

Tab C. Background and History of the Portsmouth Approach

Information in this section is based on an NHDHR individual form on the Portsmouth Approach produced by Preservation Company. Based on the form, the New Hampshire Division of Historic Resources found the approach to qualify for listing on the National Register on April 28, 2004. (See Tab K)

1. Concrete Slab Bridges – Engineering Context

The Portsmouth Approach is a five-span, 120'-long, reinforced concrete slab access-span completed in 1923. Designed by Portsmouth City Engineer W.A. McFarland, it was built to provide access (via U.S. Route 1) from the south to Memorial Bridge across the Piscataqua River. The access span continues to function as the Portsmouth Approach to the Memorial Bridge. It is owned and maintained by the City of Portsmouth.

Concrete construction began to come to the forefront of American bridge design beginning around the turn of the century. With technological improvements in the concrete itself, as well as in methods of reinforcing, concrete became the material of choice because of its lower maintenance costs and its greater design flexibility (Rudge 1989:F14). Although there continued to be experimentation in methods of reinforcing up to the 1920s, by then the use of steel bars predominated. With these factors, concrete bridges came to dominate bridge construction throughout the United States. Standardized plans for concrete bridges were quickly disseminated by the many new and expanding state highway departments.

Before 1940, the most common types of concrete bridges constructed were beam and slab bridges. Concrete slab designs were particularly popular for short spans.³² Consisting simply of a slab of concrete on piers/abutments, the slab operated like a continuous beam. The design was popular because it was simple to build and design, economical and it also increased overhead clearances as compared to girder construction. The slab design, along with the beam and slab bridge designs, was used often and was well described in contemporary professional literature.³³

The Portsmouth Approach represents a hybrid in terms of structural systems. Although it combines elements of beam and slab, and frame design, it is best characterized as a continuous slab bridge with edge beams, with its main structural system being the slab.³⁴ Little if any

³² The use of reinforced concrete in bridge design in the United States dates to 1871. Particularly from 1900-1920 there was significant experimentation with different methods of reinforcing. The size, spacing and arrangement of reinforcing in the Portsmouth Approach was similar to what would be specified today with the exception that reinforcement is now deformed while that used in the Approach were square bars varying in dimension from ½" to ¾" on a side. The use of stirrups and bent up bars, was and still is, common practice.

³³ J.A.L. Waddell, for instance, in his 1916 book *Bridge Engineering* devoted a full chapter (Chapter XXXVII) to Reinforced Concrete Bridges. The American Society of Civil Engineers (ASCE), the American Railway Engineering and Maintenance of Way Association (now AREA), The American Society for Testing Materials (ASTM) and the Association of Portland Cement Manufacturers (PCA) formed a committee in 1909 to standardize practice in the design and construction of reinforced concrete structures. Reports of the committee were made in 1909 and in 1913 with the last report published in the *Transactions of ASCE* and in summary form in *Engineering News*. Textbooks were written shortly after with Waddell referring to Vol. II of Hool's *Reinforced Concrete Construction*, Taylor and Thompson's *Concrete Plain and Reinforced* and Turneaure and Maurer *Principles of Reinforced Concrete Construction*.

³⁴ The New Hampshire Bridge Inspection Reports for the bridge incorrectly categorize it as a "Concrete Rigid Frame" Bridge or a "Concrete Continuous Frame" Bridge.

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information exists documenting the design process for the bridge and why the particular structural system was selected; it seems likely, however, that the bridge design evolved from the site conditions, the desire to have separate streets leading to and from the bridge, and a need to keep maintenance costs low. Whatever the design rationale, however, it is clear that there are many elements of the approach that are unique or rare when compared to other New Hampshire bridges of its era.

During the 1920s and 1930s in New Hampshire, although there were both many concrete bridges and many bridges of this length or longer constructed, it was rare to see a non-arched bridge of this length built of concrete construction. Instead, for spans greater than 25'-30', a variety of different types of bridge designs and materials were used, including arched concrete designs and steel, in particular steel through truss spans. Non-arched concrete designs were generally reserved for spans of less than 30'.

