

DETAILED SPECIFICATIONS FOR SEWER CONSTRUCTION
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CONSTRUCTION OF SEWER MAIN

DESCRIPTIONS

This work shall consist of excavating required trenches; laying or constructing therein pipe, encased pipe, or monolithic concrete masonry sewers, as the case may be; along with the construction of new manholes, laterals, catch basins, and other appurtenances; abandonment of certain existing sewer facilities as shown on the plans and in accordance with these specifications.

TRENCHES METHODS

SITE PREPARATION - Before any excavating is started, adequate protection shall be provided for all lawns, shrubs, landscape work, fences, hydrants, water mains, sidewalks, and curb and gutter that are to remain in place. Adequate protection shall also be provided for vehicle and pedestrian traffic in the vicinity of any open excavation. Such protection shall be maintained as long as necessary to prevent damage from the contractor's operations. Any damage that may occur shall be made good by the contract at no cost to the owner.

When damage is done to water laterals (service), sanitary sewer laterals (house connections), or any other underground facilities belonging to the Owner, which facilities are not being removed or abandoned, such damage will be repaired by the contractor's forces to the satisfaction of the Engineer. If the contractor cannot, or does not wish to, make such repairs, said repairs will be made by the Owner's forces and the contractor shall be charged for the actual cost of such repairs on a time and material basis any charges for repairs of said damages will be deducted from moneys due the contractor.

OPEN TRENCH EXCAVATION - Trenches shall be only of sufficient width to provide free working space on each side of the pipe or sewer, and such space shall not exceed 1/3 of the nominal diameter of the pipe or size of the sewer, but such space shall never be less than 6 inches; trenches shall have vertical walls to the level of the top of the pipe. However, the required working space will depend upon the size of the pipe or sewer and the character of the materials encountered in the excavation, and in every case there shall be sufficient space between the pipe or sewer and the sides of the trench or sheeting to make it possible to thoroughly ram the pipe bedding material under the bottom half of the sewer to secure proper foundation under the pipe.

Where necessary, and where required to comply with OSHA regulations, the contractor shall meet or shore all excavations with adequate sheeting and bracing. The sheeting shall be placed in such manner as to support the material in the sides of such excavations and prevent such materials from entering the excavation during the performance of the work. No sheeting below the top of the sewer pipe shall be removed after the backfilling has been begun.

Excavation for the trench shall begin at the downstream end of the proposed sewer and proceed toward the upstream end.

The trenches shall be excavated to the required alignment and grades indicated on the plans and as laid out in the field by the engineer.

In case the bottom of the excavation is unsuitable as a foundation it shall be further excavated and prepared by depositing in the bottom of the trench Class B concrete, gravel, crushed stone, or crushed gravel as the Engineer may direct. Such authorized work shall be paid for as extra work.

The Engineer may order sheeting and bracing to be left in place at the completion of the work. The contractor shall be paid for such materials left in place in open cut trenches on order of the Engineer as an extra, but no payment shall be made for the placing of same.

DISPOSAL OF EXCAVATED MATERIALS - All excavated materials from trenches, not required for, or not permitted to be used for backfilling of such trenches, shall be removed from the site of construction operations as soon as excavated. Such surplus excavation shall be the property of the Owner, (unless otherwise stated in the Special Provisions), and the contractor shall dispose of such excavated materials as directed by the Engineer at the locations spelled out in the Special Provisions.

Where excavated material is permitted for the backfilling of trenches (above the pipe bedding zone), and such material has been approved by the Engineer as suitable for backfilling, such material shall be stored in a neat pile adjacent to the excavation in a manner so as to interfere as little as possible with traffic.

MATERIALS EXCAVATED - The materials of excavation shall be classified either as earth excavation or as rock excavation.

Earth excavation shall include all clay, silt, loam, sand, gravel, slate, hard pan, pavements of all kinds, soft sandstone or limestone, loose stone, all boulders measuring less than one-third cubic yard in volume, all old sewers and manholes being abandoned and lying in the path of new construction, and all storm sewer laterals and catch basins requiring removal to make way for new sewer construction.

Rock excavation shall include ledge rock, boulders exceeding one-third cubic yard in volume, and concrete or masonry structures (other than those included under earth excavation) which, in the opinion of the Engineer, require drilling or blasting to facilitate removal. Quantity of rock excavation, and unit price therefore, shall be negotiated and agreed upon by the Engineer and the contractor.

TUNNEL EXCAVATION - Tunnel shafts shall be located as shown on the plans or as approved by the Engineer. The excavation shall be of sufficient size to permit the construction of the sewer to the lines, grades and dimensions called for by the plans.

The contractor shall adequately sheet and brace all tunnel excavations as provided under "open trench excavation" except that no payment will be made for bracing or sheeting left in place in tunnels.

Should the soil be so unstable as to require extraordinary measures to protect the work such as liner plates and/or air pressure, the measures to be adopted and the costs of the extra work shall be agreed upon in advance.

