

CHAPTER H

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H.00 Introduction

This chapter covers the maintenance of bridge structures (including groups of closely spaced pipes) and special structures such as seal slabs and major retaining walls that are identified by bridge numbers assigned by SM&I and carried in the State Bridge Log. Work performed on these structures will be under the HM3, "H" Family in the Maintenance Program.

The maintenance of Reinforced Concrete Box (RCB) culverts and pipe culverts measuring 20 feet or less between abutments and not assigned a bridge number by SM&I is covered in Chapter C5 of this manual. Work on these structures is included in the HM2 Roadside Program.

Bridge maintenance includes but is not limited to work such as repairing damage or deterioration in various bridge components, removing debris and drift from piers, performing minor scour repairs, cleaning and repairing bridge bearing seats, abutments, etc., cleaning out drains, repairing expansion joints, cleaning and painting structural steel, and sealing concrete surfaces. Also included are the maintenance of electrical and mechanical equipment on moveable span bridges, and the operation of the moveable spans.

Refer to the Maintenance Manual Volume 2 for planning, scheduling, and administrative procedures connected with the HM3, "H" Family.

H.01 Maintenance Levels

Bridge maintenance work can be grouped into two categories; work initiated by the district, and work recommended in Bridge Inspection Reports.

Work initiated by districts is generally in response to a problem on a bridge that affects public safety or the structural integrity of the structure.

Work recommendations in Bridge Inspection Reports are the result of periodic engineering inspections performed by Area Bridge Maintenance Engineers (ABME's) from Structure Maintenance and Investigations (SM&I). This work can generally be accomplished on a planned basis, and is expected to be accomplished within two (2) years of the date of recommendation. However, when the work is of a critical nature, the ABME will immediately contact the district and verbally transmit instructions regarding the work required. This will be followed by a Bridge Inspection Report covering the work recommended.

When work recommendations are made, the recommendations will suggest the work be done either by contract or by maintenance crews. These recommendations are for guidance and the district has the flexibility to accomplish the work by any means available. However, it should be noted that many of the repair recommendations affect structural components and are engineered solutions, therefore the repair recommendations, methods, and procedures shall be closely adhered to.

Because structural considerations are involved, no changes or deviations shall be made without the concurrence of the ABME. Descriptions of major or minor defects are listed in the following sections of this chapter.

H.02 Inspections by SM&I Area Bridge Maintenance Engineers (ABMEs)

To comply with federal regulations, all bridge structures (as defined in H.05) shall be inspected by SM&I Area Bridge Maintenance Engineers at a maximum interval of 24 to 48 months, and more frequently when the need is determined by the ABME. Some bridges also receive Fracture Critical Member, Special Feature Steel, Complex, Underwater and Scour inspections. As part of the inspection, an engineering evaluation is made regarding the condition of all structural, mechanical and electrical components. Work recommendations are made for any corrective actions required.

Often, the ABME will require assistance from the district crews to perform the bridge inspections in the form of lane closures, special access equipment, etc.

A summary of all completed Bridge Inspections is forwarded monthly to the Deputy District Director for Maintenance, who is responsible for scheduling and accomplishing the work recommendations in a timely manner. Copies of the Bridge Inspection Reports can be viewed through the SM&I Website at <http://smi/> using the “BIRIS” link.

Each work recommendation is identified by action type, target completion time, and accompanied by an estimated cost to do the work. A computer listing of all current and outstanding work recommendations can be viewed by visiting the SM&I website at <http://smi/> and activating the “Outstanding Work” link or the “Work Extract/LOS” link. When work is completed by District forces, the work must be marked as completed through the same web site. SM&I staff should be contacted if assistance is needed in marking work complete.

Work recommendations frequently contain recommendations that the work be done by contract. However, the districts may elect to do the work with their own forces, provided that the work is within statutory and policy limitations on work by Maintenance forces.

When work is to be done by contract, SM&I will prepare the PS&E, except for traffic handling, upon the issuance of an E-FIS Project Code by the district. Scheduling of projects will be a joint effort between SM&I and the district.

H.03 Bridge Inspections by District Maintenance Supervisors

Periodic walk through inspections shall be made by District Maintenance Supervisors to detect obvious defects, hazards or potential problems, and also to monitor known problems. Refer to the “Levels of Service” section in Maintenance Manual Volume 2 for frequency of these

inspections. The purpose of these inspections is to supplement the more detailed, but less frequent inspections by the ABME. Special attention should be given to any condition that affects the safety and/or structural capacity. If there is a question as to the relevance of a structural condition, the ABME shall be notified.

When major defects or hazards are found, they shall be immediately reported to SM&I by telephone. The ABME shall be the primary contact work up to the Area Senior and Office Chief if contact cannot be made. If an emergency condition exists, appropriate action shall be taken as soon as possible to ensure the safety of the traveling public and to prevent further structural damage from occurring. This includes, but is not limited to, restricting traffic on the bridge or closing it completely, installing temporary support systems, or making temporary repairs. SM&I will immediately send out an ABME to evaluate the condition of the structure and direct necessary repairs.

After a major storm, earthquake, or other natural event that may cause damage to bridges, area supervisors shall inspect all bridges in the affected area for signs of damage. Any damage found should be reported to SM&I.

H.03.1 Post Earthquake Inspections

There are two district related response responsibilities following an earthquake, roadways and structures inspections. Each district has their own damage thresholds that depend on the geography, soil type, history of slides, and rural or urban areas. Our California state bridges have had many years of seismic design and retrofit evolution raising the bridge response thresholds and reducing the amount of damage seen prior to 1984. Roadway and slope design basically remain unchanged, but there are regions where slides, failing shoulders, and approach settling are major concerns and need to be addressed.

Each event response is unique and is dependent on the proximity to the earthquake epicenter and measured ground motion.

Post “roadway” earthquake inspections shall be the responsibility of the district maintenance personnel and other district road crews.

Post “bridge” earthquake inspections will be conducted under the direction of maintenance area supervisors, SM&I ABME’s, and Structure Construction Engineers depending on the level of intensity and extent of damage.

Richter Magnitudes less than 5.5:

Roadway:

Post earthquake response for magnitudes less than 5.5 will be the decision of the district to send maintenance crews to inspect affected areas. The response should be based on historical roadway damage in previous earthquakes of that district. It is expected that there will be little roadway damage unless it is in combination with heavy rains and other conditions that may cause slides.

If damage is found such as settled approaches/roadways, missing guardrails, etc, then area supervisors shall inspect all roadways within the affected area. If significant damage is detected, then the affected radius should be increased to 10 miles.

Bridges:

An earthquake of less than 5.5 magnitude is considered too low to cause any bridge damage. Although unexpected, any earthquake related damage found by district Maintenance personnel shall be reported to SM&I in Sacramento.

Richter Magnitudes 5.5 to 6.2:

Roadway:

Post earthquake roadway response for magnitudes 5.5 to 6.2 will be the responsibility for each district to send maintenance crews to patrol any affected areas in a 5 mile radius of the highest ground motion or epicenter. It is expected that there will minor damage or settling to approaches and roadways in this range of magnitudes. If any significant roadway earthquake damage is found by district personnel, then the affected radius should be increased to 10 miles.

Bridge:

Only minor bridge damage is expected within the 5.5 to 6.2 magnitude limits. Specific site conditions can make damage more probable.

Area supervisors shall inspect all bridges within a 5-mile radius of the epicenter. If significant damage is detected, then the affected radius should be increased to 10 miles. SM&I shall be immediately notified of any earthquake-related damage.

Richter Magnitudes greater than 6.2:

Response for earthquakes with magnitudes greater than 6.2 will combine the roadways and bridge response. Although the roadways will sustain damage, it is the structure damage that will cause the most immediate danger to the traveling public.

Based on historical California earthquake damage assessments, there will be expected minor to moderate bridge damage when the earthquake magnitudes are in the 6.2 to 6.5 range. When the magnitudes are greater than 6.6, then the damage levels begin to compromise the overall safety of our bridges. The Richter magnitude is determined from the logarithm of amplitude of waves recorded from an event. Each 0.2 increase in magnitude corresponds to a doubling of the energy released. When the magnitude goes beyond 6.7, the energy increases dramatically (doubling each 0.2 increase) and greatly increases the amount of damage in a relatively short range at the upper levels.

Roadway:

Post earthquake response for magnitudes greater than 6.2 will be the responsibility for each district to send maintenance crews to patrol any affected areas in a 10 mile radius of the highest ground motion or epicenter. It is expected that there will minor to major damage or settling to approaches and roadways in this range of magnitudes. If any significant roadway earthquake damage is found by district personnel, then the affected inspection radius should be increased to 25 miles.

Bridge:

Bridge damage resulting from these magnitudes is probable. Specific site conditions can increase the probability of significant damage. Bridge damage may range from minor to catastrophic depending on structure type and location to the fault.

For events over 6.2 magnitudes, district area Maintenance supervisors shall inspect all bridges within a 5-mile radius of the epicenter. If significant damage is detected, then the affected radius should be increased to 10 miles. SM&I shall be immediately notified of any earthquake-related damage.

For events over 6.2 to 6.6 magnitude, SM&I and Structure Construction Engineers will prepare for mobilization based reported damage. If widespread damage is obvious, SM&I ABME's and local Structure Construction Engineers will immediately conduct independent damage inspections of bridges. SM&I will act as inspection lead and will coordinate systematic bridge damage assessments of the entire affected area.

Area supervisors and Structures Construction shall be notified of these efforts, and may act as lead until SM&I is fully mobilized.

For events over 6.7 magnitude, SM&I will analyze the scale of damage expected and then mobilize in teams from Southern and Northern California. District area Maintenance supervisors shall inspect all bridges within a 10-mile radius of the epicenter. If significant damage is detected, then the affected radius should be increased to 20 miles. SM&I shall be immediately notified of any earthquake-related damage so they can focus their response effort.