Although it is impossible to analyze all bridges that were originally constructed, based on standing bridges and bridges recently demolished, it appears that the Portsmouth Approach is the single longest extant concrete bridge built before 1925 in the state.³⁵ It is also the longest extant non-arched concrete bridge constructed in New Hampshire before 1935. Related to its length, of the over 300 pre-1930 concrete bridges in New Hampshire, the Portsmouth Approach is the only five-span concrete bridge.

The Portsmouth Approach also appears unusual for its era because it is of continuous concrete construction, that is, the concrete slab is continuous over the piers and does not have structural breaks at the points of support. It is the earliest identified concrete continuous slab bridge in New Hampshire and it appears to be the longest continuous span concrete bridge built before 1935 in the state. This type of construction would be natural given the curvature and variable width of the bridge and its relative rareness in New Hampshire bridges likely reflects the fact that most concrete bridges were single spans.

Another aspect of the design that was unique was the variable width and curvature of the bridge required to blend the end of the main bridge deck with the width of abutment necessary to provide for split access and egress lanes (i.e. the skew, or the angle of the bridge relative to its supports). In situations where there are not complicating features, bridges are usually aligned perpendicularly to their supports.

2. Background and History

Given the City of Portsmouth's critical role in bringing about the construction of a new free bridge between Kittery and Portsmouth, there does not appear to have been any controversy about funding for the New Hampshire approach to the bridge³⁶. It is clear that from quite early in the process of planning Memorial Bridge that the City of Portsmouth would be responsible for the New Hampshire approach. The day before the New Hampshire legislature appropriated its share of the cost of Memorial Bridge, it authorized the City of Portsmouth "to raise money and

³⁵ This analysis was based on a search of the Federal Highway Administration database of bridges (supplied by the New Hampshire DOT) available at granitestatehighways.com. The fact that significant numbers of bridges from that era are no longer standing, and thus are not in the database could effect the conclusions. Concrete bridges, in particular, are subject to high rates of material failure in the North Country and thus might have been demolished in greater numbers than other types of bridges.

³⁶ The text in this section is based on NHDHR Inventory Form Number POR0014 (which can be found at Tab K). The Portsmouth Approach was determined eligible for the National Register on April 28, 2004.

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issue bonds to aid in the construction of the Memorial Bridge.” The Act authorized a sum of money not to exceed one hundred and fifty thousand dollars (New Hampshire State Legislature 1919).

In May 1920, the Bridge Commission finalized the location of the New Hampshire side of the bridge. By late 1920, the “old Broughton wharf,” adjacent to the Navy Yard ferry in Portsmouth had been purchased for the bridge and the approach. By December, the John H. Broughton Company lumber sheds were being demolished in preparation for work on the south abutment (Herald 17 December 1920). Around this time also, the design and the designer of the central spans for Memorial Bridge itself were finally being decided. Concluding that a bascule design would be too expensive to build on the site, the Commissioners brought in eminent engineer and the originator of the long span vertical lift bridge, J. A. L. Waddell.

Meanwhile, Portsmouth’s City Engineer, in coordination with the Committee on City Lands and Buildings, was working on plans for the approach. In September, plans produced by the town’s engineer, W.A. McFarland, were presented before a public forum. The forum, called by the Chamber of Commerce was aimed at exploring, “Will Portsmouth’s best interest be served by a one-street approach to the Memorial Bridge?” The discussion, however, appeared largely one-sided with all present (including McFarland) favoring the slightly more expensive but more aesthetic two-way approach (Herald 2 September 1921).

In September, the City Council approved a bond issue of \$150,000 for the purchase of land and construction and began work on coming up with awards for property to be condemned for the approach. Plans and specifications were finished in October. In December, the [Memorial] Bridge Commission engineers submitted a separate set of plans to the City Council for the approach. The Herald reported, “The plans call for a slab concrete floor construction with concrete sidewalks resting upon 278 concrete piles and the Engineers estimated that it could be built for \$50,000. The Engineers estimated that a steel structure could be built for three to four thousand dollars less but the concrete would cost less than that amount for maintenance” (Herald December 21, 1921). A revised set of plans was then prepared that accommodated some of the recommendations of the bridge commission’s engineers. On December 29, 1921, the City Council approved the new set of plans for the approach. The Herald described the final version as follows:

The plans as submitted are practically the same as submitted by the Engineer McFarland, who months ago drew up plans for the Council. There are some slight changes, especially the section near the bridge abutment. The McFarland plan called for a single archway through, for a passageway between Daniel and State Streets but the present plans call for an overhead construction which will allow three or four passageways through along the water front. This is a part of the plans that were submitted by the Bridge Commission Engineers, and the only part that were acceptable. The plans call for the two street approach, Daniel and State Street from Mulberry Street down to the bridge ...” (Herald December 28, 1921).

