STATE OF NORTH CAROLINA

DEPARTMENT OF TRANSPORTATION

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MEMORANDUM TO: Project Engineers
Project Design Engineers

FROM: G. R. Perfetti, P. E.
State Bridge Design Engineer

DATE: September 6, 2006

SUBJECT: GUIDELINES FOR INTEGRAL ABUTMENTS

In order to reduce maintenance problems associated with expansion joints, engineers shall consider eliminating joints on bridges by utilizing integral abutments at the end bents, and employing continuous or continuous for live load girders over interior bents wherever possible. This memorandum provides guidelines for use of integral abutments.

Geometric Guidelines

Girder bridges with the geometric properties listed below shall be detailed with integral abutments.

- Tangent alignment.
- Skews between 70^o and 110^o, inclusive ($70^o \leq$ skew $\leq 110^o$).
- Vertical grade ≤ 5%.
- Girder height shall not exceed 6ft. (1.83m)
- Total bridge length shall not exceed:
  - 300ft. (91.44m) for steel girder bridges.
  - 400ft. (121.92m) for prestressed concrete girder bridges.

Some site conditions, such as very high rock lines, may not permit use of integral abutments. For those situations, alternative end bent substructure types should be considered on a case-by-case basis.

Project Engineers

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Superstructure

The amount of longitudinal movement that can be accommodated by an integral abutment is limited. As such, there is a limit on the total bridge length that can be detailed with integral abutments. The geometric parameters listed above show limits for the total bridge length.

When integral piers or abutments are detailed, the substructure and superstructure are connected such that additional restraints against superstructure rotation are introduced. This results in the potential to develop negative moments due to live loads in the vicinity of the abutment. As such, for a minimum distance of $0.2L$, measured from the approach slab blockout, provide a minimum of 1 percent total longitudinal reinforcing steel placed equally in the top and bottom mats of steel reinforcement.

Piles

Utilizing the prescribed bridge lengths above and detailing piles as suggested below will circumvent the need to analyze and design the piles to resist forces developed from longitudinal movements of the integral abutment.

Integral abutment bridges depend on the flexibility of the piles to accommodate longitudinal bridge movements. As such, the abutment piles should not be less than 10 ft. in length. For sites with rock, dense material, or cohesive soils, provide prebored holes as necessary to allow for adequate pile lengths. After the piles are installed and fixity is achieved, the prebored hole shall be filled with loose dry sand.

In addition, integral abutments shall be designed with a single row of vertical piles oriented such that longitudinal bridge movements shall induce **bending about the weak axis,** i.e. the pile strong axis shall be parallel to the bridge control line (workline). If bending stresses are excessive, then the piles may be oriented for bending about the strong axis.

Approach Slabs and Wing Walls

Approach slabs shall be supported on a blockout provided in the end bent integral diaphragm, and shall be anchored to the diaphragm so that it moves longitudinally in concert with the bridge. The roadway end of the approach slab shall be supported on a sleeper slab. Standard Drawing BAS11 – *Bridge Approach Slab for Integral Abutment* is available and should be used for plan development.

Brace piles for wing walls piles shall not be permitted. Wing walls may be tapered to reduce their resistance to longitudinal bridge movements.

Pour Sequence

Detail a construction joint, at least 6ft. from the approach slab blockout, such that the deck slab shall be poured prior to pouring the portion of the integral abutment above the bottom of the girders.

The attached Figures 6-132, 6-133, 6-134, 6-135, and 6-136 show details at the integral end bent for steel girder and concrete girder superstructures. The Design Manual will be updated at a later date.

GRP/GM/

Attachments

Fig. 6-132, Fig. 6-132(Metric)
Fig. 6-133, Fig. 6-133(Metric)
Fig. 6-134, Fig. 6-134(Metric)
Fig. 6-135, Fig. 6-135(Metric)
Fig. 6-136, Fig. 6-136(Metric)

