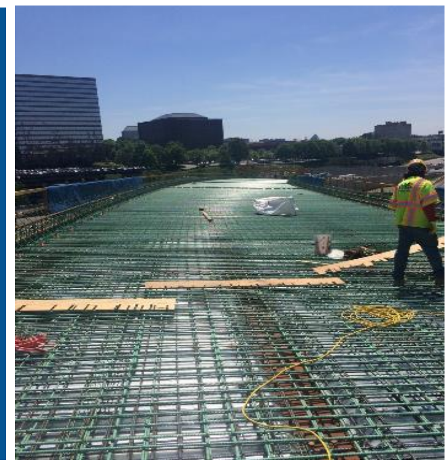
Bridge and Structures Design Manual



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Revision 3.6

Atlanta, GA 30308

GDOT

Georgia Department of Transportation

Disclaimer

This manual is intended to be an aid to designers working on projects for the Georgia Department of Transportation. It is not to be used as a substitute for sound engineering practice and will be used at one's own risk. The Georgia Department of Transportation and the authors of this document are not responsible for the consequences of the use and misuse of the contents of this document.

The latest version of this document is available at:

http://www.dot.ga.gov/PartnerSmart/DesignManuals/BridgeandStructure/GDOT_Bridge_and_Structures_Policy_Manual.pdf

Basic drawings, MicroStation customization tools, design programs, and other helpful resources can be accessed from the Office of Bridge Design and Maintenance home page:

https://www.dot.ga.gov/GDOT/Pages/OfficeDivisionDetails.aspx?officeID=25

Please send constructive comments to the Bridge Design LRFD Committee care of Douglas Franks: dfranks@dot.ga.gov.

Acknowledgement

The original Bridge and Structures Design Manual was created through the public-private partnership of the Georgia Department of Transportation and the Consulting Engineering Companies of Georgia. This document was modified from the original Design Manual for inclusion of LRFD material and general content by Georgia Department of Transportation personnel. The following people have donated their time and resources to contribute to the quality of transportation engineering in Georgia:

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Revision Summary

Revision Number	Revision Date	Revision Summary
LRFD Bridge Manual		
Original	7/8/13	Original Release Date
1.0	10/1/13	Section 3.2.3.3 - Removed “after all necessary grinding” from 8” overhang thickness; Removed “(LRFD 13.7.3.1.2)” from 8” overhang thickness Section 3.5.2.1 - Changed LRFD reference from Table 4A-1 to Table A4-1 Section 4.4.2 - Modified tower bent placement directive; Added pile fixity assumption Section 3.2.2.3 - Removed Commentary
2.0	6/2/14	Section 2.1 - Updated LRFD Specification to 6th edition, 2012; updated Georgia Standard Specification to 2013; defined all bridges as “typical” Section 2.2.2.2 - Allowed Standard Specification widening of Existing Standard Specification bridges Section 2.4 - Changed office responsible for Survey Manual Section 2.8 - Added LRFD software submittal requirements for consultants Section 3.1.1 - New section added - Set minimum beam requirement for bridges with vehicular traffic Section 3.2.2.1 - Added reference to online slab design program Section 3.2.2.4.2 - Changed placement and spacing of temperature steel in top mat of deck Section 3.3.2.2.1 - Clarified urban area locations Section 3.3.2.2.2 - Edited height of fence Section 3.4.3.15.4 - New section added – limiting coping thickness to 6” Section 3.12.2.3.1 - Check clearance between cap and PSC beam when plain pads are used Section 3.12.2.5.2 - Added new section - Directive to minimize number of pad designs for bridge Section 4.2.1 - Specified use of kips in lieu of tons or pounds for foundations Section 4.2.2.3, 4.2.2.4, 4.2.2.5 - Added maximum factored resistances and stresses for all pile types Section 4.2.3.4 - Restricted use of spirals in caisson; limited ties to maximum size of #6; Stated seismic detailing at fixity is not required in caissons Section 4.4.1.2.1 - Added limits for depth to width

		ratio of intermediate caps; Changed cap width increment to 3” Section 4.4.1.2.2 - Modified longitudinal rebar in riser of intermediate bents to # 5 Section 4.4.1.3 - Removed railroad from vehicular collision consideration
Bridge Design Manual		
Original	1/26/15	General - Incorporated Standard Specification guidance from GDOT Bridge and Structures Design Manual into LRFD Bridge Manual to produce a consolidated manual Section 1.3.3 - Added requirement to submit design calculations in PDF format Section 1.4.3.1 - Added guidance for when a deck section is required on preliminary layouts Section 1.6.9.2.2 - Removed direction about railroad shoring review Section 1.6.9.2.4 - Added reference to 8.2.10 Section 3.2.4 - Revised requirement for epoxy reinforcement Section 3.2.5 - Removed requirement for grooving under medians Section 3.3.2.2 - Modified description of new curved fence detail Section 3.3.2.2.1 - Clarified directive for the use of handrail or fence on parapets Section 3.4.1.2.1 - Removed restriction on use of 0.6” diameter strands Section 3.4.2.6.2 - Limited coping thickness to be used for composite properties Section 3.4.2.7, 3.5.2.2 - Limited beam spacing to 9’-0” Section 3.6.2 - Added the use of “weathering steel” Section 3.9.1.1 - Added provisions for use of steel diaphragms for concrete beams Section 3.15.1 - Revised Drainage Manual reference Section 4.2.2.2 - Modified “Factored Axial Load” note Section 4.2.2.3 - Clarified directive on use of 50 ksi H-piles versus 36 ksi H-piles Section 4.2.2.4 - Removed 12” PSC piles from Table Section 4.2.2.5 - Added 20” and 24” metal shell piles to Table

		Section 4.2.3.4 - Added 5" clear spacing as minimum for stirrups and vertical bars in caissons Section 4.3.4 - Modified wingwall length requirement Section 4.4.1.2.4 - Increased minimum stirrup spacing to 5" Section 4.4.1.3 - Added 4" minimum stirrup spacing requirement for columns Section 5.1.1.1 - Revised Table to change Modular Walls to Modular Block Walls Section 5.5.5 - Limited Modular Block Wall design height to 20 feet Section 8.1.1.1 - Modified when bridge plans require a revision mark Section 8.2.10 - Added direction about railroad shoring review Section 9.2.1 - Added directive to include Seismic Zone and SD1 on General Notes sheet
1.0	5/5/15	Section 2.1 - Updated LRFD Specification to 7th Edition, 2014 Section 2.1.3 - Removed Guide Specification reference; contact Bridge Office for guidance Section 2.3.3.1 - Added for vertical clearances to be satisfied for travelway Section 3.4.1.2.4 - Added that draped strands shall not be placed in the top 8" of beam Section 4.2.2.2 - Added guidance in reference to information needed in bridge plans for field measurement of driving resistance for piles for LRFD projects. Section 4.3.2, 4.4.2.1 - Added guidance that 5.10.8 need not apply to side faces of bent caps less than or equal to 2 foot high.
2.0	7/31/15	Reformatted manual to standard template
2.1	1/25/16	Section 1.3.3 – Added restriction for modifying title block Section 1.4.2 – expanded/clarified guidance for consultant QA/QC Section 1.6.7 - Added guidance for re-request for bridge condition surveys Section 2.9.4.4 - clarified span limit for pile bents for AASHTO PSC beams only Section 2.9.4.6 - Added reference to beam length limits Section 3.2.3.2.3 - changed title and added 1" difference limit for overhang Section 3.4.2.8 - Added section for beam length

		guidance Section 3.8 – Changed to include new precast beam types Section 3.10.1 - Added steel orientation guidance Section 3.11.2 - Added steel orientation guidance Appendix 3B – Changed beam charts for new beam length limits Section 4.3.2 – Waived LRFD 5.10.8 for bottom of caps Section 4.4.1.3 – Added 6” minimum stirrup spacing Section 4.4.2.1 – Waived LRFD 5.10.8 for bottom of caps Section 5.5.3.1(g) – revised coping names to match pay items Fig. 5.5.3.1-3 – revised to show sloping paving Fig. 9B-1 – Revised to show cross-ties for plastic hinge regions
2.2	10/26/16	Chapter 2 -Modified temporary vertical clearance for falsework Chapter 3 - Set maximum 28-day concrete strength for PSC beams to 10.0 ksi. Removed “with Bridge Office Approval” clause. Rewrote top strand pull force guidance for clarity Chapter 4 - Added guidance to place top mat of steel in all spread footings. Added guidance to place top mat of steel in seismic pile footings Chapter 8 - Defined lap splice requirements for welded wire fabric
2.3	7/11/17	Section 2.2 – Added guidance for application of truck-train loading Section 2.9.4.1 – Updated sq. ft costs Section 2.9.4.8 – removed cost references for steel beams Section 2.10 – Added requirement for quantities on Design-build projects Section 3.4.2.5 – Added limit for stirrup clear spacing in anchorage zone Table 3.8.1-1 – Updated span limits for cored slabs and box beams Section 3.9.1.1 – Added need for galvanization of steel diaphragm and rearranged guidance for use Section 3.10.2 – Defined what is deemed a “visible area” Section 3.14.1.3 – Added reference for utilities through MSE walls

		Section 3.14.1.6 – Added limits of utility pipe sizes based on beam depths Section 4.1.2 – Section added for stiffness approach and re-organized 4.1 Section 4.2.2.4 – Modified guidance for HPC and stainless steel use in PSC piles Section 4.2.4.3 – Guidance for allowable settlement and keying spread footings Section 4.2.5.4 – Clarified zero uplift check Section 4.2.7 – Added; alternate foundation types Section 4.4.1.1 – Modified 2 column bent guidance to 60 ft Section 4.4.1.2.1 – Removed guidance that cap should extend beyond bottom edge of beam Section 4.4.1.2 – Added additional guidance for applying collision load to columns Section 4.4.1.5 – Added guidance for use of general note for special finish for navigable water bridges Section 5.1.3 – Section added for MSE wall design requirements Section 5.2.2(d) – Added reference Section 5.3 – wall plans to be drawn to equal vertical and horizontal scales. Section 5.5.3 – Added sentence to follow section for walls Sections 5.5.3.1 and 5.5.3.2 – Re-organized to add subsections for information
2.4	10/13/17	Cover - Added Donn Digamon to the list of active committee members Section 1.6.8.1 - Reduced gross haul weight requiring routing investigation Section 2.3.3.1 - Added vertical clearance requirements for bridges over mixes use trails Section 2.9.4.1 - Revised the square foot cost for PSC beams on concrete bents Section 2.10.1 - Revised the rounding integer for pile quantities Move subsection 3.4.3.3 to 4.4.1.2.5 Section 3.3.2.3.4 - Added directive to add note for minimum lap of 2'-2" on stirrup bars in barriers/parapets Section 3.4.2.8 - Added requirement for lateral stability check by EOR when beam limits are exceeded. Table 3.12.1 - Modified to eliminate using

		unreinforced pads for Type I Mod beams Section 3.12.2.2.2 - Revised title to read Width and Length and set minimum pad length to 9inches Section 4.3.2 - Added requirements for end bent cheek walls Section 4.3.4 - Deleted guidance on mismatched wingwall lengths Section 4.4.1.2.4 - Prohibited the use of single legged stirrups Section 4.4.1.2.5 - Relocated from 3.4.3.3 Section 5.3.1 - Added requirements for wall plans Section 5.3.2 - Added requirements for wall plans Chapter 6 - Corrected chapter title Section Fig 9.B-2 - Revised figure to match directive
2.5	2/23/18	**Chapter 2** 2.3.3.2 - Added guidance regarding horizontal bridge clearance for future lanes. 2.10.1 - Revised the integer to which pile quantities shall be rounded. **Chapter 3** 3.2.2.2.3 - Revised statement explaining minimum slab thickness table. 3.4.1.1 - Set minimum difference between initial and final concrete strength for PSC beams. 3.4.1.2.3 - Added requirement to fill PSC strand pattern from bottom up. 3.9.1.1 - Revised steel diaphragm requirements 3.9.1.3 – Added subsection on diaphragm materials, including necessary General Notes. 3.12.2.3.1 - Removed option of 1/2in unreinforced pads under Type 1 Mod beams. **Chapter 4** 4.1.2- Specified that Service Limit State should note control size or design of elements. 4.2.2.2 - Revised the integer to which pile quantities shall be rounded. 4.2.4.2 – Restricted the use of stirrups as a means to control shear in spread footing. 4.2.5.2 – Restricted the use of stirrups as a mean to control shear in pile footings. **Chapter 5** 5.5.3.1.9- Removed New Jersey Barrier option from Traffic Barrier H, modified design loading, and revised figure.

		5.5.7 – Added guidance on estimating right of way need behind tie back walls. 5.5.8 – Added guidance on estimating right of way need behind soil nail walls.
2.6	6/7/18	**Chapter 2** Section 2.3.2 – Corrected Hydraulics Manual Chapter Reference **Chapter 3** Section 3.9.1.3-Added guidance on payment for steel diaphragms. Section 3.9.2.1- Revised steel cross frame preference. Section 3.12.2.2.2- Redefined minimum bearing pad width. Section 3.12.2.4.3- Added Slippage Check to bearing design. Section 3.12.2.5.4 - Added directive to specify design yield strength for bolts on the plans. Section 3.14.1.3- Added guidance on payment for water hanger steel. Section 3.15.4.4 - Revised guidance for drain pipe installation. **Chapter 4** Section 4.1.2- Defined required flood year for stream pressure calculations. Section 4.3.2- Revised minimum elevation difference to require a cap step. Section 4.4.1.2.2- Added minimum elevation difference for required cap step. **Chapter 5** Section 5.1.2.2- Changed subsection title to match common nomenclature. Section 5.1.3.4- Added direction for MSE Wall external stability calculations. Section 5.5.3.2.5- Revised guidance on calculating Additional MSE Backfill.
2.7	8/10/18	Updated GDOT logo throughout
2.8	4/19/19	**Chapter 1** 1.3.5- Added subsection describing plan quality evaluation process 1.6.8 – Edited subsection title 1.6.8.1- Broadened directive on haul weight limits requiring assistance from GDOT truck routing personnel. Appendix 1B - Added copies of Quality Evaluation

		Forms **Chapter 2** 2.1.1 - Added the bridge design policy manual to the list of controlling documents for design 2.5.1 - Specified a required minimum assumption for the width of temporary shoring and clarified the need for temporary shoring pay item 2.5.4 - Provided guidance about accommodating overhang brackets into staging layouts 2.5.5 - Specified the minimum number of beams to be used in construction stages 2.5.6 - Added guidance about including pedestrians in staging plans 2.8.1 - Revised name of general notes program 2.9 - Drew attention to section 2.5 2.9.2.2- Typo correction **Chapter 3** 3.3.2.1-1 – Replaced Table of approved barriers 3.3.2.2.1 – Revised barrier requirements for bridges with sidewalk 3.3.2.2.2 – Revised barrier requirements for bridges without sidewalk 3.3.2.2.3 - Eliminated Kansas Corral rail as an architectural bridge rail option and stated MASH requirement for alternate rail systems 3.3.2.3.3 – Modified guidance on widening barriers for fence 3.3.6 - Removed requirement for temporary barrier special provision and prohibited use of method 2 on new bridge decks 3.3.6.2 - Modified offset requirement from edge of deck for method 2 temporary barrier 3.4.1.2.3 - Modified reference to basic PSC beam drawings 3.8.1 - Added guidance for use of “Other Precast Concrete Beams” 3.13.1.1 - Modified requirements for pour strips to include all stage constructed bridges carrying traffic 3.15.4.1 - Eliminated ductile iron as a drainage system material Appendix 3E - Added barrier detail drawings **Chapter 4** 4.3.2 - Reorganized and subdivided section and increased cheek width requirements for end bents 4.4.2.3 - Added directive to deal with very short pile

		exposures **Chapter 5** 5.5.3.2.7- Expanded guidance regarding pressurized utility encasement behind MSE walls 5.5.8 - Revised requirements for permanent facing on soil nail walls **Chapter 7** 7.1 - Revised Drainage Manual Chapter Reference 7.1.2 - Modified guidance on detour bridge elevations
2.9	5/26/20	**Manual** Updated cover page and background colors in manual to comply with branding guidelines. Chapters 6, 8 and 9 contain no content changes only branding changes were made **Chapter 1** 1.6.8 - Revised the office responsible for haul route coordination **Chapter 2** 2.1- Added requirements for adherence to manual revisions 2.1.1- Clarified required design methods and specifications for GDOT structures projects 2.1.3- Revised required design specification for sign and light supports 2.1.4- Revised title and required design specification for noise barriers 2.5.7- Added directive to avoid nonsequential staging 2.8.2- Added requirement to use GDOT slab design program 2.9.1.3- Added restriction on skews over water. 2.9.2.4.1- Added shoulder width requirements for bridges carrying Diverging Diamond Interchanges 2.9.2.5- Section renumbered 2.9.4- Revised direction for using Guidelines for Selecting Bridge Type section 2.10.3- Reformatted and revised to provide clarity and an example for staged constructed continuous units. **Chapter 3** 3.2.1.2- Added guidance regarding splice lengths, and limited reinforcing steel strength. 3.2.2.2.1- Added requirement to use GDOT slab

		design program. Table 3.2.2.2-1- Reduced the number of Slab thickness cases for design. 3.2.2.3.1- Reduced maximum spacing limit for main slab reinforcement. 3.2.2.3.4- Revised guidance on determining lap splice in slab. 3.2.3- Revised guidance on the design and detailing of overhang slabs, including guidance related to MASH barriers on Standard Specification projects. 3.2.5- Added directive to account for staging in grooving quantities. 3.3.2- Revised guidance on the requirements for bridge railings. 3.3.3.1- Revised the minimum sidewalk width and guidance about approval of shared use paths. Table 3.4.1.1.3-1- Revised concrete stress limits and code references 3.4.2.7- Increased Maximum beam spacing for LRFD projects. 3.4.2.8-Revised title to clarify that section selection should be controlled by span length, and modified table to clarify Mod 1 beam use, and add additional Bulb Tee sections. 3.4.2.9- Added guidance regarding longitudinal reinforcement check for PSC beams. 3.4.2.10- Added requirement for positive camber in PSC beams. 3.4.3.1- Clarified steel clearance requirements for PSC beams 3.4.3.4- Deleted broken reference and added table of PSC beam characteristic necessary for design. 3.4.3.8- Resolved a conflict between the manual and the basic beam drawings regarding dowel chase dimensions. 3.4.3.14.3- Clarified how additional coping should be calculated. 3.6.2- Reformatted section and added guidance on use of weathering steel. 3.6.5.1.1- Revised allowable plate sized for steel girders. 3.9.1.3- Added further restrictions on the use of steel diaphragms and provided guidance on the frame design. 3.10.1- Revised guidance on detailing of edge beams.

		3.10.2- Revised requirement for PSC embedment into edge beams. 3.14.1.6- Revised table 3.14.1.4-1 to clarify limits on acceptable utility pipe diameters. **Chapter 4** 4.1.1 Revised to separate concrete and reinforcement guidance and provide lap splice guidance. 4.2.2.2- Added guidance on presenting driven pile information on plans. 4.2.6.1-Revised guidance on cofferdam coordination 4.2.6.2-Clarified detailing of seal concrete 4.2.7- Revised guidance on presenting Alternate Foundation Type quantities. 4.3.2.1-Revised guidance on end bent cap dimensioning. 4.4.2.1- Revised guidance on pile bent cap dimensioning. **Chapter 5** Table 5.1.2.1-1- Updated retaining wall standards table 5.1.3.5- Added guidance on applying an impact load to retaining wall barriers. 5.5.1- Updated Standard reference 5.5.2- Updated Standard reference 5.5.3.1.9- Simplified guidance regarding MSE barrier coping consideration. **Chapter 7** 7.4 -Revised title and added need to include vehicle collision forces in the design.
3.0	4/16/21	**Cover** Reduced the number of websites referenced to prepare for upcoming website revision **Revision Summary** The previous Revision 2.9 “revision summary” section had the incorrect version number listed for revisions dated 4/19/19 and 5/22/20. They have been corrected. **Chapter 1** 1.1.5.1-Revised BMU responsibilities 1.3.5- Added statement about return of poor-quality plans 1.4.3-Revised submission process for Preliminary Plans

		1.4.4-Revised submission process for Final Plans 1.6.4-Updated State Bridge Engineer Signature guidance 1.6.7- Put deck condition survey requests in the control of BMU as part of overall condition survey 1.6.9- Update plan distribution guidance for preliminary and final plans 1.6.13- Revised FHWA oversite guidance 1.7.2-Deleted outdated content 1.7.3-Simplified and referenced internal documents Appendix 1A- Revised example content **Chapter 2** 2.1- Provided calendar date for application of design guidance 2.1.1-Updated applicable construction specification 2.9.2- Revised bridge width requirements to functional classification system 2.9.3- Added guidance on determining bridge length and using MSE wall abutments 2.9.4.1- Updated Square Foot Bridge Costs 2.9.4.4- Revised and clarified guidance on psc spans on pile bents **Chapter 3** 3.2.2.2.2-Clarified language 3.2.2.3.1- Change directive on matching top and bottom steel reinforcement on LRFD decks 3.2.2.3.2-Set minimum steel spacing for bottom distribution steel in LRFD decks 3.2.2.3.6- Describes addition of #5 bar paralleling joints on skewed bridges 3.2.3.3.1- Added direction about not re-designing distribution steel based on overhang detailing 3.3.2.3.1-Revises end post detailing requirements, including minimum lengths 3.6.5.2.1-Split “D” dimension guidance on rolled steel beams from built up steel girders 3.10.1-Revised plan note related to edge beam form removal 3.11.2-Removed commentary statement related to article 4.3.2.2 3.12.2.5.3- Added specific method for calculating need for bearing pad shims 3.13.1- Added guidance to include a note on the deck section sheet about not tying laps in the pour

		strip 3.15.3.1-Revised and clarified guidance on using deck drains 3.15.4.4-Revised and clarified guidance on drain pipes Appendix 3B- Updated Beam Charts **Chapter 4** 4.2.2.4-Clarified use of high-performance concrete and stainless steel in psc piles 4.2.2.5-Rrefined guidance on using MS piles 4.2.3.2- Removed minimum 4ft shaft requirement for inspection and established 3ft at minimum 4.2.6.1- Modified submission requirements for cofferdam recommendation requests 4.3.2.1-Corrected cap width increase requirements to be consistent with other sections 4.3.2.2- Modified and simplified directive on skewing end bent cap steps 4.3.4- Corrected pile boxes requirements and added vertical dimension requirement for pile boxes. 4.4.1.2.4-Added requirement to terminate positive moment cap steel on the cantilever side columns 4.4.2-Provided more concise directive on determining fixity in pile bents. 4.4.2.1- Corrected cap width increase requirements to be consistent with other sections 4.4.2.2- Made sway bracing use a condition of design 4.4.2.3- Clarified directives on when and how to use paint and encasement to protect piling **Chapter 5** 5.5.3.1.1- Established guidance for embedment of MSE abutment walls under hydraulic bridges 5.5.6- Added guidance on payment quantities for soldier pile walls **Chapter 7** 7.1.2- Increased maximum detour bridge height limit. 7.3.1- Linked sign support design to chapter 2 **Chapter 8** 8.2- Added guidance about what to do if shop drawings are routed improperly 8.2.1.1- Deleted duplicate information

		8.2.1.6- revised referenced sections 8.2.1.8- Updated record keeping concept 8.2.8- Revised wall survey verification and submittal of MSE wall shop drawings 8.2.10-Established shop drawing process for PSC piles **Chapter 9** Updated spec references
3.1	11/29/21	**Cover** Revised Design Manual Committee member list **Chapter 1** 1.4.3.1- Clarified formatting of preliminary plan submittal documents 1.4.4.1- Clarified formatting of final plan submittal documents 1.6.9.1- Added the Southwestern Railroad to list of NSRR subsidiaries 1.6.9.4- Revised routing procedures for shop drawings **Chapter 2** 2.1- Updated AASHTO specification requirements for design 2.3.4.1- Revised horizontal envelope for measuring vertical clearance 2.3.4.2- Revised horizontal envelope for measuring vertical clearance and added subsidiary 2.3.5- Added guidance on coordination bridges over navigable water 2.3.6- Added guidance for clearance on recreational lakes 2.9.1.3- Added to skew angle limitations and guidance 2.9.2.3- Added arterials over 50mph to the width table 2.9.2.4-Corrected typo in freeway width table 2.9.4.11-Revised language regarding scissor bridges and added deck requirement 2.10.2 Tables- Revised to remove commas from quantities 2.10.3 Table- Revised to remove commas from quantities **Chapter 3** 3.1.2- Clarified guidance on fixing superstructure

		3.2.1.2.2-Revised lap splice table 3.3.2.2.2- Fixed typo in first sentence. Should be 42” 3.4.1.1.3-Updated LRFD reference 3.4.1.2.4- Added requirement for hold down location and containment of strands 3.4.1.2.5-Reworded top strand require top strand requirements for clarity 3.4.1.2.6- Added guidance on debonding strands 3.4.1.3- Added stirrup size limitation 3.4.2.3- Updated LRFD reference 3.4.2.4- Updated LRFD references and deleted simplified method from list 3.4.2.5-Clarified bar spacing requirements in anchorage and added requirement for transition of spacing beyond anchorage. 3.4.2.10- Added specificity about measuring positive beam camber 3.4.3.14.2-Added FIBs and others to minimum coping requirement 3.4.4- Added new section on Florida I-Beams 3.7.6- Updated LRFD Reference 3.8.1- Fixed typo. Second paragraph, first sentence should end with the word overlay 3.11.1- Added requirement for detailing endwalls for clearance 3.13.2.-Revised joint section to set preformed silicone as preferred joint material 3.14.1.3- Revised limitation on installing utilities in exterior bays Appendix 3E- Revised sidewalk and parapet drawing to show 6’-6” sidewalk **Chapter 4** 4.1.1.1d- Updated LRFD reference 4.1.1.2- Added Standard Spec lap splice direction 4.2.2.2- Clarified that pile quantities should be rounded UP 4.2.4.2- Added clarification on temp reinforcement in buried footings 4.2.5.1- Revised footing dimensioning and elevation reporting requirements 4.2.5.2- Added clarification on temp reinforcement in buried footings 4.3.2.1-Deleted repeat information about temp and

		shrinkage steel 4.3.2.4- Added guidance on location of cheek walls on end bents 4.4.1.1- Added guidance on consideration of wall piers 4.4.1.3- Revised dimensioning requirements for columns and expanded comments on round columns 4.4.3- Added wall pier detailing section **Chapter 5** General- Revised “In-House” to “Pre-Construction” as the description of plans prepared by GDOT and consultant staff 5.5.2- Added quantities calculation guidance for RC Cantilever walls 5.5.7- Added required BFPR from tie back face **Chapter 7** 7.2- Revised/ removed LRFD guidance documents **Chapter 8** 8.1.2.2.2- Revised LRFD reference 8.2- Revised show drawing routing to always go to CPM 8.2.6- Deleted directive to submit drawings to Design Policy Office 8.2.11- Added Steel Diaphragm processing guidance 8.2.12- Renumbered due to added content **Chapter 9** 9.2.1- Provided additional seismic zone division for detailing purposes 9.2.3- Provided more prescriptive detailing guidance Appendix 9B- Revised Cross Section and Stirrup detailing figures
3.2	7/26/22	**Chapter 1** 1.4.3.1-Revised preliminary plan submission list to clarify walls 1.4.4.1-Revied final plan submission list to clarify walls **Chapter 2** 2.1- Expanded on BDM application expectation 2.3.4.2- Revised NSRR layout requirements 2.7-Revised Salvage Materials request procedure

		2.9.1.4- Added guidance about profile accuracy
		2.9.2-Expanded Bridge Width introduction section
		2.9.4.1-Revised Bridge Costs
		2.9.4.13-Added approval directive for mixing superstructure types
		2.10.2-Revised example Substructure Quantities Table
		Chapter 3
		3.1.2 -Added guidance on locating fixed and expansion connection
		3.2.1 -Added Clarification to the section title so as to cover all superstructure elements
		3.2.1.2.2- Added staggered splice requirement for bridge decks
		3.2.1.2.3- Added guidance about using mechanical couplers in superstructure
		3.2.1.3- Clarified allowance of full depth Precast Deck Panels and prohibition of partial depth deck panels
		3.2.3.3.2-Change in General Note guidance
		3.2.7- Deleted Ride Quality Note guidance
		3.3.6.1- Change in General Note guidance
		3.3.6.2- Change in General Note guidance
		3.4.2.3-Clarified required use of approximate method for losses
		3.4.2.5-Revised LRFD Code Reference
		3.4.3.12-Change in General Note guidance
		3.6.5.3- Change in General Note guidance
		3.6.5.5-Added requirement for jacking stiffeners
		3.6.8-Change in General Note guidance
		3.9.1.3-Added requirement for horizontal member in steel diaphragms
		3.10.1- Added reference to materials section
		3.11.2- Added reference to materials section
		3.12.2.5.2-Clarified requirement for matching bearing pads
		3.13.2.4-Change in General Note guidance
		Chapter 4
		4.1.1-Change in General Note guidance
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List of Effective Chapters

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Chapter 1. Administration - Contents

Chapter 1. Administration

1.1 Bridge Office Organization

1.1.1 General

The Office of Bridges and Structures (also known as the Office of Bridge Design and Maintenance) supplies structural plans to Project Managers and provides maintenance support for structures in the state. This Office is divided into two units: the Bridge Design Unit (BDU) and the Bridge Maintenance Unit (BMU).

1.1.2 State Bridge Engineer

The State Bridge Engineer is the head of the Office of Bridges and Structures and reports directly to the Director of Engineering.

1.1.3 Assistant State Bridge Engineers

The State Bridge Engineer and the Assistant State Bridge Engineers are referred to as the Front Office.

The Assistant State Bridge Engineers keep track of Special Provisions, manage sections of the construction specifications relating to bridges, serve as a liaison for non-GDOT bridge projects (for local governments who don't have bridge expertise but want to use GDOT guidelines or funding), track bridge costs using data from Contract Administration, and review plans. The Assistant State Bridge Engineers also manage design groups, oversee most design policies, review plans including hydraulic studies, and helps program bridge replacement projects.

1.1.4 Bridge Design Unit

The Bridge Design Unit (also referred to as the Bridge Office) supplies bridge plans to Project Managers. The Bridge Design Unit also oversees the design of walls, culverts, sign supports and anything else requiring structural expertise.

There are 7 design groups within the Bridge Design Unit plus a group dedicated to bridge hydraulics and a bridge programming group. The design groups prepare or review preliminary layouts for bridges over railroads or roadways, prepare or review all final bridge and structural plans and load rate proposed and existing bridges and culverts. The hydraulics group prepares or reviews all the preliminary layouts and hydraulic studies for bridges over streams as well as some culverts, though most culverts are sized by roadway engineers. Most bridge hydraulic questions should be addressed to that group. The programming group works with the Front Office and BMU to program bridge replacement projects.

1.1.5 Bridge Maintenance Unit

1.1.5.1 General

The State Bridge Maintenance Engineer serves as an assistant to the State Bridge Engineer and oversees the Bridge Maintenance Unit (BMU). This unit's responsibilities include inspecting all the bridges and bridge culverts in the State (including county bridges) every two years. It also maintains the historical bridge files including inventory, bridge inspection reports, maintenance records, BFI, plans, etc. Bridge Maintenance Unit also develops bridge maintenance projects using in-house and consultant engineering. It is important to coordinate with the Bridge Maintenance Unit when doing work that will affect existing bridges.

For typical bridge design work, coordination is necessary with the Bridge Maintenance Unit for the following items: salvage material coordination, bridge condition surveys (widenings and retrofits), maintenance on existing or parallel structures to be included with widening or paralleling plans. The Bridge Maintenance Unit also coordinates with the bridge programming group and Front Office in programming projects for bridge preservation and rehabilitation.

1.1.5.2 Concept Coordination

During the Concept phase for any project that includes a bridge, the Project Manager should coordinate with Bridge Maintenance Unit to get a project justification statement on whether the bridge is suitable for widening or should be replaced (a bridge could also be replaced if the cost of widening would exceed the cost of replacement).

1.2 Other Offices and Agencies with Bridge-Related Responsibilities

1.2.1 Office of Construction

The State Bridge Construction Engineer, in the Office of Construction, serves as a resource for district construction personnel regarding bridges, participates in training, troubleshoots construction problems, sets bridge construction policies, and makes recommendations to designers on the use of cofferdams and seals.

1.2.2 Geotechnical Bureau

The Geotechnical Branch Chief is head of the Geotechnical Bureau, which is part of the Office of Materials. The Geotechnical Bureau writes or reviews the Bridge, Wall and Culvert Foundation Investigation reports that recommend the type of foundation, pile capacity, special construction situations, etc., for each bridge in the state. They also deal with geotechnical issues that arise during construction. They are responsible for geotechnical special provisions such as drilled shafts and pile driving.

1.2.3 Office of Engineering Services

The Office of Engineering Services acts on behalf of the FHWA in reviewing projects and advising on constructability. They report directly to the Chief Engineer and are therefore independent of the Engineering Division. They coordinate and conduct Preliminary Field Plan Reviews (PFPR) and Final Field Plan Reviews (FFPR) as well as value engineering studies. They review all hydraulic studies (for PFPR) as well as bridge plans (for FFPR). They are the central coordinator for writing specifications.

1.2.4 Federal Highway Administration (FHWA)

FHWA participates in projects designated as “full oversight” (FOS). FHWA has a bridge specialist, Division Bridge Engineer, who provides expertise, direction, and reviews. For projects containing bridges, the Bridge Office will coordinate with the Division Bridge Engineer for review and approval of preliminary bridge layouts, bridge hydraulic studies and final bridge plans. This coordination is also required for consultant-designed projects with the Bridge Office acting as liaison.

1.3 Quality Control and Quality Assurance (QC/QA)

1.3.1 General

In designing bridges and other highway structures our mission is to prepare safe and economical design solutions and produce a quality set of plans that meet the project requirements, use details that are consistent with GDOT Bridge Office practices, and are suitable for bidding and construction. To produce quality work requires collaboration between the designer or detailer and checker as well as a comprehensive review. The quality control and quality assurance process for bridges and other highway structures provided herein shall be followed by the GDOT Bridge Office and consultants designing structures for the Department. This process is required for preliminary layouts, bridge hydraulic studies, final bridge plans and other highway structures as necessary.

1.3.2 Quality Control

Quality control (QC) is a process in which a person designated as the “checker” evaluates the design or details prepared by a designer or detailer. In general, the checker shall be an engineer with relative experience for the work being checked. Collaboration between the checker and the designer/detailer is used to resolve any discrepancies found during the evaluation.

In the design of a bridge, the checker shall evaluate deck, superstructure and substructure. In general, this check shall be (1) a careful review of the design notes, program inputs and results or (2) an independent check of the design developed by the checker and comparison of results prepared by the designer. When checking final bridge plans, the checker shall obtain a current set of roadway plans, including utility plans, for a thorough check. The checker shall generate a geometry program based on the final bridge and roadway plans. The checker shall prepare an independent set of cap step elevations and this duplicate set shall be maintained throughout the design process should changes/revisions arise. The checker shall also prepare and maintain an independent set of quantities for all quantities included in the summary of quantities. For all highway structures, the use of a checker is required.

All bridge plans, preliminary layouts and other structural plans shall have a title block listing at a minimum the initials of the designer, detailer, checker, reviewer and approver. Under no circumstance should the designer be the same as the checker. Generally, the checker’s initials shown in the plans reflect who checked the plan details. If a different checker is used to check the design, geometry and quantities then the design notes should clearly state the responsible checker by name or initials.

As part of the quality control process, it is extremely important that the checker ensure the results of the design are appropriately shown in the plans. Therefore, it is good practice for the checker to review the design with plans complete or nearly complete. Notes and other documentation prepared by the checker shall be initialed and retained in the bridge design notes.

1.3.3 Quality Assurance

Quality assurance (QA) is a process in which a person designated as the “reviewer” ensures that the design and details have been adequately checked. The reviewer resolves differences between designer/detailer and checker. The reviewer also evaluates the complete set of plans. As a matter of practice, the reviewer should spot check the design, geometry and quantities. In general, the reviewer is a Bridge Design Group Leader or senior engineer (consultant).

Once bridge plans or other structural plans are complete and have been checked and reviewed, they are submitted to the Front Office. Plans completed by consultants shall be submitted by the GDOT Project Manager to the Bridge Office at this time. For consultant projects, the consultant shall submit design notes including but not limited to geometry, superstructure design, substructure design, clearance calculations, elevations and quantities. This information shall be submitted in the Portable Document Format (.pdf). Consultant plans will generally be reviewed by a Bridge Design liaison and may be returned to the consultant for corrections prior to the Front Office review or submitted directly to the Front Office for review. It is important that the submission include the foundation investigation(s), documentation of the bridge stakeout / site inspection, salvage of materials, deck condition survey, bridge condition survey, etc.

The Front Office review consists of a complete review of the plans by the Assistant State Bridge Engineer(s). These reviewers may review other plans or consult with other offices such as Roadway Design, Utilities, Environmental Services, etc., to ensure the structural plans meet the requirements of the project. Geometry, elevations and quantities are routinely spot checked during this review. Compilations of the required special provisions are prepared during this review.

All structural plans are given a review by the State Bridge Engineer. At the conclusion of the Front Office review, the plans shall be corrected by the design groups (or consultant). In-house projects shall then be routed to the Program Manager or Roadway Design. Consultant design projects shall be checked by the Bridge Liaison to ensure final corrections are complete before submitting final plans to the Program Manager. For consultant projects, any revisions to the design notes stated above shall be submitted to the Bridge Office.

For projects that are under full oversight by FHWA, bridge plans that have been reviewed and approved will be forwarded to the Georgia Division of FHWA for review and approval. This coordination is conducted by the GDOT Bridge Office for both in-house and consultant projects.

The title blocks shall indicate the initials of the Assistant State Bridge Engineer(s) as “Reviewed”. The initials of the State Bridge Engineer shall be shown as in the title “Approved”. After completion of the QC/QA process, the review set of plans shall be retained by the design group, at a minimum, until the final plans are approved. Saving an electronic (scanned) copy of the review set is acceptable.

Once final plans are approved, the title block initials indicating “Reviewed” and “Approved” shall not be changed during any future modifications to the sheets.

1.3.4 Other Assurance Checks

In addition to the QC/QA process mentioned above, the Bridge Office routinely conducts additional QA checks for all bridge projects during the contract bidding process. One month prior to the Letting, plans are advertised to potential bidders. The Front Office checks the contract for special provision and quantities relative to bridge projects. The review includes a check of the bridge general notes and details to ensure that the plans are up to date. The Bridge Office load rates the bridges using the Bridge Maintenance rating software as an independent check of the superstructure and substructure elements to ensure the proposed bridges meet the intended design loading. If discrepancies are found during this review, then changes/revisions are made as an amendment to the contract.

1.3.5 Quality Evaluation

Hydraulic Studies, Preliminary Bridge Layouts, and Final Bridge Plans are evaluated and scored by the Bridge Office to promote uniform and quality plans. The baseline scoring goal has been set at a score of 85% based on each individual bridge.

Once plans have been reviewed by each Assistant Office Head, the plans will be scored using the Quality Evaluation Forms (see Appendix 1B). The State Bridge Engineer will then review the plans along with the completed Evaluation Quality Form. Scores will be presented to and discussed with Bridge Design Group Leaders for in-house designed bridges. For consultant designed bridges, the Bridge Office liaison will return marked-up plans along with the scored Evaluation Quality Form. If the initial review by the liaison yields extensive comments, the liaison may return the plans, with its evaluation score, to the consultant for corrections before the Front Office review has been conducted.

Consultants wishing to discuss the Bridge Evaluation Quality Form scoring should contact the Assistant State Bridge Engineer.

Evaluation records will be maintained by the Bridge Office. Performance metrics have been developed for each employee in the Bridge Office with the 85% scoring goal for quality. Resulting scores for consultant designed projects will be used to support ratings for consultant evaluations relating to projects. Evaluation scores are associated with both the design firm, and the Engineer of Record.

As stated in subsection 1.3.4, the Bridge Office performs additional checks during the letting process. If critical deficiencies are found during this process or if critical deficiencies are later revealed during construction, the Bridge Office may elect to revisit the previous evaluation and adjust the scoring. If scoring is modified, the consultant firm will be notified in writing of the revision.

1.4 Consultants and Bridge Office

1.4.1 General

Consultant projects are managed by a GDOT Project Manager assigned to the Office of Program Delivery, the Office of Alternative Delivery, or the Transportation Investment Act (TIA) Office, even if the project consists primarily of bridge work. The Bridge Office occasionally issues task orders to consultants when the schedule or workload exceeds the capacity of the design groups. On projects with bridges and other special designed structures, a liaison from the Bridge Office will be assigned to the project. The liaison will be the point of contact for the bridge work on that project and will also coordinate with other GDOT offices on bridge activities. Much of the correspondence and coordination with other offices described below will be done by the liaison but consultants should be aware of this activity and make sure they incorporate the results in their plans.

Consultants are reminded that if their contract is with the Georgia Department of Transportation, all design questions and decisions regarding project requirements must be directed to the GDOT Project Manager for distribution to the appropriate office. Consultants shall not take direction from outside agencies for decisions regarding GDOT projects.

Consultants are responsible for the quality and content of their plans. Prior to a final review by the Bridge Office, all QC/QA procedures must be followed in accordance with Section 1.3. All bridges, special design retaining walls and other special design structural components shall be detailed in accordance with Bridge and Structures Detailing Policy Manual (including Bridge Design Title Block) and reviewed by the Bridge Office.

1.4.2 Sealing of Documents

The Following subsections outline the specific requirements related to sealing and signing structural plans at various stages of project development. If the requirements do not appear to apply to your specific project case, coordinate with the Bridge Office prior to submission of plans for confirmation.

If under the scope of the consultant contract the Bridge Office is to provide final structures plans for a project, the consultant shall provide to the Bridge Liaison a signature drawing 01-000X specifically dedicated for use by the GDOT Chief Engineer. The specific location in the signature sheet series is at the discretion of the consultant, but this sheet shall be set aside for only the Chief Engineer's use. Provide this sheet in portable document format (.pdf) formatted to fit the plan set. When final approved structural plans are provided to the consultant, this dedicated sheet, complete with the seal and signature of the Chief Engineer, will be included.

1.4.2.1 Preliminary Structural Drawings

Preliminary bridge layouts, wall layouts, and other structural drawings submitted to the Bridge Office for review or provided to the Office of Environmental Services for use in developing studies shall include on each sheet submitted a Georgia Professional Engineering seal from the engineer of record, including a notification under or adjacent thereto indicating its status per Rule 180-12-.02(4) of the Rules and Regulations of the State of Georgia. This provides the Department with a clear understanding who is responsible for the work under review.

1.4.2.2 Approved Preliminary Bridge Layouts

Once a preliminary bridge layout approval has been issued by the Bridge Office, return a copy of the approved sheets sealed, signed, and dated in accordance with Rule 180-12-.02(3) of the Rules and Regulations of the State of Georgia. Though these drawings are referred to as preliminary they represent final engineering decisions that affect subsequent phases of project development and thereby warrant certification.

1.4.2.3 Final Plans submitted for review and approval

Final bridge plans, wall plans, and other structural drawings submitted to the Bridge Office for review do not need to contain the seal, signature, and date of the engineer of record. However, the final plans package submitted for review shall include a draft copy of the signature drawing(s) – 01-000X, including necessary statements of responsibility and a Georgia Professional Engineering seal from the Engineer of Record, including a notification under or adjacent thereto indicating its status per Rule 180-12-.02(4) of the Rules and Regulations of the

State of Georgia and Chapter 2 of the GDOT Plan Presentation Guide. Include in the statements of responsibility the date of the submitted plans. This provides the Department clear understanding who is responsible for the work under review and provides for general review of the 01-000X sheet.

1.4.2.4 Approved Final Plans

Once an approval has been issued by the Bridge Office for final bridge plans, wall plans, and/or other structural drawings, return a copy of the signature drawing(s)- 01-000X sealed, signed, and dated in accordance with Rule 180-12-.02(6) of the Rules and Regulations of the State of Georgia and Chapter 2 of the GDOT Plan Presentation Guide. Include in the statements of responsibility the date of the approved plans.

1.4.2.5 Final Plans Revised after Approval

If any changes are made after plans are approved by the Bridge Office, updated plans and signature drawings shall be submitted to the Bridge Office with updated dates. If changes are made after plans are submitted to the Office of Bidding Administration, address changes to final bridge plans, wall plans, and other structural drawings in accordance to Section 7.10 of the Plan Development Process. In addition, provide an updated signature drawing- 01-000Xa sealed, signed, and dated in accordance with Rule 180-12-.02(6) of the Rules and Regulations of the State of Georgia and Chapter 2 of the GDOT Plan Presentation Guide. Include in the statements of responsibility the date of the plan revisions.

1.4.3 Bridge Office Reviews of Preliminary Plans

1.4.3.1 Initial Submittal

Consultants shall submit Preliminary Plans electronically using a Blue Beam Studio Session (BBSS) of their own creation. Requirements for the preparation of these Studio Sessions can be found on the Bridge Office website under the Procedures menu.

Transmit a link for the session to the GDOT Project Manager who will prepare a review request and send it to the Bridge Office via the Bridge Office email (bridgeoffice@dot.ga.gov).

Preliminary bridge and wall layouts must be stamped by the professional engineer responsible for the work when submitting for review and approval. (See BDM 1.4.2)

Include in the Preliminary Plans submission:

- Transmittal letter (for consultants)
- Up to date Preconstruction Status Report (PSR)
- Preliminary bridge layouts, formatted 11" x17", unless the entire project is a legacy 24" x 36" project.
- Preliminary wall layouts, presented in Section 32 and sized as noted above.
- Complete preliminary roadway plan set
- Hydraulic & Hydrological Study report, if applicable (See the GDOT Drainage Design Policy Manual for guidance)
- Hydraulic Models used to develop H&H Study (programs, not a pdf of the output)

- Preliminary calculations, including but not limited to vertical clearance checks, horizontal geometry, and deck drainage calculations.
- Existing bridge plans for structure(s) being replaced or widened, if available
- Latest bridge inspection report for existing structure(s) being replaced or widened. The inspection report is not just the SI&A report. Inspection reports can be found on GeoPI when searching by existing bridge serial numbers.
- Correspondence from the Bridge Design Office regarding delivery routes for beams (BDM 1.6.8)
- Bridge Foundation Investigation report for existing structure(s) to be replaced or widened, if available
- Bridge Condition Survey results and recommendations from BMU (for widenings or existing bridge modifications)
- Correspondence from the Bridge Maintenance Unit regarding salvageable materials (see BDM 2.7)
- QC/QA documentation for Hydraulic Studies, Design Calculations, and Plans

Preliminary Layouts for bridges that cross over a railroad or involve staged construction shall include a deck section in addition to the plan and elevation views of the proposed structure.

Preliminary plans for both bridges and special design walls shall be submitted for review and accepted by the Bridge Office before requesting PFPR.

1.4.3.2 Bridge Office Review

Preliminary Bridge Plans from consultants are first assigned to either the Hydraulics group or one of the structural design groups to establish the liaison for the project.

The liaison will perform the first level of review on the submitted package and comment within the BBSS. From there, the session will be provided to the Front Office for additional review, comment, and scoring. Once the Front Office review process is completed the liaison will send an email to the design consultant, with carbon copy to the GDOT Project Manager, notifying them that the package is ready for correction.

If the initial review by the liaison yields extensive comments, the liaison may return the plans, with its evaluation score, to the consultant for corrections before the Front Office review has been conducted.

1.4.3.3 Subsequent Reviews

Prior to subsequent submissions, each review comment shall be addressed with concurrence or response in the Bluebeam Studio Session for documentation. (See BBSS guidelines)

Corrected preliminary plans and any additional documentation necessary for the changes will be uploaded into the session by the consultant for review and approval by the Bridge Office Liaison. Once the corrected plans are uploaded to the session the consultant shall notify the liaison via email that the plans are ready for review, and carbon copy the GDOT Project Manager.

1.4.3.4 Preliminary Plan Approval

The plans have not been approved by the Bridge Office for PFPR* until all markups are addressed and an e-mail or letter accepting the plans is issued to the GDOT Project Manager. The acceptance email or letter shall address distribution responsibilities of the approved layout.

*Projects are only allowed to proceed to PFPR once the Bridge Office has approved preliminary plans, or issued a waiver based on substantial review of the preliminary plans package submitted. Submit requests for a waiver to bridgeoffice@dot.ga.gov no sooner than 30 calendar days after making plan submission for Bridge Office review and only if PFPR baseline request is in jeopardy.

1.4.3.5 Changes After Preliminary Plan Approval

Once the preliminary plans are approved, it is typical to make minor revisions in the final plans without formally revising the preliminary plans. However, in cases where significant changes are required, it is necessary to make formal revisions to the preliminary plans and coordinate the changes with the Bridge Office. Examples requiring such action would be changes in span configuration, significant changes to width, or other items effecting the footprint of the structure. Also, revisions to the preliminary plans may be necessary when railroad coordination or FHWA oversight is part of the project, as both parties are providing formal approval of preliminary plans.

Once changes deemed necessary to the preliminary plans are completed and reviewed by the Bridge Office, the liaison will transmit the revised preliminary plans as outlined for the initial approval.

1.4.4 Bridge Office Reviews of Final Plans

1.4.4.1 Initial Submittal

Consultants shall submit Final Plans electronically using a Blue Beam Studio Session (BBSS) of their own creation. Requirements for the preparation of these Studio Sessions can be found on the Bridge Office Website under the Procedures menu.

Transmit a link for the session to the GDOT Project Manager who will prepare a review request and send it to the Bridge Office via the Bridge Office email (bridgeoffice@dot.ga.gov).

Final Plan submission should include the items listed below for all the structures on the project, unless the Bridge Office has agreed in writing, in advance that segmented submission will be allowed. Segmented submission will only be considered when projects include an unusually large number of structures.

Include in the Final Plans submission:

- Transmittal letter (for consultants)
- Up to date Preconstruction Status Report (PSR)
- Sheet 01-000X per Chapter 1 of the PPG, sealed for Sections 32, 35, 36, 38, and 39 as applicable for plans submitted for review and approval (see BDM 1.4.2)
- Final bridge plans, formatted 11” x 17”, unless the entire project is a legacy 24” x 36” project.

(Name file using PI_Section_Status_date: Ex. 0123456_35_Final_03-15-21)

- Final wall plans, presented in Section 32 and sized as noted above. (Do not submit as individual sheets)
  (Name file using PI_Section_Status_date: Ex. 0123456_32_Preliminary_03-15-21)
- Bridge Foundation Investigation reports, including acceptance letters from the GDOT Geotechnical Bureau
- Wall Foundation Investigation reports (if special designed walls are part of the project), including acceptance letters from the GDOT Geotechnical Bureau
- Approved Preliminary layouts
- Approved Hydraulic Study
- FHWA approval of the Preliminary Layout for Projects of Division Interest (PoDI)
- Railroad approval of the Preliminary Layout for any bridge over a railroad
- Design notes, program runs, and other wall and bridge related calculations used to develop the Final Plans
- Complete roadway plan set
- Correspondence from the Bridge Design Office regarding the need for cofferdams (BDM 4.2.6.1)
- Correspondence from the Bridge Maintenance Unit regarding salvageable materials (BDM 2.7)
- Correspondence from the Bridge Design Office regarding delivery routes for beams (BDM 1.6.8)
- Correspondence from District personnel verifying the stakeout of the bridge (Automated Survey Manual 4.4)
- Existing bridge plans (for structure(s) being replaced or widened)
- Latest bridge inspection report (for existing structure(s) being widened)
- Bridge Condition Survey results and recommendations from BMU (for widenings or existing bridge modifications)
- QC/QA documentation for Design Calculations and Plans

Any corrections to the design notes, post Bridge Office review, shall be re-submitted for inclusion in the bridge record.

1.4.4.2 Bridge Office Review

Final Bridge and/or Wall Plans from consultants will be assigned to a structural design group to establish the liaison for the project.

The liaison will perform the first level of review on the submitted package and comment within the BBSS. From there the session will be provided to the Front Office for additional review, comment, and scoring. Once the Front Office review process is completed the liaison will send an email to the design consultant, with carbon copy to the GDOT Project Manager, notifying them that the package is ready for correction.

If the initial review by the liaison yields extensive comments, the liaison may return the plans, with its evaluation score, to the consultant for corrections before the Front Office review has been conducted.

1.4.4.3 Subsequent Submittals

Prior to subsequent submissions, each review comment shall be addressed with concurrence or response in the Bluebeam Studio Session for documentation. (See BBSS guidelines)

Corrected final plans, updated design calculations, and any additional documentation necessary for the changes will be uploaded into the session by the consultant for review and approval by the Bridge Office Liaison. Once the corrected plans are uploaded to the session the consultant shall notify the liaison via email that the plans are ready for review, and carbon copy the GDOT Project Manager.

If corrected plans and documents cannot be uploaded to the session, submit them to the GDOT Project Manager in a manner similar to that presented in BDM 1.4.4.1.

1.4.4.4 Final Bridge Plan Approval

The plans have not been approved by the Bridge Office for FFPR* or construction until all markups are addressed and an e-mail and/or letter accepting the plans is issued to the GDOT Project Manager. The final acceptance letter to the Project Manager will include, as an attachment or ProjectWise link, the structural special provisions checklist and a copy of all structural related special provisions. The Project Manager will need to include these in their submission of final plans to the Office of Bidding Administration.

Upon approval of final plans, submit to the Bridge Office a set of electronic CAD drawings. See the GDOT Bridge Detailing Manual for the formatting requirements for these CAD drawings.

> *Projects are only allowed to proceed to FFPR once the Bridge Office has approved final plans, or issued a waiver based on substantial review of the final plans package submitted. Submit requests for a waiver to bridgeoffice@dot.ga.gov no sooner than 30 calendar days after making plan submission for Bridge Office review.

1.4.4.5 Changes after Final Bridge Plan Approval

Once the final bridge plans are approved, any subsequent changes must be coordinated with the Bridge Office. BDM 8.1.1 addresses several potential scenarios related to revising plans.

Approval of changed sheets will follow the same basic flow as the Final Bridge Plan Approval with an e-mail and/or letter being issued to the GDOT Project Manager. This correspondence shall specifically state changes, if any, have been made to contract quantities.

1.5 Schedules for Bridge Design

All GDOT projects follow the Plan Development Process (PDP), which outlines project phases and activities during each phase. It is available on the GDOT website. Bridge designers should be aware of the process and their part in it to assure that project schedules are achieved. In general, the following activities are of particular importance:

1.5.1 Concept Phase

1.5.1.1 Initial Reports

Bridge designers should ensure that SIA's (Bridge Maintenance reports), Bridge and Deck Condition Surveys (if needed) have been requested by the Project Manager. The decision to widen or replace a bridge is determined during the concept phase.

1.5.1.2 Concept Structures

Bridge designers may be asked to provide conceptual bridge and/ or wall lengths, widths, and costs. Timely responses to these requests are needed in this phase. A bridge type study may be appropriate at this time. See Section 2.9.5.

1.5.1.3 Bridge Attendance at Concept Meetings

A bridge designer should attend the Concept Meeting at the Project Manager's request.

1.5.2 Preliminary Design Phase

1.5.2.1 Begin Preliminary Plans

The Project Manager will send a request to the Bridge Office for bridge or wall plans which should include preliminary roadway alignment and profile. However, the final roadway profile may depend on structure depths and clearances relating to the bridge, so some collaboration can be expected.

Consultants should begin work on preliminary plans after Notice to Proceed (NTP) has been issued by the Project Manager.

1.5.2.2 Bridge Attendance at PFPR

In general, a bridge designer should attend the PFPR.

1.5.3 Foundation Investigations

1.5.3.1 Bridge Foundation Investigations (BFI)

After the Preliminary Bridge Layout has been approved by the Bridge Office, a letter of approval will be issued to the Project Manager informing them that the Preliminary Bridge Layout is acceptable for inclusion in Section 35 of the PFPR plan set. When the foundation investigation is being developed by the Department, this letter will include instructions on requesting a bridge foundation investigation from the Geotechnical Bureau at the Office of Materials and Testing. If the foundation investigation is being developed by a consultant, the approval letter will relay to the team that foundation exploration work can begin once Notice to Proceed is given. A flow chart for the basic LRFD Bridge Foundation Investigation process can be found in Appendix 1C.

1.5.3.2 Wall Foundation Investigations (WFI)

After the Preliminary Wall Layout has been approved by the Bridge Office, a letter of approval will be issued to the Project Manager informing them that the Preliminary Wall Layout is acceptable for inclusion in Section 32 of the PFPR plan set. When the foundation investigation is being developed by the Department, this letter will include instructions on requesting a wall foundation investigation from the Geotechnical Bureau at the Office of Materials and Testing. If the foundation investigation is being developed by a consultant, the approval letter will relay to the team that foundation exploration work can begin once Notice to Proceed is given. A flow chart for basic LRFD Wall Foundation Investigation process can be found in Appendix 1C.

1.5.4 Final Design Phase

1.5.4.1 Begin Final Plans

Bridge designers should begin working on final plans after PFPR responses have been provided.

Consultants should begin work on final plans after Notice to Proceed (NTP) has been issued by the Project Manager.

1.5.4.2 Bridge Attendance at FFPR

In general, a bridge designer should attend the FFPR.

1.5.4.3 Final Plans to Office of Bidding Administration

At 10 weeks prior to the let date, final plans are due to the Office of Bidding Administration. Plans need to be stamped and signed. After this submission, any changes to the plans must be handled by formal revision.

At 5 weeks prior to the let date, one stamped and signed set of the final plans or revised final plans is sent to the GDOT print office to be scanned, printed, and sold to contractors. After this submittal, any changes to the plans must be handled by amendment.

1.5.5 Shop Drawings

It is important that shop drawings are reviewed and returned in a timely manner. See Section 8.2 for more information on shop drawings.

1.6 Correspondence

1.6.1 Correspondence Involving Consultants

Any Interdepartment Correspondence or letters on GDOT letterhead must go through the Bridge Office liaison. All transmittals from consultants shall have the PI number, county, description (e.g. “SR 1 over Altamaha River”), and project number. Coordination letters with local governments, agencies, and officials shall go through GDOT.

1.6.2 Phone Number on Correspondence

All correspondence with members of the public shall have printed or typed thereon one or more telephone numbers to which responses or questions concerning such correspondence may be directed. Within the Bridge Office, all correspondence related to projects shall have a name of a contact person and that person’s phone number (including area code) included in the body of the letter.

1.6.3 P.I. Number on Correspondence

On all correspondence related to a project, include the Project P.I. Number along with the Project Number in the heading of the letter.

1.6.4 State Bridge Engineer Signature on Correspondence

The State Bridge Engineer’s signature should be included on all correspondence with federal agencies, state agencies, local governments, members of Congress, members of the Georgia General Assembly, GDOT board members, and private citizens.

The State Bridge Engineer’s signature should also be included on escalation letters and letters related to poor consultant performance.

Correspondence needing the State Bridge Engineer’s signature should be emailed to their administrative assistant to prepare it for signature and filing.

1.6.5 Correspondence with Legislators and Citizens

When preparing correspondence concerning particular projects with members of Congress, state representatives and senators, and members of the public, send a copy of the letter to the GDOT Board member representing that district.

1.6.6 Correspondence with Contractors

1.6.6.1 Prior to Project Being Awarded

Once a project has been advertised for letting, it is under the control of the Office of Bidding Administration. If any contractor calls with questions on the project, they should be referred to the Office of Bidding Administration. The Office of Bidding Administration will contact the Bridge Office for the proper reply to any questions concerning a structure. The Office of Bidding Administration will then provide that information to all contractors who have purchased plans.

1.6.6.2 During Construction

Send a copy of all correspondence with the contractor to the proper District Office when the correspondence concerns the Contractor’s plans and/or design notes. This procedure is an effort to help the District personnel evaluate the need for time extensions on projects where the Contractor proposes changes to the contract plans. When responding to questions from the Contractor, the response should be given to the Project Manager for transmittal to the Contractor.

1.6.6.3 Contractor Cranes on Bridges

Requests from Contractors to place cranes on bridges will be reviewed by the Assistant State Bridge Engineer.

1.6.7 Bridge Condition and Bridge Deck Condition Surveys

When beginning work in the concept phase of bridge widening projects, or projects that will perform any retrofit work to a bridge, the designer shall request the bridge condition survey of the existing bridge. It is important to request the survey early on because it can take up to 6 months to be completed. The request for a bridge condition survey should go to the Bridge Maintenance Unit (BMUSubmittals@dot.ga.gov) and should include:

a) The Project Number, County and P.I. Number.

b) A description of the bridge (e.g., SR 16 over Flint River)

c) The Bridge Location ID and Serial numbers.

d) The proposed Management Letting Date for the project.

e) A description of any anticipated work beyond widening, such as placing an overlay or jacking of the existing bridge.

If deemed necessary by the Bridge Maintenance Unit, they will request a Bridge Deck Condition Survey from the Office of Materials and Testing as part of their investigation.

Request an updated bridge condition survey if the date the letter was issued is older than 3 years. Additional deterioration may have occurred during this time that needs to be addressed.

1.6.8 Routes for Hauling

1.6.8.1 Gross Hauling Weight

When developing plans for bridges requiring long PSC beams or other precast elements, determine the gross haul weight of the element, including the trucking apparatus that will carry the element to the job site. If the gross haul weight is 135,000 lbs. or greater (allowing 45,000 lbs. for the trucking apparatus), investigate whether the element can be satisfactorily trucked to the job site with the assistance of truck routing personnel from the Bridge Design Office.

1.6.8.2 Beam Length

If the beams are over 90 feet in length, provide the length and job site location to Bridge Design Office truck routing personnel and request that a route for beam delivery be determined.

1.6.9 Plan Distribution Requirements

The following subsections are drafted with a focus on bridge plans. However, much of the guidance can also be applied to special designed wall plans.

1.6.9.1 Preliminary Layouts

Upon approval of the preliminary layout, whether produced by in-house personnel or consultant, the Bridge Office liaison will submit an interoffice correspondence letter to the State Program Delivery Administrator or TIA Administrator (attn: Project Manager) informing them of the approval and instructing their request of a site inspection and a foundation investigation. This correspondence shall include a link to a folder containing the approved Preliminary Layout in ProjectWise. In the case of hydraulic bridges, the link should also lead to the approved Hydraulic Study. In the case of bridges over a railroad, the link should also lead to the completed overhead data sheet and its existence should be explained in the letter. (see below for more direction)

This interoffice correspondence should be copied to each member of the Front Office staff, the District Engineer of the district where the bridge is located, and the State Environmental Administrator (Attn: Assistant State Environmental Administrator - Ecology) in cases where the bridge is over water.

An example of this correspondence can be found in Appendix 1A and on the BrSupport drive for internal staff.

FHWA Projects of Division Interest - If the approved preliminary layout is for a project that has been designated as a Project of Division Interest (PoDI) by FHWA a separate transmittal, requesting their approval, will need to be prepared for FHWA and signed by the State Bridge Engineer. Include in the transmittal the Hydraulic Study, Preliminary Layout, and pertinent Roadway plans, to include the project cover and relevant portions of sections 5, 13, and 15.

Projects over a railroad - If the preliminary layout is for a bridge that is crossing over a railroad, an overhead data sheet for the railroad company's review will need to be completed, if required.

The "Norfolk Southern Corporation Overhead Grade Separation Data Sheet" should be completed for bridges over the following lines (includes subsidiary companies): Norfolk Southern Railway; Central of Georgia Railroad; Georgia Southern & Florida Railway; Tennessee, Alabama & Georgia Railroad; Georgia Northern Railway; the South Western Railroad; and Alabama Great Southern Railroad. A copy of the "Norfolk Southern Corporation Overhead Grade Separation Data Sheet" can be found in Appendix 1A and on the BrSupport drive for internal staff.

The "CSX Overhead Bridge Crossing Data Sheet" should be completed for bridges over CSX Transportation lines. While CSX does not have subsidiaries, former railroads identified as Seaboard Coast Line Railroad; Louisville and Nashville Railroad; Georgia Railroad; Atlanta and West Point Railroad; Gainesville Midland Railroad; Atlantic Coast Line Railroad; and Seaboard System Railroad are now part of CSX Transportation, Inc. and should be identified as CSX Transportation, Inc. for future work. A copy of the "CSX Overhead Bridge Crossing Data Sheet" can be found in Appendix 1A and on the BrSupport drive for internal staff.

There are also approximately 20 "short line" railroads operating in Georgia as well. No overhead datasheet is specifically required in coordination with these organizations.

1.6.9.2 Lockdown Plans

Certain project schedules require that "lockdown" plans be provided for environmental permitting, prior to being completed for submission to the Bridge Office for review. In such a case, provide "lockdown" plans to the Project Manager only after a determinate footprint, foundation, and construction access approach has been established for the structure and coordinated with the Bridge Office. Include a noticeable text block that says "LOCKDOWN PLANS" near the title block of each sheet provided for this purpose, to indicate that design work is not complete. "LOCKDOWN PLANS" should be included in the MicroStation version of the drawings, and not added as an overlay using a .pdf editor. This notation is required until Bridge Office approval has been formally issued for the plan set to the Project Manager. Transmit the plan sheets to the Project Manager in the portable document format using an email with carbon copies going to the Assistant State Bridge Engineers and Bridge Office liaison

1.6.9.3 Final Plans

1.6.9.3.1 Final Plans Approved by the Bridge Office

Upon approval of the final plans, whether produced by in-house personnel or consultant, the Bridge Office liaison will submit an interoffice correspondence letter to the State Program Delivery Administrator or TIA Administrator (attn: Project Manager) informing them of the approval. This correspondence shall include a ProjectWise link to the folder containing structures related special provisions and special provision checklist. In the case of in-house bridges, the link should also lead to the approved final plans. For consultant projects, this letter will provide the date of the approved plans and directive for the consultant to include them in the final plans set.

This interoffice correspondence should be copied to each member of the Front Office staff, and the District Engineer of the district where the bridge is located.

An example of this correspondence can be found in Appendix 1A and on the BrSupport drive for internal staff.

1.6.9.3.2 Final Plans Changed after FFPR

After the FFPR report has been issued, coordinate responses to the structures related comments with the Bridge Office liaison and the Bridge Design Group Manager as described in BDM 1.6.14. Once responses have been submitted, change the bridge plans accordingly. Changes at this state of plan production do not require use of the revision triangles, unless plans have already been submitted to Bidding Administration. The Bridge Office liaison should provide final concurrence to all corrections prior to any distribution. Concurrence can be made in the form of an email.

Following concurrence, submit the changed plans to the Project Manager, with a carbon copy going to the Bridge Office liaison for consultant projects. Any necessary changes or additions to the design notes as well as the CAD files for the plans should be transmitted to the Bridge Office liaison at this time as well.

Projects over a railroad - If changes to the FFPR plans include any changes to the horizontal or vertical railroad clearances, or modifications in drainage effecting the railroad, contact the State Railroad Liaison to assure that railroad coordination is updated, as submission to the railroads happens when FFPR is requested.

FHWA Projects of Division Interest - If the project has been designated as a Project of Division Interest (PoDI) by FHWA, submit the changed final plans to FHWA for approval using a transmittal signed by the State Bridge Engineer. This package will need to include the bridge plans and the approved Bridge Foundation Investigation report.

1.6.9.3.3 Final Plan Changed after Submission to Bidding Administration

Guidance on making changes to final plans that have been submitted to the Office of Bidding Administration and through construction is presented in BDM 8.1.

1.6.9.4 Shop Drawings and Contractor Designed Items

After a project has been let, the contractor is required by the contract document to submit a number of engineering or fabrication drawings for specific elements of the work. Most bridge projects will include contractor submitted bearing drawings, beam drawings, and stay in place form drawings. Depending on the details of the project they may also submit psc pile drawings, steel diaphragms, contractor designed wall plans, contractor designed sign support drawings, and bridge deck drainage drawings. Each of these submitted items are reviewed for approval or correction.

Shop drawings should be submitted by the contractor to the Construction Project Manager (CPM), who will forward the submission to the Bridge Office at bridgeoffice@dot.ga.gov or using ProjectWise Deliverables Management. If shop drawings are received by the Bridge Office from a fabricator or the Contractor, an email informing the sender of the above should be returned instructing them to resubmit to the CPM and that review will not begin until drawings are received through proper channels.

If the project was designed by a consultant who is under contract for construction services, the Bridge Office liaison will forward the drawings electronically to the consultant for review. The consultant should review the documents and stamp them as approved or in need of correction, with comments and corrections noted on the drawings. The liaison will review the comments made by the consultant, make additional comments as necessary, and add a Bridge Office stamp to the plans. This process may need to repeat until drawings are deemed acceptable. However, following the second submission, the liaison may decide to hold a collaboration meeting between the consultant, the supplier, and the liaison to resolve remaining issues.

Drawings Requiring Correction

When the drawings require correction, the liaison will return the marked drawings, with a rejection letter, to the Area Manager with attention to the CPM. If email is used to return the drawings, carbon copies should be provided to the District Engineer, the State Program Delivery Administrator or TIA Administrator, and the Assistant State Bridge Engineer.

Approved Drawings

When drawings are deemed acceptable for construction, the liaison will return the approved drawings, with an approval letter, to the Area Manager with attention to the CPM. If email is used to return the drawings, carbon copies should be provided to the District Engineer, the State Program Delivery Administrator or TIA Administrator, the Assistant State Bridge Engineer, and the appropriate branch chief at the Office of Materials and Testing (if applicable).

More guidance on shop drawing review and distribution to the Office of Materials and Testing can be found in BDM 8.2.

Copies of all submitted and returned drawings and associated items shall be maintained, by the liaison, in the Shop Drawing folder of ProjectWise. Items received through ProjectWise Deliverables Management should have a copy saved in the Shop Drawing folder as well.

For shop drawings containing significant differences when compared to the contract drawings, it is necessary to transmit a copy of the drawing(s) to the Office of Design Policy's electronic document management staff (EDM) so that they can add it to the official plan set. A ProjectWise workflow for this transmission is available on the GDOT website, but specifics are also included in the BrSupport folder. The ProjectWise workflow is called "Bridge Revision Workflows". Making this submission to EDM is necessary for PSC beams with modified designs, steel beams, steel diaphragms, contractor designed retaining walls, and other structural drawings submitted for approval. This does not apply to bearing pads, metal deck forms, or PSC beams that match the contract drawings.

1.6.9.5 As-Built Foundation Information Sheet(s)

The documentation of As-Built Foundation Information (As-Built), especially for hydraulic structures susceptible to scour, is a critical record keeping activity. A note should be included on the As-Built sheet of all bridge plans directing the Engineer to submit the complete record to the Bridge Office email address once foundations are installed. However, this is not always executed perfectly. The Bridge Office liaison for the project might need to reach out to the Construction Project Manager and request it, once pile installation is believed to be complete, or even once notification of project completion is received.

Once a copy of the completed As-Built plan sheet has been acquired or created with submitted data, it needs to be distributed to several offices for review and records.

a) For all bridges:
   - The Bridge Office liaison will transmit the sheet using an interoffice correspondence letter addressed to the Geotechnical Bureau Chief, c/o Geotechnical_Reports@dot.ga.gov. The letter should include a link to the folder containing the completed As-Built sheet in ProjectWise.
     An example of this correspondence can be found in Appendix 1A and on the BrSupport drive for internal staff. There is also a more detailed description of the processes in the BrSupport folder.
   - The Bridge Office liaison will notify the Office of Design Policy's electronic document management staff (EDM) so that they can add the As-Built to the official plan set. A ProjectWise workflow for this process is available on the GDOT website, but specifics are also included in the BrSupport folder. The ProjectWise workflow is called "Bridge Revision Workflows".

b) For bridges over water, in addition to the above, a carbon copy of the transmittal to the Geotechnical Bureau should be made to the State Hydraulics Engineer, and to the Bridge Maintenance Engineer. For the bridges over water, the ProjectWise folder containing the As-Built also needs to include a copy of the Plan and Elevation sheet, the substructure sheets, and the BFI report.

1.6.10 Reserved for future use

1.6.11 Public Access to Project Records

All project records and correspondence are to be made available to the public when requested. The only exceptions are documents within which the Department and the Attorney General's Office communicate on an attorney-client basis; all such documentation should be kept in a separate file from other project records. See MOG 3A-3 for additional requirements and forms to be used.

1.6.12 Construction Time Estimates

Do not send bridge plans to the District or to the Office of Construction for preparation of a construction time estimate. The District Construction Engineer should obtain a complete set of plans from the Project Manager to use in preparing the construction time estimate so that he can account for items not in the bridge plans which can affect the bridge construction time.

1.6.13 FHWA Review Requirements

Any project may be designated as a Project of Division Interest (PoDI) by FHWA. As long as a project is identified with this designation, the preliminary layouts, final plans and/or plan revisions shall be submitted to the FHWA Division Administrator for review and approval. See Section 1.6.9 for transmittal requirements.

1.6.14 Response to Field Plan Review Reports

Following the issuance of the final PFPR or FFPR report, it is the Design Group Leader's responsibility to provide response to any bridge related items in the report, as well as to address any additional items that might be relevant. This response can be made in the form of an e-mail with a copy being sent to the Assistant State Bridge Engineer. For more complicated issues it may be appropriate to route the response through the State Bridge Engineer for signature.

