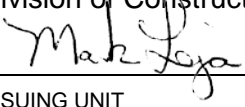




MANUAL CHANGE TRANSMITTAL		NO. 12-7
TITLE: Department of Transportation <i>Construction Manual</i>	APPROVED BY: Mark Leja, Chief Division of Construction 	DATE ISSUED: November 27, 2012
SUBJECT AREA Table of Contents and various sections of the <i>Construction Manual</i>	ISSUING UNIT Division of Construction	
SUPERSEDES CPD 04-4	DISTRIBUTION All Requested Manual Holders	

This manual change transmittal delivers the revisions of Chapter 4, Sections 4-22, 4-51, 4-52, 4-55, 4-61, 4-62, 4-64, 4-66, and 4-67 of the *Construction Manual*. Updated sections may contain updated language, information, corrections, and references resulting from updates to the 2010 *Standard Specifications*, and from policy, and procedural changes. Change bars in the margins of the revised sections indicate text that was changed or added.

Please update your manual according to the table below.

Section(s)	Incorporates	Remove Old Page(s)	Insert New/Revised Page(s)
Table of Contents	None	TOC.3 thru TOC.4	TOC.3 thru TOC.4
Chapter 4, Section 22, "Finishing Roadway"	None	4-22.1 thru 4-22.2	4-22.1 thru 4-22.2
Goldenrod, Chapter 4, Section 51, "Concrete Structures"	None	4-51.i	4-51.i
Chapter 4, Section 51, "Concrete Structures"	None	4-51.1 thru 4-51.4	4-51.1 thru 4-51.4
Chapter 4, Section 52, "Reinforcement"	None	4-52.1 thru 4-52.3	4-52.1 thru 4-52.3
Chapter 4, Section 55, "Steel Structures"	None	4-55.1 thru 4-55-2	4-55.1 thru 4-55-2
Section 4-61, "Culvert and Drainage Pipe Joints"	None	4-61.1	4-61.1 thru 4-61.2

Section(s)	Incorporates	Remove Old Page(s)	Insert New/Revised Page(s)
Section 4-62, "Alternative Culverts"	None	4-62.1	4-62.1 thru 4-62.3
Section 4-64, "Plastic Pipe"	None	4-64.1 thru 4-64.2	4-64.1 thru 4-64.2
Section 4-66, "Corrugated Metal Pipe"	None	4-66.1 thru 4-66.2	4-66.1 thru 4-66.2
Section 4-67, "Structural Plate Culverts"	None	4-67.1 thru 4-67.2	4-67.1 thru 4-67.2

Section 4-22, "Finishing Roadway"

- Updates reference and language to align with 2010 *Standard Specifications*.

Section 4-51, "Concrete Structures"

- Updates references to align with 2010 *Standard Specifications*.
- Includes web address for applicable structures manuals.
- Changes SI units to US customary units.

Section 4-52, "Reinforcement"

- Updates references to align with 2010 *Standard Specifications*.
- Includes web address for applicable structures manuals.
- Changes SI units to US customary units.
- Eliminates CPD 04-4, "Ultimate and Service Butt Splice Production Tests for Reinforcing Steel, Revised Witnessing Requirements." The CPD is no longer needed because it addressed changes in specifications for contracts in 2004. Those contracts are completed.

Section 4-55, "Structural Steel"

- Updates references to align with 2010 *Standard Specifications*.
- Includes web address for applicable structures manuals.

Section 4-61, "Culvert and Drainage Pipe Joints"

- Updates reference to align with 2010 *Standard Specifications*.
- Includes SSP 61-010 (2006) which was incorporated into Section 61 (2010).
- Distinguishes between watertightness and field leakage testing.
- Clarifies payment provisions.

Section 4-62, "Alternative Culverts"

- Updated to incorporate three new 2010 Standard Specifications sections, "Alternative Slotted Pipe," "Temporary Culverts," and "Concrete Backfill for Pipe Trenches."

Section 4-64, "Plastic Pipe"

- Expanded to include slotted plastic pipe.
- Adds certificate of compliance requirement and rapid strength concrete mix design submittals.
- Clarifies unacceptable pipe materials.

- Clarifies handling, storage, and placement language.
- Modifies for potential watertightness requirements.
- Adds measurement and payment information.

Section 4-66, “Corrugated Metal Pipe”

- Modifies opening paragraph concerning pipe designations.
- Adds slotted corrugated steel pipe construction guidance.
- Provides additional guidance for measurement and payment of the work.
- Updates reference to the *Construction Manual*.
- Removes pipe jacking guidelines because pipe jacking is not included in the 2010 *Standard Specifications*, Revised Standard Specifications, or related Standard Special Provisions (SSP). Significant changes are being made to the pipe jacking specifications and will be implemented through the SSP process at a later date. Once finalized, the need for associated construction guidelines will be evaluated.

Section 4-67, “Structural Plate Culverts”

- Modifies section title to align with new section title in 2010 *Standard Specifications*.
- Updates references to 2010 *Standard Specifications* and *Construction Manual*.
- Revises measurement and payment section.

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This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

Section 22 Finishing Roadway

Section 22 Finishing Roadway

4-2201 General

4-2201 General

The contract item known as “finishing roadway” provides payment for the final cleanup operation within project limits and the right-of-way, so that the completed project, upon acceptance, will be neat, presentable, and functional, as required by the *Standard Specifications*. This contract item does not require any specific construction work to be performed, but it does involve the performance of numerous small details. This contract item should not be mistaken for clearing and grubbing activities.