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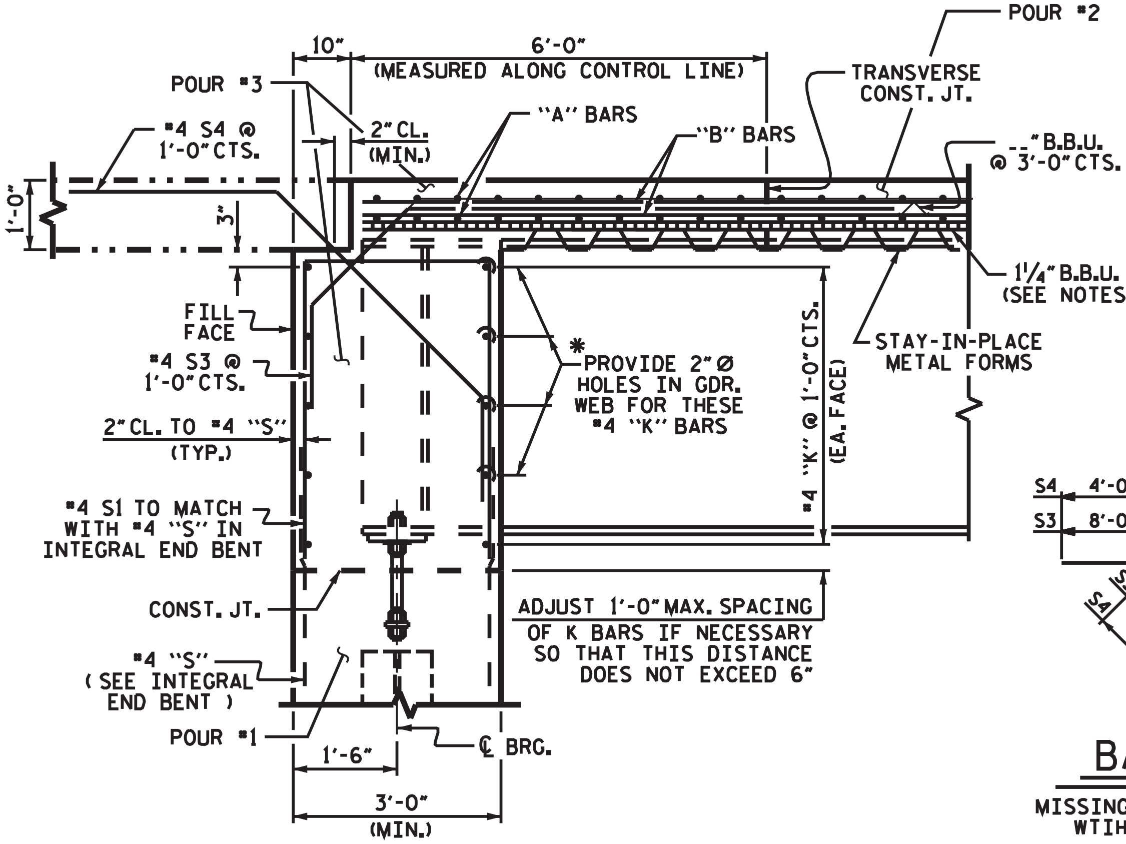
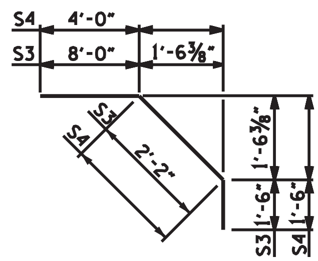


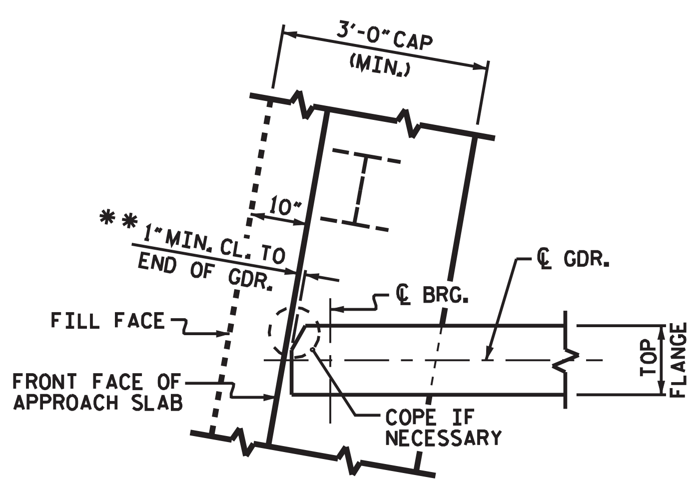
END OF GIRDER DETAIL AT INTEGRAL END BENT