FORMING FOUNDATION - The foundation of the trench shall be formed to prevent subsequent settlement so as to avert excessive pressure on the pipes or sewers and avoid consequent rupture thereon.

If the foundation is rock, an equalizing bed of concrete or well compacted sand shall be placed upon the rock. The thickness of such bed below the bottom of the pipe shall be not less than 4 inches. Pipes shall be laid in the bed so that at least the lower third of each pipe is supported its entire length.

If the foundation is undisturbed earth, the earth shall be pared or molded to give full support to the lower third of each pipe. In case the excavation has been made deeper than necessary or if for any other reason proper bearing for the sewer cannot otherwise be secured, a bed of concrete, pea gravel, crushed gravel, or other approved granular material shall be placed to form a satisfactory and well-compacted bed for the sewer. There shall be a minimum thickness of 4 inches of granular bedding

material under the pipe, and loose earth and ridges left in the trench bottom by bucket teeth shall be cleaned out of the trench before placing such granular material, so that a uniformly compacted bed may be formed for the sewer pipe. Special care shall be taken to prepare the bed for Elliptical pipe to insure fully bearing for the bottom half of such pipe.

If the foundation material encountered lacks satisfactory bearing power, the sewer shall be laid in a concrete cradle supported on a masonry foundation carried to a soil of satisfactory bearing power or supported on a structure designed to carry the weight of the sewer and its load to firm bearing.

LAYING PIPE SEWERS

All pipe shall be laid to a uniform line and grade, bell end up grade, with a firm and even bearing along the barrel of the pipe, close joints and smooth invert. The spigot end of the pipe is to be centered in, and shoved tight and secured against, the bell or socket of the previous laid pipe. The interior of each pipe shall be cleaned all excess joint and foreign material before the next pipe is laid. The pipe shall be laid in the bedding materials heretofore specified. Where Elliptical pipe is being laid, special care shall be taken to insure proper bedding of the pipe, making certain that the space under the bottom half of such Elliptical pipe is completely filled with the bedding material and that such material is properly compacted to prevent settlement of the pipe after the trenches are backfilled.

Where Y's or T's for house connections are called for on the plans, the contractor shall place such appropriate fittings in the sewer line at the locations shown on said plan. Said Y's or T's, as the case may be, shall be factory built fittings. Hand tapping of sewer mains with cold chisel and hammer will not be permitted. Y or T connections shall be placed as shown on the Standard Detail Sheet, with T connections in the top of the main for riser connections and Y connections tilted up at 45 degrees or more from the horizontal for direct lateral connection to the main.

All Y or T branches not incorporating a house lateral at the time of construction, and all ends of house laterals built under this project, shall be completely and tightly stoppered with an appropriate size stopper mortared into the bell of the fitting or lateral pipe, as the case may be.

During the laying of sewer lines and appurtenances, due care shall be taken to protect pipe, fittings, and joints from disturbance or damage, and the trench shall be kept free of water until the joints shall have set. At the close of each day's work, and at such times when pipe is not being laid, the open end of the pipe shall be protected with a close fitting stopper.

JOINTS FOR SEWERS

Specific joints to be used in the construction of sanitary sewers shall be as directed in the Special Provisions, and must be compatible with the type of pipe used. The Special Provisions will make reference to certain of the following described joints for PVC, clay or concrete sewer pipe:

FLEXIBLE COMPRESSION OR GASKET JOINTS - Reference is made to the materials section of these specifications and the part thereof pertaining to the detailed descriptions of the jointing materials to be used with vitrified clay pipe or concrete sewer pipe. The contractor shall make certain that the proper gaskets or seals are used with the particular pipe he is installing. Gasket joints shall be made according to ASTM C443.05, standard specification for joints for concrete pipe and manholes using rubber gaskets.

When constructing pipe sewers with the flexible compression or gasket joint, the bell and spigot surfaces shall be carefully and completely cleaned of dirt and foreign matter. The surfaces of the joints shall then be painted with that particular lubricant sealer recommended by the pipe being used. The spigot end of the upstream pipe shall then be carefully positioned into the bell end of the downstream pipe previously laid, and the upstream pipe pushed home to complete the joint. Special care shall be taken in handling both clay and concrete pipe manufactured for use with the compression type joint, to

prevent damage to the ends of the concrete pipe or to the factory applied gaskets in the case of clay pipe.

BACKFILLING

Except as otherwise provided for all trenches and excavations shall be backfilled immediately after the sewers have been constructed therein, but in any event backfilling of trenches or structures shall not proceed until approval has been secured from the Engineer. Before backfilling the main part of the sewer trench, the sewer and all Y's or tees or other connections shall be carefully covered with well-compacted crushed gravel or other acceptable granular materials having no stones larger than one inch in diameter, to a point at least two feet above the top of the pipe or said connection. The backfill material shall be carefully deposited in uniform layers and each layer shall be carefully and thoroughly tamped or rammed with proper tools so as not to injure or disturb the sewer. After, or above the initial bedding and covering of the pipe, the uniform layers of backfill referred to above shall be about one foot thick. Said proper tools for tamping shall be either pneumatic or vibratory tampers capable of producing a uniformly and well compacted fill.