The contract item includes such operations as grading slopes and contour areas to remove vehicle tracks; obliterating haul roads; removing debris from the pavement; removing trash and debris generated by construction activities; cleaning out culverts; cleaning culvert markers, guideposts, and signs; removing construction stakes and lath that present an unsightly appearance; and disposal of the material resulting from the finishing roadway activities.

The contractor may request and be authorized to dispose of soil and rock generated by the finishing activities within the project limits and right-of-way. Disposal of soil and rock along the roadway should not affect the overall grading or functionality of the roadway.

4-2202 During the Course of Work

4-2202 During the Course of Work

During the course of work, take the following steps:

- As portions of the work near completion, review the site and begin noting items of finishing roadway to be performed.
- To be economical and help prevent delays in completing the contract, encourage the contractor to finish work as it progresses.
- Ensure the finishing operations do not result in material stockpiling on or drifting across the finished pavement.
- Keep a list of the cleanup details, and add to and subtract from the list as new details develop or are completed. During the project’s latter stages when final cleanup operations can normally begin, give the contractor a written details list so the contractor can plan to complete the list in an orderly and efficient manner. Do not wait until the date the contractor requests contract acceptance before pointing out these details.
- If the contractor requests relief from maintenance and responsibility, as provided in Section 5-1.38 [7-1.15], “Maintenance and Protection Relief,” of the *Standard Specifications*, ensure the contractor has completed all the finishing roadway details.

- Ensure measures for permanent erosion control are installed as soon as finishing roadway activities are completed.

**4-2203
Measurement and
Payment**

4-2203 Measurement and Payment

In the daily report, record the activities the contractor performs to complete the finishing roadway item. Carefully segregate the finishing roadway work from the work required to complete other items of work.

Section 51 Concrete Structures

4-5101 General

4-5102 Before Work Begins

4-5103 During the Course of Work

- 4-5103A Placing Concrete
- 4-5103B Concrete Placed Under Water
- 4-5103C Minor Structures
- 4-5103D Forms
- 4-5103E Joints and Bearings
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4-5104 Measurement and Payment

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

Section 51 Concrete Structures

Section 51 Concrete Structures

4-5101 General

4-5101 General

This section covers items related to constructing concrete structures. Concrete structures include concrete bridges, structure approach slabs, culverts, headwalls, endwalls, drainage inlets, retaining walls, and other concrete structures shown on the plans.

Many specified requirements for concrete structures apply only to bridges and major structures and are covered in detail in the Office of Structure Construction's (OSC's) *Bridge Construction Records and Procedures* manual. Additional reference material can be found in OSC's *Foundation Manual*, *Prestress Manual*, and *Bridge Deck Construction Manual*.

<http://www.dot.ca.gov/hq/esc/construction/manuals/>

Section 3-705, "Public Safety," of this manual contains guidelines for work that temporarily impairs horizontal and vertical bridge clearance.

4-5102 Before Work Begins

4-5102 Before Work Begins

Before work begins, take the following steps:

- Review the plans and specifications. Determine the cementitious material content and compressive strength of the concrete to be used. Review Section 4-90, "Portland Cement Concrete," of this manual, which covers the mix design review, authorization, and production of concrete.
- Review and discuss with the contractor plans for placing concrete in each of a structure's parts. Before allowing the work to commence, discuss any obvious shortages of workers, equipment, or material that may prevent the completion of the structure's parts without interruption in the placing of concrete. Also discuss and evaluate project specific conditions for safely placing concrete, such as avoiding overhead lines.
- Determine what tests will be taken and the frequency and location of such testing, and assign the duties accordingly. For guidelines, refer to Chapter 6, "Sampling and Testing," of this manual.

4-5103 During the Course of Work

4-5103 During the Course of Work

Once work begins, take the steps listed for inspecting the following items:

- Placing of concrete
- Concrete placed under water
- Minor structures
- Forms

- Joints and bearings
- Drains in walls
- Surface finishing

4-5103A Placing Concrete

During the placement of concrete, do the following:

- Check for any movement or deformation of forms that may exceed the specified tolerance. If the movement or deformation exceeds the specified tolerances, take appropriate action. This action may include halting concrete placement to install additional bracing or changing the rate or sequence of concrete placement to achieve the required lines and grade.
- Ensure the contractor follows the specified order of placing. Also, ensure that concrete for horizontal members or sections is not placed until the concrete in the supporting vertical members or sections has been consolidated and subsidence has occurred.
- Through observation, ensure that concrete is placed without causing segregation. Also, ensure that high-frequency internal vibrators consolidate the concrete when specified. The method used to vibrate concrete directly affects the structure's strength. Ensure minimum contact between the vibrator and reinforcing steel. Concrete must be vibrated to the point where mortar and water flush to the surface; vibration beyond this point is not necessary or desirable. Insufficient vibration, on the other hand, will leave rock pockets (voids).
- Determining when subsidence has occurred will require judgment based on your experience with various concrete mixes. In general, subsidence has occurred when bleed water at the surface has disappeared.

4-5103B Concrete Placed Under Water

Ensure the contractor meets all specifications related to Section 51-1.03D(3) [51-1.10], "Concrete Placed Under Water," of the *Standard Specifications*. Unless otherwise provided for in the special provisions, only concrete designated as "seal course concrete" is to be placed under water.

