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## 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 or if approved by the City in writing. 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 City may deny the use of cast-in-place concrete pipe if, in the City's judgment, local conditions make the use of such pipe undesirable.

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 City.

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, "Storm 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 City. 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 City 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 City otherwise unsuitable as a foundation for the pipe, the unsuitable material shall be removed to a depth such

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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 City compacted to a relative compaction of not less than ninety three percent (93%). Alternate backfill materials and methods may be used with the approval of the City.

### **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:

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

Slump shall not exceed two inches (2") (tolerance of +/- one half inch (1/2")) 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 City.

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

<b>Internal Diameter</b>	<b>Minimum Wall Thickness</b>
24" through 30"	3"
33" and 36"	3-1/2"
42"	4"
48"	5"
54"	5-1/2"
60"	6"
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 City's written approval of the

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excavated trench. 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 ensure 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 City 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 temperature in the vicinity of the work site falls below 40 F. Whenever the 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 City. 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 City 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 are to be constructed using reinforced concrete pipe meeting the strength requirements indicated on the Plans.

### **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

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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 City. 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 City, 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 City 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 bio-degradable 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 90-1.03B, "Curing Concrete", 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.

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During the curing period, the ends of the pipeline shall be securely closed with heavy canvas, or by other methods approved by the City, 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 City shall 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 City, unless this requirement is waived by the Engineer in writing. Failure by the Contractor to ensure City is present may result in rejection of CIPCP.

Slump testing of concrete shall occur at a minimum frequency of one per 50 cubic yards or at the discretion of the City representative 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 five (5) compressive test cylinders will be cast from representative portions of each load of concrete sampled. Each cylinder shall have recorded the line, station number, date and batch ticket number. Compression tests will be made at the City'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 three (3) days and seven (7) days, at the option of the City. The other cylinders of the set will be held for testing per ASTM requirements.

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.

#### **36-12.01A Rejection**

Pipe will be rejected for any of the following reasons:

1. Rock pockets, honeycombing, blisters, voids, or other defects that extend through the pipe wall.
2. A wall thickness less than the minimum as specified.
3. A diameter that does not meet the requirements of the specifications.
4. Application of any wash coat of cement, grout, or other material prior to reinspection after the entire backfill has been placed.
5. Air bubble voids (bug holes) on interior surface of the pipe exceeding ¼ inch in depth unless pointed with mortar or other approved material.
6. Unpaired offsets or indentations, including transverse and longitudinal form

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offsets exceeding those allowed.

7. Deviation or departure from true grade or alignment exceeding that allowed by the Engineer.
8. Concrete used that has a slump of less than 1 inch or more than 3 inches or as approved by the Engineer.
9. Concrete that has had water added after slump and/or cylinder samples have been taken or that does not meet the proportioning requirements of the specifications.
10. Concrete that has core strengths less than that required by the specifications.
11. The pipe does not pass the specified load test.
12. The pipe has been damaged in any manner including but not limited to placing or compacting the backfill.
13. Concrete that has been placed when the concrete temperature exceeds specifications was less than 50 degrees F. or when the soil adjacent to the trench was below freezing.
14. The trench does not provide full, firm and uniform support over the bottom 210 degrees of the pipe or the trench width exceeds the OD by more than 2 inches unless approved by the Engineer.
15. The interior of the pipe is not at least as smooth as a steel trowel finish except for the form lap ridges.
16. The pipe was placed without City Inspection.

Repair methods shall be submitted in writing not less than seven (7) calendar days prior to use for approval by the Engineer. Any repairs performed shall ensure the specified structural strength is not compromised and by techniques which have been approved by the Engineer.

### **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 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 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 City has determined that there is an additional cost to the City for field quality control of cast-in-place concrete pipe over and above that required for other types of underground construction. For City owned projects, this additional cost is fixed at the amount specified in the Special Provisions and shall be reimbursed to the City 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. For development projects, the additional inspection and testing costs will be billed directly to the project.

**36-14 BACKFILL**

Backfill shall conform to Section 19, "Trench Excavation, Bedding and Backfill", of these Specifications. For CIPCP, the initial backfill shall be the material placed between the spring line, in contact with the trench, and the intermediate backfill. Initial Backfill for CIPCP, above the spring line, shall be in accordance with the Standard Details SD-6.0 and SD-6.1.

Initial backfill selected from job excavated material must be screened 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 City and permission to backfill has been obtained in writing from the City. The material shall be carefully placed in eight-inch (8") loose lifts so as not to disturb or damage the pipe and shall be brought up evenly on both sides.

At the option of the Contractor CDF material may be used up to the subgrade elevation (bottom of roadway structural section).

The backfill material above the CIPCP crown shall be compacted as determined by ASTM Designation: D 1557. The first eighteen inches (18") above the CIPCP crown shall be a relative compaction of at least ninety percent (90%) and ninety-three percent (93%) thereafter. Jetting is not permitted.

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 City. 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. 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 City. Pipe placed in excess of the length designated will not be paid for. The price paid per

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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 City.