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23 October 2012

Wayland Historical Commission
Wayland Town Building
41 Cochituate Road
Wayland, MA 01778

Attention: Elizabeth Von Goeler

Reference: Old Town Bridge, Wayland, MA

Dear Liz:

On 10 August 2012 we performed an investigation of the Old Town Bridge in Wayland. This included visual observations from the top, sides, and undersides of the bridge, three test pits, and several samplings and probes.

The following is a summary of our observations and findings.

Structural Description

The Old Town Bridge was constructed in 1848 as a vital east-west crossing of the Sudbury River on a former alignment of what is now Old Sudbury Road. This alignment continues from the west end of the bridge, curving toward the southwest and coinciding with what is now River Road.

The bridge has been bypassed with a new, straighter route and is no longer in vehicular service. The river meander that runs below the bridge has also been bypassed as part of a straightening project by the Army Corps of Engineers, and now sees only seasonal flow.

The Old Town Bridge is approximately 56-feet long by 18-feet wide, and has four barrel vault arch spans of approximately 11-feet across. 15- and 18-foot long splayed wing walls at each end make the total construction approximately 89-feet long.

Based upon our visual observations, test pits, and probes, the setting and bonding of the stone masonry construction were varied between different components of the bridge, accounting for different functional demands. The bridge was constructed as follows:

1. A combination of buried rubble and solid cap stones were dry laid as footings within the relatively shallow riverbed, and then 3-feet wide by 18-foot long vertical piers were dry-stacked atop the footings for a height of approximately 4-feet. The ends of these piers had full-width stones to provide a solid tie-in and to counter the dynamic effects of the river flow.

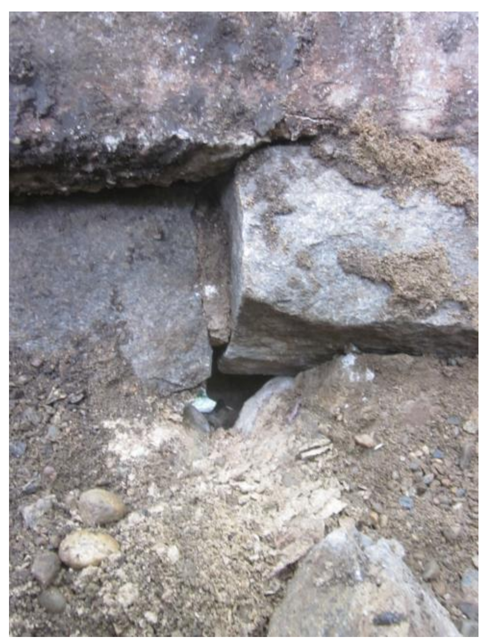
2. Arched wooden forms were then constructed between the piers to support the construction of fully mortar bedded single wythe stone arches rising approximately 5-feet off of the piers. The board form lines can be seen on the intrados of each arch, where the bedding mortar was squeezed out from between the arch stones onto the forms and then hardened.

   The considerable hardness of this mortar, along with the fact that it has lasted for more than 160 years strongly suggests that it contains a large proportion of hydraulic cement. Because artificial (portland) cement was not imported or manufactured domestically until the around 1870, the hydraulic component would almost certainly have been natural cement, which had first been used domestically around 1820 on the Erie Canal. The exposed mortar with the form lines, which we know is as old as the arches (since there would have been no other practical way of creating this effect), has the reddish brown hue that is common to most natural cements.

3. The wedge-shaped "valleys" between the arches were filled in with solidly mortared stone rubble to provide a flat surface that would not collect water. The far ends of the arch runs were squared off with fully mortared stone rubble to create buttresses that would press against the earth at each abutment to prevent spreading of the arches.

4. After this step was completed and with the mortar having gained sufficient strength, the wooden arch forms would then have been removed. Beyond their higher strength and greater resistance to weathering, hydraulic cement mortars had the advantage of setting quickly under humid and even enclosed conditions, unlike the pure lime mortars that set very slowly by absorbing carbon dioxide from the atmosphere.

