INDIANA DEPARTMENT OF TRANSPORTATION

Driving Indiana's Economic Growth

Design Memorandum No. 19-04

May 6, 2019

TO: **All Design, Operations, and District Personnel, and Consultants**

FROM: ***/s/ Elizabeth W. Phillips***
Elizabeth W. Phillips
Standards and Policy Division

SUBJECT: **End Bent Details**

REVISES: ***Indiana Design Manual*** **(IDM) Sections 409-2.04(02) and 409-2.04(03), Figures 409-2A, 409-2C, 409-2D, 409-2E, 409-3A, and 409-3B**

EFFECTIVE: **As Noted**

The referenced IDM sections and figures have been revised to incorporate additional guidance for end bent width and to establish limits for the use of spiral reinforcement. Revisions are summarized below.

IDM Section	Description
409-2.04(02)	Deleted itemized plan details information.
409-2.04(03)	New section. Incorporated plan details information from 409-2.04(02).
409-2.04(03), item 1	Revised guidance on establishing end bent width to include pile edge distance and pile misalignment. The revisions are not new requirements but represent considerations that have been overlooked previously.
409-2.04(03), item 2	Updated organizational structure to Bridge Design *Division*.
409-2.04(03), item 3	Deleted spiral reinforcement information.
409-2.04(03), item 4	Incorporated spiral reinforcement from item 3. Revised guidance to require spiral reinforcement for bridges with an expansion length of 250 ft or greater.

IDM Figure	Description
Figures 409-2A, -2E	Revised to call out expansion length limit for spiral reinforcement.
Figures 409-2C, -2D, -3A, and -3B	Revised to call out 9-in. minimum edge distance.

The revised sections and figures have been incorporated into the IDM on-line and are included for reference on the following pages.

Effective Dates

Spiral reinforcement revisions should be incorporated into Stage 3 submittals on or after the date of this memo. Projects beyond Stage 3 may revise plan details to remove spiral reinforcement where it is no longer required but are not required to do so.

End bent widths must provide the minimum pile edge distance in accordance with the AASHTO *LRFD Bridge Design Specifications*. Plan revisions to address insufficient end bent width are required, regardless of the stage of project development.

409-2.04(02) Pile Connection [Rev. Oct. 2012, Sep. 2016, Mar. 2017, May 2019]

[*Itemized plan detail information was removed from this section and added to new section 409-2.04(03). Remaining information is unchanged]*

409-2.04(03) Plan Details [Add. May 2019] [*New section, revised information is shown with the blue bar*]

Regardless of the method used, the end bent shall be in accordance with the following.

1. Width. The width shall not be less than 2.5 ft. The width shall consider

    a. Beam extension and concrete cover as noted below;

    b. clearance from the side of any pile to the nearest vertical face of the pile cap. The minimum distance should not be less than 9 in. (*LRFD* 10.7.1.2), per plan pile locations;

    c. pile misalignment per the *Standard Specifications* without requiring modifications to the end bent reinforcing or spiral reinforcing.

2. Depth. The depth from the bottom of the beam or girder to the bottom of the integral end bent should not exceed 6'- 0". Use of a deeper end bent must be approved by the Bridge Design Division.

3. Cap Embedment. For all span lengths, the pile shall be embedded 2 ft into the cap.

4. Spiral Reinforcement. For a bridge with an expansion length greater than 250 ft, the embedded portion of the pile shall be confined with spiral reinforcement. See Figure 409-2E for spiral reinforcement details.

