Box Culvert Installation

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Precast Structures

Fundamentals

PRECAST STRUCTURES:

FUNDAMENTALS

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PIPE

ASTM C76

4 SIDED BOX

ASTM C1577

3 SIDED BOX

ASTM C1504

PRECAST STRUCTURES:

FUNDAMENTALS

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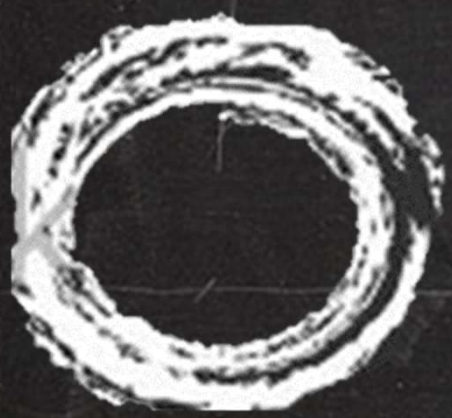
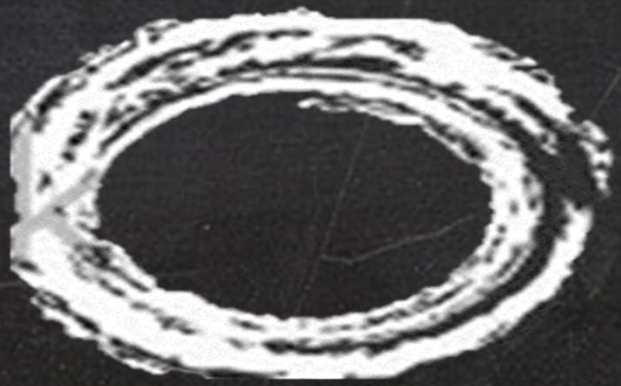
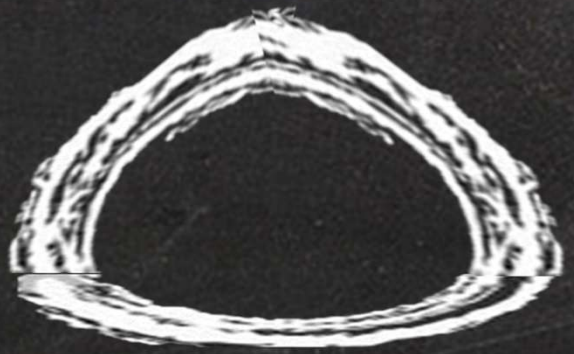


ROUND



ELLIPTICAL



ARCH

PRECAST STRUCTURES:

FUNDAMENTALS

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MONOLITHIC

BOX CULVERT

4 SIDED BOX

SEGMENTED

CLAMSHELL

SPLITBOX CULVERT

PRECAST STRUCTURES:

FUNDAMENTALS

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3 SIDED BOX

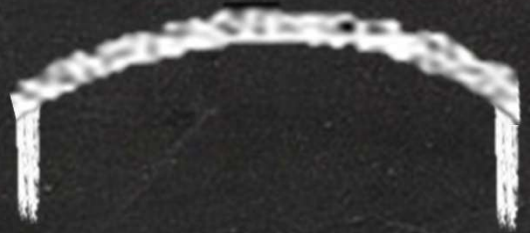
3 SIDED BRIDGE

FLAT TOP BRIDGE

CONCRETE FRAME

HYSPAN

3 SIDED BRIDGE



ARCH BRIDGE

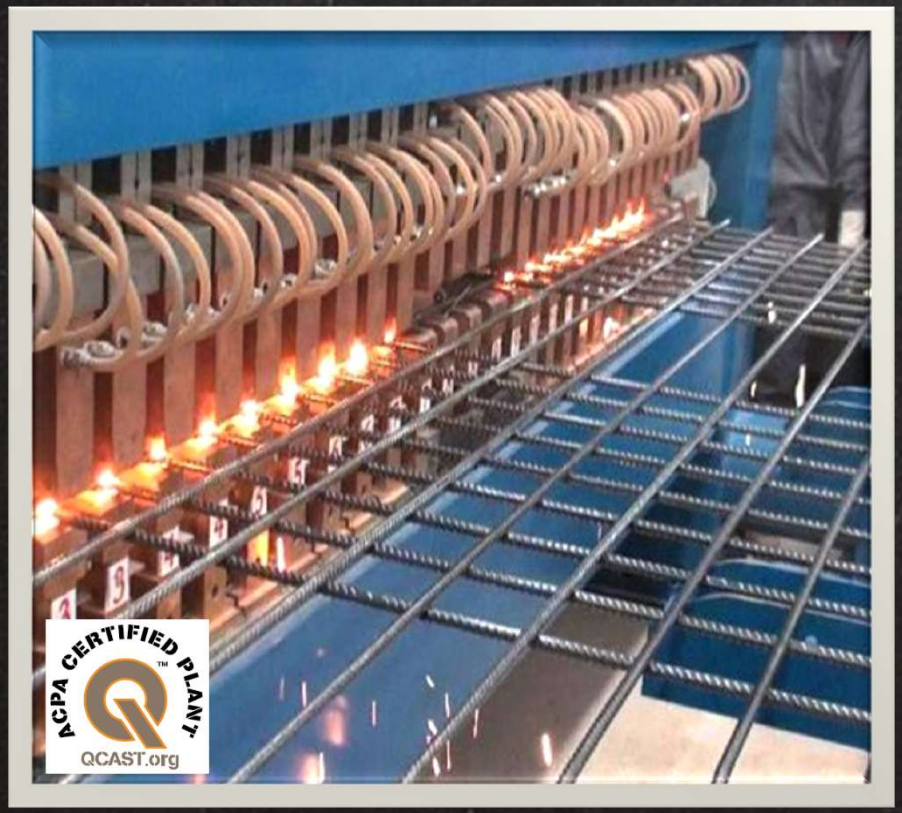
CONSPAN

ARCH FRAME

PRECAST STRUCTURES:

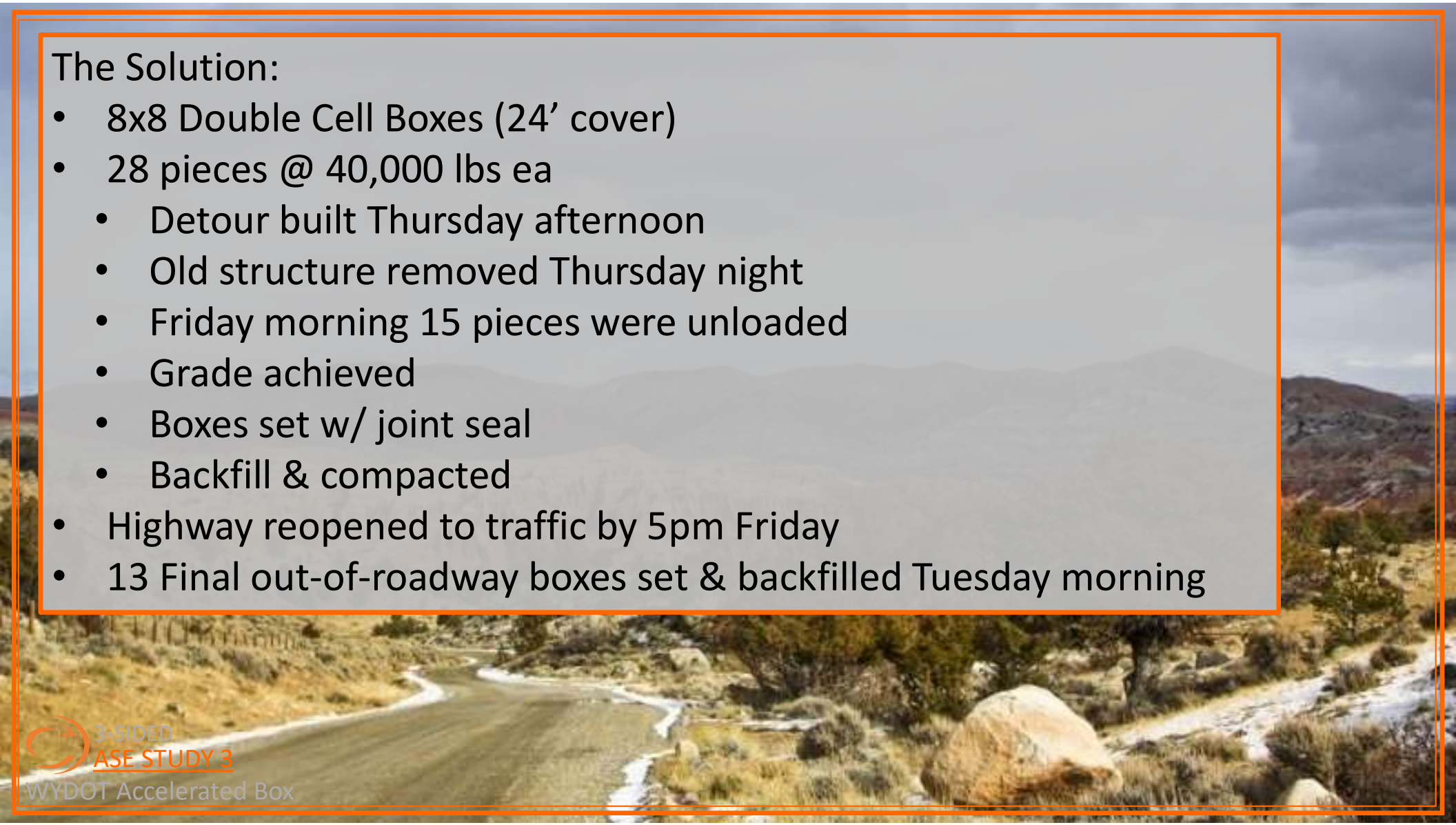
- AGENCY APPROVED IN-PLANT QUALITY CONTROL

PRECAST STRUCTURES:



- CONSISTENT ENGINEERED WELDED WIRE MESH – 65KSI MIN


The Challenge:
• Dubois, WY Bridge Replacement
• Highway detour would not be a possibility
• Detour needed to be built on site
• *24 hour window for replacement*
• 168’ of culvert, buried 24’ deep
3-SIDED
ASE STUDY 3
WYDOT Accelerated Box



The Solution:

- 8x8 Double Cell Boxes (24’ cover)
- 28 pieces @ 40,000 lbs ea
  - Detour built Thursday afternoon
  - Old structure removed Thursday night
  - Friday morning 15 pieces were unloaded
  - Grade achieved
  - Boxes set w/ joint seal
  - Backfill & compacted
- Highway reopened to traffic by 5pm Friday
- 13 Final out-of-roadway boxes set & backfilled Tuesday morning

Construction Season is Short in Wyoming:

- Must build FAST
- Temperature conditions
- Freeze-Thaw restrictions on roads
- Irrigation/Runoff considerations

- This can be May in Wyoming!

CASE STUDY 3

WYDOT Accelerated Box

Why Box Culverts?

