

CHAPTER K

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K.00 Introduction

This chapter includes all work performed on highway electrical facilities used for control of traffic with traffic signal systems, highway and sign lighting systems, Traffic Management System (TMS) Field Elements, Intelligent Transportation Systems (ITS), count stations, and other related systems.

The general objective of this program is to maintain all highway electrical facilities described above to ensure reliable electrical systems and service.

The Division of Maintenance or the district Electrical Maintenance unit will not affect any permanent changes or modifications that will change the operational characteristics of an electrical facility without prior approval in writing from the Division of Traffic Operations, the District Traffic Operations unit, or other appropriate Department Branch.

Damaged or malfunctioning electrical installations, which seriously affect public safety, or capital investment, should be highest priority in Electrical Maintenance for repair or temporary corrections until permanent repairs can be scheduled. Lower priority should be given to repair of inoperative or damaged electrical installations, which do not seriously affect public safety.

Refer to Maintenance Manual Volume 2, for administrative details and charging/coding practices for the "K" Family.

K.01 Levels of Service

Refer to Maintenance Manual Volume 2, for Levels of Service regarding the "K" Family.

K.02 Highway Lighting and Sign Illumination

Highway lighting and sign illumination is provided to improve visibility during darkness, and to promote safe and efficient use of special roadway facilities.

Maintenance of highway lighting and sign illumination is the preservation of the facility in the safe and usable condition to which it has been improved or constructed.

K.02.1 Night Lighting Inspection

Highway lighting and sign illumination should be inspected at night for proper operation once each month. Electrical Outage Worksheets, or some other recording device, should be used to list each outage by county, route, post mile, and pole number. Knocked down lighting standards and illuminated street name sign outages should also be recorded on this form.

The most recent Electrical Outage Worksheet or other record shall be kept on file at the crew supervisor's office.

Information from the recent Electrical Outage Worksheet or other record shall be entered into IMMS in a timely manner as directed by region policy. It is suggested that this be accomplished within one (1) week of the night lighting inspection.

K.02.2 Luminaries

Luminaries should be thoroughly inspected at the time of lamp replacement. These inspections should include the following items as a minimum:

- (A) Gaskets : Inspect for loose or missing gasket; repair or replace as required.
- (B) Glassware : Inspect for cracked or broken glassware; replace if necessary.
- (C) Hardware : Apply suitable thread lubricant to hardware item which must be removed in the course of routine maintenance.
- (D) Terminal Block : Inspect for cracked or broken barriers on the block; replace if necessary.
- (E) Mounting : Inspect to determine if luminaire is rigidly held in proper position; make any necessary adjustments.
- (F) Sockets and Receptacles : Inspect for burned current carrying parts and broken insulation; replace if necessary.
- (G) Wiring : Inspect for abrasions that might develop shorts or grounds, and repair as required.
- (H) Reflectors : Inspect for scum or tarnish; replace if necessary.

K.02.3 Photoelectric Controls

Photoelectric controls should be checked during routine lighting inspection and serviced periodically or replaced as required.

Attention should be given to coordinating controls to ensure that all highway lighting units turn off or on at approximately the same time within an interchange or closely spaced interchanges.

Circuits designed for early turn on of illuminated signs should have the early turn on type of photocells. When these photocells fail, it is important that they are replaced with the correct unit. See Standard Specifications for correct turn off and turn on settings.

K.02.4 Luminaire Ballast Fusing

Where primary lines of multiple ballasts are provided with fused splice connectors, fuse ratings should be as shown on the Standard Plans.

K.02.5 Relamping

Lamp outages noted on the monthly night lighting inspection should be scheduled for replacement as soon as workload permits.

All lamps should be group replaced on a planned schedule based on the rated lamp life, which is published by the manufacturer. Lamp life is based on life tests of the particular lamp operated at rated voltage and current. Group replacement has several advantages. It reduces the frequency of outages, thereby lowering the cost of maintenance, and illumination is kept to nominal levels.

Typical group relamping schedules based on current rated life are as follows:

- | | |
|-----------------------------|-----------------------------|
| (A) Fluorescent (inductive) | Group relamp every 12 years |
| (B) Mercury | Group relamp every 4 years |
| (C) High Pressure Sodium | Group relamp every 4 years |
| (D) Low Pressure Sodium | Group relamp every 3 years |
| (E) Fluorescent (tube) | Group relamp every 2 years |
| (F) LED | Group relamp every 15 years |

Accurate records should be kept indicating group relamping dates and location.

K.02.6 Sign Lighting Fixtures

It is the Department's policy to only illuminate those signs that it deems necessary. When maintaining a dark sign lighting fixture, consult with the Division of Traffic Operations or the District Traffic Operations unit to insure that the sign is being illuminated according to policy. Malfunctioning fluorescent (tube) sign lighting fixtures should be replaced with mercury or fluorescent (inductive) sign lighting fixtures, or removed, provided the Division of Traffic Operations or District Traffic Operations unit concurs.

Use fixtures specified in the Standard Specifications and use fixture spacing charts as shown in the Standard Plans.

With this change, relamping will be extended from 2 years to 4 years, or 12 years.

K.02.07 Lighting Standards and Mast Arms

Lighting Standards and mast arms should be inspected periodically for loose bolts and nuts. The inspection period should be the same as the relamping period at the minimum, or more often as outage repairs are performed.

Missing hand hole covers should be noted during monthly inspections, and replaced as soon as practical and work load permits.

Lighting standards with slip bases or slip base inserts should be inspected periodically to ensure the slip bases or slip base inserts will function properly under the impact of collision.

In particular, attention should be given to:

- (A) Soil erosion, damage, or dirt build-up around the pullboxes or foundations of the standards.
- (B) Excessive growth of grasses or bushes near the pullboxes or standards.
- (C) Any obstacles that will interfere with the operation of the slip bases or slip base inserts.

K.02.8 High Mast Lighting

In addition to the steps outlined in the previous paragraphs, special maintenance procedures have to be followed when working with high mast equipment. These procedures deal primarily with the design of the mechanical hoisting mechanism components, which provide for the luminaries to be lowered and raised. Manufacturers of high mast equipment use different designs, so only general maintenance recommendations applicable for all types of equipment can be given. To assure the proper, long, and trouble free life of the equipment, follow the steps outlined in the manufacturer's maintenance literature closely.

Listed below are steps of a general nature, which serve as a general overview of Maintenance requirements, which should be accomplished :

(A) Winch

- (1) Remove any dirt or foreign debris which may have accumulated on top of the winch or on the wire cables and clean thoroughly.
- (2) Check oil in oil bath, and add or change if excessively thick and/or dirty.
- (3) Check all bearings and lubricate if required.
- (4) Operate the lowering device through its full length of travel and visually inspect for undue wear on the winch mechanism.