* DIAMETER OF HOLES IN WEB MAY BE INCREASED TO ACCOMODATE SKEW



BAR TYPES

MISSING BAR DIMENSIONS VARY WTIH SKEW & CAP WIDTH



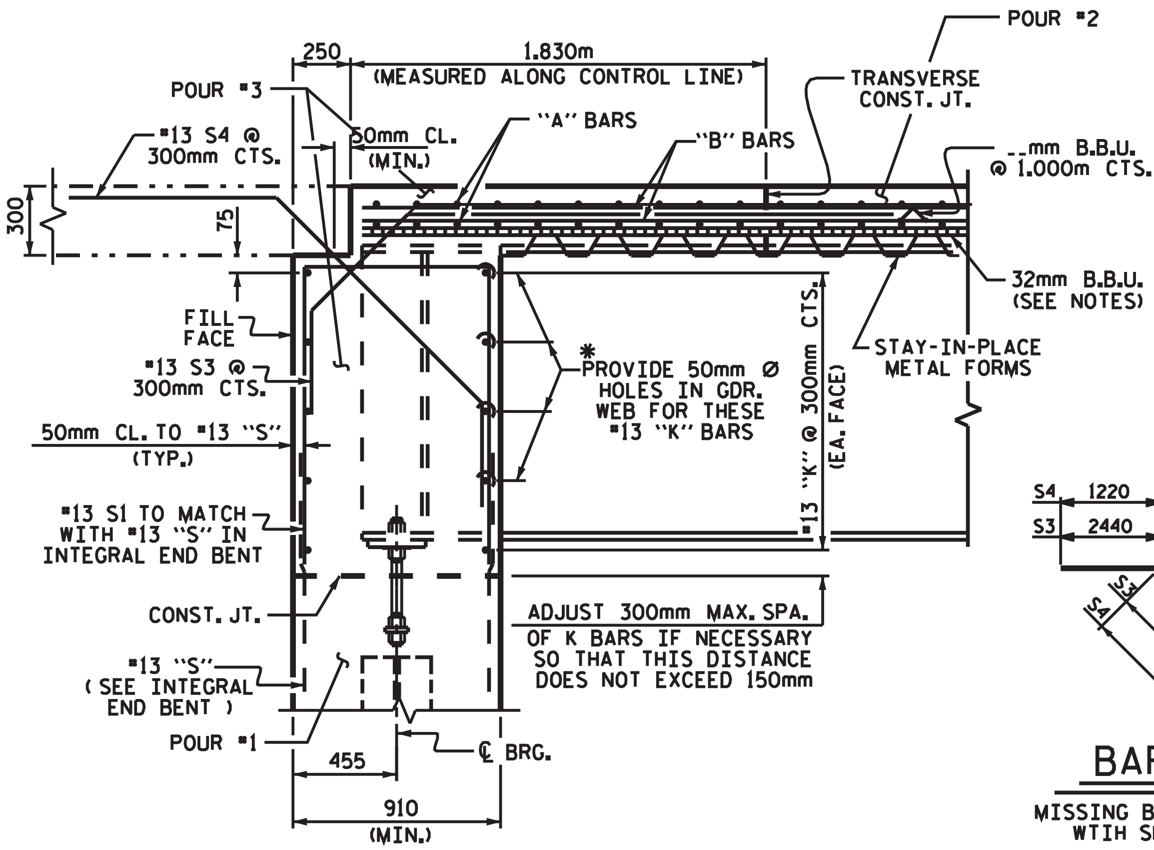
PLAN OF GIRDER AT INTEGRAL END BENT

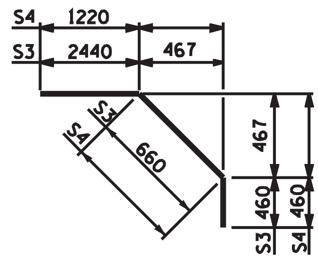
** DO NOT SHOW THIS DIMENSION ON PLANS

INTEGRAL END BENT DETAILS

STEEL SUPERSTRUCTURE

FIGURE 6 – 132



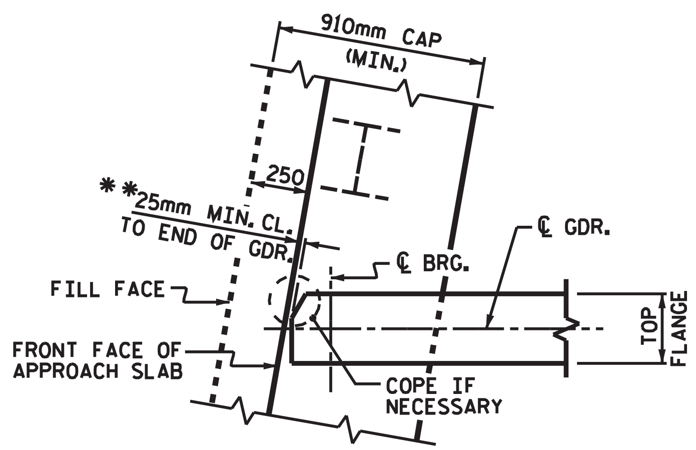


BAR TYPES

MISSING BAR DIMENSIONS VARY WTIH SKEW & CAP WIDTH

END OF GIRDER DETAIL AT INTEGRAL END BENT

