Jan Lewandoski
Restoration & Traditional Bldg.
92 Old Pasture Rd.
Greensboro Bend, Vt. 05842

The Brookline Church
Brookline, Vermont

September 21, 2014

A Preservation Trust of Vermont
Technical Assistance Survey

The Brookline Church is located at roadside in a settlement in the small rural town of Brookline in southern Vermont. The church was built in the 1830's and is of brick construction, so-called American bond with inset relieving arches over the pair of front doors, the 5 front windows and the three windows that are on each side. The arches are slightly pointed but not truly Gothic, although the pinnacles on the tower and the lack of a closed pediment make the design not fully classical either. The roof, which is covered with very thick Guilford slates in shades of gray, has an approximate 8/12 pitch. The foundation is large, long, quarried schist up on edge, and there is an extensive set of stone front steps.

The church has a two stage steeple on the front with a square wooden tower surmounted by a square wooden louvred belfry. The roof of the belfry is a low pyramid concealed by a paneled balustrade with pinnacles at the 4 corner newels. Both stages of the steeple are original to the church. A weathered shingle roof inside the belfry represents an early bell deck, superseded by another deck accommodating the larger steel alloy bell put in at some later date. This bell also has an interior roof constructed over it to act as a sounding board. While the tower and all the other timber in the church is either hewn or vertically sawn, the deck and roof around the steel bell are circular sawn, giving a later, probably post 1860 date. The tower frame is telescoping in nature, with the belfry frame beginning about 12 ft. down within the tower frame. The presence of an open choir, and the fact that the steeple truss is located deeper in the church than the vestibule wall puts unusual load on the truss at the rear of the steeple, a common problem in wooden churches of this period all over the northeast. Recently, vestibule columns have been installed, rising through the choir, but are not fully effective in supporting the steeple loads.

The roof frame of this church is a series of queenpost trusses with very long straining beams. The queenposts themselves carry long principal purlins on tenons at their tops. Half round common rafters cross these purlins and tenon into a 5 sided mortised ridge at the peak. At the rear of the tower, where more truss strength is needed, the common rafter becomes a second queenpost rafter (or brace) tenoning into the side of the rear tower post. The timber of the roof system and perhaps all of the church appears to be hemlock with some poplar and pine among the common rafters.

The main floor system is composed of 9x9 carrying beams with large half round hemlock joists. The joists and timbers pocket into the masonry walls and in the interior are propped on piles of irregular stones. There has been considerable movement of this interior foundation producing a pronounced slope to the vestibule wall.

There is a wooden addition, slightly smaller than the main body, attached to the rear gable of the church. Its foundation is less substantial than that of the church with brick on grade on the south

and rubble stone, displaced by ground movement elsewhere. Consequently, the addition is moving slightly separately from the main body of the church.

The interior of the Brookline Church is beautiful and well preserved. The floors are wide plank, the walls wainscoted and plastered and the ceiling plastered with a distinctive painted medallion at its center. There is a choir loft with a paneled balustrade. The slips are paneled and face the rear of the church, although there is evidence of a platform along the vestibule wall suggesting the internal order of seating may have been reversed at one time. Most of this woodwork is grain painted in a highly artistic fashion, representing naturalistic forms rendered slightly surreal. The grain painting may not be original but it is early.

Overall, the Brookline Church is one of the more unaltered structures I have seen in this state.

Brookline Church: Maintenance Needs (the following are in order of priority)

1. Belfry roof, balustrade and pinnacles:

I rank this repair as first priority because it will soon be leaking, if not already, but it is not likely to be noticed until it has done considerable damage to the steeple frame.

The roof of the belfry is a low pyramid, 12 ft. x 12 ft., covered by very deteriorated asphalt shingles. The actual belfry posts, starting perhaps 24 ft. below, rise up through this roof and are cased to form the corner newels of the balustrade. The pinnacles are hollow wooden shapes nailed to the top of the cased newels. Flashing where the timbers penetrate the deck is virtually nonexistent. The balustrade between the newels, 10 ft. on a side is composed of plywood and dimension lumber and represents a recent, but deteriorating repair of this hard to maintain feature.

This project can conceivably be carried out without scaffolding to the full height of the steeple, but by persons attached by safety lines, on the deck.

Remove the pinnacles and rebuild them using heavier material such a 5/4 or 6/4 pine, western red cedar, or southern yellow pine. Strip the deck and replace it with lead coated copper with raised or flattened seams.

The best practice for the balustrade is to have it sit on top of the deck, never penetrating its metal, but since the historic form of this feature at this church is the continuation of the belfry posts to become the newels, a flashing boot will have to be soldered into place around the newels. If however, the timber posts are found to be very deteriorated inside the newels, consider cutting them off below the level of the deck and letting the leaded copper pass over them.

The balustrade should be rebuilt using heavier material in general. This will not change its appearance from the ground. Don't use plywood as it will delaminate, rather use wider 5/4 or 6/4 boards within an 8/4 frame. The top rail is currently sloped to drain but the same must be done with the bottom horizontal, i.e the rail should have a sloped top with the panel material coped over it. These rails should tenon into mortises in solid timber, perhaps 6x6 inch, newels, with mortises housed so that water doesn't enter the joint. The pinnacles can then cap the newels.