The e-mail or letter should be addressed to the Project Manager with a copy to the Office of Engineering Services. The response should be prepared promptly as the Project Manager is required to respond to PFPR comments within 4 weeks and to FFPR comments within 2 weeks. It is not necessary to concur or comply with recommendations in the PFPR or FFPR report, but a response is necessary for each. If the response is negative, provide an explanation. Consultants may be asked by the liaison to write responses to the comments.

1.7 Special Provisions and Plan Files

1.7.1 Special Provisions

Project Special Provisions dealing with special construction features or construction sequences are prepared by the Assistant State Bridge Engineer. The Group Leader will provide advice and information to the Assistant State Bridge Engineer. Consultants will be responsible for preparing Special Provisions to be reviewed by the Bridge Office for their projects when a specification is not available.

1.7.2 Files for Completed Projects

Once a bridge project has been constructed and accepted by the Department, the design file is condensed and transmitted to the Bridge Maintenance Unit. Additional guidance on this process is available on BrSupport for internal staff.

1.8 Appendix 1A - Sample Letters

The following pages contain copies of sample letter that are typically used on bridge projects.

GDOT Georgia Department of Transportation

Interoffice Memo

FILE: P.I. NO. 0014907 RICHMOND CO.
SR 4 (US 1) over North Fork Spirit Creek SBL

DATE: March 8, 2021

FROM: Susan T. Beck, Bridge Hydraulics Group Leader

TO: Kimberly Nesbitt, State Program Delivery Administrator
Attn: Jeff Henry, Project Manager

SUBJECT: **APPROVED PRELIMINARY LAYOUT AND HYDRAULIC STUDY**

The Preliminary Bridge Layout and Hydraulic Study for the above listed project are now approved and are located in the following location on ProjectWise.

0014907\PE\Bridge Design\Hydraulics\Correspondence\0014907_Bridge Hydraulics Transmittal Package

Please use this information to begin the Bridge Foundation Investigation (BFI) request process and to arrange for a bridge stake out to be completed. If these activities are being completed by GDOT personnel, the necessary steps to initiate each are described below. However, if either or both of these elements are included in a consultant contract, provide notification of this approval to the consultant team as appropriate. Note that regardless of who performs the physical stake out of a given structure, a site inspection must be performed by a designated representative of the District Preconstruction Engineer. It is the responsibility of the party performing the staking to contact the District Preconstruction Engineer promptly after staking work is complete. The site inspection, to be submitted in writing to BridgeOffice@dot.ga.gov, shall confirm if the bridge will fit the site, as well as note the provided clearances from key bridge elements to the stream bank and/or traveled way limits. Guidance on staking and inspection can be found in section 4.4 of the GDOT Automated Survey Manual.

BFI by GDOT Office of Materials and Testing, Geotechnical Bureau:
Please prepare a Bridge Foundation Investigation submittal package for the Geotechnical Bureau in accordance with the Office of Materials and Testing Geotechnical & Environmental Submittal Checklist. Submit a request letter to accompany the package to Geotechnical_Report@dot.ga.gov. If the project is part of the LIBP or SFBP programs, please confirm that the BFI has already been requested.

Bridge Stake Out by GDOT Office of Design Policy and Support, Location Bureau:
Please provide the Approved Preliminary Bridge Layout, related roadway plans, and copy of the control package to the Office of Design Policy and Support, Location Bureau and request that the bridge(s) be staked out. This request should be sent to Benny Walden (bewalden@dot.ga.gov).

In addition, by copy of this letter, the Office of Environmental Services and the Roadway Designer are being notified of this Preliminary Bridge Layout approval.

SR 4 (US 1) will remain open to traffic during the proposed construction, with one lane of traffic in each direction maintained on the existing northbound bridge during construction.

If you have any questions please contact Susan Beck of the Office of Bridges and Structures at (404) 631-1862 or at email address sbeck@dot.ga.gov.

STB:

cc (by E-mail):
Donn Digamon, State Bridge Engineer
Lyn Clements, Assistant State Bridge Engineer
Steve Gaston, Assistant State Bridge Engineer
Corbett Reynolds, District Engineer - Tennille
Eric Duff, State Environmental Administrator
Attn: Gail D'Avino

NORFOLK SOUTHERN CORPORATION
OVERHEAD GRADE SEPARATION DATA SHEET

1. Location: _______________ _________________ Georgia
City County State

2. Distance from nearest Milepost to Centerline of Bridge: ________________________

3. State Project Number: ____

4. Description of Project: ____

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____

____

5. Utilities on Railroad Property:

Name	Any Adjustments required?	Contact Person

6. List all the at-grade crossings that will be eliminated by the construction of this grade separation.

DOT#	Milepost	Signalized?

7. Minimum Horizontal Clearance from Centerline of Nearest Track to Face of Pier?

   A. Proposed: __________________ B. Existing (if applicable): ______________

8. Minimum Vertical Clearance above top of high rail:

   A. Proposed: __________________ B. Existing (if applicable): ______________

NORFOLK SOUTHERN CORPORATION
OVERHEAD GRADE SEPARATION DATA SHEET

Page 2

9. List piers where crashwalls are provided:

Pier:	Distance from centerline of track:
______________________________	____________________________
______________________________	____________________________
______________________________	____________________________

10. Describe how drainage from approach roadway is handled:

____

____

____

11. Describe how drainage from bridge is handled:

____

____

____

12. List piers where shoring is required to protect track:

____

____

____

13. Scheduled letting Date: ______________________________________

NOTE: Design Criteria for Overhead bridges apply to Items 7 through 12.

All information on this Data Sheet to be furnished by Submitting Agency and should be sent with initial transmittal of project notification.

CSX OVERHEAD BRIDGE CROSSING DATA

1. Location: _______________ _________________ Georgia
City County State

2. Railroad Division: ____

3. Railroad Valuation Station at Centerline of Bridge: ________________________________

4. Distance from nearest Milepost to Centerline of Bridge: ___________________________

5. DOT Crossing Number: ____

6. State Project Number: ____

7. Description of Project:

____

____

____

8. Minimum Horizontal Clearance from Centerline of Nearest Track:

A. Proposed: ____________________ B. Existing (if applicable): ___________________

9. Minimum Vertical Clearance above top of low rail:

A. Proposed: ____________________ B. Existing (if applicable): ___________________

10. List piers where crashwalls are provided:
Pier: Distance from centerline of track:

_____________________________ ___________________________

_____________________________ ___________________________

11. Describe how drainage from bridge is handled:

____

____

12. List piers where shoring is required to protect track:

____

13. Plan Submittal: Preliminary ________________ Final _____________________

NOTE: CSX Criteria for Overhead bridges apply to Items 8 through 13.

Interoffice Memo

FILE: P.I. NO. 0013997 MADISON CO.
SR 281 over Broad River

DATE: February 19, 2019

FROM: Douglas Franks, Bridge Design Group Leader

TO: Kimberly Nesbitt, State Program Delivery Administrator
Attn: Sara Jessica Parker, Project Manager

SUBJECT: APPROVED FINAL BRIDGE PLANS

The Office of Bridges and Structures has completed a design review on the revised final bridge plans submitted for the above referenced project. These plans are approved as submitted on February 2, 2019. Please notify the design consultant to include these approved drawings in the final plan set. A copy of the structures related special provisions and associated checklist can be found on ProjectWise at:

00013997\PE\Bridge Design\Plans\Final Plans

In addition please direct the consultant to provide this office with electronic copies of the final plan drawings, both .dgn and .pdf, as well the final design calculations package for the project.

If you have any questions please contact Nathan Wilson of the Office of Bridges and Structures at (404) 631-1890 or at email address nwilson@dot.ga.gov.

DDF:naw

cc (by E-mail):
Donn Digamon, State Bridge Engineer
Lyn Clements, Assistant State Bridge Engineer
Steve Gaston, Assistant State Bridge Engineer
Bob Jones, District Engineer – Gainesville

Interoffice Memo

FILE: P.I. NO. 0015316 HARRIS CO.
SR 281 over Broad River

DATE: April 18, 2019

FROM: Douglas Franks, Bridge Design Group Leader

TO: Glen Foster, Assistant State Materials Engineer, Geotechnical Bureau
c/o Geotechnical_Reports@dot.ga.gov

SUBJECT: AS-BUILT FOUNDATION INFORMATION

A Use on Construction revision of the As-Built Foundation Information sheet for the above listed project has been prepared for inclusion into the record plan set. This sheet now reflects actual as-built foundation information as recorded by field personnel during the construction process. For your consideration and records, a copy of the revised sheet, the Bridge Plan and Elevation sheet, related Substructure sheet(s), and a link to the BFI have been placed on ProjectWise at the following location:

0015316\PE\Bridge\Plans\As-Built Foundation Package

If you have any questions please contact Nathan Wilson of the Office of Bridges and Structures at (404) 631-1890 or at email address nwilson@dot.ga.gov.

DDF:naw

cc (via E-mail):
Susan Beck, State Bridge Hydraulics Engineer
Rabi Koirala, State Bridge Maintenance Engineer

1.9 Appendix 1B – Quality Evaluation Forms

The following pages contain blank copies of the Quality Evaluation Forms.

HYDRAULIC STUDY QUALITY EVALUATION FORM

SCORE: **#DIV/0!**

Project		**Group**	
Project No.:		Group Leader:	
County:		Design Firm:	
PI Number:		Eng of Record:	
Description:			

Complexity: Difficult | Medium | Easy

Notes

Major Error = could cause safety/construction/bidding issues; EX: Missing Cell, Pay Item or General Note, Incorrect design detailing, Incorrect design programs, or Construction issues
Minor Error = can cause confusion when interpreting plans; EX: Typos, minor visual errors, Util coordinatio
NOTE: Excessive minor errors on a sheet may count as a Major Error

N/A	3+ Major Errors	1-2 Major Errors	3+ Minor Errors	0-2 Minor Errors	Section	Points Earned	Points Available	Additional Comments
X					**COVER (5 Points)**	**0**	**0**	
					PI NUMBER/COUNTY/DESCRIPTION			
					COORDINATION			
					SIGN AND DATE (PE STAMP FOR CONSULTANTS)			
X					**REPORT (25 Points)**	**0**	**0**	
					EXIST BR/PROP BR/PROP L & W/			
					DRAINAGE AREA/DESIGN STORM/ANALYSIS METHOD			
					HYDRAULIC RESULTS W NATURAL, EXIST, PROP/ REASON FOR SPAN ARRANGEMENT			
					COORDINATION/RISK/DECK DRAINS/ TRAFFIC/GUIDEBANKS&RIPRAP			
X					**SITE INSPECTION (15 Points)**	**0**	**0**	
					UPSTREAM&DOWNSTREAM DESCRIP/EVIDENCE OF SCOUR			
					EXISTING BRIDGE TYPE&SUBSTR/UTIL/ DEVELOPMENTS&STRUCTURES IN FLOODPLAIN			
X					**PHOTOS (10 Points)**	**0**	**0**	
					DOWNSTREAM FOR STREAM/FLOODPLAIN/ FACE OF BRIDGE			
					UPSTREAM OF STREAM/FLOODPLAIN/FACE OF BRIDGE			
					CL OF ROADWAY FOR APPROACH/EXIT OF BRIDGE			
X					**SUPPORT CALCULATIONS (15 Points)**	**0**	**0**	
					HYDRAULIC SLOPE/HYDROLOGY/FLOW TRANSITION			
					RIP RAP AND GUIDEBANKS/SCOUR			
					DECK DRAINS/CLEARANCE			
X					**SITE INFORMATION (15 Points)**	**0**	**0**	
					LAYOUT			
					ROADWAY PLANS			
					LOCATION MAP/DRAINAGE MAP/QUAD MAP			
					FEMA FIRMETTE/RISK ASSESSMENT/HYDRO FIELD REPORT			
X					**MISC DATA (15 Points)**	**0**	**0**	
					SCOUR SUMMARY/HYDRAULIC TABLES			
					HEC-RAS RUNS (NATURAL/EXIST/PROP)			
					TOTAL:	**0**	**0**	

RESERVED FOR POST PRELIMINARY PLANS ACTIVITIES

LAYOUT QUALITY EVALUATION FORM

SCORE: #DIV/0!

Project
Project No.: ______
County: ______
PI Number: ______
Description: ______

Group
Group Leader: ______
Design Firm: ______
Eng of Record: ______

Complexity: Difficult | Medium | Easy

Notes

Major Error = could cause safety/construction/bidding issues; EX: Missing Cell, Pay Item or General Note, Incorrect design detailing, Incorrect design programs, or Construction issues
Minor Error = can cause confusion when interpreting plans; EX: Typos, minor visual errors, Util coordinatio
NOTE: Excessive minor errors on a sheet may count as a Major Error

N/A	3+ Major Errors	1-2 Major Errors	3+ Minor Errors	0-2 Minor Errors	Section	Points Earned	Points Available	Additional Comments
X					**PLAN VIEW (20 Points)**	0	0	
					BRIDGE WIDTH/SKEW ANGLES/STREAM BANKS/ UNDERPASS			
					BEARING/PC/PT STATIONS			
					DRAWING			
X					**ELEVATION VIEW (20 Points)**	0	0	
					BRIDGE LENGTH/BENT STATIONS/BENT ELEV			
					CLEARANCES/HYDRAULIC ELEV.			
					FILL REMOVAL/SCOUR/BENT LABELS			
					DRAWING			
X					**NOTES (20 Points)**	0	0	
					BRIDGE CONSIST OF/TRAF. DATA/DESIGN DATA			
					DRAINAGE DATA/SCOUR TABLE			
					NOTES			
X					**CELLS (20 Points)**	0	0	
					SLOPE PAVING/RIP RAP			
					CLEARANCE DIAGRAM			
X					**ROADWAY DATA (20 Points)**	0	0	
					MAINLINE ALIGNMENT AND PROFILE DATA			
					UNDERPASS ALIGNMENT AND PROFILE DATA			
					TOTAL:	0	0	

RESERVED FOR POST PRELIMINARY PLANS ACTIVITIES

GDOT
Georgia Department of Transportation

BRIDGE PLAN QUALITY EVALUATION FORM

SCORE: **#DIV/0!**

Project		**Group**	
Project No.:		Group Leader:	
County:		Design Firm:	
PI Number:		Eng of Record:	
Description:		Designer:	

Complexity: Difficult | Medium | Easy

Notes

Major Error = could cause safety/construction/bidding issues; EX: Missing Cell, Pay Item or General Note, Incorrect design detailing, Incorrect design programs, or Construction issues
Minor Error = can cause confusion when interpreting plans; EX: Typos, minor visual errors, Util coordinatio
NOTE: Excessive minor errors on a sheet may count as a Major Error

N/A	3+ Major Errors	1-2 Major Errors	3+ Minor Errors	0-2 Minor Errors	Section	Points Earned	Points Available	Additional Comments
X					**PE SHEET (5 Points)**	0	0	
					PLAN VIEW			
					ELEVATION VIEW			
					CELLS/NOTES/HORIZ,VERT. CURVES			
X					**GENERAL NOTES SHEET (20 Points)**	0	0	
					BRIDGE CONSIST OF/TRAF. DATA/DESIGN DATA			
					UTILITIES/DRAINAGE/STAGING			
					GEN NOTES			
					SUMMARY OF QUANTITIES			
X					**DECK SHEETS (15 Points)**	0	0	
					DECK PLAN			
					DECK SECTIONS (Deck/Dia. / EdgeBm / EW / Int. Bent)			
					CELLS/NOTES/QUANTITIES			
X					**BEAMS / BEARINGS (15 Points)**	0	0	
					BEAM SHEETS			
					BEARING PAD SHEETS			
X					**END BENTS (15 Points)**	0	0	
					PLAN VIEW			
					ELEVATION VIEW			
					SECTIONS/NOTES/QUANTITIES/PDO			
X					**INTERMEDIATE BENTS (15 Points)**	0	0	
					PLAN VIEW			
					ELEVATION VIEW			
					SECTIONS/NOTES/QUANTITIES/PDO			
X					**MISC SHEETS (15 Points)**	0	0	
					FRAMING PLAN			
					RAILING SHEET			
					UTILITIES SHEET			
					DECK DRAINAGE SHEET			
					AS-BUILT SHEET			
					REBAR DETAILS SHEETS			
					TOTAL:	0	0	

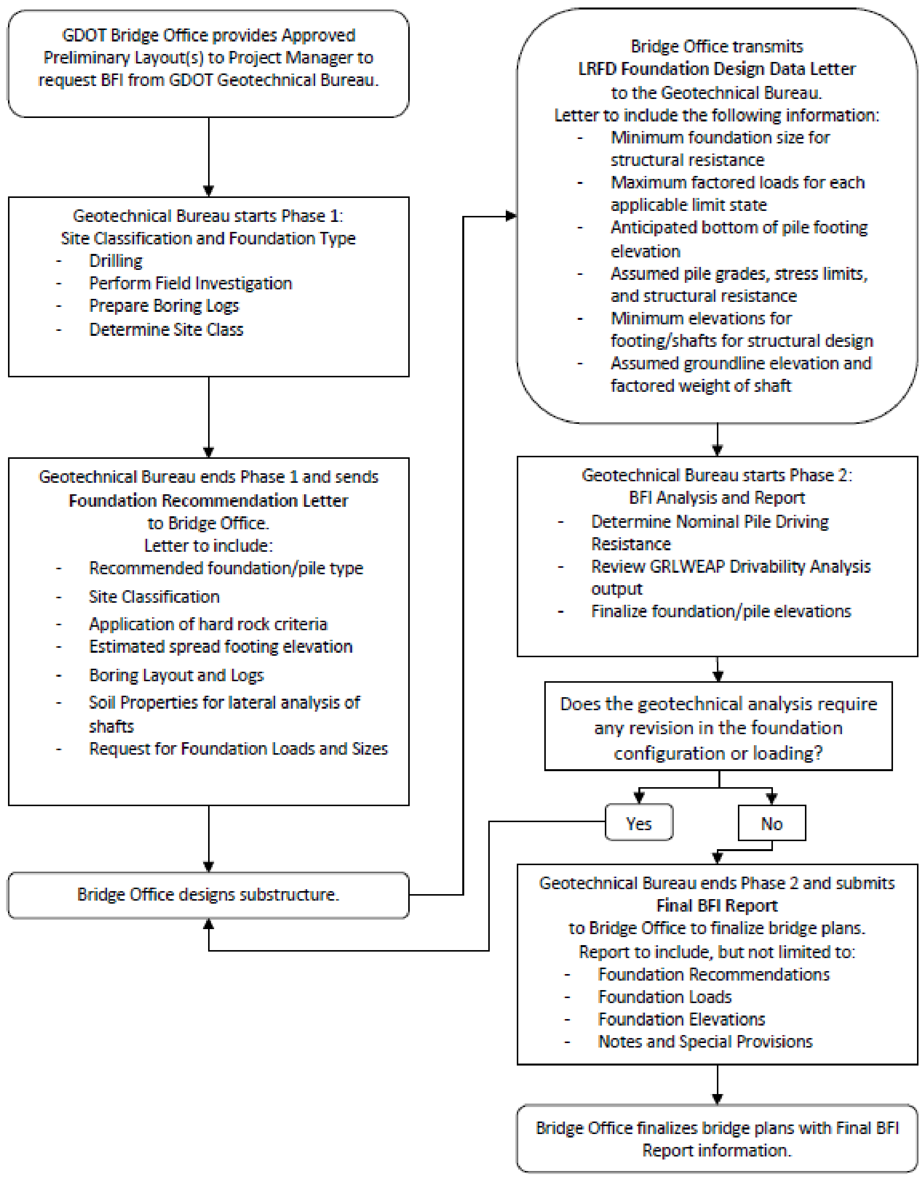
RESERVED FOR POST FINAL PLANS ACTIVITIES

1.10 Appendix 1C – Foundation Investigation Flow Charts

Updated: 03/12/2024

LRFD BFI Delivery Flowchart

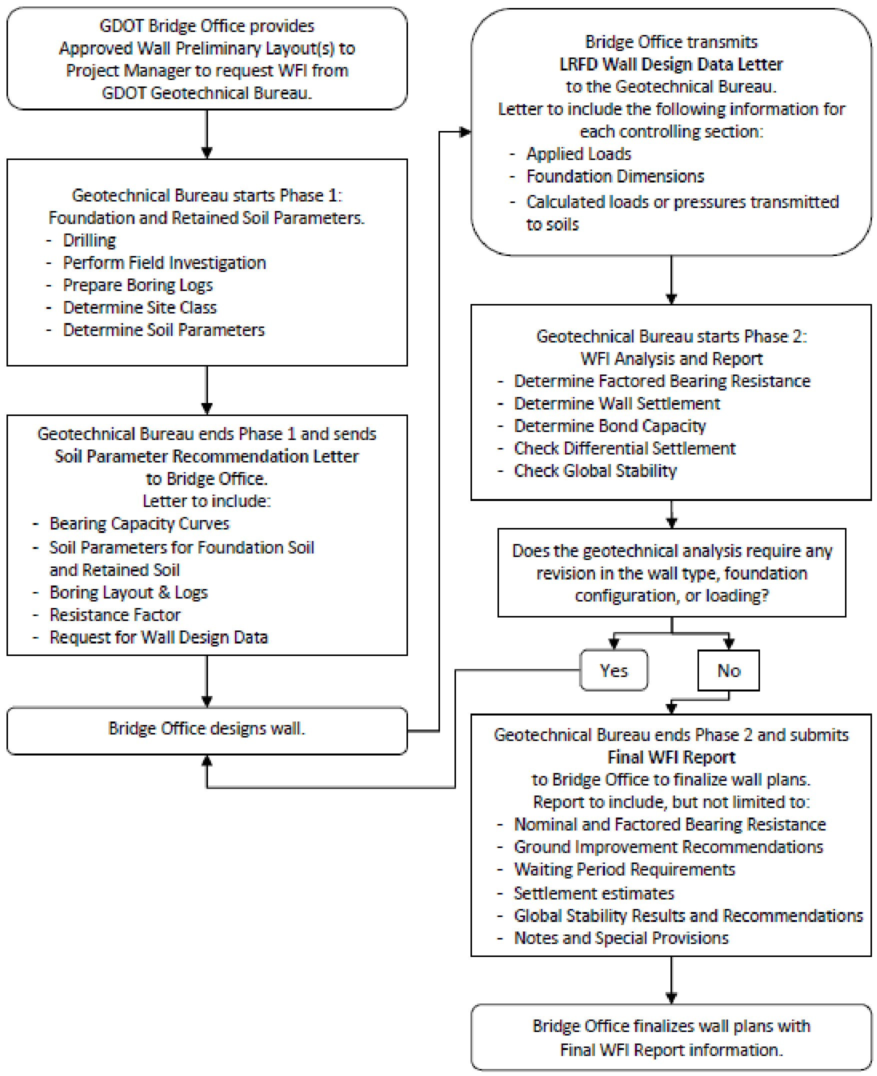
This is a concept level overview of the BFI development process, not a detailed guide for navigating the process.



Updated: 03/12/2024

LRFD WFI Delivery Flowchart

This is a concept level overview of the WFI development process, not a detailed guide for navigating the process.



Chapter 2. General Design - Contents

Chapter 2. General Design

2.1 Design Specification/Method

The following design and method requirements apply to geotechnical investigations and final design work on all projects with a Management Directed ROW date on or after January 1, 2022. Projects without a ROW phase shall meet the same requirements if the project's baseline start date for Final Construction Plans is on or after the above referenced date. In addition, any work previously negotiated to include the requirements of this sub-sections should also adhere to them.

Once a preliminary bridge or wall layout has been approved by the bridge office, changes in applied AASHTO Bridge Design Specification version should be coordinated with the Bridge Office.

Use the most current version of this GDOT Bridge and Structures Design Manual when preparing final design plans. Compliance to previous manual versions may be accepted, depending on the specifics of a project's schedule and nature of discrepancies. However, do not use previous guidance as a means for a more simplified or convenient design/detailing when work has not yet been completed. Review of Final Plans by the Bridge Office will reference the most current GDOT Bridge and Structures Design Manual. The GDOT Bridge and Structures Manual is intended to keep all designers informed of current practice. Prior manual direction or omissions will not be accepted as the ultimate justification for failing to meet current practice

2.1.1 Bridges, Culverts and Retaining Walls

All bridges, culverts and retaining walls are to be designed in accordance with the following:

- The contract documents
- GDOT Bridge and Structures Design Manual (BDM)
- AASHTO Bridge Design Specifications as designated below
- Georgia DOT Standard Specifications – Construction of Transportation Systems, 2021 Edition

In the event of conflicting information or guidance, the GDOT Bridge and Structures Design Manual supersedes the AASHTO Bridge Design Specifications.

All new or full replacement bridges and culverts on projects that include Federal Funds for any phase and with a PE authorization date on or after October 1, 2007, shall be designed using AASHTO LRFD Bridge Design Specifications, 9th Edition -2020. (AASHTO LRFD Specifications). The only projects including Federal Funds that can be designed using the AASHTO Standard Specifications for Highway Bridges, 2002, 17th Edition (AASHTO Standard Specifications) are those with a PE authorization date prior to October 1, 2007.

When widening an existing bridge designed under the AASHTO Standard Specifications, the widened portion may be designed using the AASHTO Standard Specifications 17th Edition, 2002, unless the Bridge Office requires it to be designed in accordance with the AASHTO LRFD Specifications. New barriers or parapets on the widened portion shall adhere to the requirements of BDM 3.3.2.1.1.

When widening an existing bridge designed under the AASHTO LRFD Specifications, design the widened portion using the AASHTO LRFD Bridge Design Specification as noted above for new construction. New barriers or parapets on the widened portion shall adhere to the requirements of BDM 3.3.2.1.2.

Extend existing culverts with the current 2400 series standard culvert details whenever possible. When sections are not compatible, extensions using the retired 2300 series will be allowed. Use the AASHTO LRFD Bridge Design Specification as noted above for new construction when developing special design culvert extension details.

The AASHTO LRFD Bridge Design Specifications, 9th Edition - 2020, Chapter 5: Concrete Structures requires that D-regions be designed using the strut-and-tie method for the Strength and Extreme Event limit states. Traditionally the Georgia Department of Transportation has used the sectional method in both B-regions and D-regions. Until such time that a full consideration of the strut-and-tie method and its design impacts can be examined, this sectional approach will be considered acceptable. A strut-and-tie method may be considered for hammer head caps, dapped beam ends, corbels, and girders defined as deep beams.

New and full replacement bridges and culverts on projects developed and constructed with 100% State and/or Local funds shall be designed according to the following:

- National Highway System (NHS) Bridges:
  - AASHTO LRFD Bridge Design Specifications, 9th Edition -2020

- On-System Bridges:
  - AASHTO LRFD Bridge Design Specifications, 9th Edition -2020

- Off-System Bridges (Not on NHS):
  - AASHTO LRFD Bridge Design Specifications, 9th Edition -2020, preferred
  - AASHTO Standard Specifications for Highway Bridges, 2002, 17th Edition, acceptable unless otherwise designated by the Bridge Office

Definitions:

On-System – Work on a roadway designated as a State route, Interstate route, or locally owned roadway that traverses over or under a State or Interstate route which is designated to be designed to On-System criteria by the Chief Engineer.

Off-System – Work on a Local road system that does not meet the definition of an On-System route.

All retaining wall structures on projects with a Management Directed ROW date on or after July 1, 2024 shall be designed using the AASHTO LRFD Bridge Design Specifications, 9th Edition – 2020, unless otherwise specified on the plans or contract documents.

All bridges shall be classified as "typical" as related to LRFD 1.3.5, unless specified otherwise by the Bridge Office.

2.1.2 Pedestrian Structures

All pedestrian overpass structures should be designed in accordance with the AASHTO LRFD Guide Specifications for Design of Pedestrian Bridges, 2nd Edition, 2009. Substructures and foundations shall be designed in accordance with the AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.

2.1.3 Sign and Light Supports

All sign and light support structures shall be designed in accordance with the AASHTO LRFD Specifications for Structural Supports for Highway Signs, Luminaires, and Traffic Signals, 1st Edition, 2015, with interims. Foundations for these structures shall be designed in accordance with the AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.

2.1.4 Noise Barriers

All noise barriers shall be designed in accordance with the AASHTO LRFD Bridge Design Specifications, 9th Edition, 2020.

2.1.5 Tunnels

All tunnels shall be designed in accordance with the AASHTO LRFD Road Tunnel Design and Construction Guide Specifications, 1st Edition, 2017.

2.2 Loads

2.2.1 Dead Loads

2.2.1.1 Non-Composite Dead Loads

The non-composite dead load consists of:

- Slab
- Coping
- Diaphragms
- Metal Stay-In-Place (SIP) forms: 16 lbs./ft^2 – Do not include weight for Reinforced Concrete Deck Girders (T-beam bridges)

2.2.1.2 Composite Dead Loads

The composite dead load consists of:

- Sidewalks
- Barriers and parapets
- Medians
- Future Wearing Surface: .030 ksf – All Bridges
- Utilities

For bridges meeting the conditions of LRFD 4.6.2.2.1, these loads will be summed and distributed equally to all beams except in the case of very wide bridges (over 70 feet out-to-out). For very wide bridges, the sidewalk, barrier, and parapet loads should be distributed to the four exterior beams on each side, and the median load distributed to the beams under the median. The future paving allowance will be distributed to all beams.

2.2.2 Live Loads

2.2.2.1 Design Vehicular Load

For LRFD projects, the design vehicular load shall be AASHTO HL-93. The Dynamic Load Allowance (IM) shall be included as specified in LRFD 3.6.2. Extreme force effects shall be taken as specified in LRFD 3.6.1.3, including the two design trucks plus design lane load for intermediate bents.

For Standard Specification projects, the design vehicular load shall be AASHTO HS-20 and/or Alt. Military Loading.

2.2.2.2 Bridge Widening

When an existing bridge is to be widened, its structural capacity will be accepted if the live load capacity is HS-15 or greater and the bridge does not require posting for any of the State’s legal loads. It is desirable to have at least 10% reserve capacity for each of the State’s legal loads. For bridges that are to be widened on the Interstate system and State Grip System, the structural capacity will be accepted if the live load capacity is HS-20 or greater. The Bridge Maintenance Unit will make recommendations for replacement or widening of a bridge in the bridge condition report.

2.2.2.3 Pedestrian Loads

Calculate the pedestrian load according to LRFD 3.6.1.6 and distribute the load to the beams in the same manner discussed for the sidewalk dead load in BDM 2.2.1.2.

Include pedestrian loads in the development of the live load cases for substructure analysis as described in LRFD 3.6.1.1.2. The current GDOT MathCAD program for calculating substructure loads does not automate this process.

2.2.3 Lateral Loads

Resolve all lateral loads using the stiffness of the bent to its point of fixity regardless of substructure and foundation type. See BDM 4.1.2 for guidance on the distribution of lateral loads acting through the superstructure, including but not limited to Wind, Braking, and Seismic loads. When calculating braking force loads, design for all design lanes traveling in one direction.

For pile intermediate bents and pile end bents this includes analyzing each pile as a column susceptible to bi-axial bending to the point of fixity as defined in BDM 4.2.1.1. Ignore any contributions to the design from pile encasement included in the plan detailing. Piles fully embedded while supporting columns on a footing may be considered as axially loaded only. Ignore the soil mass behind the bridge abutments and end/back walls when resolving these forces into the ground.

2.3 Horizontal and Vertical Clearances

2.3.1 Clearance Calculation

All vertical and lateral clearances for bridge sites shall be determined by mathematical calculation and checked with an independent calculation.

2.3.2 Stream Crossing

See the GDOT Drainage Design Policy Manual Chapter 8.

2.3.3 Grade Separations

2.3.3.1 Vertical Clearances

Vertical clearances shall be determined using Table 2.3.3.1-1. Ensure that vertical clearance is provided within the boundaries of the vertical clearance, including any future lanes programmed to be added to the traveled way (TW) beneath the structure.

Table 2.3.3.1-1 Vertical Clearances for Bridges

Functional Classification of Roadway Under the Bridge	Minimum Vertical Clearance*	Boundaries of Vertical Clearance
Local Road	16’-9”	TW
Collector	16’-9”	TW
Arterial	16’-9”	TW + Usable shoulder
Freeway	17’-0”	TW + Usable shoulder

*Sign Bridges, Pedestrian Bridges, and Bridges that cannot be easily raised, including but not limited to concrete box girder bridges or bridges with integral piers, shall have a minimum vertical clearance of 17’-6”.

Where falsework is necessary, a minimum temporary vertical clearance of 15’-9” shall be provided.

Where bridges pass over mixed use trail systems, a minimum of 8 ft of vertical clearance should be provided over the trail. In locations where there is a high probability that emergency or service vehicles may pass under the bridge the clearance should be increased to 10 ft.

Coordinate with the Bridge Office if any of the above listed clearances are not attainable, or to resolve ambiguity about a structure’s ability to be easily raised.

A Design Exception will be required for interstates, other freeways, and roads on the NHS with design speeds of 50 MPH or greater when minimum AASHTO vertical clearances outlined in the AASHTO Policy on Geometric Design of Highways and Streets cannot be achieved, while assuming a 6 inch future resurfacing thickness per LRFD C2.3.3.2. When the minimum AASHTO vertical clearances cannot be achieved for roadways outside the above definition, a Design Variance will be needed.

See BDM 2.3.4 for vertical clearance requirements for Railroad Crossings.

2.3.3.2 Horizontal Clearances

Intermediate bents shall be located so as to provide the desirable clear zone as specified in the AASHTO Roadside Design Guide whenever practical. Where this is not practical, the designer shall coordinate with the Project Manager to determine how to protect the columns from traffic.

For new bridges over interstates, if future lanes for the interstate are not included in the concept report and/or future typical section, provide a bridge to accommodate a minimum of one future lane in each direction outside existing or proposed lanes.

2.3.4 Railroad Crossings

2.3.4.1 CSX Transportation, Inc.

The following requirements shall be met for projects requiring CSX Transportation, Inc. coordination:

a) Provide a minimum vertical clearance of 23’-0” from top of high rail to bottom of beam. This clearance is measured along lines concentric with the centerline of the track and 6’-0” on either side. When straddle bents are being placed over the railroad, coordinate with the railroad early in the design process to establish construction clearance requirements so that necessary formwork can be considered.

b) When practical, span the CSX owned right of way. If this is not practical based on project parameters, span as much of the right of way as practical. Failure to span the right of way will require a standard deviation request package be submitted for review and approval.

c) The desirable horizontal clearance from center of track to the face of the column is 25’-0” on each side, and this should be provided whenever possible. Where multiple tracks are present, measurements are from the outermost tracks. This allows the intermediate bents adjacent to the railroad to be built without crash walls. The minimum clearance is 18’-0” for tangent tracks. Add 3½” of clearance for each inch of track superelevation on curved tracks.

d) Crash walls are to be provided where horizontal clearance is less than 25 feet. The top of the crash wall should be 6’-0” above the top of the high rail. The crash wall should be 2’-6” in thickness and extend 2’-6” beyond the outside faces of the exterior columns. The face of the crash wall on the track side should extend 6” beyond the face of the column.

e) Provide a chain link fence for all bridges over CSX Transportation facilities.

f) Existing drainage facilities parallel to the track(s) must be maintained through the structure.

g) Endrolls shall have slope paving.

h) Overpass drainage must be directed away from the railroad right-of-way.

i) See Figure 2.3.4.1-1 for railroad cross-section data for use in calculating bridge end locations. Allow 4’-9” for the depth of the ditch from top of rail to bottom of ditch. It should be noted that this work may never actually be done depending on the existing conditions, but the proposed bridge length shall be determined using Figure 2.3.4.1-1.

When these items cannot be achieved due to conditions, some items may be changed on a negotiated basis.

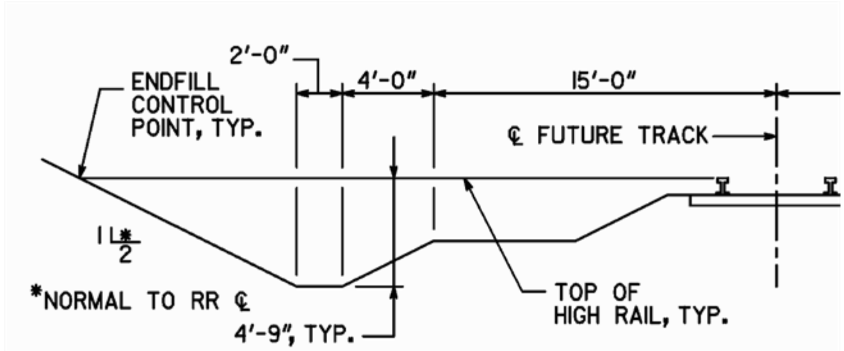


Figure 2.3.4.1-1 Endfill Control Diagram

2.3.4.2 Norfolk Southern Corporation

Subsidiaries of Norfolk Southern Corporation include:

- Norfolk Southern Railway Company
- Central of Georgia Railroad Company
- Georgia Southern & Florida Railway Company
- Tennessee, Alabama & Georgia Railroad Company
- Georgia Northern Railway Company
- The South Western Railroad Company
- Alabama Great Southern Railroad Company

The following requirements shall be met when coordinating with Norfolk Southern Corporation and its subsidiaries:

a) Provide a minimum vertical clearance of 23’-6” from top of high rail to bottom of beam. This clearance is measured along lines concentric with the centerline of the track and 6’-0” on either side. Present both the required minimum and the actual calculated vertical clearances in the bridge elevation view.

b) The desirable horizontal clearance from center of track to the face of the column is 25’-0”, whenever possible, to avoid the use of crash walls.

   For a single track, minimum horizontal clearance is 20 feet on one side and 14 feet on the other side of the track for locations where the span adjacent to the span over the railroad is not the end span. If the span adjacent to the railroad is the end span, provide 22’-0” clearance to the column between the railroad span and end span. The railroad will advise which side requires the 20 feet based on the location and the direction of mechanized maintenance machinery. For double tracks, provide 20 feet on each side.

c) Crash walls shall be provided if the horizontal clearance is less than 25’-0”. Crash walls should be 2’-6” in thickness and extend 2’-6” beyond the outside edge of the exterior column along the centerline of the pier. The face of the crash wall on the track side should extend 6” beyond the face of the column towards the centerline of the track. The top of the crash wall should be 10’-0” above the top of the high rail.

d) Provide a chain link fenced for all bridges over Norfolk Southern Corporation facilities.

e) Endrolls shall have slope paving.

f) Overpass drainage must be directed away from the railroad right-of-way.

g) See Figure 2.3.4.1-1 for railroad cross-section data for use in calculating bridge end locations. Allow 4’-9” for the depth of the ditch from top of rail to bottom of ditch. It should be noted that this work may never actually be done depending on the existing conditions, but the proposed bridge length shall be determined using Figure 2.3.4.1-1.

h) The edge of all footings must be a minimum of 13’-0” from the centerline of track.

i) MSE walls shall not be constructed on NS Right of Way or within 25’-0” of the centerline of centerline of track, whichever is greater

See GDOT Policy 6865-7: Vertical Clearance of Bridges over RR Tracks, concerning procedures for determining accurate vertical clearances over railroad tracks during construction.

2.3.5 Navigable Waters

The vertical and horizontal clearances over navigable waters regulated by the United States Coast Guard (USCG) are controlled by a USCG permit, or a waiver. Coordination on such matters for GDOT projects begins with our local FHWA Division who can either grant a waiver for the project themselves, or usher us into formal coordination and application process with the USCG.

When a formal permit is not required, it is the Department’s practice to provide vertical clearance equal to or greater than existing when replacing a structure over navigable water.

2.3.6 Recreational Lakes

When developing plans for bridges that pass over lakes with recreational boat traffic is anticipated, provide a minimum vertical clearance of 8 feet above the lake’s maximum operating pool elevation. The proposed vertical clearance shall be equal to or greater than the existing vertical clearance unless approved by the Department. The need of a greater vertical clearance should be discussed with local authorities.

2.4 Survey for Bridge Design

Designers should assure that the survey includes all the information necessary. Surveyors should be directed to the GDOT survey manual available from the Office of Design Policy and Support for more detailed information.

2.4.1 Stream Crossing – Hydraulic Studies

2.4.1.1 Property Survey

A Property Survey covers the extents of the topographic corridor and stream traverse. As a minimum, this will include property owner’s names and addresses, deeds, plats, and tax maps. The right-of-way should always be verified by deeds.

2.4.1.2 Existing Roadway Data

2.4.1.2.1 Alignment

The alignment of the existing roadway and bridge should be surveyed to the extents of the project limits. The beginning and ending centerline station should be established on the ground or pavement along with the beginning and ending centerline stations of the bridge and any PC's or PT's.

2.4.1.2.2 Profile

The profile of the existing roadway and bridge shall be determined for the same extents as the alignment. This profile shall include shots along the centerline, edges of pavement, outside edges of the roadway shoulder, and toe of the roadway embankment.

2.4.1.2.3 Intersecting Roads

Profiles are required for all intersecting roads that are located within the limits of the floodplain. These profiles shall extend 500 feet upstream and/or downstream of the intersection with the project road.

This data is also required for roadway and railroad embankments located along the stream and within the floodplain that are no further than 2000 feet upstream and/or downstream of the project site.

2.4.1.3 Existing Bridge Data

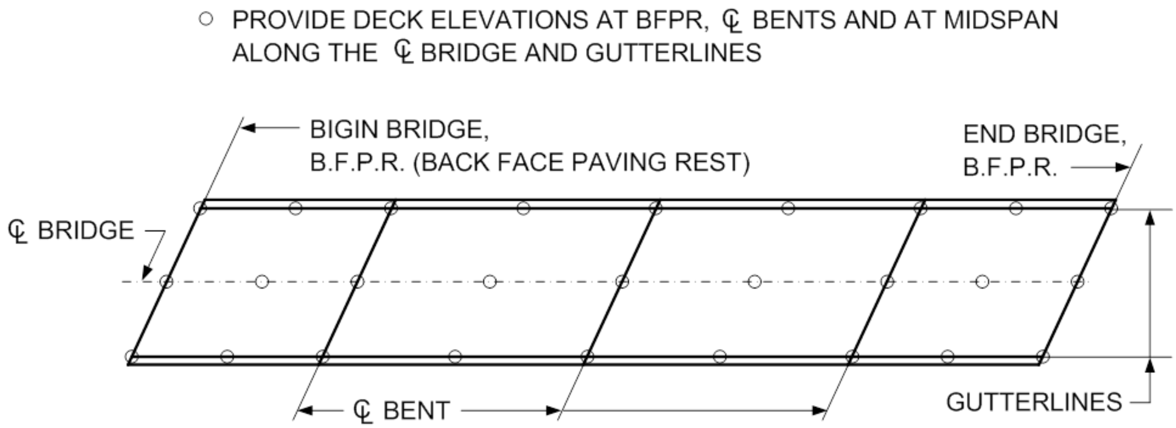
Top of deck elevations are required at several locations along the existing bridge. See Figure 2.4.1.3-1 for specific shot locations for replacement/paralleling projects and widening projects.

For all existing bridges within a project, elevation shots are required where centerline of bridge and gutter lines intersect each BFPR.

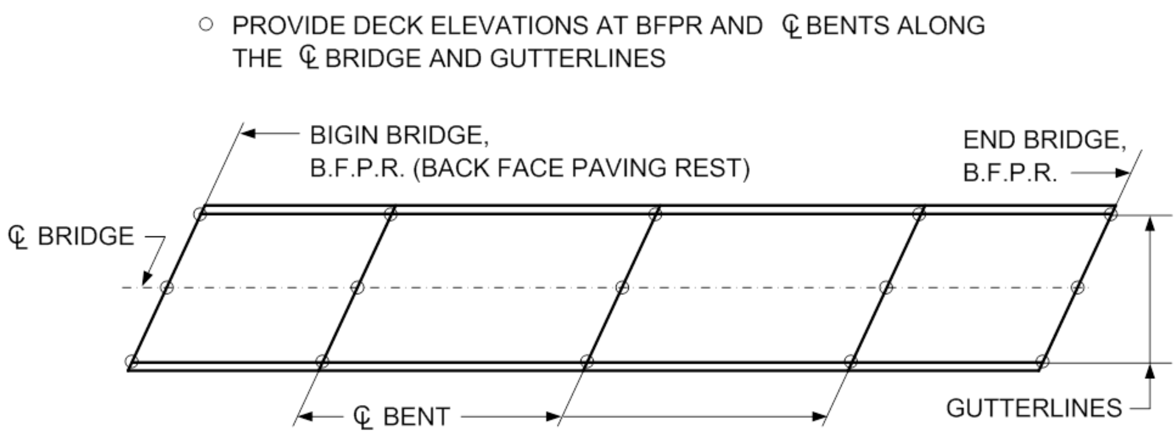
For Bridge widening project, additional elevation shots are required where the centerline of bridge and gutter lines intersect each centerline of bent and each mid-span line along the structure. Bottom of beam elevations for the outside beams at each bent shall be obtained.

The above data shall be provided for all bridges or culverts located within the floodplain that are no further than 2000 feet upstream and/or downstream of the project site.

For bridge widening projects where the existing bridge plans are not available, a more detailed survey that gives a complete description of the superstructure and substructure will be required. Surveyor shall check with Project Engineer to determine availability of bridge plans.



SURVEY SHOT LOCATIONS FOR BRIDGES TO BE WIDENED



SURVEY SHOT LOCATIONS FOR ALL OTHER BRIDGES

Figure 2.4.1.3-1 Bridge Survey Shot Locations for Deck Elevations

2.4.1.4 Topographic Coverage

Topographic coverage shall extend at least 150 ft. each side of the centerline. These coverage limits shall apply to both the existing centerline and proposed centerline, if different.

It is preferred that the hydraulic survey data be taken in DTM format. The coverage shall be detailed enough to cover all required areas specified in the field report. These survey points should be included in the InRoads file that is provided to the roadway designer. All survey points should be labeled consistently and clearly identified. All survey data shall be referenced to NAVD88.

2.4.1.5 Benchmarks

A minimum of three benchmarks are required: One at the beginning of the survey, one at the end of the survey, and one for each bridge or stream site near the right-of-way. Benchmarks should be described with a sketch, which also shows the X, Y, and Z coordinates. Benchmarks shall be referenced to the project stations with a complete physical description and elevation. All elevations should be established with a spirit level, referenced to NAVD88. Benchmarks for bridge or stream site shall be located within a distance of 300 feet from the site.

2.4.1.6 Stream Traverse

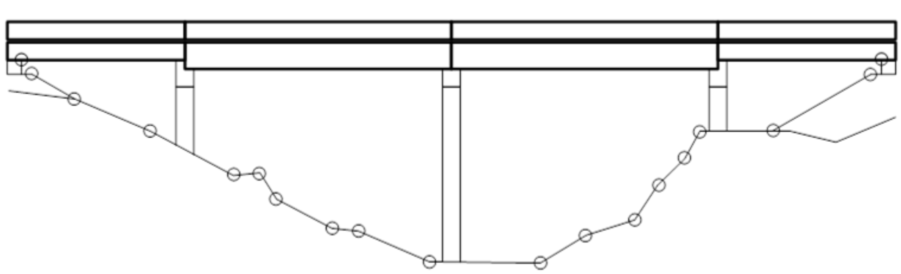
The stream traverse should begin at 500 feet upstream from the bridge centerline with Station 1+00.00 and then continue downstream to a station 500 feet below the bridge centerline. Cross sections of the stream channel are required at the following locations:

- Every 100 feet along the traverse
- Centerline of the existing bridge
- Centerline of the proposed bridge
- 50 feet and 100 feet upstream of the proposed bridge centerline
- 50 feet and 100 feet downstream of the proposed bridge centerline

These cross sections shall be detailed enough to accurately define the profile of the terrain, which usually includes end rolls, stream channel banks, streambed elevations, scoured areas, and any other breaks in the terrain (see Figure 2.4.1.6-1). A sufficient number of streambed shots shall be taken to ensure an accurate stream channel model can be created. Traverses and stream cross sections shall be provided for all stream channels in the floodplain. As stated above, the DTM method is preferred, as long as it is detailed enough to accurately define the location and cross section profile of the stream channel along the entire stream traverse.

○ REQUIRED BRIDGE OPENING SHOTS, SEE SECTION II.E OF THE HYDRAULIC ENGINEERING FIELD REPORT.

A SUFFICIENT NUMBER OF STREAMBED SHOTS SHALL BE TAKEN TO INSURE AN ACCURATE STREAM CHANNEL CROSS SECTION.



TYPICAL SECTION – PROFILE OF BRIDGE OPENING

Figure 2.4.1.6-1 Bridge Survey Shot Locations for Streambed

2.4.1.7 Floodplain Cross Sections

2.4.1.7.1 General

Two floodplain cross sections are required, one at 100 feet on each side of the roadway. Each cross section should extend to a point 2 feet above the high water mark that has been established for the stream at the bridge site. The floodplain elevations should be taken at all breakpoints in the terrain within the Bridge Survey alignment and 500 foot intervals outside the alignment.

This data is also required for bridge and roadway sites located within 2000 feet upstream and/or downstream of the project site.

2.4.1.7.2 Parallel Bridges or Small Alignment Shifts

Parallel bridge projects and/or projects with the proposed alignment shifted a relatively small distance require a floodplain cross section be taken along the new and/or parallel alignment.

2.4.1.7.3 New Locations

New location projects require that a floodplain cross-section be taken along the new alignment.

2.4.1.7.4 Abnormal Flood Conditions

For projects with abnormal flood conditions (creeks that flow into one of the state's major rivers), a floodplain cross section is required of the major river below the confluence with the creek. Since this would be an extremely costly section to have surveyed, the cross section may be approximated from USGS maps.

2.4.1.8 Bridge Sketch

Bridge sketches shall be drawn showing the elevation and centerline plus the bottom of the bridge beam at each cap. This sketch also shows the centerline station plus an elevation on all terrain breaks beneath the bridges. The stationing used to show elevations on the bottom of the beam and the profile of the ground beneath the lowest bridge beam shall be the same as the stationing for the alignment of the bridge deck. On mapping surveys, which have no alignment, the stationing for the bridge sketch shall begin with station 0+00.

For structures located upstream or downstream that could have an adverse effect of the bridge at the survey site, a sketch is required. This distance could be as much as 2000 feet. For upstream drainage structures beyond this limit, the size and type should be plotted on a quadrangle map or county map.

The surveyor shall provide, on the bridge sketch, any overflow bridge or culvert within the floodplain with the distance to the project bridge, deck elevation or culvert size, and the flow line elevation.

2.4.1.9 Hydraulic Engineering Field Report

The surveyor shall provide a Hydraulic Field Report in accordance with GDOT Standards. See Hydraulic Engineering Field Report Form in Appendix 2A.

2.4.1.9.1 Normal Water Surface Data

Water surface elevations are required at the survey centerline and at 500 feet upstream and downstream of the survey centerline. These shots shall be taken in the same time period. For tidal sites, the normal high and low tide elevations are required.

2.4.1.9.2 Historical Flood Data

The extreme high water elevation (flood of record) shall be obtained along with the date of occurrence, location (distance upstream or downstream), and the source for this information. If the site is tidal, the highest observed tide elevation is needed.

The surveyor shall record the floor elevations and locations of any houses, buildings or other structures that have been flooded, or have floor elevations within 2 feet of the flood of record. For structures that have been flooded, the surveyor shall provide the flood information, including the number of times the structure has been flooded, the date(s), and the high water elevations.

Note: The high water elevations should be obtained from longtime local residents and/or city/county officials.

2.4.1.10 Miscellaneous Survey Data

2.4.1.10.1 Dams and Spillways

For sites affected by an upstream or downstream dam, survey shots are required that describe the location, length, width and elevation of the dam embankment and spillway opening. The water surface elevation of the impounded water shall be provided.

2.4.1.10.2 Guide Banks (Spur Dikes)

Shots shall be taken that will reflect the location, length and elevation of the guide bank.

2.4.1.10.3 Longitudinal Roadway Encroachments on Floodplains

Additional floodplain cross sections will be required to determine the effects of the longitudinal encroachment. The surveyor can contact the Project Engineer for guidance on the extent of additional survey data that will be required.

2.4.1.10.4 Upstream and Downstream Crossings

For all bridges and culverts that lie between 2000 feet and 1 mile upstream and downstream from the project bridge, the surveyor shall identify basic information for each structure, such as distance from proposed structure, type of structure, route location, and structure sizes in the Hydraulic Engineering Field Report.

2.4.1.10.5 Additional Cross Sections

If the hydraulics at the project site is affected by other factors such as confluence with other streams or narrow floodplain cross sections, additional floodplain cross sections may be required. The surveyor should contact the roadway designer if a question arises during the field survey of the project.

2.4.2 Grade Separations

The following items are needed for a bridge survey over an existing road:

2.4.2.1 Property Survey

A Property Survey that covers extents of all the roadway alignments' corridors. As a minimum, this will include property owner's names and addresses, deeds, plats, and tax maps. The right-of-way should always be verified by deeds.

2.4.2.2 Existing Roadway Data

2.4.2.2.1 Alignment

The alignment of the existing roadway and bridge should be surveyed to the extents of the project limits. The beginning and ending centerline station should be established on the ground or pavement along with the beginning and ending centerline stations of the bridge and any PC's or PT's.

2.4.2.2.2 Profile

The profile of the existing roadway and bridge shall be determined for the same extents as the alignment. This profile shall include shots along the centerline, edges of pavement, outside edges of the roadway shoulder, and toe of the roadway embankment.

2.4.2.2.3 Intersection Roads

Profiles are required for all intersecting roads that are located within the limits of the survey. These profiles shall extend at least 300 feet from the intersection with the project road. These profiles shall include shots along the centerline, edges of pavement, outside edges of the roadway shoulder, and toe of the roadway embankment.

2.4.2.3 Existing Bridge Data

Top of deck elevations are required at several locations along the existing bridge. See Figure 2.4.1.3-1 for specific shot locations for replacement/paralleling projects and widening projects.

For all existing bridges within a project, elevation shots are required where centerline of bridge and gutter lines intersect each BFPR.

For Bridge widening project, additional elevation shots are required where the centerline of bridge and gutter lines intersect each centerline of bent and each mid-span line along the structure. Bottom of beam elevations for the outside beams at each bent shall be obtained.

For bridge widening projects where the existing bridge plans are not available, a more detailed survey that gives a complete description of the superstructure and substructure will be required. Surveyor shall check with Project Engineer to determine availability of bridge plans.

2.4.2.4 Topographic Coverage

Topographic coverage shall extend at least 150 ft. each side of the centerline. These coverage limits shall apply to both the existing centerline and proposed centerline, if different.

2.4.2.5 Benchmarks

A minimum of three benchmarks are required: One at the beginning of the survey, one at the end of the survey, and one for each bridge site near the right-of-way. Benchmarks should be described with a sketch, which also shows the X, Y, and Z coordinates. Benchmarks shall be referenced to the project stations with a complete physical description and elevation. All elevations should be established with a spirit level, referenced to NAVD88. Benchmarks for bridge or stream site shall be located within a distance of 300 feet from the site.

2.4.2.6 Profile and Cross Sections

Profile and Cross Sections or DTM coverage should have the same limits as the Topographic limits.

2.4.2.7 Roadway beneath Bridge

The road beneath a bridge for 300 ft left and right of the bridge requires a complete survey which includes: Alignment, property, topographic, profile levels and cross sections or DTM survey data.

2.4.2.8 Bridge Sketch

A bridge sketch is required. On this sketch, show the vertical clearance from the bottom of the outside bridge beams to the roadway pavement at the centerline of the road and at each edge of pavement of the road.

2.4.3 Railroad Crossings

The following items are needed for a bridge survey over an existing railroad:

2.4.3.1 Property Survey

A Property Survey that covers extents of the roadway alignment and railroad corridors. As a minimum, this will include property owner’s names and addresses, deeds, plats, and tax maps. The right-of-way should always be verified by deeds.

2.4.3.2 Existing Roadway Data

2.4.3.2.1 Alignment

The alignment of the existing roadway and bridge should be surveyed to the extents of the project limits. The beginning and ending centerline station should be established on the ground or pavement along with the beginning and ending centerline stations of the bridge and any PC's or PT's.

2.4.3.2.2 Profile

The profile of the existing roadway and bridge shall be determined for the same extents as the alignment. This profile shall include shots along the centerline, edges of pavement, outside edges of the roadway shoulder, and toe of the roadway embankment.

2.4.3.2.3 Intersecting Roads

Profiles are required for all intersecting roads that are located within the limits of the survey. These profiles shall extend at least 300 feet from the intersection with the project road. These profiles shall include shots along the centerline, edges of pavement, outside edges of the roadway shoulder, and toe of the roadway embankment.

2.4.3.3 Existing Bridge Data

Top of deck elevations are required at several locations along the existing bridge. See Figure 2.4.1.3-1 for specific shot locations for replacement/paralleling projects and widening projects.

For all existing bridges within a project, elevation shots are required where centerline of bridge and gutter lines intersect each BFPR.

For Bridge widening project, additional elevation shots are required where the centerline of bridge and gutter lines intersect each centerline of bent and each mid-span line along the structure. Bottom of beam elevations for the outside beams at each bent shall be obtained.

For bridge widening projects where the existing bridge plans are not available, a more detailed survey that gives a complete description of the superstructure and substructure will be required. Surveyor shall check with Project Engineer to determine availability of bridge plans.

2.4.3.4 Topographic

Topographic coverage shall extend at least 150 ft each side of the centerline. These coverage limits shall apply to both the existing centerline and proposed centerline, if different.

2.4.3.5 Benchmarks

A minimum of three benchmarks are required: One at the beginning of the survey, one at the end of the survey, and one for each bridge or stream site near the right-of-way. Benchmarks should be described with a sketch, which also shows the X, Y, and Z coordinates. Benchmarks shall be referenced to the project stations with a complete physical description and elevation. All elevations should be established with a spirit level, referenced to NAVD88. Benchmarks for bridge or stream site shall be located within a distance of 300 ft from the site.

2.4.3.6 Profile and Cross Sections

Profile and Cross Sections or DTM coverage should have the same limits as the topographic limits.

2.4.3.7 Railroad beneath Bridge

The railroad beneath the bridge for 500 ft left and right of the bridge requires a complete survey that includes:

Alignment – The alignment of the centerline on the main railroad tracks for 500 ft left and right of the bridge shall be surveyed. The intersection of the bridge alignment and the railroad alignment shall be tied to a railroad milepost.

Property survey – As described in section 2.4.3.1.

Topographic – The topographic coverage limit shall be 100 ft left and right on each side of the track. If the location has multiple tracks, coverage should be 100 ft beyond the centerline of the outermost track. The location of the existing bridge pilings should be located from the survey centerline.

Profile Levels and Cross Sections or DTM Survey Data – The profile and cross sections or DTM survey data shall be taken a minimum of 100 ft each side of the track. If the location has multiple tracks, coverage shall extend for 100 ft beyond the centerline of the outermost track. Elevations are to be taken on the top of each rail. If collecting elevations in the cross section format, a minimum of five (5) cross sections shall be taken between the proposed right-of-way limits. One at the proposed right-of-way, one halfway between the proposed right-of-way and the bridge centerline, one at the bridge centerline, and the same for the other side of the bridge. These cross-sections will be taken perpendicular to the railroad track centerline and extend for 100 ft beyond the centerline of the outermost track.

Drainage – All drainage structures and features within the 1000 ft Railroad Survey corridor shall be provided.

2.4.3.8 Bridge Sketch

A bridge sketch is required. On this sketch, show the vertical clearance from the bottom of the outermost bridge beams to the top of the railroad rail for each rail beneath the bridge.

2.5 Staged Construction

Staged construction may be required when widening bridges or circumstances require constructing the new bridge in nearly the same footprint as existing. Bridge replacement for bridges carrying Freeways will typically require staged construction, as detour bridges for Freeways are not preferred.

2.5.1 Temporary Shoring

Since it is difficult for designers to anticipate a contractor’s exact method of construction, temporary shoring shall be shown wherever it is considered necessary. Show the temporary shoring with break lines at the ends to indicate indefinite limits. For layout purposes, shoring should be assumed to be 3 feet wide. This width should accommodate most sheet piling shapes or post and lagging configurations, while allowing minimal clearance for installation and removal.

If shoring is shown on the plans, include a general note addressing the shoring or include temporary shoring in the list of incidental items. Do not use the temporary shoring pay item unless shoring is required based on a specified construction approach.

2.5.2 Pour Strips

Pour strips shall be considered for staged construction. See Section 3.13.1.1 for details.

2.5.3 Temporary Barrier

Temporary barrier shall be considered for staged construction. See Section 3.3.6 for details.

2.5.4 Overhang Brackets

When bridges are constructed in stages overhang brackets are typically used to support the slab pour at the stage line. A minimum of 5 ft of clearance is needed between the top flange of the girder nearest the stage line and the existing bridge to provide for the installation and removal of these brackets.

2.5.5 Minimum Number of Beams Per Stage

For construction stages that will carry vehicular traffic, provide a minimum of 4 beams in each span. Subsequent stages should contain a minimum of 2 beams.

2.5.6 Pedestrian Traffic

If the existing structure includes sidewalks, the proposed construction staging plan must include accommodation for pedestrians. At a minimum, pedestrians can be accommodated on a temporary 4ft wide section of bridge deck. Accommodating pedestrians in this manner will require shielding the pedestrian path with Method 1 barrier according to BDM 3.3.6.1.

2.5.7 Sequential Staging

Staging plans should avoid nonsequential bridge construction, wherein a final stage is cast between two previous stages. These configurations create difficult erection challenges, particularly as it pertains to crane usage.

2.6 Bridge Jacking

2.6.1 General

Where bridges are to be raised, the designer shall provide jacking details in final construction plans. These details should provide 16'-9" minimum vertical clearance over the travel way and paved shoulders.

2.6.2 Utility Consideration

During the preliminary design phase, the designer should inform the District Utilities Engineer that the bridge is to be raised and that a field site inspection is needed to identify and locate the utilities in place. The findings should be reported to the Bridge Office. The District Utilities Engineer shall alert the impacted utility companies and remind them of their responsibilities for coordinating satisfactory utility realignment.

2.6.3 Additional Work

A request should be made to the Bridge Maintenance Unit for a Bridge Condition Survey. Items reported in need of repair or replacement should be incorporated into the contract documents if practical.

2.6.4 Plans

Each set of bridge jacking plans should include a Plan and Elevation sheet and Jacking Details sheets sufficient to describe the overall scope of work and show the required Bridge Office details along with other pertinent data necessary to obtain accurate and competitive bids. These sheets are in addition to applicable roadway plans which would include the Cover, Index, Revision Summary, Summary of Quantities, Detailed Estimate, Typical Sections, and Plan & Profile sheets.

2.6.4.1 Plan and Elevation Sheet

The Plan and Elevation (P&E) sheet should clearly show a plan view that includes beginning and ending bridge stations, bent arrangements, deck widths, and the point of minimum vertical clearance. It should also clearly show an elevation view that includes the length of bridge, span lengths, locations of expansion and fixed bearings, bent numbers, and the minimum vertical clearance at completion. The P&E sheet should also contain the existing grade data for the bridge and any underpass roadways as well as the existing bridge Serial, I.D., and P.I. numbers.

The P&E sheet may also contain the following in accordance with the Bridge Office's standard General Notes formatting:

- An "EXISTING BRIDGE CONSISTS OF" tabulation describing the existing bridge
- A "UTILITIES" tabulation listing all existing utilities
- A "WORK CONSISTS OF" tabulation outlining the basic items of the work
- A "DESIGN DATA FOR DESIGN OF PEDESTALS" tabulation indicating the design specifications used, the typical loading, and the future paving allowance assumed
- A "CONSTRUCTION SEQUENCE" tabulation enumerating proposed steps necessary to complete the work. A note should be included immediately following these steps stating *"The aforementioned sequence shall be coordinated with the roadway operations, see roadway plans. In lieu of the above sequence, the contractor may submit a proposed sequence for approval."*
- A "TRAFFIC DATA" tabulation displaying traffic data for the existing bridge
- A "SUMMARY OF QUANTITIES" tabulation including a lump sum pay item for raising the existing bridge, pay items for joint re-sealing, and any other pay items for requested bridge rehabilitation work

- A "GENERAL NOTES" tabulation stating all applicable standard Bridge Office notes pertinent to bridge jacking operations as well as notes addressing protection of existing slope paving, removal and replacement of existing bridge joints and/or other rehabilitative work, amount of jacking and vertical clearance to be obtained with reference to special provisions, and responsibility for utility disconnects/reconnects/adjustments

The above tabulations may be included on a separate General Notes sheet if necessary or may be included on the Jacking Details sheets.

2.6.4.2 Jacking Details Sheet

Jacking Details sheets should include the following:

- Section views at endwalls/backwalls detailing required modifications including pedestals, new concrete and reinforcement, and approach slab modifications
- Schematics of utility adjustments
- Schematic plan and elevation views of bearing assemblies and pedestals
- Details of elastomeric bearings if required (may be shown on separate sheet if necessary)
- Details of wingwall modifications
- Details of expansion joints
- Steel specifications and finish requirements
- Details/requirements for anchor bolt replacement

2.6.4.3 Maintenance of Traffic

The engineer shall consider maintenance of traffic in the design and ensure adequate coordination with the roadway plans. The sequence of operations should limit elevation differences at lift points to 1-inch or less at any given time or as indicated in the Special Provision for this work.

2.6.4.4 Jacking Method

It is generally not necessary or desirable to specify a jacking method in the plans. The Special Provision for this work should contain the basic jacking requirements and the engineer should make sure that is the case. It is the intent that the contractor retains responsibility for the jacking method/details and damage to the structure. However, the engineer should fully consider all jacking loads to be placed on the structure. Members should be analyzed as necessary to ensure that the strength is adequate for jacking by conventional methods. If not, special notes or details should be developed so a method is clearly available for bidding.

2.6.4.5 Approach Slab

Detailing for bridge jacking should include provisions for retaining existing approach slabs with modifications for re-supporting on the paving rest after jacking is complete. The existing approach slabs should normally be overlaid with permanent asphalt as the bridge is jacked thereby maintaining a consistent traffic surface that will remain in place at the completion of the project. A note should be included in the plans to require the contractor to check for voids beneath the approach slab by sounding and coring prior to cutting it free of the paving rest. If voids are detected, they should be grouted with flowable fill in accordance with GDOT Standard Specification Section 600 and a nominal quantity should be set up for this purpose to be used as directed by the engineer.

2.6.4.6 Concrete Pedestals

Concrete pedestals shall be specified when the pedestal height is over 1'-9". For bridges being jacked and widened on each side, so the existing portion of the bridge will be laterally restrained, concrete pedestals are required only when the pedestal height is over 2'-3". Steel pedestals may be used for heights equal to or lower than these limits.

2.7 Bridge Salvage

In the Preliminary Design Phase, submit a request to the Bridge Maintenance Unit (BMUSubmittals@dot.ga.gov) for a list of materials to be salvaged from the existing structure. The Bridge Maintenance Unit will respond by letter either stating that nothing will be salvaged, or with a list of items to be salvaged. Depending on the guidance in that letter, include one or more of the following notes on the General Notes sheet using the Bridge Notes Program:

- "No Salvage Materials"
- "Salvage of Structural Steel Transported by Contractor"
- "Salvage of Materials Transported by GDOT"
- "Salvage of Materials Transported by Contractor"

The only items potentially salvaged by the department are bronze plaques, aluminum handrail systems, and rolled steel beams greater than 34 feet long and smaller than W30. If none of these are present on the existing structure, there is no need to submit a request to the BMU for a salvage materials determination.

2.8 Software

2.8.1 General

The following software must be used during the production of final bridge plans:

a) **Geometry (BRGEOM)** – All bridges shall have a geometry program run showing the profile grade line, centerline construction, beam lines, gutter lines and edge of bridge. Transverse lines shall include end of bridge, centerline bents, centerline of bearing, and (for T-beams only) face of cap. This requirement may be waived for simple bridges.

b) **General Notes (BridgeNotes) –** Run this program to have the correct notes and pay items in the uniform format.

c) **Reinforcing Steel (BRRBAR) –** Run this program to have the correct steel quantities and formatted rebar sheets.

2.8.2 LRFD Projects

All interior slabs shall be designed using the most current version of RCSlab.xmcd. This program is available on the Department's website for download as a zip file.

Prior to beginning final bridge design, consultants shall submit, in writing, the LRFD design software they will be using for approval by the Bridge Office.

2.8.3 Standard Specification Projects

The Bridge Design Office has a variety of programs available for design using Standard Specifications that fall into the following categories:

2.8.3.1 Required Software

Required software must be used to at least check the final design of the appropriate items unless analysis of the structure is beyond the capacity of DOT programs:

1. Prestressed Beam (BRPSBM1) – All beams must analyze without overstress in the prestressed beam program. A run will be required for every different length or load condition.
2. Pier Program (BRPIER) – Each bent must have a pier program run. Seismic Performance Category B bridges are to be analyzed by BRNCPIER which provides input for seismic loads. There is no software required for pile bents.
3. Simple Span Beam (BRSPAN) – Required for simple span steel bridges. Note that the t-beam part of the program uses allowable stress and therefore is not required but can be helpful in generating loads.
4. Continuous Beam (BRCTBM) – Required for continuous steel beams.
5. Slab Design (BRSLAB07) – You can either run this or use the latest slab charts. The design of the slab uses allowable stress design.

2.8.3.2 Recommended Software

1. Bearing Pad (BRPAD1) – Provide a run for each size of pad and for each load case or expansion case. No design is required for half-inch unreinforced bearing pads
2. SEISAB – For bridges in the seismic zone B. Use in conjunction with NCPIER.
3. DESCUS (BRDESC) – For curved steel girders

2.8.3.3 Optional Software

- BRLLCA – Live load case program. Comes up with live load input for the pier program.
- BRPCAC – PCA Column Analysis
- BRCPFT – Continuous footing program
- BRSIGN – Sign base
- BRSPAN – GDOT simple span beam program

- Merlin-Dash – Proprietary simple span or continuous beam program

2.9 Preliminary Design

The Preliminary Design Phase is when the template for the Final Bridge Plans is set. Therefore, it is critical for the designer to consider all the known aspects that may affect the bridge design and plan for them during this phase. In addition to the design elements listed in this section, consideration should be given to construction staging as addressed in section 2.5.

2.9.1 Roadway Geometry

Early in the design process the designer may need to collaborate with the roadway designers to simplify the design and construction of the bridge. Some of the parameters that should be considered during this phase are discussed in the following subsections.

2.9.1.1 Low Points

When possible, low points should be kept off the bridge spans and approach slabs. If a low point must be located on the bridge, the following locations should be avoided:

- Near a bridge joint due to long term maintenance issues
- On end spans so drainage won't fall onto unprotected slopes
- Near intermediate bents so drainage won't fall onto substructure elements

See Section 3.15 for details of deck drainage.

2.9.1.2 Superelevation Transition

Superelevation transitions on bridges should be avoided when practical. Particularly, transitions between normal crown and reverse crown should be avoided as this requires a more complex construction sequence and a longitudinal construction joint. If the roadway plans present a superelevation transition that falls within the limits of the bridge, request that the Project Manager consider the following alternatives:

- Move the entire superelevation transition completely off the bridge.
- Make a transition to a certain cross-slope, maintain it across the bridge, and then continue the transition.
- Complete the transition between normal crown and reverse crown off the bridge, then increase or decrease the superelevation on the bridge as necessary.

2.9.1.3 Skew Angle

The minimum skew angle for all bridges shall be 45 degrees, measured between the centerline of bent and centerline of roadway. When proposed alignments would call for tighter skews the engineer should consider modifications to the roadway alignment. If roadway geometry cannot be modified, straddle bents or a scissor bridge configuration may be considered. Coordinate with the Bridge Office during concept development when the most tightly skewed bent in a structure is 50 degrees or less.

2.9.1.4 Profile Control and Project Grades

On all projects the profile grade should be controlled by the points of vertical intersection (PVI) along the alignment as reported on the profile sheets. As these PVI values are reported on the plans to the hundredth of a foot (two decimal places), PVI elevations in the project model must be truncated to that precision for consistency.

For projects containing any structure, coordinate with the road designer to ensure that the above has been adhered to in establishing roadway grades and determine all elevations associated with a proposed structure based on this same approach. Structural plans based on incorrectly calculated roadway profile information, will not be accepted.

Present profile grades on the bridge plans to four decimal places.

2.9.2 Bridge Widths

Determine the necessary bridge width based on the functional classification of the roadway being carried and other parameters as specified in the following sub-sections.

The functional classification of the roadway is stated in the project concept report and should be in agreement with the Georgia State Functional Classification Map. Resolve any conflicts or questions about the functional classification prior to developing preliminary plans.

The abbreviation TW in the sub-sections below is the traveled way. The traveled way is the sum of the traffic lanes and any flush or raised median being carried on the bridge. TW shall be a minimum of 2 lanes with a minimum lane width of 10 ft each.

In the following sub-sections, “Undivided” refers to a cross-section that does not have defined inside shoulders on the roadway typical section. These sections will have either opposing lanes directly adjacent of separated by a flush or raised median.

Use a single structure for “undivided” cross-sections.

“Divided” refers to a cross-section where each direction of traffic has an inside and outside shoulder. Divided sections with the opposing travel lanes separated by a depressed median requires the use of two structures. Divided sections with the opposing travel lanes separated by a median barrier may use one or two structures, depending on highway geometry. See section 2.9.2.6 for guidance on median barrier divided alignments and how configurations affect bridge layout.

When designing a replacement bridge that has a future parallel bridge programmed, it could be appropriate to apply multi-lane divided traffic criteria instead of the 2-way traffic criteria specified in following subsections. Coordinate with the Bridge Office if this condition exists and it not specifically addressed on project concept documents.

