

AN OUTLINE TO A MANUAL ON MANAGING AND ADMINISTERING ALASKA  
MUNICIPAL PUBLIC WORKS AND STATE OF ALASKA DOT&PF HIGHWAY PROJECTS

By

Forrester Cook, B.S.

A Project Submitted in Partial Fulfillment of the Requirements

for the Degree of

MASTER OF SCIENCE

in

Project Management

University of Alaska Anchorage

May 2022

APPROVED:

LuAnn Piccard, M.S., PMP, Committee Chair

Roger Hull, B.S., PMP, Committee Member

Matthew Calhoun, Ph.D., Committee Member

LuAnn Piccard, M.S., PMP, Chair

*Department of Project Management*

Kenrick Mock, Ph.D., Dean

*College of Engineering*



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## **Abstract**

The design phase and construction phase for public works and civil transportation projects over the last century have become extensively specialized. Consequently, design guides and construction manual literature accessible to project managers, design engineers, and construction engineers has become more comprehensive and increasingly detailed, and additional specialized skill sets are now required to manage and administer heavy civil projects. Gaps exist in the available civil engineering literature and no guide or manual that follows the overall life of a public works or civil transportation project through the complete project lifecycle has been developed by an independent author, a local municipal government, or by a state department of transportation.

This project developed an outline to a comprehensive civil engineering manual for managing and administering Alaska municipal public works and State of Alaska DOT&PF highway projects. The outline has brought together necessary elements of design engineering, construction contract administration, construction inspection, materials testing and special inspections, and project management. The manual outline was progressively elaborated in conjunction with several research phases that occurred throughout a four-year period. Literature review of published resources specific to Alaska was followed by interviews with design/construction engineers and project managers (SMEs) from several state departments of transportation.

## **Key Words**

Civil engineering, transportation engineering, design engineering, construction engineering, construction project management, project management, construction contract administration, construction inspection, materials testing, stormwater management, State of Alaska Department of Transportation & Public Facilities (DOT&PF), American Association of State Highway and Transportation Officials (AASHTO), Federal Highway Administration (FHWA), design criteria, constructability review, distressed pavement, AC pavement treatments, PCC pavement treatments, schedule delays, concrete curing, change orders

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## **Introduction**

Due to necessity and coupled with advancements in engineering, construction, and technology over the last century, both the design phase and construction phase for public works and civil transportation projects have become extensively specialized. As design guides and construction manual literature accessible to project managers, designers, and construction engineers has become more comprehensive and increasingly detailed, additional specialized skill sets are now required to manage and administer heavy civil projects. As of early 2022, gaps exist in the available project management (PM), design engineering, and construction engineering literature. Significant investigation by the researcher has revealed no guide or manual that focuses on/follows the overall life of a public works or a civil transportation project through the complete project lifecycle has been developed by an independent author, a local municipal government, or by a state department of transportation.

This project primarily focused on developing an outline to a comprehensive civil engineering manual. This project constructed the outline for a manual that effectively follows the life of a civil transportation project from initiation through closeout by fully integrating elements of design engineering, construction contract administration, construction inspection, materials & special testing, and project management.

## **Project Purpose**

The researcher has identified an opportunity to fill voids in the available PM, design engineering, and construction engineering literature accessible to civil engineers responsible for managing and administering Alaska municipal public works and State of Alaska DOT&PF highway projects. The objective of this project was to develop an outline to a manual enabling the researcher to perform additional content research. The outline brings together all the necessary elements to guide the researcher's efforts to ultimately write and publish an unparalleled civil engineering manual.

Development of the manual – initiated by crafting of this report and the manual outline – will result in a comprehensive document that integrates the distinct elements of design, construction, and project management in a linear fashion through the entire project lifecycle.



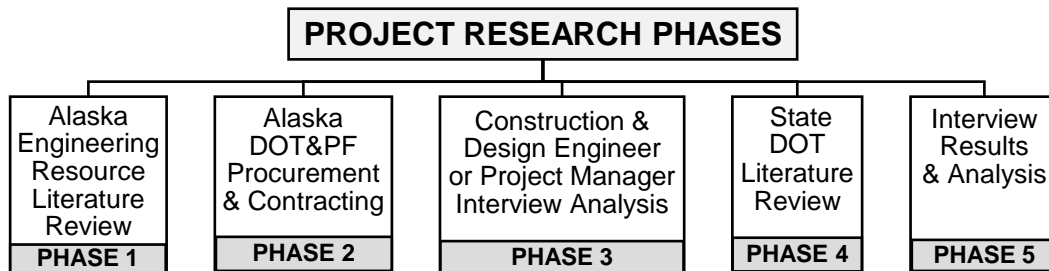
## **Post Project Benefits**

The following benefits are anticipated for Alaska heavy civil construction projects as a result of implementing strategies and approaches described in the final published manual:

- Construction cost savings to project owners.
- Maintenance and operation cost savings to project owners
- Greater early planning
- Reduced drawing and specification conflicts
- Minimized scope changes
- Less field orders and change orders during construction
- Desirably no claims, disputes, or legal actions
- The manual would combine resources and allow terminology differences among the disciplines to be shared.
- Design engineers would have an additional resource to consult when questions specific to construction – construction phasing, construction safety, construction practices / means & methods, construction equipment – arise during the design phase.
- The manual would facilitate effective communication between construction engineers and contractors pertaining to design intent for specific project elements expressed using the specifications and construction drawings
- Contractors could use the manual as an additional resource when estimating and bidding on work.

## Research Approach and Methods

Research for this project included five separate phases cumulatively occurring over a 4-year period. The first phase of research included a literature review of published resources common to Alaska, the Kenai Peninsula, the Mat-Su Valley, and the Municipality of Anchorage. Following the preliminary research phase, the second research phase focused on providing greater clarity to the big-picture timeline associated with DOT&PF civil infrastructure projects and their respective delivery models. The third research phase involved conducting telephone interviews with construction/design engineers or project managers from state departments of transportation (DOTs). The fourth research phase included a second round of literature review based upon guidance from the engineering subject matter experts (SMEs). After the SME interviews had taken place and the subsequent literature review had been completed, the final phase formulated research results and analysis from Phase 3. Exhibit 1 graphically presents the five research phases completed to execute the project.



**Exhibit 1: Five Research Phases Supporting Project Deliverables**

The researcher employed telephone interviews and literature review as the two primary research methods, and a questionnaire was the single data collection instrument. Before presenting the five research phases, design engineering for civil infrastructure will be detailed and construction engineering will be defined. Additionally, civil infrastructure projects will be categorized for both Alaska municipal public works and State of Alaska DOT&PF highway projects.

### **Design Engineering and Construction Engineering**

Civil engineers design and/or contribute to many behind-the-scene infrastructure systems. The broad spectrum of transportation and public works infrastructure includes urban and rural roadway systems, water distribution systems, wastewater systems, storm drainage systems, flood control systems, drainage and river systems, foundation systems, and structural systems. As defined by the researcher, construction engineering – as a domain of professional practice – integrates the subdisciplines of civil engineering e.g., transportation, water resources, structural, geotechnical, environmental, to facilitate the construction of infrastructure.

## **Civil Infrastructure Project Types**

DOT&PF projects generally can be described by the following classifications and categories:

- 1R – preventive maintenance (resurfacing / overlay) projects
- 3R – resurfacing, restoration, and rehabilitation projects
- 4R – new construction projects
- Roadway reconstruction projects
- Bridge repair projects
- Bridge replacement projects
- Bridge rehabilitation projects
- Intersection improvement projects
- Traffic and safety improvement projects
- Pedestrian facility projects
- Americans with Disabilities Act (ADA) improvement projects
- Utility improvement projects
- Slope stabilization projects
- Fish passage culvert projects

Alaska municipal public works projects generally align with one of the following categories:

- Preventive maintenance projects
- Roadway reconstruction projects with new water, sanitary sewer, and storm drain facilities.
- Utility infrastructure projects
- Infrastructure maintenance projects
- Subdivision development projects
- Facility projects – water treatment plants sand sewage treatment plants

## **Research Phase 1 – Alaska Engineering Resource Literature Review**

Literature review conducted during the preliminary research phase focused on design guides, construction manuals, and related literature developed by the State of Alaska Department of Transportation and Public Facilities (DOT&PF), the Municipality of Anchorage (MOA), the American Association of State Highway and Transportation Officials (AASHTO), and the Federal Highway Administration (FHWA).

The two primary goals for this research phase included:

- Identify a minimum of 15 transportation engineering, public works, or heavy civil construction resources available to civil engineers practicing in Alaska.
- Develop a comprehensive list of civil engineering subtopics related to structural engineering, environmental engineering, transportation engineering, water resources engineering, traffic engineering, construction engineering, geotechnical engineering, contract administration, owner's representation, and heavy civil project management.

The researcher used professional experience and advanced web search techniques including truncation, quick searches, and phrase searching to identify literature resources associated with goal number one. These resources including their agency author have been summarized in Exhibit 2. During the 4-year research period, the author additionally completed a Bachelor of Science degree in Civil Engineering (BSCE) at the University of Alaska Anchorage. Completion of the BSCE degree program coupled with content from Exhibit 2 facilitated the development of Exhibit 3 and Exhibit 4, which respectively provide comprehensive design-related civil engineering and construction and project management-related civil engineering subtopic areas.

<b>Resource No.</b>	<b>Document Title</b>	<b>Agency Author or Publisher</b>	<b>Focus</b>
1	<i>A Policy on Geometric Design of Highway and Streets, AKA “the Green Book”</i>	AASHTO	Highway design
2	<i>Guidelines for the Geometric Design of Very Low-Volume Local Roads</i>	AASHTO	Rural roadway design
3	<i>Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Supports</i>	AASHTO	Structural design
4	<i>Alaska Highway Preconstruction Manual</i>	DOT&PF	Roadway design
5	<i>Alaska Construction Manual</i>	DOT&PF	Construction administration
6	<i>Manual on Uniform Traffic Control Devices (MUTCD)</i>	AASHTO	Traffic safety
7	<i>Design Criteria Manual</i>	MOA	Street design
8	<i>Design and Construction Practices Manual</i>	AWWU	Water and waste water design
9	<i>Standard Specifications for Highway Construction</i>	DOT&PF	Construction
10	<i>Asphalt Paving Inspector’s Manual</i>	DOT&PF	HMA laydown
11	<i>Municipality of Anchorage Standard Specifications</i>	MOA	Construction
12	<i>Construction Manual for Highway Construction</i>	AASHTO	Construction administration
13	<i>Culvert &amp; Storm Drain System Inspection Guide</i>	AASHTO	Inspection
14	<i>Soil Mechanics: NAVFAC DM 7.01</i>	US Navy	Geotechnical design
15	<i>Foundations and Earth Structures: NAVFAC DM 7.02</i>	US Navy	Geotechnical design
16	<i>Construction Contract Administration Practice Guide</i>	CSI	Contract administration
17	<i>Design and Control of Concrete Mixtures</i>	PCA	Concrete
18	<i>The Asphalt Handbook</i>	Asphalt Institute	Hot mix asphalt
19	<i>Frozen Ground Engineering</i>	Wiley	Arctic engineering
20	<i>Cold Regions Pavement Engineering</i>	ASCE	Pavement design
21	<i>Alaska Highway Drainage Manual</i>	DOT&PF	Water resources engineering
22	<i>Alaska Bridges and Structure Manual</i>	DOT&PF	Bridge design
23	<i>Alaska Standard Plans Manual</i>	DOT&PF	Construction

**Exhibit 2: Civil Engineering Design Standards and Resources Commonly Used by Designers and Resident Engineers**

<b>Subtopic No.</b>	<b>Subtopic Description</b>	<b>Engineering Domain</b>
1	Reinforced concrete design	Structural
2	Steel design	Structural
3	Timber design	Structural
4	Water quality and water treatment	Environmental
5	Wastewater treatment	Environmental
6	NEPA permitting	Environmental
7	Air pollution, solid and hazardous waste	Environmental
8	Design of sanitary sewers	Water & Wastewater
9	Water treatment plants	Water & Wastewater
10	Pipes, pumps, and distribution systems	Water & Wastewater
11	Open channel flow & drainage channel design	Water Resources
12	Culvert design	Water Resources
13	Statistical hydrology	Water Resources
14	Runoff and stormwater collection	Water Resources
15	Groundwater hydrology	Water Resources
16	Roadway design criteria	Transportation
17	Intersection design	Transportation
18	Geometric roadway design	Transportation
19	Flexible pavement design	Transportation
20	Rigid pavement design	Transportation
21	ADA-compliant pedestrian facilities	Transportation
22	Utility coordination	Transportation
23	Public involvement	Transportation
24	Transportation planning	Transportation
25	Air, rail, and water transportation	Transportation
26	Traffic analysis and operations	Traffic
27	Traffic engineering studies	Traffic
28	Principles of traffic flow	Traffic
29	Geology, origins of soil, and soil properties	Geotechnical
30	Soil classifications/identification	Geotechnical
31	Atterberg limits	Geotechnical
32	Seepage	Geotechnical
33	Soil compressibility	Geotechnical
34	Lateral earth pressure	Geotechnical
35	Subsurface soil investigations	Geotechnical
36	Permafrost	Geotechnical
37	Shallow foundation design	Geotechnical
38	Deep foundation design	Geotechnical
39	Slope stability	Geotechnical
40	Geosynthetics	Geotechnical

**Exhibit 3: Design-related Civil Engineering Subtopic Areas**

<b>Subtopic No.</b>	<b>Subtopic Description</b>	<b>Engineering Domain</b>
1	Construction engineering	Construction
2	Construction contract administration	Construction
3	Construction inspection	Construction
4	On-site materials testing	Construction
5	Special inspection & off-site materials testing	Construction
6	Cost estimating	Construction
7	Alternative delivery methods	Construction
8	Contract change orders	Construction
9	EJCDC and AIA standard form agreements	Construction
10	State and municipal standards specifications for highway construction	Construction
11	Standard construction details	Construction
12	Stormwater management	Construction
13	SWPPP preparation	Construction
14	DOT&PF and municipal SWPPP inspections	Construction
15	SWPPP administration	Construction
16	Owner's representation	Construction
17	As-built drawings	Construction
18	Delays, claims, and disputes	Construction
19	Documentation and recordkeeping	Construction
20	Closeout requirements	Construction
21	Temporary structures and facilities	Construction
22	Construction operations and methods	Construction
23	Work zone and site safety	Construction
24	Scheduling	Construction
25	Client & quality requirements	Project Management
26	Stakeholder management	Project Management
27	Risk management	Project Management
28	Project cost analysis	Project Management
29	Logistics and project planning	Project Management
30	Bidding and letting	Project Management
31	Project management software	Project Management
32	Resource management	Project Management

**Exhibit 4: Construction and Project Management-related Civil Engineering Subtopic Areas**

Exhibit 3 and Exhibit 4 provide the results associated with the second goal of research phase 1. Following refinement of Exhibit 3 and Exhibit 4 the researcher iteratively updated the main project deliverable, the manual outline, located in Appendix A.