- Basic Box (C1577): 3x2 up to 12x12
- Custom sizes
- Multi-barrels
- Deep fill (up to 300 ft)
- Large Boxes

RCB Installation types:

Embankment

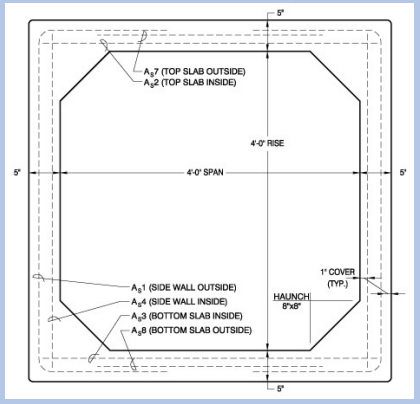
Trench

Jacked

C1577: 5x5x6

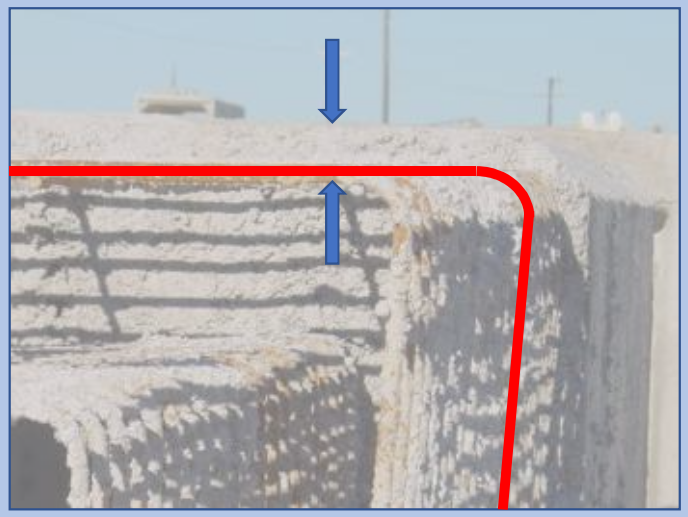
5 ft by 5 ft by 6 in.								
Design Earth Cover, ft	Circumferential Reinforcement Areas, $in.^2/ft$							
	A_{s1}	A_{s2}	A_{s3}	A_{s4}	A_{s5}	A_{s7}	A_{s8}	"M," in.
0<2[A]	0.19	0.35	0.26	0.14	0.19	0.19	0.17	
2<3	0.14	0.29	0.24	0.14				45
3-5	0.14	0.21	0.20	0.14				45
10	0.14	0.19	0.20	0.14				45
15	0.14	0.24	0.25	0.14				36
20	0.15	0.31	0.32	0.14				35
25	0.18	0.38	0.39	0.14				35
30	0.21	0.46	0.47	0.14				35

[A] Top slab 8 in., bottom slab 7 in.



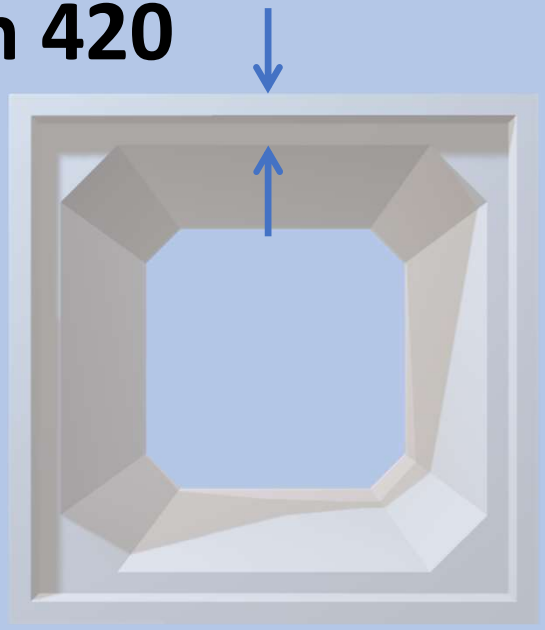
- 5x5x6 Box
  - 0-2' of Cover:
    - 6" Walls*
    - Top slab increases to 7.5"*
    - Bottom slab increases to 6"*
    - As5, As7 & As8 become structural
    - 2" Cover over As7

MSHA Standard Detail: 0-9" of fill requires epoxy coated reinforcement in outer steel layer in top slab