In certain staging situations it might be more economical to build a bridge wider than outlined in the following subsections as opposed to building a temporary structure to hold the traffic. Coordinate with the Bridge Office during preliminary design if this staging option seems justified.

The bridge width on roads with sharp curves and low traffic may be increased for traffic considerations. See Section 4.2.3 - Pavement Widening on Curves of the GDOT Design Policy Manual.

2.9.2.1 Bridges Carrying Local Roads

a) Rural section (2 lanes):

Design Year ADT	Bridge Clear Width
0-399	2’ + TW + 2’
400-2000*	3’ + TW + 3’
Over 2000	6’-6” + TW + 6’-6”’

*On designated bike routes with 1000-2000 ADT increase the shoulder width to 5 ft.

Determine the necessary bridge width for bridges that are part of the Low Impact Bridge Program per the Low Impact Bridge Program Manual, Appendix G.

b) Urban sections (with curb):

The clear width for all new or reconstructed bridges shall be the curb to curb width of the approach roadway. Provide sidewalks on all bridges where curb and gutter are provided on the approach roadway. Minimum sidewalk width on bridges shall be 6.5 ft. (see Section 3.3.3 - Sidewalks and Medians). When the roadway curb and gutter section is 2’-6”, 2 ft. is considered gutter for calculation of the bridge width.

2.9.2.2 Bridges Carrying Collectors

a) Rural section (Undivided):

Design Year ADT	Bridge Clear Width
0-399	2’ + TW + 2’
400-2000*	4’ + TW + 4’
Over 2000	6’-6” + TW + 6’-6”
Over 2000 & ≥50mph	10’ + TW + 10’

* On designated bike routes with 1000-2000 ADT increase the shoulder width to 5 ft.

b) Rural section (Divided): 6’ (inside shoulder) + TW + 10’ (outside shoulder)

c) Urban section (with curb):

The clear width for all new or reconstructed bridges shall be the curb to curb width of the approach roadway. Provide sidewalks on bridges where curb and gutter are provided on the approach roadway. Minimum sidewalk width on bridges shall be 6.5 ft. (see Section 3.3.3 - Sidewalks and Medians). When the roadway curb and gutter section is 2’-6”, 2 ft is considered gutter for calculation of the bridge width.

2.9.2.3 Bridges Carrying Arterials

a) Rural Section (Undivided):

Design Year ADT	Bridge Clear Width
0-399	4’ + TW + 4’
400-2000	6’ + TW + 6’
Over 2000	8’ + TW + 8’
Over 2000 and > 50 MPH	10’ + TW + 10’

b) Rural Section (Divided):

Traveled Way Configuration	Bridge Clear Width
2 lanes each direction	6’ (inside shoulder) + TW + 10’ (outside shoulder)
3 or more lanes each direction	8’ (inside shoulder) + TW + 10’ (outside shoulder)

c) Urban Section (with curb):

The clear width for all new or reconstructed bridges shall be the curb to curb width of the approach roadway. Provide sidewalks on bridges where curb and gutter are provided on the approach roadway. Minimum sidewalk width on bridges shall be 6.5 ft. (see Section 3.3.3 - Sidewalks and Medians). When the roadway curb and gutter section is 2’-6”, 2 ft is considered gutter for calculation of the bridge width.

2.9.2.4 Bridges Carrying Freeways

The Freeway functional classification will include not only the Interstate Highway system, but also State routes designated as such.

Lanes in One Direction	Bridge Width Clear Distance
2-3 Lanes	10’ (inside shoulder) + TW + 12’ (outside shoulder)
3 or More lanes with Truck Traffic >250 DDHV	12’ (inside shoulder) + TW + 12’ (outside shoulder)
All configurations with concrete barriers on the adjacent approach roadway	12’ (inside shoulder) + TW + 14’ (outside shoulder)

If the shoulder widths shown above are different than the paved shoulders on the roadway plans, this should be addressed as early in the process as possible since these should generally match.

The shoulder widths presented above do not consider the need for staged construction when replacing Freeway bridges. It is not preferred to use a detour bridge to maintain traffic. Whenever possible, Freeway bridges should be replaced using staged construction, which may result in wider shoulders in the final configuration.

2.9.2.5 Alternative Bridge Use

2.9.2.5.1 Diverging Diamond Interchanges

Bridges that carry traffic through a Diverging Diamond Interchange (DDI) for any route type should be wide enough to accommodate the full width of the approach roadway with the inside and outside shoulders reversed from the roadway typical section. A design variance is required when full width shoulder values given below cannot be accommodated. When accommodation of the full section is not possible the following shoulder requirements shall be used in conjunction with traveled way width and pedestrian accommodations to determine the overall width of the bridge section.

Outside Shoulders:
- 4 ft minimum required.
- 2 ft minimum considered for reconfiguration projects with approval of design variance.

Inside Shoulders:

- 8 ft minimum required.
- 4 ft minimum considered for reconfiguration projects with approval of design variance.

Shoulders on bridge may need to be wider than the above required minimums to account for proper interchange design practice, including site distance and vehicle tracking considerations.

2.9.2.6 Median Barrier Divided Alignments

When the roadway alignment is divided by a median barrier, determine if the cross sections of the opposing travel lanes share a matching profile at the centerline of the alignment for the entire length of the bridge and approach slabs.

This is most common in tangent sections but may be present in curves if the superelevation of the section is rotated around a single line.

2.9.2.6.1 Matching Profiles

If the profile of the opposing travel lanes is shared it may be appropriate to use a common bridge deck (one bridge) for both directions of travel. When this is the case, use the typical median barrier detail available in the GDOT Bridge Cell Library for the bridge and associated approach slab details.

In cases where parallel structures are preferred, such as when one bridge would be wider than 150 feet, provide 1 inch preformed joint filler between 42" S-Barriers cast back to back on the median facing overhangs of each structure. A median barrier transition will be needed on the approach slab and needs to be detailed in the plans. A design variance may be needed to address the reduced shoulder width on the bridge.

In situations where stage construction cannot accommodate the above back-to-back barrier concept, it may be necessary to detail the typical median barrier shape at the overhang of one of the structures to divide the traffic and provide a 1 inch longitudinal joint between the structures. Determine which structure receives the median barrier with consideration of superelevation so that water will flow away from the joint between structures. See BDM 3.13.2.7 for direction on longitudinal joint detailing.

2.9.2.6.2 UnMatched Profiles

When the edge profile of parallel bridges does not match, detail a 1 inch open joint between deck overhangs with a 42" S-Barrier cast as typical on the median facing overhang of the higher structure and a special design barrier addressing zone of intrusion concerns cast on the median facing overhang of the lower structure. A median barrier transition will be needed on the approach slab and needs to be detailed in the plans. A design variance may be needed to address the reduced shoulder width on the bridge.

2.9.2.7 Deck Drainage Calculations

Develop deck drainage calculations in accordance with Chapter 13 of the GDOT Drainage Design for Highways manual.

Internal GDOT staff developing preliminary layouts for grade separation bridges should request this work be completed by the hydraulics group. In the request, include the bridge Plan and Elevation, the roadway plan and profile sheets, and deck sections if available.

Depending on the specific details of the project elements, it may be possible to increase the shoulder widths on a structure to aid in achieving acceptable gutter spread widths, in lieu of a deck drain system. Urban shoulders, as previously defined, should not be widened to address drainage. Any widening of rural shoulders for the purpose of gutter spread accommodation shall be done symmetrically to both shoulders.

2.9.3 Bridge Lengths

The bridge length is mostly determined by the obstacle that the bridge must span. For nearly all road projects the obstacle falls within two general categories – Bodies of Water (Stream Crossings) or Traveled Ways (Grade Separations).

2.9.3.1 Stream Crossings

The guidelines for setting the span lengths for Stream Crossings are outlined in the GDOT Drainage Design Policy Manual. Designers should be aware that the use of Mechanically Stabilized Embankment (MSE) walls at the hydraulic opening, either as abutment walls or supporting endrolls, is discouraged due to the added structural risks associated with scour and inundation for such structures. When possible, the use of walls at the hydraulic opening should be avoided by lengthening the structure sufficiently to incorporate an endroll. When walls are unavoidable, cast in place concrete walls are preferred to MSE walls. Either wall type must be evaluated for scour in accordance with HEC 18 “Evaluating Scour at Bridges” (NCHRP 24-20 Abutment Scour Approach).

2.9.3.2 Grade Separations

Bridge spans over roads or railroads shall be long enough to span the traveled way, drainage ditches, shoulders, sidewalks, clear zone for the traveled way, and the offset distance from the toe of slope paving or face of abutment wall (See Sections 2.3.3 and 2.3.4).

The option to use abutment walls, specifically MSE abutment walls, to reduce the length of a grade separation bridge or reduce right of way should not be automatically implemented. Even if a cost analysis of comparing the longer bridges and right of way purchase appears to be more economical, consideration must be given to long term issues with an MSE structure. Installation and long-term maintenance of drainage and utilities should be weighed in the decision. When the potential purchase of right of way is included in the project, the use of an MSE wall is discouraged. In addition, if there are settlement concerns in the approach roadway then the use of MSE abutments is discouraged.

2.9.4 Guidelines for Selecting Bridge Type

Use the following sections to determine bridge type unless a Bridge Type Study (See Section 2.9.5) is required by the Bridge Office.

2.9.4.1 Typical Bridge Cost

The following square foot costs for particular bridge types may be used in preparation of preliminary cost estimates:

Item	Square foot cost (out-to-out width)
RC/PSC beams on pile bents	$215
Box/Cored Slab/Next Beam on pile bents*	$250
PSC beams on concrete bents	$225
Steel beams on concrete bents	**

*** Due to time savings on these type of structures, no net increase in total project costs are usually seen.**

****Coordinate with the Bridge Office**

2.9.4.2 Reinforced Concrete Deck Girders (RCDGs)

Historically, reinforced concrete deck girders (RCDG or T-Beam) on pile bents are some of the most economical bridges that GDOT has built. When economy governs, the designer should consider RCDG as the first choice. Typical spans are either 30 feet long (2’-3” deep) or preferably 40 feet long (2’-9” deep). When running Hydraulics, uniform span lengths should be added until an acceptable hydraulic opening is found.

2.9.4.3 Contractor PSC Beam Substitution

GDOT Standard Specifications allows contractors to substitute PSC girder spans for RCDG spans as long as minimum bottom of beam elevations are met. A note should be placed on the plans if other conditions limit the contractor’s option for the substitution.

Since many RCDG spans are being redesigned by the contractors to PSC girders, designers may now opt to utilize Type I Mod PSC girders. RCDG may still be more economical than Type I Mod PSC girders on low-lying bridges where the cost of falsework will be less.

2.9.4.4 PSC Beams on Pile Bents

When establishing span configurations for the preliminary layout, limit any spans supported on intermediate pile bents in accordance with table 2.9.4.4-1.

Beam Type	Maximum Span Length by Pile Type	
	Steel H-Pile	*PSC or MS Pile*
AASHTO PSC Beam Shapes, Bulb T Shapes, and All Similar Concepts	50 ft	70 ft
Cored Slab or Box Beam Units	55 ft	75 ft

Table 2.9.4.4-1 Pile Bent Span Limits

Pile type can be initially assumed by referencing Appendix 4A and/or reviewing plans and foundation investigations for the existing structure or structures in the area of the project. A final determination of pile type will be based on the geotechnical investigation.

Longer span lengths may be approved by the Bridge Office during the preliminary design phase of design-bid-build projects. Coordinate use of longer span lengths prior to layout submission for review.

Design-build projects must adhere to table 2.9.4.4-1.

2.9.4.5 Concrete Bents

Concrete bents, consisting of a concrete cap and columns on a concrete footing or shaft, should be used instead of pile bents for the following situations:

- Bridge is over vehicular traffic
- Bridge requires spans longer than outlined in BDM 2.9.4.4
- Column height measured between proposed ground line and bottom of cap exceeds 20 feet for PSC piles and Metal Shell Piles, and 14 feet for H-piles.

If the BFI recommends spread footings, drilled shafts or pilot holes at bent locations due to rock or hard layers close to the surface, the bridge layout should be re-examined utilizing longer span lengths on concrete bents for cost savings.

2.9.4.6 Prestressed Concrete Beams

Prestressed concrete beams are the most economical superstructure type when spans longer than 40 feet are required. Span length, beam type and beam spacing shall be considered together for the most economic design. PSC beam charts are provided in Appendix 3B for guidance. Beam spacing limits are specified in Section 3.4.2.7, and beam length limits are specified in Section 3.4.2.8. For bridges in visible areas, such as grade separations or stream crossings with significant adjacent development, same beam depths for adjacent spans should be considered (see Section 3.4.3.2).

2.9.4.7 Single Span Hydraulic Bridges

When the hydraulic opening requires a bridge that spans the stream with end spans of less than 30 feet, a single span bridge using longer beams could be the best alternative. However, it is difficult to set long beams across a stream, so a beam setting process needs to be provided in the hydraulic study. It may be possible to set them from the detour bridge or the adjacent bridge.

2.9.4.8 Steel Beams

Steel beam bridges should be considered for the following situations:

- Span lengths exceeding 150’ (Bridge Type Study may be appropriate)
- Bridges requiring a shallow superstructure depth for vertical clearance
- Widening existing steel bridges

2.9.4.9 Box Girders

Another option for long spans is steel or concrete box girder bridges. GDOT prefers not to use concrete box girders due to the extensive falsework required. However, cast-in-place box girders or segmental box girders should be considered in the Bridge Type Study for appropriate situations.

2.9.4.10 Scissor Bridges

When intersecting alignments cross at a very sharp skew (acute angle less than 45 degrees) it may be appropriate to use a scissor bridge configuration. Scissor bridges use girders that run in a more perpendicular, or transverse direction under the supported traffic than longitudinally, as is more typical. This results in many girders that only partially support the roadway. Scissor bridge spans require that a deck be placed over the entire span. A Bridge Type Study may be necessary for cost comparison between many short transverse girders and a few long longitudinal beams.

2.9.4.11 MSE Wall Abutments

An MSE wall abutment should be considered as an alternative to an end roll on grade separations. It could be a more economical solution, especially for wide bridges.

2.9.4.12 Combination of Superstructure Types

Use a consistent superstructure type (PSC Beams, Steel Beams, Box Beams, etc.) for all spans on a structure. If the specific design challenges of a structure require a mixture of superstructure types, coordinate with the Bridge Office during preliminary design for approval.

2.9.5 Bridge Type Study

A Bridge Type Study should be performed whenever the estimated construction cost of a single bridge is expected to exceed $10,000,000, or as directed by the Bridge Office. The study report serves as a reference supporting the choice of the structure type for a project.

2.9.5.1 Purpose

The Bridge Type Study establishes what alternative(s) will be carried forward in the Preliminary and Final Design phases. When alternate designs are considered, uniform design criteria, material requirements and unit costs should be applied.

2.9.5.2 Format

The report shall use 8 ½” by 11” pages with drawings on larger sheets, if necessary, folded to fit the report. The report shall be neatly written and the contents shall be presented in a logical sequence with narratives as necessary. An Executive Summary shall be included comparing the relative features and costs of the alternatives considered and recommending which alternative(s) to be carried forward into the Preliminary Phase.

The Bridge Type Study should be as self-contained as possible by including all arguments that establish, justify, support, or prove the conclusions. It is acceptable to make reference to other documents that will be included in the final submittal package. Any documentation, such as drawings, clear and concise views, or other illustrated information that assists in presenting design intent and solutions should be included in the package.

2.9.5.3 Contents

Provide cost data and other information that affects the selection of an alternative, including geotechnical survey data (if available), life cycle maintenance costs, construction time and staging assumptions, constructability, maintenance of traffic, aesthetics, etc. Various methods of handling traffic during construction should be thoroughly investigated. Data provided by others should be thoroughly reviewed and if deemed insufficient or in error should be brought to the attention of the provider. The major items that should be included are described in the following subsections.

2.9.5.3.1 Bridge Description

The Bridge Type Study should include a detailed description of each proposed alternate structure. This description should consider the following in its development:

a) Span length: Span lengths are governed by column/pier locations that provide the required vertical and horizontal clearances, then economic and aesthetic considerations.

b) Superstructure depth: Superstructure depths, particular for grade separation structures, shall be kept to the minimum as allowed by good engineering practice.

c) Span continuity: The economic and engineering advantage of simple span vs. continuous spans should be addressed.

d) Superstructure type: Consider prestressed concrete girders, steel rolled sections, steel plate girders, steel or concrete box girders, and other sections approved by the Bridge Office.

e) Pier protection: Piers located in a divided highway median must be protected from traffic, typically by guardrail or concrete barrier, when located within the clear zone.

f) Foundation: For piles and drilled shafts, assume size, length, and capacities from geotechnical information, if available. For spread footings, allowable bearing pressure should also be assumed from geotechnical information, if available.

2.9.5.3.2 Costs

The Bridge Type Study should include a cost estimate for each proposed alternate structure. This estimate should include the following:

a) Quantity estimates: Quantities should be estimated to the accuracy necessary for comparing the alternatives. For minor bridges rough quantities, such as the amount of reinforcing steel estimated from historic steel-to-concrete ratios, may be sufficient. For major and complex bridges more detailed quantity calculations may be required.

b) Unit costs: Unit costs should be derived using data available from GDOT or con-tractors/suppliers. The sources of all price data should be recorded for later reference. For major and complex structures, it may be necessary to develop unit costs from an analysis of fabrication, storage, delivery and erection costs.

c) Cost matrix: A cost matrix should be established for each alternative to reveal the most economic span arrangement.

2.9.5.3.3 Aesthetics

The Bridge Type Study should include a narrative explaining how aesthetics affected the design of each proposed alternate structure. This narrative should address the following considerations:

a) Totality of structure: A bridge should be made aesthetically pleasing in and of itself by giving proper attention to shapes, proportions and continuity of forms and lines. The basic structure of the bridge itself should be the main focus in bridge aesthetics, not enhancements, additions, or other superficial touches.

b) Compatibility with site: A bridge should be made aesthetically pleasing in context of its surroundings. Additional emphasis should be placed on the surroundings at interchanges where landscaping or unique features need to be considered.

c) Conformity of theme: Conformity of theme and unifying appearance should be created or maintained in locations with multiple bridges, such as interchanges, where aesthetics is important because of high visibility to a large number of motorists.

d) Inherently pleasing substructure shapes: Consideration should be given to structural systems that are inherently more pleasing, such as hammerhead or "T" shaped piers, oval or polygonal shaped columns, piers in lieu of bents, etc.

2.9.5.3.4 Constructability and Maintainability

All construction and maintenance requirements should be identified and appropriately reflected in any concept that is to be recommended for design.

a) Constructability: Items such as member sizes/handling/fabrication, maintenance of traffic, construction staging, equipment requirements, etc. should be considered.

b) Transportation: Special evaluation shall be made to insure against potential problems that may occur in obtaining permits and equipment to transport long and/or heavy members from point of manufacture to the project site.

c) Maintenance: Considerations for future maintenance inspection shall be taken into account in the structure's design. Such considerations may include the need for 6 feet minimum headroom inside steel or concrete box girder superstructures.

2.10 Quantities

Quantities are required on all structural plans submitted to the Bridge Office for review, including design-build projects. This includes a Summary of Quantities, quantities tables on superstructure and substructure sheets, and a reinforcing bar schedule.

2.10.1 Quantities on General Notes

For Lump Superstructure Pay Items on the General Notes sheet, present the quantities in the brackets as shown in the following examples:

- LUMP SUPERSTR CONC, CLASS AA - BR NO 1 (465)
- LUMP STR STEEL - BR NO 1 (1465450)
- LUMP SUPERSTR REINF STEEL - BR NO 1 (265430)

All quantities shall be shown as whole number. Do not include decimals or commas.

Piling quantities shall be rounded up to the next even 5 feet.

2.10.2 Quantities on Detail Sheets

All superstructure quantities shall be itemized on the superstructure detail sheet as shown in Table 2.10.2-1. Do not include a TOTAL column in this table unless all the spans in the bridge are shown in the table and the total includes all the spans in the bridge. All substructure quantities shall be itemized on the substructure detail sheet as shown in Table 2.10.2-2. Show concrete quantities to one decimal place. Reinforcing steel and structural steel quantities should be integers.

Table 2.10.2-1 Superstructure Quantity Table

SUPERSTRUCTURE QUANTITIES			
ITEM	SPAN 1	SPAN 2	TOTAL
LUMP - CY SUPERSTR CONCRETE, CLASS D	XXX.X	XXX.X	XXX.X
LUMP - LB SUPERSTR REINF STEEL	XXXX	XXXX	XXXX
LUMP - LB EPOXY COATED SUPERSTR REINF STEEL	XXXX	XXXX	XXXX
LUMP - LB STR STEEL	XXXX	XXXX	XXXX

Table 2.10.2-2 Substructure Quantity Table

SUBSTRUCTURE QUANTITIES	
ITEM	BENT 1
CY CLASS AA CONCRETE	XX.X
LB BAR REINF STEEL	XXXXX

2.10.3 Quantities for Staged Construction and Continuous Units

Bar schedules for continuous span units supported by structural steel shall be tabulated by pour. In this case, the quantity on the superstructure detail sheet shall be shown by continuous unit.

Bar schedules for stage constructed bridges shall be tabulated by stage and span. In the case of stage constructed simple spans, the quantity on the superstructure detail sheet shall be shown by stage and span.

When a continuous span unit is stage constructed, the bar schedule shall be tabulated by pour and stage, i.e. Pour 1, Stage 1; Pour 1, Stage 2; etc. In the case of stage constructed continuous spans, the quantity on the superstructure detail sheet shall be shown by stage and continuous unit.

Table 2.10.3 Superstructure Quantities

SUPERSTRUCTURE QUANTITIES					
ITEM	STAGE 1 SPAN 1	STAGE 1 SPAN 2	STAGE 2 SPAN 1	STAGE 2 SPAN 2	TOTAL
LUMP - CY SUPERSTR CONCRETE, CLASS D	XXX.X	XXX.X	XXX.X	XXX.X	XXXX.X
LUMP - LB SUPERSTR REINF STEEL	XXXXX	XXXXX	XXXXX	XXXXX	XXXXXX
LUMP - LB EPOXY COATED SUPERSTR REINF STEEL	XXXXX	XXXXX	XXXXX	XXXXX	XXXXXX

2.10.4 Bridge Removal Quantity

When preparing the summary of quantities for a bridge replacement project, and the bridge being replaced can be logically referenced back to the proposed centerline, use pay item 540-1101 which allows for the bridge being removed to be defined by a station. When using this pay item, use the station value equal to the begin existing bridge, referenced from the proposed project centerline.

When an existing structure to be removed cannot be referenced back to the proposed project centerline in a logical manner or there are multiple structures with a similar station value, pay item 540-1102 should be used and the bridge to be removed identified in the contract plan set by the same number as the proposed bridge that will replace the existing bridge.

Use similar logic as explained above when quantifying partial bridge removal.

2.11 Appendix 2A - Hydraulic Engineering Field Report

I. HYDRAULIC AND HYDROLOGICAL DATA REQUIRED FOR ALL EXISTING OR PROPOSED BRIDGE STREAM CROSSING PROJECTS

A. Project Location

District ________________ County _____________ Project No. ____________________

P.I. No. ________________ Route _____________ Stream Name ___________________

Surveyed By __________________________ Date _________________________________

B. Site Information

Floodplain and Stream Channel description:

1. Flat, rolling, mountainous, etc. ____
2. Wooded, heavily vegetated, pasture, swampy, etc. ______________________________

   ____

3. Stream channel description: well-defined banks, meandering, debris, etc.

   ____

   ____

4. Is there any fill in the upstream or downstream floodplain, which will affect the natural drainage or limit the floodplain width at this site? ______________________________

   ____

C. Required Existing Bridge Information at Project Site

Bridge Identification No. ____

Date Built ____

Skew angle of bridge bents ____

Substructure Information:

Column type (concrete, steel, etc.) ____

Size of column ____

Number of columns per bent ____

Height of curb, parapet or barrier ____

Guide Bank (Spur Dike) length, elevation and location (if applicable) _________________

____

Note any scour problems at intermediate bents or abutments: ________________________

____

D. Normal Water Surface Data

WS ELEV

500 feet upstream of the survey centerline ____________________

At the survey centerline ____________________

500 feet downstream of the survey centerline ____________________

Normal high tide ____________________

Normal low tide ____________________

E. Historical Flood Data

Extreme high water elevation at site __________ Date _________________________________

Highest observed tide elevation __________ Date _____________________________________

Location where extreme high water elevation was taken (upstream or downstream face of bridge, distance upstream or downstream, centerline)

Source of high water information ____

____

Location and floor elevation of any houses/buildings/structures that have been flooded.

____

Information about flood (number of times house/building/structure has been flooded, water surface elevation(s) and date(s) of flood ____

____

Location and floor elevation of any houses/buildings/structures that have floor elevations within 2 feet of the extreme high water elevation ______________________________________

____

F. Benchmark Information

Benchmark number ____

Location (InRoads pt. no. or project station/offset) ____________________________________

Physical description ____

____

Benchmark number ____

Location (InRoads pt. no. or project station/offset) ____________________________________

Physical description ____

____

Benchmark number ____

Location (InRoads pt. no. or project station/offset) ____

Physical description ____

____

G. **UPSTREAM AND DOWNSTREAM STRUCTURES**

Structure type (railroad or highway bridge, culvert) ____

Route number (if applicable) ____

Distance from proposed structure ____

Length of bridge or culvert size ____

Substructure information: ____

Column type (concrete, steel, etc.) ____

Size of column ____

Number of columns per bent ____

Note: The above information is required for all bridges or culverts, which lie between 2000 ft and 1 mile upstream or downstream of the project bridge.

H. **MISCELLANEOUS INFORMATION**

Are there water surfaces affected by other factors (high water from other streams, reservoirs, etc.)? ____

Give location, length, width, and elevation of dam and spillway, if applicable ______________

____

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Chapter 3. Superstructure

3.1 General Design Considerations

3.1.1 Beam Layout

For bridges that will carry vehicular traffic, provide a minimum of 4 beams in each span. When multi-stem girders are used, a minimum of 3 units shall be provided.

When the width of a tangent bridge is constant, make the beams parallel within each span.

Use the following preferential order of practice for placing beams on constant width curved bridges with parallel bents:

1. Place beams parallel to the chord of the bridge centerline, or a single chord offset from the centerline, from BFPR/centerline bent to centerline bent.
2. Place exterior beams on chords of concentric circles, then parallel interior beams towards the centerline. For this case, ensure that the non-parallel beam spacing that occurs in the middle is smaller than the parallel spacing on either side, so it doesn't control the deck design.
3. Place exterior beams on chords of concentric circles. Then place the interior beams parallel to one another at a uniform spacing with a skew that ensures that the exterior bays do not control the deck design. Setting interior beams parallel to the chord of the bridge centerline will typically result in an acceptable beam layout.
4. Place all beams on their own chords of concentric circles. This typically makes no beam parallel leading to complicated deck formwork and should be used as a last resort.

If none of the above beam geometry options can be satisfied, coordinate with the Bridge Office to present unlisted alternatives for approval.

When a constant width curved bridge contains radial bents, use chords of concentric circles to lay the beams out. This will result in parallel beams with intersecting beam centerlines.

In all cases when ahead and back spans contain the same number of beam lines, arrange all beams so that the beam centerlines from adjacent spans intersect at the centerline of the intermediate bent. For curved bridges, this approach may result in odd beam spacings within certain spans (ex: 8'-8.3581"). It is acceptable to round these spacings to the nearest 1/16" (ex: 8'-8 3/8") when shown on the deck sections. When the ahead and back spans on a bent contain different beam counts, intersect the exterior beam centerlines at the centerline of the intermediate bent.

3.1.2 Connections

Each connection between the superstructure and substructure shall be indicated on the Plan and Elevation sheet as fixed (FIX) or expansion (EXP).

Only one bent cap to superstructure connection within a continuous deck unit (between expansion joints) shall be "fixed" to prevent any differential longitudinal movement between the superstructure and substructure. This fixed condition should be achieved by the dowel bars/anchor bolts connecting the superstructure and substructure through the bearing holes. Do not detail both ends of any span as fixed.

Do not detail a fixed connection at an end bent unless the bridge is a single span, or if every span of the superstructure has an expansion joint. The latter concept is generally only present in the Box Beam and Cored Slab systems used for the Department's Low Impact Bridge Program.

When detailing a single span bridge, detail the fixed connection at the end of the bridge with the lower elevation.

All other substructure/superstructure interfaces shall be "expansion" to allow for thermal movement and/or shrinkage of the superstructure. At these expansion connections, slotted holes or chase in the beam should be provided for free longitudinal movement of the superstructure.

For PSC beams a 1 ½" smooth dowel (ASTM A709 Grade 50) shall be grouted into the substructure cap to provide connection. Similarly, a No. 10 reinforcing bar shall be used as a dowel for RCDG connection. These dowels shall be sized to ensure 2" nominal vertical clearance between top of pin and recess in the girder.

3.1.3 Use of Chemical Anchors

The use of epoxy in structural connections is generally prohibited by the Department. However, epoxy use is acceptable for the installation of bridge joints and sidewalk dowel bars. It is also appropriate for use on staged construction joints as defined by the "EPOXY RESIN ADHESIVE" general note.

3.2 Deck Design

3.2.1 Materials (for Decks, Endwalls, Edge Beams, and Diaphragms)

3.2.1.1 Concrete

For LRFD projects, use Class D concrete which has a 28-day design strength of 4.0 ksi as required by LRFD 5.4.2.1.

For Standard Specification projects, use Class AA concrete that has a 28-day design strength of 3.5 ksi.

3.2.1.2 Reinforcement

3.2.1.2.1 Materials

Use Grade 60 reinforcement. The use of higher grade reinforcement is not permitted.

3.2.1.2.2 Lap Splice Lengths

Use the following table to detail reinforcement lap splice lengths in the superstructure, utilizing normal weight concrete.

#4 or #5 uncoated	2'-0"
#5 uncoated barrier or parapet stirrups	2'-2'

#4 or #5 epoxy coated	2’-6”
#5 epoxy coated barrier or parapet stirrups	2’-6’
#8 in edge beam	3’-3”
#9 in endwall	4’-0”

For all applications of lap splices in the superstructure not specified in the table above, calculate the splice length according to LRFD 5.10.8.

Detail all lap splices in the longitudinal direction of a bridge deck such that they are staggered. Stagger splices on adjacent longitudinal bars a minimum of 10ft from end of splice to end of splice. If a splice is used, the minimum bar length is 10ft. Traditionally this has been accomplished by swapping the long and short lengths for adjacent bar pairs from one end of the span to the other.

For non-staged bridges, detail all lap splices for adjacent bars in the transverse direction of a bridge deck such that they are staggered. The top main reinforcement lap location is in the bay between beams. The bottom main reinforcement lap location is centered above the beam flange.

For staged bridges, transverse reinforcement does not need to be staggered. Splice the transverse reinforcement at the pour strip location. See BDM 3.13.1.1 for pour strip deck section note requirements.

For Standard Specification projects, calculate the splice length per Standard Specification 8.32.3. Guidance above pertaining to staggering lap splices shall also apply to Standard Specification projects.

3.2.1.2.3 Mechanical Couplers

When mechanical couplers are needed for staging that inhibits the use of a lap splice, represent the location of each coupler with a rectangle and flag one location with “MECHANICAL COUPLER, TYP. SEE SPECIAL PROVISION 511”.

3.2.1.3 PSC Deck Panels

The use of full depth precast concrete deck panels designed and detailed to replace a traditional cast in place concrete bridge deck is allowed when proposed as part of an accelerated bridge construction scheme.

Do not accommodate partial depth precast deck panels, intended to span from beam to beam and replace deck formwork, in the bridge design.

3.2.2 Interior Slab

3.2.2.1 Standard Specification Projects

For simplicity and consistency, use the required slab charts located in Appendix C3 (output from GDOT program, BRSLAB07). When using the slab charts, the effective span length is measured between the stem faces for T-beams, the top flange edges for AASHTO Types I-IV beams and the top flange quarter points for steel beams, AASHTO Type V beams, and Bulb Tee beams. The slab charts use a continuity factor of 0.8 that assumes the slab is continuous over 3 or more supports.

For top concrete cover of slab, see Table 3.2.2.2-1 Slab Thickness and Concrete Cover.

3.2.2.2 LRFD Projects

3.2.2.2.1 Design Method

All interior slabs shall be designed using the most current version of RCSlab.xmcd. This program is available on the Department's website for download as a zip file. RCSlab.xmcd uses the Traditional Design Method (LRFD 9.7.3) and the approximate method of analysis (LRFD 4.6.2.1.1) to design the slab. The program uses a Class 2 exposure condition for LRFD equation 5.6.7-1.

Empirical Design (LRFD 9.7.2) will not be allowed for deck designs on bridges in the state of Georgia.

3.2.2.2.2 Loads

Use a future paving allowance of .030 ksf on all bridges.

3.2.2.2.3 Minimum Slab Thickness and Concrete Covers

Use Table 3.2.2.2-1 to determine the minimum slab thickness, the top concrete cover and the grinding/wearing thickness. Minimum slab thickness and Top cover values include the grinding/wearing thickness.

Table 3.2.2.2-1 Slab Thickness and Concrete Cover

Case No.	Bridge Location	Minimum Deck Thickness	Top Cover	Grinding/Wearing Thickness
1	Below Fall Line* All Routes	7 ¾"	2 ¼"	¼"
2	Above Fall Line* All Routes	8 ¼"	2 ¾"	¼"

* See Appendix 3A for location of Fall Line.

Use 1" for the bottom cover on all deck slabs.

3.2.2.3 Detailing

3.2.2.3.1 Main Reinforcements

Place # 5 bars transversely in the top and bottom of the deck as main reinforcement. The maximum spacing allowed for these bars is 7". The minimum spacing is 5" to aid in the placement of the deck concrete.

Detail the top and bottom main reinforcement with the same spacing so that the bottom and top bars align

For Standard Specification projects, the maximum spacing for main reinforcement bars is 9". The minimum spacing is 5".

3.2.2.3.2 Distribution Reinforcements

For LRFD projects, use #4 bars set longitudinally above the bottom main bars as distribution reinforcement. Place these bars at equal spaces in each bay with 3” offsets from the centerlines of beams. Space #4 bottom distribution reinforcement no tighter than 5” on center.

For Standard Specification projects, use the middle half and outer-quarter information from the slab chart.

Use # 4 bars set longitudinally below the top main bars for temperature/shrinkage control. Place one bar over the centerline of each beam and then place additional bars at equal spaces between the beams and to the edges of the deck with a maximum spacing of 18”.

3.2.2.3.3 Continuous Deck Reinforcement

In simple span bridges with decks made continuous at intermediate bents, provide #6 bars across the bent in the top mat of the deck. Place two #6 bars between each #4 bars. Only these #6 bars should be continuous through the construction joint at the bent. The length of these bars should be 10’-0” total, 5’-0” on each side of the bent. The #4 bars should end 2” from the construction joint.

3.2.2.3.4 Maximum Reinforcement Lengths

A single bar of reinforcement shall not exceed 60 feet in length. When a rebar in the deck exceeds 60 feet, use a lap splice in accordance with Bridge and Structures Design Manual section 3.2.1.2.2, as appropriate. Provide detailing and notes on the plans that correspond with the lap splice.

3.2.2.3.5 Additional Reinforcement in Acute Corners

Provide 5 - #5 bars in a fan arrangement in the top of the deck just below the top mat in acute corners when the enclosed angle is 75 degrees or less. These bars, typically 5 to 10 feet long, are required at the following locations:

- Intermediate bents in simple span bridges
- Ends of continuous span units
- Construction joints in continuous span units
- Temporary acute corners adjacent to staged construction joints

The designer should ensure that these bars are shown at the corners and placed adjacent to the edges of the slab in the plans.

3.2.2.3.6 Placement of Transverse Reinforcement

On bridges with skew angles less than 85 degrees, place the transverse reinforcement normal to the centerline of the bridge then clip and bend near the joints. Detail an additional #5 bar on either side of the joint, running parallel to the joint. A cell is provided in the GDOT Bridge Cell Library to detail this condition and should be included on the superstructure plan sheets when applicable.

For quantity calculations, detail the clipped bars as continuous across the joint, ignoring the increased length from clipping and bending.

When bridges skew angles are greater than or equal to 85 degrees, the transverse reinforcement can be placed parallel to the joints to avoid clipping.

3.2.2.3.7 Shrinkage Reducing Admixtures

When a bridge carrying a state route or other NHS route has a skew angle of 60 degrees or less at any bent, include the “Deck Concrete” note on the General Notes sheet using the BridgeNotes program.

3.2.3 Overhang Slab

3.2.3.1 Standard Specification Projects

Design the overhang in accordance with the AASHTO Standard Specifications.

When MASH Bridge Rails, as discussed in section 3.3.2, are required on a structure otherwise being designed using the AASHTO Standard Specifications use load values derived from MASH testing as described here. Using the information provided in Table 3.3.2.1-1, detail an overhang that satisfies a design moment, Ms coincident with tensile force T at the gutter line due to rail collision with Ms and T calculated as follows:

$$Ms = F_t * H_e / L_c$$

$$T = F_t / L_c$$

Further reduction of the moment and tensile load at sections of analysis away from the gutter line should be reduced by increasing the distribution length in both directions by the tangent of 30 degrees multiplied by the distance from the gutter line to the point of analysis, X.

$$Lc_2 = Lc + 2X * Tan\, 30°$$

Note that Ft load should have a factor of 1.0.

When MASH Bridge Rails, as discussed in section 3.3.2, are not required. Overhangs can be designed in accordance with the loadings and distributions presented in the AASHTO Standard Specifications.

3.2.3.2 LRFD Projects

3.2.3.2.1 Design Method

The overhang design shall be evaluated for Design Case 1 and Design Case 3 as defined in LRFD A13.4.

3.2.3.2.2 Loads

Use the load transfer variables (M_c, L_c, and R_w) for the GDOT Self-Certified Bridge Railings, as presented in Table 3.3.2.1-1. For overhangs carrying a parapet taller than shown in the table, use LRFD A13.2 and A13.3, with the exception noted in section 3.3.2.1.2, to verify the parapet design and to determine the necessary parameters for overhang design.

3.2.3.3 Detailing

3.2.3.3.1 Additional Overhang Reinforcement

Reinforcement required in addition to the interior slab design to support the overhang and barrier loads shall consist of #4 and #5 bars spaced with every or alternating interior main reinforcement. Reinforcing bars larger than #5 will not be allowed. After increasing the overhang thickness to the maximum difference of 1” greater than the interior slab, there may remain a need to tighten the spacing on the interior slab reinforcement to satisfy design moments. Do not revise the distribution reinforcement spacing determined from the interior main steel demand, even though the main steel is tightened to aid in overhang design.

Extend additional overhang reinforcement steel (#4 or # 5 bars) 3’-0” beyond the centerline of the exterior beam.

3.2.3.3.2 Overhang Width

Overhang Width is defined as the distance from the centerline of the exterior girder to the outside edge of the concrete deck.

Slab overhangs shall extend a minimum of 6” beyond the exterior beam flange to provide room for the typical drip notch detail.

Maximum overhang width for PSC beam superstructures with beams larger than the AASHTO Mod-1 shall be the lesser of:

- 4’-7 ½”
- 50% of the beam spacing

The maximum overhang width for an AASHTO Mod-1 beam shall be 3’-0”.

The maximum overhang width for rolled beams and steel girders shall be 3’-6”.

For steel beams and girders where the ratio of the overhang width to the exterior beam/girder depth is greater than 0.6, include “Concrete Deck Overhangs” note on the General Notes sheet using the BridgeNotes program.

3.2.3.3.3 Overhang Thickness and Concrete Cover

The thickness of the overhang slab shall be:

- Equal to or greater than the thickness of the interior slab
- A minimum of 8” thick for projects designed using LRFD (LRFD 13.7.3.1.2)
- No more than 1” thicker than the interior slab thickness

Use the same top and bottom cover for reinforcement in the overhang slab as was designated for the interior slab.

3.2.4 Epoxy Coated Reinforcement

Use epoxy coated bars for the following bridges located north of the fall line (see the map in Appendix 3A):

- Mainline interstate bridges

- Post-tensioned concrete box girder bridges
- Interstate ramp bridges
- Bridges over the interstate with direct interstate access

Epoxy coated bars in these structures shall be used in the top mat of the deck, the entirety of the barrier/parapet and endposts, and anywhere else where reinforcements have less than 4” cover from a surface facing traffic. Epoxy coated bars are not required in sidewalks and medians.

3.2.5 Grooving

All bridge decks will be grooved to within one foot of the barrier or curb face, as specified in Section 500 of the GDOT Standard Specifications. Grooving is a pay item. Grooving is not required under medians or sidewalks. However, if stage construction calls for traffic to run on sections of the deck that will ultimately be located under medians and sidewalks, those areas should be grooved and included in the quantities measured for grooving.

3.2.6 Overlays

When it is necessary to overlay a cast-in-place concrete deck, use a Portland Cement concrete overlay. The minimum thickness should be 2” and this should be shown on the Plans. If the overlay covers only part of the deck and the remaining part of the deck is grooved, the overlay should be grooved. Coordination with the Project Manager will be necessary to ensure that the approach slab elevations match the bridge deck.

Place a mat of #4 bars at 18 inches each way in the top of an overlay with thickness of 6 inches or greater to control cracking due to temperature effects. Measure the overlay thickness from the top of the existing deck reinforcing. Provide the same cover on the overlay steel as for deck steel (See Section 3.2.2.2.3).

3.2.7 Deck Cross Slope

The cross-slope of the deck should match the roadway plans. Typically, the cross-slope is 2% on a normal crown, but is sometimes shown as ¼ inch per foot.

3.3 Barriers, Railings, Sidewalks and Medians

3.3.1 Materials

3.3.1.1 Concrete

For LRFD projects, use Class D concrete that has a 28-day specified design strength of 4.0 ksi in accordance with LRFD 5.4.2.1.

For Standard Specification projects, use Class AA concrete that has a 28-day design strength of 3.5 ksi.

In the case of bridge widening or retrofit projects where additional load due to barriers, parapets, sidewalks, or multi-use trails causes overstress in the structure, the use of lightweight concrete may be examined as mitigation. Do not automatically include lightweight mix in your design assumptions until overstress has been noted. Use a unit weight of 0.115 kcf for lightweight concrete.

3.3.1.2 Reinforcement

Use Grade 60 reinforcement.

3.3.2 Bridge Railings

All bridge railings in Table 3.3.2.1-1 are certified by the Bridge Office to meet the crash test requirements of TL-4 under the criteria established by the AASHTO Manual for the Assessment of Safety Hardware, 2016 (MASH). The bridge railings presented in that table shall be used on the following:

- Bridges carrying any state route or NHS route, regardless of the governing AASHTO Design Specifications
- Bridges under design using AASHTO LRFD Bridge Design Specifications
- Bridges being widened using the AASHTO LRFD Bridge Design Specifications

Bridges being designed or widened using the AASHTO Standard Specifications for Bridge Design in accordance with Article 2.1.1. of this manual or presented to the Department as part of an encroachment permit application are encouraged to utilize using these bridge railings but are not required to do so. If the railings in Table 3.3.2.1-1 are not used, the New Jersey Barrier details in the GDOT Bridge Cell Library shall be considered the minimum acceptable rail type.

In all cases, if the project calls for an architectural rail, then the rail must meet the requirements of BDM 3.3.2.2.3.

To assist the Bridge Maintenance Unit when they add a new structure to the bridge inventory, provide the SNBI (Specifications for the National Bridge Inventory) railing code for the proposed bridge rail into the design data section on the General Notes sheet. The codes for the primary rail types can be found in Table 3.3.2-1.

Table 3.3.2-1 SNBI Bridge Rail Codes

Bridge Rail	SNBI Bridge Rail Code
New Jersey Barrier	3503
36” S- Barrier (Typical or widened for fence)	M094
42” S- Barrier (Typical or widened for fence)	M094
42” Vertical Faced Parapet	M094
Texas Rail (C411)	M162
Texas Rail (C412)	M165

NOTE: If a rail type other than those listed in Table 3.3.2-1 is proposed, coordinate with the bridge office to determine the proper SNBI code

3.3.2.1 Design Method

3.3.2.1.1 Standard Specification Projects

Bridge railings for projects designed using the AASHTO Standard Specifications shall comply with the guidance of 3.3.2.

Where permitted by 3.3.2, design bridge railings in accordance with the AASHTO Standard Specifications. Detail stirrups to a maximum spacing of 12”.

For guidance on incorporating the bridge railings from Table 3.3.2.1-1 into an overhang design governed by the AASHTO Standard Specifications, see section 3.2.3.

When using the bridge railings from Table 3.3.2.1-1 on projects otherwise designed using the AASHTO Standard Specifications, Class AA Concrete (f’c =3500psi) shall be used to cast the bridge rails.

3.3.2.1.2 LRFD Projects

Use the appropriate bridge railing from Table 3.3.2.1-1 based on the guidance of section 3.3.2.2. All bridge railings presented in Table 3.3.2.1-1 have been self-certified as MASH TL-4 by the Department, using representative crash testing and yield line analysis based on LRFD A13.2 and A13.3 with the exception of F_t, L_t, and H_e values shown therein. Analysis for these bridge railings use updated F_t, L_t, and H_e values derived from NCHRP 20-07(395). The GDOT accepted values for these variables are presented in Table 3.3.2.1-1. The F_t, L_t, and H_e values listed for the 36” S-Barrier apply for barriers of that height. The values shown for the 42” S-Barrier apply for all cases greater than 36” tall.

Table 3.3.2.1-1 GDOT Self-Certified Bridge Railings

Barrier	36” S- Barrier	42” S- Barrier	36” S- Barrier for Fence	42” S- Barrier for Fence	42” Parapet*
f'_c (28-day concrete strength)	4000 psi	4000 psi	4000 psi	4000 psi	4000 psi
Test Level	TL-4	TL-4	TL-4	TL-4	TL-4
F_t**	68.0 kips	80.0 kips	68.0 kips	80.0 kips	80.0 kips
L_t**	4 ft	5 ft	4 ft	5 ft	5 ft
H_e**	25 in.	30 in.	25 in.	30 in.	30 in.
Typical Stirrup Spacing	# 5 at 12”	# 5 at 11”	# 5 at 16”	# 5 at 14”	#5 at 8”
Design M_c at Base	21.67 kip-ft / ft	25.38 kip-ft / ft	18.64 kip-ft / ft	22.67 kip-ft / ft	24.01 kip-ft / ft
Design L_c	12.76 ft	14.72 ft	14.41 ft	16.27 ft	13.98 ft

Design R_w	145.66 kips	164.91 kips	146.36 kips	168.60 kips	161.41 kips

* Numbers based on assumed 6'-6" sidewalk with 1% cross-slope and normal crown on deck. See section 3.3.2.2.1 for guidance on parapets of different heights.

** F_t, L_t, and H_e values are based on NCHRP 20-07(395).

Details for the all the bridge railings in Table 3.3.2.1.-1 are available in the GDOT Bridge Cell Library and are presented in Appendix 3E.

3.3.2.2 Applications

3.3.2.2.1 Bridges with sidewalks

Use a parapet that rises 42" above the top of the sidewalk for on all bridges carrying a sidewalk. A detail for one specific sidewalk configuration has been provided in Table 3.3.2.1-1. Taller parapets will require an independent yield line analysis based on LRFD A13.2 and A13.3, with the exception noted in section 3.3.2.1.2.

Detail a chain link fence on top of the parapet for bridges in an urban area (Metro Atlanta, Macon, Columbus, Savannah and Augusta) over an interstate or other limited access highway, for all bridges over railroads or as directed by the Bridge Office. See Section 3.3.5 for fence details. Chain link fence details can be found in the GDOT Bridge Cell Library.

3.3.2.2.2 Bridges without sidewalks

Use a 42" S-Barriers on the following:

- Bridges that carry an Interstate or other Limited access highway
- Bridges with a 42" S-Barrier on the adjacent approach roadway
- Bridges where bicycle warrants for the route have been met according to the concept report and bicycle accommodation is being made on the traveled way or shoulder

When a 42" S-barrier is not required by the above criteria, use the 36" S-Barrier.

If the bridge is over an interstate highway in Atlanta, coordinate with the Bridge Office to determine if a fence is needed. If the bridge is over a railroad, include chain link fence as described in BDM 3.3.5 and detailed in the GDOT Bridge Cell Library.

When a fence is required on top of a barrier, use the 36" S-Barrier for Fence detail or 42" S-Barrier for Fence detail, as appropriate.

3.3.2.2.3 Architectural rails

In historic areas, an architectural rail may be desired. Any bridge rail system proposed for use must meet the crash test requirements of MASH TL-4 or satisfy a risk assessment based on NCHRP Web Only Document 307- "Guidelines for the Selection of Test Levels 2 through 5 Bridge Railings" to allow a lesser crash test rating.

The Texas C411 rail may be used when sidewalks are present, and MASH TL-2 is allowed by the risk assessment based on NCHRP Web Only Document 307. The Kansas Corral rail is no longer acceptable for use on GDOT projects.

Because of the expense of architectural rails, use them only with permission of the Bridge Office.

3.3.2.3 Detailing

3.3.2.3.1 End Posts

A vertical faced concrete end post is needed as a transition element between roadway guardrail and bridge railings. This concept is detailed in Georgia Standard 3054.

When the end post is mounted to the superstructure the end post begins in line with the intersection of the abutment and the inside wing wall face and extends beyond the paving rest that will support the approach. When the standard 12” paving rest is present, use a minimum end post length of 4’-3”. When the end post is on the superstructure and the end bent is skewed, the end post must be lengthened to extend beyond the limit of the paving rest. The length of the end post should be increased in 3” increments. If the length of the end post exceeds 6’-6”, additional P701 and P401 bars should be added so that the spacing of these bars does not exceed 12”. In this case, include the Standard Plan Modification (Endpost) note on the General Notes sheet using the BridgeNotes program.

An end post on the superstructure does not require that details for the reinforcement be shown, but the weight of the bar reinforcement must be included in the lump sum superstructure bar reinforcement quantity. The concrete for an end post on the bridge superstructure shall be included in the lump sum superstructure concrete quantity.

When the end post is an integral part of the substructure its length will be 4’-0” regardless of skew. Detail the reinforcement in the bar reinforcement schedule and include the weight of the reinforcement and volume of the concrete needed in the substructure quantities.

Include reference to Georgia Standard 3054 on the superstructure or substructure details sheets, as appropriate. Also, specify the length, width and height of the end post under “Bridge Consists Of” on the General Notes sheet.

3.3.2.3.2 Expansion Joints in Barriers

Expansion joints shall be placed in parapets and barriers at all deck joints including construction joints, dummy joints and expansion joints. Additional expansion joints shall be added to maintain a maximum spacing of 20 feet and a minimum spacing of 10 feet.

3.3.2.3.3 Barrier Width Modifications

The top dimension should be changed to 12” when necessary to accommodate a fence, railing or glare screen.

3.3.2.3.4 Barrier Stirrup Details

Include the following note on the bridge plan sheet that includes details for the barrier or parapet:

“Provide 2’-2” minimum lap for 5XX and 5XY bars in barrier [parapet].”

3.3.2.3.5 Date Stamp

The current end post standard provides guidance on embossing the year of construction into the right-hand end post on each approach to a new structure. However, for some structures, there is no end post present in these locations, due to the presence of retaining walls. When this is the case, include the date stamp detail from the GDOT Bridge Cell Library on one of the superstructure sheets that directs the contractor to emboss the date into the barrier or parapet.

3.3.3 Sidewalks and Medians

3.3.3.1 General Requirements

Sidewalks shall be used on all bridges where the approaching roadway section has curb and gutter. Except for special cases, all sidewalks shall be 6'-6" wide, measured from the gutter line to the inside face of the parapet. Special cases could include sidewalks where there is an excessive amount of pedestrian traffic, overbuild to accommodate staging or sidewalks where bicycle traffic is allowed on the sidewalk, known as shared use paths.

The designer shall receive approval from the Bridge Office before proceeding with design of a sidewalk that is wider than 6'-6".

When separation for a shared use path is provided by buffer, the sidewalk of the bridge will be a minimum of 6'-0" wider than path shown in the roadway typical. This provides for the required 1 ft shy distance against any bridge rail and the required 5 ft offset from the curb line. When separation for a shared use path is provided by barrier, the sidewalk will be 2'-0" wider than the path shown in the roadway typical. This provides for the required 1 ft shy distance against the bridge rail on each side.

3.3.3.2 Cross-slope

Sidewalks shall be sloped towards traffic at 1% cross-slope. However, on the high side of a superelevated bridge, the designer may need to increase the cross-slope on the sidewalk to provide a minimum sidewalk thickness of 4" at the face of the parapet.

3.3.3.3 Detailing

3.3.3.3.1 Joints

Construction joints shall be provided in sidewalks and medians at deck construction joints and dummy joints. Expansion joints shall be provided in sidewalks and medians at deck expansion joints.

3.3.3.3.2 Removable Sidewalk and Median Details

All sidewalks and raised medians shall be detailed as removable.

3.3.4 Handrailing

3.3.4.1 Aluminum Handrail Post Spacing

Post spacing for aluminum handrail shall comply with Georgia Standards 3626 (one pipe aluminum handrail) or 3632 (two pipe aluminum handrail). Georgia Standard 3632 railing is rarely used, and only with permission of the Bridge Office. While satisfying the post spacing requirements on the Standards, the following characteristics are desirable:

a) Other than end spaces adjacent to the “Y” segment (see Standards), the maximum change from one space to the next should be 1’-0”.

b) End spaces adjacent to the “Y” segment should be approximately one-half of the length of the first full space.

c) The minimum post spacing for full spaces should be 6’-0”.

d) The “Y” segment should be between 0’-9” and 2’-3”.

Arrange the post spacing and the parapet joint spacing at the same time, rather than selecting the parapet joint spacing and then trying to fit the post spacing to it. Sidewalk joints have no effect on the post spacing.

3.3.4.2 Modification of Existing Aluminum Handrail

When preparing plans for an existing bridge with aluminum handrail that is to remain, the handrail shall be modified to achieve the following essential elements of the current Standards:

a) The railing should be anchored to the endpost.

b) The spacing of the posts in the first two spaces adjacent to the endpost should not exceed 4’-0”.

Details for handrail modifications shall be included in the plans.

3.3.5 Chain Link Fence

When fence is required on a bridge parapet/barrier, the default fence type should be assumed to be chain link, unless project commitments require another fence option.

3.3.5.1 Chain Link Fence

Use one of the chain link fence details presented in the GDOT Bridge Cell Library. The details with an overall fence height of 8’-4” can be used on grade separation bridges. Bridges over railroads require the use of the details with a 10’-4” overall fence height.

Chain link fence on bridge parapets/barriers shall be galvanized fence fabric with 2” square openings. Detail all sleeves, posts, rails, and hardware as galvanized. Epoxy coated chain link fence is not allowed.

Chain link fence post locations shall be shown on the plans with a maximum spacing of 10’-0” and a minimum spacing of 7’-0”. No fence post shall be placed with its center within 1’-0” of a parapet/barrier joint or end.

When chain link fence is present on a bridge rail or parapet, include the dead load of the fence in calculations for the superstructure and substructure. Use the following dead loads for the typical chain link fence details presented in the GDOT Bridge Cell Library.

- Chain Link Fence extending to a total height of 8’-4” (on Parapet or Barrier) = 0.016 k/ft
- Chain Link Fence extending to a total height of 10’-4” (on Parapet or Barrier) = 0.019 k/ft

Include the contribution of wind on the fence in calculations for the substructure. Use a relative area of 0.14 ft^2/ft^2 for the standard 9 gage chain link fence with 2” openings to modify the wind pressure calculations in LRFD 3.8.1.2. Unless a structure specific wind study is prepared, assume a minimum of Exposure Category C when calculating pressure.

3.3.5.2 Other Fence Types

When an alternate fence type is approved in lieu of required chain link fence, details similar to those for chain link fence presented in the GDOT Bridge Cell Library will need to be created. Grade separation bridges require a no-climb fence with a minimum height of 8 feet above the walking surface. Bridges Over the railroad require a fence with a minimum height of 10 feet above the walking surface. Alternate fence type details for grade separations and over railroads shall include a protrusion at the top of the fence like that shown in the chain link fence details presented in the GDOT Bridge Cell library, either using a radius or a bend. Alternative anti-climb detailing may be proposed for grade separations but not bridges over the railroad.

Any steel sleeves in the concrete barrier shall be detailed as galvanized. All steel posts, rails, pickets, fabric, and hardware shall also be detailed as galvanized regardless of additional coatings. If other base metals, such as aluminum, are accepted for use for any portion of the fence system, isolation and separation to prevent corrosion should be addressed in the detailing.

Fence post locations shall be shown on the plans based on the specific requirements of the fence system. No fence post shall be placed with its center within 1’-0” of a parapet/barrier joint or end.

When fence is present on a bridge rail or parapet, include the dead load of the fence in calculations for the superstructure and substructure. Calculate a linear foot dead load for the specific fence type being used.

Include the contribution of wind on the fence in calculations for the substructure. Use the calculated relative area of the fence to the gross fence area to modify the wind pressure calculations in LRFD 3.8.1.2. Unless a structure specific wind study is prepared, assume a minimum of Exposure Category C when calculating pressure.

3.3.6 Temporary Bridge Barrier

Temporary barriers are required on projects with staged construction. Temporary barriers will be designated as Method 1 or Method 2. Method 1 shall be used when there is 6’-0” or more distance from the centerline of the temporary barrier to an unprotected edge of the deck. Method 2 shall be used when this distance is less than 6’-0”. Method 2 shall not be used on newly constructed bridge decks. Use a 2’-6” wide barrier in examining staging options.

When preparing bridge plans where temporary barrier is to be used, refer to Georgia Standard 4960 to estimate the quantity needed, rounded up to the nearest 10 feet. Include the quantity in the Summary of Quantities on the General Notes sheet using pay items 620-0100 TEMPORARY BARRIER, METHOD NO. 1, or 620-0200 TEMPORARY BARRIER, METHOD NO. 2 as appropriate.

Coordinate with the roadway designer to verify if tapers will be needed at the ends of the bridge work, or if additional temporary barrier is needed along the roadway sections, eliminating the need for tapers. Except for necessary tapers, do not include the quantity for temporary barrier outside the bridge limits on the bridge plans.

3.3.6.1 Method 1

This method requires the contractor to provide, use, relocate and remove the temporary barrier according to the plans and in accordance with GDOT Standard Specification 620. This method shall not include any positive connectivity of the barrier to the deck. The barrier remains the property of the contractor.

When using Method 1 be sure to add the "Temporary Barriers, Method 1" note to the General Notes sheet using the BridgeNotes program.

3.3.6.2 Method 2

This method requires the contractor to furnish barrier that is certified to meet NCHRP 350 standards for impact testing. This method includes positive connectivity of the barrier to the deck, which typically involves anchoring the barrier to the deck using through bolts. Therefore, locate the traffic face of the barrier at least 9 inches from the edge of the beam flange. Also locate the barrier so the outside barrier face is at least 12 inches from the temporary edge of deck. This should be identified early in the design since it could affect staging or beam spacing.

This method also requires the contractor to use, relocate and remove the temporary barrier according to the plans and in accordance with GDOT Standard Specification 620. The barrier remains the property of the contractor.

When using Method 2 be sure to add the "Temporary Barriers, Method 2" note to the General Notes sheet using the BridgeNotes program.

3.4 Prestressed Concrete (PSC) Beams

3.4.1 Materials

3.4.1.1 Concrete

3.4.1.1.1 Concrete Final Strength (Design Strength = f'c)

The minimum 28-day concrete strength for PSC beams is 5.0 ksi. The maximum 28-day concrete strength for PSC beams is 10.0 ksi.

Concrete strengths of 9.0 ksi and above require a High Performance Concrete special provision.

Final concrete strengths shall be specified in 0.5 ksi increments.

Final concrete strength shall be a minimum of 0.5 ksi greater than the designed release strength.

3.4.1.1.2 Concrete Release Strength (Initial Strength = f'ci)

The minimum concrete release strength for PSC beams is 4.5 ksi.

The concrete release strength should be limited to 7.5 ksi to facilitate typical fabrication schedules. However, PSC beams using final design strengths over 8.0 ksi may require higher release strengths.

Release strengths shall be specified in 0.1 ksi increments.

3.4.1.1.3 Concrete Stress Limits

For LRFD projects, concrete stress limits in PSC beams shall be calculated in accordance with LRFD 5.9.2.3 and are summarized in Table 3.4.1.1.3-1.

For Standard Specification projects, concrete stress limits in PSC beams shall be calculated in accordance with Standard Specification 9.15.2 and are summarized in Table 3.4.1.1.3-2.

Table 3.4.1.1.3-1 Concrete Stress Limits for PSC Beams for LRFD Projects

Stress/Limit State	LRFD Reference	Limit Stress Formula	Conditions
Initial Compression before Losses	5.9.2.3.1a	$= 0.65\, f'_{ci}$ (ksi)	At Release
Initial Tension before Losses	Table 5.9.2.3.1b-1	$= 0.0948\sqrt{f'_{ci}}$ (ksi) $\leq\ 0.200\ ksi$	At Release
Final Compression, Service I	Table 5.9.2.3.2a-1	$= 0.45\, f'_c$ (ksi) $= 0.60\, f'_c$ (ksi)	Without Transient Load With Transient Load
Final Tension, Service III	Table 5.9.2.3.2b-1	$= 0.19\sqrt{f'_c} \leq 0.6$ (ksi) $= 0.0948\sqrt{f'_c} \leq 0.3$ (ksi)	Normal Exposure Severe Exposure

NOTES:

a) f'c and f'ci shall be in the units of ksi for the above equations.

b) Severe-exposure criteria shall apply to any bridge over waterways located partially or completely within a coastal county. The coastal counties are Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden. Normal-Exposure criteria shall be used for all other bridges.

Table 3.4.1.1.3-2 Concrete Stress Limits for PSC Beams for Standard Specification Projects

Stress Limit	Standard Spec. Reference	Limit Stress Formula	Conditions
Initial Compression before Losses	9.15.2.1	$= 0.60\, f'_{ci}$ (psi)	At Release
Initial Tension before Losses	9.15.2.1	$= 3\sqrt{f'_{ci}}$ (psi) $\leq\ 200\ psi$	At Release

Final Compression*	9.15.2.2	$= 0.60\ f'_c$ (psi) $= 0.40\ f'_c$ (psi) $= 0.40\ f'_c$ (psi)	Prestress+DL+LL Prestress+DL LL+1/2 * (Prestress+DL)
Final Tension	9.15.2.2	$= 6\sqrt{f'_c}$ (psi) $= 3\sqrt{f'_c}$ (psi)	Normal Exposure Severe Exposure

*BRPSBM1 uses 0.4f'c for all final compression stress checks. Engineer is responsible for justifying any overstress shown in the program but is within the AASHTO Specification limits presented above.

NOTES:

a) f'c and f'ci shall be in the units of psi for the above equations.

b) Severe-exposure criteria shall apply to any bridge over waterways located partially or completely within a coastal county. The coastal counties are Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden. Normal-Exposure criteria shall be used for all other bridges.

3.4.1.1.4 Unit Weight and Elastic Modulus

a) For LRFD projects, the unit weight of plain concrete shall be calculated according to the formula presented in LRFD 3.5.1-1 and will be used in the calculation of elastic modulus as specified in LRFD 5.4.2.4. This unit weight shall be increased by .005 kcf to account for reinforcement and strands in determining the self-weight of the beam.

b) For Standard Specification projects, the unit weight of plain concrete shall be 145 pcf for use in the calculation of elastic modulus as specified in Standard Specification 8.7.1. This unit weight shall be increased by 5 pcf to account for reinforcement and strands in determining the self-weight of the beam.

3.4.1.2 Prestressing Strands

3.4.1.2.1 Selecting Proper Strand Type

Use 0.6-inch diameter low-relaxation strands in Bulb Tee PSC beams. 0.5-inch diameter special low-relaxation strands or 0.6-inch diameter low-relaxation strands may be used in AASHTO PSC beams.

All prestressing strands shall be the same size within any one PSC beam shape for a bridge site.

3.4.1.2.2 Strand Properties

For LRFD projects, use Ep = 28,500 ksi for the strand Modulus of Elasticity in accordance with LRFD 5.4.4.2.

For Standard Specification projects, use Ep = 28,000 ksi for the strand Modulus of Elasticity.

Data for prestressing strands for use on PSC beam sheets are shown in Table 3.4.1.2.2-1.

Table 3.4.1.2.2-1 Properties of Prestressing Strands

TYPE	DIAMETER (in.)	AREA A_{ps} (in^2)	JACKING FORCE* P_{jack} (kip)
0.5" Regular	0.5	0.153	30.983
0.5" Special	0.5	0.167	33.818
0.6"	0.6	0.217	43.943

* $P_{jack} = 0.75\ A_{ps}\ f_{pu}$ for low-relaxation strands, where f_{pu} = 270 ksi

3.4.1.2.3 Strand Arrangement

Detail all straight strands in a 2-inch center to center grid, beginning 1" on each side of the centerline of the beam.

Strands shall be added starting at the bottom of the beam such that each row is filled before adding strands to the next row.

The bottom flange strand capacity for each girder shape is illustrated in the GDOT PSC Beam Sheets. Place 2 strands per row in the web portion of the girder.

Do not use straight strands in the bottom 3 rows of the beam in the two center strand lines (1" on either side of the centerline of the beam) in order to provide space for the 7-inch high dowel bar chase at each end of the beam.

3.4.1.2.4 Draped Strands

The two center strand lines may be draped to control eccentricities along the beam length. A hold down point for draping is typically located at the mid-point of the beam. However, dual hold down points may be used if a single point will not work. Design and detail hold down offsets at even 1ft increments, measured from the midpoint of the beam. Limit hold down force to 7 kips per strand and a total of 40 kips per assembly. Assume that 2 assemblies can be used at each design hold down location. Calculate the hold down force assuming the strands are pulled to 80% of the specified tensile strength and increase the force by an additional 5% to account for friction.

Raise draped strands high enough to clear the dowel bar chase at the ends of the beam. Do not place draped strands within the top 8" of a PSC beam.

Do not use draped strands in Type I Mod PSC beams.

All draped strands must be contained between stirrup legs.

3.4.1.2.5 Top Strands

AASHTO Type I through IV beams shall be designed with the top two strands prestressed to 75% of the specified tensile strength. The prestressing force in the top strands may be reduced to 10 kips only if doing so is necessary to satisfy the beam stress requirements, not just to save strands in the bottom.

AASHTO Type V beams and Bulb Tee beams should be designed with each top strand prestressed to 10 kips. Beams may be designed with the top strands prestressed to 75% of the specified tensile strength when necessary to mitigate camber or stress limit issues.

3.4.1.2.6 Debonded Strands

Do not design AASHTO Modified Type 1 beams using debonded strands.

Straight strands may be detailed as debonded in other beam types in accordance with LRFD 5.9.4.3.3 except for bullet 2 of restriction I under LRFD 5.9.4.3.3. In lieu of that guidance related to the bottom flange to web ratio, detail all strands as bonded in the web portion of all single web girders shapes, except the AASHTO Type II, and the AASHTO Type III.

Do not detail strands in the top flange of any beam as debonded.

Do not detail draped and debonded strands in the same beam.

Do not terminate debonding in the distance between the end of the beam and the pick-up point.

3.4.1.3 Reinforcement

Use Grade 60 for all reinforcing bars.

Use #6 bars and smaller for all stirrups.

3.4.2 Design Method

3.4.2.1 Loads

Use a future paving allowance of 0.030 ksf on all bridges.

For LRFD projects, HL-93 vehicular live loads (LRFD 3.6.1.2.1) shall be applied in accordance with LRFD 3.6.1.3, including all applicable modifications for Dynamic Load Allowance (IM: LRFD 3.6.2), Multiple Presence Factor (m: LRFD 3.6.1.1.2) and Live Load Distribution Factors (LRFD 4.6.2.2).

Distribution factors for deflection shall be the number of whole 12-foot lanes that will fit on the bridge divided by the number of beams.

For Standard Specification projects, HS-20 vehicular live loads, lane loads and military loads shall be applied in accordance with Standard Specifications 3.7.4 and 3.7.6, including all applicable modifications for Impact (Standard Specification 3.8), Reduction in Load Intensity (Standard Specification 3.12) and Live Load Distribution Factors (Standard Specification 3.23).

Distribution factors for deflection shall be calculated by multiplying the number of whole 12-foot lanes that will fit on the bridge by 2 and dividing by the number of beams. The distribution factor should not be less than 1.

All beams must analyze without overstress in the BRPSBM1. See Section 2.8.3.1.

3.4.2.2 Transformed Section

Do not use transformed section properties for PSC beam design.

3.4.2.3 Prestress Losses

When designing prestressed concrete beams for an LRFD project, calculate the prestressed losses in accordance with LRFD 5.9.3. Use only the approximate method in LRFD 5.9.3.3 to calculate the time dependent losses. Ignore elastic gains.

For Standard Specifications, prestress losses shall be calculated in accordance with Standard Specification 9.16.

3.4.2.4 Shear Design

For LRFD projects, PSC beam shear design shall comply with one of the following methods:

- General Procedure using β–θ table as specified in LRFD 5.7.3.4.2 and LRFD Appendix B5
- General Procedure using equations as specified in LRFD 5.7.3.4.2

For Standard Specification projects, PSC beam shear design shall be performed in accordance with Standard Specification 9.20.

3.4.2.5 Anchorage Zone Reinforcement

For LRFD projects, provide the minimum amount of reinforcement at girder ends as required by LRFD 5.9.4.4. The minimum clear spacing between all stirrups and confinement reinforcement in the anchorage zone shall be no less than 1.5 inches. Assume that the confinement steel will be detailed by the fabricator as two bars lapping at the bottom of the beam and affect the provided clear spacing.

When the clear spacing requirements cannot be met by use of single leg #6 stirrups, it is permissible to bundle anchorage stirrups starting with #5 bars and increasing to #6 bars if necessary.

Detail stirrups from the anchorage zone to a distance of h/2 from the end of the beam at a maximum center to center spacing of 6 inches.

For Standard Specification projects, provide the minimum amount of reinforcement at girder ends as required by Standard Specification 9.22. The minimum clear spacing between all stirrups and confinement reinforcement in the anchorage zone shall be no less than 1.5 inches. Assume that the confinement steel will be detailed by the fabricator as two bars lapping at the bottom of the beam and affect the provided clear spacing.

3.4.2.6 Composite Section Considerations

3.4.2.6.1 Composite Slab

The thickness of the composite slab for strength calculation shall be decreased by 1/4” from plan thickness to accommodate the section loss from grooving and grinding of deck surface. However, the weight of the 1/4” shall be included in the design loads.

Commentary: Although not all decks are required to meet Ride Quality Control, grooving and the general deck smoothness requirements of GDOT Standard Specification 500.3.06.D could reduce the total deck thickness available for composite action. Therefore, removing 1/4" from the deck thickness shall be used for all cases.

3.4.2.6.2 Composite Coping

The coping thickness considered in composite section property calculations (i.e., "DF" in BRPSBM1) should be conservatively set as 0 inches. A maximum value of 1" may be used with adequate justification.

3.4.2.7 Beam Spacing

For LRFD projects, the maximum beam spacing is 10'-6". PSC Beam Charts for LRFD projects are provided in Appendix 3B to assist the designer in selecting preliminary PSC beam spacing.

For Standard Specification projects, the maximum beam spacing is 9'-0". PSC Beam Charts for Standard Specification projects are provided in Appendix 3D to assist the designer in selecting preliminary PSC beam spacing.

3.4.2.8 Span Lengths

The maximum span lengths for the PSC beams are:

- 40 feet for AASHTO Type I Mod. beams
- 65 feet for AASHTO Type II beams
- 85 feet for AASHTO Type III beams
- 125 feet for 54" Bulb Tee beams
- 130 feet for 56" Bulb Tee beams
- 135 feet for 63" Bulb Tee beams
- 140 feet for 65" Bulb Tee beams
- 150 feet for 72" and 74" Bulb Tee beams

If the above maximum span lengths are exceeded under an alternate bidding process, the engineer of record is responsible for performing a beam stability analysis.

3.4.2.9 Longitudinal Reinforcement

Design checks in accordance with LRFD 5.7.3.5 may show that additional longitudinal reinforcing bars are necessary for design of a PSC beam. In lieu of adding reinforcement bars, increase the number of prestressed strands in the beam until the design check is satisfied.

3.4.2.10 Positive Beam Camber

All PSC beams shall be designed so that there is a net positive camber in the beam after the consideration of all prestressing force, and dead load deflections. Assess the camber for all permanent dead loads present at the point in time when the bridge is opened to traffic.

3.4.3 Detailing

3.4.3.1 Concrete Clearances

All strands must be contained within stirrups. Provide reinforcement cover as detailed on the GDOT PSC Beam Sheets. A minimum concrete cover of 1" is only acceptable in the web portion of the Bulb Tee Beam shapes.

3.4.3.2 Fascia Beams

A fascia beam is an exterior beam that is selected for uniform appearance rather than structural efficiency. When a multi-span bridge is in a visible area and beams of different spans have different depths, a fascia beam shall be used on the exterior of the shorter spans to match the deeper beams of the longer span. Fascia beams are not required on bridges crossing water or railroads.