4-5103C Minor Structures

Ensure that paving or surfacing has been completed immediately adjacent to a structure before the structure has been constructed to final grade.

4-5103D Forms

When using concrete forms, do the following:

- Ensure the forms are located properly. To detect any major discrepancy, include both spot-checking from the control stakes and also general observation independent of the stakes.
- For proper dimensions, measure inside the forms.
- Ensure forms are mortar tight.
- When specified, ensure the use of form oil.
- Ensure that all materials required to be embedded in concrete, such as reinforcement and miscellaneous metal, are in place and secured properly. For

details, refer to Section 4-52, “Reinforcement,” and Section 4-75, “Miscellaneous Metal,” of this manual.

- Decide whether forms are sufficiently rigid to prevent undulations that exceed the specified values. If corrective measures are necessary, advise the contractor accordingly, and note the circumstances in the daily report.
- Check the forms for exposed surfaces to ensure the surfaces are faced with form panels as specified. Where required, ensure the use of triangular fillets.
- Ensure form bolts and fasteners are the types specified.
- Before concrete placement, ensure the removal from the forms of dirt, chips, sawdust, and other foreign materials. Also, ensure the contractor dewater the forms and does any necessary pumping as specified and in accordance with the contract’s environmental provisions.
- Before concrete placement, inform the contractor of any corrective action required. Note such action in the daily report.
- Ensure forms are removed in the specified manner. When forms are removed before the end of the specified curing period, require proper curing of the concrete.

4-5103E Joints and Bearings

For specific requirements for joints and bearings, review the contract plans and specifications. For bridges and major structures, also refer to the OSC’s *Bridge Construction Records and Procedures* manual.

Ensure that joints are constructed as specified. Also, verify they are constructed in a way that ensures they will function as intended. The following are some of the important items to check:

- Verify material has been inspected at the source and is properly identified for shipment. When required, ensure the material is sampled and tested in accordance with Chapter 6, “Sampling and Testing,” of this manual.
- When an open joint is required, ensure the reinforcement does not extend across the joint.
- Ensure sheet packing, preformed pads, or board fillers are held in place as specified.
- During concrete placement, check that expansion joint armor is placed and firmly held in position.
- Verify bearing devices are placed as specified and measure concrete bearing areas to ensure placement falls within specified tolerances.
- Before additional concrete placement, ensure horizontal construction joints are cleaned as specified. Also, ensure that expansion joint filler or bond-breaking compound is placed where required. Note such observations in the daily report.
- If an emergency makes a construction joint necessary, decide on the construction details of this joint and direct the contractor during its construction.
- Check the placement of any dowels to ensure the contractor cleans the holes before grouting or bonding and places the grout or bonding material and dowels as specified.

- When mortar is used, ensure the contractor proportions it as required and places it as specified, including the curing requirements.
- Ensure water stops are installed as specified and where shown on the plans. During concrete placement, make sufficient observations to ensure the water stops are not materially shifted out of position or shape.

4-5103F Drains in Walls

Ensure that drain holes and weep holes are constructed as specified. Examine the excavation and consider other factors that could contribute to the buildup of hydrostatic pressure. When necessary, order additional drain holes or weep holes.

4-5103G Surface Finishing

Ensure the various concrete surfaces comply with the specifications. Ensure that the required finishing work is performed before structures are backfilled and that the appropriate finish is applied to all surfaces. For additional information, refer to the OSC's *Bridge Construction Records and Procedures* manual.

4-5104 Measurement and Payment

4-5104 Measurement and Payment

Take the following steps:

- In conformance with the dimensions shown on the plans, measure the quantity of concrete in structures by the cubic yard unless the quantities are designated as final pay quantities.
- Keep records of rejected concrete loads, and provide the reasons (preferably including test data) for such actions. Also keep records of any significant amounts of concrete placed outside of areas or limits for which payment is to be made.

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

Section 52 Reinforcement

4-5201 General

Items used for reinforcement include bars, welded wire fabrics, and wires. For details about reinforcement, refer to the Office of Structure Construction's (OSC's) *Bridge Construction Records and Procedures* manual at:

<http://www.dot.ca.gov/hq/esc/construction/manuals/>

4-5202 Before Work Begins

The Office of Materials Engineering and Testing Services (METS) is responsible for monitoring reinforcement materials at the source of supply. The fabricator will provide a certificate of compliance with shipments of reinforcement delivered to the job site.

Refer to the contract specifications and Section 3-605, "Certificates of Compliance," of this manual regarding Buy America requirements. Section 6-2.05 [6-1.08], "Buy America," of the *Standard Specifications* covers the use of foreign materials.