## Research Phase 2 – Alaska DOT&PF Procurement and Contracting

This research phase focused on providing transparency to the big-picture timeline associated with DOT&PF projects. Two exhibits were developed to illustrate the various timelines that materialize depending on the project delivery model.

In each region of Alaska, four project delivery models are facilitated by DOT&PF to design and construct infrastructure projects. The four primary project delivery models include:

1. DOT&PF in-house design with DOT&PF in-house construction administration (CA).
2. DOT&PF in-house design with consultant CA.
3. Consultant design with DOT&PF in-house CA.
4. Consultant design with consultant CA.

Following identification of the primary project delivery models, the researcher conducted an extensive review of the Central Region DOT&PF procurement and contracting webpages. Exhibit 5 presents the initial findings for Alaska DOT&PF procurement and contracting resources and defines important DOT&PF project timeline elements (State of Alaska, 2022: a, e-g, i).

<b>Alaska DOT&amp;PF Planning Tool &amp; DOT&amp;PF Procurement and Contracting Websites</b>	<b>Background &amp; Purpose</b>	<b>Timeline Element</b>
Statewide Transportation Improvement Program (STIP)	<p>The STIP is used as a planning tool to assist with the development and maintenance of DOT&amp;PF’s surface transportation infrastructure. The STIP details all surface transportation improvements where partial or full federal funding has been approved. The STIP does not include aviation projects, ports &amp; harbor projects, or wholly state-funded projects.</p> <p>For a selected transportation project, the STIP details the approved funding per fiscal year for the 4-year STIP period. Funding per year is allocated to project phases including right-of-way, preliminary design, utilities, and construction.</p>	DOT&PF projects are first documented and listed in the STIP before they ever reach procurement or construction. The STIP is the 1 <sup>st</sup> step for all DOT&PF projects.

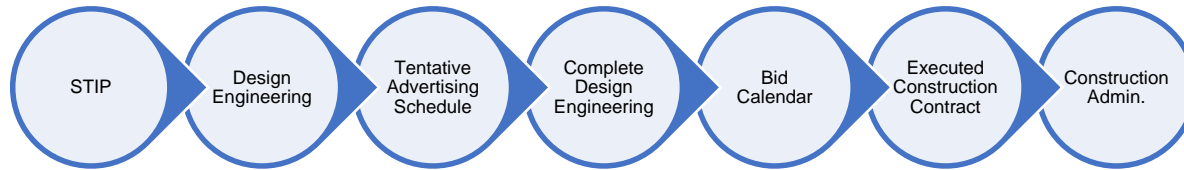
**Exhibit 5: DOT&PF Project Timeline Elements/Planning, Design and Procurement Resources**



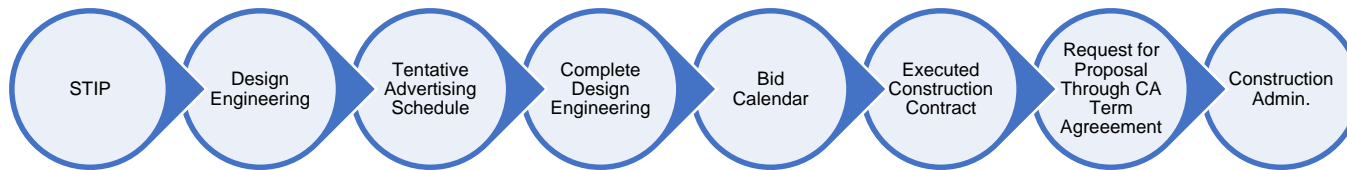
<b>Alaska DOT&amp;PF Planning Tool &amp; DOT&amp;PF Procurement and Contracting Websites</b>	<b>Background &amp; Purpose</b>	<b>Timeline Element</b>
Tentative RFP Advertising Schedule	The DOT&PF uses the Tentative RFP Advertising Schedule to identify upcoming projects where professional design services will soon be solicited. Request for proposals (RFPs) for construction administration services term agreements are also included on this list.	Projects with a consultant designer exhibit the Tentative RFP Advertising Schedule as the 2 <sup>nd</sup> element in the timeline, following the STIP.
Request for Proposal: \$200K for FHWA – Over and Under	The DOT&PF uses the RFPs Over \$200K list and the RFPs Under \$200K list to advertise professional design or construction engineering services. Design projects and construction projects are included in these lists.	For consultant design projects, this timeline element represents the solicitation and execution of a design services agreement.
Tentative Advertising Schedule (TAS)	Projects listed on the tentative advertising schedule are anticipated to be advertised/solicited for construction within the next 12 calendar months. TAS-listed projects reflect those projects where design services (DOT&PF or consultant) have not finished, and PS&E documents are still being developed.	This timeline element is amid the design engineering and complete design engineering elements for all delivery models.
Bid Calendar	Projects detailed on the bid calendar were previously listed on the Tentative Advertising Schedule and represent those projects the Department is currently soliciting for bids from construction general contractors. Bid calendar projects reflect those projects where PS&E design services are complete, aside from addendum, interpretation during bidding, etc. These projects will be constructed by a prime contractor with administration of the contract facilitated by either the Department or a consultant.	For all delivery models, this timeline element occurs directly prior to establishing a construction contract.

**Exhibit 5 Continued**

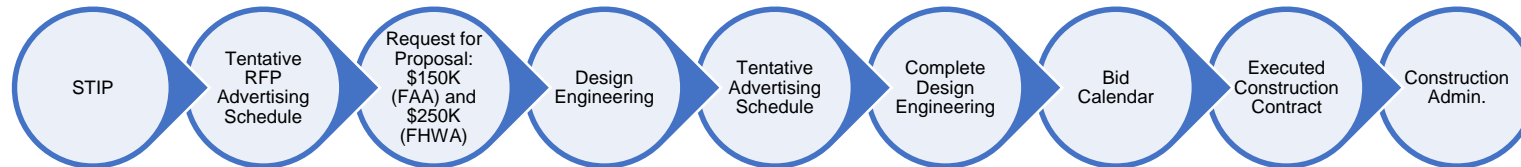
The researcher used Exhibit 5 as a starting point to develop a separate DOT&PF project delivery timeline for each of the four delivery models. Exhibit 6 presents project delivery timelines for all four delivery models.



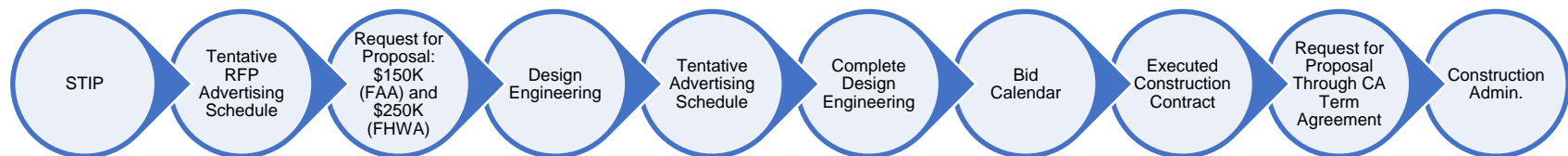
**DOT&PF In-house Design with DOT&PF In-house CA**



**DOT&PF In-house Design with Consultant CA**



**Consultant Design with DOT&PF In-house CA**



**Consultant Design with Consultant CA**

**Exhibit 6: DOT&PF Project Delivery Timelines**

While Exhibit 6 presents general project delivery timelines, the researcher developed Exhibit 7 to communicate the progression of the construction plan set. The plan set, or construction drawings, are prepared by the design engineer of record and graphically communicate the project design intended for construction. The plan set is perhaps the most critical component of the contract document package, described later in the Research Phase 5 section of the report. The project design is progressively developed through several stages. The design phases do not necessarily correlate with the timeline elements presented in Exhibit 6, however. Exhibit 7 presents the plan set categories for the progressive design phases and describes how design documents are modified to become record drawings.

<b>Design Level</b>	<b>Plan Set Category</b>	<b>Description</b>
30-50%	Local Review	Early design package without complete set of applicable survey, H&H, geotechnical, utility, and traffic data. Design(s) non-finalized.
60-75%	Plans-in-hand	Progressive design
95%	PS&E Review	Pre-final design
100%	Certification Set	Final design
100%	As Advertised	The plan set used by contractors to perform quantity take-offs and ultimately develop their bids – fundamentally the Cert. Set but includes last minute adjudications / corrections the designer made to accommodate owner comments.
100% +	As Awarded / Conformed Copy	The plan set the contractor builds with. This plan set is the As Advertised package plus any pre-contract revisions – additions/modifications from addenda issued during the bidding process.
100% +	As-built Set / Red Line As-Builts	This plan set results from the construction administration team marking up a copy of the As Awarded plans, illustrating how the infrastructure was actually constructed. Minor or major departs from the planned design – impacting the permanent elements – are documented.
100% +	Record Drawings	Developed by the owner or at owner’s direction based upon red line as-builts.

**Exhibit 7: Design & Construction Plan Set Development**

### Research Phase 3 – Construction/Design Engineer or Project Manager Interview Analysis

A questionnaire was developed by the researcher to gather data specific to engineering design manuals, local municipal design manuals, DOT construction manuals, construction engineering training, the resident engineer position, and the presence of voids in the available transportation engineering literature. As detailed below in Exhibit 8 and Exhibit 9, forty-five design engineers, construction engineers, and project managers from twenty-three state DOTs were contacted. In total, six telephone interviews were conducted, representing an outreach response rate of thirteen percent. Additional results and analysis from the SME telephone surveys are described later in the Research Phase 5 section of this report.

Agency No.	State DOT	Contacted	Surveyed
1	California	X	
2	Washington	X	
3	Oregon	X	
4	Georgia	X	X
5	North Dakota	X	
6	New York	X	
7	Florida	X	X
8	Arizona	X	
9	New Jersey	X	X
10	Pennsylvania	X	
11	New Mexico	X	
12	Wisconsin	X	
13	Minnesota	X	
14	Texas	X	
15	Alabama	X	X
16	Oklahoma	X	X
17	Ohio	X	
18	North Carolina	X	X
19	West Virginia	X	
20	Nevada	X	
21	Delaware	X	
22	Tennessee	X	
23	Kansas	X	

**Exhibit 8: State DOTs Contacted and Surveyed**

<b>Agencies/State DOTs Contacted</b>	23
<b>State DOT Engineers Contacted</b>	45
<b>State DOT Engineers Surveyed</b>	6
<b>Outreach Success Rate</b>	13%

**Exhibit 9: Research Data Table**

## **Research Phase 4 – State Specific DOT Literature Review**

The fourth research phase included a secondary round of literature review based upon guidance from the engineering SMEs. The researcher accessed the Department of Transportation websites for Georgia, Florida, New Jersey, Alabama, Oklahoma, and North Carolina and investigated the available civil engineering literature on their respective webpages. The Florida, Georgia, and New Jersey DOTs were determined to have the most robust online resources out of the DOT websites sampled. The Alabaman, Oklahoma, and North Carolina DOTs identified to have less applicable design engineering literature.

This section of the report highlights design engineering and construction engineering information obtained from the Florida, Georgia, and New Jersey DOT websites. Supplemental civil engineering background information is also provided in this section to add context to the highlighted design/construction elements obtained from the respective DOTs.

### **Florida Department of Transportation**

#### Design Criteria

The FHWA has determined controlling design criteria to be those design parameters having substantial importance to the safety and operational performance of a roadway.

These design criteria, or design parameters, must conform to the *Green Book* on all federally funded projects. Furthermore, AASHTO and FHWA have designated ten design parameters as controlling design criteria. The controlling design criteria are applicable to all projects on the National Highway System (NHS), a network of critical highways throughout the United States (Federal Register, 2016). On DOT&PF facilities (2020) the ten controlling design criteria for high-speed NHS roadways with design speed greater than or equal to 50 mph include:

1. Design speed
2. Lane width
3. Shoulder width
4. Horizontal alignment
5. Superelevation
6. Maximum grade
7. Stopping sight distance
8. Cross-slope
9. Vertical clearance
10. Structural capacity

Only two controlling design criteria are necessitated for low-speed NHS roadways – design speed less than 50 mph – and they include:

1. Design speed
2. Structural capacity

Review of Florida DOT resources (Florida Department of Transportation, 2016) revealed Exhibit 10 which provides vertical clearance criteria for several roadway functional classifications and railroads. The railroad facilities in Florida require a significantly larger vertical clearance (approximately 7-ft min.) compared to interstate, arterial, and collector roadway facilities in Florida.

Vertical Clearance Criteria						
	Criteria	Facility Above (All: Interstate, Freeway, Arterial, Collector, Railroad)			Signs/Signals/Peds	DMS
		FDOT New Const.	FDOT RRR	AASHTO	All	All
Facility Below	Interstate	16.5'	16'	16' (14' Alt)	17.5' FDOT (New/RRR) 17' AASHTO	19.5'
	Freeway		14.5'	16' (14' Alt)		
	Arterial			16' New/14' Existing		
	Collector, Other		14'			
	Railroad	23.5'	23'	N/A	N/A	
	Railroad: Elect	24.25'			N/A	N/A

**Exhibit 10: Florida DOT Vertical Clearance Criteria**

Based on Exhibit 10, the researcher reviewed the *Alaska Highway Preconstruction Manual* and located a comparable DOT&PF vertical clearance table for statewide NHS facilities, shown below with Exhibit 11.

