

*DIVISION 8
STORM & SANITARY SEWERS*

8.01 STORM SEWERS, CATCH BASIN LEADS, AND EXTENSIONS

8.01.01 Description

This work shall consist of installing lines of storm sewer pipe of the required inside diameter, and the necessary appurtenances, for the conveyance of storm water; laid in a trench and shall include excavation and backfilling.

8.01.02 Structures

a. Gas and Water Services

Gas and water services crossing the trench which the Contractor may desire to have removed during the trenching operations, shall be moved and replaced at his expense. The work of removing and replacing services shall be done by the City Water Department and Consumers Energy at the Contractor's request. The Contractor must give the Water Department reasonable notice in advance if they wish this service. For any gas or water service crossing the trench which passes through the space occupied by the completed structure, (See 1.04.06 c.)

b. The Contractor shall assume full responsibility for all sewer laterals.

Any lateral damaged by him in the course of construction shall be re-laid and the lateral left in as good a condition as it was before being damaged with the following exception. In case the grade of any sewer lateral has to be changed in order that the sewer lateral may pass over or under the storm sewer, the Contractor shall notify the Engineer and the City will change the grade of the sewer lateral and reconnect said sewer at the City's expense, (See 1.04.06 c.).

c. Miscellaneous Structures

The Contractor shall assume full responsibility for all miscellaneous structures such as telephone or electric wires and cables, poles, trees, walks and driveway culverts. These and any other structures damaged by him in the course of construction shall immediately be repaired.

8.01.03 Gas Mains, Water Mains, and Sanitary Sewer Mains

Wherever gas mains, water mains, sewer, etc., cross the sewer trench, Class B Concrete shall be used for backfill beneath them. This backfill shall extend from the bottom of the trench up to within two inches of the bottom of the pipe crossing the trench. A rough wooden form shall be used to hold the concrete in place.

The thickness of the backfill shall be six inches greater than the outside diameter of the crossing pipe. After concrete has hardened, wood blocking shall be placed between the concrete backfill and the crossing pipe to support the pipe until the earth backfill consolidates. Payment for work shall be included in the unit price bid per lineal foot of sewer.

8.01.04 Underground Structures

The City Engineering Department has shown the alignment of known underground pipe lines, sewers or structures on the sewer plans. However, some of the locations are uncertain, and the City does not assume the responsibility for locations shown or omissions of pipe lines, sewers or structures on the plans.

8.01.05 Barricades, Flares, Etc.

The Contractor shall furnish flares, barricades, warning signs, and place them, at the direction of the Engineer on the job and at such places as to protect the public at all times from injury during the progress of the work. Any expense involved in furnishing this protection shall be borne by the Contractor, (See 1.05.13).

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8.01 STORM SEWERS, CATCH BASIN LEADS, AND EXTENSIONS (Cont'd.)

8.01.06 Materials

Storm sewer pipe and catch basin leads shall be furnished by the Contractor unless otherwise provided.

- a. Non-reinforced Concrete Pipe for Storm Sewer Mains
(Six inch through 24 inch) Concrete Pipe shall be tongue and groove meeting the A.S.T.M. Specifications C14 standard strength or extra strength as specified on the plans.
- b. Reinforced Concrete Pipe for Storm Sewer Mains
(Twelve inch and greater) Concrete Pipe shall be tongue and groove and shall meet the A.S.T.M. Specifications C76 Classification as shown on the plans.
- c. Non-Reinforced Concrete Pipe for Catch Basin Leads
Concrete pipe shall be bell and spigot and shall meet the A.S.T.M. Specifications C14 standard strength or extra strength as specified on the plans.
- d. PVC Pipe for Catch Basin Leads
PVC pipe shall be bell and spigot and shall meet A.S.T.M. specification D1785 for Schedule 40 or A.S.T.M. 3034 for SDR 35.
- e. Portland Cement
Portland Cement shall conform to the requirements for Type I of the current specifications for Portland Cement A.S.T.M. Designation C150.
- f. Masonry Sand
Masonry sand shall meet the physical and grading requirements of Masonry Sand 2 NS according to MDOT Specifications.
- g. Mortar
See 8.08.05 e.
- h. External Joint Wrap
The external joint wrap shall be MIRAFI 140 as manufactured by the Celanese Corporation or TREVIRA SPUNBOUND Style 11/150 as manufactured by ARMCO, Inc.
- i. Sand Backfill
The Contractor shall furnish suitable sand for backfilling trench which shall consist of clean hard granular sand free from clay, loam or other foreign matter. Not more than seven percent by weight of this material shall pass a #200 mesh sieve.

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8.01 STORM SEWERS, CATCH BASIN LEADS, AND EXTENSIONS (Cont'd.)

8.01.07 Construction Methods

a. Excavation

All earth excavation shall be by open cut from the surface beginning at the outlet and proceeding toward the upper end, true to the line and grade required. The trench shall be of sufficient width to provide free working space and to permit ramming and compacting the backfill around the pipe, but the width shall not exceed the outside diameter of the barrel of the pipe plus six inches on each side, except that a width of less than 27 inches will not be required. When trenches are excavated wider than the above specified widths, caused by the use of power equipment, lack of bracing or other reasons, any increase in cost of excavation, backfill or other items caused by the excessive width, shall be borne by the Contractor.

