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REPORT ON MOISTURE CONDITIONS IN THE PEMBROKE (EMERSON) MILL SUNCOOK VILLAGE PEMBROKE, NEW HAMPSHIRE

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This report is based on an inspection of Pembroke (Emerson) Mill on the morning of July 29, 2009. Present were Ms. Bodie Morey of the mill's condominium association; Peter Michaud, National Register, Tax Act and Easements Coordinator of the New Hampshire Division of Historical Resources; and James L. Garvin, Architectural Historian, New Hampshire Division of Historical Resources. The purpose of the inspection was to assess in broad terms several moisture management issues that concern the condominium association that is responsible for maintaining the exterior features of the building, and to make recommendations for further investigation of these issues and for planning for their remediation.

Summary: The brick walls of the Pembroke (Emerson) Mill are the general responsibility of the condominium association that maintains the exterior of the building. These walls are therefore of concern to all occupants of the building. The walls were rehabilitated in 1985 in accordance with plans and specifications developed under a Community Development Block Grant by Salmon Falls Architecture, then of South Berwick, Maine. In the more than twenty years that have ensued, problems have become apparent in some areas of the exterior walls. These problems include water penetration through the granite rubble foundation of the mill, rising damp in areas of the brick walls above grade, spalling of bricks in certain areas, and mortar loss, generally in the same areas.

Inspection of areas of moisture damage by staff members of the Division of Historical Resources was superficial due to time constraints, but was sufficient to identify most of these issues as typical of brick buildings under the conditions that prevail at Pembroke Mill. While not yet destructive in most areas, these problems need remediation as soon as possible. It is the recommendation of the Division that these problems be studied in greater depth and detail before the condominium association commits itself to an architectural or engineering plan for treatment of the building. Further study of moisture issues at Pembroke Mill should focus on developing recommendations that are in keeping with the best standards for treatment of historic buildings. Only after a plan focusing on preservation of the building fabric has been agreed upon should the association consider seeking architectural or engineering services. The preservation plan should serve as the vehicle by which an appropriate architectural and engineering consultant is selected.

History: Pembroke Mill was built in 1860 as a successor to two earlier textile mills that had stood at the same site. The Pembroke Cotton Factory Company built the first textile mill here in 1811. The first mill was replaced by a second, which burned in 1859. The third mill, which stands today, was named Pembroke Mill. It was the first (and smallest) of three mills built in Suncook Village during the 1860s by the Suncook Manufacturing Company. It was described in the town history of 1895 as "273 feet long, 72 feet wide, has 20,000 spindles and 422 looms, and is run by two turbine water wheels, aggregating 400 horse power, and for auxiliary power has two Corliss steam engines, aggregating 400 horse power. It employs 175 female and 80 male operatives, and the monthly payroll is $6,000. It uses 1,000 tons of coal, 2,000 gallons of oil, and 1,200 pounds of starch per annum. It uses 24,000 pounds of cotton and manufactures 110,000 yards of cloth per week."[1]

A two-story addition, used as a picker house and cotton warehouse, was built on the western end of the original building in 1879; it remains as part of the condominium complex. Sanborn fire insurance maps indicate that the power house for Pembroke Mill was a detached building that stood just downstream of the existing dam, between the main mill and the retaining wall that runs along the northern embankment of the Suncook River. This structure contained both the turbines and the auxiliary boilers and steam engines. It had been entirely removed before the mill was nominated to the National Register of Historic Places in 1985.

A second factory, named Webster Mill, was built just upstream in 1865. It was larger than Pembroke Mill, being 310 feet long and 72 feet wide, and employed 500 operatives. Its dam remains, and supplies water through a power canal and penstock to a modern hydroelectric plant that interrupts the retaining wall in the approximate location of the original power house of Pembroke Mill, some 1,200 feet downstream from the Webster Mill dam.

