PHASING CONSIDERATIONS FOR BRIDGES

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What not to do

Do not used standard detail sheets for:

- Abutments
- Bents
- Spans
Span Arrangement

- When laying out spans for bridge replacement, offset old and new bent lines by at least 5 feet, if possible, to avoid fouling existing foundations.
When laying out spans for bridge replacement, offset old and new bent lines by at least 5 feet, if possible, to avoid fouling existing foundations.
Span Arrangement

- If foundation requires use of battered piles
  - Check proposed pile locations to determine possible conflicts
  - Create foundation layout to warn contractor of potential conflicts
  - Investigate potential conflicts with wingwall foundations when abutments are heavily skewed.
Span Arrangement

Possible conflicts

Batter Pilings in direction shown to avoid Existing Pilings
Superstructure – Geometric Considerations

- Things to consider when designing phased superstructure
  - Traffic Needs
  - Placement of temporary barriers
  - Clearance between proposed and existing structures (roadways)
  - Skew
  - Phase Line Placement
Superstructure – Geometric Considerations

- Traffic Needs
  - Ensure phase dimensions are sufficient to carry traffic demands
  - For phase replacement, ensure removal of existing structure provides sufficient space to carry traffic
Superstructure – Geometric Considerations

PHASE I CONSTRUCTION

REMOVE CROSS-HATCHED AREA AS SHOWN (PHASE I)

SLAB BEAM (TYP)

SLAB BEAM 8

SLAB BEAM 11

TEMPORARY PTB

2.00'

1.58'

4.02'

6'

10.02'

14'

CSH 44

19.47'

PHASE I CONSTRUCTION

18.47'

1'-0''

NOM

14' LANE
Superstructure – Geometric Considerations

- Placement of Temporary Barriers
  - Determine clear distance from back toe of rail to edge of slab
  - If clear distance < 2 ft, anchor barrier
  - If clear distance ≥ 2 ft, barrier does not need to be anchored
Superstructure – Geometric Considerations
Superstructure – Geometric Considerations
Clearance

- When building next to an existing facility (such as for phased replacements), provide enough space between the existing structure and the new construction to accommodate:
  - Splicing of deck reinforcement
  - The portion of the beam that extends beyond the edge of slab
  - The portion of the bent or abutment that extends past the beam edge
  - Any reinforcing of the bent or abutment that extends into the next phase
  - Formwork
  - Temporary Special Shoring
Superstructure – Geometric Considerations

TYPICAL TRANSVERSE SECTION FOR SPAN 1 AND SPAN 2
Superstructure – Geometric Considerations
Superstructure – Geometric Considerations
Superstructure – Geometric Considerations
Superstructure – Geometric Considerations
Skew

- For large skews where slab corners require a breakback, consider breaking back the corners of the slab at the phase line.
Superstructure – Geometric Considerations
Superstructure – Geometric Considerations

- Phase Line Placement – TxGirders
  - Do not place a phase line in the middle or at the edge of a precast panel
  - Do not place a phase line closer than 7 ½” from beam edge when using precast panels
Superstructure – Geometric Considerations

- Phase Line Placement – TxGirders
  - Place phase line a minimum of 4” past CL of girder, so that horizontal interface reinforcement (R Bars) is cast into the initial phase of the slab
  - Alternately, consider placing the phase line between two beams. Treat the slab between the beam and the phase line as an overhang. Do not allow the use of panels in this space
  - PCP standard provides guidance on stage construction limitations for panels
Superstructure – Geometric Considerations

**PREFERRED**

- **PHASE 1**
- **PHASE 2**

**ALTERNATE**

- **PHASE 1**
- **PHASE 2**

- **NO PCP's ALLOWED IN THIS BAY**

- **S <= 6'**

- **4'' min.**

- **Standard Phase Const Jt**

- **Alternate Phase Const Jt**
Superstructure – Geometric Considerations

- Phase Line Placement – Adjacent Slab or Box Beams
  - Do not place phase line within the top flange
Superstructure – Geometric Considerations

- Phase Line Placement – Adjacent Slab or Box Beams
  - Place phase line at the edge of the beam.
Superstructure – Geometric Considerations

- Phase Line Placement – U-Beams and X-Beams (Spread Box)
  - Do not place a phase line in the middle or at the edge of a precast panel
Phase Line Placement – U-Beams and X-Beams (Spread Box)

- Place the phase line along the top flange of the beam. If the phase line is located along the top flange of the beam, the majority of the beam will be under the initial phase of construction
- Do not place the phase line closer than 6 ½” from the beam edge for U-Beams and 10” for X-Beams when using precast panels
Superstructure – Geometric Considerations

Preferred Phase Const Jt

PHASE 1

6 1/2" min.

s

PHASE 2

Preferred Phase Const Jt

PHASE 1

10" min.

s

PHASE 2
Phase Line Placement – U-Beams and X-Beams (Spread Box)