Where the depth of the trench or the soil conditions require bracing, the sides of the trench shall be sheeted, shored and braced adequately to prevent sliding or caving. The bottom of trenches in earth shall be carefully excavated and graded by hand to the line and contour having a radius at least two inches (2") greater than the outside radius of the sewer pipe as shown on the plans. The excess depth shall be backfilled with sand or sand gravel which shall be compacted and carefully graded so that the barrel of the pipe will be firmly supported throughout its entire length. Recesses shall be excavated to receive the bells. If the storm sewer trench is located within the area of the proposed pavement, all clay soil which is excavated from the trench shall be hauled away and disposed of by the Contractor. All backfill used in the sewer trench which is located within the area of the proposed pavement, is to be sand backfill material.

b. Laying Sewer Pipe

The pipe shall be carefully laid in the prepared trench, groove ends up grade, with tongue ends fully entered into the adjacent groove with each section of pipe having a firm bearing throughout its entire length and true to the line and grade required. Line and grade shall be continually monitored through use of approved laser beam equipment supplied by the Contractor.

Tongue and groove joints shall be made with an approved mastic or plastic joint material. Joint material shall be placed in the groove end of the pipe in proper position and of sufficient quantity to completely seal the joint, excepting that at the bottom of the pipe a section of joint six inches long shall be left unsealed. When the pipes have been properly jointed, the joint shall be completely covered with crushed stone or crushed gravel around the full circumference of the pipe and to a minimum thickness of six inches.

The Contractor may, at his option, provide an external joint wrap in lieu of the crushed stone called for above. The external joint wrap shall be MIRAFI 140 as manufactured by the Celanese Corporation or TREVIRA SPUNBOUND Style 11/150 as manufactured by ARMCO, Incorporated. The joint wrap shall be provided in strips of two (2) foot widths and shall be of sufficient length to provide for one (1) foot overlap. The external wrap shall be positioned firmly about the joint and held in place by sand, carefully laid against the wrap, or by a sufficient quantity of joint mastic to achieve the same purpose. The external wrap shall be in contact with pipe around the entire circumference, and care shall be taken in backfilling so as to avoid disturbing the wrap.

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8.01 STORM SEWERS, CATCH BASIN LEADS, AND EXTENSIONS (Cont'd.)

8.01.07 Construction Methods (Cont'd.)

c. Laying Catch Basin Leads

Catch basin leads shall be carefully laid in trenches prepared in accordance with the plans, in reasonable close conformance with the line and grades shown on the plans or established by the Engineer. Joints between sections shall be as tight as practicable and each section shall have a firm bearing throughout its length. Bell and spigot joints shall be made with a sufficient quantity of mortar to completely seal the joint. External joint wrap shall be positioned firmly around the joint and held in place by sand, carefully laid against the wrap. The external wrap shall be in contact with the pipe around the entire circumference, and care shall be taken in backfilling so as to avoid disturbing the wrap. The joint wrap shall be provided in strips of two foot (2') widths and shall be sufficient length to provide for a one foot (1') overlap.

When PVC pipe is used for catch basin leads, a gasket seal shall be placed around the pipe at the connection to the manhole and catch basin lead in order for a water tight seal to be made between the mortar and the pipe. This gasket shall be a "FERNCO" concrete manhole adapter, a "PRESS-SEAL" WS-RS "Stretch on Gasket" or approved equal.

d. Stone Refill

In water sand or muck that is, in the opinion of the Engineer, unstable, the Contractor shall excavate below the trench bottom and refill with crushed stone, slag, or crushed gravel equivalent in grading to Michigan Department of Transportation specification No. 6A. Where refill is ordered by the Engineer, the Contractor will be paid at the contract unit price per cubic yard, computed according to the following chart:

<u>Nominal Pipe Size</u>	<u>Cubic Yards per Station</u>
8"	7
10"	7
12"	7
15"	8
18"	10
24"	13

The contract unit price per cubic yard for stone refill shall include the additional excavation and the refill material.

e. Branch Connections

Provisions for making existing live sewer connections shall be made at points shown on the plans or as directed by the Engineer. For reinforced concrete pipe sewers the opening shall be cast or cut in the sewer wall of sufficient size to receive the branch pipe.

In cases where connections are to be made to vitrified clay pipe sewers the Contractor shall furnish and build into the sewer wye branches of the required size.

All branches which will not have other pipe connected to them immediately shall be closed by the use of a vitrified clay stopper set in the bell using plastic rooting cement as shown on the plans.

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8.01 STORM SEWERS, CATCH BASIN LEADS, AND EXTENSIONS (Cont'd.)

8.01.07 Construction Methods (Cont'd.)

f. Sewer Taps

When connecting to existing sewers where there is no opening in the existing pipe at the point of connection, an opening shall be cored into the pipe of sufficient size to permit the installation of a "PREDCO" Fast Fit Saddle or approved equal. Following installation of the saddle, the pipe, with its gasket shall be inserted into the saddle in accordance with the manufacturer's recommendations or specifications. In place of cutting in a saddle, the Contractor may replace an existing section of storm main with a precast wye branch using "FERNCO" rubber couplings to seal the joints as a means for tapping into a storm main.

g. Backfilling

All storm sewers located within the area of the proposed pavement shall be completely backfilled with sand as specified. Sand backfill material shall be placed on sections of the sewer only after such sections have been approved by the Engineer for backfilling. Sand backfill material shall be carefully placed by hand under and around the pipe until the pipe is completely covered to a depth of at least one foot. This portion of the backfill shall be placed in layers not more than six inches in thickness and each layer thoroughly compacted without displacing the pipe.

