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TRANSPORTATION RESEARCH BOARD

Construction Project Staffing Strategies for Transportation Agencies

June 23, 2020

@NASEMTRB
#TRBwebinar

PDH Certification Information:

- 1.5 Professional Development Hours (PDH) – see follow-up email for instructions
- You must attend the entire webinar to be eligible to receive PDH credits
- Questions? Contact Reggie Gillum at RGillum@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Providers Program. Credit earned on completion of this program will be reported to RCEP. A certificate of completion will be issued to participants that have registered and attended the entire session. As such, it does not include content that may be deemed or construed to be an approval or endorsement by RCEP.

RCEP

REGISTERED CONTINUING EDUCATION PROGRAM

#TRBwebinar

Learning Objectives

1. Describe the factors that impact the staffing requirements for highway construction projects
2. Design a project and regionally agency staffing plan using the WOW
3. Recommend strategies to address specific workforce challenges encountered at your agency

#TRBwebinar

TRB Webinar: Construction Project Staffing Strategies for Transportation Agencies

June 23, 2020

2:00PM–3:30PMEDT

BACKGROUND INFORMATION

NCHRP 20-107 RESEARCH TEAM MEMBERS

UNIVERSITY OF KENTUCKY


Tim Taylor, P.E., Ph.D.


Roy Sturgill, P.E., Ph.D.*

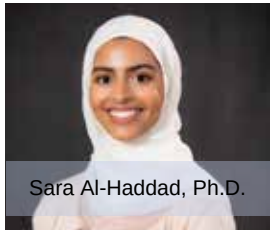

Ying Li, P.E., Ph.D.


Steve Waddle, P.E.

UNIVERSITY OF COLORADO BOULDER


Paul Goodrum, P.E., Ph.D.


Keith Molenaar, Ph.D.


Sara Al-Haddad, Ph.D.

* (now Iowa State University)

WEBINAR OBJECTIVES

At the end of this webinar, you will able to:

- Describe the factors that impact the staffing requirements for highway construction projects
- Design a project and regionally agency staffing plan using the WOW
- Recommend strategies to address specific workforce challenges encountered at your agency

JUSTIFICATION FOR PROJECT AND GUIDANCE

Evolving State Transportation Agency (STA) conditions

- Funding
- Alternative contracting methods
- Staffing levels/type
- Technology

STA staff retirements

- Less experienced personnel in higher levels of authority

Doing more with less

Between 2000–2010

- STA managed lane miles increased by 4.1%
- STA staff decreased by 9.7%
- STA full-time equivalent staff per $million of capital outlay decreased 37.3%

NCHRP 20107 OBJECTIVES

The objective of this research is to develop guidance for staffing transportation construction projects that:

1. identifies current contracting methods and associated staffing used by transportation agencies;
2. identifies staffing strategies;
3. identifies knowledge, skills, abilities, and qualifications required for project inspection and testing staff; and
4. recommends best practices for balancing project oversight responsibilities using agency staff, consultants, and contractors for transportation construction projects.

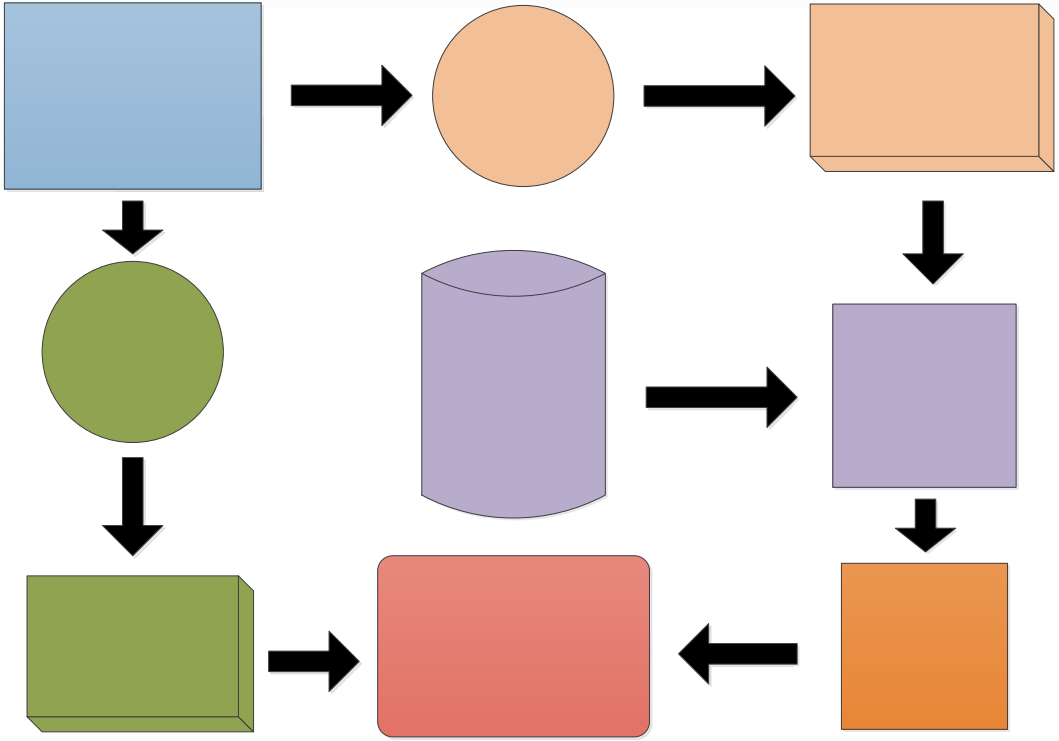
NCHRP 20107
GUIDANCE CONCEPT

Construction Inspection (I)	
I-1	Concrete Maturity Meters
I-2/A-2	Contract Requirements
I-2-1/A-2-1	Operations & Maintenance (by Contractor)
I-2-2/A-2-2	Warranty
I-3	e-Inspection
I-4/A-4/E-4	Electronic Field Books
I-5/E-5	GPR
I-6/E-6	GPS/GNSS
I-7	Infrared Temp. Systems (IRpave)
I-8	Intelligent Compaction
I-9	QC/QA/IA (Contract Based/Agency Based)
I-10	Remote Equipment Monitoring
I-11	Mobile Road Quality Monitoring Devices
I-12	Remote Video Monitoring
I-13	Risk Based Inspection
I-14/E-9	Robotic Total Stations
I-15/E-10	Schedule Milestone Inspections
I-16	Unmanned Aerial System (UAS)

