



Commonwealth of Massachusetts
Office of the State Auditor
Suzanne M. Bump

Making government work better

Official Audit Report – Issued December 1, 2015

Massachusetts Department of Transportation— Rehabilitation of the A. Piatt Andrew Bridge

For the period July 1, 2006 through December 31, 2014





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Making government work better

December 1, 2015

Ms. Stephanie Pollack, Secretary and Chief Executive Officer
Massachusetts Department of Transportation
10 Park Plaza, Suite 4160
Boston, MA 02116

Dear Secretary Pollack:

I am pleased to provide this performance audit of the Massachusetts Department of Transportation's (MassDOT's) rehabilitation of the A. Piatt Andrew Bridge. This report details the audit objectives, scope, methodology, finding, and recommendations for the audit period, July 1, 2006 through December 31, 2014. My audit staff discussed the contents of this report with management of the agency, whose comments are reflected in this report.

I would also like to express my appreciation to MassDOT for the cooperation and assistance provided to my staff during the audit.

Sincerely,

A handwritten signature in blue ink, appearing to read "SMB", written in a cursive style.

Suzanne M. Bump
Auditor of the Commonwealth

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LIST OF ABBREVIATIONS

GEA	Gill Engineering Associates
MassDOT	Massachusetts Department of Transportation
MMARS	Massachusetts Management Accounting and Reporting System
NTP	notice to proceed

EXECUTIVE SUMMARY

The A. Piatt Andrew Bridge, located in Gloucester, has undergone only minimal repairs since it was built in 1950. Bridge inspection reports issued by the Massachusetts Department of Transportation (MassDOT) indicate that the bridge’s structural rating deteriorated from “poor” in August 2004 to “serious” in August 2005. In 2006, MassDOT initiated a bridge betterment project (as opposed to a full rehabilitation project). This betterment project, which MassDOT called the “Gloucester-Route 128 over the Annisquam River Bridge Preservation Project,” was intended to make various structural and traffic safety repairs and improvements solely for the purpose of bringing the bridge up to a level of repair where it would no longer be rated structurally deficient. The project’s design work began in 2006, and since that time, because of numerous other structural problems with the bridge that were identified after the repair work began, the project has evolved into a full bridge rehabilitation project to be performed in two phases. It is anticipated that both phases will be completed by April 2016 at a total cost of approximately \$35 million, which is substantially more than the original estimated cost of \$23,290,144.

In accordance with Chapter 11, Section 12, of the Massachusetts General Laws, the Office of the State Auditor has conducted a performance audit of certain activities of MassDOT for the period July 1, 2006 through December 31, 2014. This audit focused on MassDOT’s oversight of the rehabilitation of the A. Piatt Andrew Bridge and was initiated in response to concerns expressed by state legislators and others over the structural integrity of the bridge, excessive delays in completing the project, and related cost overruns. The purpose of this audit was to determine whether MassDOT was effectively administering this project and ensuring that contract expenditures were reasonable and appropriate, that project timelines were met, and that bridge renovations met statutory safety requirements.

Below is a summary of our finding and our recommendations, with links to each page listed.

Finding 1 Page 5	MassDOT did not effectively administer the rehabilitation of the bridge: it required its design engineer to use outdated inspection reports instead of requiring the engineer to perform a new detailed site inspection, as required by contract, as the basis for developing the scope of work. As a result, structural problems were not identified until after the project began, at which time they necessitated an additional \$11.7 million of spending and five years of work.
Recommendation Page 7	MassDOT should ensure that it allows its contracted design engineers to perform current inspections of bridges that need repair, in order to develop proper scopes of work. Once this is done, MassDOT should allocate the funding required to perform all of the necessary work.

