U.S. Department of Transportation
Federal Highway Administration

Office of Technical Services

national highway institute

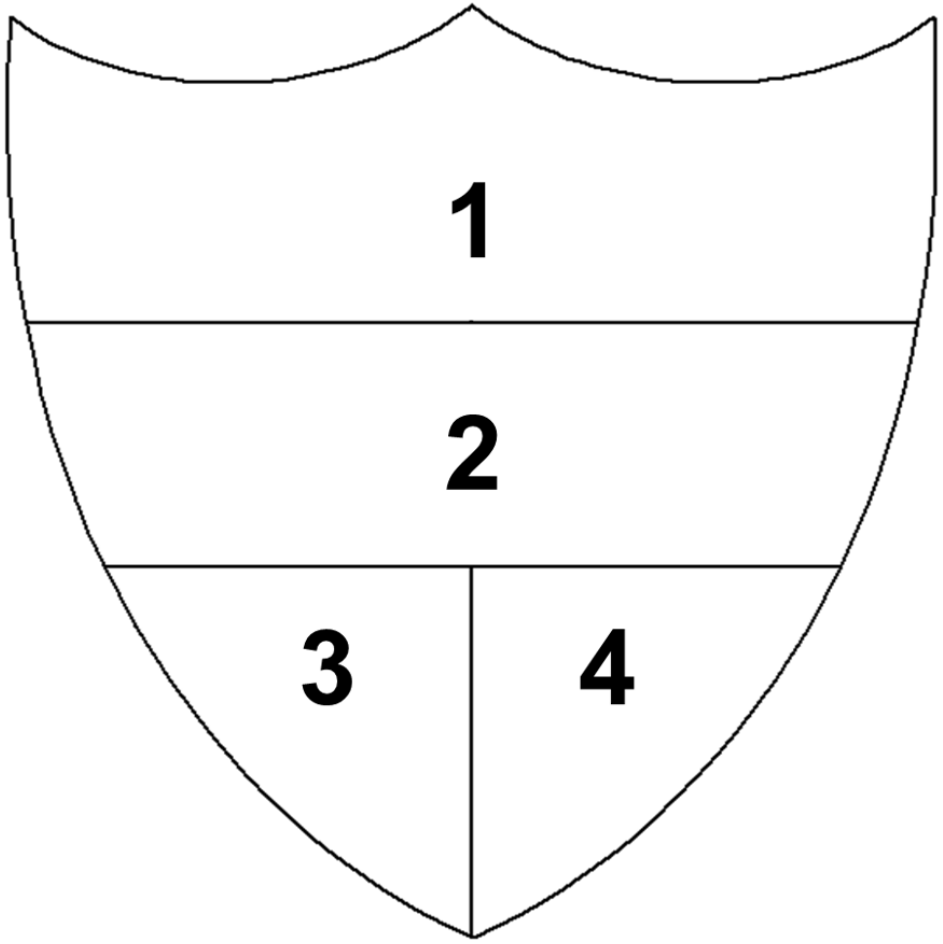
NHI Course 134001
Principles and Applications of Highway Construction Specifications

November 2020

Module 1

Introductions and Course Overview

Shield Diagram



Learning Outcomes (Lesson 2.1)

- Compare the functions of standard and supplemental specifications with the functions of special provisions
- Explain how the “order of precedence” affects writing specifications and preparing plans
- Explain the purposes of a specification

Learning Outcomes (Lessons 2.1, 2.2, 2.3)

- Describe the purpose of the general provisions
- Explain how specifications are used to assign risk and affect the behavior of different parties, within a given scenario
- Compare method and end-result specifications
- Explain each element of the AASHTO five-part format

Learning Outcomes (Lessons 3.1, 3.2)

- Explain how a consistent writing style can affect the interpretation of specifications
- Explain the potential benefits of writing in the active voice
- Rewrite passive voice sentences into the active voice
- Evaluate specifications to determine the need for imperative or indicative mood

Learning Outcomes (Lesson 3.3)

- State the five Cs used in specification writing
- Identify potential ambiguities in the wording, given a sample specification
- Identify the potential benefits of each of the five Cs

Learning Outcomes (Lesson 3.3 cont.)

- Write a new specification using the five Cs and the agency's preferred format
- Complete a checklist of the information needed before writing or revising a specification
- Apply the five Cs and the agency's preferred format to revise the specification, given a sample specification

Learning Outcomes (Lesson 4.0)

- Write a new specification to a given set of criteria using the five Cs and the agency's preferred format, given a sample specification
- Relate the type of specification to the allocation of risk
- Write an end-result specification to replace a method specification, given an excerpt from a method specification

Module 2

Purpose of Specifications

Lesson 2.1: Specifications as a Contract Document

Learning Outcomes Lesson 2.1

- Compare the functions of standard and supplemental specifications with the functions of special provisions
- Explain how the “order of precedence” affects writing specifications and preparing plans
- Explain the purposes of a specification

Learning Outcomes (cont.) Lesson 2.1

- Describe the purpose of the general provisions
- Explain how specifications are used to assign risk and affect the behavior of different parties, within a given scenario

Definition of Contract

"A contract is an agreement between the parties."

AASHTO Definition of Contract

"Written agreement between the agency and the contractor detailing the obligations of each to perform the work. The contract includes the invitation for bids, addenda, proposal, contract form, contract bonds, standard specifications, supplemental specifications, special provisions, standard plans, notice to proceed, and change orders and supplemental agreements that are required to complete the work."

Other Contract Documents

- Invitation for bids
- Addenda
- Proposal
- Contract form
- Contract bonds
- Standard and supplemental specifications
- Special provisions
- Standard plans
- Project plans
- Notice to proceed
- Change orders
- Supplemental agreements

Definition of Specification

"A written description from the agency to the contractor of what the contractor is to provide."

Group Activity 2.1

- Identify and review the definitions of standard specifications, supplemental specifications, and special provisions in the agency's standard specifications
- Discuss the differences between the three terms
- Answer the questions

Standard and Supplemental Specifications

- Standard Specifications

  “Book of specifications approved for general application and repetitive use.”

  (AASHTO definition)

- Supplemental Specifications

  “Approved additions and revisions to the Standard Specifications.”

  (AASHTO definition)

Special Provisions

"Revisions to the Standard and Supplemental Specifications applicable to an individual project."

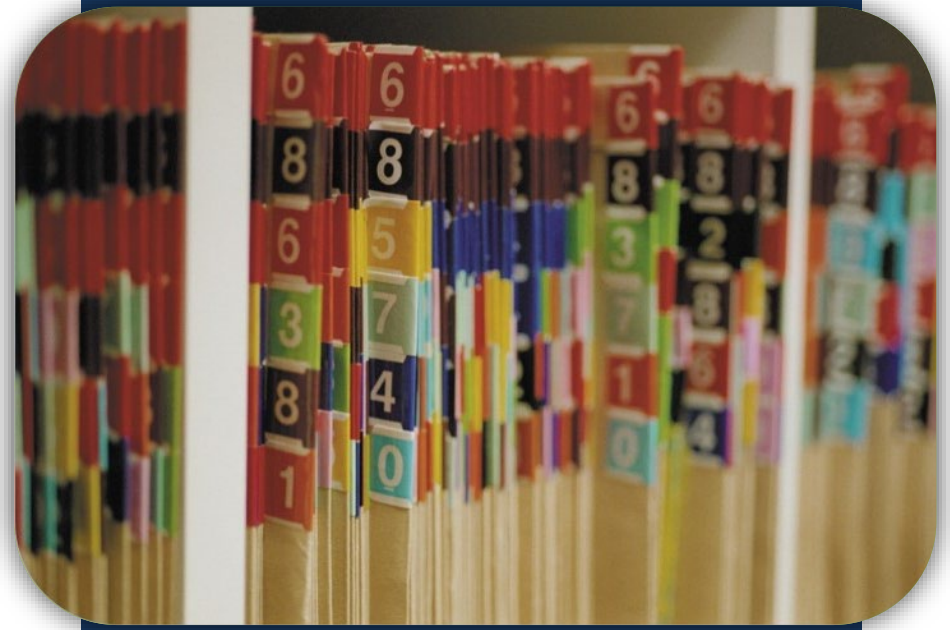
(AASHTO definition)

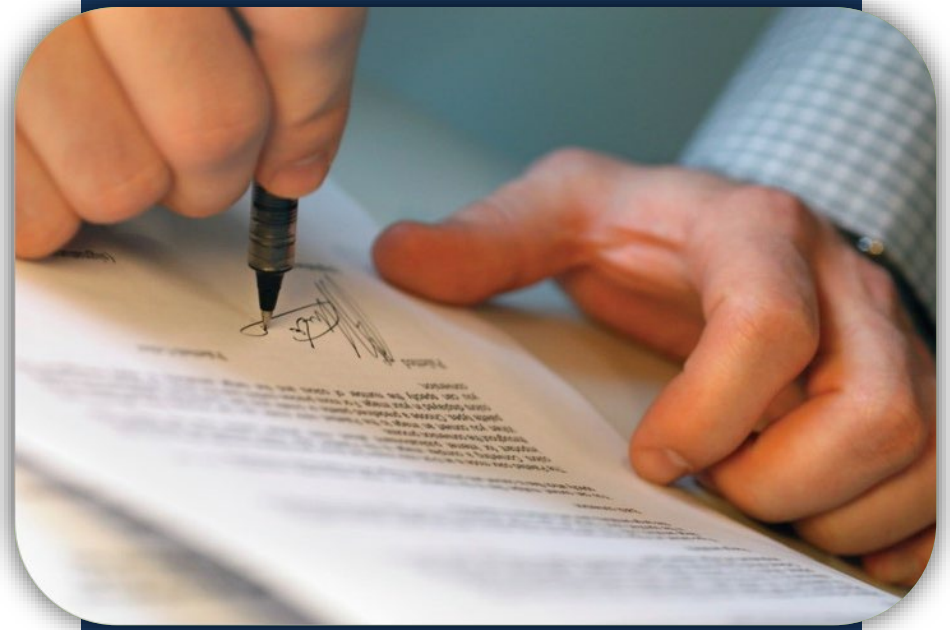
Group Activity 2.2

- Review the General Rules for the Use of Plan Notes
- Answer the questions

Defined Terms

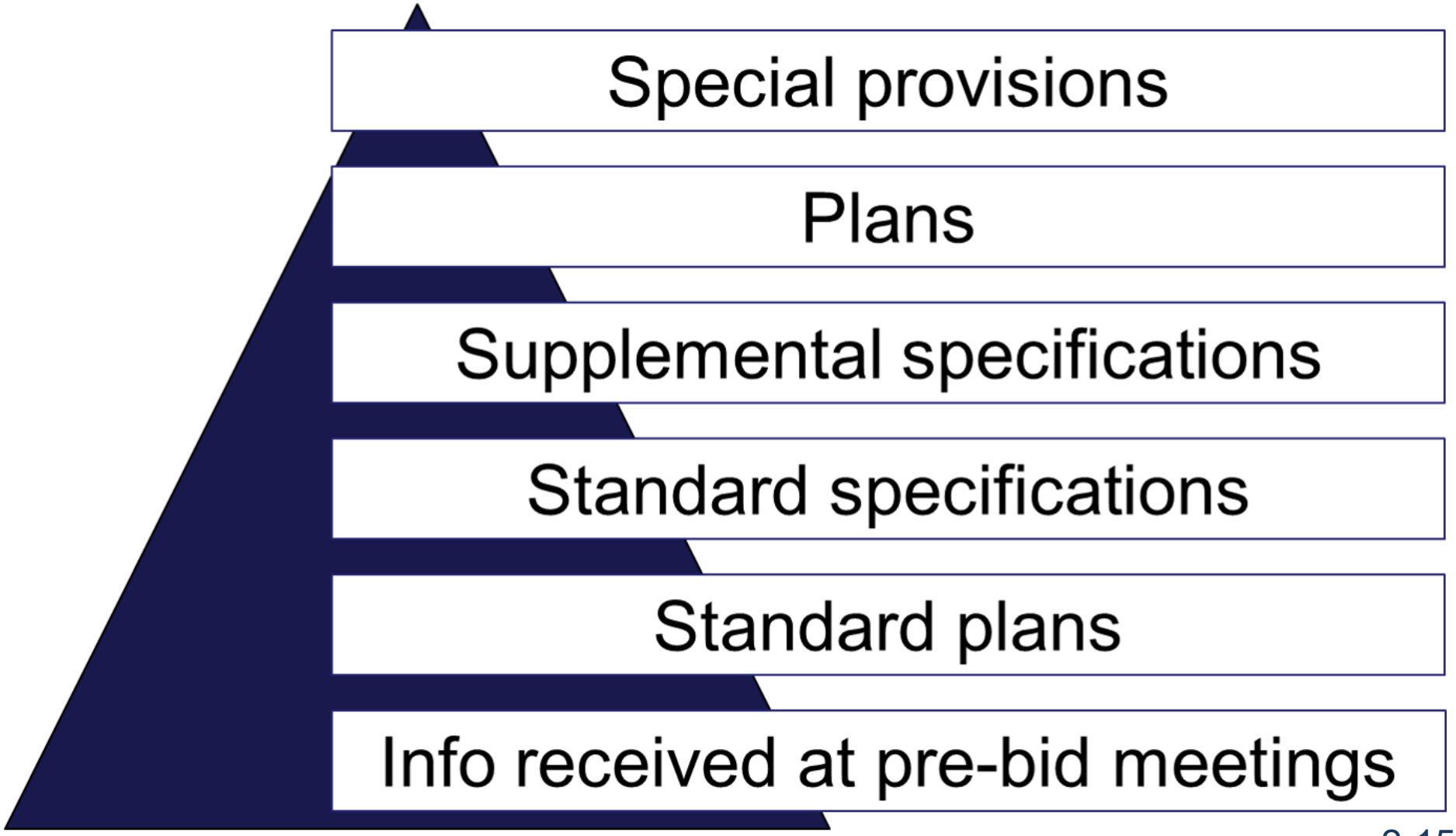
- Use consistently
- “Comply with the contract”
- Multiple documents and parties provide opportunities for confusion and conflict