During this preliminary inspection, also take the following steps:

- Verify that Form CEM-3101, "Notice of Materials to Be Used," includes reinforcement materials. Refer to Section 6-202, "Responsibilities and Procedures for Acceptance of Materials," of this manual for additional information.
- For each lot of material delivered to the project, require the contractor to conform to Section 6-3.05E [6-1.07], "Certificates of Compliance," of the *Standard Specifications* by providing Form TL-6046, "Fabricators Certificate of Compliance." Form TL-6046 can be obtained from METS.
- Inspect hook details to ensure they conform to specifications. Refer to the OSC's *Bridge Construction Records and Procedures* manual, Volume II, Section 165, for hook details (which conform to the building code requirements of the American Concrete Institute). Also, examine the bars to detect damage from bending, for example, kinks or cracking of the steel on the surfaces of the hooks.
- Check the steel for general cleanness, ensuring it does not have loose mill scale, excessive rust, or other deleterious coatings. Decide whether such coatings will destroy or reduce bonding. If cleaning is necessary, advise the contractor.
- Check some of the ends of larger bars to detect any evidence of "piping." (Piping is a cavity in the core of a bar.) Also check for such rolling defects as scabs, seams, and laminations.
- As specified in Section 52-2.02 [52-1.02B], "Epoxy-Coated Reinforcement," of the *Standard Specifications*, require repair or replacement of damaged epoxy-coated, bar reinforcing steel.

Section 52 Reinforcement

4-5201 General

4-5202 Before Work Begins

- Note the following:
 1. The contractor may substitute welded wire fabric for reinforcing bars in certain concrete work shown in the *Standard Specifications*. The *Bridge Construction Records and Procedures* manual, Volume II, Section 165, contains information that may be used to determine equivalent areas of the steel.
 2. Steel lists are required only if specifically requested by the engineer. It is Caltrans policy to not request such lists except for specific reasons, as described in Section 52 [52-1.03], “Reinforcement,” of the *Standard Specifications*.
 3. Steel lists are not to be requested for the convenience of assistant resident engineers in checking items such as sizes, dimensions, locations, clearances, and coverages. The contract plans and specifications serve this purpose.
 4. Before allowing butt welding to splice bar reinforcing steel, refer to the contract documents and the *Bridge Construction Records and Procedures* manual, Volume II, Section 180.
 5. Before allowing mechanical splicing of bar reinforcing steel, refer to the contract documents and the *Bridge Construction Records and Procedures* manual, Volume II, Section 165.

4-5203 During the Course of Work

4-5203 During the Course of Work

During the course of work, take the following steps:

- Examine the rolled-in grade marks to ensure the contractor is using the specified grade of reinforcing steel for the given structure. Refer to the *Bridge Construction Records and Procedures* manual, Volume II, Section 165, for information about identifying marks on American-made bar reinforcing steel.
- Ensure the placing of the reinforcement in the forms conforms to the plans and specifications.
- Ensure that all reinforcement is securely wired at intersections and securely held in place and that bundle bars are tied at proper intervals. Also, ensure that the reinforcement is placed in the forms in a way that will not require the contractor to add or adjust bars during the placing of concrete.
- On cast-in-place, prestressed, post-tensioned structures, it may be necessary to adjust or relocate reinforcement to conform to the prestressing system the contractor selected. It may also be necessary to place additional steel. These details are shown on contractor drawings that Caltrans reviews and authorizes. Use the authorized prestressing details to ensure that, when placing concrete, the contractor provides the required clearances to various items, including the tendons and anchorages. In particular, ensure the proper placement of grillages at end anchorages.
- When the contractor uses mesh reinforcement, check that it is rolled flat and held firmly in place during placement of concrete or shotcrete.
- After the contractor places the reinforcement, ensure it is free of any coating (such as form oil, dust, or dirt) that would destroy or reduce bonding.

- To protect epoxy-coated reinforcing steel against sunlight, salt spray, and weather, ensure the contractor uses a secure covering. The contractor must repair any visible damage to the coating as specified, in accordance with the manufacturer's recommended patching material.
- Note the following:
 1. Vibrators used to consolidate concrete containing epoxy-coated reinforcing steel must have a resilient covering to prevent damage to the epoxy coating.
 2. Prefabricated epoxy-coated reinforcing steel (purple or gray in color) is cut to size and bent to shape before the coating is applied. Prefabricated epoxy-coated reinforcement must not be bent or rebent after coating application.
 3. Epoxy-coated reinforcement (green in color) is more flexible. It is applied to straight rebar, which is subsequently cut and bent to shape.
- Until the engineer approves the proper submittals, do not permit welding of any type on reinforcing steel. Refer to the *Bridge Construction Records and Procedures* manual, Volume II, Section 180, for guidelines.
- Bar reinforcing steel is spliced by lapping bars, by butt welding bars, or by using mechanical couplers. Mesh reinforcement, reinforcing wire, or plain bars are generally spliced by lapping. Inspect all lapped splices to ensure the minimum lengths of lap and stagger distances conform to the plans and specifications. Note that the size of a bar and the grade of steel will determine the length of lap required. Ensure the laps are securely wired to maintain the alignment of the bars. Lap splices of mesh reinforcement must be tied securely with wire to prevent distortion of the mesh.
- Verify that all mechanical butt splices, butt welds, and lap welds on epoxy-coated reinforcing steel are protected from corrosion with an authorized corrosion protection system. The METS list of authorized coverings to protect against corrosion is at:

http://www.dot.ca.gov/hq/esc/approved_products_list/

The corrosion protective system must be used in accordance with manufacturer and Caltrans requirements. Ensure the cover is installed as a continuous piece with sufficient diameter and length to achieve an adequate seal and bond length. The cover must be free of dirt, grease, sharp edges, tears, or pinholes. After the cover is heated as specified, ensure it extends a minimum of 2 inches onto the epoxy-coated reinforcing steel.