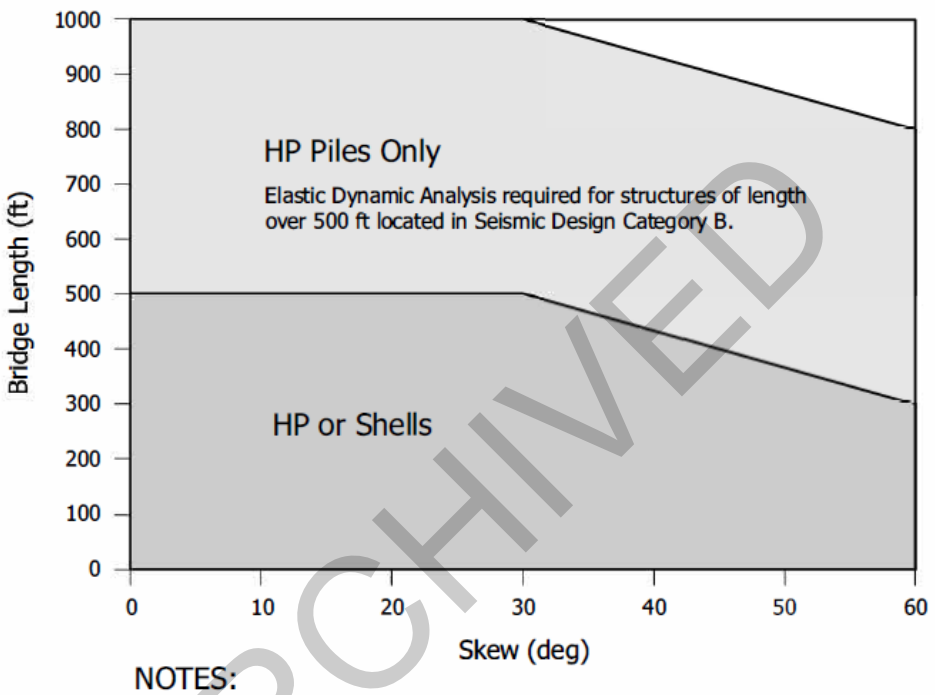
5. Beam Attachment. The beams shall be physically attached to the piling if using Method A, or to the cast-in-place cap if using Method B.

6. Beam Extension. The beams shall extend at least 1.75 ft into the bent, as measured along the centerline of the beam.

7. Concrete Cover. Concrete cover beyond the farthest-most edge of the beam at the rear face of the bent shall be at least 4 in. This minimum cover shall also apply to the pavement ledge area. The top flanges of structural steel beams/girders or prestressed concrete I-beams may be coped to satisfy this requirement. Where the 4-in. minimum cover cannot be maintained within a 2.5-ft cap, the cap shall be widened.

…

[*Remaining items unchanged*]



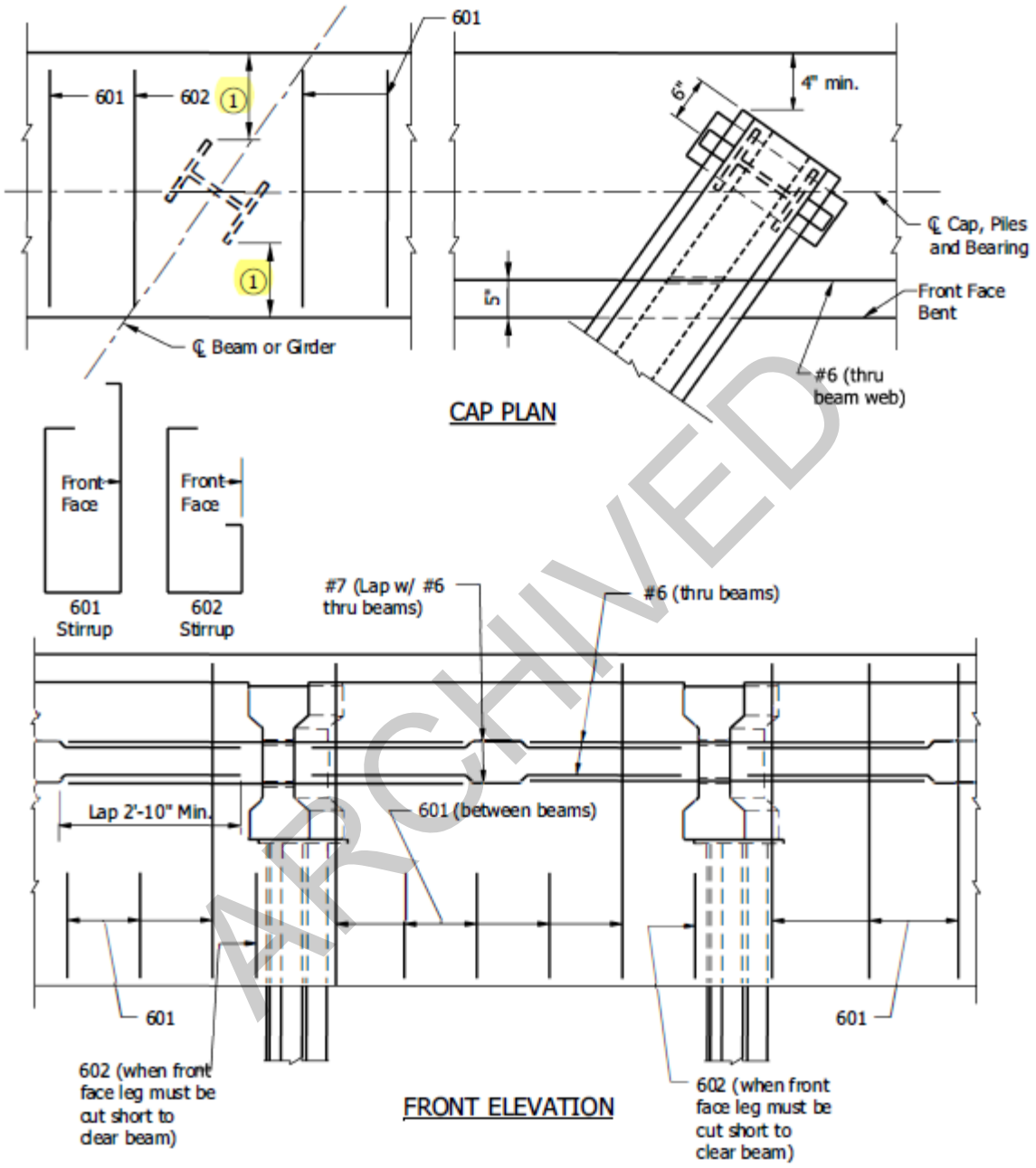
NOTES:

1. Integral end bents may be used in a curved-alignment or curved-girder structure with length of 500 feet or less, with a subtended angle in plan not greater than 30°.
2. Pile confinement spiral reinforcement required on integral end bents with expansion length greater than 250 ft.

USE OF INTEGRAL END BENT

Figure 409-2A

NOTE:
① Minimum distance from any vertical face of the end bent should be 9 in.



SUGGESTED INTEGRAL END BENT DETAILS
Method A, Beams Attached Directly to Piling

Figure 409-2C
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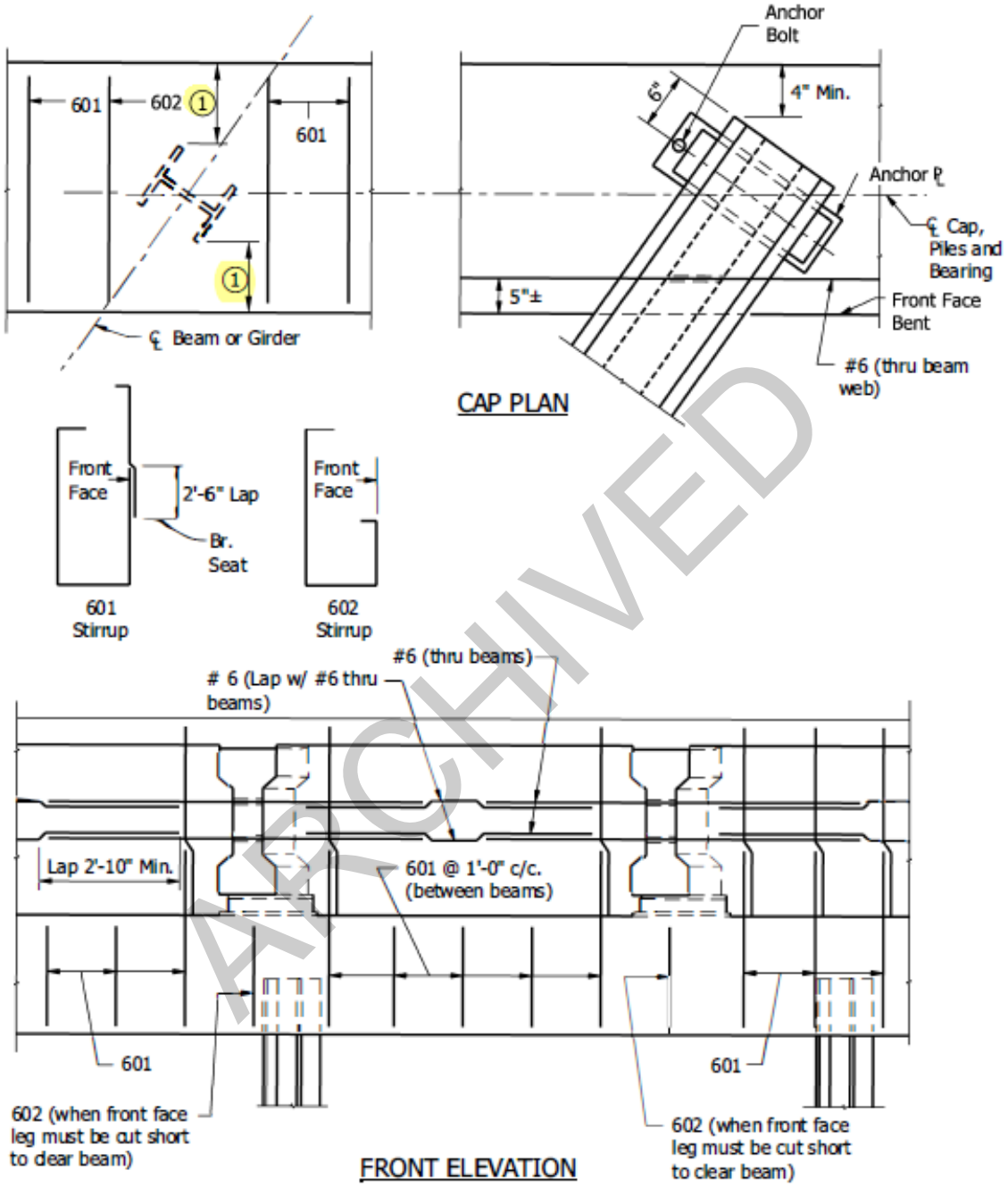
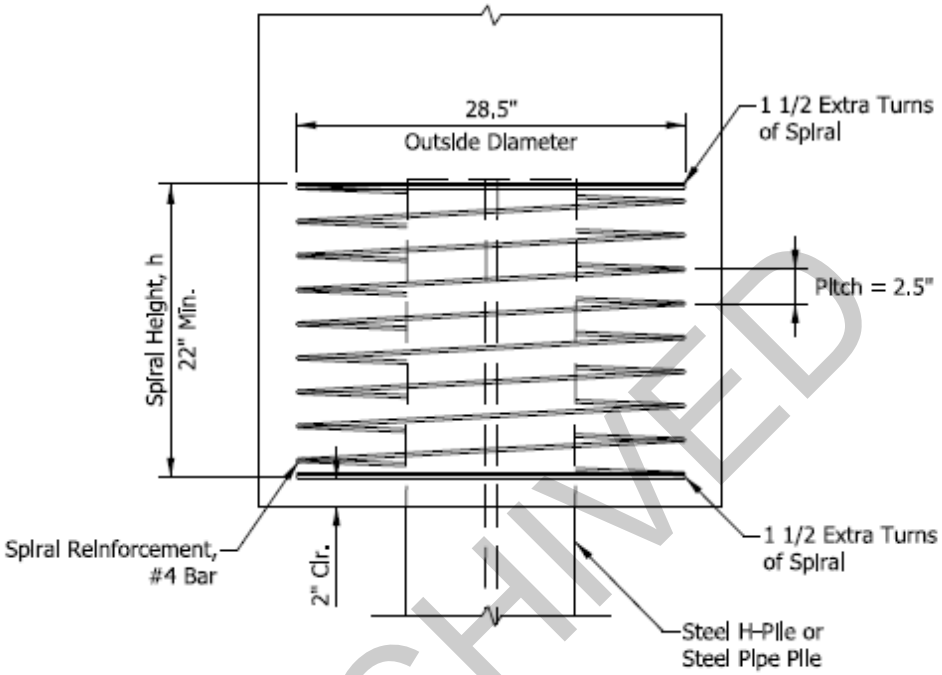
NOTE:

① Minimum distance from any vertical face of the end bent should be 9 in.



SUGGESTED INTEGRAL END BENT DETAILS
Method B, Beams Attached to Concrete Cap

Figure 409-2D
(Page 3 of 4)

