

Chapter 4

Bridge Program Drawings

Section 4.08-Bent/Pier

Introduction

Bents and piers are the intermediate supports for bridges with two or more spans. There are numerous configurations of bents and piers; however, the most commonly used are solid shaft piers and multicolumn bents.

Pier Types

SOLID SHAFT PIERS, usually referred to as hammerhead piers, have a single solid concrete cross section that supports the cap. Hammerhead piers with a rectangular cross section should be considered on higher structures. The major axis of the pier lies in the same approximate direction as the stream flow. On the other hand, a circular or smaller rectangular cross section may be used when the stream flow is not in the same approximate direction as the major axis. Hammerhead piers are usually supported by a spread footing but occasionally can be supported by a footing on piles or drilled shafts.

Bent Types

MULTICOLUMN BENTS, occasionally referred to as frame bents, have two or more concrete columns that support the cap. Consideration should be given to using this type of bent on wider structures. Because water is allowed to flow between the columns, care must be used to ensure that debris collection is not a problem. Multicolumn bents can be supported on a combined footing when the column spacing is close, or on isolated footings when the column spacing is greater. Multicolumn bents can be supported by footings, footings on piles, or drilled shafts.

PILE BENTS are a common variation of multicolumn bents, except that they are typically made of pile (HP) sections rather than concrete columns. The cap can be either a cast-in-place or precast concrete cap, or a standard rolled beam. A rolled beam cap shall be used when the bridge is center crowned and has five girders or less. Consideration should be given to using this type of bent on low height, short span structures.

General Design and Detail Information

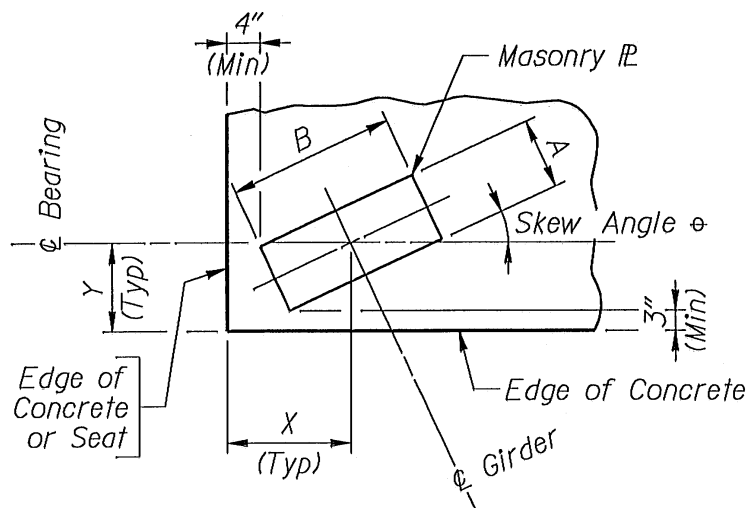
CONCRETE COLUMN DIAMETERS are designed in 6" increments because of available form work; the smallest diameter is 24". **OPTIONAL CONSTRUCTION JOINTS** shall be shown on columns that exceed 15'-0" in height. The column's longitudinal reinforcing steel shall extend into the cap a length equal to the tension development of the bar. Required turns for column and drilled shaft spirals shall be as specified in Section 4.19 – Reinforcing Steel.

Column lengths shall be shown in 3" increments.

The **CAP WIDTH** shall be of sufficient dimension to minimize the chance of concrete spalling when the loads are placed. The figure below shall be used for typical situations and adapted to suit other situations as well. The designed dimensions of the cap and bearing seats should be rounded up to the nearest 6". Cap widths shall be a minimum of 3" greater than the column diameter.