* DIAMETER OF HOLES IN WEB MAY BE INCREASED TO ACCOMODATE SKEW



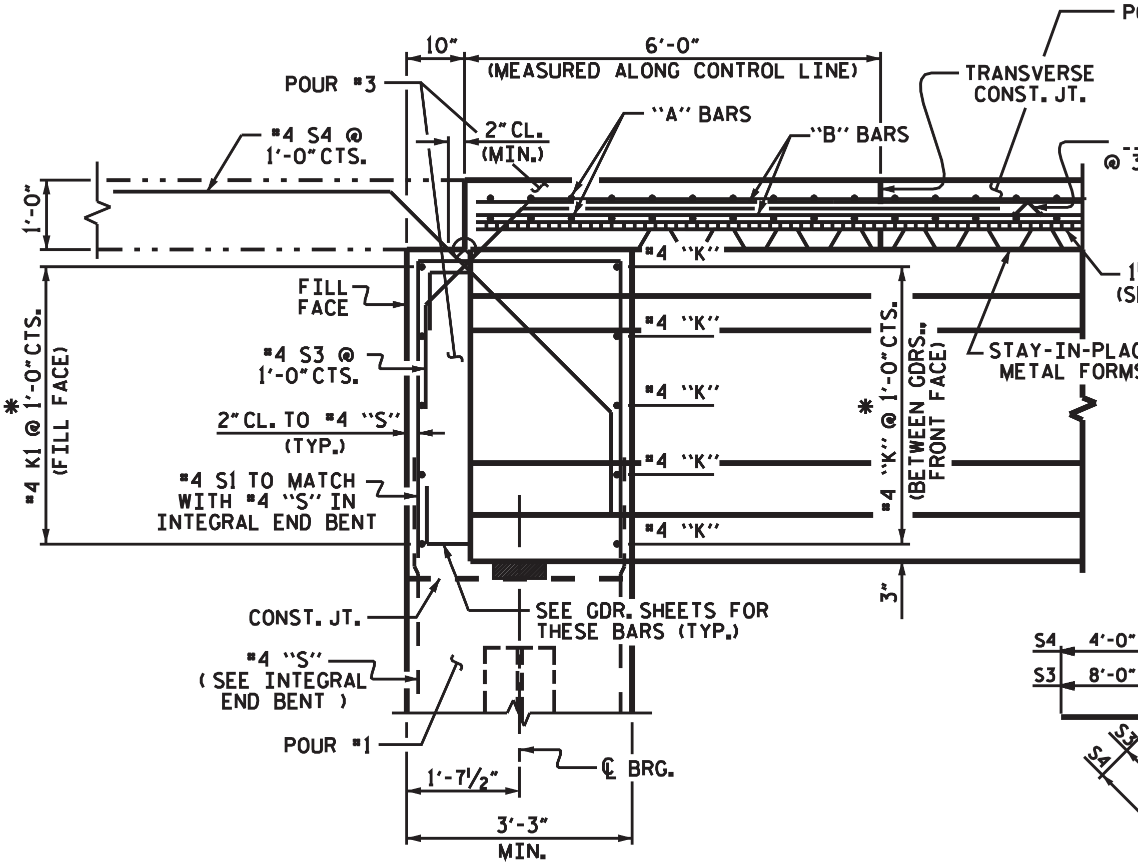
PLAN OF GIRDER AT INTEGRAL END BENT

** DO NOT SHOW THIS DIMENSION ON PLANS

INTEGRAL END BENT DETAILS

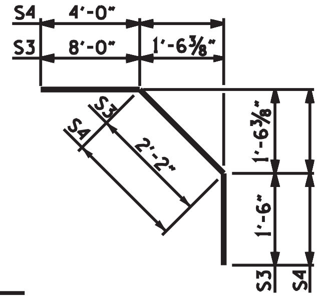
STEEL SUPERSTRUCTURE

FIGURE 6 – 132



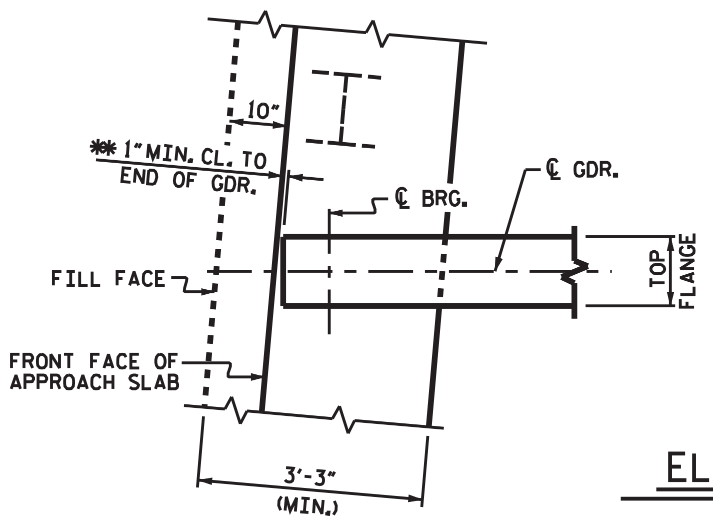
END OF GIRDER DETAIL AT INTEGRAL END BENT

* 1'-0" CTS. IS MAX. SPACING.



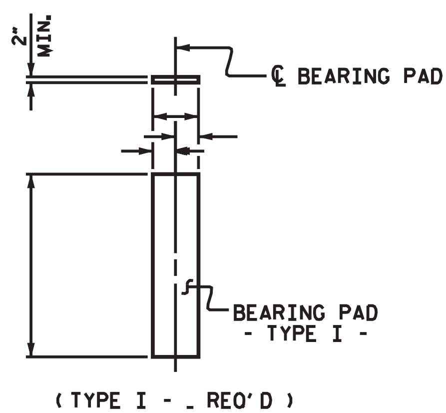
BAR TYPES

MISSING BAR DIMENSIONS VARY WTIH SKEW, CAP WIDTH, & GDR. TYPE.