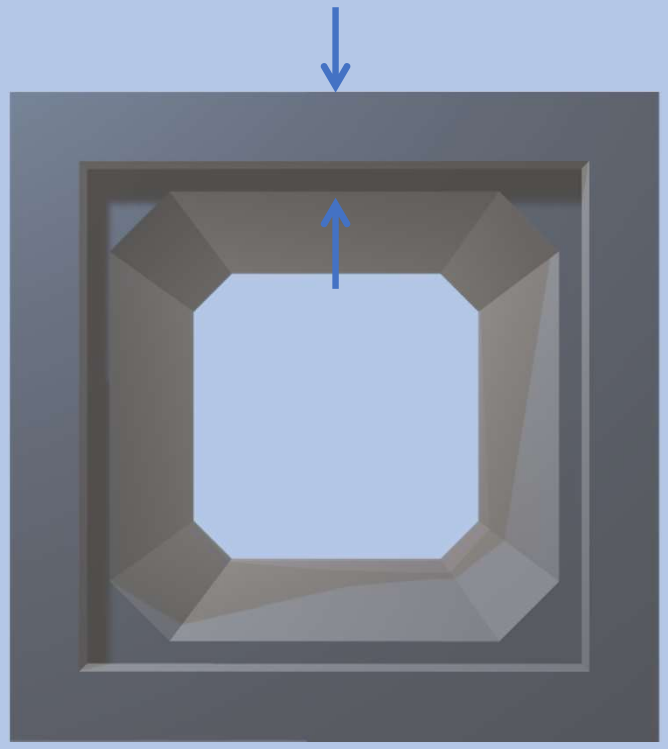


MSHA: Box Culverts

Section 420



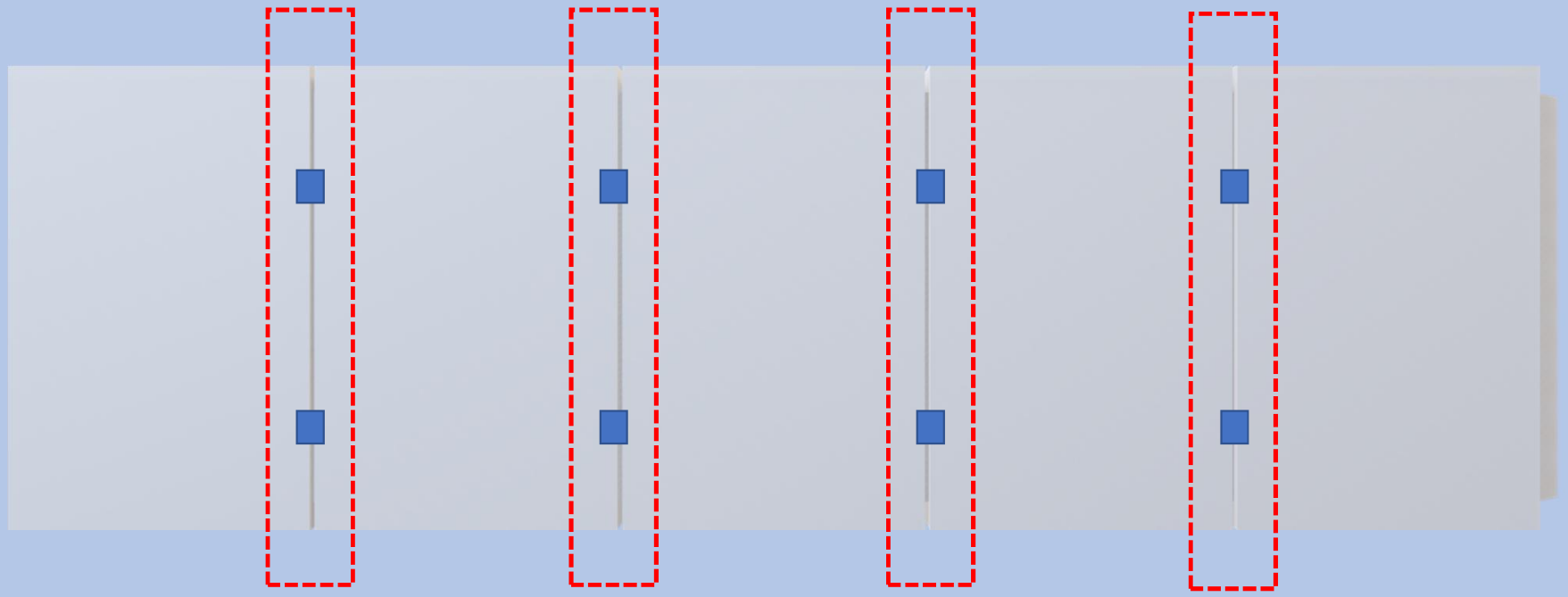
ASTM C1577
5x5x6



MSHA 12” MIN WALLS
5x5x12

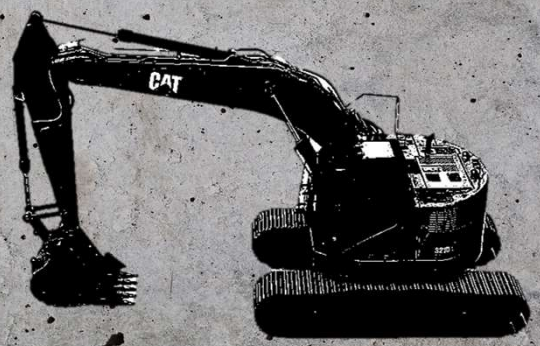
- Boxes should be designed to HL-93 loading
- MSHA State projects will not accept less than 12” walls
- Counties will be encouraged to require 12” walls (not required)
  - Must be designed to AASHTO LRFD

MSHA: Box Culverts



- Joints shall use welded shear keys
- Joining materials to be same as used on concrete pipe