3.4.3.3 Longitudinal Beam Dimensions

Do not account for vertical grades when detailing longitudinal dimensions of beams on bridge plans. Effects of vertical grades are to be included in the beam shop drawings provided by the contractor.

3.4.3.4 PSC Beam Characteristics

Use the design values presented in table 3.4.3.4-1 when performing PSC beam design or analysis.

Tabled 3.4.3.4-1 PSC Beam Data for Design

	Area (in^2)	I_{yy} (in^4)	I_{xx} (in^4)	Y_{bn} (in)
AASHTO Mod 1	332	5,222	26,495	12.83
AASHTO Type 2	369	5,333	50,979	15.83
AASHTO Type 3	559.5	12,217	125,390	20.27
AASHTO Type 4	789	24,374	260,741	24.73
54" Bulb Tee	659	37,310	268,051	27.63
56" Bulb Tee	711	40,240	307,586	27.54
63" Bulb Tee	713	37,472	392,516	32.12
65" Bulb Tee	765	40,402	445,689	31.87
72" Bulb Tee	767	37,634	545,857	36.6
74" Bulb Tee	819	40,564	614,736	36.22

3.4.3.5 Stay-In-Place Deck Forms

Stay-in-place metal deck forms are used regularly and therefore the beam design shall include an additional 0.016 ksf load to account for the weight of the forms including the concrete in the corrugations.

Filling metal deck form corrugations with foam or any other material other than bridge deck concrete is not acceptable as a design detail. Do not design or detail plans with reduced form loads based on this prohibited practice.

3.4.3.6 Deflections on Beam Sheets

On the beam sheet, do not include the diaphragm weight in the non-composite deflection since that deflection will have already occurred prior to pouring the deck. Also, do not include deflection due to future paving in the composite dead-load deflection since it might never occur.

3.4.3.7 Strand Forces on Beam Sheets

Make sure that the total jacking force is the actual sum of the jacking force per strand, including the top strands that are specified on the beam sheets.

3.4.3.8 End Slots and Holes

Provide a 1.75" wide, 4” long and 7" deep slot at the expansion ends of AASHTO PSC beams. Provide a 1.75” diameter, 6” long and 7” deep slot at the expansion end of all Bulb Tee PSC beams. Provide a 1.75” diameter, 7” deep hole at the fixed ends. Strands in the web near the bottom of the beam will conflict with these locations. Therefore, remove the 3 bottom rows of undraped strands in the web area to avoid conflict or raise draped strands high enough to clear the conflict area.

3.4.3.9 Diaphragm Holes

When diaphragms are necessary as specified in Section 3.9.1.1, provide holes for the diaphragm bars and 5” diameter block-outs for the nut and washer as shown on the GDOT PSC Beam Sheets. The designer shall ensure that the stands do not conflict with the diaphragm holes or block-outs.

Diaphragm bars shall be located to avoid interference with strands and utilities.

3.4.3.10 Beveling Top Flange

- To allow for proper fit up, the top flange of PSC beams shall be beveled to match the angle between the centerline of beam and the centerline of the bent when the angle is equal to or smaller than:
  - 87º for Bulb Tee Beams
  - 84º for the other AASHTO type beams
  - FIB sections will require beveling for all skews

The GDOT PSC Beam Basic Drawings include a general detail for this beveling.

3.4.3.11 Beam Dimensions

Detail girders to 1/16" increments and state on the plans that the lengths given are horizontal dimensions for in-place girders and that the fabricator shall adjust those lengths for grade and fabrication effects such as shrinkage and elastic shortening.

The dimensions from centerline of bent or BFPR to centerline of bearing should be calculated along the beam centerline first. The bearing-to-bearing length is calculated by subtracting these dimensions from the span length. The beam length is calculated by adding the dimensions between centerlines of bearing and beam ends.

If the beam length contains a sixteenth of an inch, the half-length shown should be rounded to a sixteenth or an eighth of an inch.

3.4.3.12 Exterior Beam Bracing

To avoid rotations of exterior beams during deck pours the contractor should be instructed to provide bracing for the exterior beams during deck placement when the exterior beam is a Type I, Type I Mod, or Fascia beams where no diaphragms are present. When one of these conditions exists, include the "Exterior Beam Bracing" note on the General Notes sheet using the BridgeNotes program.

3.4.3.13 Bearing Pad Clearance

Provide a minimum of 2" for all PSC beams from the end of the beam to the edge of the bearing pad. This is to accommodate the chamfer at the end of the beam (up to 3/4" for AASHTO beams and 1" for Bulb Tee beams) and a 3/4" tolerance on the length of the beam.

3.4.3.14 "D" Dimension and Coping

3.4.3.14.1 "D" Dimension

The "D" dimension is the distance measured from top of slab to top of beam at the centerline of bearing and is the sum of the slab thickness, minimum coping and additional coping. The "D" dimension should be provided on the plans for the contractor's use.

The "D" dimension should be calculated separately for exterior and interior beams in each span and rounded to the nearest 1/8 inch. For a group of "D" dimension values that are within 1/4 inch, it is acceptable to use the largest value for the entire group. However, it should be noted that this could increase concrete quantities and loads significantly on wide-flanged PSC beams.

3.4.3.14.2 Minimum Coping

Use a 3/4 inch minimum coping on AASHTO Type-I Mod, Type-II and Type-III PSC beams and 1½ inches on AASHTO Type-IV and Type-V PSC beams and Bulb Tee PSC beams, Florida I-Beams, and any PSC Beam with a top flange of 1'-8" or wider to accommodate potential elevation or deflection variations during construction. The minimum coping applies across the entire flange width.

3.4.3.14.3 Additional Coping

The designer shall consider additional coping due to vertical curve, cross-slope, beam throw, beam camber and beam deflection by dead load. The dead load deflections include non-composite dead loads and composite deadloads, such as barrier, sidewalks and utilities. Do not include a future wearing surface in this calculation.

3.4.3.14.4 Maximum Coping

Total coping (minimum plus additional) at any point along a beam centerline shall not exceed 6”. Modifying the PSC beam design or adding an additional beam to the cross-section are acceptable methods for controlling the coping.

3.4.3.14.5 Coping Reinforcement

Where coping exceeds 4 inches, provide additional reinforcement as shown in the COPING cell of the GDOT Bridge Cell Library.

3.4.4 Prestressed Florida I-Beam (FIB)

Use of Florida-I Beam sections may be considered to reduce the impacts of a profile increase or achieve a required minimum vertical clearance. Use of FIBs shall be approved by the Bridge Office during the concept or preliminary plans phase.

Designing FIB sections with the following practices will most likely reduce the maximum span lengths achieved by these sections as shown in FDOT's design charts. Preliminary design of FIBs shall be provided during the development of the preliminary layout to ensure FIBs are feasible for the site conditions.

The following items should be noted and applied when detailing the use of Florida-I Beam sections on projects to be constructed in Georgia.

3.4.4.1 Beam Spacing

The Beam spacing limits in BDM 3.4.2.7 apply to the use of FIBS.

3.4.4.2 Top Strands

The strands in the top flange shall be prestressed to either 10 kips or 75% of the specified tensile strength.

3.4.4.3 Top Flange Tension

Limit the initial tension in the top flange at release to 0.200 ksi as specified in BDM Table 3.4.1.1.3-1. To mitigate overstress, top strands may be prestressed to 75% of the specified tensile strength.

3.4.4.4 Concrete Strength

Detail FIBs adhering to BDM 3.4.1.1.1 and 3.4.1.1.2 as they pertain to final and release strengths for concrete.

3.4.4.5 Transverse Reinforcement

Detail stirrups and confinement reinforcement to provide the minimum clear spacing defined in BDM 3.4.2.5. Use of #6 stirrups is known to interfere with strand placement in the FIB sections. Fully investigate the detailing of strands and reinforcement for conflicts.

FDOT's stirrup details resulting in 4 vertical legs at a section are acceptable. However, do not follow FDOT details for single leg stirrups where shear demand allows. Use a minimum of two vertical legs at each location.

3.4.4.6 Edge Beam Detailing

When FIBs are used as an exterior beam, provide additional reinforcement in the edge beam similar to that described in BDM 3.10.2 for Bulb Tee Beams.

3.4.4.7 Camber Measurement

Recent experience in Georgia with the Florida I-Beams has demonstrated that the standard camber prediction approaches used in design have compared poorly with actual camber values in the field. As a result, if FIBs are included in a structure, include the "Camber Measurement" note on the General Notes sheet using the BridgeNotes program.

3.5 Reinforced Concrete Deck Girders (RCDGs or T-BEAMS)

3.5.1 Materials

3.5.1.1 Concrete

For LRFD projects, use Class D concrete that has a 28-day specified design strength of 4.0 ksi in accordance with LRFD 5.4.2.1. See Special Provision 500 – Concrete Structures.

For Standard Specification projects, use Class AA concrete that has a 28-day design strength of 3.5 ksi.

3.5.1.2 Reinforcement

Use Grade 60 reinforcement.

3.5.2 Design Method

3.5.2.1 Loads

Use a future paving allowance of 0.030 ksf on all bridges.

For LRFD projects, HL-93 vehicular live loads (LRFD 3.6.1.2.1) shall be applied in accordance with LRFD 3.6.1.3, including all applicable modifications for Dynamic Load Allowance (IM: LRFD 3.6.2), Multiple Presence Factor (m: LRFD 3.6.1.1.2) and Live Load Distribution Factors (LRFD 4.6.2.2).

For Standard Specification projects, HS-20 vehicular live loads, lane loads and military loads shall be applied in accordance with Standard Specifications 3.7.4 and 3.7.6, including all applicable modifications for Impact (Standard Specification 3.8), Reduction in Load Intensity (Standard Specification 3.12) and Live Load Distribution Factors (Standard Specification 3.23).

3.5.2.2 Beam Spacing

The maximum beam spacing is 9’-0”.

Standard beam spacing for typical bridge widths are as follows:

a) 38-foot wide (gutter to gutter): 5 beams spaced at 8'-6"

b) 40-foot wide (gutter to gutter): 5 beams spaced at 9'-0"

c) 44-foot wide (gutter to gutter): 6 beams spaced at 8'-0"

3.5.2.3 Beam Depths

A standard beam depth of 2’-3” from top of deck to the bottom of beam is used on spans of 30’ while 2’-9” is used on 40’ spans.

3.5.3 Detailing

3.5.3.1 Diaphragms

Diaphragms will not be required on RCDG bridges with spans equal or less than 40 feet.

3.5.3.2 Bearings

There are special rules for bearing pads under RCDG (see section 3.12).

3.5.3.3 Stirrups

Use No. 4 stirrups placed perpendicular to the beam centerline along the length of the RCDG. At the end of RCDGs on skewed bridges, place 3 stirrups at varying angles to transition from perpendicular to the beam centerline to parallel to the skewed end.

3.5.3.4 T” Dimension

“T” dimension is the distance measured from the bottom of the beam to the top of the cap at the cap faces and is used to maintain the design beam depth for the full beam length. The minimum “T” dimension is the bearing pad thickness plus an additional 1/2 inch thickness for construction tolerance. When bridge deck elevations are different from one cap face to the other, the “T” dimension on the higher side shall be the minimum plus elevation difference.

The “T” dimension is detailed to the nearest 1/8 inch on the plans.

3.6 Steel Beams

3.6.1 General

Steel superstructures are generally not preferred due to the high cost of fabrication and long-term maintenance in comparison to concrete bridges of similar span lengths. However, long span lengths or the widening of existing bridges may require the use of steel beams. The use of steel superstructures shall be approved by the Bridge Office prior to development of the preliminary layout. A higher level of scrutiny will be placed on projects in Chatham, Bryan, Liberty, McIntosh, Glynn and Camden counties due to their coastal environment.

3.6.2 Materials

3.6.2.1 Main Members

Use ASTM A709, Grade 50 (Fy=50 ksi) or ASTM A709, Grade 70 (Fy=70 ksi) steel for the design and fabrication of main steel members. The use of Grade 100 or higher HPS is prohibited.

The use of unpainted ASTM A709 50W or 70W “weathering steel” on highway bridges is acceptable with the following requirements:

- Potential staining of substructure elements will not detract from the aesthetics of the bridge. Pier cap and abutment wall protection maybe use used to mitigate where required.
- The Bottom of Beam elevation for "weathering steel" must be a minimum of 10 ft above the 2 year flood elevation.
- Weathering steel should not be used for a grade separation structure that exceeds 80 feet in width.
- Weathering steel near bridge expansion joints shall be painted within a distance of 1.5 times the depth of the girder. See BDM 3.6.7 for guidance on painting.
- All superstructure steel within a distance of 1.5 times the depth of girder from bridge joints shall be painted Federal Standard Color 30045 with Paint System VII per Section 535 of the Construction Specifications
- Bridge deck drainage scuppers shall freefall only if extended below the superstructure.
- Weathering steel should not be used in coastal counties. The coastal counties are Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden.

3.6.2.2 Bearing Assemblies and Non-Structural Components

Use ASTM A709, Grade 36 (Fy=36 ksi) or better for the design and fabrication of bearing assemblies and other non-structural components.

3.6.3 Design Method

For LRFD projects, steel superstructure shall be designed in accordance with LRFD Section 6, Steel Structures.

For Standard Specification projects, steel superstructure shall be designed in accordance with Standard Specification Section 10, Structural Steel.

The strength contribution of negative moment reinforcement in the slab is generally ignored.

3.6.4 Fatigue

For LRFD projects, steel beams shall be designed for fatigue based on Detail Categories and Average Daily Truck Traffic in a single lane (ADTTSL) in accordance with LRFD 6.6.1. The design life for the structure for fatigue calculations shall be 75 years. ADTTSL shall be calculated by extrapolating the traffic data and modifying in accordance with LRFD 3.6.1.4.2, as shown in the example below.

For Standard Specification projects, steel beams shall be designed for fatigue in accordance with Standard Specification 10.58. The design life for the structure for fatigue calculations shall be 60 years. ADTT shall be calculated as shown in the example below, excluding steps 5 and 6.

GIVEN:

- ADT(2013) = 20000
- ADT(2033) = 30000
- % Trucks = 5%
- Directional = 60%
- Number of Traffic Lanes in Direction of Interest = 2

FIND: $ADTT_{SL}$ to be used for fatigue design life of 75 years (60 years for Standard Specification)

SOLUTION:

1. ADT(2088) = ADT(2013) + 75 / 20 x [ADT(2033) - ADT(2013)] = 20000 + 75 / 20 x [30000 - 20000] = 57500
2. Average ADT in Design Life = [ADT(2013) + ADT(2088)] / 2 = 38750
3. ADT in Single Direction = 38750 x 60% = 23250
4. ADTT in Single Direction = 23250 x 5% = 1162.5
5. Fraction of Truck Traffic in Single Lane, P = 0.85 (LRFD 3.6.1.4.2 for 2 lanes)
6. $ADTT_{SL}$ = 1162.5 x 0.85 = 988

For LRFD projects, the fatigue limit state, either Fatigue I or Fatigue II, shall be selected based on $ADTT_{SL}$ and the Detail Category, as specified in LRFD 6.6.1.2.3.

3.6.5 Detailing

3.6.5.1 Plate Sizing

3.6.5.1.1 Flanges:

The following plate dimension limits shall be applied:

- Minimum thickness: 1”
- Maximum thickness: 3”
- Minimum width: 18”
- Maximum width: 36”

Designers should minimize the number of changes to flange dimensions along a beam to reduce the cost of labor during construction. A minimum length of flange plate is recommended to be 12 feet. It is also recommended to make changes to flange thicknesses rather than flange widths. The larger flange thickness at any transition should be limited to 1.5 times the thinner flange thickness.

Due to welding and fatigue considerations, designers should avoid a thick tension plate by decreasing beam spacing and/or increasing plate width.

3.6.5.1.2 Webs:

The following plate dimension limits shall be applied:

- Minimum thickness: 3/8”
- Maximum thickness: 1 ¼”
- Minimum height: 36”
- No maximum height (120” may be a practical limit)

Changes to web thickness are discouraged due to high cost. The designer should evaluate increasing the web thickness versus using transverse stiffeners for economy. Thickened webs are generally more economical for web depths of 72 inches and less, while stiffened webs are generally more economical for web depths greater than 72 inches.

Use of longitudinal stiffeners is prohibited.

3.6.5.2 D” Dimension and Coping

3.6.5.2.1 D” Dimension for Steel Beams (Rolled Sections)

The “D” dimension for steel beams is the distance measured from top of slab to top of beam at the centerline of bearing and is the sum of the slab thickness, minimum coping and additional coping. The “D” dimension should be provided on the plans for the contractor’s use.

The “D” dimension should be calculated separately for exterior and interior beams in each span and rounded to the nearest 1/8 inch. For a group of “D” dimension values that are within 1/4 inch, it is acceptable to use the largest value for the entire group.

3.6.5.2.1.b “D” Dimension for Steel Girders (Built-up Sections)

The “D” dimension for steel girders is the distance measured from the top of slab to the top of the girder web and is the sum of the slab thickness, the top flange thickness and the minimum coping. This value is constant over the entire length of the girder since the girder is fabricated to include the variables that comprise “additional coping” in PSC beams and rolled steel beams

3.6.5.2.2 Minimum Coping

Use a 3/8 inch minimum coping on steel beams to accommodate potential elevation or deflection variations during construction.

3.6.5.2.3 Additional Coping

The designer shall consider additional coping due to vertical curve, cross-slope, beam throw, beam camber and beam deflection by dead load except for future paving load.

3.6.5.3 Members Subject to Tensile Stresses

When steel beams or girders are included in the bridge superstructure, include the “Charpy V-Notch Test” note on the General Notes sheet using the BridgeNotes program. The beam details sheets should also have a symbol (CVN) indicating which components require Charpy V-Notch testing.

When designing complex and/or unique steel structures, consider if each steel member, only certain components/connections or none of the steel member needs to be designated as “Non-Redundant Steel Tension Members” (NSTM), formerly referred to as Fracture Critical Member. Providing the NSTM designation on a structure requires significantly more effort and control on the fabrication of the members and connections. If the NSTM is appropriate for the structure, take extra care to identify and note on the plans the specific pieces and/or connections that need to be inspected/tested to NSTM requirements.

3.6.5.4 Shear Connectors

Use 3/4 inch diameter end-welded studs for shear connectors. Shear connectors shall penetrate into the slab at least 2 inches, but the top of the stud head shall be 3 inches below the top of the deck. Use of the same height stud throughout the bridge is recommended. Shear studs shall not be located in negative moment regions.

When replacing the deck on existing steel beams that are non-composite, add shear connectors in pairs 18 inches apart in the positive moment regions of continuous beams and throughout simple span beams.

3.6.5.5 Stiffeners and Gusset Plates

Stiffeners shall be sized and attached to the girders in accordance with LRFD 6.10.11 or Standard Specifications 10.33.2, 10.34.4, 10.34.5 and 10.34.6, as appropriate.

Provide designs and details to accommodate future jacking operations for bridge bearing maintenance and replacement activities.

Gusset plates for diaphragms shall be welded to the web, top flange and bottom flange. Web stiffeners shall be welded to the web and tight fit to the compression flange. Bearing stiffeners shall be welded to the web and milled to bear against the load bearing flange.

3.6.5.6 Beam Camber

Camber diagrams are only required for continuous spans. The following note should be included with camber diagrams:

> ***“CAMBER ORDINATE SHOWN INCLUDES DEAD LOAD DEFLECTION DUE TO THE BEAM, SLAB, COPING, RAILING, SIDEWALK AND MEDIAN, AND INCLUDES THE VERTICAL CURVE ORDINATE.”***

3.6.5.7 Splices

On long-span bridges, the designer shall consider how the beams will be transported to the project site. The maximum length of beam that may be transported on state routes is limited to about 170 ft. The maximum legal load is 180,000 lbs., including 45,000 lbs. for the truck. Therefore, most long-span bridges will require field splices.

All field splices shall be welded with full-penetration butt welds. Bolted splices are not recommended, except for box girders.

Field splices shall be located near points of contra-flexure for dead loads.

All built-up girders shall be designed with stiffeners adjacent to the splice point. To provide room for welding, grinding and testing, stiffeners shall be located 12 inches from the splice. Studs should not be placed within 12 inches of a splice.

3.6.5.8 Fascia Girders

A fascia beam is an exterior beam that is selected for uniform appearance rather than structural efficiency. When a multi-span bridge is in a visible area and beams of different spans have different depths, a fascia beam shall be used on the exterior of the shorter spans to match the deeper beams of the longer span. Fascia beams are not required on bridges crossing water or railroads.

When fascia beams are used in short end spans, the dead load deflections may vary considerably, with the fascia beams having much less deflection than the interior beams. Construction problems may occur when these spans are poured, such as thin cover on slab steel if interior beams do not deflect as noted.

The designer shall examine if the use of equal-depth beams is economically viable. In cases where equal-depth beams are not feasible, the designer shall detail increased cover over the slab steel to ensure that adequate cover is obtained during construction.

3.6.5.9 Existing Extension Tabs and Back-Up Strips

For widening projects including structural steel members, Bridge Maintenance Unit may request that any old extension tabs and/or back-up strips be removed. The designer shall ensure that this work is included in the plans.

3.6.5.10 Cover Plates for Rolled Steel Beams

The use of cover plated members is prohibited. When widening a bridge that has cover plated members, the use of a larger member is suggested.

3.6.6 Welding

The designer shall indicate on the plans if the diaphragms and cross frames shall be welded before or after the placement of the deck. Diaphragms or cross frames that are not placed parallel to the centerline of bent shall be welded after pouring the deck.

Do not use groove welding for connection between a gusset plate and diaphragm/cross frame because of the need for back-up plates and special welding procedures. Use a bent plate for the attachment of skewed diaphragms or cross frames to the gusset plates.

In order to prevent cracks in the groove weld from developing where backing strips are discontinuous, the designer shall note that all backing strips are continuous for the length of the weld or that any joints in the backing strip are connected by full penetration butt welds on structural steel shop drawings.

No intersecting welds will be allowed on structural steel bridge plans or shop drawings to prevent crack propagation from welds in that area. Base metal in the intersection area of welds shall be coped 4 times the thickness of the web or 2 inches, whichever is greater.

Electro-slag welding is not permitted on bridge members.

When designing for fatigue, all welds shall be classified as Category C or better as defined in LRFD 6.6.1.2.3 or Standard Specification Table 10.3.1B, as appropriate.

3.6.7 Paint

All new structural steel shall be painted with System VII regardless of the bridge location in the state. When only new steel is included in the project scope, include either the “New Bridge Paint” or “New Bridge Paint (Weathering Steel)” note on the General Notes sheet using the BridgeNotes program as appropriate. Modify the “New Bridge Paint (Weathering Steel)” note by specifying the paint boundary equal to 1.5 times the depth of the girder from the bridge joint.

Existing structural steel outside the non-attainment areas shall be painted with System VII and existing structural steel inside non-attainment areas shall be painted with System VI. When project scope includes both new steel and maintenance of existing steel, review Sub-Section 535.03.05.C.1 of the Georgia Standard Specifications to determine the project locations status. Include either the “New and Existing Bridge Paint” or “New and Existing (Lead) Bridge Paint” note on the General Notes sheet using the Bridge Notes program as appropriate and modify paint system type to address the air quality restrictions.

For painting of H-piles, see Section 4.4.2.3.

3.6.8 Salvage of Structural Steel

Structural steel from plate girders will not be salvaged.

When the Bridge Maintenance Unit recommends salvaging structural steel from a rolled beam continuous unit, the designer shall ensure that directions for disassembly are included with the recommendation. See Section 2.7.

In cases where existing structural steel is to be reused on the project, include the “Existing Structural Steel” note on the General Notes sheet using the BridgeNotes program.

3.6.9 Beam Corrections

When structural steel fabricators place holes at the wrong location in bridge members, the fabricators will be required to fill the misplaced holes with high-strength bolts (A-325 or A-325 weathering) tightened in accordance with the GDOT Standard Specifications.

All corrective work utilizing heat procedures to obtain acceptable tolerances pertaining to sweep and camber, or to repair damaged structural steel beams shall be documented and filed in the appropriate project file. These documents shall contain a sketch showing the locations, temperature and duration of the heat applied. The amount of sweep, camber or damage shall be documented both before and after the heat corrective work. If possible, photographs of the beams should be taken before and after all corrective work utilizing heat procedures.

3.7 Post-Tensioned Box Girders

3.7.1 General

Post-tensioned box girders shall be designed in accordance with LRFD Specification Section 5 – Concrete.

3.7.2 Dimensions

The maximum cantilever overhang beyond the exterior web shall be 9'-6". The designer shall consider providing adequate vertical and horizontal clearance for required falsework for construction.

3.7.3 Materials

3.7.3.1 Concrete

Post-tensioned concrete boxes should be designed with Class AA-1 concrete as a minimum, but Class AAA concrete may be necessary if higher 28-day strength is required.

3.7.3.2 Epoxy Coated Reinforcement

Epoxy coated reinforcing steel shall be used as specified in Section 3.2.4.

3.7.4 Use of Stay-In-Place Deck Forms

Do not use stay-in-place concrete or steel deck forms or panels for the top slab of the box girder.

3.7.5 Cell Drains

4" diameter cell drains shall be provided at the low point of all closed cell boxes.

3.7.6 Post Tensioned Ducts Detailing

Clearances, duct spacing and duct support saddles shall be fully detailed on the bridge plans as shown in Section 509, Figures 1 & 3 of the GDOT Standard Specifications, except that the clear spacing between ducts shall not be less than 1.5 inches in accordance with LRFD 5.9.5.1.1.

3.7.7 Detailing of Anchorage Blisters

The dimensions, clearances, and reinforcing steel shall be fully detailed on the bridge plans as shown in Section 509, Figure 2 of the GDOT Standard Specifications.

3.7.8 Open Grate Access Doors

Concrete box girders carrying water mains shall have open grate access doors in every bay at each end of the bridge to provide emergency water run out if the water main leaks or breaks.

3.7.9 Gas Lines on Post-Tensioned Box Girders

The designer shall not detail gas lines inside the closed cell of box girders unless specifically instructed by the Bridge Office. In this case, the designer should be aware of the following criteria and should consider accommodating them in the plans where applicable:

a) Increase the wall thickness of the present pipe being used on bridge structures.

b) Ensure all welded lines are completed by certified welders.

c) Require a hydrostatic test of the pipe.

d) Detail a 6" vent in each end cell.

e) Detail a malleable iron test insert with replaceable rubber plug in each cell.

f) Provide access to allow for gas leak detection, pipe inspection and repair.

g) Verify that all lines are low pressure.

3.7.10 Segmental Construction Alternate for PT Boxes

When a segmental construction alternate is to be allowed on post-tensioned box girder bridges, the following note shall be included in the Bridge Plans:

> ***"SEGMENTAL CONSTRUCTION – PROPOSALS FOR CONSTRUCTION BY SEGMENTAL METHODS MAY BE SUBMITTED FOR CONSIDERATION AS AN ALTERNATE TO THE METHOD SHOWN IN THE PLANS. ALL PROPOSALS SHALL INCLUDE A SET OF CONSTRUCTION DRAWINGS AND COMPLETE DESIGN CALCULATIONS. ALL PROPOSALS SHALL CONFORM TO THE LATEST AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS AND NO TENSION STRESS IN THE CONCRETE AFTER LOSSES SHALL BE ALLOWED. ALL PROPOSALS SHALL ALSO CONFORM TO THE GEORGIA DOT SPECIFICATIONS AND WILL BE SUBJECT TO APPROVAL BY THE STATE BRIDGE ENGINEER. IF APPROVED FOR USE, THE ALTERNATE SEGMENTAL CONSTRUCTION METHODS SHALL BE AT NO EXTRA COST TO THE DEPARTMENT AND WITH NO INCREASE IN CONTRACT TIME."***

3.8 Other Precast Concrete Beams

3.8.1 General

In addition to the AASHTO girder shapes, three other precast beam types are being utilized by the Bridge Office to provide options for rapid delivery and rapid construction for select bridges in the state. These beam types are the cored slab beam, box beam, and NExT-D beam. The use of these beam types is limited to structures with very little to no horizontal curvature and a maximum of 4% super elevation. The department developed details for these beams are also limited to structures with no skew at the end or intermediate bents.

The cored slab beams and box beams require either a concrete or asphalt overlay. A minimum 3 1/2" thickness is required when asphalt overlay is used.

Table 3.8.1-1 shows additional guidance for appropriate use of these beam types.

Drawing files and a guidance document for both the cored slab beams and box beams can be found on the Bridge Office web page. If NExT-D beams are the selected choice for a project, contact the Bridge Office for current details and drawings.

Table 3.8.1-1 Guidance for Use of Other Precast Beam Types

	Bridge Type		
Criteria	**Cored Slab**	**Box Beam**	**NExT D Beam**
Span Lengths	25 ft to 50 ft	30 ft to 70 ft	40 ft to 70 ft
ADT	<= 3000 vpd	<= 3000 vpd	Not limited
Truck Volume	<= 100 vpd	<= 100 vpd	Not limited
Minimum Width	26’ gutter to gutter	26’ gutter to gutter	30’ gutter to gutter
Asphalt/Concrete Overlay	Use concrete for NHS	Use concrete for NHS	N/A

3.8.2 Box Beams

Designate span lengths in 1-foot increments. Do not use more than 2 different span lengths for any single bridge location. Use the same beam depth for all spans at any single bridge location.

3.8.3 Next-D Beams

Designate span lengths in 5-foot increments. Do not use more than 2 different span lengths for any single bridge location.

3.8.4 Cored Slab Beams

Designate span lengths in 1-foot increments. Do not use more than 2 different span lengths for any single bridge location. Use the same beam depth for all spans at any single bridge location.

3.9 Diaphragms and Cross Frames

3.9.1 Concrete Girders

3.9.1.1 Diaphragm Requirements

One line of diaphragms shall be provided on or near beam mid-points for spans over 40 feet long. When a bridge is to be constructed in stages, omit the diaphragm from the bay between the stages.

3.9.1.2 Location of Diaphragms on Skewed Bridges

On skewed bridges, diaphragms shall be placed perpendicular to the beam and located so that a line through the beam mid-points crosses the diaphragm at mid-bay. This results in a beam that has two sets of diaphragm holes equally spaced on each side of the beam mid-point. In cases when the skew angle approaches 90 degrees, these diaphragm holes will be too close together to fabricate independently and the diaphragm may be cast on a skew to intersect each beam mid-point.

Show the distance from B.F.P.R. or centerline of bent to the diaphragm on the deck plan sheet or beam layout as appropriate.

3.9.1.3 Diaphragm Materials

Detail Diaphragms using reinforced concrete in accordance with the GDOT Bridge Cell Library and the material requirements of BDM 3.2.1.

Steel diaphragms may be considered when the following conditions exist:

- Structures over roadways with substantial vertical clearance (20 ft or greater)
- Structures over a railroad with a minimum of 23 ft of vertical clearance
- Structures over waterways not located in the coastal counties designated in 4.1.1(c)

Steel diaphragms shall not be allowed when the following conditions exist:

- Structures carrying utilities supported on members bolted to adjacent beams
- Structures carrying utilities greater than 8” in height, width, or diameter and suspended from the slab
- Structures carrying a deck drainage system
- Structures that include Florida I Beam (FIB) sections shorter than the FIB-54

If the steel diaphragm option is appropriate, include the “Steel Diaphragms (Allowed)” note the on the General Notes sheet using the BridgeNotes program.

In lieu of using LRFD Fig. 3.8.1.1.2-1, steel diaphragms shall be designed for a minimum load equal to the force generated by a three second gust wind speed of 140mph applied to one half of the vertical surface area of the exposed beam being braced. The designer shall assume that the structure is located in exposure category D unless otherwise noted. Detail cross frames to include a horizontal angle or channel at the top or bottom of the frame. Cross Frame members shall be evaluated as secondary members according to the AASHTO LRFD Bridge Design Specifications. For the consideration of slenderness, gusset plates at the center of the frame will not be considered as a point of support to reduce the member length. Slenderness should be checked about all three axes for angle shapes.

If the steel diaphragm option is not appropriate, include the “Steel Diaphragm (Not Allowed) note on the General Notes sheet using the BridgeNotes program.

Steel diaphragms shall be galvanized and not painted.

The diaphragm material selection shall be consistent throughout all spans of a bridge.

For projects where steel diaphragms are at contractor’s option, payment for use of steel diaphragms shall be included in the price bid for “LUMP – SUPERSTR CONCRETE”. When steel diaphragms are included as part of the contract bridge plans, include the pay item “501-2001 LB STR STEEL” in the SUMMARY OF QUANTITIES on the GENERAL NOTES sheet with the calculated weight in pounds.

3.9.2 Steel Girders

3.9.2.1 Diaphragm and Cross Frame Requirements

Diaphragms or Cross Frames for steel girder bridges shall be designed in accordance with LRFD 6.7.4 or Standard Specification 10.20, as appropriate, and detailed in accordance with the GDOT Bridge Cell Library. Where necessary, K-type cross frames are preferred.

3.9.2.2 Bracing for Exterior Steel Beams

To prevent buckling of exterior beams during deck pours, the following note shall be placed on the deck section sheet for bridges with steel beams or girders:

> ***"The Contractor shall provide bracing between the exterior beam (girder) and the first interior beam (girder) until the deck has been poured, the overhang forms have been removed and the diaphragms (cross-frames) have been welded. All costs for designing, providing, installing and removing bracing shall be included in price bid for Lump – Structural Steel."***

3.10 Edge Beams

3.10.1 General

Detail edge beams at the discontinuous edges of the interior slab using reinforced concrete with stirrups that extend into the deck. Standard edge beam dimensions and reinforcing can be found in the GDOT Bridge Cell Library. Use the standard edge beam dimensions unless modification is needed to accommodate utilities, avoid conflicts with cap risers supporting the adjacent span or ensure embedment of the beam web as specified in 3.10.2. Ensure a minimum depth of 18 inches measured from top of beam in all cases. There is no specific reason to match edge beam depths on adjacent spans. Extending edge beams to the cap will not be allowed.

Detail shear stirrups in the edge beam perpendicular to the centerline of the bent.

When utilities pass through edge beams, provide additional reinforcement (typically No. 4 bars) around the opening.

In staged construction, conflicts may occur between the existing structure and exposed edge beam reinforcement required for lapping. In this case the designer shall detail bar couplers at the stage line. Couplers are not paid for separately but require a special provision.

Detail edge beams using the materials requirements outlined in BDM 3.2.1.

When the bottom of the edge beam does not extend to the bottom of web (e.g. when matching an adjacent span's edge beam) or when the bridge skew is less than 75 degrees, include the following note on the Deck Section Sheet of all multispan bridge plans:

> ***"Do not remove edge beam forms until 72 hours after the deck pour is completed or deck reaches 28-day concrete strength"***

3.10.2 Detailing for PSC Beam Bridge

PSC beams shall penetrate into the edge beam such that the shallowest face of the PSC beam web is embedded a minimum of 4”. Uniformly increase the thickness of the edge beam when necessary to achieve this requirement.

For reinforcement of an edge beam at an exterior Bulb Tee beam, add a 5-foot long horizontal No. 3 bar just below the top of the beam and a vertical No. 4 L-shaped bar along the beam centerline with the 90-degree bend over the top of the beam. See Figure 3.10.2-1 for details.

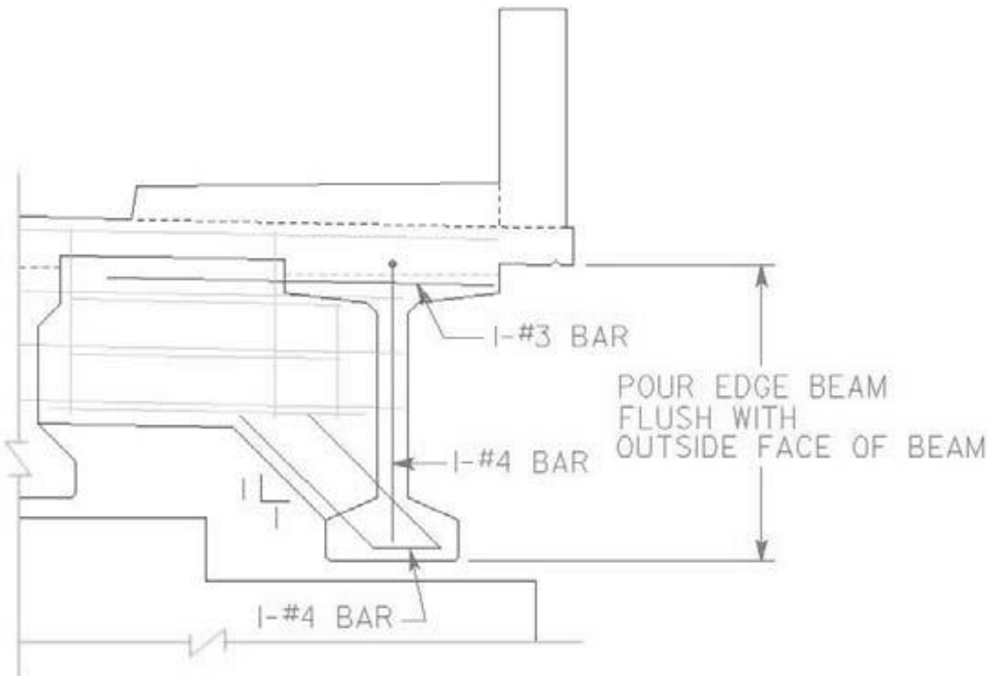


Figure 3.10.2-1 Additional Reinforcement for Edge Beam

Where fascia beams are being employed according to BDM 3.4.3.2 or exterior beams that match in shape are in high visibility areas, such as bridges over roadways, highly travel waterways and recreational areas, the designer shall ensure the edge beam is flush with the entire exterior beam face to the bottom of the beam for a smooth continuous look to the beams. In the exterior bay, detail a 1:1 sloped fillet from the bottom of the edge beam to the top of the bottom flange of the exterior beam. This allows the concrete to flow into the bottom flange area of the beam. Add a No. 4 slanted U-shaped bar along the sloped fillet into the area behind the bottom beam flange. See also Figure 3.10.2-1 for details.

3.10.3 Detailing for Steel Beam Bridge

When replacing edge beams on existing rolled steel beam/plate girder bridges that require new holes be provided in the existing beams for edge beam bars, place a note on the plans that the contractor shall drill 3” holes at each bar location.

3.10.4 Detailing for RCDG Bridge

Because RCDGs are constructed span-by-span, it may be difficult to install transverse 800 bars in the edge beam with the 600 continuity bars in place from the previous span. In this case, place the following note on the deck section sheet:

> ***"At contractor's option, 800 bar in edge beam may be spliced. One 5'-0" lap splice will be allowed at CL bridge. No additional payment will be made for optional splices."***

If there is a beam at the bridge centerline, modify the note above to locate the splice between beams.

When contractors replace RCDGs with precast stems/beams, the designer shall ensure that edge beams comply with the details from the GDOT Bridge Cell Library.

3.11 Endwalls

3.11.1 General

Endwalls shall be provided at end bents to retain the fill below the approach slab and between the wingwalls.

Endwall length is typically the same as the length of the end bent cap. Endwall width is typically one-half the width of the end bent cap between beams (18" minimum) and the full width of the end bent cap between the exterior beam and wingwall. PSC beams shall penetrate into the endwall such that the centerline of the PSC beam is embedded a minimum of 4". Detail the endwall so that all reinforcement shown in the standard detail can be placed between the end of the beam and the BFPR with proper clearances to the form and a minimum of 1 inch of clearance to the girder, including the bottom flange. In order to satisfy the above requirements, it may be necessary to increase the endwall width and shift the centerline of bearing location on the cap. If the centerline of bearing is shifted, the centerline and width of cap should be adjusted such that the centerline of cap and centerline of bearing match.

3.11.2 Detailing

Typical endwall reinforcing is provided in the GDOT Bridge Cell Library.

Detail steel extending into the paving rest, through the fillet, or into the deck perpendicular to the centerline of the bent.

In staged construction, conflicts may occur between the existing structure and exposed endwall reinforcement required for lapping. In this case the designer shall detail bar couplers at the stage line. Couplers are not paid for separately but require a special provision.

Detail the endwall using the materials requirements outlined in BDM 3.2.1.

Two feet of waterproofing shall be placed on the joint between the endwall and cap, in accordance with GDOT Standard Specification 530. This detail is shown on the endwall cells in the GDOT Bridge Cell Library.

3.12 Bearings

3.12.1 Bearing Selection

The general preference for bearing selection is shown in Table 3.12.1-1.

Table 3.12.1-1 Bearing Selection by Bridge Type and Span

Bridge Type	Distance, d, from point of fixity to bearing	Recommended Bearings	Remarks
RCDG	d ≤ 40’	U	
	40’ < d ≤ 160’	R	For d in excess of 160’ bearings typically become unstable in sliding.
AASHTO Type and Bulb Tee beams	d ≤ 200’	R	Limited by length of chase, seismic shear on dowel, and beam stability
Steel Beams or Plate Girders	d ≤ 50’ 50’ < d ≤ 160’ d > 160’	R, SB R, SBL P	
Steel Beam Widening		Match existing bearings	

Glossary:

- U: Plain elastomeric pad
- R: Steel reinforced elastomeric bearing
- SB: Plate bearings with sole and bearing plates only
- SBL: Plate bearings with sole, bearing, and lube plates at expansion ends
- P: Pot Bearing

Use of different bearings from those shown in Table 3.12.1 1 shall be approved by the Bridge Office at the start of final design phase. The Bridge Office has no standard details for reinforced elastomeric pads under steel beams.

3.12.2 Plain Elastomeric Pads and Steel Reinforced Elastomeric Bearings

3.12.2.1 Materials

3.12.2.1.1 Neoprene

Use 60 Durometer Shore A hardness neoprene, grade 2 or higher as specified in AASHTO M251, with a shear modulus between 130 psi and 200 psi.

3.12.2.1.2 Reinforced Plates (For Steel Reinforced Elastomeric Bearings)

a) Load Plates: Use 3/16” thick load plates meeting ASTM A 709 Grade 36 or ASTM A 1011 Grade 36.

b) Internal Plates: Use 10-gage, 12-gage or 14-gage internal plates, if necessary, meeting ASTM A 709 Grade 36 or ASTM A 1011 Grade 36.

3.12.2.2 Dimensions and Clearances

Detailing of elastomeric pads can be found on the GDOT Elastomeric Bearing sheets.

3.12.2.2.1 Basic Shape

Elastomeric pads should be rectangular and should be placed flat with the pad length parallel to the beam centerline. Length and width are incremented by whole inches and thickness is incremented by 1/8”. The use of tapered pads is prohibited.

3.12.2.2.2 Width and Length

The width of the pad shall be 2" narrower on each side than the nominal width of the bottom flange of AASHTO type III and larger PSC beams and 1" narrower with smaller PSC beams, RCDGs and steel beams. This will allow for beam chamfers, tolerance in fabrication of the beam, and the use of a shim plate if necessary.

The minimum pad length shall be 9 inches unless matching an existing bearing.

3.12.2.2.3 Sealing Ribs

A 3/16” sealing rib shall be used on the top and bottom of pads for precast beams and shall not be used for cast-in-place beams.

3.12.2.3 Plain Elastomeric Pad (U)

3.12.2.3.1 Application

Plain elastomeric pads shall be provided for RCDGs where the distance from the bearing to the point of fixity is 40 feet or less.

3.12.2.3.2 Dimensions

The pads shall be 9”x16”x ½” and no further analysis is required.

3.12.2.3.3 Contractor Redesign of RCDG Bridge

A note shall be placed on the bearing sheet stating that if the Contractor redesigns a RCDG bridge to use precast beams, plain elastomeric bearing pads shall remain as shown on the plans.

3.12.2.3.4 Use on Existing Bridges

When widening or paralleling a T-beam bridge, the designer shall review the existing bridge condition survey for recommendations on installing plain elastomeric pads under the existing beams. If this recommendation is agreed to by the State Bridge Engineer, then 9”x 14” x ½” unreinforced pads with slots to pass around the dowel bar shall be specified. Pay item 518-1000 – Raise Existing Bridge, Sta. – should be included in the Summary of Quantities to cover all costs for supplying and installing these pads. This requires a special provision.

3.12.2.4 Steel Reinforced Elastomeric Bearings (R)

3.12.2.4.1 Application

Steel Reinforced Elastomeric bearings are preferred for use with prestressed concrete beams, rolled steel beams, and RCDG bridges where the distance to point of fixity is greater than 40 feet.

3.12.2.4.2 Contractor Redesign of T-Beam Bridges

A note shall be placed on the bearing sheet stating that if the Contractor redesigns a RCDG bridge to use precast beams, the steel reinforced elastomeric bearings shall be redesigned accounting for the new loads and rotations in accordance with this section.

3.12.2.4.3 Design Method

For LRFD projects, bearing pads shall be designed in accordance with LRFD 14.7.6, Elastomeric Pads and Steel Reinforced Elastomeric Bearings – Method A.

Bearing pads shall also be designed to allow no slippage with service limit state loads using the following equation:

$$0.2Pu \geq GA(\frac{\Delta_u}{H_{rt}})$$

Pu = dead load from the superstructure

G = shear modulus of the elastomer

A = area of the pad

Δ_u = Shear deflection under service loads

H_{rt} = Total Elastomer thickness

For Standard Specification projects, bearing pads shall be designed in accordance with Standard Specification 14.6.6, Elastomeric Pads and Steel Reinforced Elastomeric Bearings – Method A, except as follows:

Thermal Movement

Bearings shall be designed for thermal movements based on temperature rise of 30° F and temperature fall of 40°F above or below nominal setting temperature. No adjustment shall be made for actual or anticipated setting temperature. By default, BRPAD1 uses a 70° temperature range so the distance to fixity in that program should be reduced to 4/7 of the actual.

Combined Compression and Rotation

Bearings shall be sized such that the total rotation in the bearing as given by the sum of:

- Rotation due to superimposed dead load deflection
- Rotation due to live load deflection
- Rotation due to beam camber (self weight + prestress + time)
- Bridge grade (unless shims are used)

3.12.2.5 Detailing

3.12.2.5.1 Anchorage Holes

A 3” diameter hole shall be provided at the center of the bearing to allow for a 1 ½” smooth dowel (ASTM A709 Grade 50) for PSC beams or No. 10 bar for RCDGs connecting the superstructure and substructure.

3.12.2.5.2 Uniform Design

In order to reduce construction errors and the number of test pads required for a project, the engineer should minimize the number of pad designs. Whenever possible, without violating design checks, all bearing pads with the same width should be detailed the same, including dimensions and reinforcing This requirement does not relieve the engineer from performing analysis to ensure the design adequacy of each pad.

3.12.2.5.3 Shim Plates for PSC Beams and Steel Beams

If a steep longitudinal grade produces an elevation change of 1/8” or greater across the length of a pad, a galvanized steel shim plate shall be used. Steel shim plates shall have 1/4” minimum thickness on the thin edge with the thick edge detailed to the nearest 1/8” thickness. Shim plates shall be 2” larger than the pad in each plan dimension with holes fabricated to match the holes in the pad and shall be placed on top of the pad.

Calculate the elevation change across the length of the pad by dividing the vertical delta between the determined cap step elevations on each end of the beam by the horizontal distance between them and then multiplying that value by the length of the bearing pad in the longitudinal direction. Do not use beam camber, beam deflection, or roadway profile in this calculation.

3.12.2.5.4 Anchor Bolts

Anchor bolts shall be stainless steel, ASTM A 276 Type 304. Specify the yield strength required by design on the contract drawings. On bridge widening or jacking projects, any new or replacement anchor bolts shall also be stainless steel. Seismic requirements shall be applied as appropriate.

3.12.3 Pot Bearings

3.12.3.1 Application

Pot bearings are preferred for use with steel plate girders, large rolled steel beams or box girders.

3.12.3.2 Design Method

Pot bearings are to be designed by the Contractor in accordance with AASHTO LRFD Specifications or AASHTO Standard Specifications, as appropriate. A note shall be provided requiring the Contractor to provide shop drawings for the bearings. The following note shall be provided on the substructure sheets to allow for cap elevation adjustments:

“Elevations shown for the top and bottom of the cap are based on the “X” dimension shown on the Pot Bearing Details sheet. These elevations shall be adjusted by the

Contractor to account for the actual height of the pot bearing to be used. Bent cap concrete shall not be poured until the pot bearing shop drawings have been approved and necessary adjustments have been made.”

3.12.3.3 Loads

The designer shall provide the required capacity, translation and rotation for bearings on the GDOT Pot Bearing Details Sheet.

3.12.3.4 Detailing

3.12.3.4.1 Bearing Seat Elevations

Bearing seat elevations shall be calculated and provided based on the assumed height of the bearing assembly (“X” dimension) shown on the plans.

3.12.3.4.2 Elastomeric Pad under Pot Bearing

A 1/8” elastomeric pad shall be used under the bearing in lieu of the cotton duck called for in the GDOT Standard Specifications. The pad shall be 50 to 60 Durometer Shore A hardness neoprene and be 1” larger than the base plate in each plan dimension.

A note should be added to the plans that all costs for supplying and installing this elastomeric pad should be included in the price bid for Lump – Structural Steel.

3.12.3.4.3 Anchor Rods

Anchor rods shall be stainless steel, ASTM A 276 Type 304. On bridge widening or jacking projects, any new or replacement anchor bolts shall also be stainless steel. Seismic requirements shall be applied as appropriate.

3.12.4 Self Lubricating Bearings

3.12.4.1 Application

Self-lubricating bearings are preferred for use with steel plate girders and large rolled steel beams.

Limitations: Sliding plate type bearings shall not be used where the anticipated total movement (expansion plus contraction) exceeds 3 inches for assemblies without anchor bolts through the flange and 2 inches for assemblies with anchor bolts through the flange.

3.12.4.2 Materials

Bronze plates shall conform to AASHTO M 107 (ASTM B22), Alloy C91100 and shall have an allowable unit stress of 2.0 ksi in compression.

For design purposes, a value of 0.1 shall be used for the coefficient of friction.

3.12.4.3 Bronze Plate Size Selection

Use Table 3.12.4.3-1 for the sizing of self-lubricating bronze plates.

Table 3.12.4.3-1 Plate Size Selection by Load

Size (in)			Maximum Load in Service Limit States (kips)		
Length	Width	Thickness	With 2 Slots 3" x 1$^{3}/_{16}$"	With 2 Holes 1$^{3}/_{16}$" Dia.	Plain
10	7	1			140
10	8	1¼			160
10	9	1¼			180
10½	7	1			147
10½	8	1¼			168
10½	9	1¼			189
12	6	1	131	140	144
12	7	1	155	164	168
12	8	1¼	179	188	192
12	9	1¼			216

3.12.4.4 Detailing

3.12.4.4.1 Beveling Sole Plate

When the gradient of the girder at the bearing exceeds 4.0%, the top of the upper plate (sole plate) shall be beveled to match the girder gradient.

3.12.4.4.2 Anchor Bolts

Anchor bolts shall be stainless steel, ASTM A 276 Type 304. On bridge widening or jacking projects, any new or replacement anchor bolts shall also be stainless steel. Seismic requirements shall be applied as appropriate.

3.13 Deck Joints

3.13.1 Construction Joints

3.13.1.1 Pour Strips

A pour strip is a longitudinal deck segment cast between two previously cured bridge deck portions to avoid stresses caused by differential deflection. Pour strips are required on all stage constructed bridges where traffic is present on the previous stage prior to the concrete reaching design strength on a subsequent stage. Additional guidance for specific superstructure types is as follows:

a) RCDG: All falsework must be removed before casting the pour strip.

b) Continuous steel beam: If the concrete amount for widening the deck is less than 100 CY and the maximum dead load deflection is less than 1", the deck over the entire continuous unit can be placed in one pour and a pour strip is not required.

c) Post-tensioned cast-in-place concrete box girder: The pour strip shall be placed after post-tensioning the box, removing the falsework, and waiting approximately one month to allow for creep.

Try to locate pour strips out of the wheel path of traffic to avoid inferior ride quality.

When detailing the transverse lap in a pour strip, include the following note on the deck section sheet:

"DO NOT TIE THE TRANSVERSE REINFORCEMENT LAP IN THE POUR STRIP"

When a pour strip is used, include the "Pour Strip" note on the General Notes sheet using the BridgeNotes program. This note specifies that the strip should consist of AA-1 concrete but be paid for as part of the lump sum superstructure concrete quantity. Include the quantity of concrete needed for the strip as part of the overall superstructure concrete total. Do not add an AA-1 pay item to the summary of quantities.

3.13.1.2 Transverse Construction Joints

A transverse construction joint is required in the deck at each bent where the deck is continuous in a simple span bridge, as well as between deck pours for a continuous steel unit. A shallow saw cut is required to control cracking at the joint. Detail "A" of the GDOT Bridge Cell Library shows this detail and shall be included on the plans as applicable.

3.13.1.3 Longitudinal Construction Joints

When a longitudinal construction joint is required for staging, place the joint along the edge of the top flange of the beam or the stem face for RCDGs, as practical. Do not place the joint within the limits of the beam top flange since water could be trapped in the joint and freeze.

3.13.2 Expansion Joints

3.13.2.1 General

The designer should minimize the number of expansion joints in a bridge deck to reduce maintenance problems such as leaking. However, expansion joints may be unavoidable on bridges longer than approximately 400 feet.

The use of structural sections to armor the edge of the deck at the joint, is generally not acceptable, outside of fabricated systems covered by section 3.13. Prior approval from the Bridge Office should be received before detailing their use

3.13.2.2 Silicone Joint Sealant

A silicone joint sealant is detailed on many of the approach slab standards (Georgia Standard 9017) to be used for the 3/4 inch joint at the end of the bridge between the bridge deck and the approach slab.

Due to performance and maintenance issues a preformed silicone joint seal shall be detailed on the bridge plans to be used between the bridge and approach slab. Use the method described in the subsection below to determine the appropriate size of the preformed silicone joint seal.

Silicone joint sealants should only be used with box beam and cored slab structures where the approach and bridge are to be overlayed with asphalt.

3.13.2.3 Evazote Joint Seals

Evazote Joint Seals are no longer a preferred joint seal option.

3.13.2.4 Preformed Silicone Joint Seals

A preformed silicone joint seal is the preferred type of expansion joint for bridge decks. No pay item is necessary for a preformed silicone joint seal except when it is used as a joint replacement on an existing bridge. The size of the preformed silicone joint seal should be selected based on the expansion range at the joint. Use Equation 3.13.2.4-1 to calculate the expansion range, R(in). Round the calculated R value to the nearest 1/8 inch.

$$R = \alpha \text{ x } L \text{ x } \Delta T \text{ x } 12 \text{ x } \gamma_{TU} \qquad (3.13.2.4\text{-}1)$$

Where:

α = coefficient of thermal expansion = 0.000006 in/in/^{o}F for concrete beams and 0.0000065 in/in/ ^{o}F for steel beams

ΔT = maximum variation in temperature = 70^{o}F for concrete and 120 ^{o}F for steel

L = summation of distances from the last fixed joint back and the next fixed joint ahead (ft)

γ_{TU} = 1.2 (from LRFD Table 3.4.1-1. Use for LRFD and Standard Spec Projects)

θ = skew angle (acute) measured between the centerline of bent and centerline of roadway

Example: If beam material = concrete, L = 350ft and θ = 90^o, R will equal 2.117 inches, which rounds to 2.125 inches

Using table 3.13.2.4-1 the engineer will note that a Medium seal will accommodate the range calculated in the example. However, the engineer will need to check the minimum installation width also, to confirm that a Medium seal will work.

Table 3.13.2.4-1 Preformed Silicone Joint Seals

	Expansion Range*	Joint Width, W at 70^{o}F	Minimum Install width	Range Correction for Skew , θ
Small	1 ½”	1 ⅜”	1”	-¼” for 53^o-45^o
Medium	2 ¼”	2”	1 ¼”	-¼” for 50^o-45^o
Large	3 ¼”	2 ½”	1 ¼”	-¼” for 50^o-45^o
Extra Large	4”	3 ⅛”	2 ½”	-¾” for 63^o-50^o

*See Range correction to determine reduction in range based on skew. The lower angle listed is the minimum skew allowed for the joint size.

Calculate the 40 degree and 100 degree openings by adjusting the Joint Width at 70^{o}F for the corresponding temperature differences using formula 3.13.2.4-1 without the factor γ_{TU}. Using the same example from above, the adjustment in joint opening for 100 degree is calculated as .756 inches (350’ x 0.000006 x 30^{o}F x 12 in/ft = .756”) so the joint opening, W at 100 degrees would be 1.244 inches (2”-.756”=1.244”), but this is below the minimum installation width for a Medium preformed silicone joint seal, therefore the engineer should increase size and assume a Large seal will be necessary.

Use cell EXJOBT42 or similar from the GDOT Bridge Cell Library to detail the installation of the joint at any intermediate bent location.

Modify the table in the cell to report the 70 degree joint width from table 3.13.2.4-1 as well as the calculated joint openings for 40 and 100 degrees to allow for varying ambient temperatures at the time of joint construction. Show joint widths to the nearest ⅛".

Table 3.13.2.4-2 Example Joint Opening Table for Plans

JOINT OPENING	
TEMPERATURE (ºF)	**W (in)**
40	3 ¼
70	2 ½
100	1 ¾

The joint at the end of the bridge is shown for an opening of 70 degrees without a temperature table. Use cell EXJOBT42 or similar for this end of bridge application by deleting the temperature table and transverse section, then populating the W dimension in the drawing. In addition, place the "Standard Plan Modification" note to the General Notes sheet using the BridgeNotes Program to supersede the details on the approach slab standards.

When the expansion range exceeds 4 inches, the designer should use another joint system discussed in this manual, as appropriate for the bridge expansion condition.

3.13.2.5 Strip Seals

A strip seal is a preformed elastomeric profile seal that can be used when expansion range exceeds the limit allowed for a preformed joint seal. The designer shall use cell JENEJT from the GDOT Bridge Cell Library for detailing and pay item 449-1800 - ELASTOMERIC PROFILE BRIDGE JOINT SEALS for payment of this joint. Due to the high cost of this joint seal, it may be more economical to provide additional expansion joint locations so that preformed silicone joint seals can be utilized. When the expansion range exceeds 3 7/8 inches, the designer should use a modular joint system.

3.13.2.6 Modular Joint Systems

A modular joint system is a manufactured joint that can accommodate large expansion ranges. The use of a modular joint system requires Special Provision 447 – Modular Expansion Joints. A modular joint system is preferred over a finger joint because the finger joint is not "sealed" and allows water and debris into the joint area and onto the substructure.

3.13.2.7 Longitudinal Expansion Joints

Expansion joints in the longitudinal direction of the bridge should be used on bridges wider than 150 feet. Do not detail an open longitudinal joint where bicycle traffic is expected since it can catch narrow bicycle wheels.

On steel beam bridges in urban areas carrying high-volume routes where traffic will stand on the bridge, such as a bridge with traffic signals near the ends, a 1-inch longitudinal joint shall be used at the high point of the crown so that vibration caused by traffic moving on one side of the bridge will not be felt by traffic sitting on the other side.

Longitudinal joints shall not be placed in locations where water will run across the joint. The joint shall be sealed with a preformed silicone joint seal. Do not include a pay item for the seal.

3.14 Utilities on Bridges

3.14.1 General

3.14.1.1 Utility Information Request

When utilities are to be placed on a bridge, the designer shall request that the Office of Utilities obtain the following information from the utility companies:

- Descriptions (i.e. 10” water main, four 6-inch diameter telephone conduits)
- Owner (i.e. Early County Water System, AT&T)
- Weight of the utility per foot including contents
- Opening size required through endwalls, backwalls, edge beams and diaphragms
- Maximum diameter of the pipe bell or flanges for water and sewer mains
- Hanger spacing (actual or maximum)
- Hanger details if a particular hanger system is desired
- Location on the bridge (right side, left side)

3.14.1.2 Utility Conflicts

When a utility conflict occurs, it must be resolved by bridge design modification or by utility relocation. It is not acceptable to notify the contractor that a conflict exists by a note in the plans.

3.14.1.3 Utility Attachments

Gas lines, electrical conduits, ATMS conduits, and telecommunication conduits can be supported using cast-in-place deck inserts. Water/sewer mains up to 8 inches in diameter can be supported in the same manner. Larger water/sewer mains shall be supported by channels bolted to the adjacent beams, as shown in the GDOT Bridge Cell Library. When possible, the water/sewer main shall be placed above the support channels. Do not locate utilities that will require support hardware extending through the exterior beam if the bridge is in a visible area. Bridges in a visible area would include bridges over roadways, over traveled waterways, near recreational areas, or adjacent to significant development.

When this support method is used for water/sewer mains, include the pay item "501-2000 LS STR STEEL, BR NO -" in the SUMMARY OF QUANTITIES on the GENERAL NOTES sheet. Supports for water mains are usually located 2 feet on each side of a joint. Hangers should be spaced to accommodate standard 18-foot or 20-foot pipes and to avoid locating a bell at the diaphragm, edge beam, or endwall.

Water mains usually require casing under the approach slab. Casing is available in diameters of 6-inch increments and must be large enough to accommodate the water pipe bell. When any utility is to be installed through the reinforced backfill of an MSE abutment wall, see Section 5.5.3.2.7 for guidance.

3.14.1.4 Estimated Utility Weights

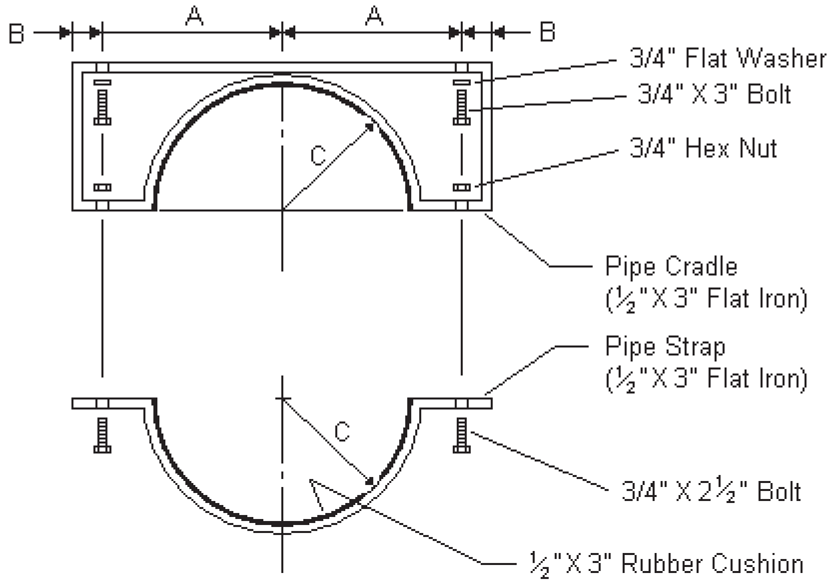
In lieu of more accurate weights provided by the utility company, the typical utility weights in Table 3.14.1.4-1 can be used.

Table 3.14.1.4-1 Utility Weights (from BIMS manual)

Water/Sewer Mains		**Gas Mains**	
Diameter (in.)	Weight (lbs/ft)	Diameter (in.)	Weight (lbs/ft)
6”	41.0	2”	3.7
8”	60.1	4”	10.8
10”	87.1	6”	19.0
12”	118.8	8”	22.4
16”	194.4	10”	28.1
30”	472.3	12”	32.4
		16”	47.0

Weight of communication conduit can be estimated at 9 lbs/ft per duct.

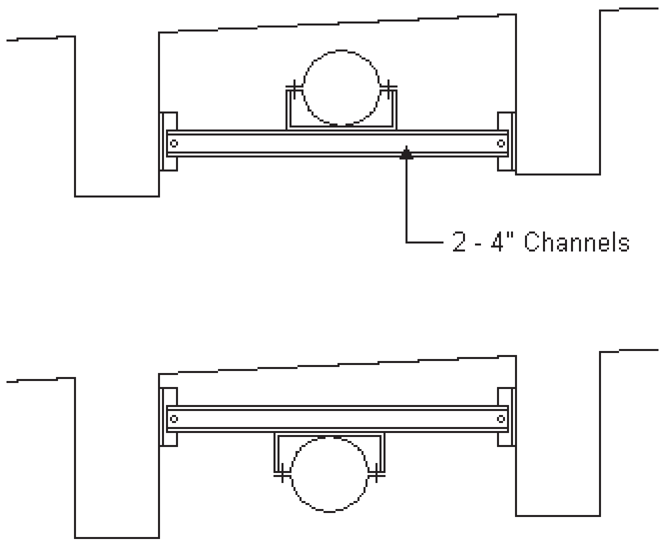
Figure 3.14.1.4-1 and Figure 3.14.1.4-2 show typical details for City of Atlanta Bureau of Water requirements.



PIPE SIZE	A	B	C RADIUS	PIPE WEIGHT PER FT. WITH WATER
8"	6.53	2.00	4.53	62 lbs
12"	8.60	2.00	6.60	119 lbs
16"	10.70	2.00	8.70	195 lbs
20"	13.00	2.00	11.00	250 lbs

Atlanta Water Works Pipe Saddle

Figure 3.14.1.4-1 Water main saddle details



Typical Details

Atlanta Water Works Pipe Saddle

Figure 3.14.1.4-2 Water main hanger details

3.14.1.5 Placement of Utilities

Utilities must be fully enclosed within a bay and must not hang below the bottom of the lowest beam.

In locating the utility and openings, the designer must ensure that conflicts with the endwall, edge beam, and diaphragms have been addressed, including possible conflicts with the diaphragm bar. Do not detail plans showing the diaphragm bar to be cut to clear utility openings.

The designer must ensure there are no conflicts with cap risers on the substructure.

3.14.1.6 Pipe Diameter Limitations

When utility pipes are proposed to be attached to a structure, the size of the pipes and/or their required encasements shall be limited based on Table 3.14.1.6-1.

Table 3.14.1.6-1 Utility Pipe Diameter Limitations

Smallest Beam Section Used in the Structure	Maximum Pipe Diameter Allowed Outside Diameter – (Nominal Size)
Type I Mod	6”
Type II	7”
Type III	13”
54” or 56” Bulb Tee	21” – (18” DIP / 20” PVC)
63” or 65” Bulb Tee	30” – (24” DIP)
72” or 74” Bulb Tee	39” – (36” DIP)
Rolled Steel Sections and Plate Girders	Coordinate with the Bridge Office

3.14.2 Designation of Utility Owners on Bridge Plans

All bridge plans shall have the caption, UTILITIES, added to the Preliminary Layout or General Notes sheet and list underneath the names of all owners of utilities that are located on the bridge. Do not list utilities which are in the vicinity of the bridge but are not located on the bridge.

If a future installation is proposed, the designer shall indicate this by placing “(FUTURE)” after the name of the owner. If there are no utilities, it shall be indicated by placing “NO UTILITIES ON BRIDGE” below the caption UTILITIES.

These requirements are in addition to all details, dimensions, etc., necessary to locate and support the utility on the bridge.

3.14.3 Hangers for Electrical Conduits

Hangers for electrical conduits on bridges shall be specified at a maximum spacing of 10’-0”.

3.14.4 Revisions to Utilities

The designer shall send any revisions of the plans dealing with utilities through the normal revision channels and to the District Utilities Engineer. The designer shall also ensure that the utility company is made aware of the changes.

3.14.5 Gas Lines on Post-Tensioned Box Girders

See Section 3.7.9.

3.14.6 Permits for Bridge Attachments

Permits are required for utilities when attaching to bridges, at all phases during the life of the structure. These permits are issued by the State Utilities Office. Coordination with the appropriate District Utilities Manager is necessary for directives concerning how to request/apply for the utility permit.

3.15 Deck Drainage

3.15.1 General

The designer shall ensure that the bridge deck will freely drain water to minimize gutter spread or ponding. This is normally accomplished by some combination of the bridge cross-slope, bridge profile and openings in either the deck or the barrier that allows the water to flow off the bridge.

For more details on deck drains and drainage, see the GDOT Drainage Design Policy Manual, Chapter 9.

3.15.2 Bridge Profile

Location of the low-point of a vertical curve on a bridge or approach slab is strongly discouraged and should only be considered when there is no feasible alternative. Before proceeding with a design that has a low point on a bridge or approach slab, the designer should consult with the roadway designer and then the Bridge Office to confirm that no other feasible option exists.

When a low-point is located on a bridge, it shall not be located within 10 feet of the BFPR or centerline of bent, and scupper spacing shall be reduced to 2'-6" within 10 feet of the low point.

If the bridge grade is less than 0.5%, the designer should consult with the roadway designer about increasing the grade to provide more efficient drainage.

3.15.3 Open Deck Drainage

3.15.3.1 Deck Drains

For bridges over water detail a 4" diameter hole through the bridge deck spaced at 10 feet along each gutterline. It is permissible to reduce deck drain spacing to a minimum of 5 feet to ensure adequate drainage.

When the bridge superstructure consists of steel girders, the 4" diameter hole shall be detailed to extend a PVC schedule 40 drainpipe 1 inch below the bottom flange closest to the drain. Include a detail for bracing the drainpipe from deck.

When the top flange of the exterior beam interferes with the placement of deck drains, use a 3" x 6" open slot in the bottom of the barrier, spaced at 10 feet along each gutterline, in lieu of deck drains. It is permissible to reduce barrier slot spacing to a minimum of 8 feet to ensure adequate drainage

Deck drain and barrier slot details can be found in the GDOT Bridge Cell Library.

When a bridge is superelevated modify the cell in the library to indicate that drains shall be placed only on either the left or right side of the travelway, as necessary.

Do not locate deck drains or barrier slots within 5 feet of the centerline of an intermediate bent. Do not locate deck drains or barrier slots over end fills. Do not locate deck drains within 5 feet of steel diaphragms for concrete beams.

Do not detail deck drains or barrier slots on grade separation structures or when otherwise restricted by environmental regulations. Consider a deck drainage system when gutter spread calculations deem it necessary.

3.15.4 Deck Drainage System

3.15.4.1 General

When drainage of the deck is required and cannot be accommodated by conventional scuppers or barrier openings, a deck drainage system is required. The deck drain system shall be made of PVC pipe Schedule 40 and consist of scuppers, drain pipes, clean-outs, and downspouts.

Design and detail all elements of the deck drainage system based on the assumption that the pipes of the system are full of water. Include this full condition loading assumption as the deck drainage system loads are applied to the superstructure and substructure.

Include the following note on the plan sheet illustrating the deck drainage system:

"FURNISH SHOP DRAWINGS FOR THE COMPLETE DRAIN SYSTEM FOR APPROVAL BY THE ENGINEER.".

3.15.4.2 Scuppers

Scuppers should be spaced along the bridge as per the deck hydraulic study at a minimum spacing of 10ft. Scuppers should have a steep sloped bottom because it is self-cleaning. Outlet should be 5 inches minimum but preferably 6 inches in diameter. The drainage grate must be bicycle safe. See Neenah product number R-3921-V1 for an example of an acceptable bridge scupper. Increase the depth of the deck to get reinforcement under the drain and around the outlet. Additional reinforcement may be required to distribute forces around the drain.

3.15.4.3 Drain Pipe

When scuppers are used to collect water from the bridge deck, connect all scuppers to a drain pipe of a size and slope calculated in the deck hydraulic study. Extend drain pipes to the longitudinal drainage system for the supported roadway, or to a downspout leading to the longitudinal drainage system of the roadway below. Drain pipes will not be allowed to pass below bridge abutments. Downspouts should not empty onto railroad right of way, or into water.

Placement of drain pipe shall adhere to the guidance of Section 3.14.1.5 with the exception that pipes may be attached to the overhang in cases where the bridge is not visible to the public and detailing is practical. PVC drainage pipes up to 12 inches in diameter may be supported using cast in place deck inserts with a maximum spacing of 8 feet. Drain pipe block outs through concrete should be detailed with 1 inch of clearance around the pipe.

Detail drainage system to include cleanouts at each scupper location and near each bent including end bents. Consider accessibility of the cleanouts in the detailing provided on final plans and when reviewing shop drawings submitted from the Contractor.

Downspouts may be placed at intermediate bents and either cast into the substructure or attached to the outside. Do not attach downspouts to the traffic face of a column. The system must accommodate any differential movement between the pipes attached to the superstructure and the downspouts attached to the substructure.

3.16 Appendix 3A - Fall Line Map

3.17 Appendix 3B – LRFD Beam Charts

Assumptions

a) Beam location: Interior beam

b) Skew angle: 90º (no skew)

c) Design length (CL bearing to CL bearing): Span length – 24 in.

d) Slab width: 43’-3” (roadway width: 40’-0”)

e) Number of lanes: 3

f) 28-day strength of slab concrete: 4.0 ksi

g) Slab thickness for non-composite loading calculation: Determined using GDOT slab design program with 2 ¾” top concrete cover (Case 4)

h) Slab thickness for composite section property: ¼” less non-composite slab thickness

i) Diaphragm: 10-in. thick diaphragm at mid-span when span length is greater than 40 ft, no diaphragm otherwise

j) Average coping thickness: 2” for AASHTO type beams and 3” for Bulb Tees

k) Coping thickness is included in non-composite loading calculation, but not in composite section property calculation.

