City of Pittsburgh 1938 Specifications for Materials and Testing with 1962 Addendums

Pittsburgh, PA

HWY22MH003

(272 pages)

CITY OF PITTSBURGH

SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION

1938 SPECIFICATIONS

1962 ADDENDUMS

CITY OF PITTSBURGH
DEPARTMENT OF PUBLIC WORKS
INDEX TO STANDARD SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION

NOVEMBER 1938

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

INDEX TO STANDARDS
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION
(Continued)

Blueprints to be Submitted for Checking.

After the tracings have been checked by the Contractor, blue prints therefrom in duplicate shall be submitted to the Director for examination, one copy of which will be returned to the Contractor with such corrections as the Director may desire noted thereon. The examination by the Director will consist only of an inspection as to the strength of the structure and the general location of main members; however, this examination shall in no manner be considered as relieving the Contractor of responsibility for the proper size and location of members as shown on the contract plans.

Tracings Submitted for Approval.

Upon receipt of corrected blueprints, the Contractor shall correct the tracings in accordance with the corrections noted on the blueprints by the Director, and submit the tracings to the Director for approval.

Making Changes on Approved Drawings.

No changes or alterations shall be made on the tracings after they have been approved by the Director, except by written permission or direction of the Director.

Tracings, etc., to become Property of City.

All tracings, original copies of sketch sheets and shop or material bills for the various members of the structure shall become the property of the City and must be delivered to the Director before final payment on the contract will be made.

6-7-8-9 -- Sections Vacant

Mill Orders.

10. The Contractor shall furnish the Director with duplicate copies of all mill orders he places with the mills for materials to be used on the contract, also of all orders for castings and miscellaneous materials which he purchases that are to form a part of the finished structure. All orders shall show the date they were placed.

Shipping Bills or Statements.

11. The Contractor shall furnish the Director duplicate copies of all shipping bills or statements which shall show the number of pieces, their marks and weights for all parts of the structure shipped to the site. Whenever materials for erection purposes which do not enter into the finished structure are shipped with material for the structure, such material shall be marked on the shipping statement as erection material. Shipping statements must show date of shipment and the car numbers containing the shipment.

12 -- Section Vacant

Models and Moulds.

13. Where noted on the contract plans that models and moulds are to be used in constructing ornamental parts, the Contractor shall construct clay models from the full size detail drawings furnished by the City. These models shall be subject to the approval of the Director.

The approved clay models shall be used to construct plaster moulds which shall be placed in the forms and used in casting the ornamental parts. The moulds shall also be subject to the approval of the Director.

Where so noted in the Contract Plans or in the Supplementary Specifications, the models will be furnished by the City.

Storage of Materials.

14. Buildings, yards or sidings that may be required for the delivery or storing of materials shall be provided by and at the cost of the Contractor. All materials thus stored shall be placed upon sleepers, housed or covered, so as to properly protect them against the action of falling or surface water, to the satisfaction of the Director.

Old Materials.

15. All old materials existent within the confines of the contract shall remain the property of the City of Pittsburgh except when otherwise stipulated in these specifications, on the contract plans or in special or supplemental specifications or ordered by the Director in the field, in which case the same shall be disposed of at the expense of the Contractor.

Office for Engineers and Inspectors.

16. The Contractor shall, if ordered by the Director, provide a suitable room near the work, with heating provision, plan table, chairs, locker and telephone service for the use of engineers and inspectors.

Sanitary Conveniences for Workmen.

17. The Contractor shall provide and maintain necessary sanitary conveniences, properly secluded, for the use of his workmen, and their exclusive use shall be strictly enforced.

Fire Hydrants.

18. Fire hydrants and fire alarm boxes shall be left at all times clear of obstruction and readily accessible. No material or obstruction shall be placed within twenty feet (20') of a fire hydrant.

Use of Water.

19. Permit for the use of water, either by attachment to fire hydrant or by the use of ferrule and meter, may be obtained from the Bureau of Water. When a job is of sufficient size, the Contractor may elect to have a meter installed. Should he desire attachment to a fire hydrant, the following instructions will govern.

The number and location of a fire hydrant having been obtained, the Contractor shall give an estimate of the quantity of water to be used to the Board of Water Assessors and shall make payment for this charge. The receipt thus obtained shall be presented to the Bureau of Water, Fire Hydrant Division, and for Ten ($10.00) Dollars security he will be loaned a special fire hydrant wrench. The Contractor shall supply a reducer and valve at his own expense. The valve is to be used for turning on or off during working hours, and at night he shall remove his entire connection from the fire hydrant and leave it in condition for its proper use. No wrench shall be used except that obtained from the Bureau of Water. The Bureau of Water reserves the right to refuse a permit for the use of a fire plug in freezing weather.

Sunday Work.

20. The employment of labor for overtime or Sunday work shall be only with the permission of the Director.

Sub-Contracts.

21. Immediately following the countersigning of this contract by the City Controller the Contractor shall submit in writing, to the Director for approval, information as to whom he proposes sub-letting any portion of this contract, whether such subcontract be for labor or material or both. This communication shall also show what portions of the work or materials he proposes having supplied by each sub-contractor. The Director reserves the right to refuse or accept this proposal and the Contractor hereby agrees to abide by the Director's decision.

Contractor to Locate his Work.

22. The Contractor shall accurately locate his work as to alignment, position and elevations, as shown on contract plans; using monuments, points and bench marks furnished by the Director.

Director to have Access to Work.

23. The Director shall have access to all parts of the work during its construction and preparation for construction, and after completion, to do all checking, inspecting and measuring he may deem necessary. The Contractor shall build all temporary platforms or scaffolds necessary for the performance of the work to the satisfaction of the Director. No materials shall be used in the construction until the Contractor is notified by the Director of its acceptance for use. When work is to be done outside the regular hours, the Contractor shall secure the consent of the Director so that the inspector may be present and at all times shall prosecute his work in a systematic way so as to facilitate supervision by the inspector. The presence of the inspector shall not in any wise lessen the responsibility of the Contractor for construction in accordance with contract requirements.

Injury to Work.

24. The Contractor shall use due precautions against injury to his work or the sub-structure upon which he is erecting his work, and shall place and maintain such signals and protection guards as may be required by the Director.

Protection to Adjoining Property.

25. Where the foundations for any part of the structure are close to the tracks of a railroad, wall of a building, retaining wall or other structure, the Contractor shall provide suitable shoring and bracing to support same during his operations and properly back-fill excavations between such structures and the parts of the structure being built. All shoring, bracing and backfilling shall be subject to the approval of the Director.

Access to Adjoining Property.

26. The Contractor shall provide suitable access to adjoining private property. Where in his operations he interferes with entrances that existed before he began work, new entrances shall be built and maintained in a substantial and safe condition by the Contractor and be subject to the approval of the Director.

Bridges over Streets.

27. Whenever a bridge is to be erected over streets, boulevards or roads, openings in the falsework shall be provided as directed by the Director to accommodate the traffic on such street, boulevard or road. The Contractor shall, if ordered by the Director, protect the traffic using said openings from falling of construction materials, by placing covers over the openings.

Structures over and under Railroad Tracks.

28. Where structures cross the right-of-way or tracks of a railroad company, the Contractor shall obtain permits from the proper officials of the railroad company owning or operating the railroad in question before he proceeds to place any materials or falsework over, under or on the right-of-way of the railroad company. The Contractor shall file with the Director a copy of the permit secured from the railroad company.

All expense involved in connection with the possible placing of watchman, or the erection of any temporary structures deemed necessary, shall be adjusted entirely between the Railroad and the Contractor. The Contractor shall relieve the City of all responsibility for any and all damage or expense claimed by the Railroad for all precautions taken or for any accidents that might occur.

Bridges over Navigable Streams.

29. Whenever a bridge is to be erected over a navigable stream, the Contractor shall obtain from the United States War Department the necessary permits to place obstruction to navigation in the stream before starting the placing of falsework or erecting steel work. Copies of such permits, together with blueprints approved by the War Department, shall be placed on file with the Director.

Sub-structures in Navigable Stream.

30. Before starting work on any sub-structure located between the U.S. harbor lines in a navigable stream the Contractor shall secure a permit from the U. S. War Department covering his work. He shall also place and maintain all signals required by them.

Competent Workmen.

31. All workmanship shall be first class in every respect. All work shall be done by competent workmen, skilled in the kind of work upon which they are employed and directed by competent foremen.

Inspecting and Testing.

32. All materials and workmanship of whatever kind entering into the work shall be subject to the inspection and approval of the Director at any and all times during the progress of and until final completion and acceptance of the work.

Contractor not Relieved of Responsibility.

33. Inspection and acceptance by the Director of any materials or workmanship of whatever kind shall not relieve the Contractor from his responsibility.

No Extra Work unless Authorized.

34. No extra work shall be commenced nor will be considered as such, except upon written authorization of the Director.

Storing of Explosives.

35. The Contractor shall provide separate fire-proof receptacles, plainly marked with three-inch letters "EXPLOSIVES--DANGEROUS." for blasting powder and dynamite, fuses and caps, as provided in Section 4 of an ordinance approved June 1st, 1905. The storing of blasting powder, dynamite, fuses and caps in a tool box will not be permitted. Explosives shall be handled with great care, and shall be at all times in charge of a competent watchman.

Blasting.

36. Blasting shall be conducted only when permitted by the Director, and shall be done so as not to endanger persons or property, and the Contractor shall be held responsible for and shall make good any damage caused thereby. He shall comply with all the laws and ordinances governing this class of work. The Contractor, before firing a blast, shall cover the trench carefully with heavy timbers, mats or other material to prevent stone or shale from flying. No blasting shall be done within twenty-five (25') feet of a newly completed sewer.

CITY OF PITTSBURGH

DEPARTMENT OF PUBLIC WORKS

STANDARD SPECIFICATIONS FOR

MATERIALS

General Requirements

101. These general requirements for materials shall form a part of each and all specifications and shall apply to each and every material to be used by the Department of Public Works, City of Pittsburgh, except where specified otherwise hereinafter, or in supplementary specifications, or noted on the Contract Plans.

The source, method of manufacture, and all substances entering into the materials required by the said Department of Public Works, shall be subject to the approval of the Director.

The Director reserves the right to have any and all materials investigated tested and analyzed, and any sources, method of manufacture or substances entering into materials not meeting with the approval of the Director, or the specifications adopted by the Department shall be sufficient cause for rejection and cancellation of contract with the holder of same.

Samples will be taken, and inspection will be made of all materials after delivery, except where mill, shop, or factory inspection has been made by the Bureau of Tests, and the material has been approved and properly marked for identification.

The Contractor must give written notice in advance as to the source and materials he intends to use, so that the Department shall have sufficient time to take samples, analyze, test and approve them. Where twenty-eight (28) day tests are required at least a thirty (30) day notice must be given.

All measuring devices or scales used for measuring or weighing materials shall be subject to the approval of the Director.

The Director reserves the right to vary the proportions of all materials entering into concrete, bituminous mixtures, paint, and all other mixtures, without extra charge, within the limits of the specifications.

A.S.T.M. Specifications

102. Where reference is made to A.S.T.M. Specifications it shall mean the specifications of the American Society for Testing Materials and shall refer to the latest revision of each designated specification adopted by the Society as a Standard or Tentative Standard.

Inspection Costs

103. The contractor shall defray all transportation expenses, and subsistence expenses not exceeding $6.00 per day, when it is necessary for the City representative to travel outside the limits of Allegheny County to inspect any materials manufactured, fabricated or processed for use on contracts for the Department of Public Works, or to inspect any manufacturing, fabricating or processing plant furnishing any material for the Department of Public Works.

Arrangements and agreements relative to such expenses of an Inspector shall be entered into between the Director and the Contractor and the invoice for expenses must be approved by the Director prior to presentation for collection.

PORTLAND CEMENT

General Requirements

104. Portland cement shall meet the requirements of the Standard Specifications and Tests for Portland Cement, adopted by the American Society for Testing Materials Designation, C 9-37.

Delivery and Storage

105. The cement shall be delivered in suitable bags with the brand and name of the manufacturer clearly marked thereon, unless shipped in bulk.

All cement, except as hereinafter specified, shall be stored in weathertight storehouses, with tight floors at least six (6") inches above the ground which shall be thoroughly drained. Provision for storage shall be ample, and the different lots of cement shall be kept separate and readily accessible to the Director for the purpose of sampling or testing.

The contractor shall keep a sufficient quantity of cement on the line of work or approved place of storage to enable the Director to make the tests hereinafter specified without delaying the progress of the work. When permission is given to store in the open, a platform raised at least six (6") inches from the ground and ample waterproof covering shall be provided as directed. All cement shall be dry, of original composition and condition, finely ground and free from lumps, caking or water marks. Cement may be delivered in bulk when approved by the Director. It is mandatory that all bulk cement be proportioned by weight. Suitable scales for weighing all other cement shall be provided by the Contractor at his expense, when requested by the Director.

Acceptance

106. The Director may permit the Contractor to use, at the Contractor's own risk, cement which has passed satisfactorily the prescribed tests for fineness, set and soundness, and seven (7) day tensile tests. The Director reserves the right to subject the cement to such additional tests as are hereinbefore provided, including the twenty-eight (28) day tests on soundness and tensile strength, as he may deem necessary; and if the cement fails to pass the tests it shall be rejected, even though it may have satisfactorily passed the first set of tests.

Should it be impracticable to store a sufficient quantity of cement on the work subject to acceptance on the basis of the seven (7) day test, the Director may permit the Contractor to use the cement prior to the completion of the prescribed seven (7) day test, upon the condition that the Contractor makes a written request for said permission and agrees in said request that if the cement fails to pass the prescribed tests, the concrete in which it is used shall be removed and replaced with satisfactory material by the Contractor at his own expense.

Permission will not be granted by the Director unless conditions on the work make it absolutely impracticable for the storage of sufficient cement.

Rejection

107. Any lot of cement which fails to conform to the requirements hereinbefore specified shall be rejected, marked for identification and promptly removed from the work.

Rejected Cement in Masonry

108. If any cement proves unsatisfactory in twenty-eight (28) day tests and portions of it have been used in the work, it shall be subject to rejection and such work shall be ordered removed and replaced with masonry built of satisfactory cement. The

entire cost of labor and materials of tearing down and rebuilding such masonry shall be at the Contractor's expense, even though the cement used may have passed the seven (7) day tests and its use in the work permitted by the Director.

Sampling Bulk Storage

109. Samples of cement taken from Bulk Storage shall be taken from the conveyor delivering to storage as described under method (a) in the ASTM Specification, Designation, C 77-37.

HIGH EARLY STRENGTH PORTLAND CEMENT

General Requirements

110. High early strength portland cement shall meet the requirements of the Specifications and Tests, adopted by the American Society for Testing Materials, Designation, C 74-36.

All the requirements of sections 105 to 109, inclusive shall apply to High Early Strength Portland Cement.

MIXING WATER

111. The water shall be clean, free from oils, acids, alkalies, or organic matter and the tensile strengths of the mortar of one part cement to three parts sand (1:3) shall be equal to that developed with distilled water when mixed in the same proportion with the same cement and Ottawa sand. Any water that would tend to discolor or impair the strength of concrete or mortar must not be used.

CONCRETE AGGREGATES

General Requirements

112. Concrete Aggregates shall conform to the requirements of the Tentative Specifications for Concrete Aggregates adopted by the American Society for Testing Materials, Designation C 33-37T, except as otherwise stipulated herein.

Failure to meet any of the required tests shall be sufficient cause for rejection.

Place of Inspection

113. All fine aggregates and coarse aggregates to be used for concrete shall be inspected by the City at a permanent place of shipment of the producer where facilities and equipment are available for making tests hereinafter required to determine the suitability of the material. No material shall be shipped from any Producers Dock for use on City Work of the Department of Public Works without the approval of a City Inspector.

Inspectors Headquarters

114. The Inspectors Headquarters shall be weather tight, but designed for proper ventilation and having the following minimum requirements:

(a) Floor space of eighty (80) square feet and eight (8) feet in height.

(b) Two (2) Windows 24" x 24"; Two (2) Electric 60 watt lamps.

(c) Door 2' - 6" x 6' - 8", which can be securely locked.

(d) One (1) Electric wall plug.

(e) One (1) Table 4' x 6' with two (2) drawers.

(f) One (1) Cupboard 2' x 2' ceiling height with shelves.

(g) Sanitary running water and sink.

(h) Sanitary toilet facilities.

Inspectors Equipment

115. The Inspectors Headquarters shall have the following equipment:

One (1) Set of Tyler Sieves: 2 1/2 - 2 - 1 1/2 - 1 - 3/4 - 3/8 - 4 - 8 - 14 - 28 - 50 - 100 (square openings).

One (1) Set of Approved Scales 1/4 oz. to 40 oz. on beam and 300 lbs. in weights as follows: 2 - 2 lbs., 1 - 5 lbs., 1 - 10 lbs., 2 - 20 lbs., 2 - 40 lbs., and 2 - 80 lbs.

One (1) Torsion Balance Scale with beams up to 500 grams and block of assorted gram weights.

Four (4) Pans, Heavy 18" x 18" with handles.

One (1) Scoop, approximately 7" x 4".

One (1) Bristled Stencil Brush with handle for cleaning sieves.

One (1) Stove.

One (1) Slump Can. Truncated Cone 4" Diameter (top) 8" Bottom Diameter, 12" High, handles and foot pieces on side - made of No. 16 gauge galvanized metal.

One (1) Rod 2' long and 5/8" in diameter, bullet shape end.

One (1) Copper, Specific Gravity Can as follows: (U.S. Dept. Agriculture Bulletin 1216 Page 23, Spetember 1928).

One (1) Bucket to catch residue water for specific gravity. Capacity 32 oz.

One (1) Cubic Foot Cylindrical Measure. (See A.S.T.M. C 29-27) I.D. 14", height 11.23", Thickness #5 U.S.Gauge.

Two (2) Buckets 14 quarts each.

One (1) Pan 3' x 3' square with 4" side No. 16 gauge for mixing trial batch.

One (1) Trowel, large with end cut off.

One (1) Small Trowel for turning over material while drying.

One (1) 32 oz. graduate to measure water.

One (1) Thermometer - Pencil size for pocket for taking temperature of concrete aggregates and water (30 to 120°F), Arthur Thomas Company Catalog #9607 - A, Page 793.

One (1) Design and Control Concrete Mixtures by Portland Cement Association.

Six (6) 250 C.C. Glass Graduates (Silt and Colorimetric Tests).

FINE AGGREGATES

Definition

116. Fine aggregate shall consist of natural sand or other approved inert material with similar characteristics. It shall be clean, with uncoated particles, strong, sound, free from injurious amounts of dust, loam, soft or flaky particles, shale, alkali, organic matter or other deleterious substances. The amount of coal contained shall not exceed one percent by weight.

Barges

117. All river sand used for fine aggregate shall be furnished at the docks only from deck barges.

Decantation Test

118. The weight removed by the decantation test, made according to the methods of the American Society for Testing Materials, Serial Designation C 117-37, shall not exceed three per cent.

Mortar Strength

119. The fine aggregate shall be of such quality that when made into mortar consisting of one part Portland Cement and three parts of dry and rodded sand, by volume, it shall have compressive strength at the end of seven day and twenty-eight days of not less than that developed by mortar of the same proportions and the same consistency, made at the same time of the same cement and standard Ottawa sand. These tests shall be made in accordance with the Standard Specifications and Tests for Compressive Strength of Portland Cement Mortars of the American Society for Testing Materials, Designation C 9-37.

The Director may require high early strength cement used in this test, in which case the required strengths shall be developed at the ends of one day and three days.

Fine and Coarse Sand

120. Fine aggregate shall be divided into two classes, and when tested dry with Tyler Standard Sieves, the per cent retained on the respective sieves shall be withing the following limits by weight.

FINE SAND suitable for mortar, plaster and grout:

On a No. 4 Sieve	0
On a No. 8 Sieve	0 to 15
On a No. 14 Sieve	20 to 60
On a No. 28 Sieve	40 to 80
On a No. 50 Sieve	70 to 95
On a No. 100 Sieve	94 to 100
On a No. 200 Sieve	100
FINENESS MODULUS RANGE	2.24 to 3.50
DESIRED FINENESS MODULUS	2.80

COARSE SAND, Suitable for concrete:

On a 3/8" Sieve	0
On a No. 4 Sieve	5 to 15
On a No. 8 Sieve	10 to 30
On a No. 14 Sieve	25 to 50
On a No. 28 Sieve	45 to 75
On a No. 50 Sieve	70 to 95
On a No. 100 Sieve	94 to 100
On a No. 200 Sieve	100
FINENESS MODULUS RANGE	2.49 to 3.65
DESIRED FINENESS MODULUS	3.00

COARSE AGGREGATE

Definition

121. All coarse aggregate shall consist of natural gravel, crushed gravel, crushed stone, or air cooled blast furnace slag. It shall be clean, having hard, strong, sound and uncoated pieces and shall be free from injurious amounts of dust, loam, soft, thin or flaky pieces, shale, alkali, flats, organic matter or other deleterious substances. Gravel with a thickness of less than one-fourth its mean diameter shall be considered a flat.

Coal and Soft Stone Content

122. The amount of coal contained shall not exceed one-half of one per cent by weight. The amount of soft friable sandstone in gravel shall not exceed 2 per cent by weight. The amount of flat pieces shall not exceed 5 per cent by weight.

Slag

123. Slag shall consist of air cooled blast furnace slag of clean, tough, durable pieces, non-glassy in character. Dried slag when tested according to the methods of the American Society for Testing Materials, Designation C 29-27, shall weigh not less than seventy-five (75) pounds per cubic foot.

Grading

124. Coarse aggregate shall be divided into three classes, and when tested dry with Tyler Standard Sieves, the per cent retained on the respective sieves shall be within the following limits, by weight:

Size of Sieve	Small Class	Medium Class	Large Class
3"			0
2 1/2"			0 to 5
1 1/2"	0	0	25 to 60
3/4"	0 - 5	25 - 60	55 to 80
3/8"	30 - 70	85 - 98	90 to 98
No. 4	94 - 100	95 - 100	95 to 100
No. 8	100 -	100	100
FINENESS MODULUS RANGE	6.24 to 6.75	7.05 to 7.58	7.65 to 8.43
DESIRED FINENESS MODULUS	6.50	7.20	7.85

Soundness Tests

125. Soundness of crushed stone, gravel and slag shall be determined by the Magnesium Sulphate Test described in the A.S.T.M. Designation C 88-37T. The treatment shall be repeated five (5) times. Any material showing a loss of more than five (5) per cent by weight shall be rejected.

Abrasion and Toughness Test

126. Crushed stone used for reinforced and plain concrete pavements shall pass an abrasion test in accordance with the standard of the American Society for Testing Materials, Designation D2 - 33, in which the percent of wear shall not exceed six (6); and a toughness test made in accordance with the Standard Method of Test for Toughness of Rock, of the American Society for Testing Materials, Designation D3 - 18, in which the number of blows shall not be less than six (6).

Until some generally recognized requirements for abrasion losses of slag and gravel are available, the suitability of such materials shall be determined by the Director.

Change of Size

127. The Director reserves the right to change the sizes of coarse aggregate where in his opinion he deems it advisable.

Washed and Crushed Gravel

128. Washed and crushed gravel shall contain not less than eighty (80) per centum of crushed pebbles by weight. It shall consist of tough, durable pebbles of high resistance to abrasion, and shall be free from shale, clay, or coatings of any character. The crushed gravel shall not contain more than two (2) per centum of disintegrated or soft material or more than five (5) per centum of flat pieces.

The gravel shall be washed at the plant by approved methods prior to loading.

The washed and crushed gravel shall be uniformly graded between the limits specified. When tested with Tyler Standard Sieves, the grading shall conform to the requirements of Section 124 of the Specifications for Materials.

Coarse Aggregate for Concrete Street Pavements

129. Coarse aggregate for concrete street pavements shall be stone unless otherwise stipulated on Contract Plans or Supplementary Specifications. The stone shall conform to the above requirements for coarse aggregate.

Coarse aggregate for concrete street pavements shall conform to the following grading when tested with laboratory sieves with square openings.

Passing 2" square opening	95 to 100 per cent
Passing 1" square opening	35 to 70 per cent
Passing 1/2" square opening	10 to 30 per cent
Passing No. 4 square opening	0 to 5 per cent

STONE

Stone for Drains
Stone for Curbs
Stone for Masonry
Stone for Paving Block

General

130. The suitability and quality of all stone or rock shall be subject to all times to the approval of the Director; therefore, the quarry or source from which the stone is originally furnished must be approved by the Director. Several samples shall be taken from different locations in the quarry for testing purposes to determine the uniformity of its product. If the quarry has not been previously approved, at least two weeks notice is required by the Director to inspect and make tests for approval of the quarry before shipments shall be made therefrom.

All stone and rock shall be clean, hard, strong, tough, durable and sound and shall pass the following tests as hereinafter stipulated.

All stone and rock of each type for each contract shall be furnished from the same stratum of the same quarry unless otherwise permitted in writing by the Director.

Soundness

All stone or rock shall be tested in accordance with the Tentative Method of Test for Soundness of Coarse Aggregates by use of Magnesium Sulphate, Designation C88-37T, adopted by the American Society for Testing Materials. After five cycles of treatment the total loss shall not exceed five per cent of the weight.

Abrasion

All stone or rock shall be tested in accordance with the Standard Method of Test for Abrasion of Rock, Designation D2-33, adopted by the American Society of Testing Materials. The amount of wear shall not exceed the percentage stipulated in the following table.

Toughness

All stone or rock shall be tested in accordance with the Standard Method of test for Toughness of Rock, Designation D3-18, adopted by the American Society for Testing Materials. The number of blows shall not be less than the number stipulated in the following table

Absorption

All stone or rock shall be tested in accordance with the Standard Method of Test for Absorption of Natural Building Stone, Designation C97-36, adopted by the A.S.T.M. The amount of absorption shall not exceed the percentage stipulated in the following table.

Compression

All stone or rock shall be tested in accordance with the Tentative Method of Compression, Testing of Natural Building Stone, Designation C98-30T, adopted by the American Society for Testing Materials. The minimum compressive strength shall not be less than the amount stipulated in the following table.

TYPE AND QUALITY OF STONE - TEST REQUIREMENTS

	Use	Compression Min. Lbs. Per Sq. In.	Abrasion Max.% of Wear	Toughness Min. No. of blows	Absorption Max.% of Weight
Stone	Drains	8,000	15	4	5
Sandstone Beaver, Baden or Freeport	(Curbs (Structures	8,000	15	4	5
Sandstone Medina	(Curbs (Structures	15,000	6	6	5
Limestone Ligonier	Paving	15,000	5	7	5
Granite Med.Grained	(Curbs (Paving (Structures	15,000	5	7	5
Limestone Oolitic	Ornamental	5,000	15	4	6
Cast Stone Onondaga or equal	Ornamental	5,000	15	4	6

Stone for Drains

131. Stone for curb drains, trench drains and drains behind walls shall conform to the general requirements for stone as stipulated in Section 130. It shall be broken to about 3 inches in size for curb drains and to sizes varying from 3 inches to 6 inches for trench drains and drains behind walls.

Sandstone

132. Sandstone shall conform to the general requirements for stone stipulated in Section 130, and be of the best Beaver Valley, Baden or Freeport sandstone or a stone equal in quality or durability. Sandstone shall be free from powder cracks, dry and incipient cracks, excessive iron stains, coal seams, nigger heads, iron nodules, or streaks, and loose or coarse grain areas and any other defects that would interfere with the use of the stone. The stone shall be uniform in color and texture.

Granite

133. Granite shall conform to the general requirements for stone stipulated in Section 130, and shall be medium grain, uniform in quality and texture, and with an even distribution of constituent parts. The stone shall be free from scales, seams, discoloration, disentegration, excess of mica or feldspar.

LIMESTONE FOR MASONRY

General Requirements

134. Cut stone shall be the Indiana Oolitic Limestone of a selected building stock within the range of variation of color and texture represented by samples acceptable to the Director, which samples are to be typical of the extremes which the Contractor proposes to furnish. Samples to be not less than four (4") inches wide by seven (7") inches long about one (1") inch thick produced so that the large faces shall show the grain or rift of the stone. The finish specified to be indicated on the large faces and at least two of the edges to be rock face.

Similar samples to be provided when select stock or specially graded hard stone is required for certain location in the structure.

Insofar as the cut stone specifications are concerned and as they pertain to the practice set out for its proper use, the standards established by the Indiana Limestone Quarrymen's Association of Bedford, Indiana, are to govern. Bidders not familiar with these standards are cautioned to inform themselves regarding same.

Indiana Oolitic Limestone shall meet the general specifications and tests for Stone, Section 130.

CAST STONE FOR MASONRY

135. The materials shall be the best quality cut cast stone made by a recognized plant with all modern facilities for manufacturing this material such as the Onondaga Litholite Company or Benedict Company. Material shall be composed of three different sizes of crushed granite combined with copper mill slag and Portland Cement mixed with continuous agitation, it shall be cured for thirty days before shipment. All finished product to be accurate for size, line of edges and plain surfaces shall be out of wind, without hollow or depressions. It shall be machine tooled 6 cuts to the inch and shall conform in quality, finish and color to approved sample on file with the Director. All material to be reinforced where necessary for handling. Cast stone shall meet the general specifications and tests for stone, Section 130.

Form 106

FLAGSTONE FOR SIDEWALKS

General Requirements

136. The flagstone shall be of the best quality of gray Cleveland Sandstone or stone equal in quality thereto, of uniform color and free from flaws or defects of any kind.

The width of the flagstone pavement shall conform to the requirements shown on the Contract Plans or as ordered by the Director in the field. Unless otherwise specified the flags shall have a width equal to the width of the pavement, a length of not less than four feet (4') and a thickness of at least three inches (3").

The surface shall be sawed to a plane, free from warps, depressions or projections. The edges shall be pitched to true lines and squared for the full depth of stones. The joints shall be cut to a straight surface and at right angles with the line and surface of the walk, for the full width and thickness of the stone.

Sandstone Curb, Dressing and Dimensions

137. The finished curb shall be not less than 3'6" nor more than 6'0" in length. It shall have a depth of 24" and minimum thickness of 6" subject to the tolerances hereinspecified. Where necessary, a combination of tangent and radius curb must be provided to give lengths not less than 3'6". The stone shall be dressed to the dimensions and tolerances herein specified.

The top shall be axed or bush-hammered to a plane surface with no projections above the plane and no depressions or irregularities more than 1/4" below the plane. It shall be 6" in width throughout the length of the stone, and the corners shall be squared and pitched to true lines.

The plane of the bottom of the stone shall be parallel to the top at the required depth with a tolerance of 1" maximum projection or recession from said plane.

The front face shall have a 1" chiseled draft along the top and a 1" chiseled draft along the ends at right angles to the top for a depth of 12" and pitched for 4 additional inches. Vertical grooves or scores spaced 2 1/2" center to center with a tolerance of 1/2" shall be cut on the face with a point and shall extend not less than 14" from the top of the stone, and the bottom of the grooves shall be in the plane of the chiseled draft with a tolerance of 3/8" projection and 1/8" recession from said plane. A tolerance of 1/4" shall be allowed in the alignment of the scores. The face for a depth of 14" from the top shall not at any place project more than 3/4" beyond the plane of the chiseled draft, nor at any place recede back of said plane more than 1/4". Below the bottom of the scoring the face of the curb shall not project more than 3" nor recede more than 1" from the plane of the chiseled draft.

The back face shall have a 1" chiseled draft along the top of the stone and shall be pointed off vertically for a total distance of 6" below the top. For this distance the face shall not project more than 3/4" beyond the plane of the chiseled draft nor recede back of said plane more than 1/4". From 6" below the top, the back face shall not project more than 3" for straight curb and 6" for radius curb beyond the plane of the chiseled draft, nor recede more than 1".

The ends shall be at right angles with the top and the face for the full depth of the stone. They shall have a 3" chiseled draft cut along the upper edge and a 1" chiseled draft along the front face edge for a depth of 14" from the top, and a 1" chiseled draft along the back face edge for a depth of 6" from the top. The end shall be pointed off in the plane of the chiseled draft to give a close fit for a depth of not less than 16" with a recession tolerance of 1/2" and with no projections beyond the plane of the chiseled draft. The ends of the stone when set must fit together within 1/8" at the top, and 1/4" at the front face 16" from the top, and within 1" at the back face 16" from the top. Recessions below the point 16" from the top of the curb shall not exceed 4" from the plane of the chiseled draft.

Granite Curb, Dressing and Dimensions

138. The finished curb shall be furnished in lengths of not less than 3 1/2' or not more than 10', and shall be not less than 22" deep and not less than 6" thick, unless otherwise specified. Where necessary, a combination of tangent and radius curb must be provided to give lengths of not less than 3 1/2'. The stone shall be dressed to the dimensions and tolerances herein specified.

The top shall be pean hammered or axe dressed to a plane surface at right angles to the face of the curb with no projections above the plane and no depressions or irregularities more than 1/4" below the plane. It shall be 6" in width throughout the length of the stone and the corners square and pitched to true lines.

The plane of the bottom of the stone shall be parallel to the top at the required depth with a tolerance of 1" maximum projection or recession from said plane.

The front face shall have a 1" chiseled draft along the top and a 1" chiseled draft along the ends at right angles to the top for a depth of 12" and pitched for 4 additional inches. To a depth of 14" below the top of the curb, the face of the curb shall be a clean quarry split or scabbled, with no projections in excess of 3/4" or depressions in excess of 1/4" from the vertical plane of the chiseled draft at the top edge. The face of the curb below a depth of 14" from the top shall not project more than 3" nor recede more than 1" from the plane of the chiseled draft.

The back face shall have a 1" draft along the top of the stone and shall be scabbled off vertically for a total distance of 6" below the top, with no recessions exceeding 1/4" inside the vertical plane from the top of the curb and no projections beyond such plane exceeding 3/4". Below this 6" depth the back face shall not project more than 3" for straight curb nor more than 6" for radius curb beyond the plane of the chiseled draft. For a depth of 8 additional inches below the bottom of the scabbled face, the face shall not recede back of the plane of the chiseled draft more than 3/8", and for the remainder of the depth shall not recede back of said plane more than 1".

The ends shall be at right angles with the top and the face for the full depth and thickness of the stone. They shall have a 3" chiseled draft cut along the top edge and a 1" chiseled draft cut along the front face edge for a depth of 14" from the top, and a 1" chiseled draft along the back face edge for a depth of 6" from the top. The ends shall be scabbled in the plane of the chiseled draft to give a close fit for a depth of not less than 16" with a recession tolerance of 1/2" and with no projection beyond the plane of the chiseled draft. The ends of the stone, when set, must fit together with 1/8" at the top, and 1/4" at the front face 16" from the top, and within 1" at the back face 16" from the top. Recessions below the point 14" from the top of the curb shall not exceed 4" from the plane of the chiseled draft.

PAVING BLOCKS

General Requirements

139. Paving Blocks furnished as required for the various types of blockstone pavements shall be of a quality to meet the requirements stipulated in Section 130, and shall be of the sizes and conform to the dressing hereinafter stipulated.

Type 1.

140. Paving Blocks, Type 1, shall be good quality Ligonier stone or stone of equal quality, uniform in color, meeting the requirements stipulated in Section 130.

They shall be from 4 to 5 inches wide, 5 to 5 1/2 inches deep, and 8 to 12 inches long. They shall be what are known in quarry terms as "Smooth Header Blocks" that will give a wearing surface with no projection of rock beyond the plane of its edges exceeding 1/2". All block shall be split and dressed with straight edges on the top, bottom and sides. The blocks in any one course shall not vary more than 1/2" in width.

The blocks shall be so cut and dressed that when laid the width of joints between blocks in the same course shall not be more than 5/8 of an inch, and the joints between blocks in adjoining courses shall average 5/8 of an inch in width and shall not in any case exceed one inch in width. The width of all joints as above specified shall be measured between the edges of the blocks at the top of the joint. Hollow faced blocks shall not be used and no blocks shall be used in which any side has a total variation of more than 3/4 of an inch from a rectangle.

Type 2.

141. Paving Blocks, Type 2, shall be of good quality Medina Sandstone or stone of equal quality thereto, uniform in color, meeting the requirements stipulated in Section 130. In all other respects Paving Blocks, Type 2, shall conform to the requirements of dressing, etc., covering Paving Blocks, Type 1.

Type 3.

142. Paving Blocks, Type 3, shall be of the best quality of granite, meeting the requirements of Section 130. In all other respects Paving Blocks, Type 3, shall conform to the requirements of dressing, etc., covering Paving Blocks, Type 1.

Reclipped Paving Blocks

143. Reclipped Paving Blocks shall consist of blockstone that have been lifted from paved roadways, of a quality conforming to the requirement governing Paving Blocks, given in Section 130, and reclipped and dressed to give straight edges on top, bottom and sides to conform to the requirements of Section 140, with the exception that the reclipped blocks shall not be less than 3 1/4" in width, and 6" long, and they shall be from 4 1/2 to 5 inches deep.

STEEL REINFORCEMENT

General

144. All Steel Reinforcement Bars for concrete shall conform to the requirements and tests of the "Standard Specifications for Billet Steel Concrete Reinforcement Bars" A.S.T.M. Designation A15-35, except as otherwise stipulated herein.

Unless otherwise stipulated on Contract Plans or Supplementary Specifications, steel reinforcement bars may be either plain bars or an approved type of deformed bar. The type of deformed bar shall be such as will provide a net cross section at all points equal to that of plain round or square bars of equal nominal size. Cold twisted bars will be accepted when meeting the specifications.

Grade

Steel reinforcement shall be of the "Structural Steel" grade and rolled from new billets.

Mill Reports

The Contractor shall furnish the Director, without cost to the City, with duplicate certified copies of the reports of all tests made at the mill where steel is rolled; such report shall give results of the chemical analysis and physical tests made in conformance with these specifications and shall further contain a list of the material rolled for this work from the several melts tested.

Test Specimens to be Furnished

The Contractor shall furnish the Director free of charge with one prepared tensile specimen from each melt. These specimens shall be cut from the finished material, shall not be less than 24 inches long, and shall be prepared as required and shall have the melt number stamped thereon. The specimen shall be prepared and delivered to the City's laboratory, Center Avenue and Dithridge Street, at the cost of the Contractor.

Marking

Reinforcing bars ahll be securely bundled and each bundle shall have the melt number and the name of the manufacturer stamped upon an attached metal tag.

Defective Material

Material which, subsequent to the above tests at the mills, and its acceptance there, develops weak spots, brittleness, cracks or other imperfections, or is found to have injurious defects, will be rejected on the work and shall be replaced by the Contractor at his own expense.

Any bar which shall be found to be deficient in weight by more than seven per cent below the theoretical weight shall be regarded as defective and shall be similarly replaced. The bars must be free from all paint, oil, grease, dirt, scale and loose or thick rust.

Variation in Weight

The weight of any lot of bars shall not vary more than 3 1/2 per cent over or under the theoretical weight for bars 3/8 inch and over in diameter, nor more than 5 per cent over or under for bars under 3/8 inch in diameter. The theoretical weight of deformed bars shall be the theoretical weight of plain round or square bars of the same nominal size. The term "lot" used in this paragraph means all the bars of the same nominal weight per linear foot in any shipment.

STEEL BAR MATS

145. Steel Bar Mats for concrete reinforcement shall conform to the "Standard Specifications for Fabricated Steel Bar Mats for Concrete Reinforcement", Designation A 184-37, of the American Society for Testing Materials. All steel reinforcement in Bar Mats shall conform to the specifications for Steel Reinforcement. The Mats may be clipped or welded.

STEEL WIRE MESH

146. Steel Wire Mesh for concrete reinforcement shall be cold drawn and shall conform to the requirements and tests of the "Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement", Designation A 185-37, of the American Society for Testing Materials.

BRONZE BOLTS AND RODS

147. The bronze used for bolts or rods shall meet the requirements of the standard specifications and tests for Naval Brass Rods for Structural Purposes, adopted by the American Society for Testing Materials, Designation B21-29.

BRONZE BEARING METAL

148. The bronze for bearing purposes shall meet the requirements of the specifications and tests for Bronze Bearing Metals for Turntables and Movable Railroad Bridges, adopted by the American Society for Testing Materials, Designation B22-36T, Class "A" grade.

The bronze plates used for expansion purposes shall have all surfaces which come in contact with other moving metal planed or machined; the finishing cut being made with the tool running in the same direction as the movement between the plates.

BRONZE CASTINGS

149. The castings shall meet the requirements of the specifications and tests for Sand Castings of the Alloy: Copper 88%; Tin 8%; Zinc 4%; adopted by the American Society for Testing Materials, Designation B60-36.

Marking

Reinforcing bars ahll be securely bundled and each bundle shall have the melt number and the name of the manufacturer stamped upon an attached metal tag.

Defective Material

Material which, subsequent to the above tests at the mills, and its acceptance there, develops weak spots, brittleness, cracks or other imperfections, or is found to have injurious defects, will be rejected on the work and shall be replaced by the Contractor at his own expense.

Any bar which shall be found to be deficient in weight by more than seven per cent below the theoretical weight shall be regarded as defective and shall be similarly replaced. The bars must be free from all paint, oil, grease, dirt, scale and loose or thick rust.

Variation in Weight

The weight of any lot of bars shall not vary more than 3 1/2 per cent over or under the theoretical weight for bars 3/8 inch and over in diameter, nor more than 5 per cent over or under for bars under 3/8 inch in diameter. The theoretical weight of deformed bars shall be the theoretical weight of plain round or square bars of the same nominal size. The term "lot" used in this paragraph means all the bars of the same nominal weight per linear foot in any shipment.

STEEL BAR MATS

145. Steel Bar Mats for concrete reinforcement shall conform to the "Standard Specifications for Fabricated Steel Bar Mats for Concrete Reinforcement", Designation A 184-37, of the American Society for Testing Materials. All steel reinforcement in Bar Mats shall conform to the specifications for Steel Reinforcement. The Mats may be clipped or welded.

STEEL WIRE MESH

146. Steel Wire Mesh for concrete reinforcement shall be cold drawn and shall conform to the requirements and tests of the "Standard Specifications for Welded Steel Wire Fabric for Concrete Reinforcement", Designation A 185-37, of the American Society for Testing Materials.

BRONZE BOLTS AND RODS

147. The bronze used for bolts or rods shall meet the requirements of the standard specifications and tests for Naval Brass Rods for Structural Purposes, adopted by the American Society for Testing Materials, Designation B21-29.

BRONZE BEARING METAL

148. The bronze for bearing purposes shall meet the requirements of the specifications and tests for Bronze Bearing Metals for Turntables and Movable Railroad Bridges, adopted by the American Society for Testing Materials, Designation B22-36T, Class "A" grade.

The bronze plates used for expansion purposes shall have all surfaces which come in contact with other moving metal planed or machined; the finishing cut being made with the tool running in the same direction as the movement between the plates.

BRONZE CASTINGS

149. The castings shall meet the requirements of the specifications and tests for Sand Castings of the Alloy: Copper 88%; Tin 8%; Zinc 4%; adopted by the American Society for Testing Materials, Designation B60-36.

The castings shall have a sand blast finish, except where required otherwise, and all irregular surfaces shall be ground smooth and even. When castings fit against structural steel or other metal they shall be ground to a true and even bearing.

STRUCTURAL STEEL

Structural Steel for Bridges

150. All structural steel for use in the construction of Bridges shall conform to the specifications and Tests required by the "Standard Specifications for Steel for Bridges", Designation A7-36 of the American Society for Testing Materials.

Structural Steel for Buildings

151. All Structural Steel for other purposes than Bridges shall conform to the requirements of the "Standard Specifications for Steel for Buildings", Designation A9-36, of the American Society for Testing Materials.

Rivet Steel

152. All steel for rivets shall conform to the requirements of the "Standard Specifications for Structural Rivet Steel", Designation A 141-36, of the American Society for Testing Materials.

STEEL CASTINGS

General

153. All Steel Castings shall conform to the Tentative Specifications for "Carbon Steel Castings for Miscellaneous Industrial Usea", Designation A27-36T, of the American Society for Testing Materials.

Unless otherwise specified all castings shall be furnished in grade B-2, fully annealed and having the following physical requirements:

Tensile Strength	Min. Lbs. per Sq. In.	70,000
Yield Point	Min. Lbs. per Sq. In.	35,000
Elongation in 2 inches	Min. percent	20
Reduction of Area	Min. percent	30

All steel castings shall have a sand blast finish except where required otherwise, and all irregular surfaces shall be filed or ground smooth and even. Where castings fit against Structural Steel or other metal they shall be ground to a true and even bearing.

All steel castings used for expansion purposes shall have all surfaces which come in contact with other moving metal planed or machined, the finishing cut being made with the tool running in the same direction as the movement between the surfaces.

GRAY IRON CASTINGS

154. Gray Iron Castings shall conform to the requirements of the "Standard Specifications for Gray Iron Castings", Designation A48-36, of the American Society for Testing Materials.

Unless otherwise specified castings of class No. 30 shall be furnished having a minimum tensile strength of 30,000 Lbs. per Sq. In.

HIGH TENSILE STRENGTH - CAST IRON

General

155. Gray Iron Castings, for which a high tensile strength and resistance to shock are required, shall conform to the "Standard Specifications for Gray Iron Castings", Designation A48-36, of the American Society for Testing Materials except as herein specified.

Physical Properties

Unless otherwise specified castings of class No. 50 shall be furnished which shall have the following physical properties.

Modulus of Elasticity	21,000,000 Minimum
Tensile Strength	50,000 Lbs. per square inch
Transverse Strength	1450 Lbs. Minimum breaking load with 2/10 of an inch minimum deflection as determined from a test bar of 3/4" diameter 15 inches long on 12 inch centers.

Patterns

All patterns shall be made of the best pattern material, sharp and true to line, and shall be approved by the Director before any castings are made. Any changes in design of patterns required by the Contractor on account of improper design, must have the approval of the Director before the patterns are made.

Moulds

Moulds shall be faced with the finest prepared facing mixed by an expert facing mixer, or shall be faced with French sand so that the casting shall have a smooth, even surface and sharp lines equal to the approved patterns. The moulds shall be baked in ovens or dried with torches. All moulding shall be done by experienced moulders.

Finished Castings

Each casting shall be perfect without shift of mould, blow holes, burnt-in sand, dull surfaces, rounded edges, irregular lines, twisted or warped surfaces, shrinkage cracks, fins, or any imperfections whatever. All lines shall be straight and true, all ornament clean and sharp. The castings shall be of uniform thickness, as called for on the drawings, and shall have a sand blast finish. All bolt or screw holes shall be as noted on contract plans. All surfaces of castings which fit against structural steel or each other shall be ground to a true and even surface.

MALLEABLE IRON CASTINGS

General

156. Malleable Iron Castings shall conform to the "Standard Specifications for Malleable Iron Castings", Designation A47-33, of the American Society, for Testing Materials.

Physical Properties

The Tension Test Specimen shall conform to the following minimum requirements.

Tensile Strength	Lbs. per Sq. In.	53,000
Yield Point	Lbs. per Sq. In.	35,000
Elongation in 2"	percent	18.0

Patterns

All patterns shall be made of the best pattern material, sharp and true to line, and shall be approved by the Director before any castings are made. Any changes in design of patterns, required by the Contractor on account of improper design, must have the approval of the Director before the patterns are made.

Moulds

All moulds shall be faced with the finest prepared facing, mixed by an expert facing mixer, or shall be faced with French sand so that the castings shall have a smooth even surface and sharp lines equal to the approved patterns. The moulds shall be baked in ovens or dried with torches. All moulding must be done by experienced moulders.

Finished Castings

Each casting shall be perfect, without shift of mould, blow holes, burnt in sand, dull surfaces, rounded edges, irregular lines, twisted or warped surfaces, shrinkage cracks, fins or any imperfections whatever. All lines shall be straight and true; and all ornament clean and sharp. Each casting shall be of uniform thickness as called for on the drawings and shall have a sand blast finish. All bolt or screw holes shall be as noted on Contract Plans. All surfaces of castings which fit against structural steel or each other shall be ground to a true and even surface.

WROUGHT IRON

Plates

157. Wrought Iron plates shall conform to the Tentative Specifications for Wrought Iron Plates, Designation A42-36T, of the American Society for Testing Materials.

Bars

158. Wrought Iron bars shall conform to the Standard Specifications for Refined Iron Bars, Designation A41-36, of the American Society for Testing Materials.

Pipe

159. Wrought Iron pipe shall conform to the Standard Specifications for Welded Wrought Iron Pipe, Designation A72-33, of the American Society for Testing Materials.

Sheets

160. Wrought Iron Sheets shall conform to the Standard Specifications for Uncoated Wrought Iron Sheets, Designation A162-36, of the American Society for Testing Materials.

CAST IRON CULVERT PIPE

161. Cast Iron Culvert Pipe shall meet the requirements of the Tentative Specifications for Cast Iron Culvert Pipe, Designation A142-35T, of the American Society for Testing Materials. Unless otherwise specified all cast iron culvert pipe shall be Extra Heavy Pipe.

EYE BAR TESTS - FULL SIZE

162. Full-sized tests on eye bars and similar members to prove their strength and workmanship, shall be made at the Contractor's expense, and the cost of material and testing shall be included in the price bid for the finished structure.

The Contractor shall submit a list of the sizes of eye bars to be manufactured from which the Director will prepare a list of eye-bars to be made for testing purposes. This number of eye-bars shall be manufactured in addition to the number required for the contract. The number of pieces so tested shall not be more than four percent of all pieces in the Contract provided, however, that at least three pieces shall be tested unless otherwise stipulated in Supplementary Specifications.

The eye bars required for full-sized tests and those required for the structure shall be made and annealed at the same time. The test bars are to be selected by the Director from the finished lot and must be fair average specimens of those which would be classed as good bars acceptable for the work. Not more than one bar is to be selected from each melt. No bar which is known to be defective in any way shall be selected for a test. The bars tested shall show a tensile strength of not less than 56,000 pounds per square inch, an elongation in 10 feet including the fracture of at least 15 percent and a reduction in area at fracture of at least 32 percent. Bars shall generally break in the body and the fracture shall be silky or fine granular. Should a bar break in the head and develop the specified ultimate strength, elastic limit, elongation and character of fracture, it shall not be cause for rejection, provided not more than one-third (1/3) of the total number of bars tested break in the head.

CINDERS OR CLINKERS

163. These specifications cover cinders or clinkers suitable for sidewalk foundation courses.

The cinders or clinkers shall be of select grade, hard, solid and free from dust, fine ash, unburned particles, or other objectionable foreign matter, and shall range in size from two and one-half (2-1/2") inches to three-eighths (3/8") inch.

GRANULATED SLAG

Granulated Slag Cushion Course

164. The Granulated Slag for cushion course under brick or block stone pavements shall be a screened, water cooled or steam cooled blast furnace slag, light in color, free from lumps, iron, cinder, coke, sculls, or other objectionable foreign matter, and not less than one hundred percent (100%) shall pass a one-fourth inch (1/4") square hole sieve.

The green colored, water cooled granulated slag, commonly called manganese slag, shall not be used.

Granulated Slag Borrow

165. All granulated blast furnace slag borrow for embankments, sub-base treatment, backfill in trenches, etc., shall be approved by the Director. Unless otherwise noted on the contract plans, or in supplemental specifications the granulated slag borrow shall be paid for by weight and the quantity measured for payment shall be computed on the weight indicated by check weight slips furnished in the following matter:

Granulated slag shall be weighed and weight slips, signed by the weighmaster, indicating the net weight of slag delivered in each load must be given to the representative of the Director designated to receive such slips. The method of weighing and the scales used for weighing slag shall be subject to approval and test by the Director. In the event of disapproval of scales, or the weights indicated on the weighmaster's slips, no further material shall be weighed on such scales until notified in writing by the Director so to do. Granulated slag in embankments shall be calculated on the basis of 2670 pounds to one cubic yard with respect to its effect on quantities measured for payment under other items for either items for either borrow or spoil. Granulated Slag shall not be weighed when containing an excessive amount of water.

TIMBER AND LUMBER

Scope

166. These specifications cover timber and lumber suitable for use in structural and construction work.

Definitions and Terms

Definitions and terms relating to timber and lumber shall be governed by those adopted by the following Associations, in so far as they apply, together with all subsequent amendments and additions thereto adopted by said Associations.

1. The National Hardwood Lumber Association. Rules for the Measurement and Inspection of Hardwood Lumber, January 1932.

2. The Southern Pine Association, Standard Specifications for Grades of Longleaf and Shortleaf Southern Pine Lumber and Timber, June 1936.

3. West Coast Lumbermen's Association, Standard Grading and Dressing Rules for Lumber, July 1926 as revised to July 1934.

4. American Lumber Standards, issued by the Bureau of Standards of the United States Department of Commerce.

5. American Society for Testing Materials Standards.

Materials Permitted

For structural timber where strength is the essential element, only the following shall be used:

(a) Southern Longleaf Yellow Pine (Pinus palustris) meeting the requirements of Sections 318 to 327 inclusive and Section 329 to 338 inclusive of The Southern Pine Association, Standard Specifications, June 1936.

(b) Douglas Fir (Pseudotsuga taxifolia), meeting the requirements of Sections 214 and 218 of the West Coast Lumbermen's Association, Standard Grading and Dressing, July 1934.

(c) White Oak (Quercus alba) meeting the requirements of the National Hardwood Lumber Association, Rules, January 1932.

For permanent construction where durability is the essential element and the wood is continuously exposed to the weather or soil conditions, Southern Shortleaf Yellow Pine (Pinus echinata), Northern White Pine (Pinus strobus), Norway Pine (Pinus resinosa), Tamarack (Larix laricina), Chestnut (Castanea dentata), Chestnut Oak (Quercus primus), Yellow Oak (Quercus acuminata), Locust (Robinia pseudacacia), Honey Locust (Gleditsia triacanthos), and other species of wood may be permitted if shown on the contract plans or specifically ordered by the Director. The rules and specifications of the above mentioned Associations shall govern the grading, inspection and quality of these species of lumber.

Grade

Unless shown on the contract plans or otherwise specified, the timber and lumber shall be of the highest quality and best grade.

General Requirements

The grades, soundness characteristics, cutting, seasoning, sizing, surfacing allowable working stresses, and defects shall conform to the specifications and rules of the above named Associations, as they pertain to the proper grading of timber and lumber.

Inspection

All lumber and timber shall be subject to the rules of inspection of the American Lumber Standards, and in case of disagreement an official inspection by the appropriate Association will be requested, it being agreed that the findings of the official inspection shall be final and conclusive.

TIMBER PILES

167. These specifications cover requirements for round timber piles to be used untreated or treated by standard preservatives.

Timber piles shall meet the requirements of the specification and test for Timber Piles, adopted by the American Society for Testing Materials, Serial Designation: D25-37, Class A.

All piles that are to form a part of the finished structure shall be either sound, live, white oak, poast oak, cypress or other hard wood acceptable to the Director. They shall be free from cracks, shakes, large or unsound knots, decay and other defects and shall be cut above the ground swell when the sap is down.

All piles shall be so nearly straight that the center of the pile at any point will not be more than one-third the diameter of the piles, at that point, from a straight line between the centers of the ends of the pile.

VITRIFIED INVERT CLAY SEWER BRICK

168. These specifications cover vitrified clay bricks intended to be used in the invert of drainage structures for the conveyance of sewage, industrial waste and storm water.

General Requirements

The Invert Clay Sewer Brick shall be best quality vitrified brick and shall meet the requirements of the standard Specifications and Tests for Clay Sewer Brick, Grade "SA", Vitrified, adopted by the American Society for Testing Materials, Serial Designation C32-37T except as otherwise specified herein.

Detail Requirements

(a) The brick shall be three (3) inches (smooth face) in depth, four (4) inches (rough face) in width, and eight and one half (8 1/2) inches in length.

(b) The Brick, Grade "SA" shall show an abrasion loss of not more than twenty-four (24) per cent when tested in a standard brick rattler, A.S.T.M., Serial Designation C-7-37T.

(c) The brick shall show an absorption of not more than four (4) percent when tested by standard methods, A.S.T.M., Serial Designation C-67-37.

(d) The brick shall have square edges and plane surfaces. Bricks with lugs, grooves, or other irregularities will not be permitted.

(e) For any lot of brick furnished under these specifications, the individual bricks shall not vary from the normal size requirements specified more than plus or minus one eighth (1/8) inch in either transverse dimension, or more than plus or minus one fourth (1/4) inch in length.

(f) All brick which are off size, over burned, misshapen, or kiln marked so that they will not form a uniform surface or align correctly with other brick, shall be rejected.

(g) The brick shall not be dumped from trucks, nor thrown in handling, but shall at all times be handled carefully, piled neatly and kept clean. Brick otherwise acceptable may be rejected.

(h) If the visual inspection appears to indicate the rejected brick will be in excess of five (5) percent, the total shipment may be rejected regardless of whether they pass the physical tests specified.

(i) Failure to meet any of the foregoing requirements shall be sufficient cause for rejection of shipment and cancellation of contract.

Common Masonry Brick

169. The Contractor shall use common masonry brick conforming to the following requirements for catch basins, inlets, manholes, sewers and other brick masonry, except as otherwise stipulated on contract plans, or in supplementary specifications.

Common masonry brick shall meet the standard specifications and tests for Building Brick, Grade "A", Common Brick, adopted by the American Society for Testing Materials, Serial Designation C-62-30, with all subsequent amendments and additions thereto, adopted by said Society, except as may be otherwise herein specified.

The brick shall meet the following physical requirements for compression, modulus of rupture and absorption when tested in accordance with the methods described in A.S.T.M. Specifications C-67-37.

Compression strength with brick laid flat wise, mean of 5 tests, 4500 pounds or over per square inch mean gross area, with individual minimum of 3500 pounds per square inch mean gross area.

Modulus of rupture with brick laid flat wise, mean of 5 tests, 600 pounds or over per square inch gross area, with individual minimum of 400 pounds per square inch gross area.

Absorption shall not exceed 12%.

Brick shall have an abrasion loss of not more than 36% when tested in a standard rattler, as described in A.S.T.M. Specifications C-7-37.

The brick shall be 2 1/4 inches in thickness, 3 3/4 inches in width and 8 inches in length. Individual brick shall not vary from the standard size by more than plus or minus 1/8 inch in depth or width and 1/4 inch in length.

The brick shall be of uniform color and texture for any one contract.

Brick shall be rejected for the following causes by visual inspection: off-size, off-color, over-burned, under-burned, unclean, misshapen, kiln-marked, chipped, cracked, warped, containing particles of lime, or other defects that would impair their serviceability in a structure.

If during the process of visual inspection the percentage of brick rejected exceeds 5% of the brick inspected, the total shipment shall be rejected even though physical test requirements are satisfactory.

Brick shall not be dumped by trucks, nor thrown in handling, but shall at all times be handled carefully, piled neatly and kept clean.

Failure to meet any of the foregoing requirements shall be sufficient cause for rejection of shipment and cancellation of contract.

Storing & Loading Inspected Brick

Brick inspected, tested and accepted for use on a designated City contract must be kept segregated at the plant and must not be used on other City contracts or shipped to any other party, except with the approval of the Director. Such brick shall be loaded for shipment on City contracts, only in the presence of a representative designated by the Director. All brick loaded must be taken from stock or piles previously inspected and approved by the City for the particular job to which shipment is to be made, except where specifically notified that inspection and sampling will be done at the site in accordance with Section 7.

Traffic Markers

Brick of contrasting colors shall be used for traffic markers whereve specified. These brick shall conform to paving brick requirements as outlined in these Specifications, and color shall be subject to the approval of the Director.

Dimensions of Brick

Repressed Lug or Wire Cut Lug brick shall be 3 1/2 inches in width by 4 inches in depth, by 8 1/2 inches in length.

Vertical fibre brick with lugs shall be 4 inches wide, by 3 inches deep, by 8 1/2 inches long.

Brick shall not vary from the above dimensions by more than plus or minus 1/8 inch in either transverse dimension or by more than plus or minus 1/4 inch in length.

Dimensions shall be determined by measuring along the edges from face to face of the bricks.

Lugs

The brick shall be provided with not less than two lugs on one side. These lugs shall project not less than 1/8" nor more than 1/4" from the body of the brick and shallhave a total area at the base of between 3/4 and 2 square inches. The brick shall also be provided with a non-continuous vertical bar lug on each end. These lugs shall be non-meshing and shall have a total base area between 3/4 and 2 square inches on each end. The end lugs shall project not less than 1/16" nor more than 1/8" beyond the body of the brick. All lugs shall be made to provide for the free horizontal flow of the filler between the brick. Beveled or grooved ends shall be permitted on repressed brick only.

Hillside Brick

When "Hillside" brick are designated on the contract plans they shall be repressed hillside brick, made with one beveled edge. The edges of the beveled surface shall be parallel to the other edges of the brick and may be rounded to a radius not exceeding 3/16 of an inch.