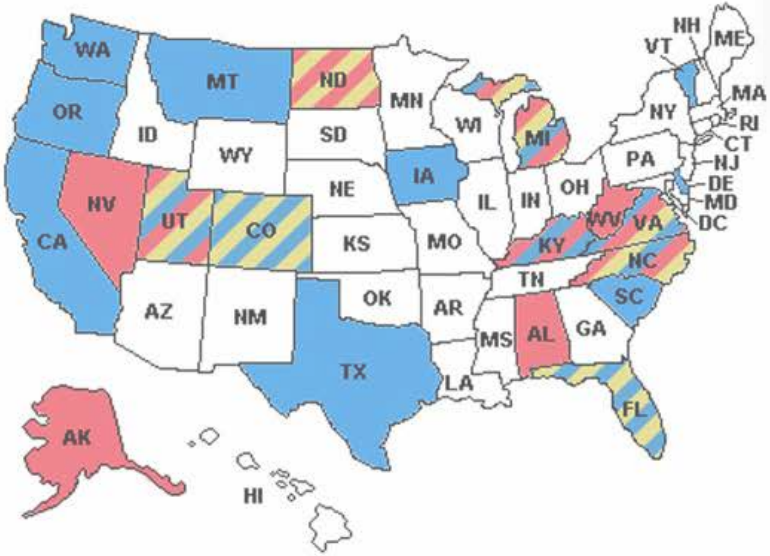
Construction Staff Function		Construction Inspection (I)																	
Strategy (Tool) / Work Type	I-1	I-2	I-2-1	I-2-2	I-2-3	I-3	I-4	I-5	I-6	I-7	I-8	I-9	I-10	I-11	I-12	I-13	I-14	I-15	I-16
Pavement Surface	☆	☆	☆	☆	☆	☆	★	★	★	★		★	★	★	★	☆	★	☆	☆
Superstructure	★	☆	☆	☆	☆	☆	★	★	★			★				☆	★	☆	☆
Excavation / Embankment		☆	☆		☆	☆	★	☆	★		★	★	★	★	★	★	★	☆	☆
Pipe / Drainage		★	★	★	☆	☆	★	☆	★			★	☆	☆	☆	★	★	☆	☆
Roadway Base		★	★	★	☆	☆	★	☆	★	★	★	★	★	★	★	★	★	★	☆
Pavement Base		★	★	★	☆	☆	★	☆	★	★	☆	★	★	★	★	★	★	★	☆
Substructure	★	☆	☆	☆	☆	☆	★		★			★				☆	★	★	☆
Temporary Traffic Control					☆	☆	★		★			★		★	★		★		★
Structural Foundation	★	☆	☆	☆	☆	☆	★	☆	★			★				☆	★	★	☆
Strips / Signs / Signals					☆	☆	★		★			★	☆	☆	☆	★	★	★	☆
Roadside					☆	☆	★		★		☆	★	☆	☆	☆	★	★	★	☆
Utilities (In contract relocations)		★	★	★	☆	☆	★	☆	★			★				★	★	☆	☆
Roadway Lighting		★	★	★	☆	☆	★		★			★	☆	☆	☆	★	★	★	☆
Intelligent Transportation Systems		☆	☆	☆	☆	☆	★		★			★	☆	☆	☆	★	★	☆	☆

Note: ★ – directly applicable and ☆ – indirectly applicable. Otherwise, not applicable.

NCHRP 20107 RESEARCH FRAMEWORK



NCHRP 20107 STATE AGENCY ENGAGEMENT

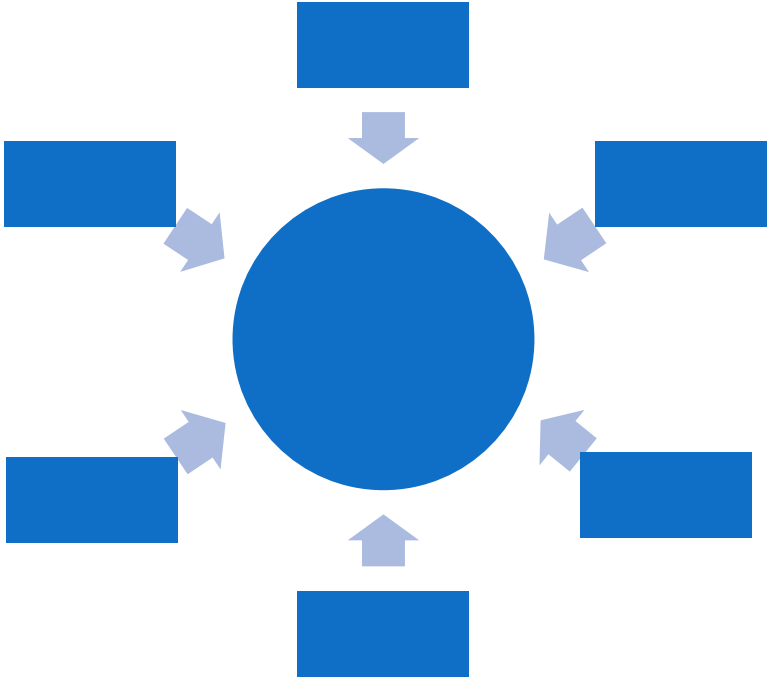


States included in staffing strategies case study (Task 3)
States included in forecasting case study (Task 4)
States included in project staffing survey (Task 6)

Data Analysis Develop Guidance

- Literature Review
- Staffing Strategy Interviews (7 states)
- Forecasting Method Interview (10 states)
- Project Survey (305 projects, 16 states)