Installation



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Installation Keys

1-HANDLING

2-DEWATERING

3-BEDDING

4-PLACEMENT

4-JOINING

5-FINAL BACKFILL

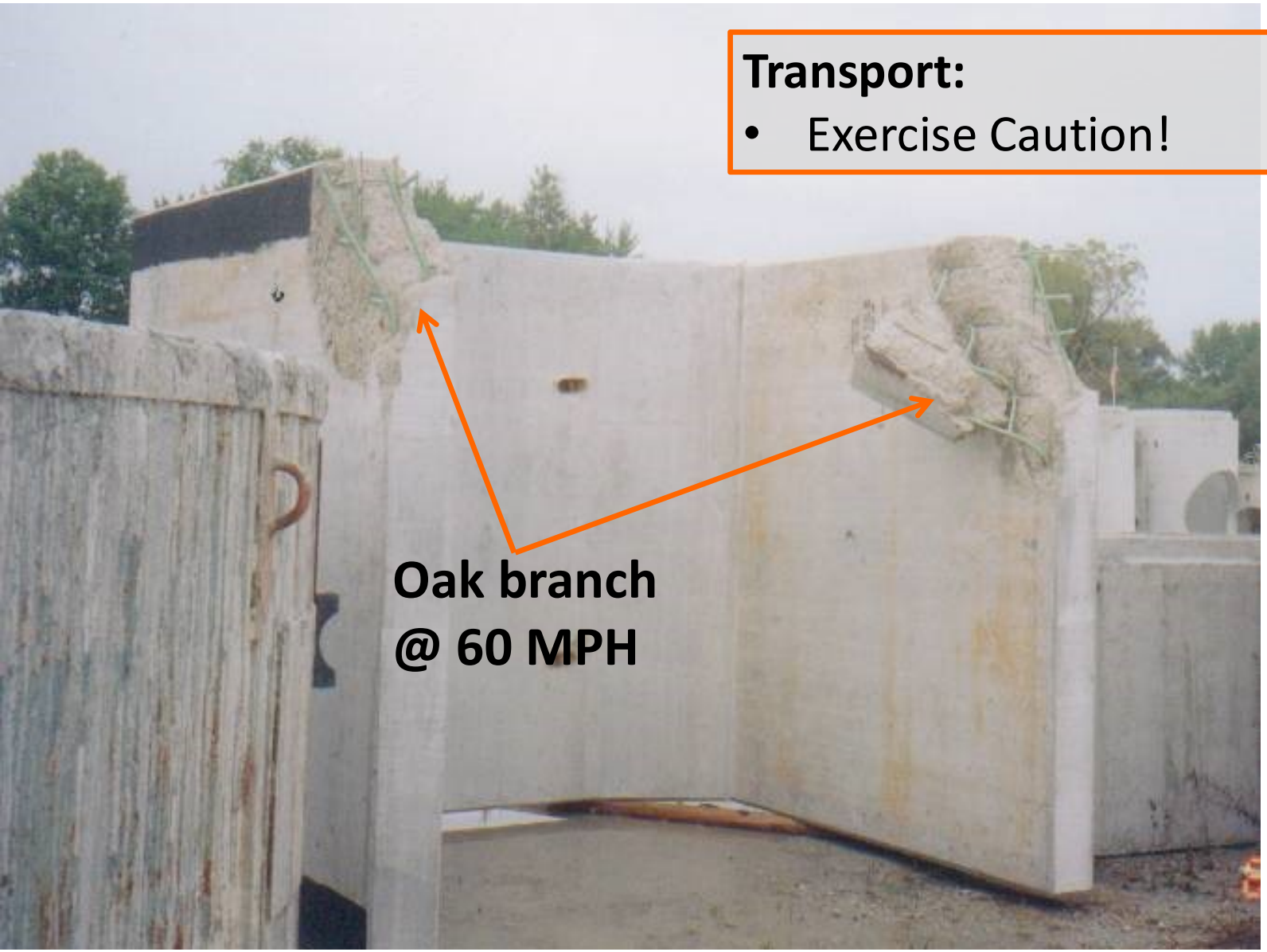
6-SPECIALS

1-Handling

Handling:

- Practice Caution!
- Handle per man. rec.
- Distribute load

This is the WRONG way to lift!!



Transport:

- Exercise Caution!

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2-Dewatering

Dewatering:

Control surface & ground Water

- **Maintain dry conditions during installation**

Dewatering:

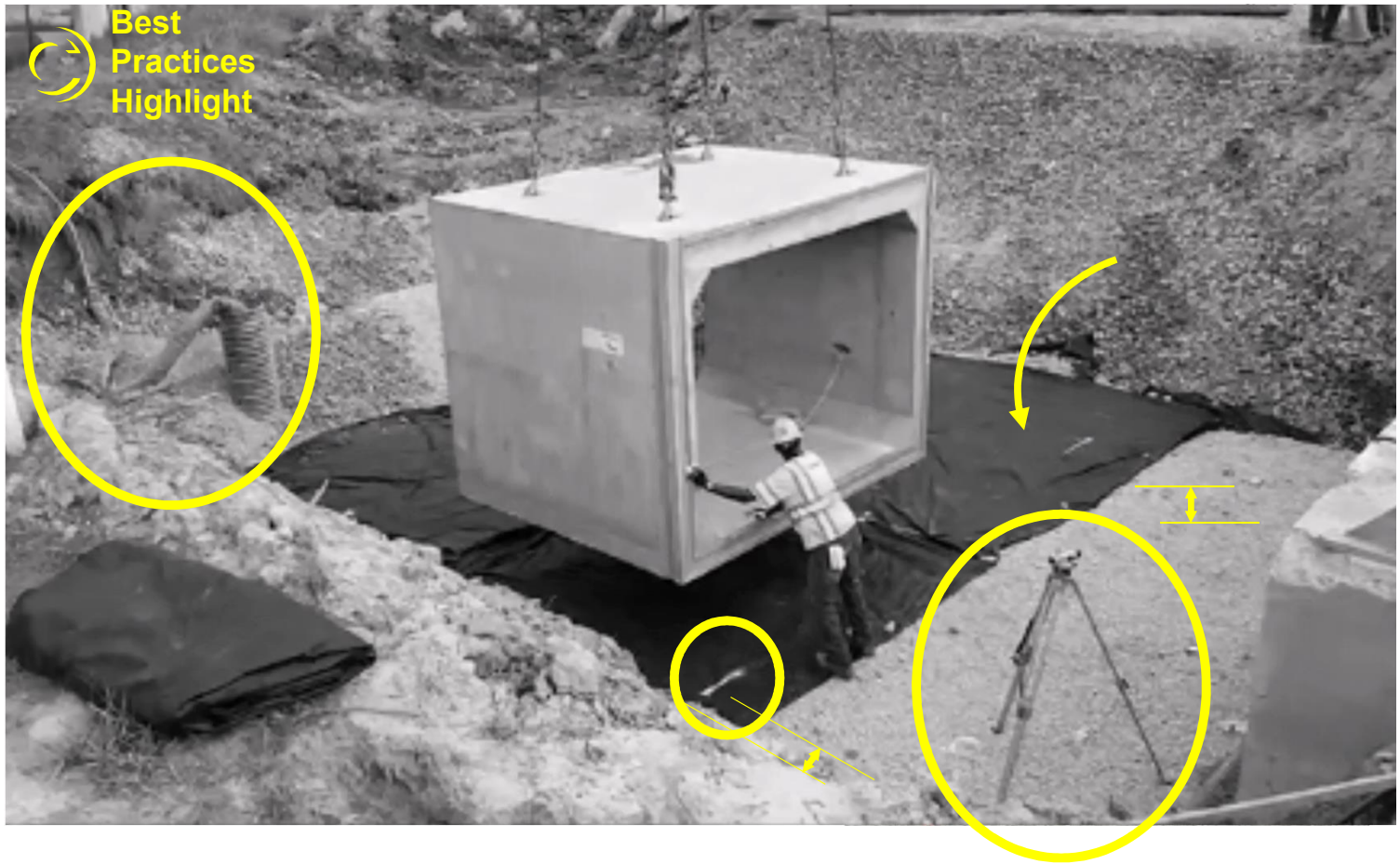
Maintain dry conditions during installation