Abrasion Loss

The brick shall be tested for loss by abrasion in accordance with the rattler test described in Section 17 to 29 inclusive of the A.S.T.M. Specifications, Designation C-7-37T, and any lot of brick for which samples of the three foregoing grades of brick show an average loss in excess of 22%, or for which any one of the samples show a maximum loss of more than 24%, shall be rejected, provided, however, that the Contractor shall have the option of requiring an additional test, which shall be conducted under the direction or supervision of the Director and made in a manner similar to the foregoing. If the percentage of loss does not exceed those above stipulated, the lot of brick shall be accepted; and if the percentage exceeds those above stipulated, the lot of brick shall be rejected; and, if already delivered, shall be immediately removed from the line of work.

Physical Requirements

The crushing strength and absorption of glazed sewer pipe shall conform to requirements given in Table No. I.

TABLE I

PHYSICAL TEST REQUIREMENTS OF CLAY SEWER PIPE

Internal Diameter, In.	Average Crushing Strength, Minimum, Lb. Per Linear Foot		Average Absorption, Maximum, Per Cent
	Three-Edge-Bearing Method	Sand-Bearing Method	
4	1000	1430	8
6	1000	1430	8
8	1000	1430	8
9	1050	1500	8
10	1100	1570	8
12	1200	1710	8
15	1370	1960	8
18	1540	2200	8
20	1720	2460	8
21	1810	2590	8
24	2150	3070	8
27	2360	3370	8
30	2580	3690	8
33	2750	3930	8
36	3080	4400	8

Note: Design loads shall not exceed the average crushing strength in this table for the Three-Edge-Bearing Test.

Sizes and Dimensions

Pipes shall be furnished in accordance with the internal diameters and dimensions given in Table No. II. The ends of the pipe shall be square with the longitudinal axis.

TABLE II
DIMENSIONS OF CLAY SEWER PIPE

Internal Diameter (D), in.	Laying Length (L), ft.	Inside Diameter at 1/2 in. Above Base of Socket (Ds), b,c, in.	Depth of Socket (Ls), in.	Minimum Taper of Socket (H:Ls)	Thickness of Barrel (T), in.	Thickness of Socket (Ts)
4	2	5 3/4	1 3/4	1:20	1/2	The Thickness of the socket 1/2" from the outer end shall be not less than 3/4 of the thickness of the barrel of the pipe.
6	2, 2 1/2,	8 1/4	2 1/4	1:20	5/8	
8	2, 2 1/2, 3	10 1/2	2 1/2	1:20	3/4	
9	2, 2 1/2, 3	11 5/8	2 1/2	1:20	13/16	
10	2, 2 1/2, 3	12 3/4	2 1/2	1:20	7/8	
12	2, 2 1/2, 3	15 1/8	2 3/4	1:20	1	
15	2, 2 1/2,33	18 3/4	2 3/4	1:20	1 1/4	
18	2, 2 1/2, 3	22 1/4	3	1:20	1 1/2	
20	2, 2 1/2, 3	24 3/4	3 1/4	1:20	1 3/4	
21	2, 2 1/2, 3	25 7/8	3 1/4	1:20	1 3/4	
24	2, 2 1/2, 3	28 3/4	3 3/8	1:20	2	
27	2 1/2, 3	33 1/8	3 1/2	1:20	2 1/4	
30	2 1/2, 3	36 5/8	3 1/2	1:20	2 1/2	
33	2 1/2, 3	40	4	1:20	2 5/8	
36	2 1/2, 3	43 1/4	4	1:20	2 3/4	

Note: When pipes are furnished having an increase in thickness over that given in last column, the diameter of socket shall be increased by an amount equal to twice the increase of thickness of barrel.

When the pipes furnished have an average diameter larger than the nominal size, the inside diameter of the socket shall be greater by the same amount than the values given in the third column.

Permissible Variations

The permissible variations from the dimensions given in Table No. II shall not exceed those specified in Table No. III.

TABLE III

PERMISSIBLE VARIATIONS IN DIMENSIONS OF CLAY SEWER PIPE

Nominal Size, Internal Diameter, in.	Length, in. per ft. (—)	Lengths of Two Opposite Sides, in. per foot of length	Internal Diameter, in.		Depth of Socket, in. (—)	Thickness of Barrel in. (—)
			Spigot (±)	Socket (±)		
4	1/4	1/8	1/8	3/16	1/4	1/16
6	1/4	1/8	3/16	1/4	1/4	1/16
8	1/4	1/8	1/4	5/16	1/4	1/16
9	1/4	1/8	1/4	5/16	1/4	1/16
10	1/4	1/8	1/4	5/16	1/4	1/16
12	1/4	3/16	5/16	3/8	1/4	1/16
15	1/4	3/16	5/16	3/8	1/4	3/32
18	1/4	3/16	7/16	1/2	1/4	3/32
20	1/4	3/16	1/2	9/16	1/4	1/8
21	1/4	3/16	1/2	9/16	1/4	1/8
24	3/8	1/4	9/16	5/8	1/4	1/8
27	3/8	1/4	5/8	11/16	1/4	1/8
30	3/8	1/4	5/8	11/16	1/4	1/8
33	3/8	1/4	11/16	3/4	1/4	3/16
36	3/8	1/4	3/4	13/16	1/4	3/16

Note: The minus sign (—) alone indicates that the plus variation is not limited; the plus and minus sign (±) indicates variation in both excess and deficiency in dimension.

Pipes intended to be straight shall have a maximum ordinate as measured from the concave side of the pipe not to exceed 1/8 inch per foot of length.

Fittings

Fittings shall have a plain spigot end and a socket end, corresponding in all respects with the dimensions specified for pipes of the corresponding internal diameter. Branch pipes shall be furnished to lay the same lengths as straight pipe. Slants shall have their spigot ends cut at an angle of approximately 60 degrees and 45 degrees with the longitudinal axis as required. Curves shall be at angles of 90 degrees, 45 degrees, 30 degrees and 22 1/2 degrees as required. They shall conform substantially to the curvature specified.

Branches shall be furnished with the spur or spurs of the size or sizes specified, securely and completely fastened in the process of manufacture, to the barrel of the pipe. T-branches and double T-branches shall have their axes perpendicular to the longitudinal axis of the pipe. Y-branches and double Y-branches shall have their axes approximately 60 degrees and 45 degrees as required from the longitudinal axis of

the pipe measured from the socket end. All spurs shall terminate in sockets, and the barrel of the spurs shall be of sufficient length to permit making a proper joint when the connecting pipe is inserted in the spur socket.

Channel or split pipes, curves, and branches shall be approximate half sections of the corresponding size of straight pipe and fittings.

Marking

Each length of pipe over six inches in diameter shall bear the initials or name of the person, company, or corporation by whom manufactured, and the location of the mill. The marking shall be indented on the exterior of the pipe near the socket and shall be plainly legible for purposes of identification..

Workmanship and Finish

All pipe and specials shall be thoroughly burned and glazed on both sides. They shall be substantially free from fractures, large or deep cracks and blisters, laminations and surface roughness, and when struck with a hammer shall emit a clear ringing sound.

Glazing

The glaze shall consist of a continuous layer of salt glaze substantially free from large blisters or large pimples. No blisters shall exceed three inches in diameter, and no blisters or pimples shall project more than 1/8 inch above the surrounding surface of the pipe for sizes up to and including 18 inches internal diameter. For sizes over 18 inches internal diameter, no blisters shall exceed in diameter more than two inches per foot of the internal diameter of the pipe, nor project above the surrounding surface of the pipe more than 1/8 inch per foot of the internal diameter of the pipe.

Not more than ten percent of the inner surface of any pipe barrel shall be bare of glaze except the socket, where it may be entirely absent. Glazing shall not be required on the outer surface of the barrel at the spigot end for a distance from the end of the pipe equal to the specified depth of socket. There shall be no well defined network of crazing lines or hair cracks. If the inside of the sockets and spigot ends are fully glazed, they shall be scored with three parallel lines extending completely around the socket and spigot end.

Inspection

Pipes shall be subject to inspection at the factory, after delivery, and after laying in the sewer, and all culled pipe shall be removed by the Contractor and replaced with new pipe to conform to the specifications. Pipes shall be subject to rejection for the following reasons:

1. Failure to meet the physical test requirements.

2. Variations in any dimension exceeding the permissible variations given in Table No. III.

3. Fractures or cracks passing through the shell or socket, except that a single crack at the spigot end of the pipe not exceeding 75 per cent of the depth of the socket, or a single fracture in the socket not exceeding three inches in width nor two inches in length.

4. Chips or fractures on the interior of the pipe exceeding two inches in length, one inch in width, and of a depth more than one-quarter of the thickness of the shell.

5. Blisters which are broken or which exceed the dimensions specified in the paragraph entitled "Glazing."

6. Fire cracks or hair cracks sufficient to impair the strength, durability, or serviceability of the pipe.

7. Variation of more than 1/8 inch per linear foot in alignment of a pipe intended to be straight.

8. Glaze which does not conform with these specifications as specified under "Glazing."

9. Insecure attachment of spurs or branches.

10. An excess of dirt or other coating that would prevent proper inspection.

CLAY AND CONCRETE DRAIN TILE

General

172. All drain tile shall be in accordance with the A.S.T.M. Standard Specifications and Tests for Drain Tile, Designation C 4-24, except as otherwise stipulated herein.

Materials

These specifications shall apply to drain tile made of shale, fire clays, or surface clays, and to drain tile made of concrete.

Sizes and Dimensions

The sizes of drain tile shall be designated by their internal diameters. Drain tile 12" in diameter and under shall have a minimum length of 12".

Physical Test Requirements

The crushing strength and absorption of drain tile shall conform to the requirements stipulated in Table I.

TABLE I

PHYSICAL TEST REQUIREMENTS
Extra Quality Drain Tile

Internal Diameter Inches	Average Crushing Strength, Minimum lbs. per linear foot		Maximum Average Absorption by Standard Boiling Test per cent		
	Three-Edge Bearing Method	Sand Bearing Method	Shale or Fire Clay Tile	Surface Clay Tile	Concrete Tile
4" to 12"	1066	1600	7	11	9

Note: Design loads shall not exceed the average crushing strength in this table for the Three-Edge Bearing Test.

Workmanship and Finish

Drain tile shall be straight and circular in cross section, with the ends regular and smooth, to readily permit making close joints by turning and pressing together adjoining tile. Drain tile shall be reasonably smooth on the inside, and free from cracks and checks extending into the body of the tile so as to decrease the strength appreciably. The tile shall not be chipped or broken in such a manner as to decrease their strength materially or to admit earth into the drain. Drain tile shall be substantially uniform in structure throughout, and shall give a clear ringing sound when stood on end and while dry tapped with a light hammer.

Permissible Variations

Drain tile of the different classes may vary from the requirements heretofore specified in accordance with the tabulations in Table II.

TABLE II

PERMISSIBLE VARIATIONS

Physical Properties Specified	Extra-Quality Drain Tile Per Cent
Allowable variation of average diameter below specified diameter...	3
Allowable variation between maximum and minimum diameters of same tile, or average diameters of adjoining tile, percentage of thickness of wall.....	65
Allowable variation from straightness, percentage of length.....	3
Allowable thickness of exterior blisters, lumps, and flakes which do not weaken tile and are few in number, percentage of thickness of wall.....	15
Allowable diameters of above blisters, lumps, and flakes, percentage of internal diameter.....	10

Rejection

All drain tile not meeting the requirements for strength and absorption, size, workmanship, and finish, within the tolerances specified, shall be rejected and shall be removed by the Contractor and replaced with satisfactory tile.

Perforated Clay Drain Tile

Perforated vitrified clay drain tile shall be furnished in 4", 6", or 8" diameter as required, and in 2' lengths. It shall be made of the bell and spigot pattern and shall be fully glazed throughout. The 4" tile shall be perforated with 28 holes 1/2" in diameter, spaced 3" center to center longitudinally, and approximately 2" center to center around half of the circumference of the tile. The 6" tile shall be perforated with 42 holes 1/2" in diameter, spaced 3" center to center longitudinally, and approximately 2 1/4" center to center around half the circumference of the tile. The 8" tile shall be perforated with 56 holes 1/2" in diameter spaced 3" center to center longitudinally, and approximately 2 1/4" center to center around half the circumference of the tile.

Porous Concrete Drain Tile

Porous concrete drain tile shall be made of concrete composed of one part of cement, two parts of fine aggregate, and three parts of hard, double porous, coarse aggregate. The tile shall be circular in shape, with interlocking ends, and shall be furnished in 4" or 6" diameter as required. The wall thickness of the 4" tile shall be not less than 1", and the wall thickness of the 6" tile shall be not less than 1 1/8".

The minimum permeability of a one foot length of 4" diameter tile shall be 10 gallons per minute, and for 6" diameter tile shall be 18 gallons per minute. Permeability shall be measured by the flow of water through the wall of the tile when standing vertical with bottom plugged, the tile filled with water to the top, and the inflowing water regulated to keep the tile full of water during the testing period.

The requirement for absorption in Table I is waived for Porous Concrete Drain Tile.

REINFORCED CONCRETE PIPE

General

173. Except as otherwise stipulated herein concrete pipe shall be made and cured in accordance with the A.S.T.M. Specification, Designation C76-37.

Manufacturing Plant

Reinforced concrete pipe shall be manufactured at a plant approved by the Director, and equipped with all facilities in good working order necessary for the proper control of the manufacture and for carrying out all the tests required in these specifications. Necessary facilities shall be provided to City representatives for the inspection of the operation of the plant and all the processes entering into the manufacture of the pipe.

Construction

The pipe shall be made of concrete, consisting of Portland cement, mineral aggregates, and water in which steel has been imbedded in such a manner that the steel and concrete act together. The aggregates shall be so graded and proportioned and thoroughly mixed with such proportion of cement and water as will produce a homogeneous concrete mixture of such quality that the concrete pipe will conform to the test and design requirements of these specifications.

Size and Shape

The pipe shall be circular in section, unless otherwise required on the contract plans, or in supplemental specifications, and shall be furnished in sections either 4' or 6' in length for sizes up to and including 36" internal diameter. Above 36" in diameter, the pipe shall be furnished in 4' lengths. Pipe required for curve alignments shall be furnished in 2' lengths unless otherwise stipulated on the contract plans, or in supplemental specifications, or by written permission of the Director.

All pipe having internal diameters of 24" and under shall be of the bell and spigot type. Pipe having internal diameters exceeding 24" in diameter shall be either of the bell and spigot type or beveled tongue and groove type. The ends of the pipe shall be so designed in such manner as to permit constructing joints that will be tight, smooth, and permanent, and effectively prevent leakage and infiltration.

Materials

All materials used in the construction of reinforced concrete pipe shall be subject to the approval of the Director, and shall be in conformity with the current specifications for such materials in the Standard Contract for Construction of the Department of Public Works, except as otherwise stipulated herein.

The coarse aggregate shall be natural gravel, crushed gravel, or broken stone.

Steel Reinforcement

Steel reinforcement may consist either of cold drawn steel wire for concrete reinforcement, or reinforcement bars made from billet steel, and shall be circular in shape. When two lines of reinforcement are used in circular pipe, one line shall be placed near the inner and one near the outer surfaces of the pipe. When a single line of circular reinforcement is used in circular pipe, it shall be placed near the inner surface of the pipe shell. The distance from the center line of reinforcement to the nearest surface of concrete shall not be less than one inch.

Each line of circumferential reinforcement shall be assembled into a unit and have sufficient longitudinal bars or members extending through the barrel of the pipe to afford rigidity and maintain the reinforcement in exact shape. The reinforcement shall be lapped not less than 20 diameters for bars, nor less than 40 diameters

for cold drawn wire and shall be securely wired together; or, if welded, the joints shall develop the full strength of the reinforcement. The spacing center to center of adjacent rings of circumferential reinforcement in a cage shall not exceed 4 inches up to and including pipe 48" in diameter, nor exceed the shell thickness for larger pipe, and shall in no case exceed 6 inches.

Openings for Branch Sewers

Recessed shouldered openings shall be provided in pipes having diameters greater than 24", for lateral or connecting sewers as shown on the contract plans, or as ordered by the Director, and having diameters not greater than one-half the diameter of the main sewer. All pipe requiring recessed shouldered openings shall be manufactured by casting in order that the recess openings shall be accurately formed. After such pipe has been laid in the trench, slants or spurs, as may be required, with ends properly shaped shall be accurately fitted into the shouldered recess and reinforced by applying sufficient mortar around the joint to make it at least as strong as the connecting sewer pipe.

Bell end tees or wyes shall be provided in pipes having diameters not over 24", for lateral or connecting sewers, as shown on the contract plans or as ordered by the Director, and having diameters not greater than one-half the diameter of the main sewer. All pipe requiring bell end tees or wyes shall be machine made, and shall have the opening for the tee or wye cut through the freshly made pipe and shall have the tee or wye connection firmly cemented therein.

Marking and Grading

The marking and grading of reinforced concrete pipe shall be subject to inspection by the Director. The date of casting shall be marked plainly on each unit and, in addition thereto, the date on which the pipe has been inspected by the representative of the Director, together with his initials.

All pipe units that are not manufactured in the immediate vicinity of the location of work shall have the manufacturer's name, brand, or trade mark plainly indicated by black lead paint, with letters not less than 2" high. Pipe units so manufactured upon which said marks are not readily discernible shall not be used for construction of sewers and appurtenances, and shall be immediately removed from the line of work.

The class of pipe shall be stenciled on each unit, using the letters "S C" for standard culvert pipe.

Strength Tests

Pipe shall be tested for strength by the three-edge-bearing method and concrete test cylinders, and shall meet the requirements stipulated in the Table in these specifications for concrete culvert pipe.

The Contractor shall, when directed, furnish and test, free of cost to the City, two lengths of each size of pipe furnished in quantities of 100 lineal feet or more. When the amount of pipe of any size exceeds 600 lineal feet, the contractor shall, as above described, furnish and test two additional lengths of pipe for each additional 600 lineal feet or fraction thereof. Pipe shall be furnished for testing, as above required, whether the pipe is made and shipped in one lot or whether shipments are required at intervals over extended periods of time. The strength test specimens shall be representative of the pipe. They shall be otherwise in accordance with the specifications and shall be selected by the Director.

All expenses connected with the testing of pipe shall be borne by the Contractor.

Three-Edge-Bearing Test

When the three-edge-bearing method is used, the ends of each specimen of pipe shall be accurately marked in halves of the circumference prior to the testing. The two lower bearings shall consist of two wooden strips with vertical sides having their interior type corners rounded to a radius of approximately one-half inch. The strips shall be straight and shall be securely fastened to a rigid block at least 6" x 6" in cross section. The interior vertical sides of the strips shall be parallel and a distance apart of 1" per foot of pipe diameter, but in no case less than 1". The upper bearing shall be a rigid block at least 6" x 6" in cross section, straight and true from end to end. The upper and lower bearings shall extend the full length of the pipe exclusive of the bell. The pipe shall be placed symmetrically between the two bearings. In testing pipe which is out of line, the lines of the bearing chosen shall be from those which appear to give the most favorable conditions for fair test.

Cracking Load

When the test load reaches the cracking load given in the table for the size and kind of pipe to be tested, the pipe shall be rejected if a crack has developed having a surface width of one-hundredth inch or more for a length of one foot or more.

The width of the crack shall be measured by means of a gauge made from a leaf one-hundredth inch in thickness and one-half inch in width from a set of standard machinist's gauges ground to a point of 1/16 inch in width with corners rounded and with the taper of 1/4 inch per inch. The crack shall be considered to be one-hundredth inch in width when the point of the gauge will just enter it to a depth of 1/16 inch at close intervals.

Cylinder Tests and Reinforcement Examination

The acceptability of the pipe will also be determined by tests of the quality of the concrete as placed in the pipe and examination of the quality, amount, and accuracy of placement of the reinforcement. The quality of the concrete shall be determined on 6" diameter by 12" test cylinders taken from the concrete used in making pipe and manufactured and cured under identical conditions with the pipe. Compression tests of these cylinders at 28 days shall show a strength not less than 3500 pounds per square inch for standard culvert pipe.

Acceptability and Re-Test

Pipe shall be acceptable under the strength tests when all test specimens and cylinders conform to the test requirements. Should any of the test specimens fail to meet the test requirements, then the manufacturer will be allowed a re-test on two additional specimens, to be selected by the Director, for each specimen that failed, and the pipe shall be acceptable only when all of these re-test specimens meet the strength test requirements. No further re-test shall be permitted. If the strength test specimens meet all the requirements of the three-edge-bearing test, and the cylinder tests show the concrete strength not less than 5% below the strength required, the Director may accept the lot of pipe representative of such tests.

Visual Inspection

Pipe shall be subject to visual inspection prior to shipment, after delivery, and after laying in the sewer, and all culled pipe shall be removed by the Contractor. Rejection of individual lengths of pipe will be made for the following causes:

(1) Fracture or cracks passing through the shell, except that an end crack that does not exceed the depth of the joint, or a fracture that at its deepest point does not exceed the depth of the joint, nor extend more than 10% around the circumference shall not be considered cause for rejection, unless these defects exist in more than 5% of the pipe inspected.

(2) Rough surface, or other defects, which indicate imperfect mixing, placing and curing of the concrete.

(3) Exposure of the reinforcement when such exposure would indicate that the reinforcement is misplaced.

(4) Spalls deeper than one-half the depth of the joint, or extending more than 4' around the circumference. When the total length of all spalls greater than 1" in length on any one edge of the pipe exceeds 10% of the circumference of that edge.

(5) Variations of the internal diameter which exceed plus or minus 1% for pipe having an internal diameter of 36" or less, and which exceed plus or minus 0.75% for larger pipe.

(6) When the shell thickness is less than the thickness specified in the Table by more than 5% at one point.

(7) When variation in the position of the reinforcement exceeds 1/4" from the position of the reinforcement required by these specifications for pipe having an internal diameter of 48" or less, and when such variations exceed 1/2" for larger pipe, and when the thickness of concrete over the reinforcement is less than 3/4" at any point.

(8) Pipe which has been plastered in attempts to remedy defects.

(9) When the planes of the ends of the pipe are not perpendicular to their longitudinal axis.

(10) When the reinforcement is more than 1 1/2" from the ends of the pipe.

Channel Pipe

When channel pipe is required, it shall be furnished in sections of 120 degrees or 180 degrees, as stipulated on contract plans or supplemental specifications, and shall be in accordance with these specifications for sewer pipe insofar as they are applicable.

Joint Reinforcement

The joints of culvert pipe shall have a circumferential reinforcement equal in unit area to that of a single line within the barrel of the pipe.

Joints

The ends of tongue and groove pipe shall be of such design that the pipe when laid shall butt together on the outside portion of the joints when a diameter of the tongue end of one pipe is in any position of the circle with respect to the diameter of the groove end of the adjoining pipe, and the inside of the pipe shall be in proper alignment to provide a smooth and uniform interior surface.

The ends of the pipe shall also be designed so that when the pipe butt together on the outside, the inside edges of the joint shall be 3/4 of an inch apart for pipe 48 inches or less in diameter; and one inch apart for pipe above 48 inches to 66 inches in diameter and 1 1/4 inches apart for pipe above 66 inches in diameter. The inside portion of the tongue end or grooved end shall be beveled to provide a key for the joint material.

Variations in Diameter

Variations of the internal diameter of the pipe shall not exceed plus or minus 1/4 inch for pipe having internal diameters of 36 inches or less and shall not exceed plus or minus 5/16 inch for larger pipe.

Form 106

TABLE NO. I

STANDARD REINFORCED CONCRETE CULVERT PIPE
A.S.T.M. Specifications C 76-37

Internal Diameter Inches	Strength Test Requirements Pounds Per Lineal Foot — Three-Edge-Bearing Method — Load to Produce Ultimate		Minimum Shell Thickness (Inches)	Minimum Strength of Concrete 3500 Lbs. Per Square Inch — Minimum Steel Reinforcement Sq. In. Per Lin. Ft. of Pipe — Circular Reinforcement in Circular Pipe	
	a 0.01 in. Crack	Load			
12	2250	3500	2	1 Line	0.07
15	2625	4065	2 1/4	1 Line	0.09
18	3000	4500	2 1/2	1 Line	0.12
24	3000	5000	3	1 Line	0.17
27	3000	5000	3	1 Line	0.17
30	3375	5750	3 1/2	2 Lines each	0.17
33	3500	6000	3 3/4	2 Lines each	0.17
36	4050	6600	4	2 Lines each	0.18
39	4050	6600	4	2 Lines each	0.187
42	4725	7350	4 1/2	2 Lines each	0.21
45	4725	7350	4 1/2	2 Lines each	0.21
48	5400	8000	5	2 Lines each	0.25
54	5850	9000	5 1/2	2 Lines each	0.30
60	6000	10000	6	2 Lines each	0.33
66	6300	11000	6 1/2	2 Lines each	0.37
72	6600	12000	7	2 Lines each	0.40
78	6800	13000	7 1/2	2 Lines each	0.43
84	7000	14000	8	2 Lines each	0.46

Design loads shall not exceed the ultimate load specified in this table for three-edge-bearing tests.

The steel areas in this table are based on the use of cold drawn steel wire with a unit stress of 27,500 pounds per square inch. If reinforcement bars of billet steel of intermediate or hard grade are used, the areas of steel given in this table shall be increased 37 1/2% to conform to a unit stress of 20,000 pounds per square inch, and if billet steel of structural grade is used, the areas of steel given shall be increased 53% to conform to a unit stress of 18,000 lbs. per sq. in.

Shipping Date

The pipe shall not be shipped until the strength of the concrete, as shown by test cylinders, is 75% or more of the 28 day strength required in the attached table.

The pipe shall not be shipped prior to ten days curing when made between May 1 and October 1, nor prior to fourteen days curing when made between October 1 and May 1. When made with high early strength cement the above curing time for the pipe may be reduced to 7 days and 10 days respectively.

INSPECTION AND TESTING AT MILLS

Mill Orders

174. The Contractor shall furnish the Director with duplicate copies of all mill orders with the name and location of the mill where the material is to be rolled therein. No Material shall be rolled, nor work done, before the Director has been notified when orders have been placed, so he may arrange for inspection.

Facilities for Inspection

The Contractor shall furnish all facilities for inspecting and testing the weight and quality of all material at the mill where it is manufactured. He shall furnish a suitable testing machine for testing the specimen, as well as prepare the pieces for the machine, free of cost to the City.

Access to the Mills

When an inspector is furnished by the Director to inspect material at the mills, he shall have full access at all times to all parts of the mills where material to be inspected by him is being manufactured.

Certified Test Reports

The Director may, if he desires, in lieu of placing an inspector in the mills, require the Contractor to furnish certified test reports. These reports shall give the melt numbers, section of piece from which test specimen are cut, chemical analysis, and physical properties of each melt from which material for the work is rolled. Accompanying the test report shall be a list of the material rolled from each melt for the work.

Test Specimen to be Furnished

If required by the Director, tensile test specimen prepared as hereinbefore specified shall be furnished, free of cost to the City, by the manufacturer from such parts of the material as desired, only one specimen to be taken from a melt. All specimens shall have plainly stamped thereon the melt number and be delivered to the Bureau of Tests, Center Avenue and Dithridge Street.

MASTIC SEAL

175. All structural steel and iron fence-members projecting through concrete shall receive a brush coat of Japan Dryer and a 1/4" trowel coat of mastic seal consisting of the following ingredients and mixed in the respective proportions set forth below:

32 lbs. Portland Cement

12 lbs. Dry, finely ground Red Lead

4 to 6 lbs. Linseed oil

2 to 3 lbs. Japan Dryer

BITUMINOUS FILLER FOR EXPANSION DAMS

176. These are of plastic trowelling consistency suitable for use in expansion dams for bridges.

They may be composed of the following:

A base of pure asphalt combined with asbestos fibre, silica dust filler, Southern Pine Tar and a Distillate solvent so proportioned and combined as to form a uniform mass that will dry tough and elastic in 24 hours.

The ingredients should be blended together in such proportion so as to make soft pliable mastic that will adhere to and adapt itself to the contraction and expansion of the surface to which it is applied and still have sufficient plasticity and resilience so that it is capable of withstanding the hottest sun temperatures, without softening or running and sufficiently tough to withstand walking, and the wear of the elements or any expansion or contraction strains to which it may be subjected.

Material for bituminous cement expansion dam filler shall have approximately (within two percent, 2%,) the following analysis:

Asbestos Fibre:	15%	
Petroleum Asphalt	35%	
Fine Silica:	10%	
Pine Tar:	3%	± 1/2%
Mineral Spirits:	37%	

A five percent (5%) variation in the Mineral Spirits content will be permitted, depending upon the weather conditions and temperature.

("BITUMINOUS JOINTS FOR PIPE SEWERS")

177. Bituminous Joints for pipe sewer shall be made of Bituminous compound for plastic joints for pipe sewers having a bituminous base more fully described hereinafter. This compound shall melt and run freely at a temperature as low as 250 degrees F., shall adhere firmly to the surfaces of the pipes, and when set shall be sufficiently elastic to permit of a slight movement of the pipes without injury to the joints or breaking of adhesion of the compound to the pipes, and shall meet the following requirements.

	MINIMUM	MAXIMUM
1. Specific Gravity at 25 C	1.45	1.55
2. Melting Point	195 deg F.	205 deg F.
3. Penetration at 25 C	8	15
4. Adhesion at 25 C lbs. per sq. inch	150	. . .
5. Total Bitumen	45%	55%
6. Total inert Mineral	45%	55%

This compound shall not deteriorate when submerged in water or domestic sewage, and shall form a tight joint when poured in pipe partly or entirely submerged in water. It shall show no deterioration of any kind when immersed for a period of five days in one percent solution of hydrochloric acid or a five percent solution of caustic potash.

ASPHALT EXPANSION JOINT MATERIAL

178. The premoulded asphalt expansion joint shall be of such quality that it will have the necessary adhesive properties, not be deformed by ordinary handling during the summer months prior to placing, and contain sufficient filler incorporated in the bitumen in order to reduce its brittleness at freezing temperature to a minimum. The asphalt expansion joint shall have a thickness of three quarters (3/4) of an inch, unless otherwise provided and a width equivalent to the depth or one quarter (1/4) inch less than the depth of the pavement where it is used. It shall be cut to conform to the cross section of the pavement and shall be furnished in strips equal to the width of the pavement, except that strips equal to the width of a traffic lane may be used when laced or clipped together in a satisfactory manner. In extra width pavements the strips may not be less than eight (8) feet in length, except where a shorter length is required due to the character of construction and in any event they shall be joined satisfactorily. The asphalt expansion joint shall meet the following requirements:

(1) Absorption. When a two (2) by six (6) inch specimen, cut from the joint material is immersed in water for twenty-four (24) hours it shall absorb not more than five (5) per centum by weight.

(2) Brittleness. The bituminous premoulded joint shall not crack or shatter when subjected to the following test:

The sample to be tested, two (2) by six (6) inches, cut parallel to lay of fibre, is clamped between two boards so the expansion joint cantilevers three and five-tenths (3.5) inches, it being held in any suitable support. A cast-iron ball weighing ninety-five hundredths (0.95) of a pound and having a diameter of one and eight hundred and seventy-five thousandths (1.875) inches is suspended by a cord tied to an eyelet soldered to the ball. For samples having a thickness of nine-sixteenths (9/16) of an inch and less, the ball is suspended one (1) foot above the center of the projected portion of the specimen. For samples over nine-sixteenths (9/16) of an inch in thickness, the ball is suspended two (2) feet above the specimen. (The ball is released by burning the string above the eyelet.) The test is made on the sample after it has been maintained at a temperature of from four (4) degrees to six (6) degrees C. for at least two (2) hours prior to testing.

(3) Distortion. The sample shall show a deflection from the horizontal of not more than one (1) inch when subjected to the following test:

The sample, two (2) by six (6) inches, cut parallel to lay of fibre, absolutely flat and straight, is clamped between two blocks so the expansion joint cantilevers three and five-tenths (3.5) inches. The clamp, with the expansion joint, is then placed in an oven at one hundred and twenty-five (125) degrees F. and left therein for two (2) hours.

(4) Bitumen. The sample shall contain not less than 70%, by weight, of bitumen soluble in carbon bisulphide.

Cork Board

179. When cork board is required for expansion joints, it shall conform to the following requirements:

Cork board shall be furnished in the thickness specified on contract plans, but not less than 3/8 inch.

For wall copings, curbs and similar structures, the cork board shall be preformed to the exact cross-section of the concrete. The exposed edges shall be smooth, flush with the face of the concrete and thoroughly coated with asphaltic waterproof coating.

For concrete walls, pavements and similar structures, the edges of the cork board shall be smooth and thoroughly coated with asphaltic waterproof coating, and shall conform to the contour of the surface of the structure.

COMPOSITION: Cork board joint material shall be formed from good quality and clean cork particles, thoroughly bonded by a synthetic resin of an insoluble nature, and shall not be exposed to a temperature in excess of 300 degrees F. in the process of manufacture.

PROPERTIES:- (a) Accelerated Weathering Test - No evidence of disentegration after 7 days at 165° F., 24 hours immersion in water, and 10 freezing and thawing cycles.

(b) Compressibility - Not more than 350 pounds per square inch required to compress to 50% of original thickness.

(c) Resilience - Shall recover not less than 90% of original thickness one (1) hour after load removal when compressed to 50% of thickness for one (1) hour. Percentage of recovery shall be construed as

$$\frac{\text{Thickness one hour after release}}{\text{Original thickness.}} \times 100$$

(d) Extrusion - Not more than 0.125" when compressed to 50% of original thickness.

(e) Chemical Resistance - Shall not disintegrate.

(1) When boiled in concentrated hydrachloric acid for 30 minutes.

(2) When immersed in commercial gasoline for 48 hours.

(3) When immersed in lubricating oil (S A E 30) for 48 hours.

SAMPLES - At least five (5) samples, 4" x 4", from each mixture from which cork board is furnished under this contract shall be delivered to the Bureau of Tests for testing.

PAINT SAMPLES AND TESTING

180. These specifications cover samples and delivery of paint, and apply to and form a part of the specifications for all paint and paint materials to be used by the City of Pittsburgh, Department of Public Works.

Samples without Drier

Drier shall in no case be added to mixed paint until such time as hereinafter specified and no laboratory samples of such paint will be taken either at the factory or on the job where this provision has been violated.

The contractor shall notify the Director where and when paint is to be mixed, in order that he can be present and secure such samples of material being used and of the finished product as he may desire.

Delivery

All paint for use on City work shall be delivered on the job not less than 10 days nor more than 15 days before it will be required for use. Drier shall be governed by the same stipulation and shipped in separate containers.

The Director shall be notified immediately of each delivery and the Contractor shall provide expedient means for the taking of such field samples as he may desire.

Samples of Mixed Paint

Samples of mixed paint shall be taken by the Director from the original packages of every lot of paint and separate drier either at the shop or on the job or both. Analysis will be made and the paint rejected or accepted within a period of not more than 15 days, from time of delivery.

Analyses, City Laboratory

Analyses will be made by the Bureau of Tests, Department of Public Works. The Laboratory of the Bureau of Tests is located at Center Avenue and Dithridge Street. The Director reserves the right to conduct tests at such points as he may designate.

Acceptance

In no case shall paint be used which has not been sampled, analyzed and approved as meeting all the requirements of the specifications.

PAINT PIGMENTS

Red Lead

181. The Red Lead shall conform to all requirements as specified in the Standard Specification: D83-31, ninety-five per cent (95%) grade, paste in oil, American Society for Testing Materials.

Basic Carbonate White Lead

The Basic Carbonate White Lead shall conform to all requirements as specified in the Standard Specification: D81-34, paste in oil, American Society for Testing Materials; unless otherwise specified.

Basic Sulphate White Lead

The Basic Sulphate White Lead shall conform to all requirements as specified in the Standard Specification: D 82-24, paste in oil, American Society for Testing Materials; unless otherwise specified.

Chrome Green, Pure

Pure Chrome Green shall conform to all requirements as specified in the Standard Specifications: D 212-27, paste in oil, American Society for Testing Materials; unless otherwise specified.

Reduced Chrome Green

The Reduced Chrome Green shall conform to all requirements as specified in the Standard Specifications: D 213-27, paste in oil, American Society for Testing Materials; unless otherwise specified.

Chrome Yellow

The Chrome Yellow shall conform to all requirements as specified in the Standard Specifications: D 211-27, paste in oil, American Society for Testing Materials; unless otherwise specified.

Yellow Ochre

The Yellow Ochre shall conform to all requirements as specified in the Standard Specifications: D 85-27, paste in oil, American Society for Testing Materials; unless otherwise specified.

Lamp Black

The Lamp Black shall conform to all requirements as specified in the Standard Specifications: D 209-30, paste in oil, American Society for Testing Materials; unless otherwise specified.

Zinc Oxide

The Zinc Oxide shall conform to all requirements as specified in the Standard Specifications: D 79-24, paste in oil, American Society for Testing Materials; unless otherwise specified.

Asbestine

The Asbestine shall be a good grade, pure, native, asbestine having typical chemical composition and physical structure. Its free alkalinity when expressed as sodium hydroxide shall not exceed 1%.

Blanc Fixe

The Blanc Fixe shall be a high grade, artificially prepared Barium Sulphat It shall be absolutely neutral.

Lithopone

The Lithopone shall conform to all requirements as specified in the Standard Specifications: D 208-26, paste in oil, American Society for Testing Materials; unless otherwise specified.

Prussian Blue

The Prussian Blue shall conform to all requirements as specified in the Standard Specifications: D 261-28, paste in oil, American Society for Testing Materials; unless otherwise specified.

Ultramarine Blue

The Ultramarine Blue shall conform to all requirements as specified in the Standard Specifications: D 262-28, paste in oil, American Society for Testing Materials; unless otherwise specified.

Toluidine Red

The Toner shall consist entirely of a pure high color toluidine red toner (metanitro-paratoluidine-azo-betanaphthol) free from any other organic coloring matter, base or substratum. The texture and purity of tone shall be equal to that of a sample mutually agreed upon.

The Lake shall consist of a pure high color toluidine red toner precipitated on Blanc Fixe as a base.

Aluminum Bronze Powder

The Aluminum Bronze Powder shall conform to all the requirements as specified in the Standard Specifications: D 266-31, American Society for Testing Materials. In addition to the above requirements, the aluminum bronze powder shall contain no lead, tin, zinc, inert filler, adulterants, and after deduction of the acetone soluble portion the weight of sample shall be ninety-nine per cent (99%) pure aluminum.

Aluminum Bronze Powder Paste

Grade and Type: This specification covers one grade of aluminum bronze powder paste in one type and degree of fineness.

Metal Portion Requirements: The metal portion of aluminum paste shall be made from commercially pure aluminum and shall be in the form of fine flakes. It shall contain no filler or adulterant such as mica, shall be suitable for making aluminum paint and shall meet the following requirements:

	Maximum	Minimum
Coarse Particles, using alcohol or Mineral Spirits as the wash liquid:		
Total Residue retained on #200 Sieve	0.5%	
Total Residue retained on #325 Sieve	3.0%	
Fatty or Oil Matter (Polishing Lubricant)	3.0%	
Non-volatile portion		63%

Liquid Portion Requirements: The liquid with which the aluminum bronze powder is compounded to form the paste shall be completely volatile at 105° C.

Leafing Properties: The aluminum paste shall show a leafing percentage of a minimum of 60% and shall still show a leafing percentage of a minimum of 60% after heating in a closed vessel for (3) three hours at a temperature of 45° C.

Settling: There shall be no appreciable settling out of the metallic portion of the paste in the container, i.e., no free liquid shall be present.

Appearance in Painted Film: The paint made by mixing with a suitable vehicle in the proportion of two pounds of aluminum paste to one gallon of vehicle shall give a free flowing, smooth, continuous coating, free from breaks and sags when applied to a smooth, vertical steel surface. This coating shall match in smoothness, luster, and appearance a mutually agreed-upon standard.

Gold Bronze Powder

The Gold Bronze Powder shall conform to all requirements as specified in the Standard Specifications D 267-31, American Society for Testing Materials.

PAINT VEHICLES

Raw Linseed Oil

182. The Raw Linseed Oil shall conform to all requirements as specified in the Standard Specifications D 234-28, American Society for Testing Materials; unless otherwise specified.

Boiled Linseed Oil

The Boiled Linseed Oil shall conform to all requirements as specified in the Standard Specifications D 260-33, American Society for Testing Materials; unless otherwise specified.

Raw Tung Oil

The Raw Tung Oil (China Wood Oil) shall conform to all requirements as specified in the Standard Specifications D 12-33, American Society for Testing Materials; unless otherwise specified.

Turpentine

The Gum Spirits of Turpentine shall conform to all requirements as specified in the Standard Specifications D 13-34, American Society for Testing Materials; unless otherwise specified.

Mineral Spirits

The Mineral Spirits shall conform to all requirements as specified in the Specifications D 235-34T, American Society for Testing Materials; unless otherwise specified.

Drier

The Drier shall be a resin-free, oil drier; composed of lead, manganese, or cobalt, or a mixture of these elements combined with a suitable fatty oil, and mineral spirits or turpentine, or a mixture of these solvents, without the addition of resins or gums.

The Drier must also conform to all the requirements of Specifications TT-D-651, United States Federal Specification Board.

Phenolic Resin Base Varnish

This specification is designed to cover a long oil phenolic resin varnish of maximum elasticity and durability for use in making aluminum paint for all exterior applications.

(a) The oil shall be entirely vegetable oil, containing not less than 75% China Wood Oil. The volatile thinner shall be free from toxic hydrocarbons such as benzol.

(b) It shall be clear and transparent.

(c) The viscosity shall be between 0.50 and 1.0 poise at 25° C., corresponding to Tubes A to D of the Gardener-Holdt Air Bubble Viscosimeter, if it is to be used with aluminum powder, or between 0.65 and 1.25 poises at 25° C., corresponding to Tubes B to E if it is to be used with aluminum powder paste.

(d) The flash point shall not be below 30° C. in a closed tester.

(e) The varnish shall contain not less than 50% by weight of non-volatile oils and resin.

(f) It shall pas a 140% Kauri Reduction Test, using the method described in Federal Specifications TT-V-81, Paragraph F-2g.

(g) It shall show no skinning after 48 hours in a three-quarters filled, tightly closed container.

(h) It shall pass the gas and draft tests as described in U.S. Navy Specifications 52V-14a.

(i) Flow-out films on tin plate panels dried 72 hours shall withstand immersion in cold water for 96 hours and hot water (77°C) for six hours without whitening, dulling checking, or showing other serious defects.

(j) Films applied to 6" x 1" test tubes by immersion in varnish to a depth of 4 inches and dried in an inverted position for 72 hours, shall show no whitening, dulling or visible attack when immersed to a depth of two inches (2") in a 5% solution of sodium-hydroxide for six hours, at 20° C., and (a separate similar film) a 4% solution of acetic acid for 24 hours at 20° C.

(k) When thoroughly mixed with aluminum powder or paste in proportion of 2 pounds per gallon of vehicle, the paint shall have good leafing quality, show satisfactory brushing and leveling properties and shall not break or sag when applied to a vertical, smooth, steel surface.

(l) Aluminum paint made with this varnish, when applied to a metal panel and allowed to dry in a vertical position, shall set to touch in not more than 2 hours and dry hard and tough in not more than 18 hours at a temperature of 20° C. to 30° C.

Glycerolphthalate Resin Base Varnish

This specification is designed to cover a glycerolphthalate resin varnish of maximum elasticity and durability for use in making aluminum paint for all exterior applications.

(a) The varnish shall consist of glycerolphthalate and suitable modifying agents, and properly thinned to yield a good working material.

(b) It shall be clear and transparent.

(c) It shall be no darker than a solution of 0.9 gram of potassium-dichromate in 100 c.c. of sulphuric acid, specific gravity 1.84 (No. 6 on the Hellige Comparator).

(d) The viscosity shall be between 0.5 and 1.0 poise at 25° C., corresponding to tubes A to D of the Gardner-Holdt Air Bubble Viscosimeter, if it is to be used with aluminum powder, or between 0.65 and 1.25 poises at 25° C., corresponding to tubes B to E if it is to be used with aluminum paste.

(e) The varnish shall contain not less than 48% by weight of non-volatile matter.

(f) A flow-out film of the varnish on 31 gauge tin plate, air dried 16 hours and then baked at 180° C. to 185° C. for 2 hours, shall show no cracking of the film when suddenly chilled to 0° C. and quickly bent sharply on itself. The bent part of the baked panel shall show satisfactory adhesion under a knife test.

(g) A flow-out film on colorless glass, baked for not less than 2 hours at 180° C. to 185° C., shall be hard tough, smooth, transparent and free from all defects such as checking, dulling or wrinkling when compared to a fresh film.

(h) It shall show not skinning after one week in a half-filled, tightly closed glass container stored in a dark place.

(i) A Flow-out film on 31 gauge tin plate, air dried for 48 hours, shall withstand immersion in cold water for 18 hours without whitening and shall show only slight dulling. A similar film shall withstand boiling water for 10 minutes without appreciable whitening or dulling and shall show no whitening after drying for 15 minutes. After removal from the water for 30 minutes, the original gloss and hardness shall return in both instances.

(j) A flow-out film on 31 gauge tin plate, air dried 48 hours, shall retain its gloss and general appearance after 24 hours immersion in straight cut gasoline. After drying 4 hours, the film shall have regained its initial hardness and toughness. There shall be no dis-solution effect on the lower immersed edge.

(k) When thoroughly mixed with aluminum powder or paste in the proportion of 2 pounds per gallon of vehicle, the paint shall have good leafing quality, show satisfactory brushing and leveling properties and shall not break or sag, when applied to a vertical, smooth, steel surface.

(1) Aluminum Paint made with this varnish, when applied to a metal panel and allowed to dry in a vertical position, shall set to touch in not more than 3 hours and dry hard and firm in not more than 16 hours at a temperature of 20° C. to 30° C.

SHELLAC VARNISH

183. Shellac Varnish shall conform to all requirements as specified in the Standard Specifications: D 359-35, American Society for Testing Materials.

The Orange Shellac Varnish shall be "Grade A", light, medium, heavy or very heavy body as specified.

The Bleached Shellac Varnish shall be "Grade Refined", light, medium, heavy or very heavy body as specified.

GREEN PAINT

184. This paint is for park benches, and similar uses.

This paint shall meet the following chemical and physical requirements.

50% Pigment
50% Vehicle

Pigment shall consist of the following:

80%: 25% Chrome Green in accordance with A.S.T.M. Specifications D 213-27 for Reduced Chrome Green except that the sum of the Barium Sulphate and insoluble siliceous material shall not exceed 75%.

20%: "Asbestine" Magnesium Silicate.

Vehicle shall consist of the following:

15%: Boiled Linseed Oil in accordance with A.S.T.M. Specifications: D 260-33.

47%: Water Resisting Spar Varnish in accordance with Federal Specifications: TT-V-121.

4%: Lead and Manganese Drier in accordance with Federal Specifications: TT-D-651.

3%: Cobalt Drier.

11%: Mineral Spirits in accordance with A.S.T.M. Specifications: D 235-34T.

20%: Cumar Varnish in accordance with the following requirements.

The gum content of the Cumar Varnish shall consist of 100% of Cumar Gum. The oils to be used shall be a mixture of refined Linseed and China Wood Oils, used in the proportion of 50 gallons of oil to each 100 pounds of gum. The varnish shall contain a minimum of 50% non-volatile, shall have an acid number of not over 15, shall have a Viscosity of "G" on the Gardner-Holdt Viscosimeter and shall pass a 60% Kauri Reduction Test.

The finished product shall set to touch within six (6) Hours and shall dry hard within eighteen (18) hours, without streaking, running or sagging. It shall be well ground, shall not settle badly or cake in the container, and shall be readily broken up with a paddle to a smooth, uniform paint of good brushing consistency.

Color to be in accordance with standard sample set up by the Director.

PAINT FOR STRUCTURAL STEEL

185. These specifications cover paints for bridges and structural steel, where shop coat, first field coat, and second field coat are used.

Shop Paint, Red

All paint used in the shop, and for touching up field rivets, retouching abrasions in shop coat and painting riveted field joints in the field, shall be ground in the proportions of approximately seventy-five (75) percent pigment to twenty-five (25) percent vehicle so that when thoroughly stirred it will give a smooth uniform paint of good brushing consistency. The pigment shall consist of eighty-five (85%) percent red lead and fifteen (15%) percent French Yellow Ochre. The vehicle shall consist of raw linseed oil. All percentages are to be by weight, and the pigments weighed when dry. After the testing and acceptance of this paint, the contractor, or user, may add not over 1/2 pint turpentine and 1/2 pint liquid drier to each gallon of paint, when approved by the Director in the field.

First Field Coat, Brown

All paint used for the first field coat shall be ground in the proportions of approximately seventy-two (72%) percent pigment to twenty-eight (28%) percent of vehicle. The pigment shall be eighty-five (85%) percent red lead, thirteen (13%) percent French Yellow Ochre, and two (2%) percent Lamp Black, and the vehicle shall be raw Linseed Oil. After the testing and acceptance of this paint, the contractor, or user, may add not over 1/2 pint Turpentine and 1/2 pint Liquid Drier to each gallon of Paint, when approved by the Director in the field.

Second Field Coat, Black or Olive Green

All paint used for the second field or finishing coat shall be one of the two following compositions. The composition to be used shall be "B", unless otherwise stated on the contract plans or in the supplementary specifications, or as ordered by the Director.

Black "A" The proportions shall be approximately fifteen (15%) percent pigment to eighty-five (85%) percent vehicle, so that when thoroughly stirred it will give a smooth uniform paint of good brushing consistency. The pigment shall consist of forty (40%) percent red lead and sixty (60%) percent lamp black. The vehicle shall be raw linseed oil. After testing and acceptance of this paint the Contractor, or user, may add not over 1/2 pint turpentine and 1/2 pint liquid drier to each gallon of paint, when approved by the Director in the field.

Olive Green - "B" The proportions shall be approximately fifty (50%) percent pigment to fifty (50%) percent vehicle, so that after the turpentine or drier is added, and thoroughly stirred it will give a smooth uniform paint of good brushing consistency. The paint shall be olive green equal to a color sample standard designated by the Director. The pigment shall be composed of approximately ninety-eight (98%) percent pure French Yellow Ochre, and two (2%) percent lamp black. Vehicle shall be raw linseed oil. After the testing and acceptance of thispaint, the contractor, or user, may add not over one-half (1/2) pint of liquid drier and not over one-half (1/2) pint of turpentine to each gallon of paint, when approved by the Director in the field.

PAINT FOR STRUCTURAL STEEL MIXED WITH BLUE LEAD

186. These specifications cover materials suitable for a green structural steal or bridge paint.

Blue Lead Pigment

The pigment for Blue Lead Paint shall consist of sublimed blue lead fume, free from all adulterants and shall meet the following requirements:

Lead Sulphate (Pb SO4)	45 to 56 percent,
Lead Oxide (Pb O)	30 to 40 percent,
Lead Sulphide (Pb S)	Not over 12 percent,
Zinc Oxide (ZnO)	Not over 5 percent,
Lead Sulphite (PbSO3)	Not over 5 percent,
Carbon and undetermined	Not over 5 percent.

This material shall be entirely a sublimed product and shall not be a mechanical mixture either in part or as a whole. Ninety-nine (99%) percent of this material shall pass a standard No. 325 sieve. The material shall be tested in accordance with A.S.T.M. Serial Designation D 126-36.

Magnetic Black Oxide of Iron

The Magnetic Black Oxide shall contain at least ninety-seven (97%) percent of oxide of iron. Ninety-nine (99%) percent of the material shall pass a standard No. 325 sieve. The specific gravity shall be 5.02 and the oil absorption 27.5.

Neutral Zinc Chromate

The Zinc Chromate shall be a strictly pure product and by analysis show ($ZnCrO4 + 3H_2O$) and when submitted to chemical tests it shall show that it is neutral.

Drier

The drier shall conform to Specification No. 20 A of the Federal Specification Board.

Blue Lead Primer

Blue Lead Paint for priming or touching up shall be mixed in accordance with the following formula:

Sublimed Blue Lead Pigment	81 pounds
Neutral Zinc Chromate	9 pounds
Raw Linseed Oil	4 gallons
Turpentine	1.5 gallons
Drier	2 pints

The Director reserves the right to order additional drier to be added to the paint at the site of the work, if required to increase its drying qualities.

Blue Lead Finish Coat

Blue Lead Paint for the finish coat shall be mixed in accordance with the following formula:

Sublimed Blue Lead	76.5 pounds
Magnetic Black Oxide of Iron	13.5 pounds
Boiled Linseed Oil	1 gallon
Raw Linseed Oil	3.25 gallons
Turpentine	1.5 gallons
Drier	2 pints

The Director reserves the right to order additional drier to be added to the paint at the site of the work, if required to increase its drying qualities.

Form 106

PAINT FOR LUMBER

187. These specifications cover paints for lumber and timber where one or more coats of paint are required.

First Coat Composition, Lumber

The following described paint for the first coat is to be used only upon lumber surfaces which either are new or which have any previous paint coats removed by burning off the paint or by the erosion of the atmosphere. The vehicle shall consist of twenty (20%) percent of Turpentine and eighty (80%) percent raw linseed oil and the pigment shall be white lead. The paint shall be ground in such proportions of vehicle and pigment that the finished product shall weigh approximately eighteen (18) pounds per gallon.

For the repainting of old timber structures upon which the existing paint film is in tact, this first coat shall be eliminated, the existing paint being a sufficient substitute.

Second Coat Composition, Lumber

All paint used for the second coat shall be of one of the two following compositions and each composition of paint shall be used only for parts of the structure included under the respective headings:

A - For the painting of all new lumber erected under the contract and for all other lumber work which does not have two or more coats of paint in good condition, the vehicle shall consist of twenty (20%) percent Turpentine and eighty (80%) percent, Raw Linseed Oil. The paint shall be ground in such proportions of vehicle and white lead that the finished product shall weigh approximately twenty (20) pounds per gallon.

B - For the painting of all lumber surfaces upon which there are two or more existing coats of paint with films in tact, the vehicle shall consist of twenty-five (25%) percent of Turpentine and seventy-five (75%) percent of Raw Linseed Oil. The paint shall be ground in such proportions of vehicle and White Lead that the finished product shall weigh approximately twenty (20) pounds per gallon.

Third Coat Composition

The third or finishing coat of paint shall be the same for all conditions of lumber. The vehicle shall consist of ten (10) percent of Turpentine and ninety (90%) percent of Raw Linseed Oil. In general the pigment shall consist of seventy-five (75%) percent of White Lead and twenty-five (25%) percent of Zinc Oxide. The paint shall be ground in such proportions of vehicle and pigment that the finished product shall weigh approximately twenty-one (21) pounds per gallon.

When called for on the contract plans or in the supplementary specifications, or by the Director, tinting pigments shall be added in such proportions as will produce the tint or color required by the Director. When tinting pigments are added the Zinc Oxide pigment shall be omitted.

CALCIUM CHLORIDE (A.S.T.M. D 98-34)

188. The calcium chloride shall be in the form of flakes and when tested by means of laboratory screens and sieves shall conform to the following requirements:

Passing 3/8 in. screen		100 percent
Retained on 1/4 in. screen	not more than	20 "
Passing No. 20 sieve	not more than	10 "

The calcium chloride shall conform to the following requirements as to chemical composition:

$CaCl_2$ (anhydrous)	not less than 77 percent
$MgCl_2$	not more than 0.5 percent
Total alkali chlorides	not more than 2.0 percent
Other impurities	not more than 1.0 percent

The calcium chloride shall be delivered in moisture-proof bags or sacks containing approximately 100 lb. each, or in air-tight steel drums weighing not more than 450 lb. each. The name of the manufacturer, the lot number, the approximate net weight, and the percentage of calcium chloride guaranteed by the manufacturer shall be plainly marked on each container.

189. Vacant

BITUMINOUS CURING COMPOUND

190. (1) The various hydrocarbons shall be present in a homogeneous solution.

(2) The viscosity shall be between 15 and 65 (Saybolt Furol) at 100°F.

(3) When distilled (A.S.T.M., D 402-34T) up to a temperature of 680°F., the total distillate shall not be less than 55 nor more than 60 percent by volume. The initial boiling point of the distillate shall not be under 240°F., and at least 45 percent of the total distillate shall have distilled over at 437°F. The residue poured from the flask immediately after the distillation shall have the following characteristics:

(a) It shall have a specific gravity not less than 0.90 at 77°F.

(b) It shall have a penetration (77°F. - 100 gm - 5 sec.) of between 2 and 10.

(c) Its solubility in carbon bisulfide shall be at least 90%.

(d) Its softening point (B. & R. glycerin bath) shall be between 180° and 225°F.

(e) It shall show between 10 and 20 percent fixed carbon.

(f) It shall not contain more than 1/2% of paraffine scale.

(4) It shall be composed of mined or native asphalts containing filler.

(5) It shall form an impervious protective film with one coat.

The curing material shall be applied uniformly by means of an approved pressure spray distributor at the rate of one (1) gallon to each 20 sq. yds. of surface and it shall be so applied that the concrete surface is completely coated and sealed at one application. The curing material shall be applied immediately after the concrete surface to be cured has been finished and before any marked dehydration has occurred. After the surface has been coated, it shall be protected from all traffic or abrasive action from any source.

COLORLESS TRANSPARENT FILM CURING COMPOUND

191. The colorless Transparent Film shall have the following characteristics:

(1) The sealing compound shall consist of a straw colored liquid:

(a) Viscosity at 64°F = 10 to 20 seconds, Saybolt Furol.
(b) Specific Gravity at 64°F., 0.87 to 0.89, with a Reimann plumat on an analytical balance.

(c) Total solids not less than 34% by weight.
(d) Compound shall not freeze when cooled to Zero F.
(e) Compound when cooled to 28°F. and then warmed to 100°F. shall show no separation.

(2) The material shall form a thin, flexible transparent film within 12 minutes at 70°F. when spread on a dry concrete surface in reasonably dry atmosphere.

(3) It shall form a continuous coherent film (or membrane) within 12 minutes when spread in a thin film on wet concrete, having a two inch (2") slump, at 70°F. in reasonably dry atmosphere. This film may be semi-transparent.

(4) The film formed by the material shall not combine with the concrete, but shall form a superficial layer over the surface.

(5) The compound shall form a continuous coherent film when sprayed or poured on water.

(6) When dry, the film shall be transparent, flexible and without breaks or pinholes.

(7) The dry film shall be water and moisture proof.

The curing material shall be applied uniformly by means of an approved pressure spray distributor at the rate of one (1) gallon to each 30 sq. yds. of surface and it shall be so applied that the concrete surface is completely coated and sealed at one application. The curing material shall be applied immediately after the concrete surface to be cured has been finished and before any marked dehydration has occurred. After the surface has been coated, it shall be protected from all traffic or abrasive action from any source.

BUILDING PAPER FOR CONCRETE CURING

192. The paper shall consist of an asphalt membrane which is reinforced with fibres or cords completely embedded in the asphalt. The membrane shall be covered on both sides with plain kraft paper.

Building paper used for curing purposes or for protection shall lap at least 4" at any joint. The joints in the paper may be glued together or held in close contact with surfaced wood strips 4" wide and weighted sufficiently to prevent misplacement. The lap shall be made with the top sheet on the high side of the grade. The edges of curing strips shall be firmly held in contact with the ground, forms, or adjoining pavement to make the covering air- and water - tight. This is the important feature of this type of curing.

EMULSIFIED ASPHALT WATERPROOF COATING

193. Emulsified asphalt waterproof coating shall be composed of 60% pure asphalt, 2% inertmineral colloid, and 38% water, thoroughly mixed so that all elements remain indefinitely in suspension. The emulsion shall be of such character that when spread 1/16 inch thick on a steel plate and allowed to dry, it will not run or sag when kept in a vertical position in an oven temperature of 200 degrees F. for two (2) hours.

HYDRATED LIME

194. Hydrated Lime for structural purposes shall conform to the Tentative Standard Specification of A.S.T.M. Designation C6-34T, for two grades known as "Masons Hydrate" and "Finishing Hydrate".

Unless specified otherwise "Masons Hydrate" grade shall be furnished.

SAND FOR ASPHALT MIXES

195. The sand for asphalt mixes shall be a Lake Sand, clean, uncoated, hard grained, free from clay, dirt, coal and all foreign matter or other deleterious substances, and shall come from a source approved by the Director of the Department of Public Works that can furnish at least 500 tons per day, and from which sand has been used satisfactorily in standard sheet asphalt pavements for at least two years.

Sand for asphalt mixes shall conform to the following grading:

1.	Passing 1/4" sieve and retained on 10 mesh sieve	0 - 3%
2.	Passing 10 mesh sieve and retained on 40 mesh sieve	15 - 35%
3.	Passing 40 mesh sieve and retained on 80 mesh sieve	35 - 55%
4.	Passing 80 mesh sieve and retained on 200 mesh sieve	30 - 45%
5.	Passing 200 mesh sieve not more than	5%

These limits shall cover the natural variation in the sources of supply but the Director reserves the right to vary the grading within the limits given, as may be rendered necessary by the character of traffic and other conditions, in order to obtain a dense and stable mixture. River sands, bank sands, and crushed sandstone sands will not be approved.

The sand will be sampled and tested by the Director after delivery. The sampling will be done in such a manner as the Director may require in order to secure representative samples of the lot. Any lot of sand which fails to conform to these specifications shall be subject to rejection, and when rejected shall be removed and disposed of by the Contractor at his own expense.

