Cored Slab and Box Beam Bridges
Cored Slab - Box Beam

- **Cored Slab Units**
  - 3 feet wide units
  - Depths
    - 18” (<45 ft)
    - 21” (<55 ft)
    - 24” (<70 ft)
  - Usually no more than 4 spans and less than 17 units in width.

- **Box Beam Units**
  - 3 feet wide units
  - Depths
    - 33” (<90 ft)
    - 39” (<100 ft)
### 18" CORED SLAB

- **Area:** 483.4 in.$^2$
- **Weight:** 3.3568 x 150 = 5041 lbs/ft.$^2$
- **$I_{xx}$:** 16209 in.$^4$
- **$I_{yy}$:** 57017 in.$^4$
- **W:** 3.00 ft.$^+$
- **J:** 30880 in.$^4$
- **H:** 15.00 in.
- **C$_T$:** 9.080 in.
- **C$_B$:** 8.920 in.
- **D:** 10.00 in.
- **$S_T$:** 1794 in.$^3$
- **$S_B$:** 1826 in.$^3$

### 21" CORED SLAB

- **Area:** 522.3 in.$^2$
- **Weight:** 3.6266 x 150 = 544 lbs/ft.$^+$
- **$I_{xx}$:** 25390 in.$^4$
- **$I_{yy}$:** 62796 in.$^4$
- **W:** 3.00 ft.$^+$
- **J:** 52094 in.$^4$
- **H:** 16.00 in.
- **C$_T$:** 10.596 in.
- **C$_B$:** 10.404 in.
- **D:** 12.00 in.
- **$S_T$:** 2396 in.$^3$
- **$S_B$:** 2440 in.$^3$

### 24" CORED SLAB

- **Area:** 630.3 in.$^2$
- **Weight:** 4.3768 x 150 = 657 lbs/ft.$^+$
- **$I_{xx}$:** 38910 in.$^4$
- **$I_{yy}$:** 74460 in.$^4$
- **W:** 3.00 ft.$^+$
- **J:** 70159 in.$^4$
- **H:** 16.00 in.
- **C$_T$:** 12.097 in.
- **C$_B$:** 11.903 in.
- **D:** 12.00 in.
- **$S_T$:** 3216 in.$^3$
- **$S_B$:** 3269 in.$^3$

---

**Figure 6 - 81**

---

**Cored Slab Properties**

For approx. max. span for HL-81, see Figure 11-3
Substructure

- Similar to other bridges.
- Dowels in place of anchor bolts.
- Non-laminated elastomeric bearing pads.
Substructure
SECTION AT BENT #1 & BENT #2
FIXED END  EXPANSION END

ASPHALT WEARING SURFACE

1 1/2" EXP. JT.

12" Ø BACKER ROD

C EXP. JT. AT BENT

JOINT SEALER MATERIAL

2 1/2" Ø DOWEL HOLES

12" Ø VOIDS

12" Ø VOIDS

ELASTOMERIC BEARING PAD

C BEARING & #6 DOWELS

ELASTOMERIC BEARING PAD

SEE "BENT" SHEETS FOR DETAILS

SECTION AT BENT

(BENTS 2 & 5)
Delivery
Delivery

- Verify correct slabs have been shipped.
- Collect material receipt documentation.
- M&T Approved Stamp?
- Inspect slabs for damage or repairs.
- Stored slabs should be supported off the ground on level dunnage placed at bearing locations.
Setting the Slabs

- ALWAYS lift from approved pick points.
- Begin setting slabs from center and work toward the outside. WHY?
  - Dimensional errors can be worked out toward the outside edges.
- Rearranging the slabs to accommodate excessive sweep in the units may be necessary.
- Extreme camber differentials may also require rearrangement, especially adjacent to exteriors.
Things to watch for!

- Camber in exterior slabs differ significantly from adjacent units.
  - Can cause reinforcing steel clearance issues on concrete overlays, may affect cover or crown slope.
  - May be necessary to adjust adjacent slab.

