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# Masonry Conditions Report

*Meredith Public Library – Meredith, NH*

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# Masonry Conditions Report

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## **Introduction**

This masonry conditions report was commissioned by the town of Meredith, NH and Erin Apostolos, Director - Meredith Public Library. The report is based on an on-site inspection of the library, (4/9/13) with Erin and a review of the masonry repair cost estimates provided by the MacMillin Co., Inc., the Bonnette Page & Stone Corporation and Frederick A Meyer III & Sons, Inc.. Erin also loaned out her own copy of Norman E. Larsen's, (Christopher P. Williams Architects) 2012 Meredith Library conditions report. Norman's well researched report contained the essential background data needed to organize this brief analysis.

The construction of the original structure, the Benjamin M. Smith Memorial Library took place at the very beginning of the 20<sup>th</sup> century but the traditional building methods and its design were developed in the previous century. The masonry materials used to build the old library were probably all made or quarried in New Hampshire with the exception of the slate roof. There were two types of bricks used to build the original library. These were water-struck or common bricks, (the two interior walls) and re-pressed bricks, (exterior or facade). The re-pressed bricks were originally produced at Canterbury Shaker Village in the mid 19<sup>th</sup> century. The Shakers invented a brick press that made these smooth faced bricks from green common brick. These bricks became very popular with Victorian era architects and were used both on residential and public structures throughout New England. They are beautiful bricks but because of the way they were manufactured they become very brittle with age and are prone to surface failure due to weathering. The chimneys were also built above the roofline using re-pressed brick but the interior flue walls of these stacks were usually built with common bricks.

The mortar used to build these brick walls and chimneys consisted of only two materials, lime and sand. The early 20<sup>th</sup> century masons used the same slaked lime that their predecessors used in the 1700's. The only difference was the library's masons used a screened or processed sand to achieve the narrow, (1/8 to 1/4" thick) mortar joint common in late Victorian masonry architecture. A basic analysis of the old library's mortar confirmed this. Although Portland cements were first imported to this country in the late 19<sup>th</sup> century they were not widely used until the 1930's. The analysis of the library's mortar did not indicate the presence of either Portland cement or of any of its earlier competitors like Rosendale cement. The basic formula for the old library's lime mortar was two to one. This means two parts sand to one part lime. Because of the fact that the face brick were installed using a running or American bond there are no header brick tying the exterior layer of bricks to the inner two walls. Norman Larsen mentioned the possibility of the presence of metal anchor ties in the library's walls in his 2012 report. Based on my experience in restoring a number of late Victorian brick buildings, these ties were usually made of iron flat stock or just tin. These metal anchors were widely used in this situation. They are very prone to rusting and failure due to water infiltration. The interior walls were laid up in a more traditional English bond which tied the two walls together by installing a header course at regular intervals. The rear wall of the library was faced with common or water struck bricks in a Flemish bond pattern which alternated

stretcher and header bricks. This bonding pattern anchored the face brick to the inner walls. The exterior or facade mortar joints were struck with a narrow concave joint.

The advanced skill level of the library's early 20<sup>th</sup> century masons who built the library is plainly revealed by the highly finished brick and granite arch work above the main entrance and the decorative brick entablature that terminated the front and gable end facades. The corbelling or dentil work was achieved with a mix of face bricks and at least six different types of terra cotta molded bricks. These bricks were actually available as stock items to late 19<sup>th</sup> century masons and architects. Besides making a strong horizontal decorative statement, corbelling the brickwork also helped to throw the rainwater clear of the wall and it provided support for the copper gutter system above it.

Fortunately for the future citizens of Meredith, the library's architect, George Swan specified granite for the building's foundation and architectural elements rather than the less expensive but more popular late 19<sup>th</sup> century building material, brownstone. Brownstone was easier to cut but very susceptible to weathering. The Meredith Library's light gray rock faced granite blocks along with the highly finished front entrance arch and letter stones are in perfect condition. Although there were many working granite quarries located in southern NH, central Vermont and northern Massachusetts during the late 19<sup>th</sup> century, the logical origin of the library's granite are the quarries just north of Concord, NH which are still in business. The original masons used a narrow beaded or rope mortar joint to finish the foundation stonework. The front entrance arch stones originally had a similar slightly larger beaded mortar joint but this area had been partially re-pointed in the recent past and only a few of the original rope joints survived on the lower part of the arch.

