

# APPENDICES

# Appendix A

## Element Environment and Guidelines

Assigning the proper element environment is vital for accurate deterioration predictions and future project identification. The environment is simply a 1 to 4 number representing the aggressiveness of the operating practices or local environment of each element. Each element can have only one associated environment but it may be different than the other elements on the same bridge. The definition of each environment is listed below.

Environment	Definition
1 - Benign	Neither environmental factors nor operating practices are likely to significantly change the condition of the element over time or their effects have been mitigated by the presence of highly effective protective systems.
2 - Low	Environmental factors and/or operating practices either do not adversely influence the condition of the element or their effects are substantially lessened by the application of effective protective systems. The most frequently occurring environment in California is Environment 2.
3 - Moderate	Any change in the condition of the element is likely to be quite normal as measured against those environmental factors and/or operating practices that are considered typical by the agency.
4 - Severe	Environmental factors and/or operating practices contribute to the rapid decline in the condition of the element. Protective systems are not in place or are ineffective.

The environment designation of an element can change over time; as it would if operating policies were changed to reduce the use of road salt. By definition, the environment designation can not change as the result of maintenance work or deterioration. The most frequently occurring environment in California is Environment 2.

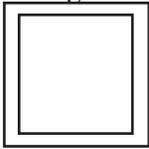
Factors that could increase the severity of the environment rating for various elements include:  
(Record the predominant environment)

Element	Factor
Timber Elements	High moisture content - All Timber Elements Pest Infestation - All Timber Elements
Steel Elements	Distance From Salt Air - All Steel Elements
Concrete Elements	Freeze Thaw Cycles - All Concrete Elements Tire Chain Wear - Concrete Bridge Decks Salting of Decks - Concrete Bridge Decks, Rails, and Substructure Elements
Petroleum Based Elements	High Skew - Joints and Bearings Extreme Temperature Ranges - Joints and Bearings Air Pollutants (smog) - Joints and Bearings
Operating Practices	High Traffic or Truck Volumes - Deck, Superstructure, and Joint Elements

## Appendix B

### Element Quantity Conventions

- **Elements not visible for inspection:** For elements that are not visible to inspect (e.g., piles or bearings) the quantity should be 1 each, independent of the number of locations of the non visible element.
- **Culverts.** The quantity for culverts will be the length of the barrel regardless of the number of individual barrels. For example if you have a 3 barrel culvert that is 75 meters long, the total length of the culvert is  $(75 \text{ m}) \times (1) = 75 \text{ meters}$ .



Quantity = 1 x Barrel Length



Quantity = 1 x Barrel Length

- **Concrete Arches:** Arches are typically recorded as the number of linear meters on each side of the bridge (2 arches). The arch type that is continuous for the width of the bridge would be coded as 1 arch. Spandrel columns, stringers, floor beams, and bent caps should be recorded as the appropriate element type and individually counted. Deteriorated secondary arch members (either vertical or perpendicular to the arch length ) should be recorded as the appropriate width of the member along the horizontal projection of the arch.



Arches with Floor Beams

- **Accounting for Skew:** Skew should be taken into account when recording element quantities for Joints, Abutments, Pier Walls, Culverts, Floor Beams, Tunnels and Bent Caps. Accounting for the skew is as simple as determining the length of the element perpendicular to the roadway and dividing by the cosine of the skew angle.

## Appendix B Cont.

- **Diaphragms and Cross Bracing:** The tributary portion of any deteriorated cross frame, diaphragm or strut should be recorded under the element being braced. A deteriorated cross frame in Congirder bridge would be recorded horizontal projection of the cross Condition State 3.



- **Box Girders:** The quantity for box girders is equal to  $1/2$  the number of visible girder faces times the length of the bridge.



Quantity =  $1/2 \times 2$  faces = 1 Box Girder x Length



Quantity =  $1/2 \times 4$  faces = 2 Box Girders x Length

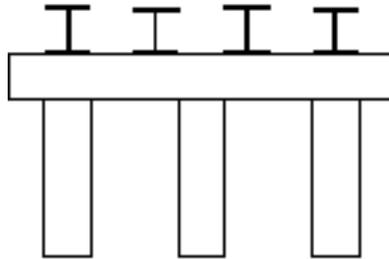
- **Bent-Type Abutments:** These abutments typically will get 3 different elements, a cap, column, and other abutment. The abutment in these cases will consist only of the backwall of the abutment.