- Alternately, consider placing the phase line between two beams. Treat the slab between the beam and the phase line as an overhang. Do not allow the use of panels in this space
Superstructure – Geometric Considerations

Alternate Phase Const Jt

PHASE 1

NO PCP's ALLOWED IN THIS BAY

S <= 13'

Alternate Phase Const Jt

PHASE 1

NO PCP's ALLOWED IN THIS BAY

S <= 8'
If a full depth open longitudinal joint is used at the phase line, the bridge is considered two structures and should have 2 NBI Numbers.
Phased superstructures may require variable spacing of beams
Superstructure – Geometric Considerations

TYPICAL TRANSVERSE SECTION (SPANS 1 & 3)

7 Eq Spa at 9.280 = 64.958°
Superstructure – Geometric Considerations

TYPICAL TRANSVERSE SECTION (SPANS 1 & 3)

6 Eq Spa at 8.826' = 52.958°
Superstructure – Structural Analysis

- When designing the beams, consider all temporary loading such as temporary rails as permanent loads for that phase.
- Design beams to meet all requirements for all phases of construction.
Superstructure – Structural Analysis

TYPICAL BRIDGE SECTION
Superstructure – Structural Analysis
The beam located under the phase line will have less dead load deflection than the other beams constructed at the same time. This beam will not deflect additionally when the remainder of the slab is cast, due to the added stiffness of the cured slab. When calculating haunch for the beam along the phase line, use the dead load deflection from the initial slab weight. Do not use the full dead load deflection due to the full slab weight (initial and final).
Superstructure – Structural Analysis
It is recommended to use PGSuper for beam design. Model phasing in PGSuper by using separate files for each phase and the completed structure.
Superstructure – Structural Analysis
Superstructure – Structural Analysis
Load rating of the existing structure is required if the phasing scheme removes portions of the existing structure. Acceptable load rating limits for phased construction of existing structures should be discussed with the District where the work is performed.
Substructure – Geometric Considerations

DO NOT

DO NOT
Substructure – Geometric Considerations

DO

DO
Substructure – Geometric Considerations

- When phasing an abutment or an interior bent, consider providing enough space between the existing structure and the new construction to accommodate splicing of the reinforcement and formwork.
- Consider how the next phase of construction will be impacted by the placement of phase lines and reinforcement that extends beyond the phase line.
Substructure – Geometric Considerations
Substructure – Geometric Considerations
Substructure – Geometric Considerations

- Avoid having splices that overlap drilled shaft/pile locations
- Consider placing first foundation element of the next phase during previous construction phase.
If unable to provide enough room to splice the reinforcement through traditional overlapping, use welded splices or mechanical couplers. In some cases, a combination of couplers/welded splices and traditional overlapping may be utilized for elements with varying bar sizes. Extend reinforcement that will be spliced by welds or mechanical couplers beyond the end of the cap by at least 1-foot.
Substructure – Geometric Considerations

ELEVATION
Interior Boat Ways 2 & 3

- Length shown is for use with Mechanical Couplers. Use splices are permissible for bars 1/2. If lap splices are used, extend bars 1/2"-1/2" all from the end of the slab.
As alternative to splicing or welding the reinforcement, a full depth joint may be used at the phase line. For abutments, if a full depth joint is used, limit the space between abutments to 1-inch. Use bituminous fiber to fill the gap between the phases. Use a PVC waterstop across the space along the full height of the cap and backwall.
Substructure – Geometric Considerations

[Diagram of bridge substructure with geometric details and notes]
Substructure – Geometric Considerations

4 Use PVC Waterstop full height of Cap & Backwall. See "PVC WATERSTOP DETAIL" (SHEET 2 OF 2)

5 Begin Bridge

1 2'-3" 2'-3"

£ Beam #1

5,000'

4,000'

3 1/2" Premolded Expansion Joint Material. Install in accordance with Item 420.2.E.

4 PVC Waterstop shall be considered subsidiary to Class "C" Concrete. (Abut)
For bent caps, the full depth open joint at the phase line should be at least 1-foot wide to allow for forming of the adjacent phases. Individual bent caps would support each phase.
Substructure – Geometric Considerations

[Diagram of a bridge with dimensions and annotations, including labels for shoulder, lane, and slope.

Completed Bridge]
When selecting column or drilled shaft/pile spacing, try to keep the distance from face of column or drilled shaft/pile to the phase line between 0.5 and 4 feet. Overhangs greater than 4 feet can result in high negative moments and permanent deflection of the overhang under loading. The construction of additional phases will not remove this deflection.

