Manufacture & Installation

Reinforced Concrete Pipe – Part 1

Concrete Pipe Association of New Jersey
Rex A Busa; Director

1

Manufacturing
Production

Dry Cast

- Vibratory
- Packerhead

Wet Cast

	Dry-Mix	Wet-Mix
w/c	0.35	0.42
slump	0 or -	+
initial set	<1 hour	4 hours

2

Manufacturing
Process – Dry Cast

Vibratory Process

- Consolidate zero slump concrete between an inner core and outer core
- Vibration is used to consolidate the concrete
- Forms may be stripped immediately

3

Manufacturing
Process – Dry Cast

Packerhead Process

- Dry mix concrete is fed into an outer form for the exterior of the pipe
- The interior of the pipe is formed by a rapidly rising, rotating mechanism called a rollerhead
- Forms may be stripped immediately

4

Manufacturing
Process – Wet Cast

Wet Cast Process

- Wet concrete is placed in forms, allowed to cure and the forms are stripped
- Typically only used for very large pipe and end sections
- Requires standard curing time

5

Manufacturing
Raw Materials

- Aggregate
- Portland Cement
- Fly Ash
- Water
- Admixtures
- Steel

6

Manufacturing
Mixing the Concrete

Sand and stone are brought into the facility by a conveyor to the batching system.

7

Manufacturing
Mixing the Concrete

- Batching system computer controls the amount of sand, stone, cement and water required for the day's mix.
- Concrete is then distributed to each pipe machine for manufacturing.
- The computer assures consistency.

8

Manufacturing
Steps of Production

- Build the steel reinforcement cage
- Set the cage in a form
- Manufacture the pipe
- Cure the product

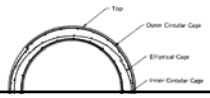
9

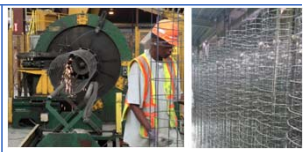
Manufacturing
Reinforcing

Cage Machines & Wire Rollers

Cage machines use reels of cold drawn steel wire and position longitudinal wires while wrapping & tack welding circumferential around.

Wire rollers use welded wire fabric in rolls or flat mats with desired size & spacing.





Cage Machine

Rolled Wire Mesh

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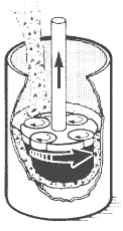
Manufacturing
Setting Forms

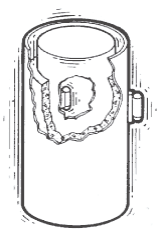
The wire cage and pallet are then enclosed in the pipe form and brought to the machine for manufacturing.

11

Manufacturing
Production



Packerhead Machine



Vibratory Machine

12

Manufacturing
Production

Packerhead Machine

Vibratory Machine

13

Manufacturing
Production

Packerhead Machine

Vibratory Machine

14

Manufacturing
Curing

After manufacturing, the pipe is placed in a kiln where the mold is immediately removed. The pipe is then steam cured overnight to complete the process.

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Manufacturing
Curing

Each morning the previous day's production is inspected to identify any defects

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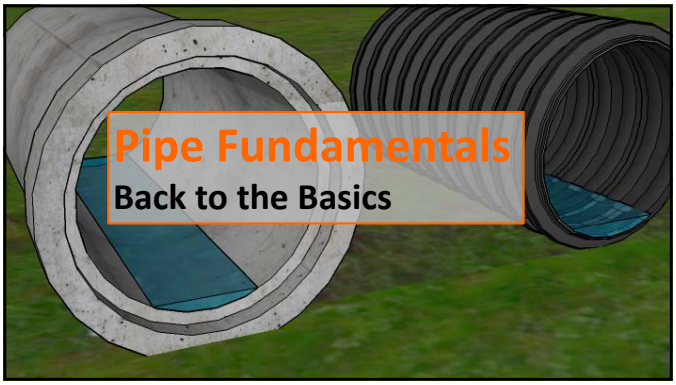

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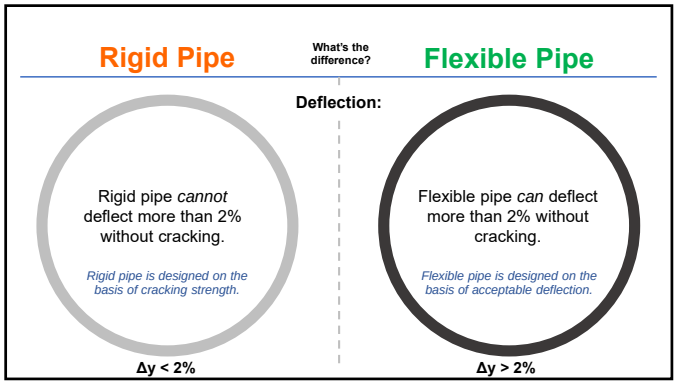
Pipe Fundamentals
Principals of a Culvert

What functions must an underground pipe perform?