3-Bedding

Bedding:

Check line and grade frequently and evenly

Bedding: Bedding is key to a smooth installation!



4-Placement

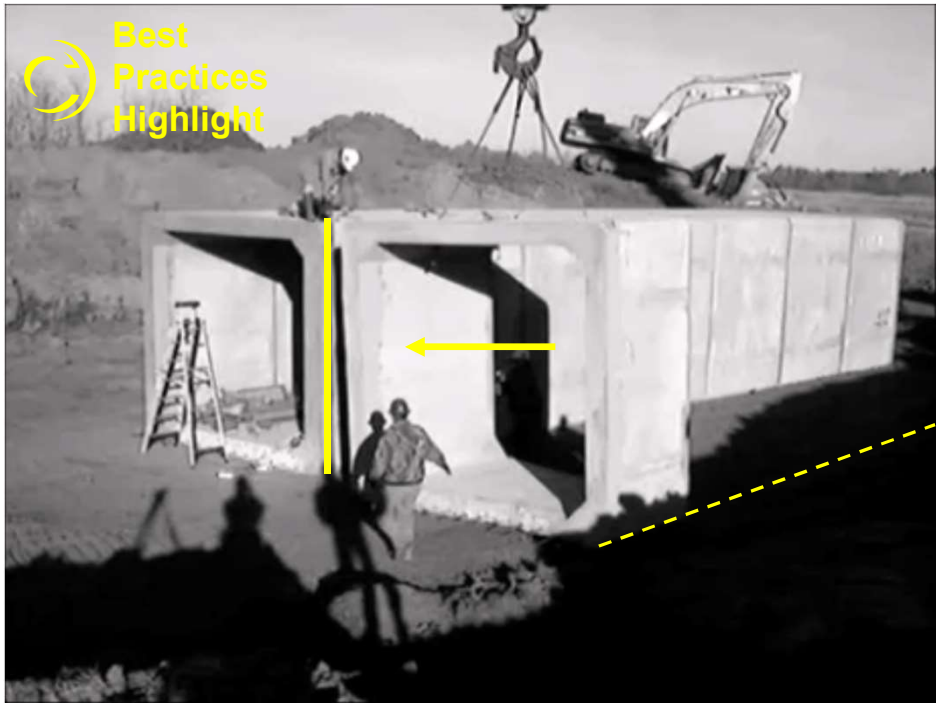
Placement:

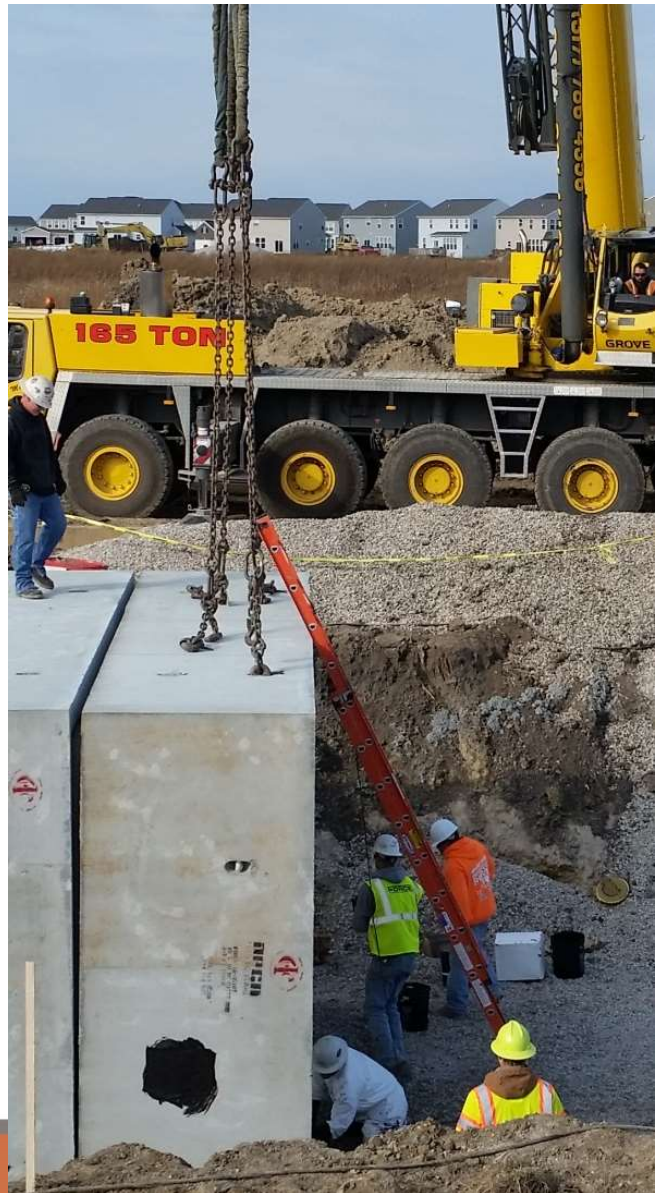
Ensure equipment is appropriate for weight & size of precast boxes

