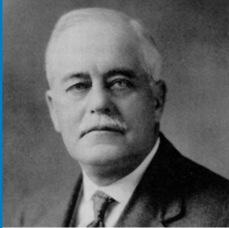
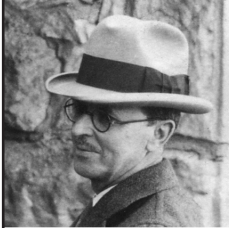





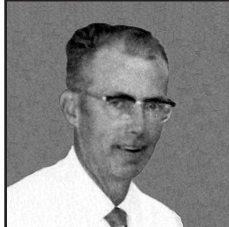
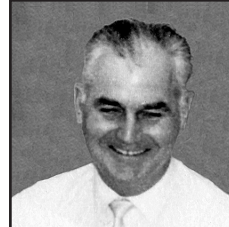
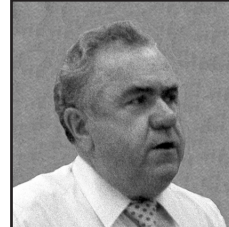
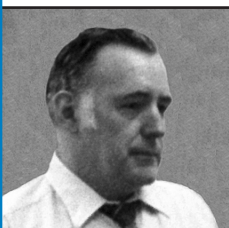


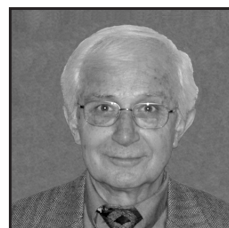



# 1920 MassDOT Bridge Section 2020

## Celebrating One Hundred Years

|  |   |   |   |  |
|--|---|---|---|--|
|  <p><i>W.F. Williams</i><br/>BRIDGE ENGINEER<br/>William F. Williams<br/>Nov. 1920 – Dec. 1922</p>                |  <p><i>G.E. Harkness</i><br/>BRIDGE ENGINEER<br/>George E. Harkness<br/>Nov. 1924 – Jan. 1942</p>    |  <p><i>R.O. Spofford</i><br/>BRIDGE ENGINEER<br/>Ralph O. Spofford<br/>Jan. 1942 – Feb. 1951</p>      |  <p><i>J.C. Rundlett</i><br/>BRIDGE ENGINEER<br/>John C. Rundlett<br/>Mar. 1951 – Dec. 1956</p>                            |  <p><i>S. Kirshen</i><br/>BRIDGE ENGINEER<br/>Simon Kirshen<br/>Dec. 1956 – Jan. 1958</p>                   |
|  <p><i>J.H. Kane</i><br/>BRIDGE ENGINEER<br/>James H. Kane<br/>Feb. 1958 – Feb. 1963</p>                          |  <p><i>J.F. McGovern</i><br/>BRIDGE ENGINEER<br/>John F. McGovern<br/>Feb. 1963 – Dec. 1965</p>      |  <p><i>R.J. McDonagh</i><br/>BRIDGE ENGINEER<br/>Robert J. McDonagh<br/>Dec. 1965 – Jul. 1971</p>     |  <p><i>John J. Aherne Jr. P.E.</i><br/>BRIDGE ENGINEER<br/>John J. Aherne<br/>Jul. 1971 – Dec. 1981</p>                    |  <p><i>Robert V. Costello P.E.</i><br/>BRIDGE ENGINEER<br/>Robert V. Costello<br/>Jan. 1982 – Jun. 1987</p> |
|  <p><i>Thomas A. Eddlem</i><br/>BRIDGE ENGINEER<br/>Thomas A. Eddlem<br/>Jun. 1987 – Nov. 1988<br/>(Acting)</p> |  <p><i>Paul J. Sullivan</i><br/>BRIDGE ENGINEER<br/>Paul J. Sullivan<br/>Nov. 1988 – Mar. 1991</p> |  <p><i>Joseph P. Gill P.E.</i><br/>BRIDGE ENGINEER<br/>Joseph P. Gill<br/>Mar. 1991 – Nov. 1994</p> |  <p><i>Arthur C. Daiopoulos</i><br/>BRIDGE ENGINEER<br/>Arthur C. Daiopoulos<br/>Nov. 1994 – Mar. 1995<br/>(Interim)</p> |  <p><i>Alexander K. Bardow</i><br/>BRIDGE ENGINEER<br/>Alexander K. Bardow<br/>Mar. 1995 –</p>            |

**Massachusetts State Bridge Engineers 1920-2020**



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## **PREFACE TO THE BRIDGE MANUAL *HUNDREDTH ANNIVERSARY EDITION***

This Edition of the MassDOT Bridge Manual celebrates the One Hundredth Anniversary of the establishment of the MassDOT Bridge Section in 1920 and all of the innovation that this Section has accomplished in over a century of service to the Commonwealth.