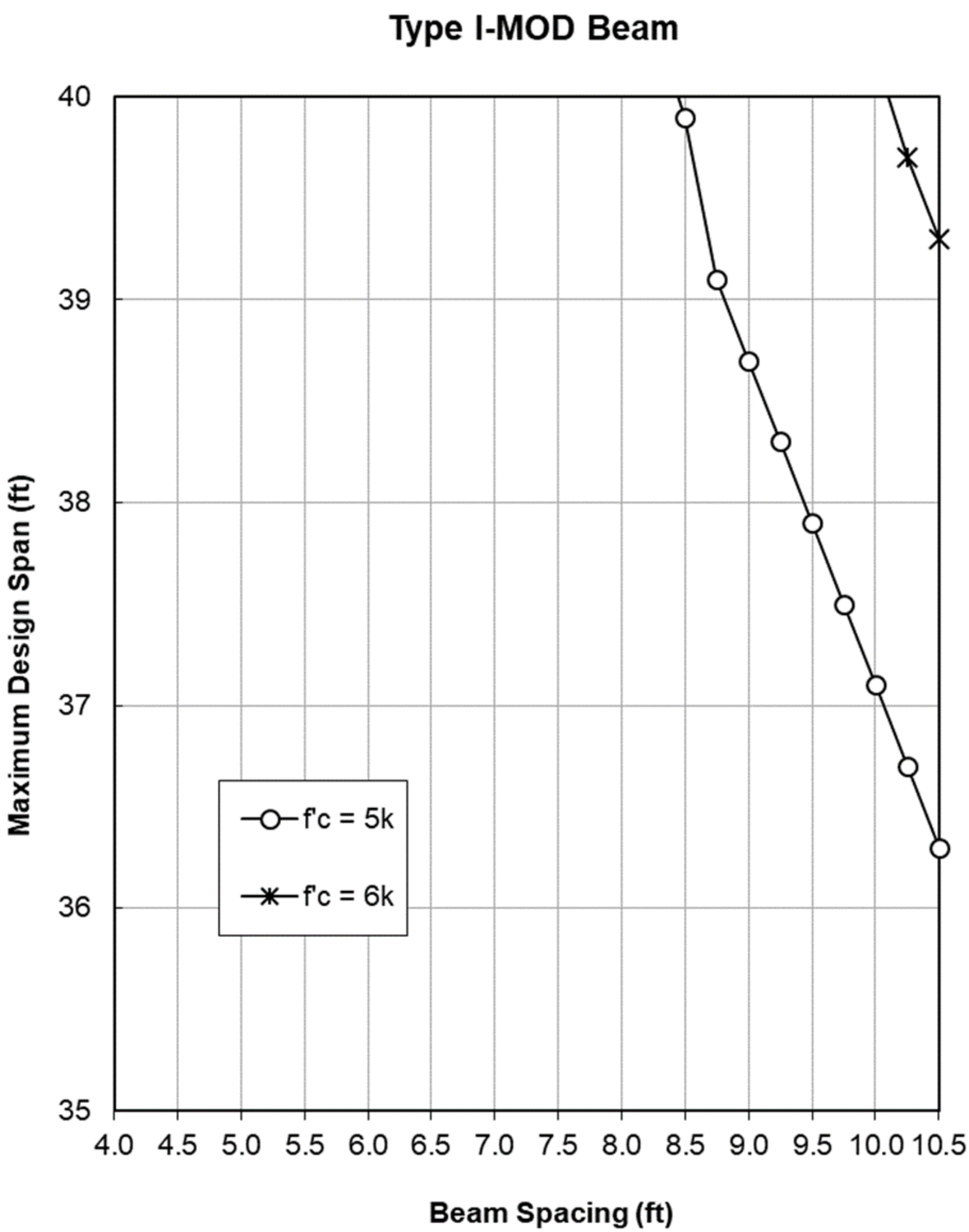
l) Release strength is 1.0 ksi less than 28-day strength for PSC beam concrete with a minimum of 4.5ksi.

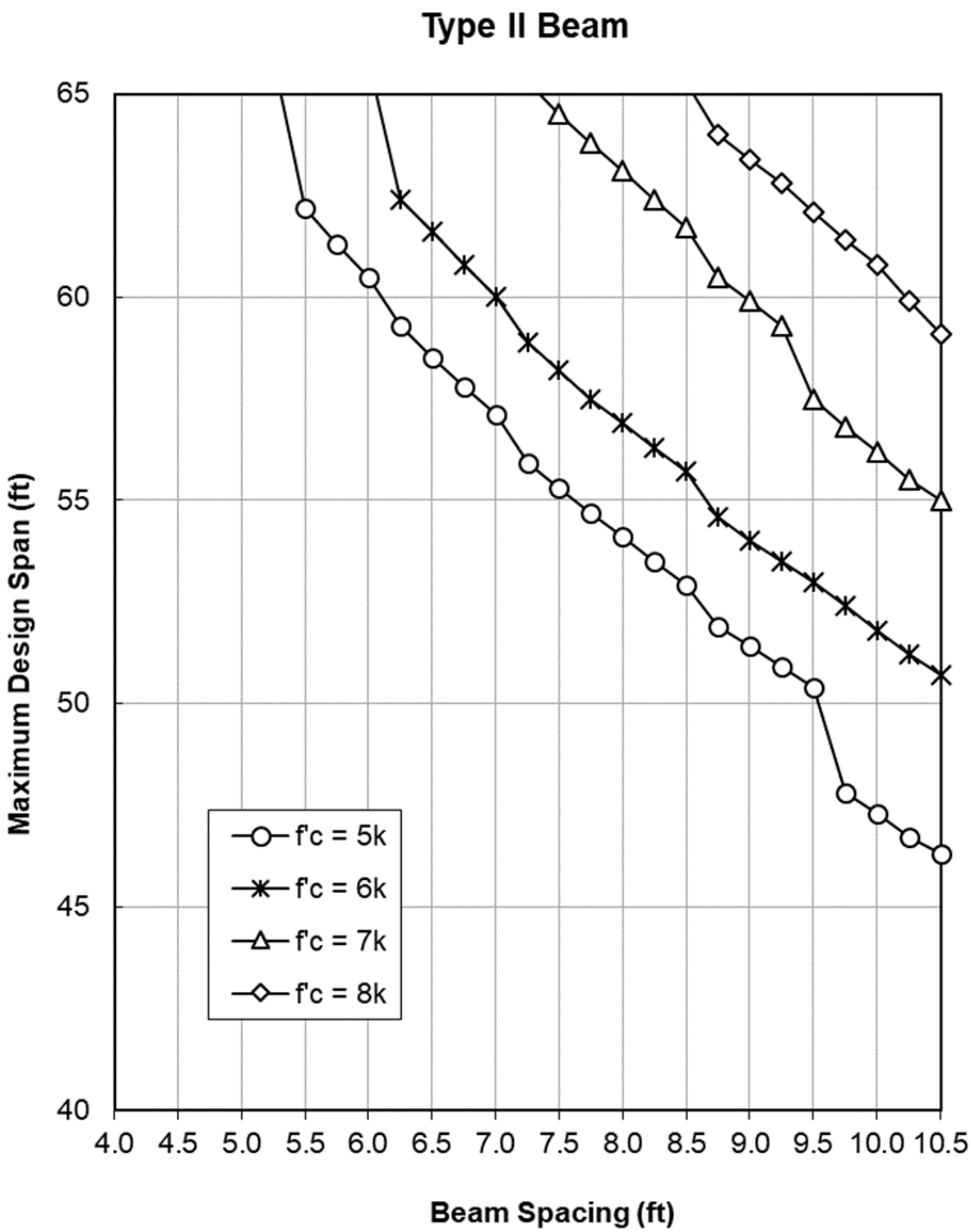
m) Strands (low relaxation type): 0.5” diameter (0.167 in^2 area) for AASHTO type beams and 0.6” diameter (0.217 in^2 area) for Bulb Tees

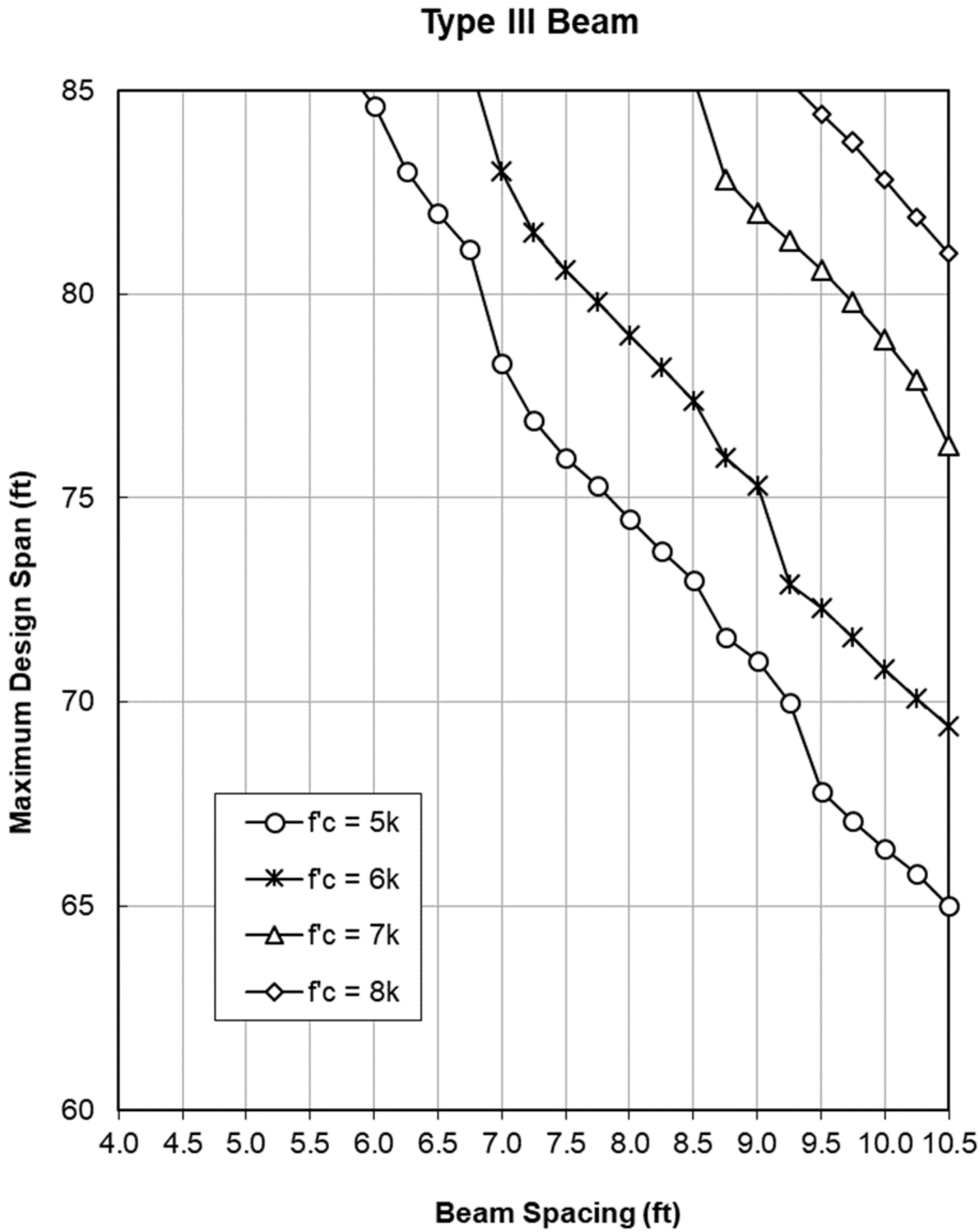
n) Prestressing forces: (0.75 x 270 ksi) to bottom and top strands for AASHTO type beams and (0.75 x 270 ksi) to bottom strands and (0.17 x 270 ksi) to top strands for Bulb Tees

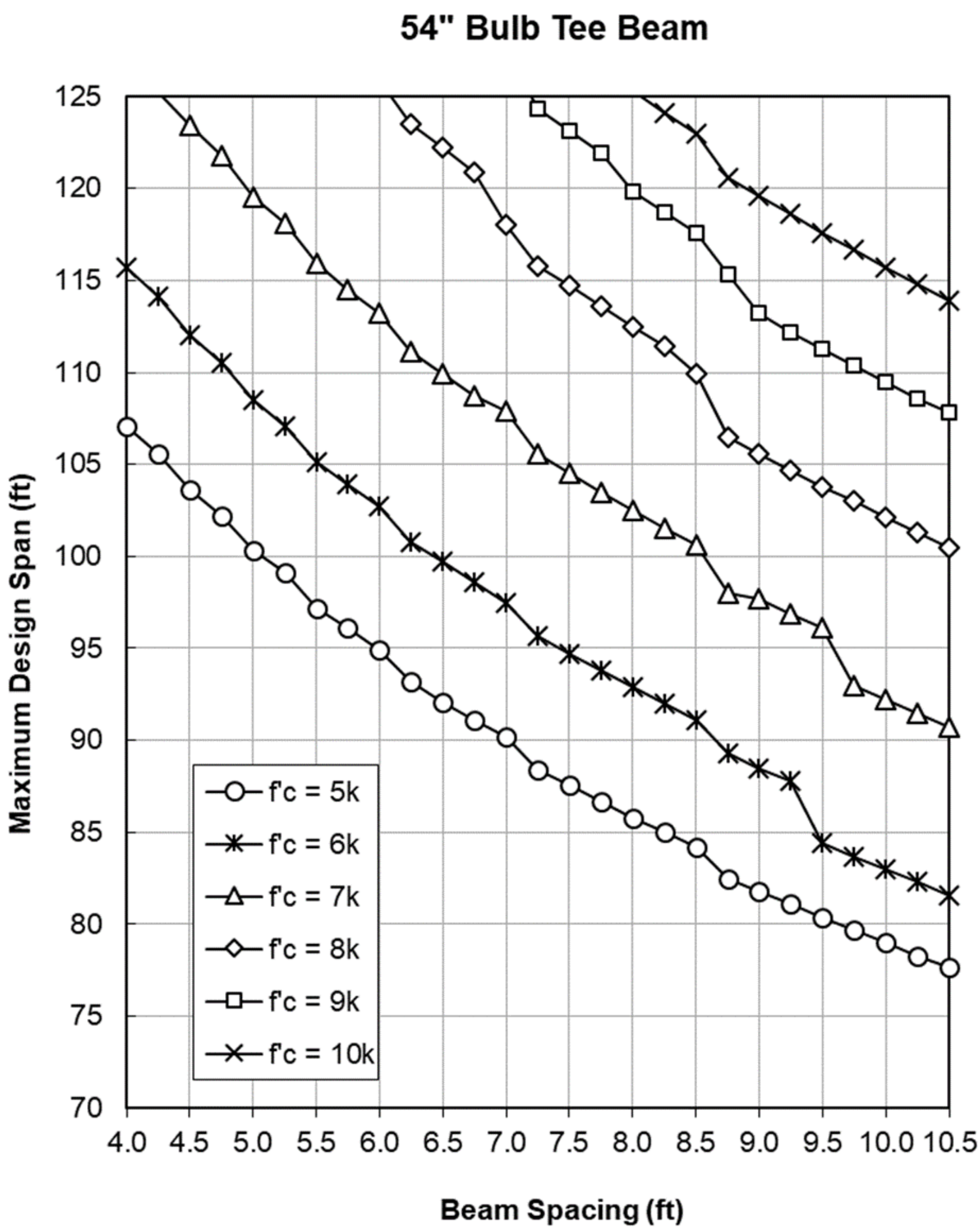
o) Draping of strands: No draping for AASHTO type I-MOD beam and two middle strands draped as necessary for other AASHTO type beams and Bulb Tees

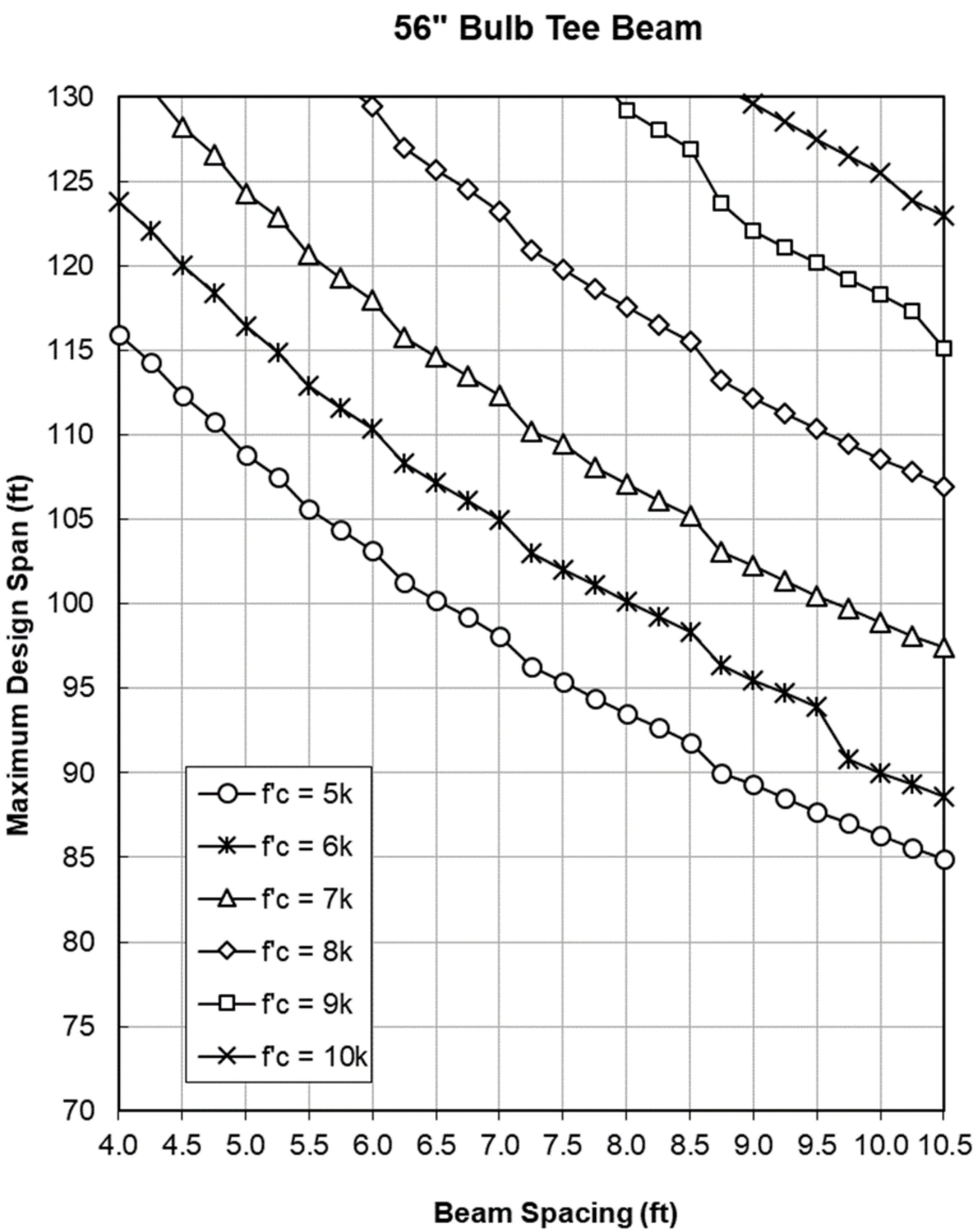
p) Exposure condition is set as normal for allowable stress calculation.

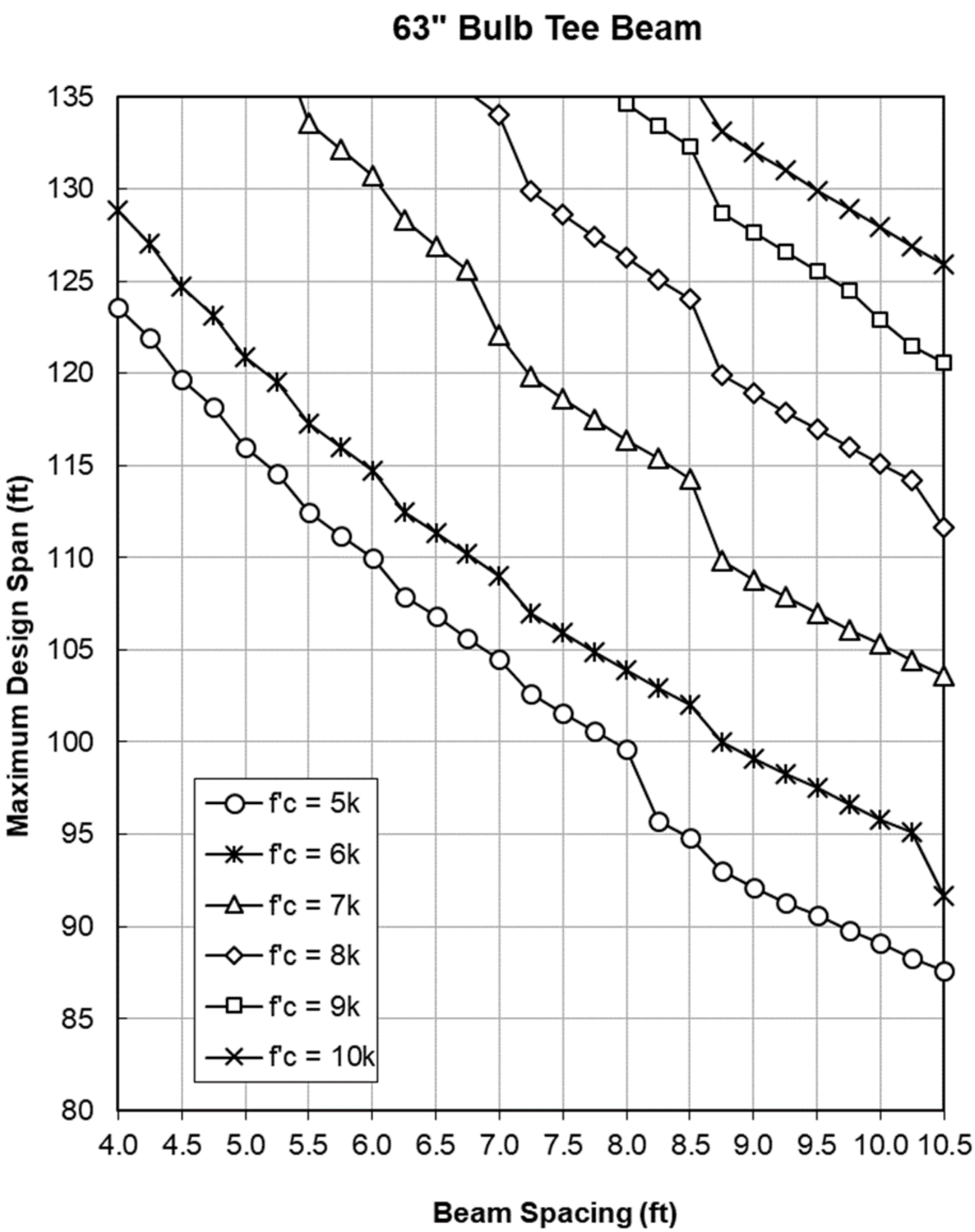

Type I-MOD Beam
Maximum Design Span (ft)
Beam Spacing (ft)
40
39
38
37
36
35
4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5
f'c = 5k
f'c = 6k

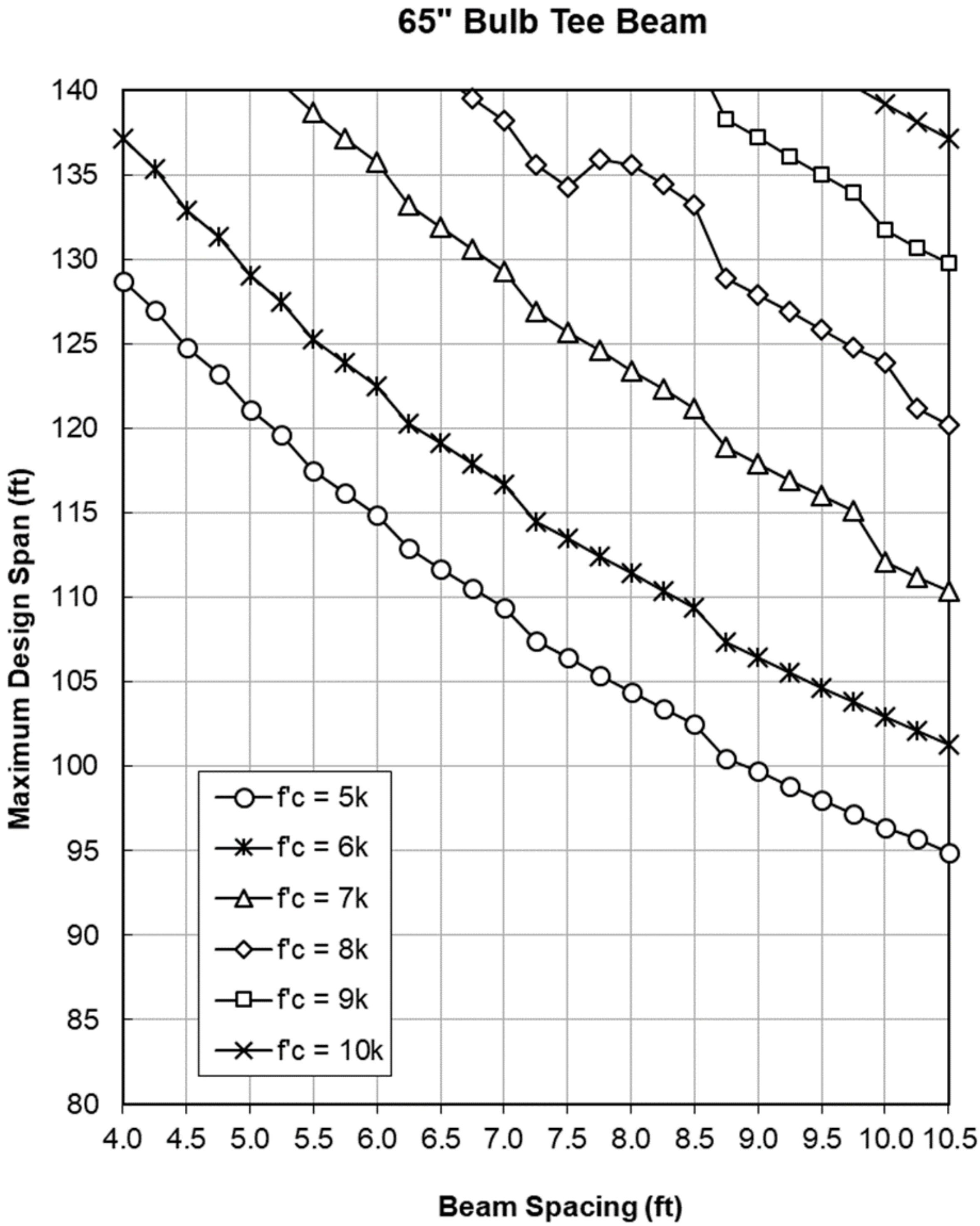

Type II Beam
Maximum Design Span (ft)
Beam Spacing (ft)
65
60
55
50
45
40
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
f'c = 5k
f'c = 6k
f'c = 7k
f'c = 8k

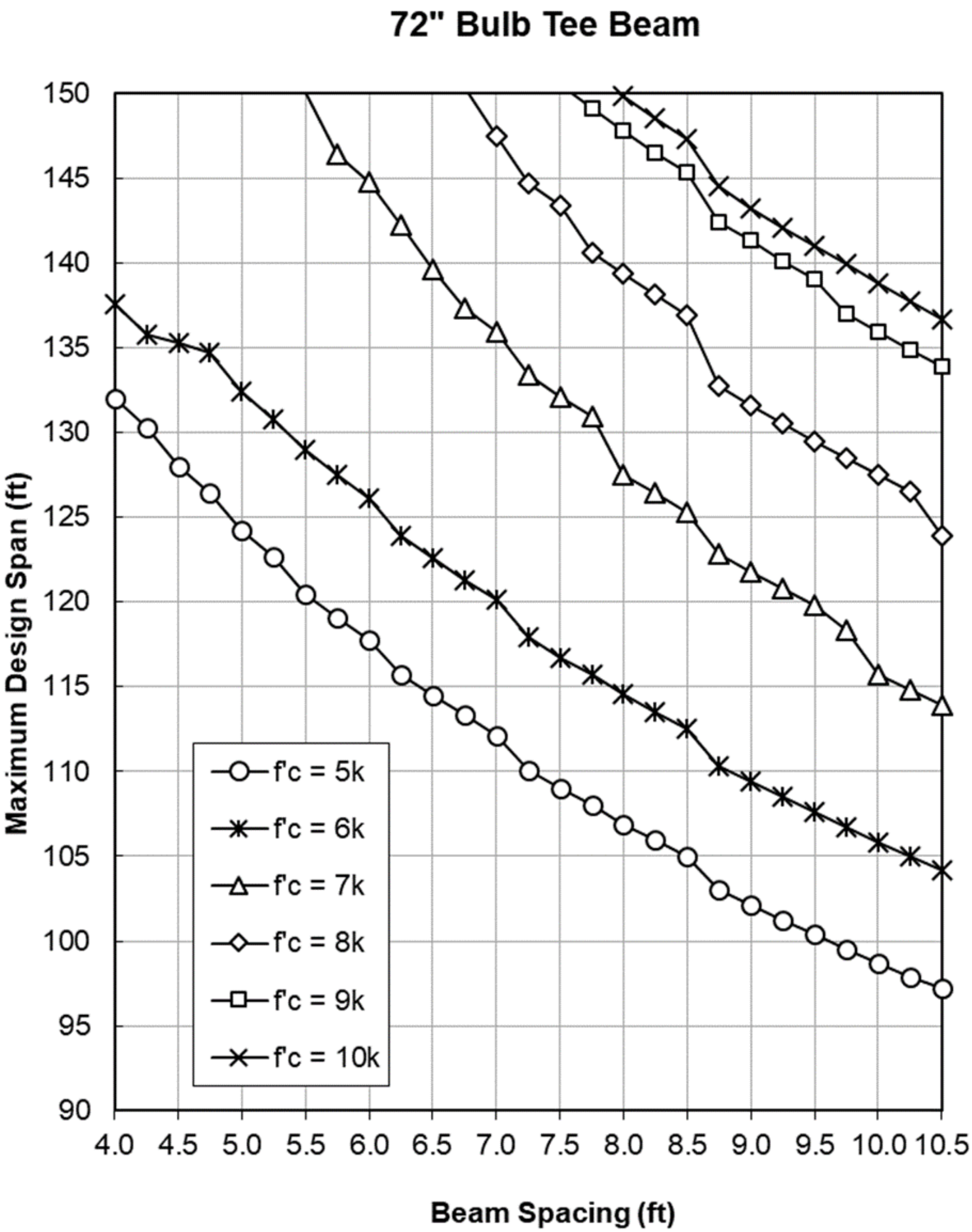

Type III Beam
Maximum Design Span (ft)
85
80
75
70
65
60
4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5
Beam Spacing (ft)
f'c = 5k
f'c = 6k
f'c = 7k
f'c = 8k

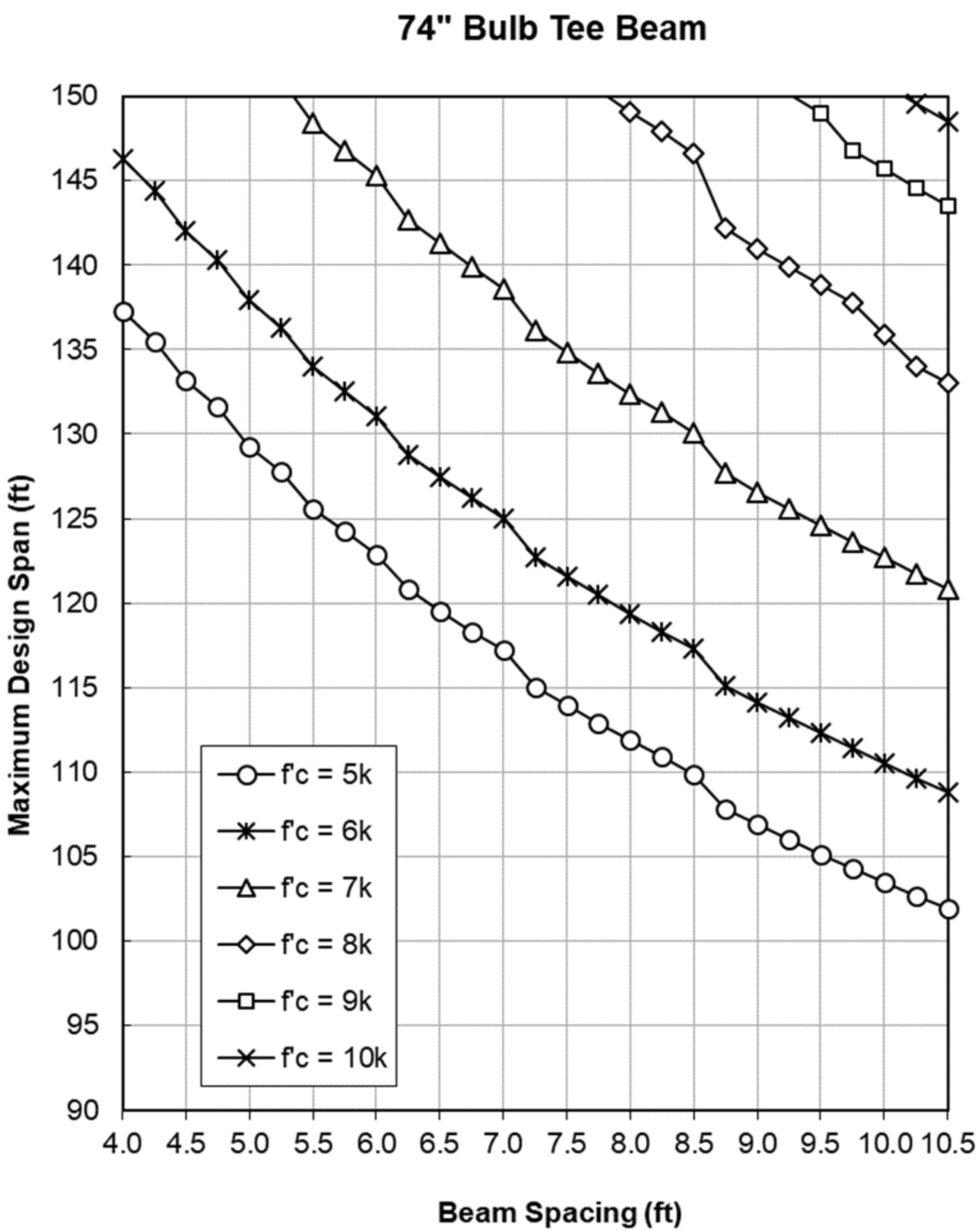

54" Bulb Tee Beam
Maximum Design Span (ft)
Beam Spacing (ft)
125
120
115
110
105
100
95
90
85
80
75
70
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
f'c = 5k
f'c = 6k
f'c = 7k
f'c = 8k
f'c = 9k
f'c = 10k


56" Bulb Tee Beam
Maximum Design Span (ft)
130
125
120
115
110
105
100
95
90
85
80
75
70
4.0 4.5 5.0 5.5 6.0 6.5 7.0 7.5 8.0 8.5 9.0 9.5 10.0 10.5
Beam Spacing (ft)
f'c = 5k
f'c = 6k
f'c = 7k
f'c = 8k
f'c = 9k
f'c = 10k


63" Bulb Tee Beam
Maximum Design Span (ft)
135
130
125
120
115
110
105
100
95
90
85
80
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
Beam Spacing (ft)
f'c = 5k
f'c = 6k
f'c = 7k
f'c = 8k
f'c = 9k
f'c = 10k


65" Bulb Tee Beam
Maximum Design Span (ft)
Beam Spacing (ft)
140
135
130
125
120
115
110
105
100
95
90
85
80
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
f'c = 5k
f'c = 6k
f'c = 7k
f'c = 8k
f'c = 9k
f'c = 10k


72" Bulb Tee Beam
Maximum Design Span (ft)
150
145
140
135
130
125
120
115
110
105
100
95
90
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
Beam Spacing (ft)
f'c = 5k
f'c = 6k
f'c = 7k
f'c = 8k
f'c = 9k
f'c = 10k


74" Bulb Tee Beam
Maximum Design Span (ft)
Beam Spacing (ft)
150
145
140
135
130
125
120
115
110
105
100
95
90
4.0
4.5
5.0
5.5
6.0
6.5
7.0
7.5
8.0
8.5
9.0
9.5
10.0
10.5
f'c = 5k
f'c = 6k
f'c = 7k
f'c = 8k
f'c = 9k
f'c = 10k

3.18 Appendix 3C – Standard Specification Deck Design Charts

SERVICE LOAD DESIGN OF BRIDGE SLAB
Minimum slab thickness is 7"
Maximum main reinforcement spacing is 9"

Georgia Department of Transportation 19-OCT-07
Office of Bridge and Structural Design 16:53:08
May 2007

WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.000	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
3- 6	6.0650	7.000	# 5 at 9.000	3-# 4	2-# 4
3- 7	6.0963	7.000	# 5 at 9.000	3-# 4	2-# 4
3- 8	6.1274	7.000	# 5 at 9.000	3-# 4	2-# 4
3- 9	6.1583	7.000	# 5 at 9.000	3-# 4	2-# 4
3-10	6.1891	7.000	# 5 at 9.000	3-# 4	2-# 4
3-11	6.2198	7.000	# 5 at 9.000	3-# 4	2-# 4
4- 0	6.2503	7.000	# 5 at 9.000	3-# 4	2-# 4
4- 1	6.2807	7.000	# 5 at 9.000	3-# 4	2-# 4
4- 2	6.3110	7.000	# 5 at 9.000	3-# 4	2-# 4
4- 3	6.3411	7.000	# 5 at 8.875	3-# 4	2-# 4
4- 4	6.3711	7.000	# 5 at 8.750	4-# 4	2-# 4
4- 5	6.4009	7.000	# 5 at 8.625	4-# 4	2-# 4
4- 6	6.4307	7.000	# 5 at 8.500	4-# 4	2-# 4
4- 7	6.4603	7.000	# 5 at 8.375	4-# 4	2-# 4
4- 8	6.4898	7.000	# 5 at 8.250	4-# 4	2-# 4
4- 9	6.5192	7.000	# 5 at 8.125	4-# 4	2-# 4
4-10	6.5484	7.000	# 5 at 8.000	4-# 4	2-# 4
4-11	6.5776	7.000	# 5 at 7.875	4-# 4	2-# 4
5- 0	6.6067	7.000	# 5 at 7.750	4-# 4	2-# 4
5- 1	6.6356	7.000	# 5 at 7.625	5-# 4	4-# 4
5- 2	6.6644	7.000	# 5 at 7.625	5-# 4	4-# 4
5- 3	6.6932	7.000	# 5 at 7.500	5-# 4	4-# 4
5- 4	6.7218	7.000	# 5 at 7.375	5-# 4	4-# 4
5- 5	6.7503	7.000	# 5 at 7.250	5-# 4	4-# 4
5- 6	6.7788	7.000	# 5 at 7.250	5-# 4	4-# 4
5- 7	6.8071	7.000	# 5 at 7.125	5-# 4	4-# 4
5- 8	6.8354	7.000	# 5 at 7.000	5-# 4	4-# 4
5- 9	6.8635	7.000	# 5 at 6.875	6-# 4	4-# 4
5-10	6.8916	7.000	# 5 at 6.875	6-# 4	4-# 4
5-11	6.9196	7.000	# 5 at 6.750	6-# 4	4-# 4
6- 0	6.9475	7.000	# 5 at 6.625	6-# 4	4-# 4
6- 1	6.9753	7.000	# 5 at 6.625	6-# 4	4-# 4
6- 2	7.0060	7.125	# 5 at 6.625	6-# 4	4-# 4
6- 3	7.0337	7.125	# 5 at 6.625	6-# 4	4-# 4
6- 4	7.0613	7.125	# 5 at 6.500	6-# 4	4-# 4
6- 5	7.0889	7.125	# 5 at 6.500	7-# 4	4-# 4

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SERVICE LOAD DESIGN OF BRIDGE SLAB
Minimum slab thickness is 7"
Maximum main reinforcement spacing is 9"

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Office of Bridge and Structural Design 16:53:08
May 2007

WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.000	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
6- 6	7.1164	7.125	# 5 at 6.375	7-# 4	4-# 4
6- 7	7.1470	7.250	# 5 at 6.500	7-# 4	4-# 4
6- 8	7.1744	7.250	# 5 at 6.375	7-# 4	4-# 4
6- 9	7.2018	7.250	# 5 at 6.375	7-# 4	4-# 4
6-10	7.2290	7.250	# 5 at 6.250	7-# 4	4-# 4
6-11	7.2597	7.375	# 5 at 6.375	7-# 4	4-# 4
7- 0	7.2869	7.375	# 5 at 6.250	7-# 4	4-# 4
7- 1	7.3140	7.375	# 5 at 6.125	8-# 4	4-# 4
7- 2	7.3410	7.375	# 5 at 6.125	8-# 4	4-# 4
7- 3	7.3680	7.375	# 5 at 6.000	8-# 4	4-# 4
7- 4	7.3988	7.500	# 5 at 6.125	8-# 4	4-# 4
7- 5	7.4257	7.500	# 5 at 6.125	8-# 4	4-# 4
7- 6	7.4525	7.500	# 5 at 6.000	8-# 4	4-# 4
7- 7	7.4793	7.500	# 5 at 5.875	8-# 4	4-# 4
7- 8	7.5102	7.625	# 5 at 6.000	8-# 4	4-# 4
7- 9	7.5369	7.625	# 5 at 6.000	9-# 4	6-# 4
7-10	7.5636	7.625	# 5 at 5.875	9-# 4	6-# 4
7-11	7.5902	7.625	# 5 at 5.875	9-# 4	6-# 4
8- 0	7.6167	7.625	# 5 at 5.750	9-# 4	6-# 4
8- 1	7.6477	7.750	# 5 at 5.875	9-# 4	6-# 4
8- 2	7.6742	7.750	# 5 at 5.750	9-# 4	6-# 4
8- 3	7.7007	7.750	# 5 at 5.750	9-# 4	6-# 4
8- 4	7.7271	7.750	# 5 at 5.625	10-# 4	6-# 4
8- 5	7.7582	7.875	# 5 at 5.750	10-# 4	6-# 4
8- 6	7.7846	7.875	# 5 at 5.625	10-# 4	6-# 4
8- 7	7.8109	7.875	# 5 at 5.625	10-# 4	6-# 4
8- 8	7.8372	7.875	# 5 at 5.625	10-# 4	6-# 4
8- 9	7.8635	7.875	# 5 at 5.500	10-# 4	6-# 4
8-10	7.8948	8.000	# 5 at 5.625	10-# 4	6-# 4
8-11	7.9210	8.000	# 5 at 5.500	10-# 4	6-# 4
9- 0	7.9471	8.000	# 5 at 5.500	11-# 4	6-# 4
9- 1	7.9732	8.000	# 5 at 5.375	11-# 4	6-# 4
9- 2	7.9993	8.000	# 5 at 5.375	11-# 4	6-# 4
9- 3	8.0308	8.125	# 5 at 5.375	11-# 4	6-# 4
9- 4	8.0569	8.125	# 5 at 5.375	11-# 4	6-# 4
9- 5	8.0829	8.125	# 5 at 5.375	11-# 4	6-# 4

Page 2 of 3

SERVICE LOAD DESIGN OF BRIDGE SLAB
Minimum slab thickness is 7"
Maximum main reinforcement spacing is 9"

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May 2007

WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.000	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
9- 6	8.1088	8.125	# 5 at 5.250	12-# 4	6-# 4
9- 7	8.1405	8.250	# 5 at 5.375	12-# 4	6-# 4
9- 8	8.1665	8.250	# 5 at 5.250	12-# 4	6-# 4
9- 9	8.1924	8.250	# 5 at 5.250	12-# 4	6-# 4
9-10	8.2183	8.250	# 5 at 5.250	12-# 4	6-# 4
9-11	8.2441	8.250	# 5 at 5.125	12-# 4	6-# 4
10- 0	8.2761	8.375	# 5 at 5.250	12-# 4	6-# 4
10- 1	8.3019	8.375	# 5 at 5.125	13-# 4	8-# 4
10- 2	8.3277	8.375	# 5 at 5.125	13-# 4	8-# 4
10- 3	8.3535	8.375	# 5 at 5.125	13-# 4	8-# 4
10- 4	8.3856	8.500	# 5 at 5.125	13-# 4	8-# 4
10- 5	8.4114	8.500	# 5 at 5.125	13-# 4	8-# 4
10- 6	8.4371	8.500	# 5 at 5.000	13-# 4	8-# 4
10- 7	8.4628	8.500	# 5 at 5.000	14-# 4	8-# 4
10- 8	8.4884	8.500	# 5 at 5.000	14-# 4	8-# 4
10- 9	8.5209	8.625	# 5 at 5.000	14-# 4	8-# 4
10-10	8.5466	8.625	# 5 at 5.000	14-# 4	8-# 4
10-11	8.6416	8.750	# 6 at 7.000	9-# 5	6-# 5
11- 0	8.6673	8.750	# 6 at 7.000	9-# 5	6-# 5
11- 1	8.6930	8.750	# 6 at 6.875	9-# 5	6-# 5
11- 2	8.7186	8.750	# 6 at 6.875	10-# 5	6-# 5
11- 3	8.7442	8.750	# 6 at 6.875	10-# 5	6-# 5
11- 4	8.7771	8.875	# 6 at 6.875	10-# 5	6-# 5
11- 5	8.8026	8.875	# 6 at 6.875	10-# 5	6-# 5
11- 6	8.8282	8.875	# 6 at 6.750	10-# 5	6-# 5
11- 7	8.8537	8.875	# 6 at 6.750	10-# 5	6-# 5
11- 8	8.8869	9.000	# 6 at 6.750	10-# 5	6-# 5
11- 9	8.9125	9.000	# 6 at 6.750	10-# 5	6-# 5
11-10	8.9380	9.000	# 6 at 6.625	10-# 5	6-# 5
11-11	8.9635	9.000	# 6 at 6.625	10-# 5	6-# 5
12- 0	8.9890	9.000	# 6 at 6.625	10-# 5	6-# 5

Page 3 of 3

SERVICE LOAD DESIGN OF BRIDGE SLAB
Minimum slab thickness is 7"
Maximum main reinforcement spacing is 9"

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Office of Bridge and Structural Design 16:53:08
May 2007

WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.250	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
3- 6	6.3150	7.000	# 5 at 9.000	3-# 4	2-# 4
3- 7	6.3463	7.000	# 5 at 9.000	3-# 4	2-# 4
3- 8	6.3774	7.000	# 5 at 9.000	3-# 4	2-# 4
3- 9	6.4083	7.000	# 5 at 9.000	3-# 4	2-# 4
3-10	6.4391	7.000	# 5 at 9.000	3-# 4	2-# 4
3-11	6.4698	7.000	# 5 at 8.875	3-# 4	2-# 4
4- 0	6.5003	7.000	# 5 at 8.750	3-# 4	2-# 4
4- 1	6.5307	7.000	# 5 at 8.625	3-# 4	2-# 4
4- 2	6.5610	7.000	# 5 at 8.500	4-# 4	2-# 4
4- 3	6.5911	7.000	# 5 at 8.375	4-# 4	2-# 4
4- 4	6.6211	7.000	# 5 at 8.250	4-# 4	2-# 4
4- 5	6.6509	7.000	# 5 at 8.125	4-# 4	2-# 4
4- 6	6.6807	7.000	# 5 at 8.000	4-# 4	2-# 4
4- 7	6.7103	7.000	# 5 at 7.875	4-# 4	2-# 4
4- 8	6.7398	7.000	# 5 at 7.750	4-# 4	2-# 4
4- 9	6.7692	7.000	# 5 at 7.625	4-# 4	2-# 4
4-10	6.7984	7.000	# 5 at 7.625	4-# 4	2-# 4
4-11	6.8276	7.000	# 5 at 7.500	5-# 4	4-# 4
5- 0	6.8567	7.000	# 5 at 7.375	5-# 4	4-# 4
5- 1	6.8856	7.000	# 5 at 7.250	5-# 4	4-# 4
5- 2	6.9144	7.000	# 5 at 7.125	5-# 4	4-# 4
5- 3	6.9432	7.000	# 5 at 7.125	5-# 4	4-# 4
5- 4	6.9718	7.000	# 5 at 7.000	5-# 4	4-# 4
5- 5	7.0028	7.125	# 5 at 7.125	5-# 4	4-# 4
5- 6	7.0313	7.125	# 5 at 7.000	5-# 4	4-# 4
5- 7	7.0597	7.125	# 5 at 6.875	5-# 4	4-# 4
5- 8	7.0880	7.125	# 5 at 6.875	6-# 4	4-# 4
5- 9	7.1162	7.125	# 5 at 6.750	6-# 4	4-# 4
5-10	7.1471	7.250	# 5 at 6.875	6-# 4	4-# 4
5-11	7.1752	7.250	# 5 at 6.750	6-# 4	4-# 4
6- 0	7.2032	7.250	# 5 at 6.625	6-# 4	4-# 4
6- 1	7.2311	7.250	# 5 at 6.625	6-# 4	4-# 4
6- 2	7.2619	7.375	# 5 at 6.625	6-# 4	4-# 4
6- 3	7.2898	7.375	# 5 at 6.625	6-# 4	4-# 4
6- 4	7.3175	7.375	# 5 at 6.500	6-# 4	4-# 4
6- 5	7.3452	7.375	# 5 at 6.375	7-# 4	4-# 4

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```
              SERVICE LOAD DESIGN OF BRIDGE SLAB
                Minimum slab thickness is 7"
           Maximum main reinforcement spacing is 9"

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                           May 2007
============================================================
  WHEEL                             SLAB    FUTURE   CONTINUITY
  LOAD      fc        fs       n   COVER    PAVING     FACTOR
 (Kips)    (ksi)     (ksi)          (in)  (kips/ft^2)
  16.00    1.400    24.000     9   2.250    0.030        0.8
============================================================
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EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
6- 6	7.3728	7.375	# 5 at 6.375	7-# 4	4-# 4
6- 7	7.4036	7.500	# 5 at 6.500	7-# 4	4-# 4
6- 8	7.4311	7.500	# 5 at 6.375	7-# 4	4-# 4
6- 9	7.4586	7.500	# 5 at 6.250	7-# 4	4-# 4
6-10	7.4859	7.500	# 5 at 6.250	7-# 4	4-# 4
6-11	7.5168	7.625	# 5 at 6.250	7-# 4	4-# 4
7- 0	7.5441	7.625	# 5 at 6.250	7-# 4	4-# 4
7- 1	7.5713	7.625	# 5 at 6.125	8-# 4	4-# 4
7- 2	7.5985	7.625	# 5 at 6.125	8-# 4	4-# 4
7- 3	7.6294	7.750	# 5 at 6.125	8-# 4	4-# 4
7- 4	7.6565	7.750	# 5 at 6.125	8-# 4	4-# 4
7- 5	7.6835	7.750	# 5 at 6.000	8-# 4	4-# 4
7- 6	7.7105	7.750	# 5 at 6.000	8-# 4	4-# 4
7- 7	7.7374	7.750	# 5 at 5.875	8-# 4	4-# 4
7- 8	7.7684	7.875	# 5 at 6.000	8-# 4	4-# 4
7- 9	7.7953	7.875	# 5 at 5.875	9-# 4	6-# 4
7-10	7.8221	7.875	# 5 at 5.875	9-# 4	6-# 4
7-11	7.8489	7.875	# 5 at 5.750	9-# 4	6-# 4
8- 0	7.8800	8.000	# 5 at 5.875	9-# 4	6-# 4
8- 1	7.9067	8.000	# 5 at 5.875	9-# 4	6-# 4
8- 2	7.9333	8.000	# 5 at 5.750	9-# 4	6-# 4
8- 3	7.9599	8.000	# 5 at 5.750	9-# 4	6-# 4
8- 4	7.9865	8.000	# 5 at 5.625	10-# 4	6-# 4
8- 5	8.0178	8.125	# 5 at 5.750	10-# 4	6-# 4
8- 6	8.0443	8.125	# 5 at 5.625	10-# 4	6-# 4
8- 7	8.0708	8.125	# 5 at 5.625	10-# 4	6-# 4
8- 8	8.0972	8.125	# 5 at 5.500	10-# 4	6-# 4
8- 9	8.1235	8.125	# 5 at 5.500	10-# 4	6-# 4
8-10	8.1550	8.250	# 5 at 5.500	10-# 4	6-# 4
8-11	8.1813	8.250	# 5 at 5.500	10-# 4	6-# 4
9- 0	8.2076	8.250	# 5 at 5.500	11-# 4	6-# 4
9- 1	8.2339	8.250	# 5 at 5.375	11-# 4	6-# 4
9- 2	8.2655	8.375	# 5 at 5.500	11-# 4	6-# 4
9- 3	8.2918	8.375	# 5 at 5.375	11-# 4	6-# 4
9- 4	8.3180	8.375	# 5 at 5.375	11-# 4	6-# 4
9- 5	8.3441	8.375	# 5 at 5.250	11-# 4	6-# 4

SERVICE LOAD DESIGN OF BRIDGE SLAB
Minimum slab thickness is 7"
Maximum main reinforcement spacing is 9"

Georgia Department of Transportation 19-OCT-07
Office of Bridge and Structural Design 16:53:08
May 2007

WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.250	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
9- 6	8.3702	8.375	# 5 at 5.250	12-# 4	6-# 4
9- 7	8.4021	8.500	# 5 at 5.375	12-# 4	6-# 4
9- 8	8.4282	8.500	# 5 at 5.250	12-# 4	6-# 4
9- 9	8.4542	8.500	# 5 at 5.250	12-# 4	6-# 4
9-10	8.4803	8.500	# 5 at 5.125	12-# 4	6-# 4
9-11	8.5123	8.625	# 5 at 5.250	12-# 4	6-# 4
10- 0	8.5383	8.625	# 5 at 5.125	12-# 4	6-# 4
10- 1	8.5643	8.625	# 5 at 5.125	13-# 4	8-# 4
10- 2	8.5903	8.625	# 5 at 5.125	13-# 4	8-# 4
10- 3	8.6162	8.625	# 5 at 5.000	13-# 4	8-# 4
10- 4	8.6485	8.750	# 5 at 5.125	13-# 4	8-# 4
10- 5	8.6744	8.750	# 5 at 5.000	13-# 4	8-# 4
10- 6	8.7003	8.750	# 5 at 5.000	13-# 4	8-# 4
10- 7	8.7261	8.750	# 5 at 5.000	14-# 4	8-# 4
10- 8	8.7587	8.875	# 5 at 5.000	14-# 4	8-# 4
10- 9	8.7845	8.875	# 5 at 5.000	14-# 4	8-# 4
10-10	8.8728	8.875	# 6 at 7.000	9-# 5	6-# 5
10-11	8.9056	9.000	# 6 at 7.000	9-# 5	6-# 5
11- 0	8.9314	9.000	# 6 at 7.000	9-# 5	6-# 5
11- 1	8.9572	9.000	# 6 at 6.875	9-# 5	6-# 5
11- 2	8.9830	9.000	# 6 at 6.875	10-# 5	6-# 5
11- 3	9.0159	9.125	# 6 at 6.875	10-# 5	6-# 5
11- 4	9.0417	9.125	# 6 at 6.875	10-# 5	6-# 5
11- 5	9.0675	9.125	# 6 at 6.750	10-# 5	6-# 5
11- 6	9.0932	9.125	# 6 at 6.750	10-# 5	6-# 5
11- 7	9.1189	9.125	# 6 at 6.750	10-# 5	6-# 5
11- 8	9.1522	9.250	# 6 at 6.750	10-# 5	6-# 5
11- 9	9.1779	9.250	# 6 at 6.750	10-# 5	6-# 5
11-10	9.2036	9.250	# 6 at 6.625	10-# 5	6-# 5
11-11	9.2293	9.250	# 6 at 6.625	10-# 5	6-# 5
12- 0	9.2628	9.375	# 6 at 6.625	10-# 5	6-# 5

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SERVICE LOAD DESIGN OF BRIDGE SLAB
Minimum slab thickness is 7"
Maximum main reinforcement spacing is 9"

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WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.500	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
3- 6	6.5650	7.000	# 5 at 9.000	3-# 4	2-# 4
3- 7	6.5963	7.000	# 5 at 9.000	3-# 4	2-# 4
3- 8	6.6274	7.000	# 5 at 8.875	3-# 4	2-# 4
3- 9	6.6583	7.000	# 5 at 8.625	3-# 4	2-# 4
3-10	6.6891	7.000	# 5 at 8.500	3-# 4	2-# 4
3-11	6.7198	7.000	# 5 at 8.375	3-# 4	2-# 4
4- 0	6.7503	7.000	# 5 at 8.250	3-# 4	2-# 4
4- 1	6.7807	7.000	# 5 at 8.125	4-# 4	2-# 4
4- 2	6.8110	7.000	# 5 at 8.000	4-# 4	2-# 4
4- 3	6.8411	7.000	# 5 at 7.875	4-# 4	2-# 4
4- 4	6.8711	7.000	# 5 at 7.750	4-# 4	2-# 4
4- 5	6.9009	7.000	# 5 at 7.625	4-# 4	2-# 4
4- 6	6.9307	7.000	# 5 at 7.500	4-# 4	2-# 4
4- 7	6.9603	7.000	# 5 at 7.500	4-# 4	2-# 4
4- 8	6.9898	7.000	# 5 at 7.375	4-# 4	2-# 4
4- 9	7.0211	7.125	# 5 at 7.500	4-# 4	2-# 4
4-10	7.0505	7.125	# 5 at 7.375	5-# 4	4-# 4
4-11	7.0797	7.125	# 5 at 7.250	5-# 4	4-# 4
5- 0	7.1088	7.125	# 5 at 7.125	5-# 4	4-# 4
5- 1	7.1400	7.250	# 5 at 7.250	5-# 4	4-# 4
5- 2	7.1689	7.250	# 5 at 7.125	5-# 4	4-# 4
5- 3	7.1978	7.250	# 5 at 7.000	5-# 4	4-# 4
5- 4	7.2265	7.250	# 5 at 7.000	5-# 4	4-# 4
5- 5	7.2576	7.375	# 5 at 7.125	5-# 4	4-# 4
5- 6	7.2862	7.375	# 5 at 7.000	5-# 4	4-# 4
5- 7	7.3147	7.375	# 5 at 6.875	5-# 4	4-# 4
5- 8	7.3432	7.375	# 5 at 6.750	6-# 4	4-# 4
5- 9	7.3715	7.375	# 5 at 6.750	6-# 4	4-# 4
5-10	7.4025	7.500	# 5 at 6.750	6-# 4	4-# 4
5-11	7.4307	7.500	# 5 at 6.750	6-# 4	4-# 4
6- 0	7.4589	7.500	# 5 at 6.625	6-# 4	4-# 4
6- 1	7.4869	7.500	# 5 at 6.500	6-# 4	4-# 4
6- 2	7.5179	7.625	# 5 at 6.625	6-# 4	4-# 4
6- 3	7.5458	7.625	# 5 at 6.625	6-# 4	4-# 4
6- 4	7.5737	7.625	# 5 at 6.500	7-# 4	4-# 4
6- 5	7.6015	7.625	# 5 at 6.375	7-# 4	4-# 4

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SERVICE LOAD DESIGN OF BRIDGE SLAB
Minimum slab thickness is 7"
Maximum main reinforcement spacing is 9"

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WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.500	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
6- 6	7.6324	7.750	# 5 at 6.500	7-# 4	4-# 4
6- 7	7.6602	7.750	# 5 at 6.375	7-# 4	4-# 4
6- 8	7.6878	7.750	# 5 at 6.375	7-# 4	4-# 4
6- 9	7.7154	7.750	# 5 at 6.250	7-# 4	4-# 4
6-10	7.7429	7.750	# 5 at 6.250	7-# 4	4-# 4
6-11	7.7739	7.875	# 5 at 6.250	7-# 4	4-# 4
7- 0	7.8013	7.875	# 5 at 6.250	7-# 4	4-# 4
7- 1	7.8286	7.875	# 5 at 6.125	8-# 4	4-# 4
7- 2	7.8559	7.875	# 5 at 6.125	8-# 4	4-# 4
7- 3	7.8870	8.000	# 5 at 6.125	8-# 4	4-# 4
7- 4	7.9142	8.000	# 5 at 6.125	8-# 4	4-# 4
7- 5	7.9414	8.000	# 5 at 6.000	8-# 4	4-# 4
7- 6	7.9685	8.000	# 5 at 6.000	8-# 4	4-# 4
7- 7	7.9956	8.000	# 5 at 5.875	8-# 4	4-# 4
7- 8	8.0267	8.125	# 5 at 6.000	8-# 4	4-# 4
7- 9	8.0537	8.125	# 5 at 5.875	9-# 4	6-# 4
7-10	8.0806	8.125	# 5 at 5.875	9-# 4	6-# 4
7-11	8.1075	8.125	# 5 at 5.750	9-# 4	6-# 4
8- 0	8.1388	8.250	# 5 at 5.875	9-# 4	6-# 4
8- 1	8.1656	8.250	# 5 at 5.750	9-# 4	6-# 4
8- 2	8.1924	8.250	# 5 at 5.750	9-# 4	6-# 4
8- 3	8.2192	8.250	# 5 at 5.625	9-# 4	6-# 4
8- 4	8.2459	8.250	# 5 at 5.625	10-# 4	6-# 4
8- 5	8.2773	8.375	# 5 at 5.750	10-# 4	6-# 4
8- 6	8.3039	8.375	# 5 at 5.625	10-# 4	6-# 4
8- 7	8.3305	8.375	# 5 at 5.625	10-# 4	6-# 4
8- 8	8.3571	8.375	# 5 at 5.500	10-# 4	6-# 4
8- 9	8.3887	8.500	# 5 at 5.625	10-# 4	6-# 4
8-10	8.4152	8.500	# 5 at 5.500	10-# 4	6-# 4
8-11	8.4417	8.500	# 5 at 5.500	11-# 4	6-# 4
9- 0	8.4681	8.500	# 5 at 5.375	11-# 4	6-# 4
9- 1	8.4945	8.500	# 5 at 5.375	11-# 4	6-# 4
9- 2	8.5263	8.625	# 5 at 5.375	11-# 4	6-# 4
9- 3	8.5527	8.625	# 5 at 5.375	11-# 4	6-# 4
9- 4	8.5790	8.625	# 5 at 5.375	11-# 4	6-# 4
9- 5	8.6053	8.625	# 5 at 5.250	11-# 4	6-# 4

SERVICE LOAD DESIGN OF BRIDGE SLAB
Minimum slab thickness is 7"
Maximum main reinforcement spacing is 9"

Georgia Department of Transportation 19-OCT-07
Office of Bridge and Structural Design 16:53:08
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WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.500	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
9- 6	8.6373	8.750	# 5 at 5.375	11-# 4	6-# 4
9- 7	8.6636	8.750	# 5 at 5.250	12-# 4	6-# 4
9- 8	8.6898	8.750	# 5 at 5.250	12-# 4	6-# 4
9- 9	8.7160	8.750	# 5 at 5.250	12-# 4	6-# 4
9-10	8.7422	8.750	# 5 at 5.125	12-# 4	6-# 4
9-11	8.7744	8.875	# 5 at 5.250	12-# 4	6-# 4
10- 0	8.8006	8.875	# 5 at 5.125	12-# 4	6-# 4
10- 1	8.8267	8.875	# 5 at 5.125	13-# 4	8-# 4
10- 2	8.8528	8.875	# 5 at 5.125	13-# 4	8-# 4
10- 3	8.8852	9.000	# 5 at 5.125	13-# 4	8-# 4
10- 4	8.9113	9.000	# 5 at 5.125	13-# 4	8-# 4
10- 5	8.9374	9.000	# 5 at 5.000	13-# 4	8-# 4
10- 6	8.9634	9.000	# 5 at 5.000	13-# 4	8-# 4
10- 7	8.9894	9.000	# 5 at 5.000	14-# 4	8-# 4
10- 8	9.0221	9.125	# 5 at 5.000	14-# 4	8-# 4
10- 9	9.0481	9.125	# 5 at 5.000	14-# 4	8-# 4
10-10	9.1434	9.250	# 6 at 7.000	9-# 5	6-# 5
10-11	9.1694	9.250	# 6 at 7.000	9-# 5	6-# 5
11- 0	9.1954	9.250	# 6 at 6.875	9-# 5	6-# 5
11- 1	9.2214	9.250	# 6 at 6.875	9-# 5	6-# 5
11- 2	9.2473	9.250	# 6 at 6.875	10-# 5	6-# 5
11- 3	9.2804	9.375	# 6 at 6.875	10-# 5	6-# 5
11- 4	9.3064	9.375	# 6 at 6.875	10-# 5	6-# 5
11- 5	9.3323	9.375	# 6 at 6.750	10-# 5	6-# 5
11- 6	9.3582	9.375	# 6 at 6.750	10-# 5	6-# 5
11- 7	9.3916	9.500	# 6 at 6.750	10-# 5	6-# 5
11- 8	9.4175	9.500	# 6 at 6.750	10-# 5	6-# 5
11- 9	9.4433	9.500	# 6 at 6.625	10-# 5	6-# 5
11-10	9.4692	9.500	# 6 at 6.625	10-# 5	6-# 5
11-11	9.4950	9.500	# 6 at 6.500	10-# 5	6-# 5
12- 0	9.5287	9.625	# 6 at 6.625	10-# 5	6-# 5

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SERVICE LOAD DESIGN OF BRIDGE SLAB
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Maximum main reinforcement spacing is 9"

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WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.750	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
3- 6	6.8150	7.000	# 5 at 8.625	3-# 4	2-# 4
3- 7	6.8463	7.000	# 5 at 8.375	3-# 4	2-# 4
3- 8	6.8774	7.000	# 5 at 8.250	3-# 4	2-# 4
3- 9	6.9083	7.000	# 5 at 8.125	3-# 4	2-# 4
3-10	6.9391	7.000	# 5 at 8.000	3-# 4	2-# 4
3-11	6.9698	7.000	# 5 at 7.875	4-# 4	2-# 4
4- 0	7.0018	7.125	# 5 at 8.000	4-# 4	2-# 4
4- 1	7.0323	7.125	# 5 at 7.875	4-# 4	2-# 4
4- 2	7.0626	7.125	# 5 at 7.750	4-# 4	2-# 4
4- 3	7.0927	7.125	# 5 at 7.625	4-# 4	2-# 4
4- 4	7.1228	7.125	# 5 at 7.500	4-# 4	2-# 4
4- 5	7.1544	7.250	# 5 at 7.625	4-# 4	2-# 4
4- 6	7.1843	7.250	# 5 at 7.500	4-# 4	2-# 4
4- 7	7.2140	7.250	# 5 at 7.500	4-# 4	2-# 4
4- 8	7.2436	7.250	# 5 at 7.375	4-# 4	2-# 4
4- 9	7.2751	7.375	# 5 at 7.500	4-# 4	2-# 4
4-10	7.3045	7.375	# 5 at 7.375	5-# 4	4-# 4
4-11	7.3338	7.375	# 5 at 7.250	5-# 4	4-# 4
5- 0	7.3630	7.375	# 5 at 7.125	5-# 4	4-# 4
5- 1	7.3943	7.500	# 5 at 7.250	5-# 4	4-# 4
5- 2	7.4234	7.500	# 5 at 7.125	5-# 4	4-# 4
5- 3	7.4524	7.500	# 5 at 7.000	5-# 4	4-# 4
5- 4	7.4812	7.500	# 5 at 7.000	5-# 4	4-# 4
5- 5	7.5124	7.625	# 5 at 7.000	5-# 4	4-# 4
5- 6	7.5412	7.625	# 5 at 7.000	5-# 4	4-# 4
5- 7	7.5698	7.625	# 5 at 6.875	6-# 4	4-# 4
5- 8	7.5984	7.625	# 5 at 6.750	6-# 4	4-# 4
5- 9	7.6295	7.750	# 5 at 6.875	6-# 4	4-# 4
5-10	7.6579	7.750	# 5 at 6.750	6-# 4	4-# 4
5-11	7.6863	7.750	# 5 at 6.750	6-# 4	4-# 4
6- 0	7.7145	7.750	# 5 at 6.625	6-# 4	4-# 4
6- 1	7.7427	7.750	# 5 at 6.500	6-# 4	4-# 4
6- 2	7.7738	7.875	# 5 at 6.625	6-# 4	4-# 4
6- 3	7.8019	7.875	# 5 at 6.500	6-# 4	4-# 4
6- 4	7.8299	7.875	# 5 at 6.500	7-# 4	4-# 4
6- 5	7.8578	7.875	# 5 at 6.375	7-# 4	4-# 4

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SERVICE LOAD DESIGN OF BRIDGE SLAB
Minimum slab thickness is 7"
Maximum main reinforcement spacing is 9"

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WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.750	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
6- 6	7.8889	8.000	# 5 at 6.500	7-# 4	4-# 4
6- 7	7.9167	8.000	# 5 at 6.375	7-# 4	4-# 4
6- 8	7.9445	8.000	# 5 at 6.375	7-# 4	4-# 4
6- 9	7.9722	8.000	# 5 at 6.250	7-# 4	4-# 4
6-10	7.9998	8.000	# 5 at 6.250	7-# 4	4-# 4
6-11	8.0309	8.125	# 5 at 6.250	7-# 4	4-# 4
7- 0	8.0585	8.125	# 5 at 6.250	7-# 4	4-# 4
7- 1	8.0860	8.125	# 5 at 6.125	8-# 4	4-# 4
7- 2	8.1134	8.125	# 5 at 6.125	8-# 4	4-# 4
7- 3	8.1446	8.250	# 5 at 6.125	8-# 4	4-# 4
7- 4	8.1719	8.250	# 5 at 6.125	8-# 4	4-# 4
7- 5	8.1992	8.250	# 5 at 6.000	8-# 4	4-# 4
7- 6	8.2265	8.250	# 5 at 6.000	8-# 4	4-# 4
7- 7	8.2577	8.375	# 5 at 6.000	8-# 4	4-# 4
7- 8	8.2849	8.375	# 5 at 6.000	8-# 4	4-# 4
7- 9	8.3121	8.375	# 5 at 5.875	9-# 4	6-# 4
7-10	8.3392	8.375	# 5 at 5.875	9-# 4	6-# 4
7-11	8.3662	8.375	# 5 at 5.750	9-# 4	6-# 4
8- 0	8.3976	8.500	# 5 at 5.875	9-# 4	6-# 4
8- 1	8.4246	8.500	# 5 at 5.750	9-# 4	6-# 4
8- 2	8.4515	8.500	# 5 at 5.750	9-# 4	6-# 4
8- 3	8.4784	8.500	# 5 at 5.625	9-# 4	6-# 4
8- 4	8.5099	8.625	# 5 at 5.750	9-# 4	6-# 4
8- 5	8.5367	8.625	# 5 at 5.625	10-# 4	6-# 4
8- 6	8.5636	8.625	# 5 at 5.625	10-# 4	6-# 4
8- 7	8.5903	8.625	# 5 at 5.500	10-# 4	6-# 4
8- 8	8.6170	8.625	# 5 at 5.500	10-# 4	6-# 4
8- 9	8.6487	8.750	# 5 at 5.625	10-# 4	6-# 4
8-10	8.6754	8.750	# 5 at 5.500	10-# 4	6-# 4
8-11	8.7020	8.750	# 5 at 5.500	11-# 4	6-# 4
9- 0	8.7286	8.750	# 5 at 5.375	11-# 4	6-# 4
9- 1	8.7605	8.875	# 5 at 5.500	11-# 4	6-# 4
9- 2	8.7871	8.875	# 5 at 5.375	11-# 4	6-# 4
9- 3	8.8136	8.875	# 5 at 5.375	11-# 4	6-# 4
9- 4	8.8401	8.875	# 5 at 5.375	11-# 4	6-# 4
9- 5	8.8665	8.875	# 5 at 5.250	12-# 4	6-# 4

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SERVICE LOAD DESIGN OF BRIDGE SLAB
Minimum slab thickness is 7"
Maximum main reinforcement spacing is 9"

Georgia Department of Transportation 19-OCT-07
Office of Bridge and Structural Design 16:53:08
May 2007

WHEEL LOAD (Kips)	fc (ksi)	fs (ksi)	n	SLAB COVER (in)	FUTURE PAVING (kips/ft^2)	CONTINUITY FACTOR
16.00	1.400	24.000	9	2.750	0.030	0.8

