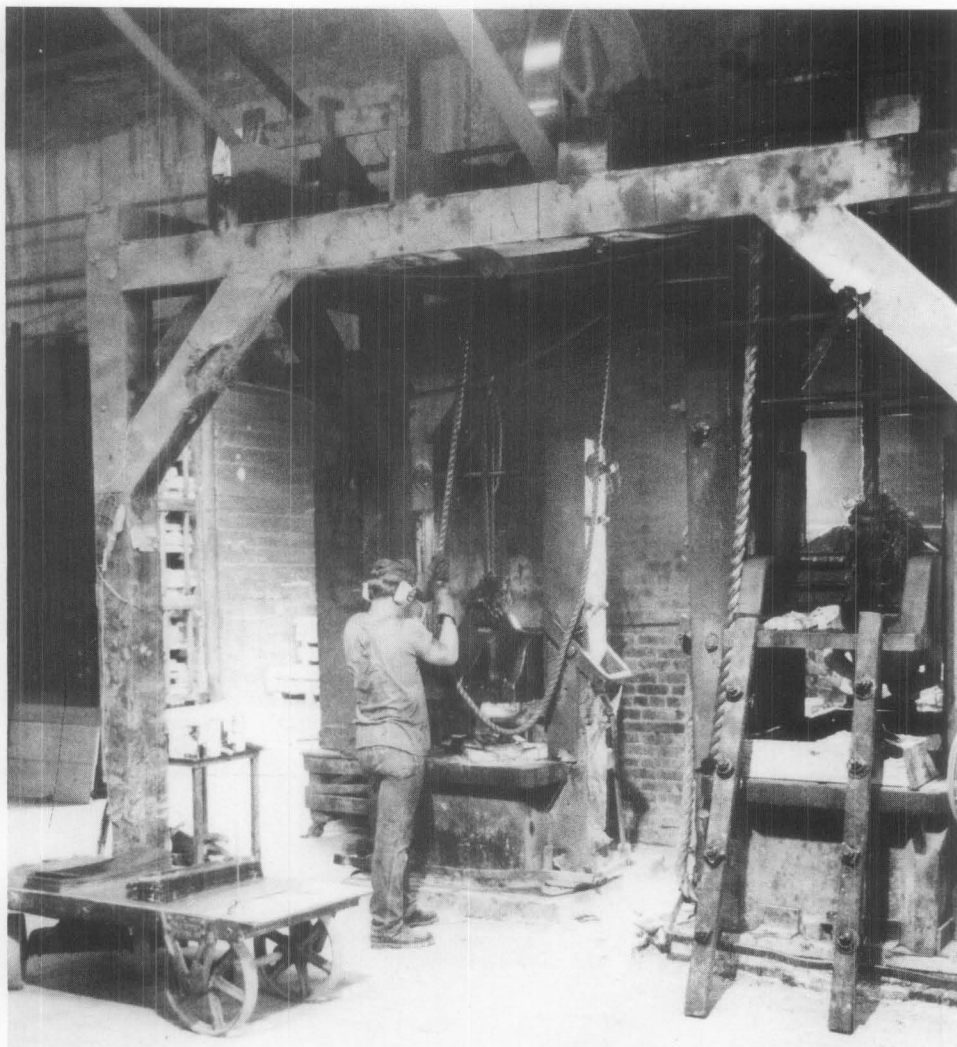
The ornamental frieze pattern, pebbled corner strip, and pebbled band were all stamped into pure sheet zinc. More malleable than galvanized steel, zinc is used when the relief of the design must be deep and sharp. The pieces of the pebbled band measured 13" by 48", and the pieces of the pebbled corner and the ornamental frieze measured 15" by 48" (see figure 8).

The fifth design, the molding that divided the frieze, pebbled band and brick patterns on the building's elevations, was formed on a brake press, which bends, flanges, and folds sheet metal. Twenty-eight gauge galvanized steel was used to produce the 2-1/2" molding in 8' sections.

## Wall Repair and Insulation

After ordering the replacement metal siding, the contractor waited approximately three months for its arrival at the job site. During this time, a new metal roof was installed and the walls were prepared to receive the new siding. The total replacement of the siding provided an opportunity to add wall insulation for enhanced energy efficiency. Insulation was installed from the exterior to avoid damage to the stamped sheet metal covering the interior walls and to permit installation of a vapor barrier. This required removal of all the exterior plank sheathing, some of which was also deteriorated (see figure 9).

