Precast Alternates

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SOP for Alternate Precast Proposal Submission

Texas Department of Transportation

Standard Operating Procedure for Alternate Precast Proposal Submission

Bridge Division

September 28, 2020 (Revised)

[Alternate Precast Proposal Submission (txdot.gov)]

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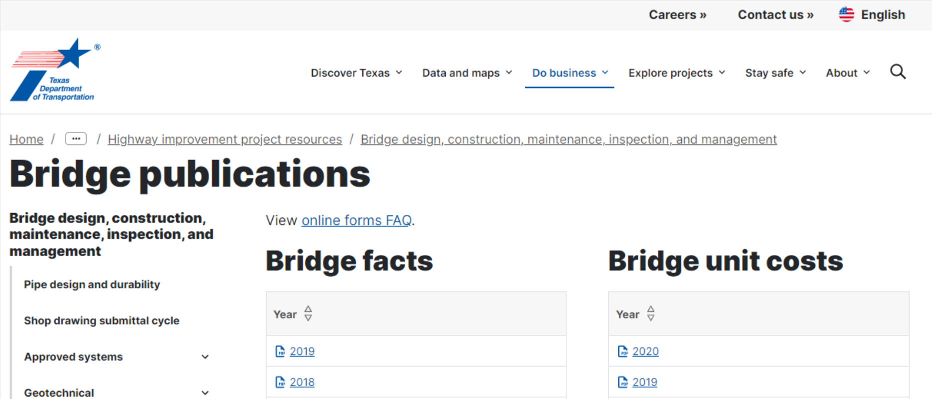
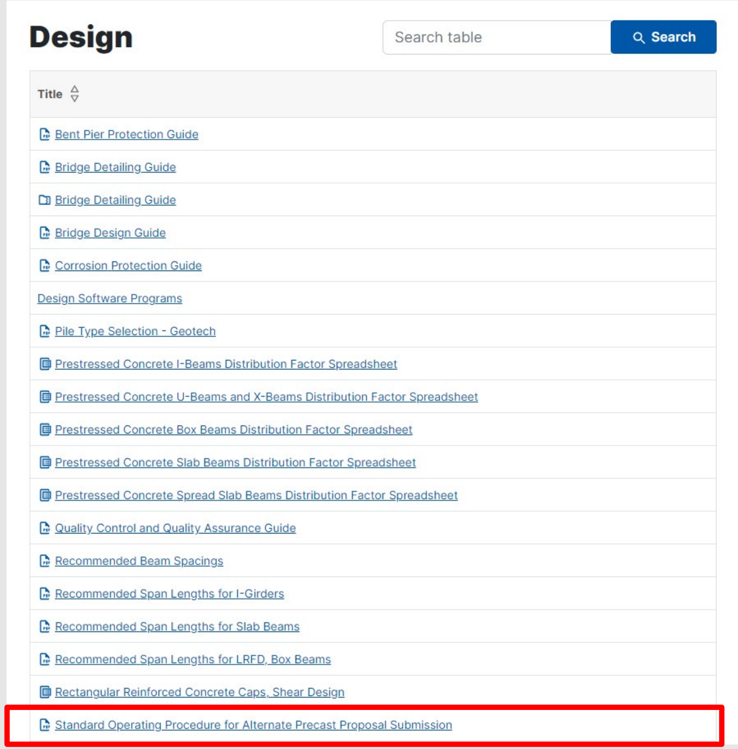
SOP for Alternate Precast Proposal Submission

txdot.gov/business/resources/highway/bridge/bridge-publications.html





Introduction

- This SOP is not intended to allow proposals for wholesale redesign of bridges.
- Acceptance of any alternate design proposal is at the sole discretion of the Engineer.
- This procedure must be followed for incorporation of alternate precast concrete designs <u>after</u> execution of a TxDOT construction contract that includes bridges.

Introduction

- This procedure does <u>not</u> replace procedures for ordinary alternate precast alternative including:
  - beam designs as permitted by the Fabrication Notes
  - precast manholes and inlets
  - details per the PBC-P, PBC-RC, and PPBC-RC standards
  - details per the PCP, PCP-FAB, PCP(O), and PCP(O)FAB standards

Plan Notes

- "For a subject project to be considered a candidate for an alternate design, potential acceptance of alternate method proposals shall be explicitly stated in the project <u>**General Notes**</u> and can be included in project plans."