H.04 Movable Span Bridges - Inspection and Testing

The mechanical and electrical equipment of movable span bridges will be inspected once a year by qualified mechanical and electrical Engineers from the Division of Engineering Services Office of Electrical, Mechanical, Water and Wastewater Engineering (OEMW&W). An inspection report will be forwarded to the appropriate districts that will include work recommendations deemed necessary based on the inspection. For bridges that are not open regularly for waterway traffic, the spans should be opened at intervals frequent enough to ensure that all mechanical and electrical equipment are functional. Diesel or gasoline powered engines should be operated at least once every two (2) weeks. SM&I will conduct structural inspections on a 24 month maximum interval and underwater inspections on a 60 month maximum interval. All inspection reports are available in BIRIS.

H.05 Definitions

The SM&I assigns an official bridge number and name to all "Bridges" meeting the following criteria:

- (A) All structures or groups of closely spaced (less than half pipe diameter) pipes which, measured parallel to the roadway centerline, have a length of more than 20 feet between the inside faces of the end abutments shall be carried as bridges regardless of the length of the spans making up this total.
- (B) In addition, bridge numbers may be assigned to other structures where periodic inspections with written reports are desired. This includes such structures as very large retaining walls, mechanically stabilized earth walls, seal slabs, specially designated culverts, short bridges, and other unique structures.
- (C) The name assigned to each structure given a bridge number has an association with its function as a highway facility. Name types are defined below and illustrations can be seen in Appendix H-1.
 - (1) Bridge

This term is used in a name when the function of the structure is to carry traffic over a watercourse such as a bay, canyon, river, creek, wash, or slough.

(2) Overhead

This term is used in a name when the function of the structure is to carry a State highway over a railroad.

(3) Underpass

This term is used in a name when the function of the structure is to carry a railroad, and provides for passage of a State highway under the railroad.

(4) Overcrossing

This term is used in the name of a structure when a county road, city street, or any facility (pipelines, tramways, pedestrian crossings, cattle-passes, equestrian crossings, etc.), other than railroads, is carried on the bridge structure and State highway traffic flows under the structure.

(5) Undercrossing

This term is used in the name of a structure that carries State highway traffic and provides for passage of a city street, county road, or other facility other than a railroad or another State highway, under the State highway.

(6) Separation

This term is used in the name of a structure that carries traffic of one State highway over another State highway.

(7) Viaduct

This term is used in the name of a structure of any length that carries State highway traffic along a steep side hill. It also is used as a compromise name for a long structure crossing over several facilities of approximately the same importance, any one of which alone would require a name category of Bridge, Overhead, Undercrossing, or Separation.

(8) Tunnel

This term refers to a roadway section through a mass of earth. Some undercrossings and separations are also tunnels.

(9) Tube

This term describes an underwater roadway facility constructed by lowering a prefabricated section in an excavated trench.

(10) Pumping Plant

This term is used in the name of a facility that is assigned a bridge number because it is an intricate facility of structural, mechanical, and electrical combination for the purpose of preventing water inundation of the highway.

H.06 Minor Defects

Minor defects are those that can be corrected with little or no risk of structure collapse or rendering of damage to adjacent or related members while making repairs or replacements.

Listed here are some examples of this class of defect:

- (A) Damaged or misplaced clearance markers.
- (B) Damaged or missing advisory and warning signs (Speed and/or Weight Limit, Vertical Clearance, Narrow Bridge, One Lane Bridge, One Lane Bridge for Trucks and Buses).
- (C) Scaled or deteriorated paint on timber railings and curbs.
- (D) Damaged or deteriorated railings and curbs.
- (E) Uneven or cracked approach and deck surfacing.
- (F) Broken or loose timber decking.
- (G) Joint Seals
- (H) Accumulated drift adjacent to bents and piers.
- (I) Minor erosions.
- (J) Accumulated dirt or debris on decks, near stringer ends at supports, adjacent to bearings, and on chords of trusses.
- (K) Plugged drains.
- (L) Settlement or roughness of approach.

- (M) Fire hazards.
- (N) Faulty electrical contacts.

H.07 Major Defects

Some defects are considered major because they involve individual members that affect the structural stability of an entire span, thus requiring underpinning of the span or supplementing of the member before removal. Others are included in this group because the cause of the defect, and thus the measures needed to correct the defect, are numerous and varied requiring structural or other technical advice, or the defect may cause equipment failure. Examples of this type of defect follow:

- (A) Bent or damaged steel beams, girders, or truss members.
- (B) Cracked or spalled concrete members, other than curb and railing.
- (C) Crushed or decayed timber stringers, caps, posts or piles.
- (D) Broken or weakened chord members of failed truss joints.
- (E) Unusual looseness or vibration of truss members.
- (F) Loosened or decayed timber deck over an extended area.
- (G) Defective bearings
- (H) Joint Seal Assemblies
- (I) Settled bents or piers.
- (J) Major erosion or scour.
- (K) Lack of paint on steel members, other than curb and railing.
- (L) Extensive fire damage.
- (M) Poor alignment or balance of movable bridge spans.
- (N) Excessive noise or vibration from operating machinery.
- (O) Lack of lubricant in machinery bearings.

- (P) Loose bolts.
- (Q) Broken timber stringers.
- (R) Ineffective supplemental bents.

H.08 Repair Materials and Procedures

All bridge crew members shall attend basic and advanced bridge crew training. This training is developed and presented by the Statewide Bridge Crew Training Coordinator at SM&I. This class will provide bridge crews with training on the most recent repair techniques and materials to supplement the techniques noted in this section. When planning repairs, bridge crew supervisors should contact the Bridge Crew Training Coordinator for up to date information on approved material and techniques.

When making repairs of defects, whether minor or major, all work shall conform as closely as practicable to requirements of the current Standard Specifications. Emergency and temporary work shall be planned to best meet the situation and protect traffic. Wherever applicable in all work, materials and procedures listed in this section should be used, unless variation from these are stated in the work recommendation listed in the reports submitted by SM&I, or upon approval of the variation by the ABME.

H.08.1 Epoxy for Patching, Bonding, and Filling Voids in Concrete

Epoxy is a two component mixture that will adhere to most clean hard substances such as steel and concrete. When cured, it forms a strong material that can be used in certain structural repairs.

Epoxy can be pumped into cracks in concrete to re-bond the separated pieces, pumped into voids in concrete such as rock pockets or spaces between steel expansion dams and concrete deck, .

Two-component epoxy shall be carefully proportioned in accordance with directions supplied by the manufacturer. The two components shall be mixed thoroughly before using and placed immediately after mixing.

Pot life of the mixed epoxy varies with the temperature of the material. When confined, the heat produced by the chemical reaction is not dissipated from the mix so the epoxy becomes progressively warmer and the chemical reaction becomes progressively accelerated. In confined lots, the pot life may be only a few minutes. The time required to harden is increased many fold by spreading out the material so its heat from chemical reaction is conducted away. If the epoxy is frozen immediately after mixing, the chemical process can be virtually stopped. So, by artificial heating or cooling, the time of set can be sped up or slowed down as is desired.

For proper final cure, the temperature of the epoxy should be a minimum of 65°F for several hours. When heating to accelerate the curing, a direct flame should not be applied to the epoxy surface. A 1-inch cover of sand, or a steel plate supported to clear the epoxy surface by 1 inch or more, makes an effective protector from the flame. Either conducts the heat effectively to the epoxy. Never heat the epoxy to the boiling point or flame point.

To pump epoxy into cracks or voids, use an epoxy injection pump.. If the void is behind a steel plate, a hole can be drilled through with the proper diameter to receive an epoxy injection fitting. Cracks in concrete, or voids to be filled, can be pumped by inserting ½ inch pipes held in with epoxy or PC grout, Open cracks to be pumped must be sealed along edges in advance of pumping with an epoxy containing a thixotropic agent to prevent flowing away before setting. Other surface mounted fittings specifically designed for epoxy injection may also be used.

Any tools or equipment used with epoxies must be cleaned before the epoxy has set (the sooner the easier), or it will be impossible to wash the epoxy off. Toluene, methylethylketone, or lacquer thinner, may be used to clean tools. Use caution with these materials, as they are flammable and can be hazardous to health. Be sure to follow all label instructions.

Epoxies suitable for the above uses can be obtained from the Transportation Laboratory.

H.08.2 Portland Cement Concrete and Steel Reinforcement

During concrete placement, mechanical vibrators shall be used to consolidate the concrete mix. Aggregates shall be clean and well graded. No more water shall be used than is necessary to provide a workable mix. Reinforcing steel shall be placed as shown on plans and securely held in position when placing concrete. Forms shall be constructed adequately to prevent leaks and to hold in proper line and grade while placing and curing the concrete.

There are many rapid setting high-strength concrete materials available for structural repairs and patches. These materials consist of either magnesium phosphate concrete, modified high alumina based concrete, or Portland Cement based concrete. The number of products available for patching purposes is too voluminous to mention here. There is a document entitled “Rapid Set Materials for Repairs to Portland Cement Concrete Pavement and Structures” produced by the Office of Rigid Pavement Materials and Structural Concrete at Translab that lists products by trade name that have passed acceptance testing. The Statewide Bridge Crew Training Coordinator has a copy of this document. It discusses characteristics and the do’s and don’ts. It is important to note that the materials in this publication are not pre-approved. Lots are acceptance tested.

Contact the Office of Rigid Pavement Materials and Structural Concrete to verify that a particular lot of material has been approved for use.