FILLER FOR ASPHALT MIXES

196. The filler shall be Portland Cement or Limestone Dust. The Portland Cement shall conform with the specifications for such material. The filler shall all pass a thirty (30) mesh sieve and at least eighty (80) percent shall pass a two hundred (200) mesh sieve, and at least fifty (50) percent of all the material passing a two hundred (200) mesh sieve shall be a true dust or flour, as determined by the elutriation method.

Separating Agent

197. Whitewash separating agent shall be prepared by mixing finishing lime and water in the proportions of not less than one and one-half (1-1/2) sacks of lime to fifty (50) gallons of water. The mixture shall be prepared at least one (1) day in advance of using.

Calcium Chloride separating agent shall be used in a solution composed of the following materials in the respective percentages indicated, by weight measurement:

Calcium Chloride	35%
Laundry Starch	1%
Water	64%

POURED JOINT FILLER - (J-1)

198. Material for pouring bituminous expansion joints, in Brick and Blockstone Surfacings, for sealing expansion joints and maintenance of cracks in plain and reinforced concrete street pavements and for bituminous seal specified in other types of concrete construction for maintenance of cracks therein, shall conform to the following requirements:

Asphalt cement: To be heated as required for proper thinning, but not in excess of 375 deg. F. This material shall be an asphalt of 85 to 110 penetration and meeting other requirements of specifications for penetration asphalt in which there has been homogeneously incorporated 15 to 25% by weight, of mineral flour, of such fineness that no appreciable separation of the mixture will occur while being maintained in a liquid condition.

SPECIFICATIONS

	Min.	Max.
Penetration at 25 deg. C., 100 grs. 5 sec.	80	100
Ductility at 25 deg. C. ,,2Cm.	30	...
Inorganic Insoluble in CS, % by weight	15	26
Evaporation loss % by weight, 50 grs. 5 hrs. 163 Deg. C...		2

ASPHALT JOINT FILLER FOR BRICK SURFACING

199. This material shall be an oxidized asphalt, homogeneous, free from water, and shall not foam when heated to 350°F. It shall meet the following requirements:

1. Specific Gravity:
   At 15.6°C (60°F) . . . . . not less than 1.005
   At 25°C (77°F) . . . . . not less than 1.00
2. Flash Point (Cleveland open cup) not less than 243°C (470°F)
3. Melting Point, (ring and ball) Minimum 74°C(165°F) Maximum 82.2°C(180°F)
4. Penetration:
   0°C (32°F) 200 gms. 60 seconds: Minimum - - - - - - 15
   25°C (77°F) 100 gms. 5 seconds: Minimum - - - - - - 30 Maximum - - - 40
   46°C (115°F) 50 gms. 5 seconds: Maximum - - - - - - 90
5. Ductility at 25°C (77°F) - Minimum 5 cms: Maximum 30 cms.
6. Loss at 163°C (325°F) 5 hrs. - not more than 1%
7. Total Bitumen, soluble in carbon bisulphide, Minimum 99%
8. Total Bitumen, soluble in carbon tetrachloride: Minimum 99%

The manufacturer's name with melting point and penetration shall be stencilled on each drum or container. If shipped in tank cars, the manufacturer will be required to furnish a statement of the tests on each car.

AGGREGATE FOR BITUMINOUS MIXES

200. CRUSHED SLAG

Slag furnished under this item shall be a hard, durable, non-vitrified, air-cooled blast furnace product, free from an excess of porous or honeycombed particles. The slag shall be broken into roughly cubical or pyramidal fragments, which are so graded, within the limits specified to produce a uniformly graded material. Presence of granulated slag, cinders, or any soft or foreign material will not be tolerated. Slag aggregate shall weigh not less than 75# per cubic foot for all types of work. When tested in accordance with the A.S.T.M. Specification C-29-27.

CRUSHED LIMESTONE

All stone aggregate shall be of approved quality and shall be obtained from tough, durable rock, source of which to meet the approval of the Director. It shall be crushed and screened to meet the mechanical analysis. The stone shall be free from slaty texture or cleavage planes and shall have a percentage of wear of not more than five (5) and a toughness of not less than six (6). The stone shall meet the requirements of the soundness test. It shall contain not more than five (5) per centum of thin or elongated pieces as determined on a sample representing materials retained on the one and one fourth (1-1/4) inch circular screen. The maximum amount of deleterious substances shall not exceed one (1) per centum of shale or one fourth (1/4) per centum of clay lumps. It shall be reasonably free from coatings of clay, silt, or crusher dust. The total loss by washing shall not exceed one half (1/2) of one (1) per centum.

ASPHALT CEMENT

201. The asphalt cement shall be homogeneous, free from water, and must not foam when heated to 175°C(347 F). It shall conform to the following requirements:

a - Specific Gravity at 25°C (77°F) - not less than 1.010

b - Flash Point, (open cup) not less than 260°C (500°F).

c - Softening Point (ring and ball method) 45°C to 64°C (113°F to 149°F).

d - Penetration at 25°C (77°F) 100 gms., 5 seconds - 50 to 60

e - Ductility at 25°C (77°F) not less than 100 cms.

f - Loss at 163°C., 5 hours: - not more than 1.0%.

1. Penetration of residue at 25°C (77°F)., 100 gms., 5 seconds as compared to penetration before heating - not less than 60%.

g - Bitumen (soluble in carbon bisulphide) - not less than 99.8%.

1. Organic matter insoluble - not more than 0.2%.

2. Inorganic matter insoluble - none.

h - Fixed Carbon - 8 to 20%.

i - Paraffin Scale (Holde Method) - not more than 4.0%.

j - Heterogeneity (Oliensis) - Negative.

202.

AGGREGATE GRADINGS - TABLE

Percent passing circular hole screens

SIZE: NO.	1/8"	1/4"	3/8"	5/8"	3/4"	1"	1-1/4"	1-1/2"	2"	2-1/2"	2-3/4"	3-1/2"	4"	6"
0		85-100	100				Containing (0-30%) passing 100 mesh							
1					95-100	100								
1 A						100	Containing 10 to 25% dust passing No. 100 sieve							
1 B	0-15	10-30				100								
1 C		0-10					95-100	100						
2		0-15					40-60		95-100	100				
2 A														
2 B			0-8	10-40						100	Containing dust of fracture			
2 C		5-25		20-60				85-100	100					
3			0-8	5-20			85-100	100						
3 A						30-65								
3 X				0-5			10-40		35-75	85-100	100			
4					0-20							95-100	100	
4 A						0-10						30-65	100	
6 X						0-15						20-75	85-100	100
													0-20	100

COAL TAR FOR HOT SEAL COATING (A.S.T.M. D108-36T)

203. The tar shall conform to the following requirements:

(a) Water . . . . . 0.00 percent .
(b) Float test at 32°C. (89.6 F.) . . . . . 60 to 150 sec. A_1
150 to 210 sec. A_2

(c) Distillation Test:

Total Distillate, by weight, 0 to 170°C.
(32 to 338°F.) . . . . . not more than 1.00 percent
Total Distillate, by weight, 0 to 235°C.
(32 to 455°F.) . . . . . not more than 10.00 percent

Total Distillate, by weight, 0 to 270°C.
(32 to 518°F.) . . . . . not more than 15.00 percent
Total Distillate, by weight, 0 to 300°C.
(32 to 572°F.) . . . . . not more than 25.00 "
Residue, by weight . . . . . not less than 75.00 "

(d) Specific gravity at 38°C. (100.4°F.) of total distillate to 300° C. (572°F.) . . . . . not less than 1.02
(e) Softening point (Ring-and-Ball Method) of residue from distillation test . . . . . , not more than 65°C. (149°F.)
(f) Total Bitumen (Soluble in Carbon Disulfide) . . . 78 to 95 percent

COAL TAR FOR PRIMING, COLD SEAL COATING (A.S.T.M. - D 104-36T.)

204. The tar shall conform to the following requirements: A maximum specific viscosity, Engler of 40 at 50°C. will be permitted.

(a) Water . . . . . not more than 2.00 percent
(b) Specific viscosity, Engler, 50 cc. at 40°C. (104°F.) . . . 8 to 35
(c) Distillation test on water-free material:

Total Distillate, by weight, 0 to 170°C.
(32 to 338°F.) . . . . . not more than 7.00 percent
Total Distillate, by weight, 0 to 235°C.
(32 to 455°F.) . . . . . not more than 20.00 "
Total Distillate, by weight, 0 to 270°C.
(32 to 518°F.) . . . . . not more than 30.00 "
Total Distillate, by weight, 0 to 300°C.
(32 to 572°F.) . . . . . not more than 35.00 "
Residue, by weight . . . . . not less than 65.00 "

(d) Specific gravity at 25°C. (77°F.) of total distillate to 300°C. (572°F.) . . . . . not less than 1.00
(e) Softening point (Ring-and-Ball Method) of residue from distillation test . . . . . not more than 60°C. (140°F.)
(f) Total Bitumen (Soluble in Carbon Disulfide) . . . 88 to 97 percent

COAL TAR FOR COLD REPAIR WORK (A.S.T.M. D 106-28T)

205. The tar cement shall conform to the following requirements:

(a) Water . . . . . not more than 2.00 percent
(b) Specific viscosity, Engler, 50 cc. at 40°C. (104°F.) . . 35 to 80
(c) Distillation test on water-free material:

Total Distillate, by weight, 0 to 170°C.
(32 to 338°F.) . . . . . 1.00 to 8.00 percent
Total Distillate, by weight, 0 to 235°C.
(32 to 455°F.) . . . . . 8.00 to 20.00 "
Total Distillate, by weight, 0 to 270°C.
(32 to 518°F.) . . . . . 16.00 to 28.00 "
Total Distillate, by weight, 0 to 300°C.
(32 to 572°F.) . . . . . not more than 36.00 "
Residue, by weight . . . . . not less than 64.00 "

(d) Softening point (Ring-and-Ball Method) of residue from distillation test . . . . . not more than 65°C. (149°F.)
(e) Total Bitumen (Soluble in Carbon Disulfide) . . . . 78 to 95 percent

Total Distillate, by weight, 0 to 270°C.
(32 to 518°F.) . . . . . not more than 15.00 percent
Total Distillate, by weight, 0 to 300°C.
(32 to 572°F.) . . . . . not more than 25.00 "
Residue, by weight . . . . . not less than 75.00 "

(d) Specific gravity at 38°C. (100.4°F.) of total distillate to 300° C. (572°F.) . . . . . not less than 1.02

(e) Softening point (Ring-and-Ball Method) of residue from distillation test . . . . . not more than 65°C. (149°F.)

(f) Total Bitumen (Soluble in Carbon Disulfide) . . . 78 to 95 percent

COAL TAR FOR PRIMING, COLD SEAL COATING (A.S.T.M. - D 104-36T.)

204. The tar shall conform to the following requirements: A maximum specific viscosity, Engler of 40 at 50°C. will be permitted.

(a) Water . . . . . not more than 2.00 percent
(b) Specific viscosity, Engler, 50 cc. at 40°C. (104°F.) . . . 8 to 35
(c) Distillation test on water-free material:

Total Distillate, by weight, 0 to 170°C.
(32 to 338°F.) . . . . . not more than 7.00 percent
Total Distillate, by weight, 0 to 235°C.
(32 to 455°F.) . . . . . not more than 20.00 "
Total Distillate, by weight, 0 to 270°C.
(32 to 518°F.) . . . . . not more than 30.00 "
Total Distillate, by weight, 0 to 300°C.
(32 to 572°F.) . . . . . not more than 35.00 "
Residue, by weight . . . . . not less than 65.00 "

(d) Specific gravity at 25°C. (77°F.) of total distillate to 300°C. (572°F.) . . . . . not less than 1.00

(e) Softening point (Ring-and-Ball Method) of residue from distillation test . . . . . not more than 60°C. (140°F.)

(f) Total Bitumen (Soluble in Carbon Disulfide) . . . 88 to 97 percent

COAL TAR FOR COLD REPAIR WORK (A.S.T.M. D 106-28T)

205. The tar cement shall conform to the following requirements:

(a) Water . . . . . not more than 2.00 percent
(b) Specific viscosity, Engler, 50 cc. at 40°C. (104°F.) . . 35 to 80
(c) Distillation test on water-free material:

Total Distillate, by weight, 0 to 170°C.
(32 to 338°F.) . . . . . 1.00 to 8.00 percent
Total Distillate, by weight, 0 to 235°C.
(32 to 455°F.) . . . . . 8.00 to 20.00 "
Total Distillate, by weight, 0 to 270°C.
(32 to 518°F.) . . . . . 16.00 to 28.00 "
Total Distillate, by weight, 0 to 300°C.
(32 to 572°F.) . . . . . not more than 36.00 "
Residue, by weight . . . . . not less than 64.00 "

(d) Softening point (Ring-and-Ball Method) of residue from distillation test . . . . . not more than 65°C. (149°F.)

(e) Total Bitumen (Soluble in Carbon Disulfide) . . . . 78 to 95 percent

COAL TAR FOR PENETRATION MACADAM (A.S.T.M. D110-36T)

206. The tar cement shall conform to the following requirements:

(a) Water . . . . . 0.00 percent
(b) Softening point (Ring-and-Ball Method) . . . . 30 to 40°C. (86 to 104°F.)
(c) Distillation Test:

Total Distillate, by weight, 0 to 170°C. (32 to 338°F.)	not more than	1.00 percent
Total Distillate, by weight, 0 to 270°C. (32 to 518°F.)	not more than	10.00 "
Total Distillate, by weight, 0 to 300°C. (32 to 572°F.)	not more than	20.00 "
Residue, by weight	not less than	80.00 "

(d) Specific gravity at 38°C. (100.4°F.) of total distillate to 300°C. (572°F.) . . . . . not less than 1.02
(e) Softening point (Ring-and-Ball Method) of residue from distillation Test . . . . . not more than 65°C. (149°F.)
(f) Total Bitumen (Soluble in Carbon Disulfide) . . 78 to 95 percent

ASPHALT FOR PENETRATION MACADAM (A.S.T.M. D 102-24T)

207. The asphalt cement shall be homogeneous and free from water. It shall conform to the following requirements:

(a) Penetration at 25°C. (77°F.), 100 g., 5 sec . . . . . 85 to 100
(b) Flash point (open cup) . . . . . not less than 175°C. (347°F.)
(c) Loss on heating at 163°C. (325°F.), 50 g., 5 hr. . . . . not more than 2 percent
Penetration at 25°C. (77°F.), 100 g., 5 sec., of residue after heating at 163°C. (325°F.) as compared with penetration of asphalt cement before heating . . . . . not less than 60 percent
(d) Ductility at 25°C. (77°F.) . . . . . not less than 30 cm.
(e) Proportion of bitumen soluble in carbon tetrachloride . . . . . not less than 99 percent

Note: When less than 99 percent of the asphalt cement is soluble in carbon tetrachloride, the percentage of bitumen (solubility in carbon disulfide) shall be reported.

ASPHALT CUT BACK FOR COLD APPLICATION - (C-1) QUICK SET

208. The material shall be heated if required, to about one hundred and twenty (120) degrees F., or to the required temperature to properly apply to the road.

This material shall be a cut-back asphalt prepared by compounding a suitable volatile naphtha with an asphalt meeting the requirements of the A.S.T.M. Serial Designation D-102-24T. The naphtha when distilled in accordance with A.S.T.M. Method D-86-35 shall yield a residue not exceeding three (3) per centum by volume and shall meet the following requirements:

	Minimum	Maximum
Water, per centum	...	0
Viscosity, Furol at 122°F., sec.	170	200
Distillation, A.S.T.M. D-402-34T		
0--320°F., per centum by volume	2.0	
0--374°F., per centum by volume	11.0	
0--500°F., per centum by volume	19.0	
0--680°F., per centum by volume	...	34.0

The total distillate at 680°F. shall not exceed the distillation fraction of 0--500°F. by more than five (5) per centum.

Distillation residue

	Minimum	Maximum
Penetration 77°F., 100 grs., 5 sec.	80	110
Ductility at 77°F., cm.	50	...
Solubility in carbon disulphide, per centum by weight	99.0	...

ASPHALT CUT BACK FOR COLD APPLICATION - (C-2) SLOW SET

209. The material shall be heated if required, to about one hundred and twenty (120) degrees F., or to the required temperature to properly apply to the road.

This material shall be a cut-back asphalt prepared by compounding a suitable volatile naphtha with an asphalt meeting the requirements of the A.S.T.M. Serial Designation D-102-24T, except the consistency shall be such as to meet the penetration requirements hereinafter specified on distillation residue. The naphtha when distilled in accordance with A.S.T.M. Method D-86-35 shall yield a residue not exceeding three (3) per centum by volume.

The viscosity of the cut-back asphalt will be subject to variations within the limits designated as may be directed. The material shall meet the following requirements:

	Minimum	Maximum
Water, per centum	...	0
Viscosity, Furol at 122°F., sec.	170	230
Distillation, A.S.T.M. D-402-34T		
0--320°F., per centum by volume	...	2.0
0--374°F., per centum by volume	4.0	11.0
0--437°F., per centum by volume	12.0	...
0--500°F., per centum by volume	18.0	...
0--680°F., per centum by volume	...	35.0

The total distillate at 680°F., shall not exceed the distillation fraction of 0-600°F., by more than three (3) per centum.

Distillation residue

Penetration 77°F., 100 grs., 5 sec.	120	150
Ductility at 77°F., cm.	50	...
Solubility in carbon disulphide, per centum by weight	99.0	...

ASPHALT BASE PRIME COATING

210. This material shall be a liquid product readily and completely absorbed by earth, gravel, and broken stone road surfaces, where it hardens in place. It shall meet the following requirements:

a - Specific Viscosity (Engler) 50 cc., at 77°F. 5 to 30
b - Total distillate to 680°F., not more than, by volume 50%
c - Penetration of residue, 77°F., 100 gm. 5 sec., not more than 300
d - Residue soluble in CS_2, not less than 99.0%

ROAD OIL DUST PALLIATIVE - (E-1) ASPHALT

211. This specification covers asphalt road oil for treatment of earth roads. The material shall be a liquid asphaltic oil meeting the following requirements: It shall be free from water and the various hydrocarbons composing it shall be present in homogeneous solution.

Test Requirements

	Minimum	Maximum
Viscosity, Furol, at 25°C., sec.	25	65
Asphaltic content at 100 penetration, per centum by weight (open evaporation not to exceed 260°C.) . .	30	45
Evaporation loss, per centum by weight, 20 grams, 5 hrs., 163°C.	15	35
Solubility in carbon disulphide, per centum by weight	99.0	--
Bitumen insoluble in 86°Cpar naphtha, per centum by "	4.0	--
Flash point, open cup °C.		

Form 106

BITUMINOUS SURFACING HE-1. (AMESITE) COLD MIX

217. The surfacing shall consist of two (2) courses of asphaltic concrete (cold mixture) and a mineral aggregate covering, and shall be constructed on the prepared base course.

It shall have an approximate total thickness, after compression under the roller, as specified or indicated on the drawings.

The Asphalt Cement shall conform to the requirements of the A.S.T.M. Designation D102-24T.

Petroleum Naphtha.

The naphtha shall be a petroleum distillate, which when distilled in accordance with the American Society for Testing Materials, Serial Designation D 86-30, shall comply with one of the following requirements:

	Initial Boiling Point °F. Minimum	Dry Point °F. Maximum	Maximum
Warm weather construction	110	220	450
Cold weather construction	200	275	500

The grade of naphtha to be used shall be as directed by the Director, dependent on the season of the year when the mixture is to be prepared and placed.

The Mineral Aggregates shall be stone or slag as specified.

The mineral aggregates and filler shall conform to the following mechanical analysis:

	Total Per Centum by Weight Passing Circular Openings (Based on Laboratory Screen Tests)					
Material	1/8"	1/4"	5/8"	3/4"	1-1/2"	2"
Bottom Course		0-5		10-30	65-85	100
Top Course	0-15	10-30	95-100	100		
Filler (both 100)		(Containing dust of fracture but having not in excess of fifty (50) per centum passing a No. 50 mesh sieve.)				

Surface Covering Material

This material shall consist of approved, clean, dry, coarse sand, slag or stone screenings of such size as will pass a laboratory screen having circular openings one-quarter (1/4) of an inch in diameter.

Hydrated Lime shall be "Masons Hydrate" conforming to the requirements of the A.S.T.M. Designation C 6-34T.

COMPOSITION & PREPARATION

All mineral aggregates and asphalt cement shall be proportioned by weight. An approved method of weighing shall be used to insure positive control of the required amounts of materials.

The petroleum naphtha shall be accurately measured either by an approved gauging or metering device.

The hydrated lime may be measured by volume on the basis of volume-weight relation.

The mixture composed of the following specified ingredients shall be combined in the following percentages by weight, as may be ordered by the Director, within the limits specified.

	Two Courses			
	Bottom Course		Top Course	
	Min.	Max.	Min.	Max.
Mineral Aggregate . . . . . %	82.0	89.0	83.0	89.0
Filler . . . . . %	5.0	10.0	5.0	8.0
Asphalt Cement . . . . . %	3.0	5.8	5.0	7.0
Hydrated Lime . . . . . %	0.5	1.0	0.5	1.0
Petroleum Naphtha . . . . . %	0.35	0.8	0.35	0.8

All aggregate shall be thoroughly dry. When necessary to heat the aggregates, the maximum permissible temperature of the mineral aggregate, as determined on the mixing platform, shall not exceed one hundred and ten (11)0 degrees F.

The asphalt cement shall be heated at the plant in kettles or tanks designed to secure uniform heating and mixing of the entire contents and shall be brought to a temperature ranging from a minimum of two hundred and fifty (250) to a maximum of three hundred (300) degrees F.

Mixing shall be effected in an approved twin pug-mill type of mixer suitably steam jacketed for efficient mixing at the lower air temperatures. The required quantities of the various materials entering into the composition of the mix shall be measured separately and accurately. The mineral aggregate, naphtha, asphalt, cement, filler and lime shall be introduced into the mixer in the order named and a sufficient interval of time allowed to elapse after the addition of each material to allow thorough incorporation prior to the introduction of the next ingredient. The naphtha shall be sprayed over the stone. The asphalt cement, filler, and lime shall be introduced in such a manner that they will be equally distributed over the mass and not deposited in one place. The minimum mixing time shall be not less than two and one-half (2-1/2) minutes, and the time shall be computed from the time the asphalt cement is added and the mixing shall be continued until a thorough homogeneous mix results.

The surface mixtures shall be hauled to the project in tight vehicles previously cleaned of all foreign materials and when required by the Director the loads shall be protected by a waterproof cover. Dispatching of vehicles shall be arranged so all materials delivered may be placed and shall have received initial compression in daylight.

BITUMINOUS SURFACING, HE-10 (AMESITE) COLD MIX

218. The surfacing shall consist of two courses of asphaltic concrete (cold mixture) formed by an intimate mixture of mineral aggregate, filler, lime, and cut-back emulsified asphalt.

Cut-back Emulsified Asphalt: This material shall be a cut-back emulsified asphalt prepared by compounding a suitable volatile naphtha with an asphalt meeting requirements of the A.S.T.M., Serial Designation D 102-24T. The prepared material shall conform to the following requirements, in which the viscosity will be subject to variation within the limits designated as may be directed.

	Minimum	Maximum
Miscibility with water	. . . .	None
Stone mixing test	Must coat wet aggregate	
Flash - open cup (Tag)	110	
Settlement Test 5 days at 77°F.	None	None
Freezing Test (15 hrs. below 30°F.)	Homogeneous	
Furol Viscosity at 104°F.	600	1000
Evaporation Loss (A.S.T.M. Oven)	15%	35%
Naphtha Content	10%	30%
Water Content - Xylol distillation	4%	12%
Ash	0.2%	1.0%

Tests on Residue	MINIMUM	MAXIMUM
Specific Gravity at 60°F.	1.00 plus	
Percentum soluble CS_2	98%	99.5%

The Mineral Aggregates shall be slag or stone as specified.

The mineral aggregates, filler and surface covering material shall conform to the following mechanical analysis:

	Total Per Centum by Weight Passing Circular Openings. (Based on Laboratory Screen Tests)						
Material	1/8"	1/4"	3/8"	1/2"	5/8"	1-1/4"	1-1/2"
Bottom Course			0 - 8		10-40	85-100	100
Top Course	0-15	30-65	90-100	100			

Filler (both courses)100 (Containing dust of fracture but having not in excess of fifty (50) per centum passing a No. 50 mesh sieve).

Surface covering material. 100 (Containing dust of fracture).

Surface Covering Material

This material shall consist of approved, clean, dry, coarse sand or stone screenings of such size as will pass a laboratory screen having circular openings one-quarter (1/4) of an inch in diameter.

Hydrated Lime

The lime shall be "Masons Hydrate" conforming to the requirements of the American Society for Testing Materials, Serial [illegible] 6-34T.

COMPOSITION AND [illegible]

All mineral aggregates an[illegible] by weight. An approved method of [illegible] of the required amounts of materials [illegible] on the basis of volume-weight relation[illegible] specified ingredients shall be combi[illegible] may be ordered by the Director within the l[illegible].

		Two Courses			
		Bottom Course		Top Course	
		Min.	Max.	Min.	Max.
Mineral Aggregate	%	82.0	89.0	85.0	90.0
Filler	%	5.0	10.0	4.0	7.0
Asphalt Cement	%	3.5	5.8	5.0	7.0
Hydrated Lime	%	0.5	1.0	0.5	1.0

The amount by weight of cut-back emulsified asphalt used shall be such as to furnish an asphalt cement residue on the aggregate as is required above.

When necessary to heat the aggregates, the maximum permissable temperature of the mineral aggregates, as determined on the mixing platform, shall not exceed one hundred and ten (110) degrees F. All aggregate must be dry.

Mixing shall be effected in an approved twin-pug-mill type of mixer suitably steam jacketed for efficient mixing at the lower air temperatures. The required quantities of the various materials entering into the composition of the mix shall be measured separately and accurately. The mineral aggregate, cut-back emulsified asphalt, filler, and lime shall be introduced into the mixer in the order named and a sufficient interval of time allowed to elapse after the addition of each material

to allow thorough incorporation prior to the introduction of the next ingredient. The cut-back emulsified asphalt, filler, and lime shall be introduced in such a manner that they will be equally distributed over the mass and not deposited in only one place. The mixing shall be continued until a thorough homogeneous mix results, and all aggregate is thoroughly coated.

BITUMINOUS SURFACING, JC-1. COLD MIX (COLPROVIA)

219. This bituminous surfacing shall be composed of two courses of asphaltic concrete composed of hard asphalt, asphaltic flux oil, fine aggregate and filler, meeting the specifications hereinafter stipulated.

Materials

The asphalt shall be used in two (2) component parts; a grade of asphalt hard enough to be reduced to powder in an impact mill, and a grade of asphaltic flux oil which is capable of complete amalgamation with the hard asphalt.

(1) Hard Asphalt. The hard asphalt shall be homogeneous and shall meet the following requirements:

	Minimum	Maximum
Solubility in carbon disulphide	99%	. . . .
Solubility in carbon tetrachloride	95%	
Penetration at 115°F., 100 gr., 5 sec.	5	15
Penetration at 77°F., 100 gr., 5 sec.	2	5
Softening Point (ring and ball method), °F.	240	275

The hard asphalt shall be reduced to powder in an impact mill. As used, not less than fifty (50) per centum shall pass an eighty (80) mesh screen, and ninety five (95) per centum shall pass a twenty (20) mesh screen.

(2) Asphaltic Flux Oil. The asphaltic flux oil shall be homogeneous and free from water. It shall be capable of complete amalgamation with the hard asphalt and shall meet the following requirements:

	Minimum	Maximum
Specific gravity at 77°F.	0.97	-
Viscosity Furol at 122°F.	600	800
Evaporation loss, per centum by weight 50 Grs., 5 hrs., at 325°F.		5

(3) Hard Asphalt and Flux. The hard asphalt and flux oil as received at the mixing plant shall be of such characteristics that a combination between forty-five (45) and fifty-five (55) per centum of either component will produce an asphalt cement of seventy (70) penetration.

In manufacturing the pavement mixtures, the hard asphalt and flux oil shall be mixed in such proportions as will produce, when completely amalgamated, an asphalt cement of the penetration required by the Director.

(4) Asphalt Cement. The asphalt cement resulting from the foregoing combination shall meet the following requirements for physical and chemical properties:

	Minimum	Maximum
Specific Gravity at 77°F.	1.02	. . .
Flash Point °F.	347	
Penetration at 77°F., 100 gr., 5 sec.	50	80
Ductility at 77°F.	15	-
Evaporation loss at 325°F., 100 gr. 5 hrs., per centum		3
Penetration of residue at 77°F., 100 gr. 5 Sec. as per centum of original penetration	50	-
Total bitumen soluble in carbon tetrachloride %	98	-

(5) Fine aggregate. The sand shall consist of clean, hard, durable grains, free from clay, loam, or other foreign or deleterious substances and shall conform to the mechanical analysis hereinafter specified.

Passing 1/4" sieve and retained on 10 mesh sieve	0 - 5%
Passing 10 mesh sieve and retained on 40 mesh sieve	15 - 35%
Passing 40 mesh sieve and retained on 80 mesh sieve	35 - 55%
Passing 80 mesh sieve and retained on 200 mesh sieve	30 - 45%
Passing 200 mesh sieve	0 - 5%

(6) Filler. The filler for sand sheet asphalt shall be thoroughly dry limestone dust, all of which shall pass a thirty (30) mesh sieve, at least eighty (80) per centum of which shall pass a two hundred (200) mesh sieve.

All materials for this work shall be subject to inspection either prior to their delivery or at the mixing plant. Any reasonable quantity of material for testing purposes to determine compliance with these specifications and suitability for these processes may be demanded at any time. Approval of sources of supply of the materials shall be obtained from the Director prior to delivery and samples of each shall be submitted as directed by the Director. Unless otherwise specified, all tests of materials shall be conducted in accordance with the latest Tentative Standards of the American Society for Testing Materials or the American Association of State Highway Officials.

COMPOSITION & PREPARATION

The various components shall be combined in such proportions by weight as to produce mixtures complying with the composition limits hereinafter specified. The proportions may be varied by the Director within these designated limits.

The mixtures shall be made in approved pug (twin) mill or other type of mixer approved by the Director. The various components of the specified mixtures shall be separately and accurately weighed for each batch to be mixed.

The mineral aggregates, if wet, shall be surface dried at the mixing plant in suitable driers. They shall reach the mixing platform at a temperature not exceeding one hundred and ten (110) degrees F. The hard asphalt shall be reduced to a powder in an impact mill, and as such shall be delivered to the mixer. The flux oil shall be used at a temperature not exceeding one hundred and twenty-five (125) deg. F.

The mixer shall be charged with the mineral aggregates including (optionally) the filler. After this has been thoroughly mixed, the flux oil shall be added and the mixing continued until every particle of the aggregate is entirely coated with the oil. A weighed quantity of the pulverized asphalt shall then be added, either alone or in combination with part or all of the filler, and the mixing continued until the pulverized asphalt is evenly distributed throughout the mixture, when it will be ready for discharge from the mixer.

When the mixture is to contain limestone filler, this filler may be introduced either alone, or partially or wholly in conjunction with the pulverized asphalt.

Composition of Surface Course

Total per centum by weight Passing and Retained on Laboratory sieve size

Mechanical Analysis		
Passing	Retained	Per Centum
No. 4 sieve	No. 10 sieve	0 -- 5%
No. 10 "	No. 40 "	8 -- 28%
No. 40 "	No. 80 "	20 -- 48%
No. 80 "	No. 200 "	12 -- 36%
No. 200 "		12 -- 17%
Bitumen soluble in carbon disulphide (CS_2)		9.5-12.5%

Composition of Binder Course

This binder course shall be composed of hard asphalt, asphaltic flux oil, coarse aggregate and fine aggregate and shall conform to the following requirements:

The coarse aggregate to be used in the asphaltic binder shall consist of broken limestone or air cooled slag and when tested by means of Laboratory sieves shall conform to the following grading:

Passing 1-1/4" sieve	100%
Passing 1-1/4" and retained on 1" sieve	0 - 5%
Passing 1" and retained on 1/2" sieve	50 - 80%
Passing 1/2" and retained on 1/4" sieve	20 - 50%
Passing 1/4" sieve	0 - 10%

The various components shall be combined in such proportions by weight as to produce a mixture with the following materials within the respective percentages indicated, by weight measurement.

Bitumen soluble in Carbon Disulphide (CS_2)	4 - 6%
Coarse Aggregate (1-1/4" to 1/4")	58 - 80%
Fine Aggregate	16 - 36%

BITUMINOUS SURFACING, JC-2. COLD MIX (TRINIDASCO)

220. This surfacing shall consist of two (2) courses of asphaltic concrete, composed of mineral aggregate, flux, pulverized asphalt and mineral filler, each of the kind and quality hereinafter specified. It shall be prepared under suitable conditions to produce a pavement which can be mixed, and laid at atmospheric temperatures, not below 60°F. upon a properly prepared base.

Materials

The mineral aggregate for the two courses shall be composed of broken stone and sand, as hereinafter specified. The sand shall be composed of angular grains, free from clay or loam, all of which will pass an eight (8) mesh sieve and not less than 95% be retained on a 200 mesh sieve. Either sand or stone screenings of equivalent grading may be used as fine aggregate.

The coarse aggregate for the Bottom Course with Large aggregate shall meet the following requirements:

Passing 4 mesh sieve	Not over 5%
" 3/4 in. Screen, retained 4 mesh sieve	10 - 30%
" 1-1/2 in. Screen, retained 1 in. screen	95 - 100%
" 2 in. Screen	100%

The coarse aggregate for the Asphaltic Concrete Top Course shall meet the following requirements:

Passing 8 Mesh Sieve	Not over 5%
" 1/4 in. Screen, retained 8 Mesh Sieve	10 - 35%
" 5/8 in. Screen, retained	95 - 100%
" 3/4 in. "	100%

The asphalt shall have characteristics within the following requirements:

It must be homogeneous

Penetration at 77°F. 100 gr. 5 sec.	Not less than 2 nor more than 6
Melting Point, R & B method	Not less than 200°F., nor more than 212°F.

Mineral Filler (Ash)	Not less than 33 nor more than 37%
Percent of Bitumen soluble in Carbon Tetrachloride	Not less than 99.8%

This asphalt shall be pulverized in an impact mill just prior to its use in the mixture to such a degree of fineness that not less than 95% will pass a 10 mesh sieve. To facilitate pulverizing, all or a portion of the mineral filler required may be passed through the mill with the asphalt, and within proper ratio thereto, or the asphalt may be pulverized in the presence of moisture.

The flux shall consist of not less than 55% by weight of a liquid bituminous flux of the character hereinafter specified properly treated and emulsified and suitable for the purpose intended.

Viscosity Furol at 212°F.	40 to 200 sec.
Specific Gravity at 77°F.	Not over 1.02
Solubility in Carbon Disulphide	Not less than 99.5%
Loss on heating 5 hrs. @ 325°F.-50 grams	Not more than 5.0%

After treatment and emulsification the flux shall contain not more than 45% of water or other volatile material.

When this emulsified bituminous flux and the asphalt in suitable proportions are carefully heated until dry and then raised to a temperature not to exceed 350°F. and thoroughly mixed together, the penetration of the resulting asphalt cement shall be not less than 80 nor more than 125 when tested at 77°F. 100 gr. for 5 sec., and the ductility thereof at 77°F. shall be not less than 40 cms. A penetration of the asphalt cement for any contract between the limits of 80 and 125 may be required by the Director of the Department of Public Works.

COMPOSITION AND PREPARATION

The composition of the mixtures apart from their volatile constituents will depend upon the character and grading of the mineral aggregate but they shall be such as will produce mixtures, proportioned to the best advantage from the materials hereinbefore specified, showing no excess or deficiency of bitumen, and within the following limitations:

	Large Aggregate Bottom Mixture	Asphaltic Concrete Top Mixture
Coarse Aggregate-Retained 8 mesh sieve	70 to 82%	70 to 85%
Fine Aggregate-Passing 8 mesh sieve	15 to 25%	10 to 20%
Filler-Passing 200 mesh sieve	0.5 to 4%	0.5 to 5%
Bitumen	3 to 5%	4 to 6%

Note: - The use of hydrated lime or equivalent mineral flocculating agent to the extent of 1% of the mixture is permitted.

The mineral aggregate, flocculating agent, emulsified flux, pulverized asphalt and filler shall be weighed accurately for each batch to be mixed. The mixture shall be made in a mixer of the twin pug type by introducing the several materials specified, in proper sequence, to produce a homogeneous mixture in which all particles of the mineral aggregate are coated with bitumen. To insure this result, the coarse aggregate may be coated with flux before introducing the fine aggregate, or the pulverized asphalt.

The mineral aggregate shall be sufficiently dry to permit it to be screened and otherwise handled readily in the plant equipment available for the work, but not warmer than 125°F. It should, preferably, be air dried and shall contain not more than two percent (2%) moisture. Any moisture present shall be compensated for when weighing the mineral aggregate for use in the mixture.

These mixtures may be laid directly after they are produced or after a lapse of several months in storage. If not laid the same day they are prepared, or when shipped by rail, they shall be covered closely with a tarpaulin or waterproof paper to prevent evaporation and to exclude accidental impurities. Should they become partially caked in storage or during shipping or chilled by low atmospheric temperatures, they shall be disintegrated by suitable mechanical means or warmed with live steam before they are spread and raked on the road.

Sheet Asphalt Surface Course (Cold Type).

This course shall consist of cold laid sheet asphalt composed of coarse sand or stone screenings, flux pulverized asphalt, hydrated lime, and mineral filler, each of the kind and quality hereinafter specified.

Materials

All materials entering into the construction of the asphalt surface course under these specifications shall conform to the requirements hereinafter stated.

The mineral aggregate shall consist of (a) natural sand or (b) stone screenings.

Natural sand shall consist of clean, hard and angular grains free from concretetions and loose bonded aggregates and other foreign materials. It shall contain not more than 3% passing a #200 sieve when washed with water and consist of mixed sizes of particles in suitable proportions to produce sand mixture (a) as given under composition and preparation of mixture.

The stone screenings shall be produced from approved rock having a toughness of not less than 6. It shall be free from all foreign materials, shall contain not more than 15% passing a #200 sieve and consist of mixed sizes of particles in suitable proportions to produce stone aggregate mixture (b) as given under composition and preparation of mixture.

The portion of the aggregate which will pass a #200 sieve shall be considered as part of the mineral filler content of the asphalt mixture.

Added mineral filler shall consist of dry pulverized silica, limestone or other sound, natural rock, all of which will pass a 50 sieve and not less than 75% pass a 200 sieve. The mineral filler used shall be of such nature as will function to the best advantage in the mixture and its manufacture.

The hydrated lime shall comply with the A.S.T.M. standard specification C 6-31.

The asphalt cement shall consist of two component parts: an asphalt sufficiently hard to be pulverized in an impact mill, and a liquid petroleum flux (emulsified) which will amalgamate with the hard asphalt.

This material shall be homogeneous and have characteristics within the following requirements:

	Minimum	Maximum
Penetration at 77°F. 100 g. 5 sec.	2	6
Melting Point (ring & Ball)	200°F.	212°F.
Mineral Filler (Ash)	33%	37%
Proportion of bitumen (by CS_2) which is soluble in carbon tetrachloride	99.8%	

This asphalt shall be introduced into the paving mixture in pulverized form, combined with hydrated lime or other mineral filler. When this asphalt is added to the paving mixture it shall be pulverized to such a degree of fineness that not less than 95% thereof will pass a #10 laboratory sieve.

The liquid petroleum flux, before emulsification, shall meet the following requirements:

	Minimum	Maximum
Viscosity Furol at 180°F.	100 Sec.	150 Sec.
Specific Gravity at 77°F.	0.92	1.02
Solubility in Carbon Disulphide	99.5%	----
Loss on heating 5 hrs. at 325°F.	-----	5.0%
Flash - open cup	300°F.	----

After treatment and emulsification of this flux, the emulsion shall have Furol viscosity at 77°F. between 100 and 800 seconds and shall contain from 68 to 70% bituminous residue by evaporation, soluble in CS_2.

For purposes of test, a sample of the flux before it is emulsified and of hard asphalt before it is pulverized, may be required by the Engineer.

When the emulsified petroleum flux and the hard asphalt hereinbefore specified in suitable proportions, are carefully heated until dry and then raised to a temperature not to exceed 350°F. and thoroughly mixed together, the penetration of the resulting asphalt cement shall be within the range specified for the mixtures, and the ductility of the asphalt cement shall be not less than 40 cm. at 77°F.

The emulsified flux shall be used at a temperature not exceeding 125°F.

COMPOSITION AND PREPARATION

All mineral aggregates, hard asphalt and emulsified flux shall be proportioned by weight. Approved methods of weighing shall be used to insure positive control of the required amounts of materials.

The mineral aggregate shall be clean at all times, and sufficiently dry and warm to permit it to be screened and otherwise handled readily in the plant equipment available for the work. It shall, if necessary, be heated to a temperature most suitable for the mixture, but shall not be cooler than 80°F. nor warmer than 145°F. when delivered to the mixer. The grading of the mineral aggregate at the weigh box shall comply with the requirements for mixtures (a) or (b) as specified.

The mixture shall be prepared in an approved mixer, by mixing the mineral aggregate, with or without all or a portion of the mineral filler, with the flux until all its particles are coated with the flux. The pulverized asphalt, lime and filler shall then be introduced and the mixing continued until these materials are evenly distributed throughout the batch.

The minimum mixing time shall be not less than one minute after the bituminous flux has been introduced and shall be continued after all the ingredients have been added to the mixture and until all particles of the mineral aggregate are coated with bitumen and a homogeneous mix results.

Mixtures not laid the same day they are prepared or when shipped by rail shall be covered closely with tarpaulins or waterproof paper to prevent evaporation and to exclude accidental impurities. When necessary to facilitate unloading from cars or handling from storage piles, the mixtures shall be disintegrated by suitable means. If steam is used for this purpose, the steam shall be dry, the pressure shall not exceed 15 pounds per square inch, and the mixture shall not be steamed more than 15 minutes in any one place. Mixtures excessively steamed or contaminated with foreign materials shall not be laid. All unloading shall be done under the direction of the engineer.

The prescribed constituents shall each comply with the detail requirements therefor as specified under (a) and (b) respectively, and shall be combined in such manner and in such proportions as to produce a mixture conforming to the following composition limits by weight.

		(a) Coarse Sand	(b) Stone Screenings
Passing #4	Retained #4 Sieve	0 - 5%	0 - 5%
" 10	" 10 "	5 - 15	0 - 45
" 40	" 40 "	20 - 55	10 - 45
" 80	" 80 "	20 - 40	5 - 35
Filler & Lime Passing	" 200 "	5 - 15	2 - 30
Bitumen (Soluble CS_2)	200	6 - 12	8 - 18
		7 - 9	8 - 10
Hydrated Lime, % of mix		1/2 - 3	1/2 - 3
Penetration Asphalt Cement at 77°F.		50 - 80	50 - 85

Note: The proportions by weight of hard asphalt, emulsified flux and mineral matter to produce mixtures complying with the compositions specified will be approximately as follows:

Hard Asphalt	6.8 - 9.8%	7.7 - 10.9%
Emulsified Flux	4.7 - 5.3	5.3 - 5.9
Mineral Aggregate & Filler	88.5 - 84.9	87.0 - 83.2
	100.0 -100.0	100.0 - 100.0

BITUMINOUS SURFACING, FP-1A SLAG AGGREGATES

ASPHALT PREMIX COLD TYPE

221. This surfacing shall consist of two courses composed of crushed slag (No. 2-B for bottom course and No. 1-B for top course) coated with asphalt emulsion or asphalt cut back by a mixing process in an approved batch type pug mill mixer of at least one (1) ton capacity. This surface course shall have a thickness of two (2) inches after compression under the roller, before application of a seal coat, unless otherwise specified or indicated on the drawings, and constructed on a prepared base course.

Materials

(1) Asphalt Cut-back (C-1), for surface mixture and seal coat.

(2) Asphalt Cut-back (C-2), for seal coat.

(3) Asphalt Emulsion (A.S.T.M. D 401-36T), for seal coat.

(4) Asphalt Emulsion (A.S.T.M. D 397-36T), for surface mixture.

(5) Slag Aggregates:
No. 2-B, for base course.
No. 1-B, for top course.

COMPOSITION & PREPARATION

The amount of asphalt residue on the slag when the No. 2-B size is used shall be not less than three and one-half (3-1/2%) percent by weight. When the No. 1-B size slag is used the asphalt residue shall be not less than four and one-half (4-1/2%) percent by weight. The bituminous material shall thoroughly coat the slag and shall form a film of sufficient thickness to furnish the desired binding properties and meet with the approval of the Director. Should the amount of asphalt residue on the slag fall below the above allowable minimum, the Director may require its removal, or at his discretion may permit the amount of bitumen to be raised by the application of an approved amount of the specified asphalt sprayed on the surface with a power distributor.

The slag shall be dry and at a temperature of not more than one hundred and ten (110) degrees F. The asphalt cut-back at time of use shall have a temperature of not more than one hundred and ten (110) degrees F. as may be required to obtain proper fluidity with no excess loss of solvent.

In this mixing process, the No. 2-B slag aggregate and bituminous material shall be proportioned by weights, and sufficient mixing time will be required to thoroughly and uniformly coat all slag particles.

(2) Delivery of Bituminous Mixture. The bituminous mixture shall be hauled to the project in tight vehicles previously cleaned of all foreign materials and when required by the Director the loads shall be protected by a waterproof cover. The dispatching of the vehicles shall be arranged so that all material delivered may be placed and shall have received initial rolling in daylight.

BITUMINOUS SURFACING, FB-1 T. SLAG AGGREGATES TAR PREMIX COLD TYPE

222. This surfacing shall consist of two courses composed of crushed slag (No. 2-B for bottom course and No. 1-B for top course) coated with High Carbon Tar Cement for use Cold in Repair Work by a mixing process in an approved batch type pug mill mixer of at least one (1) ton capacity. This surface course shall have a thickness of two (2) inches after compression under the roller, before application of a seal coat, unless otherwise specified or indicated on the drawings, constructed on a prepared base course.

Materials

(1) High Carbon Tar Cement for use Cold in Repair Work (A.S.T.M. D 106-28T), for surface mixture.

(2) Coal Tar for Hot Seal Coating, (A.S.T.M. D 108-30), for hot seal coating.

(3) Coal Tar for Cold Seal Coating (A.S.T.M. D 104-30), for cold seal coating.

(4) Slag Aggregate.
No. 2-B, for base course.
No. 1-B, for top course.

COMPOSITION & PREPARATION

The amount of tar residue on the slag when the No. 2-B size is used shall be not less than three and one-half (3-1/2%) percent by weight. When the No. 1-B size slag is used for the tar residue shall be not less than four and one-half (4-1/2%) percent by weight. The bituminous material shall thoroughly coat the slag and shall form a film of sufficient thickness to furnish the desired binding properties and meet with the approval of the Director. Should the amount of tar residue on the slag fall below the above allowable minimum, the Director may require its removal, or at his discretion may permit the amount of bitumen to be raised by the application of an approved amount of the specified tar sprayed on the surface with a power distributor.

The slag shall be dry and at a temperature of not more than one hundred and ten (110) degrees F. The tar cut-back at time of use shall have a temperature of not more than one hundred and ten (110) degrees F. as may be required to obtain proper fluidity with no excess loss of solvent.

In this mixing process, the No. 2-B or 1-B slag aggregate and bituminous material shall be proportioned by weights, and sufficient mixing time will be required to thoroughly and uniformly coat all slag particles.

Delivery of Bituminous Mixture

The bituminous mixture shall be hauled to the project in tight vehicles previously cleaned of all foreign materials and when required by the Director the loads shall be protected by a waterproof cover. The dispatching of the vehicles shall be arranged so that all material delivered may be placed and shall have received initial rolling in daylight.

BITUMINOUS SURFACING GR-1. SANDSTONE AGGREGATES COLD NATURAL KENTUCKY ROCK MIXTURES

223. This surfacing shall consist of a rock asphalt wearing surface (cold mixture) having a thickness of one and one-half (1-1/2) inches after final compression under the roller, unless otherwise specified or indicated on the drawings, and constructed on a prepared base course.

The rock asphalt shall be a mixture of bituminous sandstone. It shall be used as mined, with no preparation other than crushing and grinding. No bitumen, fine aggregate, or other material shall be mixed with the rock asphalt. It shall be crushed so that when tested by means of laboratory sieves it shall meet the following requirments by weight:

Passing 1" sieve not less than	100%
Passing 3/4" sieve not less than	80%
Passing 1/2" sieve not less than	70%

The bitumen in the rock asphalt shall be not less than six (6) or more than seven and one-half (7-1/2) per centum.

The sand in the rock asphalt shall contain not less than ninety-five (95) per centum silica (SiO_2) and when tested by laboratory sieves it shall meet the following requirements by weight:

Sieves Passing	Retained	Percentage
No. 200		
No. 80	No. 200	4.0 to 15.0
No. 40	No. 80	6.0 to 25.0
No. 10	No. 40	45.0 to 75.0
No. 8	No. 10	1.0 to 25.0
		0.0 to 8.0

Each carload of rock asphalt shall be sampled immediately upon its delivery to the project and its use withheld pending recommendations from the laboratory based on tests in order to determine its conformity to these requirements.

If at any time rock asphalt should become contaminated with any foreign material making it unsatisfactory for use, the material shall be rejected.

BITUMINOUS SURFACING. GR-2. SANDSTONE AGGREGATES

224. This surfacing shall be a processed rock asphalt wearing surface composed of an intimate mixture of heated ground natural bituminous sandstone from recognized deposits, and hot asphalt cement.

Materials

(a) The natural bituminous sandstone shall contain not less than 5.0% (loss on ignition) by weight of bitumen native to the rock. It shall be free from dirt, vegetable and other foreign matter. The sand in the rock asphalt shall be composed of not less than 95% of silica which shall be sharp angular grains. The bituminous sandstone shall be thoroughly ground before it is mixed with the asphalt cement. When tested with laboratory sieves (square openings) it shall comply with the following grading:

Retained on 3/4 inch sieve	0%
Retained on 1/2 inch sieve, not more than . .	1%
Retained on No. 4 sieve, not more than	8%

The quarries and plant producing the bituminous sandstone used in making the product furnished under these specifications shall be shown to have previously produced material which meets these specifications, and which has been previously used in construction which has given satisfactory service. When requested, the producers shall furnish a certificate setting forth the daily shipping capacity of the plant or plants from which the material is to be shipped. Approval of the sources

of supply of the bituminous sandstone shall be obtained from the Director prior to delivery of the material. Samples shall be submitted as directed.

(b) The asphalt cement shall be homogeneous and shall conform to the following requirements:

	Minimum	Maximum
Specific Gravity at 77 deg. F.	1.00	
Penetration at 77 deg. F. 100 g., 5 sec.	150	175
Ductility at 77 deg. F. (Pull at rate of 5 cm per minute)	150	
Ductility at 39.2 deg. F. (Pull at rate of 1/4 cm. per minute)	12	
Loss - 50 grams. 5 hrs. at 325 deg. F.		1.0%
Penetration of Residue at 77 deg. F.	Not less than 75% of original penetration at 77 deg. F.	
Spot Tests (Oliensis)	Negative	
Solubility in CCl_4	99.6	
Paraffin Scale		2.0%

The plant for combining the materials shall have a twin pug mill mixer of steam jacketed type. The bituminous sandstone shall be dried and heated in a suitably designed and approved revolving dryer. When internally fired, care shall be taken to so adjust or baffle the burner that the flames do not come in direct contact with the bituminous sandstone and produce overheating and burning. An accurately registering pyrometer shall be installed at a suitable point at the discharge end of the dryer with the registering device so located as to clearly indicate to the drum fireman the temperature of the mineral aggregate, when discharged.

COMPOSITION AND PREPARATION

When placed in the mixer, the temperature of the bituminous sandstone shall be between 200 Deg. F. and 285 Deg. F. No sandstone that has been heated beyond 285 deg. F. shall be used in the mixture. The asphalt cement shall be heated in kettles or other suitable appliances so designed as to secure even heating of the entire mass with an efficient and positive control of the heat at all times. Direct flames shall not come in content with the heating kettles. All asphalt lines and fittings shall be steam jacketed. The asphalt shall be heated between 275 Deg. F. and 325 Deg. F. and delivered to the mixer when between these temperatures.

The plant or plants in which the mixture is made shall be of such capacity as to produce acceptable material at a rate to comply with the terms of the contract.

The bituminous sandstone and asphalt cement shall be measured separately by weight for each batch. The hot bituminous sandstone shall first be added to the mixer, and while the mixer is in operation the asphalt cement shall be added over the full length of the mixer. After all ingredients are placed in the mixer the mixing shall continue for a period of not less than one minute and longer if necessary to produce a homogeneous mixture.

The quantity of asphalt cement shall be such as to produce the specified finished product. The mixture in the various batches shall be reasonably uniform in bitumen content. The temperature of the different batches shall not vary more than 30 deg. F. from the temperature set by the Director. The hot mixture shall be delivered on the work at such temperature that it will readily spread and rake to a smooth uniform surface.

The finished mixture shall have a loss of ignition of not less than 6.8% nor more than 8.0%. Its bitumen content by extraction shall be not less than 5.9% nor more than 7.3%.

BITUMINOUS SURFACING, GR.-3 LIMESTONE AGGREGATES

225. This Surfacing shall be a processed rock asphalt, wearing Surface composed of an intimate mixture of ground natural bituminous limestone, sand, and asphalt cement (hot mixture).

Materials

(a) The unprocessed rock asphalt shall be a natural asphaltic limestone, uniform in quality and containing not less than four (4) percent of native asphalt, by extraction, or more than ninety six (96) percent of limestone shall be practically free from sulphates, alumina, and any but minute shells. It shall be so crushed and pulverized that not less than ninety (90) percent will pass a 2 mesh sieve. The Contractor shall secure the Producer's statement showing the analysis for bitumen content of each car of rock asphalt.

(b) The asphalt cement to be incorporated with the asphaltic limestone shall be homogeneous, free from water and shall meet with the following requirements:

Specific Gravity at 25°C/25°C. not less than	1.00
Total Bitumen, Soluble in C CL_4 not less than	99.0%
Ductility at 25°C. cms. not less than	50
Loss at 165°C. 5 hrs. not more than	1.0%
Penetration at 25°C., 100 gms. 5 sec.	80-100

(c) The sand shall be free from clay, loam or other foreign matter. It shall be so graded that ninety (90) percent will pass a 4 mesh sieve and not less than thirty-five (35) percent or more than eighty (80) percent will pass a 20 mesh sieve.

COMPOSITION AND PREPARATION

The asphaltic limestone and sand shall be dried and heated in suitable designed revolving heaters to a temperature of from 300°F. to 325°F. The sand and asphaltic limestone may be mixed in the correct proportions and fed directly to the cold materials elevator. Plants equipped to dry the asphaltic limestone and sand separately and to weigh the correct amount of sand and asphaltic limestone in each batch will be required to keep both materials within the allowable temperature range specified in this paragraph.

Arrangements shall be made to by-pass asphaltic limestone around any screen in the plant having openings smaller than three quarters (3/4) inches.

The mineral aggregate in the asphaltic limestone mixture shall contain not less than fifteen (15) percent nor more than twenty (20) percent of sand.

In order to obtain a uniform mixture, the various materials to be incorporated in each batch shall be accurately weighed or measured by approved measuring devices before being placed in the mixer.

The required amount of the asphaltic limestone and sand mixture shall be placed into the pug mill mixer and the asphalt cement which previously has been heated to a temperature ranging from 275°F. to 325°F. shall then be added in sufficient quantity so that the resulting mixture shall contain not less than eight and one half (8-1/2) nor more than ten and one half (10-1/2) percent of bitumen; the percentage added being regulated by gradation of the sizes and bitumen content of the asphaltic limestone and to suit local traffic conditions.

Mixing shall be continued until the mineral aggregate is uniformly coated with the asphaltic cement. No batch shall be left in the pug mill mixer long enough so as to form a lumpy tough mix.

BITUMINOUS SURFACING

BY-1 Cold Premix Bottom Course

Materials

226. The materials shall conform to the following requirements:

Inverted Asphalt Emulsion: (Cut-back Emulsified Asphalt)

This material shall be a cut-back emulsified asphalt prepared by compounding a suitable volatile naphtha with an asphalt meeting requirements of the A.S.T.M. Serial Designation D 102-24T. The prepared material shall conform to the following requirements, in which the viscosity will be subject to variation within the limits designated as may be directed.

	Minimum	Maximum
Miscibility with water		None
Stone mixing text	Must coat wet aggregate	
Flash - open cup (Tag)	110	
Settlement Test 5 days at 77°F.	None	None
Freezing Test (15 hrs. below 30°F.)	Homogeneous	
Furol Viscosity at 104°F.	600	1000
Evaporation Loss (A.S.T.M. Oven)	15%	35%
Naphtha Content	10%	30%
Water Content - Xylol distillation	4%	12%
Ash	0.2%	1.0%
Tests on Residue:		
Specific Gravity at 60°F.	1.00 plus	
Percentum soluble CS_2	98%	99.5%

Mineral Aggregates

The mineral aggregate shall be slag and shall be thoroughly dry and conform to the following mechanical analysis.

Total Per Centum by weight passing circular openings,
(Based on Laboratory Screen Tests)

3/8	5/8	1-1/4	1-1/2
0 - 8	10 - 40	85 - 100	100

COMPOSITION AND PREPARATION

The amount of asphalt residue on the aggregate shall be not less than four (4%) per centum by weight. The bituminous material shall thoroughly coat the aggregate and shall form a film of sufficient thickness to furnish the desired binding properties and meet with the approval of the Director of the Department of Public Works. Should the amount of asphalt residue on the aggregate fall below the allowable minimum, the Director may require its removal, or, at his discretion, may permit the amount of bitumen to be raised by the application of an approved amount of the specified inverted asphalt emulsion (cut-back emulsified asphalt) sprayed on the surface with a power distributor.

In the mixing process, the aggregate and bituminous material shall be proportioned by weight, and sufficient mixing time will be required to thoroughly and uniformly coat all aggregate. Mixing shall be affected in an approved twin pug mill type mixer.

BITUMINOUS SURFACING, BY

BY-2 COLD PREMIX TOP COURSE

Materials

227. The materials shall conform to the following requirements:

Inverted Asphalt Emulsion (Cut-back Emulsified Asphalt)

This material shall be a cut-back emulsified asphalt prepared by compounding a suitable volatile naphtha with an asphalt meeting requirements of the A.S.T.M., Serial Designation D-102-24T. The prepared material shall conform to the following requirements, in which the viscosity will be subject to variation within the limits designated as may be directed.

	Minimum	Maximum
Miscibility with water		None
Stone mixing test	Must coat wet aggregate	
Flash - open cup (Tag)	110	
Settlement Test 5 days at 77°F.	None	None
Freezing Test (15 hrs. below 30°F)	Homogeneous	
Furol Viscosity at 104°F.	600	1000
Evaporation Loss (A.S.T.M. Oven)	15%	35%
Naphtha Content	10%	30%
Water Content - Xylol distillation	4%	12%
Ash	0.2%	1.0%
Tests on Residue:		
Specific Gravity at 60°F.	1.00 plus	
Percentum soluble CS_2	98%	99.5%

Mineral Aggregates

(a) The slag mineral aggregate and filler shall be thoroughly dry and conform to the following mechanical analyses on standard laboratory sieves:

Retained on 3/8" Sieve		0 - 3%
Passing 3/8" and retained on	#4	5 - 15%
#4	#10	30 - 45%
#10	#40	20 - 40%
#40	#80	8 - 20%
#80	#200	5 - 10%
#200		0 - 5%

Surface Covering Material.

This material shall consist of clean slag screenings of such size as will pass a #4 Laboratory sieve.

COMPOSITION AND PREPARATION

Proportioning

1. All mineral aggregates and bituminous material shall be proportioned by weight. An approved method of weighing shall be used to insure positive control of the required amounts of materials.

Not in excess of one (1) percentum of hydrated lime may be used, and if so used shall be measured by volume on the basis of volume weight relation.

Temperatures and Asphalt Content

2. If atmospheric temperatures are lower than (60) sixty degrees F. the bituminous material may be heated at the paving plant, in kettles or tanks designed to secure uniform heating and mixing of the entire contents, and may be brought to a temperature of sixty (60) degrees F. to eighty (80) degrees F. The amount of asphalt residue on the aggregate shall be not less than seven (7%) percent by weight.

Mixing

3. Mixing shall be effected in an approved twin pug mill type of mixer. The required quantities of the various materials entering into the composition of the mix shall be measured separately and accurately. The aggregates, bituminous material, filler and lime shall be introduced into the mixer in the order named and a sufficient interval of time allowed to elapse after the addition of each material to allow thorough incorporation prior to the introduction of the next ingredient. The bituminous material, filler and lime shall be introduced in such a manner that they will be equally distributed over the mass and not deposited in one spot. The minimum mixing time shall not be less than one and one-half (1-1/2) minutes. Mixing shall be considered as having been started at the time the bituminous material is added and shall be continued until a thorough homogeneous mix results.