General Notes Example (Mandatory):

Precast Alternate Proposals.
When a precast or cast-in-place concrete element is included in the plans, a precast concrete alternate may be submitted in accordance with "Standard Operating Procedure for Alternate Precast Proposal Submission" found online at https://www.txdot.gov/inside-txdot/forms-publications/consultants-contractors/publications/bridge.html#design

Acceptance or denial of an alternate is at the sole discretion of the Engineer. Impacts to the project schedule and any additional costs resulting from the use of alternates are the sole responsibility of the Contractor.

Project Plans Example (Optional):

BRIDGE NOTES:

The design plans depict a bridge superstructure replacement technique using simple span TxGirder assemblies integrated with a bridge deck that is prefabricated together as individual units. The prefabricated units are joined together by cast-in-place concrete closure pours and prefabricated drop-in panels (depending on option). There is a primary method using two girder assemblies with closure pours between the assemblies and is the basis of bidding. There is an alternate method with a prefabricated full depth drop-in panel between adjacent two-girder assemblies that facilitates using the top of girder interface for forming. No changes in pay items will be incorporated if this alternate is chosen, and quantities associated with this alternate are for Contractor's information only.

Beyond the methods shown in the plans, the Contractor is allowed to submit an alternative approach that meets the objectives of accelerated contruction identified elsewhere in the plans. If such an alternative approach is pursued, instructions for submission and approval can be found online here: http://ftp.dot.state.tx.us/pub/txdot-info/brg/design/alternate-precast-accelerated-sop.pdf. As noted, submission of an approach does not guarantee usage and approval in this contract.

Superstructure designed according to AASHTO LRFD BRIDGE Design Specifications, 8th Edition (2017).

Design loading for superstructure is HL-93.

Transport and lifting weights and sizes are tradeoffs to be considered. For alternate assemblies beyond what is specified, submit engineering calculations, transport, and erection plans demonstrating that the units will not be damaged or overstressed.

The design plans also depict a bridge substructure replacement technique using precast abutments and precast straddle-type interior bent caps.

Plan Notes

- Milestones can be used for an ABC project to help ensure roadway closures are reduced.
  - Helpful in rural areas with long detours or in urban areas

Milestone A - US 83 at West Fork of Horse Creek (North) CSJ: 0030-05-069

Milestone A to construct bridge is designated to facilitate construction as fast as possible.

The time allowed for the bridge construction is 20 working days in accordance with Article 8.3.1.5. Calendar Day.

Milestone A time charges will start when the bridge is fully closed to traffic. Fully closed is defined as, when traffic is shifted to the detours defined in the plans, for more than a 2-hour duration.

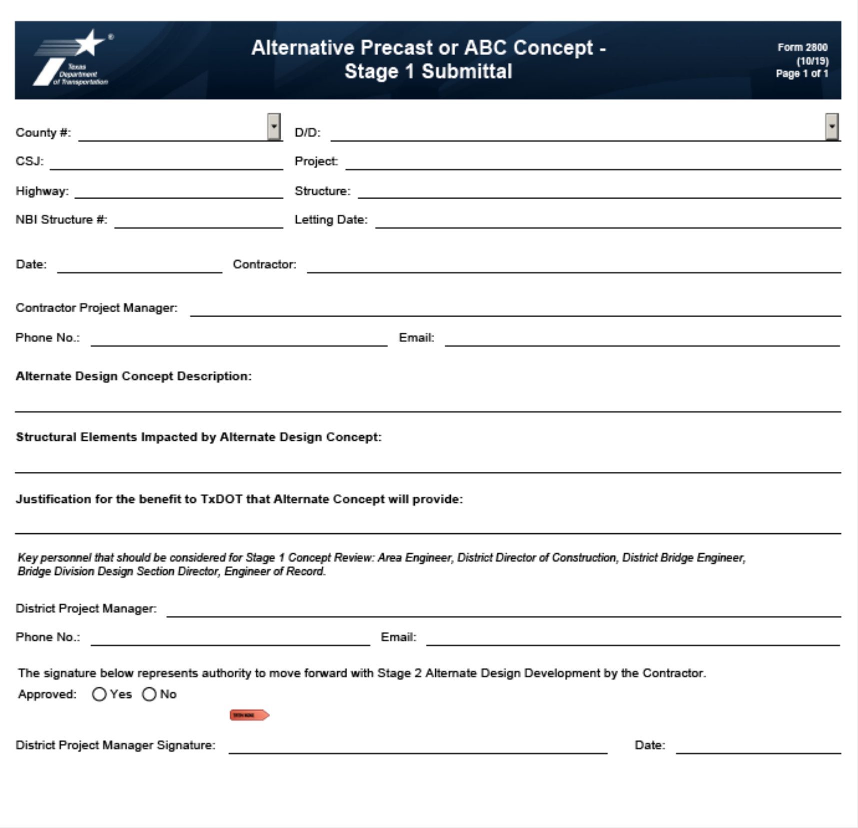
Milestone A time charges will end when the following requirement are met:

1. Both lanes of traffic are open on the bridge and approaching roadway
2. On-site detour not used for any portion of a nighttime closure

If Milestone A is complete earlier than the stated number of working days, a bonus of $10,000 per day will be awarded; up to a maximum of 15 bonus days. If the Milestone A is not completed within the stated number of days, contract administration and road user costs of $5,000 per day will be assessed for each day in excess of the stated number of allowable working days for the bridge until the milestone requirements are met. The working period charged during Milestone A will also be included in the computation of the total contract time charges for the overall project.

Stage 1: Concept Review

- Contractor submits an official request to the TxDOT District PM for the Stage 1 Alternate Design Concept by completing TxDOT Form 2800
- The concept must provide equal or better value to TxDOT.
- Phase 1 approval does not guarantee Phase 2 approval.



Alternative Precast or ABC Concept - Stage 1 Submittal

Form 2800 (10/19) Page 1 of 1

County #: ______ D/D: ______

CSJ: ______ Project: ______

Highway: ______ Structure: ______

NBI Structure #: ______ Letting Date: ______

Date: ______ Contractor: ______

Contractor Project Manager: ______

Phone No.: ______ Email: ______

Alternate Design Concept Description:

Structural Elements Impacted by Alternate Design Concept:

Justification for the benefit to TxDOT that Alternate Concept will provide:

Key personnel that should be considered for Stage 1 Concept Review: Area Engineer, District Director of Construction, District Bridge Engineer, Bridge Division Design Section Director, Engineer of Record.

District Project Manager: ______

Phone No.: ______ Email: ______

The signature below represents authority to move forward with Stage 2 Alternate Design Development by the Contractor.

Approved: ○ Yes ○ No

District Project Manager Signature: ______ Date: ______

Stage 1: Concept Review

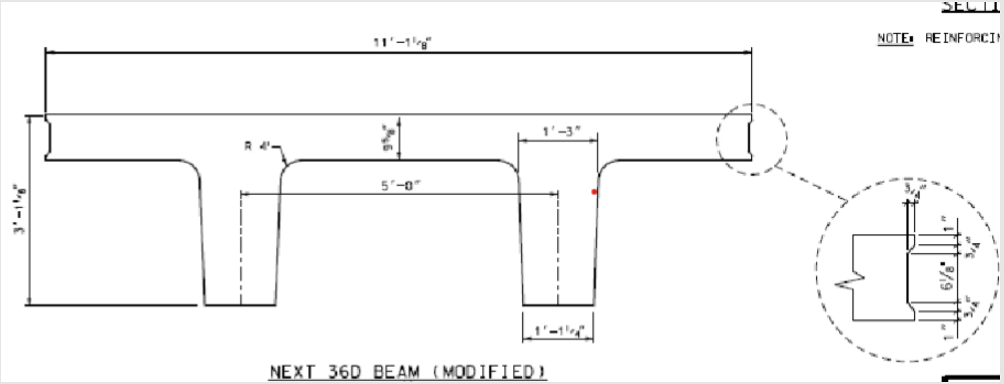
- The goals of the Stage 1 concept review include:
  - Understand the proposal
  - Establish benefits
  - Engage key personnel
  - Viability of a concept
  - Outline timelines for Phase 2
- The goal is a maximum of **10 working days** for Stage 1 review

Stage 1: Concept Review

- There are key personnel that should be considered for inclusion in the Stage 1 Concept Review:
  - Area Engineer (and TxDOT CEI representative if applicable)
  - District Director of Construction
  - District Bridge Engineer
  - Bridge Division Design Section Director