There is a co-polymer called High Molecular Weight Methacrylate (HMWM). This product is especially good for filling cracks in concrete and knitting the concrete together. Special precautions are required when using it. Refer to "Code of Safe Operating Practice - Bridge and Highway Concrete Repairs Using HMWM Resins."

The following table gives approximate quantities of materials needed to produce one (1) cubic yard of each of several classes of Portland Cement concrete. These mixes produce a mix with about a 4-inch slump if the aggregates are well graded. Adjustments must be made to produce a workable mix with proper yield.

Class	Cement Sacks = Pounds	Combined Aggregates Pounds = Cubic Yards (loose measure)	Water Pounds = Gallons
"A"	6 = 564	3200 = 0.99	290 = 35
"B"	5 = 470	3320 = 1.03	290 = 35
"C"	4 = 376	3440 = 1.06	267 = 32
"D"	7 = 658	3150 = 0.97	290 = 35

Mortar for patching, etc., can be composed of well-graded sand and cement in the following approximate proportions measured by volume:

Cement.	1 Part
Sand	3 Parts
Water	Sufficient to make a stiff mix

Additives should not be used without approval of the Statewide Bridge Crew Training Coordinator.

Steel reinforcing bars(See Appendix H-30) must comply with ASTM Designation A706/A706M. The English bar numbers are based on the nearest number of 1/8 inch included in the nominal diameter of the bar.

English	3	4	5	6	7	8	9	10	11	14	18
Metric	10	13	16	19	22	25	29	32	36	43	57

The weights have been adopted as standards. Bar number 2 is produced in plain rounds only. Existing bars shall be replaced with bars of equivalent cross sectional area. When replacing square bars with round, use the next larger round bar size (i.e. replace a 5/8" square bar with a #6 round bar).

Splicing of reinforcing bars must comply with Section 52-1.08 of the Standard Specifications. This section covers welded, mechanical, and lap splices. In general, lap splices may be as follows: Number 8 and smaller bars shall be lapped at least 45 bar diameters of the smaller bar joined, Number 9, 10 and 11 bars shall be lapped at least 60 bar diameters of the smaller bar joined. Number 14 and 18 bars may not be lap spliced.

When joining new concrete to old, chip or saw ½ inch or deeper along edges of concrete to be repaired to eliminate feather edges and produce neat, straight line joints. Chip away all unsound and loose fragments of concrete within the repair area. Remove all foreign material and rust from concrete and steel by sandblasting or wire brushing. When patching spalls, chip about 1 inch under the reinforcing steel in several locations to help anchor the patch, or apply two-component epoxy to bond the entire surface to be repaired (see Section H.08.1). Then place mortar or Portland Cement Concrete to replace all missing concrete. However, it should be noted that Rapid Set materials do not require the use of an epoxy bond coat.

The color of new mortar or concrete shall be made to match original concrete when it is cured. This usually can be accomplished by preparing a combination of 1/3 white cement and 2/3 normal cement for use in making the concrete or mortar. The proportion of white cement should be varied as required.

Strike off and finish of patches shall be done with wood or stone floats only. Steel floats impart a dark color to the surface.

Rapid setting concrete or mortar shall be cured as recommended in “Rapid Set Materials for repair to Portland Cement Concrete Pavement and Structures.” All other concrete or mortar shall be cured by keeping damp with water for 7 days, or by coating with an approved colorless curing compound.

Patching spalls in a concrete deck with asphalt concrete shall be avoided.

H.08.3 Steel

Steel members in structures shall be repaired by replacing all or part of the member, straightening, welding tears, and welding or bolting scabs over defects.

Heat can be of great assistance in straightening members if strategically applied, but shall not be used without the approval of the ABME. When such approval is given, the member must be relieved of all dead and live load before heating.

Only common mild "carbon" steel members shall be heated. The maximum temperature shall not exceed 1300° F. At that temperature, common mild carbon steels are reduced in yield point and ultimate strengths to about 10 percent of their values at 100° F. When cooled off they return to approximately original strength and characteristics. Some of the high strength steels are decidedly changed by such heat cycles.

High strength bolts of the same diameter as the rivets removed shall be used to replace rivets in re-assembly. These bolts may be satisfactorily tightened by properly using pre-painted load indicating washers.

All welding shall be done by a certified welder. The type and location of welds can dramatically reduce the fatigue life of a member. Welding on any bridge structural component shall not be performed without the approval of the ABME.

H.08.4 Timber

Timber members in structures shall be repaired by replacing or supplementing.

H.08.5 Deck Surfacing

Because it adds additional load on a bridge, deck surfacing shall not be placed without prior written approval from SM&I.

Surfacing for concrete bridge decks shall be polyester concrete or an approved multi-layer polymer concrete overlay unless otherwise specified by SM&I. Multi-layer polymer concrete overlays shall be used to increase skid resistance only and should not be used for other purposes. The surfacing shall be placed by conventional methods and adjusted to produce a smooth riding surface.

The use of asphalt concrete (AC) as surfacing for concrete decks shall be avoided. AC surfacing obscures developing deck problems such as cracking and delaminations and can accelerate existing problems such as alkali-silica reactivity (ASR or “reactive aggregate”), and constrains preventive maintenance and rehabilitation methods without removal of the surfacing. In limited site-specific locations, AC surfacing may be considered for use. The use of all AC surfacing for concrete bridge decks requires prior written approval from SM&I.

For timber or thin steel plate decks, AC surfacing may be required to increase skid resistance. In these applications, the asphalt binder, aggregate gradation and proportioning must be adjusted to produce a mix which will adhere well, be relatively impervious, have above average flexibility and provide a skid resistant surface. Usually these qualities can be achieved with an open graded mix placed over a heavy asphalt seal application on the deck. Climatic, environmental and traffic usage shall be considered in asphalt selection and mix proportioning. The surfacing shall be placed by conventional methods and adjusted to produce a smooth riding surface.

When surfacing highway approaches to a bridge with AC, taper the new surfacing down to a smooth junction with the deck grade at the paving notches. The approaches should be ground down about 1 inch near the paving notch so that the new surfacing maintains about a 1 inch minimum thickness at the transition to prevent raveling.

H.09 Repair and Reconstruction

H.09.1 Timber Stringers in Reconstruction

Salvaged stringers, if in good condition and of the proper size, may be reused. Tops of stringers shall be lined up to a true plane and placed with the same edge up as when formerly used. Stringers shall be cut to a length not exceeding the distance center to center of caps or floor beams by more than 1 foot. The length shall be sufficient to provide at least 6 inches of bearing at each end. When using new stringers, it is necessary to inspect for knots, and to place stringers so that the greatest volume of knots are in the upper third.

If knots are in the middle third, they must be placed with the greatest volume above the centerline.

H.09.2 Timber Stringers in Existing Bridge as Supplement or Replacement

A stringer to be placed in an existing span shall be of the same depth and of equal width as other stringers in the panel, when the replacement stringer is of the same kind of material as the existing stringer. When Douglas Fir (DF) stringers are used to replace or supplement Redwood (RW) stringers, the DF stringer should have the same depth, but may have two-thirds of the width of the RW stringer. In case of an emergency, the best available sizes may be temporarily used.

It is acceptable to keep bridging in place, and to set additional pieces as necessary. See Appendix H-1 for cuts required and method to use when installing a supplemental stringer or replacing an existing one.

No attempt shall be made to fit stringers to deck sag by use of an adz. The end wedges must be set to bring the stringer to same degree of tightness against deck at the center of span as adjacent stringers. As the new stringer acquires sag and fits into place, wedges should be tightened. Wedges should always be secured in place with double-headed nails.

The portion of each upper edge of each stringer that extends beyond the center of the bent shall be tapered down so it does not contact the bottom of deck. This is to prevent the deck from being pushed up over supports when the stringer is deflected under live loads.

If shims or wedges are necessary under stringers, they shall be substantial and of either Douglas Fir or Redwood, and shall be tacked with double headed nails when set. Shingles are acceptable for the purpose.

H.09.3 Supplemental Bent

When an emergency occurs requiring immediate installation of a supplemental bent, approval by the SM&I must be obtained in all cases. Details of a supplemental timber bent can be seen in Appendix H-1.

In constructing and maintaining a supplemental bent, shims may be used as required so that all stringers bear on the cap. Shims placed under posts shall be the full width of the post plus 1-inch. A series of thin shims should never be stacked. A block or plate plus two shims or just two wedges should be used. Shims or wedges must be nailed with double-headed nails.

When a bridge supplemental bent washes out or is compromised, it shall be replaced immediately. If replacement is not possible the ABME shall be notified immediately, as the bridge may need to be posted for restricted load until strengthened.

H.09.4 Bridge Rail

Damaged or deteriorated concrete railing usually will require recasting of the affected areas with new concrete. Minor spalls in the concrete surface can be patched with portland cement mortar. Concrete cracks may be injected with epoxy.

Steel railing frequently is so extensively damaged that replacement of panels is more economical than straightening or replacing miscellaneous pieces. When a panel of prefabricated railing is to be replaced, it is expedient to purchase it from the original fabricator because he is the only one who has the shop drawing available and therefore is in position to make a quick delivery.

When it is necessary to replace or repair a substantial amount of damaged or deteriorated concrete or metal railing, SM&I shall be notified and will furnish approved details.

Timber rail and wheel guards have many variations and designs. When small portions are damaged, it shall be replaced in kind. If all, or practically all, of any timber rail and wheel guard must be replaced, the entire rail and wheel guard shall be replaced as necessary to convert it all to the standard shown in Appendix H-1, or all shall be replaced with a metal beam rail subject to approval by SM&I.

H.09.5 Temporary Bridge

In the event an existing bridge washes out or is destroyed by some other means, the SM&I shall be notified immediately. SM&I will advise on an immediate plan of action and will furnish plans for both temporary and permanent repairs. When such a structure is necessary, SM&I will decide the appropriate type to be built based on materials available, obstacle to be crossed, conditions at the site, and other related factors.

