



Electrical Systems

Revision and Approval

Revision	Date	Nature of Changes	Approved By
0	04-25-2023	Original Issue	Richard Foley

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Background

This process establishes Structure Construction (SC) responsibilities and procedures for review and authorization of electrical materials and submittals affecting structure work, and the construction of electrical systems in new and existing structures. For electrical work associated with buildings, this Bridge Construction Memo (BCM) does not apply.

Prior to reviewing this BCM, it is essential to review the following [Contract Specifications](#) from Division X, *Electrical Work*, as applicable:

- Section 86-1.01C, *General – Submittals*
- Section 87-1.03B(2), *Electrical Systems – General – Construction – Conduit Installation – Conduit Installation for Structures*
- Section 87-1.03L, *Electrical Systems – General – Construction – Utility Service*
- Section 87-2.03C, *Electrical Systems – Lighting Systems – Construction – Soffit and Wall-Mounted Luminaires.*

Information in the *Contract Specifications* typically will not be repeated in the text of this BCM.

Process Inputs

1. [Contract documents](#) requiring the construction and installation of electrical systems on new or existing structures.

2. Submittals required per the *Contract Specifications* from Division X, *Electrical Work*, Section 86, *General*, and Section 87, *Electrical Systems*, for electrical systems work related to structures.

Procedure

1. All work associated with this process is charged as [Project Direct – Construction](#).
2. Inspection of field work for this process is:
 - a. [Benchmark](#) for:
 - i. Layout of electrical conduits and fittings, pull boxes, cabinets, lighting, and mechanical anchorage devices.
 - ii. Rebar conflicts and spacing prior to concrete pour.
 - iii. Installation of service connections.
 - b. [Intermittent](#) for all other activities.
3. Before construction begins:
 - a. Review the contract documents for electrical system work on structures:
 - i. Verify compatibility between the District plans (e.g. Electrical and Lighting) and the Structure plans:
 1. Identify all electrical systems shown on structures such as lighting, pull boxes, traffic loop detectors, sensors, seismic monitoring systems, etc.
 2. For new concrete structures, review the reinforcement details to determine whether there are any conflicts between electrical conduits, pull boxes, and structural rebar (e.g., concrete barriers). Resolve any conflicts by coordinating with the Designer and the Resident Engineer (RE) and notify the Contractor.
 - a. Review [Attachment 1](#), *Common Conflicts for Installing Electrical System Components in Concrete Barriers*.
 - ii. Determine whether there are any time constraints for installation of electrical system components (such as required notification periods prior to installation of service connections and/or activation of utility service), and whether the baseline critical path method (CPM) schedule and updates properly accommodate these constraints.
 - iii. Review the relevant portions of the National Electrical Code (NEC) via the [“Engineering Workbench”](#) section of the Caltrans Transportation Library (note- registration required).

- b. Review any utility agreement(s) with the Contractor and/or other agencies such as utility companies or municipalities. Review third-party utility standards if applicable:
 - i. Occasionally, Caltrans bridges provide soffit or wall mounted lighting for City/local undercrossings. Inquire with the Resident Engineer (RE) as to whether any cooperative agreements or visual quality requirements exist for the project.
- c. Review *Construction Manual (CM)*, Chapter 4, *Construction Details*, [Section 4-86, Electrical Equipment and Materials](#), and [Section 4-87, Electrical Systems](#) (with emphasis on section 4-8703A(1d), *Conduit Installation on Structures*).
- d. Establish early communication and coordination protocol with the Contractor, RE, District Utility Coordinator, the District Transportation Engineer-Electrical (DTEE), and/or third-party utility representatives. Maintain continuous points-of-contact, particularly for third-party utility representatives, to avoid service connection delay.
 - i. Review the *CM*, Chapter 4, Section 4-87, *Construction Details –Electrical Systems*, with the RE for procedures on establishing electrical service and determine whether they are consistent with the District’s practice. Additional resources to assist the RE include:
 - 1. [Utility Coordinator by District](#)
 - 2. DTEE personnel
 - a. See organizational charts on individual District websites
 - ii. Determine which field inspection components will be performed by the District RE or Electrical RE and which will be performed by SC. Wiring activities during service initiation is typically performed by the District (and covered in Caltrans Division of Construction [Code of Safe Practices](#), Section 10.4, *Special Considerations – Electrical*).
 - 1. Review and become familiar with applicable [Cal/OSHA Electrical Safety Orders](#); these are located in the California Code of Regulations, Title 8, Chapter 4, subchapter 5.
- e. Coordinate submittal review with the RE and Electrical RE:
 - i. Verify [Form CEM-3101, Notice of Materials to Be Used](#), is complete for all electrical system components on structures.
 - ii. Verify contract compliance of shop drawings (if required), product data, and certificates of compliance for all electrical system components:

1. Review and provide feedback to the RE for authorization of these submittals.
2. For structures with electrical system components running through or across expansion joints, refer to the bridge project plans for the joint movement range (MR). Determine whether the electrical system materials proposed for use by the Contractor are compatible with the MR at each joint location, and discuss with the Electrical RE.
3. Review product data submittals for electrical system components to be anchored to structures. Verify the following:
 - a. Concrete anchorage devices for electrical system components must be:
 - i. On one of the following [Authorized Materials Lists](#):
 1. [Chemical Adhesive \(Cartridge Epoxies\)](#)
 2. [Chemical Adhesive \(Drill and Bond Dowel\)](#)
 3. [Shell-Type Mechanical Expansion Anchors](#)
 4. [Stud Mechanical Expansion Anchors](#)
 5. [Cast-in-Place Concrete Inserts](#)
 6. [Resin Capsule Anchors](#)
 - ii. Appropriate for the intended use. Refer to Bridge Design Aid (BDA) 5-81, *Anchorage to Concrete*, for restrictions and guidance; this can be accessed through the [Structural Design Alerts](#) link, Alert 05/11/2020, *Anchorage to Concrete*, and the four attachments. Consult with Bridge Design (BD) Structure Project Engineer or Materials Engineering and Testing Services Representative ([METS Rep](#)) for technical support. Notes on 2020 revision of BDA 5-81:
 1. The use of shell and stud-type mechanical expansion anchors, cast-in-place concrete inserts, and resin capsule anchors are currently restricted until their respective design guidance and construction specifications are revised to comply with the currently-adopted design specifications.
 2. The use of post-installed adhesive anchors is not allowed if those devices will encounter sustained tension.
 - b. Galvanized steel mounting hardware must comply with *Contract Specifications, Section 75, Miscellaneous Metal*.

- iii. Request a work plan submittal if deemed necessary, including contingencies and provisions for confined space entry. Coordinate with the RE, DTEE, and District Construction Safety Coordinator for review.
 - 1. See *CM*, Chapter 2, [Section 2-102B](#), *Safety and Traffic – Duties and Responsibilities – District Construction Safety Coordinator*.
- iv. Discuss and review the following for requirements on anchorage to structural steel:
 - 1. *Contract Specifications*, Section 55-1.02E, *Steel Structures – General –Materials –Fabrication*.
- v. Discuss and review the following for guidance on anchorage to structural steel:
 - 1. [BCM 59-1](#), *Structural Steel Coatings – General*
 - 2. [BCM 59-2](#), *Structural Steel Coatings – Painting Structural Steel*
 - 3. [BCM 75](#), *Miscellaneous Metal*
- f. Discuss whether the electrical system work on structures will occur in areas defined as confined spaces. If so:
 - i. Request confined space training and any associated personal protective equipment from the BCE.
 - ii. Review [Attachment 1](#), *SC Staff Responsibilities for Performing Operational Activities*, of BCM A-1, *Communicating SC Staff Responsibilities for Processes Owned by Others*, for confined space guidance.
- g. Although not mentioned in 2018 *Standard Specifications* Section 87, *Electrical Systems*, it is good practice to schedule a preconstruction meeting with the RE, District Electrical RE, District Utility Coordinator, Assistant Structure Representatives, and third-party utility and/or local agency representatives. Discuss topics including, but not limited to:
 - i. Working within a confined space.
 - ii. Third-party utility company involvement.
 - 1. Coordinate with the District Utility Coordinator to complete [Form DS-P0058](#), *Utility Information Sheet*.
 - iii. Work requiring lane closures on city streets.
- h. If high voltage cables will be installed on or near bridges, coordinate with the DTEE to complete [Form DS-M-0080](#), *Data for High Voltage Cables On or Near Bridges*.