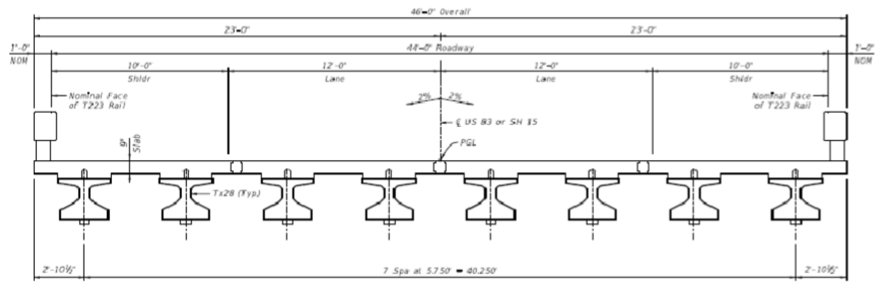
Stage 2: Alternate Design Development

- Design Plan Requirements
  - Required to be signed and sealed by a licensed Engineer in the state of Texas.
  - Required to be signed and sealed by an Engineer precertified in work category 5.2.1 Bridge Design. See Section 4 for consultant precertification information.
  - Required to show complete design calculations.

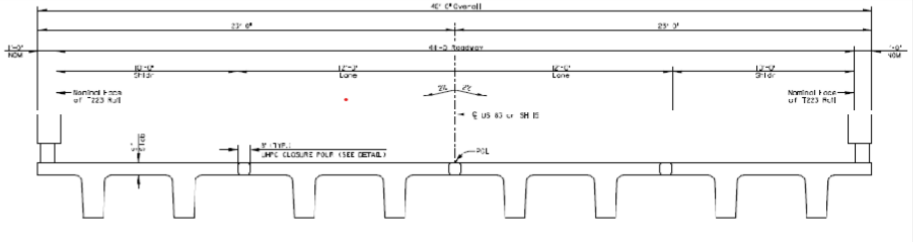


Stage 2: Alternate Design Development

- Design Calculations Requirements
  - Must be signed and sealed by an Engineer precertified in work category 5.2.1 Bridge Design as in Section 2.3.1 Alternate Design Plans Requirements.
  - Must follow the same edition of the AASHTO LRFD Bridge Design Specifications and edition of the TxDOT Bridge Design Manual as the original design.
- Submit formal Alternate Design package to the TxDOT District PM



TYPICAL SECTION WITH PRECAST CONNECTION



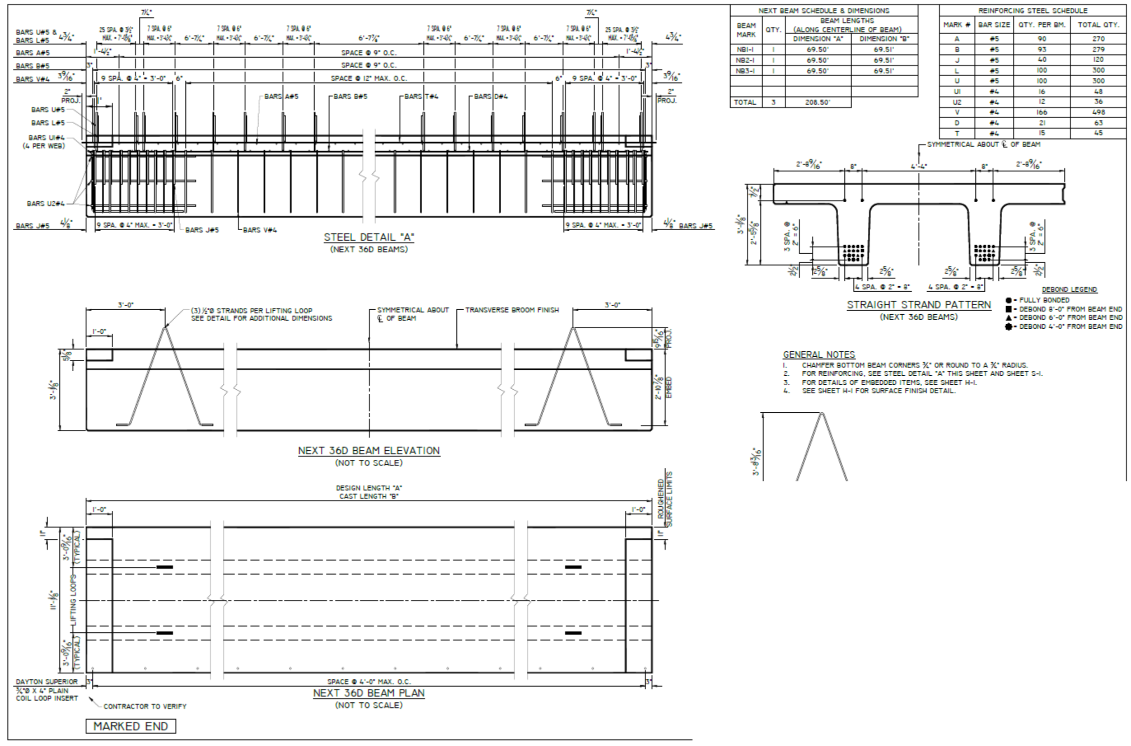
TYPICAL SECTION WITH NEXT 36D BEAM (MODIFIED)