18

NJWEA Excavation, Safety & Proper Pipe Installation, Winter 2024



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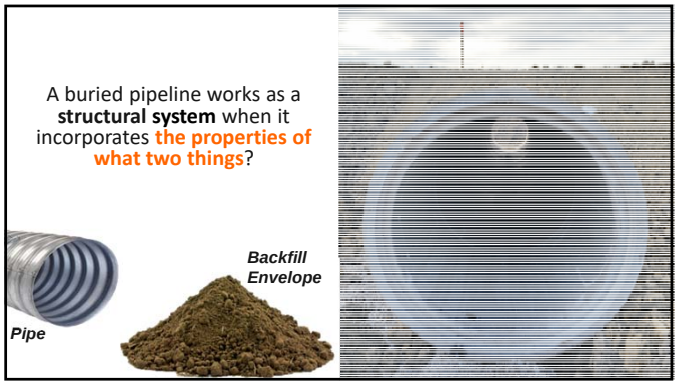

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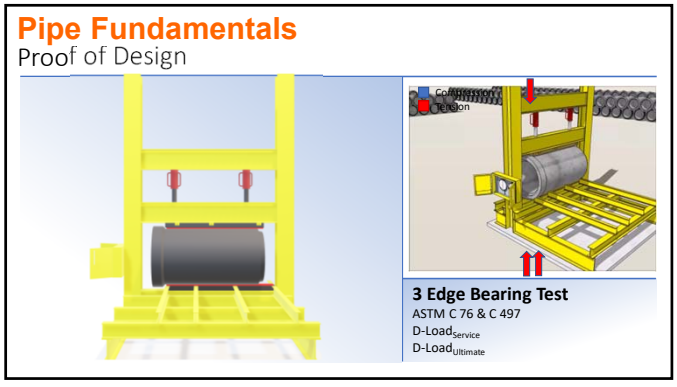

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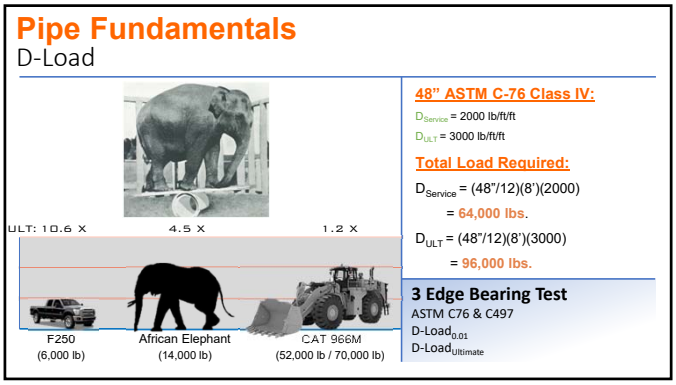

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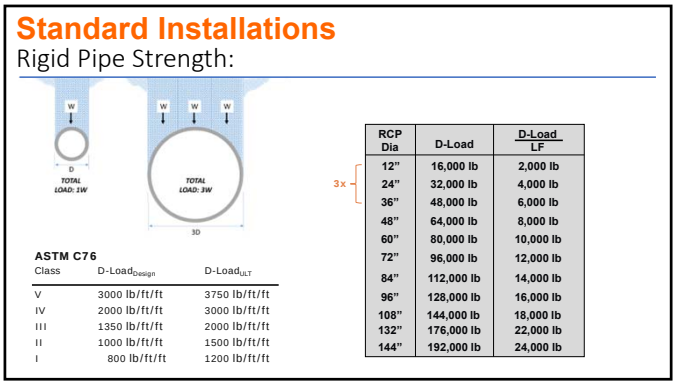