EFFECTIVE SPAN LENGTH (ft-in)	SLAB THICKNESS MINIMUM (in)	SLAB THICKNESS ACTUAL (in)	SIZE AND SPACING OF MAIN REINFORCEMENT (in)	DISTRIBUTION REINFORCEMENT MIDDLE HALF	DISTRIBUTION REINFORCEMENT OUTER QUARTERS
9- 6	8.8986	9.000	# 5 at 5.375	11-# 4	6-# 4
9- 7	8.9251	9.000	# 5 at 5.250	12-# 4	6-# 4
9- 8	8.9515	9.000	# 5 at 5.250	12-# 4	6-# 4
9- 9	8.9778	9.000	# 5 at 5.125	12-# 4	6-# 4
9-10	9.0101	9.125	# 5 at 5.250	12-# 4	6-# 4
9-11	9.0365	9.125	# 5 at 5.125	12-# 4	6-# 4
10- 0	9.0628	9.125	# 5 at 5.125	12-# 4	6-# 4
10- 1	9.0891	9.125	# 5 at 5.125	13-# 4	8-# 4
10- 2	9.1153	9.125	# 5 at 5.000	13-# 4	8-# 4
10- 3	9.1479	9.250	# 5 at 5.125	13-# 4	8-# 4
10- 4	9.1741	9.250	# 5 at 5.000	13-# 4	8-# 4
10- 5	9.2003	9.250	# 5 at 5.000	13-# 4	8-# 4
10- 6	9.2265	9.250	# 5 at 5.000	14-# 4	8-# 4
10- 7	9.2593	9.375	# 5 at 5.000	13-# 4	8-# 4
10- 8	9.2855	9.375	# 5 at 5.000	14-# 4	8-# 4
10- 9	9.3742	9.375	# 6 at 7.000	9-# 5	6-# 5
10-10	9.4071	9.500	# 6 at 7.000	9-# 5	6-# 5
10-11	9.4333	9.500	# 6 at 7.000	9-# 5	6-# 5
11- 0	9.4594	9.500	# 6 at 6.875	9-# 5	6-# 5
11- 1	9.4855	9.500	# 6 at 6.875	10-# 5	6-# 5
11- 2	9.5188	9.625	# 6 at 6.875	9-# 5	6-# 5
11- 3	9.5449	9.625	# 6 at 6.875	10-# 5	6-# 5
11- 4	9.5710	9.625	# 6 at 6.750	10-# 5	6-# 5
11- 5	9.5971	9.625	# 6 at 6.750	10-# 5	6-# 5
11- 6	9.6231	9.625	# 6 at 6.625	10-# 5	6-# 5
11- 7	9.6566	9.750	# 6 at 6.750	10-# 5	6-# 5
11- 8	9.6827	9.750	# 6 at 6.750	10-# 5	6-# 5
11- 9	9.7087	9.750	# 6 at 6.625	10-# 5	6-# 5
11-10	9.7347	9.750	# 6 at 6.625	10-# 5	6-# 5
11-11	9.7685	9.875	# 6 at 6.625	10-# 5	6-# 5
12- 0	9.7945	9.875	# 6 at 6.625	10-# 5	6-# 5

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3.19 Appendix 3D – Standard Specification Beam Charts

Beam Spacing (X-Axis) versus Maximum Design Span (Y-Axis)

Assumptions

1. Beam Spacing – 4.0' to 10.0' in .25' increments
2. Number of Lanes = 3, constant
3. Number of Beams = 6, constant
4. Slab was design using BRSLAB99 with 2½" cover
5. Maximum Design Span was determined using BRPSBM1
   a. Live Load: HS20 with Impact
   b. Concrete Properties
      i. Ec = [(145)1.5](33)[(f'c).5]
      ii. Dead Load = 150 pcf
      iii. Initial Tension in the Beam (SIT) = 6(f'ci).5
      iv. Final Tension in the Beam (SIF) = 6(f'c).5

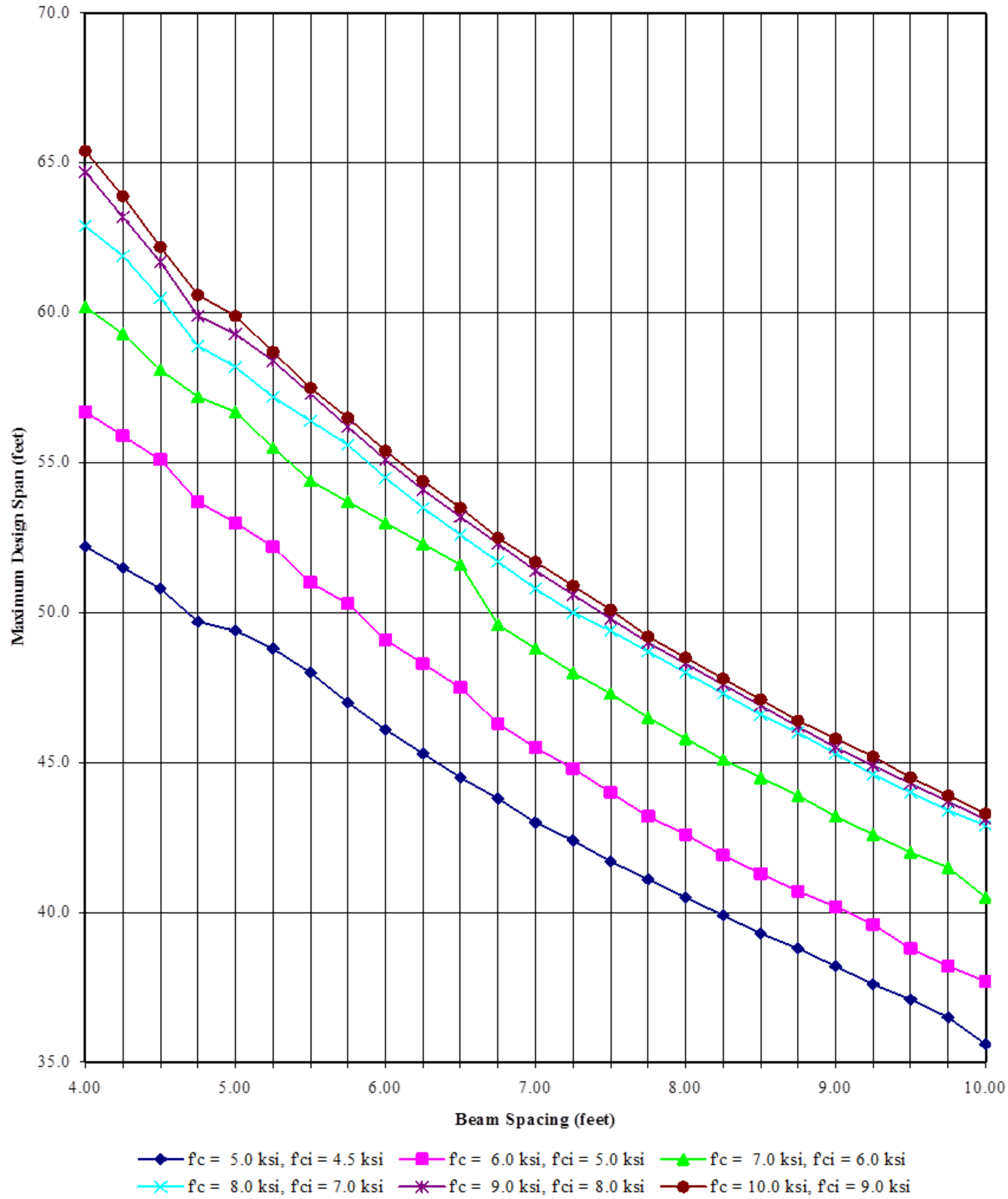
c. Distribution Factor for Deflection = 1.000

d. Composite Slab Properties – Depth of Coping (DF)
   i. 0.000, Type I MOD through Type IV PSC Beams
   ii. 1.000, Bulb Tees

e. Non-composite Dead Loads (NCDL) – Coping
   i. [(1.5)(Top Flange Width)/144](.150), Type I through Type IV PSC Beams
   ii. [(3)(Top Flange Width)/144](.150), Bulb Tees

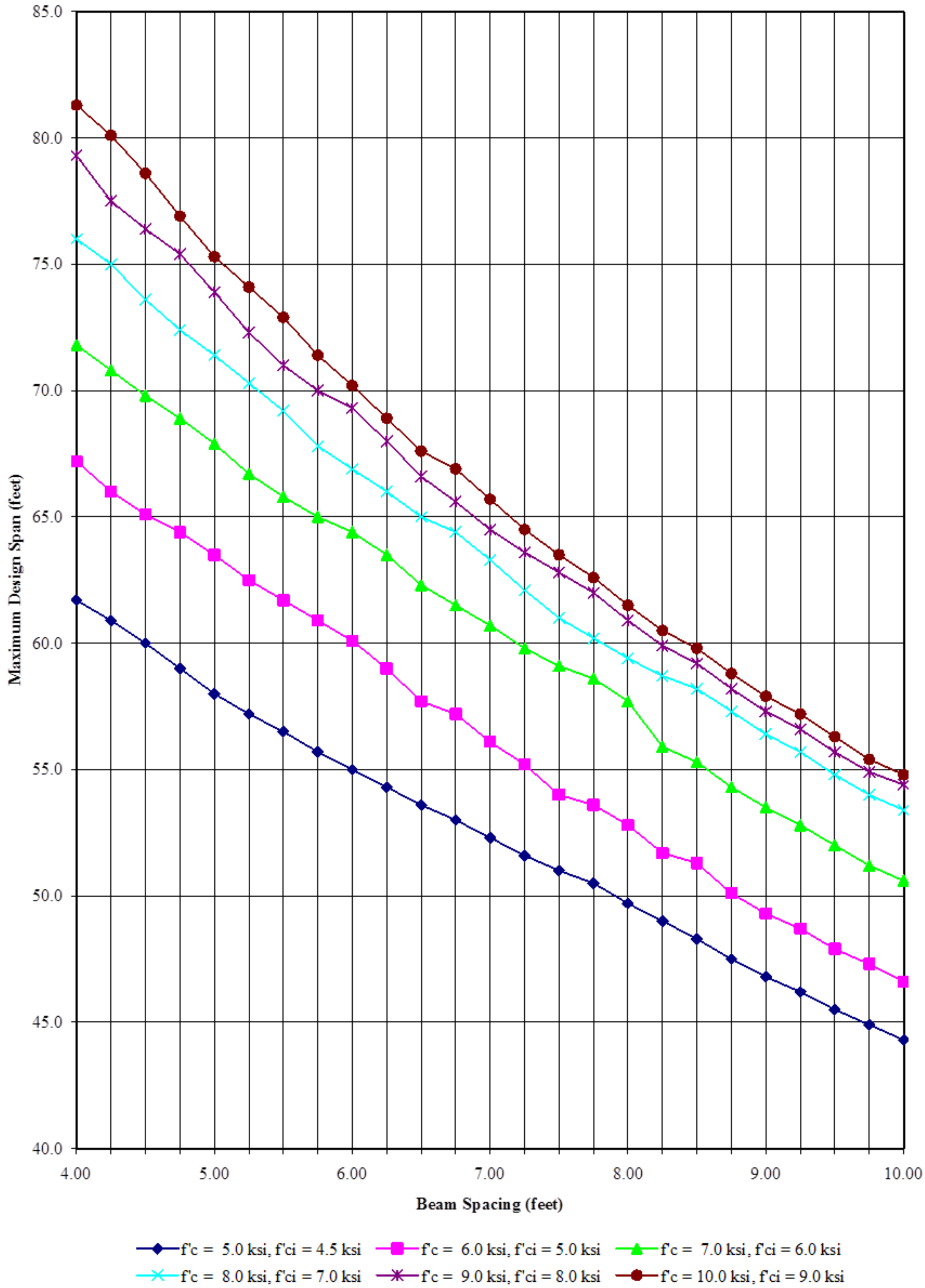
f. One Diaphragm at Midpoint for all spans greater than 40'-0"

Type I MOD PSC Beam (Standard Spec)



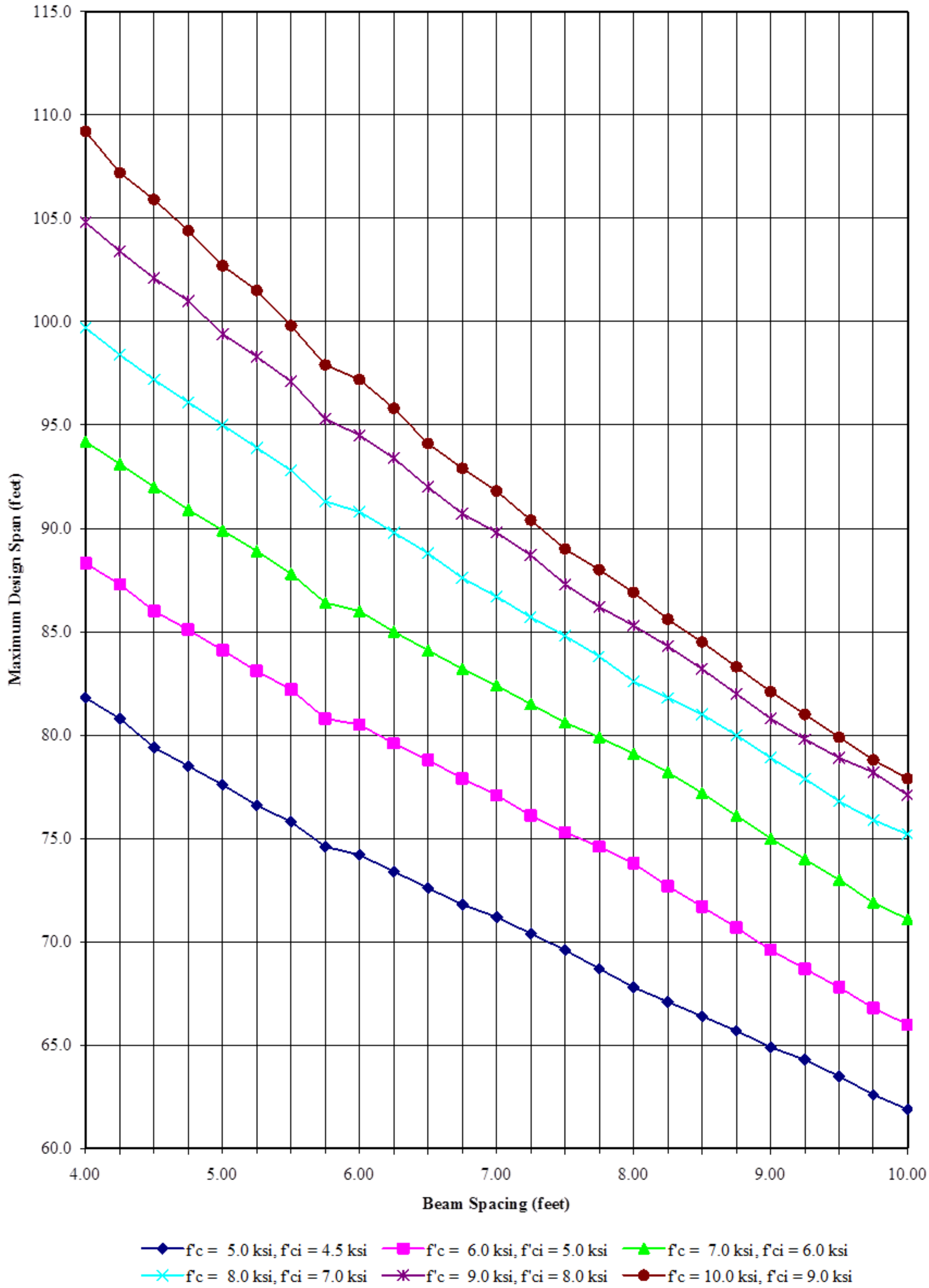
All strands are ½" diameter low relaxation strands each stressed to 33,818 pounds.

Type II PSC Beam (Standard Spec)



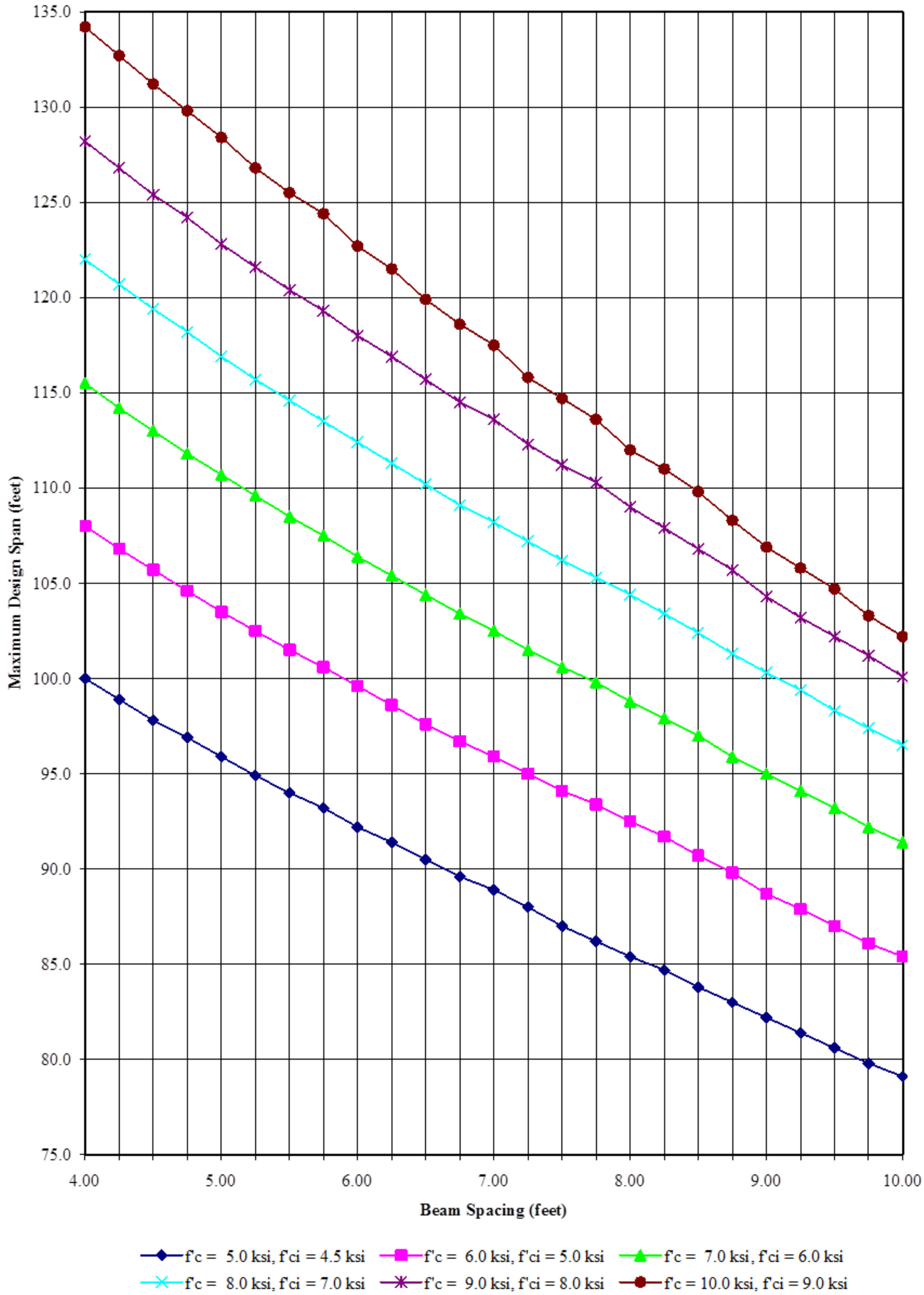
All strands are ½” diameter low relaxation strands each stressed to 33,818 pounds.

Type III PSC Beam (Standard Spec)



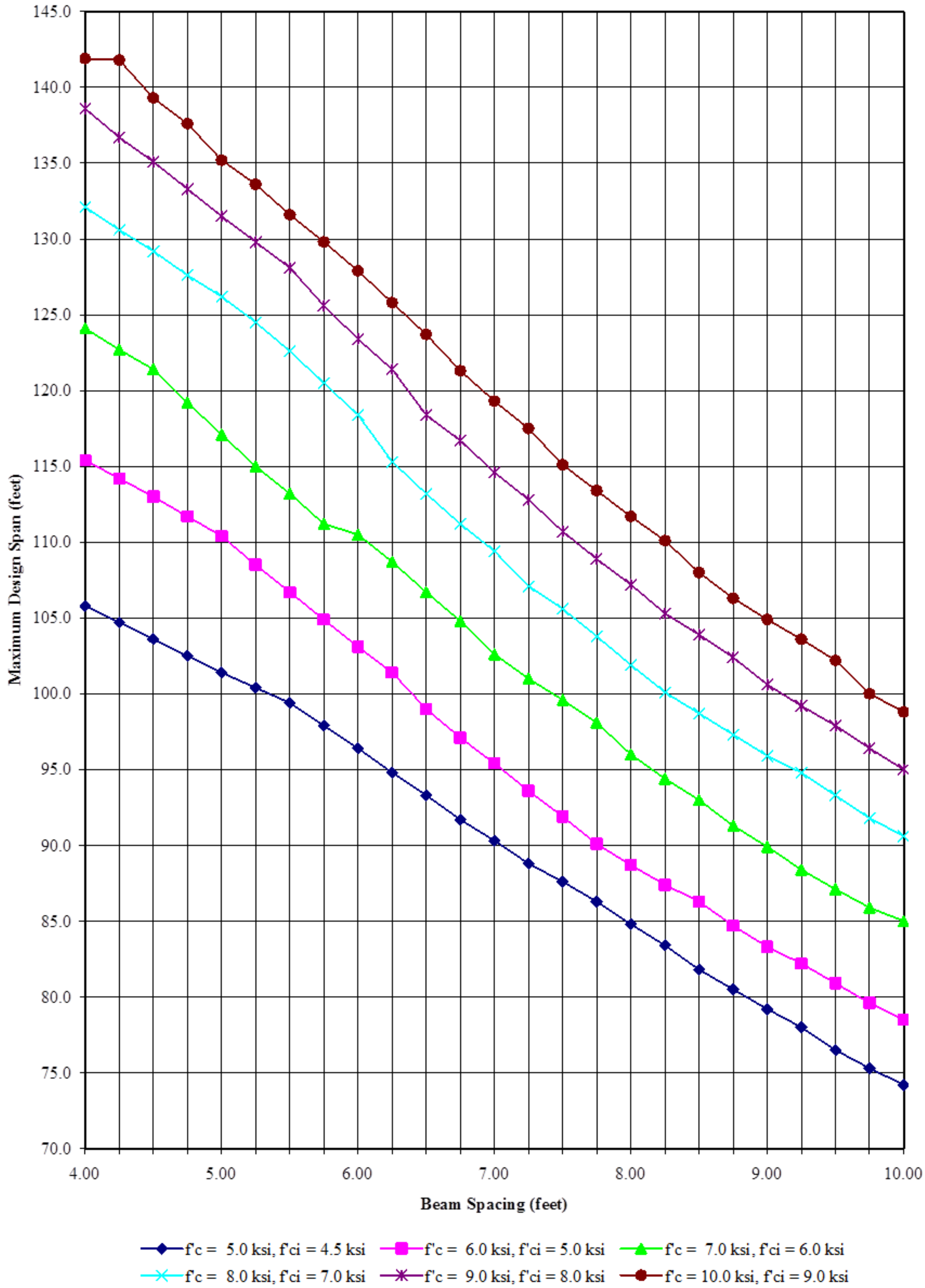
All strands are ½” diameter low relaxation strands each stressed to 33,818 pounds.

Type IV PSC Beam (Standard Spec)



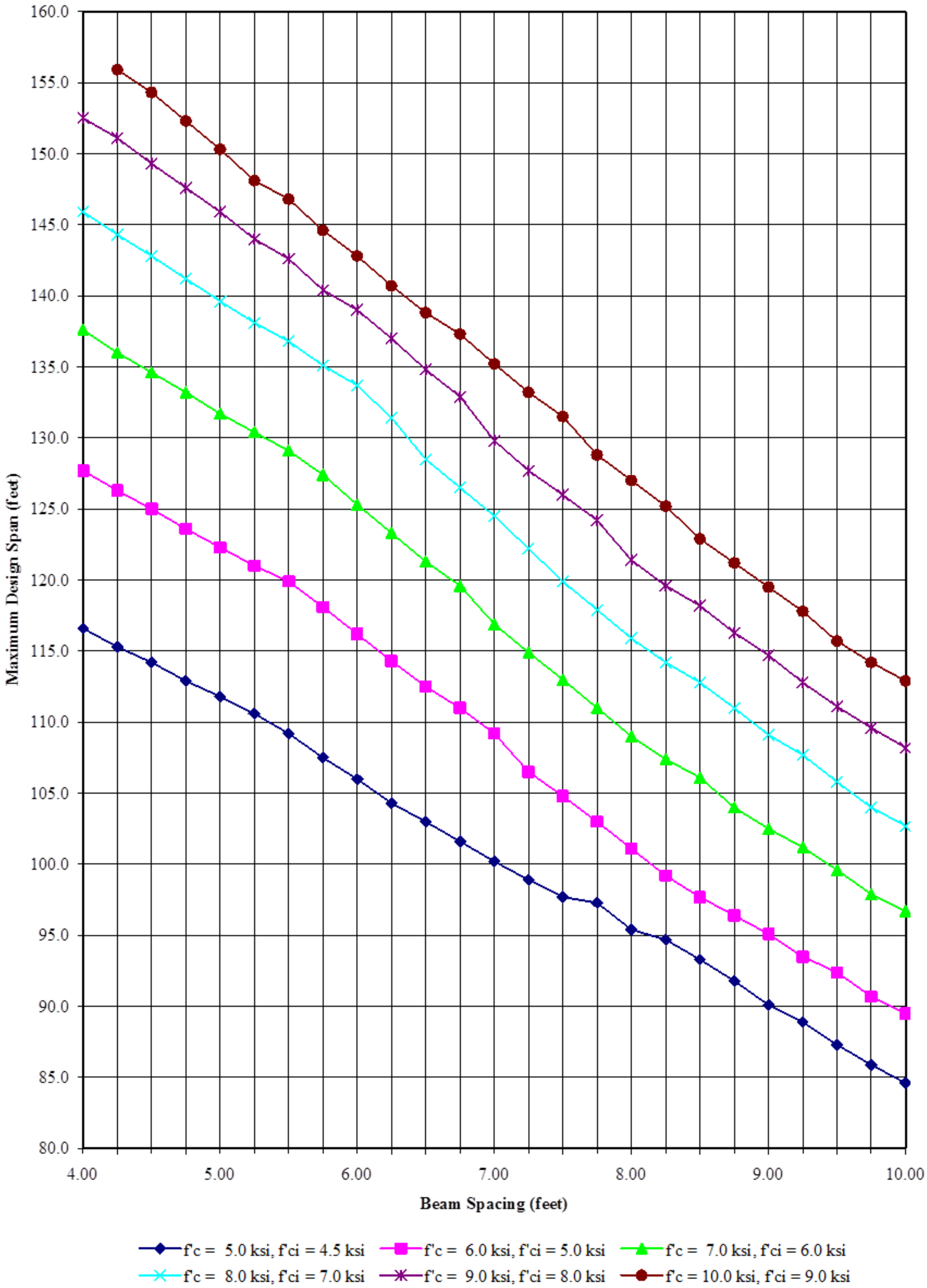
All strands are ½” diameter low relaxation strands each stressed to 33,818 pounds.

54" Bulb Tee Beam (Standard Spec)



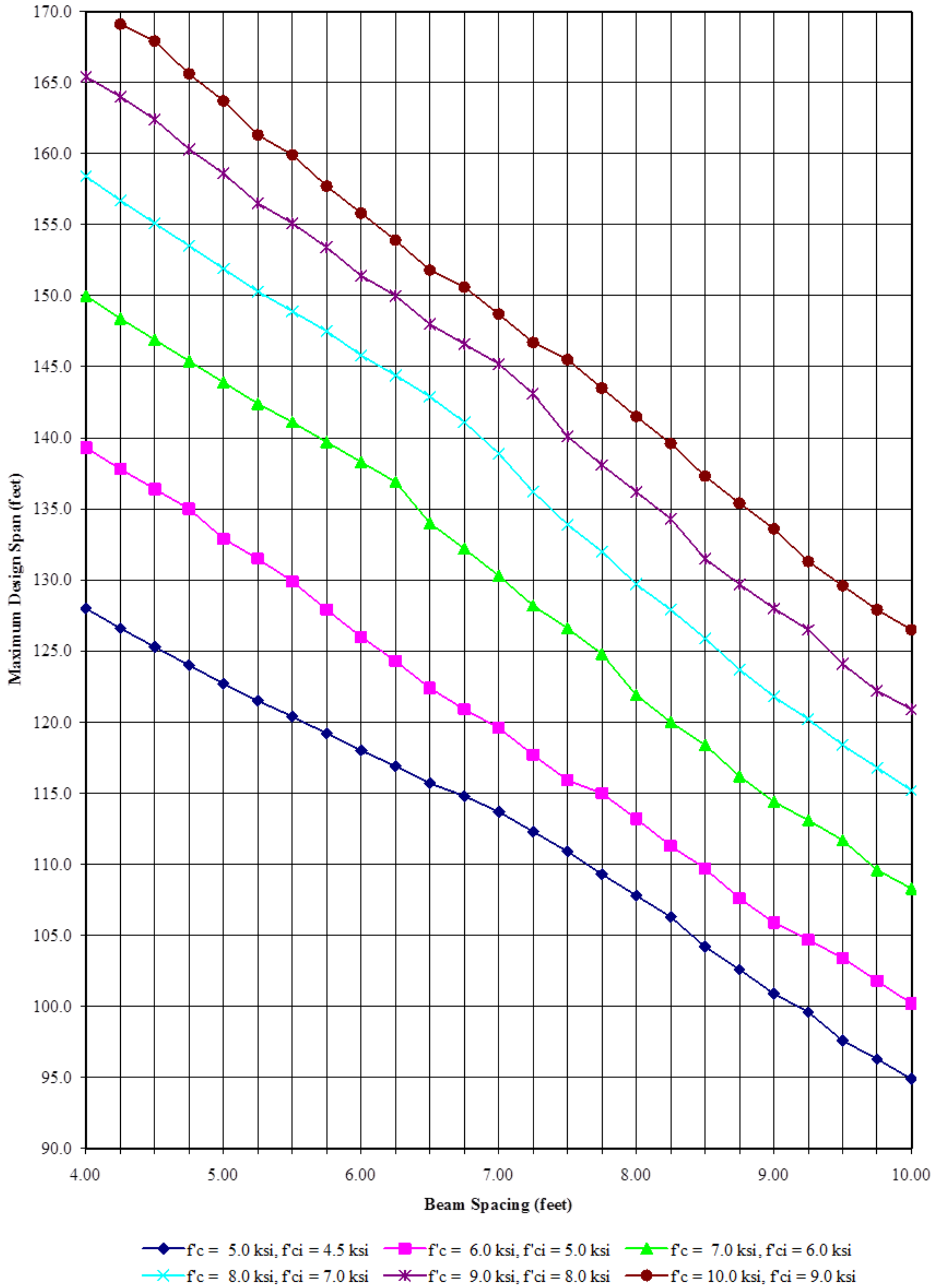
All strands are .6" diameter low relaxation strands. The 4 top flange strands are stressed to 10,000 pounds each and all remaining strands are stressed to 43,943 pounds each.

63" Bulb Tee Beam (Standard Spec)



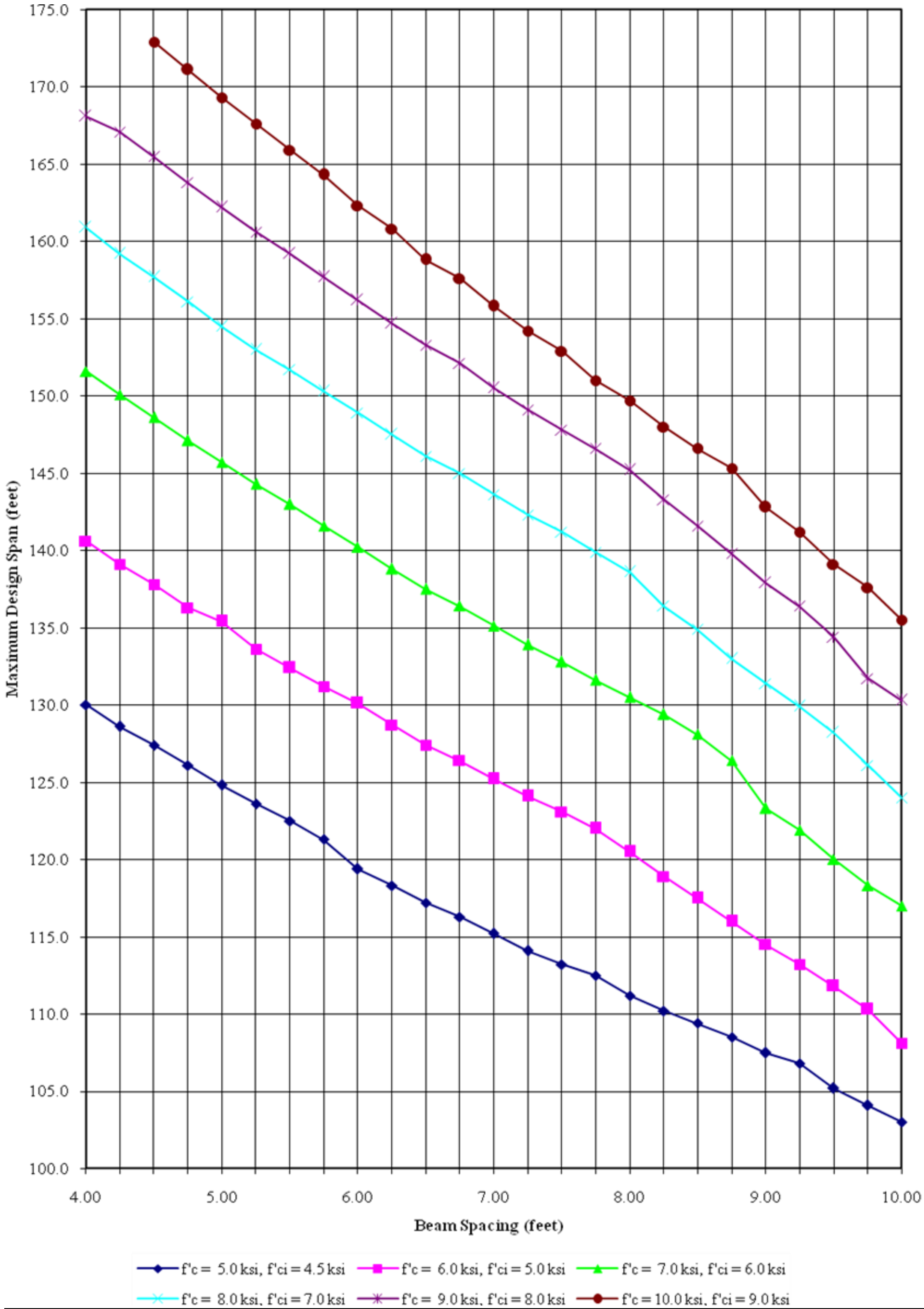
All strands are .6" diameter low relaxation strands. The 4 top flange strands are stressed to 10,000 pounds each and all remaining strands are stressed to 43,943 pounds each.

72" Bulb Tee Beam (Standard Spec)



All strands are .6" diameter low relaxation strands. The 4 top flange strands are stressed to 10,000 pounds each and all remaining strands are stressed to 43,943 pounds each.

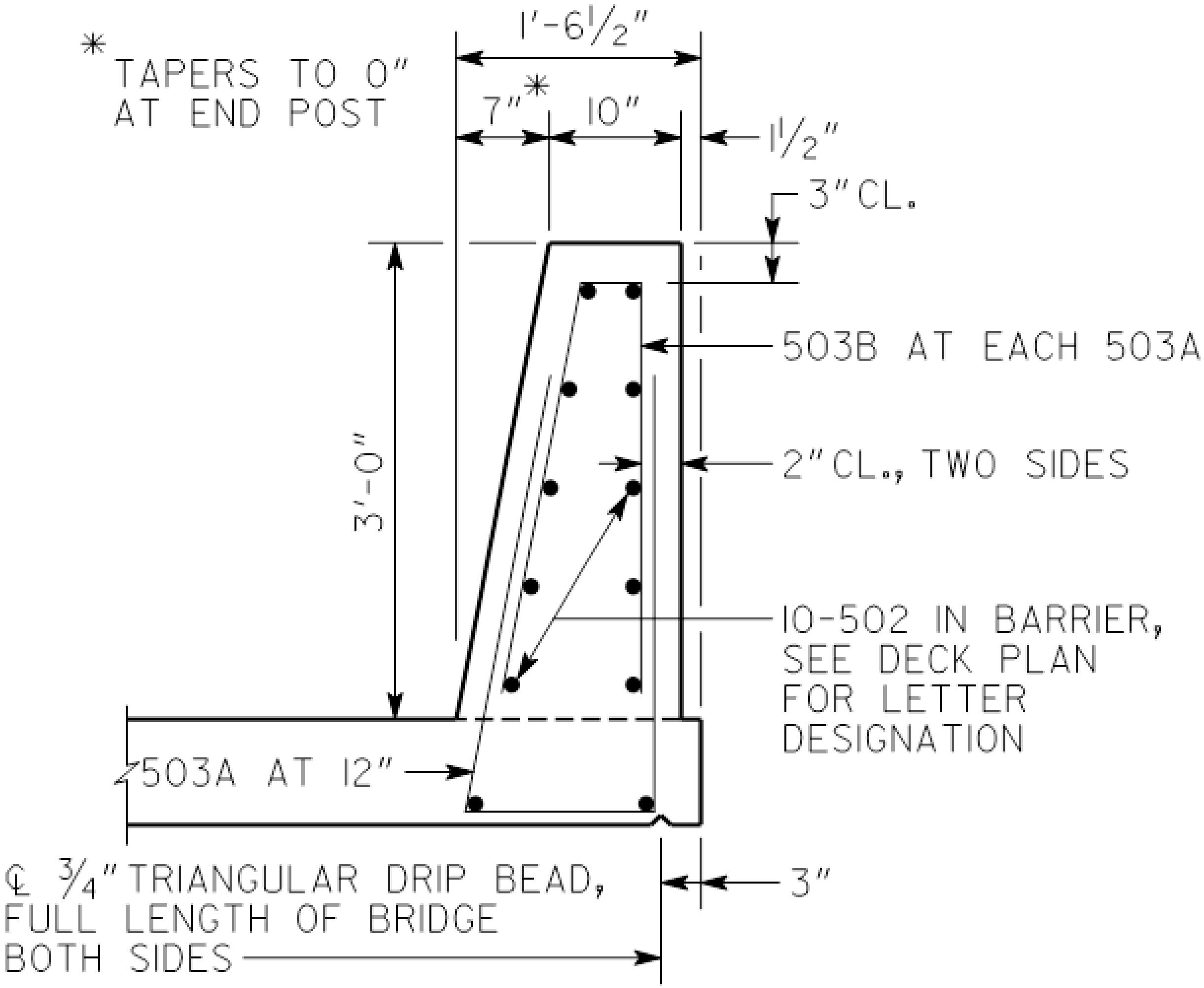
74" Bulb Tee Beam (Standard Spec)



All strands are .6" diameter low relaxation strands. The 4 top flange strands are stressed to 10,000 pounds each and all remaining strands are stressed to 43,943 pounds each.

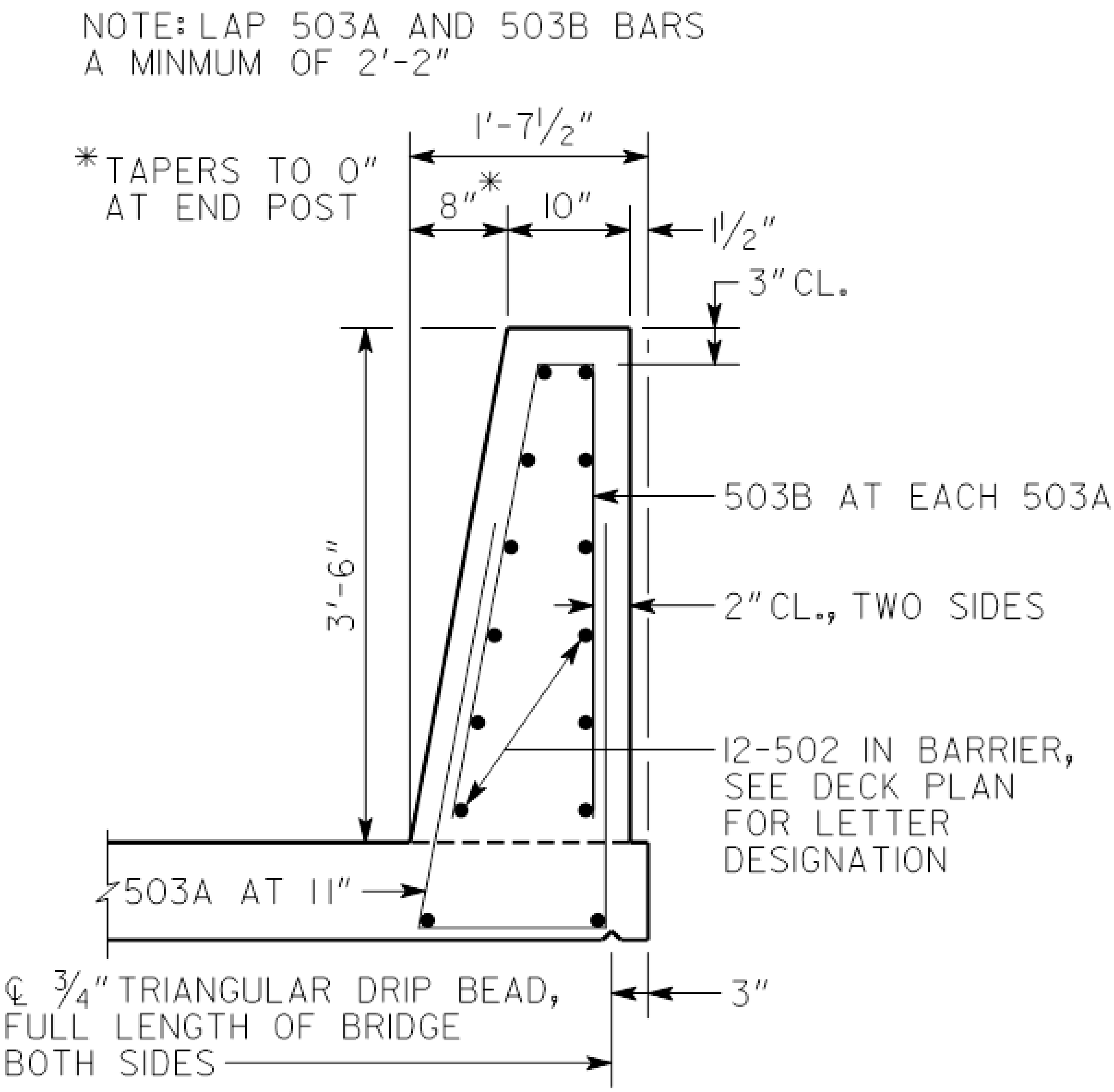
3.20 Appendix 3E – GDOT Self-Certified Bridge Railings

NOTE: LAP 503A AND 503B BARS
A MINMUM OF 2'-2"



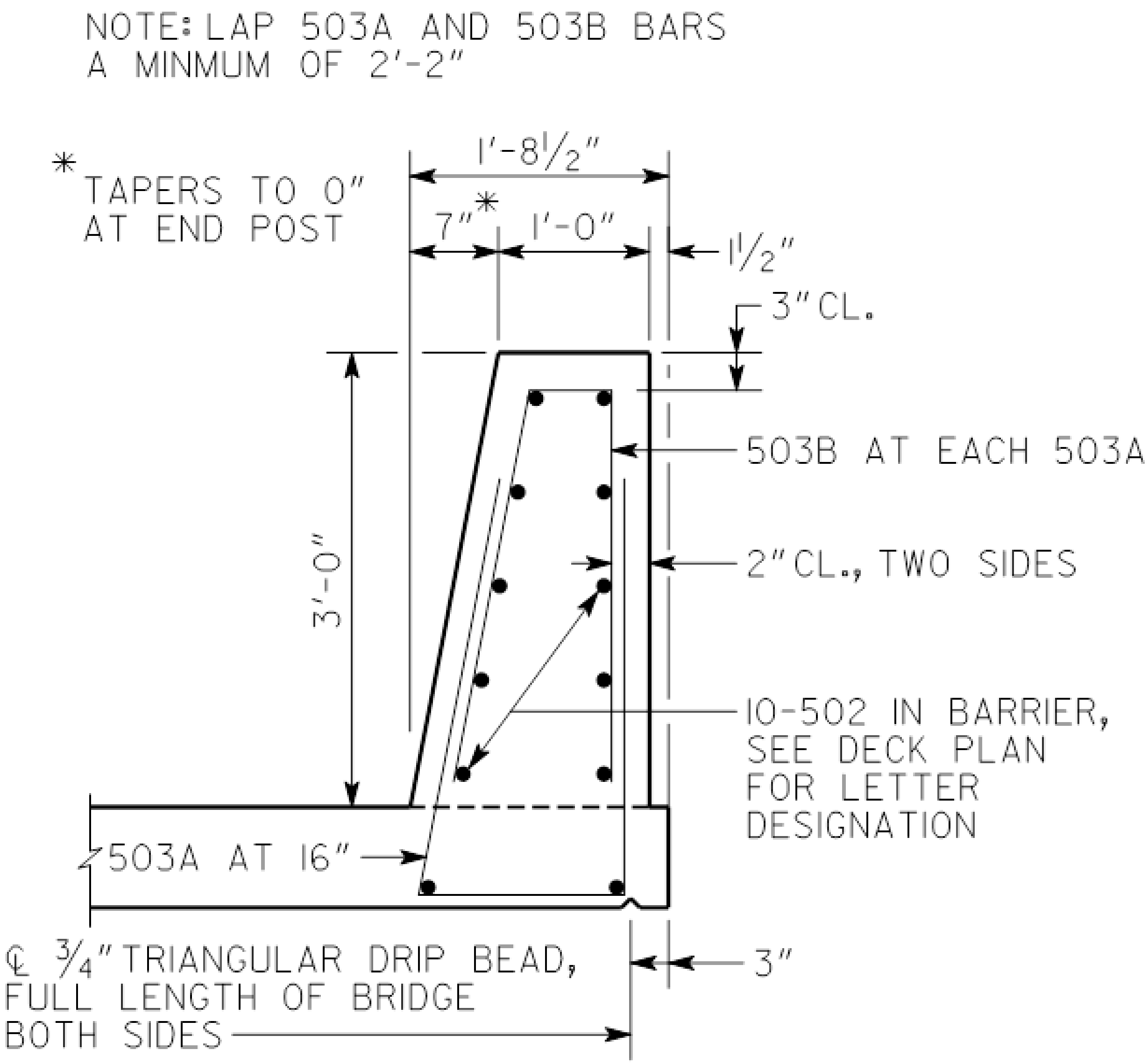
36" S-TYPE BARRIER DETAIL

SCALE: ¾" = 1'-0"



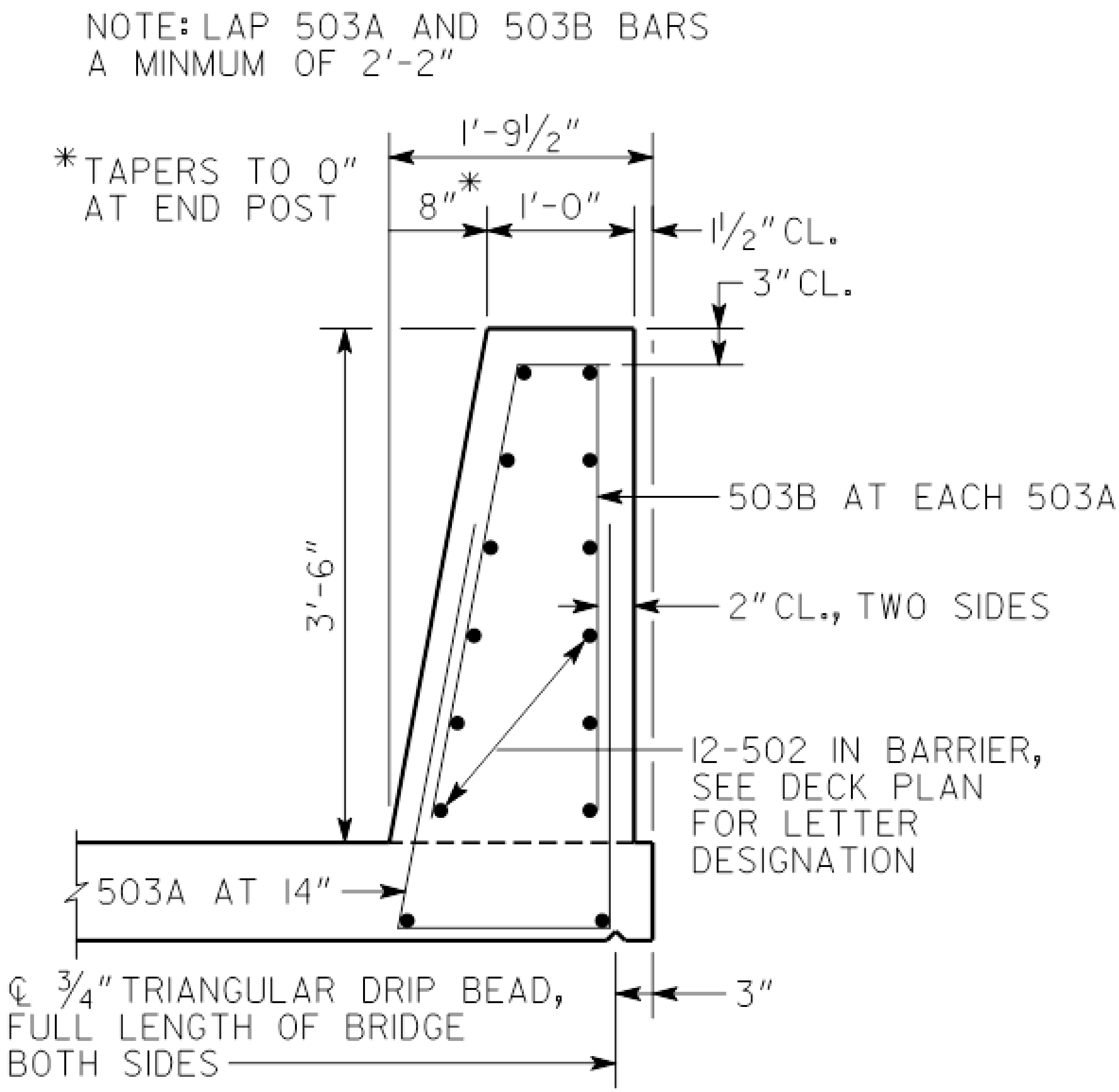
42" S-TYPE BARRIER DETAIL

SCALE: 3/4" = 1'-0"



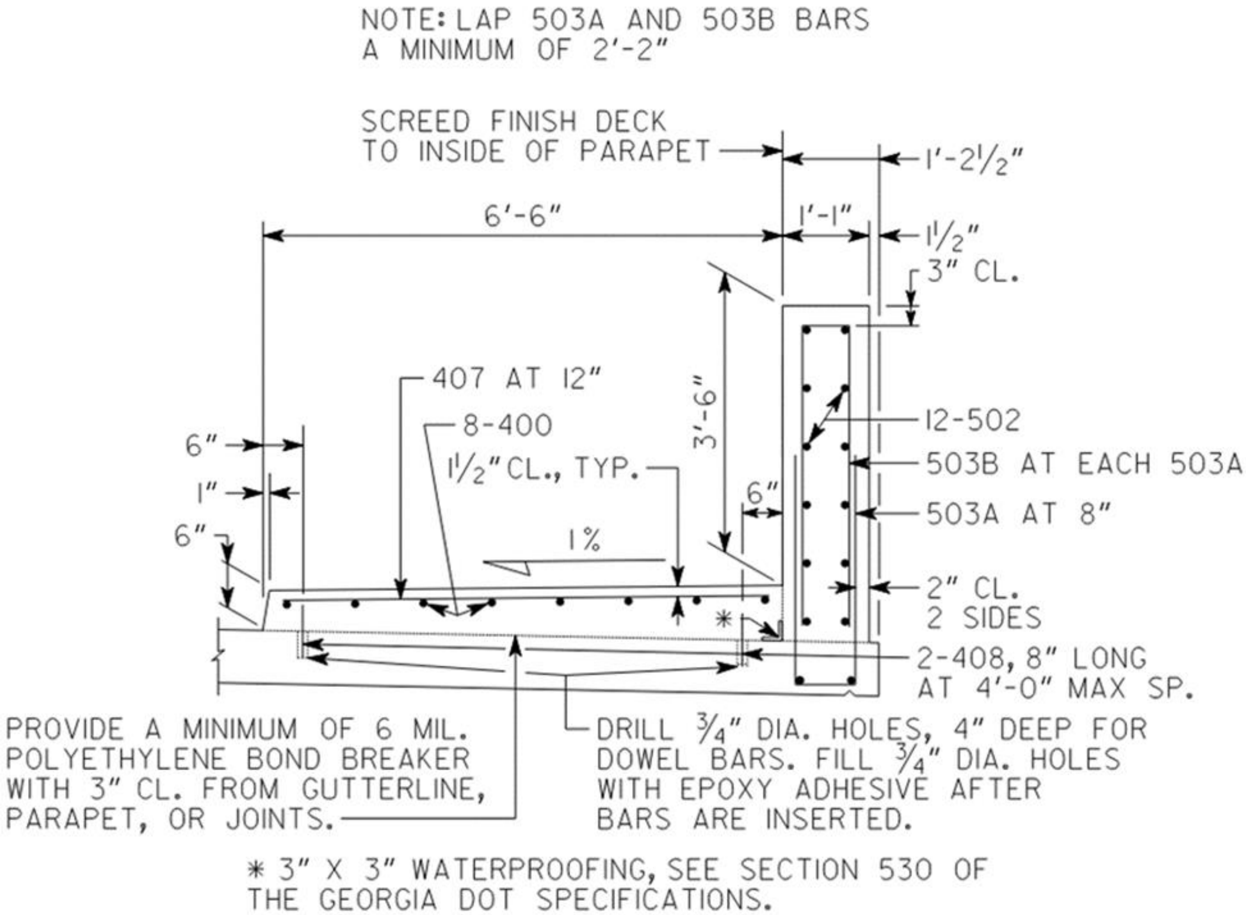
36" S-TYPE BARRIER FOR FENCE DETAIL

SCALE: ¾" = 1'-0"



42" S-TYPE BARRIER FOR FENCE DETAIL

SCALE: ¾" = 1'-0"



42" PARAPET AND SIDEWALK DETAILS

SCALE: ½" = 1'-0"

Chapter 4. Substructure - Contents

Chapter 4. Substructure

4.1 General

4.1.1 Materials

4.1.1.1 Concrete

General requirements for concrete are as follows:

a) Use 3.5 ksi concrete for all substructure elements when the bridge is supported by one or more concrete column piers.

b) Use 3.0 ksi concrete for all substructure elements if there are no concrete column piers supporting the bridge.

c) For LRFD projects, use Class 2 exposure condition in accordance with LRFD 5.6.7 for any bridges over waterways located fully or partially in the following coastal counties: Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden. Use Class 1 exposure condition for all other bridges.

d) Use 3.0 inch cover in accordance with LRFD 5.10.1 for any bridges over waterways located fully or partially in the coastal counties listed above. This requirement applies to Standard Specification bridges as well.

e) When any of the following conditions exist, use Special Provision 500 – "Concrete Structures" for mass concrete and include the "Mass Concrete" note on the General Notes sheet using the BridgeNotes program.

- Drilled shafts are greater than 6'-0" in diameter
- Non-Drilled shaft elements having a length, width, and depth greater than 5'-0". When the width or depth varies in the section, the maximum value should be used. Cap steps are not considered variation in the cap's depth.

4.1.1.2 Reinforcement

a) Use Grade 60 steel for reinforcement. Use of higher grade reinforcement is prohibited.

b) The length of detailed reinforcing bars, before bending, should not exceed 60 feet.

c) Use the following table to detail reinforcement lap splice lengths in the substructure:

#10 in pile cap when loads are transferred directly into the piles without inducing moment in the cap	3'-3"
#11 in the top of a pier cap	12'-0"
#11 in the bottom of a pier cap	9'-3"
#11 in a column	9'-3"

For all applications of lap splices in the substructure not covered above, calculate the splice length according to LRFD 5.10.8.

For Standard Specification projects, calculate the required lap splice length per Standard Specification 8.32.3.

4.1.1.3 Mechanical Couplers

When mechanical couplers are needed for seismic detailing or staging that inhibits the use of a lap splice, represent the location of each coupler with a rectangle and flag one location with “MECHANICAL COUPLER, TYP. SEE SPECIAL PROVISION 511”.

4.1.2 Design Method

The Bridge Office uses a bent stiffness approach for distributing longitudinal and transverse loads. The loads are distributed proportionally based on the relative stiffness of the bent to the entire substructure supporting the superstructure between expansion joints. Ignore the contribution of the soil mass behind bridge abutments when calculating the relative stiffness of the end bents.

The design of columns, footings, and foundations shall not be controlled by the Service Limit State. Service Limit State should be used as applicable for settlement, stability, serviceability and deflection as denoted in the LRFD Specifications.

Stream pressure calculations for substructure and foundation design shall be based on 100yr flood data for all hydraulic bridges, unless otherwise specified.

4.2 Foundations

4.2.1 General

Foundations for bridges shall be designed based on the Bridge Foundation Investigation (BFI) report approved by the Office of Materials.

All loads and resistances presented on the plans shall be in kips, kips per linear foot (klf) or kips per square foot (ksf).

Include Dynamic Load Allowance on all piles that support caps, including end bent piles surrounded by soil or mechanically stabilized embankment.

4.2.1.1 Consideration of Scour

Design bridge foundations in accordance with LRFD 2.6.4.4 and LRFD 3.7.5 with the following additions and exceptions:

- For spread footings, see BDM 4.2.4.1 for embedment criteria beyond the LRFD Specifications.
- For pile footings, see BDM 4.2.5.4 for guidance on the location of footings, in lieu of LRFD 2.6.4.4.
- In lieu of the specifications in LRFD 2.6.4.4 and LRFD 3.7.5 defining the design flood, design pile bents at the Strength and Service limit states assuming pile fixity a depth of 10ft below a conservatively selected existing groundline, based on the topographical survey and BFI report. This approach, based on confidence in the current bridge inspection and load rating practices of the Bridge Maintenance Unit, as well as the Department’s flood response inspection approach, minimizes unnecessary overdesign of these substructure elements.

Directives in LRFD 2.6.4.4 and LRFD 3.7.5 regarding the check flood is to be followed as written.

- When piles are used for pile bents or pile footings, they should penetrate a minimum of 10 feet below the 500-year scour line.

The theoretical design flood and check flood (500-year) scour should be calculated as part of the Hydraulic and Hydrologic study. The 500-year scour line shall be shown on the Preliminary Layout. Once geotechnical exploration is complete, the BFI may adjust these scour predictions based on applicable soil samples. Use these adjusted values for design.

For Standard Specification projects, deep foundations shall be designed for a Safety Factor = 1.0 for the 500 year storm event.

Scour information shall not be included in the final bridge plans.

4.2.1.2 Foundation Types

Foundations shall be designed for existing conditions. The foundations for highway bridges consist of the following types necessary to support the superstructure:

- Driven piles for pile bents
- Caissons (drilled shafts)
- Spread footings
- Pile footings

For general guidelines for foundation types in Georgia, see Appendix 4A.

4.2.2 Driven Piles

4.2.2.1 Pile Type and Size Selection

GDOT uses the following pile types:

- Steel H piles
- Prestressed concrete (PSC) piles
- Metal shell (MS) piles

Driven piles shall be designed in accordance with LRFD 10.7 or Standard Specification 4.5, as appropriate.

Detail all piles within a bent with a single pile size that will satisfy the demand of the controlling pile load.

4.2.2.2 General

All substructure sheets illustrating the use of driven piles shall include a Plan Driving Objective (PDO) for the piles. The PDO shall defines the required driving resistance in kips for LRFD projects or Tons for Standard Specification projects, and the minimum tip elevation stated in the BFI, to the nearest foot. This information shall be presented as shown in the following example:

PLAN DRIVING OBJECTIVE
"ALL PILES SHALL BE DRIVEN TO A DRIVING RESISTANCE OF XX KIPS AFTER A MINIMUM TIP ELEVATION OF XXX IS ACHIEVED."

Directly above the PDO the pile type and size shall be identified.

"ALL PILES SHALL BE (PSC, 18 IN SQ) (STEEL H, HP 14 X 73) (METAL SHELL, 18 IN OD)."

For future reference of pile design loads and for verification of loads used in preparing the LRFD BFI, include the following note just above the pile identification on all LRFD projects:

"Piles are designed for a maximum factored axial load of ____ kips."

The LRFD BFI will specify the method to measure driving resistance in the field. The methods commonly used by GDOT is Dynamic Testing. Include the correct "Driving Resistance" note for the work on the General Notes Sheet using the BridgeNotes program.

When Special Provision 523 indicates PDA test to be performed by the Contractor, include the "PDA (Contractor)" note on the General Notes sheet using the BridgeNotes program.

For all LRFD projects, place the "WAVE Equation Analysis" note on the General Note sheet using the BridgeNotes program.

Include the following pay item when Dynamic Testing is specified. The number of tests is indicated in the LRFD BFI by designating test locations.

523-1100 * EA dynamic pile test***

If FHWA-Modified Gates Formula is specified, place the "WAVE Equation Analysis" note on the General Note sheet using the BridgeNotes program.

Once the LRFD BFI report has been completed and accepted, a variation of up to 5% between the final calculated pile load and the value in the LRFD BFI report does not require a revision of the LRFD BFI report or driving resistance. Use the driving resistance from the LRFD BFI report and the final calculated maximum factored axial load on the plans.

Batter piles, where required, are typically battered at a rate of 1½ inches horizontal on 12 inches vertical. The batter shall not exceed 4:12.

For Standard Specification projects, include driving data piles on bridges at the rate of about one for every four bents. Driving data pile locations shall be designated in the "Driving Data Piles" note to be included on the General Notes sheet using the BridgeNotes program. On bridges with PSC piles, the test piles can be counted as driving data piles.

Total pay quantity for piling is rounded up to the nearest 5 feet. Length of each pile can be calculated as the difference between top of pile elevation and the estimated tip elevation (or average estimated tip if a range is given) from the BFI. The designer shall include the additional length of piles caused by batter piling.

The designer shall always include a pay item for a load test for each different pile (type and size) used on the project.

4.2.2.3 Steel H Piles

Steel H piles specified for use in the Bridge Foundation Investigation (BFI) report will be one or several of the following sizes:

- HP 10x42
- HP 12x53
- HP 14x73
- HP 14x89
- HP 14x102
- HP 14x117

One large pile may require a higher capacity pile hammer, but this may still be more economical than driving two smaller piles per beam in an end bent.

When H-pile intermediate bents are recommended in the Foundation Recommendation Letter, 36 ksi H-piles should be used for all H-piles at the bridge site. Use 50 ksi H-piles only when all the H-piles are fully embedded for the entire bridge. Do not use 36 ksi and 50 ksi piles for the same bridge.

If 50 ksi piles are used, indicate this in the Design Data section of the General Notes sheet and include the “Steel H-Piles” note on the General Notes sheet using the BridgeNotes program.

The following stresses and maximum factored structural resistance values for steel H-Piles should be used in preparation of all LRFD BFI reports and is incorporated in the GDOT LRFD BFI report template. The piles are assumed to be continuously supported during driving operations. A resistance factor of 0.5 from LRFD 6.5.4.2 was used assuming piles subject to damage with axial loading only.

Table 4.2.2.3-1 Properties for Grade 36 Steel H-Piles (LRFD)

Pile Size	Stress Limits		Max. Factored Structural Resistance, P_R (kips)
	Compression (ksi)	Tension (ksi)	
HP 10x42	32.4	32.4	223
HP 12x53	32.4	32.4	279
HP 14x73	32.4	32.4	385
HP 14x89	32.4	32.4	470
HP 14x102	32.4	32.4	540
HP 14x117	32.4	32.4	619

Table 4.2.2.3-2 Properties for Grade 50 Steel H-Piles (LRFD)

Pile Size	Stress Limits		Max. Factored Structural Resistance, P_R (kips)
	Compression (ksi)	Tension (ksi)	
HP 10x42	45.0	45.0	310
HP 12x53	45.0	45.0	384*
HP 14x73	45.0	45.0	520*
HP 14x89	45.0	45.0	653
HP 14x102	45.0	45.0	750
HP 14x117	45.0	45.0	860

* 12x53 and 14x73 H-pile sections are slender elements for Grade 50 steel and a reduction has been applied in accordance with LRFD 6.9.4.2.

For LRFD projects, when steel H-piles are driven to hard rock, verify the maximum factored structural resistance from the above tables is greater than the driving resistance for the respective pile to mitigate potential damage to the pile.

4.2.2.4 Prestressed Concrete (PSC) Piles

Prestressed concrete (PSC) piles specified for use in the Bridge Foundation Investigation (BFI) report will be one or several of the following sizes:

- 14” x 14”
- 16” x 16”
- 18” x 18”
- 20” x 20”
- 24” x 24”
- 30” x 30”
- 36” x 36”

The designer shall receive approval from the Bridge Office prior to using a PSC pile size greater than 20”.

The details of the PSC piles listed above are specified and presented on a “Basic Drawing” that can be downloaded from the Bridge Office Website for inclusion in the final bridge plans. Place the PSC Pile sheet behind the last substructure sheet.

The following stresses and maximum factored structural resistance values for PSC piles should be used in preparation of all LRFD BFI reports and is incorporated in the GDOT LRFD BFI report template. The piles are assumed to be continuously supported during driving operations. A resistance factor of 0.75 from LRFD 5.5.4.2 was used for compression controlled sections.

The 28-day concrete strength is 6.5 ksi and pile detailing is in accordance with Special Design Square Concrete Prestressed Piles drawing.

Table 4.2.2.4-1 Properties for PSC piles (LRFD)

Pile Size	Stress Limits			Max. Factored Structural Resistance, P_R (kips)
	Compression (ksi)	Tension (ksi)		
		Normal	Severe	
14” SQ PSC	4.352	1.415	1.173	612
16” SQ PSC	4.178	1.590	1.347	784
18” SQ PSC	4.460	1.307	1.065	1023
20” SQ PSC	4.375	1.392	1.150	1252
24” SQ PSC	4.527	1.240	0.988	1833
30” SQ PSC, (VOIDED)	4.341	1.426	1.184	2119
30” SQ PSC (VOIDED)	4.356	1.411	1.169	2764

When the BFI recommends PSC piles, it will also call for test piles with locations. The contractor uses test piles, longer than estimated pile lengths, to determine final order lengths of the remaining piles. The length of test pile shall be 5 feet plus the top of pile elevation minus the estimated tip elevation. Round test pile lengths up to the nearest foot. Because test piles are part of permanent construction, the engineer must deduct the calculated in-place length, not the test pile length, from the total piling quantity.

When detailing PSC Piling in the coastal counties of Chatham, Bryan, Liberty, McIntosh, Glynn, and Camden, or when detailing piling for which the BFI has identified corrosive soils, specify the use of High-Performance Concrete (HPC) by including the associated general note.

When detailing PSC piling in the coastal counties listed above that will be routinely exposed to water, such as piles used to directly support intermediate bent caps or pedestal footings, stainless steel reinforcement should be specified in addition to the HPC by including the associated general note.

Due to the high cost of stainless-steel reinforcing, piles supporting end bents and other substructure elements not expected to experience exposure to water should not automatically be detailed with stainless-steel. If alternate pile sizes can be utilized at such locations to prevent potential on site mix ups and reduce costs, this should be considered.

Freeze bearing for piles may be required in the BFI for certain conditions. In this case include the “Pile Driving (Freeze Bearing - Table)” note on the General Notes sheet using the BridgeNotes program.

Do not use the words "estimated tip" in the plans since these words are a reflection of the BFI, which is not a part of the contract.

4.2.2.5 Metal Shell (MS) Piles

Metal shell (MS) piles specified for use in the Bridge Foundation Investigation (BFI) report will be one or several of the following sizes:

- 14” O.D.
- 16” O.D.
- 18” O.D.
- 20” O.D.
- 24” O.D.

MS piles shall be driven and then filled with concrete at all locations as specified in the GDOT Standard Specifications.

Freeze bearing for piles may be required in the BFI for certain conditions. In this case, include the “Pile Driving (Freeze Bearing – Table)” note on the General Notes sheet using the BridgeNotes program. Do not use the words "estimated tip" in the plans since these words are a reflection of the BFI, which is not a part of the contract.

For piles installed to directly support intermediate bent caps or pedestal footings, do not include any metal shell thickness when analyzing for capacity. The GDOT Bridge Cell Library contains details illustrating the reinforcement requirements for each metal shell pile diameter. The reinforcing in these details provides the maximum area of steel for the section while maintaining a minimum 5” clear spacing between vertical reinforcement, in lieu of requirements stated in LRFD 5.12.9.5.2. 14” diameter metal shell piles have insufficient void space to install reinforcing steel in accordance with the above, and therefore shall only be used to support end bent caps.

For piles installed to support end bent caps, do not include reinforcement details. The metal shell thickness, reduced by 1/8 of an inch for corrosion, shall be used when analyzing the end bent for capacity.

Develop stiffness models for the distribution of lateral forces based on the presence of the entire metal shell thickness, without section loss, at all bent locations.

The following stresses and maximum factored structural resistance values for Metal Shell piles should be used in preparation of all BFI reports and is incorporated in the GDOT BFI report template. The piles are assumed to be continuously supported during driving operations. Grade 3 steel as specified in ASTM A252 (steel yield strength = 45 ksi) is used for the calculations. No factored axial structural resistances were provided since the load will be controlled by the drivability limits of the metal shell.

Table 4.2.2.5-1 Properties for Metal Shell Piles

Pile Size	Shell Thickness (in)	Stress Limits	
		Compression (ksi)	Tension (ksi)
14” Diameter	0.2500	40.5	40.5
14” Diameter	0.3125	40.5	40.5
16” Diameter	0.2500	40.5	40.5
16” Diameter	0.3125	40.5	40.5
18” Diameter	0.3125	40.5	40.5
20” Diameter	0.3125	40.5	40.5
24” Diameter	0.5000	40.5	40.5

Modify the metal shell thickness based on the outer diameter by including the “Metal Shell Pile” note on the General Notes sheet using the BridgeNotes program.

GDOT Standard Specification 520 includes two detailing options (Option 1 and Option 2) for metal shell pile closure plates. Option 1 is specified as the default option; however, if the BFI recommends Option 2, include the “Pile Closure Plate Detail” note on the General Notes sheet using the BridgeNotes program.

4.2.2.6 Timber Piles

Timber piles shall not be used on any temporary or permanent structure supporting vehicular traffic. Timber piles may be used for pedestrian boardwalk structures, and as part of foundation improvement strategies such as load transfer platforms.

4.2.2.7 Pile Driving Aids

4.2.2.7.1 Jetting and Spudding

The BFI often recommends jetting and/or spudding to assist penetration for PSC or MS piles. Jetting consists of using water at the tip of the pile to loosen the soil and aid driving. Spudding consists of using a "spud" (usually a heavy H-pile) to break up hard layers before driving the permanent pile. The designer shall include the Piling (Jetting and Spudding) note from the BridgeNotes program on the General Notes sheet when jetting and/or spudding are recommended in the BFI. No pay item is required for jetting and/or spudding.

4.2.2.7.2 Predrilling

The BFI may recommend predrilling be allowed at the contractor’s option in lieu of jetting or spudding. Predrilling consists of loosening the soil with an auger to aid driving. The BFI will include an elevation for the limit of predrilling, which will usually be referenced to the estimated or minimum pile tip. When the BFI mentions predrilling, the designer shall include the Piling (Predrilling in lieu of Jetting and Spudding) note from the BridgeNotes program on the General Notes sheet instead of the jetting and spudding note. No pay item is required for predrilling.

4.2.2.7.3 Pilot Holes

The BFI sometimes recommends the use of pilot holes for pile installation to assure adequate tip elevations can be reached. When the BFI calls for pilot holes, include the appropriate “Pilot Holes” note on the General Notes sheet using the BridgeNotes program.

If pilot holes are being socketed into rock and tapped with a warm hammer, per the BFI, replace the Plan Driving Objective note referenced in BDM 4.2.2.2 with the following:

GEOTECHNICAL DATA
ALL PILES ARE DESIGNED FOR A GEOTECHNICAL RESISTANCE OF ___ KIPS AFTER ACHIEVING A MINIMUM TIP ELEVATION OF ____.

The Geotechnical Resistance is the value presented in the BFI as either Geotechnical Resistance or Driving Resistance at the bent.

Include pay item 520-5000 PILOT HOLES in the summary of quantities to cover the required quantity of pilot holes.

4.2.2.7.4 Pile Points

When the BFI calls for pile points to ensure adequate penetration into weathered rock, include the “Pile Points” note on the General Notes sheet using the BridgeNotes program.

4.2.3 Caissons

4.2.3.1 General

When caissons are recommended in the BFI, foundation bearing strength and bottom elevations for caissons will be included. Details and requirements for caisson construction are covered under Special Provision 524 which is usually included with the BFI. Special provision 524 also includes important information such as whether the hole is dry or wet (uses slurry) and whether a demonstration shaft is required. Special Provision 524 may also include guidance on the use of the pay item for “FURNISH DRILLING AND SUPPORT”. If this pay item is included in the special provision, add the pay item to the bridge plans.

4.2.3.2 Design and Analysis

Determine a caisson’s point of fixity elevation using a P-Y curve analysis program. The point of fixity shall be assumed to exist where the caisson deflection curve reaches zero at the first point below the groundline. Use this elevation when setting up the structural model of the substructure.

For the caisson’s minimum tip to be reported on the plans, use the lower elevation of the bottom of drilled shaft elevation provided in the BFI or the theoretical point of stability (where the caisson deflection curve reaches zero for a second time). For caissons founded in rock, very small deflections may not resolve within a reasonable depth. When this is the case, coordinate with the Bridge Office to determine an appropriate point of stability.

4.2.3.3 Dimensions and Elevations

The diameter of a caisson shall be designed in 6” increments with a minimum diameter of 36”. All caissons shall have a minimum concrete cover of 6”.

Caisson tip elevations should be given to one decimal place followed by the words “OR BELOW”.