When the Massachusetts Highway Commission, a predecessor of MassDOT, was established by the state legislature in 1893, its primary mission was to improve the roads in the Commonwealth. Bridges were built as part of roadway projects, and many of these early bridges were either beam bridges with a deck or closed spandrel arch bridges, all built out of reinforced concrete. Massachusetts was a pioneer in the use of reinforced concrete for bridges because it was difficult to obtain good rubble masonry at a reasonable cost, while reinforced concrete bridges could be built with less skilled labor. At first, design services were performed by consultant engineers, but by 1904 the Commission started to design bridges with its own in-house staff.

This changed in October 1920, when a formal Bridge Section was established, led by a Bridge Engineer. The first Bridge Engineer was William F. Williams, a graduate of Columbia University and previously the City Engineer in New Bedford. Under his leadership, the first inventory of bridges in Massachusetts was performed and the alphanumeric Bridge Number system, based on the alphabetic listing of the cities and towns in the Commonwealth, was created, an inventory system that is still in use to this day.

The years after World War II introduced a new material: prestressed concrete. Once again, Massachusetts was a pioneer in the use of this material. When in 1955, two hurricanes ripped across Massachusetts, destroying 220 bridges, this new material was used to predesign and prefabricate adjacent bridge beams of various standard lengths in an assembly line fashion that could later be used to replace bridges of the required span quickly.

The decade of the 1990's brought more innovation. MassDOT introduced the use of Integral Abutment bridges and conducted research through UMass to develop design procedures and standard details. Also, starting with this decade, MassDOT began its long-standing membership in the Precast/Prestressed Concrete Institute Northeast Technical Committee. This committee has not only updated existing prestressed beam details, but developed entirely new series of beam shapes, such as the NE Bulb Tee, the NEXT beam, and integral deck versions of these beams as well, the NEDBT and the NEXT D beam. This committee also focused on developing rapid construction details, such as full depth deck panels, and prefabricated bridge elements, such as abutments, wingwalls, and piers.

This Bridge Manual represents the latest comprehensive compendium of all these innovative design methodologies and bridge construction details, but does not lose sight of those details that have stood the test of time and have demonstrated to represent the best of detailing and construction practice for over a century. With this Bridge Manual, the MassDOT Bridge Section looks forward to its next century of innovation.

## **INTRODUCTION TO THE PURPOSE AND USE OF THIS BRIDGE MANUAL**

### **i. PURPOSE**

The purpose of this Bridge Manual is to promote efficiencies in the design and construction of bridges in the Commonwealth of Massachusetts by providing uniform bridge design requirements, by standardizing construction details and by pre-designing common bridge details. Since there are as many ways to design and detail a bridge as there are Designers, it is more efficient to settle on one standard way so that Contractors, Detailers, Fabricators and Resident Engineers can get accustomed to a standard approach to the building of bridges, and the Commonwealth will reap economies of scale as bridge construction becomes a familiar, repetitive task.

The additional purpose of this Bridge Manual is to build on the wealth of knowledge gained from many decades of bridge design, construction and bridge performance in the Commonwealth. This historical perspective has allowed MassDOT to understand which details and designs have performed well, which have not and why. These lessons learned have gone into the development of the standard details of Parts II and III. The anticipated beneficial result is that good practices will be institutionalized for Designers to use so that their bridges will perform well over time.

### **ii. USE OF THIS BRIDGE MANUAL**

The bridge design guidelines and standard details presented in this Bridge Manual are specifically intended for the design and construction of new bridge structures in the Commonwealth of Massachusetts. With some modification, they are applicable for use with stage construction and superstructure replacement projects as well as deck replacement and some preservation projects.

However, this Bridge Manual cannot be expected to provide standard details or guidance to cover every type of situation that a Designer may encounter. For this reason, it is the Designer's responsibility to verify that the design guidance or details presented in this Bridge Manual are applicable to their particular project or situation. To make this assessment, Designers must be knowledgeable about bridge design and must stay up to date about all issues related to bridge design and construction, including fabrication, construction materials, safety, bridge inspection and durability. They must also demonstrate attention to detail and to the quality of design. Finally, Designers must use common sense, solving real problems rather than pursuing solutions to hypothetical "what if" problems that have little probability of ever happening in real life.

This knowledge and experience give the Designer the tools to determine if the Bridge Manual is applicable to their design situation or not or if a particular Bridge Manual standard detail needs modification in order to be applicable. Understanding the "why" behind a Bridge Manual guideline or detail is crucial. It is a poor, unacceptable practice for a Designer to just take a detail and then force it to fit a particular situation for which it is not suited just because it is in the Bridge Manual.

In situations where the Designer must stray outside of the Bridge Manual, the Designer is required to seek prior approval from the Bridge Section. The purpose of this is not to discourage the Designer's initiative, but rather to start a dialog with MassDOT about what the Designer intends to do and why, and, if needed, to collaboratively develop a mutually agreeable solution before the Designer expends too much effort towards a design that MassDOT, as the owner, may not find acceptable.