Order of Precedence

Order of Precedence Hierarchy



Limitations

- Errors and omissions
- Ambiguities
- Conflicts within a contract document
- Contract documents not included in order of precedence

Conflict Resolution

- General provisions
- Other clauses

Purposes of Specifications

- Address party responsibilities
- Set forth contract administration procedures
- Describe work performed
- Establish quality assurance requirements
- Define basis of acceptance
- Measurement and payment options set forth

Content of Specifications

Administrative Content

Technical Content

Administrative Content

- Conditions and obligations
- Roles, rights, and responsibilities
- Requirements, conditions, and restrictions

Technical Content

Include requirements for:

- Materials
- Equipment
- Construction
- Acceptance based on inspection, sampling, and testing
- Measurement and payment

Inappropriate Content

- Requirements for parties not in contract
- Procedures not performed by the contractor
- The text of laws or regulations
- Information not related to contractor's performance
- Construction or design manual information
- Explanations or justifications

Group Activity 2.3

- Guidance for inspectors or engineers as to how to perform their jobs
- Guidance to designers
- Explanation as to why work must be done

General Provisions

Technical Provisions

Provisions

General Provisions

- Mostly administrative content, little technical content
  - Administrative obligations
  - Legal responsibilities
  - General procedures
  - Rights

Technical Provisions

- Mostly technical content, little administrative content
  - Materials
  - Equipment
  - Construction
  - Acceptance
  - Measurement and payment

Agency's General Provisions

- Definitions
- Bidding documents
- Site of work
- Scope of work
- Authority of the engineer
- Unacceptable and unauthorized work
- Responsibility for work
- Scope of payment

Agency's General Provisions
Definitions

- Scope of defined terms
- Use of defined terms
- Terms not defined

Agency's General Provisions
Bidding documents, Site/Scope

- Examination of bidding documents and site of work
  - Contractor responsibilities
  - Agency responsibilities
  - Relation to contract revisions
- Scope of work
  - Relying on the term "work"
  - Avoid repetition by eliminating unnecessary phrases in technical specs

Agency's General Provisions
Authority, Validate Work

- Authority of the engineer
  - Interpret contract requirements and direct work
- Unacceptable and unauthorized work
  - Avoid repetition
  - Accept, reject, or order rework

Agency's General Provisions
Responsibility/Payment

- Responsibility for the work
  - Prevent and correct damage
- Scope of payment
  - Payment for completed work items

General Provisions

Technical Provisions

Provisions: Repetition

Individual Activity 2.1

- Review the sample specification
- Identify problems with the technical provisions
- Rewrite the provision to address the problems

Individual Activity 2.1
Sample 1

"This item consists of furnishing and installing an actuated controller and associated equipment according to these specifications and at the locations shown on the plans or as directed."

"This item consists of furnishing and installing an actuated controller and associated equipment."

Individual Activity 2.1
Sample 2

"Before cleaning with pressurized water, remove all debris from bridge sidewalks, bridge decks, curb tops, beam flanges, gusset plates, abutment bridge seats, pier tops, truss joints, deck drain systems, and other locations where debris has accumulated and as directed by the engineer."

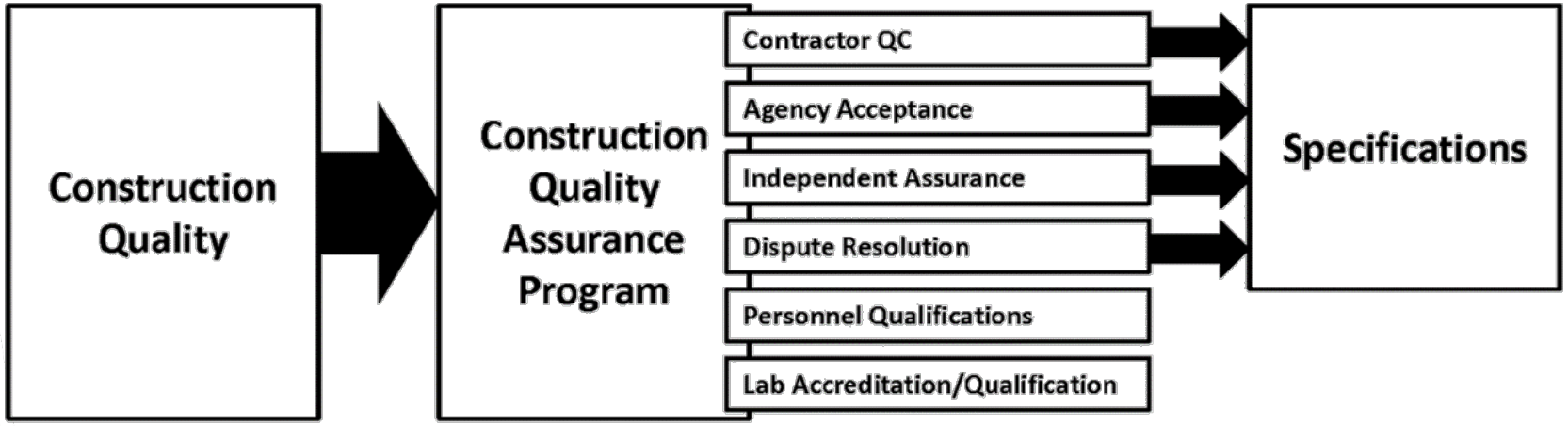
Individual Activity 2.1
Sample 2 answer

"Before cleaning with pressurized water, remove all debris from bridge sidewalks, bridge decks, curb tops, beam flanges, gusset plates, abutment bridge seats, pier tops, truss joints, deck drain systems, and other locations where debris has accumulated."

Quality

- Quality: Conformance to requirements
- Specifications: Contract tool for establishing quality

Quality Defined



Quality Definitions

- Quality Assurance
- Quality Control
- Acceptance
- Independent Assurance

Engineering Risk

Probability of event occurring

Economic consequences of event

Group Activity 2.4

- Review the sample specifications
- Identify the potential risks
- Write the potential risk in the risk column and place a checkmark in the column for the party to the contract that owns the risk

Group Activity 2.4—Debrief
Sample 1

"Remove and dispose of residue from the grooving operations as directed by the engineer to minimize dust and to prevent debris from entering drainage systems."

Group Activity 2.4—Debrief
Sample 2

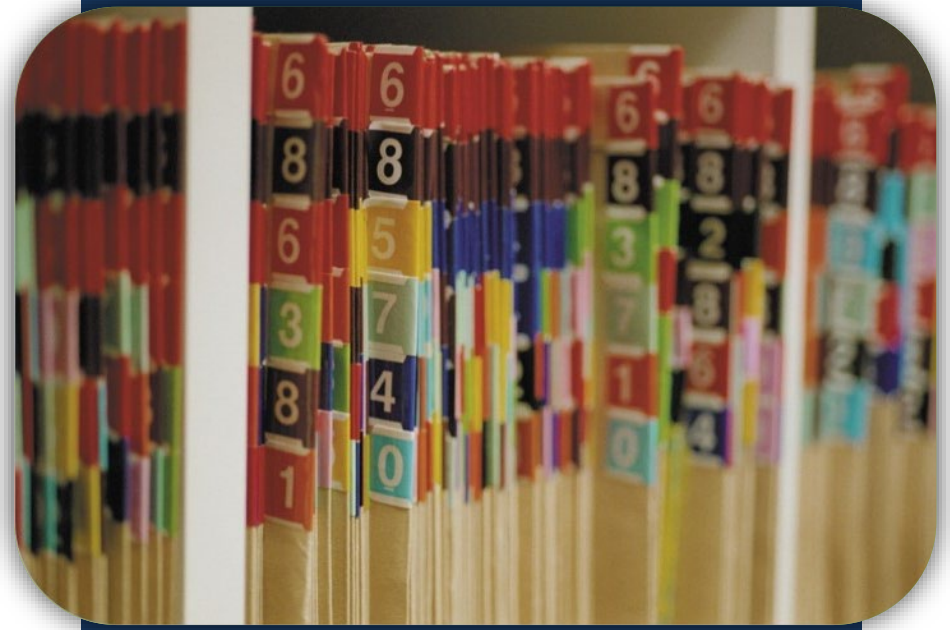
"Using methods approved by the engineer, clean dirt and debris from the pavement surface and paved shoulders before placing HMA. Remove loose material from joints and cracks using compressed air. If the engineer determines the compressed air system will not remove deleterious material, remove loose material by a hand or mechanical method, as approved by the engineer. The agency will pay for removal of material by hand or mechanical methods in accordance with subsection 501.04.E."

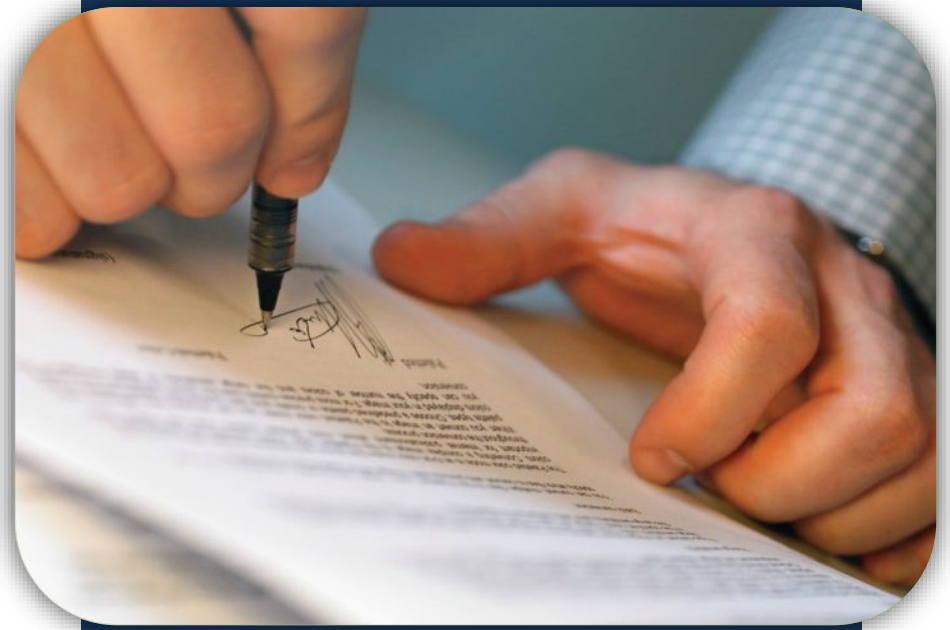
Group Activity 2.4—Debrief
Sample 3

"The surface areas of asphalt and concrete pavement that are to receive markings shall be cleaned with a high-pressure air blast to remove loose material prior to placement of the epoxy pavement marking. Should any pavement become dirty, from tracked mud or for other reasons, as determined by the engineer, it shall be cleaned prior to the placement of the epoxy pavement marking."