Where the sewer trenches lie within the paved area of a street, such trenches shall be backfilled up to subgrade elevation with compacted crushed gravel or other approved granular backfill. Where the sewer trenches lie in the terrace area or outside of paved surface areas, the trenches may be backfilled with satisfactory excavated material up to ground grade unless otherwise noted on the plans, or in the Special Provisions; such materials shall be well compacted and shall be topped with a minimum of 3 inches of topsoil suitable for seeding. Such topsoil shall be finish-graded, ready for seeding.

Normally, jetting or flooding of trenches for compaction will not be permitted. However, if jetting or water flooding for consolidating the backfilling is directed or ordered by the Engineer the first flooding shall not be applied until after the backfilling, to a height at least two (2) feet above the top of the pipe or sewer, has been thoroughly compacted by tamping, and the second flooding shall be applied during or after the subsequent filling of the trench. An excess of water shall be avoided in order to prevent undue pressure upon the pipe or sewer. When jetting or flooding is authorized such water shall be removed from the trench by well-pointing or a sump pump located downstream from the section being jetted or flooded, in order to get excess water out of the clay trenches and to facilitate better settling of the granular backfill.

In the event excavations have been sheeted or shored, the backfilling shall conform to the requirements hereinbefore set forth, and the contractor shall carefully draw and remove the sheeting and braces in a manner that will not disturb the completed work, and openings left in pulling sheeting shall be carefully refilled with approved backfill material and properly compacted.

Walking or working on the complete pipe sewers, except as may be necessary in tamping or backfilling, shall be prohibited until the trench has been backfilled to height of at least two (2) feet above the top of the pipes.

Filling and compacting of the trench shall be carried on simultaneously on both sides of the sewer in such a manner that injurious side pressures do not occur.

CLEAN OUT

All new or re-laid sewers and manholes shall be cleaned of any accumulations of silt, debris, and other foreign matter, and prior to final acceptance such installations shall be tested with water, and under such tests unimpeded flow shall be indicated.

TESTING OF SANITARY SEWER LINES

All sanitary sewer lines installed shall be tested a low pressure air test method. The air test method shall conform to ASTM C828.

The testing procedure as specified by the Engineer shall be performed by the contractor under the observation of the Engineer. The cost of the testing shall be included in the prices bid for the sewer.

Where any section of sewer fails to hold the pressure required, the contractor shall locate the source and repair it. Any visible leaks shall be repaired even though the test requirements are met.

DEFLECTION TESTS - These tests shall be performed on all ABS and PVC main line pipe installed using an approved go-no-go testing device. The test shall be conducted after all backfill has been placed and consolidated. If testing occurs with 30 days of placement of final backfill, deflection shall not exceed 5%. When testing occurs after 30 days of placement of backfill, the deflection shall not exceed 7.5%. All testing shall be done under the observation of the Engineer. For acceptance, the device must pass through the entire section between manholes in one pass when pulled by hand without the use of excessive force. Any section not meeting the requirements shall be repaired and retested.

Mandrel sizes shall be in accordance to the following:

1. PVC SDR-35 (ASTM D3034)

Pipe Size (Inches)	Mandrel Size (Inches)
8	7.28
10	9.08
12	10.79
15	13.20

2. PVC T-1/T-2 Wall Thickness (ASTM F679)

Pipe Size Wall Thickness (Inches)	Mandrel Size (Inches)
18 T-1	16.13
18 T-2	16.20
21 T-1	19.00
21 T-2	19.09
24 T-1	21.36
24 T-2	21.46
27 T-1	24.06
27 T-2	24.17

3. N-12 (5% Deflection)

Pipe Size (Inches)	Mandrel Size (Inches)
8	7.39
10	9.26
12	11.23
15	14.02
18	16.84
24	22.46
30	28.07
36	33.69
42	38.83
48	44.50

METHOD OF MEASUREMENT OF SEWERS

Sanitary sewer of the several sizes, for each type will be measured separately by the linear foot. The footage to be paid for will be the linear feet of sewer complete in place and accepted, measured along the centerline of the sewers from inside wall to inside wall of consecutive manholes. The footage to be paid for shall not include the construction into or through manholes.

In the case of sanitary sewer laterals or sections of house lateral, such laterals shall be measured separately by the linear foot of sewer pipe in place and accepted, said measurement to be made from the centerline of the sewer main (to which said lateral is connected) to the property end of the laterals as built. The lateral, when so measured, will include 1/8 bends at the main sewer connection, and also appropriate stoppers for the property end of such laterals. Payment for laterals shall be made on the basis of the previously described measurement, and the unit price bid per foot of lateral so measured shall include said 1/8 bends and stoppers complete, in place, in accordance with the specifications.