(B) Cables

- (1) Inspect the cablelay on the winch and the section of cable visible at mast door opening for frays, kinks, or corrosion.
- (2) Inspect winch cable throughout its length for frays, kinks, or corrosion.
- (3) Inspect anchorage points of winch cable on winch and of hoisting cables at luminaire supporting ring.
- (4) From the base of the mast, observe hoisting cables from luminaire support ring in lowered position to masthead for any obvious defects.

(C) Luminaire Ring

The Luminaire Ring should be lowered approximately every 6 months and inspect the following:

- (1) While lowering the ring, make sure the roller contacts of the centering arms are in contact with the pole throughout the entire length of travel.
- (2) Inspect the spring of the centering arms for corrosion, clean and lubricate if required.
- (3) Inspect guide rollers (where fitted) and lubricate and adjust as necessary.
- (4) Inspect interconnecting cables and junction boxes for damage and repair as necessary.
- (5) Inspect electric power supply cable anchorage, sockets, and connectors, and inspect cable for physical damage.
- (6) Inspect and tighten all nuts and bolts if necessary.

(D) Foundation Bolts

- (1) Check foundation bolts, and tighten nuts where necessary.

K.03 Toll Collection Systems

Toll Collection Systems are now covered under Chapter “J2” of this manual.

Traffic metering systems that are located at toll plazas are part of K.06 – Freeway Meter Signals, and should be charged/coded appropriately.

K.04 Traffic Signals

Traffic control signals are power-operated traffic control devices, which alternately direct traffic to stop and to proceed at highway and street intersections. Their purpose is the orderly assignment of right of way to the various traffic movements.

K.04.1 Legal Authority

Section 21350 of the Vehicle code authorizes the Department of Transportation to place and maintain appropriate signs, signals and other traffic control devices as required to warn or guide traffic upon the highways. A permit is required for the erection by others of traffic signals and flashing beacons, on all State highways, whether within incorporated or unincorporated areas.

K.04.2 Traffic Signal Timing and Operations

Initial timing of traffic signals and any subsequent changes in timing shall be the responsibility of the Division of Traffic Operations or the district traffic signals operation unit. Maintaining the timing is the responsibility of the Division of Maintenance or the district Electrical Maintenance unit. Temporary timing changes can be made by the Division of Maintenance or the district Electrical Maintenance unit to compensate for sudden changes in traffic conditions or malfunctioning traffic signal equipment that cannot be repaired or replaced immediately. Any temporary changes to the signal timing shall be noted in the traffic signal cabinet and the Division of Traffic Operations or the district traffic signals operation unit must be notified of any temporary timing changes as soon as possible. Signal Timing Forms will be prepared and furnished by the Division of Traffic Operations or the district traffic signals operation unit, and a copy sent to the Division of Maintenance or the district Electrical Maintenance unit. Signal timing records should be kept by both the Division of Traffic Operations or the district traffic signals operation unit, and the Division of Maintenance or the district Electrical Maintenance unit.

Any observed timing or operational traffic signal problems should be promptly reported to the Division of Traffic Operations or the district traffic signals operation unit.

The standard traffic signal program at the time of this Manual's revision is C8 v 4. This will change from time to time when improvements are made on the software. When replacing a 170 controller, contact the district traffic signal operations unit to request authorization to install the current standard signal software, and the timing parameters.

K.04.3 Traffic Signal Records

Adequate office records are a necessary function of the signal maintenance organization.

Office records should include the following types of statistical data:

- (A) Type and number of traffic signals.
- (B) Lighting equipment at each location.
- (C) Date of installation.
- (D) Type and date of all trouble calls.
- (E) Who reported the trouble?
- (F) Who repaired, and extent of the repairs.

The Division of Traffic Operations or the district traffic signals operation unit, which approves signal installations and generally prepares the specifications, would like to be informed on any operating difficulties encountered with any type of equipment or equipment from a particular manufacturer. With this information, they can change or revise the specifications on some types of equipment to eliminate any defects or eliminate use of equipment from that manufacturer.

K.04.4 Maintenance of Traffic Signals

A detailed check should be at 90 day intervals for proper operation of controller assemblies and signals. This check should include the following items as a minimum:

(A) Field Inspection

- (1) Visual check of indications.
- (2) Vehicle and pedestrian head alignment.
- (3) Pushbutton operation.
- (4) Hardware (hand-hole covers, signs, poles, backplates, etc.).
- (5) Pullbox covers (broken, missing, and clear of dirt or debris).
- (6) Condition of street name signs.
- (7) Visual check of service cabinet and equipment locks.
- (8) Traffic handling of intersection.
- (9) Visual check of loops in roadway.

(B) Cabinet Interior

- (1) Controller unit indicator lights.
- (2) Function and timing.
- (3) Detector indicator lights.
- (4) Check flasher outputs.
- (5) Check and adjust contacts.
- (6) Check monitor indicator lights.
- (7) Isolator function and operation.
- (8) Thermostat and ventilation system including filter.
- (9) Clean cabinet and interior components.
- (10) Check documentation. (timing sheets, schematics, wiring plans, etc., and inspection noted on cabinet login card).

(C) Cabinet Exterior

- (1) Condition of surface (paint, damage and graffiti).
- (2) Condition of locks and handles.

(D) Battery Backup System (BBS)

- (1) Check physical condition of batteries, cables and connections.
- (2) Check individual battery voltage and system charge current.
- (3) Test operation of BBS.
- (4) Note use indicators.

K.04.5 Maintenance of Electrical and Electronic Modular Components

This section outlines the procedures for the maintenance and repair of electrical and electronic modular components associated with traffic signals, flashers, ramp meters, CCTV, CMS, and other relevant field assets. It also details the roles and responsibilities of the three Central Repair Shops and the District Electrical Maintenance crews. For this document, the term modular component is defined as follows:

Any device to include but not limited to; 170 controllers, 2070 controllers, conflict monitors, detector cards, isolation cards, CMS components, CCTV components, or any other device that has circuit board technology and requires bench level diagnostics; repair and replacement of individual electronic components.

CENTRAL REPAIR SHOPS

- (A) All circuit board level repairs on electrical and electronic modular components will be performed at one of the three Central Repair Shops located at District 3, District 4, and District 7. District 3 will provide service to Districts 1, 2, and 10; District 4 will provide service to Districts 5 and 6; District 7 will provide service to Districts 8, 9, 11 and 12.
- (B) Defective modular components will be sent to the assigned Central Repair Shop for diagnostics and repairs. The Central Repair Shop will make a determination as to if a board or unit should be repaired or salvaged dependent on initial cost, cost of repair, and age.
- (C) The three Central Repair Shops (D3, D4, and D7) shall no longer perform repairs on the following components:
 - Model 200 Switch Packs
 - Model 204 Flashers
 - Model 208 Monitor Unit
 - Model 222 Detector
 - Model 224 Detector
 - Model 242 DC Isolators
 - Model 252 AC Isolators
 - Model 252R AC Isolator
- (D) The Central Repair Shops can repair other components not listed in (C) above, provided that the total costs of repairs (including all history) do not exceed the set salvage point for that type of component.
- (E) The Central Repair Shops shall follow the approved guidelines as to when a component **must** be salvaged and replaced with a new unit.