FACTORS INFLUENCING NCHRP 20-107 GUIDANCE



Data Analysis
Result Highlights

246

Project Managers / Resident Engineers responded

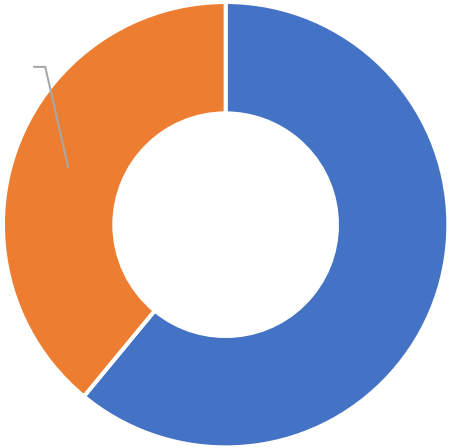
16

State Transportation Agencies represented

305

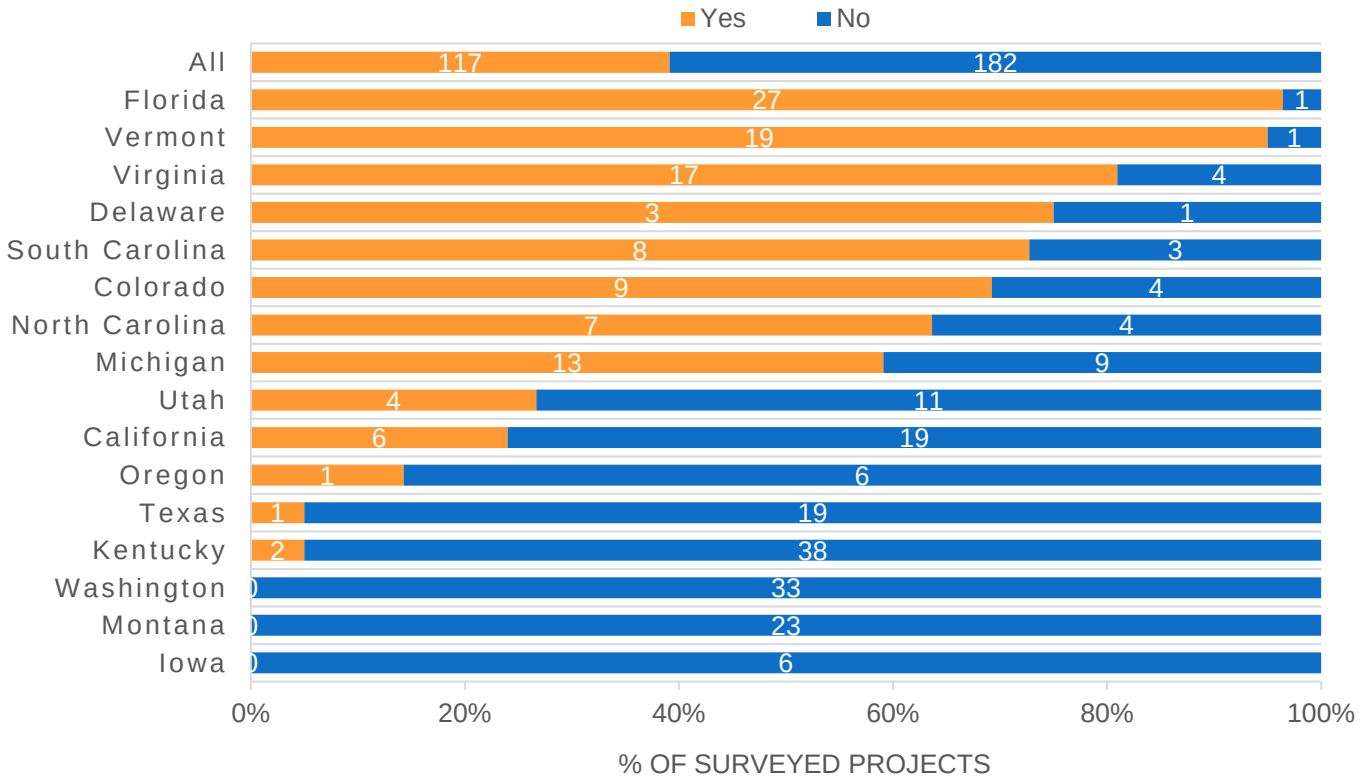
Project staffing information collected

AVERAGE PROJECT STAFFING LEVEL