Explicit and Implicit Risk

Consider both implicit and explicit risk allocation





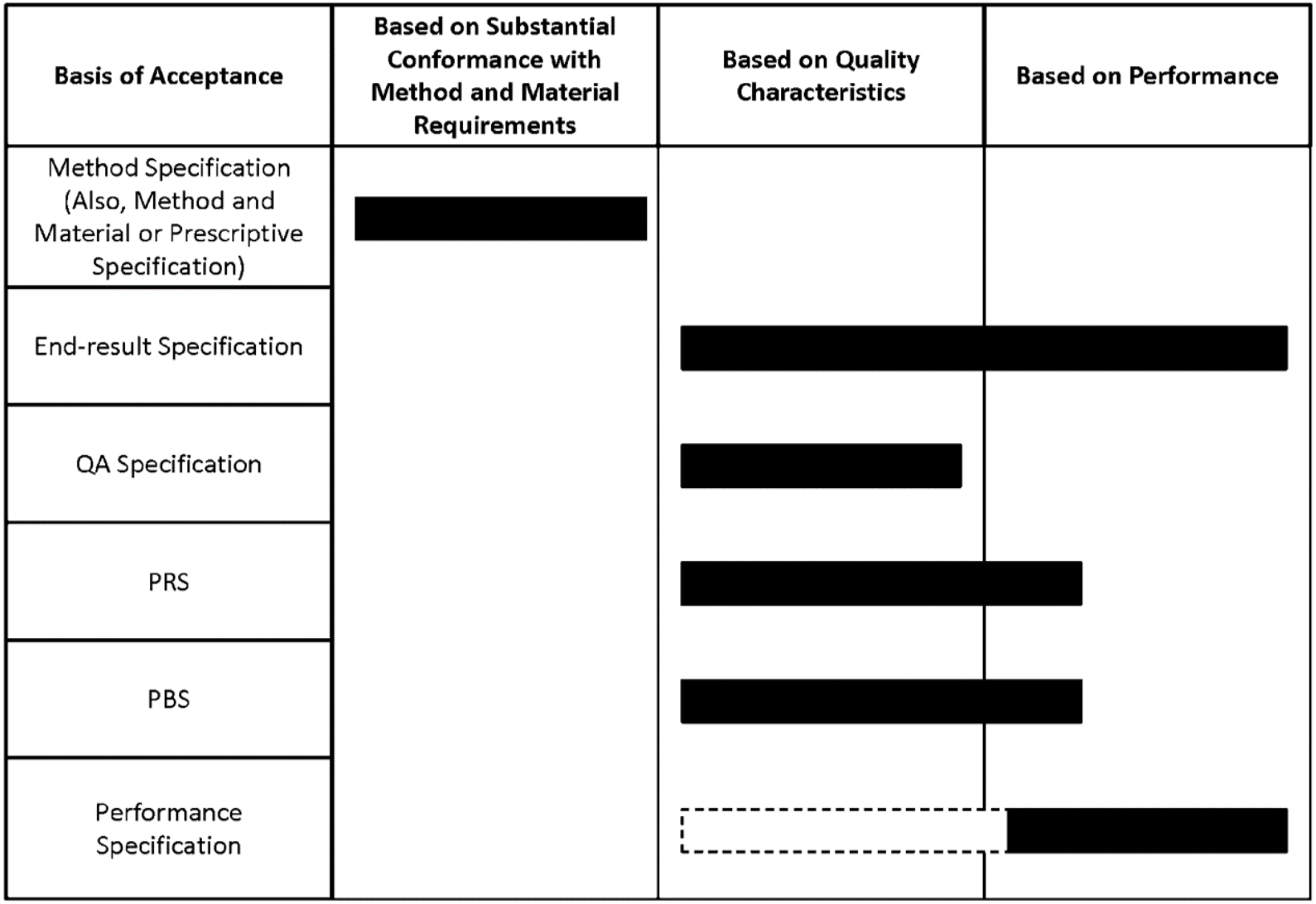
Lesson 2.2: Specification Types

Learning Outcomes Lesson 2.2

Compare method and end-result specifications

Definitions

Types of Specifications



Lesson 2.3 Formatting Specifications

Learning Outcomes
Lesson 2.3

Explain each element of the AASHTO five-part format

AASHTO Five-Part Format

- Description of Work
- Materials
- Construction Requirements
- Measurement
- Payment

Individual Activity 2.2

- Read the AASHTO Five-Part Format Functions
- Write any questions you have about the structure and function of each
- Determine agency's preferred format
- Compare and contrast the agency's preferred format and the AASHTO five-part format

Group Activity 2.5

- Read the context and criteria
- Create a general outline for a new concrete sidewalk specification
- Write the outline on the flip chart

Group Activity 2.5—Debrief

- 608 Concrete Sidewalk
- 608.01 Description of Work
- 608.02 Materials
- 608.03 Construction Requirements
  1. Equipment
  2. Methods
  3. Inspection and Acceptance
- 608.04 Measurement
- 608.05 Payment

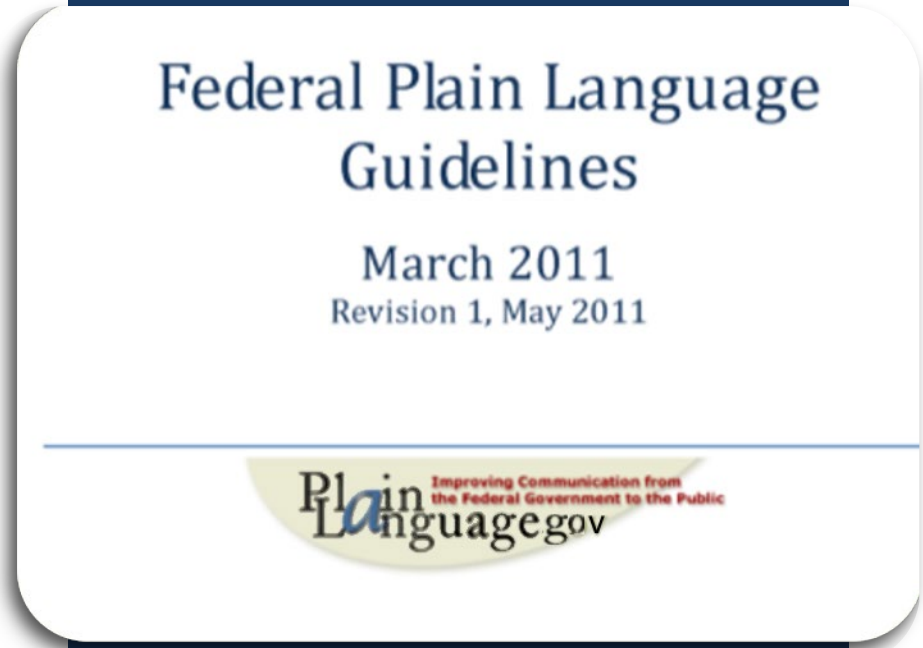
General Provisions

Technical Provisions

Module 2 Review

Module 3

Writing and Interpreting Specifications



Lesson 3.1: Introduction to Writing Style and Plain Language

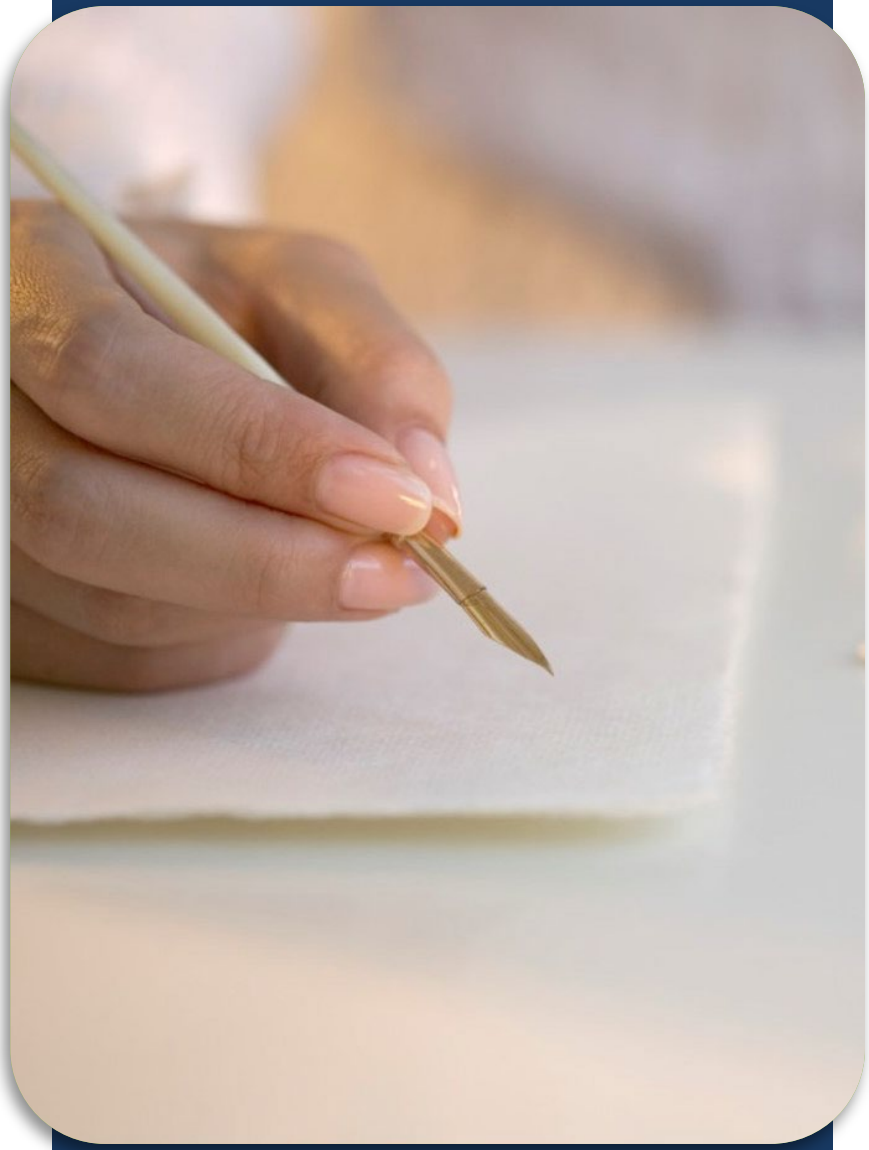
Learning Outcome Lesson 3.1

Explain how a consistent writing style can affect the interpretation of specifications

The Use of Writing Styles

"Vigorous writing is concise. A sentence should contain no unnecessary words, a paragraph no unnecessary sentences, for the same reason that a drawing should have no unnecessary lines and a machine no unnecessary parts. This requires not that the writer make all his sentences short, or that he avoid all detail and treat his subjects only in outline, but that every word tell."

—William Strunk



Writing Styles and Specifications

- Writing styles
- Writing process as a project
- Effect of writing styles on interpretation
- Plain language approach

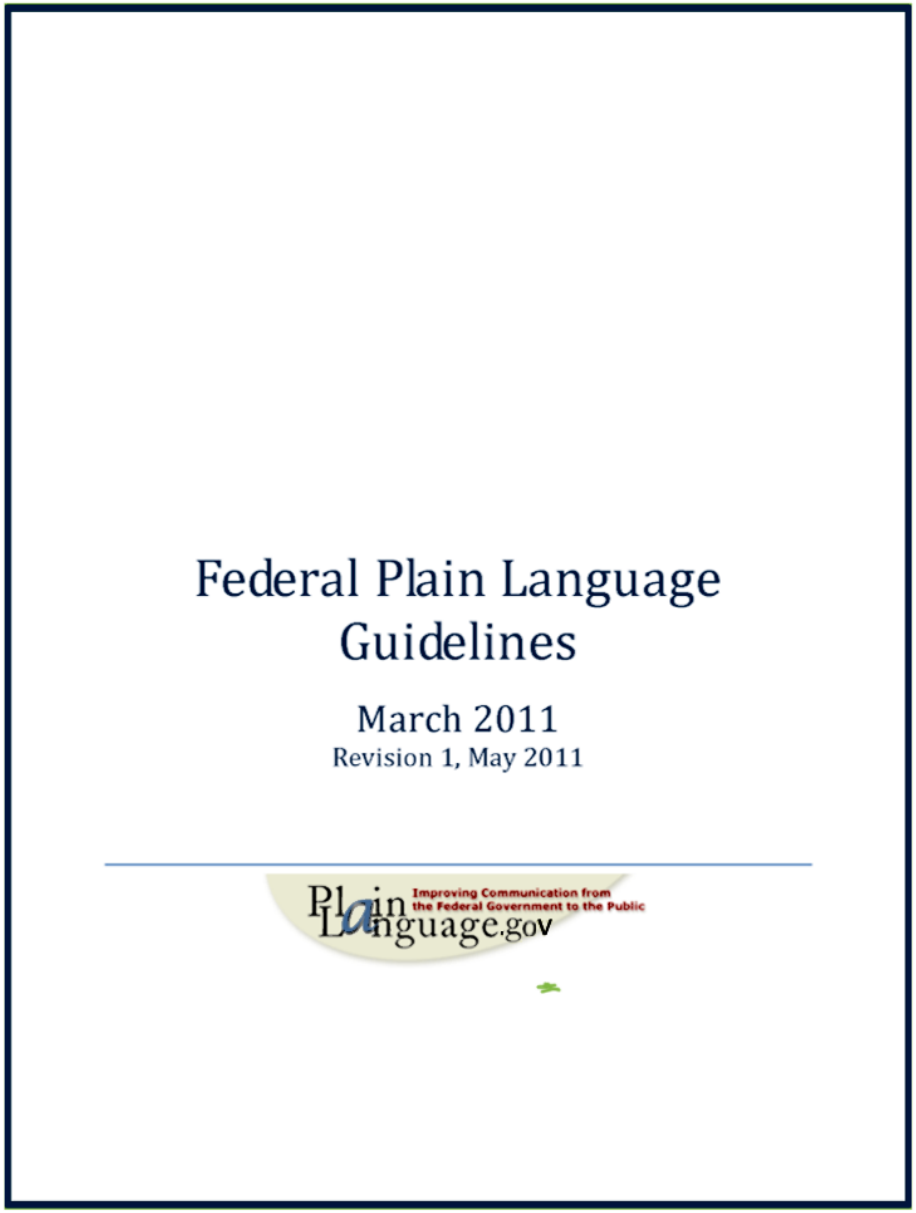
Plain Language Approach

- Goal: Make information more accessible to reader
- The audience can:
  - Find information faster
  - Understand it accurately
  - Act accordingly to understanding

Plain Language Approach (continued)

Potential to reduce project costs such as:

- Agency's costs responding to questions
- Hidden risks and their costs
- Contractor's added costs for contingencies
- Both parties' costs to resolve disputes