PLAN OF GIRDER AT INTEGRAL END BENT

** DO NOT SHOW THIS DIMENSION ON PLANS

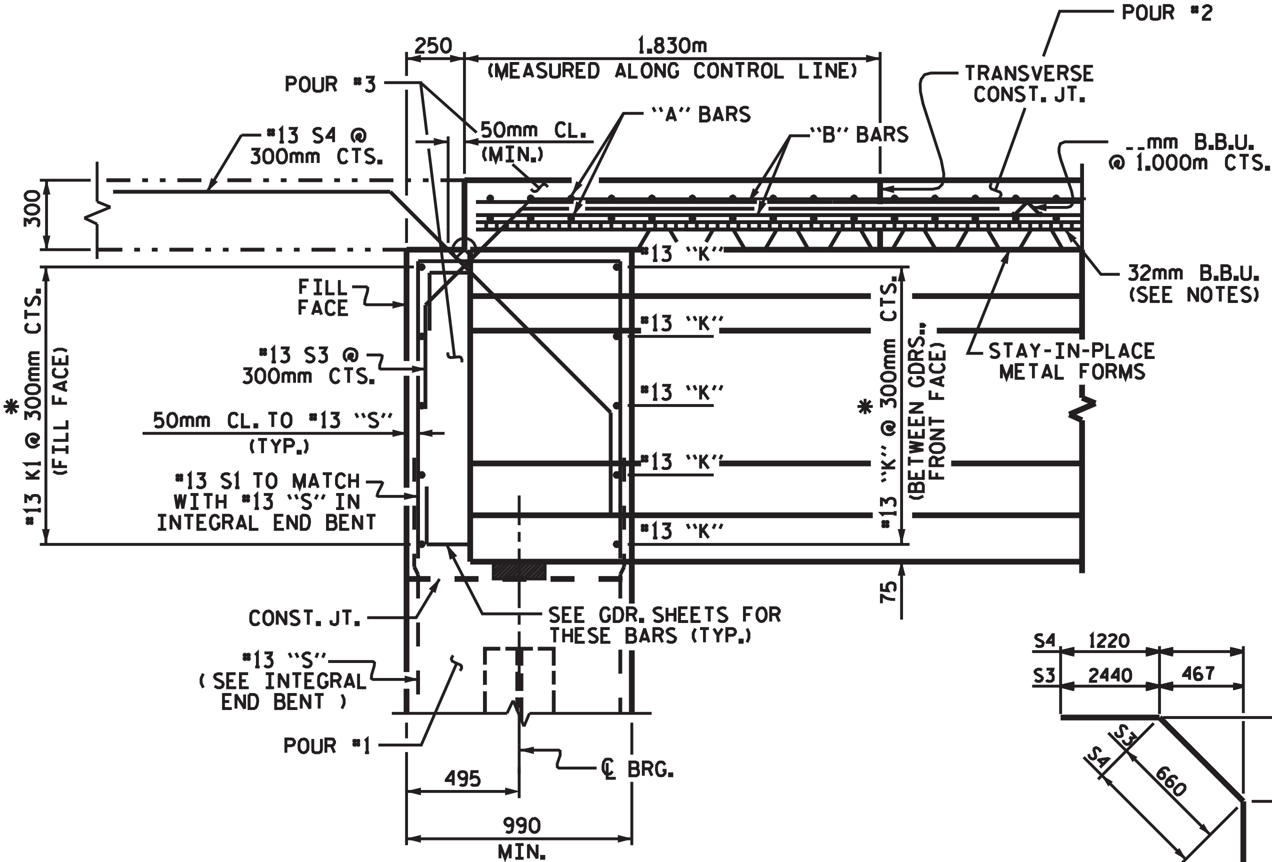


ELASTOMERIC BEARING DETAIL

INTEGRAL END BENT DETAILS

PCG SUPERSTRUCTURE

FIGURE 6 – 134

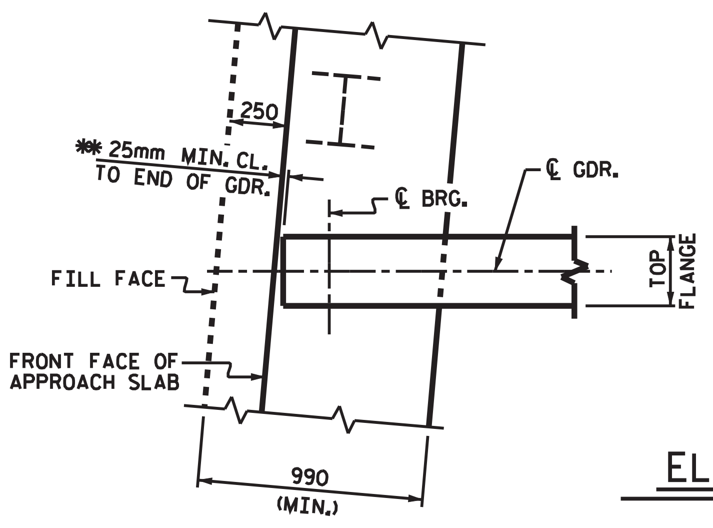


END OF GIRDER DETAIL AT INTEGRAL END BENT

* 300mm CTS. IS MAX. SPACING

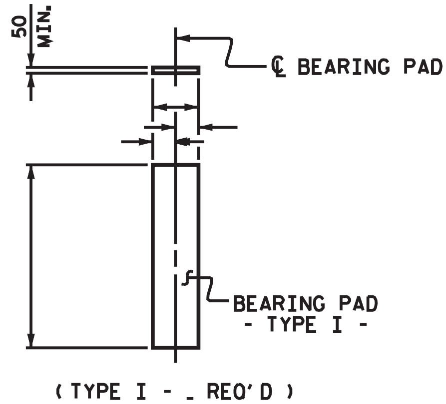
BAR TYPES

MISSING BAR DIMENSIONS VARY WTIH SKEW, CAP WIDTH, & GDR. TYPE.