The approach, as finally designed, was a five-span, 120' long, reinforced concrete structure with a width varying from 28' to 47' (Figure C-1).

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The City apparently awarded the contract for the construction of the approach early in 1922. By March 1, workers from the L. H. Shattuck Construction Company, the contractor, were at work constructing shanties and erecting a large derrick³⁷. About a half dozen buildings on the site were advertised for sale; the buildings to be moved by April 10. Those buildings that could not be moved were demolished first. At this time, also the old Broughton office building, which had been used as offices by Holbrook, Cabot & Rollins, the company constructing the substructure of Memorial Bridge, was to be moved for use of the American Bridge Company, the contractor for the superstructure of the bridge.

The construction proceeded rapidly thereafter. In April, concrete was being poured. The Herald reported in early May, "So much progress being made by the contractor on the bridge approach that it is thought they will be finished by the 15th of June at the latest and possibly before that time. A good part of the concrete has been poured and the forms are being made for the overhead work over the culverts. This is a foot and a half thick and will be heavily reinforced with steel" (Herald May 10, 1922). The Herald reported on June 1, "The concrete work on the bridge approach at the foot of Daniel street is practically finished and the work of tearing away the timber work will be started soon. It has been a remarkably quick and efficient job and credit to the Shattuck Company" (Herald June 1, 1922). By July the falsework was removed and railings were erected and the fill work begun. Some 50,000 yards of gravel was hauled, first by horse and later by truck, from a pit 2½ miles away on Greenland Road (Herald July 7, 11, 1922).

At the December 29, 1922 meeting of the City Council, after two hours of contentious testimony by various veterans' groups, no decision could be made as to which veterans should be included in a planned veteran's monument at the approach. It was, however, decided that the triangular space between State and Daniel Street would be known as Memorial Park and the new streets which would be created would be named to honor veterans. The section of road from Daniel Street to the bridge was named Scott Avenue after Captain J. Francis Scott who was killed in action in France. The section of road leading from State Street to the bridge was named Dutton Avenue after Corporal H.H. Dutton, also killed in action in France. The extension of Bow Street running between Daniel and State near the former location of Mulberry was renamed Wright Avenue after Lieut. J. Brandon Wright who died in "the aviation service" (Herald 30 December 1922).

By May of 1922, it was evident that the approach would be completed in plenty of time relative to the main portion of Memorial Bridge which was slowed due to strikes and later to technical issues related to keeping the sheaves pinned to the shafts. The finishing touches were put on the approach in the spring of 1923 when the sidewalk was poured and, in early June, the top surfaced with bithulitic (a bituminous concrete surface patented by Warren Brothers Company).

The approach, along with Memorial Bridge itself, officially opened on August 17, 1923. A host of dignitaries including the Governors of New Hampshire and Maine, members of the Bridge Commission and representatives of the US Navy were in attendance. After the speech making, and ribbon cutting thousands of enthusiastic bystanders flooded across the bridge. As soon as it opened, the bridge proved extremely popular. It allowed the two communities to be linked conveniently, and permitted a speedier trip up the eastern seaboard for travelers. Within a short

³⁷The contract came at a good time for the company, which was formed as a shipbuilding company at the beginning of World War I and was faced with financial troubles at this time. Interestingly, the company was formed by three men, Shattuck, Robert Jackson and F. W. Hartford (Robbins 2004:np). Hartford, Mayor of Portsmouth in 1921-22 was also the owner of the Portsmouth Herald and one of the biggest promoters of the construction of Memorial Bridge.