4-5204 Measurement and Payment

Refer to appropriate sections of the special provisions and *Standard Specifications* for the basis of measurement and payment. If payment is on a unit basis, you may need to keep records of reinforcement that is placed in the structure. Also, calculate any changes that result in increases or decreases in quantities of reinforcement.

4-5204 Measurement and Payment

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

Section 55 Steel Structures

4-5501 General

Section 55, “Steel Structures,” of the *Standard Specifications* includes specifications for constructing steel structures. For additional information regarding steel structures, see Section 170, “Structural Steel,” and Section 180, “Welding,” of the Office of Structure Construction’s (OSC’s) *Bridge Construction Records and Procedures* manual, available at:

<http://www.dot.ca.gov/hq/esc/construction/manuals/>

4-5502 Before Work Begins

The contractor must submit for authorization the shop drawings for structural steel in accordance with Section 5-1.23 [5-1.02], “Submittals,” of the *Standard Specifications*. The shop drawings are submitted directly to the Office of Structure Design documents unit. The review of the shop drawings is a coordinated effort between the Office of Structure Design, Office of Materials Engineering and Testing Services (METS), and OSC. The Office of Structure Design has the primary responsibility for authorizing the shop drawings.

If any welding must be performed, the contractor must submit a quality control plan for the work. For guidelines in authorizing the submittal, refer to Section 180, “Welding,” of the *Bridge Construction Records and Procedures* manual.

Verify that Form CEM-3101, “Notice of Materials to Be Used,” includes structural steel materials. Refer to Section 6-202, “Responsibilities and Procedures for Acceptance of Materials,” of this manual for additional information.

4-5503 During the Course of Work

During the work, take the following steps:

- Verify that METS has inspected and released structural steel and fastener assemblies by retrieving Form TL-0624, “Inspection Release Tag,” as the assemblies are delivered to the site and by matching the assemblies to Form TL-0029, “Report of Inspection of Material.”
- Ensure the contractor performs installation tension tests and rotational capacity tests on all lots of fastener assemblies before installation. To keep track of the location of fastener assembly placement and to protect the assemblies from the weather, ensure the contractor stores the fastener assemblies in their original containers and out of the elements.
- Witness the contractor’s verification of minimum tension as required by the specifications. Record the data in the project files.

Section 55 Steel Structures

4-5501 General

4-5502 Before Work Begins

4-5503 During the Course of Work

- For guidelines on welded connections, refer to Section 180, “Welding,” of the *Bridge Construction Records and Procedures* manual.
- After the completion of the work for each structure, the contractor must submit corrected shop drawings to the resident engineer for transmittal to the Office of Structure Design documents unit. Remind the contractor that final acceptance of the contract will not occur until the corrected drawings have been submitted.

4-5504
Measurement and
Payment

4-5504 Measurement and Payment

Refer to the appropriate sections of the special provisions and *Standard Specifications* for the basis of measurement and payment.

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

Section 61 Culvert and Drainage Pipe Joints

Section 61 Culvert and Drainage Pipe Joints

4-6101 General

4-6101 General

Section 61, “Culvert and Drainage Pipe Joints,” of the *Standard Specifications* provides an opportunity for the contractor to choose alternate types of joint systems or couplers used with culvert and drainage pipe that are specified in the following sections of the *Standard Specifications*:

- Section 64, “Plastic Pipe”
- Section 65, “Concrete Pipe”
- Section 66, “Corrugated Metal Pipe”
- Section 69, “Overside Drains”

When joint systems and couplers conforming to the provisions in Section 61 are selected, the contractor must provide test results or a mathematical analysis of the joint materials.

4-6102 Before Work Begins

4-6102 Before Work Begins

Before work begins, do the following:

- Verify that Form CEM-3101, “Notice of Materials to Be Used,” includes all pipe joint materials. Refer to Section 6-202, “Responsibilities and Procedures for Acceptance of Materials,” of this manual for additional information.
- Upon delivery of the materials for pipe joints and couplers, note whether the materials are identified by marks or inspection tags.
- Ensure that the Office of Materials Engineering and Testing Services (METS) has inspected and released the pipe joint and coupling material.
- If the contractor has chosen to supply material specified in Section 61, “Culvert and Drainage Pipe Joints,” of the *Standard Specifications*, and the material has been released, METS will have received all paperwork including certificates of compliance, test results, and mathematical analysis.
- Review contract requirements for designated culverts and drainage structures that will require field leakage testing. Where field leakage testing is shown, ensure the contractor submits test procedure, leakage calculations for exfiltration and infiltration tests, and repair procedures for sections that fail testing.

4-6103 During the Course of Work

4-6103 During the Course of Work

Various sections of this manual describe the procedures for inspecting the types of culvert and drainage pipe identified in this section. Ensure that the correct

types of joints or couplers are used and any required field leakage testing for watertightness is performed as specified.

4-6104
Measurement and
Payment

4-6104 Measurement and Payment

The payment for pipe joints and couplers is normally included in the contract prices paid for the various types and sizes of culvert and drainage pipe.

Refer to Section 61-1.04, "Payment," of the *Standard Specifications* for information on payment of culvert and drainage pipe joints.