The balance of the trench shall then be backfilled with sand in layers not to exceed 23 inches thickness and each layer compacted to not less than 95 percent of the maximum unit weight at optimum moisture. The method of compaction shall be approved by the Engineer.

Storm sewers not located in roadways will require sand backfill at least one foot above the top of the pipe. The remainder of the required backfill may consist of native material.

h. Cleanout

All new or re-laid sewer shall be cleaned of any and all accumulations or silt, debris, and other foreign materials, and shall be free from such accumulations at the time of acceptance. If deemed necessary the Engineer may require the sewer cleaned by the City's sewer cleaning machines at the Contractor's expense.

i. Cleaning Up

Upon completion of the actual work of construction the Contractor shall clean up and leave in a neat condition all the premises which he has occupied during the construction period. Before the final estimate is paid the Contractor shall remove all surplus excavation, debris, rubbish, tools, and equipment from the premises to the satisfaction of the Engineer.

8.01.08 Method of Measurement

Sewers shall be measured by the lineal foot of sewer from center to center of manholes, catch basins, and inlet connections shall be measured in lineal feet from center of manhole to center of catch basin or inlet.

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8.01 **STORM SEWERS, CATCH BASIN LEADS, AND EXTENSIONS (Cont'd.)**

8.01.09 **Basis of Payment**

Sewers shall be paid for on the basis of contract unit price per lineal foot of sewer, which price shall include furnishing materials, excavating, laying of pipe, backfilling the entire trench with sand, hauling away excess material and building the sewer complete as required. All catch basin and inlet connections shall be paid for on the basis of Contract unit price bid per lineal foot of connection, which price shall include furnishing materials, excavating, laying of pipe, backfilling the entire trench with sand, hauling away excess material and building connections complete.

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8.02 **UNDERDRAINS**

8.02.01 **Description**

This work shall consist of constructing underdrains, including excavation, stone fill or filter cloth, and backfill.

8.02.02 **Construction Methods**

Underdrains shall be carefully laid in trenches prepared in accordance with the plans, in reasonably close conformance with lines and grades shown on the plans or established by the Engineer. Joints between sections shall be as tight as practicable and each section shall have a firm bearing throughout its length. The upgrade ends of all drains shall have a suitable plug to prevent entry of soil or other foreign materials.

The pipe shall be laid with the holes or perforations on the horizontal plane.

Backfill shall not be placed on sections of underdrain before inspection and approval by the Engineer. Sand fill placed under and around the drain to six (6) inches above the pipe shall be 2NS sand as specified in the "Standard Specifications for Construction", as published by Michigan Department of Transportation.

8.02.03 **Materials**

The contractor shall furnish all underdrain materials including pipe, jointing materials, stone and filter cloth.

The pipe and fittings used shall be corrugated smooth interior pipe such as Hancor Hi-Q, ADS N-12 or approved equal meeting requirements for test methods, dimensions, and markings as found in AASHTO Designations M-252 and ASTM F-405.

8.02.04 **Method of Measurement**

Underdrains shall be measured by the lineal foot.

8.02.05 **Basis of Payment**

Underdrains shall be paid for at the contract unit price bid per lineal foot, which price shall include furnishing materials, excavating, laying pipe, backfilling and hauling away excess materials and building the underdrain complete as specified.

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8.03 **SANITARY SEWERS**

8.03.01 **Description**

This work shall consist of installing lines of sewer pipe of the required inside diameter and the necessary appurtenances for the conveyance of sanitary sewage, industrial waste or storm water; laid in trench, and shall include excavation and backfilling.

8.03.02 **Structures**

a. Gas and Water Services

Gas and water services crossing the trench which the contractor may desire to have removed during trenching operations, shall be moved and replaced at his expense. The work of removing and replacing services shall be done by the City Water Department and the Consumers Power Company at the Contractor's request. The Contractor must give the Water Department reasonable notice in advance if they wish this service. For any gas or water service crossing the trench which passes through the space occupied by the completed structure, (See 1.04.06 c.)

b. Miscellaneous Structures

The Contractor shall assume full responsibility for all miscellaneous structures, such as telephone or electric wires and cables, poles, trees, walks, and driveway culverts. These and any other structures damaged by him in the course of construction shall immediately be repaired. (See 1.04.06 c.)

8.03.03 **Gas Mains, Water Mains, and Sewer Mains**

Wherever gas mains, water mains, or other sewer mains cross the sewer trench, Class B concrete shall be used for backfill beneath them. This backfill shall extend from the bottom of the trench up to within two inches of the bottom of the pipe crossing the trench. A rough wooden form shall be used to hold the concrete in place. The thickness of the backfill shall be six inches greater than the outside diameter of the crossing pipe. After concrete has hardened, wood blocking shall be placed between the concrete backfill and the crossing pipe to support the pipe until the earth backfill consolidates. Payment for this work shall be included in the unit price bid per lineal foot of sewer.

8.03.04 **Underground Structures**

The City Engineering Department has tried to show the alignment of all known underground pipe lines or structures on the sewer plans. However, some of the alignments may not be exact and the City does not assume the responsibility for locations or omissions of pipe lines or structures on the plans.

8.03.05 **Barricades, Flares, Etc.**

The Contractor shall furnish flares, barricades, warning signs, detour signs, etc., and place them at the direction of the Engineer on the job at such places as to protect the public at all times from injury during the progress of the work. Any expense involved in furnishing this protection shall be borne by the Contractor, (See 1.05.13).