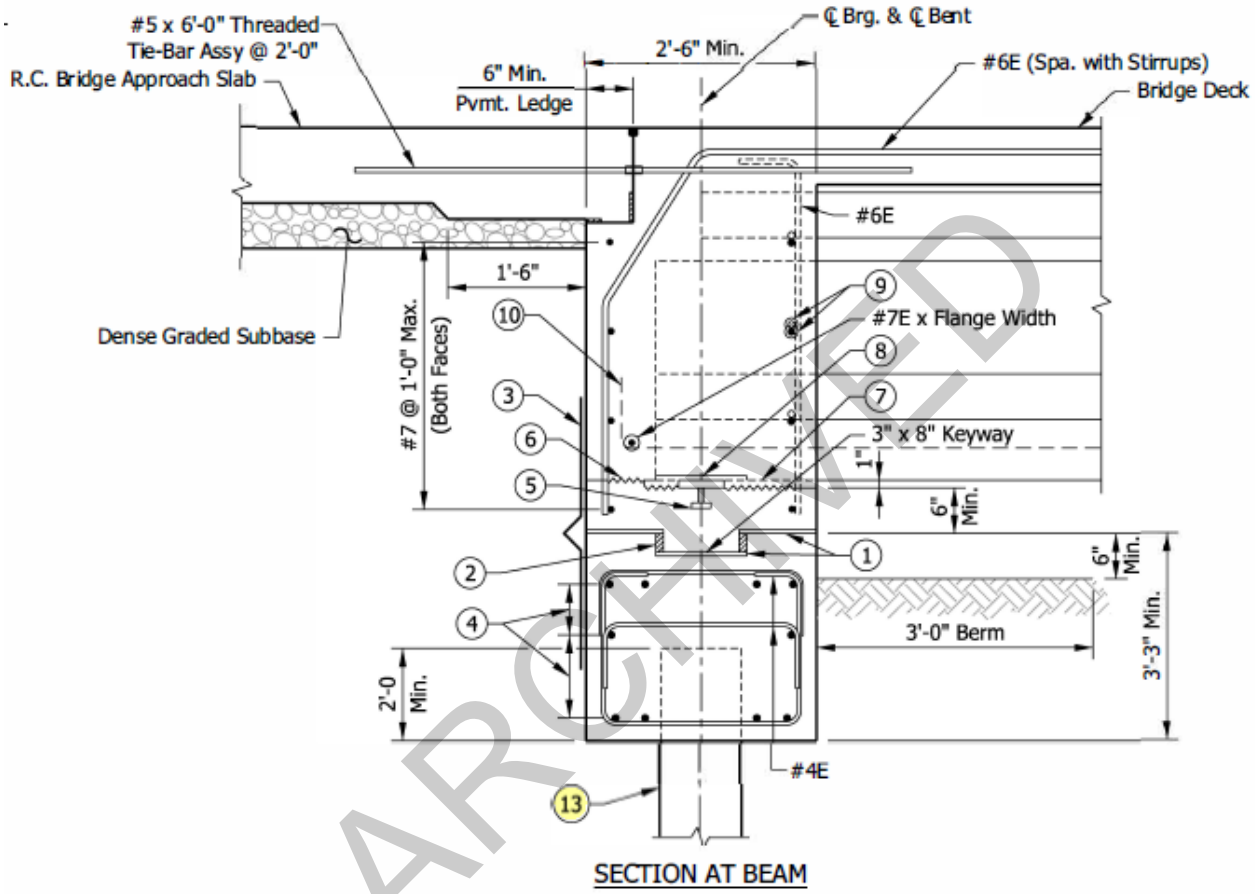


L = Total Length of Spiral Reinforcement (In.)

