PARTIAL-DEPTH PRECAST DECK PANEL DESIGN AND CONSTRUCTION IN TEXAS

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Prefabricated Elements

- TxDOT’s primary technique for accelerated bridge construction.
- In addition to increased speed, also typically comes with increased quality.
- Can encompass practically every element from the ground up.
Precast Bent Caps

Partial-Depth Precast deck panel design and construction in Texas
Precast Abutments

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Decked Slab Beams: 6 – 10 Day Construction Projects

- Precast Abutment
- Decked Slab Beams
- Precast Bent Cap
- Steel Piling
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Prestressed Concrete Panels

- In use in Texas since the 1960’s
- Change in bid code lead to rise in popularity
- About 90% of New Bridges

![Image of construction workers and diagram of partial-depth precast deck panel design and construction in Texas]
What Are They?

- Partial Depth
- 4” panel
- Top portion of deck CIP
- Optional use

![Longitudinal Panel Reinforcing](image)

![Diagram of panel and transverse reinforcing](image)
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Research

- Test of Precast Prestressed Concrete Bridge Deck Panels (1963)
  - Bond between CIP concrete and panels
  - Load transfer between panels
- Study of In-Service Bridges Constructed with Prestressed Panel Sub-Decks (145-1) (1970)
  - Load transfer to adjacent girders
- Development Length of Stands in Prestressed Panel Sub-Decks (145-2) (1970)
- Cyclic Load Tests of Composite Prestressed-Reinforced Concrete Panels (145-4F)(1972)
- Recommendations for the Use of Precast Deck Panels at Expansion Joints (0-5367-1) (2008)
Standards

- Provided in plans as a standard
- Includes Prestressed Concrete Panels and Prestressed Concrete Panel Fabrication
- [https://www.txdot.gov/insdtdot/orgchart/cmd/cserve/standard/bridge-e.htm](https://www.txdot.gov/insdtdot/orgchart/cmd/cserve/standard/bridge-e.htm)
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**Standards**
Standards (Restrictions)

- Prestressed panels not used on
  - Slab Beams
  - Box Beams
  - Curved Steel Girders
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**Fabrication Standards**

- 3/8” or 1/2” strands, #4 grade 60 bars

**Transverse Panel Reinforcement:**

- For panel widths over 5’, use 3/8” or 1/2” Dia (270k) prestressing strands with a tension of **14.4 kips per strand**.
- For panel widths over 3’-6” up to and including 5’, use 3/8” or 1/2” Dia (270k) prestressing strands with a tension of 14.4 kip per strand. Optionally, #4 Grade 60 reinforcing bars may be used in lieu of prestressed strands.
- For panel widths up to 3’-6”, use #4 Grade 60 reinforcing bars (prestressed strands alone are not allowed).

Place transverse panel reinforcement at panel centroid and space at 6” Max.

**Longitudinal Panel Reinforcement:**

- Any of the following options may be used for longitudinal panel reinforcement:
  1. (#3) Grade 60 reinforcing steel at 6” Max Spacing. No splices allowed.
  2. 3/8” Dia prestressing strands at 4 1/2” Max Spacing (unstressed). No splices allowed.
  3. 1/2” Dia prestressing strands at 6” Max Spacing (unstressed). No splices allowed.
  4. Deformed Welded Wire Reinforcement (WWR) (ASTM A1064) providing 0.22 sq in per foot of panel width. wires larger than D11 not permitted. Provide transverse wires to ensure proper handling of reinforcing. One splice per panel is allowed. See WWR Splice Detail.

No combination of longitudinal reinforcement options in a panel is allowed.