Delivery of Surface Mixture

The surface mixtures shall be hauled to the work in tight vehicles previously cleaned of all foreign materials. Dispatching of vehicles shall be arranged so all materials delivered may be placed and shall have received initial compression during daylight.

BITUMINOUS SURFACING, BY-3

COLD PREMIX SURFACE COURSE

Materials

228. The materials shall conform to the following requirements:

Inverted Asphalt Emulsion: (Cut-back Emulsified Asphalt)

This material shall be a cut-back emulsified asphalt prepared by compounding a suitable volatile naphtha with an asphalt meeting requirements of A.S.T.M., Serial Designation D 102-24T. The prepared materials shall conform to the following requirements, in which the viscosity will be subject to variation within the limits designated as may be directed.

	Minimum	Maximum
Miscibility with Water		None
Stone mixing text	Must coat wet aggregate	
Flash - open cup (Tag)	110	
Settlement Test 5 days at 77°F.	None	None
Freezing Test (15hrs. below 30°F.)	Homogeneous	
Furol viscosity at 104°F.	600	1000
Evaporation Loss (A.S.T.M. Oven)	15%	35%
Naphtha Content	10%	30%
Water Content - Xylol distillation	4%	12%
Ash	0.2%	1.0%
Tests on Residue:		
Specific Gravity at 60°F.	1.00 plus	
Percentum Soluble CS_2	98%	99.5%

Mineral Aggregate

The mineral aggregate shall be slag and shall conform to the following mechanical analysis:

Total Per Centum by weight passing circular openings,
(Based on Laboratory Screen Tests)

1/8	1/4	5/8
0 - 15	10 - 30	100

COMPOSITION AND PREPARATION

The amount of asphalt residue on the aggregate shall be not less than four and seven-tenths (4.7%) percent by weight. The bituminous material shall thoroughly coat the aggregate and shall form a film of sufficient thickness to furnish the desired binding properties and meet with the approval of the Director of the Department of Public Works. Should the amount of asphalt residue on the aggregate fall below the allowable minimum, the Director may require its removal, or, at his discretion may permit the amount of bitumen to be raised by the application of an approved amount of the specified inverted asphalt emulsion (cut-back emulsified asphalt) sprayed on the surface with a power distributor.

In the mixing process, the aggregate and bituminous material shall be proportioned by weight, and sufficient mixing time will be required to thoroughly and uniformly coat all aggregates. Mixing shall be affected in an approved twin pug mill type mixer.

SHEET ASPHALT SURFACING - SA

229. This surfacing shall consist of an asphaltic concrete binder course one and one half (1-1/2) inches in thickness, and a sheet asphalt wearing surface, one and one half (1-1/2) inches in thickness, after final compression unless otherwise specified or indicated on the drawings, and constructed on a prepared base course.

Materials

(1) Asphalt Cement (50-60 penetration)

(2) Sand (Lake Sand)

(3) Filler (Limestone Dust or Portland Cement)

(4) Coarse Aggregate (No. 2 Stone or No. 2 Slag)

BINDER COURSE

Composition and Preparation

The coarse aggregate and sand, shall be heated to a temperature of not less than two hundred and twenty-five (225) and not more than three hundred and twenty-five (325) degrees F. in approved dryers. The coarse aggregate and sand shall be weighed separately and then mixed with sufficient asphalt cement, prepared as specified, and in such proportions that the resulting mixture will contain, by weight, materials passing a No. 10 sieve from fifteen (15%) to twenty-five (25%) percent, and bitumen from four (4%) to 6-1/2%) percent, as directed. Mixing shall be effected in a twin pug mill type of mixer and shall continue for at least thirty (30) seconds or until a homogeneous mixture is produced in which all the particles are uniformly coated. The temperature of the completed mixture shall be not less than two hundred (200) nor more than three hundred (300) degrees F.

Sheet Asphalt Wearing Surface Composition

The Sheet Asphalt wearing surface mixture shall consist of asphalt cement, a filler of portland cement or limestone dust, and fine aggregate proportioned so the resulting mixture shall contain the several materials in average proportions by weight of the whole mixture as follows:

Bitumen soluble in cold carbon bisulphide	10.0% to 12.5%
Filler passing a No. 200 sieve	10.0% to 20.0%
Passing No. 80 and Retained on No. 200 Sieve	12.0% to 30.0%
Passing No. 40 and Retained on No. 80 sieve	22.0% to 45.0%
Passing No. 10 and Retained on No. 40 sieve	10.0% to 40.0%
Passing No. 8 and Retained on No. 10 sieve	0.0% to 2.0%

The bitumen and filler shall be varied within the limits designated at the orders of the Director. The item designated as "filler" with the limits named herein includes, in addition to portland cement or limestone dust, sand passing a No. 200 sieve not exceeding four and one-half (4-1/2) per centum of the entire mixture and mineral dust naturally contained in the refined asphalt.

Preparation

The asphalt cement shall be heated to a temperature of approximately three hundred (300) degrees F., but not to exceed three hundred and twenty-five (325) degrees F., and shall be agitated thoroughly by air or mechanical appliances until mixed to a uniform condition. The sand shall be heated to a temperature of at least three hundred (300) degrees F., but in no case shall the maximum temperature of the sand and filler mixture at the mixer be in excess of four hundred (400) degrees F. The filler shall be added to and mixed thoroughly with the hot sand,

after which the asphalt cement, in the required proportion, shall be added and the mixing continued for at least one (1) minute in a twin pug mill type of mixer until a homogeneous mixture is produced, in which the particles are coated uniformly. The temperature of the completed mixture shall be not less than two hundred and seven five (275) degrees F., nor more than three hundred and seventy-five (375) degrees F., and shall be regulated by the Director, within these limits according to the temperature of the atmosphere, the workability of the mixture, and the character of material employed.

Delivery of Binder and Sheet Asphalt Wearing Surface

Asphaltic concrete binder and sheet asphalt wearing surface material shall be hauled to the work in tight vehicles previously cleaned of all foreign materials and covered with an approved cover of sufficient size to protect the entire load. The dispatching of the vehicles shall be arranged so all material delivered may be placed and shall have received initial rolling in daylight.

ASPHALTIC CONCRETE SURFACING - AC

230. This surface course shall consist of an asphaltic concrete two (2) inches in thickness, after final compression, unless otherwise specified or indicated on the drawings, constructed on a prepared base course.

Materials

(1) Asphalt Cement (50-60 penetration)

(2) Sand (Lake Sand)

(3) Filler (Limestone Dust or Portland Cement)

(4) Fine Aggregate (No. 1-B Stone)

Composition and Preparation

The asphalt cement shall be heated to a temperature of approximately three hundred (300) degrees F., but not to exceed three hundred and twenty-five (325) degrees F., and shall be agitated thoroughly by air, or mechanical appliances until mixed to a uniform condition. The fine aggregate and sand shall be heated to a temperature of at least two hundred and fifty (250) degrees F., but in no case shall the maximum temperature of the fine aggregate, sand and filler mixture at the mixer be in excess of three hundred and fifty (350) degrees F. The fine aggregate, sand, filler and asphalt cement shall be weighed separately. The filler shall be added to and mixed thoroughly with the hot fine aggregate and hot sand, after which the asphalt cement, in the required proportion, shall be added and the mixing continued for at least one (1) minute in a twin pug mill type of mixer until a homogeneous mixture is produced, in which the particles are coated uniformly. The temperature of the completed mixture shall be not less than two hundred and fifty (250) degrees F., nor more than three hundred and twenty-five (325) degrees F., and shall be regulated by the Director, within these limits according to the temperature of the atmosphere, the workability of the mixture, and the character of the materials employed. The required quantity of asphalt cement shall be measured at all times by actual weighing with scales attached to the asphalt cement bucket. The asphaltic concrete mixture shall consist of asphalt cement, fine aggregate, sand and filler proportioned so the resulting mixture shall contain the several materials in average proportions by weight of the whole mixtures as follows:

Materials	Percentsges
Bitumen soluble in cold carbon bisulphide	7.5% to 9.5%
Filler passing No. 200 sieve	7.0% to 11.0%
Passing No. 80 and Retained on No. 200 sieve	10.0% to 25.0%
Passing No. 40 and Retained on No. 80 sieve	11.0% to 36.0%
Passing No. 10 and Retained on No. 40 sieve	7.0% to 25.0%
Passing 1/2 inch screen and Retained on No. 10 sieve	20.0% to 35.0%

The bitumen and filler shall be varied within the limits designated at the order of the Director. The item designated as "Filler" with the limits named herein includes, in addition to portland cement or limestone dust, fine sand passing a No. 200 sieve not exceeding four and one-half (4-1/2) percent of the entire mixture and mineral dust naturally contained in the refined asphalt.

BITUMINOUS SIDEWALK SURFACING - HOT MIX

231. The bituminous sidewalk surfacing shall be composed of the following materials in the proportions indicated and mixed in the manner specified:

1.	Pure Asphaltum (Flux)	6%
2.	Rock Asphalt Mastic Block	44%
3.	Clean Sand	13%
4.	Clean Grit	37%

The rock asphalt mastic block shall be in the original blocks and the asphaltum flux in original drums or barrels. The grit shall consist of small, hard limestone or silica grit, clean and well screened (No Dust). This aggregate is to be graded so that the voids are reduced to a minimum.

The exact proportions of all of the above ingredients are to be subject to the approval of the Director.

The material shall be charged into kettles in the following order 1 - 2 - 3 and 4, one and two to be melted before the addition of three and four. The blocks of mastic shall be broken, in order to facilitate melting. This mixture shall be cooked in kettles of approved construction for a period of not less than 5 hours at a temperature of 400 to 450 degrees F., and shall be constantly stirred to prevent caking or sticking to the bottom of the kettles.

The asphaltic mastic, when ready, shall immediately be spread upon the surface to the required thickness specified with proper equipment, and shall be brought to a true, smooth, uniform surface. No asphalt that has been burned in the cooking shall be allowed to be used.

MASTIC BED FOR BRICK SURFACING

232. The paving brick shall be laid on a mastic bed having a uniform thickness of 3/4" after compaction, and shall be composed of fine aggregate graded to conform to the requirements for coarse sand, and bituminous materials mixed in the proportion of 92 to 95% of fine aggregate, and 8 to 5% of the bituminous material by volume. Within these limits the Contractor shall so select and combine his materials as will secure the results required satisfactory to the Director. The sand shall be thoroughly dry, and the materials composing the mastic shall be thoroughly mixed in a pug mill or batch mixer of approved type. The mixture shall be such that it will spread and compact readily and retain its shape and bed during the rolling of the brick.

BITUMINOUS MATERIAL FOR THE MASTIC BED

233. The bituminous material for the mastic bed shall be in accordance with the following requirements:

(1) Tar. The Material covered by these specifications shall contain only coal tar, carburretted water gas tar and/or products derived therefrom. The tar shall be homogeneous, free from water, and shall meet the following requirements:

Water	not more than 2.00%
Specific Gravity at 25/25°C. (77°F.)	not less than 1.09
Specific Viscosity at 40°C. (104°F.)	8 to 13
Total Distillate A.S.T.M. E. I. Flask	percent by weight
Percent by Weight	
170°C. (338°F.)	not more than 5%
235°C. (455°F.)	not more than 20%
270°C. (518°F.)	not more than 35.0%
300°C. (572°F.)	not more than 45.0%
Softening Point (Ring and Ball Method of Distillation Residue)	not more than 60°C.
Specific Gravity at 38/38°C. (100.4°F.) of Total Distillate to 300°C. (572°F.)	not less than 0.96
Total Bitumen (Soluble in Carbon Disulphide)	not less than 88.0%

(2) Asphalt Cut Back. The asphalt shall be homogeneous, free from water, and shall meet the following requirements:

	Light	Medium	Heavy
(1) Furol Viscosity at 50°C. (122°F.)	80-160 secs.	200-400 secs	
Furol Viscosity at 60°C. (140°F.)			275-400
(2) Distillation No.			
(a) Distillate by Volume			
to 225°C. (437°F.) not less than	12%	10%	3%
to 315°C. (599°F.) not less than	25%	20%	14%
to 360°C. (680°F.) not more than	40%	35%	30%
(b) The residue from the distillation to 360°C. (680°F.) shall meet the following requirements:			
Penetration at 25°C. (77°F.) (100 g. - 5 Sec.)	70-110	70-110	70-110
Total Bitumen (Sol. in CS) not less than	99%	99%	99%
Ductibility at 25°C. (77°F.) not " "	60 cm.	60 cm.	60 cm.

CREOSOTE WOOD PRESERVATIVE
(A.S.T.M. - D 390 - 36)

234. These specifications cover creosote for use in preservative treatment of timber. The creosote shall be a distillate of coal-gas or coke-oven tar.

Creosote shall conform to the following requirements:

Water	not more than 3 percent
Matter insoluble in benzol	not more than 0.5 percent
Specific gravity, 38°C./15.5°C.	not less than 1.03

Distillation based on water-free oil:

Up to 210°C.	not more than 5 percent
Up to 235°C.	not more than 25 percent
Coke residue	not more than 2 percent

Owing to the complexity of the chemical composition and physical properties of coal tar creosote, and to the fact that some of the same compounds and properties which characterize coal tar creosote are found in certain petroleum derivatives, determination of the purity of creosote is difficult. When there is not certain assurance that the oil is a pure product, the following tests will aid in arriving at an opinion as to its coal tar origin:

Fraction distilling between 210 and 235°C. is usually solid or contains some solids when cooled to 25°C.

All of the fractions up to 315°C. contain tar acids in varying amounts, usually at least 1 percent, calculated on the amount of the fraction tested.

The specific gravity of the fraction between 235 and 315°C. is usually not lower than 1.025 and the specific gravity of the fraction between 315 and 355°C. is usually not lower than 1.085 at 38°C. compared with water at 15.5°C. However, some pure coal tar distillates fall slightly below these limits.

If the oil does not comply with at least one of the foregoing tests, it is undoubtedly not a pure coal tar creosote.

Wood Posts for Wire Cable Barrier

235. Wood posts for Wire Cable Barriers shall be sound, reasonably straight, black locust. The bark shall be removed, all knots hewn flush with the face, and the surface shaved smooth at the place the timber is cut. The top of the post shall be beveled and the bottom sawed square, and the posts shall be drilled as shown on Plan M83.

The lower portion of the post beginning at a point 2'-6" from the top and extending to and including the bottom shall be given one heavy coat of creosote oil by painting or dipping. The surface around the drilled holes shall also be coated with creosote oil. The oil shall conform to section 234 of the Specifications for Materials.

For the purpose of this specification, the term "reasonably straight" shall apply to posts on which the surface shows no deviation of more than 1" from a straight edge or line, 4 feet long and measured from the top of posts.

Rods, Bolts and Turn Buckles for Wire Cable Barrier

236. All hook bolts and guy rods shall conform to the detail of plan M-83 and shall be of a structural grade steel.

All eye bolts and turnbuckles shall conform to the details of Plan M-83 and shall be drop-forged steel.

After fabrication, threading, etc., all hook bolts, guy rods, eye bolts, and turnbuckles, together with nuts, plates, and washers shall be galvanized by the Hot Dip Method and shall have a continuous coating of pure zinc of uniform thickness, so applied that it will adhere to the surface of the fitting. The weight of zinc coating for each fitting shall be at the rate of at least one and five tenths (1.5) ounces of zinc per square foot of surface, and shall be capable of withstanding four (4) immersions in a standard testing solution of copper sulphate without showing any trace of metallic copper on the steel. The first three (3) immersions shall be for a period of one (1) minute each, and the fourth immersion for a period of one-half (1/2) minute.

Off-Set Blocks for Wire Cable Barrier

237. Off-Set Blocks shall conform to the details of plan M-83 and shall be malleable iron or high tensile strength cast iron. They shall be free from sand-pockets, blow-holes, or other defects, and shall be thoroughly cleaned before galvanizing. They shall be galvanized by the Hot Dip Method and shall have a continuous coating of pure zinc of uniform thickness, so applied that it will adhere to the surface of the fitting. The weight of zinc coating for each fitting shall be at the rate of at least one and five tenths (1.5) ounces of zinc per square foot of surface, and shall be capable of withstanding four (4) immersions in a standard testing solution of copper sulphate without showing any trace of metallic copper on the iron. The first three (3) immersions shall be for a period of one (1) minute each, and the fourth immersion for a period of one-half (1/2) minute.

3/4" and 1" Wire Cable for Wire Cable Barrier

238. The cable shall be manufactured of durable, galvanized, annealed steel having the properties hereinafter described.

3/4" wire cable shall be composed of three strands, each strand having 7 wires. The diameter of the finished cable shall not be less than 3/4".

1" wire cable shall be composed of 7 strands, each having 7 wires. The cable shall be fabricated with wire strand center, and six strands wrapped about same. The diameter of the finished cable shall not be less than 1".

Wire composing the above size cable shall be of such quality that the finished cable shall satisfy the requirements hereinafter set forth. All the wires in the cable shall be of the same grade of steel, and shall have approximately the same breaking strain.

The lay of the finished cable shall be regular lay, right lay, and shall not be more than 7-1/2" for the 3/4" cable, (Nor more than 10" for the 1" cable.) The lay of the wires in the finished strands shall not be more than 4-1/2". The diameter of the finished wires entering into the 3/4" cable shall not be less than 0.117 in. nor more than 0.124 in. The diameter of the finished wires entering into the 1" cable shall not be less than 0.105 in. nor more than 0.112 in. The wire shall be cylindrical in form, and free from scale, inequalities, flaws and splits. The minimum tensile strength of the 3/4" cable shall be 20,000 pounds, and of the 1" cable, 40,000 pounds.

Form 100

Soft Annealed Bundling Wire

241. Soft Annealed Bundling Wire shall be furnished in the gauge specified; and where it will be exposed to the elements in its permanent position, it shall be galvanized by the Hot Dip Method, and shall have a continuous coating of pure zinc of uniform thickness so applied that it will adhere firmly to the surface. It shall be capable of withstanding two immersions of one minute each, in the Standard testing solution of copper sulphate without showing any trace of metallic copper on the steel. It shall be capable of withstanding wrapping around a mandrel of 1/2 inch diameter without flaking, cracking or peeling.

Shop Coat - For Structural Steel

242. RED LEAD - GLYCERYL PHTHALATE TYPE

A. General Purpose:

This product is intended for use as a priming coat over ferrous metal surfaces.

B. Compositions:

1. Pigment 65.3% ± 2%

A - Red Lead 75% ± 2%
B - Silicates 25% ± 2%

A - The Red Lead shall conform to A.S.T.M. Specification D-83-31 for 95% Red Lead.

2. Vehicle 34.7% ± 2%

A - Synthetic Resin 54% ± 2.5%
B&C - Drier & Thinner 46% ± 2.5%

A - The synthetic resin shall be of the glyceryl phthalate type, containing no admixed or otherwise uncombined drying oils.

1. It shall show not less than 32% glyceryl phthalate quantitative on analysis.

2. It shall be free from rosin and rosin derivatives.

3. Its acid number shall be a maximum of 7.

B - The drier shall be such as to obtain the specified drying properties with a high degree of package stability.

C - The volatile thinner shall consist of petroleum hydrocarbons.

1. It shall be free from alcohol and ester solvents.

2. There shall be an allowable maximum of 2-1/2% moisture on the total paint.

3. The aniline point of a half and half mixture of the volatile thinner with a mineral spirits having an aniline point of 60°C. shall be a maximum of 34°C.

4. The distillation range of the volatile thinner shall be:

Initial	170°C. Min.
End	220°C. Max.

C. Physical Properties:

1. Weight per gallon shall be a minimum of 16.7#.
2. Viscosity of package shall be not less than 35 poises at 25°C. 24 hours after manufacture.

C. Physical Properties: - continued.

3. Coarse particles and skins retained on a 325 mesh screen shall be not more than .5% by weight.

4. Odor shall be normal for the composition permitted by the specification.

5. The Flash Point shall be not lower than 31.1°C. (88°F.)

6. Skinning shall be very slight in a half filled closed container after 48 hours.

7. Working properties shall be satisfactory for brushing or spraying.

8. Drying Time - A flow out film shall set to touch in a maximum of 2-1/2 hours and be ready for recoating in 18 hours.

9. Recoating after an 18 hour or longer drying period shall produce no film irregularity.

10. The gloss shall be dull.

11. The color shall correspond to that of the specified pigment. Reasonable color variation to be allowed.

12. The film prepared as in paragraph D-3 of "Methods of Inspection and Tests" after baking 30" at 200°F. shall show no cracking of the film when suddenly chilled to 0°C. (32°F.) and quickly bent sharply on itself over a 1/8" mandril. The bent part of the panel shall show satisfactory adhesion under the knife test.

13. The moisture impedance shall be 5.0 being measured as the reciprocal of the milligrams of moisture transmitted by one square centimeter of the film per hour at a film thickness of .0015 inch.

14. Gasoline Resistance - A film prepared as specified in "Methods of Inspection and Tests" paragraph D-3 aged 48 hours at room temperature shall regain its initial toughness in four hours after 24 hours immersion in straight cut gasoline (See paragraph D-20 "Methods of Inspection and Tests"). Panels to be immersed with beaded edge out of gasoline.

15. Weather exposure tests shall be made on one coat application over sanded steel panels, the upper half of the panel being second coated with a mutually agreed upon topcoat. There shall be no premature checking or cracking failure of the primer nor shall any premature rusting occur. (See Paragraph D-21, 21-A, 21-B and 21-C.)

FIRST FIELD COAT - FOR STRUCTURAL STEEL

ALUMINUM PAINT - GLYCERYL PHTHALATE TYPE

243. This specification is designed to cover a blued Glyceryl-phthalate resin varnish of maximum elasticity and durability. This varnish is designed for use in making a tinted aluminum paint for exterior application under an aluminum topcoat.

Form 106

SECOND FIELD COAT - FOR STRUCTURAL STEEL
ALUMINUM PAINT - GLYCERYL PHTHALATE TYPE

244. This specification is designed to cover a glyceryl-phthalate (alkyd) resin varnish of maximum elasticity and durability for use in making aluminum paint for all exterior applications.

(a) The varnish shall be of glyceryl-phthalate type containing no admixed or otherwise uncombined drying oils and showing not less than 35% glyceryl-phthalate (based on solids content) determined by the method described in Tentative U.S. Navy Specification ST-15B and shall be free from rosin and rosin derivatives as determined by the Liebermann Storch test.

(b) It shall be clear and transparent.

(c) The viscosity shall be between 0.60 and 1.0 poises at 25 deg. C. (77 deg.F.) corresponding to Tubes A to D of the Gardner-Holdt Air Bubble Viscometer, if it is to be used with Aluminum Powder, or between 0.65 and 1.25 poises at 25 deg. C (77 deg.F.) corresponding to Tubes B to E if it is to be used with aluminum paste.

(d) The flash point shall not be below 30 deg. C. (86 deg.F.) in a closed cup tester.

(e) The varnish shall contain not less than 48% by weight of non-volatile matter.

(f) The acid number of the vehicle shall be less than 8.

(g) A flow-out film of the varnish on 28 gauge tinplate air-dried 18 hours, and then baked at 82 deg. C. (179.6 deg.F.) to 85 deg. C. (185 deg.F.) for 2 hours shall show no cracking of the film when suddenly chilled to 0 deg. C. (32 deg. F.) and quickly bent sharply on itself. The bent part of the baked panel shall show satisfactory adhesion under a knife test.

(h) A flow-out film of the varnish on colorless glass, air-dried 18 hours, then baked for not less than 2 hours, at 82 deg. C. (179.6 deg. F.) to 85 deg. C. (185 deg. F.) shall be hard, tough, smooth, transparent, and free from all defects such as checking, dulling, or wrinkling, when compared to a fresh film.

(i) It shall show no skinning after one week in a half-filled, tightly closed glass container stored in a dark place.

(j) A flow-out film on 28 gauge tin plate, air-dried for 48 hours, shall withstand immersion in cold water for 18 hours without whitening and shall show only slight dulling. After removal from the water for 2 hours the original gloss and hardness shall return.

(k) A flow-out film on 28 gauge tin plate, air-dried 48 hours, shall retain its gloss and general appearance after 24 hours immersion in straight run gasoline. After air-drying 4 hours, the film shall have regained its initial hardness and toughness. Panel to be immersed with beaded edge out of the gasoline.

(l) When thoroughly mixed with Aluminum Paste, meeting City of Pittsburgh specification, in the proportion of 2 pounds per gallon of vehicle, the paint shall have good leafing quality, show satisfactory brushing and leveling properties, and shall not break or sag, when applied to a vertical, smooth, steel surface.

(m) Aluminum paint made with this varnish, when applied to a metal panel and allowed to dry in a vertical position shall set to touch in not less than 1 hour nor more than 4 hours and dry hard and firm in not more than 16 hours at a temperature of 20 deg. C. (68 deg. F.) to 30 deg. C. (86 deg. F.).

Form 106

CITY OF PITTSBURGH - DEPARTMENT OF PUBLIC WORKS

S P E C I F I C A T I O N S

For

M A T E R I A L

CEMENT LINED BELL & SPIGOT, CENTRIFUGALLY CAST IRON PIPE AND CEMENT LINED SPECIAL CASTINGS

SECTION 300

RESPONSIBILITY. 7. The Manufacturer shall be responsible for all Pipes and Special Castings until the removal of said Pipes and Special Castings from the cars at the railroad depots, and the Manufacturer shall be responsible and make good all losses caused by any injury or breakage in transit.

WEIGHING. 8. The pipes and special castings shall be weighed under the supervision of the Director before the application of cement lining. The Director shall have the power, at his discretion, to have the scales tested by a properly authorized officer.

MEN AND MATERIALS. 9. The Manufacturer shall provide all tools, testing machines, materials and men necessary for the required testing, inspection and weighing at the foundry of the pipe and special castings; and should the Director not inspect pipe and castings, the Manufacturer shall, if required, furnish a sworn statement that all the tests have been made as specified, this statement to contain the results of the tests upon the test bars.

POWER TO INSPECT. 10. The Director shall be at liberty at all times to inspect the material at the foundry, and the molding, casting and coating of the special castings. The forms, sizes, uniformity and condition of all special castings herein referred to, shall be subject to his inspection and approval, and he may reject, without proving, any casting which is not in conformity with the specifications or drawings.

INSPECTION COSTS TO BE DEFRAYED BY CONTRACTOR. 11. If the materials herein provided for are manufactured outside the limits of Allegheny County, Pennsylvania, the successful bidder shall bear the transportation and subsistence expenses of the City Inspector from Pittsburgh to the manufacturing plant and return, also his hotel expenses not to exceed Six ($6.00) Dollars per day, during the time said materials are being manufactured.

DESCRIPTION TYPE AND CLASS

12. The pipes shall be made with hub and spigot joints, and shall accurately conform to the dimensions given in Tables I, II, III and IV.

They shall be straight and shall be true circles in section, with their inner and outer surfaces concentric, and shall be of the specified dimensions in outside diameter and thickness of wall.

This specification covers bell and spigot cast iron water pipe in the following types and classes.

TYPE I - Class 250 - Centrifugally cast in metal contact moulds in 12 ft. and 18 ft. nominal lengths for 250 pounds maximum water working pressure.

TYPE II - Class 250 - Centrifugally cast in sand-lined moulds in 16 foot and 16 1/2 foot nominal lengths for 250 pounds maximum water working pressure.

MATERIAL & WORKMANSHIP

13. All pipe shall be made of cast iron of good quality and of such character as shall make the pipe strong, tough, and of even grain and soft enough to admit of satisfactory drilling and cutting. Each pipe shall be smooth, free from cold shuts, scale, lumps, blisters, and sand holes and defects of every nature which unfit it for the use intended. It shall be straight and shall be true circles in section with its inner and outer surfaces concentric. No plugging, filling, "burning-in" or welding will be allowed.

LENGTHS

14. Pipe shall have nominal laying lengths of 12 feet, 16 feet, 16 1/2 feet or 18 feet. Not more than 10 per cent of cut pipe shall be accepted. Such cut pipe shall be not less than 11 feet nominal laying length.

CLEANING

15. All pipe shall be thoroughly cleaned, and any rough spots in bells or in spigot ends shall be removed before coating or lining.

COATING

16. All pipe shall be completely coated on the outside with coal-tar pitch varnish to which sufficient oil shall be added to make a smooth coating, tough and tenacious when cold, not "tacky" and not brittle. The cement mortar lining shall be completely coated as specified in paragraph 41.

WEIGHING

17. Each length of pipe shall be weighed and the weight plainly and indelibly marked on the pipe. Coated pipe shall be weighed after coating. Cement lined pipe shall be weighed before lining and the mark shall be placed on the outside surface.

HARDNESS

18. The average Rockwell number shall not exceed 95 when tested in accordance with the method described in paragraph 46.

HANDLING

19. Care shall be taken in handling the pipes not to injure the coating, and no pipes or other material shall be placed in the pipes during transportation, or at any time after they have been coated.

MARKING

20. In addition to the weight being marked on the pipe as previously specified, each pipe shall have distinctly cast or stamped into the metal on the face or outside surface of the bell or on body near the bell the manufacturer's mark, and the year in which the pipe was cast and a number indicating the order in point of time in which it was cast.

TOLERANCES IN THICKNESS

21. The tolerances in thickness of pipe, plus or minus, shall not exceed those listed as follows:

TABLE IV. - Nominal weights of Type II Pipe (pounds)

Nominal inside diameter	Class 250, 250 pounds working pressure, 576-foot head			
	16-foot nominal laying length		16-1/2 foot nominal laying length	
	Weight of pipe	Weight per foot with bell	Weight of pipe	Weight per foot with bell
4	290	18.1	300	10.0
6	460	28.7	475	28.6
8	715	44.6	735	44.5
10	995	62.3	1,025	62.2
12	1,300	81.1	1,335	81.0
14	1,730	108.0	1,780	107.8
16	2,135	133.6	2,200	133.3
18	2,640	164.9	2,715	164.7
20	3,095	193.6	3,190	193.2
24	4,195	262.1	4,320	261.7

Note: Calculated weight of pipe has been rounded off to nearest 5 pounds. Weight per foot is based on weight of pipe computed to nearest pound.

CEMENT MORTAR LINING

PREPARATION OF PIPE FOR LINING

32. Pipe to be lined with cement mortar shall not be coated inside with tar or other asphaltum products before the cement lining is applied. Its interior surface shall be thoroughly cleaned of all core sand, mud, grease, foreign materials, or any sharp projections of iron which might project through the lining. Pipe shall be tested hydrostatically before being lined.

CEMENT

33. The cement used for making cement mortar shall be Portland cement complying in all respects with the standard specifications of the American Society for Testing Materials, Serial Designation C-9-30.

SAND

34. The sand for mortar shall be clean, sharp, hard, silicious sand, free from loam clay, organic matter, or other foreign substance considered as deleterious for good mortar. The sand shall be well graded and when tested by laboratory sieves shall meet the following specifications: Total passing 12-mesh sieve, 100 percent.
Total passing 100-mesh sieve, not over 5 percent.

WATER

35. The water for tempering the cement mortar shall be free from harmful amounts of oil, acid, alkali, organic or vegetable matter.

MORTAR

36. The cement mortar used for lining pipe shall be a mixture of the above-specified sand and cement in such proportions as to obtain a good, hard, dense lining, reasonably well bonded to the pipe, and with a smooth interior surface. The mixture shall consist of two or three parts cement to one part sand, by volume. The cement mortar shall be thoroughly mixed, only sufficient water being added to form a workable mixture for placing in the pipe. Only sufficient cement mortar shall be mixed for the immediate requirements of lining.

APPLICATION OF LINING

37. Sufficient cement mortar shall be introduced to produce the required thickness of lining and shall be spread evenly over the interior surface of the pipe by any suitable means. A careful examination shall be made after this operation is completed to see that the inner surface of the pipe is completely covered with cement mortar. The shoulder of the bell and the end of the spigot may be covered with cement

mortar by applying with a brush. Surplus cement mortar shall be removed from the interior of the bell so as not to interfere with proper keying of the joint. The work of lining the pipe shall be done in a building where the product shall be protected from the direct rays of the sun, and from extreme weather conditions, such as rain, frost, etc. The product shall not be put on the yard until the cement has set sufficiently to avoid injury or damage thereto. Patching of improperly lined pipe will not be permitted.

SMOOTHNESS OF LINING

38. The lining of pipe shall be smooth and substantially free from noticeable ridges, corrugations, projections, or depressions.

THICKNESS OF LINING

39. The thickness of lining shall be 1/8 inch (+1/8, -0 inch) for sizes 12 inches and under, and 3/16 inch (+1/8, -0 inch) for sizes over 12 inches. At the end of the pipe where the lining naturally tends to taper off to a thin edge, the full thickness of lining shall extend to within 1-inch of end of pipe.

CURING OF LINING

40. Immediately after pipe is lined with cement mortar, it shall be protected in a suitable manner to prevent the too rapid withdrawal of moisture from the cement mortar and, if necessary, suitable means shall be provided to keep lining damp for a period of at least 24 hours after lining.

No pipe shall be shipped until the lining is thoroughly set.

COATING FOR CEMENT LINING

41. After the cement has been allowed to set for at least 48 hours or until it is thoroughly hard, the Contractor shall coat the pipe or casting inside and out with an application of asphalt or coal tar paint brushed or sprayed on. The paint and the method of its application shall be subject to the approval of the Director and shall be demonstrated by the Contractor to the satisfaction of the Director both before its approval and during the progress of the contract as having no deleterious or objectionable effect upon the quality, taste, or odor of the water to be carried by the pipe or castings. The paint shall be so applied as to completely cover the cement surface with an integral film of asphalt or coal tar, without pin holes or holidays.

GENERAL

CASTING RECORD

42. A record of the melting and pouring temperatures of the iron shall be furnished when requested.

CHEMICAL ANALYSIS

43. Chemical analysis shall be made by the manufacturer from each heat to determine graphitic and combined carbon or total carbon if the separate determinations are not available, manganese, phosphorus, sulphur, and silicon, and duplicate copies of test reports shall be furnished when requested. Sulphur shall not exceed 0.10 per cent and phosphorus 0.90 per cent in either ladle or inspection analysis.

TESTS OF MATERIAL

44. From each 300 lengths of pipe, or fraction thereof, of each size in the contract or order, one length of pipe shall be selected by the inspector before coating. From each sample pipe there shall be cut and machined one test strip 12 inches long, 0.50 inch deep, and the full thickness of the shell in width. This shall be tested as a beam (with machined surfaces top and bottom) on supports 10 inches apart with load applied at two points 3-1/2 inches from the supports. The strip shall be accurately calipered at point of rupture and stress calculated by the formula.

$$S = \frac{PLc}{61}, \text{ or for the above specimen } S = \frac{40P}{b}$$

The secant modulus of elasticity at the breaking load shall be calculated by the formula

$$E = \frac{23PL^3}{1{,}296Iy}, \text{ or for the above specimen } E = S\,\frac{42.6}{y}$$

In these formulas - -

S = modulus of rupture.
E = modulus of elasticity.
P = total load.
L = length of span.
c = distance to extreme fiber.
I = moment of inertia.
b = width of specimen (thickness of pipe).
d = depth of specimen.
y = center deflection at load P.

If any test specimen shows defective machining or obvious lack of continuity of metal, it may be discarded and replaced by another specimen selected by the Inspector. If any of the test specimens selected fail to meet the requirements specified and the purchaser permits a retest, at least twice the number of specimens that failed shall be selected by the inspector for replacement, all of which shall meet the requirements.

HYDROSTATIC TEST

45. Each length of pipe shall be subjected to a hydrostatic pressure of 500 pounds per square inch. The pipe shall be under this pressure at least one-half minute, and while under pressure shall be subjected to a hammer test. Any pipes showing defects by leaking, sweating, or otherwise, shall be rejected.

ROCKWELL TEST

46. Upon the machined edges of each test strip there shall be made at well-distributed points not less than three determinations, using a 1.59-millimeter (1/16-inch) ball and 100 kilogram load. The average Rockwell number shall not exceed 95. An additional determination shall also be made for pipe cast in metal contact moulds, upon the outside of each pipe, using a portable type machine. The equivalent Rockwell number for the exterior shall not exceed 95.

CEMENT LINING

47. Not less than 1 per cent of pipe shall be tested, and in the event defects are discovered in the lining, testing shall proceed until the lining complies with the specification.

The thickness of lining may be determined by means of spear measurements, using a hardened steel point not greater than one-sixteenth inch in diameter. The inspector shall pierce the lining immediately after it is placed in the pipe, and before cement has set, at four diametrically opposite points of the pipe at bell and spigot ends, making two sets of measurements at each end. The first set shall be not greater than 4 inches from the respective ends of the pipe and the second set shall be made as far into the interior of the pipe as can readily be obtained by reaching into the pipe without injuring the lining. All measurements shall be within the limits specified.

Pipe showing three or more loose spots measuring 12 inches or more in diameter, or three or more shrinkage cracks over 9 inches in length, or cracks standing open perceptibly, will not be accepted. Pipe that have loose spots or shrinkage cracks and which may be accepted in accordance with the above limitations will only be accepted if in the opinion of the Director the loose spots or shrinkage cracks are not the result of inferior workmanship or material.

PACKING

48. Unless otherwise specified, the subject commodity shall be prepared for standard commercial shipment so as to insure acceptance by common or other carriers, for safe transportation, at the lowest rate, to the point of delivery.

MARKING

49. Unless otherwise specified, shipments shall be marked with the number of the contract or order.

There shall be cast in relief on the face of the bell of each pipe the initials P. B., the year and the month in which the pipe is cast and the initials of the maker's name.

Form 106

CEMENT LINED SPECIAL CASTINGS. (4" to 24" inclusive)

DESCRIPTION

50. All special castings shall be Class "D" and made in accordance with the cuts and the dimensions given in the tables of the standard specifications of the American Water Works Association, as adopted May 12, 1908, subject to all subsequent amendments and additions adopted by said association, except as herein specifically provided otherwise.

The diameters of the sockets and the external diameters of the spigot ends of the special castings shall not vary from the specified dimensions by more than .12 of an inch for castings sixteen (16) inches or less in diameter; .15 of an inch for eighteen (18) inch, twenty (20) inch and twenty-four (24) inch. These variations apply only to special castings made from standard patterns.

Special castings 4" to 12" inclusive, shall be made from Class "D" patterns. Those having spigot ends shall have outside diameters of spigot ends midway between those of the American Water Works Class "B" and Class "D" fittings and shall be tapered back for a distance of six (6) inches. The resulting castings shall in all cases provide sufficient clearance for use with bells of Class 250 centrifugally Cast Iron Pipe as hereinbefore specified.

MARKING

51. Every special casting shall have distinctly cast upon it the initials of the maker's name. Each special casting must have cast upon it figures showing the year in which it was cast and a number signifying the order in point of time in which it was cast, the figures denoting the year being above and the number below, thus:

1939	1939	1939
1	2	3

etc. also any initials, not exceeding four, which may be required by the purchaser. The letters and figures shall be cast on the outside and shall not be less than 2 inches in length and 1/8 of an inch in relief for specials 8 inches in diameter and larger. For smaller sizes of specials, the letters may be 1 inch in length. The weight and the class letter shall be conspicuously painted in white on the outside of each special casting after the coating has become hard.

ALLOWABLE VARIATION IN THICKNESS

52. For special castings of standard patterns a variation of fifty (50) per cent greater than allowed for straight pipes shall be permitted.

ALLOWABLE PERCENTAGE OF VARIATION IN WEIGHT

53. No special casting shall be accepted, the weight of which shall be less than the standard weight, by more than ten (10) per cent for pipes twelve (12) inches or less in diameter, and eight (8) per cent for larger sizes, except that curves, Y pieces and breeches pipe may be twelve (12) per cent below the standard weight, and no excess above the standard weight of more than the above percentages for the several sizes will be paid for. These variations apply only to castings made from standard patterns.

QUALITY OF IRON

54. All special castings shall be made of cast iron of good quality, and of such character as shall make the metal of the castings strong, tough and of even grain, and soft enough to satisfactorily admit of drilling and cutting. The metal shall be made without any admixture of cinder iron or other inferior metal, and shall be remelted in a cupola or air furnace.

TEST OF MATERIALS

55. Specimen bars of the metal used, each being twenty-six (26) inches long by two (2) inches wide and one (1) inch thick, shall be made without charge as often as the Director may require.

These bars when placed flatwise upon supports twenty-four (24) inches apart, and loaded in the center, shall support a load of two thousand (2,000) pounds, and show a deflection of not less than .30 of an inch before breaking. The Director may also require that tensile bars shall be made which will show a breaking point of not less than twenty thousand (20,000) pounds per square inch.

QUALITY OF CASTINGS

56. The special castings shall be smooth, free from scales, lumps, blisters, sand holes and defects of every nature which unfit them for the use for which they are intended. No plugging or filling will be allowed.

CLEANING AND INSPECTION

57. All special castings shall be thoroughly cleaned and subjected to a careful hammer inspection in the presence of the City's inspector before any coating or lining is applied.

No casting shall be coated or lined unless entirely cleaned and free from rust, and approved in these respects by the Director.

COATING

58. Every special casting shall be coated on the outside and caps, plugs, and sleeves shall be coated inside and outside with coal-tar pitch varnish. The varnish shall be made from coal tar. To this material sufficient oil shall be added to make a smooth coating, tough and tenacious when cold, and not brittle nor with any tendency to scale off.

TO BE DELIVERED SOUND

59. All special castings must be delivered in all respects sound and conformable to these specifications. The inspection shall not relieve the Contractor of any of his obligations in this respect, and any defective special castings which may have been inspected and passed upon, shall be, at all times, liable to rejection when discovered, until the final completion and adjustment of the contract; provided, however, that the Contractor shall not be held liable for special castings found to be cracked after they have been accepted at the agreed point of delivery. Care shall be taken in handling the special castings not to injure the coating, and no material of any kind shall be placed in the special castings during transportation or any time after they have received the coating and cement lining.

CEMENT LINING FOR SPECIAL CASTINGS

60. The cement lining of Special Castings (except caps, plugs, and sleeves, which shall receive the same coating inside as is specified for outside) shall be as smooth as practicable.

The interior surface of Special Castings shall be lined by applying cement mortar as specified in previous paragraphs, evenly and uniformly and as nearly as practicable of the thickness specified for the corresponding sizes of pipe, and shall be given the bituminous coating as specified in paragraph 41.

CITY OF PITTSBURGH - DEPARTMENT OF PUBLIC WORKS

S P E C I F I C A T I O N S

for

M A T E R I A L

A. W. W. A. CLASS "D" CEMENT LINED CAST IRON WATER PIPES AND CEMENT LINED SPECIAL CASTINGS

SECTION 301.

RESPONSIBILITY

4. The Manufacturer shall be responsible for all Pipes and Special Castings until the removal of said Pipes and Special Castings from the cars at the railroad depots, and the Manufacturer shall be responsible and make good all losses caused by any injury or breakage in transit.

DESCRIPTION

5. The pipes shall be made with hub and spigot joints, and shall accurately conform to the dimensions given in Tables Nos. 1 and 2 o the Standard Specifications of the American Water Works Association, adopted May 12th, 1908. They shall be straight, and shall be true circles in section, with their inner and outer surfaces concentric, and shall be of the specified dimensions in outside diameter. They shall be at least twelve (12) feet in length, exclusive of socket.

All pipes having the same outside diameter shall have the same inside diameter throughout.

ALLOWABLE VARIATION IN DIAMETER

6. Especial care shall be taken to have the sockets of the required size. The sockets and spigots will be tested by circular gauges, an no pipe will be received which is defective in joint room from any cause. The diameters of the sockets and the outside diameters of th spigot ends of the pipes shall not vary from the standard dimensions by more than .06 of an inch for pipes sixteen (16 inches or less in diameter; .08 of an inch for eighteen (18) inch, twenty (20) inch and twenty-four (24) inch pipes; .10 of an inch for thirty (30) inch thirty-six (36) inch and forty-two (42) inch pipes; .12 of an inch for forty-eight (48) inch; and 15 of an inch for fifty-four (54) inch and sixty (60) inch pipes.

ALLOWABLE VARIATION IN THICKNESS

7. For pipes whose standard thickness is less than one (1) inch, th thickness of metal in the body shall not be more than .08 of an inch less than the standard thickness, and for pipes whose standard thickness is one inch or more, the variation shall not exceed .10 of an inch, except that for spaces not exceeding eight (8) inches in length in any direction, variations from the standard thickness of .02 of an inch in excess of the allowance above given shall be permitted.

For special castings of standard patterns a variation of fifty (50) per cent greater than allowed for straight pipes shall be permitted.

SPECIAL CASTINGS

8. All special castings shall be made in accordance with the cuts and the dimensions given in the tables of the standard specifications of The American Water Works Association, as adopted May 12, 1908.

The diameters of the sockets and the external diameters of the spigot ends of the special castings shall not vary from the standard dimensions by more than .12 of an inch for castings sixteen (16) inches or less in diameter; .15 of an inch for eighteen (18) inch, twenty (20) inch and twenty-four (24) inch; .20 of an inch for thirty (30) inch, thirty-six (36) inch and forty-two (42) inch, and .24 of an inch for forty-eight (48) inch, fifty-four (54) inch and sixty (60) inch. These variations apply only to special castings made from standard patterns.

MARKING

9. Every pipe and special casting shall have distinctly cast upon it the initials of the maker's name. Each pipe must have cast upon it figures showing the year in which it was cast and a number signifying the order in point of time in which it was cast, the figures denoting the year being above and the number below, thus:

1938	1938	1938
1	2	3

etc. also the initials P. B. and the Class Letter "D". The letters and figures shall be cast on the outside and shall not be less than 2 inches in length and 1/8 of an inch in relief for pipe 8 inches in diameter and larger. For smaller sizes of pipe, the letters may be 1 inch in length. The weight shall be conspicuously painted in white on the inside of each pipe and special casting after the coating has become hard.

ALLOWABLE PERCENTAGE OF VARIATION IN WEIGHT

10. No pipe shall be accepted, the weight of which shall be less than the standard weight by more than five (5) per cent for pipes sixteen (16) inches or less in diameter, and four (4) per cent for pipes more than sixteen (16) inches in diameter.

No special casting shall be accepted, the weight of which shall be less than the standard weight by more than ten (10) per cent for pipes twelve (12) inches or less in diameter, and eight (8) per cent for larger sizes, except that curves, Y pieces and breeches pipe may be twelve (12) per cent below the standard weight, and no excess above the standard weight of more than the above percentages for the several sizes will be paid for. These variations apply only to castings made from standard patterns.

QUALITY OF IRON

11. All pipes and special castings shall be made of cast iron of good quality, and of such character as shall make the metal of the castings strong, tough and of even grain, and soft enough to satisfactorily admit of drilling and cutting. The metal shall be made without any admixture of cinder iron or other inferior metal, and shall be remelted in a cupola or air furnace.

TESTS OF MATERIALS

12. Specimen bars of the metal used, each being twenty-six (26) inches long by two (2) inches wide and one (1) inch thick, shall be made without charge as often as the Director may require.

These bars when placed flatwise upon supports twenty-four (24) inches apart, and loaded in the center, shall support a load of two thousand (2,000) pounds, and show a deflection of not less than .30 of an inch before breaking. The Director may also require that tensile bars shall be made which will show a breaking point of not less than twenty thousand (20,000) pounds per square inch.

CASTING OF PIPE

13. The straight pipe shall be cast in dry sand moulds in a vertical position. Pipe sixteen (16) inches or less in diameter shall be cast with the hub end up or down, and pipe eighteen (18) inches or more in diameter shall be cast with the hub end down, and shall be cast in such length so as to allow a minimum length of twelve (12) feet, after spigot end has been cut and machined.

The pipe shall not be stripped or taken from the pit while showing color of heat, but shall be left in the flasks for a sufficient length of time to prevent unequal contraction by subsequent exposure.

QUALITY OF CASTINGS

14. The pipes and special castings shall be smooth, free from scales, lumps, blisters, sand holes and defects of every nature which unfit them for the use for which they are intended. No plugging or filling will be allowed.

CLEANING & INSPECTION

15. All pipes and special castings shall be thoroughly cleaned and subjected to a careful hammer inspection.

No casting shall be coated unless entirely cleaned and free from rust, and approved in these respects by the Director before being coated and cement lined.

COATING

16. Every pipe and special casting shall be coated on the outside with coal-tar pitch varnish. The varnish shall be made from coal tar. To this material, sufficient oil shall be added to make a smooth coating, tough and tenacious when cold, and not brittle nor with any tendency to scale off.

HYDROSTATIC TEST

17. Before the cement lining is applied the straight pipes shall be subjected to a proof by hydrostatic pressure of not less than three hundred (300) pounds per square inch unless otherwise ordered by the Director, and while under this pressure, shall be subjected to a thorough hammer test.

WEIGHING

18. The pipes and special castings shall be weighed for payment under the supervision of the Director before the cement lining is applied. The Director shall have the power, at his discretion, to have the scales tested by a properly authorized officer.

CEMENT MORTAR LINING

PREPARATION OF PIPE FOR LINING

19. Pipe to be lined with cement mortar shall not be coated inside with tar or other asphaltum products before the cement lining is applied. Its interior surface shall be thoroughly cleaned of all core sand, mud, grease, foreign materials, or any sharp projections of iron which might project through the lining. Pipe shall be tested hydrostatically before being lined.

CEMENT

20. The cement used for making cement mortar shall be Portland cement, complying in all respects with the standard specifications of the American Society for Testing Materials, Serial Designation C-9-30.

SAND

21. The sand for mortar shall be clean, sharp, hard, silicious sand, free from loam, clay, organic matter, or other foreign substance considered as deleterious for good mortar. The sand shall be well graded and when tested by laboratory sieves shall meet the following specifications:

Total passing 12-mesh sieve, 100 per cent.
Total passing 100-mesh sieve, not over 5 per cent.

WATER

22. The water for tempering the cement mortar shall be free from harmful amounts of oil, acid, alkali, organic or vegetable matter.

MORTAR

23. The cement mortar used for lining pipe shall be a mixture of the above-specified sand and cement in such proportions as to obtain a good, hard, dense lining, reasonably well bonded to the pipe, and with a smooth interior surface. The mixture shall consist of two or three parts cement to one part sand, by volume. The cement mortar shall be thoroughly mixed, only sufficient water being added to form a workable mixture for placing in the pipe. Only sufficient cement mortar shall be mixed for the immediate requirements of lining.

APPLICATION OF LINING

24. Sufficient cement mortar shall be introduced to produce the required thickness of lining and shall be spread evenly over the interior surface of the pipe by any suitable means. A careful examination shall be made after this operation is completed to see that the inner surface of the pipe is completely covered with cement mortar. The shoulder of the bell and the end of the spigot may be covered with cement mortar by applying with a brush. Surplus cement mortar shall be removed from the interior of the bell so as not to interfere with proper keying of the joint. The work of lining the pipe shall be done in a building where the product shall be protected from the direct rays of the sun, and from extreme weather conditions, such as rain, frost, etc. The product shall not be put on the yard until the cement has set sufficiently to avoid injury or damage thereto. Patching of improperly lined pipe will not be permitted.

SMOOTHNESS OF LINING

25. The lining of pipe shall be smooth and substantially free from noticeable ridges, corrugations, projections, or depressions.

THICKNESS OF LINING

26. The thickness of lining shall be 1/8 inch (+1/8, - 0 inch) for sizes 12 inches and under, 3/16 inch (+1/8, - 0 inch) for sizes 12 inches to 24 inches, and 1/4 inch (+1/8, - 0 inch) for sizes 30 inches and over. At the end of the pipe where the lining naturally tends to taper off to a thin edge, the full thickness of lining shall extend to within 1 inch of end of pipe. Lining of greater thickness shall be furnished when specified.

CURING OF LINING

27. Immediately after pipe is lined with cement mortar, it shall be protected in a suitable manner to prevent the too rapid withdrawal of moisture from the cement mortar and, if necessary, suitable means shall be provided to keep lining damp for a period of at least 24 hours after lining.

No pipe shall be shipped until the lining is thoroughly set.

COATING FOR CEMENT LINING

28. After the cement has been allowed to set for at least 48 hours or until it is thoroughly hard, the Contractor shall coat the pipe or castings inside and out with an application of asphalt or coal tar paint brushed or sprayed on. The paint and the method of its application shall be subject to the approval of the Director and shall be demonstrated by the Contractor to the satisfaction of the Director both before its approval and during the progress of the contract as having no deleterious or objectionable effect upon the quality, taste or odor of the water to be carried by the pipe or castings. The paint shall be so applied as to completely cover the cement surface with an integral film of asphalt or coal tar, without pin holes or holidays.

CEMENT LINING TEST

29. Not less than 1 per cent of pipe shall be tested, and in the event defects are discovered in the lining, testing shall proceed until the lining complies with the specifications.

The thickness of lining may be determined by means of spear measurements, using a hardened steel point not greater than one-sixteenth inch in diameter. The inspector shall pierce the lining immediately after it is placed in the pipe, and before cement has set, at four diametrically opposite points of the pipe at bell and spigot ends, making two sets of measurements at each end. The first set shall be not greater than 4 inches from the respective ends of the pipe and the second set shall be made as far into the interior

of the pipe as can readily be obtained by reaching into the pipe without injuring the lining. All measurements shall be within the limits specified.

Pipe showing three or more loose spots measuring 12 inches or more in diameter, or three or more shrinkage cracks over 9 inches in length, or cracks standing open perceptibly, will not be accepted. Pipe that have loose spots or shrinkage cracks and which may be accepted in accordance with the above limitations will only be accepted if in the opinion of the Director the loose spots or shrinkage cracks are not the results of inferior workmanship or material.

CEMENT LINING FOR SPECIAL CASTINGS

30. The cement lining of Special Castings (except caps, plugs and sleeves, which shall receive the same coating inside as in specified for outside) shall be as smooth as practicable.

The interior surface of Special Castings shall be lined by applying cement mortar as specified in previous paragraphs, evenly and uniformly and as nearly as practicable of the thickness specified for the corresponding sizes of pipe, and shall be given the bituminous coating as specified in paragraph 28.

CLEANING AND INSPECTION

31. All special castings shall be thoroughly cleaned and subjected to a careful hammer inspection in the presence of the City's inspector before any coating or lining is applied.

No casting shall be coated or lined unless entirely cleaned and free from rust, and approved in these respects by the Director.

COATING

32. Every special casting shall be coated on the outside and caps, plugs and sleeves shall be coated inside and outside with coal-tar pitch varnish. The varnish shall be made from coal tar. To this material sufficient oil shall be added to make a smooth coating, tough and tenacious when cold, and not brittle nor with any tendency to scale off.

MEN AND MATERIALS

33. The Manufacturer shall provide all tools, testing machines, materials and men necessary for the required testing, inspection and weighing at the foundry of the pipe and special castings; and should the Director not inspect pipe and castings, the Manufacturer shall, if required, furnish a sworn statement that all the tests have been made as specified, this statement to contain the results of the tests upon the test bars.

POWER TO INSPECT

34. The Director shall be at liberty at all times to inspect the material at the foundry, and the moulding, casting, coating, and cement lining of the pipes and special castings. The forms, sizes, uniformity and condition of all pipes and other castings herein referred to, shall be subject to his inspection and approval, and he may reject, without proving, any pipe or other casting which is not in conformity with the specifications or drawings.

INSPECTION COSTS TO BE DEFRAYED BY CONTRACTOR

35. If the materials herein provided for are manufactured outside the limits of Allegheny County, Pennsylvania, the successful bidder shall bear the transportation and subsistence expenses of the City Inspector from Pittsburgh to the manufacturing plant and return; also his hotel expenses not to exceed Six ($6.00) Dollars per day, during the time said materials are being manufactured.

TO BE DELIVERED SOUND

36. All the pipes and other castings must be delivered in all respects sound and conformable to these specifications. The inspection shall not relieve the Contractor of any of his obligations in this respect, and any defective pipes or other castings which may have been inspected and passed upon shall be, at all times, liable to rejection when discovered, until the final completion and adjustment of the contract.

Care shall be taken in handling the pipes not to injure the coating or cement lining and no pipes or other material of any kind shall be placed in the pipes during transportation or any time after they have received the coating and cement lining.

Form 106

CITY OF PITTSBURGH - DEPARTMENT OF PUBLIC WORKS

S P E C I F I C A T I O N S
for
M A T E R I A L

CAST IRON, BRONZE MOUNTED GATE VALVES

SECTION 302

TYPE AND MEASURE

4. Gate valves furnished under this contract shall be at least equal to the following and shall conform with the requirements hereinafter given:

Ludlow or equal
Rensselaer or equal
Darling or equal

They shall have double bronze mounted discs, controlled and worked with a reliable bronze mounted wedge mechanism which will, in closing, push the discs to a perfect contact with the seat, the reverse of this being the action in opening the valves. The valves shall be designed for a working pressure of one hundred fifty (150) pounds per square inch, must work equally well with the pressure on either side of the gate, and turn to the right to open.

All parts of both new and old gate valves of the same type and size must be interchangeable.

All parts shall be equal, in the judgment of the Director, in material, workmanship, strength, durability and suitability for the service to be performed, to those in the makes of valves mentioned above.

The Contractor shall furnish the City detailed shop drawings showing the details and all dimensions of all parts for each size of valve ordered before proceeding with the manufacture of the valves with specifications indicating the kinds and qualities of materials to be used.

CASE AND BONNET

5. The case and bonnet shall be of cast iron conforming to the requirements of Section 18, and shall be of ample thickness to withstand all strains due to temperature in addition to those incident to their position in the ground.

All valves 16" and over in diameter, must have spots cast in two (2) places on the body of the valve to rest upon foundations, and must have a two (2) inch hole drilled and tapped and plugged in top and bottom side of bonnet for washing out of same.

All valves 16" and over in diameter shall have by-passes of size as shown in the attached drawings.

All valves must correspond to attached drawings in regard to the flanges and hub ends.

GATES — 6. The gates shall be of cast iron of the same quality as the case and bonnet. They shall be provided with machined, detailed or screwed grooves for seat rings, and be of ample thickness and well ribbed to withstand the pressure applied to them.

WEDGES — 7. The wedges shall be of cast iron, bronze mounted, simple and reliable in operation.

STEMS — 8. Stems shall be of bronze conforming to requirements of Section 19. They shall be of the non-rizing type and have square threads cut in a lathe.

STUFFING BOXES & GLANDS — 9. All stuffing boxes shall be of cast iron, bronze mounted, and shall have not less than three (3) wrought iron or steel bolts with bronze nut. They shall be independent of the bonnet. All glands shall be of solid bronze.

GATE OR SEAT RINGS — 10. The seat rings shall be of bronze or composition, and be securely fastened in an approved manner. After machining, they shall be scraped to a true and even bearing, so as to withstand the pressure without leaking.

ROLLERS & GUIDES — 11. All valves provided with bevel gears shall have bronze rollers traveling on bronze tracks for supporting the discs and facilitating their movement.

GEARING & SUPPORTS — 12. Gears shall be of tough cast iron, cast from accurate patterns and shall be chipped and filed to a good mesh, and no valve will be accepted unless the gearing works smoothly and easily. The pinion shaft may be of open hearth steel, or of bronze; if of steel, it shall turn in a bronze bushed or babbitted bearing. The bracket shall be cast iron, designed for rigidity and strength.

All valves 16" and over in diameter shall have bevel gears, with substantial grease tight gear enclosure.

INDICATORS — 13. All valves 16" and over in diameter must be equipped with simple and reliable indicators of approved design, to show the exact position of the discs.

OPERATING NUTS — 14. The operating nuts of all main valves and by-pass stems shall conform to the Bureau of Water standard.

BOLTS & NUTS — 15. All bolts used in the construction of these valves must have hexagon heads; all nuts must be hexagonal and conform to the United States standard.

MATERIAL AND WORKMANSHIP

GENERAL — 16. All material used throughout these gate valves and parts shall be of the class and grade required for the purpose specified, and entirely suitable for the work, and where the quality is not stated, it shall be understood that the best quality is to be furnished, especially adapted for the required service. The finish, fitting and workmanship shall be equal to that of the best modern practice.

NOTICE OF MANUFACTURE AND SPECIMENS — 17. The Contractor shall notify the Director of the places where the various parts and materials are to be made, and of the dates when the various operations will be commenced, and he shall furnish, without expense to the City, suitable facilities for inspecting them at all stages. He shall also furnish, properly prepared, all samples and specimens for all chemical analysis and physical tests, which the Director may require, and suitable facilities for making such analyses and tests without expense to the City.

The failure of test specimens to conform fully and satisfactorily to the requirements of these specifications shall be sufficient cause for the rejection of the whole melt or stock from which the samples were obtained.

CAST IRON — 18. The cast iron used in this contract shall be of the best grade, without any mixture of cinder iron or other inferior metal, and shall be remelted in a cupola or air furnace. It shall be uniform, sound, tough, close grained and soft enough to admit of being satisfactorily cut and drilled. Castings shall be smooth and free from lumps, core swells, scales, blisters, sand holes, cracks, shrinkage strains, cold shuts, and all defects and imperfections which may in any way impair their strength or render them unsightly or otherwise unfit for use in construction. No plugging or filling will be allowed.