Phased construction of abutments or bents may require that columns or drilled shafts be spaced at irregular intervals.
PHASE II

Substructure – Geometric Considerations

- Column Spacing: 3.917’
  - 2 Spaces at 14.250’ = 28.500’

- Girder Spacing: 2.000’
  - 4 Spaces at 8.083’ = 32.333’

- Level 3’-0” for Bearing Seat (Typ)

- Dowels D (Outside girders only)

- Bearing

- Dowels D

- Cap & Columns

- See Girder Layout for Girder Angle (Typ all Girders)

- IH 10 & PGL

- 6.750’

36.333’ ~ Phase 2

25.667’

10.667’

3.917’
Substructure – Geometric Considerations

PHASE III

Column Spacing: 3.750' - 16.250' - 12.333'
Girder Spacing: 2.000'

32.333' ~ Phase 3

3 Spaces at 8.083' = 24.250'
6.083'
38.000'

© Girder #1
Level 3'-0" for Bearing Seat (Typ)
1'-6" (Typ)

© Girder #4

Dowels D (Outside girders only)

© Bearing
© Cap & © Columns

See Girder Layout for Girder Angle (Typ all Girders)
Substructure – Geometric Considerations

PHASE IV
Substructure – Structural Analysis

- When designing bents and abutments to be continuous after phasing, consider all stages of construction (including temporary loads) and the final configuration. Select flexural and shear reinforcement so that loading in all phases can be supported.

- Design bents and abutments that have full depth joints at the phase line as individual components.
Substructure – Structural Analysis
Substructure – Structural Analysis
Substructure – Structural Analysis

PHASE II

PHASE II

- 36.333’ ~ Phase 2
- 25.667’
- 10.667’
- 3.917’
- 2 Spaces at 14.250’ = 28.500’
- 4 Spaces at 8.083’ = 32.333’

**Column Spacing**
- 3.917’
- 2.000’

**Girder Spacing**
- 2.000’

- 6.750’
- 3.6’
- 1’-6’ (Typ)
- Level 3’-0” for Bearing Seat (Typ)
- Dowels D (Outside girders only)
- Dowels D
- Dowel for Bearing (Typ)
- Cap & Columns
- See Girder Layout for Girder Angle (Typ all Girders)
- GH 10 & PGL
- GH Girder #9
- GH Girder #5
Substructure – Structural Analysis

PHASE IV
Load rating of the existing structure is required if the phasing scheme removes portions of the existing structure. Acceptable load rating limits for phased construction of existing structures should be discussed with the District where the work is performed.
Are mechanical couplers acceptable at deck widths in lieu of spliced lengths?
They are acceptable, but not recommended because of the large number that would be required.

*Question from the Audience:* As a consideration, keep buffer spacing between rails for adjacent (e.g. back-to-back) new bridge structures,

When breaking back at the phase line for skewed bridge, how would you design the expansion joint?
Joints should be extended a distance beyond the phase line (typically min 6”) to allow for connection to joint in next phase

At more than what angle should the slab have a break back during phase construction?
Typically 15°, but use engineering judgment.

The recently released Design Guide proposes the use of a 1” joint between phases of abutments in lieu of reinforcement lap splices across a construction joint. Does TXDOT prefer to see the 1” joint or a construction joint?
Follow recommendations in the Design Guide.
In some phasing projects, we’ve considered leaving a portion of the existing bent cap underneath the new beams when sufficient clearance exists. Does TXDOT have a preference for partial demolition of existing bents or is leaving the existing bent acceptable assuming clearances are checked?

You can leave a portion of the existing bent cap, and sometimes you have to. It will depend on structural capacity (analyses) and clear zone.

For slab and box beams that require phase line right at the beam edge, would the projected deck reinforcing cause difficulty to the placement of adjacent beam in the next phase? Why can't the phase line happen within the top of the beam as in X-beam and U-beam?

The projected deck reinforcing is not known to cause any problems.

Column spacing per the bridge standards for bent caps is 5’ max from edge of cap to edge of column. Would phased open joint bents be able to follow this, or would they need to follow the 4’ recommendation to minimize cantilever stress as mentioned?

Follow the 4’ recommendation, and ensure proper fit up with subsequent phases.
For bridge design, are there any recommendations for roadway alignments with PC and PTs that may fall within bridge structures at superelevated sections?

Not at this time.

*From the Audience:* Substructure phased construction joint at face of support should be intentionally rough to aid in shear transfer.

At abutment phase joints, can type 10 waterproofing be used instead of a PVC waterstop?

If using full-depth open joint, Type 10 waterproofing is not sufficient. The PVC waterstop is important in preventing the migration of fines from behind the abutment. If using a construction joint, it is not a bad idea to use Type 10 waterproofing.

*From the Audience:* The bearing seat elevations for later phases will need to be lowered to account for the potential for camber differences for the later phase girders.

With a 1" open joint, did you say to not have a wheel path over the joint or no traffic at all on either side of the joint? Why?

Do not have an open joint under a wheel path. The deck on either side can move differentially and can create a small snag, which can drag the wheel, this creates a safety issue.
Questions?

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