OVERVIEW OF AUDITED ENTITY

Chapter 25 of the Acts of 2009, An Act Modernizing the Transportation Systems of the Commonwealth of Massachusetts, as amended by Chapter 26 of the Acts of 2009, required the integration of various state transportation agencies (including the Executive Office of Transportation and Public Works and its divisions; the Massachusetts Turnpike Authority; the Massachusetts Highway Department; the Registry of Motor Vehicles; the Massachusetts Aeronautics Commission; and the Tobin Bridge, currently owned and operated by the Massachusetts Port Authority) into a newly created Massachusetts Department of Transportation (MassDOT).

MassDOT is administered by the Secretary of Transportation, who is appointed by the Governor to serve as the department's chief executive officer. During our audit period, a seven-member board of directors (including the Secretary) with expertise in transportation, finance, and engineering, appointed by the Governor, oversaw MassDOT.¹ MassDOT has four divisions: Highway, Rail and Transit, Aeronautics, and the Registry of Motor Vehicles. The Secretary appoints an administrator for each division.

MassDOT Highway Division

MassDOT's Highway Division is responsible for the operation, construction, and maintenance of all state bridges and highways. The Highway Division is separated into six district offices, located in Lenox, Northampton, Worcester, Arlington, Taunton, and Boston. According to MassDOT's website, each district office "supervises all road and bridge construction and maintenance within its jurisdiction" and "provides engineering support to cities and towns."

According to the MassDOT Fiscal Year 2014–2018 Capital Investment Plan, the division anticipates spending \$3.3 billion on bridge-construction projects.

1. During fiscal year 2016, the Legislature expanded the board to 11 members.

AUDIT OBJECTIVES, SCOPE, AND METHODOLOGY

In accordance with Chapter 11, Section 12, of the Massachusetts General Laws, the Office of the State Auditor has conducted a performance audit of certain activities of the Massachusetts Department of Transportation (MassDOT) for the period July 1, 2006 through December 31, 2014. In some instances, it was necessary to review records outside this audit period.

We conducted this performance audit in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Below is a list of our audit objectives, indicating each question we intended our audit to answer; the conclusion we reached regarding each objective; and, if applicable, where each objective is discussed in the report.

Objective	Conclusion
1. Was MassDOT's project for the restoration of the A. Piatt Andrew Bridge completed within established contract timeframes?	No; see Finding <u>1</u>
2. Upon completion, did the bridge meet statutory load-rating requirements?	Yes
3. Were all the construction costs that were incurred to restore the bridge reasonable?	No; see Finding <u>1</u>
4. Was the original scope of work to restore the bridge adequate to address its structurally deficient rating? If not, was it appropriate to omit the supplemental work that was needed to complete the bridge from the original scope of work?	No; see Finding <u>1</u>
5. Were MassDOT's management controls for the restoration project adequate and effective?	No; see Finding <u>1</u>

To achieve our audit objectives, we conducted audit testing in the following areas:

- We obtained and reviewed all inspection and rating reports for the A. Piatt Andrew Bridge from 1999 through 2014.
- We reviewed MassDOT's administrative design and construction policies and procedures for soliciting and awarding design and construction contracts. We also reviewed the project-planning process for establishing the design-project scope of services and construction scope of work.

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- We reviewed MassDOT payment information, and state accounting records in the Commonwealth's Massachusetts Management Accounting and Reporting System (MMARS), to identify payments made by the Commonwealth for the design and construction costs incurred for the bridge-restoration project. We compared this information with source documents and conducted information-security testing to determine the reliability of the data. We determined that the data were sufficiently reliable for the purposes of this report.
 - We reviewed the design and construction contracts awarded by MassDOT for the bridge project and identified and reviewed applicable laws, rules, regulations, and other requirements to assess MassDOT's compliance with these requirements. Our review of contract management and protocols and procedures revealed no significant instances of noncompliance. In addition, we reviewed all MassDOT-approved change orders² for this project to determine their justifications and review the reasonableness of the associated costs.
 - We interviewed MassDOT officials responsible for the Bridges and Structures, Design, and Fiscal Departments and the Highway Division. The purpose of these interviews was to obtain an understanding of the control environment that existed during our audit period and of various processes used by these departments/divisions in performing their work.
 - To assess the effectiveness of the internal controls that MassDOT's Highway Division and Fiscal Department had implemented over its billing and payment systems, we examined 10 of the 66 invoices pertaining to construction quantity estimates made by the construction contractor, SPS New England Inc., during our audit period. Similarly, we tested 6 out of 25 invoices for design payments submitted for review and payment for the bridge project during our audit period. We traced all recorded payments to MMARS and verified that they were made in accordance with the contract terms. We noted no exceptions for either test.