$$X = 4'' + \frac{A}{2} (\sin \theta) + \frac{B}{2} (\cos \theta)$$

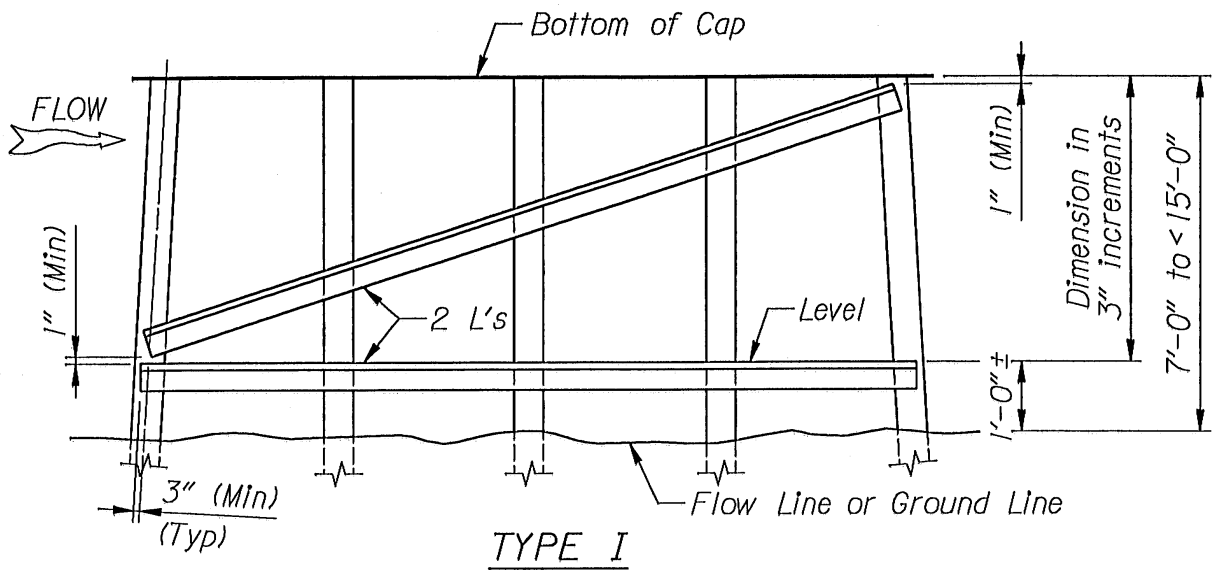
$$Y = 3'' + \frac{A}{2} (\cos \theta) + \frac{B}{2} (\sin \theta)$$



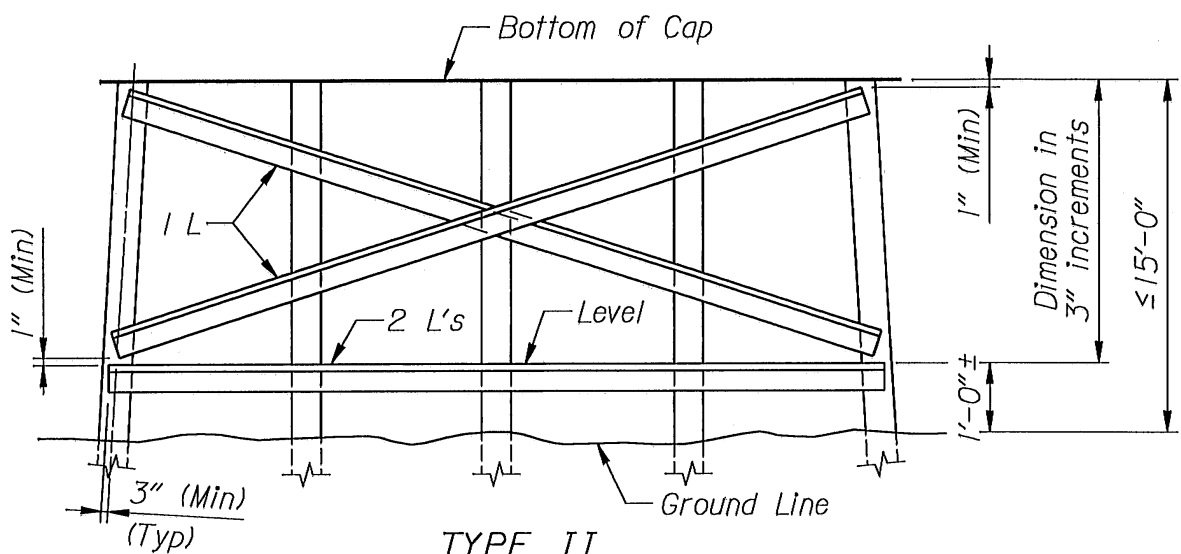
ANCHOR BOLTS shall be used to securely anchor the superstructure to the substructure. Anchor bolts shall be threaded or swaged to secure a satisfactory grip upon the material used to embed them in their holes. The holes shall be either drilled or square formed. For more information on anchor bolt sizes and