RECOMMENDED VERTICAL CLEARANCE*								
OVERPASSING FACILITY UNDERPASSING FACILITY	STATE HIGHWAY		LOCAL ROADS OR STREETS	RAILROAD	PEDESTRIAN STRUCTURES	SIGN BRIDGES	BOTTOM SIGNAL HOUSING	OVERHEAD UTILITIES
	INTER-CHANGE	GRADE SEPARATION						
LOCAL ROADS OR STREETS	16 ft - 6 in.	16 ft - 6 in. **			17 ft - 6 in.	18 ft - 6 in.	17 ft - 6 in.	20 ft - 6 in.
STATE HIGHWAY	16 ft - 6 in. **							
RAILROAD				23 ft				27 ft - 6 in.
PEDESTRIAN FACILITY				8 ft - 6 in.				

\* Clearance values shown include a 6 in. allowance for future resurfacing of the roadway.  
 \*\* From the Port of Anchorage to the North Slope the clearance of roadways underpassing railroads shall be 18 ft.

**Exhibit 11: Alaska DOT&PF Vertical Clearance Criteria**

DOT&PF's inclusion of pedestrian facility vertical clearance requirements is noted as one of the significant differences between Exhibit 10 and Exhibit 11.

#### Constructability Reviews and Constructability Evaluations

AASHTO defines constructability review as the following:

A process that utilizes construction personnel with extensive construction knowledge early in the design process of projects to ensure that the projects are buildable, while also being cost-effective, biddable, and maintainable. (AASHTO, 2000)

Constructability reviews strive to resolve any plans, specifications, and engineer's estimate (PS&E) errors, omissions, conflicts or ambiguities by identifying problems or potential problems that could be encountered during construction. Furthermore, AASHTO clarifies constructability reviews should contribute to the following outcomes:

1. The project as communicated by the plans and specifications can be constructed using appropriate construction methods, materials, and techniques.
2. The plans and specifications provide sufficiently clear and concise information allowing contractors to prepare competitive, cost-effective bids.
3. Following construction of the project as specified by the drawings and contract documents, the owner agency is able to operate and maintain the facility infrastructure in a cost-effective manner.

As supported by Pettee (2012), additional benefits gained by performing a constructability review include the following:

- Cost (construction and maintenance) and/or time savings to the owner
- Greater early planning
- Reduced drawing and specification conflicts
- Minimized scope changes
- Less field orders and change orders during construction
- Desirably no claims, disputes, or legal action

In contrast to constructability reviews which take place during the design process, post-construction reviews, or constructability evaluations, occur near or following project closeout. Constructability evaluations focus on determining whether design professionals (engineers, architects, etc.) successfully developed complete, accurate, practical, and cost-effective PS&E documents. Post-construction reviews are valuable to owners since these reviews can eliminate repeated errors, ambiguities, and mistakes that increase projects costs or negatively impact project schedules (AASHTO, 2000).

A review of Florida DOT resources revealed a constructability evaluation form intended for in-house design projects (State of Florida Department of Transportation, 2018). The evaluation form contained eight separate constructability criteria to be scored. For scoring, the form contained a performance rating scale ranged numerically from 1 to 5. The highest rating (5) indicates outstanding performance for the eight constructability criteria. Outstanding performance includes the following attributes:

- The design feature had no changes resulting in cost or time increases.
- All plan set details were clear, constructible and no requests for information were needed.
- Minimal post-design services were utilized.
- No follow up post construction contracts needed to fix design flaws.
- No premium costs incurred.
- For unforeseen issues, the engineer of record consistently exceeded expectations for teamwork, responsiveness, and clarity which minimized impact to project cost and time increases.

The next seven pages of this report present Exhibits 12-19. These exhibits contain the eight constructability criteria from the FDOT constructability evaluation form and provide an evaluation of the assorted sub-criteria associated with each of the eight criteria.

<b>A. Roadway Design Features (weight = .12)</b>		<b>Score</b>
1	Provided the required plan-profile details, cross-sections, intersection layout/details, design standard references, special details, and other required plan components as required to build the project.	
2	Provided constructible pavement details (cross slope correction, overbuild, feathering details, etc.)	
3	Provided roadway plans that addressed utility work. For example, all conflicts with known utilities are addressed, and traffic control plans are compatible with the utility work schedules.	
4	Provided roadway plans that addressed the required soil surveys and other geotechnical requirements to build the project.	
5	Appropriate pay items were included with adequate quantities to meet the project requirements.	
Average Score (Total Score / Number of sub-criteria rated)		Not Rated

### **Exhibit 12: Roadway Design Features Constructability Evaluation**

The most important elements and design considerations for a strong construction plan are arguably contained within Exhibit 12. Transportation and public works infrastructure require suitable foundations, and sub-criteria item 4 addresses subsurface soil explorations and geotechnical requirements. Sub-criteria items 1 and 2 detail important components commonly required for construction drawings. Plan and profile sheets, detail sheets, cross-sections, and roadway structural sections are standard requirements for pavement management, reconstruction, utility improvement, and new roadway construction projects.

Error-filled plans coupled with a nonresponsive design engineer of record expose an owner agency to significant risk. If a prime contractor has notified the engineer of record/owner of a contract document



issue – from confusing detail sheets to plan and profile sheet notes contradicting specifications – and a timely response was not reciprocated, the contractor could perform the work per plan but in error. In the described circumstance, rework could be required at the owner’s expense.

Utility coordination and utility conflicts are addressed with sub-criteria item 3 from Exhibit 12. New construction and roadway reconstruction projects commonly require utility adjustments, relocations, and accommodations due to the general project scope. As part of the project planning process, competent design engineers are able to identify possible or probable utility conflicts and determine appropriate mitigation measures. Unexpected utility conflicts can be costly to the owner, the contractor, or both depending on the circumstances. Moreover, utility conflicts can disrupt the project schedule and potentially delay critical path tasks and the project completion date.

Exhibit 13 presents constructability evaluation sub-criteria for traffic control design features including signage and pavement markings. The researcher recognizes the benefits of resident engineers and constructors evaluating detail sheets, the sign summary, and signage and striping sheets near project closeout or post-construction. Two key benefits include contractor input regarding design suitability and input related to sign or signpost materials. A competent design engineer with an appropriate project budget is able to identify utility conflicts, obstructions, or sensitive project areas likely to impact signage work.

<b>B. Signage and Pavement Marking Features (weight = 0.10)</b>		<b>Score</b>
1	Required level of detail for the signage and pavement marking plans was included in the plans.	
2	Foundation designs for large sign structures were included with adequate soil boring information and location was selected considering the presence of existing utilities.	
3	Appropriate pay items were included with adequate quantities to meet the project requirements.	
<b>Average Score (Total Score / Number of sub-criteria rated)</b>		Not Rated

**Exhibit 13: Signage and Pavement Marking Features Constructability Evaluation**

Exhibit 14 presents constructability evaluation sub-criteria for drainage design features. Competent water resource engineers provide sufficient hydraulic and hydrologic (H&H) design information depending on project scope. Regardless the quantity of drainage structures for a project, the contract documents need to provide the contractor with a complete and accurate picture of both the existing conditions and the to-be-built infrastructure. A complete and accurate picture of existing conditions refers to H&H data, established vertical and horizontal control and known elevations, and a general idea of subsurface soil and groundwater conditions. A complete and accurate picture does not indicate all above-grade and below-grade site conditions are fully understood or defined.

Exhibit 15 presents constructability evaluation sub-criteria for major and minor structure design features. Major structures are significant cost components for public infrastructure projects and resultingly prime

contractors often specialize in large structure types including retaining walls, fish passage and box culverts, tunnels, or bridge structures such as pedestrian underpassings, wildlife overcrossings, and multi-span timber, steel, and concrete bridges.

<b>C. Drainage Features (weight = 0.12)</b>		Score
1	Provided roadway plans that clearly addressed the required drainage details (identification and adequacy of all required pipe and drainage structure locations, positive drainage provided for each phase of construction, and sufficient R/W is allowed for trenching drainage structures).	
2	Existing Drainage patterns were considered in the design and were able to be maintained during construction until the final drainage patterns could be established.	
3	Appropriate pay items were included with adequate quantities to meet the project requirements.	
Average Score (Total Score / Number of sub-criteria rated)		Not Rated

**Exhibit 14: Drainage Features Constructability Evaluation**

Competent design engineers address sub-criteria items 1-7 collectively through the contract documents. The researcher recognizes the benefit of specialized contractors evaluating the constructability of structures with geologic or environmental challenges, structures requiring utility relocations, and high-value bid items that infrequently occur in a project region.

<b>D. Structures (weight = .12)</b>		Score
1	Structural Plans are clear. All details readily constructible with adequate clearances between existing and new components allowing for construction access; dimensions are consistent; Adequate structure vertical clearance over entire travelway.	
2	Construction conflicts with underground/ overhead utilities were anticipated and addressed.	
3	Large or heavy members can be transported without exceeding weight and size limitations of existing roads, bridges or hauling equipment.	
4	Critical temporary walls identified and detailed.	
5	Effect of construction on nearby structures addressed.	
6	Post tensioning and reinforcing details complete.	
7	Subsurface features such as rock, old foundations, water table, artesian conditions etc. were considered in the foundation design and were addressed in the plans. Structure foundation can be constructed within Right of Way.	
8	Appropriate pay items were included with adequate quantities to meet the project requirements.	
Average Score (Total Score / Number of sub-criteria rated)		Not Rated

**Exhibit 15: Structures Constructability Evaluation**

Exhibit 16 presents constructability evaluation sub-criteria for traffic maintenance and temporary traffic control. Traffic and pedestrian control are significant cost and safety components of DOT construction projects. Traffic control must be carefully planned in order to maintain access for vehicle and pedestrian users of a corridor. Depending on the scope of the project, traffic control challenges and traffic control measures can vary widely. Urban projects require planning to adequately direct traffic through alternative routes, often necessitating temporary pedestrian routes. Rural projects require an observant eye by the contractor and resident engineer towards construction zone roadway conditions, as unpaved surfaces are

susceptible to degradation caused by traffic, wind, and precipitation. Rural projects also experience a greater level of interaction between construction-related traffic and standard roadway traffic.

All temporary traffic control operations employed by contractors must conform to the Manual on Uniform Traffic Control Devices. Additionally, public agencies strive to minimally disrupt traffic along high mobility routes particularly during fishing season and tourist season. To mitigate these varied challenges and traveling public requirements, competent design engineers and owners often including phasing plans, temporary traffic control plans (TCPs), and permanent construction signage (PCS) traffic control plans as part of the PS&E package. The researcher recommends design engineers evaluate and consider bolstering their traffic control sheets (phasing plans, TCPs, PCS TCPs, etc.) specifically for roadway reconstruction, bridge rehabilitation, new roadway construction, and utility improvement projects.

<b>E. Maintenance of Traffic (weight = .14)</b>		<b>Score</b>
1	Project phasing addresses all significant work items including utility relocation, drainage construction, structures and intersection construction.	
2	MOT signing properly utilized. Temporary pavement and detours are adequate to effectively meet traffic needs. Lane closure restrictions were identified and reflected the traffic volumes experienced during construction.	
3	Work zones widths were adequate to meet the needs of construction equipment including swing radii, and ingress and egress. Dropoffs due to construction operations were considered and protection needs were addressed including attenuation if necessary.	
4	Intersection traffic control needs were addressed including any necessary temporary devices. Adequate turn lanes were provided to avoid traffic backups of through lanes.	
5	Pedestrian, bicycle, ADA needs were considered and addressed in the MOT plans.	
6	Appropriate pay items were included with adequate quantities to meet the project requirements.	
<b>Average Score (Total Score / Number of sub-criteria rated)</b>		Not Rated

**Exhibit 16: Traffic Maintenance Constructability Evaluation**

Exhibit 17 presents constructability evaluation sub-criteria for traffic signal and facility lighting design. As previously indicated, unforeseen utility conflicts are burdensome to the owner, contractor, resident engineer, and often utility companies and regulatory agencies. Sub-criteria item 1 addresses the importance of signal pole location due diligence being completed by the design engineer to accommodate construction. Sub-criteria 2 focuses on the signal and lighting needs for maintenance and operation personnel, perhaps the most vital long-term end users of transportation and public work infrastructure. For example, urban and rural projects each include categorical maintenance requirements. Urban projects are more likely to include public utility systems and pedestrian facilities, whereas rural projects frequently include roadside ditches, cross culverts, and approach culverts. An experienced design engineer understands the lifecycle for public works infrastructure, requests input from M&O personnel early in the design process, and makes reasonable accommodations to increase the efficiency and/or lower the cost of maintaining specific systems (water, sewer, drainage, etc.), facilities (treatment plants, etc.), or individual project elements such as roadside barriers (guardrail) or landscaping (trees, shrubs, grass, etc.).

<b>F. Signals and Lighting (weight = .12)</b>		Score
1	Pole locations selected with consideration given to the location of existing utilities, drainage structures and other project features.	
2	Local maintaining office requirements were addressed and included in the design.	
3	Foundation design provided was consistent with existing soil conditions.	
4	Appropriate pay items were included with adequate quantities to meet the project requirements	
Average Score (Total Score / Number of sub-criteria rated)		Not Rated

**Exhibit 17: Signal and Lighting Constructability Evaluation**

Exhibit 18 presents constructability evaluation sub-criteria for contract documents’ conformance to federal, agency, and local permit requirements. A permit can be defined as a temporary authorization *to perform or use something* in support of a transportation infrastructure project. A wide variety of authorizations, depending on the permitting authority, are encompassed in that broad definition. Typical construction permits include but are not limited to the following:

- Oversize/overweight load permits
- Utility permits
- Temporary construction easements
- Construction general permits
- Excavation dewatering permits
- Fish habitat permits
- Aquatic resource permits
- Flood hazard permits
- Specific borough habitat protection district permits
- Temporary water use authorization permits
- Nationwide permits

The project owner will obtain select preliminary environmental permits and the prime contractor is contractually obligated to obtain the remaining permits required by various authorities having jurisdiction. Additionally, project permits are a function of the specific project scope and geographic location. The researcher has identified that large earthwork projects occurring in environmentally sensitive areas are a project category that require a sizable number of permits.