Stage 3: Review of Alternate Plans and Calculations

- The TxDOT District Project Manager will send a request for approval of the alternate design to the Engineer.
  - The goal is a **maximum 20-25 working days** to review and respond to detailed submittals. Each resubmittal to address review comments will reset the target 20-25 working day period for reviewer response.

Stage 3: Review of Alternate Plans and Calculations

- Review of Plans
  - Once review is complete, the reviewing party will place an official stamp on the Alternate Plans and submit back to the TxDOT District PM.
  - All official submittals and reviews must travel through the TxDOT District PM



Stage 3: Review of Alternate Plans and Calculations

- Review of Calculations
  - The Reviewer will verify that the Calculations were designed according to the same AASHTO LRFD Edition used for the original design.
  - The TxDOT District PM archives the calculations in accordance with the procedure outlined within the TxDOT Bridge Design Manual-LRFD.

Description

deck design according to AASHTO LRFD Bridge Design Specifications

Deck Slab Geometry (per foot width)

slab width (b)	b =	12.00	*in*	
slab thickness (t)	t =	8.50	*in*	

Material Properties

f'c — 28-day strength of precast NEXT beams	f'c =	8.50	*ksi*	
fy	fy =	60.00	*ksi*	

Loads (refer to AASHTO LRFD Table A4-1, for S = 5.0 ft.

max. factored positive moment	+Mu =	4.65	*K-ft*	
max. factored positive moment	+Mu =	56	*K-in*	
max. factored negative moment				
by interpolation				

distance from Cl of girder to design section for Negative Moment	
6 in.	9 in.
2.66 K-ft	2.24 K-ft

	distance from CL of NEXT beam web to face of stem =	7.500	*in*	
max. factored negative moment	-Mu =	2.45	*K-ft*	
max. factored negative moment	-Mu =	29	*K-in*	

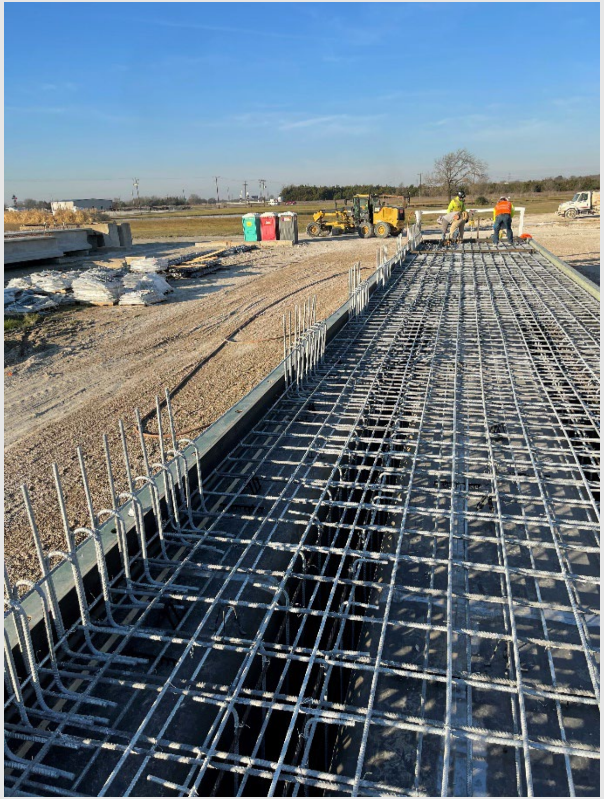
Positive (+M) Moment Capacity (between NEXT beam stems spaced at 5.00 ft.)