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

Section 62 Alternative Culverts

Section 62 Alternative Culverts

4-6201 General

4-6201 General

Section 62, "Alternative Culverts," of the *Standard Specifications* provides general specifications for constructing alternative culverts, alternative slotted pipe, and temporary culverts; and for placing concrete backfill for pipe trenches. Section 62-1, "General," of the *Standard Specifications* provides the contractor the opportunity to choose between several different kinds of culverts to be installed or constructed. Alternative culverts may include the following:

- High density polyethylene or polyvinyl chloride pipe compliant with Section 64, "Plastic Pipe," of the *Standard Specifications*.
- Reinforced concrete pipe and pipe arches compliant with Section 65, "Concrete Pipe," of the *Standard Specifications*.
- Reinforced concrete box culverts and arch culverts compliant with Section 51, "Concrete Structures," of the *Standard Specifications*.
- Corrugated steel or corrugated aluminum pipe and pipe arches compliant with Section 66, "Corrugated Metal Pipe," of the *Standard Specifications*.
- Structural steel or structural aluminum plate pipe, arches, and pipe arches compliant with Section 67, "Structural Plate Culverts," of the *Standard Specifications*.

The contract plans show the locations and alternative types of culverts. When alternative culverts are specified, the Bid Item List will designate contract items as alternative culverts for each size and type of culvert.

Section 62-2, "Alternative Slotted Pipe," of the *Standard Specifications* includes specifications for constructing alternative slotted pipe. Slotted pipes may include the following:

- Slotted plastic pipe compliant with Section 64-2, "Slotted Plastic Pipe," of the *Standard Specifications*.
- Slotted corrugated steel pipe compliant with Section 66-2, "Slotted Corrugated Steel Pipe," of the *Standard Specifications*.

Section 62-3, "Temporary Culverts," of the *Standard Specifications* includes specifications for constructing temporary culverts.

Section 62-4, "Concrete Backfill for Pipe Trenches," of the *Standard Specifications* includes specifications for placing concrete backfill in pipe trenches.

4-6202
Before Work Begins

4-6202 Before Work Begins

Before work begins, do the following:

- Review the special provisions and contract plans to determine the different types of culvert that may be used and the locations where alternative culverts may be installed.
- Review the special provisions and contract plans to determine the different types of slotted pipe that may be used and the locations where alternative slotted pipe may be installed.
- Verify that Form CEM-3101, "Notice of Materials to Be Used," includes the materials the contractor chose for alternative culverts or alternative slotted pipe. Refer to Section 6-202, "Responsibilities and Procedures for Acceptance of Materials," of this manual for additional information.

Also note the following:

- The contractor must obtain the engineer's authorization for the strength and capacity of temporary culverts before installation.
- Concrete backfill for pipe trenches must comply with specifications for minor concrete, except the concrete must contain at least 380 pounds of cementitious material per cubic yard. Rapid strength concrete (RSC) may be used instead of minor concrete for concrete backfill. When RSC is to be used as concrete backfill, a submittal including the concrete mix design and test data from an authorized laboratory must be submitted at least 10 days prior to excavation of the pipe trench. Refer to specifications for RSC material requirements. The laboratory must specify the cure time required for the concrete mix to attain 500 psi compressive strength when tested under California Test 521.

4-6203
During the Course of Work

4-6203 During the Course of Work

For guidelines for inspecting each chosen type of culvert and slotted pipe, refer to the appropriate section in Chapter 4, "Construction Details," of this manual.

Temporary culvert is to be removed and disposed of when it is no longer required for the work. A removed, undamaged, temporary culvert may be installed in the permanent work if it complies with specifications for the permanent culvert and it is new when installed as a temporary culvert on the project.

Refer to Section 62-4.03, "Construction," of the *Standard Specifications*, for concrete backfill items to review during the course of the work.

4-6204
Measurement and Payment

4-6204 Measurement and Payment

Once a type of culvert has been selected, apply the specifications for pipe and pipe arches, including measurement and payment provisions, specific to that type of culvert. To measure the various types of pipe selected, follow the guidelines in this manual. For reinforced concrete box and arch culverts paid for as alternative culvert, Section 62, "Alternative Culverts," of the *Standard Specifications* specifies the measurement method.

Once a slotted pipe type has been selected, apply the payment provisions specific to that kind of pipe.

Refer to Section 62-3.04, "Payment," of the *Standard Specifications* for payment of temporary culverts and pipe reducers.

Concrete backfill payment for pipe trenches is made under Section 62-4.04, "Payment," of the *Standard Specifications*.

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

Section 64 Plastic Pipe

4-6401 General

Section 64, "Plastic Pipe," of the *Standard Specifications* contains specifications for fabricating and constructing plastic pipe and slotted plastic pipe. Plastic pipe must be either Type C or Type S corrugated polyethylene pipe, or corrugated polyvinyl chloride (PVC) pipe with smooth interior. Slotted plastic pipe must be polyethylene.

4-6402 Before Work Begins

Well before work begins, review the plans and specifications and inspect the sites of all planned installations. Reviewing these items sufficiently in advance helps prevent scheduling conflicts and errors in ordering materials.