Quantity for Element Type: Piles = 3, Cap = 1 x width, and Other Abutment = 1 x width

## Appendix B Cont.

- **Pile Bent:** Pile bents will typically have two elements, a non integral cap and columns. Any diagonal column bracing structurally required can be considered in rating the condition of the columns.



Quantity for Element: Columns = 3 and Cap = 1 x width

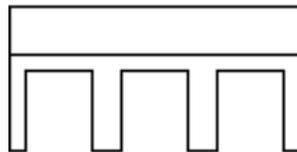
- **Stringers/Floor Beams/Girders\*:** Stringers are the small elements which run longitudinally to the deck and carry the load from the deck to the floor beams. Floor beams are transverse to the deck and carry the stringer load out to the truss or girders. Girders are the main longitudinal superstructure members which carry the loads to the substructures. See diagram below:



Quantity: Girders = 2 x length, Floor Beam = 1 x width, Stringers = 5 x length

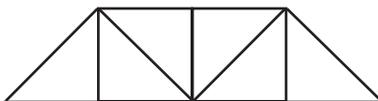
*\*Note that longitudinal timber members shall always be recorded as Stringers*

- **Concrete Channels:** These elements are precast channels with normal reinforcement (not pre-stressed). Record these elements as a reinforced concrete girder, and also include the deck as a separate element.



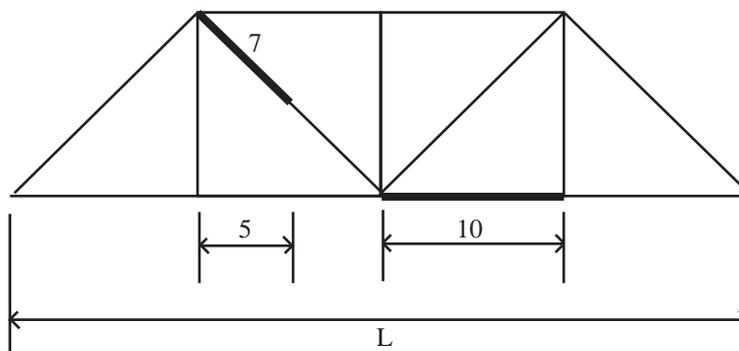
Quantity for Element:  $1/2 \times 8 = 4$  x length

## Appendix B Cont.



Quantity = 1 x length (for each truss line on the bridge)

- **Trusses:** Trusses are recorded as the number of linear meters on each truss line of the bridge. Diagonals, verticals or cross bracing are not counted as additional quantities, however the lower chord members are separate elements.



- **Deteriorated Portions of a Truss:** All measurements of the truss components are along the horizontal projection of the element. For deteriorated vertical and portal members record the appropriated horizontally projected width of the member to the nearest meter (typically 1 meter). Deteriorated portions of diagonal members should also be recorded as the horizontally projected quantity to the nearest meter. In the example above, the total deficient length to record is 15 meters.
- **Rail Length Limits:** Record the rail length that is present for the bridge itself. For a typical bridge this would mean recording all rail lengths anchored to the bridge deck/slab, any wingwalls, and isolated approach rails. If the approach rails or median rail are continuous (not isolated) only record the lengths to the ends of the structure including wingwalls. Record the lengths of vehicle Barrier Rails only. Do not record chain link fences or other pedestrian only rails.

# Appendix C

## Column and Pile Element Guidelines

*Piles that are completely submerged, in soil or water, and not visible for inspection, should typically be recorded as quantity 1 EA in Condition State 1. If the foundation piles are partially visible for inspection, record the actual number of inspected piles and the corresponding condition states.*

*The following illustrations are guidelines for the element selection of the varying combinations of columns and piles.*



ELI No. 205 & 251



ELI No. 251\*



ELI No. 251\*



ELI No. 204 or 205 and 226 or 227\*



ELI No. 206 and 228\*



ELI No. 202 or 201 (unpainted) & 225\*



ELI No. 254, 220, & Submerged Pile Type

*\*Any pile type driven full length (i.e., used as columns) should be recorded 1 each for every column location. Additionally, a submerged pile element should be used with a quantity of only one, excluding the cases when ELI No. 251 is used as a column.*