Chapter 8: Inspection

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8-1 Introduction

Benefits of the substantial effort to produce and review a bridge removal work plan are only realized if the plan is properly executed. Field inspection of bridge removal operations is also necessary to reduce adverse outcomes. The Contractor's authorized field representative and the State's field inspector are an important link between the authorized bridge removal work plan and the actual field implementation, including communication with the team members doing the physical work. Even the most well thought out plan may include reasonable assumptions that prove to be erroneous once the work is underway. The State inspector is expected to develop a comprehensive understanding of the project goals and verify that these goals are satisfactorily met during the removal operations.

Field inspection is much more than watching the Contractor work and documenting progress. There is a significant difference between "watching the work" and "inspecting the work." Inspection is active pursuit that originates with a knowledge of what is to be accomplished and what results are expected. Some of the inspector's best tools are becoming familiar with the project requirements and constraints, as well as setting expectations with the Contractor. This can be accomplished with a pre-bridge removal meeting, attending the Contractor's tailgate safety meetings, and simply providing feedback as the work progress. Something as simple as showing up when the Contractor starts work for the day and discussing the day's operations and expectations can be very beneficial towards the goal of a safe and productive operation. Figure 8-1 shows a measurement being taken for a bridge removal operation.

Figure 8-1. An Inspector Documents the Depth of Soffit Saw Cut

8-2 Project Plans and As-Built Project Plans

Ideally, the as-built project plans detail what currently exist, and the project plans detail what is to be removed. Where the project plans include dimensions regarding the existing structure, they most often originate from the as-built project plans. The project plans are supplemented by the *Contract Specifications*. For example, these written specifications might detail the minimum depth that an element is to be removed below finished grade or the minimum sawcut depth. Such contract requirements are often not detailed on the authorized bridge removal work plan; thus, it is imperative that the field inspector be knowledgeable with the *Contract Specifications*.

During the bidding phase, as-built project plans are available to the Contractor through Structures Maintenance and Investigations (SM&I) and can be requested per *Contract Specifications*, Section 2-1.06B, *Bidding – Bid Documents – Supplemental Project Information.* A prudent contractor should request and review the as-built project plans that pertain to bridge removal during the bidding phase. Some bridges are security sensitive, and a confidentiality agreement is required with the Contractor prior to providing the as-built project plans. The as-built project plans provide valuable information; however, they can be deficient. As-built project plans are simply the contract bid plans that document changes during construction. As bridges have often been modified, through bid contracts, emergency contracts, or maintenance work throughout their lifecycle, there could be changes that were not incorporated into the published as-built project plans. Concrete elements are often slightly larger than shown on the as-built project plans because concrete form deflection is often not considered when preparing as-built project plans. Such minor deviations are within construction tolerances and considered normal and expected within the industry. However, the inspector should be on the lookout for anomalous and abnormal deviations from the as-built project plans that adversely impact the Contractor or might require a modification of the authorized bridge removal work plan. Footings are often poured oversized and "neat" to the soil. If a footing is significantly oversized and removal is necessary, a contract change order may be appropriate to compensate the Contractor for the additional effort required to remove the footing that could not have been anticipated at bid time. Oversized footings were common during earthquake retrofits and can be expected on bridges that were repaired after earthquakes or during earthquake retrofits.

Additionally, the as-built project plans sometimes fail to include the incorporation of hazardous materials such as asbestos, thus necessitating coordination with the District's environmental division and a change order to capture the cost of handling and disposal.

Contract Specifications, Section 2-1.07, *Bidding – Job Site and Document Examination*, requires that the Contractor examine the job site during the bid phase. Consequently, visible potential issues not detailed on the as-built project plans may not be cause for

a contract claim. An example is visible rip-rap placed near an abutment or pier. Often, there are District contracts or maintenance work that add rip-rap to a bridge that is not shown on the latest bridge as-built project plans. A simple site examination by the Contractor will make the Contractor aware of this during bidding. Another example could be a dimension shown on the project plans as “varies.” If this was deemed a significant issue at the time of bid, the Contractor could make a bidder inquiry or a site visit and make a determination of the extent of the variable dimension.