Sanitary sewer risers shall be measured by the linear foot of riser completed and accepted; such measurement to be made from the top of the sewer main (on which the riser is built) to the top of the T-connection for laterals. The contractor's attention is directed to the Standard Detail sheet, included with the plans for this project, for details on the required construction for sewer risers. The unit price bid per foot of the riser measured as aforesaid shall include the necessary T-fitting for lateral or laterals, and the concrete collar for riser support, all complete, in place, and in accordance with said Standard Details.

BASIS OF PAYMENT

The footage of sanitary sewers, measured as provided above, shall be paid for at the contract unit price per linear foot for the items of Vitrified Clay Pipe Sewer (size), Reinforced Concrete Pipe (size), Encased (Type) Sewer (size), or PVC, as the case may be, which price shall be full compensation for furnishing all materials, including all T's and Y's, elbows and other connections required; for furnishing Granular Backfill materials; for all excavation and removals (including removal of old existing sewers and appurtenances lying in the path of new sewer construction), sheeting and shoring, forming foundation, laying pipe sewers, constructing encased and monolithic sewers, making all connections to existing fixtures, backfilling, removing sheeting and braces, and restoring the site of the work; and for all labor, tools equipment and incidentals necessary to complete the work in accordance with the plans and contract.

ABANDONING CATCH BASINS AND MANHOLES

Where old, existing, active or inactive manholes or catch basins do not lie in the path of new construction, and consequently are not included for removal under the description of excavation (see "Construction Methods, Materials Excavated"), and where such structures or appurtenances are specified for removal or abandonment on the plans, the contractor, when so ordered by the Engineer, shall abandon such facilities in the following manner:

- The walls of manholes, catch basins, or similar structures to be abandoned shall be knocked down to or below subgrade elevation; all pipe or laterals or sewer mains entering or leaving such structure shall then be sealed off with a satisfactory plug of Class B concrete. After such concrete has reached its initial set, the manhole, catch basin, or other structure being abandoned shall be backfilled in the same manner and with the same materials as sewer trenches are backfilled, with due care taken to accomplish adequate compaction.
- The Engineer will determine at the time of construction where certain manholes or catch basins are to be abandoned or if complete removal is required. If such structures or appurtenances are to be abandoned, such work shall be done by the contractor (unless otherwise noted in the Special Provisions or plans) and shall be measured as units, complete with the sealing of both ends of any piping entering or leaving the manholes or catch basins being abandoned.
- Payment for the items of "Abandoning Manholes" and "Abandoning Catch Basins" shall be made at the unit price bid for each such structure abandoned in the manner aforesaid, and such payment shall be full compensation for furnishing all materials and labor necessary to accomplish the work described above, including the sealing of all open ends of sewer lines being abandoned.

INACTIVE UTILITY LINES OR LINES BEING ABANDONED

Where trenching or excavating operations for this contract intersect or cut through old sanitary sewer, storm sewer, or water lines which the Engineer determines are inactive or are being abandoned, such lines shall be sealed off on both sides of the trench or excavation with plugs of Class AA concrete (or cement brick and mortar) before backfilling operations are commenced. All such sealing of old utility lines so encountered shall be done at the contractor's expense, and the cost of such sealing shall be included in the unit prices bid for the pertinent new sewer lines. All those locations at which such inactive line or lines to be abandoned are likely to be encountered will be noted on the plans, insofar as existing records and field surveys indicate. However, the omission of any note regarding the requirement of such plugs or the existence of some unknown line requiring such plugging shall not absolve the contractor of his responsibility to seal all those lines so encountered when directed by the Engineer to do so.

CONSTRUCTION OF SEWER MANHOLES

DESCRIPTION

This work shall include the construction or reconstruction of manholes consisting of concrete masonry, brick masonry, or concrete block masonry with necessary reinforcement, metal frames and lids, including required excavation and backfilling; all in accordance with the plans and contract.

MATERIALS

The materials furnished and used in the work shall conform to the requirements for the type or class of material named and described in a later section of these specifications.

Specific reference is made to the following:

- Concrete sewer pipe
- Concrete masonry
- Mortar
- Brick masonry and concrete block masonry
- Miscellaneous metals
- Reinforcement

CONSTRUCTION METHODS

General: The construction methods used in performing the work shall conform to the pertinent requirements set forth for the classes of work involved in the completion of the structures. Specific reference is made to methods of excavation and backfilling. Excavation, disposal of excavated materials, and backfilling for manholes and catch basins shall be done in accordance with the methods and materials required in the Detailed Specifications for Sewer Construction.

Manholes shall be constructed of concrete masonry, reinforced where required, concrete block masonry, concrete brick masonry, or reinforced concrete culvert pipe (precast manholes.)

Standard manholes shall be built as shown on the Standard Detail Sheet included with the plans, and of such diameter as the pipe size entering the manhole may require or as called for on the plans.

Special manholes shall be built of reinforced concrete masonry, in combination with concrete brick or block masonry, as shown on standard detail drawings included with the sewer plans. Where variations in interior dimensions from those shown on the Standard Detail drawings are required to accommodate unusual pipe entrance conditions, such variations may be made if approved by the Engineer. Manholes are considered "Special Manholes" only if so designated on the plans for this project.