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8.03 **SANITARY SEWERS (Cont'd.)**

8.03.06 **Materials**

Sanitary Sewer pipe shall be furnished by the Contractor unless otherwise provided.

a. Vitrified Clay Pipe

Unglazed clay pipe with A.S.T.M. C425 preformed joints shall be used for all sanitary sewers and combined sewers up to and including 12 inches in diameter.

Clay Pipe shall meet the A.S.T.M. Specifications C700-77, and National Clay Pipe Institute Specification ER 4-67.

b. Concrete Pipe

Concrete Pipe with A.S.T.M. C443 preformed joints shall be used for all sanitary sewer and combined sewers over 12 inches in diameter unless otherwise shown on plans.

Non-reinforced concrete pipe (15" and 18") shall meet the A.S.T.M. specification C-14 Standard Strength or Extra Strength as specified on plans.

Reinforced Concrete Pipe (21" and greater) shall meet the A.S.T.M. specification C76 Classification as specified on plans.

c. PVC Pipe (6"-12")

All PVC pipe shall be ASTM 3034 gasketed sewer pipe with a SDR of 26 or lower.

d. Precast Reinforced Concrete Manholes

Sanitary Manholes shall be precast reinforced concrete meeting the requirements of ASTM C478 specifications. Minimum diameter shall be 48". Preformed water-tight joints shall be used to join sections of the precast concrete manhole and shall have "O"-ring seals or premium rubber gasket. Inlet and outlet pipes shall be joined to the manhole with a flexible watertight, gasket-type connection. Said connection shall be "KOR-N-SEAL" as manufactured by National Pollution Control Systems, Inc., or approved equal. Precast manholes shall be furnished with integral bottoms. Manhole steps shall be made of corrosion resistant cast iron or plastic coated steel. Manhole Castings shall be EJIW 1040 AGS with gasket seal and shall have a minimum access opening of 24" diameter.

8.03.07 **Construction Methods**

a. Excavation

All earth excavation shall be by open cut from the surface beginning at the outlet end and proceeding toward the upper end true to the line and grade required. The trench shall be of sufficient width to provide free working space and to permit ramming and compacting the backfill around the pipe, but the width shall not exceed the outside diameter of the barrel of the pipe plus six inches on each side, except that a width of less than 27 inches will not be required. When trenches are excavated wider than the above specified widths caused by the use of power equipment, lack of bracing or other reasons, any increase in cost of excavation, backfill or other items caused by the excessive width shall be borne by the Contractor.

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8.03 SANITARY SEWERS (Cont'd.)

8.03.07 Construction Methods (Cont'd.)

Where the depth of the trench or the soil condition requires bracing, the sides of the trench shall be sheeted, shored, and braced adequately to prevent sliding or caving. The bottom of trenches in earth shall be carefully excavated graded to the line and contour having a depth at least four inches below the outside of the sewer pipe as shown on the plans. This excess depth shall be backfilled with sand or gravel which shall be compacted and carefully graded so that the barrel of the pipe will be firmly supported throughout its entire length. Recesses shall be excavated to receive the bells. The trench backfill for the pipe foundation embedment/initial backfill shall be an appropriate material per ASTM D2321 for flexible pipes or ASTM C12 for rigid pipes. Backfill from 4 inches below the pipe to 12 inches above the top of pipe shall meet MDOT Class II granular material modified so that 100% passes a 1-1/2" sieve. The final trench backfill shall contain no debris, frozen or organic material within two feet of top of pipe.

b. Laying Sewer Pipe

All sewer installation shall be completed in accordance with ASTM D 2321 for flexible pipe, ASTM F1417 for PVC pipe, ASTM C1479 for Concrete pipe and ASTM C12 for vitrified clay pipe. The pipe shall be carefully laid in the prepared trench, bells up grade with the spigot end entered tightly into the adjacent bell, each section of pipe having a firm bearing throughout its length and true to the line and grade required. Line and grade shall be continually monitored through use of approved laser beam equipment supplied by the Contractor. Unless otherwise provided, all joints shall be preformed and shall be demonstrated to be water tight. They shall be inspected before the pipe is laid and no pipe shall be used if either collar shows any void or unfilled space. No jute or other calking material will be permitted. When laying pipe the linings and collars shall be painted with approved lubricant.

c. Stone Refill

In water, sand, or muck that is, in the opinion of the Engineer, unstable, the Contractor shall excavate below the trench bottom and refill with crushed stone, slag, or crushed gravel equivalent in grading to Michigan Department of Transportation Specification No. 6A. Where refill is ordered by the Engineer, the Contractor will be paid at the contract unit price per cubic yard, computed according to the following chart:

<u>Nominal Pipe Size</u>	<u>Cubic Yards per Station</u>
8"	7
10"	7
12"	7
15"	8
18"	10
24"	13

The contract unit price per cubic yard for stone refill shall include the additional excavation and the refill material.

d. Branch Connections

Provisions for making existing live sewer connections shall be made at points shown on the plans or as directed by the Engineer. Where connections are to be made of vitrified clay pipe sewers, the Contractor shall furnish and build into the sewer "Y" branches of the required size.

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8.03 SANITARY SEWERS (Cont'd.)