Place longitudinal panel reinforcement above or below transverse panel reinforcement. Must be placed above transverse panel reinforcement for skewed end panels with supplemental #4 reinforcement.
Bedding Strips

- Min of ½” vertical and 1 ½” horizontal overhang
- Allows space for concrete
- Important mechanism for live load transfer

**TABLE OF BEDDING STRIP DIMENSIONS**

<table>
<thead>
<tr>
<th>WIDTH</th>
<th>HEIGHT (Min)</th>
<th>HEIGHT (Max)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; (Min)</td>
<td>½&quot;</td>
<td>2&quot;</td>
</tr>
<tr>
<td>1 ¼&quot;</td>
<td>½&quot;</td>
<td>2 ½&quot;</td>
</tr>
<tr>
<td>1 ½&quot;</td>
<td>½&quot;</td>
<td>3&quot;</td>
</tr>
<tr>
<td>1 ¾&quot;</td>
<td>½&quot;</td>
<td>3 ½&quot;</td>
</tr>
<tr>
<td>2&quot; (Max)</td>
<td>⅝&quot;</td>
<td>4&quot;</td>
</tr>
</tbody>
</table>

*Notes:*
- Place bedding strip at flange edge as shown.
- Min of ½" vertical and 1 ½” horizontal overhang.
- Allows space for concrete.
- Important mechanism for live load transfer.
Bedding Strips
Phased Construction

- Place phase line to accommodate PCP
PCP Advantages

- Fast Construction
- Less Formwork
- Better Durability
- Safer Work Area
Owner’s Perspective
  – Inexpensive
  – Fast
  – Durable

Contractor’s Perspective
  – Fast
  – $$$*

* Sometimes difficult for Primes to let go of cast-in-place
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Construction Procedures

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Durability

- Low Permeability
  - Fly Ash
  - Steel Form Finish

- Produced in Controlled Environment
  - Low Water-to-Cement Ratio
  - Moist Curing
  - QC/QA

- Repair and Rejection – Plant vs. Job Site
– Prestressed bridge deck panels **will be rejected** for any of the following conditions:

– any crack extending to the reinforcing plane and running parallel and within 1 in. of a strand for at least 1/3 of the embedded strand length; or

– any transverse or diagonal crack, including corner cracks and breaks, intersecting at least 2 adjacent strands and extending to the reinforcing plane.

– Prestressed bridge deck panels that sustain damage, cracks not listed above, or surface defects during fabrication, handling, storage, hauling, or erection are **subject to review**.
Repair and Rejection – Plant vs. Job Site

- Geometry Control in the Plant vs. Job Site

<table>
<thead>
<tr>
<th>Dimension</th>
<th>I-beams</th>
<th>U-beams</th>
<th>Box and Slab Beams</th>
<th>Double-T Beams</th>
<th>Bridge Deck Panels</th>
<th>Piling</th>
<th>Wall Panels¹</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length (perpendicular to strands for bridge deck panels)</td>
<td>±1”</td>
<td>±1”</td>
<td>±1”</td>
<td>±3/4”</td>
<td>±1/2”</td>
<td>-1”²</td>
<td>±3/16”</td>
</tr>
<tr>
<td>Width (parallel to strands for bridge deck panels)</td>
<td>+3/4”</td>
<td>±1/4”</td>
<td>±1/4”</td>
<td>±1/2”</td>
<td>±1/2”</td>
<td>±1/4”</td>
<td>±3/16”</td>
</tr>
<tr>
<td>Nominal depth (thickness in case of panels)</td>
<td>+1/2”</td>
<td>±1/4”</td>
<td>±1/4”</td>
<td>±1/4”</td>
<td>+1/4””</td>
<td>±1/4”</td>
<td>±3/16”</td>
</tr>
</tbody>
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¹Wall Panels: ±3/16”
New Concepts
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Detail over interior

CONVENTIONAL INTERIOR BENT
Panel against Panel between Bns/Girders.

2. $\frac{3}{8}$" thick timber board, leave in place. Place straight, within $\frac{3}{8}$" of Centerline of Bent or face of Inv-T, across bridge width and end board at exterior flange edge of fascia beams/girders. Do not extend into overhang.
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Detail over interior

Place additional (#4) bar 5'-0" in length between every slab bars T. Center (#4) bar on joint.
Problems with large haunches

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Precast Overhang Deck Panels with Pockets

Partial-Depth Precast deck panel design and construction in Texas
PreCast Overhang Deck Panels with Channel
Long-term Performance
Few Problems of Delamination
Few Problems of Delamination
Precast Deck Panels
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