SECTION 36 - CAST-IN-PLACE CONCRETE PIPE (CIPCP)

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36-1 GENERAL

Construction of cast-in-place concrete pipe will be permitted when shown or specified in the Contract. Cast-in-place concrete pipe shall consist of portland cement concrete placed in a prepared trench at the locations shown and specified in the Contract and these Specifications. The Agency may deny the use of cast-in-place concrete pipe if, in the Agency's judgment, local conditions make the use of such pipe undesirable.

Unless otherwise specified herein, the placement of cast-in-place concrete pipe shall conform to the requirements of Section 38, "Sewer and Drain Construction", of these Specifications.

It is the Contractor's responsibility to determine the suitability of the excavated trench for the placement of cast-in-place concrete pipe. The Contractor shall determine whether the trench walls will provide sufficient lateral support to prevent deflection and cracking of the pipe due to backfill and live loads, and that the trench width at the top of the pipe will be sufficiently narrow to preclude additional loading on the pipe.

If, after examining the sides of the trench, the Contractor elects to place cast-in-place concrete pipe, and the pipe subsequently develops longitudinal cracks exceeding five feet (5') in length, the Contractor, at the Contractor's expense, shall repair or replace the pipe as directed by the Agency.

Should the Contractor decide not to place cast-in-place concrete pipe after examination of the trench sidewalls, alternative pipe conforming to the requirements in Section 38, "Sewer and Drain Construction", of these Specifications shall be furnished and placed, and no additional payment will be made.

36-2 PIPEMAKING EQUIPMENT

The pipe shall be constructed with equipment specially designed for constructing cast-in-place concrete pipe, as approved by the Agency. The Contractor shall furnish evidence of successful operation of the proposed equipment on other work. Equipment not suitable to produce the quality of work required for the pipeline will not be permitted to operate on the Work.

36-3 TRENCH EXCAVATION

Trench excavation shall conform to Section 19, "Trench Excavation, Bedding and Backfill", of these Specifications. The trench shall be excavated to the lines and grades of the completed pipe as shown on the Plans and within the tolerance specified in these Specifications. The trench shall be of the proper width and the bottom of the trench shall be shaped to the external diameter of the pipe to be constructed. The bottom of the trench shall be prepared to provide full, firm, uniform support by undisturbed earth or compacted fill over a minimum of the bottom one hundred eighty degrees (180°) of the outside of the pipe. Trench width at the top of pipe shall not exceed the outside diameter of the pipe at the spring line.

Unless otherwise directed by Agency or specified in the Special Provisions, the trench in which pipe was placed during the previous 24 hours, plus the trench required for the next day's work, plus additional trench one half the length of the trench required for the next day's work, is the total maximum allowable length of trench on any one portion of the Work that may remain open at the end of each Working Day. The remainder of the trench shall be backfilled and compacted, and when in streets or highways, opened to traffic as soon as practicable.

36-4 SPECIAL FOUNDATION TREATMENT

Whenever the bottom of the trench is soft, rocky or in the opinion of the Agency otherwise unsuitable as a foundation for the pipe, the unsuitable material shall be removed to a depth such that when replaced with a suitable material, it will provide a stable and satisfactory foundation. Suitable materials for backfilling the trench below the pipe shall consist of select material approved by the Agency compacted to a relative compaction of not less than ninety percent (90%). Alternate backfill materials and methods may be used with the approval of the Agency.

36-5 CONCRETE

Concrete shall be Class "A-1" portland cement concrete conforming to Section 50-5, "Portland Cement Concrete", and these Specifications.

The maximum aggregate size shall be determined by the size of cast-in-place concrete pipe constructed, and shall be as follows:

Pipe Size	Maximum Aggregate
48" or less	1"
Over 48"	1-1/2"

Gradation for combined aggregates shall conform to Section 90-3.04, "Combined Aggregate Gradings", of the State Specifications.

Slump shall not exceed two inches (2") as determined by the slump cone method of ASTM Designation: C 143 or an equivalent slump as determined by California Test Method 533, unless otherwise permitted or directed by the Agency.