8.03.07 Construction Methods (Cont'd.)

All branches which will not have other pipe connected to them immediately shall be closed by the use of a vitrified clay stopper set in the bell and held in position by the use of mastic as shown on the plans.

e. Sewer Taps

When connecting to existing sanitary sewer mains where there is no opening at the point of connection, an opening shall be cut into the pipe of sufficient size to permit installation of a "PREDCO" Fast Fit Saddle or approved equal. Following installation of the saddle, the pipe, with its gasket, shall be inserted into the saddle in accordance with the manufacturer's recommendations or specifications. Cost for sewer taps shall be paid at the contract unit price bid per each.

f. Testing

All sanitary sewers shall be subject to an air test prior to acceptance. All labor, tools, materials and equipment required to conduct the test shall be furnished by the Contractor. The Engineer, or his representative, will observe the test and verify the results. The test shall be conducted as follows:

1. Air Test - The air test is to be used as a preliminary test on newly laid segments of sewer. Individual runs between manholes shall be tested but in no case shall the Contractor have three runs in place without testing prior to starting construction of a fourth run. The air test shall not be used on any pipe of a diameter larger than 24".

The air testing procedures shall conform to ASTM standards. For plastic pipe use ASTM F1417, for clay pipe use ASTM C828, and for reinforced concrete pipe use ASTM C924.

The sewer line shall be tested in increments between manholes. The line shall be cleaned and plugged at each manhole. Such plugs shall be designed to hold against the test pressure and shall provide an airtight seal. One of the plugs shall have an orifice through which air can be introduced into the sewer. An air supply line shall be connected to the orifice. The air supply line shall be fitted with suitable control valves and a pressure gauge for continually measuring the air pressure in the sewer. The pressure gauge shall have a minimum diameter of 3 1/2 inches and a range of 0-10 psig. The gauge shall have minimum division of 0-10 psig. and an accuracy of +/- 0.04 psig.

The sewer shall be pressurized to 4 psig greater than the greatest back pressure caused by ground water over the top of the sewer pipe. At least 2 minutes shall be allowed for the air pressure to stabilize between 3.5 and 4 psig. If necessary, air shall be added to the sewer to maintain a pressure of 3.5 psig or greater.

Manholes on sewers to be subjected to air tests shall be equipped with a 1/2 inch diameter galvanized capped pipe nipple extending through the manhole, 3 inches into the manhole and at an elevation equal to the top of the sewer pipe. Prior to the air test the ground water elevation shall be determined by blowing air through the pipe nipple to clear it and when connecting a clear plastic tube to the pipe nipple.

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8.03 SANITARY SEWERS (CON'T.)

8.03.07 Construction Methods (Cont'd.)

f. Testing (Cont'd.)

1. Air Test (Cont'd.)

The tube shall be suspended vertically in the manhole and the ground water elevation determined by observing the water level in the tube. The air test pressure shall be adjusted to compensate for the maximum ground water level above the top of the sewer pipe to be tested. (Add 0.433 psig for each foot of ground water, using the average water depth at the manhole at each end>) After all tests are performed and the sewer is ready for final acceptance, the pipe nipple shall be plugged in an acceptable manner.

After the stabilization period, the air supply control valve shall be closed so that no more air will enter the sewer. The sewer air pressure shall be noted and timing for the test begun. The test shall not begin if the air pressure is less than 3.5 psig, or such other pressure as is necessary to compensate for ground water level.

The time in minutes, required for the air pressure to decrease 1.0 psig during the test shall not be less than the time shown in the following table:

Pipe Diameter	<u>Length of Feet</u>					
	<u>10-59</u>	<u>60-84</u>	<u>85-149</u>	<u>150-249</u>	<u>250-349</u>	<u>350-399</u>
4	0.0	0.0	0.5	0.5	1.0	1.0
6	0.5	0.5	1.0	1.5	2.0	3.0
8	0.5	1.0	1.5	2.5	4.0	4.0
10	1.0	1.5	2.0	4.0	5.0	5.0
12	1.5	2.0	3.0	4.5	5.5	5.5
15	2.0	3.0	4.0	7.0	7.5	7.5
18	3.0	4.5	6.0	8.5	8.5	8.5
21	4.0	6.0	8.0	10.0	10.0	10.0
24	6.0	8.0	10.0	12.0	12.5	12.5

Add together the times for each amount of various size pipe to get the total time required.

NOTE: The air test can be hazardous under certain conditions. It is extremely important that all air plugs be properly secured and that care be exercised during the test and in the removal of plugs. A 15" plug with 4.5 psi applied to it exerts almost 800 pounds of force. This is an example of the potential hazard that exists if plugs are not correctly installed or are not completely relieved of air pressure before being removed. As a safety precaution it is suggested that pressurizing equipment be provided with a 10 psi pressure relief device to reduce hazards and to avoid over-pressurization of any sewer lines.

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8.03 **SANITARY SEWERS (Cont'd.)**

8.03.07 **Construction Methods (Cont'd.)**

g. Backfilling

All sanitary sewers and service connections located within the area of the proposed pavement shall be completely backfilled with sand as specified. All plastic pipe shall be bedded in stone and covered with filter fabric as shown on the Standard Plastic Pipe Trench Detail. Sand backfill material shall be placed on sections of the sewer only after such sections have been approved by the Engineer for backfilling.

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8.03 SANITARY SEWERS (Cont'd.)

g. Backfilling (Cont'd.)

Sand backfill materials shall be carefully placed by hand under and around the pipe until the pipe is completely covered to a depth of at least one foot. This portion of the backfill shall be placed in layers not more than six inches in thickness and each layer thoroughly compacted without displacing the pipe.