H.10 Miscellaneous

H.10.1 Preventive Maintenance

Maintenance forces shall take necessary precautions, and perform various acts of maintenance that will prevent conditions that could contribute to the defects listed in Sections H.06 and H.07.

H.10.2 Mark High Water

A record of the highest high water mark for major streams shall be indicated by painting a white line 1 inch wide and 18 inches long, together with the date on any convenient abutment, pier, or column.

Records shall also be made of abnormally high water, unusual flow conditions, and any other peculiar conditions during high water periods. These conditions tend to cause scour of the streambed or bank, and can alter the channel flow.

H.10.3 Approach Surfacing

When resurfacing the highway, the new surfacing should be tapered down to a smooth junction with the existing deck grade at the paving notches or the approach slabs.

H.10.4 Bridge Numbers, Names, and Date Built

The bridge number, name assigned to each bridge by SM&I, and the year it was built shall be plainly stenciled on each structure in a position visible to traffic. Name signs are to be installed at bridges where structure or stream is of sufficient size or importance to justify publicizing its name. Installation of this sign shall conform to requirements of the Traffic Manual, and approval of the Traffic Operations Program. Typical name types are shown in Section H.05.

Locations at which names, numbers, and dates should be painted are depicted in the sketches in Appendix H-1. The lettering should be about 2 inches high and in black or white to contrast with the background provided by the structure. Backgrounds should not be painted for purposes of enhancing the lettering. When possible, numbering shall be placed over 9 feet off the ground to help prevent the numbering from being painted over by graffiti.

For large structures, the support numbers should be painted on the columns and corresponding rail locations for reference during inspections. The ABME can be contacted to obtain the proper numbering convention, if needed.

H.10.5 Vertical Clearance

Every structure over a State highway having a vertical clearance of 15 feet 6 inches or less, exclusive of shoulders, shall have the clearance indicated by a sign in adherence to Traffic Operations Program Directive Number 00-03 dated August 25, 2000 “Vertical Clearance Sign Policy.” This policy applies to all underpasses, overheads, viaducts, overcrossings, undercrossings, grade separations and pedestrian overcrossings. Per the adoption of the 2003 MUTCD as of May 20th, 2004, the following sign codes are now the current codes for vertical clearance signing in California:

- W34 (CA) was replaced with the Federal W-12-2 Low Clearance sign for use in CA.
- W34A (CA) Distance Ahead Plaque has been retained for use in CA.
- W34B (CA) was replaced with the Federal W12-2P ___ FT ___ IN plaque for use in CA.
- W34C (CA) CAUTION VERTICAL CLEARANCE ___ ’ ___ ” Arrow has been retained for use in CA.

The CA sign specifications, W34A and W34C, can be found at the following webpage: <http://www.dot.ca.gov/hq/traffops/engineering/mutcd/index.htm>, under the Warning section. The Federal sign specifications, W12-2 and W12-2P can be found in FHWA’s Standard Highway Sign book, or on the internet at: http://mutcd.fhwa.dot.gov/pdfs/2009r1r2/pdf_index.htm. Policies for all 4 signs are contained in both the MUTCD 2009 with revisions 1 and 2 dated May 2012, and the 2012 California MUTCD.

Any time there is a planned reduction in vertical clearance of a structure, Maintenance Area Superintendents and supervisors shall be responsible to notify the Caltrans Construction/Maintenance Liaison not less than 15 days prior to the change. Notification shall be in writing and a clearance diagram shall be attached. Clearance Diagram Form Std TR-0019, TR-0020, and TR-0029 can be obtained from Caltrans Electronic Forms System (onramp/forms.htm) on the Caltrans Intranet. . Samples of these forms are shown in Appendix H-2 and Appendix H-3. If there is a reduction in vertical clearance due to unplanned events, the Caltrans Construction/Maintenance Liaison shall be notified immediately, and a revised clearance diagram shall be sent to the Permits Office..

If a new roadway surface is being placed on a section of roadway that travels under a structure, the new roadway surfacing can be feathered out to meet the existing surface grade under the structure a short distance in advance, with no reduction in vertical clearance under the structure.

H.10.6 Weight and Speed Restrictions

In order to safeguard the traveling public and the structure, the Department has authority, under Section 124 of the Streets and Highways Code, to restrict the use of, or close a bridge considered in imminent danger of failure under legal loads. In such cases, weight limit signs of cloth shall be posted immediately, showing the safe weight limit for the structure. These temporary signs

are available from Material Operations. Each district shall have a small supply on hand for immediate use, should they be required.

Permanent limit restrictions are established by order of the Department of Transportation, following an engineering investigation and public hearing as prescribed in Sections 35750, 35751 and 35752 of the Vehicle Code.

The investigation is conducted by SM&I. The hearing is held by an appointee of the Director, usually an employee of SM&I.

These laws require a notice of the hearing be posted upon the bridge at least five (5) days before the date of hearing. This shall be done by placing copies of the formal "Notice of Hearing" attached to plywood boards at both ends of the structure in locations visible to traffic. One copy of the formal notice, showing time and date of posting hearing and signed by the person erecting the notice, shall be returned to Headquarters Office.

The restrictions ordered by the Director are effective and binding upon the public only after signs stating the limitations are erected and enforceable only while such signs are in place.

H.10.7 Safety Measures

For detail as to guardrail, clearance markers and warning and regulatory signs applicable to bridges, see Chapter "M" of this manual.

H.10.8 Fire Protection

Suitable fire extinguishers shall be installed in each control room and machinery room of each drawbridge. In drawbridges where electricity is the prime source of power, only Dry Chemical or Carbon Dioxide extinguishers shall be installed.

H.10.9 Electrical Equipment

Repair or adjustment, of electrical equipment, shall be done by qualified personnel only.

Permanent changes in the circuitry of drawbridges shall not be done without consulting SM&I. This is not intended to prevent electricians from making necessary emergency connections.

H.10.10 Lubrication

Standard items of manufacture such as electric motors, engines, compressors, gear reducers and pillow blocks incorporating sealed ball or roller bearings are usually furnished with maintenance manuals, which include recommended lubrication practices. These manuals shall be made a part of the Maintenance Manual in the control room and the recommended lubrication practices shall be followed exactly, unless overruled by "Specific Lubrication Instructions."

Lubrication of open gears, wire ropes and sleeve bearings must be varied to meet the conditions under which they operate. Open gears seldom used and subject to accumulation of sand or dirt will be better protected and get less wear by painting with State Specification 8010-61J-45 paint, and leaving all oil or grease off the teeth. Due to the great variation in proper lubrication requirements of somewhat similar facilities, the proper practice for each drawbridge will be covered in Specific Lubrication Instructions.

The manufacturer's manual and the Specific Lubrication Instructions for each bridge shall be made a part of the Special or Supplemental Orders included in data posted in each control room.

H.10.11 Overhead and Changeable Message Signs

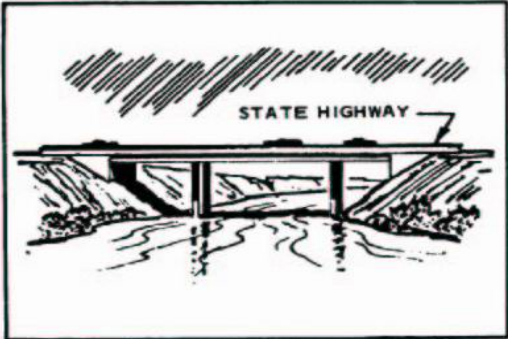
Inspection and maintenance of these signs is covered in Chapter "M" of this manual. SM&I provides inspections and reports, as requested by the district.

H.10.12 Horizontal Restrictions

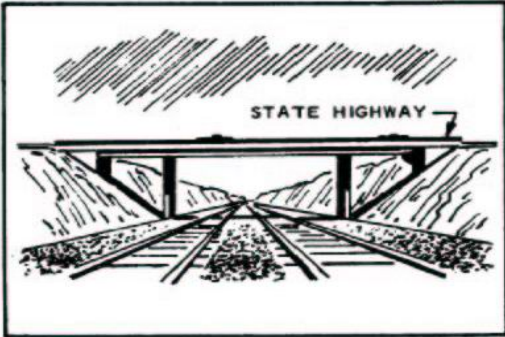
Maintenance Area Superintendents and supervisors are responsible to notify the Regional Transportation Permit Liaison Engineer of any permanent or semi-permanent horizontal restriction that will reduce usable highway width. Notification shall take place at least 15 days prior to placing any device that would reduce horizontal clearance. Such restrictions may include, but are not limited to, the placement of temporary K-rail or any channelizing device that cannot be immediately removed by Maintenance forces. The notification shall be in writing, either by memorandum or departmental e-mail.