Without any original construction documents I cannot comment on the origin of the dark gray slate roofing. The possible sources are the historic quarries around Montpelier, Vermont or Granville, New York. The chimney and valley flashings were made of sheet copper along with the integrated rain gutter system. The downspouts or drops for the rain gutters seem to have been removed at some point in the past.

## **Existing Building Analysis, Repair/Restoration Cost Estimates and Recommendations**

### **Chimneys and Slate Roof**

**Observations:** It is apparent that the library's two brick chimney stacks are in very poor condition due to weathering. There are many open mortar joints and the old lime mortar has deteriorated to the point where the chimney bricks have lost their bonding. It appears that the chimney crowns have been partially rebuilt and re-pointed in the past. The copper chimney flashing also appears to have been replaced. The slate roof is in fair to good condition for its age which is to be expected. However the areas of the slate roof around the chimneys appear to have been poorly reinstalled when the flashing was replaced. Between the deteriorated stack brickwork and these slates, this is definitely an area of water infiltration into the building.

**Recommendations and Cost Estimates:** It is recommended that both chimney stacks be carefully dismantled to at least 24" below the roofline and rebuilt to their original dimensions. This will involve the handling of at least 1000 exterior re-pressed bricks and about the same number of interior common

bricks that make up the flue walls. Based on experience about 1/3 to 1/2 of the chimneys bricks will have to be replaced. Many of the existing bricks have lost their outer surface due to weathering. There are at least two brick manufacturers in New England that make a face brick that is a close match to the library's re-pressed brick. The existing bricks are of a fairly standard size, (length – 8". thickness -2 1/4"). This should make it possible to find a replacement brick for the chimney work. It is also recommended that an experienced slate and copper contractor be included in this work. The reconstruction of the chimneys, the replacement of their flashing systems and the slate roof repairs around the stacks should be treated as one project. It is also recommended that because of the chimneys continual exposure to the elements and the ongoing changes in our climate, the mortar formula for this reconstruction be altered from the original high lime mix. This will extend the life of the repairs and make the stacks more resistant to water infiltration. Although I do not recommend this mix for re-pointing the walls, it has been my experience that the re-pressed bricks have enough compressive strength to use a mortar mix where equal parts of lime and Portland cement are added to six parts sand.

The existing chimney and counter flashing should be removed during the stack dismantling along with the roof slates around the chimneys. Replacement copper flashing can be premade on the ground and custom fitted into the new brickwork as it is built. Special attention should be paid to the copper chimney "cricket" on the upper side of the stacks as this area is very prone to water infiltration. After the chimneys are rebuilt, the Slater can reinstall the roof in the proper way, replacing any broken or cracked slates as needed. I have encountered a few talented slate and copper artisans over the years. They usually charge about \$100 per hour plus the material cost to do basic roof and gutter repair. They are usually worth every penny. I recently met a slate and copper contractor, Steven J Tolmie from Raymond, NH, (603 244 2746) who seems very knowledgeable and is interested in restoration work. I also know the slate roofer who taught Steven the trade, Mark Goodrich, (603 778 0455). I have encountered Mark on a few restoration projects in Portsmouth, NH and his work is very good.

Over the past twenty years I have installed a number of "chase" covers on museum house chimneys in Portsmouth, NH. These are custom made copper caps that cover the top of the stack and can be made to allow the penetration of a flue liner. They are sized to allow the escape of water condensation from inside the chimney and are mechanically connected to the chimney crown with masonry anchors. These covers are almost invisible from ground level and are very effective in reducing water infiltration into the building.

The previous repair cost estimates for the library's chimneys are certainly competitive bids from very reputable masonry contractors but there is no mention of the flashing or roof repair in these documents. There is also no mention of how far below the roofline that the stacks will be dismantled which is important. If the chimneys are only dismantled to the roof flashing level, the rebuilt stacks will be prone to failure because of the wind loads and one of the most important aspects of the project, the flashing and the roof repairs will not be addressed. Because of my long experience as a mason contractor I understand how hard it is to put together an estimate for a project like this. It will require a fair amount of staging just to safely access the chimneys and also protect the slate roof.