- Slab does not sit uniformly on bearing pad.
  - Slab may be pinching on adjacent slab, debris on the bearing pad, seat slope incorrect.
  - May need to pick up and investigate, adjust location of the unit, possibly install shim plate.
Things to watch for!

- Dowels don’t line up.
  - Did not set from center out?
  - Layout incorrect, plan errors.
- Ends are out of alignment.
  - Skews are most common problem.
  - Can cause problems if joint is to be installed at approach slab.
  - Bond breaker for approach slab doesn’t function correctly.
  - Adjustments should be made to improve alignment.
Alignment
M&T Match Marks
HiCAMS Materials Received
Post-tensioning

- Once slabs are set, post-tensioning strands are tensioned to pull slabs together.
- 0.6 Inch strand inside a lubricated plastic sheath is threaded through strand duct (diaphragm).

After tensioning and grouting shear keys, slabs act as one unit and transfer load throughout all the slabs
Post-tensioning

Tension to 43,950 lbs

Cored Slabs and Box Beams now use the same diameter strand and are tensioned to the same load
Post-tensioning

Tension to 43,950 lbs

Cored Slabs and Box Beams now use the same diameter strand and are tensioned to the same load
Post-tensioning
Post-tensioning

- Diaphragms with 2 strands must be tensioned symmetrically (Box Beams)

*Article 430-6(C) - At each diaphragm location, maintain a symmetric tension force between each pair of strands in the diaphragm*
Post-tensioning

Partially tension first strand
Post-tensioning
Fully tension next strand
Post-tensioning
Post-tensioning

Complete tensioning first strand
Post-tensioning

Multiple jacks can also be used

Complete tensioning first strand
Post-tensioning

- Begin tensioning strand near mid-span first and work symmetrically along the length of the span.
Strand Jacks

- Must be calibrated by certified testing facility within 12 months.
- Contractor should provide calibration certificate and pressure/tension chart.
Contractor should provide jack information.
Verify correct pressure.

- Jack data sheet should provide effective area of cylinder.
- Tension = Pressure x Effective Area.
- Correct pressure would be 43,950 lb. /Eff. Area. (psi)
Check jack maximum stroke prior to tensioning.

Check maximum stroke

Max. stoke during tensioning = false tension readings.
Post-tensioning

- Contractor must use a reaction frame to allow access to set the wedges after tensioning.
- Tensioning against the wedges will not be allowed.
Strand Vise

- Strand Anchors consist of a collar and hardened wedges.
- Proper installation is critical to achieve correct tension in units.
Strand Vise

Double Strands

Strand Collar
WHERE'S THE TENSION BEING MEASURED???
Jacking against wedges setup
Not a good idea.
Jack Setup with reaction frame
Jack Setup with reaction frame
Double Acting Jack
Other Things To Consider

- Install strand vise on dry, clean cable only. No grease from strand should be on cable ends.
- Good idea to mark strand behind the strand vise to make sure the cable does not slip.
- Apply jack pressure to ensure proper tension is attained. 43,950 lbs. (need load charts for jack)
- Hold pressure for at least 2 minutes to ensure no pressure losses.
- Cut excess strand with saw. No flame cutting!
Cored Slabs/Box Beams

Grouting

- 2012 Specifications and Other Resources
  - Division 4 (Section 430), Page 4-52, 53, 54
  - Construction Manual (Section 430), Page 4-43, 44
  - Plans
  - Project Special Provisions (Grout for Structures)
  - Division 10 (Section 1003), Page 10-19 (DOES NOT APPLY)

GROUT FOR STRUCTURES

1.0 DESCRIPTION

This special provision addresses grout for use in pile blockouts, grout pockets, shear keys, dowel holes and recesses for structures. This provision does not apply to grout placed in post-tensioning ducts for bridge beams, girders, or decks. Mix and place grout in accordance with the manufacturer’s recommendations, the applicable sections of the Standard Specifications and this provision.
Cored Slabs/Box Beams
Grouting

Approved Mix Design

- Must have an approved concrete mix design.
- Cannot use grout that contains soluble chlorides or more than 1% soluble sulfate.