<b>G. Conformance to Permit Requirements (weight = .12)</b>		Score
1	All permit requirements were properly addressed in the contract documents.	
2	Permit requirements were doable and constructable.	
3	Appropriate pay items were included with adequate quantities to meet the project permit requirements.	
Average Score (Total Score / Number of sub-criteria rated)		Not Rated

**Exhibit 18: Conformance to Permit Requirements Constructability Evaluation**

Exhibit 19 presents constructability evaluation sub-criteria related to the designer's ability to develop a coordinated design/contract document package. Through professional experience, the researcher has determined the contract document package is an ambiguous term, and that contract document packages vary between local and state construction projects. Furthermore, project owners can be unsophisticated or lack adequate staffing to manage their capital improvement efforts. As a result, consultant engineering firms are often tasked with design phase, procurement phase, and construction phase services to aid project delivery and provide owner's representation. Presented below are three contract document package categories the researcher has encountered.

For municipal public works infrastructure projects, the contract documents frequently include the following:

1. Construction drawings / plan set
2. Referenced municipal, city, or borough construction standard details
3. Standard specifications for construction
4. Special provisions
5. Bonding and certifications
6. Pre-contract revisions / addenda
7. Construction contract
8. Modifications / change orders (if required)

Alternatively, when Engineering Joint Contract Documents Committee (EJCDC) or American Institute of Architects (AIA) standard form agreements are used for public works infrastructure projects, the contract documents frequently include the following:

1. Construction drawings / plan set
2. Referenced municipal, city, or borough construction standard details
3. Standard specifications for construction
4. Special provisions
5. General conditions of the contract
6. Supplementary conditions of the contract
7. Bonding and certifications
8. Pre-contract revisions / addenda
9. Owner-contractor agreement
10. Modifications / change orders (if required)

For state DOT transportation infrastructure projects, the contract documents commonly include the following:

1. Construction drawings / plan set
2. Referenced state construction standard details
3. Standard specifications for highway construction
4. Standard modifications
5. Special provisions
6. Pre-contract revisions / addenda
7. Bonding and certifications
8. Construction contract
9. Modifications / change orders (if required)

In practice during construction, the resident engineer and the contractor will primarily rely upon the construction drawings, the construction details, the standard specifications, and the special provisions to build various infrastructure elements. It should be noted that for both municipal public works and state DOT highway projects, H&H reports, subsurface investigation reports, and record drawings generally are not contract documents. These informational drawings, data, and reports are instead categorized as reference documents. Additionally, shop drawings – drawings, etc. prepared by the contractor to communicate work completion or detail – are not part of the contract document package.

<b>H. Overall Coordination of Contract Documents (weight = .16)</b>		<b>Score</b>
1	The plans were properly supported and complimented by the specifications and were not in conflict.	
2	Individual Plan Components were consistent with one another and were not in conflict.	
3	Appropriate pay items were included with adequate quantities to meet the project requirements.	
4	Communicated and coordinated with all Department offices, Local Agencies, Utilities during design to meet the project requirements.	
<b>Average Score (Total Score / Number of sub-criteria rated)</b>		Not Rated

**Exhibit 19: Contract Document Coordination Constructability Evaluation**

**Georgia Department of Transportation**

**Distressed Pavement**

Pavement structures includes one or several layers that transfer and distribute vehicular loading to the underlying existing subgrade soils (Andersland & Ladanyi, 2003). The design life for flexible pavement is a function of the project classification. For hot mix asphalt (HMA) overlay projects and design standard update projects, the pavement design life can range from 15-20 years, whereas on full depth reclamation and new construction projects the pavement design life can range from 30-40 years. The researcher should note that flexible pavements utilizing design lives that are decades long will still require

appropriate pavement maintenance treatments likely 15-20 years following construction. Portland cement concrete (PCC) is an appropriate and cost-effective material for pavements in many parts of the US, though Alaska DOT&PF and local communities generally use HMA as their pavement material. PCC pavements are considered rigid pavement and the design life can be considerably longer than flexible pavements (Washington State Department of Transportation, 2010).

Exhibit 20 presents twenty separate AC pavement / flexible pavement distress root causes described by the Pavement Interactive on their *Pavement Distresses* webpage.

No.	Pavement Distress Root Cause
1	Loss of subgrade, subbase, or base course support due to poor roadway cross-slope or inadequate roadside drainage.
2	Vehicular loading exceeds design loading.
3	Inadequate structural support – too thin of structural layers (subbase, base, surface).
4	Inadequate construction techniques.
5	Poor HMA mix design.
6	Improper HMA air void content.
7	Asphalt binder aging.
8	Aggregate segregation.
9	HMA mix contamination.
10	Poor HMA manufacturing.
11	Excessive subgrade moisture content.
12	Subgrade settlement.
13	Pavement fatigue.
14	Moisture infiltration
15	Subbase rutting
16	Improper mix design (excessive asphalt binder content, excessive mineral filler, inadequate quantity of angular aggregate particles).
17	Vehicular braking or turning.
18	High water table and poor structural drainage
19	Frost susceptible subbase or base course materials
20	Spring thaw and snow mounded roadway shoulders.

**Exhibit 20: AC Pavement Distress Root Causes**

Exhibit 20 provides primary and secondary reasons why AC pavements or flexible pavements fail. The next section of this report explores the particular categorizations of pavement failure, also known as pavement distress. As shown below with Exhibit 21, the FHWA has classified AC pavement failures/degradations into six categories with fifteen specific AC pavement distress types (FHWA, 2014). Moreover, Exhibit 22 illustrates how jointed PCC pavement failures include four distress categories and sixteen distress types, while Exhibit 23 presents how continuously reinforced PCC pavement failures include three distress categories and sixteen distress types.

<b>Distress Category</b>	<b>Distress Type</b>
<b>A. Cracking</b>	
	1. Fatigue cracking
	2. Block cracking
	3. Edge cracking
	4. Longitudinal cracking
	5. Reflection cracking at joints
	6. Transverse cracking
<b>B. Patching and Potholes</b>	
	7. Patch/patch deterioration
	8. Potholes
<b>C. Surface Deformation</b>	
	9. Rutting
	10. Shoving
<b>D. Surface Defects</b>	
	11. Bleeding
	12. Polished aggregate
	13. Raveling
<b>E. Miscellaneous Distresses</b>	
	14. Lane-to-shoulder drop-off
	15. Water bleeding/pumping

**Exhibit 21: AC Pavement Distress Categories and Types**



<b>Distress Category</b>	<b>Distress Type</b>
<b>A. Cracking</b>	
	1. Corner breaks
	2. Durability cracking
	3. Longitudinal cracking
	4. Transverse cracking
<b>B. Joint Deficiencies</b>	
	5. Joint seal damage
	6. Spalling – longitudinal joints
	7. Spalling – transverse joints
<b>C. Surface Defects</b>	
	8. Map cracking and scaling
	9. Polished aggregate
	10. Popouts
<b>D. Miscellaneous Distress</b>	
	11. Blowups
	12. Faulting of transverse joints and cracks
	13. Lane-to-shoulder drop-off
	14. Lane-to-shoulder separation
	15. Patch/patch deterioration
	16. Water bleeding/pumping

**Exhibit 22: Jointed PCC Pavement Distress Categories and Types**

<b>Distress Category</b>	<b>Distress Type</b>
<b>A. Cracking</b>	
	1. Durability cracking
	2. Longitudinal cracking
	3. Transverse cracking
<b>B. Surface Defects</b>	
	4. Map cracking and scaling
	5. Polished aggregate
	6. Popouts
<b>C. Miscellaneous Distress</b>	
	7. Blowups
	8. Transverse construction joint deterioration
	9. Lane-to-shoulder drop-off
	10. Lane-to-shoulder separation
	11. Patch/patch deterioration
	12. Punchouts
	13. Spalling – longitudinal joints
	14. Water bleeding/pumping
	15. Longitudinal joint seal damage

**Exhibit 23: Continuously Reinforced PCC Pavement Distress Categories and Types**

## AC Pavement Treatments

Implementing appropriate AC pavement treatments along roadway corridors is considered a best practice as part of state or local agency pavement management programs. A review of Georgia DOT design manuals revealed a *Guide for Pavement Preservation Treatments* (Georgia Department of Transportation, 2014). The *Guide* includes an AC pavement treatment decision matrix that recommends specific AC pavement treatments for the varied pavement distress conditions presented with Exhibit 21. The matrix includes thirteen AC pavement treatment types which are shown with Exhibit 24.

<b>Treatment No.</b>	<b>AC Pavement Treatment</b>
1	Chip seal
2	Cold in-place recycling & foamed asphalt
3	Crack seal
4	Fog seal
5	Full depth reclamation
6	Hot in-place recycling
7	Micromilling
8	Microsurfacing and slurry seal
9	Open graded interlay
10	Overlay
11	Pothole patching
12	Ultra-thin bonded wearing course
13	White topping

**Exhibit 24: Recommended AC Pavement Treatments, Georgia DOT**

Certain AC pavement treatments, such as full depth reclamation and cold in-place recycling supplemented with foamed asphalt, are appropriate for several types of pavement distress. Conversely, other AC pavement treatments such as fog seal and micromilling are only appropriate for a few select pavement distress types.

## PCC Pavement Treatments

The *Guide* recommends several PCC pavement treatment methods as detailed in Exhibit 25, and additionally provides a PCC pavement treatment selection matrix which is presented with Exhibit 26.

<b>Treatment No.</b>	<b>PCC Pavement Treatment</b>
1	Diamond grinding
2	Dowel bar retrofit
3	Joint sealing
4	Partial depth repair
5	Full depth repair

**Exhibit 25: Recommended PCC Pavement Treatments, Georgia DOT**

		GUIDELINES FOR PCC PAVEMENT TREATMENT SELECTION						
		PCC TREATMENTS						
Specifications								
PAVEMENT CONDITIONS	PARAMETERS	Joint Sealing	Diamond Grinding	Soil Stabilization	Crack Sealing	Mastic Patching	Spall Repair	Full Depth Repair
FAULTING		•	•	•	X	?	X	•
TRANSVERSE CRACKING	Level 1	X	X	X	•	X	X	X
TRANSVERSE CRACKING	Level 2	X	?	X	•	•	X	?
LONGITUDINAL CRACKING	Level 1	X	X	X	•	X	X	X
LONGITUDINAL CRACKING	Level 2	X	?	X	•	•	X	?
CORNER BREAKS		X	X	X	?	?	•	•
SHATTERED SLAB		X	?	X	X	X	X	•
REPLACED SLABS		?	?	X	?	X	X	•
FAILED SLABS		?	?	X	X	X	X	•
JOINTS W/SPALL		X	X	X	X	?	•	X
JOINTS W/PATCHED SPALL		?	X	X	X	?	?	•
JOINTS W/FAILED SPALL		?	X	X	X	?	•	•
SHOULDER JOINT DISTRESS		•	X	•	X	X	X	X
ROUGHNESS		X	•	X	X	X	X	?

Recommended      •  
 May be recommended      ?  
 Not recommended      X

**Exhibit 26: Portland Cement Concrete Pavement Treatment Selection Matrix**

**Schedule Delays**

Critical path method (CPM) schedules are a contractual requirement for federally funded DOT projects. The CPM schedule requirement often extends to local municipal public works projects.

The CPM schedule graphically represents a contractor’s plan to execute a project. The critical path is the longest path/work sequence that determines the project completion date. A delay is an activity or event that postpones the ultimate completion of a work task or the project (American Society of Civil Engineers, 2022). When analyzing project schedules, the focus should be on critical delays, or those delays that negatively impact the critical path.

From an owner’s viewpoint, critical delays can be categorized as either excusable or non-excusable. Excusable delays include all delays where the contractor is entitled to a time extension. Additionally, excusable delays can be compensable where a contractor is entitled to time and money, or they can be non-compensable where a contractor is entitled to a time extension but not additional money (ASCE, 2022).

Following review of Georgia DOT resources, the researcher identified an interoffice memo focusing on twelve specific drivers/areas the GDOT has identified as being responsible for critical delays during the planning, design, or construction project phases. Exhibit 27 presents the twelve project areas GDOT identified as contributing to schedule delays.

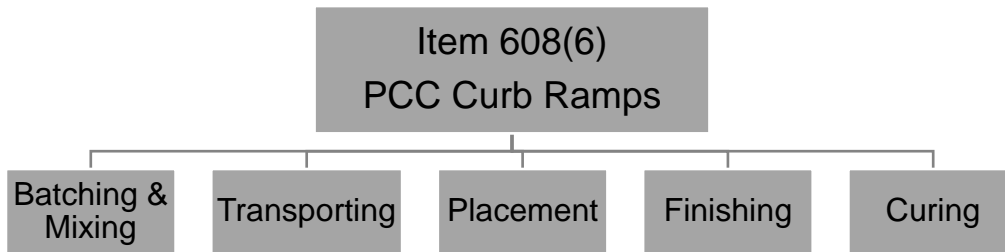
Area No.	Area Responsible for Delay
1	Site conditions
2	Earthwork
3	Base and pavement
4	Drainage
5	Structures
6	Traffic control plans
7	Maintenance considerations
8	Special provisions
9	Construction staging
10	Right-of-way
11	Schedule
12	Utilities

**Exhibit 27: Areas Responsible for Schedule Delays**

**New Jersey Department of Transportation**

Concrete Curing

Exhibit 28 presents a simple work breakdown structure (WBS) for installing Americans with Disabilities Act (ADA) compliant PCC curb ramps. For illustrative purposes all demolition, excavation, grading and formwork activities have been omitted from the WBS.



**Exhibit 28: Work Breakdown Structure for PCC Curb Ramps**

Concrete curing is a critical work task associated with most concrete structures and elements. The Portland Cement Association (PCA) defines curing as:

The maintenance of a satisfactory moisture content and temperature in concrete for a sufficient period of time during and immediately following placing so that the desired properties may develop. (PCA, 2016).

Strength, freeze-thaw resistance, permeability resistance, scaling resistance, abrasion resistance, and volume stability are all hardened concrete properties influenced and improved by proper curing. The PCA also describes an optimal temperature of 50 degrees F to 60 degrees F to maximize hardened concrete properties. Frequently, concrete cannot be placed, finished, and cured in the optimal temperature range.

As a result, contractors need to address considerations for hot weather concreting and cold weather concreting depending on the project circumstances. A review of New Jersey DOT resources identified the *Construction Scheduling Manual* which contained Exhibit 29. This Exhibit indicates concrete formwork for piles, footings, retaining walls, and abutment walls shall not be removed until a 24-hr curing period has elapsed. The Exhibit also indicates formwork for wing walls, pier caps, arches, culverts, approach slabs, and bridge decks are to remain in place for a 14-day curing period. Additionally, Exhibit 29 provides curing periods for the aforementioned structural elements for cold weather concreting.