Issues related to site access, soffit elevations, and clearances are easily observed during a site visit. The Structure Representative and all field staff assigned to a project should make a site visit prior to bid and take extensive photographs of the bridge removal location, including photographs of the site as a whole and individual bridge elements. This could provide valuable information of the existing visible conditions.

As-built project plans are maintained by SM&I through their Bridge Inspection Records Information System (BIRIS), which can be accessed through the Caltrans intranet.

Concurrent with the review of the Contractor’s proposed bridge removal work plan, the Structure Representative should download and review the as-built project plans, bridge inspection reports, and all other relevant information provided in BIRIS. This information can be obtained by contractors, outside agencies, and consultants with requests to SM&I as outlined above. The Area Bridge Maintenance Engineer (ABME) and the Bridge Maintenance Superintendent are also valuable resources that should be consulted prior to bridge removal, especially if there are minimal or no as-builts records and/or if the bridge is complicated or unique.

8-3 Bridge Removal Work Plan

The authorized bridge removal work plan must be available at the site prior to bridge removal. The Contractor’s bridge removal superintendent and onsite engineer must have the authorized bridge removal work plan. The Structure Representative and field staff should discuss the authorized bridge removal work plan with the Contractor’s staff prior to the commencement of bridge removal operations. If there are multiple bridges on a project that require removal, then each bridge on the project will have a site-specific bridge removal work plan. All bridges, no matter how similar, have site specific considerations that need to be addressed in the bridge removal work plan. Something as simple as identical bridges with reversed skews can have a catastrophic impact to removal operations, illustrating the importance of site-specific bridge removal work plans.

Any hazardous materials must be addressed as a first order of work prior to authorization of the bridge removal work plan. This includes asbestos abatement, lead removal, bat guano, and crystalline silica protection among others. As an industry

standard and a Cal/OSHA requirement, a hazardous waste survey must be made prior to bridge removal. The survey identifies the nature and estimated quantity of hazardous materials. The survey generally includes a review of as-built project plans, bridge inspection reports, and other relevant bridge data as well as samples taken from the site and evaluated as necessary. Common hazardous materials found in bridges include lead, asbestos, and crystalline silica. Lead is often found in structural steel coatings, yellow traffic stripe, and soils around the bridge. Lead in the soil adjacent to the bridge can be the result of aerial deposit from vehicle exhaust in the days when gasoline was leaded in California or from previous painting or paint removal operations. Asbestos may be found in some geologic formations, concrete aggregates, sheet packing and shims, piping, and bearing materials. The quantity of hazardous materials must be estimated since special containers and handling requirements may be necessary, including disposal at an approved hazardous waste landfill. Hazardous materials generated from the bridge removal are often stored in sealed containers and, if short term storage is necessary on site, security fencing must be provided. In most cases, the goal with lead in the soil is to not increase the existing lead levels in the soil from the bridge removal operations, which is verified by pre and post bridge removal sampling evaluations.

The bridge removal work plan will detail the removal sequence. The order of operations may list preliminary work that will precede more significant bridge removal activities. Preliminary work may be authorized to proceed with protective covers, as required. Preliminary work is defined in the *Contract Specifications*, Section 60-2.02C(3), *Existing Structures – Structure Removal – Bridge Removal – Construction – Preliminary Work*, as work that will not reduce the structural strength or stability of the bridge or cause debris or materials to fall onto the roadway.