- (F) The Central Shops will not perform repairs on components that are obsolete or beyond the point of economical repair. If the cost of a single repair to a component exceeds the set point of salvage, the repairs will not be performed, regardless of the type of component. The cost of repairs should also include any past costs as well as consideration for the type of problem and reoccurrence of similar problems. An exception would be made for components that have no replacement available.
- (G) If the Central Repair Shop receives a component from a district that is beyond economical repair, the component is to be salvaged in the Central Repair Shop (not returned to the district). The district should be notified of salvages so they can order replacements.
- (H) The Central Repair Shops will retain repair history for larger dollar components (170, 210, CIA, cameras, etc.). These history records will be reviewed prior to performing repairs on the component. If the cost of past repairs is approaching the point of salvage, then the unit will be salvaged.
- (I) The Central Repair Shops will track the salvage of high cost components (170 Controller, 210 Conflict Monitor, CCTV equipment, etc.) or any other component as needed in IMMS. Property Management does not need to be notified when salvaging these components.
- (J) The Central Repair Shops will make every effort to correctly charge repairs in IMMS.
- (K) The Central repair Shops will report any unauthorized district repairs on components. If components are delivered to the shop with obvious signs of unauthorized repairs, note the location and district, and notify Headquarters Maintenance.
- (L) The Central Shops will make every effort to use the most cost-effective methods when performing repairs on components.

DISTRICT ELECTRICAL MAINTENANCE CREWS

- (A) The work performed at the asset location by the field crews will be limited to a diagnosis to determine if the modular component is causing the problem. If the modular component is determined to be defective, it will be replaced in its entirety with a new or repaired component. 170 and 2070 controllers will also be reprogrammed with the operating program module. The controller diagnostic module will not be used for field level diagnosis. If the modular

component is one listed in (C) below, then it will be disposed of in the district's recycle bin.

- (B) The work performed in each district's Signal Maintenance Shop will be limited to a determination if the modular unit is beyond the point of economical repair, and should be discarded or sent to the Central Repair Shop for repairs. In the case of the 170 controllers, diagnosis of the controller unit can be performed using a diagnostic module. No work will be performed on printed circuit boards or power supplies at this level. The complete controller unit as it came from the field will be sent to the Central Repair Shop with detailed description of the problem and the E-FIS Project Code (E-Number) of the location from where it was removed.
- (C) District Electrical Maintenance crews will no longer send the following defective components to their local Central Repair Shop nor will the districts perform any types of repairs on these components. These components are to be disposed of in the districts recycle bins as the cost of handling, shipping and repairing of these items is no longer cost effective.
- Model 200 Switch Packs
 - Model 204 Flashers
 - Model 208 Monitor Unit
 - Model 222 Detector
 - Model 224 Detector
 - Model 242 DC Isolators
 - Model 252 AC Isolators
 - Model 252R AC Isolator
- (D) The District Electrical Maintenance crews will order modular components as needed directly from the Division of Procurement and Contracts (DPAC) Warehouse. These items do not have to be ordered by the Central Repair Shops and the districts do not need approval from the shops to order. The districts can order these directly, and the costs do not affect the district budget. Headquarters Maintenance allocates funds to the warehouse to fund the purchase of these items. Therefore, the funds do not come out of the district's allocation.
- (E) District Electrical Maintenance crews will not send warranty issue components to their Central Repair Shop. These issues are best handled within the districts, unless the component came from the Central Repair Shop. In some cases, the Central Shops may be gathering information about specific components and will notify the districts if there is a need to return these components to the Central Shop.

- (F) District Electrical Maintenance crews will not ship components that are obviously obsolete or beyond the point of economical repair to the Central Shops. Components that are totally destroyed due to third party damage, lightning strikes, etc., can be salvaged (destroyed and disposed of in a recycle bin) within the district, and replaced with a new component from the district's stock. The districts do not need Central Repair Shop approval to replace components. Property Management does not need to be notified when salvaging these components
- (G) District Electrical Maintenance crews will not perform any repairs to controllers, conflict monitors, isolation cards, detector cards, or any other modular component. The roles and responsibilities of the Central Repair Shops and the districts are clearly stated.
- (H) District Electrical Maintenance will store an appropriate number of spare components to ensure safe and proper operations of the field assets independent of the components in route to Central Shops for repairs. This is due to the possibility that components will be salvaged due to repair costs.

K.04.6 Pedestrian Signal Indications

When existing WALK-DONT WALK or WALK-WAIT pedestrian signals reach the end of their service life and indications appear dim or need to be relamped, they shall be replaced with the symbol signal. It is acceptable to mix types of pedestrian signals at an intersection.

LED symbol type pedestrian signals shall be used for maintenance replacement of all types of pedestrian signals.

K.04.7 Arrow Indications

Use 3-arrow conventional signal face in lieu of PV units with concurrence from Division of Traffic Operations or the district traffic signals operation unit. Remove any conflicting signing. Where the secondary indication for left turns is located at the far left, replacement indications should be 3-arrow conventional heads, in lieu of PV units or 8 inches red louvered, 8 inches yellow louvered, and 12 inches green units.

K.04.8 Relamping

Incandescent Lamps

Incandescent lamps shall not be used in relamping traffic signals. If a traffic signal has recently been relamped with incandescent lamps, the traffic signal should be group relamped with LED modules one (1) year from that relamp date. If the red indicators have been replaced with LED's,

the yellow and green sections should be relamped with LED modules within two (2) years from the last relamp.

LED modules

Red LED traffic signal modules should be group relamped every five (5) years. All other modules shall be group relamped every ten years.

K.04.9 Traffic Signal Conflict Monitors

Conflict monitors and program cards shall be shop or field tested for proper operation approximately once every 12 months.

Monitor testers shall be shop certified by qualified personnel at Central Repair Facilities approximately every 12 months, or as recommended by the manufacturer.

K.04.10 Battery Backup Systems (BBS)

The intent of the battery backup systems installed at traffic signalized intersections shall be to provide emergency power for traffic signals for short power interruptions and the initial response period of long power interruptions. For the operation of traffic signalized intersections beyond the capacity of the BBS, refer to Section K.04.11 (Traffic Signal Operation During an Emergency or a Power Outage). The BBS is not intended to maintain signal operation in the case of an indefinite power interruption.