clearance to reinforcing	clear cover (bottom) =	1.81	*in*	
bottom reinforcing diameter (#5)		0.625	*in*	
fr = 0.2sqrt(f'c); LRFD Art. 5.4.2.6	fr =	0.583	*ksi*	
reference Art. 5.8.3.4.3				
Ig = bh^3/12	Ig =	614	*in^4*	
Sc = Ig/(h/2)	Sc =	145	*in^3*	
minimum reinforcing; LRFD Art. 5.7.3.3.2				
where:				
M min = lesser of 1.33*Factored Moment or Mcr				
	1.33Factored Moment =	74	*K-in*	
	alpha 3 =	0.67		
	alpha 1 =	1.60		
	Mcr =	90	*K-in*	
	M min=	74	*K-in*	
M design = greater of M min or Factored Moment				
	M design =	74	*K-in*	
resistance factor (phi); LRFD Art. 5.5.4.2.1	phi (moment) =	0.90		
for tension-controlled reinforced concrete				
Factored Moment Resistance Mr = phi(Mn); LRFD Eq. 5.7.3.2.1-1				
where:				
As = provided area of reinforcing (+M)	As (prv'd), #5 @ 9" =	0.41	*in^2*	
a = depth of equivalent stress block (Asfs)/(0.85f'cb) =	a =	0.29	*in*	
ds = distance from compression face to center of rein.	ds =	6.38	*in*	
Mn = Asfs(ds-a/2); LRFD Eq. 5.7.3.2.2-1	Mn =	155	*K-in*	
	Mr =	139	*K-in*	OK

>>>>> Longitudinal Distribution Reinforcement

	girder stem spacing (S) =	5.00	*ft*	
	girder stem width =	1.25	*ft*	
effective span length (AASHTO LRFD Section 9.7.2.3), taken at girder stem face				
	effective span length =	3.75	ft	
for primary reinforcement perpendicular to traffic (AASHTO LRFD Section 9.7.3.2), As = 220/sqrt(S), maximum 67%				
	% As =	113.6075	%	
	use % As =	67	%	
	As req'd =	0.28	in^2/ft	
Therefore provide #4 at 6.5-inch spacing	As prv'd =	0.37	in^2/ft	OK

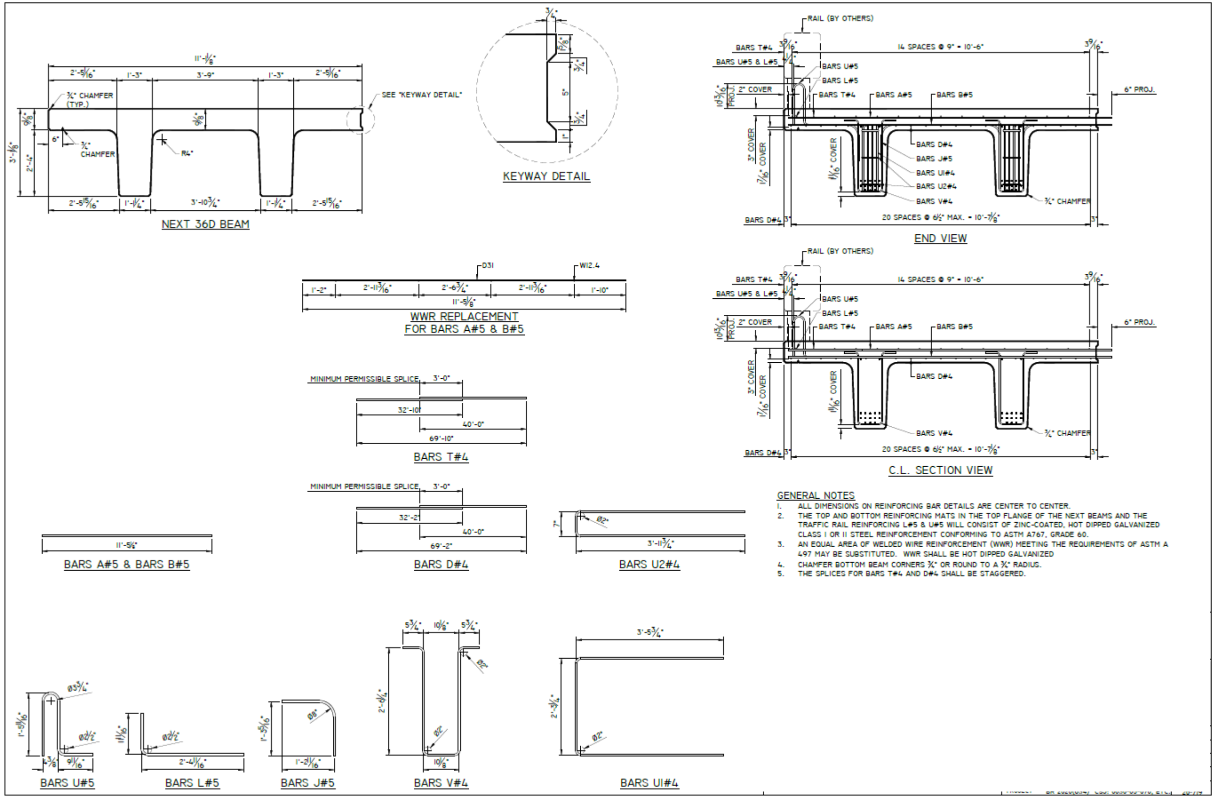
Notification and Filing of Alternate Plans