Test bars of metal used, each being twenty-six (26) inches long by two (2) inches wide and one (1) inch thick, shall be cast as often as the Director may require. Each bar placed flatwise upon supports twenty-four (24) inches apart and loaded in the center shall support a load of two thousand (2,000) pounds, and show a deflection of not less than thirty-five one hundredths (0.35) of an inch before breaking. In addition to this, the iron shall show a tensile strength of eighteen thousand (18,000) pounds per square inch.

BRONZE

19. Bronze used in the stems must be first-class hammered or rolled bronze, and must have a tensile strength of not less than thirty-six thousand (36,000) pounds per square inch. All other bronze used must be made of such mixture as is especially adapted for the work in each case, and approved by the Director.

STEEL

20. All steel used must be of first quality of open hearth steel and must have an ultimate strength of not less than sixty thousand (60,000) pounds, nor more than seventy thousand (70,000) pounds per square inch, and an elastic limit of not less than one-half the ultimate strength.

PACKING

21. All valve stems will be packed with the best Italian hemp packing.

PAINTING

22. The inside and outside of the valves, together with the working parts, except those of bronze and machined faces, must be covered with two (2) coats of approved asphaltum paint.

HYDROSTATIC TESTS

23. When the coating has become hard on the inside of the gate valves, they shall be subjected to a proof test by hydrostatic pressure of not less than three hundred (300) pounds per square inch, under which pressure they shall be tight, and while under this pressure, shall be subjected to a thorough hammer test.

G E N E R A L

MEN AND MATERIALS

24. The manufacturer shall provide all tools, test machines and men necessary for the required test and inspection of gate valves and parts, and should the Director not inspect gate valves and parts, the Manufacturer shall, if required, furnish a sworn statement that the tests have been made as specified, this statement to contain the results of test.

POWER TO INSPECT

25. The Director shall be at liberty to, at all times, inspect the metal at the foundry, the moulding, casting, cutting and machining of all gate valves and parts. The forms, sizes and any other conditions of the gate valves and parts referred to herein, shall be subject to his inspection and approval; and he may reject without proof, any part or casting which does not conform with the specifications or drawings.

INSPECTION COSTS TO BE DEFRAYED BY CONTRACTOR

25A. If in the opinion of the Director any inspection of materials, processes of manufacture, fabrication, shop coating, testing or otherwise shall require that the City Inspector travel outside of Allegheny County, Pennsylvania, the Contractor shall defray the costs of said Inspector's transportation to and from the plant where his presence is required, together with subsistence costs (not to exceed Six ($6.00) Dollars per day) during the period of inspection.

PATENTS

26. The Contractors entering into the contract to supply gate valves under these specifications, shall bind themselves, their successors and assigns, to indemnify and save harmless the City of Pittsburgh, from all such actions at law, of every nature and description, which may be brought against the said City, for or on account of any patent, invention, or article, or arrangement that may be used by the Contractor in the construction of said gate valves and the work connected therewith, furnished under these specifications.

LIABILITY

27. The Contractor shall be responsible for all gate valves during the life of this contract.

PLANS

28. The Contractor shall submit in quadruplicate, for approval within twenty (20) days after the date of the award of this contract, complete working drawings of the gate valves herein specified, or required to complete the work as part of the contract, showing completely all details of design and construction of said gate valves. No work shall be done on valves until these drawings are approved.

Form 106

CITY OF PITTSBURGH - DEPARTMENT OF PUBLIC WORKS

S P E C I F I C A T I O N S

for

MISCELLANEOUS WATER PIPE LINE MATERIAL

SECTION 303.

HEMP

Hemp used for making cast iron water pipe joints shall be dry, clean, braided hemp, without oil or tar, of the best grade suitable for making pipe joints with joint compound.

JOINT COMPOUND

Where joint compound is used for making cast iron water pipe line joints it shall be of the best quality and shall be equal in all respects to the following:

Leadite or equal
Tegul Mineralead or equal
Hydrotite or equal

PIG LEAD

Where pig lead is used for making cast iron water pipe line joints it shall be soft lead conforming with all the requirements as to chemical composition of the standard specifications of the American Society for Testing Materials, Serial Designation B-29-35 for common lead (Grade III).

LUMBER

Lumber for blocking shall be No. 2 rough white pine free from imperfections.

CITY OF PITTSBURGH
DEPARTMENT OF PUBLIC WORKS
SPECIFICATIONS FOR CONSTRUCTION

GENERAL

401. All work shall be done in accordance with the requirements of the Contract Documents and in conformity with the following requirements insofar as they apply to the respective items of work, except as otherwise stipulated on Contract Plans or in Supplemental Specifications.

MATERIALS IN COMPLETED WORK

402. All materials used on the work which form, or become a part of the completed work shall conform to the specifications for the respective materials.

GENERAL EXCAVATION

NO CLASSIFICATION FOR MATERIALS TO BE EXCAVATED

403. All items of work involving grading, trenching, tunnelling and all other kinds of excavation, shall be done in conformity with the requirements of these specifications regardless of the character and kind of materials encountered, or of the number, location and kind of structures or substructures encountered, and payment made at respective contract unit prices for the items of work involved shall be full compensation therefor. No compensation for any additional cost and expense shall be made that is caused by reason of failure to indicate such material, structures, or sub-structures on the contract plans, or in Supplemental Specifications, or that is caused by reason of the Contractor encountering materials, structures, or sub-structures other than anticipated by him.

FORMATION OF SUBGRADE, SIDEWALKS AND SLOPES
Sections 404 to 419, Inclusive

GENERAL

404. The Contractor shall clear the ground of all obstructions, remove existing pavement, curbs and sidewalks, do all grading required, construct embankments and perform such other work as may be necessary and incidental to the proper formation of the subgrade of the roadway and the grade of sidewalks.

GRADING

405. Grading shall consist of the removal of all material above the proper elevation of all finished subgrade of roadway, grade of sidewalks and slopes, and excavation below finished subgrade of roadway for increased depth of concrete paving base and for concrete reinforcement over trenches that is done in conformity with stipulations given on Contract Plans, or any Supplementary or Special Specifications or orders given in the field, either prior or subsequent to the completion of rough grading; and shall further include the placing of all such material in embankments as hereinafter specified.

Quantities shall be computed as the volume between the existing surface of the ground and finished subgrade of the roadway, grade of sidewalks and finished slopes, and the neat lines of excavation required to be done below finished subgrade, all within the lines and grades as shown on the Contract Plans or as ordered by the Director in the field.

Where material is required to be removed prior to the formation of embankment, the quantity of grading shall be computed, as the volume between the existing surface of the ground and the required finished elevation at the bottom of the unsuitable material required to be removed.

Compensation for excavation required to be done for broken stone sub-base and placing same in embankments as hereinafter specified shall be included in payment made at contract unit price for Broken Stone Sub-Base.

FINISHED SLOPE LINES

406. Finished slope lines shown on the contract plans for grading required to be done on various improvements are approximate only, and the estimated quantities involved in grading, borrow and spoil, as contained in the approximate estimate of quantities given on the Contract Plans, proposals and in Supplemental or Special Specifications are computed on the basis of the slope lines indicated on the Contract Plans. At respective contract unit prices for Grading, Borrow and Spoil, the Contractor shall construct all slopes in cut and fill to the required neat lines ordered done in the field, regardless of increased effect on the approximate estimate of quantities given for Grading, Borrow and Spoil. The increases in quantities thereof, however, shall be subject to the provisions of the requirements of the General Conditions.

Wherever the excavation or embankment is extended beyond the lines and grades given by the Director, the Contractor shall, at his own expense replace or remove this material in a manner so as to conform with the Contract Plans and Specifications.

BORROW

407. All material required for the purpose of fill or embankment in excess of that required and paid for under other items of this contract shall be known as "Borrow". Borrow shall be procured by the Contractor from sources external to the contract and shall be approved by the Director prior to being placed in embankment.

The quantity for which payment shall be made under this item shall be the volume computed between the surface of the ground, or neat lines of bottom of excavated unsuitable material to the finished subgrade of roadway, grade of sidewalks or subgrade of sidewalk, pavements, and finished slopes within the lines and grade shown on the contract plans, or as ordered by the Director in the field, from which volume there shall be deducted the amount of fill or embankment placed in conformity with the requirements of Section 405 governing Grading that is computed to required neat lines.

SPOIL

408. All material from the work paid for as grading, and not required to bring the roadways and sidewalks to the proper subgrade and grade respectively, shall be removed from the site of work by the Contractor for which payment will be made as spoil as hereinafter specified.

The volume of spoil removed shall be computed as the difference between the total excavation made under all items of grading and the total fill required in conformance with the contract plans or as ordered by the Director in the field.

Compensation will not be allowed under spoil for disposal of excavated materials from any item of work except grading unless otherwise stipulated on contract plans or Supplementary Specifications.

PLACING AND MECHANICAL RAMMING EMBANKMENTS

411. When stipulated on contract plans, or in Supplemental or Special Specifications, that granulated slag borrow is to be mechanically rammed it shall conform to the following requirements:

Before commencing the placement of granulated slag borrow, the Contractor shall provide a compressor plant of sufficient capacity to ensure, in the opinion of the Director, the continuous operation of six pneumatic rammers of a size and design approved by the Director. The size and number of compressors and other appurtenances shall be increased when required by the Director but in all cases they shall be sufficient to secure a pressure of at least 80 pounds at the nozzle of each rammer.

The slag shall be spread evenly, in horizontal layers of 6 inches, and each layer shall be thoroughly consolidated and compressed with pneumatic rammers, the ramming of each layer to be continued until the six inch layer is thoroughly compressed, after which the next layer of 6 inches of slag shall be spread and treated in like manner. Whenever, for any cause whatsoever, rammers are not continuously operated, the delivery and spreading of granulated slag must cease, and shall not be resumed until the foregoing treatment shall have been completely complied with. All of the layers of slag shall be sprinkled with water as ordered by the Director in the field. Slag containing moisture content to an extent to cause bulking shall not be used for embankment required under this contract.

Compensation for granulated slag required to be placed in embankments shall be on a tonage basis in accordance with weight slips furnished as stipulated in Section 408 for Granulated Slag Borrow.

MATERIALS FOR EMBANKMENT

412. Materials for embankment shall in all cases be subject to the approval of the Director and shall be good earth, clay, sand, gravel, soft shale, granulated slag, or other acceptable material, free from all foreign or perishable matter, such as sticks, tin cans, rubbish, ashes, etc. The use of cinders for filling shall not be permitted.

Broken rock or shale may be placed in embankment but only in quantities and locations satisfactory to the Director. Such material shall be broken to sizes not exceeding 6 inches in their largest dimension at the location where same is excavated and before same is placed on any vehicle for transportation. Where side casting is permitted such material must be broken before being side cast and under no circumstances shall any such material be deposited in the area of any required embankment prior to being subjected to the foregoing treatment.

SIDE HILL FILLING

413. Where stipulated on the Contract Plans, or in Supplemental or Special Specifications, the embankment may be constructed by side-hill filling or dumping, in which case the Contractor shall prepare the base of the embankment by benching and stripping as required in Section 409, and shall carry out the work as follows:

The dumping of embankment in one particular location will not be permitted, but the side-hill dumping shall be carried along in approximately uniform layers not to exceed eight (8") inches before settlement.

PREPARATION OF SUB-GRADE IN CUT

414. Excavation for the roadways and sidewalks shall be made to the sub-grade parallel with the finished cross section of the street in accordance with the lines and grades given on the Contract Plans, or as ordered in the field by the Director. The surface of the ground at the sub-grade shall be thoroughly compressed and compacted by a roller weighing not less than ten (10) tons. Any part of the street which cannot be reached with a roller must be rammed with heavy iron rammers. All ruts and holes caused by unavoidable hauling on the finished sub-grade shall be refilled with acceptable material and thoroughly rammed. The portion of the sub-grade so disturbed shall then be rerolled until brought to the required finished cross section, all of which shall be done without additional compensation.

Rolling the sub-base of streets prior to the placing of concrete base shall not be omitted unless by permit personally signed by the Director of the Department of Public Works.

CROSS SECTIONS OF SUB-GRADE

415. The cross-section of the sub-grade shall be tested by template furnished by the Contractor, containing steel prongs at three (3) foot intervals, adjusted to the required finished contour of the sub-grade. This template must be tested and approved by the Director before sub-grade is started. The template will be moved along the street after the sub-grade work is completed, in order to determine conformity with requirements. The finished sub-grade must be brought to within one-quarter (1/4") of an inch of the cross-section required under the contract.

In no case shall concrete be placed in pavement base unless the sub-grade has been trimmed and prepared as above required and ready for the placing of concrete for a distance of not less than fifty (50) feet from the point where concreting is in operation.

HAULING PROHIBITED OVER WET OR SOFT SUB-GRADE

416. Transportation of materials, tools or equipment is prohibited by means of vehicles that will cut or cause rutting of wet or soft sub-grade after same has been compacted and shaped. When soft and wet sub-grade obtains, the contractor shall, when ordered in the field, deposit all materials, tools and equipment at points designated by the Director outside the limits of the prepared sub-grade and shall then transport same by means of hand buggies in such manner that will cause no disturbance to the prepared sub-grade.

When necessary to accomplish such result, the Contractor shall provide tracks prepared with planks of not less than two (2) inches in thickness, laid close together, or sheet metal plates of minimum thickness of one-eighth (1/8") inch and satisfactorily fastened together.

When ordered by the Director the space on which materials are deposited from vehicles shall be similarly prepared with planks or metal plates so that the material may be handled and stored without becoming dirty or mixed with deleterious substances.

All the foregoing shall be done at the Contractor's own cost and expense.

DRAINAGE

417. The Contractor shall, unless otherwise provided in the Contract, provide at his own expense, suitable and adequate means for the drainage of the surface or sub-grade water to prevent damage to any part of the work or made necessary for the proper maintenance of traffic, and where any damage is done, shall repair the same at his own expense. The water shall be diverted, carried around, through or over the said work temporarily until the same

Form 100A

PUBLIC SERVICE STRUCTURES

418. All underground structures owned by the City of Pittsburgh, including street sewers, house sewer connections, or house laterals, water pipes, electrical conduits, and any other structures owned by the City which are encountered in carrying out the work under this Contract, shall be protected from injury, supported in place and the service maintained by the Contractor at his expense, until final disposition of the same has been determined. Where the said underground structure is to be rebuilt, relocated, or replaced under this Contract, the Contractor's obligation shall continue until the said sub-structure has been rebuilt, replaced or relocated. The provisions of The General Conditions governing Protection, Supporting and Maintenance of Structures, including underground structures, whether owned by the City or others shall be strictly adhered to.

WATER SERVICES

419. Water service pipes which are exposed by grading, shall be protected, supported and the service maintained by the Contractor for such length of time as the Director may deem reasonable, and then shall be removed by the Contractor at his expense and delivered to the owner in good condition.

SUB-BASE FOR STREET PAVEMENTS

MATERIALS

420. When Sub-base for Street Pavements is indicated on the Contract plans, or ordered by the Director, the Contractor shall have the option of constructing same with washed and crushed gravel, crushed air-cooled blast furnace slag, or broken stone, either exclusively or in combination.

The materials shall conform to the requirements for coarse aggregates for concrete, Section 121 to 128 inclusive of the Specifications for Materials, except for size.

SPREADING COARSE MATERIAL

After the subgrade for the sub-base has been shaped and rolled in conformity with the requirements of the Contract for Construction governing preparation of sub-grade, to a depth below finished sub-grade of concrete paving base, or concrete pavement, that is indicated upon the contract plans, or ordered by the Director, the coarse material shall be spread uniformly on the sub-grade with stone forks from piles along the side of the roadway, or from dumping boards, or by means of approved stone spreaders, or directly from trucks when such work is handled satisfactorily so as to spread the stone to the required depth. Whenever the coarse material is dumped in piles upon the sub-grade, it shall be entirely rehandled in spreading. All segregated, fine or coarse material shall be removed and replaced with well graded material. It shall not be spread upon a wet subgrade or more than an average day's work in advance of rolling and filling.

The Contractor shall use a templet cut to the crown of the pavement, of concrete paving base, and also one cut to the crown of the subgrade for checking the crown in the pavement, or concrete paving base and subgrade respectively, he shall also use a straight edge not less than 10 ft. in length for testing for irregularities of surface. The quantity of coarse aggregates placed upon the subgrade shall be sufficient to allow for impregnation in the subgrade, for compaction and for keying with fine aggregates of one of the materials above stipulated graded in conformity with the stipulations governing LARGE CLASS, of Section 124 of the Specifications for Materials.

ROLLING COARSE MATERIALS

The coarse material shall be rolled with a three-wheel power roller weighing not less than 10 ton, until it is compacted to a firm even surface to the depth specified. However, a smaller roller may be used when permitted by the Director, on such improvements where the steepness of grade, location and number of structures extending to the surface of the finished pavement, and other conditions encountered renders the use of the 10 ton roller impracticable.

Portions of the sub-grade where a roller cannot be operated shall be compacted to the satisfaction of the Director with hand rammers of approved type and design. The rolling shall begin at the sides and progress to the center, except on super-elevated curves, where rolling shall begin on the low side and proceed to the high side. The rolling shall be parallel to the center line of roadway uniformly lapping each preceding track and covering thoroughly the entire surface with the rear wheels, and continuing until material does not creep, or wave ahead of the roller.

SUB-BASE FOR STREET PAVEMENTS

APPLICATION OF SCREENINGS

420. After the coarse material has been compacted in conformity with the foregoing requirements screenings consisting of material above stipulated and graded to conform to sizes which when tested with Tyler standard sieves will show 100% passing a 3/4" sieve, and 5 to 20% passing a 100 mesh sieve. It shall be spread in thin layers, each layer, swept in and rolled dry. This process shall be continued until no more screenings can be forced in the voids. After the completion of the application and rolling of dry screening the surface shall be sprinkled with water and rolled. All excess screening formed in piles and cakes upon the surface shall be loosened and scattered by sweeping. The sprinkling and rolling shall be continued and additional screenings applied where necessary until the coarse material is well bonded and firmly set. The quantity of screening and water necessary shall be determined by the Director in the field and shall be sufficient only to produce a rough granular surface. The rolling shall conform to the stipulations above given governing Rolling of Coarse Material.

FINISHING

The contractor shall provide a templat cut to required crown of the sub-base to be used for checking the crown thereof. When the surface of the sub-base is completed it shall be tested by the Contractor with an approved standard straight edge 10 ft. in length to detect surface irregularities and any irregularities exceeding 1/2" above or below the required finished surface of the sub-base shall be remedied to the satisfaction of the Director by loosening the surface and removing, or adding coarse stone as may be required, after which the entire area including the surrounding surface shall be rolled, screenings and water applied and rolling continued until it is compacted satisfactorily to a uniform surface.

If at any time sub-grade material should become thrown up or mixed with base coarse materials, the Contractor shall without additional compensation dig out and remove the mixture, reshape and compact the sub-grade and replace the materials removed, with clean coarse material which shall be rolled and filled until compacted satisfactorily. The Contractor shall not haul heavy loads over this base course, and any damage caused by the Contractor shall be satisfactorily repaired at his own expense.

COMPENSATION FOR EXCAVATION AND DISPOSAL

Where excavation or additional excavation for sub-base for Street Pavements is done in conformity with the requirements herein given, and the stipulations given on the Contract Plans or orders given in the field, either prior or subsequent to completion, the rough grading for all contracts for Grading, Paving, Curbing, or Repaving, or otherwise, compensation for such excavation and for disposal thereof shall be included in payment made at the contract unit price for Sub-base for Street pavements. However, where material excavated under this item is placed in embankment required to be constructed under this contract, the quantity so involved shall be deducted from the quantity measured for payment for Borrow.

RAZING AND REMOVAL OF BUILDINGS

DESCRIPTION

421. The Contractor shall raze and remove such buildings or portions of Buildings indicated on the Contract Plans by respective Item numbers that lie within the proposed street lines. All material and debris shall be removed from the premises, cellars, basements and vaults. Cellar walls and other foundations shall be taken out to an elevation one foot below the required finished sub-grade of roadway and of sidewalk pavements; provided, however, that work shall be done only on such buildings, or portions thereof when and as ordered in the field.

TRENCH EXCAVATION

Sections 425 to 429, Inclusive

TRENCH EXCAVATION CLASSIFICATION

425. Excavations for the following work where done in conformance with the requirements of the Contract Plans or as ordered in the field by the Director, shall be classed as trench excavation and paid for per cubic yard as hereinafter provided under "Measurement and Compensation".

(a) Excavation for retaining walls, abutments, footings, piers and similar structures.
(b) Excavation for cribs.
(c) Excavation for the connection for Pipe drains laid behind retaining walls, with sewers and other outlets that is not included in other items of work.
(d) Excavation for sewer construction not included under other items of work or excavation classified as Extra Trench Excavation.
(e) Excavation for the above mentioned items of work required to be done below the depth shown on the contract plans will be classified and paid for as Extra Trench Excavation.
(f) Excavation required for test pits and similar excavations ordered by the Director to a depth not exceeding ten (10') feet, excavation of this nature below a depth of ten (10') feet will be classified as Extra Trench Excavation.

All excavation, however, required to be done above the finished grade of the curb or sidewalk outside the roadway area and above the sub-grade within the roadway area will not be classified as trench excavation, but shall be classified and paid for as grading. This refers particularly to walls and cribs on the high sides of improvements.

The requirements of Sections 418 governing Protection Supporting, and Maintenance of Structures, including Underground Structures, whether owned by the City or others, shall be strictly adhered to.

Additional excavation beyond the neat lines of the proposed structure for the purpose of placing sheeting and bracing, forms for concrete, or resulting from caving in or slipping of the ground or due to the negligence of the Contractor or his methods of executing the work, shall not be considered as Trench Excavation or Extra Trench Excavation, and no payment therefor shall be made. All such additional excavation shall be refilled by the Contractor in accordance with the Specifications for "Backfill", at his own expense, with satisfactory materials.

The Contractor shall, at his own expense, do all pumping and bailing necessary to remove any water which may be encountered or which may flow into the trenches, test holes, excavation for manholes, catch basins or other structures, from any cause whatsoever.

BACK-FILLING

426. The price bid per cubic yard for Trench Excavation or Extra Trench Excavation shall include back-filling the trenches for all structures to the original surface of the ground, unless otherwise specified or provided on the Contract Plans, or ordered by the Director in the field, and shall be done by mechanical ramming.

The back-filling behind retaining walls and cribs shall be placed in horizontal layers not exceeding six (6") inches in thickness, and shall be sprinkled with water where required and thoroughly tamped and consolidated by mechanical ramming. The placing of back-filling behind the retaining walls shall proceed in the manner and at such times after the concreting of the wall as the Director may require.

TRENCH EXCAVATION

Sections 425 to 429, Inclusive

TRENCH EXCAVATION CLASSIFICATION

425. Excavations for the following work where done in conformance with the requirements of the Contract Plans or as ordered in the field by the Director, shall be classed as trench excavation and paid for per cubic yard as hereinafter provided under "Measurement and Compensation".

(a) Excavation for retaining walls, abutments, footings, piers and similar structures.
(b) Excavation for cribs.
(c) Excavation for the connection for Pipe drains laid behind retaining walls, with sewers and other outlets that is not included in other items of work.
(d) Excavation for sewer construction not included under other items of work or excavation classified as Extra Trench Excavation.
(e) Excavation for the above mentioned items of work required to be done below the depth shown on the contract plans will be classified and paid for as Extra Trench Excavation.
(f) Excavation required for test pits and similar excavations ordered by the Director to a depth not exceeding ten (10') feet, excavation of this nature below a depth of ten (10') feet will be classified as Extra Trench Excavation.

All excavation, however, required to be done above the finished grade of the curb or sidewalk outside the roadway area and above the sub-grade within the roadway area will not be classified as trench excavation, but shall be classified and paid for as grading. This refers particularly to walls and cribs on the high sides of improvements.

The requirements of Sections 418 governing Protection Supporting, and Maintenance of Structures, including Underground Structures, whether owned by the City or others, shall be strictly adhered to.

Additional excavation beyond the neat lines of the proposed structure for the purpose of placing sheeting and bracing, forms for concrete, or resulting from caving in or slipping of the ground or due to the negligence of the Contractor or his methods of executing the work, shall not be considered as Trench Excavation or Extra Trench Excavation, and no payment therefor shall be made. All such additional excavation shall be refilled by the Contractor in accordance with the Specifications for "Backfill", at his own expense, with satisfactory materials.

The Contractor shall, at his own expense, do all pumping and bailing necessary to remove any water which may be encountered or which may flow into the trenches, test holes, excavation for manholes, catch basins or other structures, from any cause whatsoever.

BACK-FILLING

426. The price bid per cubic yard for Trench Excavation or Extra Trench Excavation shall include back-filling the trenches for all structures to the original surface of the ground, unless otherwise specified or provided on the Contract Plans, or ordered by the Director in the field, and shall be done by mechanical ramming.

The back-filling behind retaining walls and cribs shall be placed in horizontal layers not exceeding six (6") inches in thickness, and shall be sprinkled with water where required and thoroughly tamped and consolidated by mechanical ramming. The placing of back-filling behind the retaining walls shall proceed in the manner and at such times after the concreting of the wall as the Director may require.

BACK FILLING (Cont.)

The backfilling within the members forming cribs, and behind the crib structure shall also be placed in horizontal layers not exceeding six (6") inches in thickness, and each layer sprinkled to the satisfaction of the Director and thoroughly tamped and consolidated by mechanical ramming, but at no time shall the construction of the crib progress to such an extent that more than two courses of headers and stretchers are placed in position above the top of back-filling treated in conformity with the foregoing requirements. The consolidation of back-fill within and in back of cribbing is an essential part of the construction of the cribbing, and has a material effect upon the strength and integrity of the structure, and if not done in strict conformity with the foregoing requirements, may result in failure and collapse of the structure. If for any reason whatever, the foregoing requirements are not strictly complied with, the Contractor shall, at his own cost and expense, remove and reconstruct with new materials all or any portion of the cribbing including back-filling that is required by the Director.

The back-filling in front of retaining walls and cribs, shall be done in conformity with the foregoing requirements up to the level of the original surface of ground on the face of the retaining wall, or to other finished lines indicated on the Contract Plans. However, in any case, the top of such back-filling shall be formed to provide proper drainage away from the face of the wall.

DISPOSAL

427. The price bid per cubic yard for Trench Excavation, or Extra Trench Excavation shall include disposal of excess material not required for back-filling or for embankment. Material not suitable for back-fill or embankment must be disposed of by the Contractor.

SHEETING, BRACING AND SHORING

428. The Contractor shall, where necessary or where ordered by the Director, properly sheet, brace and shore the trenches for protection of workmen and to prevent the settlement of ground adjacent to the trench and to prevent damage to any surface or subsurface structure. The compensation for furnishing all materials, placing and removing all sheeting, bracing and shoring shall be included in the price bid per cubic yard for Trench Excavation. No additional compensation shall be made for excavation beyond the line of the required excavation where such excavation is made for the purpose of placing sheeting, bracing or shoring. All sheeting, bracing, or shoring shall be withdrawn or removed unless required to be left in place to prevent settlement or damage to adjacent structures.

Where a retaining wall or other structure is to be built under this Contract along or adjacent to a street which is required to be kept open for traffic by the express requirements stated on the Contract Plans, or in the Specifications for the work, the Contractor shall, at his own expense, sheet, shore, brace and otherwise protect the street in such a way as to maintain traffic and erect the structure. If necessary, he shall drive sheet piling for this purpose and the cost thereof and of the foregoing work shall be included in the price bid per cubic yard for trench excavation.

MANNER OF HANDLING TRENCH EXCAVATION

431. The storage of material excavated from trenches shall at all times be subject to orders of the Director with respect to quantity and location. The materials shall not be scattered but shall be piled in the manner that in the opinion of the Director will cause least interference to vehicular and pedestrian traffic. When sewer trenches are to be excavated on important or busy traffic arteries, or other highways where considerable loading and unloading is required to be done for the conduct of business and industry in abutting and adjacent properties, or elsewhere, where deemed advisable by the Director, the Contractor shall open a section of trench approved by the Director, and shall remove the excavated materials to locations selected by him, and then proceed with the work by placing the excavated materials in the previously excavated trench.

Where permitted by the Director, materials may be so stored that one straight and continuous lane shall be open to traffic and at least 3 clear feet of width on all sidewalks for pedestrian traffic. Fire hydrants and water gate boxes must be kept accessible at all times. Free passage for surface water shall be maintained by the Contractor in the gutters of all highways upon which work is in progress. At all times the length of trench opened beyond the finished section of sewer shall be subject to the approval of the Director.

SHEETING, SHORING AND BRACING IN OPEN TRENCHES

432. The Contractor shall, where necessary or when ordered by the Director, properly sheet and brace the trench with lumber of suitable dimensions and strength for the protection of workmen, to prevent the settlement of the ground adjacent to the trench and to prevent damage to all surface or sub-surface structures. Where the nature of the excavation demands the Contractor shall place tongue and groove sheeting, suitably braced and driven to the proper depth to permit the laying of the sewer. The compensation for sheeting, bracing and shoring shall be included in the price bid for the item under which the excavation is done. Compensation for additional excavation for purpose of placing sheeting, bracing or shoring that is required to be done beyond the neat width of trench hereinafter stipulated in the specifications for the various classes of work shall be included in payment made at the contract unit price for the item of work for which such additional excavation is required to be done. All sheeting, bracing or shoring shall be withdrawn or removed unless required to be left in place to prevent settlement or damage to adjacent structures.

CONTRACTOR NOT RELIEVED OF RESPONSIBILITY

The Contractor shall not be relieved of his responsibility for the prevention of damage to buildings, sub-structures or other surface and sub-surface structures by reason of the failure, neglect or refusal of the Director to order the placing of sheeting, bracing and shoring.

CONSTRUCTION BY TUNNELLING OR BENCHING METHOD

433. All sewers included in this contract shall be constructed by the open cut method, with the exception of such portions where tunnelling required is indicated upon the Contract Plans or in Supplemental or Special Specifications, or where tunnelling is required or permitted by the Director in the field. Where the total length of portions constructed by the tunnel method exceeds 100 ft. or when otherwise required by the Director, no work shall be commenced thereon until detail plans showing design of shoring, sheeting and bracing, and the method of construction shall be prepared by the Contractor and submitted to and approved by the Director.

BACKPACKING IN TUNNELS

For all portions of sewers constructed by the tunnelling method or benching method, the backpacking shall be mechanically rammed in conformity with the following requirements, or placed by pneumatic pressure unless otherwise specified; regardless of whether backfill is required to be made with selected excavated material, granulated slag, concrete back packing, or other material as required by the specifications, or ordered by the Director in the field.

Before commencing backpacking for any portions of the sewer constructed by the tunnelling or benching method, the Contractor shall provide plant and equipment, deemed necessary in the opinion of the Director to ensure satisfactory compactment and consolidation with mechanical rammers, or pneumatic pressure. Backfilling by mechanical ramming shall be made in layers as nearly vertical as practicable, not exceeding 12 inches in thickness and each layer thoroughly tamped and compacted before placing succeeding layers. In all other respects mechanical ramming and equipment therefor shall conform to the requirements of Section 444 governing Mechanical Ramming of backfill.

SHEETING AND BRACING IN TUNNELS

All shoring, sheeting and bracing required for sewers, or portions thereof constructed by the tunnel method in conformity with requirements indicated on the Contract Plans, or when permitted by the Director in the field, shall be left intact, and compensation for such lumber left in place shall be included in payment made at the contract unit price per lineal foot for the respective types of sewers.

The Director reserves the right to terminate construction by the tunnel method at any time in the field; however, when such termination affects portions of sewers where tunnelling required is indicated on Contract Plans, or in Supplemental or Special Specifications, sheeting, shoring and bracing used in the construction of such portions of sewers which have been changed, to the open cut method shall be left in place where required by the Director, and compensation therefor shall be included in payment made at the contract unit price per lineal foot for the respective type of sewer affected.

All sheeting, shoring and bracing required for the construction of shafts and bulkheads and entries for portions of sewers where tunnelling required is indicated on Contract Plans, or in Supplemental or Special Specifications, shall be left in place when required by the Director, and compensation therefor shall be included in payment made at the unit price bid for the respective type of sewers.

MAINTENANCE OF PAVEMENTS, BASES, CURBS, SIDEWALKS, ETC.

434. All roadway pavement surfacing, bases therefor, curbs and sidewalk pavement, that may become disturbed, settled, or damaged by subsidence, or other causes, due to the construction of sewers under this contract, whether constructed by the open cut, tunnelling, or benching method, during a period of one year after the acceptance of the work by the Director, shall be relaid, repaired, or reconstructed as may be ordered by the Director, at the expense of the Contractor.

SOFT FOUNDATIONS

435. Wherever the material at the bottom of the trench, when excavated to the depth required upon the Contract Plans is found too soft or otherwise unsatisfactory for supporting the sewer or other structure, the Contractor shall excavate to the depth or depths required by the Director. Such excavation shall be classed as Extra Trench Excavation and the Contractor shall receive compensation for the same as provided in the Specifications for "Extra Trench Excavation". When in the opinion of the Director the bottom of the trench has been rendered unfit for the construction of the sewer by the negligence of the Contractor, he shall excavate to such depth as ordered by the Director and shall refill the same to the required elevation without additional compensation therefor, even to the extent of filling the same with concrete, if ordered by the Director.

SPECIAL FOUNDATIONS

436. When ordered by the Director or required on the Contract Plans the Contractor shall construct special foundations of timber platforms or concrete. This work shall be done in accordance with the Contract Plans or as ordered by the Director and shall further be done in accordance with the Specifications for this class of work and the Contractor shall receive compensation for the same as provided in the Specifications for "Extra Concrete" and "Timber Platforms", unless otherwise provided.

REINFORCEMENT AROUND PIPE

437. When required on the Contract Plans that concrete reinforcement shall be constructed around Terra Cotta Pipe Sewers, the cost of the same shall be included in the unit prices bid per lineal foot for the respective sizes and types of sewers as shown. Said unit prices shall include all necessary excavation, disposal of surplus material and all other work necessary to make the same complete.

REMOVAL OF TEMPORARY WALLS

438. Temporary retaining walls placed in the trench to retain fill over the completed work shall not be permitted except by the express permission of the Director, and when placed shall be removed by the Contractor at his own expense before the succeeding section of the trench is back-filled.

BRIDGING OF TRENCH FOR TRAFFIC

439. Where ordered by the Director, the Contractor shall construct suitable platforms for bridging the trench at street intersections, at driveways to properties abutting the line of the work and at such other points as may be required. The bridging shall be of sufficient strength to safely carry the loads required. For public vehicle crossings the bridge shall be required to carry 15 ton trucks.

PUMPING AND BAILING

440. The Contractor shall, at his own expense, pump, bail or temporarily provide drainage for any water which may be encountered, or which may flow into or over the work from any cause whatsoever and the Contractor shall further provide drainage for all surface water which may flow on or into the streets upon which sewers are being constructed under this contract until the completion of the work.

MAINTENANCE OF EXISTING SEWERS

441. The Contractor shall furnish all materials, tools and labor, shall perform all necessary excavation, construct temporary drains or sluices, pump, furnish all machinery and plant required to do all work necessary to provide complete and adequate drainage in all existing sewers in which the flow is interrupted or obstructed, or encountered during the construction of the sewer or sewers embraced in this Contract. The Contractor shall receive no extra compensation for the maintenance of flow in existing sewers in accordance with the above requirements, but the cost of this work shall be included in the price bid per lineal foot of sewer or sewers.

BACK-FILLING AROUND SEWER

442. No back-filling shall be placed around or over pipe sewers until the sewer as laid has been inspected by the Inspector assigned to this contract, and passed by the Inspector as meeting all the requirements of the contract governing laying, proper bearing, filling of joints and alignment of sewer.

Any sewer pipe not found to meet all of such requirements or which in any way is found to be defective with respect to workmanship or materials, shall immediately be remedied or removed and replaced with new materials and proper construction, as required by the Director.

After sewers have been laid in conformity with the foregoing requirements, carefully selected material free from all stone shall be thoroughly tamped and consolidated in layers not exceeding six (6) inches over and around the pipe and within two (2) feet of the top thereof. In back-filling below the top of the sewer, the top of the filling at each side of the sewer shall be kept at the same level, and this back-filling shall be rammed with pipe rammers specially made for this purpose, of a type and design approved by the Director. In no case shall this portion of the back filling be commenced until pipe rammers meeting the foregoing requirements are available on the site of work to the number deemed necessary by the Director.

BACKFILL OVER SEWERS

443. The trenches over all sewers from a point 2 ft. above the top of the sewer to the surface of the adjoining ground, or to finished subgrade, as may be required, shall be filled with excavated material deemed suitable and satisfactory to the Director, and shall be mechanically rammed in conformity with the requirements of Section 444.

SPRINKLING & RAMMING METHOD

When backfilling by the sprinkling and ramming method is ordered by the Director, backfilling shall be made in layers of not more than 6 inches in thickness and each layer sprinkled with water in sufficient amount to soften lumpy and hard material to the extent deemed necessary by the Director to permit of thorough consolidation by mechanical ramming. Each layer shall be thoroughly rammed before the next layer is placed.

MECHANICAL RAMMING OF BACKFILL

444. All sewer trenches unless otherwise stipulated on the Contract Plans, or in Supplemental or Special Specifications, including the backfill of trenches for house lateral connections and reconnections, catch basin connections and reconnections, and the backfill for manholes, catch basins and other chambers constructed in connection with such sewers, shall be made with material satisfactory to the Director and thoroughly consolidated in layers by mechanical rammers, in conformity with the following requirements:

Before commencing the backfilling of any trenches required to be consolidated by mechanical rammers, the Contractor shall provide a compressor plant of sufficient capacity to ensure in the opinion of the Director the continuous performance of at least one pneumatic rammer for each 30 lineal feet of trench for which backfilling is made at any one time. The pneumatic rammers must be available in proper working order and with sufficient power available for the number required to comply with the foregoing requirements before commencing the backfilling of trenches. The rammers shall be of the size and design approved by the Director; however, the size and number of compressors and other appurtenances shall be increased when required by the Director, but in all cases they shall be sufficient, in size and number, to secure a pressure of at least 80 pounds at the nozzle of each rammer.

The backfilling of the trenches shall be made in horizontal layers not exceeding 6" in thickness, each layer thoroughly consolidated and compressed with pneumatic rammers, the ramming of each layer to be continued until the 6" layer is thoroughly consolidated and compressed, after which the next layer of 6" inches shall be spread and treated in like manner. When for any cause whatsoever, pneumatic rammers are not continuously operated, the backfilling must cease and shall not be resumed until the foregoing treatment can be continued and completely complied with.

GRANULATED SLAG BACKFILL

445. When granulated slag backfill is required to be placed in trenches of sewers, house lateral connections and reconnections, catch basin connections and reconnections, and for sewer chambers, granulated blast furnace slag shall be constructed in horizontal layers not exceeding 6 inches in thickness before compacting and each layer shall be thoroughly consolidated by pneumatic rammers. All of the layers of slag shall be sprinkled with water to the extent ordered by the Director in the field. Compensation for granulated slag in sewer trenches when not included in the price bid per lineal foot of sewer shall be paid for by weight in accordance with weight slips furnished as described in Section 408 and payment made therefor shall be full compensation for the disposal of surplus excavation displaced by the backfill. Where trenches are excavated to a greater width than neat lines indicated for this contract in order to place sheeting, shoring and bracing, or for any other reason, and where caveins occur, granulated slag back fill must also be supplied and treated in conformity with the requirements herein stipulated, compensation for which, however, shall be made as above stipulated.

CONCRETE BACK PACKING

446. When concrete back packing is to be done in conformity with the requirements of this contract, such construction shall conform to the following requirements:

The concrete shall be mixed in the proportions of one part Portland cement, two parts sand, and six parts gravel. Only sufficient water shall be used in mixing to ensure a mix dry enough to maintain its position when back packed in layers as nearly vertical as practical, not exceeding 12 inches in thickness. Each layer shall be thoroughly compacted with mechanical rammers for a period of at least five minutes during each period of 10 minutes succeeding placing thereof until 30 minutes thereafter.

Payment made at the unit price bid under this item shall include compensation for disposal of displaced material. Before commencing the construction of concrete back packing the Contractor shall provide compressor plant, mechanical rammers and other appurtenances in conformity with Section 444 governing the furnishing of plant and equipment before commencing work shall be strictly adhered to, and the further requirements governing the continuous operation of compressors of aforesaid section shall also be adhered to in the construction of concrete back packing.

BACKFILLING MATERIAL DEFICIENT

447. Where the material removed from the excavation of the trench is not considered satisfactory by the Director for filling around and over the sewers, in accordance with the foregoing requirements of Section 442 and 443, the Contractor shall, without extra compensation, furnish satisfactory material for this work.

TEMPORARY REPAVING

448. When the backfilling of the trench is completed the Contractor shall temporarily repave or resurface the openings in the pavements in such manner as to make the surface of the roadway accessible for traffic, in a manner satisfactory to the Director, and maintain the same until the permanent repaving is placed. The compensation for temporary repaving or resurfacing shall be included in the price bid per lineal foot of sewer.

PERMANENT STREET REPAVING

449. Sewer trenches for the various types of sewers, house laterals and excavation required for test pits, manholes, catch basins and other types of construction done on paved roadways, shall be repaved with pavement surfacing, laid on concrete or gravel bases, as stipulated on Contract Plans, or ordered by the Director in the field. Unless otherwise shown on Contract Plans or ordered by the Director, concrete bases for repaving over such trenches shall conform to the detail of trench repaving shown in the Standards for Construction.

Where old blockstone or brick surfacing is to be relaid the Contractor shall furnish any new blockstone or vitrified paving brick required to replace old paving blocks and bricks found to be unsound, broken, spalled, chipped or which cannot be cleaned of all foreign matter regardless of whether such block or brick exists in the present pavement or result from prosecution of this contract.

Payment made at respective contract unit prices per square yard for block stone surfacing and vitrified brick surfacing of the several types shall be full compensation for furnishing all labor, material and tools required to complete the blockstone or vitrified brick surfacing in conformity with the requirements of the contract governing Repaving with Blockstone Surfacing, or vitrified brick surfacing, respectively.

Bituminous surfacings and concrete pavements required to be relaid will be measured for payment at contract unit prices per square yard for Repaving with such respective types of pavement surfacing.

REPLACING CURBS AND SIDEWALKS

450. All curbs and sidewalks 6" outside the neat lines of excavation for sewers, manholes, catch basins, shafts or other sewer work, shall be maintained by the Contractor; and any settlement, movement out of line or damage to such curbs and sidewalks shall be corrected by the Contractor at his own expense and such reconstruction shall be in accordance with the specifications for the respective classes of work.

All curbs and sidewalks within the lines 6" outside the neat lines of excavation for sewers, manholes, catch basins, shafts or other sewer work, and other curbs and sidewalks when so stipulated on Contract Plans, or in Supplemental Specifications, or ordered by the Director, shall be reconstructed in accordance with the Specifications for the respective classes of work; and compensation therefor shall be in accordance with the unit prices bid for the respective classes of work.

Where the line of sewer, or sewers, built under this contract is located under flagstone or brick sidewalks, or where in any case the removal of such sidewalk is necessitated, the Contractor shall remove the same, store the materials moved therefrom, and upon the completion of the work shall relay the flagstone or bricks on a new base, in conformity with the requirements of these specifications governing Flagstone Sidewalks Relaid, and Brick Sidewalks Relaid, respectively. The relaying of stones or bricks damaged during the progress of the work will not be permitted, but the Contractor shall, at his own cost and expense, furnish new material conforming in quality and appearance to the existing sidewalk pavement.

Where the line of sewer, or sewers, built under this contract is located under a bituminous or concrete sidewalk, the Contractor shall as ordered by the Director break up the existing pavement and remove same from the line of work, and shall reconstruct new bituminous or concrete sidewalk, as may be required, on a new base in conformity with the requirements of this contract governing the construction of such types of sidewalk pavements.

DISPOSAL OF SURPLUS EXCAVATION

451. The Contractor shall at his own expense remove or dispose of all rubbish and surplus excavation, all temporary structures and all surplus materials on or used in the work and which are not the property of the City by virtue of this contract. The surplus excavation shall be deposited by the Contractor at such point or points as he may provide; except, that when required upon the Contract Plans the Contractor shall haul and deposit such portion of the surplus excavation as is thereon required, and shall deposit the same at the points designated and in the manner shown on the Contract Plans and as ordered by the Director. Where the work is upon private property, the Contractor shall clean up the surface of the ground and restore it to its original condition. The beds of all runs and water-courses shall be leveled and restored to their original condition and all obstructions removed therefrom.

CLEANING UP

452. Where the work under this contract is done on streets, alleys or other highways of the City, the Contractor shall, during the progress of the work, clean the surface of all pavements, remove surplus materials flush gutters and clean out catch basins up to a point within two hundred (200) feet of the end of the finished work unless otherwise expressly permitted by the Director.

ADDITIONAL EXCAVATION

453. Additional excavation beyond the required lines for the purpose of placing sheeting and bracing or forms for concrete or resulting from caving in of the ground, slipping, due to negligence of the Contractor or his methods of executing the work, shall not be considered as Extra Compensation. All such additional excavation shall be refilled by the Contractor at his own expense with satisfactory materials and when required by the Director, he shall refill the same with concrete.

INCREASE IN WIDTH OR DEPTH

454. Where excavation for construction of sewers and appurtenances is increased either in width or depth, payment therefor shall be made in conformity with the requirements of Section 429.

455. Vacant

DITCHING

456. Where required on the Contract Plans or ordered by the Director ditches shall be excavated, or widened and deepened to provide gutters leading to existing or proposed catch basins and inlets, and alongside of roadways and in water courses. Excavated material shall be used in conformity with orders of the Director for the construction of embankments or berms to form ditches to required neat lines, compensation for which shall be included in payment under item of work in which such material was excavated. Surplus excavation shall be disposed of at points provided by the Contractor. Compensation for the foregoing shall be included in payment made at the contract unit price for Ditching.

FOUNDATIONS FOR LAND STRUCTURES

457. The Excavations for land piers, pedestals, abutments and retaining walls, which are to be constructed on earth bottom shall not be made to full depth until the Contractor is in position to place the concrete footing courses immediately after excavation is completed.

Excavation shall be done in accordance with the requirements for trench excavation except as otherwise stipulated herein and, in case water is encountered, provision shall be made for pumps to keep the excavated area clear of water after same is finished and until concreting is completed above water level.

Excavations for piers, pedestals, abutments and retaining walls, which are constructed on piles, shall be made before the piles are driven. The bottom of the excavation must be leveled up and all loose material removed before concrete is placed.

When so stated on the Contract Plans or permitted by the Director, the excavation may be made after the piles are driven.

No additional compensation shall be allowed on account of any movement of earth or additional excavation made necessary due to the driving of piles.

FOUNDATIONS FOR RIVER STRUCTURES

458. River piers, sewer outlets, walls, abutments, etc. that are to be constructed on piling shall have the area covered by the pier or abutment excavated or dredged to a uniform level, to the full size of the base of the pier or abutment, and to the depth or elevation shown on the contract plans. The excavating or dredging shall include the removing of all timbers, riprap or other obstructions that will interfere with the construction of the foundation or with the driving of piles for same.

Before any piles are driven the excavation shall first be completed to the bottom of foundation, unless otherwise ordered by the Director.

Excavation and Dredging shall be done in accordance with the requirements for trench excavation unless otherwise stipulated.

COFFER-DAMS

459. Coffer-dams shall be used for the construction of river piers, sewer outlets and abutments which are to be constructed on piling and may be used for piers and abutments constructed on rock.

The coffer-dams may be constructed with either wood or steel sheet piling, driven well below the bottom of the pier or abutment base, where piling is used under pier or abutment, or to rock when pier or abutment rests on rock, and must be well braced and tightly built.

Coffer-dams shall be constructed true to dimensions and of such size that the inside face of the sheet piling will conform to the outside faces of the pier or abutment base.

The excavating or dredging may be done either before or after the coffer-dam is constructed. In any case the bottom of the excavation must be leveled up before concreting.

The bracing within the coffer-dam must be so constructed that it can be removed as the concreting proceeds. Incorporating any timbers in the concrete work will not be allowed.

When possible and unless otherwise ordered by the Director, the Coffer-dams shall be freed of water before bases are concreted.

When piers or abutments rest on rock, the coffer-dams shall be freed of water and the rock surface thoroughly cleaned off. Care must be taken to prevent sand, gravel and mud or silt from entering under or through the joints in the sheet piling before concrete is placed.

PNEUMATIC CAISSONS

PNEUMATIC CAISSONS

460. Pneumatic Caissons may be used for the construction of river piers and abutments which are constructed on rock foundations.

Pneumatic Caissons may be constructed of either reinforced concrete combination timber and concrete or sheet steel. They shall be provided with steel cutting edges and so arranged that they can be settled to their proper location as to alignment in all directions.

After Caissons are landed on the rock bottom, they shall be thoroughly cleaned out and all loose or rotten rock removed.

After Caissons are cleaned out they shall be thoroughly sealed around their edges and all concrete shall be laid in the dry.

CONCRETE CONSTRUCTION

Sections 461 to 512 Inclusive

GENERAL

461. Unless otherwise provided in Special or Supplemental Specifications, or stipulated on the Contract Plans, concrete for the various types of construction required under this contract shall conform to the requirements set forth hereinafter.

CONCRETE MIX

462. To each sack of 94 pounds of cement used, the maximum permissible amount of water used shall be 6 gallons including all free water in the aggregates. If, in the opinion of the Director, sufficient workability of the concrete will be obtained with less water, he may reduce the amount of water per sack of cement. The coarse aggregates shall be gravel or stone, except when stone aggregate is specifically required, and the combined dry weight of fine and coarse aggregates shall not exceed the amounts hereinafter stipulated. The relative proportion of fine and coarse aggregates and water shall be determined in the field by the Director so as to secure that combination of strength, workability and density which in his judgment is most satisfactory. All cement and aggregates for concrete shall be proportioned by weight, and shall be weighed on balance scales. Concrete may be mixed at the site, at a central mixing plant, or in an approved truck mixer.

When approved by the Director, very small quantities of concrete may be proportioned by volume and mixed by hand.

CLASS A CONCRETE MIX

463. When Class "A" Concrete is required, the cement and aggregates shall be mixed in the proportion of 94 pounds of cement to 564 pounds of fine and coarse aggregates.

CLASS B CONCRETE MIX

464. When Class "B" Concrete is required, the cement and aggregates shall be mixed in the proportion of 94 pounds of cement to 658 pounds of fine and coarse aggregates.

HIGH EARLY STRENGTH CONCRETE

465. When high early strength is required for either Class "A" or Class "B: Concrete, the concrete shall be mixed in the above respective proportions except that high early strength special cement shall be used. When Class "A" Concrete of high early strength is required, it shall be designated as "Class "AA". When Class "B" Concrete of high early strength is required, it shall be designated as "Class "BB".

VOLUME MIX CLASS A

466. When Class "A" Concrete is proportioned by volume, the proportions shall be one part Portland Cement, 2.1 parts of fine aggregate struck measured on damp and loose materials, and 3.2 parts of coarse aggregate loose struck measured. One bag of cement weighing 94 pounds shall be considered as one cubic foot.

VOLUME MIX CLASS B

467. When Class "B" Concrete is proportioned by volume, the proportions shall be one part Portland Cement, 2.5 parts of fine aggregate struck measured on damp and loose materials, and 3.8 parts of coarse aggregate loose struck measured. One bag of cement weighing 94 pounds shall be considered as one cubic foot.

MIXING TIME

468. All Class "A" and Class "B" Concrete and all Class "AA" and Class "BB" Concrete shall be mixed for not less than 2 minutes, except that whenever the average temperature falls below 45 degrees Fahrenheit the concrete shall be mixed for not less than 3 minutes.

CLASS OF CONCRETE TO BE USED

469. Unless otherwise stipulated on Contract Plans or in Supplemental Specifications, all concrete having an average thickness less than 18 inches shall be class "A" mix, and all concrete having an average thickness of 18 inches or more, such as retaining wall, large piers, abutments, sewer outfalls, etc., shall be Class "B" mix. All reinforced concrete sewers shall be Class "A" concrete.

SIZE OF AGGREGATES TO BE USED

470. All Class "B" concrete shall be mixed with large coarse aggregate. All class "A" concrete shall be mixed with medium size coarse aggregate, except where otherwise specifically required. Concrete for pavement bases shall be mixed with large aggregate.

INGREDIENTS FOR CONCRETE MIX

471. All the ingredients in concrete mixes shall conform to the Specifications for Concrete Materials Section 104 to 129 inclusive.

SLUMP TESTS

472. At frequent intervals as determined by the Director in the field slump tests shall be taken for the various types of construction. The slumps desired for the various types of construction shall be as ordered by the Director, to meet the conditions obtaining in the field. However, these tests shall be taken only for the information of the Director and his assistants as an aid in judging suitability, workability and quality of the concrete.

DETERMINATION OF MOISTURE CONTENT

473. All concrete shall be proportioned to give necessary workability without exceeding the quantities of mixing water above stipulated. Moisture in the fine and coarse aggregates shall be measured by a method satisfactory to the Director which will give results within one pound for each 100 pounds of aggregate. The actual moisture content of the aggregates must be determined frequently so that suitable correction can be made from time to time to the quantity of mixing water.

CONCRETE FOR PILES

474. Concrete for piles shall be mixed in the following proportions. To each sack of cement used the maximum permissable amount of water used shall be 5 gallons including all water in the aggregates. The cement and aggregates shall be mixed in the proportion of 94 lbs. of cement to 170 lbs. of fine aggregate and 250 lbs. of coarse aggregate. Medium size aggregate shall be used.

VOLUME PROPORTIONING

If concrete for piles is permitted to be proportioned by volume, the proportions shall be one part of Portland Cement, 1.9 parts of fine aggregates struck measured on damp and loose materials, and 2.3 parts of coarse aggregates loose struck measured. One bag of cement weighing 94 lbs. shall be considered as 1 cubic foot. Crushed slag shall not be used for coarse aggregate.

CURING BOX

475. The Contractor shall provide a strong, tight, wood curing box, 2'-6" wide x 4'-0" long, x 18" deep, inside measurement for storing 24 concrete test cylinders. The lid shall be hinged and provided with a hasp and padlock. Additional boxes shall be provided if required by the Director.

TEST CYLINDERS

476. During frequent intervals, samples will be taken from all concrete work and tested for compressive strength, permeability and quality. At least 75% of the samples taken from each contract must equal or surpass standard samples prepared by the Bureau of Tests Laboratory from the same materials mixed in the same proportions. If said tests are not passed, the concrete shall be removed and replaced at the Contractor's expense.

TEST CYLINDERS (Cont.)

Test Cylinders must be taken as follows for the different types of concrete construction:

For sidewalks, curb, fence supports, and reinforced concrete in parapet walls, and structures approximately similar in size and general shape, 2 test cylinders for each 20 cu. yds. or fraction thereof.

For all other concrete construction, 2 test cylinders for each morning and afternoon pour. When morning or afternoon pours exceed 50 cu. yds. additional cylinders shall be taken.

The Director may require additional cylinders for particular pours or unusual weather conditions. The cylinders shall be placed in the curing box as quickly as possible after casting and shall be completely embedded in damp sand while in the curing box. The Bureau of Tests shall be notified to collect cylinders not later than 5 days after pouring.

The Contractor shall furnish all moulds required for making test cylinders, and they shall be of a type approved by the Director.

CONCRETING IN COLD WEATHER STEAM CURING

477. In no case shall materials containing ice, snow, or frost be used in mixing concrete, nor shall concrete be placed when the temperature is below 40 degrees F., nor shall it be placed in winter weather when the temperature is below 45 degrees F. and falling, except by express permission of the Director which will not be given unless the Contractor installs adequate means for heating the ingredients and for protecting the concrete as hereinafter specified, prior to placing the concrete. Concrete placed under these conditions and found damaged by the effects of frost, shall be removed and replaced by the Contractor at his own expense, even though permission to do such work had been granted by the Director. The placing of concrete for Plain and Reinforced Concrete Street Pavements shall further conform to the requirements pertaining to weather conditions stipulated in the particular specifications for such types of pavements.

Whenever the outside temperature drops below an average of 45 degrees F. for a 24-hour period, all concrete shall be mixed for not less than 3 minutes after all ingredients are in the mixer and further, the Contractor shall take the following precautions:

The aggregates shall be heated by perforated steam pipes to a minimum temperature of 60 degrees F. The mixing water shall be heated by steam to between 60 degrees F. and 120 degrees F. The temperature of the mixed concrete when placed in the forms shall be between 60 degrees and 120 degrees F., depending on the outside air temperature.

The Contractor shall cover his forms for concrete with tarpaulins or other approved covering and shall run sufficient steam lines with 2-1/16 inch diameter perforation spaced every 5 feet or closer under the tarpaulins or straw to maintain a minimum temprerature of 70 degrees F. around all surfaces of the concrete for 7 days from the time the concrete is poured.

The Contractor shall provide sufficient maximum and minimum self recording thermometers to adequately indicate the temperature maintained around the concrete to be cured.

Form 106A

CONCRETING IN COLD WEATHER CURING WITH SALAMANDERS

On very minor structures the use of salamanders for protecting concrete in cold weather may be permitted by the Director. The Contractor may apply to the Director by letter in quadruplicate for permission to use salamanders on any minor structure. If in the opinion of the Director the job is too small to require the use of a steam heating plant and he is satisfied the concrete will be properly protected with salamanders, he may permit their use subject to the following conditions.

The structure shall be covered with tarpaulins to retain and distribute the heat of the salamanders. The number and arrangement of the salamanders shall be such as to maintain a minimum temperature of 60 degrees F. and a maximum of 90 degrees F. at all points of the structure for a period of seven (7) days. Sufficient self recording maximum and minimum thermometers shall be placed on the structure at points designated by the Director to check the temperature at any time. Salamanders shall be arranged to secure the maximum efficiency without overheating or otherwise injuring the concrete and their method of use is at all times subject to the approval of the Director. When in the opinion of the Director satisfactory protection is not being secured by the use of salamanders, he may order the Contractor to discontinue their use and install a steam heating plant, which order must be immediately complied with by the Contractor. When salamanders are used, the Contractor shall thoroughly sprinkle the concrete and forms every three (3) hours.

The use of any admixture to lower the freezing point of water is expressly forbidden.

FORM 408A

MIXING

MIXER METHOD

478. The concrete shall be mixed in a mechanical mixer of a type approved by the Director, except when special permission is given, relatively small quantities may be mixed by hand. The use of a mechanical mixer equipped with a chute will not be permitted for concrete construction required in concrete paving bases or for plain or reinforced concrete pavements. The mixer used for such construction shall be equipped with a boom and bucket, or similar device approved by the Director. The use of continuous mixers will not be allowed.

The mixer shall be operated for the time hereinbefore prescribed for the respective classes of concrete. It shall have a peripheral speed of 200 feet per minute and shall be equipped with a timer adjustable for timing batches from 1 1/2 minutes to 3 minutes, and automatically started when all materials are in the mixer. The volume of mixed material per batch shall not exceed the manufacturer's rated capacity for the mixer.

The mixer shall be equipped with suitable charging hopper, water storage and water measuring device controlled from a case which can be kept locked and so constructed that the water can be discharged only while the mixer is being charged.

The entire contents of the drum shall be discharged before recharging and the mixer shall be cleaned at frequent intervals while in use.

The mixing of concrete either by hand or by machine shall be thorough and shall be continued until every particle of aggregate is covered with mortar, the cement is uniformly distributed, and the resulting mass is uniform in color and homogeneous in appearance.

HAND MIXING

When permitted, hand mixing shall be done on a water-tight wood or metal surface of suitable size. The cement and fine aggregate shall be mixed without the addition of water until a mixture of uniform color is produced. The coarse aggregate shall be spread to a depth of approximately eight (8) inches and wetted, the mixture of cement and fine aggregate spread over it, and the whole turned once; then water not in excess of the quantity heretofore stipulated shall be added to produce the desired consistency and the whole mass turned not less than six (6) times. Hand mixed batches shall not exceed one-half (1/2) of a cubic yard.

HANDLING MATERIALS

All cement used shall be delivered to the mixer in the original packages or in weather-tight containers. The same shall be emptied directly into the charging skip of the mixer. No cement shall be dumped on or in with the aggregates in batch boxes or trucks. When stock piles of fine and coarse aggregates are formed, the materials shall be piled not over 4' high on space that has been properly prepared. Materials shall be handled without becoming wet, dirty, or mixed with deleterious substance.

FORMS

GENERAL

479. The Contractor shall provide all forms, bracing, Templets, etc., necessary for the proper shaping of the concrete. Tongue and grooved or ship lap shall be used for all sheeting on forms that are used for surface of concrete that will be exposed to view on the finished structure with the exception of the various types of concrete Curbing. Forms shall be water-tight, true to required lines and grades and of the required size and shape; they shall have sufficient strength and be braced so that they will withstand the ramming or such other operations incident to the placing of the concrete without being deformed or displaced.

Form 106A

Forms 479 Continued

WATER-TIGHT

Special care shall be taken to make the forms water-tight and the Contractor shall caulk, if necessary, all joints with oakum or other suitable material for which he shall provide suitable tools.