The batteries for a BBS unit should be replaced at a minimum of every five (5) years or sooner, depending of manufacturer's recommendations. The batteries used to replace shall be 12 VDC, 65 Amp-hr, and be valve regulated, sealed lead-acid type, and be either gel-cel or absorbed glass mat construction. Used batteries shall be disposed of by recycling with an approved battery recycler.

Refer to the Code of Safe Operating Practices for proper handling and disposal procedures for leaking/damaged batteries.

K.04.11 Traffic Signal Operation During an Emergency or Power Outage

The emergency mode of operation for all traffic signals shall be flashing operation.

The California Highway Patrol (CHP) or local police are authorized to place a traffic signal on flash or turn it off to direct traffic in the event of any emergency, to expedite traffic, or to ensure safety as conditions may require, notwithstanding any provisions of the Vehicle Code.

The following procedures will be followed in the event of a utility company power outage:

- (A) An unplanned utility company power outage is usually caused by severe weather conditions or system failures such as shorted transformers or downed poles or lines.

This type of outage is unpredictable and usually for an unknown period of time. It will be the general policy of Caltrans not to provide standby electrical power or stop signs at traffic signals during an unplanned utility company power outage as described above. If a permanent battery backup system has been previously installed, the intent is to operate the signals up to the capacity of the batteries, and not to provide additional backup support.

- (B) A utility company may make a planned power shutdown to make repairs on their facilities and request standby electrical power or stop signs from Caltrans when it affects our traffic signals.

It will be the Caltrans general policy, that upon 72 hours notice, to provide standby power or stop signs where possible, consistent with availability of equipment and personnel.

This is the Caltrans general policy on providing backup control at traffic signals during power outages. In power outages, as in any other emergency, it is the function of the California Highway Patrol and the local police to provide immediate short-term traffic control. Generally, the CHP will provide traffic control in unincorporated areas and the local police will provide those services in incorporated areas.

As with any general policy, there may be extenuating circumstances that require exceptions to this policy. These exceptions may be approved by the Deputy District Director, Maintenance.

It is our intent to cooperate as fully as possible with the California Highway Patrol and the local police, consistent with our resources limitations. Contact should be made with the appropriate law enforcement offices to discuss our capabilities and establish the appropriate Caltrans contact person for CHP and the local police then requesting our assistance.

K.05 Flashing Beacons

Flashing beacons are usually standalone flashing traffic signal indications used to assist in the warning of motorists of a potential danger or to assist in the operation of an intersection controlled by stop signs. Flashing beacons may be red or amber. Flashing traffic signal indications used to warn of an upcoming traffic signalized intersection are part of the traffic signal, and are not standalone flashing beacons.

K.05.1 Maintenance of Flashing Beacons

Flashing beacons should be inspected for proper operation at intervals of approximately 120 days. This check should include the following items as a minimum:

(A) Field Inspection

- (1) Visual check of indications.
- (2) Signal indication alignment.
- (3) Hardware (hand-hole covers, signs, poles, backplates, etc.).
- (4) Pullbox covers (broken, missing, and clear of dirt or debris).
- (5) Visual check of service cabinet and equipment locks, and flasher circuitry.
- (6) Traffic handling of intersection.

K.05.2 Group Relamping

Flashing beacons should be group relamped with the appropriate color, size, and type of LED module every five (5) years.

Incandescent lamps shall not be used in relamping flashing beacons. If a flashing beacon has recently been relamped with incandescent lamps, the flashing beacon should be group relamped with LED modules one (1) year from that relamp date.

K.05.3 Flashing Beacon Operation During an Emergency or Power Outage

The emergency mode of operation for all flashing beacons shall be “off” or deactivated. BBS are not to be used with flashing beacons. Maintenance forces shall not respond to a flashing beacon in the event of a power outage. Maintenance forces shall not provide generators or other power sources in the event of a planned power outage by the servicing utility or others.

K.06 Freeway Meter Signals

Freeway meter signals are power-operated traffic control devices, which meter traffic on a freeway. Freeway meter signals may be located on on-ramps, freeway-to-freeway connectors, and on the mainline at the beginning of freeways or major structures. There is no control over conflicting phases at freeway meter signals. Their purpose is the orderly control of traffic on freeways.

K.06.1 Maintenance of Freeway Meter Signals

Meter signals should be checked for damage, proper operation, and timing every 120 days. This check should include the following items as a minimum:

(A) Field Inspection

- (1) Visual check of indications.
- (2) Signal indication alignment.
- (3) Hardware (hand-hole covers, signs, poles, backplates, etc.).
- (4) Pullbox covers (broken, missing, and clear of dirt or debris).
- (5) Visual check of service cabinet and equipment locks.
- (6) Visual check of loops in roadway (if possible).

(B) Cabinet Interior

- (1) Controller unit indicator lights and display.
- (2) Function and timing.
- (3) Detector indicator lights and operation.
- (4) Check output devices, including interconnect systems.
- (5) Thermostat and ventilation system including filter.
- (6) Clean cabinet and interior components.
- (7) Check documentation (timing sheets, schematics, wiring plans, etc., and inspection noted on cabinet login card).

(C) Cabinet Exterior

- (1) Condition of surface (paint, damage, graffiti).
- (2) Condition of locks and handles.
- (3) Operation of Police panel switches.

K.06.2 Meter Timing and Operations

Initial timing of meter signals and any subsequent changes in timing shall be the responsibility of the Division of Traffic Operations or the district traffic operation unit.

Maintaining the timing is the responsibility of the Division of Maintenance or the district Electrical Maintenance unit.

Temporary timing changes can be made by the Division of Maintenance or the district Electrical Maintenance unit to compensate for sudden changes in traffic conditions or malfunctioning traffic signal equipment that cannot be repaired or replaced immediately.

In the event of a malfunction that cannot be compensated for in the software, the meter signal shall be deactivated until proper repairs can be made.

The Division of Traffic Operations or the district traffic signals operation unit must be notified of any temporary timing changes or deactivations as soon as possible.

Signal Timing Forms will be prepared and furnished by the Division of Traffic Operations or the district traffic signals operation unit and a copy sent to the Division of Maintenance or the district Electrical Maintenance unit.

Meter timing records should be kept by both the Division of Traffic Operations or the district traffic signals operation unit, and the Division of Maintenance or the district Electrical Maintenance unit.

Any observed timing or operational traffic metering problems should be promptly reported to the Division of Traffic Operations or the District Traffic Operations unit.

There is no standard statewide meter signal controller software for the Model 170 controller. Personnel working on meter signals should familiarize themselves with the software version used on the meter signals in their areas.