Federal Plain Language Guidelines

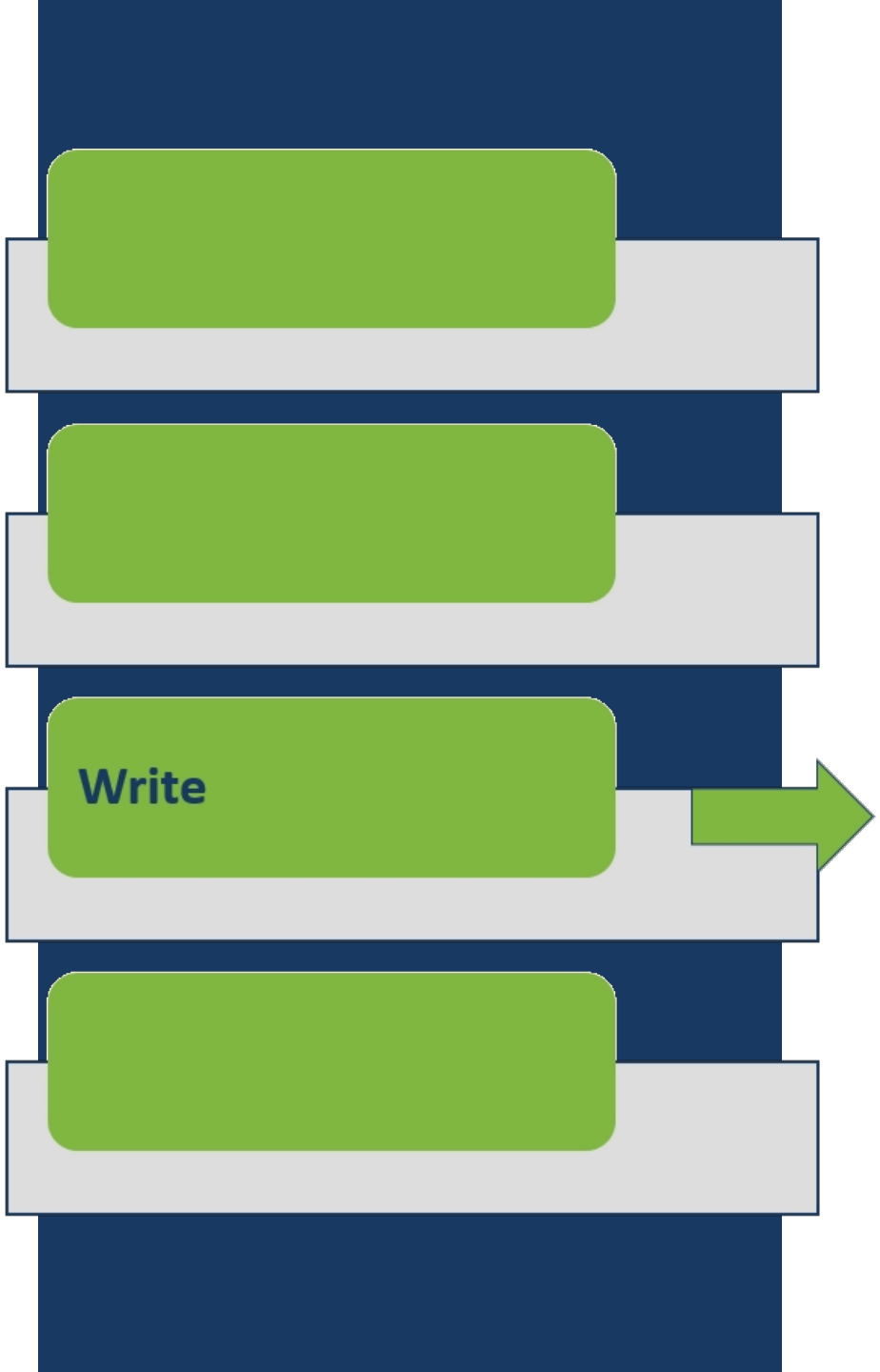
- Think about audience
- Organize
- Write
- Test

Step 1

- Audience research
- Level of expertise
- Audience/author gap
- Separate audiences

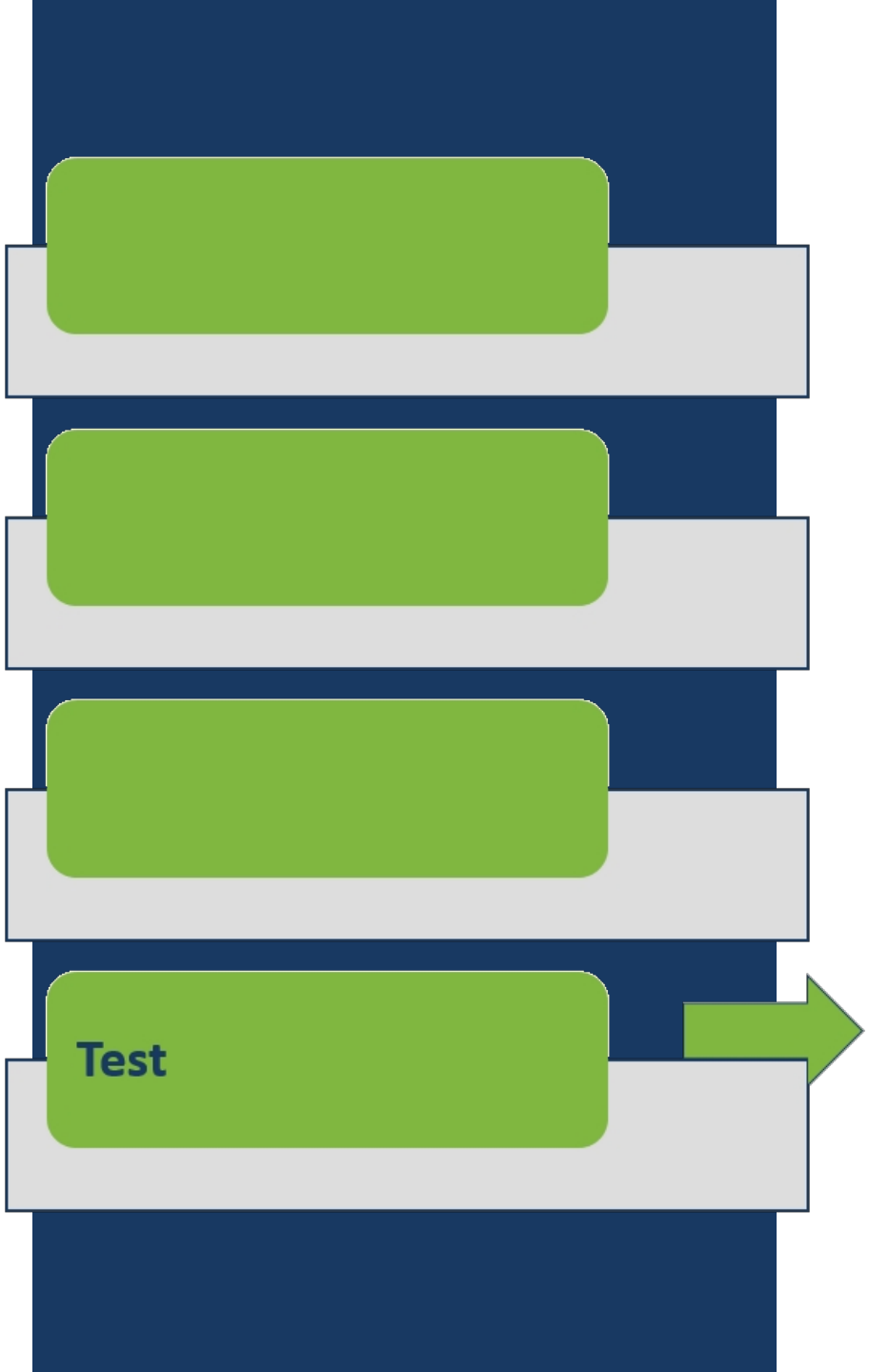
Step 2

- Review team
- Writing references
- National Highway Specification Web site
- Word processing software



Step 3

- Style guide
- Review and revision times

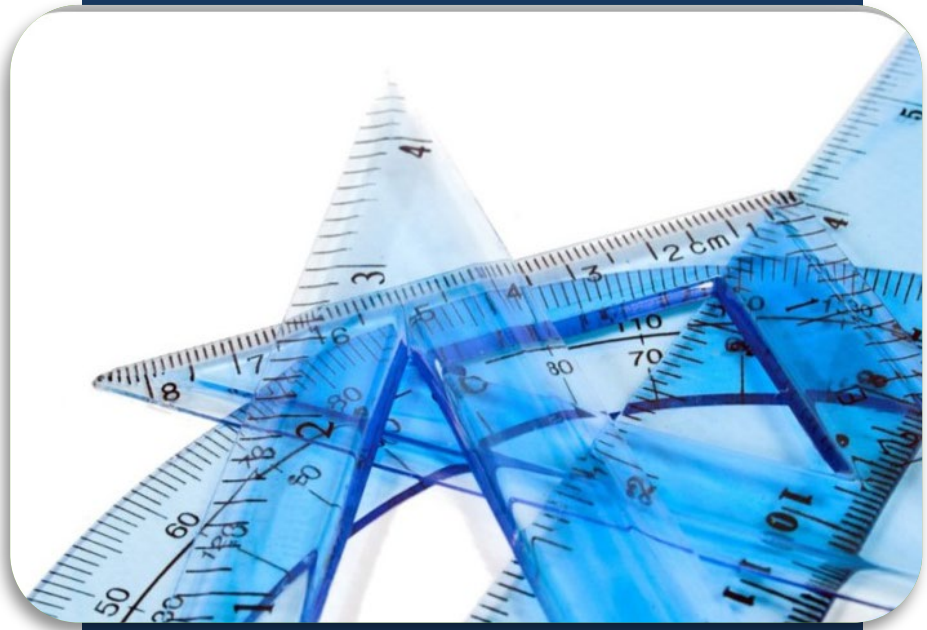


Step 4

- Before use
- After use

Partner Activity 3.1

- What questions do you have about the tasks?
- What tasks would you add to your checklist and why?



Lesson 3.2: Voice and Mood in Specifications

Learning Outcomes Lesson 3.2

- Explain the potential benefits of writing in the active voice
- Rewrite passive voice sentences into the active voice
- Evaluate specifications to determine the need for imperative or indicative mood

Voice—Active and Passive

Characteristic of a verb that reflects whether verb's subject acts or is acted upon

- Active voice: Subject performs action
- Passive voice: Subject receives an action

Active Voice Examples

The **contractor** shall **place** the **concrete** in continuous horizontal layers.

The **contractor** shall **test** the concrete **cores** for compressive strength.

Passive Voice Examples

Subject ⬇ Verb ⬇ Object?

The **concrete** shall be **placed** in continuous horizontal layers.

Subject ⬇ Verb ⬇ Object?

The concrete **cores** shall be **tested** for compressive strength.

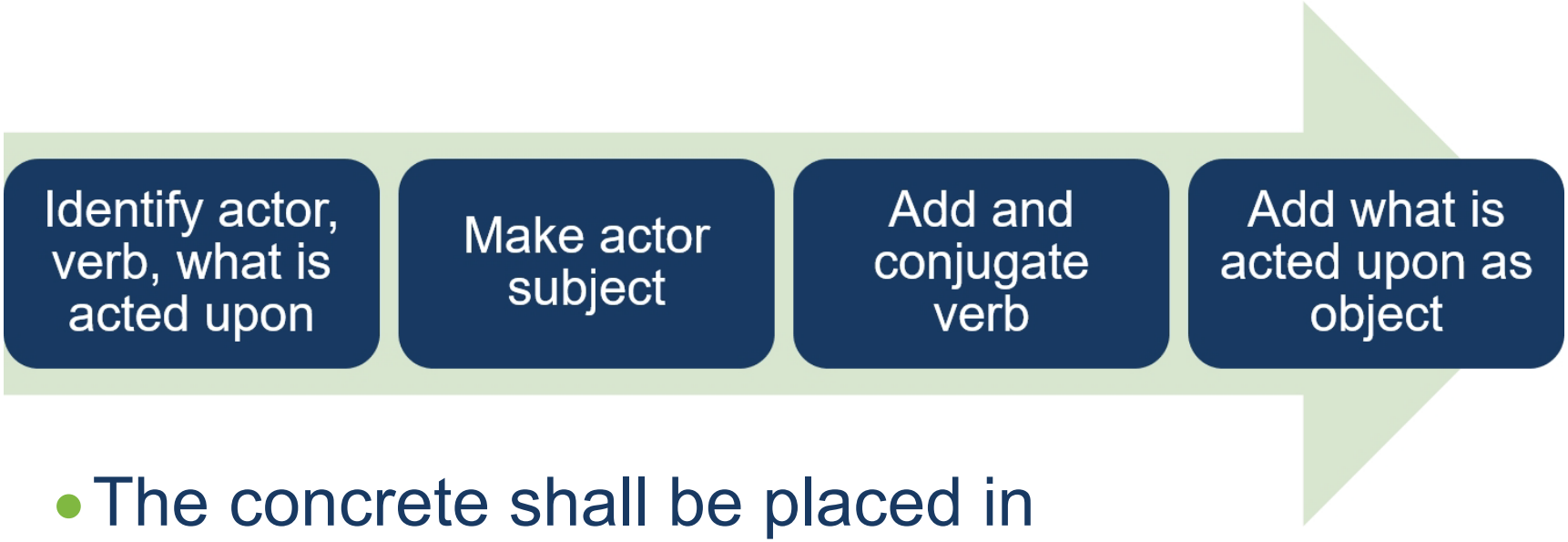
Voice—Active and Passive Use

- Passive voice is used in scientific and technical documents
  - Who performs the work is not important
- Specifications are technical and contractual
  - Who performs the work is important

Benefits of Active Voice

- More direct
- More concise
- Shorter
- Clearer
- Emphatic

Rewriting Passive to Active



- The concrete shall be placed in continuous horizontal layers.
- The contractor shall place the concrete in continuous horizontal layers.