It is recommended that the budget to rebuild each chimney and complete all the additional repairs mentioned above including the installation of the chimney covers should be \$40,000.00

The total repair cost estimate for the chimney reconstruction is \$80,000.00

## **Integrated Copper Gutter System**

**Observations:** Over the past 30 years I have completed many masonry assessments of historic town halls and libraries throughout New England. The most commonly neglected architectural features on these structures and possibly one of the most important are the rain gutter systems. Unfortunately these gutters which were usually made of copper on late 19<sup>th</sup> century buildings are very difficult and expensive to repair. I have encountered building after building where the gutters have been covered over and the leaders have been removed. This is what appears to have happened at the Meredith Public Library at some point in the past. I have come to understand the reasons for disabling a gutter system since the repair or replacement costs usually run into the six figures. Very few towns have the budget for a complete restoration of their historic buildings and they are forced to make tough decisions. These partially hidden copper gutters performed a critical role in preventing water infiltration into the entire building from the dentil brickwork down to the granite foundation. There is evidence on the facade brickwork, (staining and damaged bricks) and on the underside of the existing gutters, (patched holes) that there may have been at least six original leaders or drops on the exterior walls. These gutters were designed to carry the large amounts of water produced during a typical rainstorm down the leaders and away from the foundation. That rainwater is now flowing down over the brick entablature and down the exterior walls into the basement. It appears based on my recent inspection visit, that the old gutters, (which were probably disabled in the first place because they were leaking, are still allowing water infiltration into the top layers of the brick walls. From my observations the brickwork that directly supports the integrated gutter system has lost its bonding in a number of places on the front and south facades due to water infiltration. Virtually all the recent repair work to the brick entablature and dentil work on these walls has already failed and washed out.

**Recommendations and Cost Estimates:** It is recommended that the restoration of the library's copper integrated gutter system be considered as an important part of the building's exterior restoration and its long term maintenance. There is no reason to continue any more brick re-pointing or masonry cleaning on the interior or exterior walls until this gutter work is addressed. The cost estimate for this copper restoration project would include repairs to the deteriorated brick courses under the gutters, a partial removal of the slate roof above the gutters and staging to access the work. Based on prior experience there will probably be repairs to the wood roof structure and brick anchors under the gutters and behind the brick entablature. A project like this will involve the skills of a slate/copper contractor, a preservation mason and carpenter/timber frame contractor. The recommended budget for this project would be \$250,000.00.

## **Exterior and Interior Brickwork – Restoration, Repair and Cleaning**

**Observations:** Despite the lack of a working gutter system, the library's exterior brick walls are still in good condition. There are areas which need spot re-pointing especially in the places where the gutters are still leaking. This type of mortar joint repair takes a great deal of skill in order to match the surrounding intact older mortar joints. There is no reason to remove intact existing mortar joints as has been proposed for the south wall and no rotary grinders should be allowed for mortar joint removal. This work should only be done with hand tools because of the very narrow mortar joints and the delicate facade bricks. Most of the potential re-pointing work is located along the tops of the building's walls and the corner pilaster panels. There are two additional areas of concern; the lower side walls of the front facade clock tower and the alcove walls at the southwest corner of the building. The areas of exposed brickwork on the lower walls of the clock tower appear to have been re-pointed with roofing tar which is not an appropriate or effective method of preventing water infiltration into this area of the building. The flashing on the shed roof that protects the south west entrance to the library is also not appropriate or effective. These two areas of flashing should be made of copper and not the existing sheet metal which has been attached to the brick walls with rusty nails and caulk. The bigger problem with this corner area is the large amount of rainwater pouring down the walls off the main roof. This condition has caused the deterioration of most of the mortar joints above the lower shed roof and down along the adjacent brick wall. It is apparent that this water infiltration is getting into the basement level based on the deterioration of the interior brickwork and the heavy crust of soluble salts on the lower brick wall next to the back steps.

**Recommendations and Cost Estimates:** The estimates already received by the library for repairing and cleaning the library's brickwork vary greatly in cost and scope. Besides the budget, the methods and materials used in these repairs are also important factors in a successful restoration project which are not covered by these bids. From this point on no contractor should be allowed to carry out masonry repairs on the library without a detailed restoration plan and a proven track record in masonry conservation. To streamline the bid process only prequalified contractors should be allowed to bid on the repairs. The masonry consultant is willing to help in this process.

