

**NEW ENGLAND TRANSPORTATION CONSORTIUM
QUARTERLY PROJECT PROGRESS REPORT**

A. PROJECT NUMBER AND TITLE:

Project: NETC 18-1

**Title: Development of MASH Computer Simulated Steel Bridge Rail and Transition Details
State Project No.: 023430.18**

B. PRINCIPAL INVESTIGATOR(S) & UNIVERSITY(S):

Chuck A. Plaxico, Ph.D.

Roadsafe LLC

Canton, ME

C. WEB SITE ADDRESS: www.RoadsafeLLC.com

D. START DATE (Per NETC Agreement): 09-October 2018

E. END DATE (Per NETC Agreement): 1-June 2020

F. ANTICIPATED COMPLETION DATE: 15-March 2020

G. PROJECT OBJECTIVES:

Phase I

The objectives of the project are to: 1) review existing NETC bridge rail and AGT designs and assess performance aspects to determine preliminary MASH compliance/equivalency, 2) review current standard details and specifications for NETC style bridge rails and transitions used by MaineDOT, NHDOT, RIDOT and VTrans to identify differences in material specifications and dimensional details and 3) evaluate the crash performance of the NETC bridge rail and approach guardrail transition (AGT) designs using finite element analysis (FEA) computer simulation. The impact conditions and assessment procedures for the FEA will conform to the specifications in *MASH* for TL-3 or TL-4 (as appropriate) and will include evaluations of structural capacity of the railing, risk of occupant injury, and vehicle stability during impact and redirection. The systems included in the evaluation are listed below along with the target test level for each system:

- Bridge Rail Systems:
 - NETC curb-mounted 2-Bar Rail (TL3)
 - NETC curb-mounted 3-Bar Rail (TL4) (4-bar curb mounted NETC rail would be considered equivalent to this type)
 - NETC sidewalk-mounted 4-Bar Rail (TL4)
- Bridge Rail Transitions:
 - NETC Style 2-Bar Rail to Thrie Beam (TL3) (NHDOT steel rail transition)
 - NETC Style 3-Bar Rail to Thrie Beam (TL4) (NHDOT steel rail transition)
 - Concrete Transition Barrier to Thrie Beam (TL4) (MaineDOT standard detail)

Project Tasks

- Task 1: Literature Review and Preliminary Assessment of Current Designs
- Task 2: FEA Model Development and Validation of Baseline R350 Design(s)

- a) Develop model of sidewalk-mounted 4-bar bridge rail based on existing validated model reevaluate validity against Test NETC 3.
 - b) Develop model of NETC AGT for 2-Bar bridge rail and validate with Test 401181-1 (R350 Test 3-21).
- Task 3: MASH TL-4 Simulations for NETC 3-Bar Bridge Rail
 - Task 4: MASH TL-4 Simulations for NHDOT 3-Bar Transition
 - Task 5: MASH TL-4 Simulations for NETC 4-Bar Bridge Rail
 - Task 6: MASH TL-4 Simulations for MaineDOT 4-Bar Transition
 - Task 7: MASH TL-3 Simulations for NETC 2-Bar Bridge Rail
 - Task 8: MASH TL-3 Simulations for NETC 2-Bar Transition

H. REPORT PERIOD:

Quarter 3, 2019 (July 1 – September 30)

I. ACCOMPLISHMENTS THIS PERIOD:

- Task 8 was completed.
- Draft Final Report was submitted:
 - a) 9/5/2019: Initial draft report was submitted to the Panel for review
 - b) 9/12/2019: Project meeting was held with the panel to discuss edits/comments regarding preliminary conclusions and recommendation made in the report.
 - c) 9/26/2019: Final draft report submitted to Panel.

J. PROBLEMS ENCOUNTERED (If any): A proposal for additional evaluations was submitted to, and approved by, NETC and MEDOT. The proposed work increased the overall scope and budget for the project and extended the anticipated contract completion date from 12/31/2019 to 3/15/2020 (i.e., 2.5 months). However, the original contract end date of June 1, 2020 should not be affected by the extended scope. Additional details are provided below:

- a. As part of the Project meeting held on 9/12/2019 several design revisions for the NETC systems were discussed for improving performance of the NETC 3-Bar and 4-Bar designs, as well as evaluation of alternative post-spacing between the final bridge rail post and the first post of the approach guardrail transition. The general scope for Phase II was also determined during this meeting.
- b. 9/16/2019: A proposal was submitted to the Panel for performing additional evaluations of the NETC bridge rail and transition systems. The objectives of the additional evaluations (Phase II) are to use FEA simulations (1) to determine if increasing the size and/or strength of the lower railing will improve crash performance for MASH Test 4-10, (2) to determine if increasing post spacing between the 3-Bar NETC bridge rail and transition system to from 3 ft to 5.5 feet will result in unacceptable crash performance of the system for MASH TL4, and (3) to determine if increasing post size for the NETC 4-Bar bridge rail to meet MASH equivalency requirements will notably improve crash performance for that system for MASH Test 4-12.
- c. 9/23/2019: The Phase II proposal was accepted by all members of the project Panel.
- d. 9/24/2019: The Phase II proposal was submitted to, and approved by, the Advisory Committee.
- e. 9/24/2019: The Phase II Proposal was submitted to MEDOT to generate the contract modification.