Individual Activity 3.1

Rewrite each specification sample to active voice

Individual Activity 3.1—Debrief
Samples 1-2

Sample 1

"The contractor shall store and handle materials to preserve its fitness for the work."

Sample 2

"At least 30 days before the beginning of lime treatment, the contractor shall supply adequate quantities of soil and lime to the Materials Division for determination of lime requirements."

Individual Activity 3.1—Debrief
Samples 3-4

Sample 3

"The contractor shall remove or uncover completed work to allow inspection by the engineer."

Sample 4

"The contractor shall provide the test cylinders and all associated equipment; the engineer will sample and test the concrete."

Individual Activity 3.1—Debrief
Sample 5

Sample 5

"The contractor shall correct any pile damaged by reason of internal defects or improper driving, or any pile driven out of its proper location or driven below the elevation fixed by the plans or the engineer at no cost to the agency."

Individual Activity 3.1—Debrief
Sample 6

Sample 6

"The agency will consider the submission of a bid as prima facie evidence that the bidder has made such examination and is satisfied as to the conditions to be encountered in performing the work and as to the requirements of the plans, specifications, supplemental specifications, special provisions, and contract."

Mood

- Indicative mood “indicates” something
- Imperative mood is “imperious” or “imperial” and demands something

Indicative Mood

- Makes a statement, asks a question, or states an opinion
- Is most common

Indicative Mood Uses

- When defining or describing something
- With the existing shall/will convention
- When minimal or no action is performed
- When the contractor may make a choice in how to perform the work

Indicative Mood Examples

"The contractor shall place the concrete."

"The engineer may reject dowels with coatings not meeting the thickness requirements or dowels with coating damage."

"A Daily Average Profile Index is a roughness value obtained by averaging . . ."

Imperative Mood

- Expresses a command or gives direction
- Omits subject of sentence
- Is concise and easy to understand

Imperative Mood Use

- Subject “contractor” is implicit or understood
- Verb generally becomes the first word in the sentence
- Verb is conjugated to the second person
- Auxiliary verb “shall” is not used

Imperative Mood Examples

"Place the concrete in continuous horizontal layers."

"Test the concrete cores for compressive strength . . ."

"Remove material from the roadway foundation and salvage or dispose."

Imperative Mood Examples (continued)

"Roll and bend tube rail sections with a hydraulic ram."

"Provide Grade D concrete containing . . ."

"Consult with the appropriate utility company before beginning work."

"When using mineral filler, provide an additional bin."

Individual Activity 3.2

- Rewrite the specification samples in the active voice and imperative mood
- Determine how many words were eliminated

Individual Activity 3.2—Debrief

Sample 1

"Assemble the truss sections and posts in the shop before galvanizing."

Sample 2

"Obtain the engineer's approval of facilities and services before installing on the project site."

Sample 3

"Provide a written record of each shop assembly set-up as requested by the engineer."

General Guidelines

If a provision…	Then write the provision…
Reflects obligation or requirement of contractor	In active voice and imperative mood
Reflects an option, choice, or right of contractor	In active voice and indicative mood
Reflects on obligation, requirement, choice, right of agency	In active voice and indicative mood
Reflects statement of fact	In active voice and indicative mood
Reflects obligation, requirement, choice, right of agency and contractor	In active voice and indicative mood

Partner Activity 3.2

Rewrite the specification samples with the appropriate combination of voice and mood based on the general guidelines discussed

Partner Activity 3.2—Debrief

Sample 1 - Active/Imperative

"Compact the fill in accordance with the quality compaction requirements in 205, 'Excavation and Embankment."

Sample 2 - Active/Indicative

"The contractor may use preformed joint filler to form vertical joints."

Lesson 3.3: The Five Cs of Specification Writing

Learning Outcomes Lesson 3.3

- State the five Cs used in specification writing
- Identify potential ambiguities in the wording, given a sample specification
- Identify the potential benefits of each of the five Cs

Learning Outcomes (cont.) Lesson 3.3

- Write a new specification using the five Cs and the agency's preferred format
- Complete a checklist of the information needed before writing or revising a specification
- Apply the five Cs and the agency's preferred format to revise the specification, given a sample specification

The 5 Cs

Contains all necessary and relevant information	Complete
Uses current references and proper grammar, accurately describes technical requirements	Correct
Facilitates reading and understanding	Clear
Does not contain explanations, reasons, or use repetitive phrases	Concise
Uses phrases or terms the same way	Consistent

5 Cs of Specification Writing
Match

Not use different terms and phrases to describe similar elements and concepts	Consistent
Contain current references, accurate technical provisions, and proper grammar	Correct
Contain all relevant information for performing scope of work and not be missing any information	Complete
Not be confusing or difficult to read	Clear
Not be long and full of explanatory language	Concise

Complete

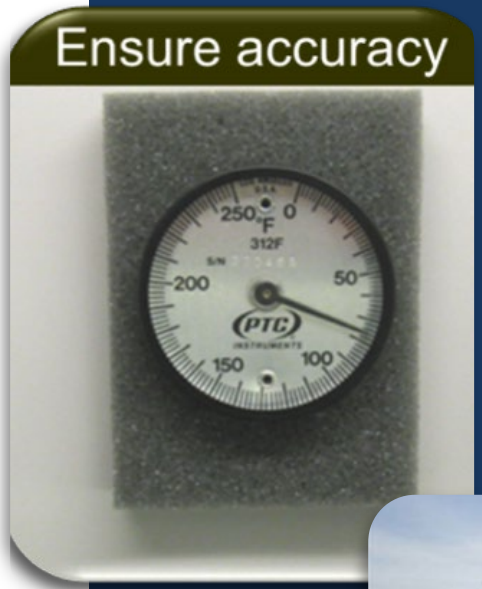
- Complete
- Correct
- Clear
- Concise
- Consistent

AASHTO Five-Part Format

- Description of Work
- Materials
- Construction Requirements
- Measurement
- Payment

Technically Correct

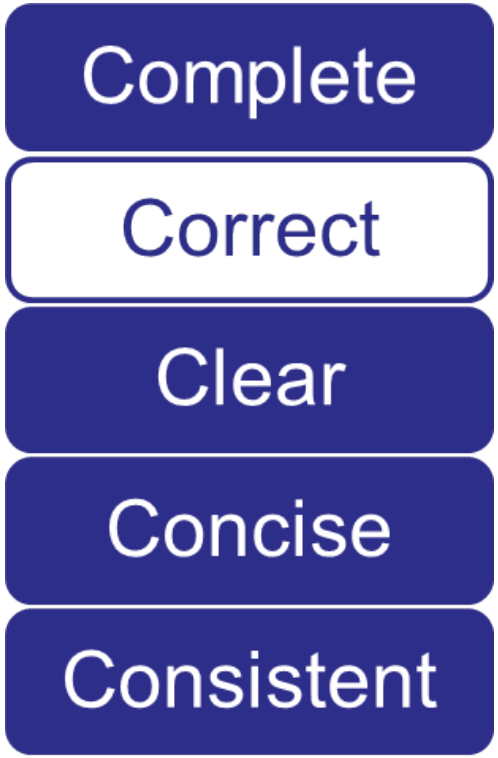
- Complete
- Correct
- Clear
- Concise
- Consistent




Review new materials, equipment, and methods


Identify best practices by networking and feedback

Grammatically Correct

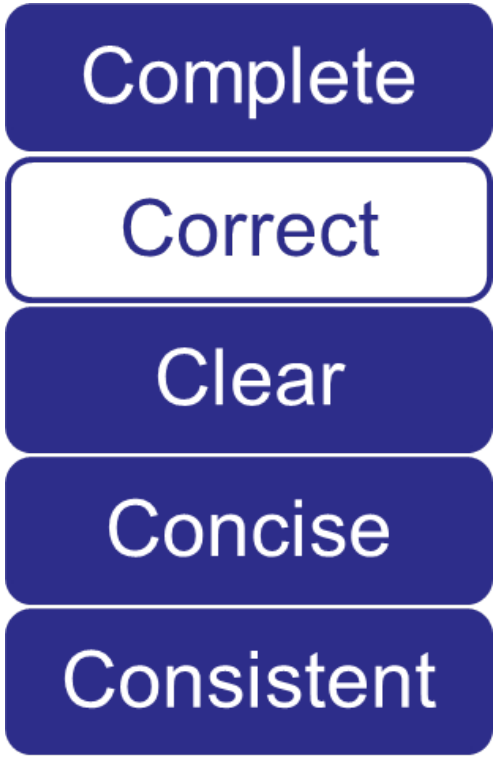


Eliminate misplaced modifiers

- Keep subjects and objects close to verbs
- Place modifiers next to words they modify

Grammatically Correct

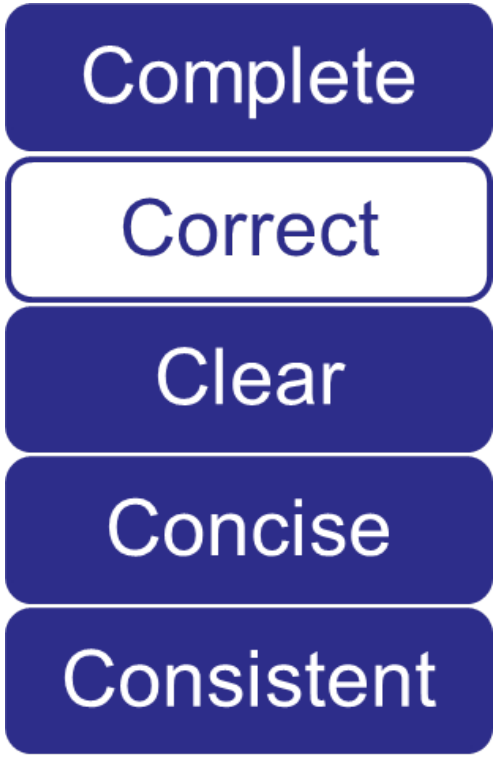
Discussion



"Obtain authorization from the engineer in writing."

- "Obtain authorization in writing from the engineer."
- **"Obtain written authorization from the engineer."**

Grammatically Correct
Rules



- Eliminate misplaced modifiers
- Do not drop articles
- Avoid serious sentence faults
- Use proper punctuation

Refer to agency style guide

Grammatically Correct

Guidance

- Complete
- Correct
- Clear
- Concise
- Consistent

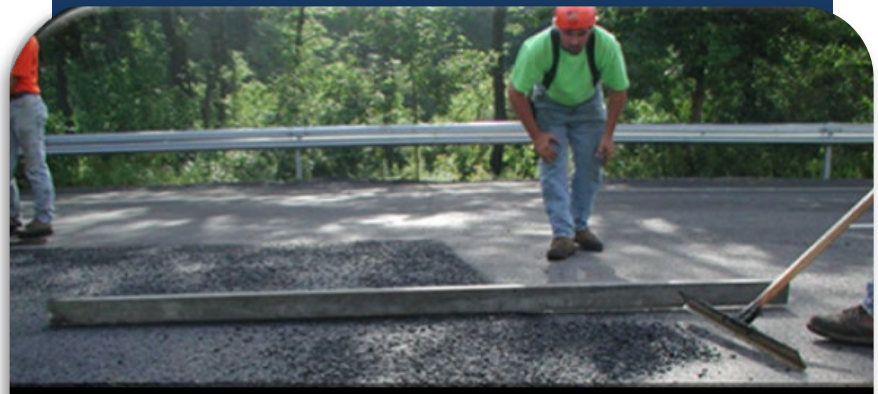
Partner Activity 3.3

- Read the Costly Comma scenario
- Answer the questions

Partner Activity 3.3—Debrief

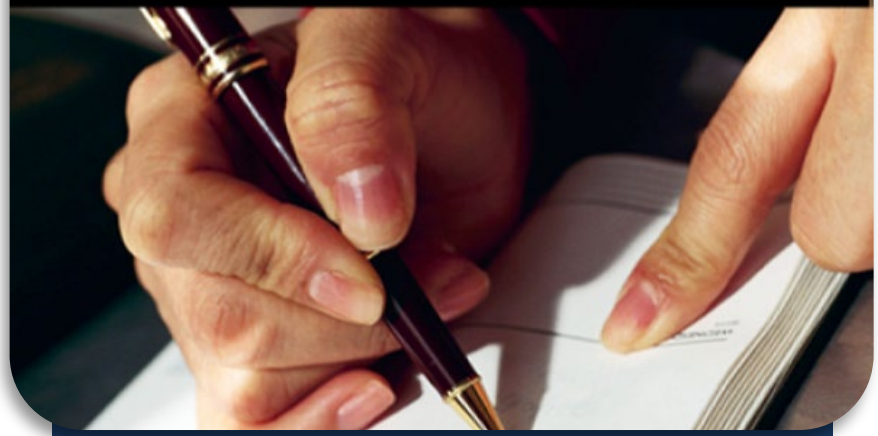
"This agreement shall be effective from the date it is made and shall continue in force for a period of five (5) years from the date it is made, and thereafter for successive five (5) year terms, unless and until terminated by one-year prior notice in writing by either party."