Whenever sampling was used, we applied a non-statistical approach, and as a result, we were not able to project our results to the population.

2. Change orders are documents requesting, acknowledging, and approving (or disapproving) work that is either added to or deleted from the project scope, altering the original guaranteed maximum price in the contract, the planned completion date, or both.

DETAILED AUDIT FINDINGS WITH AUDITEE'S RESPONSE

1. MassDOT did not properly administer the rehabilitation of the A. Piatt Andrew Bridge; this resulted in significant project delays and cost overruns.

The Massachusetts Department of Transportation (MassDOT) did not properly administer the rehabilitation of the A. Piatt Andrew Bridge. Specifically, MassDOT officials told us that the department had originally planned to perform repairs only to the extent to which the bridge would not be considered structurally deficient. Therefore, when MassDOT hired a design engineer for this project in 2006, it did not provide funds for this contractor to perform a new inspection of the bridge—even though such an inspection was provided for under the consultant's contract—to properly determine the extent of repair work that was needed at the time. Instead, MassDOT directed the design engineer to use the information from a 1999 MassDOT rating report and a 2005 inspection report to develop the scope of work for the project. As a result, after construction began, numerous other structural problems were identified that needed to be addressed, resulting in MassDOT's having to spend an additional \$11.7 million and extend the project's original completion date by approximately five years.³ Had MassDOT properly allowed the design engineer to inspect the bridge and develop the full scope of work required to rehabilitate it properly, the department might have been able to ensure a more timely completion of this project. It might have also been able to complete the project at a lower cost, since approximately \$2.6 million of the costs it incurred on the project were processed through contract change orders and were not subject to competitive bidding.

Project Background

The A. Piatt Andrew Bridge was built in 1950. According to MassDOT's records, the only significant work completed on the bridge before the recent rehabilitation work was the replacement of the roadway deck in 1991, installation of new drainage pipes in 1992, and repainting in 1993. Consequently, according to MassDOT bridge-inspection reports, the bridge's overall structural rating deteriorated from "poor" in August 2004 to "serious" in August 2005. In response, in May 2006, MassDOT hired a design-engineering firm, Gill Engineering Associates (GEA), to help prepare an evaluation of the bridge's most critical components and prepare a scope of work to be performed that would address only the areas of the bridge that needed immediate repair. GEA used a 1999 MassDOT rating report and a 2005 inspection report

3. Despite numerous structural deficiencies, the bridge never went below its mandated load rating.

about the bridge to prepare the scope of work. Accordingly, the original project was designated by MassDOT as a bridge betterment or maintenance project, not a major rehabilitation project. According to MassDOT, a bridge betterment project is a limited rehabilitation project intended to address only deficiencies that are currently making a bridge structurally deficient but are not pervasive enough to require a full replacement or a major rehabilitation. MassDOT's original budget for this project was \$8.5 million, but upon the completion of GEA's final design specifications for the construction work, MassDOT increased the project's budget to \$17 million.

On July 30, 2008, MassDOT awarded a contract for this project to SPS New England Inc. in the amount of \$23,290,144,⁴ with a notice to proceed (NTP) for September 11, 2008 and an estimated completion date of June 13, 2011. However, once the contractor began work, it identified a number of locations on the bridge where the structural steel had deteriorated and needed to be repaired that were not included in the original scope of construction work. GEA and MassDOT agreed that these additional steel repairs would be completed in phases.