The balance of the trench shall then be backfilled with sand in layers not to exceed 12 inches thickness and each layer compacted to not less than 95 percent of the maximum unit weight at optimum moisture. The method of compaction shall be approved by the Engineer. Sanitary sewers not located in roadways will require sand backfill at least one foot above the top of pipe. The remainder of the required backfill may consist of native material.

8.03.08 Cleanout

All new and re-laid sewer shall be cleaned of any and all accumulation of silt, debris and other foreign material and shall be free from such accumulations at the time of acceptance. If deemed necessary the Engineer may require the sewer cleaned by the City's sewer cleaning machines at the Contractor's expense.

8.03.09 Cleaning Up

Upon completion of the actual work of construction the Contractor shall clean up and leave in neat condition all the premises which he has occupied during the construction period. Before the final estimate is paid, the Contractor shall remove all surplus excavation, debris, rubbish, tools and equipment from the premises to the satisfaction of the Engineer.

8.03.10 Method of Measurement

Sanitary sewers shall be measured by the lineal foot of sewer from the center to center of manhole.

8.03.11 Basis of Payment

Sanitary Sewers shall be paid for at the contract unit price bid per lineal foot of sewer, which price shall include excavating, laying of pipe, furnishing material, backfilling the entire trench with sand, hauling away excess material and building sewer complete as required.

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8.04 LATERAL HOUSE SEWERS (IN R.O.W.)

8.04.01 Description

This work shall consist of constructing six inch sanitary and 4 inch storm house sewers, including excavation and backfill, within the right-of-way of any street where detailed on the plans or as ordered by the Engineer.

8.04.02 Materials

a. Sanitary Sewer Laterals

Sanitary sewer laterals within the right-of-way shall be six inches minimum diameter vitrified clay sewer pipe with A.S.T.M. C-425 preformed joints. Where PVC Pipe sewer is allowed, the house lateral sewer shall be constructed of SDR 23.5 PVC sewer pipe (solvent welded joints).

b. Storm Sewer Laterals

Storm sewer laterals within the right-of-way shall be 4 inches minimum diameter Schedule 40 PVC pipe (solvent welded joints) meeting A.S.T.M. D 3034. Lateral connections to the storm sewer main shall be made by an approved factory installed saddle or a field installed "PREDCO" fast fit saddle or approved equal in accordance with the manufacturer's recommendations or specifications.

8.04.03 Construction Methods

Shall be as specified in Section 8.03.07

8.04.04 Cleaning Up

Upon completion of the actual work of construction the Contractor shall clean up and leave in neat condition all the premises which he has occupied during the construction period. Before the final estimate is paid the contractor shall remove all surplus excavation, debris, rubbish, tools and equipment from the premises to the satisfaction of the Engineer.

8.04.05 Method of Measurement

House lateral sewers shall be measured by the lineal foot of sewer from the center of the main sewer to the end of the lateral.

8.04.06 Basis of Payment

House lateral sewers shall be paid for at the contract unit price bid per lineal foot of lateral, which price shall include excavation, laying of pipe, furnishing materials, completely backfilling trench with sand or gravel as specified, hauling away excess material and building house lateral sewer complete.

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8.06 **CLEANOUTS FOR SEWERS**

8.06.01 **Description**

This work shall consist of building cleanouts over a bend in a sewer of tile the same as specified for the sewer except that the size of tile may be different from that of the sewer; and shall include furnishing materials, excavating and backfilling, at locations shown on the plans or as directed by the Engineer.

8.06.02 **Materials**

Vitrified tile (bell and spigot), six inches in diameter shall be used for the vertical section from the top of 45 bend up to the top of the bend for at least a distance of six inches outward from the wye and bend to give lateral backing. Also a cleanout plug will be required to cap the top of tile.

8.06.03 **Construction Methods**

This cleanout shall be constructed concurrent with the construction of the sewer. The wye shall be placed in the proper location as the tile is laid for the sewer. The joints shall be made as specified under sewers.

Backfilling shall be done by hand, carefully tamping the material around the cleanout to prevent settlement and breakage. A brass plug will be placed in the top of the uppermost tile.

8.06.04 **Method of Measurement**

Cleanouts shall be measured as a unit.

8.06.05 **Basis of Payment**

Cleanouts will be paid for at the contract unit price each, which price shall include the excavation, furnishing of all materials, building the item, placing concrete lateral backing, backfilling by hand and entirely completing the work.

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8.07 PAVEMENT CROSSING FOR SEWER

8.07.01 Description

This work shall consist of supplementing the work of laying a sewer which crosses a pavement by placing concrete lateral backing, carefully tamping sand backfill and replacing the pavement as required by the Michigan Department of Transportation.

8.07.02 Construction Methods

Concrete lateral backing shall completely fill the excavated space between the outside of the pipe and the wall of the trench to a height equal to half of the outside diameter of the pipe. Sand backfill of suitable material shall be carefully tamped by hand or machine. Sand shall be placed in layers no more than six inches thick and each layer completely compacted before placing succeeding layers. This procedure will be followed until the backfill is complete. The concrete pavement shall be replaced to its original condition as required by the Michigan Department of Transportation. The Contractor will be required to cooperate with any other Contractor or City Department which may wish to utilize the pavement crossing for another utility.

8.07.03 Method of Measurement

Pavement crossings shall be measured as a unit.

8.07.04 Basis of Payment

Pavement crossings will be paid for at the contract lump sum price each, which price shall include furnishing of all materials, doing the work as specified, and entirely replacing the crossing to its original condition.