Meant the third part of the sentence describing the termination process (one-year written notice) applied to both the five-year term and five-year renewals



Convey exact meaning and use measureable standards

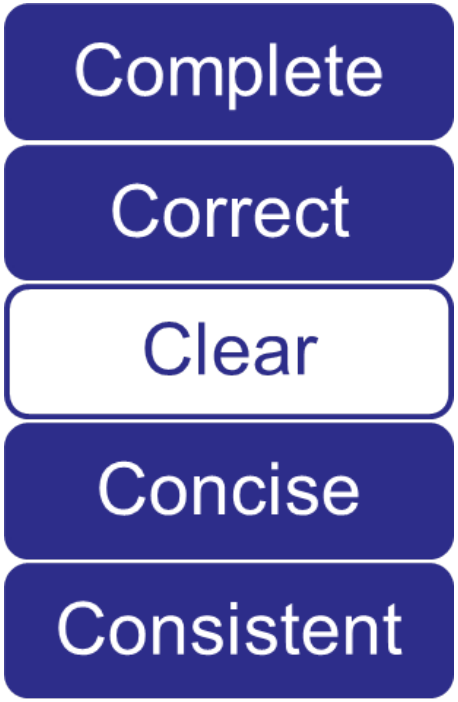
Use the right words the right way



Clear
Avoid Ambiguity

- Complete
- Correct
- **Clear**
- Concise
- Consistent

Clear
Correct Usage



- Any" vs. "all"
- "From . . . to . . ." vs. "between . . . and . . ."
- "Each" vs. "either"
- Restrictive and non-restrictive clauses

Any vs. All

- Complete
- Correct
- Clear
- Concise
- Consistent

- "Crush any oversized material. Repair all cracks."
- "Crush all oversized material. Repair all cracks."
- **"Crush all oversized material. Repair cracks greater than 3 mm wide."**

From…to…vs. Between…and…

- Complete
- Correct
- Clear
- Concise
- Consistent

- "The contractor shall open the ramp between July 3rd and July 5th."

- "The contractor shall open the ramp from July 3rd to July 5th."

Each vs. Either

Complete

Correct

Clear

Concise

Consistent

- "A stable shoulder shall be constructed on either side of the roadway."

- "Construct a stable shoulder on each side of the roadway."

Restrictive and Non-restrictive

- Complete
- Correct
- Clear
- Concise
- Consistent

- "The concrete surface must be clean."

- "Provide a concrete surface free of dirt, grease, oil, and other foreign material before applying the coating."

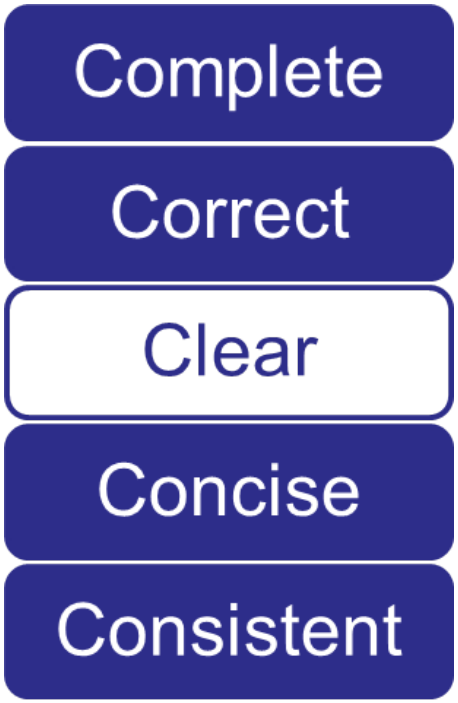
Clear
Use of "which" vs. "that"

- Complete
- Correct
- **Clear**
- Concise
- Consistent

- "Provide a lock with an audible warning device, which signals each time the lock is released."

- "Provide a lock with an audible warning device that signals each time the lock is released."

Clear
Specification Writer Tips

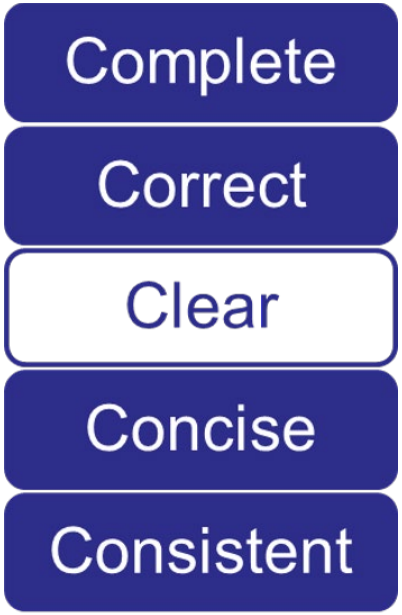


- Terms with subjective meaning
- Vague adjectives and adverbs
- Latent and patent errors
- Vertical lists

Individual Activity 3.3

- Read the “Original Specification” and the “Original Specification Rewritten with a List”
- Answer the questions

Clear



- Positive phrasing
  (Do not overuse negative phrasing)
- Parallel construction
- Best verb
- Other common problems

Clear specifications unambiguously establish roles and responsibilities

Individual Activity 3.4

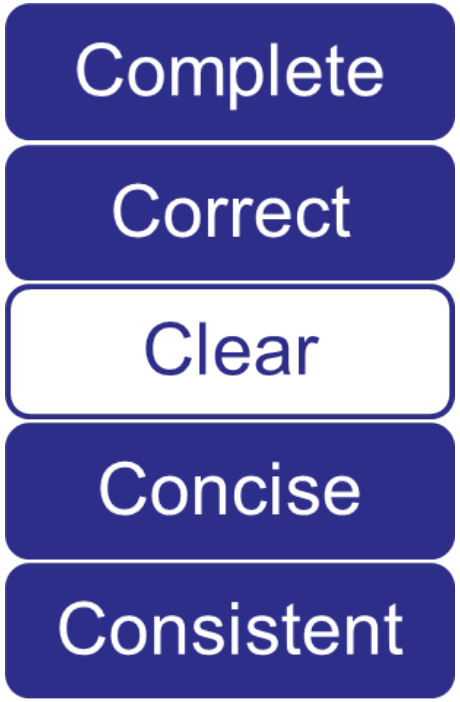
Rewrite the sentences using the guidance in the workbook

Positive Phrasing

- Complete
- Correct
- Clear
- Concise
- Consistent

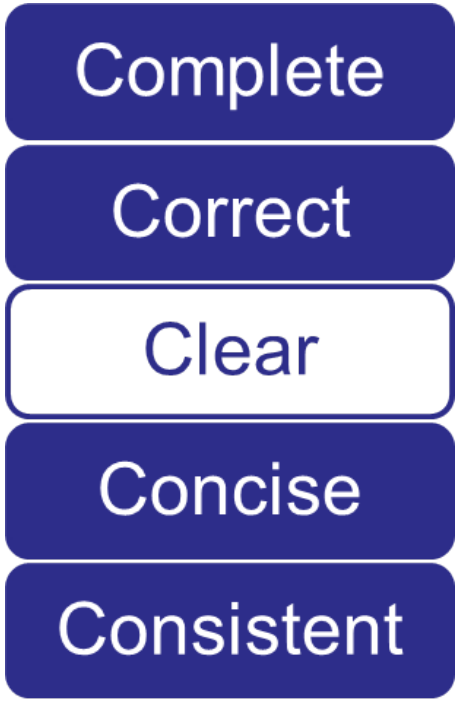
- "Do not add water to the surface of the concrete to aid in finishing without the approval of the engineer."
- "Obtain the approval of the engineer before adding water to the surface of the concrete to aid in finishing."

Positive Phrasing (continued)



- "Do not bunch up the strokes in the cross-section of each layer."
- "Uniformly distribute the strokes over the cross-section of each layer."

Parallel Construction



- "Submit the payment application for record keeping and to receive payment."
- "Submit the payment application to provide a record and to receive payment."

Contains all essential information

Omits needless words

Concise

- Complete
- Correct
- Clear
- **Concise**
- Consistent

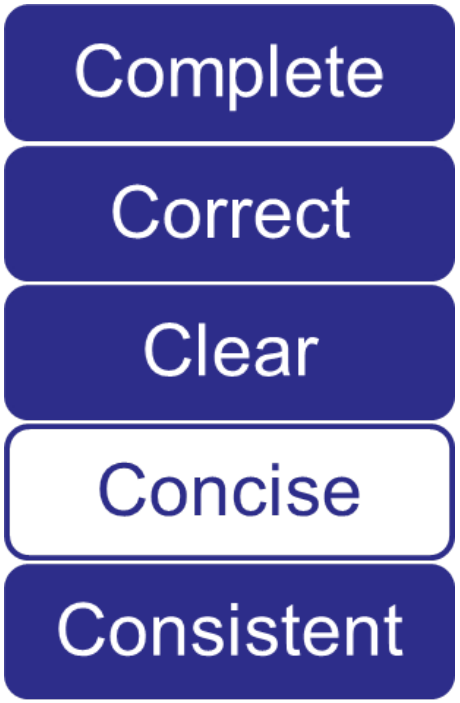
Common Phrases

Common Use	Suggested
absolutely essential	*essential*
successfully complete	*complete*
a minimum of	at least
not less than	at least
enclosed herewith	enclosed, included
at a later date	later
commence	start, begin
heretofore	until now, before
prior to	before

Common Phrases (cont.)

Common Use	Suggested
subsequent to	after
for the purpose of	for, to
through the use of	using
until such time as	until
in lieu of	instead of
utilize	use
in order to	to

Concise Specification



- Contains no reasons or suggestions
- Uses indicative and imperative moods
- Uses simple words
- Uses short sentences
- Uses short paragraphs
- Eliminates repetition

Consistent

- Complete
- Correct
- Clear
- Concise
- Consistent

Federal 6

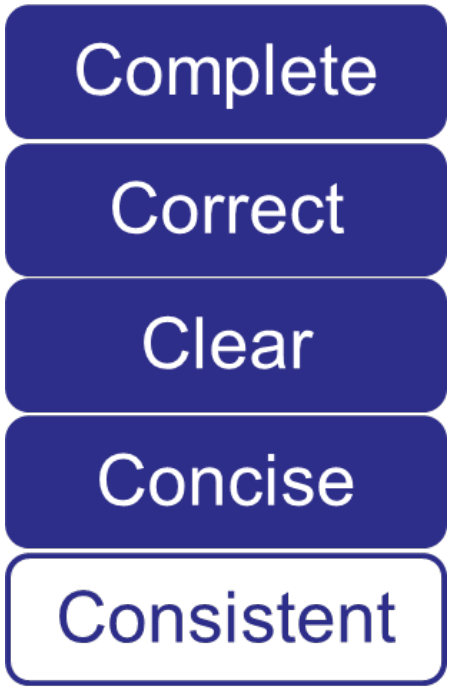
"Greater than"

permit

113.1 Acceptance

The Chicago Manual of Style Online

Consistent Use



- Terms and phrases
- Abbreviations and acronyms
- Units of measure and symbols
- Numbers
- Capitalization
- Format and organization
- General provisions
- Style guides and aids
- Training and guidance

Group Activity 3.1

Write a method specification

Group Activity 3.1 (cont.)

- Exchange method specifications with another group
- Review and comment on the method specification
- Use the Specification Writer's Checklist as a guide for the review

Group Activity 3.1—Debrief

- Return the other group's specification
- Review the comments and Example Method Specification for a Concrete Sidewalk (Appendix D)
- Identify areas of disagreement and prepare to discuss them with the group

5 Cs of Specification Writing

- Complete
- Correct
- Clear
- Concise
- Consistent

- Order is important
- Content comes first, then style
- All have equal weight and are interrelated

Individual Activity 3.5

- Read the sample specification
- Identify issues in the sample specification by completing the Specification Writer's Checklist
- Rewrite the specification as necessary

Individual Activity 3.5—Debrief

"616.03 Construction Requirements. Excavation and backfill shall be according to the requirements of Section 801, "Traffic Control Plan.""

"616.03 Construction Requirements. **Excavate** and backfill **in accordance with Section 205, "Excavation and Embankment.""**

Individual Activity 3.5—Debrief *(continued 1)*

"The agency will perform acceptance sampling and testing of the compacted backfill material in accordance with Subsection 208.03 at the frequencies established by the Agency in Section 205, "Excavation and Embankment.""

Individual Activity 3.5—Debrief *(continued 2)*

"The agency will sample and test the compacted backfill material in accordance with Subsection 208.03, "**Acceptance,**" at the frequencies established in **Section 205**, "**Excavation and Embankment**.""

Individual Activity 3.5—Debrief *(continued 3)*

"Precast reinforced concrete box culvert units shall be bedded on a foundation of firm and stable material, accurately shaped to conform to their base."

Individual Activity 3.5—Debrief *(continued 4)*

"**Place** precast reinforced concrete box culvert units on a foundation of **bedding** material provided **in accordance with Subsection 835.04, "Drainage Structure Bedding Material."** Accurately shape **the foundation** to conform to the base **of the culvert**."

Individual Activity 3.5—Debrief *(continued 5)*

"When required by the plans, special bedding material shall be provided as required in Section 616.02. The special bedding material will be furnished at no cost to the agency."

"**The plans may** require special bedding material."

Individual Activity 3.5—Debrief *(continued 6)*

"Joints and joint materials shall comply with the requirements of Section 608."

"**Provide** joints and joint materials **in accordance with** Section 608, "**Structural Concrete Joints**.""

Individual Activity 3.5—Debrief *(continued 7)*

"Lifting holes shall be filled with mortar or concrete and cured as directed."