$L = [(h/2.5" + 2(1\ 1/2\ turns)]\ \pi\ 28.5"$

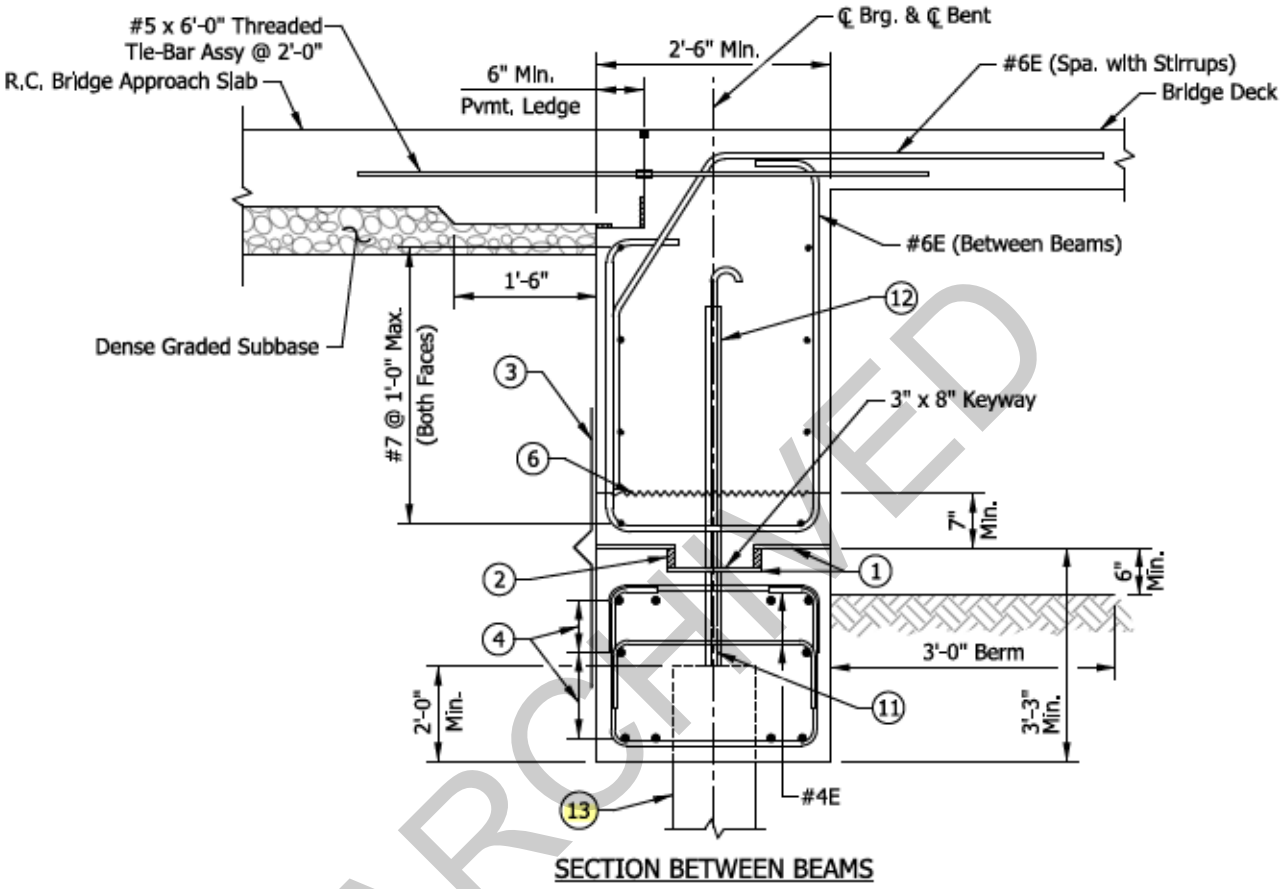
SPIRAL REINFORCEMENT
FOR BRIDGES WITH EXPANSION LENGTH GREATER THAN 250 FT

Figure 409-2E



SUGGESTED SEMI-INTEGRAL END BENT DETAILS
(Method 1)

Figure 409-3A
(Page 1 of 4)



SUGGESTED SEMI-INTEGRAL END BENT DETAILS
(Method 1)

Figure 409-3A
(Page 2 of 4)