During Phase 1 of the project, SPS agreed to perform repairs that were essential to keeping the bridge safe for an additional \$1,097,475. To complete these repairs, MassDOT extended the completion date to July 7, 2012. According to MassDOT's records, all construction activities for Phase 1, including repainting, were substantially complete by December 2013, 2.5 years later than the original estimated completion date. During Phase 1, MassDOT approved eight extra work orders, totaling \$2,606,347, and a project extension of 390 days, moving the completion date from June 13, 2011 to July 7, 2012. As of December 31, 2014, a total of \$25.9 million had been spent on Phase 1 construction activities.

In June 2012, MassDOT had to decide how to handle the rest of the structural repairs, which were not being performed during Phase 1. At that time, MassDOT determined that the remaining repairs represented a significant amount of money and that these services would be competitively bid rather than being processed through change orders. On September 17, 2014, MassDOT awarded this project to the lowest bidder, Cianbro Corporation, for \$9,062,447. MassDOT issued the NTP to this contractor on October 17, 2014, with an expected completion date of April 19, 2016.

4. The original budget was \$17 million, but the bid submitted by the lowest responsible bidder, SPS New England Inc., was approximately \$23 million.

Authoritative Guidance

MassDOT's contract with GEA for this work (Attachment A of its Contract for State Highway Work) includes a Rehabilitation of Existing Bridges section that states,

Upon written notice from the Department for an assigned project, the Consultant shall visit the project site to conduct a structural inspection or evaluation of the bridge in order to determine the extent of the improvements which may be required to place the bridge in serviceable condition.

Reasons for Noncompliance

MassDOT officials told us that because of limited funding and the urgent need to repair the bridge to the point where it would no longer be considered structurally deficient, the department had decided to limit the scope of work to address the problems it had identified in its 1999 rating report and 2005 inspection report.

Recommendation

MassDOT should ensure that it allows its contracted design engineers to perform current inspections of bridges that need repair, in order to develop proper scopes of work. Once this is done, MassDOT should allocate the funding required to perform all the necessary work.

Auditee's Response

Overall we find the report to be thorough and accurate and acknowledge the findings it contains. . . .

The 1999 report you refer to was a Rating Report. While an inspection report documents the condition of the members of the bridge, a rating report actually calculates the structural capacity of the various bridge members. It is after a rating report is completed and accepted that a bridge may be posted for weight restrictions. In this instance, GEA used the most recent inspection and rating reports available at the time for the A. Piatt Andrew bridge project.

We feel that you should also be aware of the background of this, and other bridge preservation projects, at the time the project was initiated. Being a large bridge structure, with many individual bridge members, we were cognizant of its deteriorated condition and the need for repairs. As there was limited funding available for a full rehabilitation, we advanced the project as a "bridge preservation" project. The American Association of State Highway Transportation Officials (AASHTO) defines Preservation Projects as "actions or strategies that prevent, delay or reduce deterioration of bridges or bridge elements, restore the function of existing bridges, keep bridges in good condition and extend their useful life. Preservation actions may be preventative or condition-driven." It was never our intention to perform a complete bridge rehabilitation of this structure when the project was initiated. However, as construction work progressed, substantial

additional repairs were identified, and we felt it was in the interest of public safety to address them at that time, rather than postponing the work until adequate funding could be identified for a full rehabilitation or replacement. While some of those additional deficiencies would have been found had a full inspection been performed prior to the start of design, many would only have been identified during construction, particularly when cleaning the bridge prior to painting it. Bridge cleaning operations in particular tend to reveal additional deficiencies that are difficult, if not impossible, to determine from viewing the unclean steel components.

We also feel it is important to let you know that our current practice is to have an inspection performed prior to starting design on all repair and preservation contracts.

Auditor's Reply

We acknowledge that MassDOT provided GEA with its most recent inspection and rating reports; however, considering the apparent rapid rate of deterioration of the bridge, the most prudent action would have been for MassDOT to allow the design engineer to conduct a detailed site inspection and test the critical bridge members in accordance with the requirements of the contract. Instead, as we stated in our report, MassDOT directed GEA to use the 1999 rating report and 2005 inspection report as the basis for designing the repairs to the bridge. The fact that this information was inadequate for this purpose is documented in a letter of Condition Summary prepared by GEA for MassDOT in June 2012, which states,

The original work assignment for the [A. Piatt Andrew Bridge] was scoped as a bridge maintenance project . . . to strengthen some primary bridge elements identified in the 1999 bridge rating. . . .