"**Fill** lifting holes with mortar or concrete, and cure **in accordance with Subsection 620.03.D, "Curing Mortar and Concrete.""**

Individual Activity 3.5—Debrief *(continued 8)*

"When precast boxes are used to form multiple barrel structures, they shall be placed in conformance with the details shown on the plans. Material required between barrels shall be as shown on the plans. The material between barrels will be furnished at no cost to the agency."

Individual Activity 3.5—Debrief *(continued 9)*

"**If using** precast boxes to form multiple barrel structures, **place the boxes** in **accordance** with the details shown on the plans. **The plans will identify the material** required between the barrels."

Individual Activity 3.5—Debrief *(continued 10)*

"Connections of precast boxes to cast-in-place boxes or to any required headwalls, wingwalls, riprap, or other structures shall comply with the details shown on the plans."

"Connect precast boxes to cast-in-place boxes or to any required headwalls, wingwalls, riprap, or other structures **in accordance** with the details shown on the plans."

Individual Activity 3.5—Debrief *(continued 11)*

"Headwalls, wingwalls, and footings shall be according to the details of the plans, except that the overall widths of the headwalls and footings shall be modified to fit the finished width of the various structures."

Individual Activity 3.5—Debrief *(continued 12)*

"**Install** headwalls, wingwalls, and footings **in accordance with** the details **shown on** the plans, except **modify** the overall widths of the headwalls and footings to fit the finished width of the various structures."

Individual Activity 3.5—Debrief *(continued 13)*

"The number of drainage structures to be furnished will be listed on the plans or in the Proposal. The Contractor shall protect all drainage structures until the engineer has determined that all construction work has been completed."

"**The plans will list** the number of **required** drainage structures."

Collaboration

Module 3 Review

AASHTO Five-Part Format

- **Description of Work**
- **Materials**
- **Construction Requirements**
- **Measurement**
- **Payment**

- Complete
- Correct
- Clear
- Concise
- Consistent

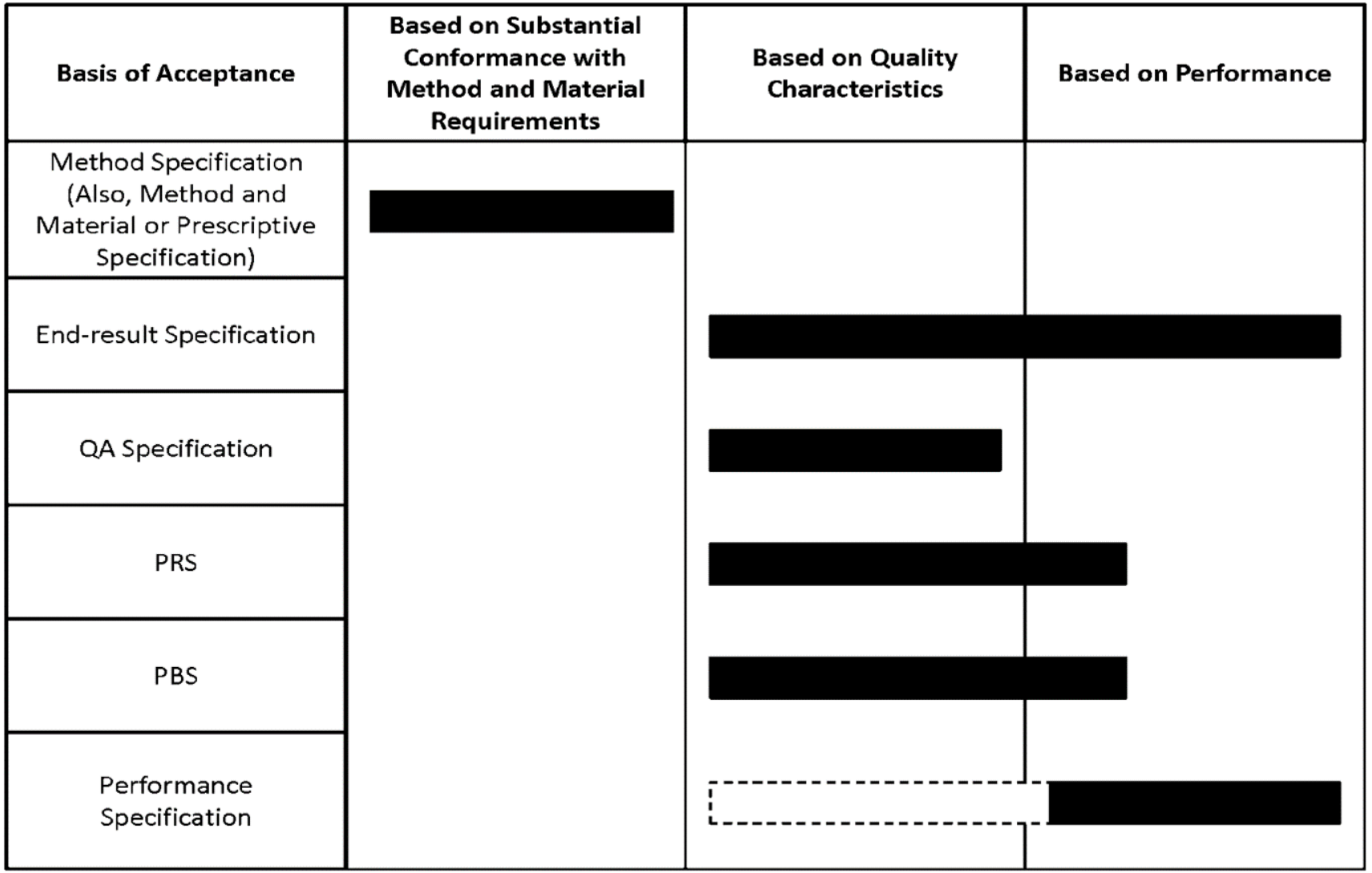
Module 4

Method or End-result Specifications

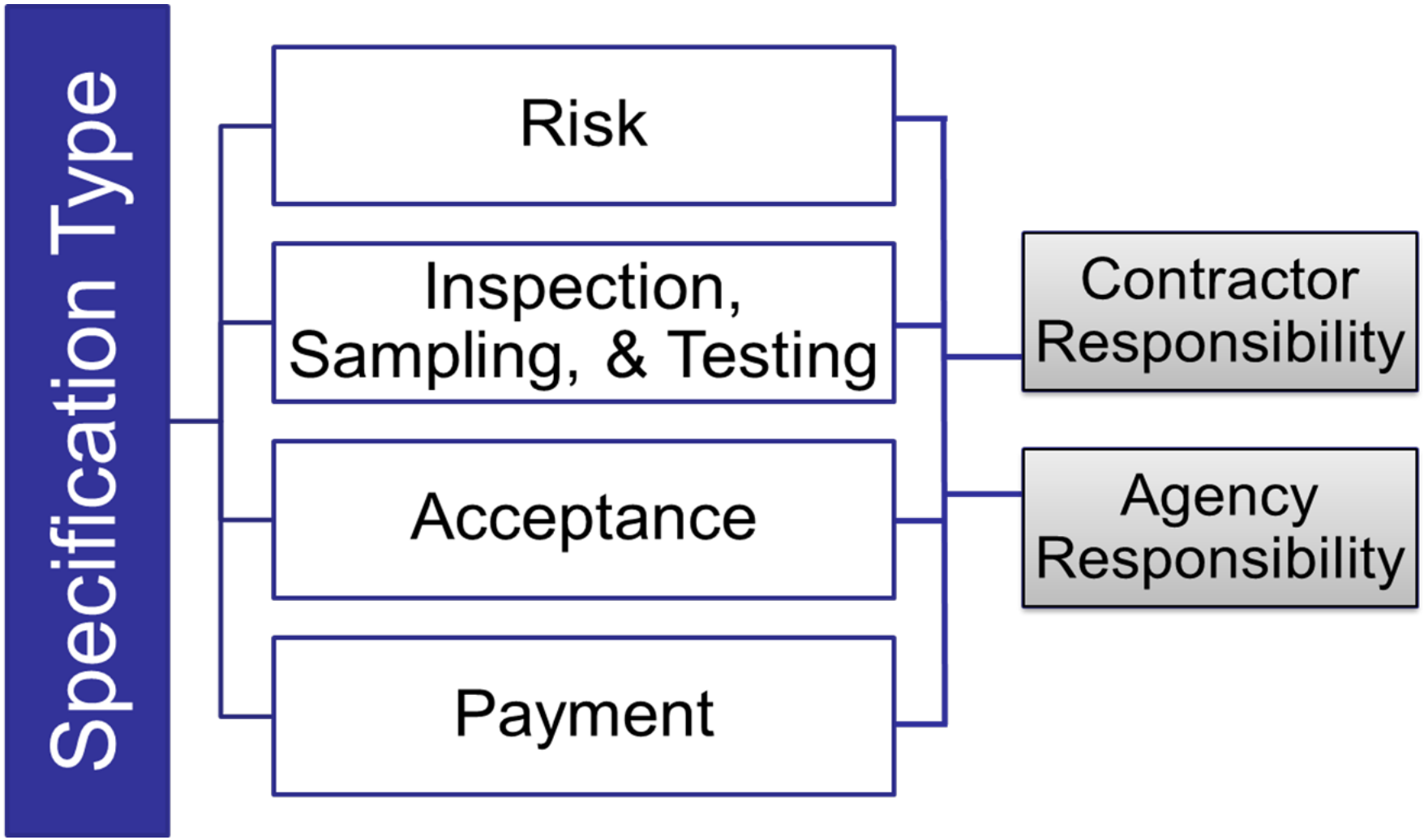
Learning Outcomes

- Write a new specification to a given set of criteria using the five Cs and the agency's preferred format, given a sample specification
- Relate the type of specification to the allocation of risk
- Write an end-result specification to replace a method specification, given an excerpt from a method specification

Types of Specifications



Specification Attributes



Method Specifications

Specifications that require the contractor to use specified materials in definite proportions and specific types of equipment and methods to place the material

Industry Terms

- Descriptive
- Prescriptive
- Recipe
- Methods and materials

Method Specification Characteristics

Risk

Acceptance

Inspection, Sampling & Testing

Payment

Method Specification Advantages

- Well established and easily understood
- Agency can exert control over the work
- Requirements based on methods and materials that have worked in the past

Method Specification Disadvantages

- Contractor has little opportunity to deviate from the specification
- Few built-in incentives for contractors to provide enhanced performance
- Prescribed procedures may discourage contractor from using innovative procedures

Method Specification Disadvantages (continued)

- Contractor payment not tied to performance or quality of work
- Acceptance decisions based on test results of field samples can increase disputes

End-result Specifications

Specifications that require the contractor to take the entire responsibility for supplying a product or an item of construction

End-result Specification Characteristics

Risk

Acceptance

Inspection, Sampling & Testing

Payment

End-result Specification Advantages

- Contractor innovation is promoted
- Contractor assumes more performance risk
- Contractors have flexibility to select materials, techniques, and procedures
- More rational mechanism for adjusting payment based on quality or performance

End-result Specification Disadvantages

- Agency can exert less control over the work
- Opportunities for smaller, local construction firms reduced
- Challenge to identify all parameters critical to performance
- Roles and responsibilities of the contractor and agency can blur

Quality Assurance Specifications

Specifications that require contractor quality control and agency acceptance activities throughout production and placement of a product

Quality Assurance Specification Characteristics

Risk

Acceptance

Inspection, Sampling & Testing

Payment

Partner Activity 4.1

- Review and discuss the notes on the matrix of attributes
- Match each sample specification with the best representative type of specification. Use the information you noted and discussed
- Write your answers in the Types of Specification table

Specification Sample 1

"**609.4.4 Finishing**. When using forms, trowel exposed surfaces smooth and give a fine brush finish with brush strokes parallel to the curb line. After removing forms, fill surface blemishes that will be exposed with grout and finish . . ."

Method specification

Specification Sample 2

"**609.4.6 Surface Tolerance**. Ensure that the finished top and face of the curb are true and straight and that the top surfaces are of uniform width and free from irregularities. Do not leave the finished surface with variation greater than 3/16 in. [5 mm] every 10 ft. [3 m] in any direction. Correct excess variation by removing and replacing the curb section."

End-result specification

Specification Sample 3

"**605.03. Concrete Production**. The contractor shall provide quality control measures for the production of concrete in accordance with Section 604. The engineer will not sample or test for quality control or assist in controlling the contractor's production operations . . ."

Quality assurance specification

Specification Sample 4

"**401.16 Density**. Acceptance will be based on lots and sublots in accordance with 401.07.

Density of the compacted dense graded mixture will be determined from cores except where . . ."

End-result specification

Specification Sample 5

"**716.03 General Requirements**. The contractor shall submit a quality control plan, QCP, in accordance with ITM 803. The QCP shall be submitted to the engineer for review and acceptance, at least 15 days prior to the start of trenchless pipe installation operations."

Quality assurance specification

Specification Sample 6

"**5. Preparing Pavement Surface.** Prepare the pavement surface to receive the chip seal. Clean pavements requiring treatment with a motorized power broom to remove loose material. Use a hand broom to clean cracks and other areas inaccessible by power broom. Use pick-up sweepers adjacent to lawns or roadways with curb and gutter."