DETAILED SPECIFICATIONS FOR SEWER CONSTRUCTION

Footings for floors for manholes shall be of the thickness and dimensions shown on the detail drawings, and shall be constructed on Class A concrete. Those surfaces which will be exposed to the flow of water or sewage inside the manhole shall be given a smooth troweled finish.

In the construction of manholes, care shall be taken to provide walls with smooth interior faces, the masonry being laid up in a workmanlike manner. Concrete block masonry shall be constructed in horizontal courses with vertical joints broken, and where concrete manhole block are used in manholes having inside diameters greater than 4 feet, such block shall be 12 inches long (rather than the usual 16 or 18 inches) to produce more regular inside walls. Brick masonry shall be constructed in horizontal courses, with a header course every fifth course. Concrete block and brick sidewalls shall be laid with full mortar joints. Joints on interior walls shall be struck smooth. Concrete block and brick manholes, from the base to the top of the cone, shall be back-plastered with a mortar coat one-half (1/2) inch thick, with a mortar of the same consistency and of the same ingredients specified for use in sidewalks. Such mortar coat shall be placed on the outside face of the walls as indicated on the Standard Detail Sheet for Construction of Sewer Appurtenances attached to the plans for the project.

No pipe joint shall fall within the manhole walls, but shall lie far enough inside or outside such walls to make it possible to joint pipe (in future repair work) without damaging the manhole walls. All manhole masonry shall be constructed with extra care around pipe barrels to prevent leakage into the sewer system around pipe entering and leaving the manhole. Adequate provisions shall be made to support pipe outside the manhole walls to prevent shearing off of said pipe after backfilling and tamping is completed.

When designated within the drawings and/or Special Provisions, sanitary manholes shall be precast reinforced manhole sections and shall conform to ASTM Specification C-478 and shall meet the design, physical tests, finish and marking requirements of this specification. All materials shall be subject to visual inspection by the Owner's representative at the job site. The purpose of this inspection is to cull and reject any materials that fail to conform to the requirements as to general finish, exposed reinforcement and cracked or damaged materials. Manhole joints shall be constructed utilizing either a rubber gasket joint conforming to ASTM Designation C-443 where the preformed flexible butyl rubber joint shall conform to AASHTO M-198, or an embedded bell gasket meeting the requirements of ASTM C443, C478 and C497. When an embedded bell gasket manhole is used it shall have bell and spigot style joints with an embedded gasket. The embedded gasket shall have wedge shaped ribbed rubber material that is cast into the inner portion of the bell of the manhole. All manhole base sections shall be equipped with molded neoprene boots of appropriate size conforming to ASTM Designation C-443. Said boots shall be equal to "Kor-N-Seal" or "A-Lok". The boot shall be located in the manhole section to allow for a minimum of two (2) inches of concrete below the bottom of the sewer main. All boots shall come complete with all required stainless steel hardware. Flow channels through manholes shall be constructed to the full height of the adjacent pipe(s), with full-sweep radius channels.

Manhole steps shall be approved by the Owner and OSHA and shall be installed in all manholes. Such steps shall be placed in the manhole wall in true vertical alignment, with a vertical center to center spacing of approximately sixteen (16) inches. They shall project uniformly from the inside face of the wall five (5) inches to the centerline of the step.

Manhole frames shall be set in a bed or mortar at such level that when the cover is placed thereon their top surfaces will conform with existing grades, or in new street construction, with the proposed finish grade of the new pavement which grade shall be set by the Engineer. Surfaces of contact between frames and covers shall be sufficiently true so that no rattling occurs when vehicles pass over the cover. If rattling does occur, the cover shall be removed and machined so as to eliminate the rattling.

The frames and lids shall be accurately set so that the complete installation will be at the correct elevation required to fit the adjoining surfaces. When installed in concrete surfaces, the grates or lids shall not be in place while the adjoining concrete is struck off and finished.

CHIMNEY SEALS

The contractor shall furnish and install internal manhole chimney seals in all sanitary manholes. Such internal manhole chimney seals shall be of the type design and specification similar or equal to the internal manhole chimney seal produced by Cretex Specialty Products of Waukesha, Wisconsin, or approved equal. This chimney seal is intended to provide a seal between the manhole frame and the masonry chimney of the manhole. The seal shall provide water tightness, while having the flexibility to allow the manhole frame to move with the surrounding pavement as it reacts to the forces of frost heave, thermal expansion/contraction, and traffic loading. The product proposed for use on this project shall be subject to approval by the project engineer.

CLEAN OUT

All manholes and similar structures shall be thoroughly cleaned of an accumulation of silt, debris or foreign matter of any kind, and shall be clear of such accumulations at the time of final inspection.

METHODS OF MEASUREMENT

Manholes shall be measured separately as units, classified either as "Standard Manholes" or "Special Manholes". Under either classification a unit shall include the cast iron manhole frame and cover and all pipe connections into or through the manhole; a unit shall be the complete manhole in place and accepted, backfilled, tamped, and ready for placement of base course for payment.