5. Using the completed arch spans as a base, wing walls were constructed, together with parapet walls along the sides to contain compacted soil that would become the surface of the roadway. This was done using semi-wet laid construction, where stones were mostly dry laid but with blobs of mortar serving the purpose of chinking, which would not only provide greater bearing areas but would help "glue" them together. This very common contemporaneous practice provided a sufficiently strong and internally drainable wall while at the same time saving on cement, which was considerably more expensive that the stone and earth materials that made up the rest of the construction.



6. The parapet and wing walls were tuck pointed on the exposed surfaces, as were the vertical ends of the arches in order to provide weather protection and a uniform appearance.

7. Railings were then added atop the side and parapet walls and the roadway surface was later asphalt paved. Presently, there are concrete

curbs atop the wing and parapet walls with cast-in iron stanchions that support wooden railings. A photograph apparently taken in 1935 shows exactly the same construction as viewed from the side that presently exists.

Noted Conditions

The following conditions were noted during our investigation:

- The basic foundations, piers and arches appear to be in generally sound structural condition, although there are open gaps in several places that are in need of re-chinking.
- The majority of the mortar joints on the side faces of the bridge are cracked and/or eroded and are in need of cutting and repointing. These surfaces include the wing walls, parapet walls, and the ends of the arches and "wedge" sections.

- There are oriented structural cracks that follow the some of the joint lines where the partially wet laid parapet wall construction meets the fully bedded arch and valley wedge construction, and the parapet wall construction has become loose and has shifted outward in several locations by as much as 3-inches.
- There are other scattered areas where the stonework has become loose or shifted, particularly at the end approaches, which were dry-laid and then tuck pointed with mortar.

- The concrete curbs that run along the tops of the parapet walls are cracked through at most of the stanchions because the stanchion bases are rusting.

- There are efflorescent deposits and short stalactites on the undersides of the arches, caused by water seeping through the roadway and trickling through the arch masonry and leaching salts out of the mortar and soil materials within the path of flow.

Recommendations and Associated Costs

Considering the existing construction and its present condition, we recommend that repairs be done in a way that is sympathetic to the original construction, while providing the needed improvements in longevity and repair as well as allowing the bridge to structurally function in the same manner that it traditionally has.

This can be done in the following manner:

1. Remove all vegetation, paving and soil over the tops of the supporting arches and end skirts.

2. Fully document and dismantle the wooden rails, iron stanchions, and concrete curbs along the topsides of the bridge. Document and dismantle loose and/or shifted portions of stone masonry parapet and side walls.

3. Wet-chink and locally underpin ends of supporting piers. This would be a limited operation, mainly intended just to fill gaps within and below the foundations.

4. Chink, spot-cut, and point remaining wet-laid and semi-wet laid wing walls, side and parapet walls and arches. Locally remove and re-set stones that become loose during the cutting process and insert stones in places where they are missing.

5. Reconstruct dismantled sections of masonry to match original appearance and geometry. Removed sections of the parapet walls should be reconstructed as solidly bedded construction for greater longevity.

6. Add a bonded mortar topping over the stone arches that is pitched toward the ends and cover with a fluid applied waterproofing membrane and drainage composite. This would drain into new crushed stoned filled dry wells that would be created against the far edges of aprons within the approaches at each end.

7. Cover the bridge deck with compacted structural fill and pave to create a roadway surface.

8. Clean, hot-dip galvanize, and shop paint the original, salvaged iron stanchions and reinstall at their original positions.

9. Form and place new reinforced concrete curbs to match the original curbs.

10. Re-create the wooden side rails.

Please see the attached elevation and section drawings that graphically layout the scope of work.

Associated Costs

We estimate that the above repairs would cost in the range of $450,000 to $560,000.

Thank you for the opportunity to provide this evaluation of this very interesting structure and important historical resource. Please contact me if you have any questions or would like further clarification.

Respectfully Yours,

John M. Wathne, PE, President
Structures North Consulting Engineers, Inc.