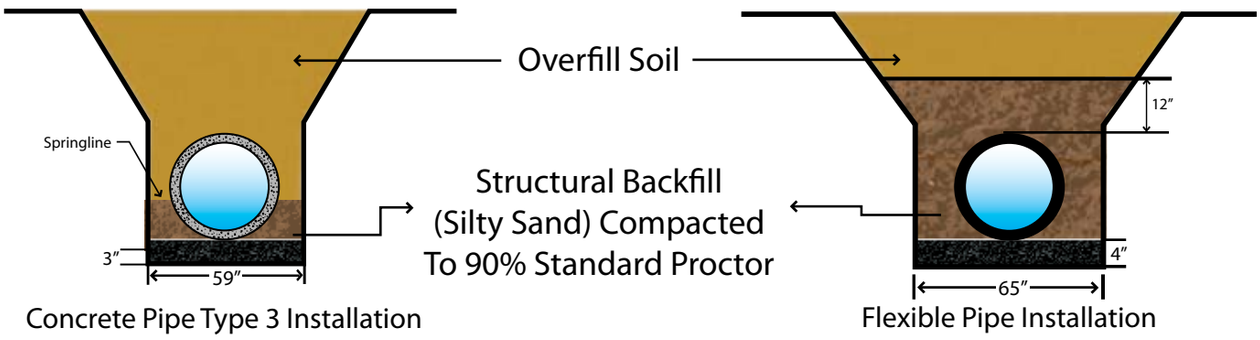
# Concrete and Flexible Pipe Installation Considerations

## For Inspectors and Contractors

**System Strength**

There are fundamental differences between concrete pipe (rigid pipe) and plastic pipe (flexible pipe). One fundamental difference is that rigid pipe is a structure whereas flexible pipe is essentially a liner and the structure is built in the field.

Example: 36” concrete and plastic pipe installed in a trench with 6’ of cover over top of pipe.




Concrete Pipe Type 3 Installation

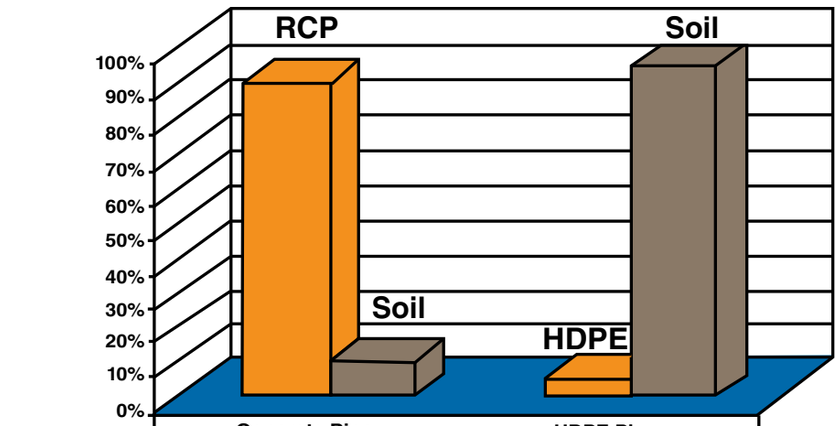
Flexible Pipe Installation

3 ft³ Granular Backfill

10 ft³ Granular Backfill

**How Critical is Installation?**

Installation is critical to the strength of the flexible soil / pipe system. In this example HDPE pipe only contributes 5% whereas RCP contributes 90% of the structural strength of the soil/pipe system. Therefore, post installation inspection is imperative to ensure the constructed flexible soil / pipe system was properly built.




| | Concrete Pipe | HDPE Pipe |
|---|---|---|
| Pipe Strength | 90% | 5% |
| Soil Strength | 10% | 95% |

**Installation Checklist***

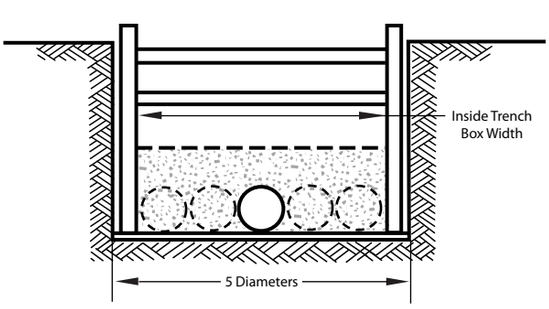
| **Concrete** trench width O.D. x 1.3 | **HDPE** trench width O.D. x 1.5+12” |
|---|---|
| ☐ trench width O.D./6 | ☐ trench width O.D. +16” or O.D. x 1.25 +12” |
| ☐ in-situ embedment | ☐ imported granular embedment |
| ☐ 3” bedding | ☐ 4” bedding |
| ☐ compact haunch to 85-95% Std. Proctor. | ☐ compact haunch to ≥ 90% Std. Proctor. |
| ☐ compact backfill in 8” lifts to spring-line | ☐ compact backfill in 6” lifts to 12” above pipe |
| ☐ minimum cover designed | ☐ 2’ minimum cover |

*Checklist based on minimum requirements. The Contract Documents may be more stringent.