During the preliminary review and inspections, the resident engineers and assistant resident engineers should also do the following:

- Identify any unsolved drainage problems.
- Make any plan changes necessary to fit field conditions.
- Determine the locations and lengths of the pipes.
- Once the previous step is accomplished, if necessary, give the contractor a revised pipe list. The list should include any pipes added or altered by a change order.
- Verify that Form CEM-3101, "Notice of Materials to Be Used," includes plastic pipe and plastic slotted pipe. Refer to Section 6-202, "Responsibilities and Procedures for Acceptance of Materials," of this manual for additional information.
- Obtain a certificate of compliance for plastic pipe, including the average pipe stiffness, resin material cell classification, and date of manufacture. For corrugated polyethylene pipe, the contractor must also provide a manufacturer's copy of plant audits and test results from the National Transportation Product Evaluation Program for the current cycle of testing for each pipe diameter furnished.
- If rapid strength concrete is to be used as concrete backfill for slotted plastic pipe, obtain the concrete mix design and test data in advance of excavation of the trench in conformance with specification requirements.

4-6403 During the Course of Work

During work operations, the resident engineers and assistant resident engineers should do the following:

- Ensure the contractor constructs embankments as specified before any structure excavation.

Section 64 Plastic Pipe

4-6401 General

4-6402 Before Work Begins

4-6403 During the Course of Work

- Before pipe installation, ensure that excavations and any required bedding are as shown in the *Standard Plans* and meet the specifications.
- Verify the final acceptability of the pipes following the guidelines in Section 6-2, "Acceptance of Material and Sampling Methods," of this manual. The following problems with pipe are unacceptable:
 1. Pipe walls with cracks, holes, blisters, voids, foreign inclusions, or other defects affecting the pipe wall integrity or visible to the naked eye.
 2. Pipes or fittings with abrasions or scratches deeper than 10 percent of the wall thickness.
 3. Gaskets that are cracked or split.
 4. Rough surfaces, ridges, fractures, cracks, or imperfections at joint surfaces where gaskets will bear.
- During the onsite storage of PVC pipes, verify that pipes are protected from long-term exposure to sunlight, or brittleness may result. Ensure that pipes are protected from any kind of damage throughout all operations.
- Verify that pipes of the specified size, type, and class are placed in the proper locations.
- Verify pipe joints are installed as specified.
- Require methods of handling and storage that will not damage the pipes.
- When atmospheric temperature is 40°F or less, ensure PVC installation methods using mechanical assistance do not damage pipes.
- Ensure that backfill work complies with the details on the contract plans, *Standard Plans*, or both. Refer to Section 4-19, "Earthwork," of this manual for additional instructions on excavation and backfill.
- Pay particular attention to pipe joint requirements including any specified testing for watertightness.
- Before construction loads are allowed over culverts, require that culverts meet the minimum fill conditions as shown on *Standard Plan Sheet D88*.
- Continue to periodically inspect pipes as work progresses. A critical time to inspect is after the completion of the grading and before the start of base and surfacing. During the final phases of the project, make another inspection, primarily to find any pipes that need cleaning.

4-6404 Measurement and Payment

4-6404 Measurement and Payment

Refer to Sections 64-1.04, "Payment," and 64-2.04, "Payment," of the *Standard Specifications* for payment information for plastic pipe and slotted plastic pipe, respectively.

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

Section 66 Corrugated Metal Pipe

Section 66 Corrugated Metal Pipe

4-6601 General

4-6601 General

Corrugated metal pipe, designated by pipe diameter or dimension, type, and metal thickness, includes both steel and aluminum pipe. The *Standard Plans* specify the requirements and other details for coupling bands.

4-6602 Before Work Begins

4-6602 Before Work Begins

The resident engineer should take the following preliminary steps:

- Review plans and specifications.
- Inspect the job site for the locations of all proposed installations.
- Modify plans when necessary to fit field conditions. Prepare change orders for major changes from approved plans; for example, additions, deletions, or changes in type or size of pipe. When structures are staked, adjustments may be made in location or length of cross drains or side drains, as necessary without requiring a change order.
- After determining final locations and lengths, give the contractor a revised pipe list, including those pipes added or altered by change order.
- Verify that Form CEM-3101, "Notice of Materials to Be Used," includes all fabricated materials. Refer to Section 6-202, "Responsibilities and Procedures for Acceptance of Materials," of this manual for additional information.

4-6603 During the Course of Work

4-6603 During the Course of Work

During the work, do the following:

- Upon delivery of the pipe, note whether it is identified by marks or inspection tags (Form TL-0624, "Inspection Release Tag.") Check the pipe for any possible damage sustained after inspection at the source. Require the repair of minor damage to coatings or galvanizing. If satisfactory repair cannot be achieved, require the contractor to remove this unacceptable pipe from the project. If the pipe is properly identified as inspected, project personnel normally do not need certificates of compliance or mill test reports. An inspector from the Office of Materials Engineering and Testing Services (METS) will have already obtained these documents.
- Before excavating pipe, require that embankments be constructed as specified. Refer to Sheet A-62F of the *Standard Plans* for excavation and backfill requirements.

For instructions about inspecting backfill, see Section 4-19, "Earthwork," of this manual. Corrugated metal pipe can be displaced or damaged during backfill. Therefore, insist on precautions to prevent damage.