K.06.3 Group Relamping

(A) Incandescent Lamps

Incandescent lamps shall not be used in relamping meter signals. If a meter signal has recently been relamped with incandescent lamps, the meter signal should be group relamped with LED modules two (2) years from that relamp date. If the red indications have been replaced with LEDs, the yellow and green sections should be relamped with LED modules within three (3) years from the last relamp. If a meter signal is used in

limited operation, it should be relamped with LED modules three (3) years from the last relamp date.

(B) LED modules

LED traffic signal modules should be group relamped every 15 years.

K.06.4 Meter Signal Operation During an Emergency or Power Outage

The emergency mode of operation for all meter signals shall be “off” or deactivated. BBS systems are not to be used with meter signals. Maintenance forces shall not respond to a meter in the event of a power outage. Maintenance forces shall not provide generators or other power sources in the event of a planned power outage by the servicing utility or others.

K.07 Traffic Management Systems (TMS) Field Elements

TMS field elements are systems that are controlled and/or monitored by the District Traffic Management Center (TMC), and do not directly control traffic. Examples of these systems are changeable message signs (CMS), closed circuit television cameras (CCTV), and vehicle detector stations (VDS). Due to the changing nature of the technology employed by the TMCs, these systems are varied in appearance and operation. Close attention should be paid to any manufacturer’s maintenance and operations manual.

K.07.1 Changeable Message Signs (CMS)

All types of changeable message signs should be routinely inspected for proper operation at least every 120 days. This check should include the following items as a minimum:

(A) Field Inspection

- (1) Visual check of indications.**
- (2) Sign Panel**
 - (a) Check inter-connectable connections.**
 - (b) Test pixel matrix for failures.**
 - (c) Replace failed pixels or pixel matrix modules.**
- (3) Pullboxes (damage, covers missing or damaged).**
- (4) Visual check of service cabinets and locks.**

(B) Cabinet Interior

- (1) Controller and associated units indicator lights.
- (2) Function, timing, and communications (modem).
- (3) Thermostat and ventilation system including filter.
- (4) Clean cabinet and interior components.
- (5) Check documentation (schematics, wiring plans, etc.).
- (6) Check operation of all GFI receptacles.
- (7) Check that cables are not stressed.
- (8) Check components mounting hardware securely fastened.
- (9) Remove any dirt and debris.
- (10) Clean dimming sensor.

(C) Cabinet Exterior

- (1) Condition of surface (paint, damage, graffiti).
- (2) Condition of locks and handles.

Changeable message signs should be relamped as required. When relamping a CMS with xenon pixel matrix modules (PMM), consideration should be given to relamp the CMS with LED PMMs. Contact the Division of Maintenance for further guidance and information on the use of LED PMMs.

K.07.2 Closed Circuit Television Systems (CCTV)

All closed circuit television systems should be routinely inspected for proper operation every 180 days for proper operation, or as per manufacturer's recommendation. Due to possible presence of fiber optic equipment and cabling, or other special equipment, only qualified personnel are to perform routine maintenance inside camera control cabinets. Read Section K.07.9 for further instruction on the maintenance of TOSNet field communications systems. This check should include the following items as a minimum:

(A) CCTV Camera Assembly:

- (1) Visual check of camera assembly and cables.
- (2) Inspection of camera control sub-assemblies for proper operation and function as per manufacturer's instructions.
- (3) Clean enclosure window.
- (4) Check humidity indicators
- (5) Camera Control Check enclosure pressure.
- (6) Re-charge enclosure pressure (every year).
- (7) Insure pan/tilt drive unit operates freely over entire range of pan/tilt travel.

(B) CCTV Receiver:

- (1) Condition of surface (paint, damage, graffiti).
- (2) Condition of locks and handles.
- (3) Check mounting screws are securely fastened.
- (4) Check cable connections are securely fastened.
- (5) Using a lap-top computer check the following:
 - (a) Pan/tilt operation from stop to stop.
 - (b) Lens zoom in/out.
 - (c) Iris auto/manual (adjust iris as necessary).

(C) Video Transmitter:

- (1) Using a power meter, measure and record optical output power.
- (2) Check power light.
- (3) Check cable connections.

(D) Fiber Distribution Unit:

- (1) Clean end of fiber.
- (2) Check spare fiber is capped.
- (3) Check fiber is not stressed.

(E) Field Equipment Cabinet:

- (1) Check operation of all GFI receptacles.
- (2) Check cables are not stressed.
- (3) Check operation of fan.
- (4) Check component mounting hardware is securely fastened.
- (5) Remove any dirt and debris.
- (6) Change vent filter.

K.07.3 Wrong Way Detection systems

All wrong way detection systems should be routinely inspected every 90 days for proper operation.

K.07.4 Vehicle Detection Systems

All Vehicle Detection Systems should be routinely inspected for proper operation every 120 days. This check should include the following items as a minimum:

(A) Field Inspection

- (1) Hardware (hand-hole covers, signs, poles, backplates, etc.).
- (2) Pullbox covers (broken, missing, and clear of dirt or debris).
- (3) Visual check of service cabinet and equipment locks.
- (4) Visual check of loops in roadway (if possible).
- (5) Visual check of detector sensor (other than loops).

(B) Cabinet Interior

- (1) Controller unit indicator lights and display.
- (2) Function and timing.
- (3) Detector indicator lights and operation.
- (4) Check output devices, including interconnect systems.
- (5) Thermostat and ventilation system including filter.
- (6) Clean cabinet and interior components.
- (7) Check documentation (timing sheets, schematics, wiring plans, etc.).

(C) Cabinet Exterior

- (1) Condition of surface (paint, damage, graffiti).
- (2) Condition of locks and handles.

Examples of different Vehicle Detection Systems include the following:

- (A) Inductive loop detector.
- (B) Magnetometer.
- (C) Magnetic detector.
- (D) Micro-loop inductive detector.
- (E) Microwave Vehicle Detection System (MVDS): (RTMS is one example).
- (F) Video Image Processing System (VIPS) (for specific items to check during PM check; see the section on CCTV systems, K.07.02.).

K.07.5 Fiber Optic Systems (TOSNet)

All fiber optic systems should be routinely inspected for proper operation every 120 days or as per manufacturer's recommendation. Due to specialized equipment and fiber optic cabling, only qualified personnel are to perform routine maintenance inside fiber optic cabinets. Read Section K.07.9 for further instruction on the maintenance of TOSNet field communications systems. This check should include the following items as a minimum:

(A) Cabinet Exterior

- (1) Condition of surface (paint, damage, graffiti).
- (2) Condition of locks and handles.

K.07.6 Highway Advisory Radio (HAR)

All HAR systems should be routinely inspection for proper operation every 120 days. Due to specialized equipment, only qualified personnel are to perform routine maintenance inside HAR cabinets. Assistance with HAR installations may be obtained from Division of Maintenance, Office of Radio Communications. This check should include the following items as a minimum:

(A) Equipment

- (1) Check range of transmitter signal.
- (2) Check power supply level.
- (3) Field equipment cabinet.
- (4) Check operation of all GFI receptacles.
- (5) Check that cables are not stressed.
- (6) Check operation of fan.
- (7) Check component mounting hardware is securely fastened.
- (8) Remove any dirt and debris.
- (9) Change vent filter.