If there is the option of closing the deck fully above the belfry posts, the entire balustrade assembly can sit on little lead or rubber blocks under the newels on top of the deck, and be kept in place by 4 small metal rods that run from the sides or newels of the balustrade to the very top of the pyramidal roof, where they can be screwed through with little danger of leakage.

2. Tower and Roof Framing:

At the south rear tower post, and at the south eaves where the rafters supporting that post bear, water infiltration has caused two problems that are acting together. Evidence of this can be seen from the outside in the form of a slight bump upward in the eaves about 12 ft. back from the front gable. This is caused by the failure of a portion of the tie beam end at that point allowing the heavily loaded upper queenpost rafter to slip outward. This put all the load on the lower queenpost rafter, and with the straining beam not located in direct opposition to this rafter, the steeple load has caused that rafter to crush into the side of the softwood queenpost. This series of events has allowed the rear steeple truss to sag and caused the steeple to lean slightly backwards.

The second similarly located problem is the hollowing out of the horizontal connecting girt on the south side of the tower frame where it meets the rear steeple post, including the complete loss of the tenon connection. This girt was meant to carry the ends of the short rafters rising from the eaves to the side of the steeple and their weight has forced this girt inward about 2 inches from its correct position, causing a local sag in the roof. The hollowing of this girt has been caused by water infiltration, probably blown up the roof to above the top of the last slate, by strong south winds, and dripping onto this girt.

Repairing this situation will require bringing several large and stiff pieces of timber into the attic, spanning them from front plate to truss chord, and then using these as a base to jack the rafters off the rotted girt and to jack the girt back into its correct position. To do this without risk of depressing the steeple truss further, a jacking position composed of structural scaffolding or a strong post on a jack should rise from the church floor chord under the rear steeple post. Use a wide block of wood on top of this post so as to lessen danger to the plaster. This post from the floor, in turn, must be supported on cribbing from in the basement. (This should be done at both rear steeple posts locations since this shoring will be needed for a further operation involving the added vestibule posts and their method of supporting the belfry framing.)

Once the load is removed from the connecting girt it can examined and either repaired or replaced whole with solid timber. It will probably have to engage the belfry post with a free tenon and rest on a 3 x 9 shoulder block bolted to the post as well. Also, the mortise of the post needs to be examined in case any rot has spread into it, requiring more repair.

When the connecting girt and post are repaired, and the common rafters bearing at the correct height, the failed common-queenpost rafter position needs to be addressed. Scaffold to the eaves of the church at the position, remove several courses of slate and cut some boarding to expose the tie beam end. I don't expect extensive rot, only a relish failure behind the rafter tenon, but that will be discovered. Bring the rafter back to its correct position, or alter it so it is correct, repair the tie beam end (but don't expect it to bear a lot of thrust) and restrain the rafter to the tie beam and the rafter below by a u-strap, perhaps 3/8 x 3 inch steel, that captures the rafter and lags into the sides of the lower rafter and tie beam. The lags should be large: 5/8" or 3/4 " x 4-5", with two on

the tie beam.

Close the slate roof up after this and also add a folded line of copper or leaded copper flashing at the point where the roof meets the steeple, which will involve lifting some slates at this point.

3. Vestibule Post Improvements:

The idea of running posts up along the vestibule wall and through the choir to help support steeple loads is a good one. An unfortunate feature of the design of this church, and many others, is that the truss at the rear of the steeple is not directly over the vestibule wall and choir, yet no one wants to add posts to the open portion of the room to support this often sagging truss, which will always look like a desperate repair.

The columns added in recent years to vestibule wall and choir rise up beyond the steeple truss to support the sleeper beams that carry the second level belfry framing, a good plan. However, they bear on their rather small end grain surface about 3 ft. in from where the rear belfry posts deliver their weight, and cantilevered weight is much more difficult to sustain than direct bearing, and may result in compression, bending or even breakage of the sleepers over the new posts, or even buckling of the posts. The solution is to slightly unweight the belfry sleepers, and thus the belfry load, from the top of the posts, cut about 10 inches off the tops of the posts, and insert 9 x 10 inch lintels under the belfry sleepers that span from front to rear, almost reaching under the posts themselves. These will serve to stiffen and spread the load on the sleepers and reduce the danger of bending or breaking above the posts. The posts will still have a lot of load and I would recommend adding structural screws (such as GRK types), at several locations where the posts are exposed in the attic.

Support under the floor in the basement for these posts can be addressed when support of the entire vestibule wall is, but, if the vestibule wall is to jacked several inches from the basement, it should be done when the posts are cut and still spaced below the belfry sleepers above.

4. First Floor Framing and Interior Supports:

The first floor frame has two problems. The first is the sagging of the long carrying beam under the vestibule wall. This can be mostly solved by jacking the beam at several points while the vestibule posts are free and spaced from the belfy sleepers. Jack from the crawl space until the beam and floor level above is either straight, or it becomes very hard to lift (assuming you are pushing with three 12 to 20 ton jacks) indicating that work, such as plastering or reframing, has been done above it after it was depressed or it has acquired some permanent set. Keeping the beam in level will involve more stable stone piers, probably with some new flatter stones added. I would dismantle the existing piers and dig into the silt floor and see if anything harder can be found down there. If not just spread your stone bases wider and perhaps add a third pier at the middle.