**General Note to Inspectors**

The Engineer of Record must approve any deviation from the requirements in the Contract Documents due to the high dependence of the HDPE pipe system strength on the compacted soil and other installation requirements. Examples would include, but not be limited to soil type, density requirements, trench width, use of trench boxes, water table or wet trench conditions, and minimum cover before allowing construction equipment to cross over the trench.

**Plastic Pipe Trench Box Detail**




“If it is necessary for a trench box to be dragged through a trench, do not raise the box more than 24” above the work surface. Another alternative for when the box will be dragged is to use a well-graded granular backfill material at least two diameters on either side of the pipe and compact it to a minimum of 90% standard Proctor density before moving the box.” *ADS Technical Note, TN 5.01, March 2009*

Failure to adhere to these trench box requirements or other HDPE manufacturer recommended procedures could void the product’s warranty, increase the project’s risk of failure, and jeopardize your professional liability.

| PIPE INSTALLATION COMPARISON: CONCRETE / HDPE / SRHDPE | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Material** | **Applicable Material Specifications** | **Significant Material Requirements** | **Installation Specifications** | **Trench Width** | **Foundation & Trench Wall Support** | **Bedding Materials** | **Haunch Materials** | **Embedment Materials** |
| Concrete Pipe | Manufacture/ Materials:<br>reinforced pipe ASTM C 76, AASHTO - M 170<br>Plain concrete pipe: ASTM C 14 | Composed of cement, reinforcing steel (for reinforced concrete pipe), aggregates, and water in accordance with national and local specifications. | ASTM C 1479<br>AASHTO LRFD Bridge Construction Specifications (Section 27) | ASTM C 1479 & AASHTO Section 27 states minimum trench width = O.D./6 each side and shall be adequate to enable compaction.<br>**Sample Calculations:**<br>O.D. = 24" ID + 3" wall thickness x 2 =30"<br>Total trench width = O.D. + (O.D./6 x2)<br>30" + (30/6 x 2)<br>30" + 10" = 40" min. | Foundation - moderately firm to hard in-situ soil or stabilized soil or compacted material<br>In-situ soil at foundation & trench walls should be strong enough to support pipe & compaction of embedment materials<br>Confirmation of strength of foundation<br>90-95% standard proctor | Uniform support & grade<br>Thickness normal earth foundation O.D./24 min 3"<br>In rock thickness O.D./12 min 6"<br>No compaction directly under pipe | Helps pipe support load, uniformly transfers load from pipe wall to foundation. **Pipe can provide MAJORITY of system strength**<br>Hand placement of material in this area is not required for RCP<br>Placed in 8" lifts to allow compaction to 85% - 95% standard proctor.<br>No compaction effort may be permissible depending on soil type | Compact to required density in 8" lifts up to springline according to installation Type (1, 2, 3, or 4)<br>**Required only up to springline** |
| HDPE Pipe | Manufacture/ Materials:<br>ASTM F 2306<br>AASHTO M 294 | Virgin resins must be used. Cell class 435400C.<br>Material must have ability to withstand stress cracking | ASTM D 2321,<br>AASHTO LRFD Bridge Construction Specifications (Section 30) | AASHTO Section 30:<br>1.50.$D_O$ + 12"<br>**Sample Calculations**<br>O.D. 24" HDPE = 28"<br>Trench width =<br>(28" x 1.50) + 12" = 42 +12 = 54" minimum trench width | Moderately firm to hard in-situ soil or stabilized soil or compacted material<br>In-situ foundation and trench wall soil should be strong enough to support pipe & compaction of embedment materials.<br>Confirmation of strength of foundation<br>90-95% standard proctor | Uniform support & grade<br>Coarse grain soils – manufactured aggregates normally imported<br>Thickness normal earth foundation - min 4"<br>In rock thickness min 6"<br>No compaction directly under pipe | **Haunch materials provide MAJORITY of structural strength of flex pipe/soil system**<br>Materials same as used in bedding zone<br>Work materials in by hand<br>Place in 6" lifts<br>90% minimum compaction (per section 30) | Compact to required density in 6" lifts to 12" above top of pipe<br>Removal of trench box must not allow movement of compacted material<br>Usually requires imported select material |
| SRHDPE Pipe | Manufacture/ Materials:<br>ASTM F 2562<br>AASHTO provisional | Vertically placed thin metal hoops encapsulated by HDPE plastic | **DO NOT EXIST** | **No nationally approved installation or design specification. Research indicates that deflection limits will be significantly lower than conventional HDPE.** | | | | |

# Different Pipe Types Require:

## Different Design Considerations

- Rigid pipe (RCP) can provide the majority of the structural load carrying component of the pipe/ soil system. Designers must understand and select proper pipe class for construction method.
- Soils placed around flexible pipe in flexible soil/pipe systems carry majority of load. Designers must properly predict soil strength component in designs and must confirm construction of the soil structure does not change during construction.