BASIS OF PAYMENT

The work under the item of "Standard Manholes" or "Special Manholes", measured as provided in the foregoing section, shall be paid for at the contract unit price each (lump sum), which price shall be full compensation for furnishing all materials including all masonry, frames and covers; also conduit and sewer connections, steps, and other fittings; for all excavation, backfilling, disposal of surplus material, and restoring the site of the work; and for all labor, tools, equipment, and incidentals necessary for each structure complete.

MATERIALS USED IN CONSTRUCTION OF SANITARY SEWER AND APPURTENANCES

MATERIAL COVERED

These specifications cover all those materials intended for use in the construction of sewers, sewer laterals, manholes and special junction structures and other pertinent parts of the sewer system.

PIPE BEDDING AND BACKFILLING MATERIALS - Bedding materials for rigid pipe shall conform to ASTM C 12, bedding classes A, B or C. Bedding materials for flexible pipe shall conform to ASTM D 2321, bedding classes I, II or III. The specific bedding class shall be specified by the Engineer for the specific pipe being used.

SAND - Where sand is specified as a pipe bedding or backfill material, it shall be granular material almost entirely passing a No. 10 sieve and predominately retained on a No. 200 sieve. Sand shall be free from deleterious substances, organic impurities, and silt as required in Sub-section 501.3.6.3 Fine Aggregate State of Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction.

PEA GRAVEL - Pea gravel shall consist of small or fine natural gravel almost entirely passing a 3/8-inch sieve and predominately retained on a No. 16 sieve. The material shall be washed clean of impurities and deleterious substances, and shall meet with the approval of the Engineer.

CRUSHED GRAVEL - Crushed gravel shall consist of hard, durable particles of crushed natural gravel and a filler of natural sand. Oversize material encountered in deposits from which the material is taken shall be removed by screening or shall be crushed to the required size. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall meet the requirements of the following gradation schedule:

<u>Sieve Size</u>	<u>Percentage by Weight Passing</u>
1 inch	100
3/4 inch	85-100
3/8 inch	50-80
No. 4	35-65
No. 10	25-50
No. 40	15-30
No. 200	3-10

CONCRETE CRADLE - Where a concrete cradle is specified on the plans, or is required in the opinion of the Engineer, such cradle shall be constructed of Class B, Normal Portland Cement Concrete. Specifications for classes of concrete appear elsewhere in these specifications.

SAND-GRAVEL BACKFILL - This material shall consist of sand or a mixture of sand with gravel, crushed stone or other broken or fragmented material having sufficient fine material to fill all the voids in the coarser material. The Engineer shall approve of the pit and type of material to be used for backfilling trenches, where the Contractor wishes to use pit-run materials.

Reference is made to Sub-section 401.2.2 and 501.3.6.3 State of Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction, latest edition. Definitions for sand, gravel, crushed gravel, etc. shall be as stated in aforesaid Section 401.2.2 Sand, gravel backfill material shall meet the requirements of said Sub-section 501.3.6.3 for freedom from deleterious substances, organic impurities, and silt content.

Sand, gravel backfill shall contain no stone or aggregate larger than 6 inches in diameter, but in no case shall stones of this size (or somewhat smaller) be so numerous as to make the material difficult to place and compact in the trenches or as to make it doubtful that sufficient fines exist to fill all voids in the large material. The Engineer may reject specific loads of pit-run material where he considers the gradation to be unsatisfactory.

REINFORCED CONCRETE PIPE - Where reinforced concrete pipe is specified on the plans, such pipe shall conform to ASTM Specifications Designation C 76, for Reinforced Concrete Culvert, Storm Drain and Sewer Pipe, and shall meet the requirements for the various classes of pipe covered in said Specifications. Unless otherwise specified on the plans, Class III Reinforced Concrete Pipe shall be used except for 12" sewer laterals as noted below. All reinforced concrete pipe shall be tongue and groove type, or shall be modified bell and spigot type if gaskets or compression-type joints are used.

POLY VINYL CHLORIDE, (PVC) PIPE - Where PVC pipe is specified on the plans, said pipe shall conform to ASTM Designation D-3034 and the minimum wall thickness shall conform to SDR-35 unless otherwise specified. All PVC pipe and fittings shall have elastomeric or rubber gaskets positively secured in place at the point of manufacture. The joints shall provide a continuous watertight conduit having an infiltration rate not exceeding 50 gallons per inch of diameter per mile per day.

All sections of pipe shall have the name or trademark of the manufacturer, and the symbols SC for standard strength, XC for extra strength, and NR or S for non-reinforced pipe cast or stamped in the concrete on the inside of the pipe at the time of casting, or immediately after removal of the molds, in such a way as to leave an imprint forming a durable, permanent identification. Reinforced pipe shall have the ASTM class of such pipe similarly stamped or marked. The day and month of manufacture shall be stamped, stenciled or inked on each section of the pipe. Elliptical pipe with circular reinforcing and circular pipe with elliptical reinforcing shall have the word Top or Bottom clearly marked on the inside of the pipe at the correct place to indicate the proper orientation when laid.

