AGENDA
- BOX CULVERT DESIGN
- SUBMITTAL PROCESS
- MANUFACTURING PROCESS
- INSTALLATION OF A PRECAST BOX CULVERT
- BOX CULVERT APPLICATIONS/FEATURES

INSTALLATION METHODS
- Trench
- Embankment
- Tunnel
- Bedding - Leveling Course

Bedding - Leveling Course
- A bedding thickness of no less than 4 inches.
- If foundation is rock bedding should be a minimum of 6”.
- RCBs are designed for installed conditions not test conditions.
- Bedding should have a uniform flat surface.
- Coarse bedding materials are not beneficial due to irregular/sharp angles.
- Bedding width should equal the width of the box and the length of the box.
- This protects the box culvert during installation from impact damage.
- Should be placed in uniform layers along sides/over top of box sections.
- Should NOT contain debris, organic matter, frozen material or large stones.
- Placed and compacted to prevent settlement at the surface.
- Compaction and equipment loads should not exceed design strength.

Compacted Fill Material
- ASTM C850
- AASHTO M273
- ASTM C789
- AASHTO M259

ASTM/AASHTO STANDARDS FOR RCB
- Welded wire fabric 65,000 psi
- Concrete 5,000 psi
**2 LAYERS OF STEEL**

- AS7
- AS6(LONG)
- AS6(LONG)
- AS1
- AS4
- AS3
- AS1
- AS8

**REINFORCEMENT**

- Circumferential Steel
- Longitudinal Steel

- Reinforcement
  - Two Layers
  - 8 Areas of Steel
  - Circumferential/Longitudinal

**MANUFACTURING**

- Dry Cast or Wet Cast
  - 5,000 psi concrete (min.)
  - 65,000 psi steel
  - Steam Cured

- One Form
  - Adjustable or Set Form

**MANUFACTURING**

- Standard Lengths
  - Typically 8' Length
  - Depends on Size
  - Depends on Application

**SUBMITTAL PROCESS**

- Preconstruct Contract
  - Contractor
  - Approve for Submission

- Production and Delivery
  - Submittal and Approval
  - Review and Approval
**ASTM Specifications**

1. Steel Reinforcement Strength
   - 65,000 psi
2. Concrete Strength (min.)
   - 5,000 psi
3. Side Wall Thickness
   - Spans 6 – 7 ft.
     - 3 ft. + 1 inch
   - Spans 7 ft. +
     - SPAN
4. Top Slab Outside – Concrete over Steel (in.)
   - 0 - 2 ft. of cover - 2 inches
   - 2 ft. + of cover - 1 inch
5. Walls – Concrete Cover over Steel
   - 1 inch

**Practical Exercise**

**Situation**
You have a typical section for a trench detail.

**Task**
Identify the terminology related with a trench detail.

**Trench Terminology**

**Trench Terminology**

**TYPICAL SECTION**
Loads on Box Culverts

Earth Loads  Live Loads

- Scheduling/Unloading should be discussed to insure efficient delivery process.
- Prepare site, excavate trenches to the minimum required for box culvert installation.
- Divert drainage.
- Establish a good level grade using fine to medium granular material.
- Bedding – Leveling course should be a minimum of four (4) inches, except in rocky foundation it should be six (6) inches minimum.
- Make sure the first few box sections are installed correctly, this will influence line and grade to follow.
- Place joint material on the bottom half of the groove & top half of the tongue of box.
- Make certain to check that boxes are aligned correctly prior to pushing home.
- Keep the weight of the box section, being set, on the crane and use winches to pull the joint home/dozer to home.
- Place backfill around structure to finished grade.

Demolition/Excavation

Site Preparation

- Demolition
  Caution must be exercised
  Excavate enough for backfill/bedding

Dewatering

Divert Drainage

- Dewatering
  Control of surface and subsurface water is required to maintain dry conditions for installation
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Setting Grade/Site Prep

Bedding
Key to smooth installation
Establish bedding at 4'-6' Minimum

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Foundation/Bedding

Bedding and Foundation
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Scheduling/Unloading

Unloading RCBs
Caution must be exercised
Handled per Manufacturer's recomm.
Distribute load properly
Lifted not dragged
Crane with stabilizers
Scheduling/Unloading

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Crane with stabilizers

Section Placement
Install first few boxes
Influences line and grade of remaining

Placement of RCBs
1st RCB sets the stage
Take your time and get it right
More time on #1 smoother it goes

Placement of Gasket
Wrap around joint completely
Do not overlap gasket material
Fabric at joints

Gasket Placement

Joining/Homing

Homing of box culverts
Several techniques driven by crew capabilities, EQPT/Conditions
Continual Check Grade/Bedding
**Post-Tensioned**

- Bedding/Adjustments
  - **Bedding**
    - Keep Bedding Level
    - Continuously check Grade
    - Heavy/Light Approach

- Bedding Placement
  - **Homing of box culverts**
    - Ensure bedding is smooth at face of joint
    - Smooth out in order to improve homing of RCBs

- Joining/Homing
  - **Homing of box culverts**
    - Protect the Joint
    - Maintain Lift Pressure on Box
    - Utilize Buffer

- Joining/Homing
  - **Homing of box culverts**
    - Keep Sections off Bedding
    - Reduce Friction/Reduce Required