The structure must be stable during each stage of bridge removal. Unanticipated structural collapse can have severe consequences and must be avoided. Temporary bracing or supports are often installed to ensure stability during progressive demolition. The design of temporary supports requires an extensive engineering review and calculations, coupled with a good understanding of the design and as-built conditions of the bridge being removed. Care is required both in the selection and installation of temporary supports, and to verify that the materials used are adequate and fit for purpose. Assumptions such as soil bearing values should be verified. The inspection of these temporary supports is required, similar to typical falsework construction. It is common during partial bridge removal operations to establish survey controls and monitor the bridge for movement.

The bridge removal work plan shall identify locations where work is to occur over traffic, utilities, railroad property, or an environmentally sensitive area. These are common locations for the installation of protective covers. Protective covers must contain not only the larger debris, but also any dust or slurry generated from the removal operation.

Protective covers should be augmented with any barriers or engineering controls required to prevent debris and dust from migrating from the containment site.

The bridge removal work plan will identify areas where debris can be processed, sorted, and loaded out for removal from the project site. Frequently, reinforced concrete is processed on site for recycling by removing reinforcement from the concrete. Some projects may have an embankment where the disposal of concrete debris may be appropriate, under certain conditions and restrictions. Inspection should verify that debris is contained within the areas anticipated and that adequate final clean-up is accomplished.

The bridge removal work plan should specify where and when saw cutting will take place. Where partial bridge removal is performed, the depth of the saw cut and preservation of existing reinforcement will be detailed. The depth of the saw cut may be reduced to preserve existing reinforcement. The Contractor is required to protect any existing reinforcement that will be incorporated into the new work, and this should be clearly detailed in the bridge removal work plan. See Figure 8-2, which illustrates the close working quarters and congested nature of reinforcement retained, during a partial hinge replacement. This figure also depicts the hazards of working near a tangle of reinforcement, and the need for the workers to be cognizant of their surroundings, while employing the use of personal protective equipment.

The State has a proprietary interest in the ultimate disposal locations for demolition debris. The State can be held accountable, as the generator, for debris not properly disposed of. Hazardous materials are accounted for on a manifest and the manifest becomes a record in the project files. Due to its high alkalinity, concrete debris can be detrimental to aquatic life; therefore informal agreements between a landowner and the Contractor may not be appropriate for concrete debris disposal. The inspector should document debris disposal locations in the daily diary.

8-4 Traffic

The order and pace of work of bridge removal operations is often greatly influenced by the traffic handling and lane closure restrictions. Traffic handling is usually a significant part of the project plans, which requires training and experience for successful implementation. Temporary lane closures are carefully planned and scheduled in advance, and are continually evaluated for effectiveness and safety. While partial bridge removal of the edge of a bridge deck is behind a temporary barrier, access might require temporarily closing the adjacent lane for access. Traffic handling can be further complicated by night work. Adequate illumination that doesn’t adversely affect drivers can be an ongoing challenge. Construction activities can also distract drivers. Periodic observation of the traffic flow can reveal the effectiveness of the traffic control operations. The inspector should loop around and drive the project limits through

the reduced lanes, to reveal the experience of the traveling public. During this loop, special attention is given to the placement of warning signs, flashing arrows, lane tapers, and placement of light towers to verify functionality of the same.

If a bridge is to be completely removed, bridge removal work shall not begin until the bridge is completely closed to, and cleared, of public traffic.

Demolition falsework that is over or adjacent to traffic requiring a protective cover or temporary supports has minimum horizontal and vertical clearance requirements. The minimum horizontal clearance is 8 feet to a lane or shoulder open to traffic. The minimum vertical clearance is 15 feet. Any anticipated reduction of vertical or horizontal clearances needs to be reported to the Caltrans Permits Office at least two weeks in advance of the reduction in clearance; refer to BCM C-6, *Required Documents to be Submitted During Construction* and Attachment 2, *Guidance for Completing Required Documents Submitted to SC HQ*, for guidance. The Contractor is required to report any planned reduction of clearances to the Resident Engineer at least 25 days prior to the actual reduction. After the temporary supports are erected, the inspector is to verify that the actual clearance is not less than the planned and reported clearance.