Removal of the plank sheathing also permitted repair and replacement of some deteriorated original framing, primarily on the south side of the house and at the lower portions of the walls. A vapor barrier was installed against the back of the interior plank sheathing. Sheets of 3-1/2" fiberglass

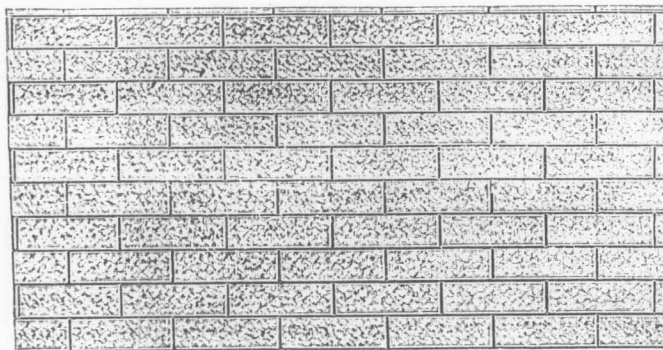


6. The stamped-metal siding was made the traditional way using gravity drop hammers and cast-iron dies. Photo: Lance Carlson.

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THE W. F. NORMAN SHEET METAL MANUFACTURING CO., NEVADA, MO.

## Brick Siding

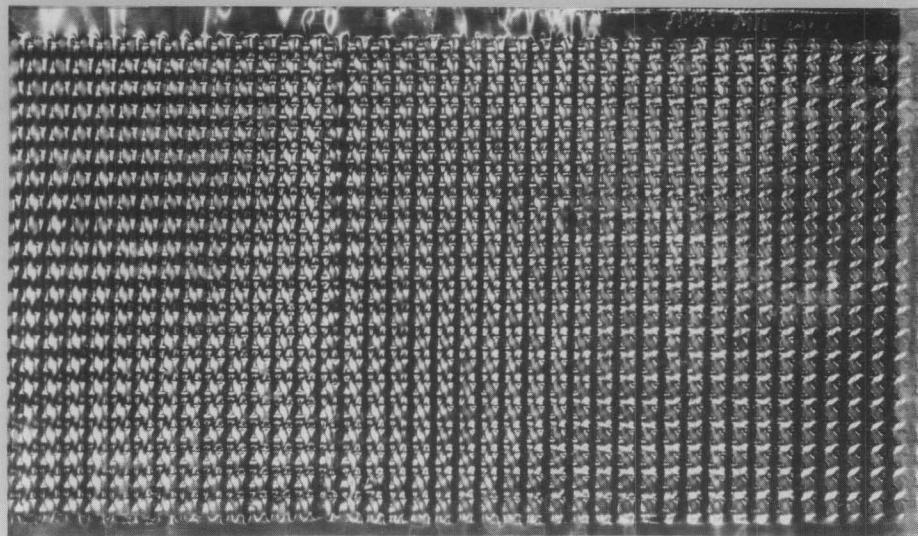
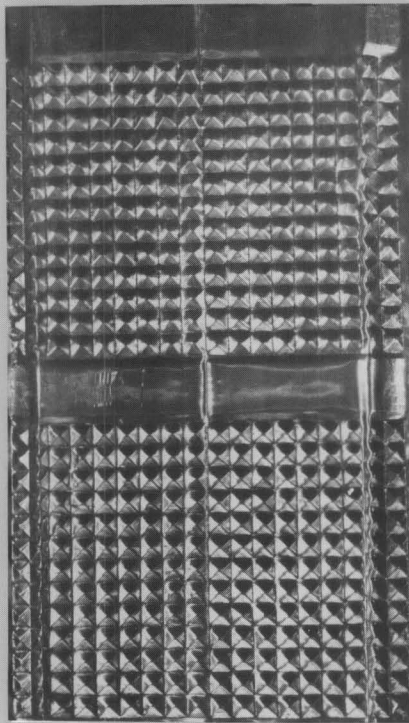
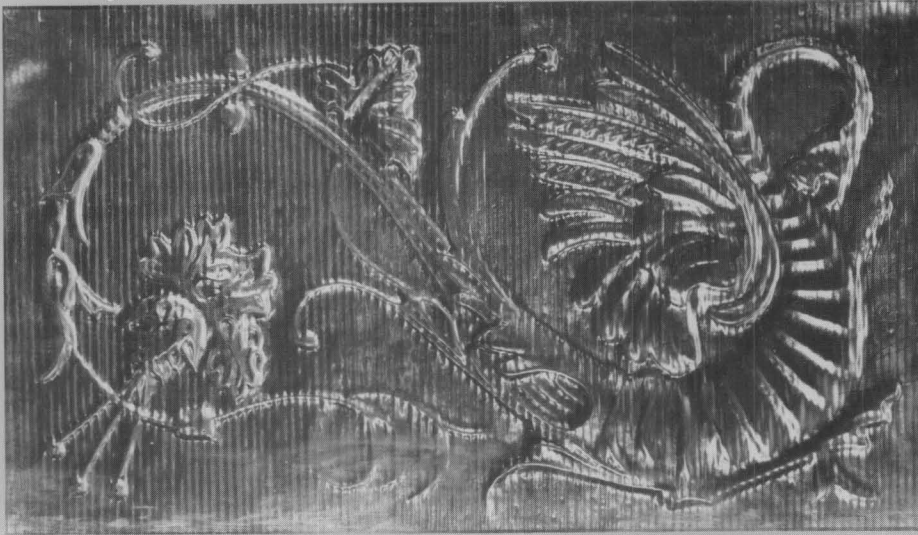