OILED FORMS

The inside faces of all forms for concrete which will be exposed to view in any manner in the finished structure shall be dressed smooth, cleand and uniform and shall be coated with a non-staining mineral oil or other material approved by the Director. The oil shall be applied before the reinforcement is placed.

REMOVAL

The forms shall be so constructed that they can be removed from the work without damage to the edges of the mouldings or the corners of the concrete. Forms on vertical surfaces which do not sustain loads shall be removed within not less than 24 hours nor more than 48 hours after placing of concrete, unless otherwise directed. In cold, damp or freezing weather all forms shall remain in place until the concrete has set thoroughly.

RODS TO HOLD FORMS

The use of small rods to hold the forms will be allowed, provided the proper means be used to take out a portion of each of the rods nearest the surface, to a depth of at least two (2) inches. All holes left after the removal of the rods shall be immediately and completely filled with cement mortar, and the surface left true and in good condition.

Wire ties will be permitted only on light and unimportant work, and then only with the expressed consent of the Director; they will not be permitted through surfaces where discoloration would be objectionable.

FORMS FOR LATE REMOVAL

Special care shall be taken with the forms that cannot be removed before the concrete has thoroughly hardened to attain its strength, to have their surfaces which come in contact with the concrete true, smooth, well caulked and well coated so the concrete will present a good, smooth surface and not require excessive work to obtain a finish that will harmonize with the finish on the other parts of the structure.

INSPECTION AND CLEANING

Inspection holes shall be provided at the bases of all columns and walls and other places where necessary to facilitate inspection and cleaning immediately before depositing concrete.

HOLES FOR TAMPING AND PLACING

Holes shall be provided in the back of walls, columns or other thin sections of considerable height to permit the concrete being placed without dropping from heights which, in the opinion of the Director, are excessive and permit the tamping, working and spading of the concrete. The Contractor shall make provision to cover these holes as the concreting progresses and perform the closing so as to fulfill all requirements of these specifications for forms and finish.

SHARP CORNERS

Unless otherwise provided or specified, suitable mouldings or bevels, approved by the Director, shall be placed in the angles of forms to round or bevel the edges of the concrete.

DRIPS FOR COPINGS

An inverted "V" shaped recess one (1") inch deep shall be placed on the lowest horizontal face of copings to prevent water from following the surface to the face of the wall.

CONSTRUCTION AND EXPANSION JOINTS

At all vertical construction and expansion joints a "V" strip shall be used on the inside of the forms to provide a recessed "V" joint 1 inch deep on the exposed face of the concrete.

Forms 479 Continued.

FORMS REUSED

Forms and centers used more than once shall be subject to all the requirements specified. If re-used they shall be thoroughly cleaned and all particles of cement or other foreign matter adhering to the surfaces exposed to the concrete removed to the satisfaction of the Director. The use of forms that have become distorted or are otherwise considered unsatisfactory by the Director shall not be permitted, and if condemned by him shall be immediately removed from the work.

REMOVAL AND REJECTION OF FORMS

No forms or centers shall be removed or struck without the express consent of the Director, and the removal of all forms shall be done with great care so as to avoid injury to the concrete.

Forms not conforming to the Specifications shall not be used and when rejected shall be immediately removed from the work.

CENTERING AND FORMS WHEN STRUCK

The centering under the Arch ribs or ring and forms under the floor system girders, beams and other parts of the structure where the vertical load of the concrete is supported by the forms while it is being placed and until it has attained sufficient strength to be self supporting, shall not be struck for at least twenty days after the placing of the concrete has been finished. The Director reserves the right to extend this length of time, if he deems it advisable, or decrease it, if he is satisfied the structure will not be injured by so doing.

PLACING

REFERENCE TO GENERAL AND PARTICULAR REQUIREMENTS

480. Concrete for the various types of construction shall be placed in conformity with the following general requirements covering the Placing of Concrete. Where stipulated under the requirements governing particular types of concrete construction, concrete therefore shall be placed in strict conformity with such requirements, subject also, however, to compliance with the general requirements of Placing Concrete as herein given where same are applicable.

CONVEYING

481. The concrete, after mixing, shall at once be conveyed to the place of deposit in the work, in such a manner as to prevent the loss of mortar and separation of the coarse aggregate from the mortar, and at all times be so handled that the material deposited shall be of uniform composition throughout. The mortar paste must not be permitted to become separated from the coarse aggregate at any time.

In case of a breakdown concrete may be mixed by hand, to complete the section, provided permission is first obtained from the Director. Any concrete in excess of that needed to complete a section at the stopping of work shall not be used.

RETEMPERING

482. Retempering of mortar or concrete which has partly hardened, that is, remixing with or without additional materials or water, shall not be permitted.

THROWING DROPPING AND CHUTING

483. The ingredients of the concrete shall not become separated during the process of placing in the work. Concrete shall be conveyed to the point of deposit so that it will not be thrown or fall more than 4 ft. Concrete in walls and piers shall be placed with a tremie. Concrete shall not be moved laterly within forms more than 5 feet.

Chuting of concrete will not be permitted with the exception of a maximum length of 12 feet from the center of the mixer door.

CONCRETE TO BE VIBRATED

484. Unless otherwise stipulated on Contract Plans, or in Supplemental Specifications, all concrete in forms, including steps and landings, sewers, etc., all concrete curbs, concrete paving bases and concrete street pavements shall be thoroughly compacted by means of internal vibrators, in accordance with the following requirements, except where otherwise stipulated on Contract Plans or Supplementary Specifications or ordered by the Director.

INTERNAL VIBRATORS

485. Vibrators for compacting concrete shall be operated either electrically, pneumatically, or by internal combustion engines and of a type satisfactory to the Director. The free speed of the vibrator shall be not less than 7000 impulses per minute, and the speed under normal load shall be not less than 6000 impulses per minute when operated at 80 pounds per square inch pressure for pneumatic equipment, or 110 volts for electric equipment, by internal combustion engines.

When pneumatically operated vibrators are used, the air compressor and hose must be of sufficient capacity to deliver air at the vibrator at a pressure not less than 80 pounds per square inch and in sufficient amount to enable the vibrator to maintain the specified impulses per minute. When air compressors of a rated capacity of 110 cubic feet, or an actual capacity of 105 cubic feet, or less, are used, only one vibrator shall be operated from such a compressor and no other pneumatic equipment shall be connected to the compressor while the vibrator is in use.

For vibrating concrete in forms in which the concrete is less than 12 inches in thickness, in concrete curbs, concrete paving bases and concrete pavements, in concrete steps and platforms and in all similar work where one or more dimensions of the concrete volume is small, the vibrating element shall not be more than 1-3/4 inches in diameter.

The Contractor shall furnish and use at least one (1) internal vibrator for each 25 cubic yards of concrete placed per hour, and he shall have one spare unit in reserve on the site of the work in proper condition ready for use at all times.

PLACING AND COMPACTING CONCRETE

486. Where concrete is placed in forms, the concrete shall be uniformly spread in horizontal layers not exceeding eighteen (18) inches in thickness, and each layer shall be thoroughly spaded and the portion next to the form cut with a spade to insure a smooth external surface. Particular attention shall be given to the working of the concrete next to the forms and around reinforcing steel and embedded fixtures or inserts in a manner that will produce a continuous homogeneous mass filling all corners and angles of the forms and thoroughly imbedding the reinforcement and fixtures and eliminating segregation of aggregate and air pockets.

After the concrete is so worked and treated, it shall be further compacted by inserting the internal vibrator into the concrete for a period to produce concrete of maximum density. Where possible the vibrator shall be inserted vertically. Where this is impossible, the vibrator shall be inserted at a sufficient angle to reach and vibrate the entire mass of the concrete.

Particular attention is called to the insertion of the vibrator into the concrete of the inverts of sewers, where frequently it is impossible to insert the vibrator vertically and where concrete of maximum density is necessary. The vibrator shall be inserted at intervals from 18 inches to 30 inches in any horizontal directions, depending upon the thickness of the concrete. It shall be held in position until a slight excess of mortar appears on the top surface, which will require from five to fifteen seconds depending upon the slump of the concrete.

PLACING AND COMPACTING CONCRETE (CONT.)

486. All concrete shall be vibrated within fifteen minutes after placing in the form. Care shall be exercised throughout the entire operation of vibrating. The concrete must not be over-vibrated, and the vibrator shall not be permitted to penetrate into layers of concrete which have been previously vibrated and partially hardened. Vibrator shall not be permitted to come in contact with reinforcing steel, or any inbedded fixtures or inserts. Particular attention must be paid to the vibrating of the edges and all joints, both transverse and longitudinal, of concrete paving bases and of concrete road pavement; and particular attention is again called to the necessity of using extreme care in the vibrating of the concrete in sewer inverts.

BOTTOMS OF BEAMS COVERED WITH MORTAR

487. The bottoms of floor slabs, beams, girders, etc., which are not to be covered with gunite and which will be exposed when the forms are removed, shall have the forms covered with a layer of cement mortar 1/2 inch thick immediately in advance of placing the concrete and shall not be permitted to dry out or set so as to loose its mobility before the concrete is placed on top of it.

PLACING CONCRETE UNDER WATER

488. Concrete laid under water shall be placed by tube or drop bottom bucket method in horizontal layers about twenty-four inches in thickness and be placed uniformly and continuous over the whole area beginning at one corner, thence in parallel lines across base until the layer over the entire area is completed without breaks in process of laying such layer or course.

TUBE (TREMIE) METHOD

The layers shall be placed by means of suitable water-tight tubes (tremie), extending from the mixer or receiving hopper downward into and well below the top surface of the layer of concrete being formed by continuous flow of concrete through the tube. Water must not enter tube when concrete is being placed. When placing concrete the tube must be constantly and regularly moved about laterally in such manner as will deposit a layer of concrete reasonably uniform in thickness, level and uniform and even as to surface. Care shall be taken in placing successive layers not to disturb the layer below and to keep the lower end of tube submerged in the flowing concrete.

DEEP BOTTOM BUCKET METHOD

The layers shall be placed by means of a drop bottom bucket provided with a suitable cover. The bucket shall be so arranged that it can be lowered to the bottom of the excavation and while resting on the bottom previously laid layer of concrete the latches holding the doors shall be released and the contents deposited as the bucket is slowly raised. Care shall be taken in lowering and raising the bucket through the water not to agitate the water and cause currents within the coffer-dam in which the concrete is being placed.

CONSTRUCTION JOINTS

489. Construction joints and joints caused by the completion of a day's work shall be located at points shown on the contract drawings or at such other points as are designated by the Director. The joints shall be well keyed together, the type of joint and method of keying shall be subject to the approval of the Director.

In case concreting is interrupted at any point other than the construction joints shown on the contract plans or designated by the Director, for a period sufficiently long for the concrete to attain final set, the Contractor shall remove such concrete as the Director deems necessary.

JOINING NEW CONCRETE TO OLD

490. When joining new concrete to old concrete, or one day's work to another, the old concrete shall be thoroughly cleaned of all dirt, shavings, scum, laitance or foreign matter and shall then be thoroughly saturated with water. Where the joint is vertical it shall be sprinkled with dry Portland Cement; where the joint approaches the horizontal the surface shall be covered with neat Portland Cement Mortar.

491. Steel reinforcement or bond bars that extend through construction joints, shall be thoroughly cleaned with wire brushes or other suitable applicances of all laitance, or inert mortar, dirt and rust adhering thereto, before concreting is resumed.

Care must be taken that none of the oil, grease or soap used for coating forms, comes in contact with the steel reinforcement. If by accident the steel becomes coated or spotted with these substance they shall be completely removed with acids or torches in a manner approved by the Director before concreting is proceeded with.

DEFECTIVE WORK

492. All concrete masonry shall be completed in a manner satisfactory to the Director, and any concrete that fails to set up properly and becomes damaged before the final acceptance of the work shall be repaired in accordance with the instructions of the Director, even to the extent of removing and replacing the concrete.

PROTECTION OF WORK

493. The Contractor shall protect all concrete from damage by any means. It shall be protected from washing and from the addition of excess water during stormy weather, until such time as it has sufficiently hardened. It shall be protected from persons or animals walking on it before it has sufficiently hardened. The Contractor must not permit any teaming, trucking or moving of any heavy load upon or over any concrete until permission is first secured from the Director.

CONCRETING ARCH RIBS.

494. Arch ribs shall be concreted in sections with intervening key-ways and in the order designated by the Director in the field or as shown on the contract plans.

KEY-WAYS

495. The faces of the sections in arch ribs at key-ways shall be in a plane perpendicular to the axis of the rib and shall have indented keys as shown on contract plans.

CONCRETING ARCH RINGS

496. Arch rings shall be concreted in longitudinal strips; these strips shall be as wide as possible to permit the strip to be concreted in a day's run. Concreting of a strip shall be carried on simultaneously from both ends towards and completing at the center. The first strip to be concreted shall be on or adjacent to the center of the arch ring. Where there are a series of arches this strip shall be concreted in all adjoining arches before an additional strip is placed in any of the adjoining spans. The subsequent strips of the arch rings shall be placed in line in the adjoining arches. The longitudinal joints between the arch strips shall be well keyed together as hereinbefore specified for construction joints.

CONCRETING FLOOR SYSTEMS

497. Floor systems, consisting of floor-beams, sidewalk brackets, stringers, curb-girders and floor slabs may be concreted as a monolith or by separate operations as follows:--The floor beams, sidewalk brackets, stringers and curb-girders at one operation; the roadway floor slab at another operation and the side-walk slab, fascia girder and curb at another, provided the Contractor furnishes and places, without additional cost to the City, 3/4 inch square twisted or deformed bar dowels 26 inches long spaced 24 inches apart connecting roadway floor slab to floor beams, stringers and curb

CONCRETING FLOOR SYSTEMS (CONT.)

The Contractor shall notify the Director which method he proposes using in placing the floor system. Also furnish him with the weight per lineal foot of bridge of his falsework for the floor system. The Director will then furnish the Contractor with a sketch showing the order in which the various sections shall be concreted.

SUPPORTING FLOOR SYSTEM FORMS

498. The form for floor systems on arch rib or ring spans shall be supported upon the arch ribs or ring and shall not be placed until after the centering has been struck from under the ribs or ring.

CONCRETING COLUMNS

499. The columns from ground line or top of arch ribs or arch rings to the bottom of the floor beams resting thereon shall wherever possible be concreted in one operation to prevent horizontal construction joints in columns which would show and mar the appearance of the finished structure. Where columns have caps, a construction joint may be placed between column shaft and cap.

CONCRETING CROSS WALLS

500. Wherever in the design cross walls are used instead of columns and floor beams, they shall be concreted after the arch rib or ring has been finished. Bases for walls shall be concreted and reinforcing dowels placed during the concreting of the arch rib or ring as shown on the contract plans.

CONCRETING SPANDREL WALLS

501. The spandrel walls shall not be concreted until arch centering has been removed.

CONCRETING COPINGS

502. Copings which project beyond, or recess into the plane of the supporting wall shall not be concreted until the supporting concrete has taken its final set.

FINISH

NATURAL FINISH

503. It is the purpose of the Director to leave the natural finish on the concrete as it exists when the forms are removed. Extreme care must be exercised in building the forms, spading and vibrating the concrete and in removing the forms so that all crevices and surfaces will be well filled straight and smooth and without honeycombing.

HONEYCOMBED CONCRETE RECONSTRUCTED

504. Where honeycombing occurs in any concrete construction that to any extent affects the appearance, strength, permanance, or other desired requirements of the structure affected, the following remedial measures shall be carried out at the Contractor's own expense.

If, after careful examination or inspection by means determined by the Director, it is found that honeycombing exceeds 1/5 the thickness of the concrete in the structure affected, the entire section of the structure affected or any portion thereof to the extent determined by the Director shall be entirely removed and reconstructed with new materials to the satisfaction of the Director.

HONEYCOMBED CONCRETE PLASTERING

505. If the depth of honeycombing is found to be less than 1/5 the thickness of the structure involved, plastering done in conformity with the following requirements may be permitted:

The honeycombed concrete, and concrete around same to the area and depth determined by the Director shall be cut out and removed and retempered cement mortar containing 2% or 3% of lime which shall be permitted to stand for two hours after original mixing and which shall be remixed three times during this period without the addition of water shall be applied by throwing the first coat with a paddle, the cut surface of the concrete having first been thoroughly wetted, but not saturated. In about two days the remaining area shall be filled with similar mortar which shall be trowelled in place. After this second application has become somewhat firm it shall be marked with boards to agree with the grain left by the forms on the rest of the structure. It shall then be given a brush coat which will not conceal the board marks previously placed. After such operation the restored portions shall be kept moist for a period of 7 days by means of burlap hung over them and sprinkled with water.

CURING CONCRETE AND GROUT

506. The Contractor has the option of curing concrete by either of the following methods subject to the limitations specified under each type.

BITUMINOUS CURING COMPOUND

507. Bituminous Curing Compound may be used only for curing pavement bases where bituminous cushion or bituminous surfacing is to be applied. The curbs shall be protected with building paper as any curing compound deposited on the curbs must be removed. The Bituminous Curing Compound shall conform to the requirements of Section 190 of the Material Specifications and shall be applied as specified in Section 508.

COLORLESS TRANSPARENT FILM CURING COMPOUND

508. Colorless Transparent Film Curing Compound may be used for curing all concrete except concrete pavement bases on which a cement sand cushion is to be applied or concrete to which future concrete is to be bonded. It shall be applied in the following manner and shall conform to the Specification for Materials, Section 191.

The curing material shall be applied uniformly by means of an approved pressure spray distributor at the rate of one (1) gallon to each 20 sq. yds. of surface for the bituminous curing compound and one (1) gallon to each 30 sq. yds. of surface for the colorless

508. (cont.) transparent film, and it shall be so applied that the concrete surface is completely coated and sealed at one application. The curing material shall be applied immediately after the concrete surface to be cured has been finished and before any marked dehydration has occured. After the surface has been coated, it shall be protected from all traffic or abrasive action from any source.

Complete duplicate spraying outfits shall be on the site of the work where this method of curing is adopted before concreting is started.

BUILDING PAPER CURING METHODS

509. Building Paper for Curing Concrete may be used for curing all concrete where it can be applied in accordance with the following specification. The paper shall conform to the requirements of Section 192 and of the Specifications for Materials.

Building paper used for curing purposes or for protection shall lap at least 4" at any joint. The joints in the paper may be glued together or held in close contact with surfaced wood strips 4" wide and weighted sufficiently to prevent misplacement. The lap shall be made with top sheet on the high side of the grade. The edges of curing strips shall be firmly held in contact with the ground, forms, or adjoining pavement to make the covering air and water-tight. This is the important feature of this type of curing.

BURLAP AND WATER METHOD

510. All concrete may be cured by placing a double layer of burlap over the concrete as soon as it can be placed without disturbing the concrete and keeping the same wet by frequent sprinkling during the required curing period.

CURING TIME PORTLAND CEMENT CONCRETE

511. All Portland Cement Concrete shall be cured for 7 days before traffic will be permitted to use same or any load applied, except concrete sidewalks which may be opened for pedestrian traffic after 5 days, provided curing is continued for the 7 days.

CURING TIME HIGH EARLY STRENGTH CONCRETE

512. All High Early Strength Concrete shall be cured for 3 days before traffic will be permitted to use same or any load applied, except concrete side walks which may be opened for pedestrian traffic after 2 days, provided curing is continued for 3 days.

FORM NO. 106A.

SANDSTONE CURB

DESCRIPTION 513. Sandstone Curb, shall consist of sandstone furnished in conformity with the requirements governing Quality and Tests of Section 132 and the requirements governing Dimensions and Dressing of Section 137 for sandstone curb and set in place in a broken stone foundation and curb drain in conformity with the following requirements. Unless otherwise shown on the Contract Plans or provided in supplemental or special specifications all work shall conform to the detailed drawings for such class of work contained in the Standard Plans M-126A M-127A.

SANDSTONE CURB DELIVERED DRESSED OR PARTLY DRESSED The delivery of sandstone curb on the site of the work either undressed, partially or fully dressed, shall be optional with the Contractor. However, where spalling, or other damage, occurs to such dressings of curbs, the curb shall be rejected and removed from the line of work.

BROKEN STONE CURB DRAIN A trench 18" in width shall be excavated to a depth of 3 feet 0 inches below the finished curb grade and filled with broken stone to form a curb drain. The stone for curb drains shall conform to the requirements of Sections 130 and 131 insofar as same are applicable.

SETTING SANDSTONE CURB All stone curb shall be set in the following manner:

The broken stone base shall be levelled off at an elevation about one inch below the bottom of the curbstone. A layer of building paper, or tar paper, three inches wider than the curbstone shall be placed on the broken stone base symmetrical with the center line of curbstone. On this layer of concrete mixed as herein specified shall be placed at least two inches deep and levelled off uniformly.

The stone shall then be set on the concrete and tamped down and adjusted to proper elevation and line. The stone shall then be braced in position and protected from disturbance until permanently secure. The depth of the stone shall not vary more than one inch more or less from the depth specified.

The concrete shall be mixed in the proportions of one part Portland Cement to three parts of sand and five parts of gravel passing a 3/4" screen with only sufficient water added to make a stiff mix. The concrete must be thoroughly mixed and they may be mixed by hand.

SANDSTONE CURB Continued.

Backing.

The trench at the back of the curb six (6) inches in width, where there is a sidewalk pavement adjoining, shall be filled with broken stone up to the subgrade of the sidewalk foundation; where there is no sidewalk pavement, the trench at the back of the curb shall be filled within a foot of the curb grade. The ditch in front of the curb shall be filled to the subgrade of the roadway pavement with broken stone and covered with tar paper. The curb shall be backed up to the top with suitable material well rammed, and the placing of broken stone and back-filling shall be done as soon as the curb is set.

Cutting and Replacing Sidewalks

Where sidewalks are disturbed or damaged in setting the curb, the Contractor shall repair the same as hereinbelow provided in accordance with the respective conditions existing. The loam between the curb and the sidewalk shall be replaced with suitable top soil to a depth of three (3") inches and the area shall be seeded with a good quality of grass seed. Brick sidewalk pavement shall ba relaid for a distance of not to exceed eighteen (18") inches back from the inner edge of the curb. Flagstone sidewalk pavements extending to the curb shall be removed and recut to fit the curb and then relaid in a workmanlike manner. Concrete sidewalk pavements when damaged or disturbed shall be cut to a true line parallel with the curb and at least eight (8") inches back from the inner edge therefrom and shall be replaced with new work. Sidewalk damaged beyond this line shall be replaced with new material at the Contractor's expense. All of the foregoing work and the repaving or repairing of sidewalks shall be done and all materials therefor furnished in accordance with the requirements of these Specifications for the various classes of work and materials. The cost of the repairing and replacement of sidewalks, pavements and the cutting of the same to line and grade as above provided shall be included in the price bid per lineal foot for Sandstone Curb.

New Sidewalk

When in the opinion of the Director the work cannot be satisfactorily done without the removal of a larger portion of the sidewalk than hereinbefore provided, the Contractor shall, when ordered by the Director, relay the sidewalk with new material at the price bid per square yard for "Sidewalk Pavement" of the type and kind ordered.

Care to be Exercised

Care must be exercised in handling and setting all curb not to chip or otherwise damage the edges or joints thereof.

Derrngement to be Rectified.

Should any settlement of the curb occur, or should it be pushed out of line or in any other way deranged or damaged before the payment of the final estimate, the Contractor will be required to raise, reline, redress or replace all such curb as the Director may require.

DEPRESSED CURB FOR PRIVATE DRIVEWAYS

Requirements

514. At the respective contract unit prices for various types of Concrete and Stone Curbing, the Contractor shall construct depressed curb in conformity with the details shown on the Standards for Construction M-126-A & M-127-A, or on Contract Plans to the number and in the location ordered by the Director in the field. Where Contract Plans designate an approximate number of driveways, it is agreed that this is given for its worth as information to the Contractor, and shall not be considered as in any way affecting the amount of depressed curb required to be constructed for private driveways. Intending bidders are required to ascertain in their own way the probable number of private driveways which may be required. Compensation for Depressed Curb shall be included in the price bid for Straight Curb of the respective types.

SANDSTONE RADIUS CURB

Requirements

515. Sandstone Radius Curb shall conform to the foregoing requirements governing Sandstone Curb, except as otherwise provided and supplemented by the following requirements.

Radii

Tangent Closures

The curbs shall be cut to the radii shown on the Contract Plans or ordered in the field by the Director. The finished Radius Curb shall be not less than 3'-6" long. All closures must be made with tangents when necessary to give lengths of not less than 3'-6". The full length of curb used in such closures will be paid for as Radius Curb. Stone set to radii of 100 ft. or more will not be considered as Radius Curb but shall be paid for as Straight Curb.

GRANITE CURB AND GRANITE RADIUS CURB

Requirements

516. The stone furnished for Granite Curb, shall conform to the requirements of Sections 130, 133 and 138 governing Granite Curb. In all other respects it shall conform to the requirements governing Sandstone Curb and Sandstone Radius Curb.

PLAIN CONCRETE CURB

PLAIN CONCRETE RADIUS CURB

Description and Requirements

517. Plain Concrete Curb and Plain Concrete Radius Curb shall be constructed in conformity with the details shown on the Standard Plans M-126-A & M-127-A. If the curb is constructed without steel bar reinforcement it shall be constructed in sections 6 ft. in length, except at closures where the lengths shall be adjusted so that the minimum length shall not be less than 3'-6". The sections shall be separated with two layers of tar paper, which shall be trimmed to the neat lines of the finished curb.

Bar Reinforcement

Where the curb is constructed with bar reinforcement, the length of section shall be not less than 15 ft. nor more than 20 ft. and each section shall be separated by a joint filled with two layers of two-ply tar paper for the full width and depth thereof. The tar paper shall be carefully trimmed to the neat line of the finished curb.

Pgs 152 - 171

SANDSTONE CURB RECUT AND RESET AND STONE CURB RESET

518. The Contractor shall recut and reset, or reset as is designated in the proposal, old curbing found in place on the line of work. The curb to be recut and reset shall be that ordered in the field by the Director.

Removing and Resetting.

The old curb and broken stone drain shall be taken out by the Contractor and stored along the line of work in locations and in the manner approved by the Director. The trenches shall be excavated, a new broken stone drain and curb foundation constructed, and the curb shall be set and backed up, and all other work in connection therewith shall be done in strick accordance with the specifications for "Sandstone Curb," and the cost of all the above work shall be included in the price bid per lineal foot for work done under these Items.

Dressing of Curb.

The top shall be axed to a plane surface of not less than five (5) inches width throughout its whole length and the edges cut to a true line. The depth shall be not less than twenty (20) inches, unless otherwise stipulated on Contract Plans, or in Supplemental Specifications. The front shall be rough pointed at right angles with the top for a depth of twelve (12") inches. The back shall be pointed off vertically for six (6") inches below the top. The recutting or resetting of radius curb shall be included under the price for recutting and resetting curb.

Where sidewalks are disturbed or damaged in resetting the curb, the Contractor shall do all work necessary for placing the new curb, and shall repair the sidewalks in accordance with the requirements stipulated for "Sandstone Curb."

CONCRETE MARGINS

Description

519. Concrete Margins Type 1 and 2 shall conform to the sections shown on the Standard Plan M-127-A and shall be laid in accordance with the specifications for Concrete Base.

The exposed surface of the margin shall be finished to a true surface, flush with the surface of the adjoining pavement.

Compensation for the above work shall be included in payments made for concrete base and the respective type of surfacing.

FORM NO. 106A.

CONCRETE SIDEWALKS

Description

520. Concrete Sidewalks shall consist of a base of gravel, air cooled slag, or broken stone ~~five~~ four inches in depth, and a slab of Portland Cement concrete ~~five~~ four inches in depth. The sidewalks shall be laid with a slope conforming to the details of sidewalk construction as contained in the Standards for Construction, and the work shall conform thereto in all respects unless otherwise shown on the Contract Plans or ordered in the field by the Director. Acceptable cinder or clinker conforming to the specifications for cinders may be used in the base.

Requirements for Concrete

Concrete for Concrete Sidewalks shall conform to the requirements of Class "A" Concrete with medium class of course aggregate. The total amount of mixing water used shall not exceed 5-1/2 gallons per 94 pounds of cement.

Sub-Grade.

The excavation for the sidewalk between the surface of the finished sidewalk and the sub-grade of the foundation shall be included in the price bid per square yard for Concrete Sidewalk.

Forms and Size of Slabs.

The forms shall be smooth, free from warp, of sufficient strength to resist springing out of line and of a depth to conform to the depth of the finished sidewalk. They shall be well staked, thoroughly braced, properly and accurately set to the established line with their upper edges conforming to the proper finished surface.

The sidewalk slabs shall not be more than six (6) feet in length, nor shall they contain more than thirty-six (36) square feet of surface area.

Placing Slabs.

The concrete shall be deposited between cross-forms in alternate sections forming slabs of the dimensions hereinbefore required, and shall be properly tamped against the forms. The surface shall be finished with a wooden float, care being taken to thoroughly compact the concrete and the wearing surface, when finished, shall have a moderately rough surface. On steep grades the surface shall be roughened, as ordered by the Director in the field. Working with a steel trowel is expressly prohibited. Adjacent slabs shall be separated by 2 layers of Tar Paper. All edges of the slab shall be finished to a radius of about three-eighths (3/8") inch. The application of cement to hasten hardening is prohibited. Excess water shall be removed with a rag or mop.

The Contractor shall adjust manhole and catch basin castings where ordered by the Director for sidewalk construction in accordance with the specifications for setting castings in Section 539. No deductions shall be made for the area of City castings which are within the lines of the sidewalk as shown on the Contract Plans or ordered by the Director.

Expansion Joints

Concrete sidewalks shall be provided with 1/2 inch expansion joints, extending the full depth and width of the slab, at intervals not exceeding 50 feet, at all street and way intersections, and along all abutting curbs and catch basins castings. When stipulated on Contract Plans, or in Supplemental Specifications or ordered by the Director in the field, they shall also be provided along walls, buildings and other structures, and at other locations determined by the Director. Expansion joints shall be constructed of Cork Board expansion joint material conforming to the requirements of Section 179.

Payment shall be made at the contract unit price per square feet for the types of expansion joint filler constructed in conformity with the requirements of this contract.

FLAGSTONE SIDEWALKS

Description

521. Flagstone Sidewalks shall consist of a gravel or cinder base 4 inches in depth, a sand cushion 3 inches in depth, and a flagstone wearing surface 3 inches in thickness, making the total thickness of the completed pavement at least 10 inches.

Dimensions

Unless otherwise specified the flags shall have a width equal to the width of the pavement, a length of not less than four (4) feet and a thickness of at least three (3") inches.

Surfaces, Edges and Joints

The surface shall be sawed to a plane, free from warps, depressions of projections. The edges shall be pitched to true lines and squared for the full depth of stones. The joints shall be cut to straight surfaces and at right angles with the line and surface of the walk, for the full width and thickness of the stone.

Laying

The flags shall be set with close joints and with a firm bearing on the cushion throughout their entire area and brought to the required grade and cross-section. Where ordered, the top and edge of the flags shall be trimmed and trued after the flags are laid.

CUTTING FLAGSTONE SIDEWALK TO CURB LINE

Description

522. Where existing flagstone sidewalks extend to the curb line, the Contractor, when ordered by the Director shall dress the edge of the flagstone to conform to the face of curb and gutter.

FLAGSTONE SIDEWALKS RELAID ON NEW BASE

Description

523. The Contractor shall, when required upon the Contract Plans or ordered by the Director, remove, store for subsequent use and relay flagstone sidewalks on a new base.

All work and material shall conform in every respect to the requirements of the Specifications for "Flagstone Sidewalks."

The Contractor shall furnish new stone to replace stone broken or damaged during his operations.

Grading, etc.

The price bid per square yard for work under this Item shall include all grading required for the relaying of the sidewalk, unless expressly provided to the contrary on the Contract Plans. The disposal of surplus material and the removal and disposal of the old base, shall also be included in the price bid per square yard for this Item.

Recutting and Redressing.

The stone shall be recut and redressed so that the edges, joints and surfaces of the same will conform to the requirement stipulated in the Specification for "Flagstone Sidewalks;" the cost of this work shall be included in the price bid per square yard for work done under this Item.

BRICK SIDEWALKS RELAID ON NEW BASES

Description

524. The Contractor shall, when ordered by the Director, relay and adjust old brick sidewalk pavement on a new base where the same has been damaged or disturbed by the execution of work under this Contract.

The extent of the sidewalk to be relaid shall conform to the orders of the Director given in the field. The old bricks shall be relaid in a workmanlike manner on a sand cushion two (2") inches in depth laid upon a base of cinder or gravel four (4") inches in depth. As soon as the bricks have been laid, the joints shall be filled and the pavement covered with dry sand and the pavement shall then be rammed to a firm bearing with uniform surface and brought to the required grade and cross-section.

The Contractor shall furnish new brick to replace the original material when same is broken or damaged to the extent it is unfit for relaying.

FORM NO. 106A.

BRICK MANHOLES

Standard Manholes

530. The details and dimensions of standard manholes of the various classes are given in the "Standards for Construction," and on the Contract Plans, and all standard manholes shall conform thereto.

Special Manholes and Details

Where special details are shown in part for manholes on the Contract Plans, the remainder of the manhole not shown shall conform to "Standards for Construction."

Brick and Concrete Masonry

The brick masonry in the manholes shall be built with common masonry brick conforming to the requirements of Section 159 and the Construction of Masonry shall conform to the requirements of these specifications governing Brick Masonry.

All concrete masonry shall be furnished in place in accordance with the requirements of these specifications governing Concrete Construction Class "A."

Excavation, Back-Filling, Etc.

Excavation, back-filling, repaving and all work incidental thereto shall be done in accordance with the Specifications and provisions for this class of work under excavation, back-filling, and repaving.

Bond.

All brick shall be laid in courses of headers and stretchers and there shall be at least one (1) course of headers to every four (4) courses of stretchers.

Mortar Plaster.

The exterior surface of the manholes shall receive a one-half (1/2") inch coat of Portland Cement mortar, which shall be applied as the brick work is carried up.

Invert.

Inverts of Class "A" manholes shall be formed by bedding split sections of terra cotta pipe in full beds of mortar and the grade of the invert shall conform to the grade of the sewer. Inverts of manholes, Classes "B" and "C," shall be formed by molding the same in a concrete base.

Castings.

Manhole frame and cover castings and manhole steps shall be furnished by the City and will be delivered upon the site of the work free of cost to the Contractor. The Contractor shall place all castings on the brick work in full beds of mortar. The top of the castings shall in all cases conform to the established grade and cross-sections of the street.

Steps

Cast iron steps conforming to the detail shown in the "Standards for Construction," shall be placed in each manhole.

Prices to be Bid.

The unit price bid per each for standard or special manholes shall be a lump sum price per manhole, complete in place, unless otherwise stipulated on contract Plans or in Supplemental Specifications.

TIMBER PLATFORM

Platforms for Terra Cotta Pipe Sewers

531. Unless otherwise required on the Contract Plans, all timber platforms in foundations for terra cotta pipe sewers shall be constructed as follows:

Sills shall be laid transversely in the trench and planking securely spiked thereto. The dimensions and the spacing of the timbers and planking to be used will be given in the field. When ordered in the field, the Contractor shall drive four inch by four inch (4" x 4") timbers into the bottom of the excavation to a satisfactory bearing and shall spike the sills to the same. The price bid per thousand feet board measure (M. ft. B. M.) for timber platforms shall include furnishing and driving such hand piles.

EXTENSION OF MANHOLES

532. Under this item the Contractor shall extend brick manholes to conform to the details shown on the contract plans, or as ordered by the Director in the field.

ALTERATION AND ADJUSTMENT OF CATCH BASINS, INLETS AND MANHOLES

Description

533. Under this item the Contractor shall alter and adjust brick catch basins, inlets and manholes where said alteration requires same to be raised or lowered more than twelve (12") inches, or alter or adjust catch basins and inlets to line where said change in alignment is more than six (6") inches. When alteration and adjustment of catch basins, inlets and manholes are less than the dimensions above specified, payment will be considered as having been included in other items of work.

FORM NO. 106A.

PARTIAL RECONSTRUCTION OF CATCH BASINS AND INLETS

Description.

534. Under this item the Contractor shall, when shown on the Contract Plans, or as ordered by the Director in the field, tear out existing catch basins to the top of stanch plate, and inlets to the invert of outlet pipe, and reconstruct with new brick masonry to the lines and grades determined in the field. The entire inside of the structures shall receive a coat of Portland Cement mortar one-half (1/2") inch in thickness.

Storage and Resetting of Old Castings

All castings removed, either for extension, alteration and adjustment or partial reconstruction of brick catch basins, inlets and manholes under items of work hereinabove described, shall be carefully stored by the Contractor and reset on the reconstructed or altered brick structure. All castings shall be placed in a workmanlike manner upon a bed of mortar. Contractor is responsible for all broken, lost or destroyed castings. Old castings not required to be used on the work, shall remain the property of and be disposed of by the City.

PLACING ADDITIONAL WEIR CASTINGS

534A. Where shown on the contract plans or ordered in the field the Contractor shall place weir plate castings, furnished by the City, in front of existing catch basins. Weir plates shall be set in a bed of Portland Cement mortar and brought to the required grade. All the foregoing work shall be included in the unit prices bid respectively for new pavements or repaving.

BRICK MASONRY

535. All brick for masonry shall conform to the requirements of Section 169 of the Specifications for Materials.

The brick shall be culled on the ground by the Contractor and all condemned brick immediately removed from the work. Bats shall not be used in the work except where necessary for making a closure. The contractor will be required to handle the brick in such a manner as to prevent breaking and spalling of the edges. Brick that are chipped or spalled shall not be permitted in the work.

Each brick shall be bedded in full joints of Portland Cement mortar on its bed, ends and sides. The joints shall not exceed one-half (1/2") inch in thickness and special care shall be taken to make the face of the brick work smooth. All exposed surfaces shall be neatly struck with a trowel or pointed to the satisfaction of the Director.

All bricks shall be thoroughly wet before being laid and all surfaces of old masonry or of completed work upon which brick are to be laid shall be thoroughly cleaned and wetted before bricks are laid. Brick masonry shall be laid in horizontal courses, properly bonded together and all edges and surfaces shall be true to the required lines and grades shown upon the Contract Plans or ordered by the Director.

The construction of brick masonry in cold weather shall be subject to all the provisions of Concreting in Cold Weather.

During the progress of the work the Contractor shall provide suitable barricades and covering so as to protect the work during the progress of its construction and to prevent damage to the same.

Water shall not be permitted to flow over brick masonry during its construction or at any time until the mortar has finally set.

SPECIAL CEMENT SUBSTITUTED FOR PORTLAND CEMENT

536. When indicated on the contract plans or stipulated in Supplemental or Special Specifications or ordered in the field by the Director, the Contractor shall substitute High Early Strength Special Cement for Portland Cement for mixing concrete required under any of the items of work included in this contract. Where such substitution is ordered, the type of construction affected shall conform to the requirements governing same with the exception that Curing and Protection shall conform to the requirements herein given therefor when High Early Strength Concrete is used.

Payment made at the contract unit price per bag of 94 pounds each under this item shall be additional to payment made at the contract unit price for the respective items of work affected and shall be full compensation for all additional cost and expense involved. However, no payment shall be made at the contract unit price under this item for any type of concrete construction requiring High Early Strength Concrete for which other contract unit prices can be applied.

Extra Concrete

537. Extra Concrete shall be all miscellaneous concrete not shown on the contract plans or which cannot be properly classified under other items of work included in the contract that is constructed in conformity with orders given in the field. However, when specially stipulated on Contract Plans or in Supplemental or Special Specifications, concrete construction shown on the Contract Plans shall be included for payment at contract unit price for this item.

Unless otherwise stipulated concrete construction done under this item shall conform to the requirements of the contract governing Class A Concrete, and payment made at the contract unit price shall be full compensation for the concrete construction complete in place including forms, tooling, finish, construction joints and all labor required to provide proper workmanship for the type of structure involved.

STEEL REINFORCEMENT

FABRICATION AND ERECTION

Kind of Reinforcement

538. Steel Reinforcement Bars conforming to the requirements of Section 144, shall be provided for all steel reinforcement shown and specified, and shall be of the length and shape stipulated. When plain bars or deformed bars are designated such types of bars must be furnished. Where such designation is not made, either plain or deformed bars may be furnished, the deformed bars to be of approved types.

Bends and Hooks

Where curved or bent bars are required on the Contract Plans, the same shall be bent to the radius shown thereon. All bends shall be made cold, except that, when permitted by the Director, hooks in bars 3/4 inch and larger bent to a radius not exceeding six (6) times the diameter of the bar may be brought to a dull red heat and then bent.

Bars which have been bent shall not be straightened and used in the work and no bars shall be used which have any kinks whatever or any bends not called for on the contract plans or ordered by the Director in the field.

538. STEEL REINFORCEMENT Continued.

Spacing and Holding

All reinforcing bars or wire mesh shall be accurately placed in the proper position and secured against displacement by using annealed iron wire of not less than No. 18 gauge, or suitable clips at intersections, and by the use of metal or concrete chairs, or by metal hangers, or other approved supports. The methods used shall be subject to the approval of the Director and shall be such as will hold the bars securely and firmly in position during concreting. Supports and ties shall be not more than 3 feet center to center, unless otherwise permitted by the Director.

Splices

Where splices in reinforcing bars are located or dimensions on the Contract Plans, the splices shall be made as thereon required and as hereinafter specified.

Splices - How Paid For

Where the steel reinforcement is included in a lump sum bid, such bid shall include the cost of all splices shown on the Contract Plans. Where the steel reinforcement is not included in a lump sum bid, but is paid for under unit prices bid therefor, the steel in the splices will be paid for at the unit price bid under such items. No payment will be made for splices not called for on the Contract Plans, but which are permitted by the Director at the request and expense of the Contractor.

Splices not Called for on Plans

The Contractor may at his own expense and only when permitted by the Director, make additional splices not shown or required on the Contract Plans; such additional splices shall conform to the requirements herein above specified, and shall be made in the locations and in the manner ordered by the Director.

Splices - How Made

All splices shall be staggered. Unless otherwise required on the Contract Plans, the splices shall conform to the following requirements for Bond Laps and Contract Laps. In no case shall the bars be lapped less than two (2) feet.

Bond Laps shall be made where it is possible to get two and one-half (2-1/2") inches of concrete in the clear between the two parts of the splice and between adjacent parallel bars, the clearance to be obtained for the full length of the splice. In Bond Laps, the bars shall be lapped at least forty (40) diameters for deformed bars and at least fifty (50) diameters for plain bars.

When a Bond Lap cannot be made, as before described, a Contact Lap shall be used. The Contact Lap shall be made by placing the bars in actual contact with each other and wiring the same securely together. In Contact Laps, the bars shall be lapped at least forty-five (45) diameters for deformed bars and at least ninety (90) diameters for plain bars.

Splices in structural steel reinforcement shall be located at the points and made in the manner shown on the Contract Plans. In arch ribs that are concreted in sections with the splices located in intervening key-ways, the holes for field splices shall be drilled and field splices made after the sections have been concreted.

STEEL REINFORCEMENT Continued

Protection of Steel

538. All reinforcing steel shall be carefully stored on the site of the work and protected from the injurious effects of the elements. It shall at all times be so handled and stored as to prevent distorting or bending and the placing of reinforcement that has become bent or distorted shall not be permitted in the work

Cleaning Reinforcement

All reinforcement, before being placed in the work, shall be thoroughly cleaned of all loose rust, scale, dirt, grease or other foreign matter. During the progress of the work, concreting shall not proceed until all foreign matter adhering to the steel has been removed to the satisfaction of the Director and particular care shall be taken to remove accumulation of inert mortar.

Expansion Joints

The steel reinforcement shall not extend into or through the expansion joints.

Setting Castings

539. The Contractor is required to construct inlays elsewhere provided for and to set all City castings to the proper slope and elevation on full mortar beds laid on solid masonry foundations. To accomplish this purpose, he shall provide at his own expense, any mortar, concrete, or brick masonry required for a change in elevation of 12 inches or less. Where existing masonry is in poor conditions, the Director will order the reconstruction of such portions as are necessary, which shall be paid for at the prices bid for extra concrete or brick masonry.

Any castings set more than 3/16 of an inch above or below the finished surface of the adjoining concrete, brick, block stone or bituminous surface, as determined by a 10 ft. straight edge, shall be reset by the Contractor at his own expense.

The Contractor is also required to see that all public utility company castings are set at the proper elevation and slope and on solid masonry before placing the inlays around them. Public utility castings are subject to the same requirements for setting as City castings, and any that do not meet those requirements shall be reset. The Contractor shall remove the inlays and arrange with the utility company to reset the castings and the Contractor shall then replace the inlay and pavement surfacing.

The Contractor shall maintain all City and Utility castings at their proper elevation for a period of one (1) year after acceptance of the work by the Director.

Setting Castings (Cont.)

If at any time within theguarantee period, the casting tops or the surface of the concrete inlays are found to vary more than 3/16 of an inch either above or below the surface of the adjoining sidewalk or street pavement, except asphalt surfacing, as determined by a 10 ft. straight edge, the Contractor shall, at his own expense, remove the inlays and pavement surfacing, reset the City castings and arrange to have the Utility castings reset, then replace the inlays and resurfacing.

Pipe Railing Material

540. All pipe for rails shall be standard weight black wrought iron pipe, and all pipe for railing posts shall be extra strong black wrought iron pipe, in accordance with the A. S. T. M. Specifications, Serial Designation A-72-33, except that the pressure test of the pipe is waived. All rivets shall be soft steel. All fittings shall be high grade malleable iron ball type or High Tensile Strength Cast Iron and shall conform to the details shown on the Contract Plans.

Paint for Pipe Railings

All pipe railings including fittings shall have one coat of red lead paint applied in the shop, and two coats of aluminum paint applied in the field, all in accordance with the Specifications in the Contract for Construction.

Wearing Surface for Concrete Steps

541. Unless otherwise noted on Contract Plans, or in Supplemental Specifications, all public concrete steps and platforms shall have one-half (1/2) inch thick wearing surface of Portland Cement mortar and Aluminum Oxide Abrasive Grains. The wearing surface shall consist of one part by volume of Portland Cement, one part of clean dry sharp sand, one and one-half parts of Aluminum Oxide Abrasive Grains mixed in the following proportions, 20% each of #8, 12, 16, 20, and 24 grains. The above material in their specified proportions shall be thoroughly mixed dry. Water shall then be added in sufficient quantity to produce a mortar of the desired consistency, and the whole thoroughly mixed until a homogeneous mass is produced. The above mixture will require about 2 pounds of Abrasive Grains per square foot of wearing surface.

After the base for the steps and platform is placed, and before it has reached its initial set, fresh wearing surface mixture shall be spread over the base and worked sufficiently to produce a uniform layer 1/2 inch thick, compact and monolithic with the base. The nosing shall then be formed and the surface finished with a wooden float.

After the steps and platforms have been properly surfaced with a wood float, a top dressing shall then be added consisting of equal parts by volume of Portland Cement and Aluminum Oxide Grains. This shall be spread evenly over the top surface to the amount of 1/4 pound of Aluminum Oxide Grains to the square foot. The grains shall then be worked into the surface with a wooden float, taking care that they are not worked in too deeply.

It is the purpose of the Director to have a moderately rough and uniform finish over the the entire surface of the steps and platforms.

Metallic Iron Bond Coat

542. When Metallic Iron Bond Coat is required by the contract Plans, or Specifications, it shall be mixed and applied in the following manner:

MIXTURE: The Bond Coat shall consist of three (3) parts by volume of finely ground metallic iron powder and one (1) part of Portland cement thoroughly mixed dry, then sufficient water added until the mixture has the consistency of cream or heavy paint.

APPLICATION: The surfaces of steel or concrete to which the bond coat is to be applied shall be thoroughly cleaned and scoured with a wire brush and all loose particles, dirt, rust, etc. removed. The surface of the concrete shall then be sprayed with clean water for 1/2 hour and the steal work shall be wetted. All free surface water shall be removed and the first bond coat applied with a stiff fibre brush. The bond coat mixture shall be kept stirred to prevent the separation of the ingredients and should be applied with a rotary motion of the brush so that all pockets and depressions are filled. The brush should be dipped deep into the mixture to reach the iron powder which will settle to the bottom.

SECOND COAT: Let at least 1/2 hour elapse between the first and second coat application, and if the first coat is dry, sprinkle lightly with water and remove any surface water remaining. The second coat shall then be applied with a paint brush or hair brush and brushed on the first coat. The concrete shall then be poured before the 2nd coat has set or dried.

Granulated Slag and Cement Concrete

543. Whenever slag and cement concrete is required for back packing in tunnels, for sidewalks, or for other purposes, it shall be mixed in the following manner.
One (1) part Portland cement and eight (8) parts granulated blast furnace slag, volume measure, with only sufficient water added to make a stiff mixture, and then thoroughly mixed in a concrete mixer. Slag and cement concrete must be thoroughly rammed or tamped in place.

PORTLAND CEMENT MORTAR

Mortar for Laying Stone and Brick Masonry

544. The mortar for laying stone masonry and Brick Masonry shall be mixed in the proportions of one volume Portland Cement and two volumes sand. Mortar may be mixed by machine or hand. When mixed by hand, the sand and cement shall be evenly spread and thoroughly mixed dry on a water-tight platform or in a water-tight mortar box. A sufficient quantity of water shall then be added to produce a mortar of the required consistency, the whole to then be quickly and thoroughly worked with hoes or other efficient tools. Mortar shall be mixed in such quantities as will allow it to be used very quickly after being mixed, and any mortar not used within half of an hour after being first wet will be rejected. The retempering of mortar will in no case be permitted.

Mortar for Pointing Stone Masonry

Mortar for pointing shall be composed of equal volumes of Portland Cement and sand and shall be mixed as specified for mortar for laying stone masonry. It shall be mixed in small quantities and just enough water used to bond the grains together.

PORTLAND CEMENT GROUT

544-1/2. Grout shall be mixed in the proportions of 94 pounds High Early Strength Portland Cement to 225 pounds of fine sand. The cement and sand shall be thoroughly mixed dry and only enough water added to make the grout workable for the purpose intended, not exceeding 7 gal. per sack of cement, including all water in the sand.

TERRA COTTA PIPE SEWERS

Excavating Back-Filling Repaving,etc

545. The work shall conform in all respects to the requirements specified under Excavation, Back-filling and Repaving, inclusive, and the compensation per lineal foot for sewer shall include doing all work therein provided or incidental thereto as specified in the above mentioned sections.

The trench in all classes of materials, shall at all times during the progress of the work be excavated to the required depth and widths as hereinbelow stipulated for a distance of at least ten (10') feet in advance of the end of the pipe in place.

Dimensions of Excavation

The trenches shall be excavated to the depth necessary to construct the sewer or sewers as shown upon the Contract Plans and the width of the trenches and the lines of required excavation shall be as follows:-

The line of required excavation for the sides of the trench shall be vertical and the required width of trench shall be such as to extend on each side of the center line of proposed sewer distance of six (6") inches more than one-half of the greatest external diameter of the barrel of the pipe laid therein. In firm ground the bottom of the trench shall conform to the bottom of the sewer and in shale or rock the Contractor shall excavate to a depth of six (6") inches below the outside bottom of the pipe.

The required width of trench for pipe sewers both in firm ground and hard ground or rock and the shape of the bottom of the trench and the lines of required excavation are shown in the Standards for Construction, and the trench shall be excavated as shown therein.

No additional compensation shall be made for excavating beyond the lines of required excavation rendered necessary in any manner for the construction of the sewer as shown on the Contract Plans; nor shall any additional compensation be allowed for excavation beyond the lines of required excavation due to any other cause, except when ordered by the Director, as provided in Section 429.

Bedding Pipe

The pipe shall be laid with a full and even bearing; sufficient space shall be excavated at the bell holes to permit the proper caulking of the joint. No blocking of pipe will be allowed. The excavation for bell holes beyond the required lines of excavation for the sides and bottom of the trench shall be included in the price bid per lineal foot for the sewer, and no compensation under Extra Excavation shall be allowed for the same.

Refilling Bottom of Trench

Where the sewer trench is in rock, the trench having been excavated six (6") inches below the bottom of the pipe, as hereinbefore required, the space between the pipe and the bottom of the trench shall be refilled with a selected quality of material to the proper grade of the sewer. This filling shall be very carefully placed and thoroughly consolidated with heavy iron rammers, so as to furnish a solid foundation for the bedding of the pipe.

Laying Pipe

The pipe shall be laid true to the lines and grades shown upon the Contract Plans, and given in the field. Each pipe shall be carefully laid to the grade and line given in the field and the ends of adjoining pipes shall butt against each other in such a manner that there will be no shoulder or unevenness of any kind. Special care shall be taken that the invert of the pipe be a smooth continuous surface. Unless expressly ordered by the Director, each pipe shall be brought to the required grade as established from grade lines. The Contractor shall, at his expense, furnish all materials, tools and labor and shall construct cross-frames or horses at such intervals as the Director may order in the field. The Contractor shall further furnish all other implements necessary to determine the proper setting of the pipes.

Making Joints

After the pipe has been laid to proper line and grade in conformity with the foregoing requirements, compound meeting the requirements of these specifications governing Bituminous Joints for Pipe Sewers shall be heated in gasoline, or other suitable furnace to a temperature approximately 400 deg. F., so that it can be poured rapidly and smoothly. Before pouring, the joint shall be thoroughly caulked with a closely twisted gasket of dry hemp or jute, free from oil or grease, long enough to go around the pipe and of sufficient thickness to hold the pipe, securely in their proper relative positions. The contractor shall provide a satisfactory thermometer on all jobs for taking the temperature of the joint compound.

After the pipe is properly caulked, a suitable runner shall be placed and the compound shall be poured in so that it shall run around the pipe, completely filling the annular space.

In cold weather when the compound is likely to cool too rapidly in running around the larger pipe, the lower half of the joints shall be poured first from both sides, then the upper part of the joint shall be poured from the top.

In case the pipe joint is not completely filled, the unfilled part of the joint shall be poured again with hot material so as to form a complete watertight joint. Wherever permitted, sections of two of three pipes may be joined at the side of the trench, provided the pipes are held firmly to correct alignment. In lowering the sections so made into the trench, a piece of timber shall be run through the pipes to support their weight and prevent the joints or bells from being broken.

Interior Joints

The joint on the inside of the pipe shall be carefully wiped and all joint material, dirt, stone or rubbish left on the inside of the pipe shall be carefully removed and the pipe left smooth and clean throughout.

Bell Holes to be Kept Dry

Bell holes shall be kept free of water while the pipe is being laid or else each bell hole shall be completely filled with mortar or concrete, for which mortar or concrete no extra compensation will be allowed.

Ball Holes to be filled — As soon as the cementing of any joint has been completed, the bell hole under the bell shall be carefully and compactly filled with sand, loam, or fine earth.

Branches & Specials — The ends of the branches in combined sewers shall be securely closed with earthenware or cement covers. The ends of branches or house laterals on sanitary sewers shall be closed with an earthenware or cement cover fitting within the bell. The joint between the cover and the bell shall be filled with cement mortar and the entire surface of the cover plastered with cement mortar.

House Laterals & Y's — The depth and location of the main sewer and the approximate location of the house laterals are shown on the Contract Plans. All house laterals, connections, extensions, reconnections and Y's, which are not otherwise specified shall be eight (8") inches in diameter and shall be constructed with a grade of one (1") inch per foot in accordance with the requirements given in the Standard for Construction, except when otherwise required on the Contract Plan or ordered by the Director in the field.

The price bid for house laterals, extensions and reconstructions shall include all necessary specials in place.

End of Sewer — The ends of all pipe sewers shall be closed with terra cotta or cement discs securely cemented in place with Portland Cement mortar. At all times during the progress of the work the open end of the pipe shall be temporarily closed with a wooden cover made special for that purpose.

Protection of Pipe — Walking or working over the pipes after they are laid will not be permitted, except as may be necessary in the refilling of the trench, until they have been covered with at least two (2') feet of dirt. The ends of the pipe shall be protected when blasting is in progress with heavy planking and blasting will not be permitted within twenty-five (25') feet of the completed work. In freezing weather the materials used for the mortar in making joints shall be heated in a manner satisfactory to the Director.

Connection with existing Sewers — Where connections of sewers laid under this Contract are made with existing sewers, the connections shall be made in the following manner:---

A length at least six (6') feet of the existing sewer shall be opened up to the surface of the ground with a width of trench equal to the hereinbefore specified for that size of pipe. At least two (2) lengths of the existing sewer pipe shall be removed, the new branch or special inserted and the connection completed by inserting a length of pipe cut to fit the closure. The pipes shall be fitted together by raising the pipe in the trench a sufficient distance to permit the slipping of joints. The joints for closures shall be made as above provided.

Mortar — Mortar where required shall be mixed in the proportion of one (1) part of cement and two (2) parts of sand and shall conform in all respects to the requirements specified under Concrete Masonry and Portland Cement Mortar.

FORM NO. I06A

Plumbing Laws	All work shall conform to the requirements of the Plumbing Laws of the City of Pittsburgh, Department of Health.
Branches and Specials	All branches, tees, quarter bends, curved pipe and all other specials shall be furnished where required upon the Contract Plans and the compensation for the same shall be included in the price bid per lineal foot for straight pipe.
House Laterals	The depth and location of the main sewer and the approximate location of the house laterals are shown on the Contract Plans. All house laterals shall be constructed with a grade of one (1") inch per foot except when otherwise required on the Contract Plan or ordered by the Director in the field. The price bid for house laterals, extensions and reconnections shall include all necessary specials in place.
Manholes and Catch Basins	Manholes and Catch Basins shall be constructed in accordance with the Standard Specifications and Details therefore except as otherwise noted on Contract Plans, or ordered by the Director. Separate payment shall be made for Manholes and Catch Basins.

REINFORCED CONCRETE PIPE SEWERS

Reinforced Concrete Pipe

546. Pipe provided for sewers constructed under this Item shall conform to the requirements of Section 173.

Excavation and back Filling

Excavation and back-filling of trenches for reinforced concrete shall conform to the requirements specified under Excavation, Ba filling and Repaving for sewers.

Laying of Pipe

Reinforced concrete pipe shall be laid in accordance with the re ments specified under Laying Terra Cotta Pipe Sewers, except as herein specified.

Joints

When reinforced concrete pipe of the bell and spigot type are furnished, the joints shall be bituminous joints conforming to th requirements therefor given governing Terra Cotta Pipe Sewers. When reinforced concrete pipe is furnished in the beveled tongue and groove type, the joints shall be made in conformity with the following:

The interior recess of the joint shall be thoroughly cleaned, wetted, and filled with Portland cement mortar to thoroughly seal the joint and prevent leakage, or infiltration; and so as to make a continuous smooth invert.

Slants Spurs and Discs.

Where slants or spurs are stipulated on the Contract Plans, or in Supplemental or Special Specifications for reinforced concrete pipe, the slants or spurs shall be made in conformity with the requirements of these specifications governing Bell and Spigot Terra Cotta and Concrete Pipe. The shaping of the inner ends thereof and the placing of a collar of concrete reinforcement around same shall conform to the requirements therefor given in Section 173. The bell ends of all slants and spurs to which other sewer connections or house lateral connections are not required to be made under this contract shall be closed with Terra Cotta or cement discs securely sealed with cement mortar.

BRICK SEWERS

547. The brick masonry in sewers shall be built with common masonry brick conforming to the requirements of Section 169 except that the invert shall be lined with Vitrified Invert Sewer Brick in accordance with the requirements of Section 168.

Excavation, Back-filling Repaving, etc.

The work shall conform in all respects to the requirements specified under Excavation, Back-filling and Repaving for sewers, and the compensation per lineal foot for sewer shall include doing all work therein provided or incidental thereto as specified in the above mentioned sections.

Dimensions of Excavations

The trench shall be excavated to the depth necessary to construct the sewer or sewers as shown upon the Contract Plans, and the width of the trenches and the lines of required excavation shall be as follows:

The trench shall be excavated to a required width inside of all sheeting, shoring, and bracing, equal to the greatest external width of the sewer section. The sides and bottom of the trench shall conform to the neat lines of the sides and bottom of the sewer section as shown on the Contract Plans or as ordered by the Director.

Dimensions of Excavations (Cont.)

547. The required width of trench for brick sewers, both in firm ground or hard ground or rock and the shape of the bottom of the trench and the lines of required excavation are shown in the Standards for Construction, and the trench shall be excavated as shown therein.

No additional compensation shall be made for excavation beyond the lines of required excavation rendered necessary in any manner for the construction of the sewer as shown on the Contract Plans; nor shall any additional compensation be allowed for excavation beyond the lines of required excavation due to any other cause, except for additional excavation measured between required neat lines, that is caused by changed alignment ordered by the Director.

Cross-Section and Alignment

The cross-section of the sewer or sewers and their foundation and alignment shall conform to the details, lines and grades as shown upon the Contract plans and as given in the field.