ELLIPTICAL PIPE

Where elliptical pipe is specified on the plans, such Elliptical Reinforced Concrete Pipe shall conform to ASTM Specifications, Designation C-507 or the latest applicable ASTM Specification.

NOTE

All reinforced concrete pipe shall be furnished with "Wall B", as covered in ASTM Specification referred to above, unless otherwise specified in the plans.

COMPRESSION TYPE JOINT MATERIALS

These materials shall meet the requirements of applicable ASTM specifications for jointing the particular kind and type of pipe to be used.

When concrete pipe are being used, compression type joint materials shall conform to the requirements of ASTM Designation C 443, or the latest revision of such specifications. The contractor shall use only that joint lubricant-sealer recommended by the pipe manufacturer for his particular joint material.

In any case, when compression type joints are to be used, the contractor shall submit to the Engineer the manufacturer's data on the joint proposed for use in the project, and shall obtain the Engineer's approval therefore before ordering the pipe with such joint.

CEMENT MORTAR JOINTS

These joints will not be allowed.

MORTAR

Sand for mortar shall conform to the requirements of the specifications for Aggregate for Masonry Mortar, ASTM C-144. The gradation required shall be such as to produce a mortar which is not harsh, not difficult to handle, and will produce a weather-tight joint. However, the gradation shall also be such that the mortar will not require high mixing water content, with resultant loss in strength and increase in shrinkage of the mortar produced.

Water used in mixing mortar shall be clean, potable water fit to drink.

Proportioning for mortar mixes shall be as follows, the proportions being stated by volume:

Either: One (1) part masonry cement (Tentative ASTM Specification C-91 Type II) and 2 to 3 parts or mortar sand in damp, loose condition.

Or: One (1) part normal portland cement, ½ to 1 ¼ parts hydrated lime, and 4 ½ to 6 parts mortar sand in damp, loose condition.

Mixing mortar shall be done by first mixing the proper amounts of dry mortar materials to a uniform color in a batch mixer or tight mortar box, and then thoroughly mixing with water added gradually until the required consistency is obtained.

Retempering of mortar will be permitted only when such retempering takes place within two (2) hours after original mixing when air temperatures are 80 degrees F. or higher, and within three hours after original mixing when air temperatures are below 80 degrees F. Mortar not used within the above time limits shall be discarded.

Brick shall conform to the requirements for Grade WA, of the "Standard Specifications for Sewer Brick (made from clay or shale.)" ASTM Designation M-91.

Concrete brick shall conform to the requirements of Grade A of the Standard Specifications for Concrete Building Brick. ASTM Designation C-55.

Concrete manhole blocks shall conform to the requirements of the Standard Specifications for Concrete Masonry Units for Construction of Catch Basins and Manholes, ASTM Designation C-139 supplemented by the following requirements: The blocks shall be solid and shall be curved to the required radii for 4-foot diameter or 6-foot diameter manholes, as the case may be. The blocks shall have tongue and groove and groove or other approved type of joint at the ends so that the units interlock. Curved blocks shall have the inside and outside surfaces parallel. Where correct radius block are not available the Engineer may approve the use of other radii block if, in his opinion, such block will form satisfactory manhole walls. Each block shall have a length of not more than 18 inches, a height of not more than 8 inches, and a width or thickness of not less than 6 inches. Blocks intended for use in the cones or tops of manholes or other structures shall have such shape as may be required to form a sound, proper cone on a 4-foot diameter manhole, with inside and outside joints not to exceed ½ inch in thickness. The block must also be designed so that only full length or half-length units are required to lay any one course.

Concrete masonry, reinforced concrete masonry where specified or required on the plans, shall conform in all respects to the requirements of Section 501 - Concrete Masonry State of Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction, latest edition. The subject requirements shall include item on tests of materials and payment by the contractor therefore.

Where reference is made elsewhere in these specifications to a grade or class of concrete to be used for a specific purpose, such grade or class shall conform to the following master mix limits, using normal Portland Cement.

The quantities of materials listed below are the relative quantities and proportions per sack (94 pounds) of cement.

Concrete Grade or Class	Total Aggregate, Fine & Coarse, Pounds	Fine Aggregate in % of Total Aggregate	Water Maximum Net Gallons
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DETAILED SPECIFICATIONS FOR SEWER CONSTRUCTION

A	645	30-40	6
AA	560	35-45	6
B	920	30-40	8

All reinforced concrete masonry shall be constructed with Class "AA" concrete, except manhole or catch basin footings (reinforced or non-reinforced) which may be constructed with Class "A" concrete. Concrete for pipe cradles or pipe encasement may be Class "B" concrete, unless otherwise noted on the plans.

The contractor may, at this option, and without additional expense to the Owner, use class "A" or "AA" concrete in place of Class "B", and Class "AA" concrete in place of Class "A".