The minimum wall thicknesses for the various sizes of pipe shall conform to the following table:

Internal Diameter	Minimum Wall Thickness
24” through 30”	3”
33” and 36”	3-1/2”
42”	4”
48”	5”
54”	5-1/2”
60”	6”
66”	6-1/2”
72”	7”
78”	7-1/2”
84”	8”
90”	8-1/2”
96”	9”
108”	10”
120”	12”
132”	14”
144”	15”

The compressive strength of the concrete shall be not less than seven hundred pounds per square inch (700 psi) at one day, not less than fourteen hundred pounds per square inch (1400 psi) at three (3) days, not less than twenty-one hundred pounds per square inch (2100 psi) at seven (7) days, and not less than thirty-five hundred pounds per square inch (3500 psi) at twenty-eight (28) days, as determined by moist-cured test cylinders.

36-6 PLACING CONCRETE

Prior to placing any pipe, the Contractor shall secure the Agency’s written approval of the excavated trench. Concrete placement shall conform to the provisions of Section 51-1.09, “Placing Concrete”, of the State Specifications. All surfaces against which concrete is to be placed shall be free from standing water, mud, and debris, and shall be firm enough to prevent contamination of the concrete by earth or other foreign material. Absorptive surfaces against which concrete is to be placed shall be moistened thoroughly so that the moisture will not be drawn from the freshly placed concrete.

An approved method or device shall be used when placing invert concrete to insure that thickness is maintained at not less than minimum wall thickness at any point. Written approval of this method or device shall be obtained from the Agency prior to beginning concrete placement.

The cast-in-place concrete pipe shall be constructed in one placement around the complete periphery.

The temperature of the concrete when it is being placed shall be not more than 90°F and not less than 40°F in moderate weather, or not less than 50°F in weather during which the

mean daily temperature in the vicinity of the work site falls below 40°F. Whenever the mean daily temperature in the vicinity of the work falls below 40°F for more than one day, the concrete shall be maintained at a temperature not lower than 50°F for at least seventy-two (72) hours after it is placed. Concrete shall be protected against freezing temperatures for three (3) days immediately following the seventy-two (72) hours of protection at 50°F. Where artificial heat is employed, special care shall be taken to prevent the concrete from drying. If concrete is placed when the weather is such that the temperature of the concrete would exceed 90°F, the Contractor shall employ effective means, such as precooling of aggregates and mixing water and placing at night, as necessary to maintain the temperature of the concrete, as it is placed, below 90°F.

36-7 START AND CLOSE SECTIONS

A starter section may be used at the beginning of each run of cast-in-place concrete pipe, such as beginning from an existing structure, or from a manhole, at a change in size or from a manhole at an angle point. Starter sections shall be approximately six feet (6') in length and of the same inside diameter as the cast-in-place concrete pipe, unless otherwise approved by the Agency. The strength of the reinforced concrete starter section shall be as shown on the Plans and shall be placed in accordance with the requirements of these Specifications.

A closing section shall be used when directed by the Agency or where it is not possible to complete a run of cast-in-place concrete pipe because of lack of clearance ahead in the trench.

Starting and closing sections may be either concrete pipe or corrugated steel pipe meeting the strength requirements indicated on the Plans. However, if the combined length of the starting and closing sections exceeds twelve feet (12') in one reach between manholes, concrete pipe shall be used.

36-8 CONSTRUCTION JOINTS

If construction of the pipe stops short of a manhole or for a period exceeding twenty (20) minutes, the resulting construction joint shall be reinforced with a concrete collar. This collar shall extend one foot (1') either side of the joint and shall be a minimum thickness equal to that of the pipe. The resulting end of pipe shall be securely closed by a heavy canvas or equal to prevent excessive dehydration of the concrete already placed.

Joints shall be clean and damp when covered with fresh concrete or mortar. Cleaning of construction joints shall consist of removing all laitance, loose or defective concrete, coating, and foreign material.