required holes, see Section 4.09 - Superstructure. The clearance from the edge of the concrete seat to the edge of an anchor bolt should be 6" minimum. At least one shear stirrup is to be placed between the anchor bolt and the end of seat.

PILE SUPPORT ANGLES are required on pile bents when the distance from the flow line or ground line to the cap bottom equals or exceeds 7'-0". Type I cross frames are required when the distance is greater than or equal to 7'-0" but less than 15'-0". A Type II crossframe is required when the distance is greater than or equal to 15'-0", but is generally not used in streams and rivers. If possible, the length of the support angles should not exceed 40'-0".

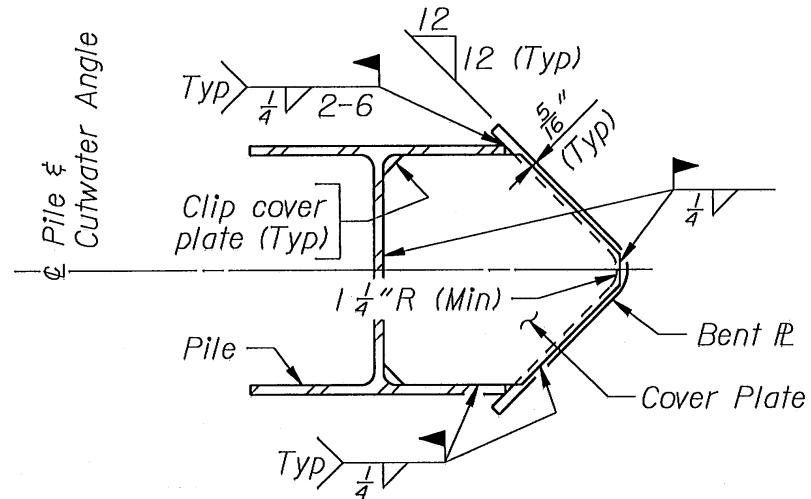


TYPE I



TYPE II

CUTWATER ANGLES are bent plates field welded to the upstream pile to protect the pile from debris. Cutwater angles are used when the drift potential of the stream is large trees and logs, or when the stream has the potential to ice over in the winter. The top of the cutwater angle is 1'-0" above the design highwater but no less than 6" clear of the bottom of the cap. The bottom of the cutwater angle shall be 2'-0"± above the streambed or flow line with the length of the cutwater angle given in 3" increments.

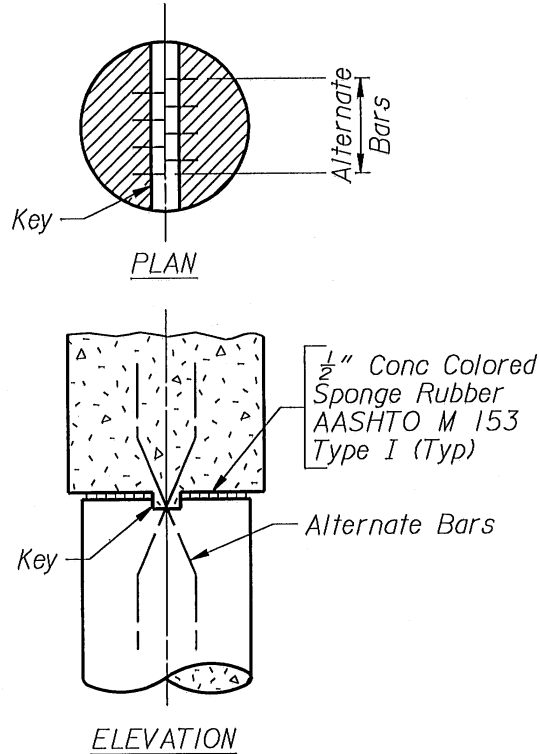


CUTWATER ANGLE DETAIL

BEVELED PLATES shall be used under the bearings when specified in the bearing design. Beveled plates shall be fabricated in accordance with the provisions set forth in Section 4.09 - Superstructure.