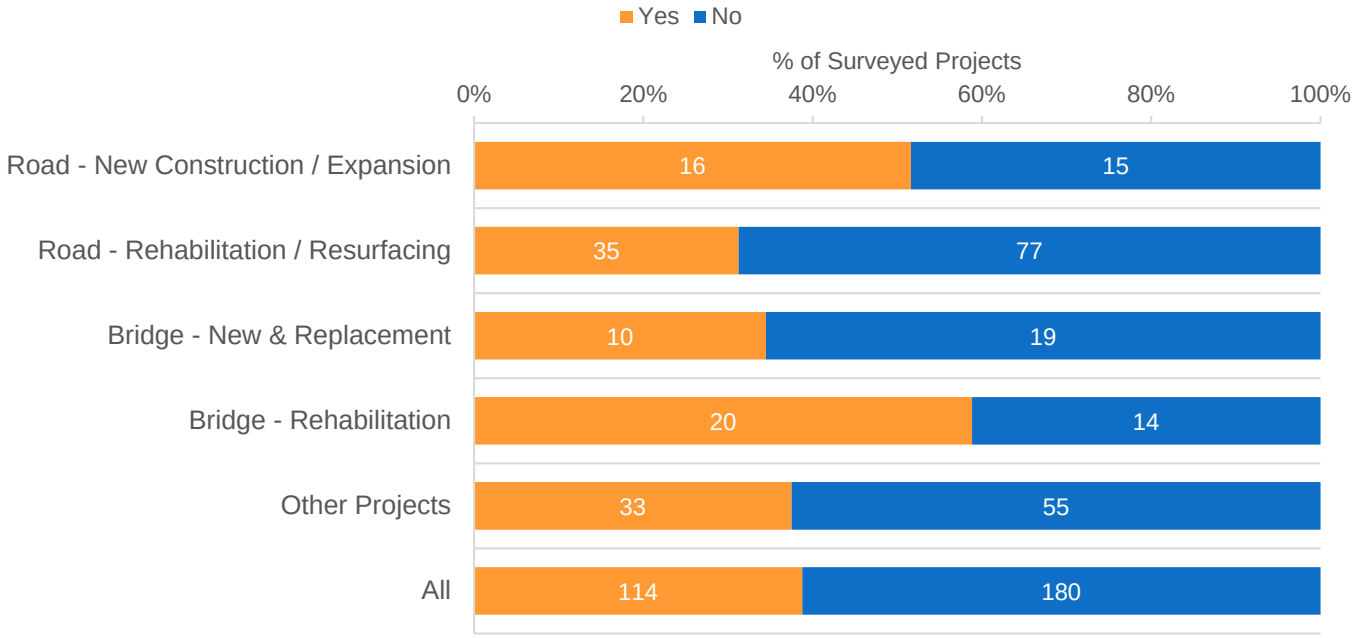


Over one third (39%) of the 305 projects included in the survey were reported to be under staffed.

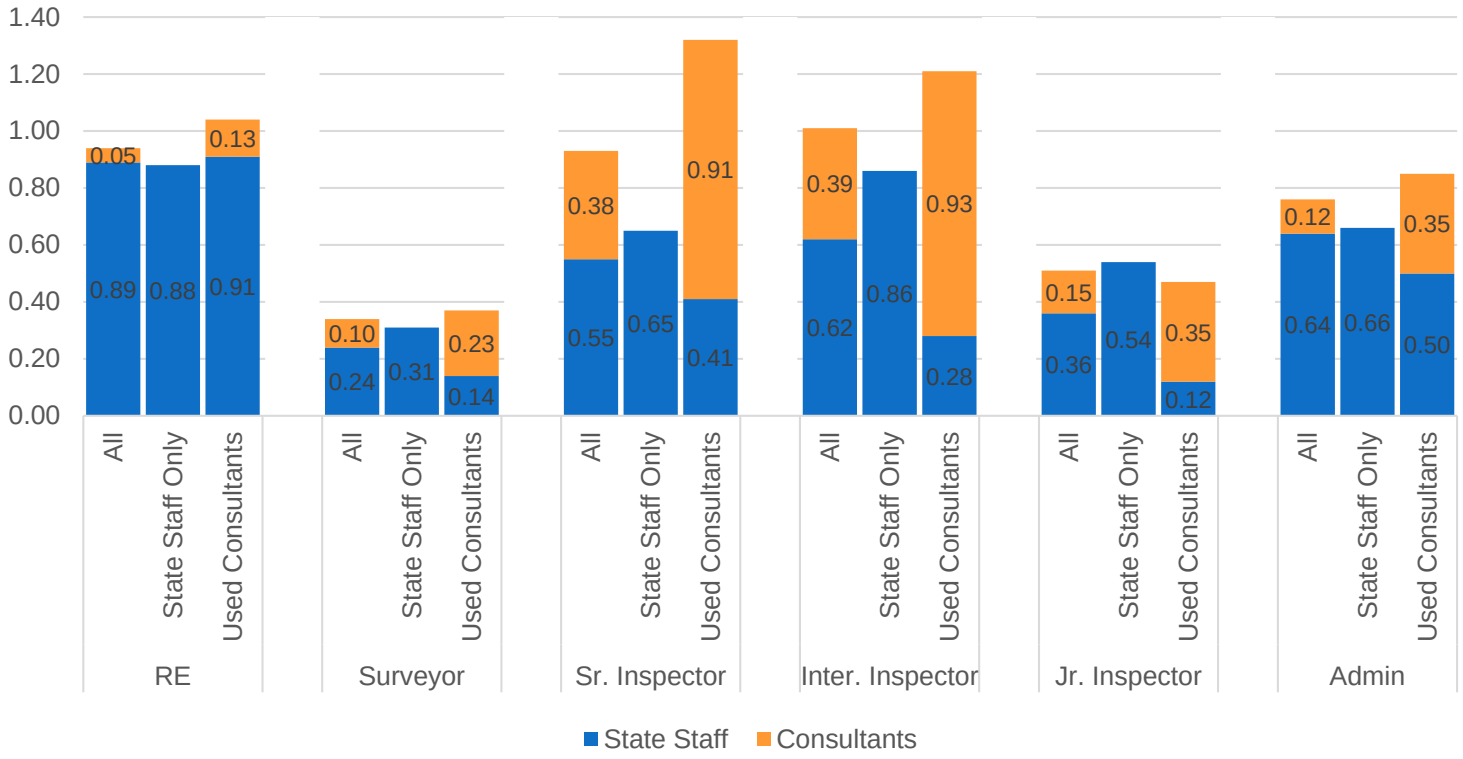
On average, surveyed projects were reported to be staffed at 86.9% of their required FTEs per DOT policy and procedure manual.