APPENDIX H-1

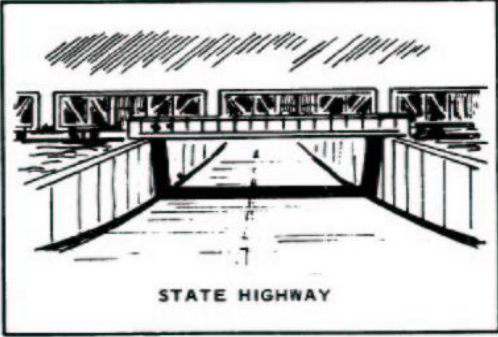
Naming conventions for structure types.
For definitions see H.05 (C)



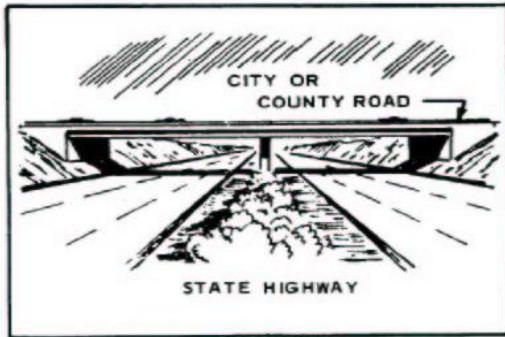
BRIDGE



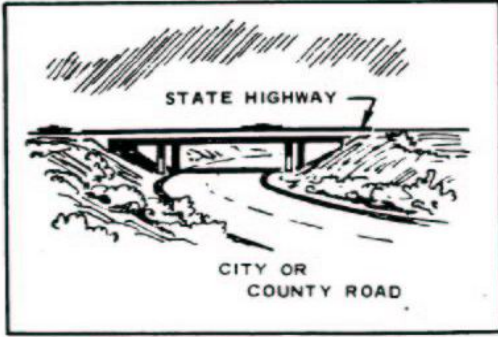
OVERHEAD



UNDERPASS

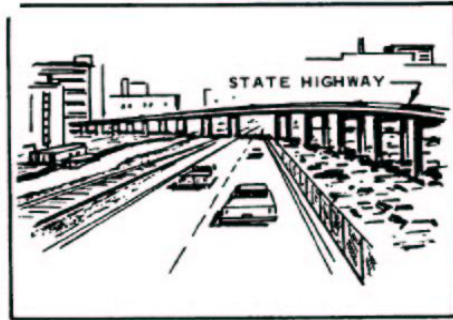


OVERCROSSING



UNDERCROSSING

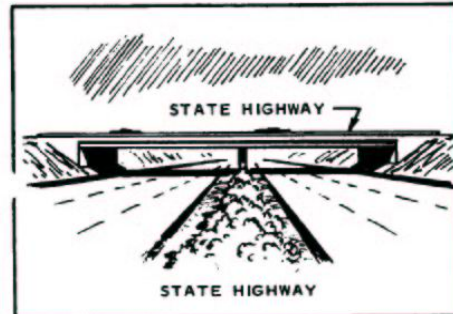
APPENDIX H-1 (continued)
Naming conventions for structure types.
For definitions see H.05 (C)



VIADUCT



VIADUCT



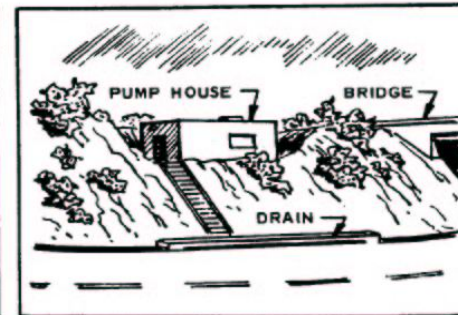
SEPARATION



TUNNEL



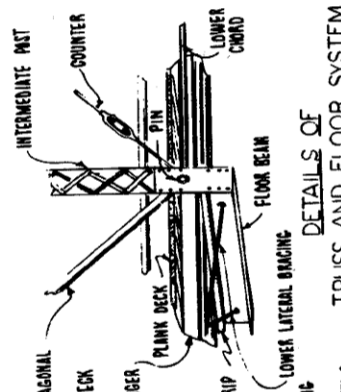
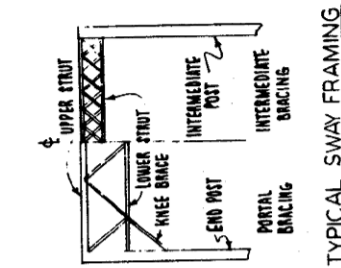
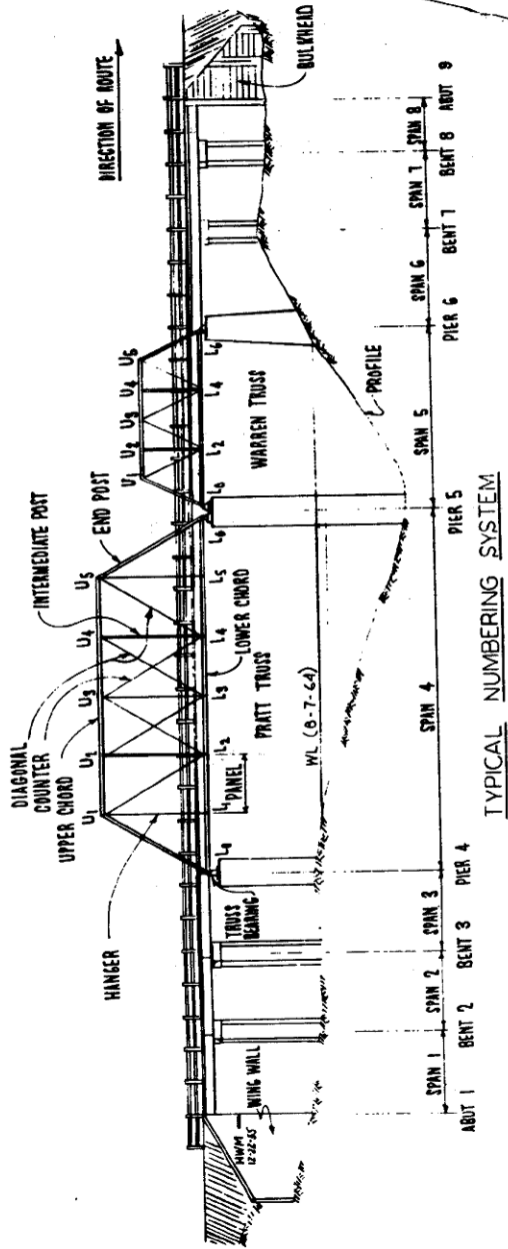
TUBE



PUMP

July 2014

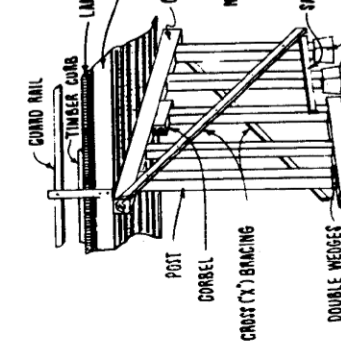
BRIDGES



ABBREVIATIONS

- RC REINFORCED CONCRETE
- RW REDWOOD
- UF UNTREATED FIR
- BT- BRUSH TREATED FIR (WOOD PRESERVATIVE)
- CDP CREOSOTED DOUGLAS FIR (PRESERVE TREATED)
- WS WEARING SURFACE
- WL WATER LEVEL
- HWM HIGH WATER MARK
- VC VERTICAL CLEARANCE
- D/B DISTANCE BACK TO BACK
- C/C DISTANCE CENTER TO CENTER

TYPICAL TIMBER BENT



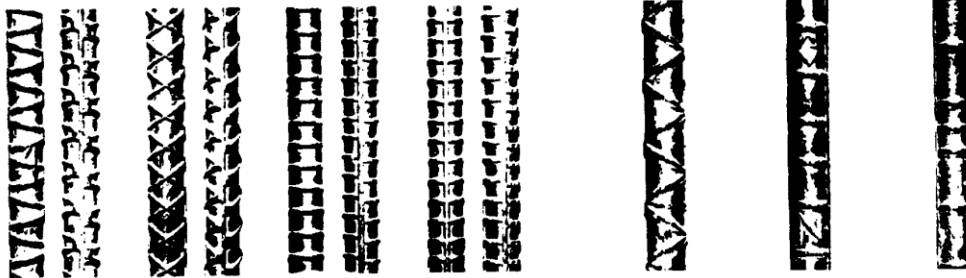
BRIDGES

REINFORCING STEEL BAR SIZES AND DIMENSIONS

REINFORCING STEEL					
STANDARD A305 REINFORCING BARS					
BAR SIZES		WEIGHT POUNDS PER FOOT	NOMINAL DIMENSIONS — ROUND SECTIONS		
OLD (INCHES)	NEW (NUMBERS)		DIAMETER INCHES	CROSS SECTIONAL AREA - SQ. INCHES	PERIMETER INCHES
$\frac{1}{8}$	2	.167	.250	.05	.786
$\frac{3}{16}$	3	.376	.375	.11	1.178
$\frac{1}{2}$	4	.668	.500	.20	1.571
$\frac{5}{8}$	5	1.043	.625	.31	1.963
$\frac{3}{4}$	6	1.502	.750	.44	2.356
$\frac{7}{8}$	7	2.044	.875	.60	2.749
1	8	2.670	1.000	.79	3.142
1	9	3.400	1.128	1.00	3.544
1 1/8	10	4.303	1.270	1.27	3.990
1 1/4	11	5.313	1.410	1.56	4.430
	14	7.650	1.692	2.25	5.316
	18	13.600	2.256	4.00	7.088