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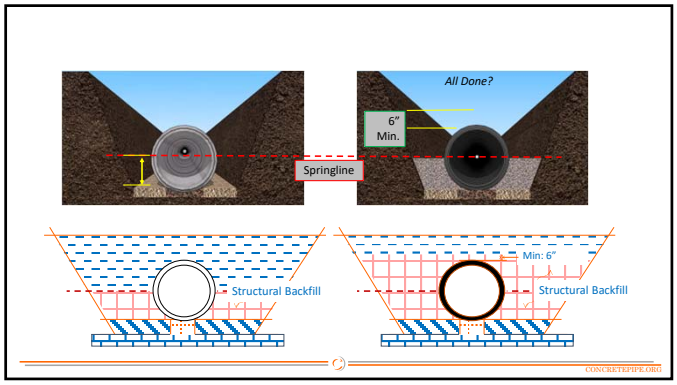
NJWEA Excavation, Safety & Proper Pipe Installation, Winter 2024



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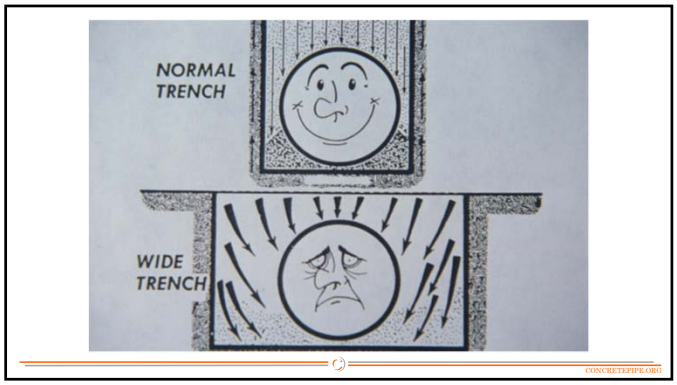

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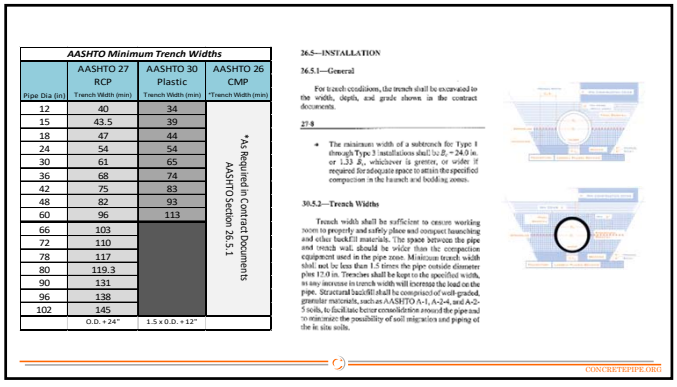

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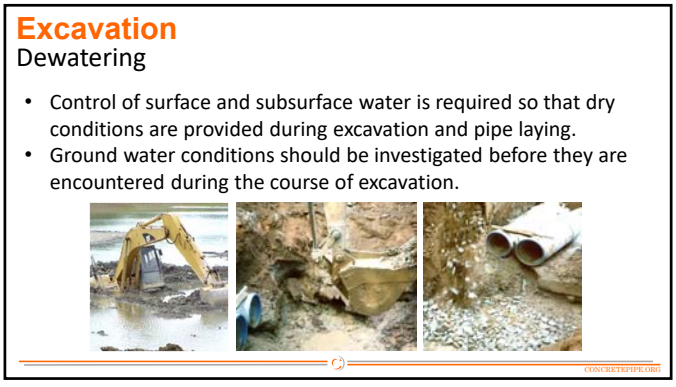


30

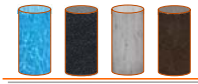
Excavation
Dewatering

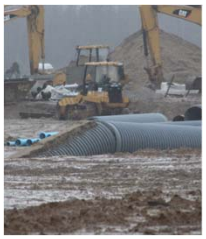
Buoyancy:

Relative Densities

γ_{H_2O} = 62.4 pcf
γ_{HDPE} = 60 pcf
γ_{RCP} = 150 pcf
γ_{SOIL} = 120 pcf

Flotation Force ≤ Soil Resistance + Pipe Weight





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31

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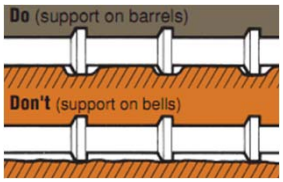
32

Bedding
Cushion/Load Distribution

American Concrete Pipe Association

Set bedding to grade, and provide bell holes in bedding for flared bell pipe to keep bearing on pipe barrel



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35

Foundation
Support the Structure

- The foundation must support the bedding, pipe, embedment, and backfill.
- The foundation is either suitable or unsuitable for pipe installation.