Approved Pre-Packaged

- A list of approved packaged grout is on M&T’s web site.
- Must be non-metallic & non-shrink grout.
- Consult manufacturer to determine if it is suitable for the application & meets strength, durability, etc. requirements.
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Cored Slabs/Box Beams Grouting

- **Preparation To Place Grout:**
  - Clean the areas (shear keys, dowel holes, recessed areas) to remove all dirt, debris, grease, oil, etc.
  - Saturate the concrete surfaces with clean water and remove excess water prior to placing grout.
  - Use backer rod or spray foam to seal cracks, holes, etc. Due to spray foam expansion, it should be trimmed as required.
Cored Slabs/Box Beams
Grouting

- Mixing Approved Pre-Packaged Grout:
  - Per Article 1024-4, use potable water only.
  - Follow Manufacturer’s recommendations for mixing. Instructions should be printed on the packaging.
- Per Project Special Provisions -
  - Aggregate may be added to the mix only where recommended or permitted by the manufacturer & Engineer.
  - The quantity & size of aggregate shall be in accordance with the manufacturer’s recommendation.
Cored Slabs/Box Beams
Grouting
Cored Slabs/Box Beams
Grouting
Cored Slabs/Box Beams

Grouting

- Grouting on Crown Typical Sections:
  - Grout center shear keys *before* post-tensioning when the caps (of end bent/interior bents) are crowned.
Cored Slabs/Box Beams

Grouting

- Dowel holes at fixed ends shall be filled with grout.
- Dowel holes at expansion ends shall be filled with joint sealer to 1 ½” above the dowels, then filled with grout.
Cored Slabs/Box Beams

Grouting

- Placing Loads on Cored Slabs/Box Beams:
  - Per Project Special Provisions, construction loading & traffic loading shall not be allowed until the 3 day compressive strength is achieved. (5000 psi)
  - Construction loading & traffic over legal load limit should be submitted for review & approval. This includes loading for top down construction.
Cored Slabs/Box Beams

Grouting

- If you observe cracks in the grout, prior to asphalt or concrete overlay, epoxy seal the cracks.
Cored Slabs/Box Beams
Grouting

End Rotation
CRACK

Outward Rotation Due to Barrier ?

PT Correctly ?
Camber in the cored slab/box beam units requires varying overlay depths along the span. Mid-span depth is the minimum overlay.
Barrier Rail

- Barrier rail is placed prior to overlay.
- Barrier rail will vary in depth to match the camber in the slabs.
- In addition to camber, overlay thickness must also be factored in to attain minimum rail height above finish grade.
Asphalt Wearing Surface

- Establish the plan grade line to determine wedging limits.
- Grades should be provided along the centerline and gutter lines.
- Several paving lifts may be necessary to bring bearing locations to grade.
Variable height concrete in barrier rail.
Variable depth asphalt or concrete overlay.
(wedging areas)
Variable height concrete in barrier rail, and variable depth asphalt or concrete overlay
Concrete Wearing Surface
Concrete Wearing Surface (CWS)

- Class AA – 78M mix design
- Place and finish according to 420-14 (just like cast in place decks on girder bridges)
- Adhere to 420-20 – 14 days cure and 4500 psi prior to placing loads on deck.
- Due to camber, deck thickness varies across the span. Grade lines are necessary to obtain proper depth and reinforcing steel cover.
- Screed set up must be based on finished grade elevations and rebar chairs adjusted to obtain proper cover.
CWS Longitudinal Construction
Joints
Cracking in CWS

- CWS will crack over the grout joint between spans.
- A tooled joint or sawed joint can control this crack.
- Sawed joints within 12 hours.
- Do not saw the joint if it has already cracked.
Sidewalks

- Tool joints in sidewalk on skew and over grouted, fixed joints between spans.
Do Not Allow This!
Reinforced Bridge Approach Fill

- Two types
  - Standard Design
    - Major routes – Interstate, Primary, Major collectors, etc.
  - Sub-Regional Tier Design
    - Minor collectors, local, and secondary roads.
    - Common for cored slabs and box beam bridges.
    - Not common in Coastal Plain
Subregional Tier