There is no reason to spend money on cleaning and re-pointing the exposed interior brickwork in the attic level Children's Room. This was the way the original masons intended the interior wall to look and any re-pointing work will do nothing to stop the water infiltration. The repair of the interior basement walls are also a very low priority until the gutter problems are resolved. There is also no reason to carry out any extensive cleaning of the exterior masonry. The use of acidic masonry cleaners even those rated for preservation work should be avoided because of their long term effect on lime mortars. All potential cleaning agents should be tested first before using on the tougher stains. I have found that white vinegar or a mild detergent soap diluted with clean water is often effective in cleaning old brick and stonework. These days when I look for effective masonry cleaning agents I also look for products that will not potentially harm the environment or the buildings occupants. The Diedrich Technologies Co. makes a good masonry cleaning product, (Envirestore 100 - 1 800 283 3888) that is based on citric acid. It can remove most of the darker environmental stains on the library's exterior brickwork if needed. The light white stains on the brickwork beneath the library's windows are caused by the migration of white lead from the window trim paint. This can be safely removed using a new "green" product, (LeadOut –

Franmar Chemical Co. 1 800 538 5069) which is a soy based product that converts the lead to an inert material. All lead paint removal should be carried out by a qualified lead paint removal contractor.

Before any cleaning agent is applied to the exterior walls, the brick and stonework should be thoroughly soaked with water, (hose pressure only) to prevent the migration of the cleaning agent into the wall. No power washers should be allowed on the site. They can drive the water and the cleaning agents deep into the brickwork which will eventually cause the deterioration of the lime mortar. The six vertical control joints are located at intervals on the 1988 addition's brick walls and where it joins with the old library. These expansion joints are composed of a foam backer rod which is sealed with caulking. These joints have reached the end of their effectiveness and need to be replaced.

**Recommendations and Cost Estimates:** It is recommended that no previous bid for the cleaning and re-pointing of the library's masonry walls be accepted at this point. The plan for the 100% removal and re-pointing of the south facade brickwork should be avoided at all costs. There are areas of deteriorated brickwork located on all four walls of the old library but most of the original exterior mortar joints are still intact. These deteriorated areas could be re-pointed by a small crew of skilled masons in approximately six weeks. This does not include the potential brick repair underneath the existing gutters. It is also recommended that there will be no aggressive cleaning of the exterior brickwork and that any cleaning agents that are eventually used after the masonry repairs are completed are tested first on a small panel of brickwork, (in a discreet area). The removal of the decorative terracotta entablature bricks should be carried out only if they have lost their bonding. Decorative bricks that are intact in the wall but are chipped or cracked can be repaired in place with the non polymer single component repair mortars manufactured by masonry preservation companies like the Conproco Company in Dover, NH. These mortars can be color matched to the library's brickwork and can also be carved after being installed. These can be effective long lasting repairs if done right. I have also used this repair mortar to repair damaged or cracked facade brick in place. Individual deteriorated re-pressed bricks are extremely difficult to remove without damaging the intact adjacent brick.

A budget of \$60,000.00 should cover the facade brickwork re-pointing/repairs and minor cleaning on all four exterior walls of the old library. An additional budget of \$2000.00 will be needed to replace the control joints located on or between both buildings. There does not appear to be any brick repair needed on the library addition. Nothing will be accomplished by re-pointing the exposed brickwork in the attic level Children's Room except the removal of some of the library's original lime mortar. Any repair work to the interior basement walls should not take place until all the work on the upper exterior walls, slate roof, and copper gutters have been completed.

**Granite Front Steps - Observations, Recommendations and Repair Cost Estimates:** The massive looking dressed granite blocks that make up the library's front step system are actually supported by a lightweight brick foundation. The stepped parallel footing walls that support the granite treads were built with common bricks and lime mortar. These walls appear to have partially failed and the granite has started to shift. This is typical for many late 19<sup>th</sup> century masonry buildings in New England. I have acted as consultant on two granite step restoration projects similar in size to the Meredith library's front steps - the Rockingham Hotel in Portsmouth and the Randolph Vermont Public Library. On both projects the granite pieces were lifted off their foundations using a crane. After the brick footing walls were rebuilt the granite steps were carefully put back in place. The budgets were similar for both of these projects, (about \$55,000.00). The high level of skill exhibited by the early 20<sup>th</sup> masons who built the Meredith Public

Library now requires an equally skilled crew of preservation specialists to restore the building's exterior masonry. It is better to plan carefully and find the right people before undertaking a repair campaign that could potentially remove intact historic masonry or make changes that cannot be undone.