## Different Installation Methods

- RCP installations (Type 1-3) require structural embedment materials placed only up to springline.
- RCP structural embedment materials may be in-situ materials in many cases.
- Placement of materials in haunch for RCP not as critical as flexible pipe.
- Flexible pipe structural embedment materials placed to a height of one foot above pipe.

## Different Inspection Techniques

RCP (AASHTO Sect. 27.6.1) = Inspect for structural damage/defects (cracks, spalling, etc)

- Cracks ≤ 0.01" = no issue, no action
- Cracks > 0.01" and ≤ 0.10" = evaluation by PE
- Cracks > 0.10" = evaluation by PE for repair or replacement

HDPE (AASHTO Sect. 30.5.6) = inspect for control of deflection = structural confirmation of system

- Deflection ≤ 5% = no issue, no action
- Deflection > 5% but < 7.5% = evaluation by PE
- Deflection exceeding 7.5% = evaluation by PE for repair or replacement

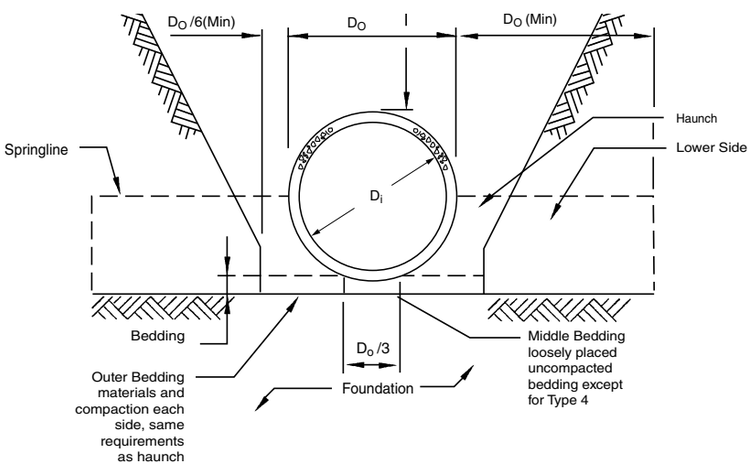
CMP (AASHTO Sect. 26.5.7) = inspect for control of deflection

- Deflection exceeding 7.5% evaluation for repair or replacement

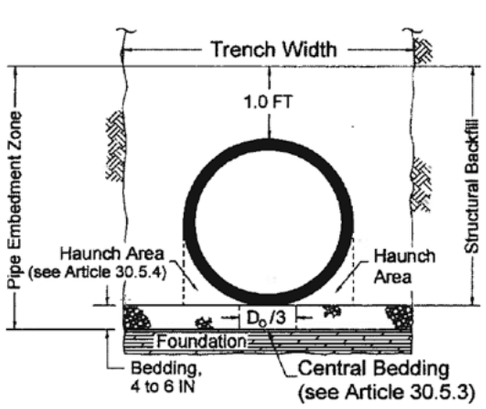
Inspection methods include the following:

- Video combined with laser deflectometer = check deflection
- Mandrels also may be used for deflection testing
- Video + micrometer used to measure cracks, joint gaps for all types

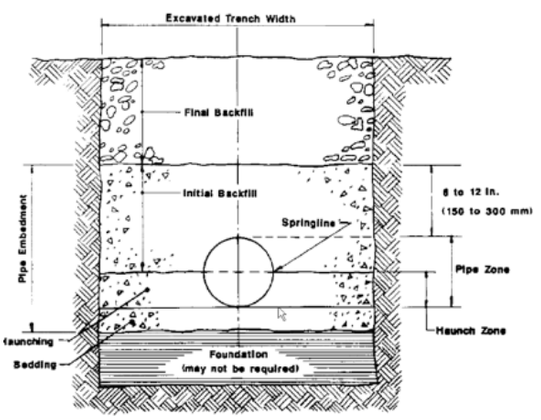
## AASHTO - Concrete Pipe Standard Installation




## Plastic Pipe National Standards




**AASHTO Section 30**




**ASTM D2321**