CRASH WALLS are to be provided according to American Railway Engineering Association (AREA) Specifications for bents whose columns are within 25'-0" of the centerline of any existing or proposed track.

When required by design, **HINGES** may be employed to reduce the moment transferred to the substructure. The following illustration shows an example hinge detail.



Cells

Name	Description
COVP10X42	Cover Plate Details HP10x42
COVP12X53	Cover Plate Details HP12x53
COVP12X74	Cover Plate Details HP12x74
COVP14X73	Cover Plate Details HP14x73
COVP14X89	Cover Plate Details HP14x89
CUTWATER	Cutwater Angle Detail
HP10X42E	Elevation of HP 10X42
HP10X42P	Hidden Plan of HP 10X42
HP10X42S	Side View of HP 10X42
HP12X53E	Elevation of HP 12X53
HP12X53P	Hidden Plan of HP 12X53
HP12X53S	Side View of HP12X53
HP12X74E	Elevation of HP 12X74
HP12X74P	Hidden Plan of HP 12X74
HP12X74S	Side View of HP12X74
HP14X73E	Elevation of HP 14X73
HP14X73P	Hidden Plan of HP 14X73
HP14X73S	Side View of HP 14X73
HP14X89E	Elevation of HP 14X89
HP14X89P	Hidden Plan of HP 14X89
HP14X89S	Side View of HP 14X89

Bent/Pier Checklist

Plan

- Centerline Bent/Pier/Bridge Roadway
- Centerline Girder/Pile/Drilled Shaft/Column
- Working Line/Construction Line Call-out
- Skew and Complement
- Width/Length Dimensions
- Girder/Pile/Drilled Shaft/Column Spacing
- Girder Angles (if different than skew)
- Station Note
- Holes for Swedge Bolt Spacing/Size
- Radius Call-out
- Line Styles

Elevation

- Detail Projected from Plan
- Centerline Bent/Pier/Pile/Drilled Shaft/Column
- Vertical/Horizontal Dimensions
- Seat Length/Level
- Elevations
- Pile Cut-Off Dimension/Call-out
- Reinforcing Size/Spacing/Lap/Call-outs
- Keyway/Construction Joint Call-outs
- Pile Batter
- Pile Call-out
- Pile Support Angle Sizes/Clearances/Welds
- Cutwater Angle Call-out
- Flow Arrow (pile bents)
- Section Symbols
- Line Styles
- Looking Back/Ahead Station (under title)

Sections

- Centerline Bent/Pier/Pile/Drilled Shaft/Column
- Width/Diameter Dimensions
- Reinforcing Size/Spacing/Clearance/Call-outs
- Keyway/Construction Joint Call-outs
- Pile Call-out
- Line Styles/Patterning

Section Showing Footing

- Width/Length Dimensions
- Reinforcing Size/Spacing/Clearance/Call-outs
- Centerline Bent/Pier/Footing/Pile/Drilled Shaft/Column
- Pile/Drilled Shaft/Column Locations
- Line Styles/Patterning

Miscellaneous

- Cutwater Angle/Cover Plate Details
- Crash Wall Sections
- Hinge Detail
- Bill of Reinforcement

Notes

- Reinforcing Laps/Extensions/Placement
- Pile Cut-Off Elevations
- Pile Spacing
- Drilled Shafts/Columns/Footings Identical
- Number of Turns Top and/or Bottom for Spiral
- Reinforcing Not Included in Quantity
- Prefix Note
- Concrete Quantity