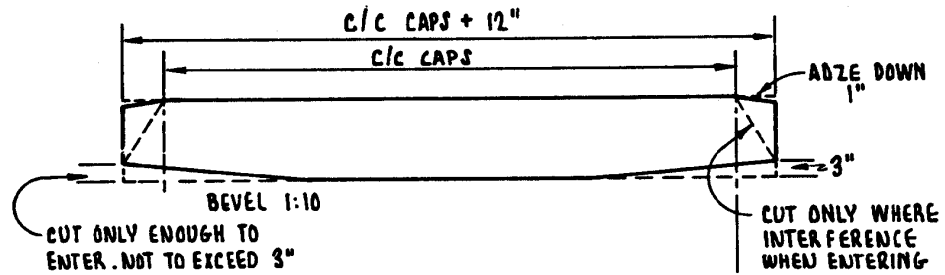
New Type Deformed Bars

Old Type Deformed Bars

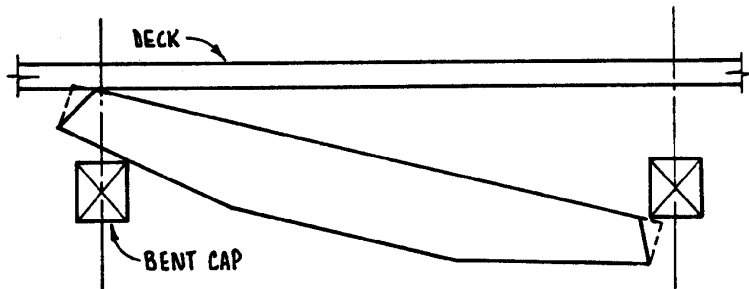


BRIDGES

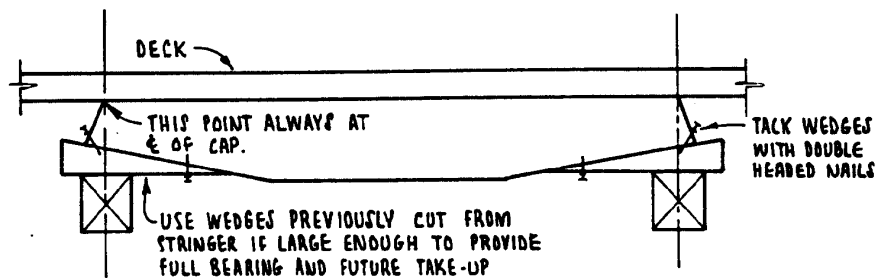
METHOD OF REPLACING EXISTING STRINGERS



CUTS TO BE MADE



ENTERING STRINGER



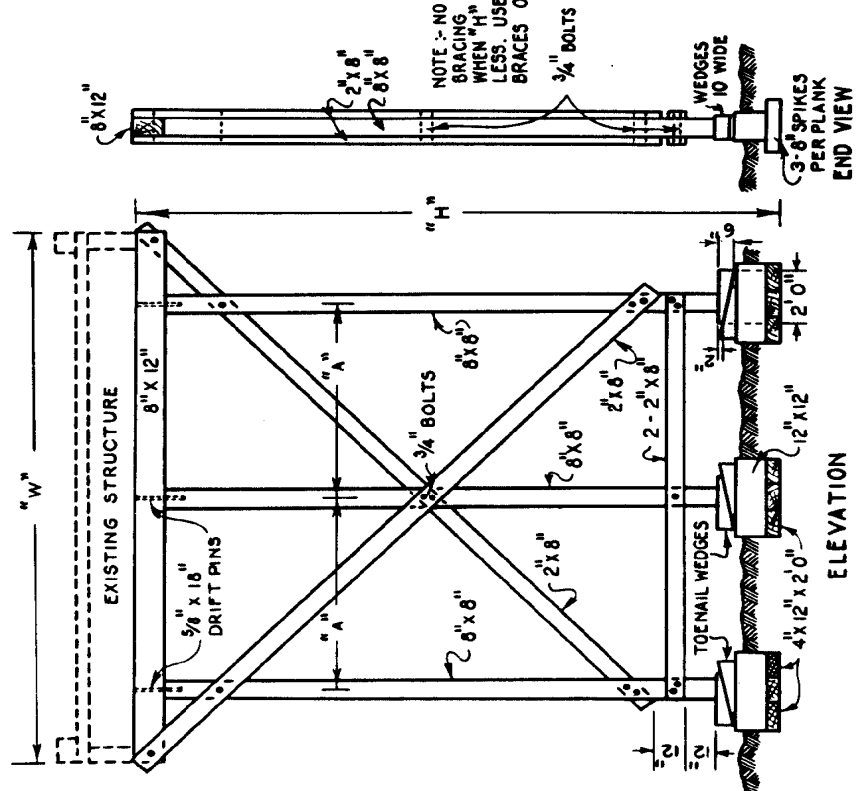
WEDGED IN PLACE

BRIDGES

DETAIL OF SUPPLEMENTAL TIMBER BENT

GENERAL NOTES

TO BE USED ONLY FOR REINFORCING EXISTING BRIDGES. LOCATION AND USE TO BE APPROVED BY THE BRIDGE DEPARTMENT.
 EXCAVATION TO BE CARRIED TO SUFFICIENT DEPTH TO PROVIDE SAFETY FROM SCOUR.
 AN ADDITIONAL 12"x12" MAY BE PLACED ON FOOTING IF NECESSARY TO KEEP WEDGES ABOVE GROUND SURFACE. WEDGES TO BE CUT FROM 8"x10"x2'-0" BLOCKS.
 FOOTING PLANKS AND BLOCKS TO BE HEFT STRUCTURAL GRADE REDWOOD WEDGES AND OTHER TIMBER ABOVE GROUND SURFACE TO BE CONSTRUCTION GRADE DOUGLAS FIR.



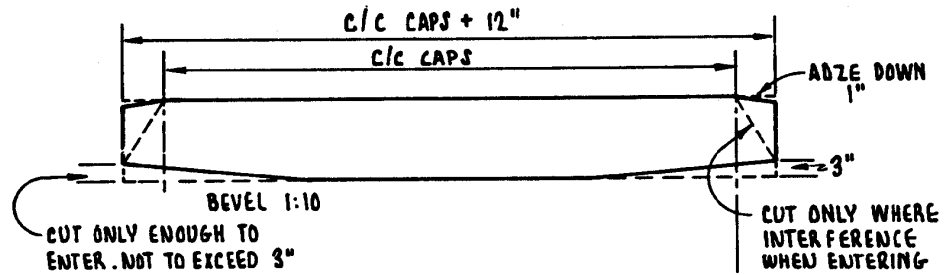
TOTAL FBM IN STANDARD BENT				
H\W	14	16	18	20
4	380	400	435	440
6	410	435	455	475
8	480	510	535	555
10	510	545	565	590
12	550	575	605	645
14	590	615	635	680
16	630	645	675	705
18	660	685	705	725
20	700	715	745	765

"W"	"A"
14'	5'-6"
16'	6'-6"
18'	7'-0"
20'	7'-6"
22'	8'-0"

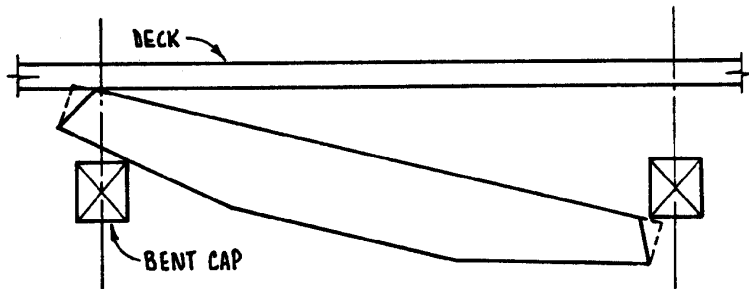
HARDWARE IN ONE BENT		
QUANTITY	ITEM	WEIGHT LBS
3	5/8" x 18" DRIFT PINS	4.1
8	3/4" x 12" MACHINE BOLTS	23.2
7	3/4" x 14" MACHINE BOLTS	4.0
30	3/4" MALLEABLE IRON WASHERS	10.0
	TOTAL	41.9