	Form Removal	Form Removal with Strength	Cold Weather Curing
Barrier Curb	Concrete holds shape	NA	5 DAYS at 60 °F
Piles	24 HOURS	NA	5 DAYS at 60 °F
Footing	24 HOURS	NA	5 DAYS at 60 °F
Abutment Wall	24 HOURS	NA	5 DAYS at 60 °F
Cast in Place Retaining Wall	24 HOURS	NA	5 DAYS at 60 °F
Wing Walls	14 DAYS	3 DAYS 3000 PSI	5 DAYS at 60 °F
Battered Columns	14 DAYS	3 DAYS 4000 PSI	5 DAYS at 60 °F
Pier Caps	14 DAYS	3 DAYS 4000 PSI	5 DAYS at 60 °F
Arches	14 DAYS	7 DAYS 4000 PSI	7 DAYS at 60 °F
Culverts	14 DAYS	7 DAYS 4000 PSI	7 DAYS at 60 °F
Approach Slab	14 DAYS	7 DAYS 4000 PSI	7 DAYS at 60 °F
Deck	14 DAYS	NA	7 DAYS at 60 °F
Bridge Sidewalk	24 HOURS	NA	5 DAYS at 60 °F
Bridge Parapet and Barrier	Concrete holds shape	NA	5 DAYS at 60 °F
ALL ELSE	24 HOURS	NA	5 DAYS at 60 °F

**Exhibit 29: Concrete Curing Time Table**

#### Construction Contract Change Order Contingencies

Change orders are a contract instrument used to modify some element of the agreement between an owner and a contractor. Change orders arise due to several reasons including unforeseen conditions, owner directed, plan and specification errors and omissions, and plan quantity changes. Resultingly, change orders can modify the plans or specifications and frequently result in an adjustment to project cost and schedule. Although change orders for DOT projects share common components (main change order documents, backup documents, etc.), each change order on every project is unique.

For public infrastructure projects, the resident engineer or construction project manager normally determines the need for a change order. Construction contractors are encouraged to initiate or request contract changes as appropriate, including value engineering circumstances where the contractor could potentially provide significant cost savings to a project.

The researcher recognizes on Alaska DOT&PF projects, the construction project manager approves change orders up to \$25K whereas the group chief approves any change order above \$25K. The resident engineer for DOT projects cannot approve change orders.

A review of New Jersey DOT resources revealed the *Cost Estimating Guideline* (2019). The *Guideline* contained Exhibit 30 which provides construction change order contingency amounts for various project types such as new construction, resurfacing, etc. Exhibit 30 is a resource for NJDOT employees during the development of conceptual project cost estimates. As detailed by the Exhibit, projects with construction contracts valued between \$100-500K are allocated a total contingency amount of \$25K for change orders, while projects valued over \$15M are allocated a total contingency amount of \$0.5M. The researcher notes by happenstance that a value of \$25K is applied to DOT&PF project manager’s change order approval threshold and change order contingency total amounts for conceptual cost estimates. No correlation exists between the processes.

Total Federal Participating Items in Millions of \$	Construction Change Order Contingency Amount
\$0 to 0.1	\$6,000
0.1 to 0.5	25,000
0.5 to 5.0	25,000 + 4% of amount in excess of \$500,000
5.0 to 10.0	205,000 + 3% of amount in excess of \$5,000,000
10.0 to 15.0	355,000 + 2% of amount in excess of \$10,000,000
15.0 and Above	500,000

**Exhibit 30: Contingency Amounts for Construction Change Orders**

## Research Phase 5 – Research Results and Analysis

As detailed in the Research Phase 3 section of this report, six design/construction engineers and project managers responsible for overseeing the development of state DOT projects were interviewed. The questions were tailored to agency-level engineers and projects managers and were specific to the following areas:

- Engineering design manual update frequency
- Variance between state DOT and local municipal engineering design manuals
- Processes employed by state DOTs to develop construction manuals
- Internal engineering and project management training available to DOT personnel
- Construction inspection as a prerequisite to becoming a resident engineer
- Transportation engineering literature void assessment

This section of the report presents results from the SME interviews. Each interview question is presented with an exhibit showcasing particular state DOT results. Analysis conducted by the researcher specific to each interview question follows presentation of the results.

### Question #1

#### Results

Exhibit 31 presents results for the first interview question, which is centered around the frequency state DOTs update their roadway engineering design manual.

<b>How often does your state's DOT update their engineering design manual?</b>	
<b>STATE DOT</b>	<b>ENGINEER or PM RESPONSE</b>
Georgia	N/A – did not know.
Florida	Continuously updated through Design Bulletins. Design manuals are updated every 1-2 years.
New Jersey	Updates/modifications occur as design standards change. Design manuals are updated on an ongoing basis.
Alabama	Every 3-5 years.
Oklahoma	Design manual is currently being updated and has not been updated since 1992.
North Carolina	Every 6 years.

### Exhibit 31: Engineering Design Manual Update Frequency

#### Analysis

The Florida and New Jersey DOTs provide the most frequent design manual updates. The Alabama and North Carolina DOTs update their design manuals less frequently. The roadway design manual for the

Oklahoma DOT had not been updated for over 25 years – an informational note the researched did not expect to uncover.

**Question #2**

Results

Exhibit 32 presents results for the second interview question. The second SME interview question focuses on the variance between state DOT and local municipal engineering design manuals.

<b>How much variance exists between state-level and local-level engineering design manuals?</b>	
<b>STATE DOT</b>	<b>ENGINEER or PM RESPONSE</b>
Georgia	Most local municipalities piggyback on the Georgia design manuals.
Florida	The “Florida Greenbook” developed by FDOT is used by my local agencies and municipalities. Some local agencies have their own design manuals.
New Jersey	Very little variance exists.
Alabama	N/A – did not know.
Oklahoma	Smaller towns essentially use the state DOT standards and drawings.
North Carolina	N/A – did not know.

**Exhibit 32: Variance Between State DOT and Local Municipal Engineering Design Manuals**

Analysis

Engineers and project managers from the Georgia, Florida, New Jersey, and Oklahoma DOTs indicated little variance exists between local municipal and state DOT engineering design manuals. Based on professional experience in Alaska, the researcher has determined several divisions from the *Municipality of Anchorage Standard Specifications (MASS)*, and the associated construction standard details, share commonality with divisions and standard details from the *Alaska DOT&PF Standard Specifications for Highway Construction*. However, the MOA and AWWU oversee public works utility projects unlike the DOT&PF. As a result, *MASS* includes several divisions such as sanitary sewers and water systems not found in the *DOT&PF Standard Specifications*. Furthermore, the City of Homer, the City of Sitka, the City of Kodiak, and the City of Valdez each have standard public works specifications specific to their community. Examination of these standard specifications not surprisingly reveals a tendency towards mirroring and adopting content from the MOA’s *MASS* and not the DOT&PF’s *Standard Specifications*.

**Question #3**

Results

Exhibit 33 presents results for the third interview question. This question focuses on processes DOTs employ to develop their construction manuals.



<b>What processes has your state's DOT employed to develop their construction manual?</b>	
<b>STATE DOT</b>	<b>ENGINEER or PM RESPONSE</b>
Georgia	A running list of bridge construction and road construction issues are developed. Semiannual updates to the construction manual incorporate any substantive issues needing addressed.
Florida	A statewide committee reviews the construction manual yearly and updates appropriate sections as necessary based on current issues.
New Jersey	The construction manual has not been updated in several years. <i>Construction Advisories</i> have been provided by NJ DOT for construction administration personnel to help administer construction projects.
Alabama	For the last eight years, the construction manual has been going through a continuous update. Resident engineers have been consulted during this process.
Oklahoma	N/A – did not know.
North Carolina	N/A – did not know.

**Exhibit 33: Processes Employed by State DOTs to Develop Construction Manuals**

Analysis

The Florida and Georgia DOTs respectively provide yearly and on-going updates to their construction manuals. The Florida DOT uses a statewide committee for updates whereas the Georgia DOT develops specific bridge construction and road construction lists for update consideration. The *Construction Manual* published by the Alaska DOT&PF provides guidance for inspecting and administering highway, airport, and marine construction projects. The *Construction Manual* contains eighteen chapters – seven were last updated in 2021, six chapters were last updated in 2017, three were last updated in 2014, and two chapters were updated in 2019 and 2020. Therefore, approximately half the *Manual* has been updated within one calendar year and nearly the remainder of the manual has been updated within the last five years.

**Question #4**

Results

Exhibit 34 presents results for the fourth interview question. The fourth SME interview question focuses on internal engineering and project management training available to DOT personnel.

<b>What type of internal training programs are available for design engineers, construction engineers, and project managers?</b>	
<b>STATE DOT</b>	<b>ENGINEER or PM RESPONSE</b>
Georgia	An internal program for construction staff is available and geared towards improving knowledge in the field.
Florida	<ul style="list-style-type: none"> <li>• A complete construction engineering &amp; inspection certification process</li> <li>• Project Administration School</li> <li>• Project Management Institute (PMI) training</li> <li>• Professional engineer training program</li> <li>• Construction training safety awareness</li> </ul>
New Jersey	<ul style="list-style-type: none"> <li>• Project management training</li> <li>• Construction administration and inspection training.</li> </ul>
Alabama	Case by case basis. Specialized training occurs as necessary for topics including claims, critical path method scheduling, etc. Project managers perform the duties of the resident engineer.
Oklahoma	Not a lot of significant training.
North Carolina	Several design-focused classes including Civil3D, and one-on-one on-the-job (OJT) training.

**Exhibit 34: Internal Engineering and Project Management Training Available to DOT Personnel**

Analysis

Based on the SME responses, the Florida DOT provides the most comprehensive collection of civil/construction engineering and project management training content out of the sampled DOTs. The Georgia and New Jersey DOTs have less robust training programs, but wide-ranging nonetheless. The Oklahoma DOT was noted to not have a significant training program. In Alabama DOT construction projects are contractually administered by project managers. By contrast, in Alaska, Washington, California, and many other states, the DOT uses a resident engineer, not a project manager, to act the owner’s designated representative responsible for administering the construction contract in accordance with the PS&E and additional contract documents.

**Question #5**

Results

Exhibit 35 presents results for the fifth interview question. This question focuses on construction inspection experience being a prerequisite to becoming a resident engineer.

<b>Do a significant number of resident engineers work their way up through the inspection ranks?</b>	
<b>STATE DOT</b>	<b>ENGINEER or PM RESPONSE</b>
Georgia	Yes – internally, REs work up through the ranks. With consultants, the REs also have inspection experience.
Florida	In the past, yes, a significant number of REs would work their way up through the inspection ranks. Currently, REs are required to be degreed and professionally licensed. They tend to work their way up through internship type programs. FDOT has adopted a consultant-based inspection program. Although many upper-level construction project administration and engineering personnel are FDOT employees, all jobsite inspection functions are performed by consultant employees.
New Jersey	Construction administration teams can include inspectors, technicians, and a resident engineer. Most REs were inspectors at one time. Several tests must be passed before employees can move up in the rankings.
Alabama	No, most resident engineers do not work their way up through inspection. Most are hired on as project managers.
Oklahoma	Yes, and ODOT wants professional engineers as their resident engineers.
North Carolina	It is a mix – most resident engineers did not come up through the inspection ranks. Several were hired directly as resident engineers.

**Exhibit 35: Construction Inspection as a Prerequisite to Becoming a Resident Engineer**

Analysis

Engineers from the Georgia and Oklahoma DOTs indicate construction inspection experience is indeed a requirement before advancing to or being hired as a resident engineer. Additionally, in Florida a resident engineer must also be a professional engineer, and in Oklahoma the DOT prefers but not requires their resident engineers to be professionally licensed. The New Jersey DOT indicates most resident engineers previously acted as inspectors. The Alabama DOT was the outlier for this question. The SME response indicated project managers responsible for contract administration generally do not have inspection experience.

**Question #6**

Results

Exhibit 36 presents results for the sixth interview question. The final question from the SME interviews assesses whether voids exist in the available literature for engineers managing transportation projects.

<b>Does a void exist in the available literature for engineers managing transportation projects?</b>			
<b>STATE DOT</b>	<b>ENGINEER or PM RESPONSE</b>		
	<b>YES</b>	<b>NO</b>	<b>UNSURE</b>
Georgia		X	
Florida		X	
New Jersey	X		
Alabama	X		
Oklahoma	X		
North Carolina			X

**Exhibit 36: Transportation Engineering Literature Void(s) Assessment**

Analysis

50% of the SMEs indicated a void or several voids exist within the available civil engineering literature.

If the North Carolina DOT response (unsure) is excluded, the concurrence percentage increase to 60%.

## **Research Conclusions**

Research conducted in support of this project enabled the author to develop an outline to a comprehensive civil engineering manual for managing and administering Alaska municipal public works and State of Alaska DOT&PF highway projects. The manual outline effectively follows the life of a civil transportation project from initiation through closeout by fully integrating the distinct elements of design engineering, construction contract administration, construction inspection, materials testing and special inspection, and project management. The outline manual was iteratively developed in conjunction with several research phases. This section of the report presents conclusions from each research phase.

### **Phase 1 to Phase 5**

Efforts for the first research phase produced a list of civil engineering design standards and resources commonly used by designers and resident engineers, and design-related civil engineering subtopic areas and construction and project management-related civil engineering subtopic areas respectively presented by Exhibits 2-4. An early iteration of the manual outline was also developed.

The second research phase provided transparency to the big-picture timeline associated with DOT&PF projects. This phase also detailed the progression of a traditional construction plan set. These endeavors are showcased with Exhibits 5-7.

Following the development of a transportation engineering questionnaire, forty-five design engineers, construction engineers, and project managers from twenty-three state DOTs were contacted. In total, six telephone interviews were conducted, representing an outreach response rate of thirteen percent.