Where transit mixed concrete is used, truck mixers shall be of the revolving drum type, with the mixing drum watertight when closed. The size of each truck batch shall not exceed the maximum rated capacity of the mixer, as stated on the particular unit by the manufacturer. Where several loads of concrete are required to make a specific pour, the time interval between successive loads shall not exceed 15 minutes.

The maximum allowable slump permitted will be determined by the Engineer for the particular pour to be made, and such slump shall be as little as possible to make a workable mix for the specific type of work being poured. In general, a maximum slump of 3 inches will be permitted for non-reinforced concrete such as footings or pipe encasement, while for reinforced concrete such as footings or pipe encasements, while for reinforced slabs or similar structures of relatively thin section a maximum slump of 5 inches will be permitted.

REINFORCEMENT

Bar Steel Reinforcement shall meet the requirements of the Standard Specifications for Billet-Steel Bars for Concrete Reinforcement AASHTO Designation M-31, Rail-Steel Bars for Concrete Reinforcement AASHTO Designation M-42, Axle-Steel Bars for Concrete Reinforcement AASHTO Designation M-53. Cold twisted or hot-twisted bars will not be accepted.

Unless otherwise provided on the plans or in the contract, all bar steel reinforcement shall conform to the requirements of the Standard Specifications for Minimum Requirements for the Deformation of Deformed Steel Bars for Concrete Reinforcement, AASHTO Designation M-137.

Fabricated Steel Bar or Rod Mats for concrete reinforcement shall conform to the requirements of the Standard Specifications for Fabricated Steel Bar or Rod Mats for Concrete Reinforcement, AASHTO Designation M-54.

CONSTRUCTION METHODS - Storage, protection, placing, bending etc. of all reinforcement shall conform to the requirements of Sub-section 505.3 of the State of Wisconsin Department of Transportation Standard Specifications for Highway and Structure Construction, latest edition.

MISCELLANEOUS METALS

Manhole Steps shall be manufactured from high-test cast iron having a minimum tensile strength of 30,000 pounds per square inch and shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects affecting their strength and value for the service intended.

Manhole steps shall be of the style or type equivalent to Neenah Foundry Company No. 1980-I or Brillion Iron Works No. 4 M 3. The foot pad shall be serrated or checkered to afford good footing. All manhole steps shall be asphalt coated for corrosion protection.

Manhole Frames and Covers shall be manufactured from high-test cast iron or gray iron conforming to the requirements for Class 25 of the Standard Specifications for Gray Iron Castings. ASTM Designation A-48, supplemented by the following requirements:

Casting shall be true to pattern in form and dimensions, free from pouring faults, sponginess, cracks, blow holes, and other defects in positions affecting strength and value for the service intended. Castings shall be sandblasted or otherwise effectively cleaned of scale and sand so as to present a smooth, clean and uniform surface, and shall be coated with coal tar pitch varnish of a quality which will make a smooth coating, tough and tenacious when cold, not tacky and not brittle.

Manhole frames and covers shall comply with the dimensions given for Type "J" on Plate 5-3.8.2 for "Manhole Covers," State of Wisconsin Department of Transportation, Facilities Development Manual Standard Detail Sheets. Round frames and covers shall have machined bearing surfaces so fitting that parts will not rattle or rock under traffic.

Manhole lids or covers shall be lettered or marked "Sanitary" to indicate the type sewer over which manhole is to be built. Such lids or covers shall have checkered or indented top design. Top design with protruding knobs or lugs will not be accepted.

Malleable Iron Castings where permitted or required shall conform to the requirements for Grade No. 32510 of the Standard Specifications for Malleable Iron Castings, ASTM Designation A-47 supplemented by the same requirements for quality, painting, etc. specified for Gray Iron Castings.

TREATED TIMBER PILING

Treated Timber Piling incorporated in this work shall conform to all applicable requirements of Section 508 of the Wisconsin State Highway Commission Specifications for Road and Bridge Construction, latest edition pertaining to Class A piles. The butt and tip diameters shall be as required in Sub-section 508.2.2.4 of said Highway Specifications. Such piles shall be pressure treated in accordance with Sub-section 508.2.2.6 of said specifications, and the sawed ends after the final cut off shall be treated in conformance with Sub-section 508.3.5.4 thereof.

PROJECT CLOSEOUT

PROJECT CLOSEOUT REQUIREMENTS – RECORD DRAWINGS

The Owner or Developer of newly installed sanitary sewer pipe and manhole shall provide the Village or Sanitary District Owner and the City a digital copy of records drawings for each project. Submittal shall be made to the attention of the City of Fond du Lac Director of Public Works. Acceptable formats include AutoCAD files, Microstation files, or ESRI ArcMap files; similar digital files can be accepted with prior approval from the TSC. Handwritten plan sheets, Adobe PDFs, or similar formats are not acceptable. Record drawings shall be in Fond du Lac County Coordinate System with NAVD88 datum elevations. Required information is final location and elevation of sanitary sewer manholes, lift stations, or cleanouts; pipe size, direction, and invert; and sanitary WYEs and lateral end or connections.