PLAN OF GIRDER AT INTEGRAL END BENT

** DO NOT SHOW THIS DIMENSION ON PLANS

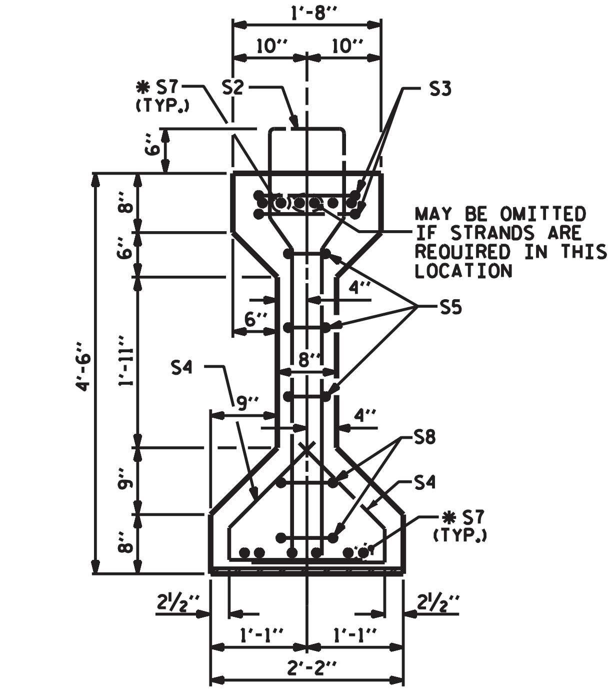


ELASTOMERIC BEARING DETAIL

INTEGRAL END BENT DETAILS

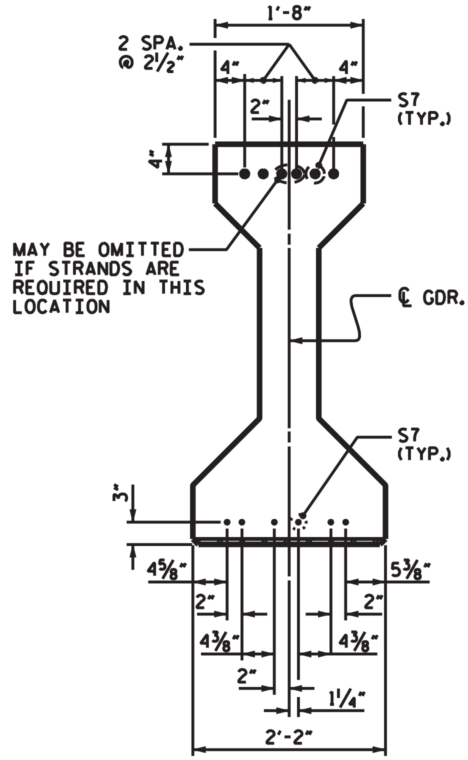
PCG SUPERSTRUCTURE

FIGURE 6 – 134

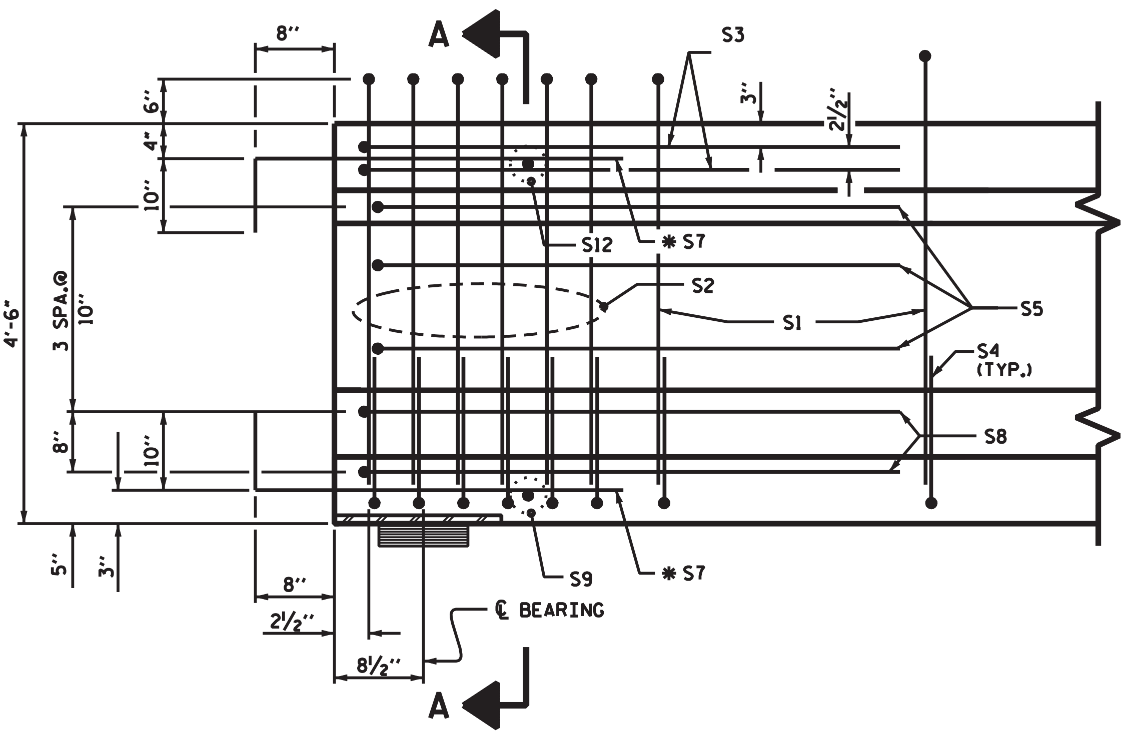


SECTION A-A

* FOR S7 BARS, SEE DETAIL "A"



DETAIL "A"