39% of State Transportation Agencies (STA) surveyed are using CEI Consultants



CEI use appears to be more common in larger and more complex projects

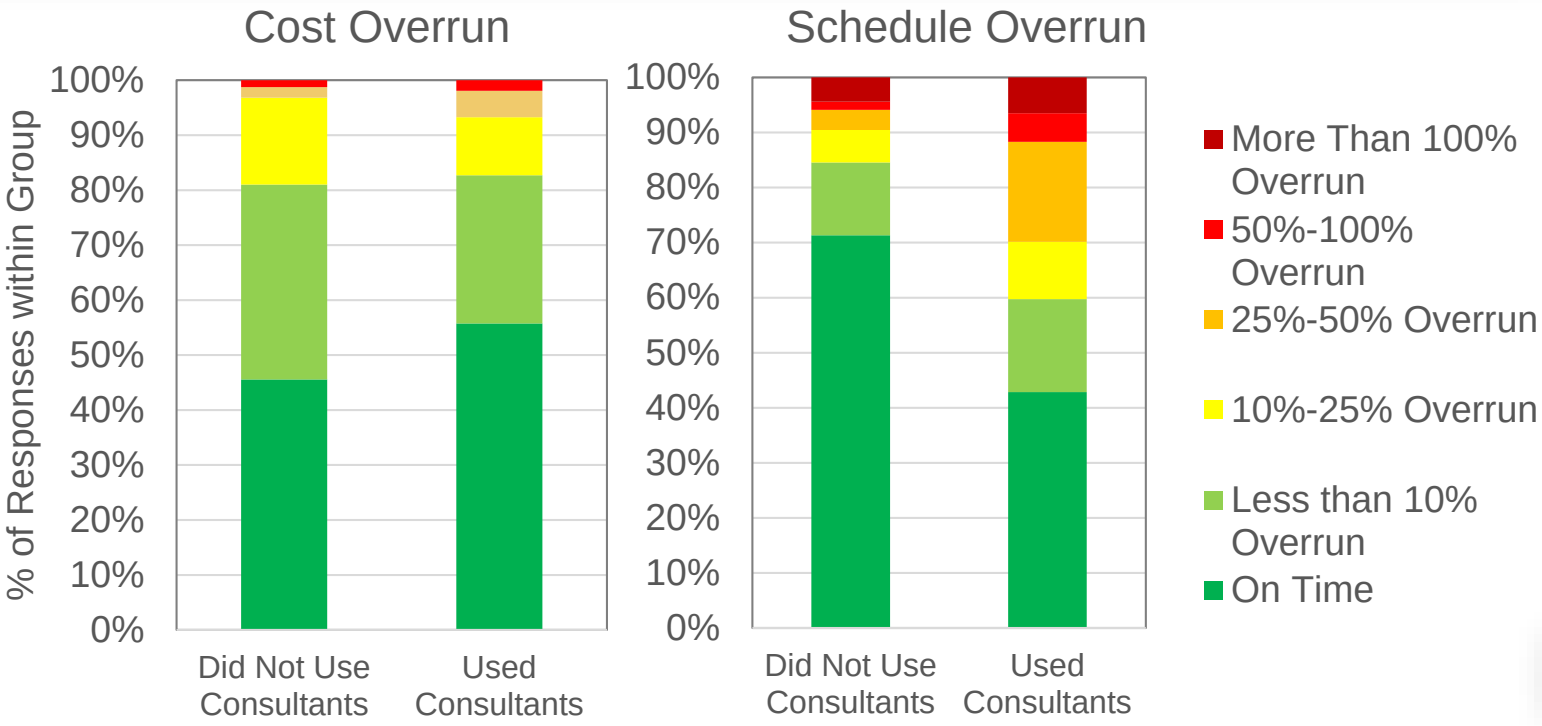


Full Time Equivalents (FTEs) reported for fully staffed projects (186 projects)

COMPARISON OF PROJECT PERFORMANCE WITH AND WITHOUT CEI CONSULTANTS

	No Consultants	Used Consultants	Total
Average Schedule Overrun	-7.70%	20.20%	2.40%
Average Cost Overrun	3.36%	3.34%	3.35%

COMPARISON OF PROJECT PERFORMANCE WITH AND WITHOUT CEI CONSULTANTS



Workforce Optimization Workbook (WOW)

What the WOW/eWOW is……

Construction season staff planning

Scalable

Project
Section
District

Guidance to less experienced managers

Starting point for staffing decisions

Structured, organized, and quantified method for staffing decisions

Starting point for staffing strategy selection

Short term
Long term

…….what the WOWe WOW is not!

THE solution to staffing shortages

Daily staffing assignments

A replacement for knowledge and experience

Local conditions
Contractors
Project specific challenges
Individual FTE capabilities

A black box that makes staffing decisions

Staffing strategy implementation tool

AVERAGE FTE REQUIREMENT BY POSITION AND BY PROJECT TYPE

Project Type	Resident Eng.	Surveyor	Sr. Inspector	Inter. Inspector	Jr. Inspector	Admin.
Road- New Construction / Expansion	1.27	0.71	1.69	1.95	0.63	1.16
Road- Rehabilitation / Resurfacing	0.94	0.20	0.90	1.01	0.71	0.69
Bridge - New & Replacement	1.08	0.42	1.17	0.92	0.50	0.75
Bridge - Rehabilitation	0.85	0.42	0.81	0.92	0.23	0.57
Other Projects	0.82	0.26	0.68	0.66	0.32	0.65
Special Structures (Rest Areas, Weigh Station, Toll Station, etc.)	1.00	1.33	0.67	1.67	0.33	1.67
All	**0.94**	**0.34**	**0.93**	**1.01**	**0.51**	**0.74**

WOW RISK RANKING

Constant Direct Field Involvement Required ← → No Direct Field Involvement Required

Road - New Construction / Expansion	Road - Rehabilitation / Resurfacing	Bridge - New / Replacement	Bridge - Rehabilitation	Other Projects
Pavement Surface	Pavement Surface	Superstructure	Excavation / Embankment	Intelligent Transportation Systems
Superstructure	Pavement Base	Structural Foundation	Structural Foundation	Temporary Traffic Control
Excavation / Embankment	Temporary Traffic Control	Substructure	Substructure	Structural Foundation
Pipe / Drainage	Roadway Base	Pavement Surface	Superstructure	Pipe / Drainage
Roadway Base	Excavation / Embankment	Excavation / Embankment	Pavement Surface	Excavation / Embankment
Pavement Base	Strips / Signs / Signals	Temporary Traffic Control	Pavement Base	Roadway Base
Substructure	Pipe / Drainage	Roadway Base	Roadway Base	Pavement Surface
Temporary Traffic Control	Superstructure	Pavement Base	Temporary Traffic Control	Utilities (In contract relocations)
Structural Foundation	Roadside	Pipe / Drainage	Roadside	Strips / Signs / Signals
Strips / Signs / Signals	Utilities (In contract relocations)	Utilities (In contract relocations)	Pipe / Drainage	Pavement Base
Roadside	Intelligent Transportation Systems	Strips / Signs / Signals	Strips / Signs / Signals	Roadside
Utilities (In contract relocations)	Roadway Lighting	Roadside	Utilities (In contract relocations)	Roadway Lighting
Roadway Lighting		Roadway Lighting		
Intelligent Transportation Systems				