(B) Flashing Beacon

- (1) Check pole mounting hardware.
- (2) Check flasher circuitry.

(C) Field Inspection

- (1) Check condition of storage batteries, if solar panel is present.
- (2) Contact traffic management center to turn on flashers and check for proper operation.
- (3) Inspect and clean flasher lens and solar panel if present.
- (4) Inspect advisory sign for damage or graffiti.

K.07.7 Communication Hubs (TOSNet)

All field communications systems should be routinely inspected for proper operation every 120 days. Due to specialized equipment and fiber optic cabling, only qualified personnel are to perform routine maintenance as per manufacturer's recommendations. Read Section K.07.9 for further instruction on the maintenance of TOSNet field communications systems. This check should include the following items as a minimum:

(A) Building Exterior

- (1) Check door locks and handles for damage.
- (2) Check condition of surface for graffiti, damage, etc.

(B) Optical Receiver Rack

- (1) Check power and carrier lights are operative.
- (2) Check coax and optical fiber connections are clean and secure.
- (3) Using power meter, measure and record optical receive levels.
- (4) Check that fibers are not stressed.
- (5) Check all unused fiber terminations are capped.

(C) Video Multiplexer and Demultiplexer

- (1) Remove and clean each circuit card with a vacuum cleaner and small brush.
- (2) Check coax cable connections are secure.
- (3) Check optical fiber connections are clean and secure.
- (4) Check power supplies' LED indicators are lit.
- (5) Using power meter, check and record optical output power.
- (6) Check status of all LED indicators on all cards.

(D) Channel Bank

- (1) Check mounting screws are securely fastened.
- (2) Check cable connections are securely fastened.
- (3) Check power supplies' LED indicators are lit.
- (4) Check line interface unit (LIU) LED indicators are all lit.

(E) DS-1 Optical Modem

- (1) Using power meter, measure and record optical output power.
- (2) Using power meter, measure and record optical receive power.
- (3) Check power light is operative.
- (4) Check data cable connection screws are not loose.
- (5) Check optical fiber connection is clean and secure.

(F) Video Monitor

- (1) Check all controls operate properly.
- (2) Check coax cable connections are secure and not stressed.
- (3) Check appropriate termination at rear of unit.
- (4) Clean monitor assembly.

(G) General

- (1) Check operation of all GFI receptacles.
- (2) Check cables are not stressed.
- (3) Check operation of all fan assemblies.
- (4) Check component mounting hardware securely fastened.
- (5) Remove any dirt and debris.
- (6) Check A/C unit is operating properly.

K.07.8 TMS Field Element Operation During an Emergency or Power Outage

The emergency mode of operation for all TMS field elements shall be “off” or deactivated. Battery backup systems are not to be used with TMS field elements. Maintenance forces shall not respond to a TMS field element in the event of a power outage. Maintenance forces shall not provide generators or other power sources in the event of a planned power outage by the servicing utility or others.

It is understood that some TMS field elements may be solar/battery powered for normal operations.

K.07.9 Maintenance of TOSNet Communications Systems to TMS Field Elements

The normal maintenance functions on the TOSNet field communications systems are to be coordinated and monitored by the District Traffic Operations unit, and performed by the TOSNet contractors. The district Electrical Maintenance crews are to assist the TOSNet contractor(s) when workload and resources permit. This includes the communications equipment for all TMS field elements and ramp meters, as well as communications hubs, and fiber-optic systems.

K.08 Traffic Census Counters/Speed Monitor Stations

Traffic census counters and speed-monitoring stations are systems that used periodically to monitor conditions on the State highway system.

All traffic count loop detectors should be checked and repaired on notification of malfunction by Traffic Operations Program or District Traffic Operations unit. Since the use of these systems is not continuous, there is no predefined preventative maintenance interval.

K.09 Miscellaneous

K.09.1 Painted/Decorative Standards and Poles, and Painted Hardware

New or existing steel standards and poles for traffic signals should not be painted or repainted by State forces.

Participating local agencies may be granted permission to paint steel standards and poles or use decorative standards or poles on State highways to match painted or decorative standards and poles on their streets or roads. The local agency will be responsible for maintaining the visual aesthetics of the painted/decorative standards or poles. The local agency shall be responsible for providing replacement standards or poles in the event replacement is necessary. The use of decorative poles shall be approved by the Division of Engineering Services for compliance with Caltrans structural standards. The division of responsibility for painted steel or decorative standards and poles should be delineated in the Electrical Maintenance Agreement (see section K.09.2).

When existing galvanized signal standards and poles are not repainted to maintain color, deteriorated paint should be removed or painted over with aluminum paint.

On non-galvanized (painted) steel signal standards and poles (that are not being maintained by the local agency) or on galvanized steel signal standards and poles where the galvanizing is in poor condition, surfaces should be maintained as required. Replacement of deficient standards, mast arms, and poles should be considered.

Interior of signal visors, louvers and front faces of back-plates should be painted with flat black paint. Signal heads, signal head mountings, brackets and fittings, outside of visors, pedestrian push button housings, pedestrian signal head housings and visors, and back of back-plates, should be painted with flat black or dark olive green paint.

K.09.2 Distribution of Traffic Signal and Lighting Costs

The cost of maintenance and energy of traffic signals and highway lighting facilities at intersections of county roads and/or city streets with a conventional State highway should be

shared between the agencies concerned in the same ratio as the number of legs in the intersection under each jurisdiction bears to the total number of legs.

In accordance with the above, the cost of maintenance and energy of a traffic signal and intersection lighting on a 4 leg crossing at grade would be shared on a 50-50 basis. Such costs on a "T" or "Y" intersection at grade would be shared on a $33 \frac{1}{3}$ - $66 \frac{2}{3}$ basis.

The same principle of cost distribution will apply to freeways, except that with interchanges the concept of the overall facility will be used. The participation ratio will be based on the ratio of the number of legs of the respective agencies to the total number of legs of the interchange facility.

In Example "A" (Page K-31) we have a simple diamond interchange, which is a State facility crossing a local facility, with lighting and a traffic signal at the intersection of the local facility and the State ramps. This type of interchange is similar to a 2-quadrant cloverleaf. The cost distribution would be $\frac{1}{2}$ local, $\frac{1}{2}$ State.

At a "T" type interchange it would be $\frac{1}{3}$ local, $\frac{2}{3}$ State.

Frontage roads that may be adjacent to the freeway, and intersect only with the local road, should not be considered a part of the interchange facility. These intersections are local and 100 percent the responsibility of the local agency.