Rule of Thumb:

- If a person can walk on the foundation without sinking into the soil, it is acceptable
- If person sinks, or feels the soil quiver underfoot, then it is too soft, and it is unacceptable

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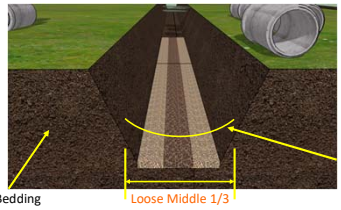
Bedding
Cushion/Load Distribution

AASHTO: 3”-4”-6” thick – middle 1/3 should be loosely placed to cradle pipe invert.



The bedding acts as a cushion/cradle for the bottom of the pipe as it works to distribute the load to the foundation.

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36

37

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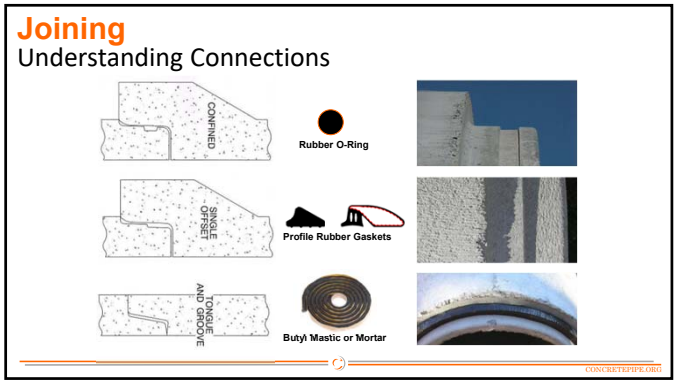

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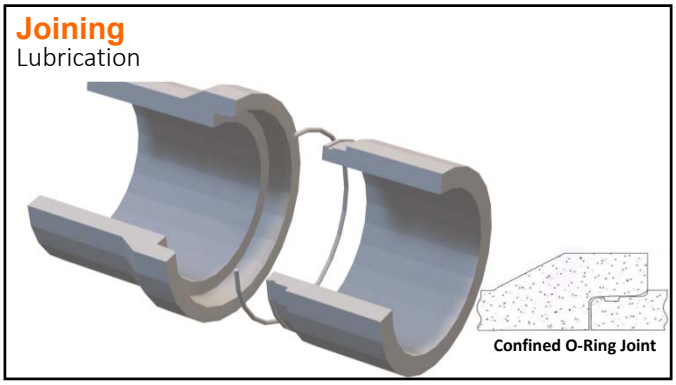

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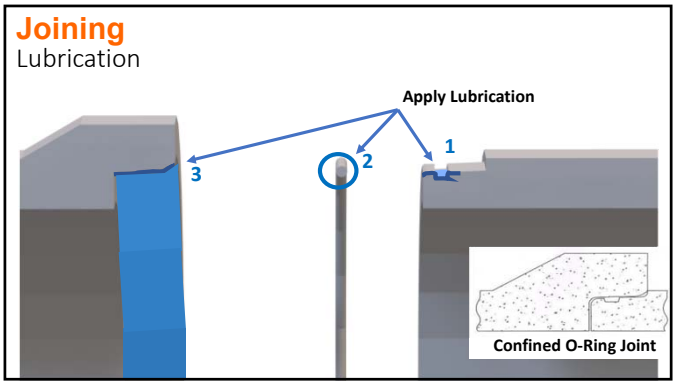