STRATEGIES TO ALLEVIATE STAFF SHORTAGE

33 Strategies

Organized by:

Administration, Engineering, Inspection or Management/Public Relations

Construction Administration (A)	
A-1	Accelerated Construction Methods
A-2/I-2	Contract Requirements
A-2-1/I-2-1	Operations & Maintenance (by Contractor)
A-2-2/I-2-2	Warranty
A-2-3/I-2-3	Performance Based Specifications
A-3	Electronic Business Processes
A-3-1	Change Orders
A-3-2	Document Storage/Management/Work Flow
A-3-3	e-Signature
A-3-4	RFI
A-4/E-4/I-4	Electronic Field Books
A-5	GIS

STRATEGIES TO ALLEVIATE STAFF SHORTAGE

Applicability of Strategies

Each Tool Describes the What, Why, How & Additional Resources

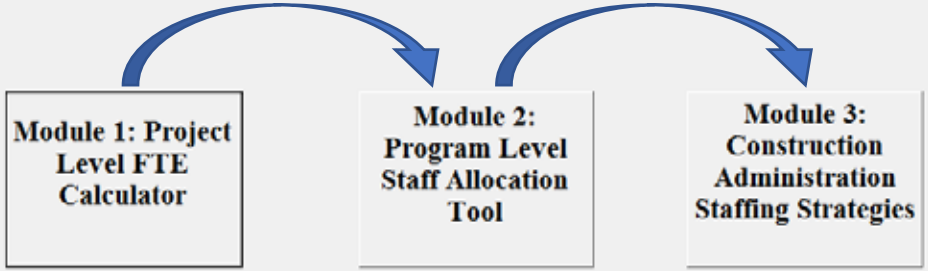
Construction Staff Function		Construction Administration (A)										
Strategy (Tool) / Work Type	A-1	A-2	A-2-1	A-2-2	A-2-3	A-3	A-3-1	A-3-2	A-3-3	A-3-4	A-4	A-5
Pavement Surface	★	☆	☆	☆	☆	☆	☆	☆	☆	☆	★	★
Superstructure	★	☆	☆	☆	☆	☆	☆	☆	☆	★	★	☆
Excavation / Embankment	★	☆			☆	☆	☆	☆	☆	☆	★	☆
Pipe / Drainage	☆	★	★	★	☆	☆	☆	☆	☆	☆	★	☆
Roadway Base	★	★	★	★	☆	☆	☆	☆	☆	☆	★	☆
Pavement Base	★	★	★	★	☆	☆	☆	☆	☆	☆	★	☆
Substructure	★	☆	☆	☆	☆	☆	☆	☆	☆	★	★	☆
Temporary Traffic Control	☆				☆	☆	☆	☆	☆	☆	★	★
Structural Foundation	★	☆	☆	☆	☆	☆	☆	☆	☆	★	★	☆
Strips / Signs / Signals	☆				☆	☆	☆	☆	☆	★	★	★
Roadside					☆	☆	☆	☆	☆	☆	★	★
Utilities (In contract relocations)	☆	★	★	★	☆	☆	☆	☆	☆	★	★	★
Roadway Lighting	☆	★	★	★	☆	☆	☆	☆	☆	★	★	★
Intelligent Transportation Systems		☆	☆	☆	☆	☆	☆	☆	☆	★	★	☆

Note: ★ – directly applicable and ☆ – indirectly applicable. Otherwise, not applicable.

eWOWDemonstration

e-WOW

Electronic Workforce Optimization Workbook



The Electronic Workforce Optimization Workbook (e-WOW) is a decision support tool designed to walk a user through the process of allocating construction staff, identifying shortages, and selecting strategies to mitigate those shortages. There are three e-WOW modules listed above and these may be used independently or in combination. To work through the entirety of e-WOW, start with Module 1 and follow the accompanying instructions.

FTE Calculator

Module 1: Project Level FTE Calculator

When used alone, this tool can assist in estimating the number of full-time equivalent (FTE) employees needed to staff a construction project for administration and inspection. The required project inputs are highlighted in yellow. Several of these inputs provide drop-down lists from which to choose. Based on the input information, the e-WOW will present the minimum, average, and maximum staff recommended based on similar data collected from over 1,000 projects. Users also have the option to enter their own staffing requirements by clicking the "Enter DOT Input Data" button and following the commands. The user can then toggle between the preloaded data and DOT input data. When used with the other modules of the e-WOW, this tool will allow the user to enter a single project ("Submit Project & Go To Module 2") or multiple projects ("Submit Project Information & Next Entry," using the "Go To Module 2" button for the last project entry) for analysis in the e-WOW.

Get Started!

Main Menu

Project Level FTE Calculator

Project Description			
Project Name	Anticipated Start Date	Anticipated Completion Date	
Project Type	Construction Estimate	Complexity	Use of CEI

Project Level FTE	Engineer	Surveyor	Admin Staff	Inspectors	Total Insp. Staff & Eng.
Minimum	#N/A	#N/A	#N/A	#N/A	#N/A
Average	#N/A	#N/A	#N/A	#N/A	#N/A
Maximum	#N/A	#N/A	#N/A	#N/A	#N/A

Enter DOT Input Data

Which dataset would you like to use for estimating staffing needs for this project?

(●) Preloaded Data ( ) DOT Input Data

NOTES:

- **The engineering and inspection staffing needs will be used in Module 2. This can be modified in Module 2.**
- FTE estimates are based on a national database of over 1000 projects.
- If you would like to use your own DOT's staffing needs in the FTE calculation, please click the "Enter DOT Input Data" button.
- Projects details vary so alteration of these estimates may be necessary(in Module 2).
- Project location and union status should be considered but minimally affect staffing needs.