The third factory, China Mill, was built on the south (Allenstown) side of Suncook River in 1868. It is 510 feet long and 72 feet wide, and employed 800 people in 1895. It still produces textiles and generate hydroelectric power through its own turbines and a rope-driven dynamo within the mill.

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[1] N. F. Carter and T. L. Fowler, *History of Pembroke, New Hampshire, 1730-1895*, 2 vols., reprint of the 1895 ed. (Pembroke: Allenstown-Pembroke Bicentennial Committee, 1976), I: 355.

According to a report prepared as part of a proposal to carry out the Pembroke Mill rehabilitation in 1985, "Suncook was affected heavily by the great depression. The population declined dramatically. During this time, the Pembroke Mill shut down, but was saved by a citizens' group who bought it in 1938, held it for eight months and sold it to the Textron Manufacturing Company. This company also produced textiles, cotton, as well as the newly developed rayon and nylon synthetic fabrics. They may have produced uniforms during World War II, but more research is necessary to substantiate this period."[2] Current understanding is that Textron produced parachute cloth during World War II.

In the 1950s, the Emerson Furniture Company bought the Pembroke and Webster Mills. Emerson manufactured non-upholstered furniture in Webster Mill and the then-popular upholstered Emerson Lounges in Pembroke Mill.[3] During this period, Pembroke Mill became commonly known as "Emerson Mill," and this name remains attached to the building today. As noted above, the building was converted to "Emerson Apartments" circa 1985. It is now a condominium complex.

Moisture Issues: The building exhibits a series of moisture conditions that are characteristic of brick buildings. These include groundwater issues and rain or roof water issues. All can be addressed by straightforward and traditional methods, but they need to be studied in greater detail and understood before they can be addressed effectively.

Among the water management issues are:

Water penetration through the stone foundations. Because much of the first floor (below-grade) story is subdivided into private condominiums, it was impossible during this inspection to gauge the full extent of water penetration. Water penetration is, however, apparent in the stairwell that lies adjacent to the eastern wall of the mill in the center of the building. Here, water is visibly leaching through the stonework, and has already dampened new gypsum board that abuts the stone wall, causing a bloom of mold. Because of the nature of its construction, this area undoubtedly has suffered from chronic dampness since the building was erected. Some provision for capturing and channeling the water was provided by a grated floor channel that runs adjacent to the eastern wall, and then turns at right angles and follows the east-west corridor wall for some distance. This drain was probably installed in 1985. Its engineering design is not clear; it could end in a sump pit, or could deliver water to an underground pipe that may pitch toward the river to the south.

Depending on local circumstances, some water penetration of a rubble stone wall that is below grade is inevitable. Photographs at the Division of Historical Resources, taken in 1985 for a National Register nomination, show that the eastern wall of the mill has long had earthen fill placed against the building to the elevation of the floor level above the basement story. While this level area of fill is now landscaped as a pocket garden or

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[2] Artelia Lyn Wilson, *Suncook Village, Pembroke, New Hampshire, Cultural Resource Survey, Inventory, and Plan*, June-September 1983. Central New Hampshire Regional Planning Commission.
[3] Ibid.

park, its history as a filled area must be early, and possibly extends back to construction of the mill in 1860. A railroad spur formerly extended alongside the mill on its northern side, below the Front Street retaining wall, and crossed Main Street near the north abutment of the Main Street Bridge, continuing into the yard of Webster Mill. Because rail lines must be as level as possible, the placement of fill against the north and east sides of the mill must extend back at least to the construction of this rail siding, which may be contemporaneous with construction of the building in 1860; the railroad had arrived in Suncook Village in 1852, well before the present mill was built.

One noticeable feature of the terraced garden or park that now stands east of the end of the mill is the expanse of pervious soil in this area. This soil is terraced at several levels, each terrace being supported by retaining walls of timber cribbing. This expanse of open soil forms a natural catchment area for rainwater. Moving downhill as it penetrates the ground, much of this rainwater must impinge against the buried foundation of the building. Because of the nature of rubble wall construction, water that collects against such a foundation must penetrate the masonry, at least to a degree. The only prevention of some amount of water leakage into the building along this surface would be through a moisture barrier or an effective collecting mechanism adjacent to the foundation wall.