PRESSED STEEL, BRICK SIDING.

Galvanized or Painted.

Made in all gauges No. 24 and lighter. Sheets 28 inches by 60 inches. 8 4/7 sheets required to cover 100 square feet. This siding should be applied over solid sheathing. Always lay the concave or hollowed part of the joint to the outside.

7. The brick pattern was a stock design still available from the company. The description from their 1913 catalogue is unchanged from today.



8. The four stamped patterns used at the Hexagon are shown (samples in photograph are smaller than the actual sheet size).



9. Original exterior siding was removed, revealing the exterior plank wall sheathing, which was also removed in order to install additional insulation and a vapor barrier. Photo: Mary Cay Bartush Jones.

insulation were placed in front of the vapor barrier, and 3/4" plywood was installed as an exterior sheathing in place of the original planks.

The galvanized metal window hoods were also repaired and prepared for reinstallation. The painters removed all old layers of paint with heat guns, and a local sheet metal shop re-soldered all their split and splayed joints.

### Preparation and Painting of Siding

The metal siding arrived at the job site in several shipments throughout the fall and winter. The owner wanted the new siding painted prior to stopping exterior work for the winter, to avoid leaving the highly visible building in a shiny, silver unpainted condition until spring. Therefore, installation needed to begin immediately in order to be completed before the onset of cold weather. To facilitate this, painters prepared the individual pieces of new siding prior to installation and applied the first coat of paint indoors. [They returned the following spring to apply the second, final coat of paint to the installed siding.]

The new galvanized steel siding, the new zinc siding, and the old galvanized window hoods each received different paint treatments. Manufacturers often recommend that new galvanized metal be allowed to weather for several months after installation before being painted, to clean and roughen the metal's surface for better

paint adherence. However, several additional preparation steps can be substituted for the weathering period, as was done at the Hexagon. First, the painting crew wiped each galvanized piece with a non-petroleum-based paint thinner to remove most of the factory-applied oil coating. The pieces then received a wash primer (polyvinyl butyral zinc chromate), which removed the remaining factory-applied oil finish so that paint would adhere to the metal.

The stamped zinc ornamental bands did not have the oily surface coating and, therefore, needed no wash primer. These pieces received a rust-inhibiting primer of the type used on galvanized metal. Both the primers and the first finish coat were sprayed onto the siding pieces indoors. The final coat of paint was rolled onto the face of the installed siding.

### Installation of Metal Siding

After the painters prepared the metal surfaces and applied the initial coat of paint, the contractor's crew installed the metal siding. In addition to basic carpenter's tools, tin snips and a brake press were required to complete this aspect of the work. The siding was placed over the air infiltration barrier and face-nailed to the frame walls with #4 galvanized nails.

The pebbled vertical corner pieces were installed first. Since the new pieces matched the original corners, they had been fabricated to fit around the original 7/8" planks. Therefore, the new corner pieces had to be slightly rebent on a brake onsite to accommodate the new 3/4" plywood backing material.

Once the corner pieces were in place, flashing was installed at the point where the frame walls met the dressed stone foundation. The carpenter's crew bent and formed the flashing in 10' sections on a brake at the job site. Its finished height on the wall was approximately 9-1/2".

The last and largest step of the process was the installation of the brick pattern siding and the ornamental bands sheathing the building's elevations. Using a "story pole" of his own design, the carpenter marked the heights of each siding design on the individual elevations to ensure that the different patterns would be installed at the same locations on every side of the building.