- If the Alternate Plans are approved, TxDOT District PM notifies contractor PM with approved copy of Alternate Plans
- TxDOT District PM ensures that approved Alternate Plans are filed with contract plans to ensure the as-built plans are accurate and notifies the district bridge inspection coordinator of the change.

Shop Plans

- TxDOT District PM informs the contractor who/where to send the shop drawing submittals for review. Contractor submits shop plans according to the **Guide to Electronic Shop Drawing Submittal.**
- Engineer reviews submitted shop plans against the approved Alternate Design Plans.
- From this point on, shop drawing submittal/review/approval process follows the typical procedure.



Bridge Design Manual Update

Texas Department of Transportation

Bridge Design Manual - LRFD

Bridge Division

January 2023

https://tntoday.dot.state.tx.us/BRG/Documents/Site%20Documents/Bridge%20Design/lrf.pdf

Chapter 3 — Superstructure Design *Section 18 —Prefabricated Superstructure Alternatives*

Section 18

Prefabricated Superstructure Alternatives

When possible, allow precast and prefabricated alternatives to the as designed cast-in-place concrete or precast bridge superstructures.

If desired, provide post-letting allowance for precast and prefabricated bridge element alternates by adding the following note to Item 5 in General Notes:

> "When precast or cast-in-place concrete bridge elements are included in the plans, a precast concrete alternate may be submitted in accordance with "Standard Operating Procedure for Alternate Precast Proposal Submission" found online at https://ftp.txdot.gov/pub/txdot-info/brg/design/alternate-precast-proposal-submission.pdf. Acceptance or denial of an alternate is at the sole discretion of the Engineer. Impacts to the project schedule and any additional costs resulting from the use of alternates are the sole responsibility of the Contractor."

Develop alternates using the TxDOT Bridge Standards and working drawings for precast elements or use the concepts demonstrated within the standards and working drawings to the extent possible.

Submit design concepts beyond the scope of TxDOT Bridge standards and here within, in accordance with "Standard Operating Procedure for Alternate Precast Proposal Submission" found online at https://ftp.txdot.gov/pub/txdot-info/brg/design/alternate-precast-proposal-submission.pdf.

Bridge Design Manual Update

Section 11
Precast and Prefabricated Substructure Alternatives

Bent Caps and Abutments

Provide equal or better corrosion resistance to the originally designed bent cap and cap to column connection as shown in the project plans.

Limit initial tension stress to 0, "no tension" during release, lifting, and hauling. Precast, prestressed bent caps designed to "no tension" using uncoated strand and reinforcement provides the equal corrosion resistance to uncoated, epoxy coated, and galvanized reinforcement.

If the precast bent cap alternate reduces the number of columns, design the alternate bent cap and columns to meet the requirements for vehicular collision presented in Chapter 2, Section 2, and Chapter 4, Section 7.

Do no use the following without prior approval from TxDOT Bridge Division:

- Hollow shells subsequently infilled
- Hollow voids
- Lightweight concrete
- Separate pieces joined together in the field

Precast Concrete Columns

Do not use precast concrete columns without prior approval from the TxDOT Bridge Division.

Prefabricated Steel Bent Caps

Design prefabricated steel bent caps for load path redundancy, system redundancy, or internal redundancy. Due to level of effort associated with pursuing acceptance of system redundancy or internal redundancy, obtain prior approval from the TxDOT Bridge Division before progressing with design.

Questions?

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