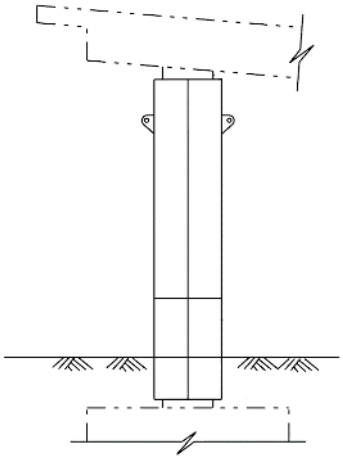
# Section 7 – Bridge Seismic

## Column Casing – Steel

### XS Sheet Numbers

XS7-010

### Description of Component



Seismic retrofit of existing concrete columns is mainly due to deficiency in flexural confinement, lap splices in plastic hinge regions, or lack of seismic shear capacity. Jacketing outside perimeter of existing concrete columns with strong materials has been shown substantial improvement in ductile response of concrete columns in many experimental programs.

Compression region of plastic hinge regions has lateral dilation due to Poisson's effect of column axial compression. Spalling of concrete cover in the compression region results in buckling of main column reinforcement limiting ductile response of concrete columns. When lap splices are located in plastic hinge regions, jacketing method provides adequate clamping pressure to prevent lap splice slipping. Lateral dilation of concrete cross-section due to dead loads already occurred in existing concrete columns. Thus, additional dilation induced by seismic moment will be restrained by passive jacketing method.

There are few different proposed methods to estimate required thickness of steel casing. The simple approach to maintain minimum confining pressure in casing based on column dimensions in BDA 14-2 was used to develop this XS sheet. Hydrostatic pressure of grout during construction is also considered in BDA 14-2.

Jacketing also enhances seismic shear capacity of existing concrete columns because the additional clamping pressure induced by jacketing acts similar to that of column hoops. However, the required thickness of steel casing to enhance column shear

capacity must be engineered based on overstrength plastic moment of column and shear capacity of existing concrete columns.

## Standard Drawing Features

XS7-010 provides details for fixed-fixed (Type F) and fixed-pinned (Type P/F) column casings. It includes instructions for fabricating, welding, placing, and grouting a Steel Column Casing.

## Design/General Notes

Steel Casing Type: Bridge Standard Detail sheet, xs7-010 shows two different types of steel column casings. Type "F" achieves fixity at both top and bottom ends of existing column to superstructure and footing. Type "P/F" achieves fixity at "F" end and pin behavior at "P" end. Typically Type "P/F" is used if existing column is pinned to the footing, or existing footing has “starter bars” 30 inches to 36 inches long, which are lap spliced with column longitudinal reinforcement. For multi-column bridges "P" casing at base of column is appropriate to prevent damage to the footings. For single-column bents fixity at the base of column is absolutely essential, therefore "P casing cannot be used.

Casing Thickness: Designers must determine the required thickness of steel casing and show it on Contract Plans. For circular column of 4 feet-4 inches in diameter or less, the casing must be at least ¼ inch thick. For larger circular columns and for elliptical jackets, the casing must be at least 3/8 inch thick. For confinement purposes (as controlled by plastic hinge region), the casing thickness is specified in BDA 14-2. If steel casing is used to increase seismic shear capacity of existing column, designer should perform seismic shear demand and capacity analysis per SDC 3.6. The deficient shear capacity must be provided by steel casing considered as equivalent hoop reinforcement per unit length. The required jacket thicknesses due to flexural confinement, lap splices, and shear strength enhancement are not additive. The largest thickness shall control as the required thickness.

Welded Field Splice: Optional welded field splice is allowed for long columns. Welded horizontal splice must not be located where moment demand exceeds 0.75Mp.

Casing Opening: If existing bridge column has drainage pipe or conduit for utility line at steel casing location, the pipe/conduit should be extended outside of casing minimum of 3 inches from the face of column casing. Designer should check the condition of existing drainage or utility in columns. For existing pipes provide a pipe extender of the same diameter. For steel pipes, the pipe extender must be connected by butt weld or

steel pipe sleeve. If existing pipe is PVC, sleeve connection in Std. Plans B7-6 must be used. Steel pipe extender is shown on the plans, however, the designer must modify the details based on the existing condition.

Limit of Polyethylene (Type "P/F"): Polyethylene must be extended from top of footing to end of starter bars in existing columns. The limit must be shown on Contract Plans.

## Additional Drawings Needed to Complete PS&E

Columns with flares, tapers, and other non-prismatic shapes require an additional drawing(s) to show how the steel casing will confine it.

Tall columns require an additional drawing(s) showing supports and other details to prevent buckling during lifting and grouting.

XS7-020 is for a minimum 3/8 inch and maximum 1 inch steel casing. Other steel casing thicknesses require an additional drawing(s).

When the long cross-section dimension is over four times the small cross-section dimension, the steel casing becomes much less effective. In this case the designer should consider an alternative. Similarly, steel casing for columns with large cross-section areas may not be effective.

## Contract Specifications

Caltrans Standard Specifications Section 60 Existing Structures; Section 60-40.06 Steel Column Casings.

## Restrictions on Use of Standard Drawings

Tall and non-prismatic columns require special details. Very wide, tall, or non-prismatic columns may require special details and the project specific design criteria per Memo to Designers 20.11.

## Special Considerations

The Office of Bridge Architecture and Aesthetics shall be consulted to obtain a workable and aesthetically pleasing solution when different plate thicknesses are joined, exterior stiffeners are attached, or through bolts are installed.