4. During construction:
 - a. Coordinate with the Contractor to verify planned electrical work on structures. Verify that advance notification has been provided for installation of service equipment prior to installation of service connections and/or activation of utility service.
 - b. Verify lane/traffic closure windows and that approved closures are obtained for planned work.
 - c. Coordinate with the DTEE and third-party utility representative to verify layout markings for electrical system components and utility openings in structures.
 - d. Any electrical substitutions proposed by the Contractor should be reviewed with the Designer of Record and RE prior to authorization.
 - e. Upon delivery to the project site, verify that electrical system components to be installed on structures match the authorized shop drawings and product data submittals and include the required certificates of compliance and/or test data. Identify any deficiencies and notify the SR/RE immediately:
 - i. Verify State-furnished electrical system components delivered to the project site are in good condition and note any damage that occurs after delivery.
 - f. For electrical materials which were not source inspected and released by METS, utilize [Form CEM-4102](#), *Material Inspected and Released on Job*, with attached supporting documentation. Attach the product data sheets, certificates of compliance, and quality assurance test results, as applicable.
 1. Coordinate assistance with the field release process with the METS Rep, if required.
 - g. Collaborate with the Electrical RE to verify electrical work is performed in accordance with the contract documents (including any utility agreements), the [Cal/OSHA Electrical Safety Orders](#), NEC, and the manufacturer's installation instructions:
 - i. Verify luminaire refractors are oriented in the proper direction.
 - ii. For electrical system components to be cast into new concrete barriers, review the items listed in [Attachment 1](#), *Common Conflicts for Installing Electrical System Components in Concrete Barriers*.
 - iii. For electrical system components to be installed on existing structures, verify:
 1. Exposed conduit will be painted the same color as the existing structure.

2. Conduit runs do not undulate (up/down or in/out).
 3. Conduit runs are supported appropriately, as described in the contract documents.
 - iv. Verify conduit extensions are the same material as existing conduit, and conduit material transitions only occur at pull boxes.
 - v. Request a corrective work plan for any noncompliant electrical system work.
 - vi. Obtain quantities for bid item work related to installation of electrical system components on structures as the work is being performed, and provide these quantities to the RE.
 - vii. Perform final walk-through inspection with the RE, District Utility Coordinator, District Electrical RE, and/or third-party utility representatives before power is turned on to verify that there are no wiring or installation errors:
 1. Coordinate with the RE for final acceptance of the work.
 - h. Coordinate with the RE and DTEE to verify the digital Geographic Information Systems mapping file submittal is received, found to be acceptable, and forwarded to appropriate Caltrans recipients.
 - i. Document all inspection, construction, and quality assurance activities, pertinent to this BCM, on [Form CEM-4601](#), *Assistant Resident Engineer's Daily Report*, per [BCM C-7](#), *Daily and Weekly Reports*.
5. Following construction:
- a. Generate as-built project plan notations for electrical system components on structures, and verify that electrical system components have been incorporated into as-built shop drawing submittals.
 - b. Perform periodic visual inspection for installed/activated electrical system components on structures to verify that they remain in working order until relief of maintenance has been granted to the Contractor. Notify the Contractor of any necessary corrective work.
6. File all project documentation (correspondence, materials acceptance documentation, daily reports, etc.) in the appropriate category in the project records as specified in the *CM*, Chapter 5, [Section 5-102](#), *Contract Administration – Project Records and Reports – Organization of Project Documents*.

Process Outputs

1. Completed [Form DS-P0058](#), *Utility Information Sheet*, and [Form DS-M-0080](#), *Data for High Voltage Cables on or Near Bridges* (if applicable)
2. [Form CEM-4601](#), *Assistant Resident Engineer's Daily Report*, for electrical system work on structures
3. [Form CEM-4102](#), *Material Inspected and Released on Job*, for electrical materials, with attached supporting documentation
4. Fully installed electrical system components and/or utility service on structures, conforming to contract requirements; activated electrical systems
5. As-built project plans and, when applicable, as-built shop drawings

Attachments

1. [Attachment 1](#), *Common Conflicts for Installing Electrical System Components in Concrete Barriers*