The fourth research phase included a secondary round of literature review based upon guidance from the engineering SMEs. The Florida, Georgia, and New Jersey DOTs were determined to have the most robust online resources out of the DOT websites sampled. A large portion the supplemental civil engineering background information provided to highlight specific design and construction elements has been drawn from the researcher's professional experience. Exhibits 10-30 were developed to present several specific design and construction elements including:

- Design criteria
- Constructability reviews and constructability evaluations
- Distressed pavement
- AC pavement treatments
- PCC pavement treatments
- Schedule delays
- Concrete curing

- Construction contract change order contingencies

The final phase – Phase 5 – formulated research results and analysis from Phase 3. Results from Phase 5 research support the author’s assessment that voids exist in the available literature. 50% of the SMEs indicated a void or several voids exist within the engineering literature available for managing transportation projects. The concurrence percentage increases to 60% when the North Carolina DOT response (unsure) is excluded.

## Product Development

In conjunction with crafting this report, the primary project objective was to develop a comprehensive civil engineering manual outline that effectively follows the life of a civil transportation project from initiation through closeout by fully integrating elements of design engineering, construction contract administration, construction inspection, materials & special testing, and project management. Appendix A presents the Manual Outline (MO) fulfilling the central project objective. The Manual Outline is organized as follows:

- Volume 1 – Design Engineering
- Volume 2 – Procurement Phase
- Volume 3 – Construction Engineering
- Volume 4 – Project Management

The researcher used a combination of professional trade and engineering experience, technical and vocation education & training, and six principle civil engineering resources to ultimately develop the Manual Outline. The six resources include:

- *A Policy on Geometric Design of Highways and Streets* (AASHTO, 2011)
- *Municipality of Anchorage Standard Specifications* (Municipality of Anchorage, 2015)
- *Design and Construction Practices Manual* (Anchorage Water and Wastewater Utility, 2018)
- *Alaska Construction Manual* (Alaska DOT&PF, 2021)
- *Standard Specifications for Highway Construction* (Alaska DOT&PF, 2020)
- *Alaska Standard Plans Manual* (Alaska DOT&PF, 2021)

The Manual Outline is both complex and simple, and disseminating dozens of MO components was notably very challenging. The researcher used progressive elaboration as an integration and development tool. Accordingly, the product presented in Appendix A is significantly more refined than earlier iterations. Elements from this project report also contributed to development of the MO and are appropriately distributed throughout the four volumes.

## **Recommendations for Further Research**

The secondary objective associated with assembly of the manual outline included identifying design engineering, construction engineering, and project management domains and subtopics areas to further investigate after project completion.

Content areas highlighted throughout this report recommended for further research include:

1. Alaska DOT&PF procurement and contracting
2. DOT&PF project delivery models
3. Design & construction plan set development
4. Roadway design criteria
5. Constructability reviews and constructability evaluations
6. AC pavement treatments and distressed pavement
7. Schedule delays
8. Concrete curing
9. Construction contract change order contingencies

Additionally, the collective seventy-two civil engineering subtopic areas presented by Exhibit 3 and Exhibit 4 are recommended for further research.

A review of the Manual Outline located in Appendix A reveals forty-two total modules – ten design engineering modules, nine procurement phase modules, eleven construction engineering modules, and twelve project management modules – recommended for further research.



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## **Appendix A**

### **An Outline to a Manual on Managing and Administering Alaska Municipal Public Works and State of Alaska DOT&PF Highway Projects**

**THE ALASKA PROJECT MANAGEMENT,  
DESIGN & CONSTRUCTION MANUAL**  
A Guide to Managing & Administering Municipal Public  
Works and State of Alaska DOT&PF Highway Projects

**VOLUME 1 – DESIGN ENGINEERING**

**1 STRUCTURAL ENGINEERING**

- 1.1 Reinforced Concrete Design**
- 1.2 Steel Design**
- 1.3 Timber Design**
- 1.4 Bridge Design**
- 1.5 Tunnel Design**
- 1.6 Fish Passage and Box Culvert Design**
- 1.7 Underpassing and Overcrossing Design**

**2 ENVIRONMENTAL ENGINEERING**

- 2.1 Water Quality and Water Treatment**
- 2.2 Wastewater Treatment**
- 2.3 NEPA and Environmental Permitting**
- 2.4 Air Pollution, Solid and Hazardous Waste**

**3 WATER AND WASTEWATER ENGINEERING**

- 3.1 Design of Sanitary Sewers**
  - 3.1.1. Design Capacity
  - 3.1.2. Design Flow & Peak Design Flow
  - 3.1.3. Sanitary Sewer Main Slope
  - 3.1.4. Sanitary Sewer Service Connection and Extension Slope
  - 3.1.5. Minimum Pipe Size – Gravity Sewer Main
  - 3.1.6. Minimum Pipe Size – Force Sewer Main
  - 3.1.7. Minimum Pipe Size – Private Sewer Line
  - 3.1.8. Authorized Pipe Materials and Fittings
  - 3.1.9. Unauthorized Materials and Fittings
  - 3.1.10. Standard Depth of Cover & Minimum Depth of Cover
  - 3.1.11. Deep Service Risers
  - 3.1.12. Sanitary Sewer Manholes
  - 3.1.13. Sanitary Sewer Service Lines

3.1.14. Sanitary Sewer Lift Stations

### **3.2 Water Treatment Plants**

### **3.3 Pipes and Pumps**

### **3.4 Water Distribution Systems**

3.1.1. Design Data

3.1.2. Existing Grid Network

3.1.3. Authorized Pipe Materials and Fittings

3.1.4. Unauthorized Materials and Fittings

3.1.5. Main Lines Minimum Sizes

3.1.6. Commercial and Industrial Service Connections and Extensions

3.1.7. Residential Service Connection and Extensions

3.1.8. Depth of Bury

3.1.9. Dead Ends

3.1.10. Fire Hydrants and Flow Requirements

3.1.11. Crossings

3.1.12. Valves

3.1.13. Mainline Live Taps

3.1.14. Thrust Restraints

3.1.15. Special Structures – Pumping Stations, Storage Tanks, Diversions Valves, Meter Vaults, etc.

3.1.16. Large Diameter Transmission Mains

3.1.17. Water Service Connections into Main

3.1.18. Water Service Extension Meters

3.1.19. Corp Stops and Curb Stops

3.1.20. Key Boxes

3.1.21. Booster Stations

3.1.22. Pressure Regulating Valve (PRV) Stations

### **3.5 Air Pollution, Solid and Hazardous Waste**

## **4 WATER RESOURCES**

### **4.1 Open Channel Flow and Drainage Channel Design**

### **4.2 Culvert Design**

### **4.3 Storm Drain System Design**

### **4.4 Statistical Hydrology**

#### **4.5 Runoff and Stormwater Collection**

#### **4.6 Groundwater Hydrology**

### **5 TRANSPORTATION ENGINEERING**

#### **5.1 Geometric Roadway Design**

3.1.1. Functional Classification for Motor Vehicles

3.1.2. Content Classification for Geometric Design

3.1.3. Multimodal Considerations

3.1.4. Elements of Design

3.1.5. Design Criteria

3.1.6. Horizontal Alignment

3.1.7. Vertical Alignment

3.1.8. Cross-section Elements

3.1.9. Local Roads in Rural Areas

3.1.10. Local Streets in Urban Areas

3.1.11. Collectors in Rural Areas

3.1.12. Collectors in Urban Areas

3.1.13. Arterials in Rural Areas

3.1.14. Arterials in Urban Areas

3.1.15. Freeways in Rural Areas

3.1.16. Freeways in Urban Areas

#### **5.2 Intersection Design**

#### **5.3 Grade Separations and Interchange Design**

#### **5.4 ADA-compliant Pedestrian Facilities**

#### **5.5 Flexible Pavement Design**

#### **5.6 Rigid Pavement Design**

#### **5.7 Highway Lighting and Lighting Design**

#### **5.8 Roadside Barrier Design**

#### **5.9 Standard Sign Design**

#### **5.10 Striping Design**

#### **5.11 Traffic & Pedestrian Control Design**

#### **5.12 Vegetation and Landscaping Design**

#### **5.13 Transportation Planning**

**5.14 Utility Coordination**

**5.15 Public Involvement**

**5.16 Air, Rail, and Water Transportation**

## **6 TRAFFIC ENGINEERING**

**6.1 Traffic Analysis and Operations**

**6.2 Principles of Traffic Flow**

**6.3 Traffic Engineering Studies**

## **7 GEOTECHNICAL ENGINEERING**

**7.1 Geology, Origins of Soils, and Soil Properties**

**7.2 Soil Classifications / Identification**

**7.3 Atterberg Limits**

**7.4 Seepage**

**7.5 Soil Compressibility**

**7.6 Lateral Earth Pressure**

**7.7 Subsurface Soil Investigations**

**7.8 Permafrost**

**7.9 Shallow Foundation Design**

**7.10 Deep Foundation Design**

**7.11 Retaining Wall Design**

**7.12 Slope Stability**

**7.13 Geosynthetics**

## **8 PROGRESSIVE DESIGN**

**8.1 Phases of Design**

**8.2 Plan Set Development**

**8.3 Specifications**

**8.4 Cost Estimates & Engineer's Estimates**

**8.5 Quantity Calculations**

**8.6 Design Reports**

**8.7 Design Surveys**

**8.8 Design Review**

**8.9 Architectural Design**

## **9 STORMWATER MANAGEMENT**

**9.1 Best Management Practice (BMP) Guides**

**9.2 2021 Alaska Construction General Permit**

**9.3 Erosion and Sediment Control Plan (ESCP) Preparation**

**9.4 Storm Water Pollution Prevention Plan (SWPPP) Preparation**

**9.5 Arctic Stabilization & Biotic Soil Media**

## **10 MISC. DESIGN**

**10.1 Arctic Engineering**



**THE ALASKA PROJECT MANAGEMENT,  
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Works and State of Alaska DOT&PF Highway Projects

**VOLUME 2 – PROCUREMENT PHASE**

**1 STRATEGIC PLANNING**

**1.1 Owner’s Representation**

**2 TRADITIONAL PROJECT DELIVERY**

**2.1 Owner’s Representation**

**2.2 Design-Bid-Build – Competitive Bidding**

**3 A/E SELECTION AND CONTRACT NEGOTIATIONS**

**3.1 Owner’s Representation**

**4 PUBLIC PROCUREMENT PROCESS**

**4.1 Phase 1 – Solicitation Preparation**

**4.2 Phase 2 – Solicitation Advertisement**

**4.3 Phase 3 – Proposal or Bid Evaluation**

**4.4 Phase 4 – Contract Award**

**4.5 Phase 5 – Contract Management & Administration**

**5 ALTERNATIVE DELIVERY METHODS**

**5.1 Design Build (DB)**

**5.2 Progressive Design Build (PDB)**

**5.3 Best Value Procurement (Design-Bid-Build Plus Parameter)**

**5.4 Construction Manager General Contractor (CM/GC)**

**6 CONTRACT DOCUMENT PACKAGE CATEGORIES**

**6.1 Municipal Public Works Infrastructure Projects**

**6.2 EJCDC / AIA Standard Form Agreement Public Works Infrastructure Projects**

**6.3 DOT&PF Transportation Infrastructure Projects**

**7 STANDARD FORM CONTRACTS**

**7.1 EJCDC E-Series / Engineering Series**

**7.2 EJCDC C-Series / Construction Family Series**

**7.3 AIA A-Series / Owner-Contractor Agreements**

**7.4 AIA B-Series / Owner-Architect Agreements**

**7.5 AIA C-Series / Architect-Consultant Agreements**

**7.6 AIA G-Series / Construction Administration Forms**

## **8 CONSTRUCTION SPECIFICATIONS INSTITUTE**

**8.1 MasterFormat Specifications**

**8.2 Construction Administration Documentation**

## **9 ALASKA DOT&PF PROCUREMENT AND CONTRACTING**

**9.1 STIP**

**9.2 Tentative RFP Advertising Schedule**

**9.3 Request for Proposal: \$200K**

**9.4 Tentative Advertising Schedule (TAS)**

**9.5 Bid Calendar**

**9.6 Primary Project Delivery Models**

**THE ALASKA PROJECT MANAGEMENT,  
DESIGN & CONSTRUCTION MANUAL**  
A Guide to Managing & Administering Municipal Public  
Works and State of Alaska DOT&PF Highway Projects

**VOLUME 3 – CONSTRUCTION ENGINEERING**

**MODULE NUMBER AND DESCRIPTION**

- 1 MUNICIPAL CONSTRUCTION ADMINISTRATION TASKS**
- 2 MUNICIPAL CLOSEOUT PACKAGES**
- 3 DOT&PF CONSTRUCTION ADMINISTRATION**
- 4 DOT&PF'S FHWA PROJECT CLOSEOUT PACKAGE**
- 5 MEMO TO DOT&PF QA ENGINEER FOR MATERIAL SUBMITTAL**
- 6 CA PROJECT RECORDS DELIVERED TO DOT&PF QUALITY ASSURANCE UNIT  
SATISFYING COMPLETE PROJECT CLOSEOUT**
- 7 INTERNAL DOT&PF FINAL CLOSEOUT PACKAGE**
- 8 STORMWATER MANAGEMENT**
- 9 DOT&PF STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION**
- 10 DOT&PF STANDARD CONSTRUCTION DRAWINGS**
- 11 MUNICIPAL STANDARD SPECS AND STANDARD CONSTRUCTION DRAWINGS**

# **1 MUNICIPAL CONSTRUCTION ADMINISTRATION TASKS**

## **1.1 Preliminary Activities**

- 4.1.1. Project Management (Scope, Schedule, Budget Mgmt.), Invoicing
- 4.1.1. Coordination With Contractor and Contract Administration
- 4.1.1. PM Software Set-Up
- 4.1.1. SWPPP Review, Approval, Management
- 4.1.1. Preconstruction Meeting
- 4.1.1. Scheduling, Logistics
- 4.1.1. Mobilization
- 4.1.1. Safety Planning, Training, And Coordination
- 4.1.1. Develop Connect Cards
- 4.1.1. Develop Submittal Register
- 4.1.1. Develop Material Summary and Special Inspection Schedule

## **1.2 Construction Administration**

- 1.2.1. Project Management (Scope, Schedule, Budget Mgmt.), Invoicing
- 1.2.2. Submittal Reviews and Processing
- 1.2.3. On-Site Inspection and Owner's Representation
- 1.2.4. SWPPP Oversight and Management
- 1.2.5. RFIs/DCVRs
- 1.2.6. Change Orders
- 1.2.7. Pay Application Recommendations
- 1.2.8. Reoccurring Progress Meetings
- 1.2.9. Demobilization