8-5 Protective Covers

Protective covers can be structurally independent, entirely mounted to the existing structure, or a portion of the existing structure, or a hybrid installation. Mounting to the existing bridge requires additional inspection since the goal is to provide a mounting system that fulfills the intent of the design without causing damage to the existing bridge that is to remain in place. Any temporary anchors installed need to be eventually removed and the holes repaired, as outlined in *Contract Specifications*, Section 51-1.03F, *Concrete Structures – General – Construction – Finishing Concrete.*

When protective covers are part of the authorized bridge removal work plan, they must be field worthy and effective. Part of the inspection process involves an evaluation of the effectiveness of the protective cover. If the cover is not protecting as designed, a revision to the removal plan or operational mechanics is required.

Verify member dimensions, anchor installations, and that the required workmanship of the authorized protective cover plans is adhered to. Inspection is not limited to the installation process. As debris accumulates and is removed, the protective cover can be damaged or overloaded, or simply rendered ineffective. Inspection vigilance is an ongoing requirement until the protective cover is removed. Most often, the protective cover design is similar to falsework in nature and the *Falsework Manual*, Chapter 9, *Inspection,* will prove to be a useful reference.

8-6 Equipment and Crew

The authorized bridge removal work plan will be very specific regarding the equipment to be used. If equipment is operated from the bridge deck, the operating weight is a significant consideration. Equipment that exceeds the capacity of the bridge deck might be restricted to only operating over the bridge girders or other specified locations. Sometimes for heavy lifting, equipment might be operated on top of dunnage to distribute the load. Whatever the situation, no change in the authorized equipment should be made without an amendment to and reauthorization of the removal plan. Field staff tasked with inspecting this operation should be very familiar with the equipment listed in the bridge removal work plan, how to identify this equipment, and any restrictions on its use.

The energy of hydraulic breakers is limited by the contract when used for partial removal situations where the in-situ concrete is to be preserved. The *Contract Specifications*, Section 60-2.01C, *Existing Structures – Structure Removal – General – Construction,* limits the striking energy to 1200 ft-lb per blow. Excessive striking energy increases the likelihood of damage including micro fractures in the remaining concrete. Micro fractures are especially detrimental when they occur adjacent to embedded reinforcement, as this promotes future corrosion and eventual delamination of the concrete which can lead to costly repairs or failure of the bridge.

Generally, the Department's field staff does not direct the Contractor. Communication between the inspector and the Contractor's engineer, foreman, and/or superintendent directing the work is the usual protocol. However, the inspector should intercede directly with an operator if errors or significant damage is occurring, and the Contractor's usual supervision is not immediately available.

The skill level of operators varies, sometimes dramatically. A new operator on rented equipment might benefit from some close observation and feedback. It is not the inspector's task to train apprentices, but unacceptable results should be brought to the Contractor's attention as soon as possible.

Furthermore, in situations where a freeway or other public thoroughfare is being closed under a limited time frame, it is paramount that the inspector verifies that all of the crew and equipment that are required to be onsite are there before bridge removal operations commence, including supervision.

Figure 8-2. Workers Removing a Portion of a Hinge, San Francisco

8-7 Superstructure

Safety and stability are always concerns, but especially when the work is elevated. When work is elevated, the workers and the equipment are often situated on the bridge deck. Along the leading edge, there are fall hazards and the potential for falling debris.

Not usually an explicit part of a written plan is a limitation on unnecessary personnel or equipment near removal operations. Common sense makes this even more of a concern when the work is elevated. Curious, nonessential personnel have been injured while visiting the site of demolition work. Access should be controlled; if access is desired for someone like a photographer or to accommodate a job tour, a natural pause in the work or a temporary recess can be utilized. With a pause in the work, directions, explanations, or verbal cautions are easily communicated by the chaperone.