In the absence of construction plans for the 1985 rehabilitation, we cannot know whether such a barrier or collecting system was attempted, except for the evident floor drain inside the building. The presence of some type of drainage system close to the east wall is suggested by a polyvinyl chloride (PVC) pipe that projects through the south retaining wall of wooden cribbing, delivering water to a drain at the lowest level of the lawn, near the southeast corner of the mill building.

Another factor in the likely saturation of the soil east of the mill is the fact that Main Street slopes continuously toward the curb cut and driveway that provide entry to the mill yard from the road. There is no grated drainage channel at the curb cut, and the continuous pavement invites water to flow across the adjacent street surface directly into the mill's driveway during heavy rainfall. The nearest effective catch basin is downhill from the curb cut. It does not intercept water flowing across the broad, sloping expanse of the adjacent street.

Roof water management: The two-story picker house addition of 1879 at the western end of the original building has a very gently sloped roof that pitches from a central ridge toward the north and south eaves. Taking advantage of this pitch in 1985, the architects installed eaves gutters, with leaders (downspouts) at four points on the north and south elevations of the picker house. This system collects and channels roof water to predetermined points on the ground. On the north elevation, this water drops from the ends of the leaders onto asphalt pavement that abuts a granite foundation. On the south elevation, the leaders empty onto concrete troughs that carry the water a short distance from the building. Here, the soil has built up in places above the granite underpinning stones (see below, *Rising Damp*). For this reason, water finds its way back to the brick walls in many areas and rises through the lower zones of these walls by capillary action.

The main mill of 1860 has a flat roof that is covered with a modern roofing membrane. The edges of the main roof are trimmed with a large metal crown molding in the form of an ogee. Lack of access to the roof of the mill prevents a full understanding of the system for managing roof water. The water may simply cascade off the edges of the roof, falling onto the bed of pea stone that has been laid below the drip line. More likely, there is some form of internal drainage system that collects roof water and channels it down through the building inside internal drains. Until the water management system of the main roof can be understood, it is impossible to describe the effect of rainwater that falls onto the roof of the main building.

Rising Damp: However the roof water may be managed, the soil immediately around the perimeter of the building is wet. In many areas, the soil has built up, or has been placed, above the level of the granite underpinning. Placement of damp soil or asphalt pavement against a brick wall guarantees the saturation of the brickwork through capillary action of water. This condition is called "rising damp." It is normally prevented by the placement of granite underpinning stones in the lower wall, adjacent to sources of water.

Unlike brick, granite is largely impervious to saturation by water, and so forms an effective barrier between the soil and the brick fabric above. By contrast, most bricks are quite susceptible to the absorption of water. Even though they are a ceramic, bricks act like sponges, absorbing considerable quantities of water. Under normal conditions in a well-designed wall, this water soon evaporates, doing little harm to the bricks or the mortar. When bricks are exposed to chronic dampness under conditions like those described above, however, they may be damaged simply by constant dampness or by spalling when the water within them freezes during the wintertime.

Several symptoms of rising damp may be seen on both the north and the south sides of the building. On the north side, the elevation of the asphalt pavement is above that of the granite underpinning in most areas. This allows water to flow directly against the brick walls. The presence of dampness on this side of the building has encouraged vegetative growth, both in the form of moss and leafy weeds, within the eroding mortar joints of the lower walls.

On the south side of the building where turf abuts the brick walls, there are likewise areas of moss growth. Bricks on this side of the building have spalled in some areas, and testing with a moisture meter showed that bricks in such zones are at 100% of their absorptive capacity.