## **1.3 Closeout**

- 1.3.1. Develop Close-Out Documentation Summary/Checklist
- 1.3.2. Contractor As-Built Coordination
- 1.3.3. Commissioning Plan and Oversight of System Integration
- 1.3.4. Record Drawings
- 1.3.5. QA of Close-Out Documentation, Connect Cards, and Record Drawings
- 1.3.6. Coordination with DEC for Approval to Operate
- 1.3.7. Contractor Coordination for Commissioning

## **2 MUNICIPAL CLOSEOUT PACKAGES**

- 2.1 Photo/Video Records of Pre-Construction Conditions**
- 2.2 A Complete Set of Final As-Built Drawings**
- 2.3 Construction Contract**
- 2.4 Construction Correspondence**
- 2.5 Project Permits**
- 2.6 Change Order Documentation**
- 2.7 Processed Pay Requests**
- 2.8 Owner's Representative Daily Reports and Photo Logs**
- 2.9 All Water Main Flushing and Testing Supporting Documentation**
- 2.10 Sewer Line Pressure Testing or CCTV Records**
- 2.11 Additional Pay Quantity Documentation**
- 2.12 All Material Test and Special Inspection Reports**
- 2.13 Certificate of Substantial Completion and Certificate of Completion**

## **3 DOT&PF CONSTRUCTION ADMINISTRATION**

- 3.1 Construction Overview**
- 3.2 Project Funding & Expenditures**
- 3.3 Preliminary Activities**
- 3.4 Field Office Set-Up & Recordkeeping**
- 3.5 Field Lab Set-Up, Equipment & Recordkeeping**
- 3.6 Managing Staff**
- 3.7 Administrative Programs**
- 3.8 Contract Administration in the Office**
- 3.9 Contract Administration in the Field**
- 3.10 Documenting & Reporting the Contractor's Progress**
- 3.11 Sampling and Testing the Contractor's Work**
- 3.12 Contractor Payments**

### **3.13 Contract Changes**

### **3.14 Contract Time**

### **3.15 Final Field Construction Activities**

### **3.16 Project Closeout**

## **4 DOT&PF'S FHWA PROJECT CLOSEOUT PACKAGE**

### **4.1 Final Construction Report**

#### 4.1.1. Final Estimate Assembly / Package

- \* Certification of Final Estimate
- \* Contractor's Release
- \* Summary of Quantities
- \* Materials Diploma / Materials Certificate
- \* As-built plans
- \* Department of Labor tax Clearance
- \* Department of Revenue tax Clearance
- \* Department of Labor Notice of Completion
- \* Alaska Railroad Release

#### 4.1.2. Final Construction Report Summary Sheet

#### 4.1.3 Report on Design Recommendations

#### 4.1.4. Report on Claims

#### 4.1.5. Explanation of Overruns and Underruns

#### 4.1.6. Summary of Change Documents

#### 4.1.7. ROW Clearance Forms

## **5 MEMO TO DOT&PF QA ENGINEER FOR MATERIAL SUBMITTAL**

### **5.1 Materials Closeout Includes**

#### 5.1.1 Final Progress Estimate – Summary of Quantities

#### 5.1.2. Copy of All Executed / Signed Change Orders

#### 5.1.3. Completed Material Summary / Materials Testing Summary

#### 5.1.4. All Field Test Results

#### 5.1.5. All Lab Test Results

#### 5.1.6. Project Materials Report (PMR) for Minor Quantity Items

#### 5.1.7. All Correspondence Related to Failing Materials

#### 5.1.8. Completed Materials Certification List (MCL) – Signed

- 5.1.9 Materials Certificates
- 5.1.10 Memorandum of Exceptions

## **6 CA PROJECT RECORDS DELIVERED TO DOT&PF QUALITY ASSURANCE UNIT SATISFYING COMPLETE PROJECT CLOSEOUT**

### **6.1 Contract Document Files**

- 6.1.1. Conformed Contract
- 6.1.2. Letter of Award and Notice to Proceed (NTP)
- 6.1.3. Approved Subcontracts
- 6.1.4. Project Funding Agreement and Bid Tab
- 6.1.5. Progress Schedules
- 6.1.6. Directives
- 6.1.7. Permits
- 6.1.8. Change Orders & Supplemental Agreements – Complete
- 6.1.9. Change Orders & Supplemental Agreements – Backup
- 6.1.10. Requests for Proposals (RFPs)
- 6.1.11. Interim Work Authorizations (IWAs)
- 6.1.12. Utility Agreements
- 6.1.13. Professional Service Agreements
- 6.1.14. Approved Traffic Control Plans (TCPs)
- 6.1.15. TCS and Flagger Certifications
- 6.1.16. Truck MAVW & Scale Certification
- 6.1.17. Preconstruction Conference

### **6.2 Correspondence and Report Files**

- 6.2.1. Correspondence – State to Contractor
- 6.2.2. Correspondence – Contractor to State
- 6.2.3. Requests for Information (RFIs)
- 6.2.4. Claims
- 6.2.5. Correspondence with District
- 6.2.6. Correspondence with Government Agency
- 6.2.7. Correspondence with Local Utilities
- 6.2.8. Progress Meetings
- 6.2.9. Safety Meetings
- 6.2.10. Inspector Daily Reports
- 6.2.11. Project Engineer's Diary

- 6.2.12. Regional QA Review Memo/Responses
- 6.2.13. Labor Compliance Interview
- 6.2.14. Commercially Useful Function (CUF)
- 6.2.15. EEO Utilization
- 6.2.16. Non-Material Submittals
- 6.2.17. Certified Payroll
- 6.2.18. SWPPP
- 6.2.19. Final Closeout Package

### **6.3 Pay Estimate, Quantity, and Pay Item Files**

- 6.3.1. Pay Item Files
- 6.3.2. Lump Sum Agreements
- 6.3.3. Stockpiled Materials
- 6.3.4. Progress Estimates
- 6.3.5. Time and Materials Work

### **6.4 Material Files**

- 6.4.1. Submittals
- 6.4.2. Materials Certifications
- 6.4.3. Materials Testing
- 6.4.4. Fabrication Testing

### **6.5 Administrative Files**

- 6.5.1. Master Index
- 6.5.2. State Funding Information
- 6.5.3. Federal Funding Agreements
- 6.5.4. Letters of Assignment
- 6.5.5. Personnel Certifications
- 6.5.6. Overtime Requests
- 6.5.7. Personal
- 6.5.8. Stock Requests
- 6.5.9. Misc. Bills & Vouchers
- 6.5.10. Equipment Inventory
- 6.5.11. Photographic Records
- 6.5.12. Safety



## **6.6 Design and Project Development Data Files**

6.1.1. Material Sites, Mining Plans, Blasting

6.1.2. Design Files, Pre-Award Information, and Computations

6.1.3. Right of Way Information

6.1.4. Project Survey Data

## **7 INTERNAL DOT&PF FINAL CLOSEOUT PACKAGE**

**7.1 Final Construction Report Routing and Distribution Sheet**

**7.2 Final Acceptance Letter**

**7.3 Transmittal of Final Documents Letter – Certified Mail**

**7.4 FHWA Project Closeout Package Checklist**

**7.5 Final Estimate Review Report**

**7.6 Certification of Final Estimate**

**7.7 Final Progress Estimate – Summary of Quantities**

**7.8 Estimate Summary by Funding Report**

**7.9 Contractor’s Release**

**7.10 Final Construction Report Summary Sheet**

**7.11 Letter of Project Completion**

**7.12 Division 670 Manufacturer Warranty for Inlaid MMA Pavement Markings (if applicable)**

**7.13 Explanation of Overruns and Underruns**

**7.14 Summary of Change Documents**

**7.15 Project Records Index**

**7.16 DBE Clearance**

**7.17 Project Materials Certification / Materials Diploma**

**7.18 Materials Testing Summary / Materials Acceptance Summary**

**7.19 Materials Certification List**

**7.20 Department of Revenue Tax Clearance**

**7.21 Department of Labor Tax Clearance Request Form for Contractors**

**7.22 Department of Labor Tax Clearance – Notice of Completion**

**7.23 As-Built Memorandum to Quality Assurance Engineer**

**7.24 Right-of-Way Clearance (if applicable)**

**7.25 Land Survey Monument Record (if applicable)**

**7.26 Environmental Clearance Forms**

**7.27 Catalog Cuts and/or M&O Manuals Transmittal Letter (if applicable)**

**7.28 FHWA – Final Inspection of Federal-aid Project**

**7.29 Project History**

**7.30 Lessons Learned / Report on Design Recommendations**

**7.31 Report on Claims (if applicable)**

**7.32 Alaska Railroad Release (if applicable)**

**7.33 Copy of Piledriving Records (if applicable)**

## **8 STORMWATER MANAGEMENT**

**8.1 SWPPP Review and Approval**

**8.2 DOT&PF SWPPP Inspections**

**8.3 Municipal SWPPP Inspections**

**8.4 SWPPP Administration**

**8.5 SWPPP Closeout**

## **9 DOT&PF STANDARD SPECIFICATIONS FOR HIGHWAY CONSTRUCTION**

**9.1 General Provision Division**

9.1.1. Bidding Requirements and Conditions

9.1.2. Award and Execution of Contract

9.1.3. Scope of Work

9.1.4. Control of Work

9.1.5. Control of Materials

9.1.6. Legal Relations and Responsibility to Public

9.1.7. Prosecution and Progress

9.1.8. Measurement and Payment

9.1.9. Disadvantaged Business Enterprise (Dbe) Program

## **9.2 Earthwork Division**

- 9.2.1. Clearing and Grubbing
- 9.2.2. Removal of Structures and Obstructions
- 9.2.3. Excavation and Embankment
- 9.2.4. Structure Excavation for Conduits and Minor Structures
- 9.2.5. Excavation and Fill for Major Structures
- 9.2.6. Filter Blanket

## **9.3 Bases Division**

- 9.3.1. Aggregate Base and Surface Course
- 9.3.2. Subgrade Modification
- 9.3.3. Reconditioning
- 9.3.4. Subbase
- 9.3.5. Stockpiled Material
- 9.3.6. Asphalt Treated Base Course
- 9.3.7. Emulsified Asphalt Treated Base Course
- 9.3.8. Crushed Asphalt Base Course

## **9.4 Asphalt Pavement and Surface Treatments Division**

- 9.4.1. Hot Mix Asphalt Pavement
- 9.4.2. Tack Coat
- 9.4.3. Prime Coat
- 9.4.4. Seal Coat
- 9.4.5. Surface Treatment
- 9.4.6. Rumble Strips

## **9.5 Structures Division**

- 9.5.1. Concrete for Structures
- 9.5.2. Prestressing Concrete
- 9.5.3. Reinforcing Steel
- 9.5.4. Steel Structures
- 9.5.5. Piling
- 9.5.6. Timber Structures
- 9.5.7. Bridge Barriers and Railing
- 9.5.8. Waterproofing Membrane
- 9.5.9. Removal of Concrete Bridge Deck

- 9.5.10. Mechanically Stabilized Earth Wall
- 9.5.11. Forms and Falsework
- 9.5.12. Field Painting of Steel Structures
- 9.5.13. Concrete Surface Treatments
- 9.5.14. Drilled Shafts
- 9.5.15. Expansion Joints, Bearings, and Waterstops
- 9.5.16. Temporary Crossings
- 9.5.17. Commercial Concrete

## **9.6 Miscellaneous Construction Division**

- 9.6.1. Metal Flume Downdrains
- 9.6.2. Structural Plate Pipe
- 9.6.3. Culverts and Storm Drains
- 9.6.4. Manholes and Inlets
- 9.6.5. Underdrains
- 9.6.6. Guardrail
- 9.6.7. Fences
- 9.6.8. Sidewalks
- 9.6.9. Curbing
- 9.6.10. Ditch Lining
- 9.6.11. Riprap
- 9.6.12. Sacked Concrete Slope Protection
- 9.6.13. Monuments and Markers
- 9.6.14. Concrete Barrier
- 9.6.15. Standard Signs
- 9.6.16. Thaw Pipe and Thaw Wires
- 9.6.17. Railroad Crossings
- 9.6.18. Seeding
- 9.6.19. Soil Stabilization
- 9.6.20. Topsoil
- 9.6.21. Planting Trees and Shrubs
- 9.6.22. Rest Area Facilities
- 9.6.23. Block Sodding
- 9.6.24. Calcium Chloride for Dust Control
- 9.6.25. Pipe Hand Rail

- 9.6.26. Sanitary Sewer System
- 9.6.27. Water System
- 9.6.28. Geotextile for Embankment and Roadway Separation, Stabilization and Reinforcement
- 9.6.29. Geotextile for Subsurface Drainage and Erosion Control
- 9.6.30. Paving Fabric
- 9.6.31. Silt Fence
- 9.6.32. Geogrid for Embankment and Roadway Stabilization and Reinforcement
- 9.6.33. Insulation Board
- 9.6.34. Gabions
- 9.6.35. Driveways
- 9.6.36. Mobilization and Demobilization
- 9.6.37. Erosion, Sediment, and Pollution Control
- 9.6.38. Construction Surveying and Monuments
- 9.6.39. Traffic Maintenance
- 9.6.40. Services to be Furnished by the Contractor
- 9.6.41. CPM Scheduling
- 9.6.42. Signals and Lighting
- 9.6.43. Electric Load Centers
- 9.6.44. Traffic Markings

## **9.7 Materials Division**

- 9.7.1. Hydraulic Cement and Supplementary Cementitious Materials
- 9.7.2. Asphalt Materials
- 9.7.3. Aggregates
- 9.7.4. Masonry Units
- 9.7.5. Joint Materials
- 9.7.6. Concrete and Plastic Pipe
- 9.7.7. Metal Pipe
- 9.7.8. Paints
- 9.7.9. Reinforcing Steel and Wire Rope
- 9.7.10. Fence and Guardrail
- 9.7.11. Concrete Curing Materials and Admixtures
- 9.7.12. Miscellaneous
- 9.7.13. Structural Timber, Lumber, and Piling