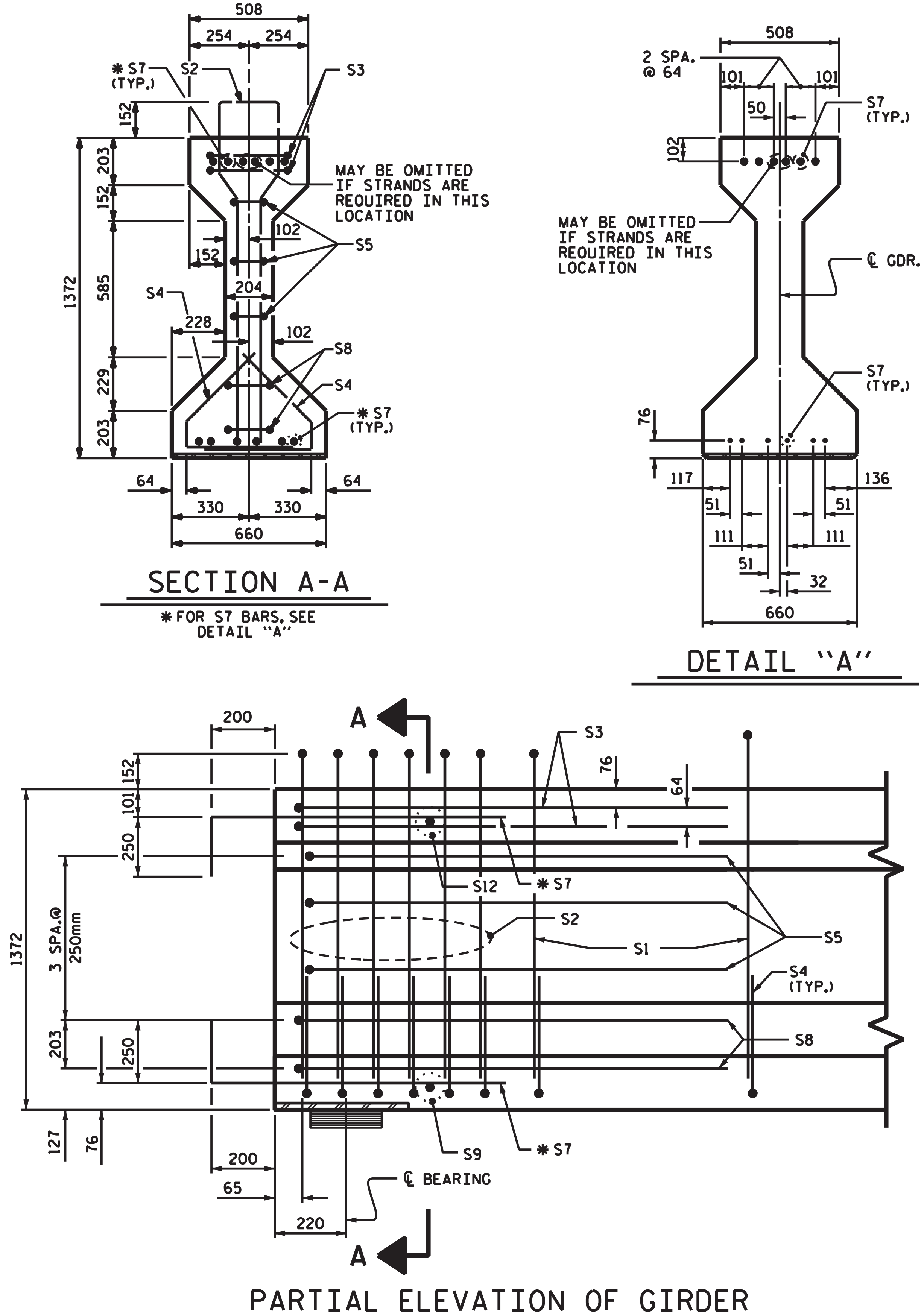


PARTIAL ELEVATION OF GIRDER

INTEGRAL END BENT DETAILS

PCG SUPERSTRUCTURE

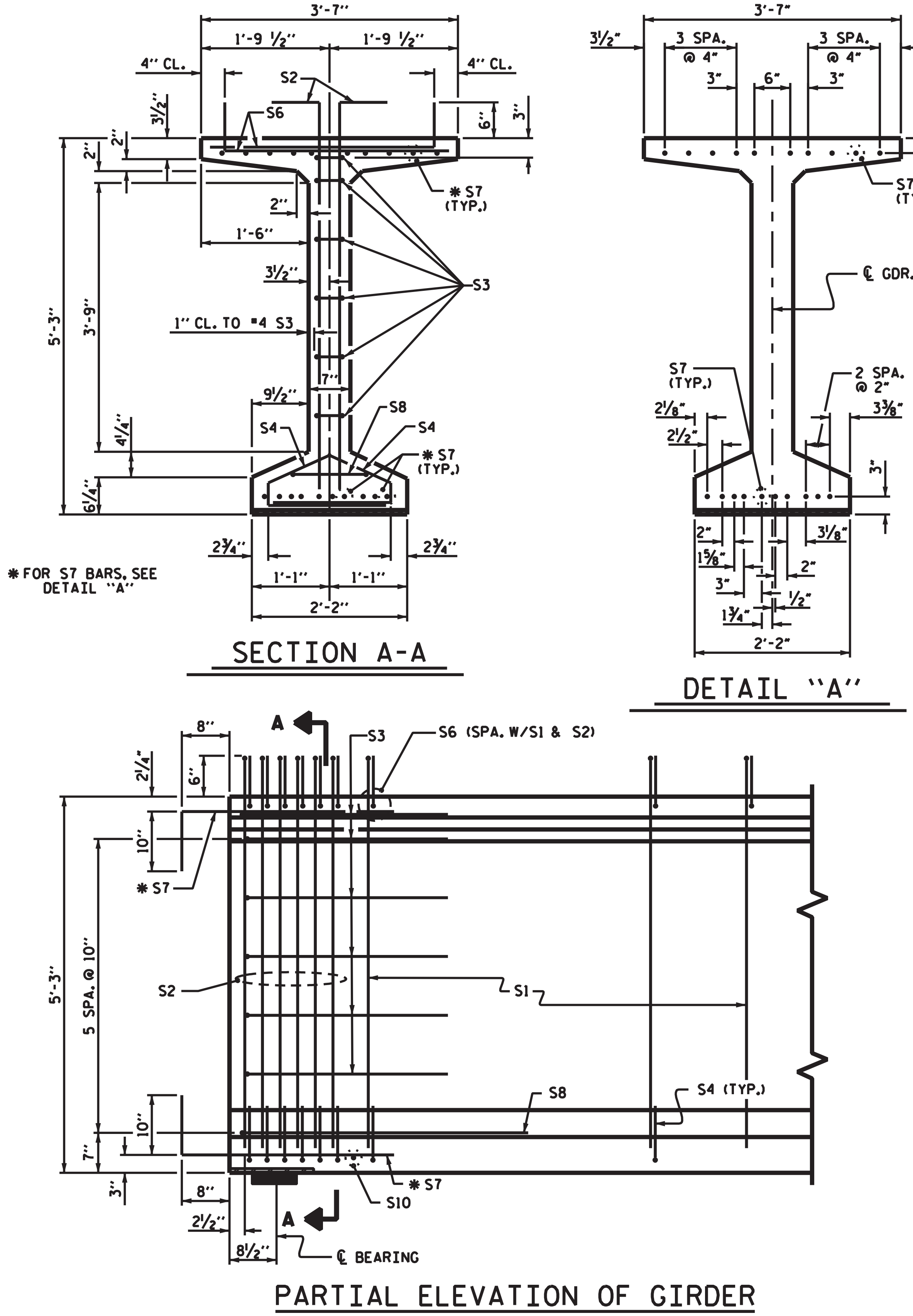
FIGURE 6 – 135



INTEGRAL END BENT DETAILS