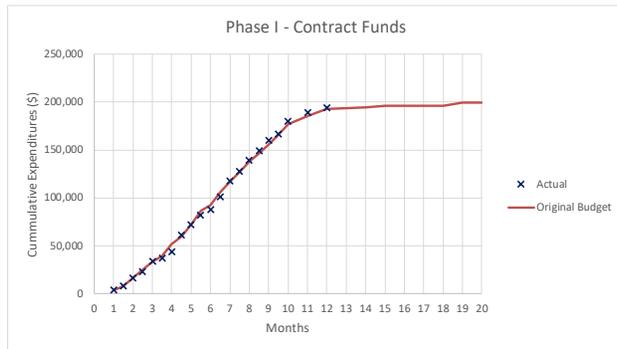
- f. 10/28/209: The contract mod was signed by Roadsafe LLC and MEDOT. The contract budget was increased \$30,307.82 for work to be performed in Phase II.

K. TECHNOLOGY TRANSFER ACTIVITIES: The results from the project were presented at the annual summer meeting of the Transportation Research Board Subcommittee on Design (AFB20) held in Reno, Nevada July 21, 2019. The title of the presentation was “Crash Performance of MassDOT and NETC Transition Designs Using FEA.”

L. STATUS BY TASK:

NO.	Task Code	Task Description	QTR	Phase I												Phase II							% Complete			
				QTR 1			QTR 2			QTR 3			QTR 4			QTR 5			QTR 6					QTR 7		
				Month	Oct	2	3	Jan	5	6	Apr	8	9	July	11	12	Oct	14	15	Jan	17	18		Apr	20	21
1	Literature Review	Literature Review and Preliminary Assessment of Current Designs		25	50	75	85	100																	100	
2(a)	BR Model Validation	Development and Validation of NETC 4-Bar Bridge Rail Model			25	50	80	90	100																100	
2(b)	AGT Model Validation	Finite Element Model Development and Validation of 2-Bar AGT				10	12	15	70	100															100	
3	3-Bar BR (TL4)	TL4 Simulations of the NETC 3-Bar Bridge Rail Design						10	50	75	100														100	
4	3-Bar AGT (TL4)	TL4 Simulations for AGT to 3-Bar Bridge Rail							25	50	75	100													100	
5	4-Bar BR (TL4)	TL4 Simulations for the NETC 4-Bar Bridge Rail Design								50	100														100	
6	4-Bar AGT (TL4)	TL4 Simulations for AGT to Concrete Abutment									50	80	100												100	
7	2-Bar BR (TL3)	TL3 Simulations of the NETC 2-Bar Bridge Rail Design									33	66	100												100	
8	2-Bar AGT (TL3)	TL3 Simulations for AGT to 2-bar Bridge Rail										25	60	100											100	
9	Interim Meetings	Interim Reports / Meetings				13	25	38	50	63	75	88	100												100	
10	QPR	Quarterly Progress Reports					33			67			100												100	
11	Final Report	Final Report										13	65	97.2											97	
	Direct Expense	Computational Resources and Software (Is-dyna)		0	8	17	25	33	42	50	58	67	75	75	75										75	
3B	3-Bar BR (Mod)	Test 4-10 on NETC 3-Bar Bridge Rail with Larger Lower Rail																							0	
4B	3-Bar AGT (Mod)	TL4 for 3-Bar Transition with 5.5-ft spacing																							0	
5B	4-Bar BR (Mod)	Test 4-12 on NETC 4-Bar Bridge Rail with 8x28 Posts																							0	
9B	Interim Meetings	Interim Reports / Meetings																							0	
11B	Final Report (Mod)	Update Draft Final Report																							0	
	Direct Expense	Computational Resources and Software (Is-dyna)																							0	

Original Schedule
Projected Schedule



Phase I	
Funds Expended:	97.16%
Contract Amount:	\$ 199,936
Expended this Month:	\$ 4,723.52
Total Expended to Date:	\$ 194,253.42
Balance:	\$ 5,682.78

Time Expended: 60%
Start Date: 10/9/2018
Completion Date: 6/1/2020

Phase II	
Funds Expended:	0.00%
Contract Amount:	\$ 30,307.82
Expended this Month:	\$ -
Total Expended to Date:	\$ -
Balance:	\$ 30,307.82

M. PERCENT COMPLETION OF TOTAL PROJECT : 60%

N. ACTIVITIES PLANNED FOR NEXT QUARTER:

Tasks 3B, 4B and 5B of Phase II will be complete. As of the date of this submission, Task 3B is 90% complete.

O. FINANCIAL STATUS:

As of September 30, 2019

Total Phase I Project Budget: \$ 199,936

Total Phase I Expenditures : \$ 159,826.12

Total Phase II Project Budget: \$ 30,307.82

Total Phase II Expenditures: \$ 0.00