36-9 FINISH

Flowline elevations of the completed pipe shall not vary more than 0.05 feet from the design grade shown on the Plans. Variations in the internal diameter shall not exceed one thirty-second inch (1/32") per diameter inch. (For example, for 24-inch pipe, 1/32" x 24" = 3/4" variation). Offsets at form laps shall not exceed the limits specified in the following table:

Pipe Diameter	Maximum Offset
24” through 30”	3/8”
33” through 42”	1/2”
48” through 66”	5/8”
72” through 90”	7/8”
96” through 108”	1”
120” and larger	1-1/8”

The finished surface of the concrete pipe shall be substantially free of fractures, cracks and interior surface roughness.

The Contractor shall hand trowel the bottom ninety degrees (90°) of the inside of the pipe unless alternate provisions are made to provide a smooth interior surface satisfactory to the Agency. The remaining interior surface of the pipe not covered by forms shall be equivalent to a steel screeded finish. All extraneous concrete shall be removed from the interior surface as soon as possible after placing. Any additional finish work or repair work required to be done on the pipe shall be completed within five (5) days after the pipe is placed.

If obvious segregation or honeycombing or inadequate wall thickness is found by the Agency, the pipe may be rejected.

36-10 FORMS

Forms shall be strong enough to permit the placement and vibrating of the concrete without causing distortion at any point. Form support systems shall be constructed so that previously placed concrete will not be damaged. Form structure bearing plate indentations shall not exceed one-eighth inch (1/8”) and care shall be taken when removing the forms to prevent damage to the pipe. After removal of the forms, the inside of the pipe will be inspected by the Agency and any repairs made promptly by the Contractor, at the Contractor’s expense.

The surfaces of the forms against which concrete is to be placed shall be cleaned of all dirt, mortar, and foreign material. Forms shall be thoroughly coated with form oil prior to use. The form oil shall be a commercial quality form oil or other equivalent coating that will permit the ready release of the forms.

36-11 CURING

Immediately after finishing exposed exterior surfaces, the curing of these surfaces shall be undertaken by any one or a combination of the following methods:

- Pigmented curing compound, blanketing, cotton mat, polyethylene film or spraying methods as specified in Section 90-7.01, “Methods of Curing”, of the State Specifications.
- A six-inch layer of moist earth backfilled over the pipe. Care shall be taken to avoid damage to the fresh concrete while placing the backfill. This backfill shall be kept moist for not less than seven (7) days.

During the curing period, the ends of the pipeline shall be securely closed with heavy canvas, or by other methods approved by the Agency, to maintain a humid condition within the pipe for a minimum of seven (7) days, except during periods when repair work is actually in progress on the inside of the pipe.

36-12 FIELD QUALITY CONTROL

36-12.01 Placement Tests

The Agency will be present for testing and inspection at all times during construction of a cast-in-place concrete pipe. No cast-in-place concrete pipe may be constructed without the presence of the Agency.

A slump test of each truckload of concrete will be made by the Agency before the concrete will be permitted to be placed in the pipe casting machine.

Any concrete having a slump that exceeds the specified slump by more than one-half inch (1/2") will be rejected. At least three (3) compressive test cylinders will be cast from representative portions of each load of concrete. Each cylinder shall have recorded the line, station number, date and batch ticket number. Compression tests will be made at the Agency's expense. Concrete compressive strength shall be determined from six-inch by twelve-inch (6" x 12") cylinders conforming to ASTM Designation: C 31, tested in conformance with ASTM Designation: C 39.

One (1) cylinder of each set will be tested after curing for two (2) days and seven (7) days, at the option of the Agency. The other cylinder of the set will be held for testing in the event that the Agency wishes to retest any batch.

If more than two (2) cylinders tested in any day's concrete placement fall more than ten percent (10%) below the minimum specified compressive strength, cores will be taken from the pipe and tested for compressive strength at the expense of the Contractor. If cores indicate concrete strength more than twenty percent (20%) below the minimum specified compressive strength, that portion of pipe shall be removed and replaced with precast concrete pipe, at the expense of the Contractor.