PCG SUPERSTRUCTURE

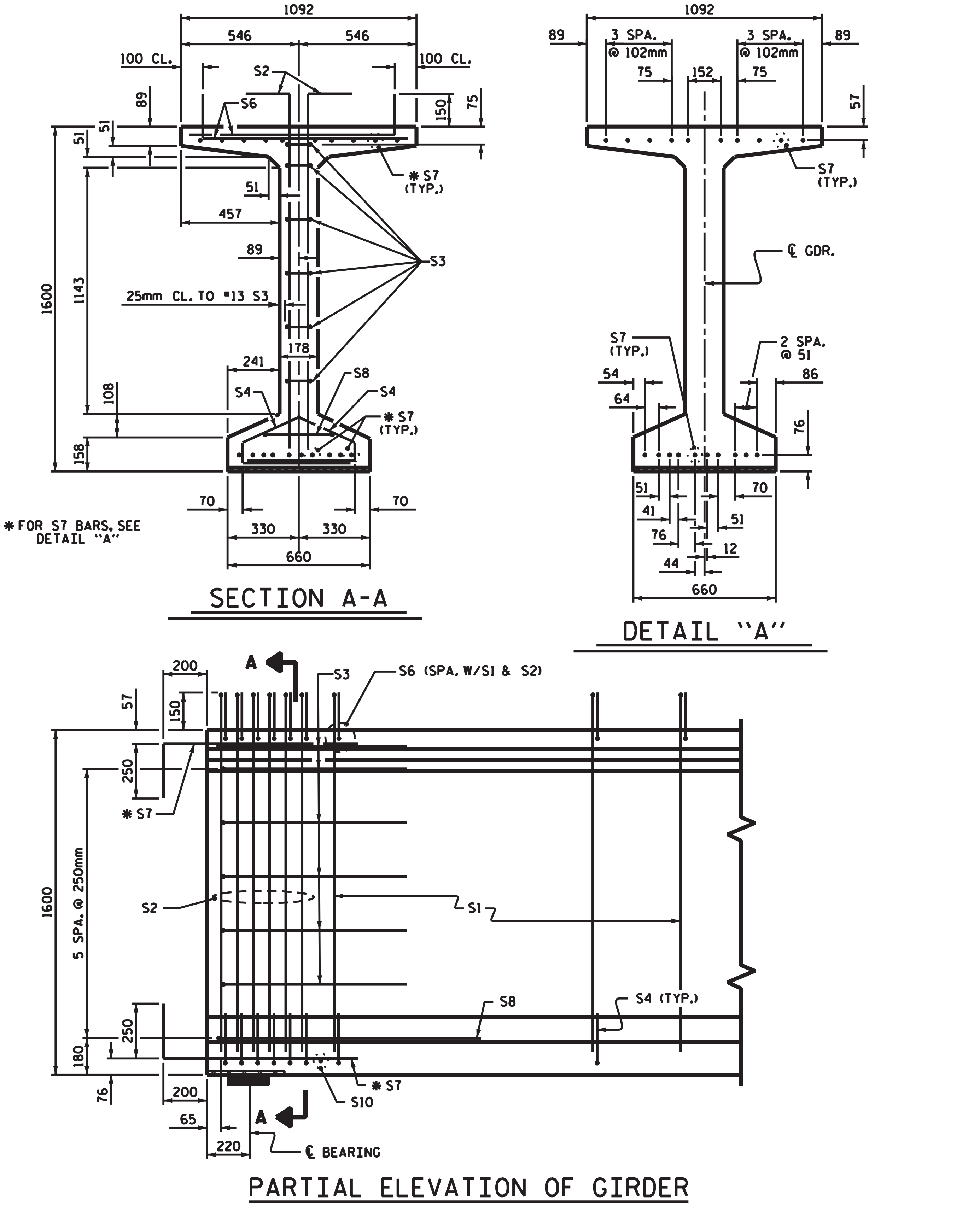
FIGURE 6 – 135



INTEGRAL END BENT DETAILS

PCG SUPERSTRUCTURE

FIGURE 6 – 136



INTEGRAL END BENT DETAILS

PCG SUPERSTRUCTURE

FIGURE 6 – 136