Behavior of bricks and mortar in damp conditions: Except where repairs or infill have occurred, the bricks in the walls of Pembroke Mill were molded and fired circa 1860, undoubtedly not far from Suncook Village. During the nineteenth century, the manufacture of bricks became a major industry along the Merrimack River, not only in Pembroke but also in adjacent Concord, Allenstown, and Hooksett. This portion of the Merrimack Valley had been inundated by a glacial lake that had permitted the slow deposition of clay at the end of the ice age. Glaciers also deposited much sand in the area. The manufacture of bricks requires the mixing of native glacial clay, which is thick and viscous, with enough sand to make the clay sufficiently plastic to be pressed into wooden molds.

The beginnings of the industry are recorded in the account book of Sterling Sargent of Pembroke and Allenstown, which documents Sargent's activities during the period between 1813 and the 1850s.[4] Sargent worked at brick-making only sporadically, mostly during the spring and fall months, and on a small scale, burning perhaps 50,000 or 55,000 bricks at one time.

Sargent was the father of two sons, Philip and Warren, who continued the trade of brick manufacturing into the era when the arrival of the railroad encouraged production on a much larger scale and permitted the creation of a brick village like Suncook, whose buildings consumed millions of bricks. By 1832, as the first brick dwellings were appearing in Pembroke, local production in the Pembroke-Allenstown-Hooksett area was a respectable 1,271,000 bricks per year. But by 1878, well after the advent of the railroad in Pembroke and adjacent Hooksett, six brick manufacturers in Hooksett, Suncook Village, and the banks of the Merrimack in Pembroke were employing sixty men in making bricks. Each local yard averaged about 80,000 bricks per year per man employed, for a total of about 4.8 million bricks.[5] By 1895, maps in Carter and Fowler's *History of Pembroke* and Hurd's New Hampshire atlas indicate brickyards owned by Henry T. Simpson (Simpson owned two yards, and his showpiece brick house stands at 422 Pembroke Street), Edmund Elliott, the Whittemore family, F. S. Whitehouse, and G. N. Simpson. These yards were placed at intervals along the Merrimack River between the Concord border (Soucook River) on the north and the Allenstown border (Suncook River) on the south. An additional brickyard, owned by Martin H. Cochran and Isaac G. Russ, operated on Buck Street near McDaniel's Brook.

The bricks in the walls of Pembroke Mill are therefore significant materials of an important local architectural tradition. Preservation of the mill through proper care of these brick walls will simultaneously preserve an important chapter of local history.

The bricks of the mill are common (not pressed) bricks that appear to be hard and enduring by mid-nineteenth-century manufacturing standards. These bricks have survived not only the damp conditions described above, but also the abuse and neglect that occurred when the mill was adapted to different purposes and eventually closed and essentially abandoned. Photographs taken in 1985 for the National Register nomination show a building in a state of deterioration. It is clear from these photographs, and also from physical evidence that is still visible, that the roof was then leaking badly and that the upper portions of the brick walls were suffering from the penetration of water and from the resulting freeze-thaw cycles.

Because the walls of the mill are today in far better condition than they were in 1985, their principal needs are for careful diagnosis and treatment of the conditions that affect

[4] Sterling Sargent, account book, 1813-1857, New Hampshire Historical Society, Concord.
[5] James L. Garvin, "Small-Scale Brickmaking in New Hampshire," *IA: The Journal of the Society for Industrial Archaeology* 20 (1994): 19-31. This article illustrates one of the Simpson brickyards.

them, particularly in the lower zones where water is most prevalent, followed by cyclical maintenance

As noted above, a common result of chronic dampness in brick walls in a cold climate is spalling, or the splitting off of the outer faces of the bricks. Spalling removes the protective (but largely invisible) glaze that helps to resist the penetration of moisture, instantly making the brick still more vulnerable to water absorption and further deterioration. The agency that causes spalling is usually frost. When the water that is trapped in a brick freezes, it expands. This expansion can make the brick virtually explode from internal pressure.