There is a lot going on in the partial bridge removal in the Figure 8-3 photograph. The work is taking place in the number one lane. Traffic is passing on the other side of the median barrier and the number two lane is open to traffic behind the photographer. This is a noisy environment as the workers are using small pneumatic hammers. The

schedule is such that there is very little room for unanticipated events. This bridge joint repair can only be accomplished in one shift if the well thought out plan was executed as anticipated. However, the plan must provide for contingencies. If the work cannot maintain the anticipated schedule, then some means of temporarily bridging the joint will be necessary. The inspector will have verified that the contingency provisions are in place before the works begins and then monitor the progress of the work throughout the night as tasks are completed. Often with such time constraints, progress is monitored in minutes. Even if there are no complications such as equipment breakdowns, concrete curing issues, or traffic accidents, the inspector will have a very busy shift verifying the workmanship, materials, and adherence to the schedule.

Figure 8-3. Repair of Bridge Joint at Night, Yuba River

Partial bridge removal is sometimes required on brand-new structures before they are placed into service to correct deficiencies in materials or workmanship on individual elements. The next photograph in Figure 8-4 is a soffit repair on a new structure where the concrete was defective. Concrete removal on a new bridge is similar to working on an existing bridge; all the best general practices apply. Some cases may require a remediation plan or bridge removal work plan, depending on the extent of the repairs.

Figure 8-4. Soffit Repair at Doyle Drive, San Francisco

8-8 Substructure

Usually by the time the demolition reaches the substructure, the Department's inspector has fostered a working relationship with the demolition crew and many of the early concerns have been resolved.

However, there is still a substantial portion of the removal plan to execute. Elements of the substructure in the water can still pose challenges, and safety continues to be a priority. Substructure removal in open water situations might require cofferdams, divers, or water diversions. Old construction debris or other debris adjacent to piers in water can impede progress, since the old debris will likely need to be removed prior to the bridge removal work, and may not have been anticipated in the schedule. Previously undocumented obstructions should be included in the daily reports, as potential adjustments in compensation might be necessary. Regardless of the actual field conditions, it is still important to protect the natural resources and meet any commitments made to resource agencies.

8-9 Special Locations

The Caltrans *Falsework Manual* and the *Contract Specifications*, Section 48-2.02B(4), *Temporary Structures – Falsework – Materials – Design Criteria – Special Locations,* list locations with special concerns and requirements. These locations are subject to vehicular impacts, and any temporary supports or falsework in these locations require additional impact resistant elements. Falsework over or adjacent to traffic and railroads will be identified on the bridge removal work plan and will include the required resistive design and elements. Special locations have requirements for additional signage or lighting when encroached upon by falsework. Sometimes it is not anticipated that temporary works might shadow or obstruct existing signage, traffic lights, or reduce sight distance to the same. An inspector should evaluate negative impacts that temporary works and activities might have on traffic, and mitigate as appropriate.

The inspector needs to verify that the additional requirements at special locations are met. This includes documentation of vertical or horizontal clearance changes.

8-10 Contractor's Engineer

The Contractor is responsible for quality control and jobsite supervision. Contract Specifications, Section 60-2.02A(4)(c), Existing Structures – Structure Removal – Bridge Removal – General – Quality Assurance – Quality Control, requires that for bridge removal work plans signed by a registered engineer, the Contractor's engineer must be present at all times during bridge removal activities.

The Contractor's engineer is required to write daily inspection reports that must be available at the site at all times. The Contractor's daily report should document the progress of the work, as well as document the condition of the remaining structure each day. For partial removal, the diary should document any damage to the existing structure. Stability of the structure should be documented in cases of complete removal or partial removal, where major load-supporting members are altered or removed. The inspector must verify that the Contractor's engineer is onsite at all times during active bridge removal and that the reports are available. Figure 8-5 illustrates the collaborative working relationship of personnel in the field during removal operations.

Figure 8-5. Engineers Discussing Plan