36-12.02 Crack Repair

After completion of entire backfill and compaction, all cracks shall be repaired as follows: Crack width shall be determined by penetration to more than 0.25 inch (6.4mm) of a standard machinist gage leaf defined in AASHTO T 280.

Where the pipe function requires repair, circumferential cracks greater than 0.01 inch (0.3mm) and less than 0.06 inches (1.5mm) in width shall be cleaned and filled with mortar. Circumferential cracks 0.06 inches or more in width shall be cleaned and filled to a depth of 0.38 inches (9.5mm) with an elastomeric sealant.

Longitudinal cracks with a width of more than 0.01 inches (0.3mm) and a length less less than that determined by the formula 0.0005 times the outside pipe diameter shall be cleaned and filled to a depth of 0.38 inches (9.5mm) with an elastomeric sealant.

Longitudinal cracks having displacement greater than 0.08 inches (2.0mm) or width greater than that determined by the formula 0.0005 times the outside pipe diameter shall be repaired by full depth epoxy pressure grouting.

36-13 REIMBURSEMENT FOR FIELD QUALITY CONTROL

The Agency has determined that there is an additional cost to the Agency for field quality control of cast-in-place concrete pipe over and above that required for other types of underground construction. This additional cost is fixed at the amount specified in the Special Provisions and shall be reimbursed to the Agency in order that bids received for various pipe materials and methods of construction will be comparable in total cost. Reimbursement will be deducted from the prices paid per linear foot for each size of cast-in-place concrete pipe.

36-14 BACKFILL

Initial backfill shall be the material placed between the top of the pipe shoulder in contact with the trench and a point twelve inches (12”) above the top of the pipe. Initial backfill selected from job excavated material must be finely divided and free from debris, organic matter and pieces larger than one inch (1”). The material shall be placed immediately after the pipe has been completed, inspected and accepted by the Agency and permission to backfill has been obtained in writing from the Agency. The material shall be carefully placed so as not to disturb or damage the pipe and shall be brought up evenly on both sides.

The material shall be compacted to a relative compaction of at least ninety percent (90%) as determined by ASTM Designation: D 1557. Jetting will not be permitted during placement of initial backfill.

Jetting may be permitted for backfill above twelve inches (12”) over the pipe, if approved by the Agency.

As an alternative to job excavated material, initial backfill may consist of imported three-quarter inch (3/4”) clean crushed rock conforming to ASTM D 448 sieve size number 6 or 7 and to Section 50-16, "Clean Crushed Rock", of these Specifications.

Intermediate and final trench backfill shall conform to Section 19, “Trench Excavation, Bedding and Backfill”, of these Specifications.

36-15 LOADING DURING CURING

No backfill other than a six-inch (6”) layer permitted for curing purposes shall be placed until the tests designated have been made and permission to backfill has been obtained from the Agency. Depth of backfill over the top of the pipe shall not exceed twelve inches (12”) until the concrete compressive strength reaches seven hundred pounds per square inch (700 psi) or the pipe has been in place twenty-four (24) hours, whichever is longer. Light traffic [axle load less than six thousand (6000) pounds] may be routed over the pipe when loosely backfilled and prior to jetting. Unrestricted traffic will be permitted over the pipe when the concrete strength reaches fourteen hundred pounds per square inch (1400 psi) or the pipe has been in place for seventy-two (72) hours, whichever is longer. In all cases, the Contractor is responsible for correcting any damage to cast-in-place concrete pipe caused by premature or excessive loading prior to the end of a seven (7) day curing period.

36-16 MEASUREMENT AND PAYMENT

The length of cast-in-place concrete pipe to be paid for will be the slope length designated by the Agency. Pipe placed in excess of the length designated will not be paid for. The price paid per linear foot for cast-in-place concrete pipe includes full compensation for furnishing all labor, materials, tools, equipment, and incidentals, and for doing all the work involved in constructing the pipeline, complete in place, including excavation, bedding material, special foundation treatment, backfill, and construction joints, as shown or specified in the Contract, specified in these Specifications, and directed by the Agency.