- 9.7.14. Preservatives for Timber
- 9.7.15. Steel for Piles
- 9.7.16. Structural Steel
- 9.7.17. Steel Forgings
- 9.7.18. Steel, Gray-Iron and Malleable-Iron Castings
- 9.7.19. Bearings
- 9.7.20. Prestressing Steel and Fittings
- 9.7.21. Bridge Railing
- 9.7.22. Waterstops
- 9.7.23. Seed
- 9.7.24. Fertilizer
- 9.7.25. Topsoil
- 9.7.26. Soil Stabilization Material
- 9.7.27. Geosynthetics
- 9.7.28. Sign Materials
- 9.7.29. Waterproofing Membrane
- 9.7.30. Signals and Lighting Materials

## **10 DOT&PF STANDARD CONSTRUCTION DRAWINGS**

### **10.1 Bridges and Structures**

- 10.1.1. Cantilevered Retaining Wall Type I
- 10.1.2. Cantilevered Retaining Wall Type I – High Seismic Cantilevered Retaining Wall Type II
- 10.1.3. Cantilevered Retaining Wall Type II – High Seismic Cantilevered Retaining Wall Type III
- 10.1.4. Cantilevered Retaining Wall Type III – High Seismic Cantilevered Retaining Wall Details
- 10.1.5. Bin Walls

### **10.2 Construction Barricades and Signing**

- 10.2.1. Location of Double Traffic Fine Signs
- 10.2.2. Interim Pavement Markings

### **10.3 Drainage Culverts and Sewers**

- 10.3.1. Culvert Pipe & Arch Installation Details
- 10.3.2. Pipe And Arch Tables

- 10.3.3. Pipe and Arch Tables (Steel Pipe)
- 10.3.4. Pipe and Arch Tables (Plastic Pipe)
- 10.3.5. Pipe and Arch Tables (Spiral Rib Pipe)
- 10.3.6. Culvert End Sections
- 10.3.7. Culvert Bevels
- 10.3.8. Culvert Marker Post
- 10.3.9. Culvert Circulating Thaw Pipe
- 10.3.10. Culvert Thaw Wire Installation
- 10.3.11. Remote Thaw Wire Installation
- 10.3.12. Manholes, Frame and Cover
- 10.3.13. Stormdrain Manhole Frame and Grate Details
- 10.3.14. Curb Inlet Box, Frame & Grate
- 10.3.15. Inlet Frames and Grates
- 10.3.16. High-Capacity Curb Inlet Box Frame and Grate
- 10.3.17. High-Capacity Inlet Frames and Grate (Field and Gutter Inlets) Type “A” Inlet Boxes
- 10.3.18. Headwalls – Cast-in-Place – Type I
- 10.3.19. Headwalls – Cast-in-Place – Type II
- 10.3.20. Headwalls – Precast – Type I
- 10.3.21. Headwalls – Precast – Type II
- 10.3.22. Type “C” Inlet Box, 18 Inch Pipe on 4:1 Slope
- 10.3.23. Type “D” Outlet Box, 18 Inch Pipe on 4:1 Slope
- 10.3.24. Type “C” Inlet Box, 24 Inch Pipe on 4:1 Slope
- 10.3.25. Type “D” Outlet Box, 24 Inch Pipe on 4:1 Slope

#### **10.4 Erosion and Landscaping**

- 10.4.1.1 Slope Rounding and Warping

#### **10.5 Fences and Gates**

- 10.5.1. Chain Link Fence
- 10.5.2. Chain Link Fence Gate
- 10.5.3. Woven Wire Fence
- 10.5.4. Woven Wire Fence with Barbed Wire

#### **10.6 Guardrail, Median Barriers and Crash Cushions**

- 10.6.1. Standard Guardrail Hardware (Nuts, Bolts, and Washers)

- 10.6.2. Standard Guardrail Hardware (Rail and Splices)
- 10.6.3. Standard Guardrail Hardware (Terminal Connectors)
- 10.6.4. Standard Guardrail Hardware (Miscellaneous)
- 10.6.5. Standard Guardrail Hardware (Flexible Delineators)
- 10.6.6. MASH Box Beam Guardrail
- 10.6.7. Steel Post W31 Guardrail
- 10.6.8. Wood Post W31 Guardrail
- 10.6.9. Steel Post Modified Thrie-Beam Guardrail
- 10.6.10. Guardrail Post Installation
- 10.6.11. W31 Guardrail Transition Details
- 10.6.12. W31 Downstream End Anchor
- 10.6.13. W31 Guardrail Buried-In-Backslope Terminal
- 10.6.14. Widening for Guardrail End Terminals
- 10.6.15. W31 Short Radius Guardrail
- 10.6.16. Long Span W31 Guardrail
- 10.6.17. MASH Bridge Rail Thrie Beam Transition
- 10.6.18. MASH “F” Shape Concrete Barrier

## **10.7 Intersections, Approaches and Pavement Design**

- 10.7.1. Curb Cut, Curb and Gutter and Curb Ramp Details
- 10.7.2. Parallel Curb Ramp
- 10.7.3. Perpendicular Curb Ramp
- 10.7.4. Accessible Parking
- 10.7.5. Superelevation Transition

## **10.8 Luminaires and Lighting Standards**

- 10.8.1. Lighting Standards
- 10.8.2. Junction Boxes for Electroliers and Traffic Signals
- 10.8.3. Type 1 Load Center

## **10.9 Miscellaneous**

- 10.9.1. Survey Monument
- 10.9.2. Brass Cap Monument and Monument Case
- 10.9.3. Mailbox Location
- 10.9.4. Mailbox Installation
- 10.9.5. Mailbox Mounting and Anchoring Details



10.9.6. Cable Safety Rail

## **10.10 Sign and Sign Supports**

10.10.1 Sign Framing

10.10.2 Bracing for Signs Mounted on Single Post

10.10.3 Post Mounted Sign Offset and Height

10.10.4 Sign to Sign Post Connections

10.10.5 Pole and Mastarm Sign Mounting

10.10.6 Light Sign Structure Post Embedment

10.10.7 Sign Framing

10.10.8 Bracing for Signs Mounted on Single Post

10.10.9 Post Mounted Sign Offset and Height

10.10.10 Sign to Sign Post Connections

10.10.11 Pole and Mastarm Sign Mounting

10.10.12 Light Sign Structure Post Embedment

10.10.13 Sign Post Base and Foundation

10.10.14 Sign Post Base and Foundation Behind Barrier

10.10.15 Overhead Sign Mounting

## **10.11 Traffic Control**

10.11.1. Guide Marker Placement

10.11.2. Recessed Pavement Markers

10.11.3. Pavement Marking Applications

10.11.4. Pavement Marking Applications

10.11.5. Pavement Marking Symbol Dimensions

10.11.6. Crosswalk Location at Signalized Intersections

10.11.7. Milled Rumble Strips

10.11.8. Traffic Signal Hardware

10.11.9. Traffic Signal and Accessories Foundation

10.11.10. Loop Detector Installation

10.11.11. Controller Cabinet Foundation

10.11.12. Concrete 42-inch Dia. Signal Pole Foundation

10.11.13. Concrete 48-inch Dia. Signal Pole Foundation

10.11.14. Signal Pole with 15 to 35' Mastarm

10.11.15. Signal Pole with 40 to 50' Mastarm

10.11.16. Signal Pole with 55 to 65' Mastarm

10.11.17. Signal Pole with 70 to 75' Mastarm

## **10.12 Utilities**

10.12.1. Thrust Blocks

# **11 MUNICIPAL STANDARD SPECS AND STANDARD CONSTRUCTION DRAWINGS**

## **11.1 Municipal Standard Specifications – General Provisions Division**

11.1.1. Bidding Requirements and Conditions

11.1.2. Award and Execution of Contract

11.1.3. Scope of Work

11.1.4. Control of Work

11.1.5. Legal Relations and Responsibilities

11.1.6. Measurement and Payment

11.1.7. Forms

## **11.2 Municipal Standard Specifications – Earthwork Division**

11.2.1. Exploratory Test Pits

11.2.2. Clearing and Grubbing

11.2.3. Removal of Trees

11.2.4. Removal of Sidewalk

11.2.5. Removal of Curb and Gutter

11.2.6. Removal of Pavement

11.2.7. Grading Existing Surfaces

11.2.8. Dewatering

11.2.9. Trench Excavation and Backfill

11.2.10. Trench Excavation, Backfill and Compaction for Service Connections

11.2.11. Furnish Trench Backfill

11.2.12. Furnish Bedding Material

11.2.13. Furnish Filter Material

11.2.14. Drain/Filter Rock

11.2.15. Furnish Foundation Backfill

11.2.16. Unclassified Fill and Backfill

11.2.17. Classified Fill and Backfill

11.2.18. Leveling Course

11.2.19. Cobbles

11.2.20. Riprap

- 11.2.21. Geotextile Fabric
- 11.2.22. Insulation
- 11.2.23. Disposal of Unusable or Surplus Material
- 11.2.24. Reconstruct Driveway
- 11.2.25. Pipe Casing
- 11.2.26. Shoring, Sheeting and Bracing/Shoring

### **11.3 Municipal Standard Construction Drawings – Earthwork Division**

- 11.3.1. Typical Sections – 20’/24’ Strip Paved and RAP Streets
- 11.3.2. Typical Sections – Secondary Streets
- 11.3.3. Typical Sections – Primary Streets
- 11.3.4. Typical Section – Deep Excavation
- 11.3.5. Typical Section – Alley
- 11.3.6. Typical Section – Pathway
- 11.3.7. Driveway Connection Detail
- 11.3.8. Trench Backfill and Bedding Layout
- 11.3.9. Pipe Insulation
- 11.3.10. Class B Bedding Material
- 11.3.11. Class C Bedding Material
- 11.3.12. Class D Bedding Material
- 11.3.13. Foundation Materials
- 11.3.14. Type II Classified Fill and Backfill
- 11.3.15. Type II-A Classified Fill and Backfill
- 11.3.16. Type V Classified Fill and Backfill
- 11.3.17. Type VI Classified Fill and Backfill
- 11.3.18. Leveling Course
- 11.3.19. Pipe Encasement
- 11.3.20. Compaction of Backfill within the Right-of-Way

### **11.4 Municipal Standard Specifications – Portland Cement Concrete Division**

- 11.4.1. PCC Curb and Gutter & PCC Valley Gutter
- 11.4.2. PCC Sidewalk
- 11.4.3. PCC Curb Ramps
- 11.4.4. Structures and Retaining Walls
- 11.4.5. Concrete Masonry Retaining Walls
- 11.4.6. Concrete – Building Structures

- 11.4.7. PCC Cluster Mailbox Base
- 11.4.8. Concrete Parking Bumpers
- 11.4.9. Colored Concrete
- 11.4.10. Sidewalk Joint Sealant

### **11.5 Municipal Standard Construction Drawings – Portland Cement Concrete Division**

- 11.5.1. Curb and Gutter Cross Sections
- 11.5.2. Curb and Gutter Termination Transition
- 11.5.3. Typical Section – Valley Gutter
- 11.5.4. Typical Section – Median/Curb Nose
- 11.5.5. Steel Curb Facing
- 11.5.6. Driveway Curb-cut with Attached Sidewalk
- 11.5.7. Driveway Curb Return with Attached Sidewalk
- 11.5.8. Perpendicular Curb Ramp
- 11.5.9. Parallel Curb Ramp
- 11.5.10. Accessible (Type 1A/2A) Curb and Gutter Sections
- 11.5.11. Curb Ramp Clearances
- 11.5.12. Pedestrian Push Button Access
- 11.5.13. Curb Type Retaining Wall – 2’ to 3’
- 11.5.14. Sidewalk Retaining Wall – 6” to 24”
- 11.5.15. Sidewalk Retaining Wall – 2’ to 5’

### **11.6 Municipal Standard Specifications – Asphalt Surfacing Division**

- 11.6.1. Seal Coat
- 11.6.2. Prime Coat
- 11.6.3. Tack Coat
- 11.6.4. Crack and Joint Sealant
- 11.6.5. Asphalt Concrete Pavement / Hot Mix Asphalt
- 11.6.6. Permanent Asphalt Speed Humps
- 11.6.7. Recycled Asphalt Pavement (RAP)
- 11.6.8. Bituminous Surface Treatment
- 11.6.9. Pavement Rotomilling
- 11.6.10. Remove and Replace Asphalt Surfacing
- 11.6.11. In-Place Full Depth AC Pavement Reclamation and Leveling Course
- 11.6.12. Pavement Seam Repair Infrared Method

## **11.7 Municipal Standard Construction Drawings – Asphalt Surfacing Division**

- 11.7.1. Typical Resurfacing Detail – Gravel
- 11.7.2. Typical Resurfacing Detail – Non-Gravel Surfaces
- 11.7.3. Standard Speed Hump

## **11.8 Municipal Standard Specifications – Sanitary Sewers Division**

- 11.8.1. Furnish and Install Pipe
- 11.8.2. Sanitary Sewer Concrete Structures
- 11.8.3. Sanitary Sewer Pipe Connections and Extensions
- 11.8.4. Sanitary Sewer Flow Control
- 11.8.5. Existing Manhole Modifications
- 11.8.6. Sewer Closed Circuit Television Inspections
- 11.8.7. Remove and Dispose of Existing Cesspools or Septic Tanks

## **11.9 Municipal Standard Construction Drawings – Sanitary Sewers Division**

- 11.9.1. Sanitary Manhole - Type A - Pipe 8” to 24”
- 11.9.2. Sanitary Manhole - Type B - Pipe Dia 30” to 36”
- 11.9.3. Sanitary Manhole - Type C - Pipe Dia 40” to 48”
- 11.9.4. Type A and B Manhole Base Plan
- 11.9.5. Manhole Heights
- 11.9.6. Copolymer Polypropylene Manhole Step
- 11.9.7. Sewer Service Connect for On-Site Lift Station 1-1/2” and 2”
- 11.9.8. Manhole Cover
- 11.9.9. Manhole Frame
- 11.9.10. Watertight Manhole Ring
- 11.9.11. External Drop Connection
- 11.9.12. Internal Drop Connect
- 11.9.13. Typical Beaver Slide Manhole
- 11.9.14. Sanitary Sewer Service (Complete)
- 11.9.15. Large Diameter Lateral Connection to Concrete Pipe
- 11.9.16. New Construction of Sewer Lines Service Riser/Top Entry for Deep Sewer –  
Ductile Iron
- 11.9.17. Sanitary Sewer Service Connection (R.O.W. Only)
- 11.9.18. Sanitary Sewer Cleanout Cover
- 11.9.19. Sanitary Cleanout
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