BRIDGES

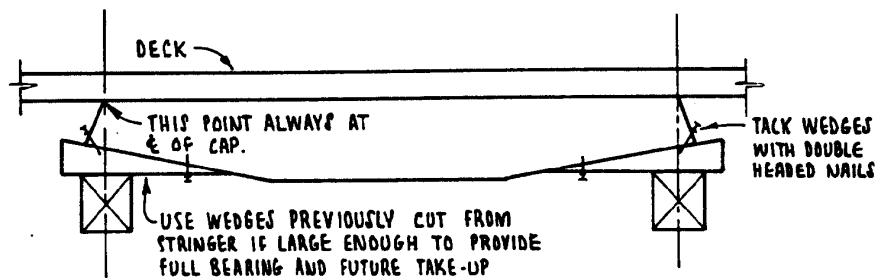
METHOD OF REPLACING EXISTING STRINGERS



CUTS TO BE MADE



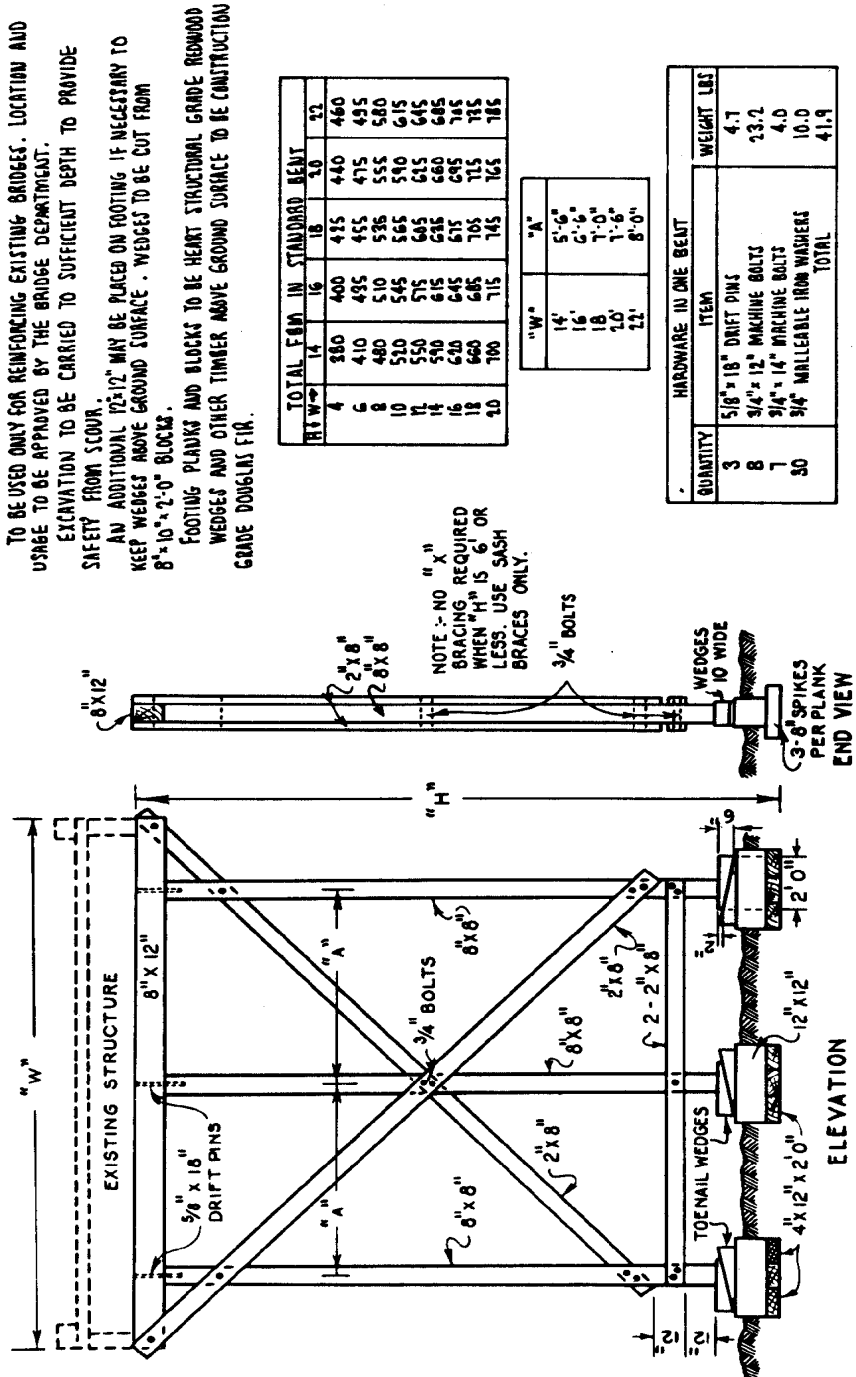
ENTERING STRINGER



WEDGED IN PLACE

BRIDGES

DETAIL OF SUPPLEMENTAL TIMBER BENT



GENERAL NOTES

TO BE USED ONLY FOR REINFORCING EXISTING BRIDGES. LOCATION AND USE TO BE APPROVED BY THE BRIDGE DEPARTMENT.
 EXCAVATION TO BE CARRIED TO SUFFICIENT DEPTH TO PROVIDE SAFETY FROM SCOUR.
 AN ADDITIONAL 12x12" MAY BE PLACED ON FOOTING IF NECESSARY TO KEEP WEDGES ABOVE GROUND SURFACE. WEDGES TO BE CUT FROM 8"x10"x2'-0" BLOCKS.
 FOOTING PLANKS AND BLOCKS TO BE HEFT STRUCTURAL GRADE REDWOOD WEDGES AND OTHER TIMBER ABOVE GROUND SURFACE TO BE CONSTRUCTION GRADE DOUGLAS FIR.

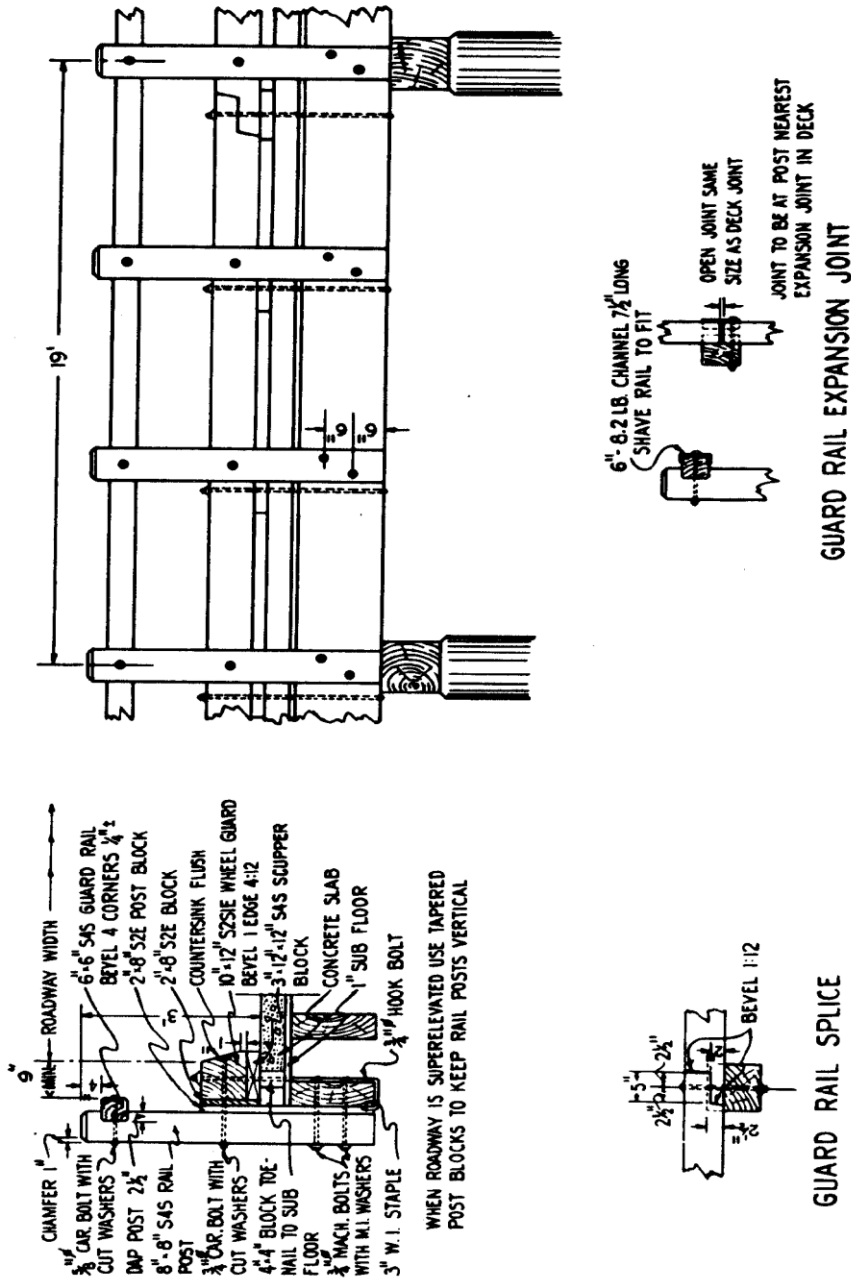
TOTAL FBM IN STANDARD BENT				
H\W	14	16	18	20
4	380	400	435	440
6	410	435	455	475
8	480	510	535	555
10	510	545	565	590
12	550	575	605	645
14	590	615	635	680
16	630	645	675	705
18	660	685	705	725
20	700	715	745	765

"W"	"A"
14'	5'-6"
16'	6'-6"
18'	7'-0"
20'	7'-6"
22'	8'-0"

HARDWARE IN ONE BENT		
QUANTITY	ITEM	WEIGHT LBS
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7	3/4" x 14" MACHINE BOLTS	4.0
30	3/4" MALLEABLE IRON WASHERS	10.0
	TOTAL	41.9

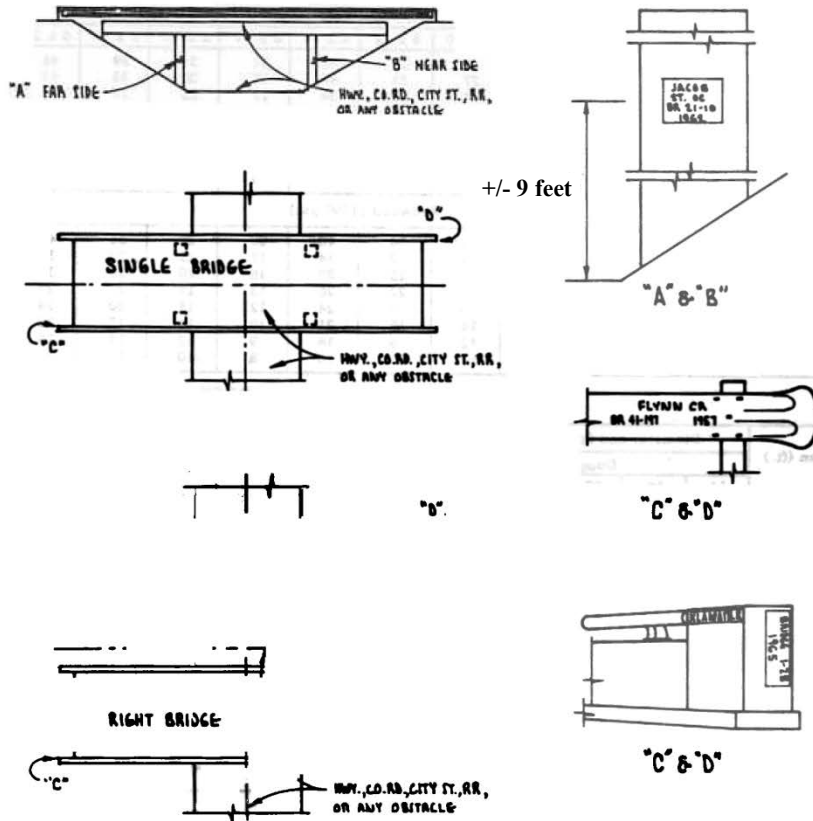
BRIDGES

STANDARD TIMBER GUARD RAIL AND WHEEL GUARD



NOTE : ALL HARDWARE TO BE GALVANIZED
ALL TIMBER TO BE HEAT STRUCTURAL GRADE REDWOOD.