On each story, installation began at the bottom and proceeded upward toward the roofline (see figure 10).

Each piece of siding lapped over the piece of siding below it and was face-nailed to the house's wood frame. The siding also lapped over the already installed corner pieces. Since the new sheets and bands of siding were identical in size to the originals, only minor trimming was required.

Zinc, the more malleable metal, responded better to being nailed to the wood frame than did the stiffer galvanized siding. However, zinc can be easily dented and bent, so it required careful installation. The larger, stiffer sheets of galvanized metal were easier to install, even though they sometimes buckle in response to spot nailing.

In the original construction of the Hexagon, the siding had been installed before the windows had been set into the walls. During this project, the window frames were retained in place, so the new siding was bent around and tucked back alongside them. A quarter-round molding was then installed and the edges sealed with a silicone-based caulk. The window hoods were reinstalled after the siding was in place (see figure 11).

By the time the pre-painted siding was installed, it was too cold for further exterior work. The painters returned in the spring to apply a silicone-based caulk to all of the ex-



10. Installation of siding began at the base of each story of the building. Corner pieces were installed first, followed by the base flashing, and the stamped brick siding. Care was taken to match the patterns from one elevation to the next around the building. Photo: Mary Cay Bartush Jones.



11. Finished appearance of several elevations. Siding has been face nailed to underlying materials and second coat of paint has been applied. Each piece of siding laps over the piece below it, and all overlap the corner pieces. Photo: Richard Neumann.



12. The replication of the stamped metal siding has restored the Hexagon to its historic appearance. A new metal panel roof system that duplicates the appearance of the original standing seam roof also contributes to the restoration. Photo: Richard Neumann.

posed nailheads and any remaining gaps around the windows. The painters then applied the final coat of paint.

### Project Evaluation

The replacement of the stamped sheet metal siding on the Hexagon demonstrates a successful effort to work with a fairly uncommon exterior siding material. The project team is pleased with the exact match between the historic and the new siding and with the restored historic appearance of the house.

While the historic appearance of the building's exterior was successfully replicated, the addition of the insulation and vapor barrier required the removal and, unfortunately, the loss of the original exterior plank sheathing. Although plank wall construction is fairly common in the area, the Hexagon was unusual in having both exterior and interior plank sheathing. Repair would have been the preferred preservation approach in this case and, perhaps with more careful scheduling, would have been a practical and cost-effective alternative.

This project does deserve special merit for its recognition of the importance of pressed metal siding as an historically significant feature of the building. Galvanized sheet metal work can still be found in ornamental cornices and decorative roofing shingles on many late-19th and early-20th century buildings. However, its use as a siding material, either ornamental or simulating other building materials, is much less common and often not recognized for its historic significance.

The work on the Hexagon also demonstrates that custom pressed metal work can be both the practical and the appropriate preservation solution for even small projects where historic stamped metal siding is an important feature of the building (see figure 12). When special molds are necessary to duplicate a specific pattern, additional planning time may be required. However, stock patterns, such as the simulated brick siding on the Hexagon, may be available, allowing for quicker delivery and cost savings. Properly prepared, finished, and maintained, galvanized and zinc pressed metal can have a long useful life.

## PROJECT DATA

### Building:

The Hexagon (Ephraim Shay House)  
Harbor Springs, Michigan

### Owner:

Mary Cay Bartush Jones  
Harbor Springs, Michigan

### Project Dates:

October, 1989–June, 1990  
(Exterior work)

### Designer:

Richard Hiler  
Hiler Designs  
Harbor Springs, Michigan

### Stamped Metal Siding:

W. F. Norman Corporation  
Nevada, Missouri

### General Contractor:

Bob Michaels  
Bob Michaels Builders  
Harbor Springs, Michigan

### Carpenter:

David Dunshee  
Bob Michaels Builders  
Harbor Springs, Michigan

### Painting Contractor:

John McCaffrey  
John McCaffrey Painting and  
Decorating  
Harbor Springs, Michigan

### Project Costs:

Total metal siding replacement costs,  
including materials and labor for  
installation was \$26,453.50.

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cessfully maintaining and preserving cultural resources. All techniques and practices described herein conform to established National Park Service policies, procedures, and standards. This Tech Note was prepared pursuant to the National Historic Preservation Act Amendments of 1980 which direct the Secretary of the Interior to develop and make available to government agencies and individuals information concerning professional methods and techniques for the preservation of historic properties.

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