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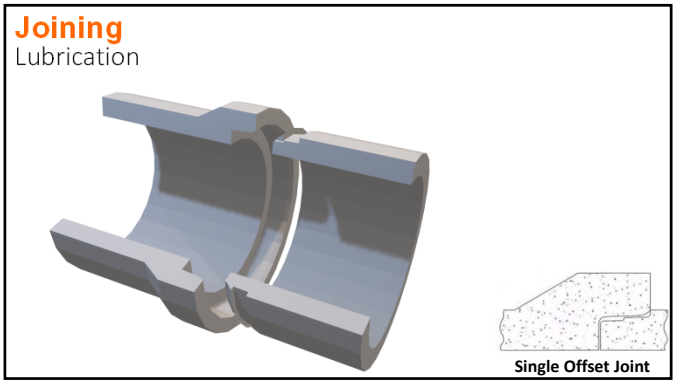
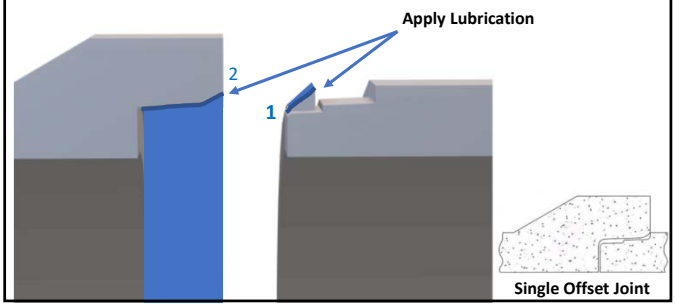


42

Joining
Lubrication



43

Joining
Equalization

44

Joining

AASHTO R-82 - Joint Selection for Highway Culvert and Storm Drains

- Four Basic Joint Leakage Allowances:
  - **Soil Tight**
    A joint that is resistant to infiltration of particles larger than those retained on the No. 200 sieve. There is no ASTM joint specification for a soil tight joint.
  - **Silt Tight**
    A joint that is resistant to infiltration of particles that are smaller than particles passing the No. 200 sieve. **ASTM C443 (max 2psi)**
  - **Leak Resistant**
    A joint which limits water leakage at a maximum rate of 200 gallons/inch-diameter/mile/day for the pipeline system for the project specified head or pressure. **ASTM C443 (max 10.8psi)**
  - **Water Tight**
    A joint that provides zero leakage of water infiltration and exfiltration for a specified head or pressure application. **Special Design**

45

Joining
Understanding Connections

- Begin at downstream end – Bells upstream
- Align spigot
- Keep weight off bedding
- Push home manually if possible

46

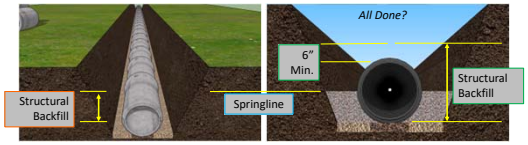
Connections
Understanding Connections

47

48

Embedment
Initial Backfill

- Provides structural support for flexible & rigid products.
- Compaction under haunches is important for rigid products & critical for flexible products.
- For flexible pipe this zone builds the soil arch – protecting the pipe from distortions due to loading



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49

Embedment
Initial Backfill

Manual compactors allow contractor to get up close to the pipe without damaging it.

Hoepacks, and other large compaction equipment can do damage to a pipe if there is not enough soil cushion over or around the pipe.

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50

Embedment
Completion



Best Practices:
- Prevent Pipe from Shifting
- Compact in Lifts (6" to 4")
- Use Proper Compaction Equipment

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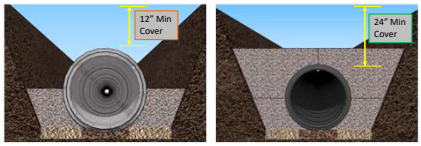
51

52

Final Backfill
Height of Cover


- Does not add to strength of rigid system – compact as needed for improvements above.
- **AASHTO:** 2′ minimum fill height for thermoplastic pipe.
- **AASHTO:** 1′ minimum fill height for thermoplastic pipe.



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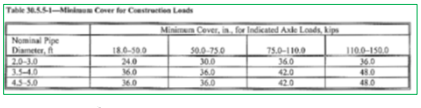
Final Backfill
Height of Cover



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54

Final Backfill
Height of Cover

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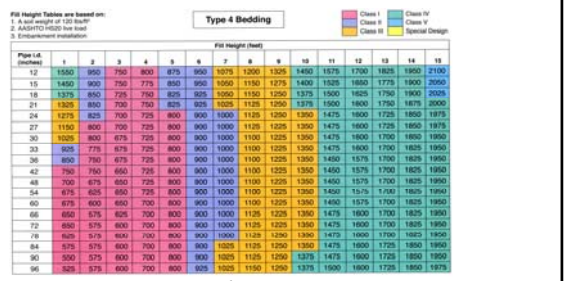
Final Backfill
Height of Cover



56