- For slotted corrugated steel pipe, ensure installation is not begun until after paving has been completed on traffic lanes adjacent to the pipe. Ensure materials are prevented from entering pipe slots during backfilling and paving activities.
- For information about concrete backfill and slurry cement backfill, see Section 4-65, "Concrete Pipe," of this manual.
- Be particularly alert to ensure the required type and thickness of pipe at each location. To avoid galvanic corrosion, prohibit the combination of steel and aluminum in any installation.
- Note whether the ends of pipe have been reinforced where required. Where pipe terminates at a structure, require the end of the pipe to be flush with the face or interior surface.
- Ensure circumferential joints and side seams are positioned as required. Especially note whether spaces between lengths of pipe permit a correct fit by couplers. For helically corrugated pipe, corrugations must be matched across field joints with proper space maintained between lengths of pipe. Angles, lugs, or other projections on couplers must be positioned about halfway between the crown and the side of the pipe. Before permitting backfill, couplers must be snug and tight.
- Before joint materials for culvert and drainage pipe arrive at the site, a METS inspector will inspect and test the material as necessary.
- When siphons or watertight joints are installed, witness the required field leakage and hydrostatic tests.
- As shown on Sheet D88 in the *Standard Plans*, ensure minimum fill conditions are met for construction loads on culverts.
- Throughout the progress of the work, inspect installed pipes periodically. If you discover any structural deficiencies, ensure the deficiencies are corrected before the start of the base or surfacing operations, where pipes underlie pavements. Before accepting the contract, or recommending a granting of relief from maintenance, all pipes must be inspected and, if necessary, cleaned. The contractor is responsible for cleaning pipes placed under contract.

4-6604 Measurement and Payment

4-6604 Measurement and Payment

Refer to Section 66-1.04, "Payment," of the *Standard Specifications* for payment of corrugated metal pipe and pipe reducers.

This manual is being updated to reflect changes from the 2006 to the 2010 *Standard Specifications*. Bracketed section numbers refer to the 2006 *Standard Specifications*.

Section 67 Structural Plate Culverts

Section 67 Structural Plate Culverts

4-6701 General

Specifications for fabricating and constructing structural plate culverts as pipe, arches, and pipe arches that are assembled in the field from structural steel or structural aluminum plates are included in Section 67, “Structural Plate Culverts,” of the *Standard Specifications*. The plans and specifications designate the number and thickness of plates in each installation.

4-6701 General

4-6702 Before Work Begins

Before work begins, take the following steps:

- Sufficiently in advance of the contractor’s start of operations to prevent conflicts in scheduling or errors in ordering materials, review the contract plans, *Standard Plans* (sheets A62F, D88A, and B14-1, as appropriate), and specifications. Inspect the site of each planned installation. Note any unsolved drainage problems.
- As soon as final locations and lengths are determined, furnish the contractor a revised pipe list.
- Verify that Form CEM-3101, “Notice of Materials to Be Used,” includes all fabricated materials. Refer to Section 6-202, “Responsibilities and Procedures for Acceptance of Materials,” of this manual for additional information.
- Before assembling the structural plates, ensure the receipt of the manufacturer’s assembly instructions. Ensure the instructions conform to the plans and specifications.

4-6702 Before Work Begins

4-6703 During the Course of Work

Once work begins, do the following:

- Upon delivery, determine whether Form TL-0624, “Inspection Tags,” identifies the pipe.
- Also, upon delivery, note the condition of the pipe. Require the repair of minor damage to galvanizing or bituminous coatings. Prohibit the repair of serious damage, such as buckled, bent, cracked, or torn plates. Reject plates with damage of this extent.
- Double-check to ensure the proper type, size, and thickness of pipe at each location.
- If mastic for protective coating will be field applied, ensure an inspector from the Office of Materials Engineering and Testing Services (METS) has inspected the material.

4-6703 During the Course of Work

- Normally, the METS inspector will have obtained the certificates of compliance or mill test reports. If materials are properly identified as previously inspected, project personnel do not need these documents.
- Before structure excavation, require that embankments be constructed as specified. Note the requirement on the plans for shaped bedding.
- Require assembly according to the manufacturer's instructions. The following items must comply with instructions and specifications:
 1. Sequence of placing plates
 2. Longitudinal and circumferential joints and laps
 3. Types and sizes of bolts and nuts to be used
 4. Manner of bolt placement
 5. Number of bolts to be placed before tightening
 6. Bolt-tightening sequence and torques
 7. Type of end treatment
- Check maximum as well as minimum torque to ensure they comply with the requirements in Section 67-2.03 [67-1.05], "Construction," of the *Standard Specifications*. During the checking of torque, insist on an adequate working platform and safety devices to prevent injury in case of the shearing of a bolt or the breaking or slipping of a torque wrench.
- Refer to the *Standard Plans* for the design of required strutting and for the minimum cover for construction loads. Require that minimum fill conditions, as shown on the plans, are met for construction loads on culverts.
- When bituminous coating is required, determine that all bolts on the outside of the pipe are coated with mastic before backfill. When coating is field applied, require the sealing of all joints before backfill.
- Refer to Section 4-19, "Earthwork," of this manual for instructions on inspecting backfill. Refer to Section 4-65, "Concrete Pipe," of this manual regarding slurry cement backfill.
- Throughout the progress of the work, periodically inspect installed pipes and arches. If you discover any structural deficiencies, ensure these are corrected before the start of base or surfacing, where pipes or arches underlie pavements.
- Before you recommend acceptance of the contract or make a recommendation to grant relief from maintenance, require the contractor to clean all pipes and arches if necessary.

4-6704 Measurement and Payment

4-6704 Measurement and Payment

Refer to Sections 67-2.04, "Payment," and 67-3.04, "Payment," for payment information on structural metal plate pipe and metal liner plate pipe, respectively.