- Joining/Homing
  - **Final Touches**
    - Alignment/String, tape measure
    - Compress Gasket
    - Pipe Ties (if required)
Joining/Homing

Homing of box culverts
Come-along/tugger pulls home boxes

Joint Wrap

Placement of Membrane
All box joints
Top external joint
Extend 1’ down sides
Min. width/12”-6” of centerline

Joining/Homing

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Joint Wrap

Multi-Barrel

Multi-Barrel
Create distributed load condition
Lean Grout (6” min.)
Lifts (8” max.)
1.5 Sacks pc/Ton material mixture
Or
3 to 6 inches Aggregate
Size No. 78 or No. 8 (min. Grade B)

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**Complete Backfill**

- Complete Backfill
  - Backfill material placed in lifts
    - (6” loose/4” compacted)
  - Backfill free of lumps/stumps/Rocks
  - Bedding/Leveling Course (4’-6”)

**Structural Backfill**

- Structural Backfill
  - Compact 6” loose/4” tight
  - Avoid Damage to Box Culvert
  - Compact to Receive Driving Surface

**End Treatments**

- End Treatments
  - Footings
  - Toe walls/Wingwalls
  - Aprons
  - Headwalls
  - #4 Rebar @ 10” o.c. top of headwall
  - #4 J Bar (2 per box) for headwall

- End Treatments
  - WWF exposed along top/walls/bottom
  - WWF exposed along top/walls/bottom
End Treatment

- Grade Beam
- End Section 2-1 or 3-1 Slope

End Treatments

- Headwalls/Apron/Wingwalls
- Match Embankment Slope
- Flared to Maximize Flow
- Reduce Maintenance

Roadway-Subgrade

- Subgrade Prep
  - Compacted
  - Provides Good Base for Asphalt

ACCELERATED PRECAST CONSTRUCTION CHARACTERISTICS

- Multi-Barrel
- Skews
- Penetrations
- Low Water Crossing
- Elbows
- Minimal Cover
- Open Channel
- Bottomless Box
- Large Box Culverts
- Multi-Cell
- Jacking Box Culverts

Obrien County, Iowa

Hancock Concrete Products

Curved Alignment

- Single 12' x 10'
  - Curved Alignment
  - Obrien County, Iowa
  - Hancock Concrete Products

- End Section 2-1 or 3-1 Slope
  - 0-15-30-45 degree skews

Multi-Cell

- Multi-Cell
  - Reduces Installation Time
  - Requires Greater Lift Capability
  - Precast Headwall Attached
Mercer County
Low Flow Culvert
Corbels for Approach Slabs

Innovative

Large Box Culverts
Larger spans

Two 14’x11’
Single 20’ x 12’
23’ x 8’ Reducer

SPECIAL DESIGN (compare)

Determine the weight of:
- an 8’ section of 8’x8’ RCB
  - Cast in place (9.5x9.5) = 2.01 tons/ft.
  - Precast
    - (8x8x8”) = 1.8 tons/ft.
  - 28 Day Compressive Strength
  - Dewatering for duration

Which does a contractor prefer:
- 5’x2’ Cast In Place
- 5’x2’ Precast

LOW WATER CROSSING
Before/After Replacement

Features
Triple Barrel CMP
Vertical Curve with Highpoint
Roadway Washes Away Each Event

LOW WATER CROSSING
After Replacement

Features
Multi-Cell Precast Box Culvert
Level Grade to Minimize Velocity
Toe-Walls & Apron Tied into Boxes

LOW WATER CROSSING
After Replacement

Features
Seven Barrel RCB Low Water Crossing
Replaced Triple Barrel CMP
Concrete Driving Surface with Curb
Rock Face Aesthetic Look
**SKewed END**
- RCIs are skewed
  - Left Forward Skew
  - Right Forward Skew
- Limited: size/degree of skew

**SKewed END/PENETRATION**

**PENETRATION**
- Features
  - Penetration Addressed in Plant
  - Can Design Field Penetration Solution
  - Top and Bottom Penetrations

**Elbows/Bends**
- Features
  - Manufacture Any Bend Angle
  - Bends on Multi-Barrels
  - Saves Money/Eliminates Junction Box

**MINIMUM COVER**
- Maximum Hydraulics
  - 0' Cover
  - Maximize Hydraulic Capacity
  - Place Road Surface directly on top

**Miscellaneous**
- Pedestrian Water Crossing
- Storage Container – Ft. Riley
- Decorative End Treatments
  - Rock or Brick
  - Angle Iron Attached
Jacking Box Culverts

Factors
1. Nature of soil, water table & effects of dewatering
2. Jacking/Receiving Pit
3. Length, alignment and outside dimension of pipeline
4. Jacking Forces
5. Pipe Joints
6. Loads on shield and pipe
7. Size of overbore
8. Lubrication
9. Grouting
10. Spoils Removal

Accelerated Precast Construction
Fundamentals Attributes

Reduce
- Reduce Road User Impacts
- Reduce Costs
- Reduce Construction Time
- Reduce Weather Related Time Delays

Improve
- Improve Durability/Quality
- Improve Work Zone Safety

Minimize
- Minimize Environmental Impact
- Minimize Impact to Existing Roadway Alignment

Thank You

QUESTIONS?