Some frontage roads are integrated with the interchange such as the case where the freeway ramps connect to the frontage road before connecting to the local road as shown on Example "B". Usually, in this case, the short piece of frontage road between the ramp terminal and intersecting local road should be considered as belonging to the local agency, even though it is used to complete the interchange with the local road. The frontage roads approaching the interchange cannot be considered local legs of the interchange and should not be counted as local legs. In general, the freeway will be intersecting with the local road or street and not the frontage roads constructed strictly for property access. An isolated ramp; Example "E", cannot be considered an interchange, and we must then use the concept of an intersection at grade. The participation ratio of Example "E" would then be $\frac{1}{3}$ State and $\frac{2}{3}$ local.

Example "H" shows a State highway intersecting a City/County street or road and a driveway. The cost distribution would be shared on a 50-50 basis between the State and city/county. City/county is responsible for the driveway leg. Costs, to be shared, are accrued in those areas in the immediate vicinity of the intersections considered to be within the interchange. These are intersections of the various ramps and/or frontage roads with city streets and county roads. While the typical examples at the end of this chapter are to be used as a guide, there may be extenuating circumstances that may allow further consideration based on local conditions.

A past alternate method of sharing maintenance and energy costs was to have the local agency bear 100 percent of the energy costs, and the State bear 100 percent of the maintenance costs.

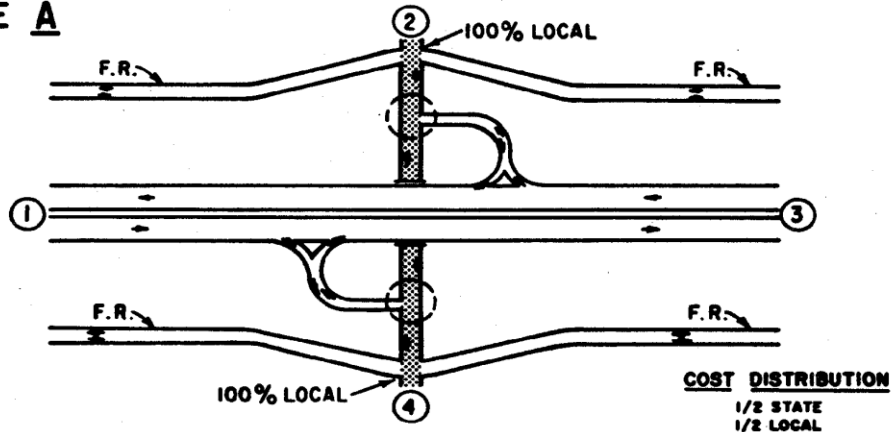
New facilities may be added to the Exhibit “A” of an existing agreement. Existing agreements of this type may stay in effect until the facilities covered by this agreement are no longer in service, the facilities are relinquished, or the agreement is terminated and replaced by a new Electrical Maintenance Agreement. If a new agreement is to be initiated, all facility costs are to be shared according to the standard Electrical Maintenance Agreement.

K.09.3 Safety Precautions

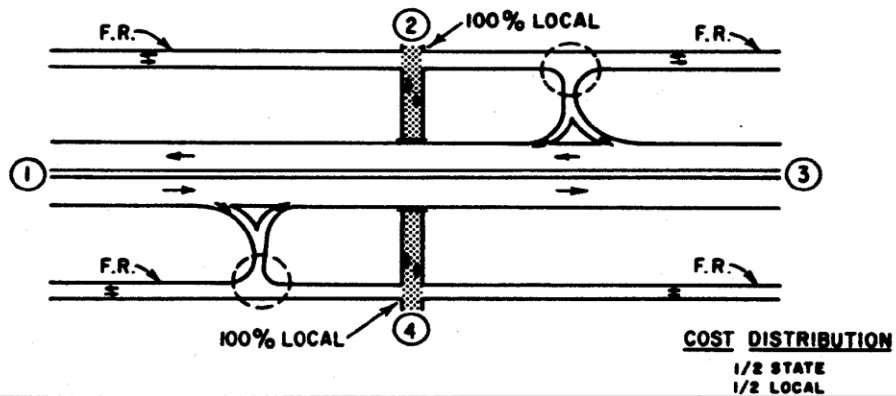
It is the responsibility of all Maintenance Managers, Caltrans Highway Electrical Maintenance Supervisors, and employees to understand and follow the applicable Codes of Safe Practices. All pertinent Departmental Maintenance Manual sections, Departmental Safety Manual sections, Departmental Policy and Procedure Memoranda, Safety Orders, Maintenance Code of Safe Practices Manual, and district instructions relating to employee safety and health are to be followed.