Average FTE Requirement by Position and Project Type

Project Type	Project Count	Engineer	Surveyor	Sr. Inspector	Inter. Inspector	Jr. Inspector	Admin	Total Insp. Staff & Eng
Road - New Construction / Expansion	19	1.27	0.71	1.69	1.95	0.63	1.16	5.54
Road - Rehabilitation / Resurfacing	69	0.94	0.2	0.9	1.01	0.71	0.69	3.56
Bridge - New & Replacement	12	1.08	0.42	1.17	0.92	0.5	0.75	3.67
Bridge - Rehabilitation	24	0.85	0.42	0.81	0.92	0.23	0.57	2.81
Other Projects	47	0.82	0.26	0.68	0.66	0.32	0.65	2.48
Special Structures (Rest Areas, Weigh Stations, Toll Stations, etc.)	3	1.00	1.33	0.67	1.67	0.33	1.67	3.67
All	174	0.94	0.34	0.93	1.01	0.51	0.74	3.39

Submit Project Information & Next Entry

Submit Project & Go To Module 2: Staff Allocation

Go To Main Menu

Staff Allocation Tool

Module 2: Staff Allocation Tool

When used independently, users may enter project information, their project priorities (based on staffing), and their available crew (highlighted fields) to review where and when staffing shortages may occur. If used in conjunction with Module 1, only the priorities and available crew will need to be entered. Once the project priorities are entered, the user may click the "Review FTE Demands Schedule" button to review when staffing needs occur. The user may wish to modify start and completion dates (ONLY within the green cells) in an attempt to level resource needs. This module also allows users the opportunity to make other data alterations based on judgement as needed (green and yellow cells). Once the FTE needs are determined the user may wish to proceed to Module 3: Staffing Strategies.

Get Started!

Main Menu

Program Level Staff Allocation

Program of Projects

Go To Main Menu

Review FTE Demands Schedule

Go To Module 3: Staffing Strategies

Crew Available

Crew FTE Available	3

Review FTE Calc
(Enter Project # Below, Before Clicking)

Project # to Review	1

Clear Project

Project # to Clear

Clear All Projects

Prioritization	Project Name	Project Type	Engineer FTE	Inspector FTE	FTE Required[1]	Start	Completion	Project #
1	Mountain Parkway Examp	Road - New Construction / Expansion	1.47	9.23	10.70	6/1/2017	12/30/2019	1
6	A	Bridge - Rehabilitation	0.58	2.02	2.59	3/1/2018	9/30/2018	2
4	B	Road - New Construction / Expansion	1.20	2.68	3.88	5/1/2018	7/30/2020	3
3	C	Bridge - New & Replacement	0.88	2.01	2.89	3/1/2018	9/30/2018	4
5	D	Bridge - New & Replacement	0.88	2.01	2.89	6/1/2018	11/30/2018	5
2	E	Road - New Construction / Expansion	0.80	0.90	1.70	10/1/2017	9/30/2018	6
7	F	Road - Rehabilitation / Resurfacing	0.78	1.66	2.44	6/1/2018	9/30/2018	7
								8
								9

Staff Allocation

	Eng FTE Req	0	0	0	0	0	1.5	1.5	1.5	1.5	2.3	2.3	2.3	2.27	2.3	3.7	3.7	4.9	6.6	6.6	6.6	6.6	3.5	3.5	2.7	2.67	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	1.2	1.2	1
	Insp FTE Req	0	0	0	0	0	9.2	9.2	9.2	9.2	10	10	10	10.1	10	14	14	17	21	21	21	21	14	14	12	11.9	12	12	12	12	12	12	12	12	12	12	12	2.68	2.7	2
	FTE Required	0	0	0	0	0	11	11	11	11	12	12	12	12.4	12	18	18	22	27	27	27	27	17	17	15	14.6	15	15	15	15	15	15	15	15	15	15	15	3.88	3.9	3
	FTE Available	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	FTE Needs	0	0	0	0	0	7.7	7.7	7.7	7.7	9.4	9.4	9.4	9.4	9.4	15	15	19	24	24	24	24	14	14	12	11.6	12	12	12	12	12	12	12	12	12	12	12	0.88	0.9	0
	Year	2017												2018												2019												2020		
	Month	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3	4	5	6	7	8	9	10	11	12	1	2	3
Priority																																									
1	ntain Parkway Example																																								
Eng Needs	1.47						1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.47	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.47	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5			
Insp Needs	9.23						9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.23	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.23	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2	9.2			
FTE Needs	10.70						11	11	11	11	11	11	11	10.7	11	11	11	11	11	11	11	11	11	11	11	10.7	11	11	11	11	11	11	11	11	11	11	11			
Start	6/1/2017																																								
Complete	12/30/2019																																								
2	E																																								
Eng Needs	0.80										0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8																			
Insp Needs	0.90										0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9																			
FTE Needs	1.70										1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7	1.7																			
Start	10/1/2017																																								
Complete	9/30/2018																																								
3	C																																								
Eng Needs	0.88															0.9	0.9	0.9	0.9	0.9	0.9	0.9																			
Insp Needs	2.01															2	2	2	2	2	2	2																			
FTE Needs	2.89															2.9	2.9	2.9	2.9	2.9	2.9	2.9																			
Start	3/1/2018																																								
Complete	9/30/2018																																								
4	B																																								
Eng Needs	1.20																	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1.2	1
Insp Needs	2.68																	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.68	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.7	2.68	2.7	2
FTE Needs	3.88																	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.88	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.9	3.88	3.9	3
Start	5/1/2018																																								
Complete	7/30/2020																																								
5	D																		0.9	0.9	0.9	0.9	0.9	0.9																	
Eng Needs	0.88																		2	2	2	2	2	2																	
Insp Needs	2.01																		2.9	2.9	2.9	2.9	2.9	2.9																	
FTE Needs	2.89																																								
Start	6/1/2018																																								
Complete	11/30/2018																																								
6	A																																								

Staffing Strategies Selection

Module 3: Staffing Strategies Selection Tool

When used alone, users may enter the work types associated with their portfolio of projects and the risk level associated with the construction administration and inspection of those work types. Based on the input information, the most applicable tools will be highlighted in green, those likely applicable will be highlighted in orange, and less applicable tools will be highlighted in blue. The staffing strategy applicability was assigned by an expert panel of practitioners. The user can 'click' the hyperlinked name of the strategy to review detailed information on implementing the selected tool.

Get Started!