1/2:1 SLOPE OR STEEPER (TO BE DETERMINED BY THE CONTRACTOR)

4" DIA. PERFORATED PVC PIPE

+78M STONE BACKFILL

TYPE I GEOTEXTILE

2 LAYERS OF 30 LB. ROOFING FELT TO PREVENT BOND

GROUT

CORED SLAB or BOX BEAM

Inset 'A'
Materials

**Standard RBAF**
- Class III or V Select backfill
- Type 5 Geotextile Fabric
- PVC pipes, fittings and outlet pipes.
- PVC, HDPE, Linear low density polyethylene (LLDPE) – 30 mils thick
- Class B concrete outlet pads with rodent screens.
- 78M stone (drain)

**Sub-Regional Tier**
- Class V Select Backfill (78M)
- Type 1 Geotextile Fabric
- PVC pipes, fittings, and outlet pipes.
- Class B concrete outlet pads with rodent screens.
Geotextiles – Section 1056

Refer to 2012 Standard Specifications for required engineering properties of Type 1, Type 5, & Geomembrane

Refer to National Transportation Product Evaluation Program or NTPEP to verify geotextile meets requirements for specific type.

RBAF – Construction Methods

- **Excavation**
  - Depth to bottom of cap.
  - 5 foot bottom width on 4 % slope toward cap.
  - Backslope 1 ½:1 or flatter extending 4 feet beyond end of approach slab.
RBAF - Construction Methods

- Install Impermeable Geomembrane
  - Geomembrane necessary to make RBAF work correctly.
  - Attach to the cap and wings using adhesives, tape, etc. to hold in place.
  - Vertical limits as shown in std. drawing.
  - Glue or weld seams to prevent leakage between pieces.

Drain outlet through the impermeable membrane must be sealed to prevent leaking.
RBAF- Construction Methods

- **Drain Installation**
  - Place first layer of TYPE 5 geotextile and construct drainage as shown in details.
  - Slope perforated PVC pipe to drain.
  - Pipe and 78M stone wrapped in Type 1 geotextile.
  - Drain outside RBAF must be solid.
RBAF – Construction Methods

- 1’-6” Type 5 fabric layers
- 4 ft. overlap on top of each layer with 2 ½’ buried in the lift.
- Overlap on 3 sides.
- Overlap adjacent layers 18”.
- Number of layers based on height of the backwall. See Std. Drawings
Std. Drawing Details

Inset 'B'

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<td>7'-3'' - 8'-8''</td>
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<td>10'-2'' - 11'-8''</td>
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Typical Geotextile Lift and Wrap
Showing Second and Above Lifts
Sub-regional Tier Construction Methods

- **Excavation**
  - Depth to bottom of cap.
  - 3 ft. bottom sloping 6” away from cap.
  - Must be graded to function as a drain.
  - 1 ½: 1 or steeper backslope.
Sub-regional Tier Construction Methods

- Place Type 1 fabric on all excavated faces and 1’-8” minimum on cap face and wing walls.
- Place perforated PVC drain in bottom of excavation and lay on grade to drain.
- Backfill with 78M stone.
**Drill Your Own Holes**

**SCH40/80 & DWV PVC Pipe Perforated To AASHTO M278**

**Highway Underdrain Specifications**

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<td>Rows of Holes: 2 @ 90°, 3 @ 120°</td>
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<tr>
<td></td>
<td>Rows of Holes: 4 @ 90°, 2 @ 160° +/- 3°</td>
</tr>
<tr>
<td>12&quot;</td>
<td>Center-to-Center: 3&quot; +/- 1/4&quot;</td>
</tr>
<tr>
<td></td>
<td>Rows of Holes: 6 @ 90°, 2 @ 120°, 2 @ 160° +/- 3°</td>
</tr>
</tbody>
</table>

*Note: NATIONAL ASTM D-1785 (SCH40/80), ASTM D-2665 (DWV) Pipe is manufactured from a PVC compound with a cell class 13434 B, as defined in ASTM D 1784, and meets the standard specifications of Penn-DOT Publication 408, Section 610.2. Standard pipe length: 20".*