Bond

The brick shall be laid in courses of stretchers parallel to the longitudinal axis of the sewer and each course shall break joints with the adjoining course at least one-third the exposed length of a brick and shall be thoroughly bonded. During the progress of the work the end of each section shall be kept racked back in a manner approved by the Director, the end of the completed section, when the laying of brick is not under way, shall be toothed so as to insure the bond with the following section.

Before beginning each day's work and whenever ordered by the Director, the surface of the completed work shall be thoroughly cleaned and all foreign matter attached thereto removed to the satisfaction of the Director.

Joints and Finished Brick Work.

Each brick shall be bedded in full joints of Portland Cement mortar on both its beds, ends and sides. The brick will be laid on radial planes and no joint on the inner surface of the sewer shall measure more than one-quarter (1/4") inch in thickness. The face of the brick masonry shall be smooth and all joints in the face struck with the point of a trowel. The face of the completed work shall be clean.

Building Invert

The lower third of the inner ring of all brick sewers shall be built with Vitrified Invert Sewer Brick as hereinbefore specified. The brick in the invert shall be laid in regular straight courses of stretchers parallel with the longitudinal axis of the sewer, beginning at the center of the invert, carrying the sides up even to the last course on each side of the invert. All inverts shall be laid with templates accurately set and aligned. In firm ground and in rock the brick shall be laid on a bed of mortar one-half (1/2") inch in thickness placed on the bottom of the trench. After not more than eight (8) courses have been laid in the trench, a board shall be laid on the invert in order to protect the work laid. The invert shall be laid true to line and grade as given and shall be finished so as to give the smoothest possible surface. The flowing of water over the invert shall not be permitted until forty-eight (48) hours after its completion, unless permitted by the Director.

Arch Ring

The arch ring shall be formed on strong centers of correct form and dimensions in accordance with the cross-sections shown upon the contract plans. In building the arch ring, the two sides shall be carried up uniformly and the interior of the sewer shall be kept smooth and cylindrical in shape. The last five (5) courses of brick work in keying the arch shall be laid with push joints and the arching keyed to place with stretchers tamped in with a hammer.

FORM NO. 106A

Excavation Back-Filling Repaving, etc.

The work shall conform in all respects to the requirements specified under excavation, back-filling and repaving for sewers, and the compensation per lineal foot for sewer shall include doing all work herein provided or incidental thereto as specified in the above mentioned sections.

Dimensions of Excavations

The trenches shall be excavated to the depth necessary to construct the sewer or sewers as shown upon the contract plans, and the width of the trench and the lines of required excavation shall be as follows:

The trench shall be excavated to a required width inside of all sheeting, shoring and bracing, equal to the greater external width of the sewer section. The sides and bottom of the trench shall conform to the neat line of the sides and bottom of the sewer section as shown on the Contract Plans or as ordered by the Director.

The required width of trench for concrete sewers, both in firm ground or hard ground or rock, and the shape of the bottom of the trench and the lines of required excavation are shown in the Standards for Construction, and the trench shall be excavated as shown therein.

No additional compensation shall be made for excavation beyond the lines of required excavation rendered necessary in any manner for the construction of the sewer as shown on the Contract Plans, nor shall any additional compensation be allowed for excavation beyond the lines of required excavation due to any other cause, except for additional excavation measured between required neat lines that is caused by change of alignment, ordered by the Director.

Cross-section and Alignments

The sewer shall be built in accordance with the lines and grades as shown upon the Contract Plans or as given in the field. The cross-section of the sewer or sewers and their foundations shall conform to the sections shown upon the Contract Plans. Concrete placed by the Contractor beyond the neat lines of the section shown on the Contract Plans or beyond the neat lines ordered by the Director will not be paid for.

Additional Concrete

Where additional concrete is required to be provided for items of work involved in the construction of sewers that can be considered as an increase in quantity of work involved by changes in dimensions for items covering concrete construction, exclusive of items in which concrete construction is incidental, and where such increased quantity of concrete is not included in other items contained in the contract, such increased quantity of concrete shall be considered as extra concrete and so paid for; however, all concrete required to be constructed over trenches for sewers shall be measured and paid for as concrete paving base, if such item of work is incorporated in the contract.

Construction of Invert

548, cont. After the trench has been excavated to the required depth and cross section, the invert of the sewer shall be constructed by placing a block of concrete, the upper surface of which shall conform to the proper line and grade of the invert of the sewer.

This invert block shall be placed in length not exceeding ten (10') feet, the upper surface of which shall be screened, troweled and finished to a smooth surface, conforming to the dimensions, grade and cross-section shown on the Contract Plans. Vertical construction joints of the type shown on the Contract Plans or ordered in the field shall be placed at the end of each section continuously poured, and further, such construction joints must always be placed at the end of a day's work, and at all other points where concreting has been stopped for a period exceeding two (2) hours. Each succeeding section shall be properly keyed to preceding section. Horizontal construction joints for the proper keying of the side walls shall be constructed in conformity with the details shown on Contract Plans or orders given by the Director.

Construction of Side Walls and Arch

After the invert blocks have set up for sufficient length of time, as determined by the Director, the forms and centers for constructing the side walls and arch of the sewer shall be set in place true to the required line and grade and firmly braced so as to prevent displacement. The barrel of the sewer shall be constructed in lengths conforming to the vertical construction joints placed in the invert. The vertical construction joints in the barrel shall conform to the foregoing requirements governing such construction joints in the invert. Each section of the barrel shall be properly bonded to the invert. The side and arch of the sewer shall be poured monolithic and the method employed in concreting each section shall be approved by the Director.

Curves

All horizontal curves shall be true arcs of circles and the profiles of the invert shall be properly arranged and centered and the forms constructed so as to conform accurately with the required radii of the curves as shown upon the Contract Plans or as ordered by the Director.

Spurs and Slants

Spurs and slants of vitrified tile pipe shall be built into the sewer where specified in the Contract Plans and the cost of the same shall be included in the price bid per lineal foot of the sewer. Branches of the diameter specified on the Contract Plans or ordered shall be set at an angle with the line of the sewer, slanting in the direction that the grade falls and shall be placed at such heights as the Director may order, with the bells turned outward. The interior ends of spurs and slants shall be moulded or trimmed flush with the inside of the sewer and all outer ends closed with terra cotta or cement discs and securely cemented with Portland Cement mortar or bituminous pipe joint filler.

Defective Work

The inner surfaces of completed sewers shall be smooth and continuous without irregularities or projections of any kind. Plastering shall not be permitted. If upon the removal of centers a portion of the sewer is found defective and if in the opinion of the Director, satisfactory repairs cannot be made, said defective work must be torn out to the extent ordered and rebuilt in a manner satisfactory to the Director at the Contractor's expense.

Manholes and Catch Basins

Manholes and catch basins shall be constructed in accordance with the Standard Specifications and Details therefore, except as otherwise noted on the Contract Plans, or ordered by the Director. Payment for manholes and catch basins shall be made under separate items.

Steel Reinforcement

548 cont. Steel Reinforcement Bars shall be furnished and placed in accordance with the requirements of Section 538.

The price bid per lineal foot for Reinforced Concrete Sewers shall include furnishing and placing the steel reinforcement as shown on the Contract Plans. Where extra steel reinforcement is ordered by the Director the Contractor shall receive extra compensation for same under the item of steel reinforcement.

RAIL PLASTER

Description

549. The Contractor shall when required upon the Contract Plans or ordered by the Director in the field, plaster both sides of rails located within the railway area, in accordance with the detail shown in the "Standards for Construction" or on the Contract Plans.

Mixing and Placing

Rail plastering shall be mixed in the proportion of one part Portland Cement and two parts sand and only sufficient water shall be added to make the plaster sufficiently plastic to be against the rails and stand in place without the use of forms. The plastering shall extend from the top of the concrete base to the bottom side of the top of the rail and shall fill the space from the web of the rail to a vertical plane at the outside edges of the top of the rail.

If rail plastering is not done immediately preceding the laying of the pavement surfacing adjoining the rails on either side, it must be wet sand cured for seven (7) days, or until adjacent pavement is placed, and any plaster that falls out of place must be replaced with new material at the Contractor's expense.

GENERAL SPECIFICATIONS FOR REPAVING

General Requirements

550. When repaving with any type of pavement surfacing, such pavement surfacing shall conform to the requirements governing the respective types, except as otherwise provided herein, or in Supplementary Specifications or stipulated on Contract Plans.

Removal and Disposal of Old Paving Materials etc.

Where required for the execution of work under this contract and unless otherwise specifically provided on the Contract Plans, or in Supplemental Specifications the Contractor shall remove the old pavement including the surfacing material, cushion and base, and excavate to the required subgrade and remove the old curb, broken stone and curb drains and foundation of same, old catch basins and inlets and shall dispose of such materials not required to be relaid, at his own expense at such places as he may provide, with the exception that the old paving materials when so designated shall remain the property of the City. Old manhole and catch basin castings not required to be reset shall be turned over to the Bureau of Highways and Sewers.

Old Paving Material Delivered to City Yards

550. (cont'd) When unit prices are requested to be bid for old paving materials delivered to City yards, old paving materials required to be lifted and not required to be relaid shall be loaded, hauled and delivered to the City yard or yards designated, or to other yards as determined, at approximately the same hauling distance. Such material must be neatly piled and not scattered over the yards. When specified on the Contract Plans that such materials shall be stacked, the blocks first delivered shall be stacked in 3 rows along 3 sides to the lengths determined by the Director. The Paving Blocks shall be stacked to a height of 6 ft. and the enclosure then piled with Paving Blocks to the top of the stacked block. Additional Paving Blocks delivered shall be stacked and piled in a similar manner. When old paving materials are not required to be delivered to City yards, the cost of the removal and disposal thereof shall be included in payment made at contract unit prices for the item of "Pavement Surfacing" of the respective types.

Old Pavement Surfacing Delivered from City Yards

Where an approximate quantity of old pavement surfacing required to be delivered from City yards is given on the Contract Plans, or Supplemental Specifications, the Contractor shall load, haul and deliver such old pavement surfacing to the site of the work and shall store same along the line of work at such place, or places as the Director shall approve, which are most convenient to the location shown on the Contract Plans where such old pavement surfacing is required to be laid. Compensation for all of which shall be included in the payment made at the unit price bid per M. Old Block Stone, or Paving Brick, for the actual quantity hauled or delivered in conformity with orders given by the Director in the field.

Old Sewer Castings Delivered to City Yard

All castings for existing manholes, catch basins, or storm inlets that are not required to be reset shall be loaded and delivered to the City Yard assigned to the Division of the Bureau of Highways and Sewers in which this contract is located. Where a particular yard is designated on the Contract Plans, the castings shall be delivered thereto.

Compensation for all the foregoing shall be included in the payment made at the contract unit price each for Old Castings for Manholes and Catch Basins delivered to City Yard.

Paving Materials to be Relaid

Where paving materials are to be relaid, the same shall be removed and culled by the Contractor in the presence of an Inspector. The satisfactory material shall be neatly piled along the line of work in the locations and in the manner ordered by the Director, while the rejected materials shall be disposed of as above provided. Old brick shall be thoroughly cleaned before being relaid.

Definite Areas for Old, Reclipped and New Blockstone

Where Reclipped Blockstone, and/or Old Blockstone are required to be laid under contracts in which New Blockstone is required to be laid for a portion of the area of the new roadway, definite areas will be shown on the Contract Plans for which the foregoing classes shall be laid, and no deviation therefrom shall be made unless written permission so to do has been given by the Director.

Assistant Engineers and Inspectors shall keep a permanent record in their field books showing the areas in which the different classes of stone shall be laid as designated on the Contract Plans, together with any variations thereof for which permission is given by the Director, and date of authorization for such change.

Grading

All Excavation and embankment required for the preparation of the subgrade for new pavement shall be done in accordance with the requirements of the specifications for Grading. Compensation for such grading and for all excavation for curbs, curb and broken stone drains, and for new catch basins, and for disposal of surplus excavation account thereof shall be included in payment made at the contract unit price for Repaving with the respective types of pavement surfacing, or of Old Pavement Surfacing Relaid. Where excavation is required to be done between existing surface of roadway pavements and side-walks and the finished surface of the new roadway and sidewalks, and where other grading is stipulated on the Contract Plans or ordered by the Director, payment therefor shall be made at the unit contract prices for Grading, Borrow and Spoil in conformity with the specifications governing measurement and payment therefor; however, where payment is made under these items, no payment will be made for Spoil account disposal of excavated materials made necessary by other items of work.

Where existing catch basins are to be abandoned, the Contractor shall tear out the old brick work for a depth of at least four feet below the curb grade, bulkhead the pipe connection and fill the hole with suitable filling material, the cost of which shall be included in the price bid per square yard for Repaving.

Additional Excavation - Below Finished Subgrade of Roadway.	Compensation for excavation required to be done below finished subgrade shown on the contract plans for broken stone sub-base, increased thickness of concrete paving base and concrete reinforcement over trenches, shall be included in payment made in conformity with the requirements of Section Nos. 405 and 420.
Storage of Materials	During the progress of the work, the Contractor will be permitted to store paving materials along the line of work in such place or places as the Director shall approve. In all cases fire hydrants and gate boxes of water lines shall be kept accessible and free passage for surface water shall be maintained in the gutters of all streets upon which work is in progress.
Cross Sections	The surface of the completed pavement shall conform to the cross sections for that type or class of pavement as shown in the "Standards for Construction," except where the same may be modified or otherwise required upon the Contract Plans or ordered in the field by the Director.

551. SHEET ASPHALT RESURFACING.

Under this item the Contractor shall remove and dispose of all existing bituminous surfacing and lay new sheet Asphalt Bituminous Surfacing Type "SA", in accordance with the Standard specifications therefor on the old concrete base unless otherwise stipulated on Contract Plans or in Supplemental Specifications.

Thickness of Binder Course

The thickness of the binder and wearing surface courses to be laid under this Item shall conform to the requirements of the Specifications for Sheet Asphalt Surfacing, unless otherwise shown on the Contract Plans. Where a greater depth of binder is required to be laid than stipulated in the above mentioned Specifications or shown on the Contract Plans, the same shall be furnished and laid by the Contractor and the extra quantity so required shall be paid for at the price bid per ton for "Extra Binder in Bituminous Surfacing," but no payment for extra binder shall be made except when the depth of the binder is more than one half (1/2") inch greater than that required in the above mentioned Specifications or shown on the Contract Plans.

Maintenance

Where failure of Surfacing is caused by weakness of old Base the Contractor shall not be required to maintain the pavement laid under this Item subsequent to the payment of the final estimate.

552. TREES.

Trimming and Protecting Trees.

Wherever Contractor's Equipment, such as ditching machines, power shovels, mixers, finishing machines, etc., interfere with the trees along the improvement, the Contractor shall protect and preserve the trees wherever possible. Trimming shall be done only where ordered by the Director and in a manner approved by the Director.

Trees shall be trimmed as sparingly as possible, and cuts shall be made with a saw, finished smooth and sloped in such a manner that water will not be retained on the cut, and all cuts must be painted with paint to be approved by the Director. Trunks and large limbs shall be protected from injury by Contractor's equipment with timber staves wired to the trunk or limbs in a proper manner.

Removal of Trees

No trees shall be removed except where specifically noted on the Contract Plans, or ordered by the Director in the Field. Where it is necessary to remove trees, the trunk and large roots shall be removed to a depth of four feet below the curb grade.

Trees left in place

Valuable trees on private property within the area of the slopes required for the improvement shall be protected and left in place, if the property owner will maintain same in a manner satisfactory to the Director.

Compensation

Compensation for trimming, protection and removal of trees shall be included in the prices bid for other items of work in the contract, unless otherwise provided for.

CORE DRILLED TEST BORINGS

General

553. The Contractor shall furnish all labor, tools, materials, equipment, and other facilities for core drilling test borings in the locations and to the depths required by the Director. The contractor shall procure samples of the over-burden and strata encountered, and shall record any crevices or other pertinent information obtainable.

Drilling Equipment

The work shall be done with power driven diamond drilling machines which will produce a core of not less than 2-1/4" in diameter. The contractor shall provide sufficient diamond drilling outfits in good working order ready to commence work within time specified, and to complete same within the time specified.

Reference Stakes

The Director will set stakes flush with the ground within three feet of which borings will be drilled, or other reference points shall be given. Depth of borings shall be measured to the tops of the respective stakes or reference points, and other data in the log of the borings shall be referred to such stakes. A careful log of the drilling of each boring shall be kept by the contractor, with special reference to the occurrence and magnitude of the crevices or other openings encountered in drilling, the loss of water, difficulties in drilling and their possible cause, and similar data.

Log of Borings

The log of each boring shall be plotted with black waterproof ink or tracing cloth to a suitable scale, and in proper sequence. The tracing or tracings to be of standard City Size, with proper title, and signed by the Contractor, and delivered to the Director for a permanent record.

Preservation of Cores

For the preservation of cores the contractor shall furnish wooden boxes made of planed boards securely fastened together. The cores shall be carefully placed in such boxes in the order which they occupy in the ground, and the depth of occurrences of strata shall be marked on the boxes at the proper points with waterproof paint. These boxes shall also contain speciments of over-burden, the over-burden to be contained in half-pint glass jars securely capped and properly labeled. All such boxes and their contents shall be furnished to the Bureau of Engineering as a part of the provisions of this contract and delivered to the Superintendent, Bureau of Tests.

Samples of Over-Burden

Drive pipes shall be driven through material overlying bed rock, and the material encountered shall be obtained by driving the pipe dry. No washing or chopping of the material will be permitted. The drive pipes shall be not less than 3" nominal diameter and made with flush joints in such manner that no collars or couplings will disturb the formation drilled. Where drive pipes cannot be driven to bed rock successfully without washing, the location of the boring shall be shifted and the pipe again driven.

However, other methods for taking dry samples of material overlying bed rock that will operate by taking drilled cores through undisturbed material prior to sinking of drive pipes will be permitted, provided the method meets with the approval of the Director. Cores shall be taken at approximately five foot intervals.

Drilling in Bed Rocks

Drilling in bed rock shall be done with double tube core barrels of a design approved by the Director, and the drills shall be operated at such speed and pressure as will permit of procuring the best cores possible consistent with material encountered. The cores shall be not less than 2-1/4" in diameter. The drill runners must be men experienced in using the double tube core drills and in coring soft formation.

Depth of Borings

The quantity and location of test borings shown on the contract plan are approximate.

Borings for sewer locations shall extend five (5) feet below the invert of the proposed sewer unless otherwise stipulated.

The Contractor shall drill all borings in the location and to the depths indicated on Contract Plans, or in Supplemental Specifications, or as ordered by the Director.

FORM NO. 106A

CONCRETE WALLS

Types of Construction Included

554. Concrete Retaining Walls, Abutments, Walls for Steps, Concrete Piers, Curtain Walls, Cross Walls, and similar high vertical structures shall be constructed in conformity with all the requirements of Sections 461 to 512 inclusive, in so far as same apply, with special reference to the requirements governing the Class of Concrete and Method of Curing, and with the following particular requirements:

General Requirements

Dimensions Approximate

The dimension of the walls, and of the footings and foundations of the same, as given on the contract plans, are approximate only and will be finally determined in the field by the Director depending upon the nature of the foundation and character of the materials encountered in the excavation.

Increases and Decreases in Dimensions, etc.

When the depth, width, height or length of the walls, as shown on the Contract Plans, are increased or decreased by order of the Director in the field, the Contractor shall receive payment only for the quantity of concrete actually placed by order of the Director without any other compensation per cubic yard by reason of or on account of the said change or additions. However, the quantity of concrete measured for such payment shall be exclusive of any quantity involved in increased dimensions for footings, piers, and other foundations for such walls, payment for which shall be made as provided in the following section:

Increases and Decreases in Dimensions of Footings, Piers and Other Foundations for Walls

When the depth, width, height, and length of footings, piers or other foundations of walls, as shown on the Contract Plans are decreased by order of the Director in the field, the Contractor shall receive payment only for the quantity of concrete actually placed by such order, without any other compensation per cubic yard by reason of, or on account of said change.

When such dimensions are increased by order of the Director in the field, the quantity of concrete involved by an increase of any of the dimensions shall be measured for payment at the unit price bid per cubic yard for Additional Concrete in Footings and Piers for Walls.

Miscellaneous Steel Reinforcement

Where steel dowel bars and miscellaneous reinforcing steel is required upon the Contract Plans, or ordered by the Director in the field for walls included in this group, or other walls designated on the plans, payment at the unit price bid per pound of Steel Reinforcement shall be full compensation for all labor and materials required to place the Reinforcing Steel in Concrete.

Joining to Old Work

Where the wall or walls to be constructed under this group adjoin or connect into existing stone or concrete walls, the price bid per cubic yard for respective types of concrete construction shall include making the connection therewith in a neat, workmanlike manner, and the Contractor shall remove the existing masonry to the extent ordered by the Director; without compensation other than payment per cubic yard for the quantity of new concrete placed in conformance with the orders of the Director and as shown on the Contract Plan.

Expansion Joints

Walls and similar structures shall be provided with expansion joints where shown on the Contract Plans and at such other places as ordered by the Director in the field. These joints shall be keyed joints filled to the full width and depth thereof with 1/2 inch cork board expansion joint material conforming to the requirements of Section 179. After a section of walls, or similar structure, has been poured the Contractor shall place the cork board against the end and conforming to the shape thereof; and before any concrete is poured in adjoining section, the exposed face of the cork board shall be covered with a layer of two-ply tar paper for the full area thereof. A layer of two-ply tar paper 12 inches wide shall also be placed on the back face of the structure across each expansion joint for the full height thereof.

Full compensation for expansion joints, including all labor and material shall be included in the contract unit price bid per cubic yard for the type of wall or structure affected.

At all vertical expansion joints a recessed "V" joint one inch deep shall be provided on the exposed face of the concrete.

Broken Stone Backing

Broken Stone Drains 9 inches in thickness shall be placed behind all walls against which backfilling is required to be placed. Such drains shall extend from a point 1 foot below the finished surface behind the walls to the top of clay puddle unless otherwise shown on the contract plans. Broken Stone therefor shall range in size from 3 inches to 9 inches in their largest dimension, at least 50% of which shall be not over 5 inches in the largest dimension.

Weep Holes

Six (6) inch Terra Cotta pipe weep holes shall be placed transversely through all walls where broken stone backing is required, and on other walls where stipulated on the Contract Plans. Unless otherwise stipulated on the Contract Plans these weep holes shall be spaced 10 ft. apart, and each shall be backed up with 1/3 cu. yard of broken stone.

Drains Behind Walls

When stipulated on the Contract Plans the Contractor shall furnish and place a longitudinal pipe drain behind walls of the dimensions and in the location shown. This pipe shall conform to the specifications for Clay and Concrete Drain Tile in Section 172 and shall be thoroughly bedded in clay so that it will readily collect and carry off the drainage, the portion of its joints extending above the clay imbedment shall be covered with a layer of burlap or tar paper. Drains behind walls shall be constructed with a minimum slope of 3/8" per foot.

Walls Poured Monolithic to bottom of Coping

Where any horizontal construction joints are not shown on the contract plans at the top of footings for walls required to be constructed under this group the entire wall below the bottom of copings including footings shall be poured in one continuous operation unless permission is given in writing by the Director to pour same in horizontal sections, and in which case the Contractor shall at his own expense provide dowel bars and other reinforcing steel required by the Director.

Copings

The pouring of all walls shall stop at the bottom of coping where an approved construction joint shall be provided. Copings shall not be poured until 24 hours after the section of wall below the coping has been in place. The alignment and elevation of Coping forms must be checked after the wall is poured and before the Coping is poured.

Steel Reinforcement

Steel Reinforcement of the kinds, lengths, shapes and dimensions required upon the Contract Plans shall be furnished and placed in conformance with the Specifications for Steel Reinforcement in Section 538 and payment therefor shall be made as provided under that Item.

SECTION 555 VACANT.

FORM NO. 106A

CONCRETE PAVING BASE

General Requirements

556. Concrete for paving base shall conform to all of the requirements of Sections 461 to 512 inclusive, insofar as same are applicable, and the following particular requirements:

Finish Inspection Openings

The upper surface of the concrete shall be screeded to give a smooth and uniform finish which shall be parallel to the required cross section of the finished pavement and shall have no variation therefrom exceeding 1/4 of an inch in the length of a 10 ft. straight edge.

Concrete Bases to be covered with a vitrified brick surfacing on a Mastic Bed must have all base above the required plane ground off. The bases shall be screeded with a suitably designed and effective template with a steel cutting edge, and adequately braced and trussed. The screed must be approved by the Director before it is used.

Special care must be taken at catch basins, inlets and intersections to obtain the proper elevation of the base.

Catch Basin Sumps

The contractor shall construct a wooden form to block out an area 2.5' in width from the face of the curb and 10.0' in length along the curb at all catch basins and inlets when constructing concrete paving base. This form shall be located as ordered by the Director to provide for the construction of the sump in front of the catch basins or inlets after the general roadway pavement base is completed. The above form shall be set with the top at the finished elevation of the concrete base and shall have a beveled strip along the middle of the form on the roadway sides to provide a key for anchoring the inlay. The key strip shall be 2-1/2" wide at the face of the form and shall be not less than 1-1/4" in depth. After the general base slab is sufficiently hardened to permit the removal of forms, the sump shall be constructed and hand finished to the proper shape as ordered by the Director.

Preparation for Placing Concrete Base

Before any concrete is placed for concrete roadway base, all materials entering into the base and becoming a part of the permanent structure must be approved by the Director, together with the source of supply. Before any concrete is placed for concrete roadway base, all the following equipment must be on the site ready for use and in good working order and approved by the Director:

Concrete Mixer, when required
Screed for finishing course
Sub-grade tester
Trowels, edging tools, lutes, 10 foot
Straight edges, hand belt, and other necessary tools when required
Approved curing agent

Except in the Railway's Area, transverse construction joints shall be provided in all concrete pavement bases not more than 30 ft. apart; and over all transverse construction joints in concrete bases, the Contractor shall provide asphalt saturated burlap strips 3 in. wide, in accordance with the requirements of A.S.T.M. Specification No. D-174-25. Before the asphalt strips are placed, the concrete along the joints shall be thoroughly cleaned and given a heavy bituminous coating 3 inches wide, which will securely bond the asphalt strips to the concrete base. Compensation for the asphalt strips shall be included in payment made for concrete base.

556. (Cont'd.) Transverse joints shall be formed at right angles to the center line and perpendicular to the surface of the base.

Longitudinal joints with or without joint plates and dowels shall be constructed in accordance with the Standard Plans unless otherwise stipulated on Contract Plans or in Supplemental Specifications.

Attention is directed to Section 572 covering Inlays at Manholes, etc., and Section 571 covering Test Cores in Concrete Pavement or Base; Section 570 covering Deficient Depth of Base, and Section 573 covering Misplaced Reinforcement.

Where steel reinforcement is to be placed in concrete paving base the same shall conform to the requirements of Sections 144 to 146 inclusive insofar as they are applicable. The reinforcement shall be placed as shown on the Contract Plans or as required by the Supplemental Specifications or ordered by the Director.

Payment for such reinforcement shall be made under the item of Steel Reinforcement.

557. BITUMINOUS SURFACING - CONSTRUCTION

GENERAL

When Bituminous Surfacing of any type is stipulated on the Contract Plans or in Supplemental Specifications, the materials and mixture shall conform to the specifications for the type designated and the surfacing shall be placed in accordance with the following specifications, unless otherwise stipulated in Supplemental Specifications or ordered by the Director.

THICKNESS OF SURFACING

When Sheet Asphalt Surfacing of any type is specified for new streets or for Repaving Streets other than patch work, it shall be constructed in two courses consisting of a Binder Course 1-1/2 inches in thickness after compression, and a Wearing Surface 1-1/2 inches in thickness after compression. The thickness of other Bituminous Surfacings shall be stipulated on the Contract Plans or in Supplemental Specifications. Not more than 2-1/2 inch thickness of bituminous surfacing shall be placed in one course.

REPAIR WORK

Where Bituminous Surfacing of different types and variable depths are necessary to be laid in conjunction with City improvements to match existing bituminous surfacings, the Contractor shall construct such surfacing with type "SA" hot mix, or type "JCI" cold mix, or "JC-2" cold mix and use the mixture and size and kind of aggregate that will best match each adjoining type of bituminous surfacing. Bituminous Surfacing placed in such manner shall be paid for by weight and shall be computed on the weight indicated by check weight slips furnished in the following manner.

Bituminous Surfacing shall be weighed and weight slips signed by a weighmaster, or City Inspector at the plant where weighed, indicating the net weight of bituminous surfacing material delivered ineach load, which must be given at the point of delivery to the representative of the Director designated to receive such slips. The method of weighing and the scales used for weighing shall be subject to the approval and test by the Director. In the event of disapproval of scales or of weights indicated on weighmasters slips, no further material shall be weighed on such scales until notified in writing by the Director so to do.

COURSES

Where Binder Course, Bottom Course or Base Course are referred to they are one and the same.

Where Top Course, Wearing Surface or Surface Course are referred to they are one and the same.

WEATHER CONDITIONS

Bituminous Surfacing shall not be placed when the temperature is below 45 degrees F. nor when it is raining, nor when the concrete base or bottom course is wet or damp, nor when any condition exists that is detrimental to surfacing.

PREPARATION OF BASE

Prior to the arrival of the surface mixture, the base shall be thoroughly cleaned of all dirt and foreign matter. Contact surfaces of curbs, gutters, castings, rails and other structures shall be painted with a thin uniform coating of asphalt cement. Asphalt cement placed on curbs above the top of surfacing must be removed.

DELIVERY OF MATERIAL

Bituminous Surfacing material shall be hauled to the site of work in tight vehicles, previously cleaned of all foreign materials, and covered with an approved waterproof cover of sufficient size to protect the entire load. Placing and rolling bituminous pavement will not be permitted after darkness and the dispatching of vehicles shall be arranged so all material delivered shall be placed and rolled in daylight. Hot mixtures shall be delivered to the site at a sufficiently high temperature to insure its proper compaction before cooling. The temperature shall be not less than 225 degrees F. for the binder course and not less than 325 degrees F. for top course.

MECHANICAL SPREADING AND SCREEDING MACHINES

If the Contractor so elects he may use mechanical spreading and screeding equipment with suitable side forms approved by the Director in accordance with the following specifications.

If permanent side supports such as curbs, headers, or gutters are not in place, approved steel or wood side forms of suitable depth shall be placed and rigidly supported so as to carry and positively control the elevation of the screed to insure the placing of the paving mixture to the correct elevation and cross-section given.

Upon arrival at the work the mixture shall be spread and struck off between the side supports. It shall be handled by mechanical spreading and finishing equipment, either a combination machine or in multiple units, to distribute it into place either for the entire width or for such partial width lanes as may be practicable and to strike it off to the given cross-section. The screed assembly shall be adjustable to give the cross-section required and shall be so designed and operated in connection with the side form or forms hereinbefore specified as to provide a binder course of the required thickness.

All spreading and finishing machines shall have a floating screed assembly arranged to ride directly upon the side forms or to be controlled as to elevation of strike-off directly by the forms, and shall be self-powered and propelled. Blade graders or drags shall not be used. Equipment which leaves tracks or indented areas which are not corrected by the scheduled operations, or produce other permanent blemishes, will not be approved.

The term "screed" includes any cutting, crowding or other practical action which is effective on the mixture at the workability specified and obtainable, without tearing, shoving or gauging, and which produces a finished surface of all the evenness and texture specified.

Small irregular areas, where the use of mechanical spreading and screeding machines is not practicable, may be spread and screeded by hand. If hand methods are used, the mixture shall be deposited on the base outside the area on which it is to be spread or placed on movable platforms and distributed by suitable means in a loose layer to provide a course of the thickness desired using measuring blocks or strips to assist in obtaining satisfactory distribution.

HAND SPREADING AND SCREEDING

Bituminous surfacing courses to be spread and placed by hand, shall be constructed in the following manner. Upon arrival at the work the material shall be deposited in small piles on the clean base or bottom course, or on movable platforms, from which all material shall be distributed to the place where it is to be laid. The temperature of hot mixtures at this time shall be not less than 225 degrees F. for binder course and not less than 325 degrees F. for Top Course.

If permanent side supports such as curbs, headers, gutters, rails, etc., are not in position to be used as guides for screeds, approved steel or wood side forms of proper depth shall be placed and rigidly supported so as to carry and positively control the elevation of the screed to insure placing of the paving mixture to the correct elevation and cross section.

FORM NO. 106A.

WELDING STRUCTURAL STEEL

General

606. All welding shall be done by the electric arc oxy-acetylene, or oxy-hydric process, but unless otherwise specified on Contract Plans or in Supplemental Specifications, it shall be done by the electric arc process in accordance with the Standard Specifications for Arc Welding Metal Bridge Structures adopted by the American Association of State Highway Officials, dated 1935, with all subsequent additions and amendments thereto, except as otherwise stipulated herein.

Equipment

Plant. The power plant shall be equipped with suitable control for adjusting current and voltage output. They shall deliver a constant current at the required voltage for each setting of the control. This equipment shall be fitted with an accurately adjusted voltimeter and an ammeter.

Protectors. Suitable helmets, hand shields, glasses, gloves, aprons, screens and other equipment necessary for the protection of welders, helpers and inspectors shall be provided.

Assembling Devices. Preparatory for welding, the assembled elements of members shall be held rigidly in position by the use of hand or power operated vices, clamps, bulldozers or other devices adapted to the purpose and capable of exerting pressures requisite to remove local distortions; compress the parts into intimate contact, and prevent excessive deformation during welding. The joints resulting from the assembling of members, if designed to secure close contact of their parts, shall be adjusted and held to correct positions by assembling devices.

Electrodes

Metallic Electrodes. The metal of electrodes shall be mild carbon steel or an alloy thereof made by the open-hearth, electric-furnace or crucible process. Its chemical composition and physical properties shall be adapted to the structure metal and the thicknesses of the parts to be welded in order to insure effective penetration and an intimate uniform blending or coalescence of the weld and structure metals.

The electrode wire or core shall be smooth-finished; homogeneous in physical structure; free from pipe, laps, or other harmful defects, and its surface shall be free from injurious scale, rust, grease or other foreign matter. The diameter of electrode cores shall range from one-eighth inch to one-fourth inch; the size used being adapted to the position of welding and other conditions attending the formation of the welds, in order to secure satisfactory results. The diameter shall vary not more than three-thousandths inch from that specified. The length of the electrodes shall not vary more than one-fourth inch from the nominal length.

A fluxing material shall be provided, either in the form of a covering on the wire or as a separate autogenizer fed into the arc stream at a uniform rate controlled by an automatic device, in order to protect the arc stream, the deposited metal and the adjacent structure metal from contamination from the atmosphere and other sources. Coatings shall be concentric with the wire; of uniform composition, and shall withstand moisture and the handling or other service involved in ordinary shop and field operations without becoming injuriously abraded, chipped or torn.

Electrodes (Cont'd.)

To permit adjustment of covered electrodes in the electrode holder, the wire or core shall be free of covering material a length of three-quarters to one and one-eighth inches on one end, while the opposite or arc striking end shall protrude a length not to exceed three-sixteenths inch from the covering, but sufficient to permit satisfactory operation.

Electrodes shall function satisfactorily in producing welds in one or more of the positions, flat, vertical, and overhead, as may be required in the work to be accomplished. They shall not produce in the welding operation fumes or gases, poisonous or otherwise injurious to the health of the operators, inspectors and workmen.

Bare wire electrodes or newly developed electrods products possessing merit demonstrated by satisfactory tests involving the structure materials proposed or supplied for the given project may be used only when approved by the engineer.

Physical properties of deposited metal. The quality of the deposited metal shall be such that it will conform to the following minimum requirements when formed in test welds by a competent welder:

Tensile strength, pounds per square inch--minimum specified for the structure metal.
Yield point, pounds per square inch--75 per cent of the developed tensile strength.
Elongation in 2 inches--20 per cent.

Physical properties of welded joints. The minimum welded joint requirements shall be as follows:

Tensile strength--minimum specified for structure metal.
Free bend test--25 per cent elongation.
Free bend and nick-break tests as provided herein under "Test Speciments and Procedures."

When immersed in a 50 per cent solution of hydrochloric acid for a period of 72 hours the weld metal shall show no more corrosion than the accepted structure metal under the same conditions.

Physical properties shall be determined from results secured from test specimens.

Electrodes supplied under these specifications shall be identified by the following:

(a) The manufacturer's name, and number or symbol for identifying date of processing the electrodes.
(b) Trade name, purpose for which the electrodes are intended, and recommended instructions for use.
(c) Size of electrode wire or core.
(d) Net weight of electrodes, including weight of flux covering.

Operators

Operators shall be properly trained in arc welding, experienced in welding structures and capable of producing uniformly reliable fillet and butt welds in flat, vertical and, overhand positions. Operators shall be required to weld, in the presence of an inspector, test specimens involving fillet and butt welds having the detail dimensions herein shown for operators specimens. These welds, when broken, shall indicate the perfection of fusion and coalescence of structure and weld metals specified for the welds in structures. The proved ability of an operator to produce satisfactory welds with flux-coated electrodes shall not be accepted as indicating ability to weld with bare electrodes, and vice versa.

Operators (Cont'd.)

The Director reserves the right to reject any operator whether the test specimens prove satisfactory or not; and any operator once approved may be removed from the work at any subsequent time when the Director feels that satisfactory welding is not being done. The Director may also require that additional test specimens be made at any time during the progress of the work.

Test Specimens

General. The tests to be made and, correspondingly, the specimens to be prepared shall be of two general classes, viz:

A. Tests to determine the strength, ductility and other physical properties of welds, and the adaptability of weld and structure metals to the production of reliable welds.

B. Tests to determine the qualifications of welding operators for the work to be performed upon a given fabrication or erection project.

Test specimens to determine the strength, ductility and other physical properties of welds, including the adaptability of weld and structure metals to the production of reliable welds, shall be representative of the materials proposed or supplied for the given project. The welding equipment and details of welding procedure, including the type and size of electrodes and the position or positions involved in making the welds, shall be, in so far as practicable, the same as used or to be used upon the given project.

Specimens intended to evidence the ability of welders and determine their qualifications for the work to be performed upon a given fabrication or erection project, shall include the same or almost identical materials, equipment and working conditions as will be embodied in actual construction operations, thereby eliminating or reducing to a minimum the conditions likely to produce adverse results. With the object of determining the qualities of the welds produced, they shall be so planned as to render their destruction a practicable operation providing evidence of the conditions of penetration, coalescence of the metals, weld structure and other factors affecting the service strengths and reliability of the welds.

Weld Metal Test. The test specimens used for determination of the physical properties of deposited weld metal shall be the Standard 2-Inch Gage Length Tension Test Specimen adopted by the A. S. T. M. for rolled steel and castings. The shank or parallel section portion of each specimen shall consist entirely of weld metal deposited between two plates at an adequate distance from their original surfaces to preclude the effects of coalescence of the metals within the fusion zone. The plates shall be, preferably, representative of the metal to be used in the contemplated structure and indentical in composition with that used or to be used in the preparation of welded joint test specimens. The details of the deposited weld metal specimen and of the test specimens secured therefrom are shown in Figure 1, of the above mentioned Specifications.

In the formation of the deposit each layer shall be permitted to cool sufficiently to permit the removal of slag before a succeeding layer is deposited, and consolidation of the weld metal by hammering shall not be permitted except only that the weld may be struck lightly with a roughing tool to break and remove the slag adhering to its surface. Neither the completed weld metal deposit nor the specimen cut therefrom shall be annealed or otherwise heat treated.

Test Specimens (Cont'd.)

Tension Joint Test. In the formation of tensile specimens of butt welds the procedure shall be the same as described for weld metal specimens, except that when this type of specimen is used as an operator's specimen, the operator shall, in general, be permitted to use the procedure he would adopt for actual working conditions with the welding position or positions required or specified. The details of single and double "V" welded specimens and the tensile test specimens secured therefrom are shown in Figure 2, of the above mentioned Specifications.

The plates used may be of sufficient length to produce the total number of tensile, free-bend and nick-break test specimens required. They shall be so adjusted and supported that when completely welded the deformation from a continuous plane surface will not attain a batter in excess of one-half inch in one foot. The welded specimens shall be divided into test specimen blanks by flame cutting or other practicable means, care being taken not to produce heat-treatment conditions affecting the weld metal portion of the test specimens. Specimen blanks found to be warped or bent shall be straightened cold by the application of pressure rather than by hammer blows or other means involving impact action.

The weld metal surfaces shall be slightly convexed to insure satisfactory metal within the test specimen but this convexity shall not exceed one-sixteenth inch. When the single "V" type of weld is involved it shall be consolidated upon its beginning of weld side by the depositing of weld metal to secure the required convexity. In the machining of test specimens the excess metal shall be removed and the surface finished flush with the plate. The tool marks resulting from this operation shall be parallel to the lengthwise dimension.

Free Bend Test. The specimen blanks for this test are the same as specified for tension joint specimens, except that only the double "V"weld type shall be used. The details of the test specimen are shown in Figure 3, of the above mentioned Specifications.

The finished test specimen may be given an initial deformation by fixing it in a blacksmith's vise or other adaptable holding equipment permitting the specimens to be bent at locations adjacent to but not within its weld portion. Whether bent by the application of hammer blows or other means, the operation shall not subject the weld to more than light impact and shock stresses.

Prior to or after being initially deformed, preferably the latter, a gauge length shall be fixed within the body of the weld and in the center line of the side surface to be made the convex portion of the bend. This length shall be clearly defined by very small punch marks. The specimen, after preparation as described, shall be placed in a compression machine or other device adapted to the application of uniform even pressure upon its ends without impact or shock to produce bending within the weld. Bending shall be continued until a minute initial crack is produced in the convex surface within the body area of the weld rather than at the arrises. Development of an initial crack shall be considered failure and the flexing of the specimen shall be immediately discontinued.

The elongation of the weld metal shall be determined by measurement of the final gauge length, the width of the failure crack being given consideration only when it traverses the gauge length line. Accuracy in this measurement shall be considered especially important and a flexible scale or other reliable means shall be used in its determination. The elongation shall be recorded in per cent.

Nick-Break Test. The specimen blanks for this test shall be the same as specified for tension joint specimens, with the exceptions that only the double "V" type weld shall be used and that the metal producing the slightly convexed shape of weld surfaces shall not be removed. The details of the test specimen and the arrangement of the supports for testing are shown in Figure 4, of the above mentioned

Test Specimens (Cont'd)

The finished test specimen shall be placed upon supports as specified and broken by the application of a power hammer or a ing weight blow applied concentrically upon the transverse section of the weld and having sufficient intensity to produce sudden failure of the specimen by a break through the nicked portion. The fractured surfaces of the broken specimen will show the internal structure of the weld metal deposit and the condition of fusion and coalescence of the structure and weld metals.

Nick-Bend Test. The specimen blanks for this test shall be the same as specified for tension joint specimens, with the exception that the metal plate may be of any thickness from three-eights to one-half inch. The details of the test specimen ar shown in Figure 5, of the above mentioned Specifications.

The finished test specimen varies from that used in the tension joint test only in that the removal of the metal involved in producing the slightly convexed shape of weld surfaces need not produce smooth finished surfaces, nor is it necessary that the tool mark be parallel to the lengthwise dimension. After the excess metal has been removed, a narrow groove-like nick or slot having a depth one-sixteenth inch shall be produced at the center of the weld and on one side only by hack-sawing, filing or otherwise machining to produce a clean-cut incision.

The finished test specimen shall be given a slight initial bend by lightly hammering to produce a convex surface on the side containing the incision. The specimen so bent shall then be subjected to a compressive force by being placed in a compression machine or other device adaptable to exerting a slow, even pressure adequate to collapse the specimen without impact or shock.

This test shall be considered supplementary to the tension joint test and intended to discover brittleness from any cause. The fractured portion of the tested specimen, combined with the constriction, if any exists, at the ends of the nick and extending slightly below it will indicate the ductility of the metal. A corresponding enlargement within the interior portion or compression zone of the bend may result from the ductility of the structure metal rather than that of the weld.

Testing. The physical properties of deposited electrode metal and of welded joints shall, unless otherwise provided, be determined from results secured from the testing of specimens in conformity with the requirements of Specifications T-68 of the American Association of State Highway Officials "Standard Methods of Testing Metallic Materials," 1935 (A. S. T. M. Designation E8-33).

The yield point shall be determined by the drop of the beam or the halt in the gauge of the machine.

Number of Specimens. The number of specimens involved in any given test shall be three, unless otherwise provided.

In tests intended to determine the quality and acceptability of electrode metal, three tension specimens for each welding position and for each size of electrode shall be made for each 4,000 pounds of electrodes, including their flux covering. However, when less weights are supplies the same number of specimens shall be made.

When a tension test specimen shows defective machining or develops flaws attributable to the machining operation it may be discarded and another specimen substituted.

Test Specimens (Cont'd).

When the percentage of elongation of one of the tension test specimens is less than that specified and any part of the fracture is more than three-quarters inch from the center of the gauge length, as indicated by scribe scratches marked upon the specimen before testing, two additional specimens shall be made and tested and, if both these specimens prove satisfactory, the material shall be considered acceptable.

Appearance of Fracture Surfaces. The fracture surfaces produced by breaking test specimens without appreciable time being permitted for deformation of the metal shall show uniformly bright, even texture, free from occluded slag or other foreign material, and any porosity indicated by holes in the surfaces as resulting from occluded gas shall be uniformly distributed and very limited. Quality and soundness of the weld metal are indicated by texture, color and other appearances of the fractured surface.

Workmanship

General. The conditions attending the shop fabrication and field erection of a structure shall produce welds having the dimensions, rigidity, strength and other physical properties, contemplated in the structure design and detail plans.

Formation of Welds. In the making of welds the electric current shall be adjusted to secure, with the electrode used, fusion of the surface metal of the structure parts (structure metal) and its coalescence with the metal of the arc (weld metal) to produce a uniform, even deposition of the latter, free from pits, porosity, and inclusions of slag and clinker. Welds shall cool slowly and shall show neither discoloration indicating burned metal nor undercutting, unfused edges, overlaps or other manipulation defects. Defective welds or portions of welds shall be removed and satisfactorily replaced.

The length of arc shall be regulated to prevent splashing of molten metal, provide an even flow of metal across the arc with least possible opportunity for its oxidation. In general, its length will depend upon the diameter and type of electrode used and the thickness or other chill-producing conditions of the structure metal.

Whenever the bending of an electrode to facilitate accessibility to the location of a weld or to adapt it to a welding position results in cracking, scaling, or other injury considered detrimental to its serviceability, the portion so damaged shall be discarded.

Welds having a maximum dimension greater than five-sixteenths inch shall be, in general, of multi-layer construction, the layers being deposited by parallel overlapping runs by "weaving," "lacing," or other manipulation tending to produce advantageous soundness, strength, ductility and annealing effects. When the conditions render multi-layer construction impracticable, the finished welds, when authorized by the engineer, shall be peened, after having all slag or other adhering foreign matter removed from their surfaces.

Upon the completion of each run, including the final one, the surfaces of the weld shall be wire brushed or otherwise abraded to remove slag or other adhering foreign matter and to permit observation of the deposited weld metal. The finished surface may be undulating but, in general, shall be slightly convexed, uniform and even with terminating portions blending into the surface of the structure metal.

All craters shall be filled with weld metal, and whether occurring within the intermediate lengths of the welds or at their extremities, they shall be freed from slag or other harmful material before continuing or completing the depositing of weld metal.

Workmanship (cont'd)

In fillet and butt-and-bond welds the application of the first run of a weld shall be given special attention to insure satisfactory fusion and penetration of the structure metal forming angular or recess-like portions of the joint.

The weld metal shall be deposited in a manner which will minimize the expansion and contraction effects of the localized welding heat and thereby counteract and relieve the stresses tending to produce structure deformations and distortions. Welds located on opposite sides of the webs of beams, girders and columns or other similarly located parts shall, when practicable, be formed simultaneously and the stresses tending to produce deformations minimized by welding at slightly offset rather than directly opposite locations. Tack welds holding assembled members or elements of members in position and adjustment prior to complete welding shall be so located and formed that they will become integral portions of final welds except when they are to be removed. When long welds are to be made the contraction stresses may be in part eliminated by forming the welds in intermittent lengths or sections thoroughly welded at their points of juncture.

In welds wherein the induced expansion of the metal tends to completely close the space between the parts to be welded or to reduce this space to smaller dimension than required for welding properly, the adjacent surfaces shall be wedged apart or otherwise restrained.

To improve the strength and general effectiveness of welds and to provide for the distribution of stresses into the structure parts, the ends of welds shall terminate, when practicable, in weld extensions consisting of wedgelike, pyramidal or other tapered forms. At each end of the weld the extension shall not be less than three times the weld dimension beyond the net lengths of weld considered effective in transmitting stress. When a weld is placed along the end of a member it shall be "boxed" by returning the extensions around its corners wherever practicable. End welds, when so located that rain water or other moisture may enter between the surfaces of the elements and be retained, shall be constructed with a short gap to provide a drainage.

The full nominal size of butt, butt-and-bond and fillet welds shall be secured by shaping their surfaces to flat oval forms extending onto the adjoining surfaces of the structure metal. When, for constructional reasons, it is required that the surfaces of butt and butt-and-bond welds be finished flush with the adjacent structure metal, the additional metal shall be applied to assure the full section and later removed by milling, filing or grinding.

Welds of the butt type uniting members or elements of members having single bevel cut end surfaces shall be consolidated upon their beginning of weld sides by the depositing of weld metal to produce the required weld thickness and secure the metal increment and convexed surface specified above.

Plug and slot welds devised to completely fill the holes shall be finished with convexed surfaces having the extreme edges fused into the structure metal. When formed with fillet welds at their perimeters forming a water pocket, the portions remaining unfilled shall be filled with a moisture-resistant material which will adhere to the metal surfaces; provide a workmanlike appearance, and prevent the infiltration of moisture. Materials likely to promote corrosion of the metal or to destroy paint applied upon or adjacent to the filled areas shall not be used.

Workmanship (Cont'd.)

When the joints produced by contiguous surfaces are not sealed by welds throughout their length the fit shall be sufficiently close to exclude water after the surfaces are painted. No painting shall be done prior to the inspection and approval of fits.

Weld Dams. Wide joint spaces resulting from mill cutting tolerances, erection clearances, and from diverse fabrication and erection irregularities shall be welded by the use of dams placed against or within the spaces. These dams shall consist of blocks, bars, strips, or other forms composed of fire clay, carbon, asbestos, or other refractory material, or of copper or steel. Refractory materials shall be adapted to complete removal from the weld surfaces and shall not detrimentally affect the composition of the metal. When shapes or strips of copper are used the welding procedure shall not melt the surfaces and thereby affect the weld composition. When steel is used its chemical composition shall be the same as that of the electrodes or welding rods used and the dams shall, in general, be entirely removed. However, any portion becoming welded upon the deposited metal shall be chiseled or otherwise cut to remove all free parts and that remaining shall be fused to render it an integral portion of the weld.

Peening. Peening of welds, authorized by the engineer, will preferably be done with a pneumatic hammer striking blows having only sufficient force to produce flow in the metal. The tool point shall be blunt and without sharp edges. No peening shall be done prior to the metal becoming cooled.

Physical Structure of Welds. When welds are chipped or broken to discover the physical character of their metal they shall show bright, dense, even textured, silky or fine granular fracture surfaces; good fusion and penetration at the juncture of the weld and structure metals and the absence of iridescent colors within the weld metal.

Welding in Cold and Inclement Weather. Welding operation shall be discontinued whenever the atmospheric temperature or other climatic conditions militate to produce unsatisfactory welds. The air temperature shall be in no case below 25° F. nor shall the metal to be welded contain more than that degree of frost. In general, welding shall not be done in the presence of rain, snow or wind. Heating apparatus, coverings and wind-breaks shall be approved by the Engineer.

Erection of Steelwork

606-1/2. During the erection of steel work riveted joints shall be well pinned with full size traffic pins with a diameter not more than 1/64 of an inch smaller than the hole. The full size diameter of the traffic pin shall have a length at least 1" longer than the thickness of the metal through which it passes and shall be driven to project on either side of the metal connected. A sufficient number of traffic pins shall be used to safely transmit all erection tresses. A minimum of 40 percent of the holes shall be filled with traffic pins. In addition, a sufficient number of bolts shall be used to hold the joint plates firmly together. Before any riveting is done the steel work shall be checked for alignment, camber, grade and elevation; and each joint must be well matched with holes in proper alignment. The Contractor shall submit a riveting schedule to the Director for his approval before any riveting is done.

Field Connections Riveted

All field connections shall be riveted unless otherwise shown on contract plans or in places inaccessible for riveting. In the latter case, turned bolts shall be used in reamed holes.

Field Rivets How Driven

In general, all field riveting shall be done with pneumatic hammers, hand-driven rivets shall be used only with the expressed consent of the Director.

Grouting

All steelwork placed upon concrete or masonry foundations shall be set upon wedges and after the structure has been properly aligned and leveled the space underneath shall be completely filled with a mortar composed of one part Portland Cement and two parts of clean sharp sand. The mortar shall be of such consistency that it may be moulded with the hands and upon removing the pressure will retain its shape. It shall be placed by forcing small quantities into the space and ramming with stout hammers until the space is completely filled and the resistance of the mass is felt. When retempered grout is required by the Contract Plans or ordered by the Director it shall be allowed to stand for two hours after the original mixing and shall be thoroughly remixed three times about forty minutes apart during the two hour period. No water shallbe added at any time after the original mixing.

Anchors

Where foundations and anchor bolts are specified, the bolts shall be set in wood or steel boxes or tubes, giving at least one-half (1/2") inch clearance around the bolt and having bulkheads at the ends for the exclusion of concrete. All such boxes shall be in length 50% of the embedded section. of the bolt, but not, however, to exceed eighteen inches (18"). For large bolts the clearance and depth of tubes shall be approved by the Director.

INSPECTION AND TESTING AT SHOPS

Facilities for Inspection

607. The Contractor shall furnish all facilities for inspecting and testing the weight of the material and quality of workmanship at the shops where the work is fabricated. He shall furnish a suitable testing machine for testing full sized members, if required.

Starting Work

The Director shall be notified well in advance of the start of the work in the shops, in order that he may have an inspector on hand to inspect material and workmanship, if he desires.

Accepting Material

The Director shall stamp each piece accepted with a private mark. Any piece not so marked may be rejected at any time at any stage of the work. If the Director, through an oversight or otherwise, has accepted material or work which is defective or does not comply with the requirement of the specifications, this material, no matter in what stage of completion, may be rejected by the Director.

Shop Drawings

The Contractor shall furnish Director such blue prints from the approved shop drawings as he may require for his use while making shop inspection.

Shipping Invoices

Complete copies of shipping invoices in duplicate shall be furnished the Director with each shipment. These shall show the scale weights of individual pieces. Materials used for erection only, when shipped with parts entering the finished structure must be so marked on the shipping statement and have their weights given separately. The shipping statements shall be sent to the Bureau under which the work is being done.

All pickets shall be well riveted or tightly swedged into each piece through which they pass. All holes in newel posts to take steel panels shall be true to position and a neat close fit to the part entering same. All fences and railings shall, when finished, be free of any parts having broken corners, mould fins, kinks or cracks, and shall have all exposed sheared ends cut true and smooth.

Newel and Lamp Posts

All newel and lamp posts for fences and railing shall be high tensile strength cast iron or, Malleable Iron conforming to the requirements of Sections 155 or 156 respectively.

Where the contract plans show structural steel or combined structural steel and malleable iron lamp posts, they shall be made in a neat workmanlike manner. All joints, miters, etc., shall be made to a tight fit throughout, and every precaution shall be taken to give the posts a neat, smooth finish.

TIMBER CONSTRUCTION

WORKMANSHIP

General

610. All timbers arriving upon the site of the work shall be supported upon sleepers and when so required elsewhere in the contract shall be provided with a satisfactory cover so as to be protected from above.

Cutting

The cutting of timbers shall be done along neat and accurate lines. The ends of all exposed members shall be cut at true right angles with their length unless beveled cuts are necessary on account of matching other members or for the maintenance of clearance for vehicles and pedestrians or for the purpose of continuing the lines of the structure. Floor stringers and other timbers not exposed to view need not be cut to a true ninety degree and, provided, however, that failure to make such cut will in no manner affect the strength or durability of the structure.

Bolts and Nuts

Bolts shall be of the size called for on the contract plans and shall be of such length as to permit the use of Cast Iron Washers, whose diameter across the bearing face is at least four times the diameter of the bolt, at points where called for. Furthermore, the contractor shall provide extra lengths of thread beyond the nut and shall damage same after erection to prevent the loosening of the nuts. Hexagon nuts shall be used.

Bolt Holes

Bolt holes shall be bored the same size as the bolt to be used at that point. The bolt will then be dipped in paint and driven into position.

Bearing Connections

All connections shall bear tightly. In no case shall the stress or load in a truss compression, a column or the end bearing connection of a beam or stringer, be carried by means of the bolts or spikes at the connection. All of the above mentioned members shall be firmly fitted into position before boring bolt holes or driving spikes.

Splices

Where necessary to splice timbers carrying stress, such splices shall in general be made as follows. The total sectional area of the splices on beams and stringers shall be at least twice as great as the area spliced and the splices shall have a total length of at least six times the width of the splice. All splices shall be as wide as the member spliced. Sufficient nails or spikes, at the following values, to transmit the entire stress shall be used, divided equally in number between the faces of the member spliced.

8 d	2-1/2" long	10-1/4 gauge	75 pounds
10 d	3 " long	9 gauge	80 pounds
12 d	3-1/4" long	9 gauge	150 pounds
16 d	3-1/2" long	8 gauge	125 pounds
20 d	4 " long	6 gauge	200 pounds
30 d	4-1/2" long	5 gauge	300 pounds
40 d	5 " long	4 gauge	275 pounds
50 d	5-1/2" long	3 gauge	350 pounds
60 d	6 " long	2 gauge	450 pounds

Columns and compression members shall be cut to match on the ends so as to secure a uniform bearing and in addition a splice shall be placed on each face, each splice being sufficiently strong to safely carry one-fourth of the total column load at the above values for spikes.

Holes for Spikes

Holes of one-eighth inch less in diameter than the spike shall be bored in timbers for all boat spikes and drift bolts three-quarters of an inch or more in diameter.

Deflections

Due allowance shall be made by the Contractor in the framing of built up members for deflections and settlements which will occur at the various joints upon the application of full live and dead loads. The dimensions and outlines of the built up members, as shown on the plans, are for the complete structure loaded.

Water Pockets

The structure shall be so arranged in the field that there shall be no pockets or depressions in the timber work which would gather and hold moisture and debris.

Nails and Spikes

The number, location and size of nails or spikes shown on the plans or otherwise specified shall be strictly adhered to by the Contractor. Unless otherwise shown the following schedule of spiking shall be observed.

Location	Size of Timbers	Size of Spike	Spikes In End Connection	Spikes Intermediate Connection
Sidewalk	2 x 12	20 d	4	3
Sidewalk	2 x 8	20 d	3	2
Handrail	1 x 6	10 d	3	2
Handrail	3 x 4	10 d	2	2
Handrail	4 x 4	60 d	2	2
Handrail	3 x 4	60 d	2	2
Handrail	2 x 4	20 d	2	2
Roadway	3 x 12	60 d	4	3
Roadway	3 x 8	60 d	3	2
Roadway	3 x 6	60 d	2	2
Roadway	3 x 4	60 d	2	1
Roadway	4 x 3	60 d	as shown on plans	
Stringers	2" thick	40 d	as shown on plans	
Stringers	3" & over	60 d	as shown on plans	
Cribbing		9" wire	as shown on plans	
Framing	2" thick	20 d	as shown on plans	
Framing	3" thick	60 d	as shown on plans	
Framing	over 3"		as shown on plans	

TIMBER CRIBS

Description

611. The Contractor shall furnish all material and construct Timber Cribs complete, including dry rubble masonry, in conformance with the Contract Plans and as specified. The cribs shall be constructed in the location shown on the contract plans or as ordered by the Director in the field.

Lumber

All lumber shall be new and may be unsurfaced.

Framing

All work shall be done in such a manner as to insure its stability. The cribbing shall be built with stringers running horizontally with headers spaced as shown on the contract plans. The top stringers shall conform to the grade of the street. The stringers and headers shall be fastened together with nine (9) inch wire spikes, except the top stringers which shall be fastened together with lag bolts of the size shown on the contract plans. Joints in the stringers shall be made only at alternate headers.

Dry Rubble Masonry

The masonry constructed in connection with, and as part of the crib, shall be a dry rubble stone masonry wall extending from the base to the top of the crib and, unless otherwise required on the contract plans, of the thickness herein required:-

For a 4 foot width of crib use 18" thickness of masonry.
For an 8 foot width of crib use 24" thickness of masonry.
For 12 ft. or more of crib use 36" thickness of masonry.

The dry rubble masonry shall consist of flat stones of good quality, hard, durable and not affected by the weather. The stones shall be laid in horizontal courses on their natural beds, properly bonded to secure first class work.

WOOD FENCE

Description 612. The fence shall be new white pine lumber at least equal in quality to the requirements for Select Structural Timbers as given in these Specifications.