**DISTRIBUTION OF SIGNAL AND LIGHTING
COSTS ON FREEWAYS**

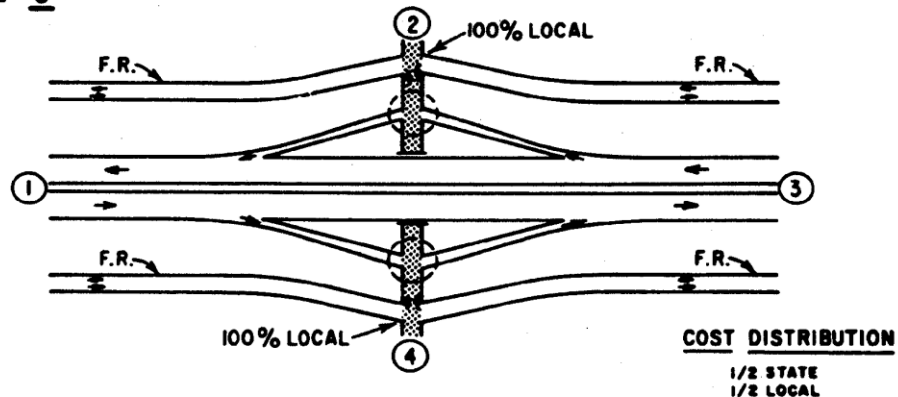
EXAMPLE A



EXAMPLE B

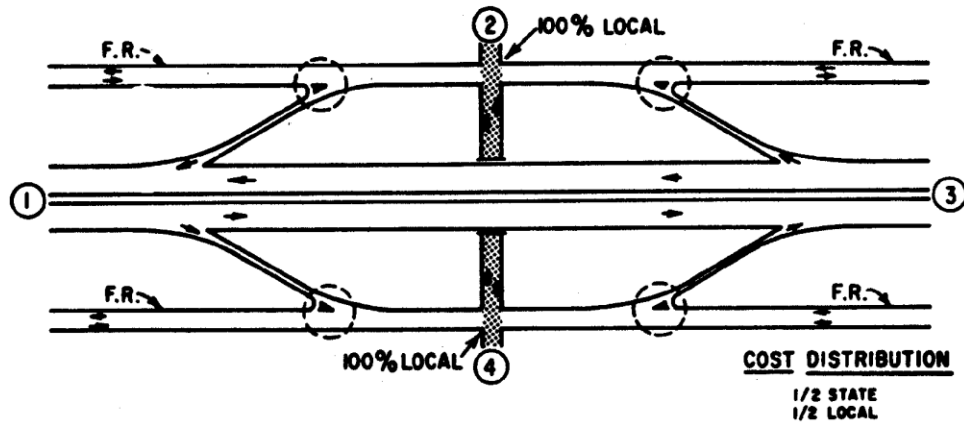


EXAMPLE C

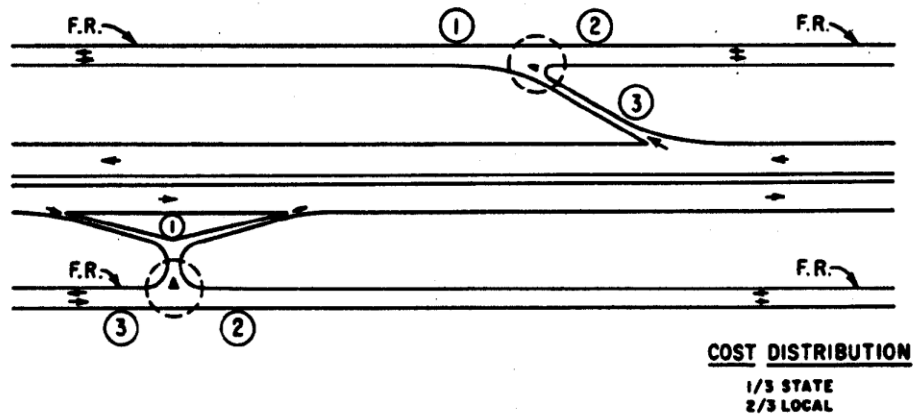


**DISTRIBUTION OF SIGNAL AND LIGHTING
COSTS ON FREEWAYS**

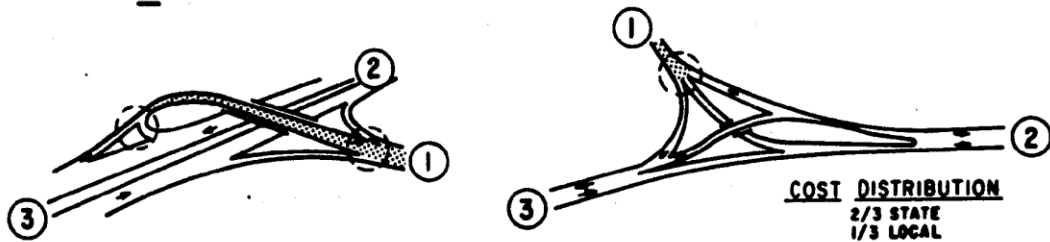
EXAMPLE D



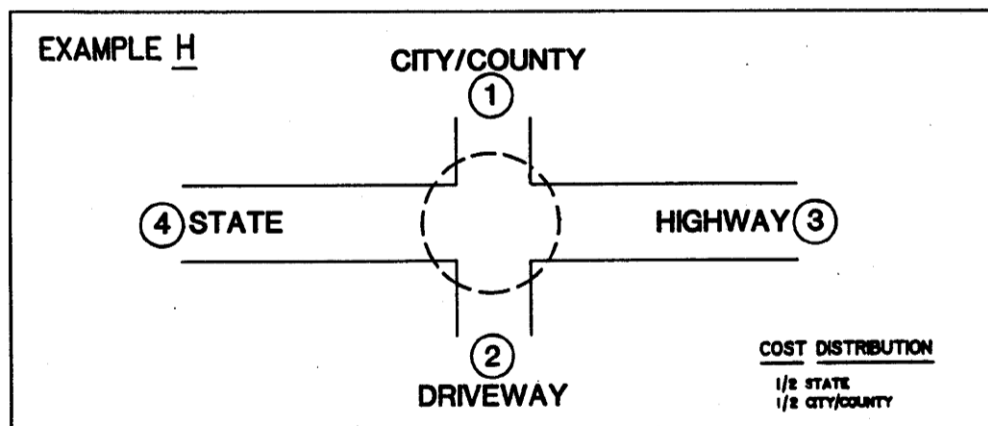
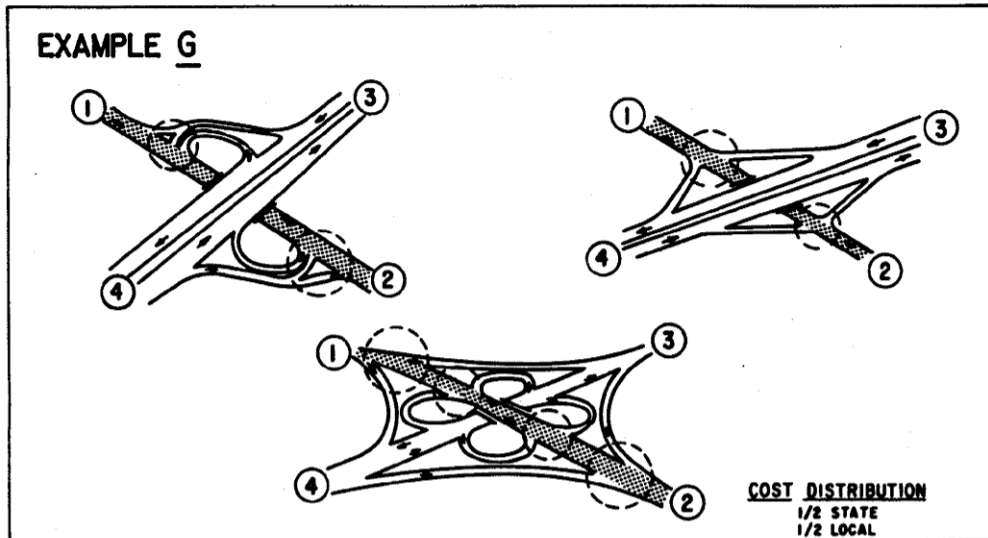
EXAMPLE E



EXAMPLE F



**DISTRIBUTION OF SIGNAL AND LIGHTING
COSTS ON FREEWAYS**



NOTE: RATIO OF PARTICIPATION IS BASED ON NUMBER OF LEGS AS NUMBERED.

——— -STATE HIGHWAY

——— -COUNTY ROAD OR CITY STREET

F.R. -FRONTAGE ROAD

○ -APPROX. AREA OF INTERSECTION WHEREIN LIGHTING AND
SIGNAL MAINTENANCE COSTS, TO BE SHARED, ARE ACCURED