Inspection of Pembroke Mill revealed relatively little spalling. Most areas of damage were adjacent to the soil on the south elevation of the mill. It is possible that this damage was the result of earlier actions near the wall, including the presence of now missing fire escapes, low roofs, or adjacent structures that may have caused water to behave in damaging ways. In general, spalling is not a severe problem on this building.

A second component of a brick wall is mortar. Before the end of the nineteenth century, the mortar that was used in bricklaying was generally a relatively soft material composed of slaked lime (made from limestone) and sand. This is a low-strength mortar, often having a compressive strength of 75 pounds per square inch (psi). To prevent cracking or spalling through differential expansion, it is important that mortar not equal or exceed the strength of the adjoining bricks. When Pembroke Mill was rehabilitated in 1985, the proposed treatment of the brick walls called for a soft mortar that was compatible with the strength of the bricks—essentially a duplicate of the mortar that had been used in 1860. The proposed specifications stated that

> Exterior brick surfaces will not be cleaned or water proofed. Missing or damaged dentils or cornice material will be restored/duplicates as necessary. Repointing, where necessary, will be done so as to match the original [mortar] in composition, color, texture, joint size, profile and method of application.[6]

When conditions of dampness like those described above are juxtaposed with soft, lime-sand mortars, the result is the erosion and loss of the mortar. As may be seen in the lower walls of Pembroke Mill, this loss is usually slow and, unless greatly prolonged, is confined to the outer zone of the mortar, usually not more than an inch in depth. The proper treatment of this condition is periodic pointing with fresh mortar of the same formula as the original.

Recommendations: For further understanding of the current condition of Pembroke Mill, the Division of Historical Resources recommends a review of several documents, called *Preservation Briefs*, which have been prepared by the National Park Service.

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[6] Salmon Falls Associates, "Pembroke (Emerson) Mill, Suncook, New Hampshire" (no date; received November 9, 1984). Report on file at the New Hampshire Division of Historical Resources.

Those *Briefs* that may be most helpful are:

Robert C. Mack and John Speweik, *Preservation Brief 2*, "Repointing Mortar Joints in Historic Masonry Buildings," available online at: http://www.nps.gov/history/hps/tps/briefs/brief02.htm

Sharon C. Park, *Preservation Brief 39*, "Holding the Line: Controlling Unwanted Moisture in Historic Buildings," available online at: http://www.nps.gov/history/hps/tps/briefs/brief39.htm

Secondly, as noted at the beginning of this report, the Division recommends the development of a more detailed report than the present document, based on a more thorough inspection of the mill. To avoid the waste of funding for unneeded services, the Division suggests that the condominium association obtain such a report before considering the employment of consulting architects or engineers to design treatments for Pembroke Mill.

Funding for such a report may be available from the New Hampshire Preservation Alliance, New Hampshire's statewide, non-profit preservation advocacy organization. The Alliance offers Preservation Services Grants. These are small matching grants that assist non-profit organizations in hiring a consultant to address many aspects of preservation planning. An overview of the program and an application (PDF) are available at http://nhpreservation.org/pdf/RevApp&Guideline7-09.pdf. Applicants are advised to schedule a visit with the Field Services Representative, Maggie Stier, before submitting an application. Contact the Project Director Beverly Thomas at bt@nhpreservation.org with questions, or call (603) 224-2281.

If the condominium association does not qualify as an applicant for a Preservation Services Grant due to its income-producing status, a local committee, *Meet Me in Suncook*, a non-profit corporation, may be willing to cooperate with the association in seeking such a grant. *Meet Me in Suncook* provided similar cooperation for entities in Allenstown who were seeking advice on the preservation of China Mill.

If, after consulting with the New Hampshire Preservation Alliance, the condominium association wishes to inquire whether *Meet Me in Suncook* would cooperate in a grant application, please contact:

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