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period, the volume of traffic on the bridge had skyrocketed. By the late 1930s, 4,000,000 vehicles used the bridge annually and an additional bridge to cross the Piscataqua, was being contemplated.

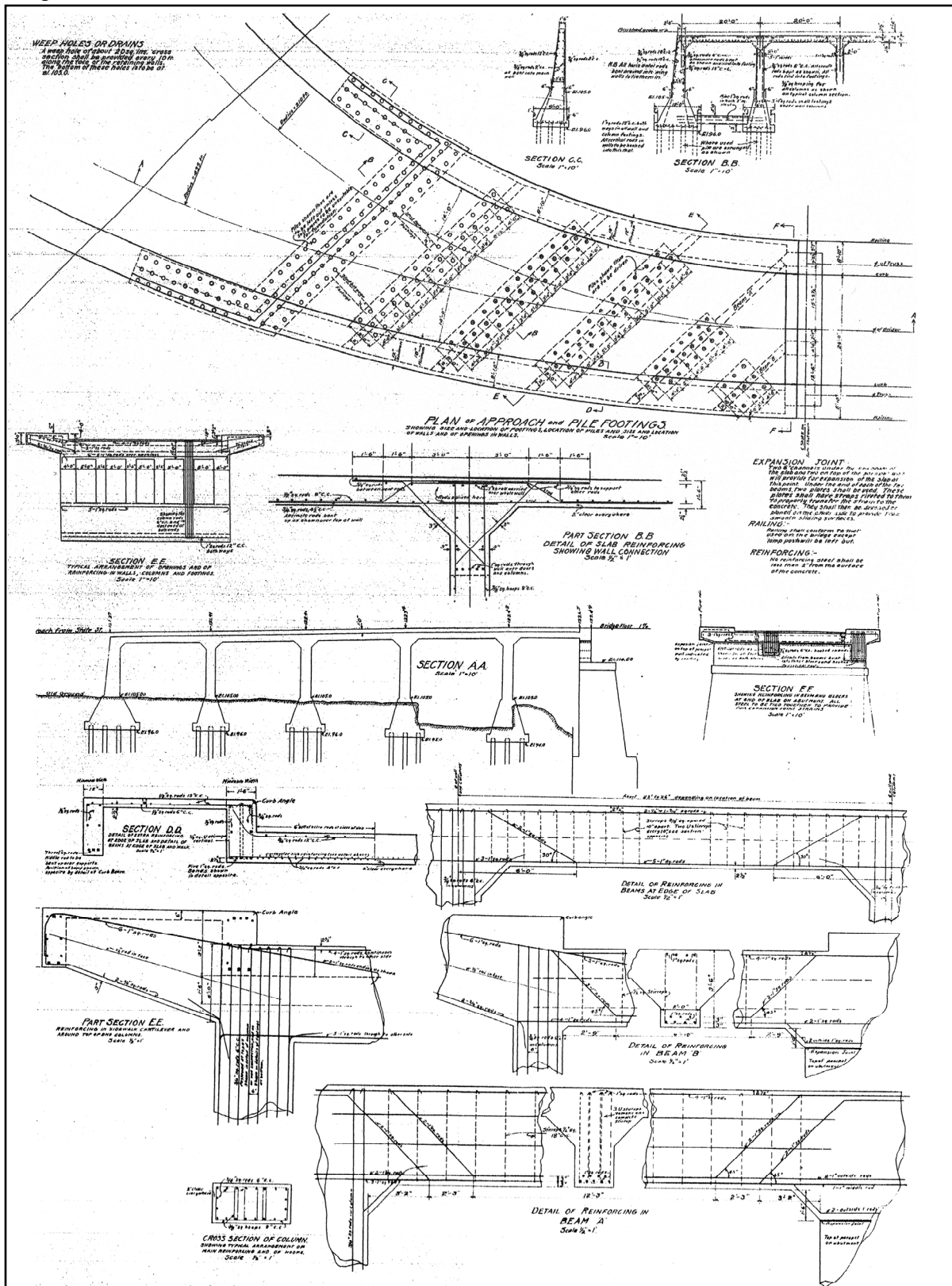


Figure C-1: Portsmouth Approach Concrete Details (NHDOT) (See full drawing at O-19)