Method specification

Performance-Related Specifications

Specifications that describe the desired levels of key materials and construction quality characteristics that correlate with fundamental engineering properties that predict performance

Performance-Related Specification Characteristics

Risk

Acceptance

Inspection, Sampling & Testing

Payment

Performance-Based Specifications

Specifications that are based on the desired levels of fundamental engineering properties that are predictors of performance and appear in primary prediction relationships

Performance-Based Specification Characteristics

Risk

Acceptance

Inspection, Sampling & Testing

Payment

Group Activity 4.1

- Review the Example Method Specification for a Concrete Sidewalk
- Identify components of the example not appropriate for use in an end-result specification
- Strike through the method requirements to be replaced with end-result requirements
- Identify and record ideas for end-result acceptance criteria

Group Activity 4.1—Debrief

608.01 Description of Work

This work consists of constructing a concrete sidewalk.

Group Activity 4.1—Debrief *(continued 1)*

608.02 Materials

Provide material for constructing a concrete sidewalk as follows:

1. ~~Bed course material in accordance with Subsection 703.12~~
2. Reinforcing steel in accordance with Subsection 711.01
3. Concrete, Class B, in accordance with Section 601 and Subsection 713.01(B)
4. Joint filler in accordance with Subsection 707.01(D)
5. ~~Form release agent approved by the engineer~~
6. ~~Curing compound in accordance with Subsection 713.02(C)~~

Group Activity 4.1—Debrief *(continued 2)*

608.03 Construction Requirements

~~1. Equipment~~

- ~~Excavator and hand tools for excavation and placement of bed course material.~~
- ~~Hand-driven compactor for compaction.~~
- ~~Forms and hand tools for placing, consolidating, finishing, jointing, and texturing the concrete.~~

Group Activity—Debrief *(continued 3)*

608.03 Construction Requirements

2. Methods

- ~~*Excavating*. Excavate to the depth and width necessary to allow for the proper depth of the bed course material and the installation and bracing of the forms. Replace soft and yielding material with the specified bed course material. Place, shape, and compact the bed course material to the line and grade established by the plans.~~
- ~~*Forms*. Use full-depth forms that, when properly braced, are strong enough to resist the concrete pressure. Maintain horizontal and vertical alignment. Use clean forms and coat with a form-release agent.~~

Group Activity—Debrief *(continued 4)*

608.03 Construction Requirements

- ~~*Reinforcing Steel.* Place reinforcing steel as specified in Subsection 809.~~
- ~~*Placing Concrete*. Moisten the foundation prior to placing concrete. Proportion, mix, and place as specified in Subsection 601. Place uniformly in one course.~~
- *Finishing*. ~~Float and apply a light broomed finish~~. Edge all outside slab and all joint edges to a ¼ in. (6 mm) radius.

Group Activity—Debrief *(continued 5)*

608.03 Construction Requirements

- *Joints*. Fill expansion joints with the specified preformed expansion joint filler. Section the sidewalk using false joints at 5 ft. (1.5 m) intervals ⅛ in. (3 mm) wide and at least 1 in. (25 mm) deep ~~using a jointing tool~~. Match curb or pavement joints.
- Form full-depth construction joints around all appurtenances, such as manholes and utility poles. Install full-depth preformed expansion joint filler between concrete sidewalks and structures.

Group Activity—Debrief *(continued 6)*

608.03 Construction Requirements

- ~~*Curing. Cure concrete as specified in Subsection 808.03(I) for 72 hours. Do not allow pedestrian and vehicle traffic on the concrete for 7 days unless the surface is protected by planks, plywood, or a minimum 1 in. (25 mm) sand layer. Do not place protection directly on the concrete for a minimum 12 hours after application of the curing compound.*~~

Group Activity—Debrief *(continued 7)*

608.03 Construction Requirements

3. Inspection and Acceptance
   - ◊ Notify the engineer 24 hours before beginning the placement of concrete sidewalks.
   - ◊ The engineer will inspect the form work, bed course, and reinforcing steel installation before concrete is placed.

Group Activity—Debrief *(continued 8)*

608.04 Measurement

The engineer will measure accepted sidewalk separately by the square foot (square meter) of concrete placed.

Group Activity—Debrief *(continued 9)*

608.05 Payment

The agency will pay for accepted sidewalk in accordance with the contract pay items for sidewalk.

Group Activity 4.2

- Fill in the blanks of the end-result specification
- Use the Specification Writer's Checklist as a resource

Group Activity 4.2 (continued)

- Exchange your group's end-result specification with another group
- Review and comment on the end-result specification
- Use the Specification Writer's Checklist as a guide for review

Group Activity 4.2—Debrief

- Review the Example End-result Specification for a Concrete Sidewalk and the other group's comments
- Identify points of disagreement and prepare to discuss them with the group

Deciding Between Specification Types

Deciding Between Types
Discussion

- Performance definitions
- Performance measurements
- Key performance parameters
- Performance risk
- Other considerations

Deciding Between Types

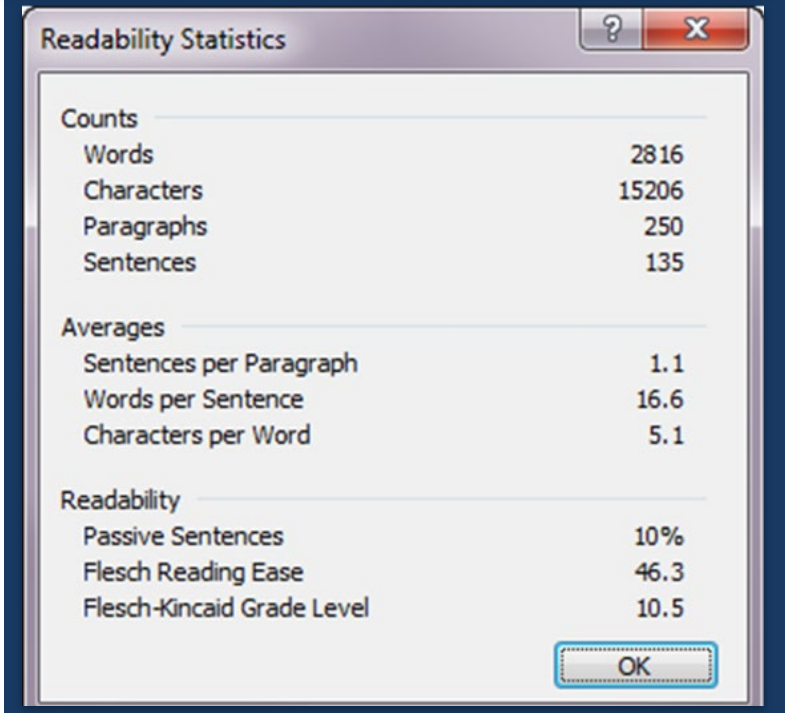
Module 4 Review

Module 5

Conclusion and End-of-Course Activities

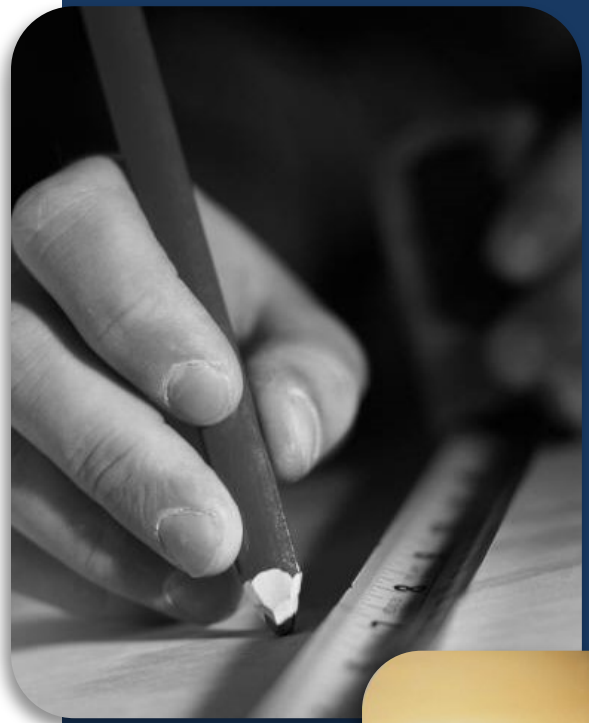
Specification Writing References

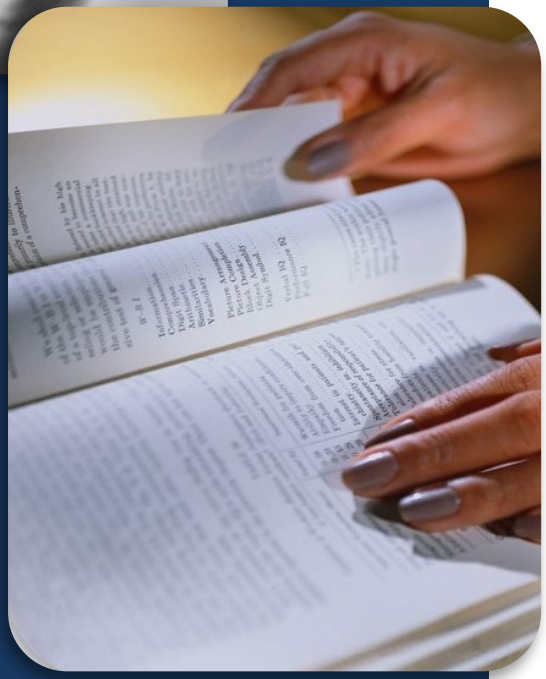
- Style guides
- Checklists
- Glossaries
- Federal Plain Language Guidelines
- Web site
- FHWA technical advisory document
- Strategic Highway Research Program (SHRP) publication
- AASHTO publications
- Construction Specifications Institute publication



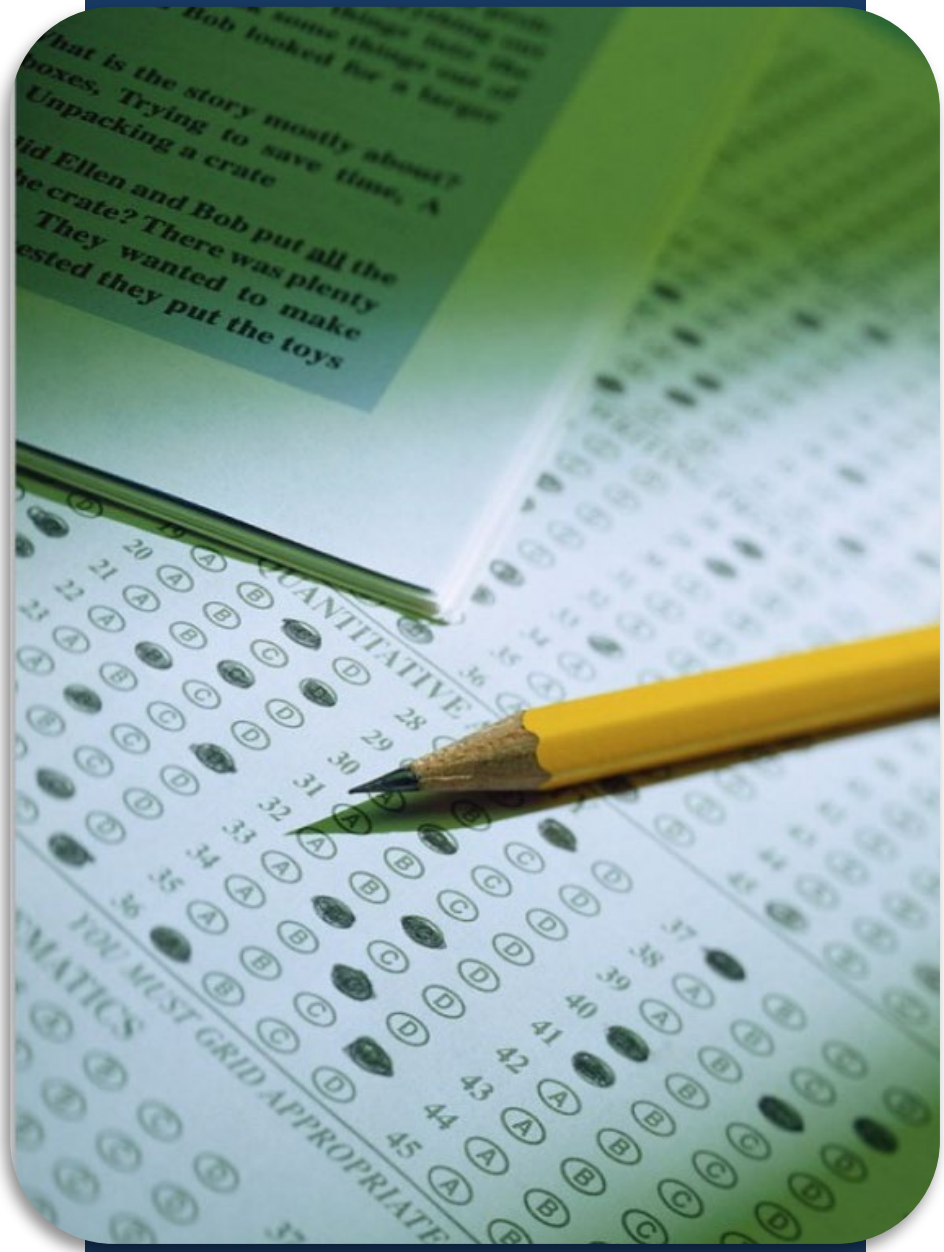
Word Processing Tools

- Spelling and grammar check
- Readability statistics
- Track changes
- Comments
- Compare documents





Learning Outcomes



Exam and Evaluation

- Exam
  - 60 minutes to complete
  - Open-book
  - Individual not group
- Evaluation
  - Required to receive certificate