For caissons in the water, detail the top of the caisson 1 foot above the normal pool elevation for quantity calculations. For caissons on land, detail the top of caisson 1 foot below the groundline for quantity calculations. In either case, if the distance from the top of any caisson at the bent to the bottom of the cap is less than 4 feet, detail that individual bent such that all caissons extend to the bottom of the cap. If the joint between the caisson and column would be located within the plastic hinge, extend the caisson to the bottom of the cap.

Include a note on the substructure sheet specifying the Top of Caisson Elevation assumed for quantities calculation.

Include a note on the substructure sheet directing the contractor to set the top of caisson 1 foot above the water surface at the time of construction for caissons in water. For caissons on land, include a note to set the caisson 1 foot below groundline. If there is ambiguity between whether the caisson is in water or on land, use a note that addresses both. See appendix 4C for notes.

4.2.3.4 Reinforcement

Reinforcement in the caisson is specified by size only (#11 instead of 1110) because payment for it is included in linear feet of caisson. However, when using a transition bar that laps with the steel in the caisson and the steel in the column, that steel can be detailed and included in the bar schedule. Do not use hooked bars in the top of a caisson.

Use hoop stirrups for caissons. Spiral reinforcement is not allowed in caissons. Stirrups shall not be larger than #6 bars. The clear spacing between caisson stirrups shall be limited to a minimum of 5” to allow for effective movement of concrete. Similarly, vertical caisson reinforcement should have a minimum of 5” clear spacing.

No seismic detailing for a plastic hinge is required near the theoretical fixity location.

4.2.3.5 Caisson Notes

When the bridge foundation consists of drilled caissons, there are a number of notes that need to be included on the substructure sheet(s). See Appendix 4C for a list of caisson related notes and guidance on when they should be used.

4.2.4 Spread Footings

4.2.4.1 Dimensions and Elevations

Use a square spread footing whenever possible. Plan footing dimensions shall be detailed in 3 inch increments in each direction. Spread footings shall be a minimum of 2’-3” thick to allow for the development of the hooks of No. 11 bars from the column.

Bottom of spread footing elevation should be given to one decimal place and a plus/minus sign to indicate possible variations. Bottom of footing elevations should be set to provide a 2 foot minimum soil cover over the footing.

4.2.4.2 Reinforcement

When using a square footing, use the same reinforcement in both the transverse and longitudinal directions to avoid incorrect installations in the field.

In addition to the mat of reinforcement at the bottom of the footing for design, detail a mat of reinforcement at the top of the footing comprised of #4 bars spaced at a maximum of 12” in each direction.

If a footing is not fully buried, satisfy LRFD 5.10.6 for reinforcement checks for all faces exposed to daily temperature change. For buried footings, these criteria will not apply.

Stirrups shall not be employed as a method of shear resistance in footings.

4.2.4.3 Design and Additional Considerations

To allow for field variations in rock elevation, intermediate bents shall be designed for the case where the bottom of footing elevation is 3 feet lower than that indicated in the BFI. The designer shall include the Footing Elevations note from the BridgeNotes program on the General Notes sheet.

When recommended in the BFI, spread footings and the seals beneath spread footings should be keyed into the underlying material and the following note included on the substructure sheet:

KEY THE ENTIRE (footing or seal) A MINIMUM OF __ FOOT INTO _____ ROCK.

When spread footings are to be placed on materials other than rock, the designer shall ensure that the footing is sufficiently embedded to resist lateral loads.

Spread footings will not be allowed on rock embankments.

Design spread footings to limit settlement to a maximum of 1 inch.

Include the following note on the substructure sheet when the foundation consists of a spread footing(s):

SPREAD FOOTING IS DESIGNED FOR A FACTORED BEARING RESISTANCE OF X.X KSF ON SOIL/ROCK..

4.2.5 Pile Footings

4.2.5.1 Footing Dimensions and Elevations

Use a square pile footing whenever possible. Plan footing dimensions shall be detailed in 3” increments in each direction. Pile footings shall be a minimum of 3’-3” thick when steel H-piles are used and 3’-6” when PSC piles or metal shell piles are used to allow for the development of the hooks of No. 11 bars from the column.

Bottom of pile footing elevations should be detailed to two decimal places and to the nearest 3” (Ex. XXX.00, XXX.25, XXX.50, or XXX.75).

4.2.5.2 Footing Reinforcement

Detail 180 degree hooks for the bottom reinforcement mat in pile footings. The bottom reinforcement mat can be placed directly on top of H-Piles. However, the designer shall detail 3 inches of clearance on top of metal shell and PSC piles to allow the footing concrete to properly bond with the footing reinforcement. When using a square footing, use the same reinforcement in both the transverse and longitudinal directions to avoid incorrect installations in the field.

When seismic detailing is required for the bridge, detail a mat of reinforcement at the top of the footing comprised of #4 bars spaced at a maximum of 12” in each direction.

If a footing is not fully buried, such as a pedestal footing, satisfy LRFD 5.10.6 for reinforcement checks for all faces exposed to daily temperature change. For buried footings, these criteria will not apply.

Stirrups shall not be employed as a method of shear resistance in footings.

4.2.5.3 Pile Layouts

Use one of the GDOT pile layouts that are presented in Appendix 4B to design pile footings.

Minimum pile spacing and edge distances shall be determined in accordance with LRFD 10.7.1.2 and detailed in 1 inch increments.

4.2.5.4 Design and Additional Considerations

Pile footings shall be designed for zero tension (no uplift) in the piling for the strength limit state only.

The top of the pile footings should be a minimum of 2 feet below ground, with the following exceptions for the bridges over the streams:

a) If the bridge is located in one of the coastal counties and the waterway has very low flow velocity and low debris potential (such as in a coastal swamp), then the bottom of the footing will be located 1 foot above mean water level. This is known as a “pedestal bent”.

b) If the bridge requires a large number of cofferdams for pile footing construction, pedestal bents could be used to eliminate the high cost cofferdams. However, use of this option must be approved by the Bridge Office.

When the BFI or the Office of Construction recommends setting up Type II backfill material under a footing, do not increase the bridge excavation quantity for this material since the GDOT Standard Specification covers additional excavation up to three feet below the plan elevation of the bottom of footing.

4.2.6 Cofferdams and Seals

4.2.6.1 General

When a bridge with concrete footings crosses a stream or its footings are located close to the water table, cofferdams and/or seal concrete may be necessary for intermediate bent construction. Before finalizing the design, the designer shall send a request to the Bridge Office for a cofferdam recommendation. The Bridge Office will coordinate with the Office of Construction to determine the need for cofferdams and seals.

Submit a request for cofferdam recommendations via email to BridgeOffice@dot.ga.gov. The message should include the Bridge Plan and Elevation Sheet, the substructure sheet for all intermediate bents under consideration (including elevations and dimensions), a copy of the Bridge Foundation Investigation and boring logs for each bent under consideration, 2 year flood elevation and water surface elevation at time of survey. The latter two items can be found in the Hydraulic Study.

Seals should not be used except as recommended by the Bridge Office due to the possibility of future voids under the seal. Contractors should not be allowed to substitute a concrete seal in lieu of dewatering cofferdams.

4.2.6.2 Dimensions and Elevations

For calculation of Seal Concrete quantity use the dimensions of the footing plus 1'-6" wider on each side multiplied by the thickness of the seal. Use the following seal concrete thickness and strength that have been determined to resist the buoyant force from the hydraulic head (H).

- Seal concrete thickness for pile footings = 0.25 x H ≥ 2 feet
- Seal concrete thickness for spread footings = 0.4 x H ≥ 2 feet
- Seal concrete strength = 2.0 ksi

The hydraulic head (H) is the difference between the water elevation on the outside of the cofferdam and the proposed bottom of seal elevation inside the cofferdam. The water elevation used to determine the footing height should be shown on the intermediate bent sheet.

The Plan and Elevation sheet should show the elevation of the bottom of the seal for spread footings, but the bottom of the footing for pile footings.

4.2.6.3 Seal Concrete Payment

If the plans do not include seal concrete but field conditions require it, the seal concrete price is based on the cost of Class A concrete according to the GDOT Standard Specifications. When the plans include cofferdams but do not include either seal concrete or Class A concrete, a special provision is required to address payment for seal concrete.

4.2.7 Alternate Foundation Types

When concrete intermediate bents are anticipated as part of a bridge, practical alternative foundation types shall be considered. This effort should be collaborative between the bridge engineer, the geotechnical engineer, and environmental personnel and may result in a presentation of bidding alternatives whenever appropriate for site specific parameters.

Following field investigation work that yields potential practical alternatives for the foundation type, schedule a meeting to include the GDOT Bridge Office, GDOT Geotechnical Bureau, and the project ecologist during which the viability of each alternative can be evaluated. Schedule this meeting prior to full development of the alternatives from a design or geotechnical perspective to reduce potentially wasted efforts.

Environmental permitting and documentation shall consider the impacts of all alternates presented in the plans.

If foundation alternatives are proposed, each shall be presented on separate substructure detail sheets in the bridge plans.

Quantities for the alternates shall be broken out on the Summary of Quantities section of the General Notes sheet such that all the quantities for the superstructure and bents that are common to all alternates are shown under one heading and the quantities for bents with alternates are shown under headings for alternate 1 and alternate 2.

Reinforcement Schedules should clearly reflect the reinforcement for the alternates under separate headings. Bar marks may be duplicated between alternates as necessary

4.3 End Bents

4.3.1 General

The following note shall be added to all end bent sheets that references Georgia Standard 9037 for drainage details required at end bents:

"SEE GA. STD. 9037 FOR DRAINAGE DETAILS AT END BENTS."

The GDOT Standard Specifications state that no separate measurement will be made under the item of Bridge Excavation for any excavation necessary for end bent construction.

However, when a spread footing abutment is required, include the "End Bent Excavation" note on the General Notes sheet, using the BridgeNotes program.

4.3.2 End Bent Caps

4.3.2.1 Cap Dimensions

Use 3ft wide and 2 ft deep as the minimum end bent cap dimensions.

Increase the cap width in 3-inch increments when required by the following:

- Maintain 9 inches of cover on all piles
- Provide a minimum of 3-inch clearance from the edge of bearing pad to the edge of cap or riser. On skews sharper than 75 degrees, this clearance can be reduced to 2 inches.

Increase the cap depth to 3ft minimum when piles are greater than 20" in width or diameter.

Embed piles up to 20" in width or diameter 12 inches into the end bent cap. Embed piles larger than 20" in width or diameter 18" into the end bent cap.

The typical reinforcement approach for pile caps with piles under each point load can be found in the bridge cell library and includes #10 bars at each corner and two #4 bars equally spaced in the top as the default detailing. When point loads are offset from the piles, detail reinforcement as appropriate for design, maintaining the #10 bars at each corner as the minimum.

4.3.2.2 Cap Risers and Steps

Cap step lengths do not need to match the calculated skewed beam distance so detail the cap steps to the nearest 1”. Include the fractional remainders in the outermost steps. Locate cap steps roughly midway between each beam, including end bents that require staged construction.

When an end bent is to be constructed in stages, locate the construction joint within the step that supports the outermost beam in the stage. Do not place the construction joint at the same location as the edge of cap step. Modify the step length or staged cap length, if necessary, to provide a minimum of 1’-0” between the construction joint and the edge of cap step. Orient the construction joint perpendicular to the cap face, regardless of whether the cap steps are skewed.

If the elevation difference between adjacent cap steps is less than 3/4 inch, detail both steps to the lower elevation. No change to the D-dimension is necessary for this adjustment.

When different beam sizes or severe cross-slopes cause the top of cap step to be more than 6” above the main reinforcing, additional reinforcement will be required for that step. In this case, detail two No. 4 bars in the same direction of the main reinforcement at the top of the cap step with 2-inch clearance. Detail stirrups with approximately 1-foot spacing and with the legs extended down into the main cage a minimum of one foot. Based on historical detailing and inspection records the detailing practices noted here provide sufficient crack control in lieu of LRFD 5.10.6.

For a skew of 75 degrees or less, skew the cap steps to align with the centerline of girder.

4.3.2.3 Detailing

Detail a 3-inch diameter by 12-inch deep hole at each dowel bar or anchor bolt location. A deeper hole may be required for steel spans longer than 100 feet. For RCDGs, detail a No. 10 dowel bar to be cast in place.

The provisions for temperature and shrinkage reinforcement in LRFD 5.10.6 can be waived for side faces of bent caps with a minimum height of 2 feet or less. LRFD 5.10.6 can also be waived for the bottom of the pile cap for bents 3.5 feet wide or less.

Detail shear reinforcement in the cap in the form of stirrups, #4 preferred but no larger than #6, at a maximum spacing of 12 inches. A minimum of 4 stirrups shall be detailed over each pile in a typical pile cap. Detail all the primary stirrups in the cap using the same diameter bar.

4.3.2.4 Cheek Walls

In situations where wing walls are replaced by approaching retaining wall, end bent caps should be detailed to include cheek walls at the end of the cap. End bent cheek walls shall be a minimum of 12 inches in width and be reinforced with two mats of #5 reinforcement steel embedded into the cap. This reinforcement should be detailed at a maximum spacing of 12 inches. Position cheek walls at the end of the cap such that the exterior face of the cheek wall is in plane with a line tangent to the edge of deck at the front face of cap. Detail the top of the cheek wall to an elevation 1 inch below the bottom of the overhang with an open joint between the overhang and top of cheek wall.

4.3.3 End Bent Piling

End bent piles should support all loads including loads from the approach slab. A typical 30-foot GDOT standard approach slab is designed based on the assumption that up to 10 feet of the subgrade could be lost, transferring the load to the paving rest and remaining soil. Therefore, it is assumed that the paving rest supports one end of the approach slab, which is modeled as a 10-foot simple beam and transfers the dead and live loads to the piles.

If the end bent fill height is greater than 20 feet, add battered piles between beams at a rate of 1 per 4 or 5 vertical piles. If the pile spacing is very close, some of the load-bearing vertical piles can be battered instead of adding piles.

4.3.4 Wingwalls

The end of wingwall is determined by projecting the slope of the end roll up until it meets the shoulder grade at the inside face of the wing, as shown in Figure 4.3.4-1. The length of the wingwall is the distance from this end to the front face of cap, accounting for the effect of the skew.

Generally, use the same length for both wingwalls at an end bent. The minimum wingwall length shall be 8 ft. Wingwall length shall be detailed to the nearest 6 inches.

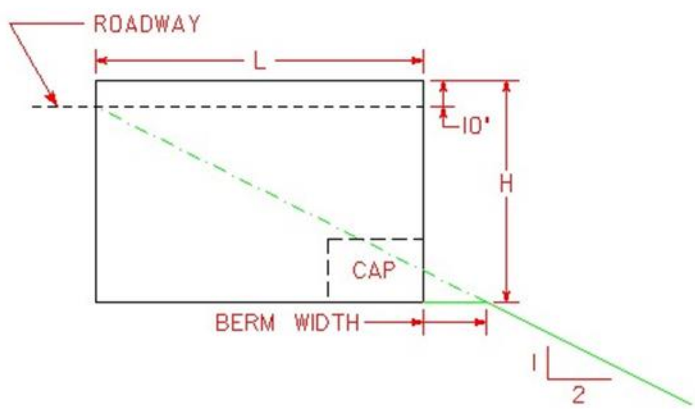


Figure 4.3.4-1 Wingwall Dimensions

The top of wingwall is determined by adding 4 to 10 inches to the shoulder grade at the beginning and end of the wingwall. Use 6 inches as a minimum to match the transition curb of the approach slab when present. The top of the wingwall should be leveled to the higher elevation if the difference is less than 6 inches. The bottom of the wingwall should be level.

On curved alignments, do not curve wingwalls. Skew the wingwall to prevent its encroachment on the shoulder.

Use of piling under wingwalls is governed by wingwall length (L) as follows:

a) When L ≤ 12 ft, no piles are needed.

b) When 12 ft < L ≤ 16.5 ft, add one pile at the end.

c) When 16.5 ft < L ≤ 20 ft, add one pile each at the mid-point and at the end

d) When L > 20 ft, add one pile each at the end and at third points along the wingwall length.

A 2'-6" square by 2'-0" deep pile box should be placed at each pile location in the wingwall. Increase the size of the box to 3'-0" square when using 18-inch or larger piles to maintain minimum clearance.

4.3.5 Rip Rap

At stream crossings, indicate rip rap on the endrolls as specified on the preliminary layout and in the hydraulic study. Extend the rip rap limit 20 feet beyond the end of the wingwall. The calculated rip rap quantity should also be used for the quantity of filter fabric.

If the BFI report recommends a different type and/or depth of rip rap, the designer shall consult with the hydraulic engineer and the geotechnical engineer to determine the appropriate rip rap requirements.

When the Hydraulic Data indicates abnormal flows, the elevation for the top of rip rap shall be 2 feet above the abnormal 100-year flood elevation.

If the 100-year flood elevation calls for rip rap to be placed on the berm at the abutment, coordinate with the hydraulics engineer to confirm that 18 inches of rip rap on the berm will provide sufficient protection, while also providing a minimum of 6 inches of clearance between the top of rip rap and the bottom of the beams. If 18 inches of rip rap is not adequate, the berm elevation may need to be lowered and the abutment depth increased

4.3.6 Slope Paving

Slope paving shall be used on all grade separation and railroad crossing bridges. The footprint of the slope paving extends beyond the edge of the deck by 2 feet on each side of the bridge. For skewed bridges, the slope paving parallels the edge of the bridge on one side and is normal to the bottom of the slope on the other side, so that runoff water from bridge stay on paved slope all the way to the bottom (see Figure 4.3.6-1). However, on railroads in cut sections limit the slope paving to 2 feet outside the edge of deck on both sides to minimize additional cut in the endroll (see Figure 4.3.6-2).

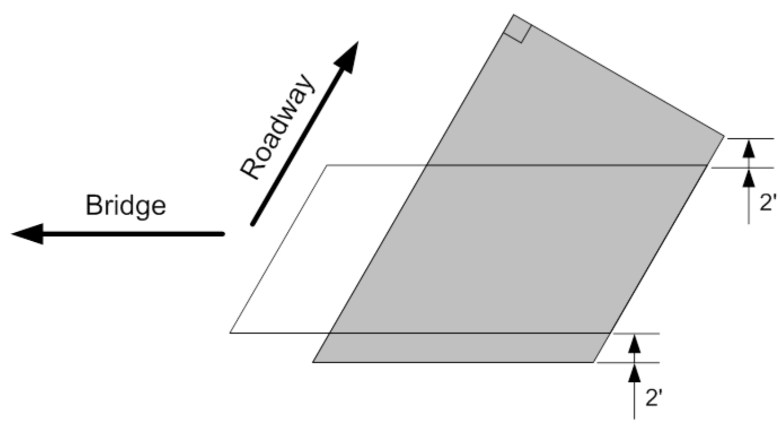


Figure 4.3.6-1 Typical Slope Paving at End of Bridge

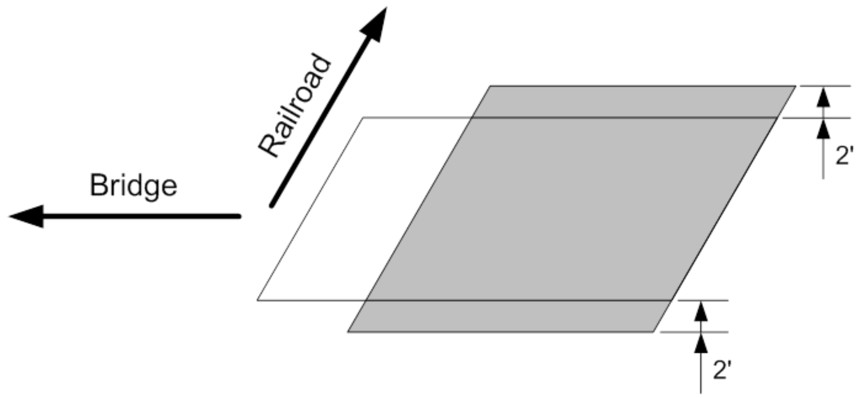


Figure 4.3.6-2 Slope Paving at Railroad Cut Section

4.4 Intermediate Bents

4.4.1 Concrete Column Bents

4.4.1.1 Preliminary Design Considerations

A two-column bent is recommended when the cap length is 60 feet long or less. The columns should be arranged to balance the dead load moments on either side of the centerline of the column to avoid long-term bowing due to creep. The dead load moments on either side of the column centerline shall be within 5% to be considered balanced. Experience has shown that setting the cantilever lengths at approximately 20% of the cap length can accomplish this. For cap lengths greater than 60 feet, use a three-column bent or divide into 2 two-column bents.

When possible, use one column size for the entire bridge. For 90-degree bridges, set the column width equal to the cap width. However, it is acceptable and generally preferred to use a smaller column in skewed bridges that have wider caps to accommodate the bearings. The minimum column width should be 75% of the cap width.

Short column bents may have an issue with accommodating the forces generated by the shrinkage of the cap. When the design height of the columns is approximately 60% or less of the center to center spacing between the columns, consider the use of a wall pier with a strip footing. Determine the material quantities and pile capacity demands for the multi-column and wall pier options for comparison. If the wall pier appears to be the more economical choice, coordinate with the Bridge Office for approval of use, prior to incorporating it as a design solution. See BDM 4.4.3 for wall pier detailing requirements.

4.4.1.2 Concrete Column Bent Caps

4.4.1.2.1 Cap Dimensions

The width of an intermediate bent cap should be a minimum of 3 feet and increased in 3-inch increments to account for skew, bearing size and edge distances. The depth and length of a cap should be detailed in 3-inch increments. For bent caps at grade separations, use a minimum depth to width ratio of 0.75, with a ratio of 1.0 preferred at road underpasses, in order to provide a more aesthetic appearance.

Size the pier cap to provide a minimum of 3-inch clearance from the edge of bearing pad to the edge of cap or riser. On skews sharper than 75 degrees, this clearance can be reduced to 2 inches since only the corner of the bearing pad would be too close to an edge and most of the pad would still be beyond the 3 inch limit.

4.4.1.2.2 Cap Risers and Steps

When the back and ahead beams have different depths, a riser will be required on the cap to compensate for the difference. When the height of the riser is more than 4 inches, two No. 5 bars should be detailed in the top of the riser in the direction of the main reinforcement. If the riser height is more than 18 inches, additional No. 4 bars should be distributed along each face of the riser to control cracking. Detail stirrups with approximately 1-foot spacing and with the legs extended down into the main cage a minimum of one foot. Do not attempt to control cracking by putting a joint in the riser between steps. This detail concentrates stresses at that point and can cause cracking in the main body of the cap.

When a cross-slope or fascia beam causes the top of cap step to be more than 6” above the main or riser reinforcing, additional reinforcement will be required for that step. In this case, detail two No. 5 bars in the same direction of the main reinforcement at the top of the cap step with 2-inch clearance. Detail stirrups with approximately 1-foot spacing and with the legs extended down into the main cage a minimum of one foot. Based on historical detailing and inspection records the detailing practices noted here provide sufficient crack control in lieu of LRFD 5.10.6.

If the elevation difference between adjacent cap steps is less than 3/4 inch, detail both steps to the lower elevation. No change to the D-dimension is necessary for this adjustment.

4.4.1.2.3 Maximum Cap Moment and Shear at the Columns

When designing the negative moment reinforcement over the columns, the designer should consider the moment at the quarter point as maximum. The shear at the face of column should be considered as maximum in the design for stirrups.

4.4.1.2.4 Detailing

A minimum concrete cover of 2 inches is required in the cap.

Detail #11 bars to resist flexure. Limit stirrup reinforcement to #6 bars and smaller.

When positive moment reinforcement between the columns is terminated in lieu of continuing it to the end of the cap, the bars should be detailed to terminate at the side of the column closest to the cantilever.

Minimum spacing for stirrups in the cap shall be 5 inches. Use double stirrups in high shear areas as necessary. The use of single-legged cross ties is prohibited. Using ‘open top’ stirrups to miss anchor bolt hole block outs is permitted but usually not necessary. The contractor is able to shift stirrups in order to miss block outs for the anchor bolt holes. The maximum spacing for stirrups in the cap shall be 12 inches.

Cap step lengths do not need to match the calculated skewed beam distance so detail the cap steps to the nearest 1”.

4.4.1.2.5 Cheek Wall

A cheek wall is typically a 4” thick concrete wall built up on the end of a bent cap to hide a joint in the superstructure for improving the appearance of the bridge. The cheek wall length shall extend from cap face to cap face. The gap between the face of the bottom flange of the beam and the cheek wall shall be 6” or less. In a skewed bridge, the end of the cap shall be skewed so the cheek wall can be parallel to the beam face.

4.4.1.3 Columns

4.4.1.3.1 Vehicular Impact Loading

All columns that have less than 30’-0” horizontal clearance from the edge of roadway shall be designed for the vehicular collision force in accordance with LRFD 3.6.5. Protection by barrier or embankment will not waive this requirement. Do not consider the transfer of the vehicular collision force to the components fully buried underground.

Where bridge columns are within 25’-0” of the centerline of a railway, design columns to provide structural resistance for the same vehicular collision force as specified in LRFD 3.6.5.

The shear force created by the vehicular collision load shall be analyzed with the assumption of a single shear plane.

4.4.1.3.2 Cross Section

The column cross sections should be dimensioned in 6-inch increments beginning at 3 feet. Columns narrower than 3 feet should not be used unless it is necessary to match the existing column size and to maintain horizontal clearance. Square columns are the default shape approach for detailing and should be reinforced with a square reinforcing pattern consisting of the same number of bars in each face. Use round columns on drilled shaft foundations. Round columns may also be used on footings as a design alternative to address seismic detailing or scour.

For drilled caissons, it is recommended to use a column that is 6 inches smaller in diameter than the caisson to line up the reinforcements and meet the different requirements in concrete cover.

4.4.1.3.3 Construction Joints

Use Table 4.4.1.3-1 to determine the number and location of required construction joints in columns. Column height, x, is measured from top of footing to bottom of cap.

Table 4.4.1.3-1 Construction joints in columns

Column Height, x	Construction Joints
X ≤ 30 ft	No construction joint
30 ft < x ≤ 40 ft	1 construction joint at mid-height
40 ft < x ≤ 60 ft	2 construction joints at one-third points
X > 60 ft	Construction joints at 20 ft max. spacing

Reinforcement should be detailed to take the construction joint into account.

4.4.1.3.4 Reinforcement Detailing

Detail #11 bars to resist flexure. Limit stirrup reinforcement to #6 bars and smaller.

Do not hook column bars in the top of the cap.

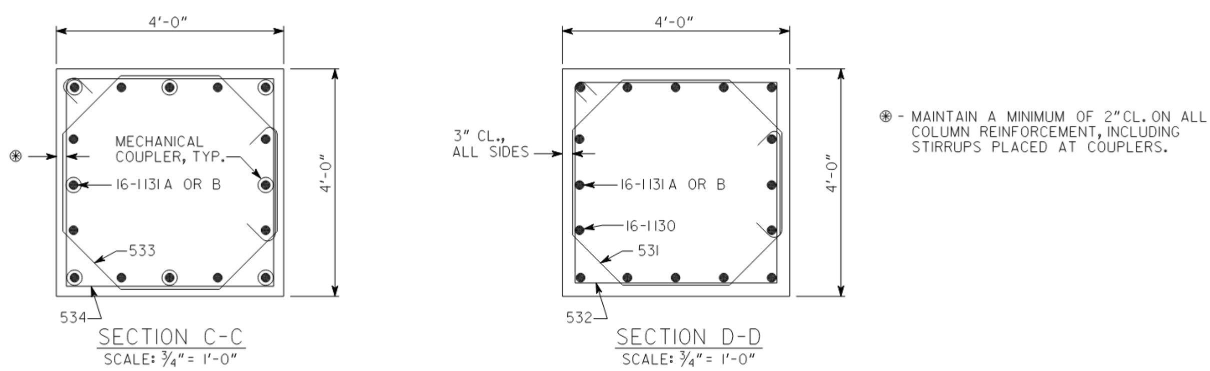
Detail column reinforcement to provide at least a 6" center to center spacing between stirrups. The maximum spacing for stirrups in the column shall be 12 inches center to center.

When detailing bridges in seismic zone 1, based on historical detailing and inspection records, the cross tie spacing requirements found in LRFD 5.10.4.3 may be waived for square columns up to 48 inches in width. Column cross-ties shall be arranged to accommodate at least a 6-inch tremie to facilitate concrete placement.

When detailing seismic columns using an octagonal "stop sign" bar, note that there is not an equivalent shape on Bar Bending Details Standard 3901. Detail the bar on the reinforcement schedule as a Type 60 bar and include cell TYPOCT from the GDOT Bridge Cell Library on Reinforcement Schedule sheet.

Use a minimum concrete cover of 2 inches for all columns. Increase concrete cover to a minimum of 3 inches when mechanical couplers are used. The additional 1 inch of cover will provide for the 2 inch minimum at the couplers.

Label concrete cover in the column as shown below, when mechanical couplers are used:



When the cap and column widths are detailed as the same, increase the cover on the column reinforcement to prevent conflicts between the main cap and column steel.

When mechanical couplers are used, include the following notes on the intermediate bent sheet:

- **STAGGER COUPLER LOCATIONS ON ADJACENT VERTICAL REINFORCEMENT A MINIMUM OF 2'-0" VERTICALLY.**
- **FULL LENGTH REINFORCEMENT MAY BE USED AS ALTERATE TO USE OF COUPLERS.**

4.4.1.4 Footings

See Sections 4.2.4 and 4.2.5 for information about spread footings and pile footings.

4.4.1.5 Substructure Finish for Bridges over Navigable Waters

When a bridge crosses a highly traveled waterway and a higher level surface treatment is desired, include the “Special Surface Coating for Substructures” note on the General Notes sheet using the BridgeNotes program.

4.4.2 Pile Bents

Pile bent consists of a concrete cap formed directly on top of piles. Typically, a pile is placed under each beam. Exterior piles are generally battered outwards at a 1.5:12 ratio for lateral stability.

A tower bent is a pile bent with two piles under each beam battered at a 1.5:12 ratio in the longitudinal direction for additional stability. Tower bents should be considered at fixed bent locations when the bridge length requires an intermediate expansion joint. The preliminary layout sometimes precludes tower bents at certain locations.

4.4.2.1 Pile Bent Caps

Use 3ft wide and 2 ft deep as the minimum pile bent cap dimensions.

Increase the cap width in 3-inch increments when required by the following:

- Maintain 9 inches minimum cover on all piles
- Provide a minimum of 3-inch clearance from the edge of bearing pad to the edge of cap or riser. On skews sharper than 75 degrees, this clearance can be reduced to 2 inches.

Increase the cap depth to 3ft minimum when piles are greater than 20” in width or diameter.

Embed piles up to 20” in width or diameter 12 inches into the pile bent cap. Embed piles larger than 20” in width or diameter 18” into the pile bent cap.

The typical reinforcement approach for pile caps with piles under each point load can be found in the Bridge Cell Library and includes #10 bars at each corner and two #4 bars equally spaced in the top as the default detailing. When point loads are offset from the piles, detail reinforcement as appropriate for design, maintaining the #10 bars at each corner as the minimum.

Detail shear reinforcement in the cap in the form of stirrups, #4 preferred but no larger than #6, at a maximum spacing of 12 inches. A minimum of 4 stirrups shall be detailed over each pile in a typical pile cap. Detail all the primary stirrups in the cap using the same diameter bar.

For guidance on cap step and riser details see BDM 4.3.2.2.

The provisions for temperature and shrinkage reinforcement in LRFD 5.10.6 can be waived for side faces of bent caps with a minimum height of 2 feet or less. LRFD 5.10.6 can also be waived for the bottom of the pile cap for bents 3.5 feet wide or less.

4.4.2.2 Sway Bracing

Sway bracing may be used to reduce unsupported H-pile length in the transverse direction, when necessary, by design. If utilized, sway bracing is normally comprised of L4x4x3/8 angles arranged in an “X” fashion. Include details for the placement of sway bracing, according to the design requirements, on the intermediate bent substructure sheet. Detail sway bracing such that it is placed 6 inches above the top of the pile encasement and 4 inches below the bottom of the cap.

4.4.2.3 Pile Protection

4.4.2.3.1 Painting

When steel piling is used to support intermediate bent caps, pedestal footings, or end bents (excluding MSE abutments), include the “Special Protective Coating for Piles” note on the General Notes Sheet using the BridgeNotes program. This note is needed to augment Sections 520 and 535 of the GDOT Standard Specification and specify 2P coating.

4.4.2.3.2 Encasement

Except in cases where sway bracing has been included in the design of a H-pile supported intermediate bent, detail a square pile encasement around each H-pile that extends from 2ft below the ground to the bottom of the concrete cap. A pile encasement cell is available in the GDOT Bridge Cell Library.

If sway bracing is designed for the bent, detail the same square pile encasement around each H-pile from 2ft below the ground to 2 feet above the ground, or 2 feet above normal pool/ 2-year flood elevation, whichever is greater.

All piling shall also receive 2P coating as noted in BDM 4.4.2.3.1, so inclusion of the “Special Protective Coating for Piles” note remains necessary when piles are encased.

4.4.3 Wall Piers

Wall piers should be considered when short intermediate bents are needed under a structure and shrinkage forces in the cap lead to unreasonable footing configurations. Request approval from the Bridge Office to use a wall pier prior to incorporating it as a design solution.

Projects delivered via alternative bidding methods may utilize wall piers as determined appropriate by the Design Build Team.

4.4.3.1 Cap Details

Use 3 ft wide and 2 ft deep as the minimum wall pier cap dimensions. Ensure that the cap width extends a minimum of 3 inches on each side beyond the face of stem. Increase the cap width in 3-inch increments to provide a minimum of 3-inch clearance from the edge of bearing pad to the edge of cap or riser. On skews sharper than 75 degrees, this clearance can be reduced to 2 inches.

The minimum reinforcement for wall pier caps is #10 bars at each corner and two #4 bars equally spaced in the top. Detail #4 cap stirrups at a maximum spacing of 12 inches.

4.4.3.2 Stem Details

Detail the stem of the wall pier so that the construction joint between the stem and cap is horizontal.

Use a stem width with a minimum dimension of 24 inches. The stem width should be controlled by design and not increased to match the cap width.

Extend the length of the stem to equal the length of the cap.

Do not hook column bars in the top of the cap.

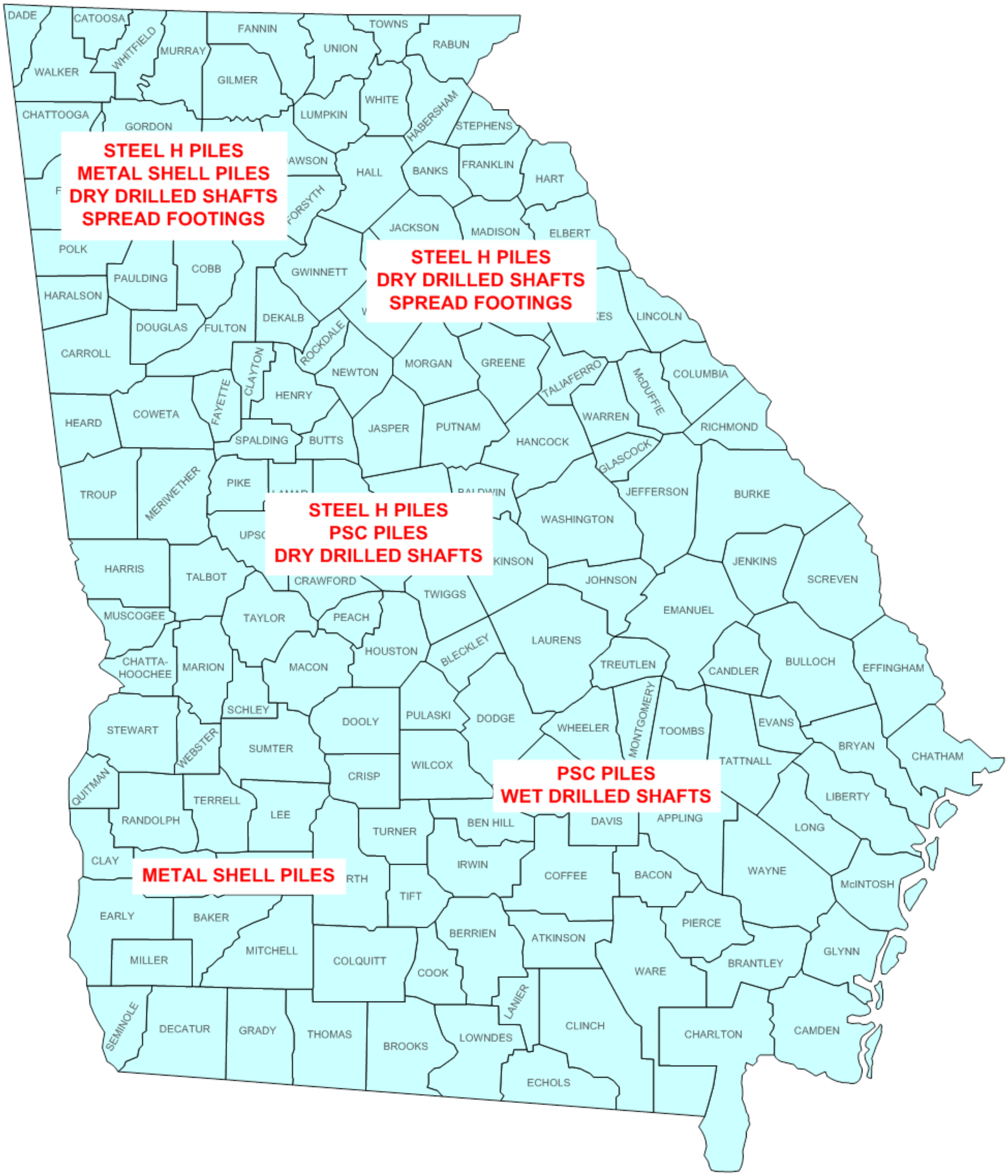
Detail wall pier stem reinforcement in accordance with LRFD 5.11.4.2 when seismic detailing is necessary according to BDM Chapter 9.

4.4.3.3 Footing Details

Use spread or pile footings a minimum of 2 ft wider than the pier stem in each direction.

Space piles supporting a wall pier at a maximum center to center spacing of 9 ft.

4.5 Appendix 4A - General Guide Map for Foundation Types



4.6 Appendix 4B - Preset Pile Layouts

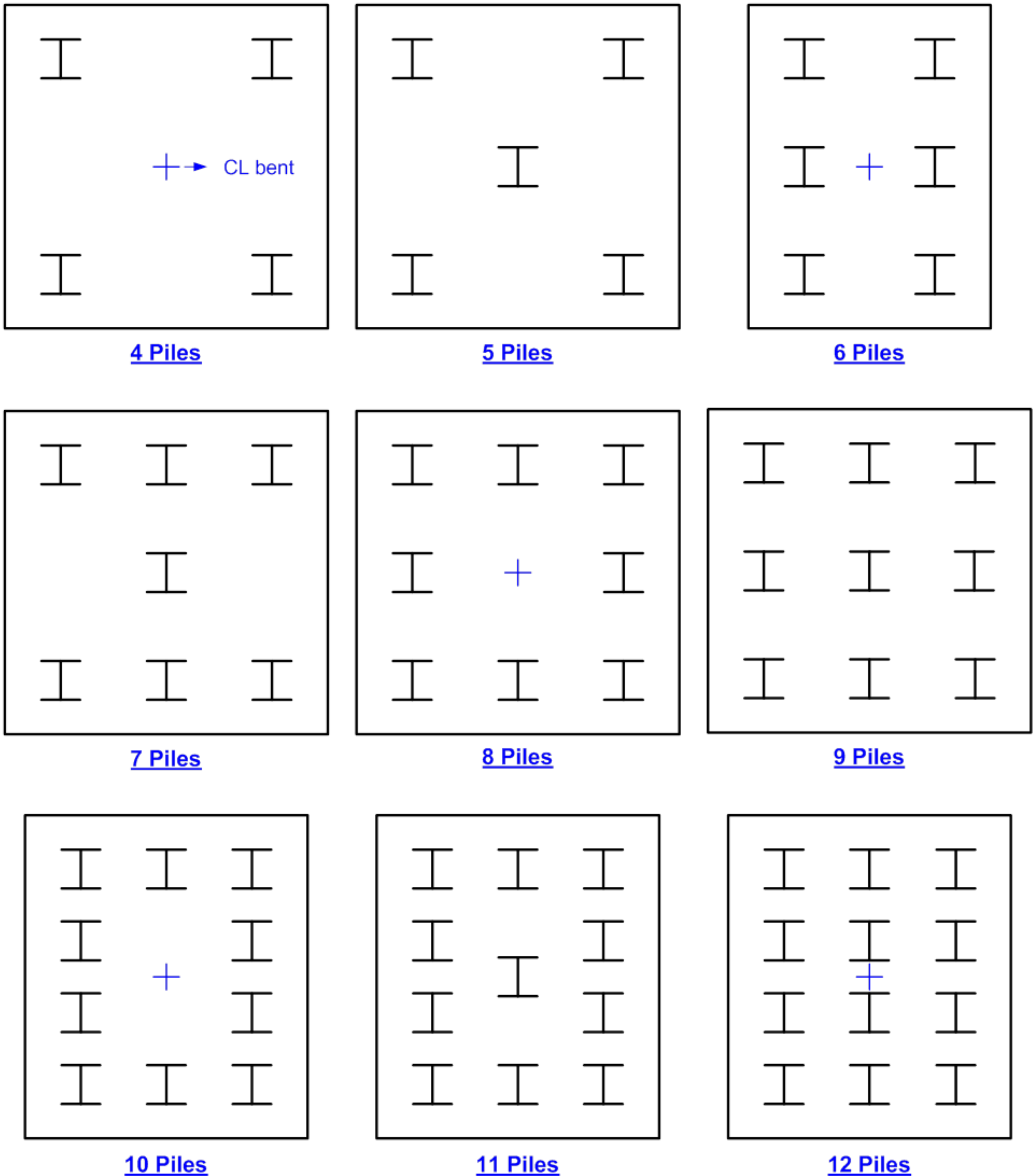


Figure 4B-1 GDOT Pile Layout (4 to 12 Piles)

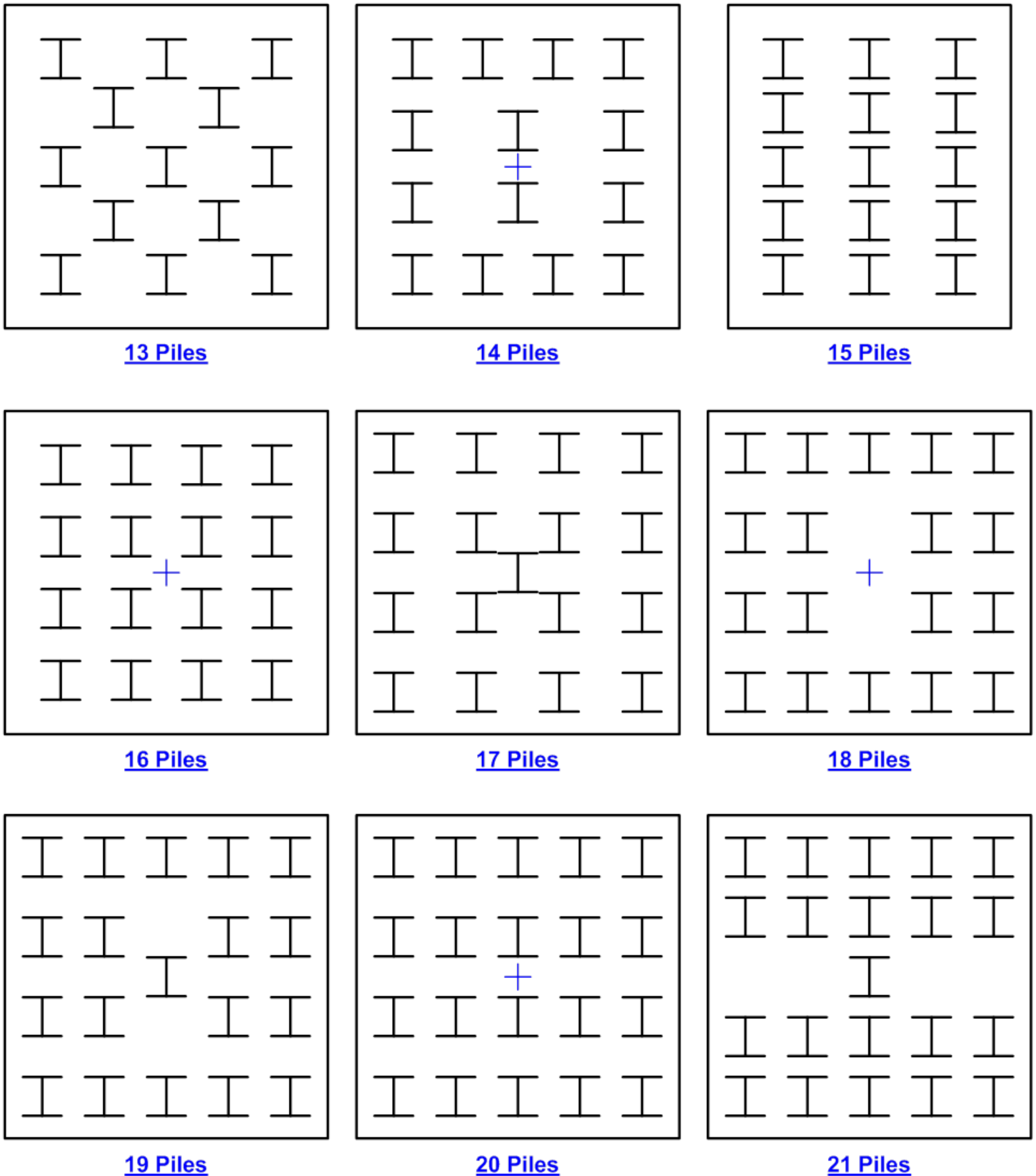
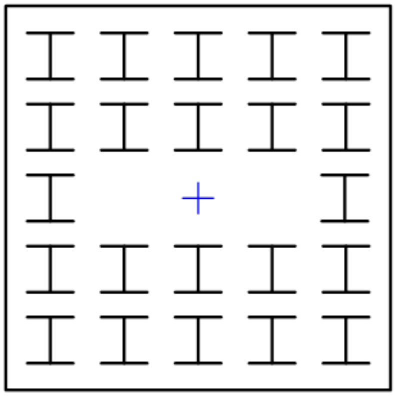
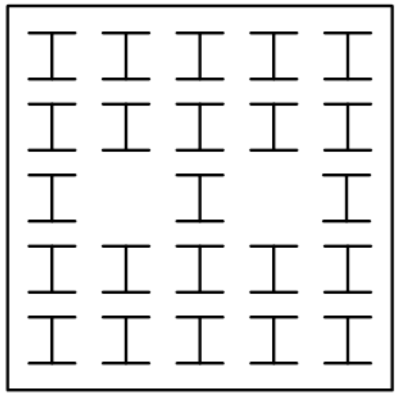


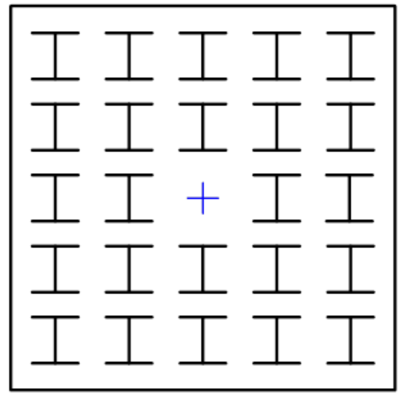
Figure 4B-2 GDOT Pile Layout (13 to 21 Piles)



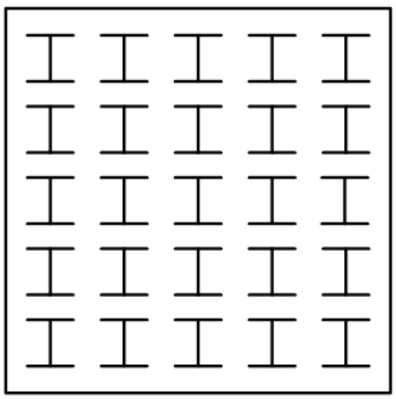
22 Piles



23 Piles



24 Piles



25 Piles

Figure 4B-3 GDOT Pile Layout (22 to 25 Piles)

4.7 Appendix 4C – Caisson Notes

TEMPORARY CASING MAY BE NECESSARY TO INSTALL DRILLED CAISSONS.

- As directed in BFI or special provision

PROVIDE PERMANENT CASING TO AT LEAST AN ELEVATION OF XXX.X TO INSTALL THE DRILLED CAISSON.

- As directed in BFI, special provision or if caissons are installed in water

PROVIDE PERMANENT CASING TO INSTALL DRILLED CAISSONS. IF THE BOTTOM OF PERMANENT CASING IS LOWERED DURING DRILLING, EXTEND THE BOTTOM OF DRILLED CAISSON DEEPER, INCLUDING REINFORCEMENT, AS DIRECTED BY THE ENGINEER TO COMPENSATE FOR LOSS OF CAPACITY.

- For skin friction caissons, as directed in BFI

DRILLED CAISSONS ARE DESIGNED FOR A FACTORED TIP RESISTANCE OF ___ KSF ON ______ ROCK.

- For end bearing caissons, as directed in BFI

DRILLED CAISSONS ARE DESIGNED FOR A FACTORED SIDE RESISTANCE OF ____ KSF TO RESIST A MAXIMUM FACTORED AXIAL LOAD OF ___ KIPS AT THE GROUNDLINE. EMBED DRILLED CAISSONS A MINIMUM OF ___ FEET INTO ________ SOIL/ROCK. LENGTH SUBJECT TO CHANGE BASED ON REQUIRED LOAD TEST. SEE SPECIAL PROVISION 524.

- For skin friction caissons, as directed in BFI

SOCKET DRILLED CASSIONS A MINIMUM OF X'-X" INTO SOUND ROCK.

- As directed in BFI

DO NOT RAISE DRILLED CAISSON TIP ABOVE ELEVATION XXX.X FOR STRUCTURAL STABILITY.

- Use on all drilled caissons. Elevation to be set by the designer.

EXTEND NO. 11 BARS 9'-3" ABOVE TOP OF DRILLED CAISSON TO LAP WITH COLUMN BARS.

- Use for all caissons with columns on top or detail in Elevation View

EXTEND NO. 11 BARS A MINIMUM OF X'-X" INTO THE CAP. IF LAP IS UTILIZED FOR NO. 11 BARS, PROVIDE A MINIMUM LAP OF 9'-3".

- Use for situations where the vertical shaft reinforcement extends into the cap. Penetration of #11 bars into the cap should be maximum amount allowed without interfering with top flexural cap steel.

INCLUDE COST OF NO. X BARS IN THE PRICE BID FOR "DRILLED CAISSON."

- Use when stirrups are not contained within the limits of the caisson and not detailed as part of the substructure steel quantity.

QUANTITIES AND REINFORCEMENT LENGTHS WERE CALCULATED BASED ON AN ASSUMED TOP OF DRILLED CAISSON ELEVATION OF XXX.X.

- Use for all caissons

TOP OF DRILLED CAISSONS SHALL BE 1'-0" BELOW GROUNDLINE.

- Use for all caisson on land and detail in Elevation View

TOP OF DRILLED CAISSONS SHALL BE 1'-0" ABOVE WATER SURFACE AT THE TIME OF CONSTRUCTION.

- Use for all caisson in water and detail in Elevation View

TOP OF DRILLED CAISSON SHALL BE 1'-0" BELOW GROUNDLINE, OR 1'-0" ABOVE WATER SURFACE AT THE TIME OF CONSTRUCTION, WHICHEVER IS HIGHER.

- Use for situations where control of the top of caisson is ambiguous, including when differing controlling conditions exist for multiple bents presented on one plan sheet.

Chapter 5. Retaining Walls - Contents

Chapter 5. Retaining Walls

5.1 General

All retaining walls shall be designed in accordance with the AASHTO Specifications outlined in BDM 2.1.1 and as noted in the following subsections.

All retaining walls shall be founded on existing material, and not fill material.

See Sections 31 and 32 of the Plan Presentation Guide for guidance on the creation of retaining wall envelopes and special design retaining wall plans, respectively.

5.1.1 Wall Types

The type of wall should be determined based on economy, constructability and geotechnical conditions. Coordination between the roadway designer and Bridge Office shall take place during the preliminary design phase before Right-of-Way plans are finalized.

The wall types allowed on GDOT projects are presented in Table 5.1.1-1 with their corresponding design options. Any wall type not included in the table should receive advanced approval from the Bridge Office before inclusion.

Table 5.1.1-1 Current GDOT Wall Types and Design Options

Wall Type	Design Option
Gravity (Concrete or Rubble Masonry)	GDOT Standards
Reinforced Concrete Cantilever	GDOT Standards or Pre-Construction Design
MSE (Panel or Modular Block)	Contractor Design
Soldier Pile	Pre-Construction Design
Tie-Back	Contractor Design
Soil Nail	Contractor Design

5.1.2 Wall Design

5.1.2.1 GDOT Standard Design

Whenever possible, the roadway designer should use a pre-designed concrete wall found in the GDOT Standards, as listed in Table 5.1.2.1-1. For the wall standards to be applicable the following is required:

- the wall shall be used in the manner illustrated in the standard drawings
- the maximum wall height, with consideration of any necessary steps in the footing, must fall within the limits shown on the standard.
- the “Standard Walls Usage without Wall Foundation Investigations” section of the Geotechnical Manual must be satisfied

If all criteria for using a standard wall are met, the roadway designer will include the appropriate standard in the contract plans and a retaining wall envelope for the structure under section 31 of the contract plans.

Table 5.1.2.1-1 GDOT Standard Retaining Walls

Standard Number	Title	Application
4949B	Concrete Side Barrier Types 2-S, 2-AA, 2-SB, and 2-SC	RC cantilever fill wall adjacent to roadway
4949C	Concrete Side Barrier Types 6-S, 6-SA, 6-SB, and 6-SC	RC cantilever cut wall adjacent to roadway
4949D	Parapet Retaining Wall, Types P1, P2, and P3	RD cantilever fill wall adjacent to sidewalk
9031L	Retaining Wall Typical Sections, Raising Headwall, And Typical Pipe Plug	Gravity wall with or without barrier face

5.1.2.2 Special Design

When the GDOT Standards are not applicable for a given wall location, the roadway designer will request a special designed retaining wall. Special design retaining walls will be prepared under the Pre-Construction Design approach or Contractor Design approach, depending on the type of wall. In either case, a Preliminary Wall Layout including the plan view, elevation view, typical section, and design specification will be prepared for Bridge Office approval. The approved layout can then be transmitted as part of the wall foundation investigation request (WFI) and included in section 32 of the PFPR plans. Once an approved WFI is available, final wall plans will be produced for approval and inclusion in section 32 of the FFPR and Final Plans.

5.1.2.2.1 Pre-Construction Design

Reinforced Concrete Cantilever walls (gravity) and Soldier Pile walls (non-gravity cantilever) are both Special Design Retailing walls that are developed as Pre-Construction Design walls. This means that following the activities of preliminary design, the Bridge Office or its consultant partners prepare complete final wall design plans for inclusion in section 32 of the contract plans. These plans include all the structural design, detailing, notes and material quantities necessary for bidding and construction in the field.

5.1.2.2.2 Contractor Design

MSE, Soil Nail, Tie Back, Modular and Modular Block walls are Special Design Retaining walls that are developed as Contractor Design walls. This means that following the activities of preliminary design, the Bridge Office or its consultant partners prepare final wall plans that include a P&E sheet, typical sections, design criteria, notes and quantities for inclusion in section 32 of the contract plans. The provided information and requirements guide the Contractor's engineer (typically specialty suppliers or sub-contractors) in developing specific design plans based on proprietary systems and techniques after the contract is awarded. The Contractor then provides the final design to the Bridge Office for review and approval as shop drawings.

5.1.3 Design Requirements

5.1.3.1 Design Life

MSE walls within 100 feet of a bridge shall be designed for a 100 year design life. All other retaining walls, including MSE walls not within 100 feet of a bridge, shall be designed with a 75 year design life.

5.1.3.2 Live Load Surcharge

A surcharge of 0.250 ksf shall be applied to all retaining walls whose pressure surface is within a horizontal distance H/2 from traffic loads, where H is the design height of the retaining wall. Traffic loading should be assumed present on the travel way and the shoulder. The pressure surface is at the back of the reinforced mass for MSE systems or a vertical line extended up from the heel for cast-in-place cantilevered gravity walls.

5.1.3.3 Horizontal Forces from Structures

Retaining walls that support or are directly adjacent to bridge abutments shall be designed with consideration of the horizontal loads transmitted from the bridge superstructure. If there is no specific load information, the wall designer should account for an unfactored horizontal load equal to 5 percent of the dead load presented on the bearing pad detail sheet in the bridge plans divided by the beam spacing at the abutment.

5.1.3.4 External Stability for MSE Retaining Walls

In preparation of the contract drawings for MSE retaining walls it is necessary to calculate the bearing pressure as well as the minimum and effective strap lengths for representative sections of a wall envelope so that a geotechnical evaluation of the site can be completed.

Typically soil borings are taken at the site with reference to the proposed wall envelope and basic soil parameters established for the foundation and backfill soils. This information is then used, along with applied load information, to determine the necessary reinforcement length that satisfies the required sliding, eccentricity, and bearing pressure checks. The results of this effort are then used to complete the foundation investigation report and develop recommendations for the plans.

When conducting the above stated external stability checks, the engineer should use the following assumed values unless more specific project information is available:

For Projects North of the Fall Line*:	Cohesion ----------------------------------- 0 PSF
	Angle of Internal Friction ------------------ 34°
	Unit Weight --------------------------- 135 PCF
For Projects South of the Fall Line*:	Cohesion ----------------------------------- 0 PSF
	Angle of Internal Friction ------------------ 30°
	Unit Weight --------------------------- 120 PCF

*-See Appendix 3A for map that includes the location of the Fall Line

Representative sections of the MSE wall should be determined by the designer and consider variations in load conditions, wall height, and effective foundation widths.

5.1.3.5 Rail Loading

Retaining walls with a barrier at the top, such that impact to the rail causes an overturning load, shall be evaluated for stability using a static design load of 15kips, applied over 5ft at the top of the barrier shape used.

For cast in place cantilever walls this load can be dispersed at a 1:1 slope in one direction, assuming impact happens near a joint. Use the resulting moments for evaluating overturning, sliding, and bearing pressure, as well as designing the stem and footing elements of the wall. Barrier or parapet sections should be detailed to satisfy the yield line analyses of LRFD A13, with the exception noted in section 3.3.2.1.2, assuming fixity at the base of the barrier.

See section 5.5.3.1.9 for application of rail road on MSE walls.

5.2 Preliminary Wall Design

If the roadway plans are being prepared by GDOT staff, the roadway designer will submit a request to the Bridge Office for a special designed retaining wall. The following sub-sections provide information on what items need to be included in the wall request, critical items to coordinate between offices, and the Wall Foundation Investigation (WFI) process. During preliminary design the bridge designer will prepare a Preliminary Wall Layout including the plan view, elevation view, typical section, and design specification, and provide it to the Project Manager for inclusion in the request for a WFI. The same preliminary wall layout will be provided back to the road design team for inclusion in the PFPR plan set in section 32.

If the wall is to be designed by a consultant, a Preliminary Wall Layout will be prepared in the same manner as above and submitted to the Bridge Office for approval prior to PFPR. See BDM 1.4.3.1 for an outline of the preliminary plan submittal requirements.

5.2.1 Initial Design Request from Roadway Designer

When a special design retaining wall is required on a project, the roadway designer shall submit the following information to the Bridge Office:

a) An elevation view (profile) of the wall showing the following:
   - Beginning and ending wall stations
   - Elevations on top of the wall at the beginning, end, and at profile break points
   - The original ground profile
   - The proposed ground profile

b) Roadway cross-sections in the vicinity of the wall that show the existing and final slope behind the wall

c) Project Cover Sheet

d) Project typical sections associated with the wall

e) Project plan-and-profile sheets showing the following:

- Limits of right-of-way
- Superelevation data
- Horizontal and vertical alignment data
- Horizontal offsets to the face of the wall, gutterline at barrier or face of parapet on the wall as applicable
- Location and height of any sound barriers on the wall
- Location of any overhead signs near the wall
- Location of any roadway lighting near the wall
- Location of any drainage structures that will affect the wall

f) Any construction sequence requirements for the wall construction

g) Any architectural treatment required for the wall

5.2.2 Items to Coordinate with the Roadway Designer

Once the initial request for a special design wall has been received, the following items should be considered during coordination between the Bridge Office and roadway designer:

a) Right-of-Way: Right-of-Way and easement limits may be affected by the selected wall type.

b) Existing Structures: Surcharges from existing adjacent structures should be considered as well as the impact of the wall on those structures. If walls are proposed above an existing concrete drainage structure, it should be evaluated for capacity and for condition before planning to retain the structure.

c) Wall Termination Points: Termini for the wall should be selected to avoid construction and right-of-way issues. A situation to consider is when there is an elevation difference between the proposed top of wall and ground line at an end of the wall. In this case, the subsequent slope wrapping around the front face of the wall may interfere with obstacles or boundaries.

d) Top of Wall Profile: The top of wall should be designed to present a smooth profile with no sharp breaks, peaks or valleys. See DM 5.5.3.2.1 for guidance in establishing top of wall profiles for any type abutment wall.

e) Surface Drainage: Run-off water from behind the wall is typically collected in a paved ditch at the top of the wall. An appropriate top of wall slope and ditch should be provided to allow the water to drain to the ends of the wall. Consideration should also be given to where the water outfalls and the volume of water that will be present.

f) Utilities: All utility locations near the proposed wall should be verified as both buried and overhead utilities may conflict with wall construction. The wall footing should be set so that it will not be influenced by any adjacent water line that may fail in the future.

g) Drainage systems installed in or near a retaining wall should be coordinated and minimized when possible. Drainage structures in the foundation of any wall must be either cast in place or precast. The foundation is the envelope bounded by a 1:1 slope extending downward from the front and back of the wall footprint. Similarly, all drainage structures within the reinforced backfill of an MSE wall or within 5ft of the front of or behind an MSE wall must be cast in place or precast. Brick structures are prohibited where precast or cast in place are required.

When possible, drainage pipes and structures within the reinforced MSE backfill should be avoided. This can be accomplished in part by routing longitudinal systems elsewhere or by providing direct outfalls from structures through the face of the MSE wall in lieu of longitudinal pipe runs within the MSE backfill.

5.3 Final Wall Plans

Final wall plans shall be developed based upon the recommendations previously approved and the Wall Foundation Investigation. If the WFI reveals unexpected geotechnical conditions, the designer shall submit a second wall recommendation, as necessary, to the Bridge Office for concurrence prior to proceeding with final wall plans.

Whether Final Plans are being prepared using the Pre-construction Design approach or the Contractor Design approach, the final wall plans shall be developed as described in Chapter 2-Section 32 of the GDOT Plan Presentation Guide.

5.4 Staking for Retaining Walls on Construction

GDOT Standard Specification 149.3.03.D addresses the construction requirements in regards to staking for retaining walls. Prior to approving the calculations and plans for contractor designed walls, the reviewer shall have a letter from the contractor stating that the wall has been staked out and that the field conditions match design assumptions.

5.5 Special Considerations for Individual Wall Types

5.5.1 Gravity Wall

GDOT Standard 9031L outlines the use of a gravity wall under various front face and retained slope conditions. The maximum height of a gravity wall in any case is limited to 10 feet.

It is not recommended to use a gravity wall adjacent to roadways or parking lots where it creates a potential vertical drop for a vehicle. In this case, use a Type 2-S side barrier wall as specified in GDOT Standard 4949B or a parapet wall as specified in GDOT Standard 4949D.

5.5.2 RC Cantilever Wall

Standards 4949B and 4949C, and 4949D present three types of RC cantilever walls that can be applied appropriately without design or review by the Bridge Office. The maximum heights for these walls are presented in Table 5.5.2-1. The 4949 Series Standards do not address many detailing items that might be necessary for the project, including but not limited to pipe penetration and bends in the wall alignment. Special details will need to be included in the contract plans to address these and other specifics.

Table 5.5.2-1 Standard RC Cantilever Walls and Height Limits

Wall Type	Maximum Height
Type 2-S Side Barrier	13’-0”
Type 6-S Side Barrier	10’-6”
Parapet Retaining Wall	14’-0”

When the pre-construction design option is used for a special design RC cantilever wall, prepare a complete set of design plans in accordance with BDM 2.1.1 specification requirements. See BDM 5.3.1 for a basic list of required plan elements. Use the Cast-In-Place Wall notes bundle, edited as appropriate, to populate the General Notes sheet in the plans. Fully detail wall reinforcement using sections, panel schematics, details, and a reinforcement schedule.

Design RC cantilever wall footings to limit settlement to a maximum of 1 inch.

Identify expansion and contraction joints on the wall elevation view. Place joints a minimum of 4ft from any bend in the wall alignment. Space contraction joints at a maximum spacing of 20’-0”. Include expansion joints at a maximum spacing of 80’-0”. Do not extend longitudinal reinforcement through either expansion or contraction joints in the wall stem. However, do detail longitudinal reinforcement in the footing as continuous between expansion joints. When footing dimensions change, extend longitudinal steel from the smaller footing into the larger a minimum of 2’-0”.

The GDOT Bridge Cell Library may be used to assist with final detailing.

Use of counter forts is allowed when it results in the most cost-effective design. RC cantilever wall footings shall be embedded a minimum of 2 feet below the proposed ground line. In calculating the passive resistance force at the face of the wall, this 2-foot soil layer shall be neglected to account for potential disturbance in the future.

RC cantilever walls are measured for payment by the component parts. Individual quantities for “CLASS A CONCRETE, RETAINING WALL”, “BAR REINF STEEL”, are the typical elements, but additional items may be necessary.

5.5.3 MSE Walls

Contractor-designed MSE walls are governed by Section 627 of the GDOT Standard Specifications. This specification covers the design and construction of MSE walls, and refers to Section 626 for additional construction requirements. Contract drawings for MSE walls should be prepared in accordance with these specifications.

5.5.3.1 MSE Walls Detailing (General)

5.5.3.1.1 Wall Embedment

The minimum cover from the proposed ground line to the bottom of the wall (top of leveling pad) shall be two feet. Increase the cover when required as follows:

- Where the proposed ground line slopes downward from the front face of the wall, the top of leveling pad elevation shall be set to maintain a minimum 10’ berm in front of the wall (see Figure 5.5.3.1.1-1).

- The top of leveling pad elevation shall be set at or below the level of adjacent utilities such as water lines that may fail and scour the foundation in the future.
- The top of leveling pad elevation shall be at least 2' below the bottom of an adjacent ditch. (see Figure 5.5.3.2.5-1). However, if the 10' berm stated above can be achieved before reaching the ditch, then the embedment can be based on the slope/groundline and not the ditch. See Section 12.1.7 of the GDOT Drainage Design for Highways manual for minimum offset requirements for ditches.
- When a proposed wall is adjacent to a stream or impounded water of any type, see Section 12.1.7 of the GDOT Drainage Design for Highways manual for embedment and protection requirements.

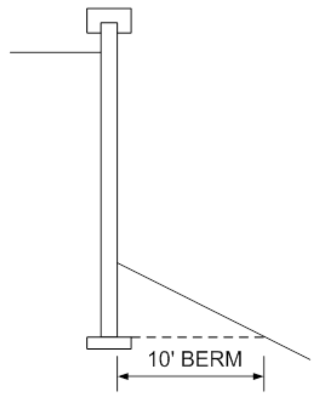


Figure 5.5.3.1.1-1 Berm in Front of Wall

5.5.3.1.2 Soil Characteristics

For LRFD project it is necessary to list the soil characteristics of both the foundation soils and retained backfill material. List each separately on the contract drawings, even if they are the same.

5.5.3.1.3 Maximum Back Slope

The maximum slope behind any retaining wall shall be 2 horizontal to 1 vertical.

5.5.3.1.4 Top of Wall Elevations

The top of wall elevation of all walls which retain sloping backfills shall be set to accommodate a drainage ditch, such as the one presented in Construction Detail D-49 or a larger ditch as drainage area requires. The V-shaped ditch intended for gravity walls shall not be used. Ditch paving behind the wall is a roadway item, so it should be confirmed with the roadway designer that this quantity is included on the roadway plans.

5.5.3.1.5 Avoiding Underground Utilities

Before using MSE walls on urban streets, the designer shall investigate to see if underground utilities will interfere with the wall system and its modules or straps. In general, MSE walls shall not be used in situations in which maintenance crews of the underground utilities will dig into the straps, mesh or modules. RC cantilever walls shall be used in these instances.

5.5.3.1.6 Aesthetic Finishes

A series of “Finish” notes are available in the BridgeNotes program to address varied requirements for specific finishes to match wall panel aesthetics. However, if there is no environmental commitment to a specific pattern, and no written directive from the project manager to use a specific pattern, include the “Finish” note that states that “no architectural finish is required” on the wall plans.

5.5.3.1.7 Graffiti Proof Coating

Whenever a wall face will be visible to the traveling public, include the “Graffiti Proof Coating” note on the General Notes sheet using the BridgeNotes program.

5.5.3.1.8 Overhead Sign Foundations

Overhead sign foundations shall not be placed on the reinforced backfill of MSE walls.

5.5.3.1.9 MSE Wall Coping

There are 3 types of MSE wall copings available as follows (See Figure 5.5.3.1.9-1):

- Coping A: Basic coping without barrier
- Coping B: Coping with parapet and moment slab to be used adjacent to sidewalk
- Traffic Barrier, Type H: Coping with S-Type barrier and moment slab to be used adjacent to traffic

For Coping B and Traffic Barrier H the overturning and sliding of the coping and external stability of the wall system shall be evaluated using a 15kip load, applied at the top of the barrier shape and distributed to an assumed continuous moment slab length of 30ft.

5.5.3.1.10 Moment Slab Conflicts with Approach Slabs

When an MSE wall near a bridge abutment is configured such that Traffic Barrier H or Coping B are running adjacent to the bridge approach slab, and there is a potential conflict between the approach slab and moment slab for the wall coping, add the “Moment Slab Conflict” note to the General Notes Sheet using the BridgeNotes program.

5.5.3.1.11 Slip Joints

When an MSE wall will intersect or cross over a box culvert, detail a slip joint in the wall at the edges of the box culvert to account for potential differential settlement. This requirement does not apply to reinforced concrete pipe.

Detail a slip joint in the MSE wall as directed by the WFI where other differential settlement concerns are identified.

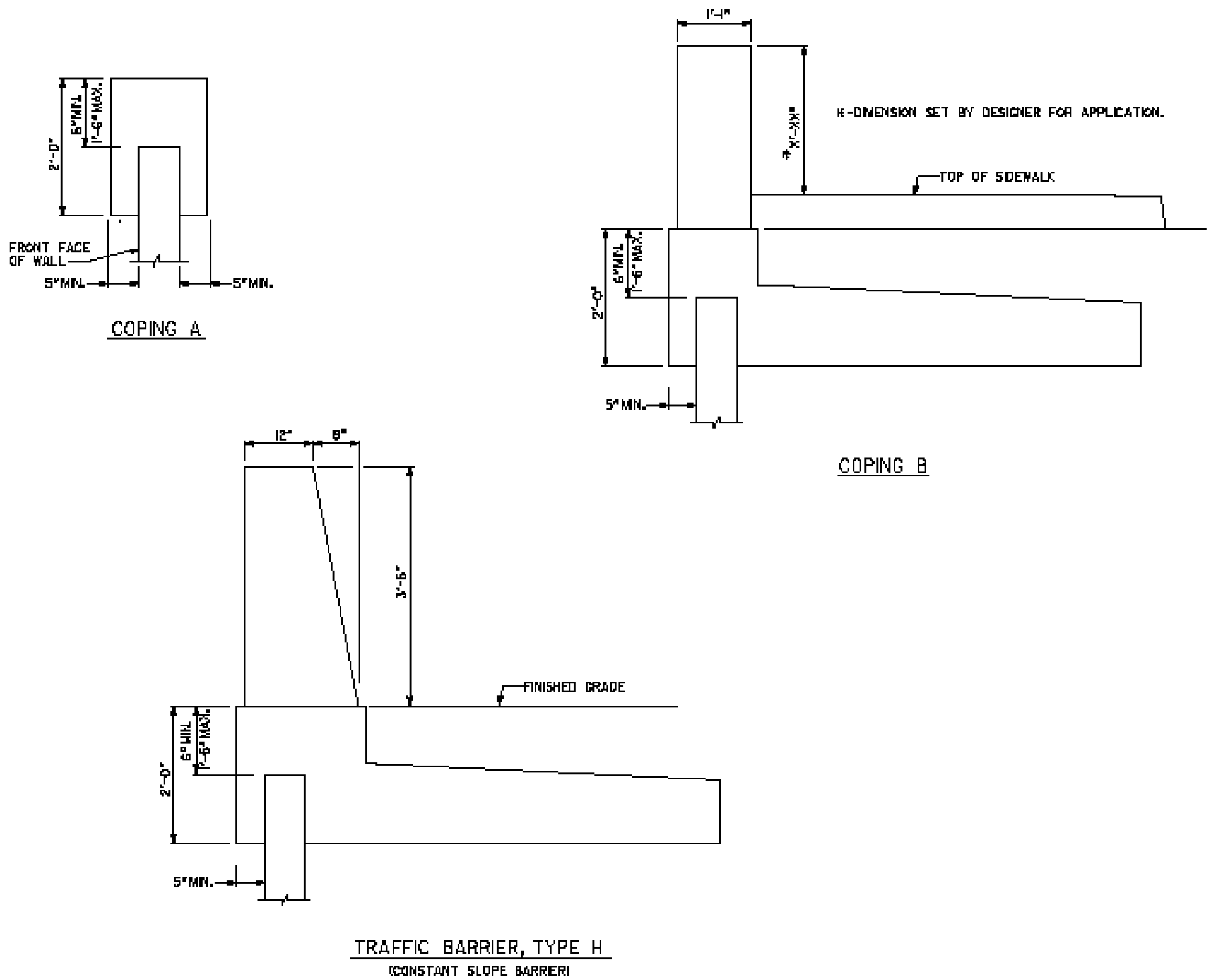


Figure 5.5.3.1.9-1 MSE Coping Sections

5.5.3.2 MSE Wall Detailing (Bridge Abutments)

5.5.3.2.1 Top of Wall Elevations Under Bridges

The top of wall elevation for walls directly in front of bridge abutments should be approximately 1 foot above the bottom of the adjacent abutment.