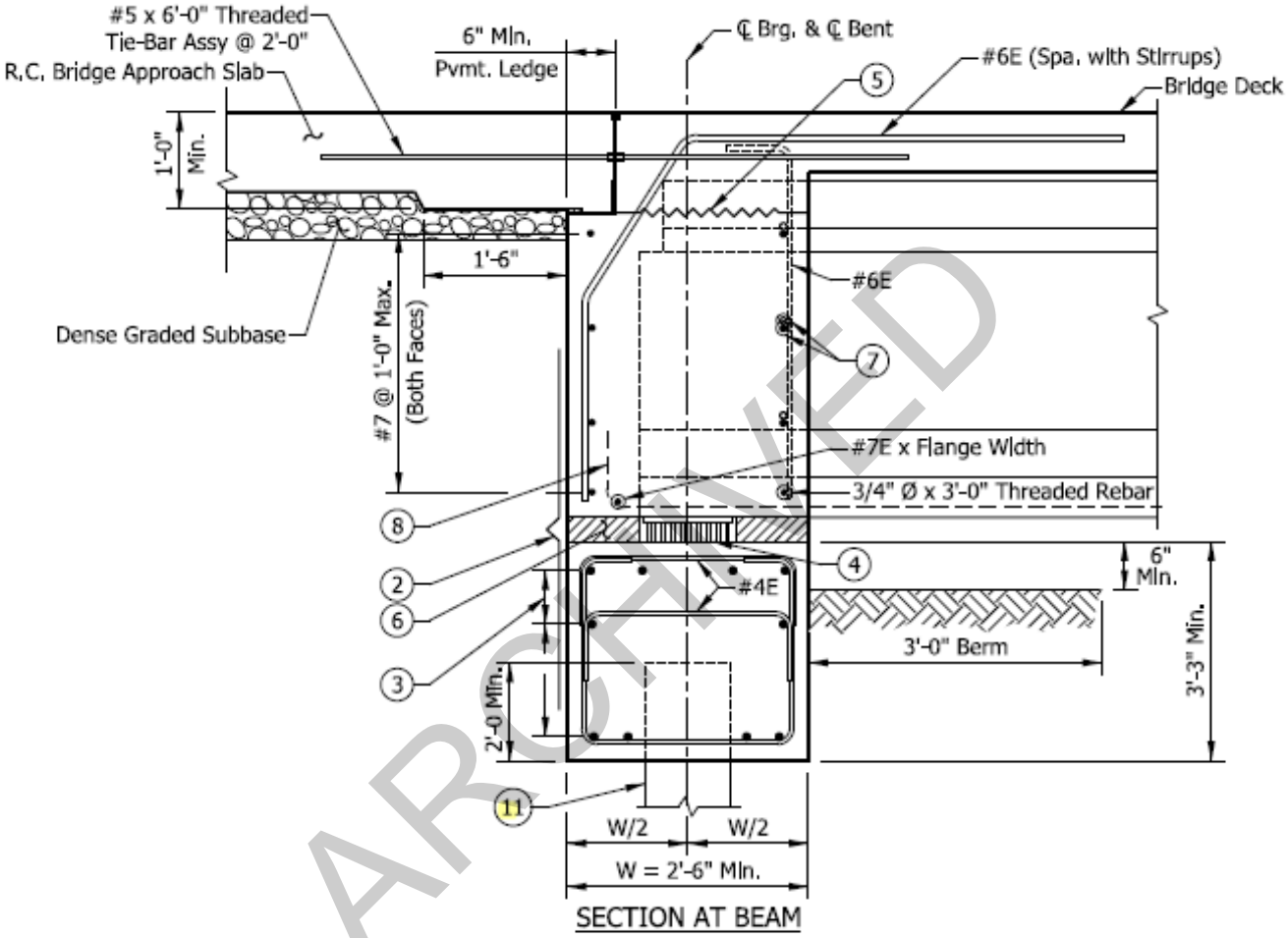
NOTES:

1. 3 layers of medium weight roofing felt with grease between layers over 1/8" high-density plastic bearing strip with smooth side up.
2. Expanded polystyrene, size to be determined by designer.
3. Polychloroprene joint membrane attached to concrete. See Figure 409-3C.
4. Main cap reinforcing. Reinforce for dead and live loads. Stirrup size determined by designer, spaced at 1'-0" minimum.
5. Anchor plate. See Detail on Sheet 3 of 4.
6. Construction joint, type A.
7. 1" thickness expanded polystyrene, to be extended to 1/2" outside limits of beam, so that beam does not come in contact with construction-jointed concrete.
8. Plate 1/2" x 1'-0", full width of beam, cast in beam.
9. #6E x 6'-0" through 1" Ø holes cast in beams, lapped with #7E between beams.
10. Prestressed strand extension.
11. #6 reinforcing bar set in 1'-0" depth field-drilled hole filled with epoxy grout, min. pullout 26,500 lb.
12. a. PVC sleeve, size determined by designer. Top of sleeve to be sealed before concrete is poured.

    b. Used only if uplift is expected, or if bridge is in Seismic Category B.
13. Minimum distance from any vertical face of end bent to edge of pile should be 9".

SUGGESTED SEMI-INTEGRAL END BENT DETAILS (Method 1)

Figure 409-3A (Page 4 of 4)



SUGGESTED SEMI-INTEGRAL END BENT DETAILS
(Method 2)