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8.08 MANHOLES, CATCH BASINS, AND INLETS

8.08.01 Description

This work shall consist of constructing storm manholes, catch basins, and inlets of concrete, cast in place or precast, concrete block masonry or brick masonry, all with metal frames and covers, and shall include excavation and backfilling.

8.08.02 Materials

Portland Cement shall conform to the requirements of the current specifications for Portland Cement ASTM Designation C175. Fine aggregate shall meet the MDOT Specification for fine Aggregate No. 2NS. Masonry sand shall meet the MDOT Specification for coarse Aggregate No. 6-A. Water shall be clean and free from injurious amount of oil, alkali, organic matter or other deleterious substances.

Precast concrete manhole pipes, adjusting rings, cone and tee sections shall meet all applicable industry standards and ASTM Specification C-478.

The structure shall be cleaned thoroughly and a mastic-type adhesive shall be placed prior to placing the heat shrink material. The material used for this application shall be WRAPIDSEAL Manhole Encapsulation System or approved equal and shall be installed as per the manufacturer's specifications.

Masonry units, including clay brick, concrete brick, concrete block or salvaged paving brick, shall meet the specifications for Masonry units as outlined under the MDOT Standard Specifications for Highway construction.

Castings used in the construction of manholes, catch basins, and inlets shall be Class 30 gray iron castings except cast iron steps which shall be Class 35 unless otherwise specified. All manholes, catch basins and inlet castings will be furnished by the Contractor from an approved source. (See 8.08.04 d.)

8.08.03 Construction Methods

Excavation

Excavation shall be made of sufficient size to permit construction of the base of the structure. Concrete shall not be placed until the depth of excavation has been checked by the Engineer. The excavation may be trimmed to the exact size of the footing and the footing forms omitted where conditions permit and when approved by the Engineer.

Excavation not occupied by the structure shall be backfilled with sand, in layers and each layer compacted to 95 percent of the maximum unit weight at optimum moisture. All surplus excavation shall be disposed of by the Contractor.

8.08.04 Concrete Construction

Manholes, catch basins or inlets may be built of concrete unless the plans call for a different type of construction. If concrete construction is used, the concrete shall meet the requirements as specified in Division 7 and as shown on the plans.

a. **Forms**

All forms shall be built mortar tight of sound material sufficiently strong and rigid to prevent distortion during the placing and curing of concrete. They shall be built true to the line designated on the plans and shall be securely braced to prevent movement while placing concrete and shall be maintained in this condition until the concrete has sufficiently hardened to permit their removal.

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8.08 MANHOLES, CATCH BASINS, AND INLETS (Cont'd.)

8.08.04 Concrete Construction (Cont'd.)

b. Steel Reinforcement

Where steel reinforcement is called for on the plans, the reinforcement shall be properly spaced and held in the correct position during the placing of the concrete.

c. Inlet or Outlet Connections

Pipe or tile inlet or outlet connections called for on the plans shall extend through the walls and beyond the outside surface of the walls in sufficient distance to allow for connection. When required, traps shall be installed as called for on the plans.

d. Castings

All manhole, catch basin, and inlet castings shall be as detailed on the plans and furnished by the Contractor from an approved source. Where manholes are within the paving limits, the final grade shall be set after the bituminous leveling course has been placed.

Standard manhole casting:

- EJIW 1040 with Type A Solid Cover (storm)
- EJIW 1040 with Type AGS Solid Cover (sanitary)

Standard curb-type catch basin casting:

- EJIW 7000 with Type M1 Grate (square back curb)
- EJIW 7420 (mountable curb)
- EJIW 5105 with Type M3 Grate (ADA sidewalk ramp)
- EJIW 7000 with Type M3 Grate (driveway)

Non-curb catch basins in ditch:

- EJIW 1040 with Type 02 Grate

Non-curb catch basins in parking lot or other paved area:

- EJIW 1040 with Type M1 Grate

24" Tile catch basin:

- EJIW 1140 with Type 02 Grate

e. Wrought iron, galvanized steel or cast iron steps shall be installed where called for on the plans, and as shown on the detailed sheet. Manhole steps shall comply with ASTM C-478.

f. Backfill

The excavated space left after building the structure shall be backfilled with sand in layers not to exceed 12 inches in thickness and each layer compacted to not less than 95 percent of the maximum unit weight at optimum moisture. The method of compaction shall be approved by the Engineer.

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8.08 MANHOLES, CATCH BASINS, AND INLETS (Cont'd.)

8.08.05 Brick Masonry

Where this type of construction is used or called for on the plans, the work shall consist of laying brick as required in cement mortar beds and shall include excavation, backfilling, pipe or tile or outlet connections, castings and steps, concrete foundation and completing the construction of the unit. Material specifications have been covered before under 8.08.02.

a. Construction Methods

Base of the structure shall be of concrete as shown on the plans. Concrete shall meet the requirements as previously specified under concrete construction.

The following specifications shall be followed on all brick masonry construction.

b. Preparing and Laying Brick

Before being laid, all brick shall be wetted and the surface dried just enough to prevent slipping of mortar. Brick shall be laid in courses with full and close mortar joints. Courses shall be level unless otherwise specified. Adjoining courses shall break joints by one-half the length of a brick as near as practicable.

c. Joints

Joints shall not be more than 1/2 inch in thickness unless otherwise provided and shall be a uniform thickness throughout the structure. All joints shall be struck and pointed.

d. Plaster Coat

A 1/2 inch plaster coat will be required on the outside of all brick or block structures, and on the inside of structures with sumps, between the outlet and the bottom of the structure.

e. Mortar

Mortar shall be composed of one part of a combination of Portland Cement and hydrated lime and three parts of masonry sand, or one part of masonry cement and two parts of masonry sand by volume. The combination of Portland Cement and lime shall consist of 90 percent of Portland Cement and 10 percent of hydrated lime by volume.