Main Menu

Your maximum staffing deficit is:	24.09

Work Type Survey	Applicable?	Risk Level
Pavement Surface	Yes	High
Superstructure	Yes	Medium
Excavation / Embankment	Yes	High
Pipe / Drainage	Yes	Low
Roadway Base	Yes	Medium
Pavement Base	Yes	Low
Substructure	Yes	High
Temporary Traffic Control	Yes	Medium
Structural Foundation	Yes	High
Strips / Signs / Signals	Yes	Low
Roadside	No	
Utilities (In contract relocations)	No	
Roadway Lighting	No	
Intelligent Transportation Systems	No	

Go To Main Menu

NOTES:

- Select the applicability of the work types based on your portfolio of projects.
- Assign risk to those work types according to quantity of work involved, the risk of it not being inspected, complexity, etc.
- Tool colors assigned according to practitioner feedback. Green are applicable tools, orange are likely applicable, and blue are likely not applicable.

Potential Tool Applicability	Construction Administration (A)	
3.80	A-1	Accelerated Construction Methods
2.20	A-2/I-2	Contract Requirements
1.90	A-2-1/I-2-1	Operations & Maintenance (by Contractor)
1.90	A-2-2/I-2-2	Warranty
2.10	A-2-3/I-2-3	Performance Based Specifications
2.10	A-3	Electronic Business Processes
2.10	A-3-1	Change Orders
2.10	A-3-2	Document Storage/Management/Work Flow
2.10	A-3-3	e-Signature
3.00	A-3-4	Electronic RFI
4.20	A-4/E-4/I-4	Electronic Field Books
2.70	A-5	Geographic Information Systems (GIS)

Potential Tool Applicability	Construction Engineering (E)	
3.10	E-1	3D Engineered Models for Construction
3.00	E-2	Automated Machine Guidance
3.10	E-3	Digital Terrain Models (DTMs)
4.20	A-4/E-4/I-4	Electronic Field Books
2.00	E-5/I-5	Ground Penetrating Radar (GPR)
4.20	E-6/I-6	Global Navigation Satellite Systems (GNSS)
2.30	E-7	Light Detection and Ranging (LiDAR)
4.20	E-8/HR-3	Resource Allocation/Leveling--
4.20	E-8-1/HR-3-1	District & Project Level
4.20	E-8-2/HR-3-2	Project Phasing
4.20	E-8-3/HR-3-3	Shifting Letting Dates
4.20	E-9/I-14	Robotic Total Stations
2.90	E-10/I-15	Project Inspection Test Plan

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A-4/E-4/I-4 Electronic Field Books

What is it?

Electronic Field Books refer to an array of hand held electronic devices that are self-contained and possess the ability to run multiple software applications as well as store and retrieve text and graphical data remotely. Electronic Field Books may be in the form of either laptop or tablet personal computers. The devices may either be connected to remote servers with the ability to continually access and retrieve data when needed or designed to synchronize their data when they come in range of a hotspot, such as through a smart phone, or other signal type of Wi-Fi signal.

Why use it?

The integration and automation of information systems improves task productivity of construction staff thereby allowing them to working across multiple projects over larger geographical areas. Major benefits of Electronic Field Books are an increase in the organization of field-generated data, a decrease in the cycle time of that data's availability to other construction staff, and the decrease in the time required for contract administrative duties.

Additional Resources

National Cooperative Highway Research Program (NCHRP) (2007). Emerging Technologies for Construction Delivery. NCHRP Synthesis 372. The National Academies Press.

When to use it?

Electronic field books help with any or all of the following applications: data organization, data documentation, data exchange, and data access.

The following table summarizes how electronic field books can be used to alleviate staffing shortages for various work types and project types.

✓✓ Directly Applicable (There has been documented application for this strategy specifically for this work type.)
✓ Indirectly Applicable
X Not Applicable

Project Types	Road New Construction / Expansion	Road Rehabilitation / Resurfacing	Bridge - New / Replacement	Bridge Rehabilitation	Other Projects
Pavement Surface	✓✓	✓✓	✓✓	✓✓	✓✓
Superstructure	✓	✓	✓	✓	✓
Excavation / Embankment	✓✓	✓✓	✓✓	✓✓	✓✓
Pipe / Drainage	✓✓	✓✓	✓✓	✓✓	✓✓
Roadway Base	✓✓	✓✓	✓✓	✓✓	✓✓
Pavement Base	✓✓	✓✓	✓✓	✓✓	✓✓
Substructure	✓✓	✓✓	✓✓	✓✓	✓✓
Temporary Traffic Control	✓	✓	✓	✓	✓
Structural Foundation	✓✓	✓✓	✓✓	✓✓	✓✓
Strips / Signs / Signals	✓✓	✓✓	✓✓	✓✓	✓✓
Roadside	✓	✓	✓	✓	✓
Utilities (In contract relocations)	✓✓	✓✓	✓✓	✓✓	✓✓
Roadway Lighting	✓✓	✓✓	✓✓	✓✓	✓✓
Intelligent Transportation Systems	✓	✓	✓	✓	✓

USEFUL TOOLS TO REVIEW RELATIVE TO COVID-19

A-3	Electronic Business Processes
A-3-1	Change Orders
A-3-2	Document Storage/Management/Work Flow
A-3-3	e-Signature
A-3-4	RFI
A-4/E-4/I-4	Electronic Field Books
A-2/I-2	Contract Requirements
A-2-1/I-2-1	Operations & Maintenance (by Contractor)
A-2-2/I-2-2	Warranty
A-4/E-4/I-4	Electronic Field Books

USEFUL TOOLS TO REVIEW RELATIVE TO GOV (Cont.)

E-1	3D Imaging
I-1	Concrete Maturity Meters
I-3	e-Inspection
E-5/I-5	GPR
E-6/I-6	GPS/GNSS
I-7	Infrared Temp. Systems (IRpave)
I-13	Risk Based Inspection
E-9/I-14	Robotic Total Stations
E-10/I-15	Schedule Milestone Inspections
I-16	UAV
HR-1	CEI Consultants

THANKS!

Any questions?

You can find us at:

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Roy Sturgill, *Iowa State University*

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