The second problem is several rotten half round joists. This basement space is unventilated and , while not having free water in it, gives evidence of excessive humidity in the rotting of the exterior of many joists (although not the hewn carrying timbers?) as well as mildew in the main room above, which will be discussed on its own below.

The joists are large and can stand some rot, but crawling through the space with a member of the Church Committee we identified 7 joists in need of replacement. 5 are in the bay on the north side, another is the easternmost in the middle bay, and another 2nd from rear in the south bay. These are large (typically 8 inch diameter) hemlock rounds with flattened tops. To get new ones in, one end can be shaped and fitted into the stone and brick work while the other will need the assistance of a metal hanger, either custom made or found fabricated, to hang it from the carrying beam. There is a chance that some of these joist sit in pockets with enough room to slide an elongated lap in several inches on one end and then engage and slide a lap on the other end into its pocket, with still 3-4 inches of bearing left at each end.

5. Mildew in the Main Room:

Entering the main room of the church, the bottom chords of the roof trusses can be identified by the pattern of blackish mildew following them across the ceiling. Other mold is found at the tops and corners of the wall. There is little evidence of serious roof leakage ever occurring in the attic so the moisture is probably rising from the earth of the basement, which lacks any ventilation of its own. Church members told me that the ceiling has been repeatedly cleaned with bleach and repainted, but to no lasting effect. Solutions to moisture problems are difficult in unheated and unventilated buildings. In some cases the dirt floor of the basement is covered with plastic, but I would not recommend this in the case of a brick structure since it may force the still rising damp to the perimeter and accelerate spalling of the brick.

If you wish to get rid of the mildew, you may have to consult an expert on ventilation in historic structures, one of whom was mentioned to me by a Committee member, another of whom is Leonard Spencer of Cabot whom I spoke with this morning; Leonard said that all these mildew problems are very site specific, but there are a number of different anti-mildew products, one of which might work in this case, and not all of which require repainting.

Fortunately, this moisture problem is largely cosmetic. It does not appear to be running down the windows and rotting sash or sills or dislocating the plaster. Rot of basement joists is very slow. However, if the Church ever decides to insulate the attic or affix tight storm windows, the problem should be solved as it will become much worse.

6. Foundation of the Addition:

The addition to the church is on very minimal foundation, but, like the main body of the church, the ground drainage must be good since large displacements of the building have not occurred. However, on all 3 sides, but particularly the north and rear, the stone and brick foundation is either pushed in from or dropped away from the sills. If enough support is lost, the building will sag and drop away from its connection with the brick church, a harder problem to solve.

Jack under the sills of the addition and lift it to a straight and near level position. In order to maintain the historic foundation, it might be wise to excavate holes 3-4 feet deep at the corners and halfway along the walls, fill them with rubble stone , and place large stone piers on top of this fill to provide main support for the sills. The rest of the distance can be filled in with existing stones or bricks. Along the north side of the addition it may be wise to dig in a line of drainage pipe as well. This is an inexpensive and probably effective solution to the foundation problem.

7. Windows: There are 11 windows in the brick portion of the Brookline Church; five 12 over 12's on the front and three 20/20 double hung sash on each of the long walls. The large windows on the south long wall are the most weathered but all the windows will need some attention eventually lest they lose panes of glass.

The south windows in the worst condition have numerous areas of glazing compound missing and in some cases, worn down or broken parts of the exterior muntins. The usual procedure is to remove the sash, cover the opening with plywood, and take the window to a shop where the glass can be removed, old paint and glazing scraped away, and where necessary, muntin and sash bars built up with glued on strips of wood or replaced in part. The sashes are also examined for rot at the pinned joints, particularly the lower ones. Painted reglazed and reinstalled, this procedure can easily cost $1600 per window.

Brookline Church: Cost Estimates

1. Belfry roof, balustrade and pinnacles:
New leaded copper roofing and complete rebuild of woodwork:
Cost: Roofing: $8000-10000
Balustrade and Pinnacles: $8000-9000

2. Tower and Roof Framing:
Work at rear south steeple post and truss
Cost: $14000-16000

3. Vestibule Post improvements:
Support, cut off, add lintels
Cost: $5000-6000

4. First Floor Framing and Interior Supports:
Jack and support vestibule wall and replace 7 joists.
Cost: $12000-14000
Steps 2-3 & 4 need to be carried out together (except joist replacement) since they are all dependent upon the same shoring and rigging.

5. Mildew in the Main Room:
You need the advice of a specialized consultant, but covering the dirt floor with plastic is likely not a good option.

6. Foundation of the addition:
Jacking, excavation, stone work, drainage
Cost: $16000-18000 as described above

7. Windows:
Removal, temporary covering, repair and rebuild, paint, put back in place.
Cost: $1600-2000 per window