The masonry sand and combination of Portland Cement and lime or masonry cement shall be mixed in a clean tight box, until a mixture of uniform color is produced after which water shall be added in such quantity as to form a mortar of the consistency of stiff paste. Retempering of mortar will not be permitted.

f. Castings

See 8.08.04 d

g. Steps

See 8.08.04 e

h. Backfilling

See 8.08.04 f

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8.08 **MANHOLES, CATCH BASINS, AND INLETS (Cont'd.)**

8.08.06 **Concrete Block, Construction Methods, Base**

The base of the structure shall be of concrete as shown on the plans. Concrete shall meet the requirements as previously specified under 8.08.04.

The following specifications shall be followed on all concrete block masonry construction.

a. Preparing and Laying Blocks

The first course of blocks as placed on the prepared base or footing shall be on a full bed of mortar. All blocks shall be laid in courses with full and close mortar joints. The courses shall be level throughout, except where otherwise specified. Adjoining courses shall break joints by one-half the length of the block as near as practicable.

b. Joints

Joints shall be of a uniform thickness throughout the structure. All joints shall be struck and pointed, and exposed surfaces shall be true and smooth.

c. Plaster Coat

See 8.08.05 d

d. Mortar

See 8.08.05 e

e. Castings

See 8.08.04

f. Steps

See 8.08.04

g. Backfilling

See 8.08.04 f

8.08.07 **Method of Measurement**

Inlets will be measured as a unit. Catch basins will be measured by the vertical foot of depth from the top of the masonry to the bottom (inside) of the catch basin. Manholes will be measured by the vertical foot of depth from the flow line of the sewer to the top of casting at finished grade. Precast tee manhole sections shall be measured as a unit from the flow line of the sewer to the top of the precast tee section. From the top of the precast tee section to the top of the casting at the finished grade shall be measured by the vertical foot of depth.

8.08.08 **Basis of Payment**

Inlets will be paid for at the contract unit price each, which price shall include the excavation, furnishing of all materials, building the structure, setting the casting, backfilling and entirely completing the structure.

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8.08 **MANHOLES, CATCH BASINS, AND INLETS (Cont'd.)**

Manholes will be paid for at the contract unit price per vertical foot of depth. Precast tee section manhole will be paid for at the contract unit price each, and the additional distance from the top of the precast tee section to the top of the casting will be paid for at the contract unit price per vertical foot of depth of manhole. The above prices shall include excavation, furnishing of all materials, building the structure, setting the casting, backfilling and entirely completing the structure.

Catch basins will be paid for at the contract unit price per vertical foot of depth, which price shall include the excavation furnishing of all materials building the structure, setting the castings, backfilling with sand and entirely completing the structure.

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8.09 REGRADING AND RECONSTRUCTING DRAINAGE STRUCTURES

8.09.01 Description

This work shall consist of excavation, rehabilitation of a portion of an existing structures, setting the casting to the required grade and backfilling.

8.09.02 Materials

As specified in 8.08.02.

8.09.03 Construction Methods

a. Excavation

Excavation shall be of a sufficient size and depth to permit rebuilding of the manhole to the standard shape and size as shown on the plans.

b. Regrading and Reconstructing Drainage Structures

The price bid for Regrade Drainage Structure shall include adjusting the top of the masonry structure to the finished grade, with casting installed. The method for regrading shall include the placement of precast reinforced concrete adjusting rings in accordance with ASTM C-478. Brick will not be allowed for regrades. The casting and all adjusting rings and 6” of the original structure shall be covered with a mastic patching and surfacing compound material at a thickness of 1/8TH inch. The mastic material shall be Tremco Inc. TREM proof 250 GC-R or approved equal. Prior to the mastic setting-up, a minimum of an 18” wide piece of external pipe joint material meeting Mirafi 140 shall be wrapped around the circumference of the structure and shall overlap at least 6” installed around the top of the structure and casting to seal the joint from water entering the sewer system. The structure shall be cleaned thoroughly prior to placing the mastic material. The price bid shall also include all required saw cutting of existing pavement and placement of 8” of 22A crushed limestone, the top of which shall be 4” below the top of pavement.

Where new castings are called for on the plans, or authorized by the Engineer, the castings will be paid for separately.

c. Preparing and Laying Brick

See 8.08.05 b

d. Joints

See 8.08.05 c

e. Plaster Coat

See 8.08.05 d

f. Mortar

See 8.08.05 e

g. Castings

See 8.08.05 f

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8.09 REBUILDING AND REGRADING MANHOLES (Cont'd.)

8.09.03 Construction Methods (Cont'd.)

h. Steps

See 8.08.05 g

i. Backfilling

See 8.08.05 h

j. Cleaning Manholes

The Contractor shall clean out any brick, mortar or debris which may fall down inside the manhole during the operation of "Regrading Manhole", and shall leave the manhole in as clean a condition as it was before starting the work.

8.09.04 Basis of Measurement and Payment

The Regrade Drainage Structure pay item shall cover up to 12" below the bottom of the casting and will be paid per each structure. Depths exceeding 12" below the bottom of the casting shall be covered by the Reconstruct Drainage Structure and will be paid per vertical foot. Regrades will not be paid for new structures.