NAME, BRIDGE NUMBER, YEAR BUILT ON STRUCTURES



LOCATIONS

TYPICAL DETAILS

STRUCTURE FUNCTION	DATA TO BE PLACED ON STRUCTURE		
	NAME	BRIDGE NO.	YEAR BUILT
HWY OVER STREAM	C, D	C, D	C, D
HWY OVER CO. RD.	C, D	A, B, C, D	A, B, C, D
HWY OVER CITY ST.	C, D	A, B, C, D	A, B, C, D
HWY OVER HWY	A, B, C, D	A, B, C, D	A, B, C, D
HWY OVER RR.	C, D	C, D	C, D
HWY OVER OBSTACLE	C, D	C, D	C, D
HWY UNDER CO. RD.	A, B	A, B, C, D	A, B, C, D
HWY UNDER CITY ST.	A, B	A, B, C, D	A, B, C, D
HWY UNDER RR.	A, B	A, B	A, B
HWY UNDER OBSTACLE	A, B	A, B	A, B

Appendix H-2

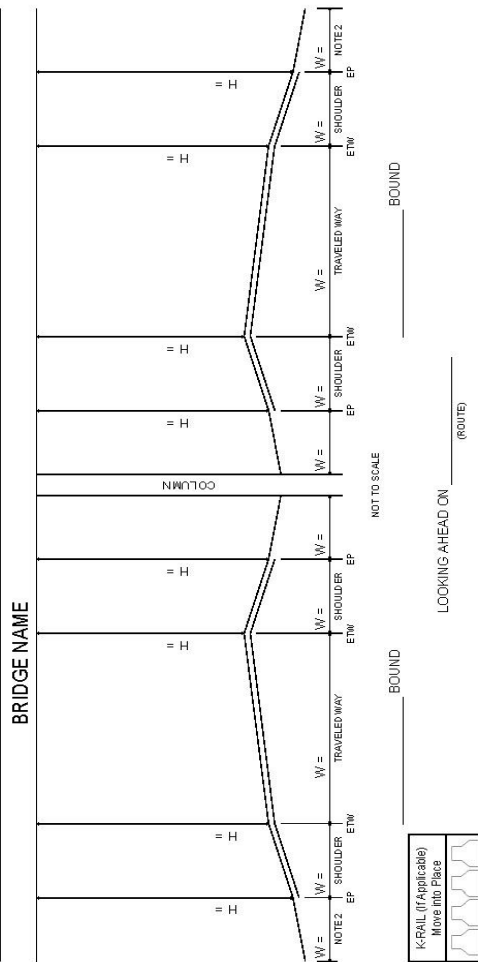
STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
NOTICE OF CHANGE IN CLEARANCE OR BRIDGE WEIGHT RATING

TR-0019 (NEW 6/2000)

**PLEASE FAX THIS FORM TO: NORTH REGION CONST/MAINT LIAISON (916-322-4957) FAX (916)-322-4081
SOUTH REGION CONST/MAINT LIAISON (909-388-7077) FAX (909)-383-4296**

BRIDGE NAME		BRIDGE NUMBER		DATE	
DISTRICT	COUNTY	ROUTE	PM	EA	CITY
SUBMITTED BY		PHONE NUMBER		FAX NUMBER	
TYPE OF CHANGE (SELECT ONE)					
<input type="checkbox"/> PERMANENT <input type="checkbox"/> TEMPORARY (SEE NOTE 1)					
TENTATIVE START DATE			TENTATIVE END DATE		
BRIDGE WEIGHT RATING CHANGE (SELECT ONE)			NEW BRIDGE WEIGHT RATING		
<input type="checkbox"/> YES <input type="checkbox"/> NO					

CLEARANCE DIAGRAM



NOTES:

- 1) FOR TEMPORARY VERTICAL CLEARANCE CHANGES, DIMENSIONS ARE TO BOTTOM OF FALSEWORK
- 2) INCLUDE DISTANCE TO ANY OBSTRUCTION (i.e. -GUARDRAIL, COLUMNS, K-RAIL)

FOR LIAISON USE ONLY.

DATE RECEIVED BY LIAISON _____	DATE OF RCD/TRD CHANGE _____	LIAISON SIGNATURE _____
--------------------------------	------------------------------	-------------------------

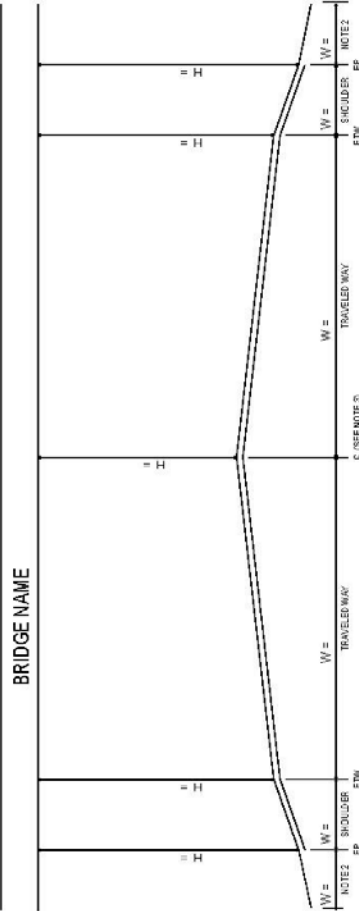
ADA Notice For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6410 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS-89, Sacramento, CA 95814.

STATE OF CALIFORNIA - DEPARTMENT OF TRANSPORTATION
NOTICE OF CHANGE IN CLEARANCE OR BRIDGE WEIGHT RATING
TR-0029 (REV 8/2000)

PLEASE FAX THIS FORM TO: NORTH REGION CONST/MAINT LIAISON (916-322-4957) FAX(916)-322-4081
SOUTH REGION CONST/MAINT LIAISON (909-388-7077) FAX(909)-383-4296

BRIDGE NAME		BRIDGE NUMBER		DATE	
DISTRICT	COUNTY	ROUTE	PM	EA	CITY
SUBMITTED BY		PHONE NUMBER		FAX NUMBER	
TYPE OF CHANGE (SELECT ONE)		TENTATIVE START DATE		TENTATIVE END DATE	
<input type="checkbox"/> PERMANENT <input type="checkbox"/> TEMPORARY (SEE NOTE 1)		EXISTING BRIDGE WEIGHT RATING		NEW BRIDGE WEIGHT RATING	
<input type="checkbox"/> YES <input type="checkbox"/> NO					

CLEARANCE DIAGRAM



NOT TO SCALE

K-RAIL (If Applicable) More Info Please
 LOOKING _____ ON _____ (R/O/T/E)
 MAINLINE RAMP

- NOTES:**
- 1) FOR TEMPORARY VERTICAL CLEARANCE CHANGES, DIMENSIONS ARE TO BOTTOM OF FALSEWORK
 - 2) INCLUDE DISTANCE TO ANY OBSTRUCTION (i.e. -GUARDRAIL, COLUMNS, K-RAIL)
 - 3) FOR DIVIDED HIGHWAYS, USE FORM NUMBER TR-0019

FOR LIAISON USE ONLY:
DATE RECEIVED BY LIAISON _____ DATE OF RCD/TRD CHANGE _____ LIAISON SIGNATURE _____

ADA Notice
For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6410 or TDD (916) 654-6380 or write Records and Forms Management, 1120 N. Street, MS-69, Sacramento, CA 95814.

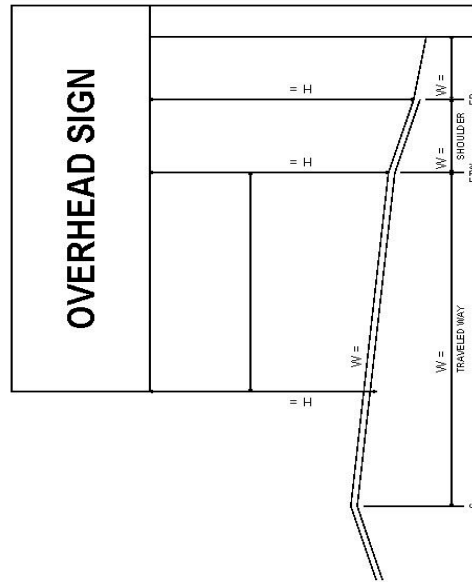
Appendix H-3

STATE OF CALIFORNIA • DEPARTMENT OF TRANSPORTATION
NOTICE OF CHANGE IN VERTICAL OR HORIZONTAL CLEARANCE
TR-0020 (NEW 6/2000)

PLEASE FAX THIS FORM TO: NORTH REGION CONST/MAINT LIAISON (916-322-4957) FAX(916)-322-4081
SOUTH REGION CONST/MAINT LIAISON (909-388-7077) FAX(909)-383-4296

SIGN NAME		SIGN NUMBER		DATE	
DISTRICT	COUNTY	ROUTE	PM	EA	CITY
SUBMITTED BY		PHONE NUMBER		FAX NUMBER	

CLEARANCE DIAGRAM



NOT TO SCALE

LOOKING _____ ON _____
(DIRECTION) (ROUTE)

MAINLINE RAMP

FOR LIAISON USE ONLY: DATE RECEIVED BY LIAISON	DATE OF RCD/TRD CHANGE	LIAISON SIGNATURE
---	------------------------	-------------------

ADA Notice For individuals with sensory disabilities, this document is available in alternate formats. For information call (916) 654-6410 or TDD (916) 654-3880 or write Records and Forms Management, 1120 N Street, MS-89, Sacramento, CA 95814.