[GEA's] scope did not include hours for a detailed field assessment of the structure to evaluate specific repairs . . . but rather it provided time to evaluate the existing rating report and to use this information to identify and design the repairs. . . .

The only information available to GEA was the [National Bridge Inspection Standards] inspection reports, which do not clearly define the limits of deterioration and the original construction drawings that were incomplete and inadequate to properly detail the repairs.

Accordingly, although GEA used the most recent reports available, the reports were outdated and incomplete at the time of the contract award. For this reason, MassDOT should have required and funded GEA's conducting its own detailed site assessment before preparing the scope of work for bid.

Also, although we are aware of the limited funding that is available for much-needed bridge repair, we reiterate that we believe that much of this additional work could have been completed in a more cost-effective manner if it had been part of the original competitively bid construction contract and not through more costly change orders after the contract was awarded. MassDOT must ensure that it allocates money

adequately to each project in order to ensure that all necessary work identified during pre-design inspections will be addressed and completed.

Finally, we believe the measures that MassDOT indicated that it has taken are appropriate and responsive to our concerns in this area.

APPENDIX

Bridge Inspection and Rating Process

The Massachusetts Department of Transportation (MassDOT) has adopted the practices of the federal National Bridge Inspection Standards in accordance with 23 US Code 151, which outlines the frequency of, and procedures for, bridge inspections. MassDOT officials told us the department uses engineering firms to perform biannual bridge inspections to evaluate the various components of each bridge and develops ratings for each bridge based on these reviews.

Condition ratings are used to describe the current status of various bridge components, such as the decking, roadway surface, superstructure, and substructure of each bridge. Bridge inspectors assign condition ratings by evaluating the severity of the deterioration or disrepair and the extent to which it may affect the integrity and performance of the component being evaluated. These ratings provide an overall characterization of the general condition of the entire component. Ratings of 5 or higher indicate a situation where maintenance work and minor rehabilitation of the general components can return a bridge to a high performance level. It is imperative that remedial actions be taken before any components reach a rating equal to or lower than 4, which would correspond to an overall rating of “poor,” indicating advanced deterioration and loss of structural integrity.

Bridges rated 4 or lower are considered structurally deficient. Such bridges may have weight restrictions or lane closures put in place until corrective repairs have been completed. According to MassDOT officials, the department’s eventual goal is to have the number of structurally deficient bridges decrease to approximately 248 by fiscal year 2021.

Bridge Load Ratings

The purpose of calculating load ratings is to guard against structurally deficient bridges becoming dangerously stressed by loads that exceed their current capacity. The load rating is a calculation of the weight-carrying capacity of the bridge and is critical to the bridge’s safety. A load-rating calculation is performed separately from a bridge inspection and is based on design capacities combined with data and observations of the bridge’s physical condition provided by a bridge inspector. The load rating, expressed in tons, is the basis for posting signs noting any vehicle weight limits or the bridge’s maximum weight limit. A structurally deficient bridge is not necessarily unsafe for use or incapable of carrying legally permitted

loads, provided that the load ratings are fully documented. A maximum-weight-limit sign must be posted on all National Highway System bridges (such as the A. Piatt Andrew Bridge) whenever the maximum vehicle weight that the state's regulations allow on that highway exceeds the bridge's current maximum weight limit. In most states, including Massachusetts, the maximum gross vehicle weight is 40 tons for a typical fully loaded 18-wheel tractor-trailer with five axles. According to the Bridges and Structures Department of MassDOT's Highway Division, the load rating for the A. Piatt Andrew Bridge was consistently held at the maximum of 40 tons throughout the design and reconstruction period, January 1, 2006 through December 31, 2014.