Figure 409-3B
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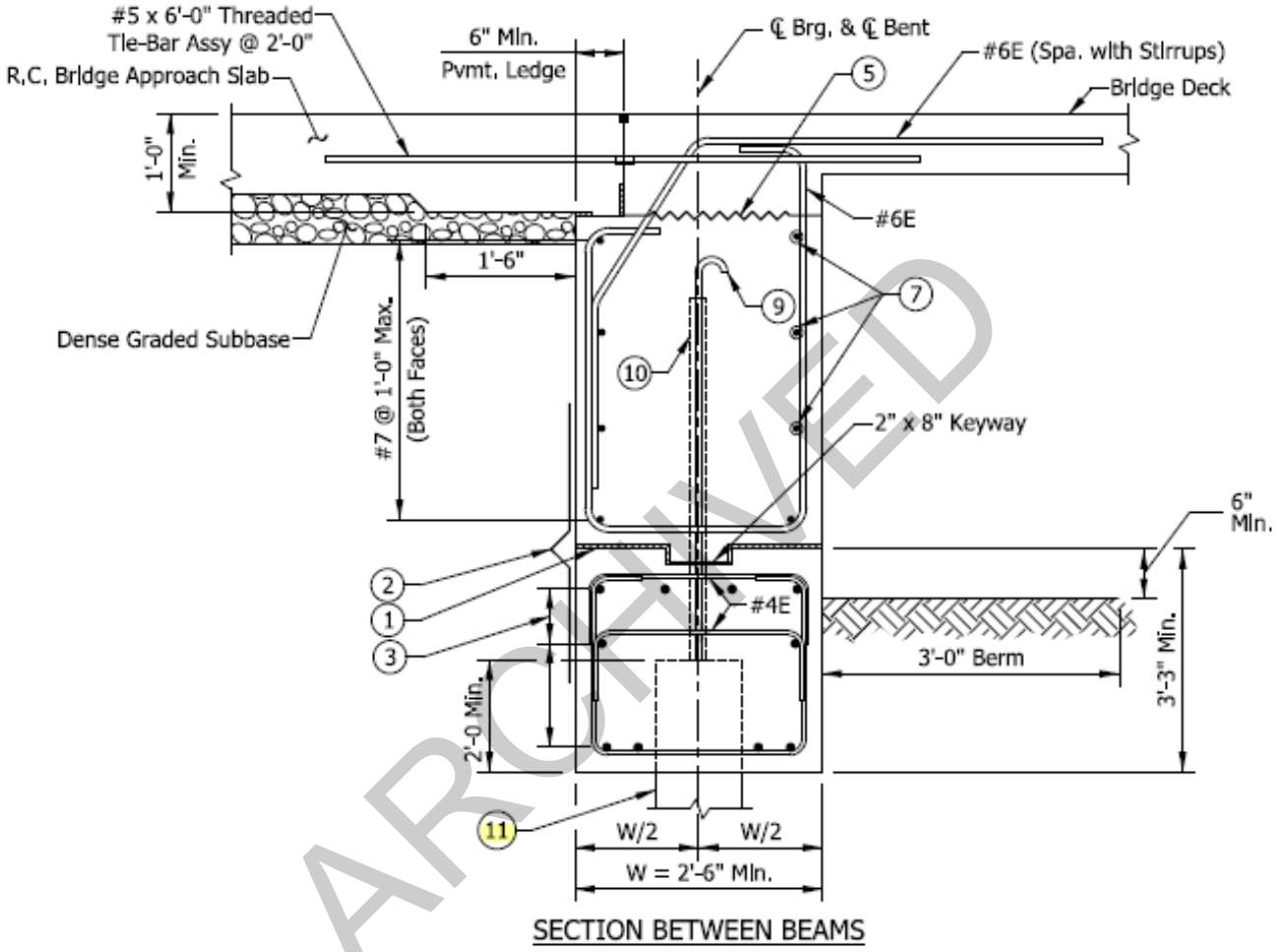

SUGGESTED SEMI-INTEGRAL END BENT DETAILS
(Method 2)

Figure 409-3B
(Page 2 of 3)

NOTES:

(1) 1/2" expanded polystyrene (horizontal face), 1" expanded polystyrene (vertical face).

(2) Polychloroprene joint membrane attached to concrete. See Figure 409-3C.

(3) Main cap reinforcing. Reinforce for dead and live loads. Stirrup size determined by designer, spaced at 1'-0" minimum.

(4) Elastomeric bearing pad.

(5) Optional construction joint, type A.

(6) Expanded polystyrene cut to clear bearing pad by 1/2".

(7) #6E x 6'-0" through 1" Ø holes cast in beams, lapped with #7E between beams.

(8) Prestressed strand extension.

(9) #6 reinforcing bar set in 1'-0" depth field-drilled hole filled with epoxy grout, min. pullout 26,500 lb.

(10) a. PVC sleeve, size determined by designer.
Top of sleeve to be sealed before concrete is poured.

b. Used only if uplift is expected, or if bridge is in Seismic Category B.

(11) Minimum distance from any vertical face of end bent to edge of pile should be 9".

SUGGESTED SEMI-INTEGRAL END BENT DETAILS (Method 2)

Figure 409-3B
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