5.5.3.2.2 Wall Profile Breaks

In cases where the abutment wall is a single plane placed parallel to the abutment, detail the location of break points in the top of wall in such a way as to accommodate the wrap around slopes above the wall. Break points at the top of the wall shall be located a minimum of 10' beyond the wingwalls, measured perpendicular to the centerline of the bridge (see Figure 5.5.3.2.2-1).

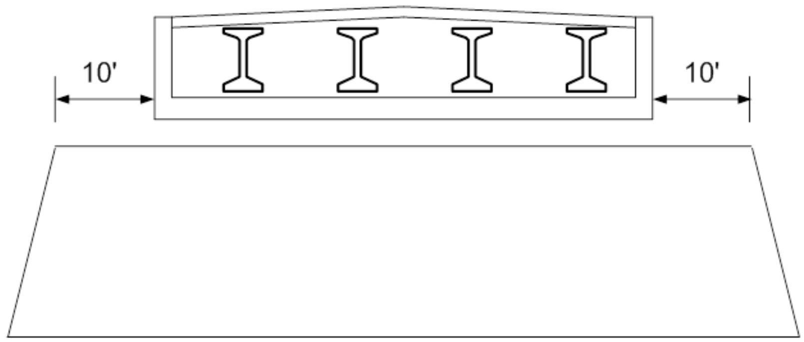


Figure 5.5.3.2.2-1 Shoulder Points of MSE Wall at Abutments

5.5.3.2.3 Offset from Back Face of Paving Rest

The minimum distance from the Back Face of Paving Rest to the front face of an abutment wall shall be 6’-0”, measured normal to the wall.

5.5.3.2.4 Abutment Walls for Staged Bridge Construction

If an abutment wall will be constructed beneath a bridge being constructed in stages, a vertical joint shall be detailed on the construction drawings at the stage line. This will require the contractor’s wall design to provide a similar joint to accommodate differential settlement between stages.

5.5.3.2.5 Additional MSE Backfill

At abutment walls the contractor is required to use MSE backfill material from the bottom of the abutment cap to the base of the approach slab. This volume is bound in the horizontal plain by the wingwalls, the abutment, and the back edge of the reinforced soil mass and shall be quantified on the contract drawings as “Additional MSE Backfill”. Since the exact width of the reinforced mass is determined by the contractor, the contract drawings should assume that the distance from the back of abutment to back edge of reinforced soil is equal to the design height of the abutment wall minus 6ft, or 11ft, whichever is greater. (see Figure 5.5.3.2.5-1).

In situations where abutments are placed above three sided wall structures, most of the “Additional MSE Backfill” is negated by the volumes included in the panel area of walls running parallel to the centerline of the bridge.

The “Additional MSE Backfill” quantity on the contract drawings shall also include material required for undercut prescribed by the WFI.

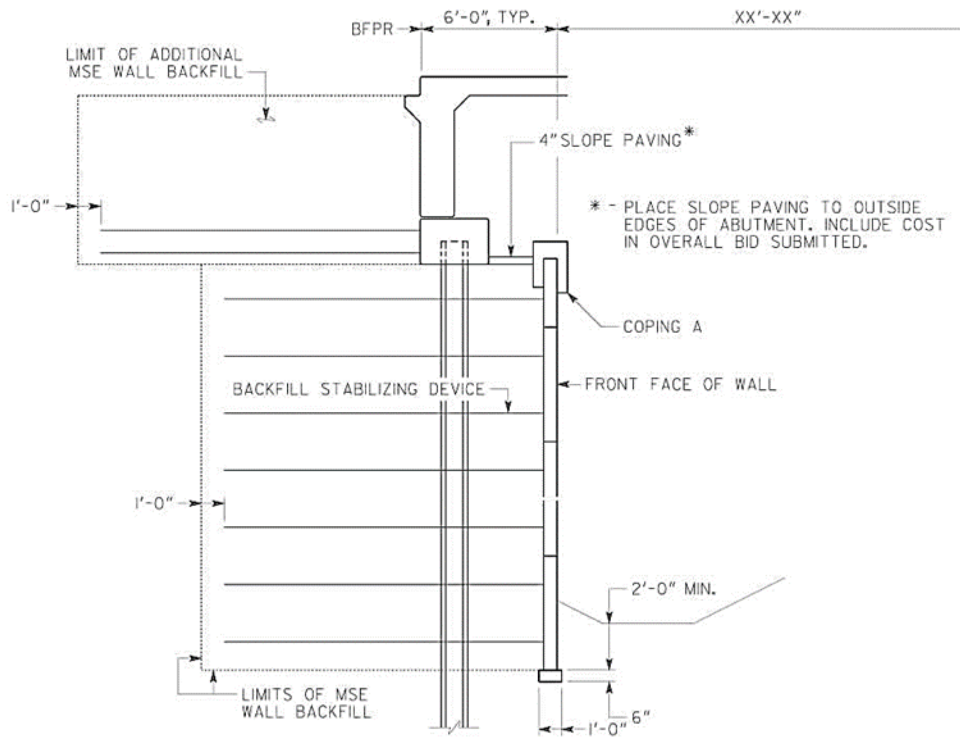


Figure 5.5.3.2.5-1 Typical Wall Abutment Detail

5.5.3.2.6 Erosion Protection for End Bents

When an MSE wall is used at the abutment, the area between the front face of the end bent cap and the back face of the wall shall be detailed with 4-inch concrete slope paving. This detail is used to prevent erosion or loss of fines due to concentrated water flowing in this area. The plans should note that cost for this slope paving should be included in overall bid submitted for the contract.

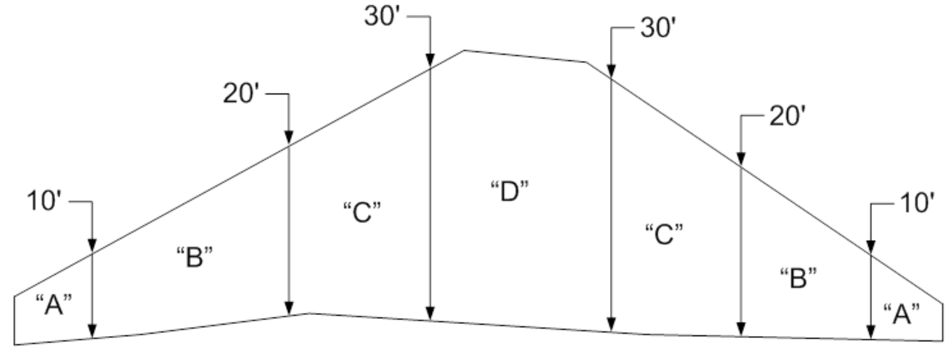
5.5.3.2.7 Pressurized Utility Line Encasement

When the installation of pressurized utility lines through MSE retaining walls is approved by the Bridge Office, the designer shall include the “Utility Casing” note on the General Notes sheet of both the bridge and retaining wall plans using the BridgeNotes program.

The requirement for non-metallic casing shall not be overturned by the engineer.

5.5.3.3 Calculation of Quantities

Walls constructed according to GDOT Standard Specification 627 are paid for per square foot of wall face area. Wall face area shall be measured in vertical bands and paid for according to the height range of that band, as shown in Figure 5.5.3.3-1. The height shall be measured from the top of the leveling pad to the top of coping, gutter line, or top of side walk, depending on application. Additional payment for location of steps in the leveling pad is not allowed. Instead, payment is restricted to the wall envelope area in the contract plans unless the envelope changes due to field conditions.



PAY ITEM NUMBER	QUANTITY	UNIT	PAY ITEM
627-1000	“A”	SF	MSE WALL FACE, 0-10FT HT, WALL NO-1
627-1010	“B”	SF	MSE WALL FACE, 10-20FT HT, WALL NO-1
627-1020	“C”	SF	MSE WALL FACE, 20-30FT HT, WALL NO-1
627-1030	“D”	SF	MSE WALL FACE, GTR THAN 30FT HT, WALL NO-1

Figure 5.5.3.3-1 Calculation of Wall Face Pay Item Quantities

5.5.4 Prefabricated Modular Wall

There are currently no prefabricated modular wall systems approved for inclusion in contract documents.

5.5.5 Modular Block Wall

Modular block walls, such as Keystone™ shall be procured using the contractor design option as described in 5.3.2, and will require Special Provision 630 to be included with the contract documents. Modular block walls should not be used to support roadway or in other situations requiring a barrier at the top of the wall.

Modular block wall design height shall be limited to a maximum of 20 feet.

5.5.6 Soldier Pile Wall

Soldier pile walls up to 15 feet in height may be used when temporary shoring is undesirable due to cost or right of way restrictions. These walls can be built from the top and wood lagging acts as the necessary shoring prior to the installation of a concrete facing.

Soldier Pile walls shall be designed using the Coulomb’s method to determine active earth pressure. A minimum of 2 feet of soil in front of the wall shall be neglected in the calculation of passive resistance against the discrete support elements. This depth may need to be increased if the ground line in front of the wall slopes down from the face.

Discrete support elements consist of rolled steel W or HP sections embedded in pilot holes filled with concrete. Pilot hole section to be embedded under the proposed ground line (from the bottom of the hole to the bottom of the facing) shall be filled with class A concrete and reinforced with 8-#6 longitudinal bars confined by #4 stirrups spaced at 12”. The remainder of the pilot hole (from the bottom of facing to the existing ground line) shall be filled with flowable fill without reinforcement.

A 12 inch thick cast in place concrete facing shall be attached to the rolled steel sections with shear studs. The amount of front and back face reinforcement in the facing shall be determined neglecting any support resistance provided by the temporary wood lagging. Wall facing shall extend 2 feet below the proposed ground line at the face of the wall.

If a soldier pile wall is used as temporary shoring, the contractor is responsible for the design and detailing.

Soldier pile walls are measured for payment by the component parts. Individual quantities for “CLASS A CONCRETE, RETAINING WALL”, “BAR REINF STEEL”, “PILOT HOLES”, “FLOWABLE FILL”, and the appropriate HP or W sections pay item(s) are the typical elements, but additional items may be necessary. Shear studs, timber lagging, and water stop should be noted as incidental in the Incidental Items note on the plans.

5.5.7 Tie-Back Wall

Tie-back walls shall be procured using the contractor design option as described in 5.1.2.3. GDOT Standard Specification 617 covers the use of tie-back walls. Permanent facing for tie-back walls shall be cast-in-place concrete. Pneumatically applied concrete (shotcrete) will not be permitted.

Provide a minimum of 25ft of right of way behind a tie back wall face to accommodate anchor placement. Actual anchor lengths are determined by the contractor's engineer.

When Tie Back walls are proposed under a bridge to allow for the removal of the end roll, locate the face of the wall a minimum of 10ft away from the Back Face of Paving Rest, measured normal to the wall face.

5.5.8 Soil Nail Walls

Soil nail walls shall be procured using the contractor design option as described in 5.1.2.3 and will require Special Provision 628 to be included in the contract documents.

Soil nail walls are subject to settlement, so they should not be used to support pavements or structures. The final exposed face of a soil nail wall shall be cast in place, reinforced concrete, designed to resist all design loads. Pneumatically applied concrete will not be allowed as a permanent wall facing, nor will precast wall panels attached using mechanical connections. Any additional surface treatment shall be specified on the final plans.

Soil Nails lengths should be assumed to be equal to the height of the wall plus 10ft for the purpose of setting right of way limits. Actual nail lengths are determined by the contractor's engineer.

Chapter 6. Culverts - Contents

Chapter 6. Culverts

6.1 General

Culverts for GDOT projects are normally sized by roadway/hydraulic designers and selected from the GDOT Roadway Standards, so they are considered roadway items. When unusual circumstances preclude the use of a standard culvert as listed in Section 6.3, a culvert shall be designed in accordance with LRFD 12.11 or Standard Specification Section 6.

6.2 Culvert Sizing

Culvert sizes shall be determined following the methods as specified in the GDOT Drainage Design Policy Manual.

6.3 Standard Culvert Design

Whenever possible, the designer should use the pre-designed concrete culvert sections found in the GDOT Roadway Standards, as listed in Table 6.3-1.

Table 6.3-1 GDOT Standard Culverts

Standard Number	Description
2312	Details for extending culverts 2ft or less
2317	Details for extending culverts
2318	Details for extending culverts with skews below 75 degrees
2400-1	Index of Reinforced Box Culvert drawings
2401 Series	Reinforced Concrete Single Box Culverts
2402 Series	Reinforced Concrete Double Box Culverts
2403 Series	Reinforced Concrete Triple Box Culverts
2404-1	Reinforced Concrete Wingwalls, Toe Walls and Parapets
2405 Series	Reinforced Concrete Skewed Wingwalls, Toe Walls and Parapets
2406 Series	Concrete Box Culvert Aprons and Baffles
2530	Precast Box Culvert Barrels
2535	Precast Box Culvert Ends

6.4 Required Notes for Culvert Plans

The notes presented below shall be included in all project plans containing culverts in order to minimize concrete cracking that tends to occur when culverts settle. The minimum earth cover and location of construction joints presented in these notes are not specified uniformly in the GDOT Standard Specifications or pre-designed concrete culvert sections found in the GDOT Roadway Standards.

With concurrence between the Office of Construction and the Bridge Office, these notes should be placed in a prominent position on plan sheets containing box culvert details. The recommended location for the following notes is on each drainage cross section sheet where a box culvert is included:

BOX CULVERT REQUIREMENTS:

MINIMUM FILL HEIGHT FROM TOP OF CULVERT TO BOTTOM OF BASE WITHIN TRAVELWAY SHALL BE 12 INCHES.

MAXIMUM POUR LENGTH SHALL NOT EXCEED 30 FEET ALONG THE LENGTH OF THE CULVERT.

TRANSVERSE CONSTRUCTION JOINTS SHALL BE PLACED IN THE BARREL, NORMAL TO THE CENTERLINE OF CULVERT, AT THE OUTSIDE SHOULDER BREAK POINTS. LONGITUDINAL BARREL REINFORCING STEEL SHALL NOT BE CONTINUOUS THROUGH THESE JOINTS, PROVIDED THAT THE JOINTS ARE MORE THAN 15 FEET FROM THE BARREL ENDS.

WHEN TRANSVERSE CONSTRUCTION JOINTS OCCUR WITHIN 15 FEET OF THE BARREL ENDS OR WITHIN THE LIMITS OF THE PAVEMENT, THE LONGITUDINAL BARREL REINFORCING SHALL THEN BE CONTINUOUS THROUGH SUCH JOINTS. THE MINIMUM LENGTH OF LAP SPLICE FOR LONGITUDINAL REINFORCING SHALL BE 24 INCHES.

TRANSVERSE CONSTRUCTION JOINTS PLACED AT ANY OTHER LOCATION NOT SPECIFIED ABOVE SHALL BE FORMED WITH NO LONGITUDINAL REINFORCING STEEL PASSING THROUGH THE JOINTS.

6.5 Three-Sided or Bottomless Culverts

A bottomless culvert is allowed only when no other practical solution, such as a bridge or standard box, will satisfy the project requirements. This may occur when the only way to obtain an environmental clearance is through the use of a bottomless culvert. In this case, the detailed plans for the bottomless culvert must be included in the contract documents. The provisions for the sizing of bottomless culverts are outlined in the GDOT Drainage Design Policy Manual.

The foundation design for the bottomless culvert must be included in culvert details and stamped by a registered Georgia Professional Engineer. In addition, the foundation design must detail how the bottomless culvert foundation will be protected from scour. Rip-rap is not considered satisfactory for protecting a spread footing from scour. Footings must be keyed into solid rock or founded on piling embedded well below the scour line.

Chapter 7. Miscellaneous Structures - Contents

Chapter 7. Miscellaneous Structures

7.1 Temporary Detour Bridges

Temporary detour bridges are used to facilitate the construction of a project and are intended to be removed upon either completion of the entire project or at a particular project stage. Temporary detour bridges are generally used for stream crossings, but they might be utilized for grade separations or railroad crossings. GDOT Standard Specification 541 addresses the materials, design, construction, maintenance, removal and payment for detour bridges.

Site specific hydraulic studies play an important role in design of detour bridges at stream crossings. See the GDOT Drainage Design Policy Manual Chapter 8 for design criteria governing detour bridges.

7.1.1 Temporary Detour Bridge Length

1) Compare the stream velocities between the natural (unconstricted) stream and the existing bridge opening. If the existing bridge velocities are less than approximately 2.0 times the natural (unconstricted) velocities and there are no visible signs of scour at the existing bridge, then consideration can be given to having a temporary detour bridge length less than the existing bridge. The detour bridge length should be minimized. A temporary detour bridge length approximately 2/3 the length of the existing bridge length (typically a good first iteration) should be considered – though this must be analyzed, verified and refined if necessary. A temporary detour bridge length less than the existing bridge will act as a constriction and will tend to increase backwater upstream of the bridge. The temporary detour bridge length should remain large enough so that it will not induce:
   a) Design-year velocities through the temporary detour bridge opening which are more than approximately 2.0 times the natural (unconstricted) stream velocities unless:
      i. The temporary detour bridge length matches the existing bridge length, or
      ii. The streambed is comprised of a scour-resistant material
   b) An increase in the design-year backwater more than 1.0 ft. above the existing bridge conditions
2) If the existing bridge velocities are greater than approximately 2.0 times the natural (unconstricted) stream velocities or there are visible signs of contraction or local scour at the existing bridge, then the temporary detour bridge shall be the same length* as the existing bridge. *See note 5 below.
3) The length of the temporary detour bridge shall be long enough to ensure that the toe of slopes of the bridge be a minimum 10 ft from the top of banks of the main channel. This buffer zone is needed for erosion control measures.
4) Temporary bridges should be studied in incremental lengths divisible evenly by 20 ft
5) While unlikely, it is possible that a temporary detour bridge can be longer than the existing bridge. This scenario could arise as a result of extreme or unusual hydraulic circumstances.

The designer and the Department should be in agreement before specifying a detour bridge longer than the existing bridge.

7.1.2 Temporary Detour Bridge Elevations

1) The design storm used for the detour bridge shall be the 10 year storm. For off-system roads with a design year ADT of 400 vpd or less, the design storm used shall be the 2 year storm.
2) The low member of the temporary detour bridge shall be set to clear the design year floodstage elevation by 1.0 ft.
3) The temporary detour bridge shall be sized to limit backwater to an acceptable increase above the natural condition, in accordance with the GDOT Drainage Design Policy Manual. Impacts of increased backwater to any development in the upstream floodplain shall be considered for all sites.
4) The profile of the temporary detour bridge shall be set so that the maximum distance from top of deck to groundline shall be no greater than 20 ft.

7.1.3 Temporary Detour Bridge Location

1) It is recommended that unless other considerations exist (environmental, right-of-way, buildings, other structures, utilities, roadway geometry, channel geometry, etc.), the temporary detour bridge be located downstream of the existing bridge. This should ensure that, in the event that the temporary detour bridge is breached during a design flood, its failure will not result in the loss of the existing bridge or the proposed bridge.
2) For 2-lane bridges, the centerline to centerline distance of the temporary detour bridge to the existing bridge should be a minimum of 50 ft. This offset should ensure the constructability of the temporary and permanent bridge as well as the temporary and permanent roadway. At the engineer's discretion in spatially-constrained situations, this offset distance can be reduced to as little as 42 ft.
3) It should be assumed that the temporary detour bridge be centered about the stream channel and/or aligned with the existing bridge.

7.1.4 Temporary Detour Bridge Width

The detour bridge width shall accommodate the number and width of lanes shown in the roadway detour plans. The minimum lane widths for detour bridges are typically 11 feet for interstate detours and 10 feet for non-interstate detours. The minimum clearance from edge of travelway to traffic barrier is 2 feet.

7.1.5 Identifying Site Restrictions

When a temporary detour bridge is required for maintenance of traffic, the designer shall note any known restrictions on the type of structure to be used by the contractor. Include any potential limitations on the location of foundations, foundation type, etc. on both the Section 20 plans and in the Section 35 General Notes.

7.2 Pedestrian Bridges

Pedestrian bridges are structures which primarily carry pedestrian and/or bicycle traffic. The Americans with Disabilities Act (ADA) requires that no grade be steeper than 1:12 (8.33%) for structures that carry pedestrian traffic.

For LRFD projects, design pedestrian structures according to the guidance listed in BDM 2.1.2.

For Standard Specification projects, the design of these structures shall be in accordance with the following:

- AASHTO Standard Specifications for Highway Bridges, 17th Edition, and
- AASHTO Guide Specifications for Design of Pedestrian Bridges, 1997.

Projects containing pedestrian bridges may have very specific architectural requirements. Coordination with the GDOT Project Manager is necessary prior to commencing work on this structure type.

7.3 Support Structures for Signs, Signals and Lights

7.3.1 Standard Supports

Use GDOT standard supports as listed in Table 7.3.1-1. Structures not addressed by these standards shall be designed by the contractor in accordance with Section 638 of the GDOT Specifications and as specified in Section 2.1.3. The contractor is required to submit shop drawings for approval by the Bridge Office.

Table 7.3.1-1 GDOT Standard Supports

Standard/Detail Number	Description
4030	Circular Guardrail for Protection of R.R. Signs
9022A	Railroad Grade Crossing Gates and Cantilevers
9024A	Railroad Grade Crossing- Railroad Signing and Marking Crossing with RR signals and/or Gates
9041	Assembly Details on Aluminum Bolted Extruded Panels for Special Roadside Signs
9042	Aluminum Bolted Extruded Panels Assembly Components Details (for Special Roadside Signs)
9054A	Erection and Foundation Details for Special Roadside Signs, Breakaway Post
9054B	Erection and Foundation Details for Special Roadside Signs, Breakaway Type Post
9054C	Erection and Foundation Details for Special Roadside Signs, Breakaway Type Post
T03c	Details of Strain Pole Erection for Overhead Signs
T03d	Details of Timber Pole Erection for Overhead Signs

TS-04A	Traffic Signal Support Structures
TS-04B	Traffic Signal Support Structures
TS-05	Strain Pole and Mast Arm Foundations
TS-06	Grounding for Traffic Signal Support Structures

7.3.2 Strain Poles on Bridges

Overhead lane signs are sometimes needed over bridges with turn lanes. These signs are attached to tensioned wires supported by Type I, II or III strain poles, as specified in the GDOT Standard Specification 639. Whenever possible, these strain poles shall be stand-alone structures with their own foundation. However, in some urban areas there is not an appropriate place to locate a strain pole on the ground and therefore a strain pole must be mounted on the bridge. When this situation occurs, only steel strain poles shall be used and supported on the bridge substructure, not the superstructure. Both of the poles in the pair shall be located at the same bent and the cables attached to the poles shall be parallel to the bent, in order to keep all loads in the plane of the bent. Since anchor bolts for strain poles are typically 54 inches long, through-bolts are necessary on caps less than 57 inches deep.

Type IV strain poles supporting cable or mast-arm mounted traffic signals are generally not allowed on bridges.

7.4 Noise Barriers

A sound barrier is a structure erected to attenuate noise created by traffic. It consists of rolled steel section posts supporting wall panels made of various materials. The posts are embedded in a concrete shaft or mounted with bolted base plates to footings, traffic barriers or retaining walls.

Whenever possible, the roadway designer should use GDOT standard sound barriers as listed in Table 7.4-1. Structures not addressed by these standards are designed by the contractor in accordance with Chapter 15 of the AASHTO LRFD Bridge Design Specifications. Vehicular collision forces shall be accounted for in the design of noise barrier systems as outlined in Section 15.8.4 of the AASHTO LRFD Bridge Design Specifications. In lieu of the vehicular collision forces defined in LRFD Chapter 13, a vehicular collision load of 80 kips distributed over 5 feet shall be applied perpendicularly to the alignment of the sound wall. The contractor is required to submit shop drawings for approval by the Bridge Office.

Table 7.4-1 GDOT Standard Sound Barrier Details

Detail Number	Description
N-1A	Foundation and Post Details
N-1B	Foundation and Post Details
N-2	Details at Concrete Side Barrier
N-3	Spread Footing Alternate for Sound Barrier Wall
N-4	Sound Barrier, Type B, Interlocking Steel Panels
N-5	Sound Barrier, Type C, Precast Concrete Panels
N-6	Sound Barrier, Type F, Glass Reinforced Thermo Composite Panels Filled with Recycled Tire Rubber
N-7	Sound Barrier, Type G, Precast Autoclaved Aerated Concrete Panels

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Chapter 8. Final Plan Revisions, Shop Drawings, and As-Builts - Contents

Chapter 8. Final Plan Revisions, Shop Drawings, and As-Builts

8.1 Final Plan Revisions and Re-Designs

8.1.1 Revisions and Amendments

8.1.1.1 Revisions Prior To Letting

Use the following procedure when revising plans after they have been signed by the Chief Engineer:

a) Check with the Project Manager to find out whether the plans can be revised. If they can, revise the plans and transmit them to the Project Manager.

b) If the plans cannot be revised, the designer, in consultation with the Assistant State Bridge Engineer shall prepare an amendment listing the required changes. This amendment will be provided to the Office of Bidding Administration by the Assistant State Bridge Engineer.

Revised quantities can be changed prior to the advertisement (4 weeks prior to the letting), but after the plans are in the hands of the public, the original quantity can only be lined through with the new quantity written in adjacently.

8.1.1.2 Amendments

8.1.1.2.1 General

Once a project has been let, amendments to the contract must be posted to the plans. Amendments should not be posted until the project has been awarded or rejected.

8.1.1.2.2 For Rejected Projects

If the project is rejected, the amendments should be made as soon as possible so that they will be in the plans when the project is re-bid. The amendments should be marked as revisions, and any other revisions should be made at this time. The Group Leader should make sure that the revisions are posted before the plans are re-advertised.

8.1.1.2.3 For Awarded Projects

If the project is awarded, all changes to the plans which are included in the amendments should be made when a copy of the amendments is received from the Office of Bidding Administration. Changes should be made exactly as shown in the amendment. These changes should be marked as revisions, with the notation “Per amendment X” in the Revision box. Include the date that the amendment was issued next to this description in the Revisions box. No other changes should be transmitted with these revisions. If any other changes to the plans are needed, the changes due to the amendments should be transmitted, then, at a later date, any other revisions should be processed. In the transmittal letter for the amendments, include the comment “As per amendments” and attach a copy of the corresponding amendments to the transmittal. This is to ensure that everyone understands that the changes to plans are actually already part of the contract since they were issued as an amendment.

When transmitting contract drawings, the designer should fill in the sheet number and total number of sheets located in the top right hand corner of each revised sheet, if the awarded plan set included those values in the sheet boarder.

8.1.1.3 Revisions after Letting ("Use on Construction" Revisions)

After a project has been let to construction, any necessary revisions to the plan sheets are to be done using a "Use On Construction" revision, often referred to as a UOC. Below are some basic requirements for how sheets should be marked up when revising various aspects of the structural plans. Ultimately all revisions made on structural plans must be collaborated with the Design Phase Leader so that they can be captured in Section 3 of the contract drawings.

Do not change the character of the work without consulting with the Office of Construction concerning the need for a Supplemental Agreement.

Transmit any revisions to the Design Phase Leader with a letter that contains brief statements of the changes. The transmittal shall indicate any pay items for which the quantities changed. If any change to right of way or utilities is necessary by the revision this should also be noted. When revisions are being made to a plan set to make them agree with shop drawings, make note of that in the transmittal.

8.1.1.3.1 Identifying Changed Items

Use revision triangles placed adjacent to drawings, notes, etc. that have been altered so that the changes can be located by the plan reader. Each triangle shall contain a number associated with the revision round being made to each sheet and a similar triangle shall be placed near the revision box in the bottom right corner of the sheet to connect the revisions with the description. The revision number in the triangle is unique to each sheet and each round of revisions. This means that on a given date in time you may be performing revision round "2" on one sheet and "3" on a different sheet.

Use the Revision Triangle cells from the Bridge Cell Library for this detailing.

When a specific drawing is being revised in multiple ways, a triangle should be placed adjacent to each revision. In cases where revisions are so extensive that triangles become difficult to follow, it may be better to place a single triangle near the drawing title.

Do not use "clouds" or circles as a method to highlight changes.

8.1.1.3.2 Revision Dates

Coordinate with the Design Phase Leader regarding the revision date that should be used on the structural drawings before completing them. If other sections of the plan set are being revised at the same time for related or unrelated reasons, the Design Phase Leader will ask for the dates to coincide so that Section 3 of the plans and all transmittal correspondence are easily connected.

8.1.1.3.3 Revision Descriptions

Use a revision description in the revision box that describes the changes in broad terms. The description should explain what is happening on each given sheet. It is preferred that this description fit on one line of the revision box, but 2 lines will be allowed. A more detailed description of the revisions can be provided to the Design Phase Leader for inclusion in Section 3 of the plans. If one design or detailing concept affects drawings on multiple sheets, it is not necessary that the descriptions match from sheet to sheet.

8.1.1.3.4 General Notes

When the content of a General Note is being modified or a complete General Note is being added, place a revision triangle adjacent to the title of the note. When a complete General Note is being deleted, place a revision triangle next to a space equal to 1 blank line of text where the note previously existed. Note locations may be shifted when deletions and/or additions are required.

Do not line through portion of notes, or entire notes.

8.1.1.3.5 Quantities

Revise quantities in the Summary of Quantities or on detail sheets by lining through the previous quantity and placing the new quantity above it. If multiple revisions are made to a single pay item, each revision shall remain and be lined through. If a quantity is being deleted entirely, line through the pay item number, description, and quantity.

8.1.1.3.6 Reinforcement Schedule

When revising the reinforcement schedule, place a revision triangle at the beginning of any row where a change has been made in the content. If a bar is being deleted, a triangle shall be placed next to the row and the deleted row left blank. If wholesale changes are made to a structural unit (Example: spread footing is changed to a drilled caisson), the revision triangle can be placed adjacent to the unit description. If a change is being made to one structural unit that is combined with others on the schedule, the two units shall be split out.

8.1.1.3.7 Added or Deleted Sheets

When a revision requires more sheets than were included in the original contract drawing set the additional sheets shall be labeled and saved using the sheet number before the desired location of the new sheets and adding an alphanumeric value to the end. (Example: sheets added behind sheet 35-0003 would be numbered as 35-0003A, 35-0003B, etc.).

If a sheet included in the contract drawing set needs to be removed, but not replaced, the sheet should be labeled with “VOID ON CONSTRUCTION” (instead of “USE ON CONSTRUCTION”) and submitted as a revision. The original plan sheet will be stamped void in the Current Plans Folder on ProjectWise and the revised sheet will also be added as a revision.

8.1.2 Plan Changes and Revisions during Construction

8.1.2.1 General

Once a Contract has been awarded, any bridge plan changes or revisions shall be coordinated with the Office of Construction or the GDOT field engineer in charge of the project. This policy must be carefully followed to minimize conflicts among material suppliers, contractors, GDOT personnel and other interested parties. Since the Districts are responsible for administering construction contracts, any revisions or changes affecting the contract must be coordinated with the District Construction Office.

When the Contractor's redesign is approved, full-size prints shall be obtained. The Contractor should put a title block in the upper right corner of the plans and use sheet numbers as shown in the roadway plans, when practical. If the Plan and Elevation (P&E) sheet for the bridge was roadway sheet 64 of 135, then the redesign sheets would be 64A, 64B, etc. If only the beam design is changing, then use the sheet number of the beams. The revised sheets shall be sent to the Office of Design Policy and Support for inclusion in the record set of plans.

8.1.2.2 Contractor Redesign by Specifications

Contractor redesigns in accordance with the GDOT Standard Specifications, as described in the following sections, do not require the approval of the Office of Construction

8.1.2.2.1 Reinforced Concrete Deck Girders

When the contract plans feature RCDGs, contractors may submit a re-design utilizing either pre-stressed concrete stems or Type I Mod beams in accordance with GDOT Standard Specification 542. The GDOT engineer shall verify the structural adequacy of the re-design and that all hydraulic requirements of the initial design are met before approving the submittal.

8.1.2.2.2 Welded Wire Fabric

GDOT Standard Specification 865 allows the substitution of welded wire fabric (WWF) for rebar in PSC beams, but does not address substitutions in other structural elements. It is the policy of the Bridge Office to allow such substitutions as long as the WWF will provide an area of steel equal to the plan value in each direction. No reduction in area will be allowed based on higher strength of WWF.

Lap and development lengths for such substitutions shall comply with AASTHO Standard Specifications 8.32.5.1 and 8.32.5.2 or LRFD 5.10.8.5, and 5.10.8.2.5, as applicable. In either case, the design yield strength of WWF should be assumed to be 60 ksi, regardless of the yield strength of the material to be substituted.

8.1.2.3 Other Contractor Redesigns

Proposals by the Contractor to revise the project for efficiency, cost savings or other considerations are subject to approval by the Office of Construction with a review performed by the Bridge Office as necessary. In all communications with the Contractor during the review process, the designer shall keep the GDOT field engineers informed and coordinate with the liaisons of the Office of Construction. All proposed changes originating with material suppliers or fabricators must be submitted by the Contractor.

8.1.2.4 Revisions for Errors and Field Conditions

When the contract plans need to be modified, the following actions shall be taken depending on the cause of the error:

a) Construction Errors: When the Contractor makes an error during construction, the Contractor shall propose a solution to be approved by the Department. Department personnel should not offer solutions to the Contractor. Any damages or reduction in payment are negotiated by the Office of Construction.

b) Design Errors: When there is an error on the plans, the Department will typically propose corrections.

c) Field Conditions: When unexpected conditions are encountered that force a change to the design, the solution should be found through cooperation with all parties.

Any revisions made for the above conditions shall be coordinated with the State Bridge Construction Engineer or the GDOT field engineer in charge of the project. The revision of the plans shall be made as specified in Section 8.1.1.3. The revised sheets shall be sent to the Project Manager for distribution as a “Use On Construction” revision.

8.2 Shop Drawings

Shop drawings are required as specified in GDOT Standard Specification 105.02. Items requiring shop drawings include metal deck forms, bearing pads, PSC beams, steel beams, detour bridges, cofferdams, fencing, handrail, other types of bearings, etc. The shop drawings should be submitted by the Contractor to the Construction Project Manager (CPM). If shop drawings are received by the Bridge Office from the fabricator or the Contractor, an email informing the sender of the above should be returned instructing them to resubmit to the CPM and that review will not begin until drawings are received through proper channels.

8.2.1 Shop Drawing Review

8.2.1.1 Timeliness of Review

Because the fabricator must have the plans approved before starting fabrication, shop drawing approvals are time critical and should be given high priority by engineers responsible for distribution and review.

8.2.1.2 Professional Engineer’s Stamp for Design Changes

Shop drawings shall be stamped and signed by a Georgia Professional Engineer when a design change is made from the contract plans. This includes revisions to design details presented in the contract drawings as well as when the contract requires that design work be performed as a submittal for a contracted item. Each sheet shall be stamped individually in accordance with Rule 180-12 of the Rules and Regulations of the State of Georgia. A summary sheet, as allowed by that rule, will not be accepted. This allows the department to archive such drawings as individual sheets.

8.2.1.3 Shop Drawing Compatibility

In addition to evaluating the compliance of each shop drawing submittal, the designer should ensure that no conflicts occur with other shop drawings or the contract drawings. Potential areas of conflict include the following:

- beams and deck forms
- beams and diaphragm holes
- handrail post spacing on the shop drawings and the insets for post on the bridge plans

8.2.1.4 Conditional Approval

The reviewer shall not provide conditional approval for shop drawings or mark them “Approved as Noted”. If changes are minor the reviewer may allow corrected sheets to be substituted so that the entire set can then be approved.

8.2.1.5 Stamping of Drawings

The reviewer shall stamp every page of each copy of approved shop drawings. When shop drawings are to be revised, the reviewer may stamp only those sheets requiring revision. Only the first sheet of design calculations needs to be stamped.

8.2.1.6 Distribution

See BDM 1.6.9.2.5 and subsequent sections of BDM 8.2 for guidance on distribution of corrected and approved shop drawings.

8.2.1.7 Shop Drawing Log

The designer shall keep a shop drawing log showing the date of the submittal to the Bridge Office, date of return to the Contractor and an indication of approval or rejection.

8.2.1.8 Record Keeping

Copies of all submitted and returned drawings and associated items shall be maintained, by the Bridge Office liaison, in the Shop Drawing folder of ProjectWise. Items received through ProjectWise Deliverables Management should have a copy saved in the Shop Drawing folder as well.

8.2.1.9 Consultant Review

Shop drawings reviewed by consultants must be sent through the Bridge Office which will also stamp them after the consultant’s review. Fabrication is not allowed to proceed without a Bridge Office approval stamp.

8.2.2 Metal Deck Forms

8.2.2.1 Professional Engineer’s Stamp

Metal deck form shop drawings must include the stamp of the registered Georgia P.E. responsible for the design.

8.2.2.2 Key Review Items

Metal deck form shop drawings indicating intermediate supports between beams shall not be approved.

Metal deck forms shall have a minimum of 1” of bearing on the support angle at each end, as specified in GDOT Standard Specification 500.08.E.10.

The reviewer shall ensure that the gauge of steel shown on the shop drawings matches the design calculations and that the calculated deflection does not exceed the allowable limits.

For continuous steel beams, there shall be no welding between the hangers and the flange at the locations where the top flange is in tension under any loading condition. Therefore, the shop drawing shall indicate that straps connecting these hangers across the top flange are provided at these locations which should be clearly indicated on the plans.

8.2.2.3 Submittal to the Office of Materials and Testing

Approved shop drawings for metal deck forms are not required to be forwarded to the Office of Materials and Testing.

8.2.3 Bearing Pads

Bearing pads located farther than 40 feet from a fixed bent shall be redesigned when the contractor replaces RCDGs with Type I Mod PSC beams. The reviewer shall ensure the shop drawings match with the bearings in the redesigned bridge plans.

Approved shop drawings for bearing pads shall be forwarded to the Inspection Branch Chief at the Office of Materials and Testing.

8.2.4 PSC Beams

8.2.4.1 PE’s Stamp on Modified Beam Drawings

PSC beam shop drawings may contain slight modifications from the contract drawings to aid in the fabrication process. As long as these modifications do not change the stress distribution in the PSC beam from the original design, the Contractor does not need to submit calculations and no PE stamp is required.

Sometimes PSC beams in shop drawings are modified from one hold-down to two to reduce the hold-down force. If there are no other changes in the beam design, the Contractor will not be required to submit redesign calculations provided that the new hold-downs are no more than 3’-0” from the mid-point of the beam.

When the modifications change the stress distribution from the original design, the Contractor shall submit design calculations along with a set of beam drawings, stamped by a registered Georgia PE, to be included in the record set of plans.

8.2.4.2 Fabrication Length

The reviewer shall verify the fabrication lengths which may be slightly different from the plan lengths. The fabrication length accommodates elastic shortening, grade adjustments, concrete shrinkage, epoxy coating end treatments, etc.

8.2.4.3 Strands and Stirrups

The arrangement of straight and draped strands shall be verified to ensure no conflict with either diaphragm holes or dowel bar chases. The middle strands in the top flange may be shifted to be located between the stirrups.

Stirrups shall be detailed outside the strands in the web.

8.2.4.4 Embedded Elements

PSC beam shop drawings shall correspond with the metal deck form shop drawings since the clips must be located correctly on the beams in order for the deck forms to be installed. Inclusion of overhang brackets shall be verified on exterior beams.

For safety rail supports, it is acceptable to use a reinforcing bar embedded in the beam at the rail post locations. This bar should be cut off or bent into the deck steel after the safety rail is no longer needed. It is not acceptable to detail pipes in the top of a PSC beam to support safety railing posts. This is not acceptable since these pipes may hold water which freezes and causes splits in the beam.

Lifting loops shall be adequately embedded near the girder ends. The lifting loops shall extend through the girder to within 4” of the bottom so that the weight of the girder will not cause tension stresses at the junction of web and top flange. The location of the lifting loops shall comply with the contract drawings.

8.2.4.5 Minimum Release Time

PSC beam strand release strength is controlled by the GDOT Standard Specifications as administered by the Concrete Branch of the Office of Materials and Testing.

8.2.4.6 Submittal to the Office of Materials and Testing

Approved shop drawings for PSC beams should be forwarded to the Concrete Branch Chief at the Office of Materials and Testing.

8.2.5 Detour Bridges

The detour bridge shall be designed by the Contractor and the shop drawings shall be stamped by a registered Georgia Professional Engineer. When the Contractor submits a new detour bridge design, the Bridge Office encourages that the design be in accordance with AASHTO LRFD Specifications to ensure its long term viability. However, the current GDOT policy allows for designs in accordance with the AASHTO Standard Specifications.

The reviewer shall verify the design of the detour bridge including compliance with the plans for length, width and minimum bottom of beam elevation.

There are pre-approved detour bridge designs owned by some bridge contractors. Since the shop drawings for these bridges have been previously reviewed and accepted by the Bridge Office, the Contractor is not required to submit the shop drawings but the reviewer may request them. The reviewer shall still verify whether the overall size of the bridge matches the contract plans and if the pile types and sway bracing comply with the height requirements on the pre-approved drawings.

Approved detour bridge shop drawings are not required to be forwarded to the Office of Materials and Testing.

8.2.6 Steel Beams

When a steel beam design is modified by the Contractor from the original design, the Contractor shall submit design calculations along with a set of beam drawings, stamped by a registered Georgia Professional Engineer.

Approved shop drawings for all steel structures including plate girders, welded continuous rolled beams and pot bearings shall be forwarded to the Inspection Branch Chief at the Office of Materials and Testing.

8.2.7 Post Tensioned Members

Approved shop drawings for post-tensioned members shall be forwarded to the Office of Design Policy and Support for inclusion in the record set of plans. Design calculations for the post-tensioning operation shall be retained in the bridge design files.

8.2.8 Contractor-Designed Walls

Contractor-designed wall shop drawings shall be stamped by a registered Georgia Professional Engineer. The reviewer shall ensure the shop drawings comply with plan requirements including finish and graffiti proof coating. Prior to approving the calculations and plans, the reviewer should have sketches or other data submitted by the contractor verifying either that the wall will fit the final field conditions or indicating where revisions are necessary. See Section 149.3.03.D and 149.1.03.E of the Standard Specifications.

Approved shop drawings shall be forwarded to the Office of Design Policy and Support for inclusion in the record set of plans. A copy of approved shop drawings for MSE retaining walls shall be forwarded to the Concrete Branch Chief at the Office of Materials and Testing.

8.2.9 Contractor-Designed Sign Supports

Contractor-designed sign support shop drawings shall be stamped by a registered Georgia Professional Engineer. The reviewer shall ensure the shop drawings comply with plan requirements.

Approved shop drawings shall be forwarded to the Office of Design Policy and Support for inclusion in the record set of plans. It is required to forward approved sign support shop drawings to the Inspection Branch of the Office of Materials and Testing.

8.2.10 Prestressed Concrete Piling

PSC piling shop drawings are not required for projects using an approved GDOT Standard for the item. However, when a contract includes special designed piles or the manufacturer proposed an alternate to the Standard, shop drawings shall be submitted for approval.

PSC piling shop drawings may contain slight modifications from the contract drawings or Standard to aid in the fabrication process. As long as these modifications do not change the stress distribution in the PSC pile from the original design, the Contractor does not need to submit calculations and no PE stamp is required. If pile details differ significantly from the Standards or Plans, the manufacturer shall provide calculations and drawings signed and stamped by a Professional Engineer, licensed in the state of Georgia.

Approved shop drawings for PSC piling should be forwarded to the Concrete Branch Chief at the Office of Materials and Testing.

8.2.11 Steel Diaphragms

Shop drawings for steel diaphragms, when allowed, should be submitted to the Engineer for review and approval. Drawings should be stamped by a registered Georgia Professional Engineer and accompanied by design calculations for review.

Approved shop drawings for all steel diaphragms shall be forwarded to the Inspection Branch Chief at the Office of Materials and Testing.

8.2.12 Deck Drainage Systems

Shop drawings for deck drainage systems should be submitted to the Engineer for review and approval. The review shall ensure that the shop drawings comply with the plan requirements.

Approved shop drawings for deck drainage systems are not required to be forwarded to the Office of Materials and Testing.

8.2.13 Miscellaneous Shop Drawings

Shop drawings for miscellaneous items such as fencing, shoring, and cofferdams are not required, but will be reviewed if submitted.

Shoring plans requiring railroad approval shall be submitted directly to the railroad once they have been approved by the Bridge Office.

8.3 As-Built Foundation Information Sheet

Each set of bridge plans shall include an As-Built Foundation Information sheet. This sheet will include spaces for field personnel to record the tip elevations of all piles, top and tip of caisson elevations, the bottom of footing elevations and the bottom of seal elevations. For pile footings, a schematic should be included, with the piles numbered left to right, then back to ahead.

As-Built Foundation Information sheets shall be completed by the GDOT Project Engineer and returned to the Bridge Office. This information shall be incorporated in the design files and a revised sheet will be transmitted as specified in Section 1.6.9.2.5. This information is important for long-term evaluation of the structure.

Information collected during data pile driving may be sent to the Bridge Office by mistake. It should be forwarded to the Geotechnical Bureau of the Office of Materials and Testing.

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Chapter 9. Seismic Design Guidelines - Contents

Chapter 9. Seismic Design Guidelines

9.1 Standard Specification Design

For Standard Specification projects, design bridges based on the requirements for bridges in Seismic performance Category A, except when the bridge is in the portion of Georgia where the Acceleration Coefficient is greater than 0.09. Design bridges located in the region with an Acceleration Coefficient greater than 0.09 in accordance with the requirements for bridges in Seismic Performance Category B. These requirements are defined in the Standard Specifications, Division 1A. Georgia's Seismic Category B region is illustrated in Figure 9A-1 in Appendix 9A.

An alternative (BRNCPIER) to GDOT's typical pier design program is available on the Bridge Office website and is configured to incorporate seismic forces into our standard pier design approach. The seismic loads must be calculated by other means before running the program.

Support length requirements for Categories A or B can be fulfilled using the cap dimensions, not just the bearing pad dimensions.

When a project calls for widening a bridge in a Category B region where the existing structure was originally designed for Category A, the widened portion shall be designed for Category B.

9.2 LRFD Specification Design

Design and analyze all LRFD bridges with regard to potential seismic loading in accordance with the LRFD 3.10, LRFD 4.7.4 and LRFD 5.11, unless specified otherwise in this chapter.

Use the design earthquake and subsurface soil condition at the bridge site to determine the seismic performance zone and design/detailing requirements for the bridge.

9.2.1 Determining the Seismic Performance Zone

Determine the Seismic Hazard at a bridge site by establishing the design response spectrum as specified in LRFD 3.10.2.

For convenience and consistency, a spreadsheet based on the content of this section and entitled USGS Design Map Summary Report is available on the Bridge Office Website and will determine the S_{D1}, A_S, and Seismic Performance Zone of a structure when its location and soil site classification is provided.

> S_{D1} = Horizontal response spectral acceleration coefficient at 0.1-s period modified by long-period site factor
>
> A_S = Peak seismic ground acceleration coefficient modified by the short-period site factor

Present the seismic performance zone, S_{D1}, and A_S values in the Design Data section of the General Notes sheet.

9.2.1.1 Site Class

Site class, from A to F, at the bridge location shall be determined based on the soil type and properties of the upper 100 feet of the soil profile, as specified in LRFD 3.10.3.1. It will be determined by the Geotechnical Bureau and provided on the Bridge Foundation Investigation (BFI) report.

For site class A through E, the seismic performance zone and design response spectrum can be determined using the general procedure as specified in LRFD 3.10.2.1. Site class F requires the site-specific procedure, as specified in LRFD 3.10.2.2, to determine seismic performance zone and to establish design response spectrum.

9.2.1.2 Design Earthquake Parameters

Use the 2007 AASHTO Seismic maps presented in the 2009 AASHTO Seismic Guide Specifications and included in LRFD 3.10.2.1 to determine the following three acceleration coefficients for the geographical location of the bridge:

- Horizontal peak ground acceleration coefficient, PGA
- Horizontal response spectral acceleration coefficient at period of 0.2 second, S_S
- Horizontal response spectral acceleration coefficient at period of 1.0 second, S_1

The values for PGA, S_S, and S_1 will all be used to determine the design response spectrum and seismic performance zone for the bridge.

9.2.1.3 Design Response Spectrum

For the bridges in site class A through E, design response spectrum shall be established as specified in LRFD 3.10.4.1, using the acceleration coefficients read from the maps in LRFD 3.10.2.1 and the site factors specified in LRFD 3.10.3.2. Determine the long-period acceleration coefficient, S_{D1} as shown in LRFD 3.10.4.2.

For the bridges in site class F, the design response spectrum shall be established from a site response analysis in accordance with LRFD 3.10.2.2 and provided in the Bridge Foundation Investigation (BFI) report. The long-period acceleration coefficient, S_{D1}, shall be determined from the site response analysis.

This Design Response Spectrum should be used to determine the lateral force by the design earthquake. This lateral force will be applied to the substructure and connections as specified in Section 9.2.2.

9.2.1.4 Seismic Performance Zone

In LRFD Table 3.10.6-1 there are four Seismic Performance Zones established on the basis of the acceleration coefficient S_{D1}.

Seismic performance zone, from 1 to 4, of the bridge site shall be determined using the long-period acceleration coefficient, S_{D1}, in accordance with LRFD 3.10.6, except for the bridges in the site class F. S_{D1} shall be calculated by multiplying S_1 and the corresponding site factor for long-period spectrum range, F_v, as determined in accordance with LRFD 3.10.3.2. Seismic performance zone for the site class F shall be determined using the value of S_{D1} from the site-specific response analysis.

The state of Georgia is located in a relatively low seismic hazard zone and bridge sites will predominantly fall into the Seismic Performance Zones 1 or 2.

LRFD 5.11.2 makes a further division in Zone 1, as it relates to seismic detailing requirements, based on the determined value of S_{D1} at a bridge site. In lieu of LRFD 5.11.2 GDOT has established the following subdivisions for Seismic Performance Zone 1:

Zone 1A: $S_{D1} < 0.1$ OR $0.1 \leq S_{D1} \leq 0.15$ and $A_s < 0.13$

Zone 1B: $0.1 < S_{D1} \leq 0.15$ and $A_s \geq$ to 0.13

Seismic detailing requirements, addressed in later sections, will only apply to Zone 1B.

9.2.2 Seismic Design Procedures

Seismic analysis methods to determine the design earthquake loads on the substructure shall be selected as specified in LRFD 4.7.4, unless specified otherwise by the Bridge Office. The analysis method is selected based on the seismic zone, operational class and regularity of the bridge. All bridges are designated as "Other Bridges" for the operational class as defined in LRFD 3.10.5, unless designated otherwise by the Bridge Office.

The requirement for minimum support length at expansion bearings, as specified in LRFD 4.7.4.4, shall be satisfied for all bridges.

The seismic design flowchart presented in LRFD APPENDIX A3 may be used as an aid for design of bridges in different seismic zones.

9.2.2.1 Single Span Bridges

Single span bridges do not require a seismic analysis regardless of the seismic zone, as specified in LRFD 4.7.4.2. The connection design forces in restrained directions shall be determined in accordance with LRFD 3.10.9.1.

9.2.2.2 Multi-Span Bridges in Seismic Performance Zones 1A and 1B

Multi-span bridges in seismic zones 1A or 1B do not require a seismic analysis, as specified in LRFD 4.7.4.3. The connection design forces in restrained directions shall be determined in accordance with LRFD 3.10.9.2, using the load factor for live loads of 0.5.

9.2.2.3 Multi-Span Bridges in Seismic Performance Zone 2

Multi-span bridges in seismic zone 2 require a seismic analysis, as specified in LRFD 4.7.4.3. One of three elastic analysis methods, i.e., uniform load method, single-mode method, or multi-mode method, should be used for the seismic analysis.

Horizontal static earthquake loadings in longitudinal and transverse directions should be calculated from one of the analysis methods specified in LRFD 4.7.4.3.1, then combined and modified to determine the seismic design load cases as specified in LRFD 3.10.9.3. These load cases shall be combined with other loads for the Extreme Event I Limit State, as specified in LRFD 3.4.1.

For the Extreme Event I Limit State, the load factors for dead loads, γ_p, shall be 1.0 for steel pile bents in accordance with LRFD 6.5.5. For all other substructure types, the load factors for dead loads shall be in accordance with LRFD 3.4.1.

The load factor for live loads in the Extreme Event I Limit State, γ_{EQ}, shall be 0.5 for all substructure types, unless specified otherwise by the Bridge Office.

The resistance factors in the Extreme Event I Limit State shall be 1.0 for steel pile bents in accordance with LRFD 6.5.5 and 0.9 for other substructure types in accordance with LRFD 5.11.4.1.2.

9.2.2.4 Multi-Span Bridges in Seismic Performance Zones 3 and 4

Multi-span bridges in seismic zones 3 and 4 require a seismic analysis, as specified in LRFD 4.7.4.3. An elastic method or time history method should be used for the seismic analysis. Horizontal loadings should be taken as the lesser of the modified design forces calculated in accordance with LRFD 3.10.9.4.2 or the inelastic hinging forces determined in accordance with LRFD 3.10.9.4.3. These horizontal loadings should be combined and modified to determine the seismic design load cases as specified in LRFD 3.10.9.4. These load cases shall be combined with other loads for the Extreme Event I Limit State, as specified in LRFD 3.4.1.

For the Extreme Event I Limit State, the load factors for dead loads, γ_p, shall be 1.0 for steel pile bents in accordance with LRFD 6.5.5. For all other substructure types, the load factors for dead loads shall be in accordance with LRFD 3.4.1.

The load factor for live loads in the Extreme Event I Limit State, γ_{EQ}, shall be 0.5 for all substructure types, unless specified otherwise by the Bridge Office.

The resistance factors in the Extreme Event I Limit State shall be 1.0 for steel pile bents in accordance with LRFD 6.5.5 and 0.9 for other substructure types in accordance with LRFD 5.11.4.1.2.

9.2.3 Seismic Detailing Requirements

Bridge substructures shall be detailed as required in LRFD 5.11. The seismic detailing requirements for the amount and spacing of reinforcement shall always be checked after the general detailing requirements are met, and more reinforcement shall be added as necessary.

Seismic hooks of lateral reinforcement, as specified in LRFD 5.10.2.2, shall be used in the plastic hinge regions, typically located at top and bottom of columns and pile bents.

9.2.3.1 Bridges in Seismic Performance Zone 1A

Do not provide bridge detailing in response to potential seismic activity to those bridges in Seismic Performance Zone 1A, as defined in BDM 9.2.1.4, other than may be necessary to satisfy LRFD 3.10.9.2.

9.2.3.2 Bridges in Seismic Performance Zone 1B

Detail bridges in Seismic Performance Zone 1B, as defined in BDM 9.2.1.4, according to the guidance in LRFD 5.11.2, except that the transverse reinforcement spacing requirements specified by referenced LRFD 5.11.4.1.5 shall be revised to a minimum center to center spacing of 6 inches.

When round columns are detailed, do not detail the use of spiral reinforcement. Detail seismic hooks on all hoops within a round column, not just those at the plastic hinge location.

When rectangular columns are detailed, it is preferred that an octagonal (“stop sign”) bar be used in the lieu of cross ties, when possible, to allow for easier access into the core of the column for concrete placement. See Fig. 9B-1.

See BDM 4.4.1.3.4 for guidance on column detailing.

Lap Splices are acceptable in Zone 1B structures, even in the plastic hinge. Do not detail welded rebar splices.

9.2.3.3 Bridges in Seismic Performance Zone 2

Detail bridges in Seismic Performance Zone 2 according to the guidance in LRFD 5.11.3 with the exceptions outlined in the following subsections.

9.2.3.3.1 Piles

For pile footings supported on steel H piles, use cell “PILE-HSEISMIC” as detailed in BDM Fig. 9B-3 to anchor piles into the footing. Piles should be embedded into the footing a minimum of 1ft.

For pile footings supported by prestressed concrete piles or metal shell piles, embed the piles into the footings a minimum of 1ft, with no additional anchorage or confinement reinforcing required. Use prestressed concrete piling, as detailed on GDOT Standard 3215, and metal shell piles as described in BDM 4.2.2.5.

Embed all pile types into pile caps in accordance with BDM 4.4.2.1, with no additional anchorage or confinement reinforcing required.

9.2.3.3.2 Pile Caps

In lieu of LRFD 5.11.4.1.5, do not provide confinement reinforcement around the pile embedment in a pile cap.

9.2.3.3.3 Caissons

Do not detail a plastic hinge in a caisson at the theoretical point of fixity, top of rock, or groundline.

When a column with a diameter at least 18 inches smaller than the caisson is used, a seismic hinge should be detailed at the caisson to column interface, otherwise no plastic hinge detail is needed at this location.

Adhere to the reinforcement guidance provided in BDM 4.2.3.4.

9.2.3.3.4 Footings

Detail a mat of reinforcement in the top of spread or pile footings to satisfy the forces generated in the extreme event limit state. Detail a top mat with a minimum of #4 bars spaced at a maximum of 12” in each direction.

9.2.3.3.5 Columns

Detail columns in accordance with the guidance in LRFD 5.11.3, except that the transverse reinforcement spacing requirements specified by referenced LRFD 5.11.4.1.5 shall be revised to a minimum center to center spacing of 6 inches.

Adhere to maximum spacing recommendations for the longitudinal (vertical) steel spacing included in LRFD C5.11.4.1.4.

When round columns are detailed, do not detail the use of spiral reinforcement. Detail seismic hooks on all hoops within a round column, not just those at the plastic hinge location.

When rectangular columns are detailed, it is preferred that an octagonal (“stop sign”) bar be used in the lieu of cross ties, when possible, to allow for easier access into the core of the column for concrete placement. See Fig. 9B-1.

Detail only mechanical splices in accordance with LRFD 5.11.4.1.6 except that the transverse reinforcement spacing requirements shall be revised to a minimum center to center spacing of 6 inches. The limits of the “length of the splice” referenced in LRFD 5.11.4.1.6 shall be 1 foot above and below the centerline of the coupler on adjacent bars. See Fig. 9B-2.

See BDM 4.4.1.3.4 for guidance on column detailing.

Indicate on the intermediate bent sheet that plastic hinge regions at the top and bottom of the column can contain no splice of any type.

Dimension the embedment distance from the bottom of cap or top of footing to the last required stirrup of the seismic hinge.

Do not detail welded rebar splices.

9.2.3.4 Bridges in Seismic Performance Zones 3 and 4

The bridges in seismic zone 3 or 4 shall meet the seismic detailing requirements specified in LRFD 5.11.4. Columns/pile bents and wall-type piers shall be detailed in accordance with LRFD 5.11.4.1 and LRFD 5.11.4.2, respectively.

The amount of longitudinal reinforcement in a column shall be determined in accordance with LRFD 5.11.4.1.1. This requirement for longitudinal reinforcement shall apply to the entire height of the column.

The amount of transverse reinforcement in a column or pile shall not be less than that required in LRFD 5.11.4.1.3 or LRFD 5.11.4.1.4. The spacing of transverse reinforcement shall not be larger than that required in 5.11.4.1.5. These requirements for transverse reinforcement shall apply to the plastic hinge regions. The transverse reinforcement shall extend into the adjoining members in accordance with LRFD 5.11.4.3.

Splicing of longitudinal reinforcement shall conform to the provisions in LRFD 5.11.4.1.6.

9.3 Appendix 9A – Seismic Category B for Standard Specification

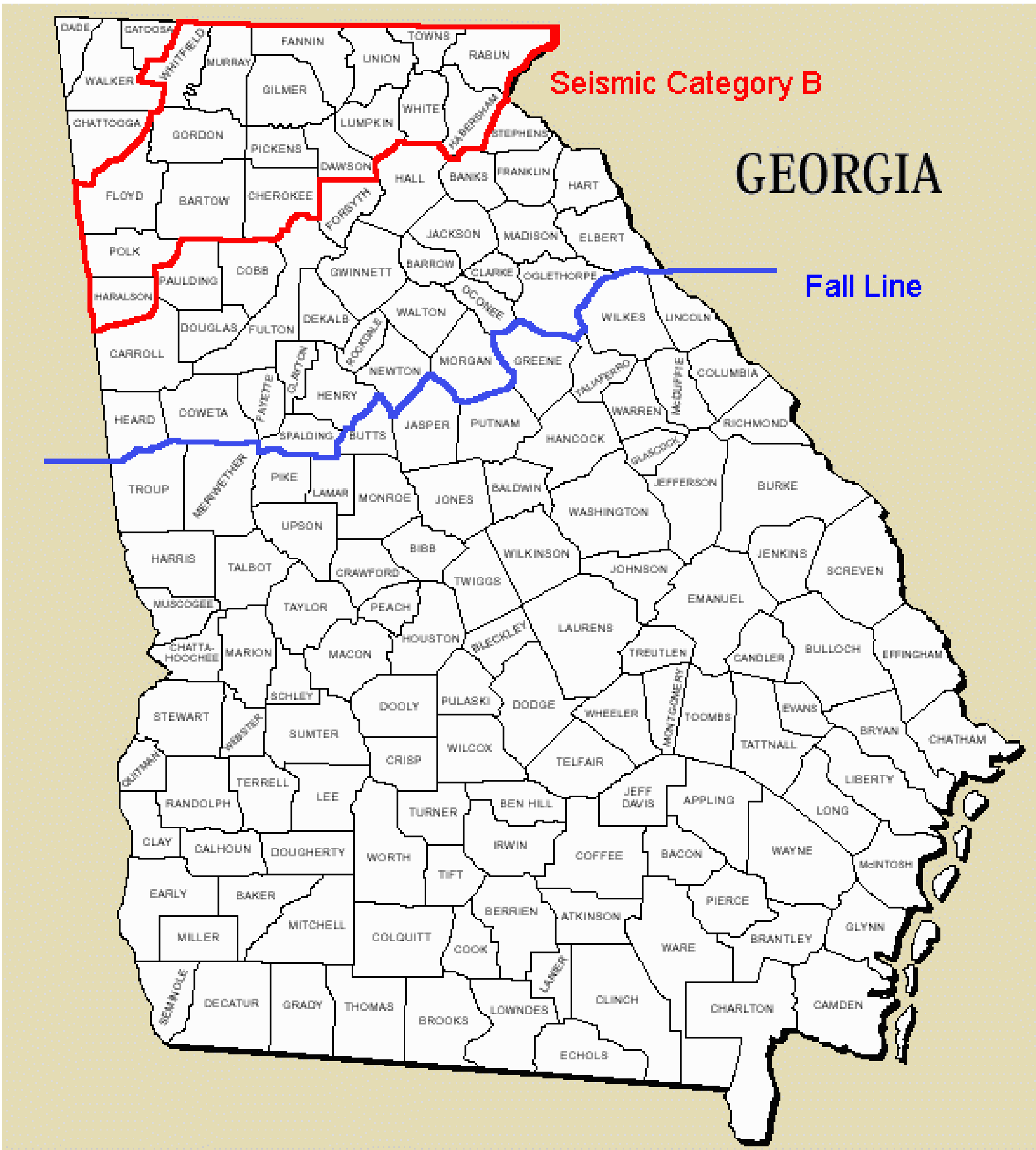


Figure 9A-1 Map of Seismic Category B Counties

9.4 Appendix 9B - Typical Seismic Detailing

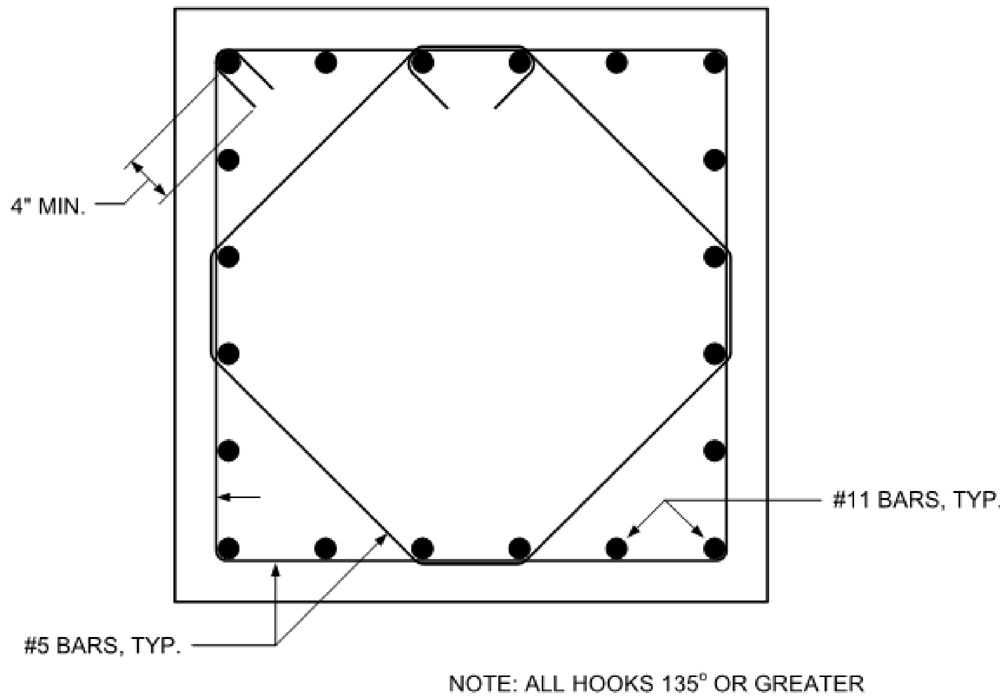


Figure 9B-1 Typical Section of Rectangular Column in Plastic Hinge Regions for Seismic Zones 1B, 2, 3 and 4

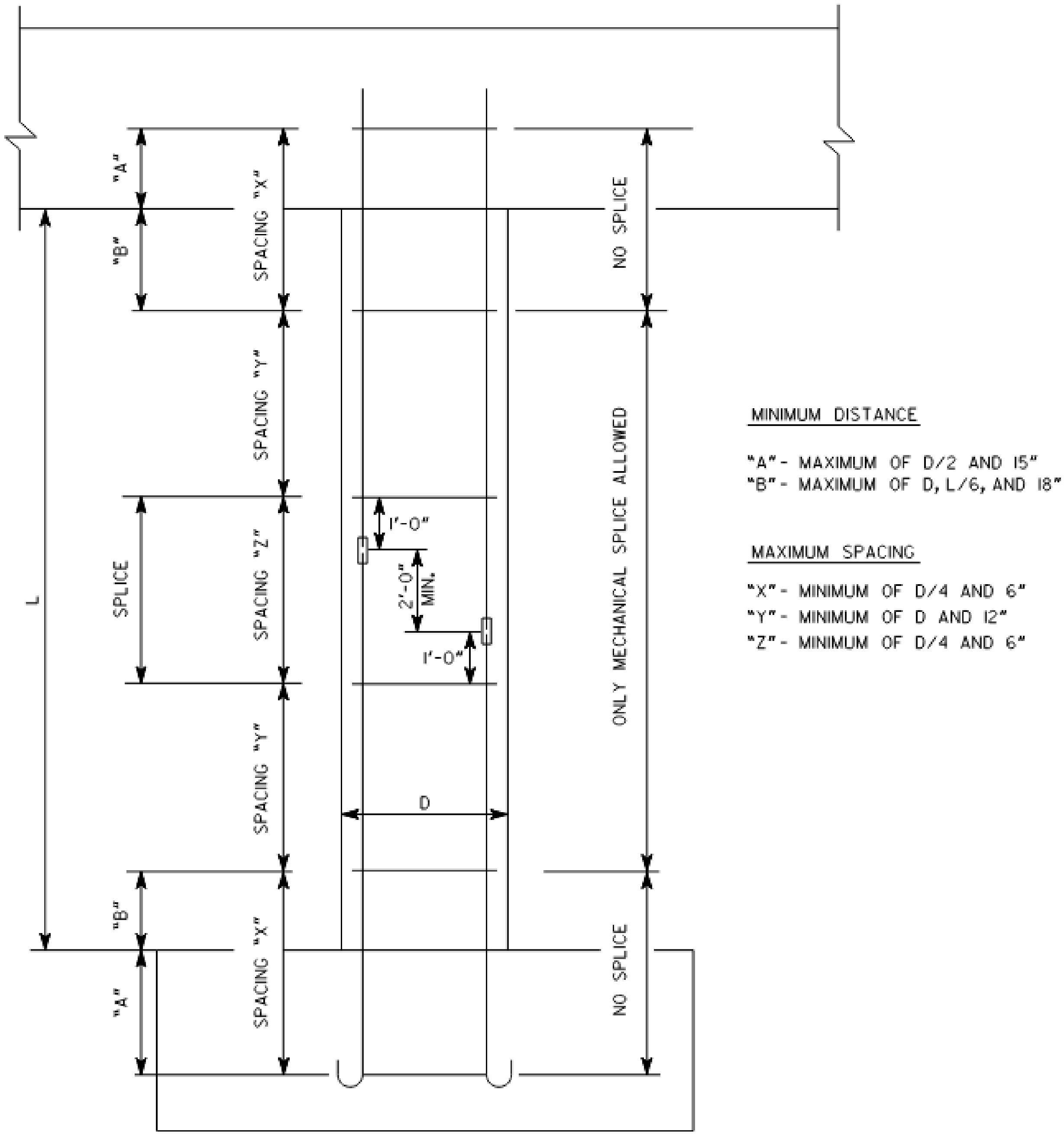
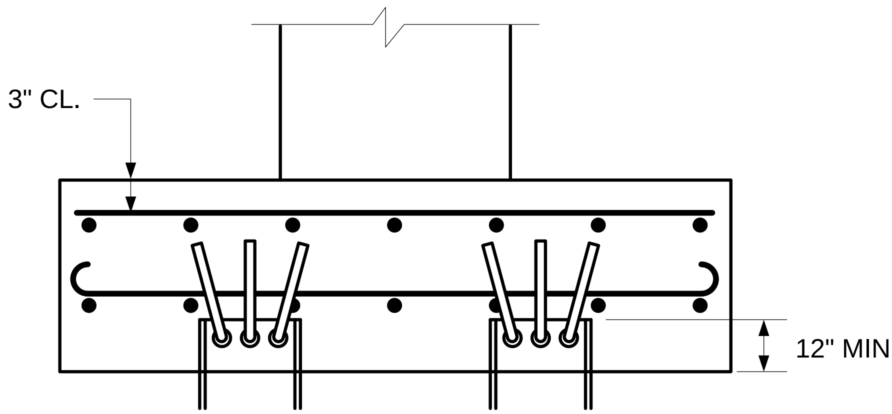
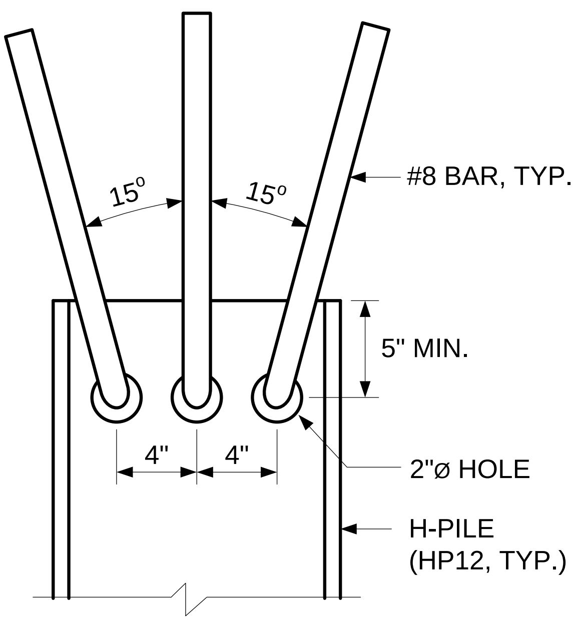


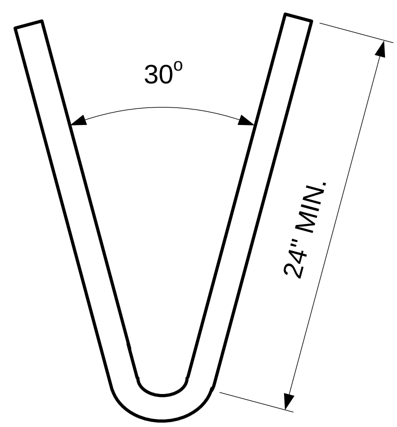
Figure 9B-2 Column Detailing Guidance for Seismic Zones 2, 3, and 4



DETAIL AT FOOTING



TOP OF PILE



#8 BAR

Figure 9B-3 H-Pile Connection Detail for Seismic Zones 2, 3, and 4