Placement:

Sequential marking helps proper placement on large/complex jobs

Placement:





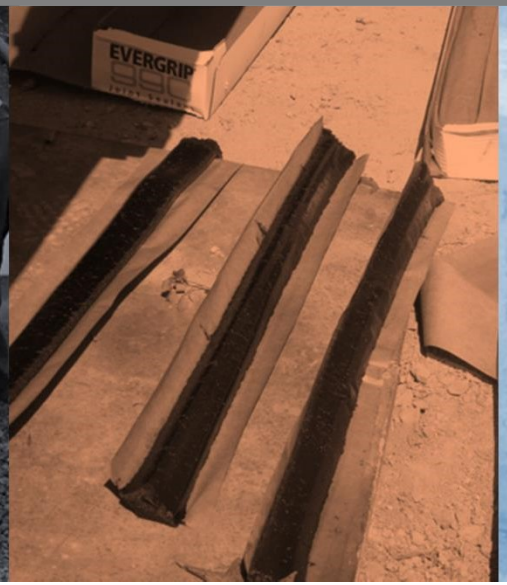
- 1st RCB sets the stage
- Take your time – get it right
- More time on #1 – Smoother it goes

4-Joining

Joining:

Various joint materials are used in the market:

- Mastic
- Butyl Sealant
- Joint Wrap
- Gaskets

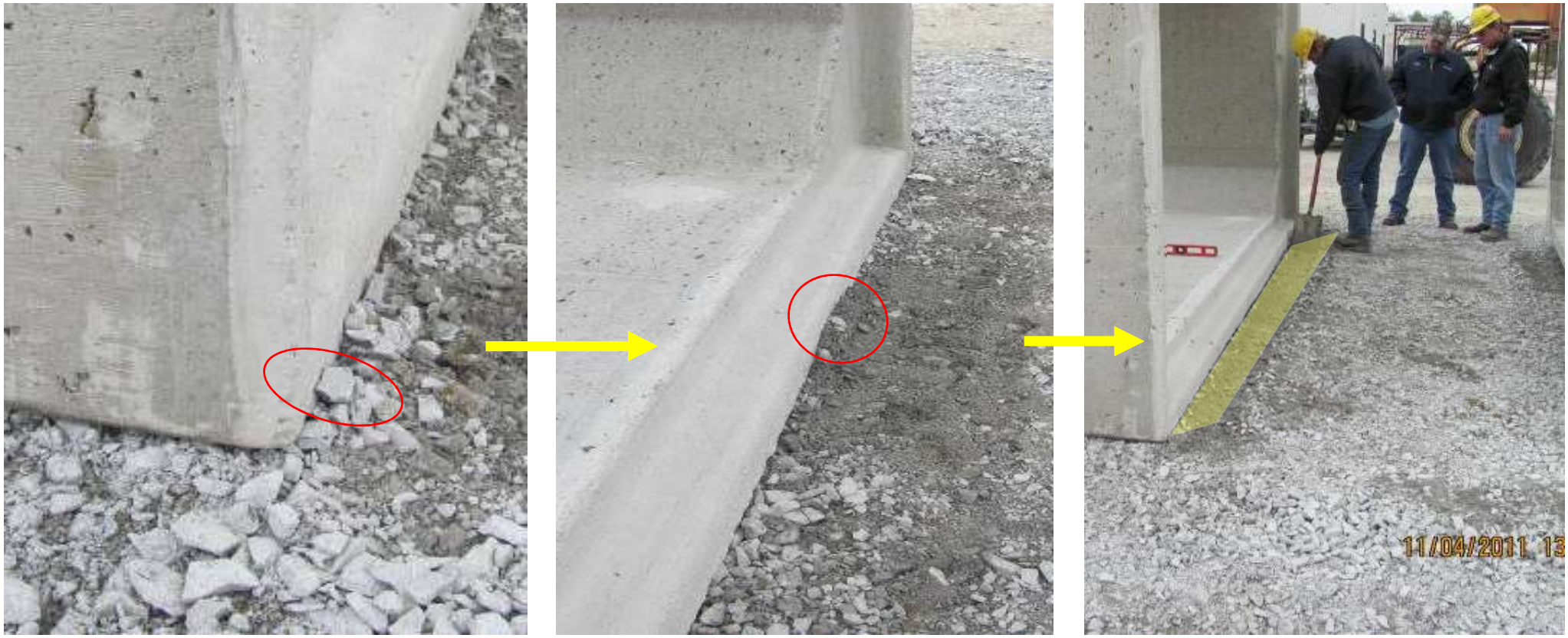




Joining:

Joint materials should be applied as recommended by manufacturers:

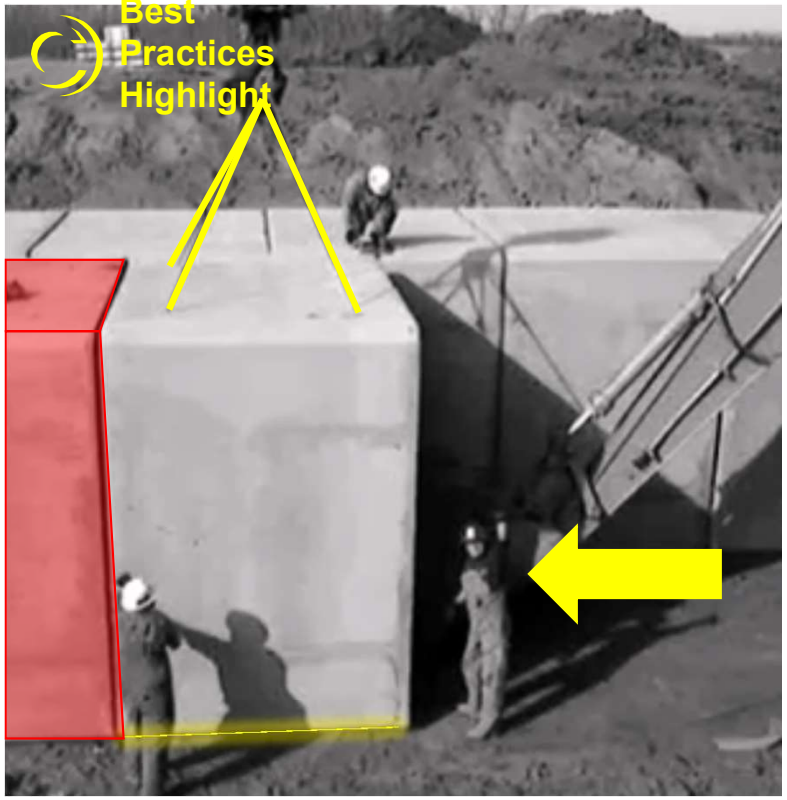
Joining:

- Prevent bedding material entering the joint.
- Smooth the bedding to improve homing the joint.



Joining:

Homing techniques driven by capabilities of crew, equipment & conditions.



Joining:

Check alignment before pushing/pulling boxes home

Joining:

Sometimes the best method is the simplest.

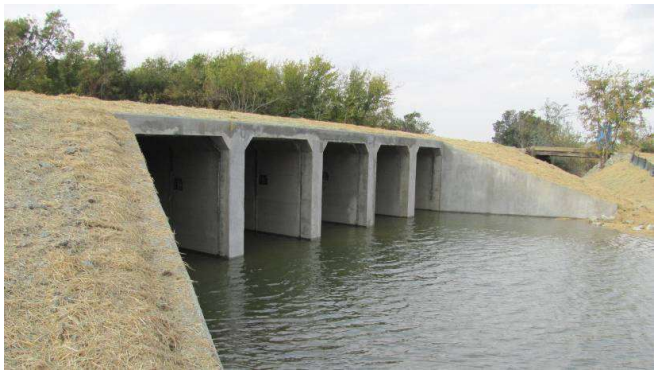
5-Final Backfill

Final Backfill:

- Minimize trench excavation
- Compact backfill in lifts
- Avoid large rolling compactors over the culvert

- **Avoid Construction loading with less than 3’ of cover!**

Successful 1st Installation:



6-Specials

Specials:

Bends can save money & eliminate Junction boxes

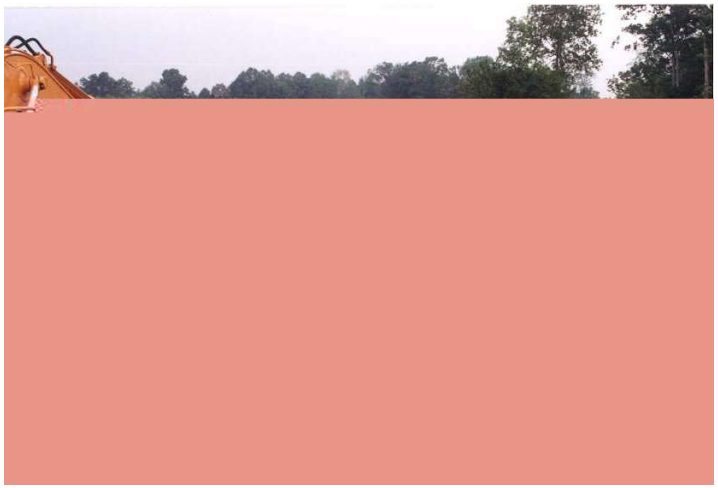
Penetrations:

- Penetration addressed in plant
- Can be designed for field penetrations
- Top, bottom & side penetrations

Multi Boxes:

Multicell vs Multibarrel

Skewed Ends:



Skews are limited by size & geometry.

Min Cover:

0’ cover:

- Maximizes hydraulic capacity
- Place road surface directly over boxes

End Treatments:

Ends can be precast as well

End Treatments:

- 120 feet of 16’ x 5’ box
- Major Collector
- CIP was $7,000 less than precast
- Planned on 8 weeks for installation
- Precast was installed in one weekend


CAT