Framing The lumber shall be surfaced on all four sides and shall be of the dimensions of, and framed in the manner called for in the Standards for Construction, on contract plans or in the Supplementary Specification. The fence shall be erected true to line, with posts set vertically and the rails parallel to top of crib, curb, walk or bridge floor below.

CLEANING AND PAINTING TIMBER

Cleaning 613. Before painting any portion of the structure it shall be thoroughly cleaned, by means of scrapers, wire brushes or by such other means as required of all dirt, grease or other substance which would be detrimental to the paint. No painting shall be done until advised by the Director that the cleaning has been performed in a satisfactory manner.

Contact Surfaces All surfaces of timbers coming in contact shall be painted, using the paint marked "First Coat" as described.

Surfaces Inaccessible after Erection All surfaces of timbers and metal work which after erection would be inaccessible for painting, but exposed to the action of the atmosphere or of surface drainage water shall be given three coats of paint.

Condition of Surfaces Painting shall be done only when the surfaces of the timbers are thoroughly dry. It shall not be done in wet or freezing weather, unless protected under cover and maintained at a temperature above 32 degrees Fahrenheit until thoroughly dry. Under special conditions or emergencies, painting may be done at slightly lower temperatures than 32°F., but only when specifically approved by the Director.

Number of Coats The entire structure shall be given three (3) coats of paint, designated as first coat, second coat and third coat.

How Applied Each coat of paint shall be thoroughly and evenly applied with brushes by experienced painters; it shall be thoroughly worked into all joints and other spaces. Each coat must be thoroughly dry before applying the succeeding coat. No painting shall be done until so ordered by the Director, since no field painting will be permitted until after the completion of all work which might discolor the paint, nor until suitable weather conditions prevail.

Samples of Paint Materials Drier shall in no case be added to mixed paint until such time as hereinafter specified and no laboratory samples of such paint will be taken either at the factory or on the job where this provision has been violated.

The contractor shall notify the Director where and when paint is to be mixed, in order that he can be present and secure such samples of materials being used and of the finished product as he may desire.

Delivery of Paint

All paint for use on City work shall be delivered on the job not less than 10 days nor more than 15 days before it will be required for use. Drier shall be governed by the same stipulation and shipped in separate containers.

The Director shall be notified immediately of each delivery and the purchaser shall provide expedient means for the taking of such field samples as he may desire.

Samples of Mixed Paint

Samples of mixed paint shall be taken by the Director from the original packages of every lot of paint and separate drier either at the shop or on the job or both. Analysis will be made and the paint rejected or accepted within a period of not less than 10 days nor more than 15 days from time of delivery.

Analysis Where Made

Analysis will be made by the Director of the Department of Public Works, the present laboratory of the Bureau of Tests is located at Center Avenue and Dithridge Street, but the Director reserves the right to conduct tests at such points as he may designate.

No Paint to be used Until Accepted

In no case shall paint, drier or any ingredient be used which has not been sampled, analyzed and accepted in full conformance with these specifications.

Dryers

Dryers shall be shipped to the site in separate packages and added to the paint on the ground in the presence of the Inspector. No paint to which any dryer has been added during its manufacture at the paint works will be accepted. Not more than one-half (1/2) pint of dryer may be added to a gallon of paint, except that no dryer shall be added to the first coat.

Thinner

When the paint as delivered from the paint manufacturer is in the opinion of the Director too thick to permit of its being properly applied to the wood work, it may be thinned to the proper consistency with raw linseed oil. Raw linseed oil, turpentine, or both, fulfilling the requirements hereinbefore specified for raw linseed oil and turpentine.

Section 614. VACANT

FORM NO. 106A.

LUMBER IN TEMPORARY STRUCTURES & FACILITIES

General Requirements

615. The Contractor shall provide all labor, tools and material for installing, maintaining and removing temporary facilities for maintaining pedestrian and vehicular traffic and for safeguarding the public and the work, all as hereinafter required and in conformity with the Contract Plans or as hereinafter specified.

Standards for Construction

The following temporary facilities shall be provided as stipulated on Contract Plans or in Supplemental Specifications.

(a) Temporary Roadway Crossings for use on Intersecting Streets and Ways.
(b) Temporary Roadway Crossings for Driveways to Public and Private Engrances.
(c) Temporary Loading Platforms.
(d) Temporary Cross and Side Footwalks

The construction of the foregoing facilities shall conform to the details shown in the Standards for Construction, provided, however, that other types of construction differing in detail will be permitted to be used provided that approval thereof has been previously given by the Director.

All sleepers, sills, timbers and other lumber forming the foundation for such structures must be properly bedded when placed, and must be kept properly bedded and shall be framed when necessary to prevent displacement and rocking to an extent, which, in the opinion of the Director, interferes with the free movement of traffic.

In addition to the temporary facilities above stipulated, the Contractor shall provide the following, which are not indicated on the contract plans:

(e) Wooden barricades, fences, guards, warning signs, and temporary structures, all as may be required to prevent accident, protect the work, and protect the public and abutting properties during the execution of the contract.

(f) Steps and walks to entrances to private properties which are disturbed during the progress of the work to such an extent as conditions make necessary for the convenience or protection of the public, as ordered by the Director in the field.

(g) Temporary alterations to accommodate pedestrian traffic to and from all existing public walks and steps, access to, or use of which, are disturbed by his operations. Said temporary alterations shall conform to type of construction deemed satisfactory by the Director. The Contractor shall further permanently reconstruct to the altered grades and alignments, determined by the Director in the field, all public wooden walks and steps, including railings and other appurtenances therefor, that are distrubed by his operations. Such permanent reconstruction shall conform to the type of construction of the disturbed structures.

Maintenance for Vehicular Traffic. Temporary Facilities for Roadway Crossings

The number of traffic lanes required to be maintained at certain roadway crossings is indicated on the Contract Plans. The Contractor shall, at all times, during his operations provide a minimum traversable width of 8 feet for each lane of traffic required to be maintained. Traffic shall be accommodated for the number of lanes indicated, either by traversing existing pavement surfacings, or new pavement surfacing, or a combination thereof. When such surfacings are not available to the width required for the number of traffic lanes indicated, the Contractor shall provide temporary facilities by constructing wooden roadway crossings to the required width and length, and such temporary facilities shall be provided at all times throughout the Contractor's operations where old, and/or new, pavement surfacing to the required width is not available, except for certain intervals hereinafter stipulated.

Such temporary facilities shall be taken up and relaid for each operation of the Contractor in removal of existing pavement surfacings, bases therefor, and excavation for sub-base treatment, and for construction of new sub-base, paving base, and pavement surfacing. In each instance, temporary facilities shall be taken up and relaid to required depth by means of sleepers, fillers, and/or additional layers of lumber, all as may be necessary to provide crossings of proper elevation.

Exceptions to the continuous maintenance of required number of lanes for accommodation of traffic, when approved by the Director, shall be limited to the following intervals for certain types of construction. An interval of 24 hours after time of pouring concrete paving base, for plain or reinforced concrete street pavements; an interval of 12 hours where such type of construction is made with high early strength concrete; and interval of 3 hours after completion of affected portions of various types of bituminous surfacings and brick and blockstone surfacing with Portland cement grouted joints.

The Contractor shall provide temporary wooden crossings, to the extent necessary to accommodate required lanes of traffic, immediately upon expiration of said 3 hours interval after completion of such types of pavement surfacings and maintain same until such time as required by the Director.

Crossings for Driveways

Temporary crossings shall also be maintained for one lane of traffic for the number of private driveways for which crossings therefor are indicated on the Contract Plans.

Loading Platforms

Temporary loading platforms shall be provided for street car stops to the number indicated on the Contract Plans. Such loading platforms shall be 4 ft. wide and 8 ft. long for each unit, with the exception that where double loading platforms are indicated they shall be 4 ft. wide and 16 ft. long. Where separate platforms are required for street cars with trailers, same shall be considered as two loading platforms.

Cross Walks

Temporary cross walks shall be provided in the locations and to the widths indicated on the Contract Plans.

Relaying and Continuous Maintenance

Crossings for driveways, loading platforms and cross walks shall be taken up, relaid and continuous maintenance thereof provided, in conformity with the foregoing requirements governing Temporary Facilities for Roadway Crossings, in so far as same apply.

Sidewalks

Temporary side footwalks shall be provided to the length and width, and in the locations indicated on the Contract Plans. The sidewalks shall be taken up and relaid as often as may be necessitated by the Contractor's operations, and shall in all events be maintained continuously to the elevation determined by the Director in the field.

Quality of Lumber

All lumber used in the foregoing types of construction, reconstruction, and alterations shall be suitable and sound, new or used rough dressed lumber, with the exception of that required for railings which must be planed on all sides and bevelled along top edges.

Shifts in Location of Structures and Facilities

Where the points at which temporary structures and facilities at time of the first operations of the Contractor are subsequently shifted account Contractor's operations, to conform to street car operation, or on account of orders given by the Director in the field, such shifts shall not be considered as affecting the number of such structures and facilities indicated on the Contract Plans, since the same service and accommodation is intended to be provided in the vicinity of the points indicated on the Contract Plans.

Compensation

Compensation for all of the above work and materials shall be included in the prices bid for the various items of work.

ADDITIONAL LUMBER IN STRUCTURES & FACILITIES

616. Under this item the Contractor shall furnish all labor, tools, and materials necessary to construct any wood structures or facilities, ordered by the Director, which are not required to be constructed in accordance with Section 615 of these Specifications.

Quality of Lumber

The lumber used shall conform to the specifications and requirements governing the work done under Temporary Structures and Facilities.

When lumber structures ordered to be done under this item are similar to structures stipulated in groups indicated under (a), (b), (c) and (d) under the foregoing lump sum item, and are additional to the number of such structures indicated on the contract plans, they shall conform to the requirements stipulated in the foregoing section governing Workmanship, Taking up, relaying and continuous maintenance thereof. All other structures required to be constructed under this item shall conform to such requirements in so far as same are applicable.

Payment for work under this item shall be based upon measurements taken daily and entered in the engineers' field books of the actual quantity of lumber used in such structures and facilities regardless ofwaste, and the contractor shall at the close of each day's work check the quantity with the engineers' records. In no case shall lumber used for the same service and accommodation at a given location be measured for payment more than once regardless of shifts in the points, or subsequent relaying in the vicinity of the first installation, or of the number of times that same shall be required to be taken up and relaid.

Payment made at the contract price per M. ft. B.M. under this item shall be full compensation for furnishing all labor, materials, and tools, for constructing wooden structures and facilities complete in place, in conformity with the foregoing requirements, and including all maintenance or replacements made necessary during the progress of the work and removal and disposing of the materials.

TIMBER PILES

Location and Cut-Off

617. The piles shall be driven in the locations shown on Contract Plans, care shall be taken to maintain the spacing shown as nearly as possible. The piles shall be cut off at the elevations shown on contract plans or to a lower elevation when necessary to remove that part of the pile injured during driving.

Length of Piles

All piles shall be of sufficient length to permit of their being driven to a sufficient depth to satisfy the load requirements as hereinafter specified and extend sufficient above their cut-off to permit all of that part of pile damaged in driving to be removed by the cut-off.

Trimming & Sharpening

All piles shall have their butt or large end cut square with their axis, have all bark removed, have all branches and knots trimmed off smooth and even with the surface and be properly sharpened in a workmanlike manner.

To be Driven in Leaders

Piles shall be driven in leaders so arranged that the vertical alignment of the pile, both above and below water, can be assured and determined. Timber Piles shall conform to the requirements of Section 167 in the Specifications for Materials.

Unless otherwise noted on Contract Plans or in Supplemental Specifications, Timber Piles shall be designed to sustain a safe working load of 15 tons per pile and shall be tested in accordance with the requirements of Section 625, except that the loads applied shall be one-half those stipulated in said section for the same settlements.

Driving Formula for Piles

618. All bearing piles shall be driven with a pile driver capable of delivering not less than 15,000 foot pounds of energy per blow and shall have their respective safe working loads determined in a preliminary manner by the following driving formula.

$$\text{Safe Load equals } \frac{2 W_h \quad H}{S \left\{ I + \frac{W_p}{W_h} \right\}}$$

Where H. Equals fall of driving ram in feet
Wh equals weight of ram

Wp is equal to weight of pile or mandrel
S equals penetration of last blow in inches

For double acting stream hammers: Wh equals W plus A P
Where W equals weight of ram

A equals effective striking area of piston.
P equals mean effective steam pressure in hammer cylinder.

Concrete Piles

619. All concrete piles shall be driven to carry a safe working load of 60,000 lbs.

Concrete Requirements

Concrete for concrete piles shall conform to the requirements of Section 461 to 512 insofar as same are applicable.

Location and Cut-off

The number and arrangement of piles shall be as shown on Contract Plans. Care shall be taken to accurately locate the piles in their proper position. All piles shall have their tops cut-off to the elevations shown on contract plans.

Length of Piling

The lengths of piling shown on the Contract Plans are only approximate and the actual lengths may vary widely from those shown. In all cases the piling shall be of sufficient length to permit their being driven to such a depth that the penetration will not exceed the requirements set forth for the various types of piling.

CONCRETE PILES

Type A Piles

620. This type shall cover cast in place piles constructed in the following manner.

To a steel pipe form, 16 inches in diameter, there shall be fitted a cast iron, steel, or concrete driving point or a suitable pointed mandrel. When a mandrel is used its length must be such that its point will not extend below the pipe form more than 12 inches; it must also be so constructed that its withdrawal will not produce a suction at the bottom of the shell and must fit closely in the bottom of the pipe form to prevent dirt entering between pipe form and mandrel during driving.

Concrete must then be placed in the form in sufficient quantity to fill the pile hole completely after the form is withdrawn. This concrete must be placed in a continuous operation with the least possible delay, and the form withdrawn as soon as possible before the concrete has set to an extent that would cause adherence thereof to the sides of the form. In any case the concrete must freely settle in and fill the entire cross section of the hole as the form is withdrawn.

Heavy ramming of the concrete to cause an enlargement of the hole at any point is prohibited, only such tamping as is necessary to cause the concrete to completely fill the hole made by the form will be permitted. Suitable lights shall be lowered into the forms when required for inspection purposes.

Type B. Piles

621. This type shall cover cast in place piles constructed in the following manner:

Upon a tapered collapsible core, which is at least 8 inches in diameter at the point and 18 inches in diameter at top for a pile 35 feet long, shall be placed a conical sheet steel shell of sufficient strength and rigidity to resist back pressure of soil when core is removed and have a pressed steel boot fitted closely on the point. Type "B" piles with fluted steel shell driven without a mandrel and with minimum point diameter of 8" and taper of 1" in seven (7') feet are optional. Modifications of Type B piles when approved by the Director may be used.

The shell shall then be filled with concrete which shall be carefully tamped into the shell as it is filled. When concreting of a shell is started, a sufficient amount of grout to coat the inside of the shell shall be thrown in the shell before placing the concrete. In case water rises in the shells after driving, before they are concreted, it must be removed before the concrete is placed. Suitable lights shall be lowered in to the forms when required for inspection purposes.

Type "C" Piles

622. This type shall cover what is known as pre-cast piles, i.e., piles cast and thoroughly set before driving. The piles may be either straight or tapered and be round or octagonal in cross section. Straight piles shall have a minimum diameter of 16 inches. Tapered piles, if octagonal in cross section, shall have a minimum point diameter of 9 inches and a taper of one inch in 10 feet; if round, they shall have a minimum point diameter of 10 inches and same taper as given for octagonal piles. All piles of this type shall be fitted with cast iron or steel driving point and have thoroughly reinforced driving heads and the entire pile shall be reinforced with longitudinal rods and hoops or spiral winding so they will resist without injury the blows from driving.

Sequence of Driving

623. Cast in place piles types "A" & "B" shall be driven in the following manner.

Where the condition of the surrounding material is such that lateral pressure, in the opinion of the Director, will adversely affect the section of cast in place piles before the concrete has set, the concrete for such piles shall be mixed with High Early Strength Special Cement; and driving for other piles shall not be closer than 10 feet to piles already cast, until the piles already cast have been in place 24 hours, unless otherwise ordered by the Director.

Pile Reinforcement

624. Where reinforcement for piles is shown on the contract plans it shall be provided and placed by the Contractor in piles types A and B before the piles are concreted. Care shall be taken to properly place the reinforcement in the piles.

TESTS FOR CONCRETE PILES

General

625. When tests on concrete piles are called for on the contract plans they shall be made by the Contractor as hereinafter specified. The number of piles to be tested will be given on the contract plans. In case any or all the piles tested fail to fulfill the requirements hereinafter specified, the Contractor shall, if ordered by the Director, make such tests on other piles without additional compensation. All piles for testing shall be selected by the Director and the tests shall at all times be subject to the orders of the Director.

Additional Piles

In cases where the test or tests of piles in any particular group or groups shall fail to meet the hereinafter specified requirements, such group or groups shall be considered as the test pile or piles and the safe carrying capacity shall be considered one-half the load of the said test pile or piles when a settlement of three-eights (3/8") inch was obtained. The number and location of such additional piles as are, in the opinion of the Director, necessary to safely carry the load, will be given the Contractor by the Director. The Contractor shall then drive such additional piles in the locations, ordered by the Director, to the depths of the adjoining piles without additional compensation.

Increasing Size of Pile Caps.

Should additional piles be driven, as hereinabove specified, thereby necessitating, in the opinion of the Director, increasing the size of the pile cap or caps in order that the proper load may be brought upon such additional piles, the Contractor shall construct the pile cap or caps to the dimensions and in the manner ordered by the Director without extra additional compensation, doing all excavation, placing such steel and all work ordered by the Director, receiving only such compensation as he would have received if the tested piles had sustained the specified loads and the work constructed as shown on the Contract Plans.

Time of Testing

The tests shall be made thirty days after the concrete has been placed in the cast-in-place piles. Premoulded piles can be tested when, in the opinion of the Director, the tests will not be disturbed by surrounding construction work. The Director will select the hour at which the test will start.

Preparation of Piles for Test

Piles selected by the Director to be tested shall have placed in their top a suitable steel dowel or plug, securely grouted in place, with its top round and the test loads shall be so placed that a level rod can be set on the plug and read at any or all times. Upon the pile shall be placed a suitable platform properly balanced so that the test load acts vertically on the pile.

Readings: The following readings shall be taken by the Director:

First, before any load or platform is placed on the pile; second, immediately after the thirty (30) ton load has been placed on the pile; third, thirty-six (36) hours after the thirty (30) ton load was placed on the pile; fourth, when the forty (40) ton load has been placed on the pile; fifth, when the fifty (50) ton load has been placed on the pile; sixth, immediately after the sixty (60) ton load has been placed on the pile; seventh, thirty-six (36) hours after the sixty (60) ton load has been placed on the pile; eighth, when the load on the pile has been reduced to thirty (30) tons, and ninth, immediately after the entire load and platform has been removed from the pile.

Allowed Settlement: The pile to be acceptable must not show a settlement exceeding one-fourth (1/4") inch between the first and third readings, or settlement exceeding three-eighths (3/8") inch between the first and seventh readings, or a variation between the first and ninth readings exceeding five-sixteenths (5/16") inch.

Bearing Power: The piles will be grouped by the Director and the bearing power of each particular group will be determined by the Director from all available date for each particular group and will be based on one-half the load which caused a settlement of three-eighths (3/8") inch.

Steel Piles: 626. Steel piles furnished under this contract shall be of the sizes stipulated on Contract Plans or in Supplemental Specifications. They shall be made of Open Hearth Steel in accordance with A S T M Specifications A7-34, and shall have a copper content of 0.2 to 0.3 percent. The pile shall conform at the time of driving to camber and sweep as permitted by allowable mill tolerance.

The piles shall be driven with open ends and on the basis that they will carry a safe load of 60,000 pounds per pile. The safe working load shall be determined by the driving formula specified in Section 818.

The Contractor shall determine in his own way the length of the piles required.

Piles less than 25 feet in length shall not be spliced and only one (1) splice shall be permitted in any one pile over 25 feet in length. Where splices occur in steel beam piles, the ends of the beams shall be milled and the splices made by welding sufficient plates to the inside faces of the beam so as to develop the full moment value of the pile section.

All piles shall have their tops cut off level at the elevation shown on the contract plans and the surface made as smooth as possible. A steel plate at least 3/4" thick and 13" square shall be placed symmetrically over the top of the pile and welded thereto.

All welding shall be done in accordance with the requirements of the Contract for Construction.

Steel piles shall be tested in accordance with the requirements of Section 825.

COMPENSATION FOR PILE DRIVING

627. On contracts involving the Driving of Piles an item for Moving Pile Driving Equipment shall be included in the Contract. This shall include moving all pile driving equipment to and from the job and for all moves from one location to another on the job, as required by the Contract Plans or ordered by the Director.

Payment for the respective types of piles driven shall be per lineal foot of accepted pile in place.

WATERPROOFING

Emulsified Asphalt

628. Where stipulated on the contract plans or in Supplemental Specifications Waterproofing, shall be applied in surfaces of concrete and other structures which are to be in contact with earth or inaccessible for painting and therefore, subject to dampness. Waterproofing material shall conform to the requirements of Section 193 of the Specifications for Materials.

Application

Before application of the waterproofing material the concrete surface or other surfaces shall be thoroughly cleaned and scoured with a wire brush or scraper, and all blisters , loose particles of dirt and dust removed. No waterproofing shall be done until such cleaning has been performed to the satisfaction of the Director. This waterproofing material shall be applied like paint until the surface of the concrete is thoroughly and consistently covered with a heavy coat at least 1/32 inch in thickness.

GUNITE

Finished Product

629. Gunite as used herein shall be deemed to be a mixture of one part Portland Cement to three parts of dry rodded sand. The field mix to be corrected for bulking, and thoroughly mixed in a nominally dry state, and placed under pneumatic pressure through a machine manufactured under the trade name "Cement Gun," and mixed with water under pressure at the nozzle before being shot into place.

The finished gunite shall be compact, dense, impervious and durable, without cracks, joints or sand pockets. The finished surfaces shall be as shown on Contract Plans; they shall be uniform, reasonably smooth, and in the same plane, with sharp angles and straight lines. All gunite work not satisfactory to the Director, or cracks which in the opinion of the Director are in any manner detrimental to the gunite, shall be dug out and reshot.

Equipment

The equipment used for placing Gunite shall be of Standard construction with all parts proportioned to yield the best possible quality of Gunite. Compressors must be of generous capacity to insure continuously satisfactory operation of the equipment fed by them. Air pressure at the gun shall be uniform and steady, and shall not be less than 35 pounds per square inch when 50 feet length of hose is being used, and shall be increased proportionately with greater lengths of hose so as to prevent a reduction of pressure at the nozzle. Means shall be provided for drying the air when necessary to prevent the material from clogging the hose. All nozzles shall be of standard construction, and have a nozzle tip not larger than 1" diameter, and shall be of such construction that the material will be discharged at a high velocity, and shall be completely atomized. Any nozzle which in the opinion of the Director has a tendency to affect the quality of the Gunite adversely shall not be used. No material hose larger than the standard 1-3/8" hose shall be used, nor shall excessive lengths of hose be permitted.

Materials and Mix

All materials shall conform to the City's Standard Specifications, except as otherwise stipulated herein. Sand shall conform to the specified grading for coarse sand and should contain a normal content of from 4 to 8 percent of moisture.

The sand and cement shall be measured by suitable measuring devices approved by the Director. These materials shall be thoroughly mixed in the proportions specified and screened through a 3/8 inch square mesh screen before being passed to the cement gun. The proportion of sand shall be corrected in the field for bulking. On every job on which the area of gunite to be placed exceeds 500 square feet, the materials shall be mixed in a concrete mixing machine.

Materials and Mix Cont.

Water for dydration shall be mixed at the nozzle at a pressure at least 15 pounds above the air pressure at the pneumatic machine.

Preparation of Surface for Gunite

New concrete surfaces to be gunited shall be thoroughly cleaned with an air and water blast from the nozzle of the cement gun. Where gunite is to be applied to surfaces of new concrete that have been exposed for sometime, these surfaces shall be thoroughly cleaned by sand blasting, if ordered by the Director.

Old concrete surfaces to be repaired by gunite and which have not been chipped shall be thoroughly cleaned by sand blasting.

Where gunite is to be applied directly against steel members, they shall be thoroughly cleaned of rust, paint and other foreign matter by means of sand blasting. All surfaces to be gunited shall be thoroughly wetted down immediately before the application of the gunite.

Removing Defective Concrete

All defective concrete shall be removed with pneumatic or hand tools. The depth and extent to which defective concrete is to be removed shall be determined by the Director in the field and shall depend on the condition and thickness of the concrete to be repaired.

In removing defective concrete no surface shall be chipped to a depth less than 1-1/2" even if sound concrete is reached at a less depth. No patch or repair shall be brought to a feather edge, but must be undercut or dovetailed and be at least 1-1/2" deep.

Repairing Cracks

Where cracks are to be repaired a strip of concrete at least 4" wide and 1-1/2" deep shall be dug out along the cracks and the sides dovetailed. Where the width of the repair along a crack exceeds 6", wire mesh must be used and this area shall be paid for as square feet of gunite, assuming the width of the strip to be 12" The width of the strip to be cut out will be determined by the Director in the field.

Anchorage for Reinforcement

Where gunite is to be applied against concrete, anchors for the wire fabrics shall be spaced not over 24" center to center on large areas, closer together on small areas and not less than 2 rows staggered on narrow strips. Where anchorage has not been provided by other means, or is insufficiently provided, American Expansion Bolts or equivalent shall be used. These anchor bolts shall be 3/8" diameter where one lawyer of reinforcing fabric is to be used and 1/2" diameter where more than one layer of reinforcing fabric is to be used. They shall be inserted into the solid concrete to a depth not less than 3".

Where gunite is to be applied against steelwork, anchorage for the wire fabric shall be provided by drilling or punching small holes through the webs of the beams or girders close to the flanges or stiffeners. Through these holes #14 gauge black wire shall be passed to secure 3/8" diameter reinforcing rods which shall be placed vertically or horizontally along the webs as best suits the existing conditions. The holes shall be spaced not more than 2'6" center to center in a horizontal direction, and not more than 3'0" in a vertical direction.

Where holes have not been provided in the steelwork or insufficiently provided they shall be drilled in the field to meet the above spacing unless otherwise ordered by the Director.

Reinforcement

Unless otherwise required by the Contract Plans or Supplementary Specifications one layer of wire fabric reinforcing shall be used where the thickness of the gunite is 3" or less. Where the average thickness of Gunite is more than 3" it shall be applied in two or more coats not exceeding 3" in thickness with one layer of wire fabric reinforcing for each coat of gunite. On small areas or pockets where the depth of the gunite is greater than the average, the necessity for an additional layer of reinforcing shall be determined by the Director.

Unless otherwise required by the Contract Plans or Specifications, or specifically approved by the Director, 3" x 3", #10 x #10 gauge electric welded galvanized wire fabric shall be used on all vertical surfaces; and 2" x 2", #12 x #12 gauge electric welded galvanized wire fabric shall be used on all over-head surfaces. The wire fabric shall be in flat sheets. It shall lap at least 4" and be securely wired together at intervals not exceeding 9" with #14 gauge black wire.

The wire fabric shall be adequately stretched and securely fastened to the anchor bolts, tie wires, reinforcing bars or other permanent anchorage with #14 gauge black wire, and supported with chairs, spacers or other means where necessary to maintain its proper position in the gunite. It shall not be sprung around corners or beams but must be bent to follow the finished surface of the gunite. The wire fabric shall not be less than 3/4" nor more than 1-1/4" from the finished surface of the gunite.

Application of Gunite

All gunite work shall be done under the continuous supervision of an experienced foreman, using only experienced men as gun and nozzle operators. No man will be considered an experienced man who cannot satisfy the Director that he has done considereable work on other contracts, similar to the work required herein.

Unless otherwise required by the Contract Plans or Supplementary Specifications the minimum thickness of gunite around the top or bottom flanges of beams, girders or bottom chords of trusses shall be two inches. The minimum thickness of gunite on all other steelwork shall be 1-1/2". The minimum thickness of gunite on the bottom of reinforced concrete floor or sidewalk slabs or on other concrete shall be 1-1/2". The gunite shall in general follow the outline of the members. Sheeting or guide strips shall be placed around all corners to insure proper thickness of gunite and to secure true lines and sharp angles. These strips shall be placed so they will not trap rebound and shall be removed before the application of the flash coat. Any sand pockets formed as the result of these strips or from any other cause shall be immediately cut out and reshot.

The gunite shall be brought to within 1/4" of the completed surface. This coat shall then be lightly screeded to true lines by using a flat sharp steel edged screed board, or by a trowel or other sharp cutting edge. In no case shall the gunite be "Dragged." The flash or finish coat shall then be applied which shall not be floated or troweled.

Before application of each succeeding coat, the previous coat shall be thoroughly washed down with compressed air and water.

In sheeting all surfaces the nozzle shall be held at such distance and position that the stream of flowing material shall strike as nearly as possible at right angles to the surface being covered. Any deposit of loose sand shall be removed prior to placing any original or succeeding layers of gunite and any sand deposit covered with gunite shall be cut out.

Application of Gunite

No gunite shall be placed in freezing weather nor against any surface in which frost is present, nor at any time when in the judgment of the Director conditions are not suitable for good and permanent work to be done.

Curing and Protecting

After the final coat is applied to the gunite, it shall be protected from the blast of locomotives, rain, or other influences which would tend to injure the gunite.

The gunite shall be kept damp after placing by spraying frequently with water for at least 4 days, and for a longer period if in the opinion of the Director weather conditions require it. Gunite work which is exposed to the direct rays of the sun shall be protected with a tarpaulin.

Scaffolding

The Contractor shall be required to move or provide scaffolding at such parts of the structure or structures as the Director may require, for making a thorough inspection of the concrete, to determine the extent of disintegration and the necessity for additional gunite repair work.

SHOTCRETE

630. Shotcrete as used herein shall be a mixture of Portland Cement, Sand and Water in the proportion of one part cement, to three parts dry rodded sand. The field mix to be corrected for bulking. The material shall be applied by a pressure gun of a type that will supply and maintain a regulated and constant quantity of material in an air stream at all times.

Shotcrete as above stipulated may be placed instead of gunite unless otherwise noted on Contract Plans or Supplemental Specifications.

The specifications for Gunite Section 629 shall apply to Shotcrete insofar as they are applicable.

Curb Cocks and Boxes

631. When ordered by the Director the Contractor shall furnish and install new curb cocks and new curb boxes on private water service lines in accordance with the Specifications and Regulations of the Bureau of Water including necessary service pipe up to 3 feet in length.

Private Water Service Lines

632. When ordered by the Director, the Contractor shall reconstruct or replace private water service lines from the supply line in the street to private property to the extent ordered by the Director in accordance with the Specifications and Regulations of the Bureau of Water. The new pipe shall be of the same size as the existing pipe and shall be double "X" lead, or copper pipe "K" grade, unless otherwise ordered by the Director.

FORM NO. 106A.

CONTRACT FOR CONSTRUCTION
CITY OF PITTSBURGH
DEPARTMENT OF PUBLIC WORKS

PART 6

CONTRACT SPECIFICATIONS

for
CAST IRON WATER PIPE WORK
as follows

SECTION 640

DETAIL SPECIFICATIONS

1C. These specifications describe the work to be done and are intended to apply to all cast iron water pipe work done and material furnished under this contract.

MAJOR WORK TO BE DONE

2C. The work to be done under items Numbers.....
.....inclusive, in the annexed proposal consists in furnishing all materials, labor, tools and equipment, and completing the following pipe line work:-.....
.....
.....
.....
.....
together with all the required appurtenances and connections complete, and making ready for service, including the digging, draining, sheeting, shoring, protecting and backfilling of excavations; the furnishing and setting of all special castings, gate valves, fire hydrants, air valves, dead caps and other appurtenances, the building of all manholes, vaults and concrete blocking, the making and connecting up of all branch connections, drains, blowoffs and services, and furnishing of all material for same, also the testing of all pipe in place, the thorough mechanical ramming of the back-filling in trenches, the repairing and repaving of streets, the removal of all surplus material promptly, and all and everything necessary for the proper completion of the work, in accordance with the contract plans, working drawings, these detail specifications and all other requirements of this contract.

LAYING

3C. Laying shall be understood to consist of the use of all new material in pipe lines, and the installation of the same in accordance with the drawings of said work, and the provisions of this contract.

RELAYING

4C. Relaying shall be understood to consist of the installation of a new pipe line, using new materials, the reconnecting to the new pipe line of all main and service pipe connections; and the removal, where directed, of all existing pipes, appurtenances and specials, together with the cleaning and delivery of such removed material and the stacking of the same at a designated yard of the Bureau of Water, as directed in accordance with the drawings and the provisions of this contract.

RAISING AND LOWERING

5C. Raising or lowering shall be understood to consist of the use of existing materials in pipe lines, and the changing of same, together with all connecting main pipe lines and services, from the present or old grade to the new grades, in accordance with the drawings and the provisions of this contract.

RIGHT OF WAY

6C. The City will provide the right of way for the proposed pipe lines, connections and structures. Where the lines lie along the public streets and roadways, the right of way will be limited to the

width of said street or roadway, subject to the provisions, however, that such streets or roadways must always be kept open to safe travel. Where any pipe line extends through park or private property, the Contractor will confine himself to a strip of ground not generally wider than fifty feet through the Park and not wider than the right of way through private property. If any greater width is required by the Contractor, he shall secure the right to use same; and such right of way through park or private property must be so used and occupied as to meet with the approval of the Director and the owner of the private property.

LOCATION OF TRENCH GRADE

7C. The contract plans are diagrammatical only, and the location in which the pipe, appurtenances and special castings shall be installed, may be anywhere within the street limits, right of way, or public property.

DEPTH WIDTH OF TRENCH EX_ CAVATION

8C. Trenches or other excavations made by the Contractor shall conform to the given grades and the finished depth of the excavation for the pipe lines shall be such as to bring the top of the pipe, when installed, four feet below the surface of the established grade, unless otherwise specified, and the width of ditch shall be not less than twelve inches greater than the outside diameter of the pipe, all with an additional width and depth at joints sufficient to provide ample room for making and caulking same.

EMBANKMENT

9C. In case the existing street or ground surface is at such elevation that adequate cover over the pipe line will not be obtained by filling to said surface, the Contractor shall install the pipes at the specified depth below the established grade line, and the pipe line, when installed, shall be well supported by a substantial trestle and properly filled around and over, so as to afford an adequate covering of earth above the top of said pipe line, the earth covering to have a width of not less than three feet six inches across the top, and the sides to have slopes of not less than one and one-half to one when firmly settled into position.

LENGTH OF TRENCH OPEN

10C. The number of points at which the Contractor will be permitted to work, and the length of continuous trench that he will be permitted to open will be governed by the Director; however, in no case shall sidewalk or pavement be removed more than two hundred feet in advance of the trench excavation, nor more than three hundred feet in advance of the laid pipe.

CARE OF OTHER STRUCTURES

11C. The Contractor shall maintain service in, shore up, sling, support, protect, restore and make good, as directed, all water pipes, gas pipes, service pipes, sewers or sewer connections, conduits, manholes, drains, vaults, buildings, tracks or other property, public or private, whether shown on the plans or not, that may be liable to disturbance or injury during the progress of the work; and all such pipes, sewers, or conduits of any description, which may have been cut off, must at his own expense, except as specifically provided in the items of the contract, be reconnected and restored by the Contractor and in accordance with the plans and instructions.

In no case shall the Contractor make any change in the position of any tracks, gas pipes, electric conduits, or other public service utilities, without the consent of the proper parties, or upon an order from the Director.

Wherever the trench crosses under a railroad or street railway track, notice must be given by the Contractor to the owner of same and a reasonable time given to the said owner to support and maintain such track, the cost of supporting such track, to be paid by the Contractor. No obstructions of any kind shall be placed on such tracks.

PROTECTING EXCAVATION

12. The Contractor shall do all the necessary sheeting, shoring, bracing, pumping, bailing, and draining to keep the excavation in a safe condition, and as dry as possible, and he shall promptly break down and remove any unsupported or undermined earth, pavement or foundation, and replace the same as provided for hereinafter.

TUNNELING

13C. Tunneling, or undermining, shall be done only by permission of the Director. Where it is permitted, the Contractor shall, be. backfilling, remove the pavement, pavement foundation and all material over the full length of the tunneled section, and backfill the same as herein provided.

BLASTING

14C. If the Contractor should desire to do blasting, he shall first secure permission from the Director. No blasting will be allowed in close proximity to buildings or other structures, unless the blast is covered with heavy timbers or mat, to prevent damage to persons or property. All blasting shall be done in a manner satisfactory to the Director. The Contractor shall be responsible for any and all damage caused by blasting.

EQUIPMENT BARRED

15C. No coal fired or equipment of any kind, except lead or leadite melting pots, shall be used, except upon written permission of the Director.

MAINTAINING TRAFFIC

16C. The Contractor shall store, or dispose of all construction and excavated material so as not to obstruct any gutter, drain, fire hydrant, sidewalk or driveway, and such storage or disposal shall be done in such a manner as to cause the least possible interference with traffic.

DISPOSAL OF EXCAVATED MATERIAL

17C. The Contractor shall retain a sufficient quantity of suitable excavated materials for the making of backfills, and he shall dispose of the remainder as soon after excavation as practicable.

DEFECTIVE MATERIAL

18C. Before installation of pipe, appurtenances, or special casting the Contractor shall hammer test each piece, completely operate each valve and hydrant, and set aside any piece that may be found to be defective, and immediately notify the Director of such defect. The Contractor shall be responsible for defective material installed and any such material installed shall be removed and replaced by the Contractor at his own expense.

CLEANING MATERIAL

19C. Before installation of pipes, appurtenances, or special casting the Contractor shall thoroughly clean each piece to remove any foreign matter, and shall keep them clean thereafter; and he shall carefully plug every open end before leaving the work for the night. Spigots and bells shall be wiped clean and dry before entering.

INSTALLATION OF PIPE AND APPURTENANCES

20C. The Contractor shall carefully roll each pipe, appurtenances or special casting to the trench, and lower the same to place; shall lay the same singly and true to line and grade; shall support each piece on two wooden blocks (size two inches by six inches, by a length not less than the external diameter of the pipe) firmly bedded and level across the trench, the blocks being adjusted to grade by the use of wooden wedges; shall so adjust all spigots in bells as to give a uniform space of not less than one-fourth inch all around, and if the pipe does not allow such space, it shall be replaced by one of proper dimensions.

HUB JOINTS

21C. The Contractor shall make all hub joints with the best quality of braided hemp tightly caulked into the joint to the depth hereinafter specified and the remaining part of the joint shall be filled with hot joint compound.

Both bells and spigots shall be carefully and thoroughly cleaned before they are joined and all joints shall be thoroughly clean when the joints are made. The hemp shall be thoroughly caulked to the bottom of the joint leaving no loose strands and making a tight joint past which the joint compound cannot penetrate.

An asbestos or rubber jointer shall be used and shall be secured to prevent leakage of a joint compound with ample room at the top for the free flow of the compound.

A high pouring gate at least six inches high above the top of the bell and of ample size for free flow of the compound, shall be used.

The joint compound shall be heated to the proper temperature for best results and while in a very liquid condition and free from froth shall be poured into the joint without pause until the joint and pouring mouth are thoroughly filled. The jointer shall not be removed before the joint compound has solidified fully.

Care shall be taken to keep all foreign material and dirt out of the joint compound.

Joint compound shall not be overheated or burned.

When finished, joints shall be solid, thoroughly filled and must be tight under test. Faulty joints shall be cut out completely, the joint space thoroughly cleaned and the joint shall be rerun so as to produce tight work under test.

At no place shall the depth of joint compound be less than 2-1/2" from the face of the bell.

The depth of hemp used shall be as follows with each strand lapped at ends as required for tight work:

4" to 24" pipe	-	1 strand of braided hemp
30" to 48" pipe	-	2 strands of braided hemp

Where possible, 1/2" braided hemp shall be used. For very thin joints 3/8" hemp may be used, and for unusually heavy joints 5/8" braided hemp shall be used.

Where two strands of hemp are used the hemp shall be cut for neat butt joints in the two strands shall be at opposite sides of the pipe.

CUTTING PIPE

22C. The Contractor shall cut and install any pipe or special castings as required, the cutting to be done with a diamond pointed tool in such a manner as to give a straight edge to the pipe or casting, which will support the hemp and prevent it from being driven into the pipe.

SPECIALS

23C. The Contractor shall install bends, sleeves, other specials, and cut pipe only where, in the opinion of the Director, their use is necessary.

CLAMPS AND RODS

24C. The clamps, rods and bolts required to hold fittings and appurtenances in place, shall be furnished and installed by the Contractor.

SETTING OF FIRE HYDRANTS

25C. Fire hydrants shall be installed by the Contractor as directed. The hydrants shall be set on a concrete slab or flat stone not less than fifteen inches square, which shall be of hard close-grained material, free from defects, and not less than four inches thick. The hydrant shall be well braced with stone against the pressure of water. Broken stone, having a size not greater than three inches at its greatest diameter, and to the amount of not less than ten cubic feet, shall be put under and around the base of each hydrant, half of which broken stone shall be placed underneath the above mentioned square stone base and the balance to be filled in around the hydrant above said stone to a height not to exceed eight inches above waste hole of hydrant. Over the top of the broken stone filling, three-ply tar paper must be tightly laid, to prevent dirt working down among the stone.

SETTING GATE VALVES AND BOXES

26C. Gate valves shall be furnished and set by the Contractor upon well supported concrete foundations of specified size where directed. Where concrete supports are required, the blocking under gates shall be so located as not to interfere with the proper placing of the concrete. Around all gate valves shall be placed a box, or manhole of cement laid brick, or concrete, as may be required, resting upon cement laid brick or concrete foundations, and so set to make the covers conform exactly with the grade or slope of the finished surface of the graded or paved roadway or walk; all as shown on plans or required by the Director.

AIR VALVES AND BOXES

27C. The City will tap the pipe for air valves where required. Contractor shall furnish, install and protect such valves and construct the required box or manhole with foundation, similar to, and conforming with the requirements for valve boxes.

BRICK MASONRY

28C. Brick masonry required for the support of gates or boxes, or for the enclosing of gates, manholes, air valves or washouts, or other required work, shall be done by the Contractor.

DRAINS WASH OUTS

29C. The Contractor shall furnish and lay all vitrified drain pipes required from gate boxes, vaults, or air valves, to the nearest sewer or natural drainage flow, including making the necessary connections; such drain pipes shall be of double strength terra-cotta pipes, laid with well cemented joints to true grade and line.

The Contractor shall furnish and lay all cast iron pipes for blow-offs connecting same to the sewers where ordered in accordance with specifications for pipe laying.

OPERATION OF VALVES

30C. The operation of valves necessary for making connections with existing mains will be done only by City pipe-men, upon sufficient notice given by the Contractor to the Director. No allowance will be made for any delay in the operation of such valves.

MATERIALS

31C. The materials to be incorporated in the work shall be the best of their respective kind, and be in harmony with the intent of this contract to secure first class work. The major materials to be so furnished shall conform to the following requirements:-

CAST IRON PIPE

Cast Iron Pipe from 4" to 24" in nominal diameter shall be of centrifugally cast iron and shall be cement lined. Pipe and fittings shall comply with the City's attached standard specifications under the heading of "SPECIFICATIONS FOR CEMENT LINE BELL AND SPIGOT, CENTRIFUGALLY CAST IRON PIPE AND CEMENT LINED SPECIAL CASTINGS", Paragraphs numbered 7 to 60 inclusive.

Cast Iron Pipe and fittings from 30" to 48" in nominal diameters shall conform with the City's attached standard specifications under the heading of "SPECIFICATIONS FOR A.W.W.A. CLASS "D" CEMENT LINED CAST IRON WATER PIPES AND CEMENT LINED SPECIAL CASTINGS", Paragraphs numbered 4 to 36 inclusive.

RAISING, LOWERING, RELAYING

32C. All of the general provisions herein specified, and all of the specific provisions for the laying of pipe lines and appurtenances herein specified, shall be considered to apply to the relaying, raising and lowering of pipe lines, and in addition, the special provisions contained in Section 34C, 35C and 36C shall apply.

REMOVAL OF OLD PIPE AND SPECIAL CASTINGS

33C. On raising, lowering, laying or relaying work, the Contractor shall, unless otherwise specified, carefully remove all old or unused pipe, special castings, appurtenances and connections, (special care being taken to preserve the lead, and such other material as directed), and deliver and stack the same at a designated yard of the Bureau of Water, at the Contractor's own expense.

MAINTAINING WATER SERVICE, TRANSFERRING CONNECTIONS

34C. The Contractor, while raising, lowering, laying or relaying pipe shall maintain water supply to all service connections. When a section of pipe is relaid, ready for service, and the City has transferred the corporation cocks, and the tee service connections are in place, the Contractor shall immediately connect the existing service lines to such cocks, or tees, using material and workmanship equal to that of the service lines as originally connected.

When raising, lowering, laying or relaying pipe, upon written permission from the Director, the Contractor may abandon short sections of pipe, and relay the same to its new position; however, nothing herein contained shall relieve the Contractor of his obligation to maintain, at his own expense, water supply to all service connections, either by installation of a temporary supply main, or otherwise.

The Contractor shall make all main line, fire hydrant, washout, or other connections, with the least possible interruption to the water supply.

REMAKING JOINTS

35C. When raising, lowering, or relaying pipe, the Contractor shall recaulk, or repour, or remake any and all joints which, in the opinion of the Director shall have been in the least manner damaged.

TESTING

36C. Before pipe lines that have been laid, raised, lowered, or relaid, are filled over, such pipe lines must be subjected to a test by water pressure of 50 pounds per sq. in. more than the working pressure, provided that the test pressure shall not be less than one hundred and fifty pounds per square inch, the gauge to be located at the highest joint in the line. During the test the Contractor shall keep joints accessible for inspection, and should any leaks, faulty material, or workmanship be indicated, the Contractor shall make the necessary repairs and replacements at his own expense, and retest the line until leaks have been stopped, and all faulty materials and workmanship replaced. Where sections are tested against gate valves, the City will not be liable for any delay due to leakage through these valves. The test pressure must be secured by means of a force pump, and the necessary labor, tools and appliances required for the making of such tests must be supplied by the Contractor, at his own expense.

The pipe line shall be tested in sections not more than 1500 feet long between valves, or plugs installed by the Contractor, at his own expense, except where conditions make it impracticable to do so and the Director's consent has been obtained for testing in longer sections.

The pipe line shall be held under normal working pressure for at least three days before tests are run.

The duration of each test shall be at least two hours if joints are exposed and at least 24 hours if joints are covered. All visible leaks at exposed joints and all leaks evident on the surface shall be repaired and stopped, regardless of the total amount of leaking shown by the test. The total leakage during any test of acceptable pipe line shall not exceed 200 gallons per 24 hours per inch diameter of pipe per mile of pipe line. Any leakage in excess of the above mentioned amount shall not be discovered, repaired and stopped and the line shall be retested until it shows leakage within the stated allowable maximum.

BACK FILLING

37C. Whenever a pipe line with its branches and appurtenances shall have been laid, relaid, raised, or lowered, properly inspected and tested, and all defects of any nature whatsoever remedied by the Contractor to the satisfaction of the Director, the excavation shall be backfilled by the Contractor with the best carefully selected earth material, free from stones, large pebbles, hard lumps or frozen earth. Before commencing the backfilling of any trenches required to be consolidated by mechanical rammers, the contractor shall provide a compresser plant of sufficient capacity to ensure in the opinion of the Director the continuous performance of at least one pneumatic rammer for each 30 lineal feet of trench for which backfilling is made at any one time. The pneumatic rammers must be available in proper working order and sufficient power available before commencing the backfilling of trenches, to the number required to comply with the foregoing requirements. The rammers shall be of the size and design approved by the Director; however, the size and number of compressers and other appurtenances shall be increased when required by the Director, but in all cases they shall be sufficient in size and number to secure a pressure of at least 80 pounds at the nozzle of each rammer.

The backfilling of the trenches shall be made in horizontal layers not exceeding 6" in thickness, each layer thoroughly consolidated and compressed with pneumatic rammers, the ramming of each layer to be continued until the 6" layer is thoroughly consolidated and compressed after which the next layer of 6 inches shall be spread and treated in like manner. When for any cause whatsoever, pneumatic rammers are not

continuously operated, the backfilling must cease and shall not be resumed until the foregoing treatment can be continued and completely complied with. The backfilling shall be thoroughly tamped and rammed underneath and around the pipe and specials, so as to support the same thoroughly and continuously, done so carefully that the pipe and specials will not be scratched or abraided. No backfilling shall be done until all cut under or undermined earth or pavement shall have been broken down and the sides of the excavation are vertical or inclined outward.

RESTORING SURFACES PAVING

38C. The Contractor shall restore the surface of all excavations made for the execution of the work under this contract, to the condition in which it was found before the work was commenced, whether in a paved or unpaved street, roadway, or turf. Where no special width of repaving is specified or shown on plans over refilled excavations, it shall be understood to mean that the paving shall be taken up, replaced and restored wherever it may have been in the least manner distrubed, whether within the lines of the actual excavation or not. Repaving of streets or roadways over excavations shall be of the same class of material as that removed or destroyed in making the excavation, unless otherwise specified, and such repaving must be done in accordance with the standard specifications of the City of Pittsburgh, Department of Public Works. Where any paving material removed by the Contractor, is injured, or is not suitable for relaying, the Contractor shall, at his own expense, provide and lay new and suitable material. Where any improved pavement has been disturbed for an excavation, the Contractor shall, unless otherwise specified, shown on plans, or directed, replace such pavement and in addition construct a base with a concrete slab, in accordance with the Standard Detail for Trench Repaving, and of composition and placement to conform with the Standard Specifications of the City of Pittsburgh, Department of Public Works as heretofore mentioned. In case it is not advisable, practicable or possible, from any cause whatsoever, to immediately repave with the permanent paving, the excavation must be temporarily paved with good hard brick laid on edge, or with stone block, and maintained in good repair and condition until permanently paved.

COMPENSATION MAJOR WORK

39C. The prices bid by the Contractor for laying, raising, lowering or relaying water pipe lines, drains or washouts and other items of the contract, as shown on the proposal of said Contractor, hereto annexed shall be full and complete compensation for the furnishing of all materials, and the complete execution of all the work shown on the plans or heretofore in these specifications described.

ADDITIONAL WORK TO BE DONE

40C. Additional work which is ordered by the Director, over and above that shown on the drawings or described in these specifications will be of approximately the same character as that shown on the drawings or described in these specifications, and the Contractor shall execute such additional work as ordered, in accordance with the requirements of the specifications for themajor work to be done, as heretofore described, including all requirements of this contract, and including the following special requirements for additional excavation.

The price bid for additional excavation shall include the refilling of such excavation with selected earth materials, the resurfacing of the street with materials similar to the paving removed as outlined in Section 39C, and the disposal of all excess material. The width of additional excavation in trench to be paid for will, in no case, exceed the external diameter of the pipe by more than twenty-four inches.

TEST PITS

41C. The Contractor shall excavate test pits of such dimensions as the Director may order in writing, such work to be classed as additional excavation.

REPLACING UNSUITABLE MATERIAL

42C. Where the bottom of the excavation for any pipe line or structure pertaining thereto, after having been excavated to the required depth, shows material unsuitable for a good foundation, or for the proper support of pipes, specials, or any structure connected therewith, or wherever rock is encountered in the bottom of a trench, the

Contractor shall excavate to such additional depths as may be required by the Director, and shall refill the trench, or other excavation, in such places with approved material, to bring the bottom of the trench, or other excavation, up to required grade line; said new material to be thoroughly rammed into place so as to make a solid and safe foundation; said work to be classed as additional excavation.

CHANGE IN ALIGNMENT

43C. Where change in alignment of the pipes or other structures has been ordered by the Director, and the Contractor is in no way at fault in causing such work, the necessary additional excavation, brick work and mass concrete shall be classed as additional work; however, nothing herein contained shall relieve the Contractor of his obligation to do all the work and furnish all of the materials for the major work described herein to be done for the prices bid.

PROTECTION FOR PIPE

44C. Where excavation is made through coal, cinders, ashes or other material liable to injure pipes or appurtenances, pipe shall be surrounded with clay, concrete or other suitable materials ordered by the Director. The Contractor will be paid for such work at a price agreed upon by the Director and the Contractor. No work of this kind will be paid for unless the Director has issued a written order for same.

COMPENSATION FOR ADDITIONAL WORK

45C. The prices bid by the Contractor for additional work, as shown on the proposal of the contractor, hereto annexed, shall be full and complete compensation for the furnishing of all materials, and the complete execution of all additional work as herein described, and as covered by the unit price items of the contract.

MEASUREMENTS

46C. To determine the amount of pipe laid, relaid, raised or lowered under this contract, upon which payments will be based, the lineal feet of pipe line will be measured along the center line of such pipe line, before backfilling, to or from the following described points. (In this description, "new" refers to material laid under this contract and "existing" refers to material previously laid):-

(a) At the face of the bell, flange or sleeve involved where work begins or ends, or connection is made to the existing pipe or special.

(b) At the center line of special casting of connection where same is part of new pipe line.

(c) At the center line of fire hydrant, or at face of dead plug, dead cap, flange or spigot at end of new pipe line.

(d) At ends of new inserted material where connection is made by breaking, and insertion in existing pipe line (this inserted material, regardless of size, shall be considered as being of the same size as the connecting pipe, and paid for as such).

(e) The laying length of valves will be excluded from the measurements made for computing payments for pipe work.

To determine the amount of additional work done under this contract, measurements will be made to conform strictly with the limits described in the written order of the Director, authorizing such additional work.

FORM NO. 114

MEASUREMENT AND COMPENSATION
Sections 1201 to 1288, Inclusive

GENERAL

1201. The quantities measured for payment at the unit prices bid respectively for all items of work included in this contract shall be computed from the neat lines shown in the "Standards for Construction" and on the contract plans or as ordered by the Director in the field and such payment shall be full compensation for the furnishing of all labor, materials, tools, plant, equipment, maintenance as so stipulated and such incidental items as are required to complete the item of work in a satisfactory and workmanlike manner and in harmony with contiguous items of work and the contract as a whole, as shown on the "Standards for Construction," on contract plans and stipulated in Specifications or as ordered by the Director in the field.

The method of measurement for quantities, and payment of compensation, for the various unit items of work described herein are to be used only when that particular class of work is specifically designated in the Contract to be paid as a unit item. Any or all of the unit items of work herein described may be required under one or more lump sum items, or combined with any other item. Payment for any work shall be made as required by the Contract.

MAINTENANCE

1202. Payment at the unit prices bid shall include full compensation for the cost of maintenance of the items hereinafter stipulated for the periods set forth, from and after the acceptance of said work by the Director. It shall further include maintenance of such items of work, whether they have been constructed as a new improvement, or repaving, or reconstruction on account of other work.

Where the Contractor is required to make repairs in order to fulfill the provisions for Maintenance set forth herein, all materials and workmanship employed shall conform in all respects to the requirements of the specifications for the respective classes of work. Wherever the base is found to be defective, the entire pavement including the base, shall be taken up and relaid. Where fifty (50%) percent or more of the surfacing material is found defective, the entire surfacing material originally laid under the Contract shall be removed and relaid with new material. In defective curb or sidewalk, each section found to be defective in any portion shall be removed in its entirety and shall be replaced with new material.

ITEMS FOR WHICH MAINTENANCE IS GUARANTEED	PERIOD
Asphalt Surfacing, all types on concrete base, or structural base	5 years
New Blockstone Surfacing, all types	1 year
Reclipped Blockstone Surfacing all types	1 year
Blockstone Surfacing on concrete base all types	1 year
New Vitrified Brick Surfacing, all types	5 years
Brick Surfacing on concrete base all types	1 year
Concrete Street Pavements, all types	1 year
Concrete Sidewalks, all types	1 year
Concrete Curbs, all types	1 year
Stone Curbs, all types	1 year
Concrete Base for Street Pavements(Asphaltic Concrete Base	Same period as for respective types of Pavement Surfacing laid thereon.

Elevation of Castings for inlets, catch basins, manholes, gate boxes etc., within the area of the contract except castings for which private owners are responsible..... 1 year

1202 Continued. If at any time during the said maintenance period of the above items of work, laid under this agreement, the said items or any parts thereof, in the opinion of the Director, requires repairs and the Director notifies the Contractor to make the repairs so required, the said Contractor shall immediately commence and complete the same to the satisfaction of the Director; and in case of failure or neglect on his or their part, within five days from the date of the service of the aforesaid notice, to begin the said repairs and faithfully prosecute the same to completion, the Director shall have the right to purchase such materials as he may deem necessary and to employ such person or persons as he may deem proper and to undertake and complete the said repairs, and to charge the expense thereof to the said Contractor.

When any final repairs on the items of work laid under this contract are ordered by the Director before the expiration of the guaranty period, and the Contractor, for any reason, is unable or unwilling to complete such repairs before the expiration of said period, the said guaranty period shall be extended and this contract be in full force until such time as such repairs are completed, in accordance with the specifications and accepted in writing by the said Director.

The date of acceptance of work by the Director, with respect to the period for which items of work are guaranteed, shall be the date upon which the final estimate is approved by the Director.

CUBIC YARD UNITS
Sections 1203 to 1224, Inclusive

ITEMS OF WORK

1203. The following items of work shall be measured and payment shall be made at unit prices bid per cubic yard, except as otherwise stipulated herein or shown on the Contract Plans or specified in the Supplementary or Special Specifications:

Grading
Borrow
Spoil
Sub-base for Street Pavements
Trench Excavation
Extra Trench Excavation
Excavation and Dredging for Special Structures
Concrete in Walls
Extra Concrete
Gravel Base
Cyclopean and Rubble Concrete
Broken Stone Sub-Surface Drain
Additional concrete in Footings and Piers
Brick Masonry
Chambers, Bulkheads and Miscellaneous Structures
Concrete Paving Base
Marginal Concrete Curb
Asphaltic Concrete Paving Base
Sandstone Masonry
Limestone Masonry
Granite Masonry
Ditching
Concrete Back Packing.

GRADING

1204. The quantity of grading measured for compensation shall be the volume of excavated materials computed in conformity with the requirements of Section 405 of these Specifications, and payment made on such basis shall be full compensation for embankment constructed in conformity with the requirements of these specifications governing Formation and Construction of Embankment. No allowance shall be made from such computed volume account shrinkage or bulking of excavated material.

BORROW

1205. The quantity of Borrow measured for compensation shall be the volume of materials computed in conformity with the requirements of Section 407 of these Specifications, and payment made on such basis shall be full compensation for embankment constructed in conformity with the requirements of these Specifications governing Formation and Construction of Embankment. No allowance shall be made for such computed volume account shrinkage or bulking of excavated material.

CONCRETE BACK PACKING

1206. The quantity of concrete back packing measured for compensation shall be the volume of compacted concrete back packing computed to required neat lines shown on the contract plans, or otherwise ordered, and payment made in conformity therewith shall be full compensation for the disposal of surplus excavation displaced by the back packing. Where the trenches are excavated to greater width than the neat lines indicated for this contract in order to place sheeting, shoring and bracing, or for any other reason, and where caveins occur, concrete back packing must also be supplied and treated in conformity with the requirements of Section 446 compensation for which, however, shall be included in payment made as aforesaid for the volume of compacted concrete back packing measured between required neat lines.

SPOIL

1207. The quantity of Spoil measured for compensation shall be the volume of all material excavated under the item of Grading in this contract computed in excess of the required total fill or embankment. No payment will be made for disposal of materials excavated in street repaving work, unless the excavated material required to be disposed of, is obtained from portions of repaving work specially designated as Grading in the specifications, on the contract plans, or ordered by the Director. The compensation therefore shall not include disposal of material excavated from any other items of work in this contract unless specifically designated in the supplemental specifications, on the contract plans, or ordered by the Director.

SUB-BASE FOR STREET PAVEMENTS

1208. Sub-base for Street Pavements constructed in conformity with the requirements of Section 420 of these specifications shall be measured for payment at the contract unit price for such item on the basis of the volume computed for a depth of 50% greater than that indicated on the contract plans, or as otherwise ordered by the Director, below the required sub-grade for concrete paving base and concrete street pavements, and such payment shall be full compensation for constructing the sub-base for street pavement complete in place, including excavation therefor and disposal thereof, and for impregnation of the coarse material in the sub-grade, and for shrinkage account compaction.

TRENCH EXCAVATIONS

1209. The quantity of Trench Excavation measured for compensation shall be the volume of excavation computed between the neat lines shown on the Contract Plans, and as stipulated in the Specifications or ordered by the Director in the field, for walls, abutments, footings, piers, cribs and other similar structures, and for the connection for terra cotta pipe drains laid behind walls with sewers or other outlets, and the volume of excavation for test pits and for sewer and other construction computed in conformity with the stipulations set forth in Section 425 to 429, inclusive.

WALL EXCAVATION ABOVE CURB GRADE

1210. Excavation for walls or cribs on the high side of improvements above finished curb grade will not be considered as trench Excavation, but shall be classified and paid for as Grading.

EXTRA TRENCH EXCAVATION

1211. The quantity measured for compensation for Extra Trench Excavation shall be the volume of material computed to required neat lines that is removed below the grades indicated on contract plans and in specifications, in conformity with the requirements of Section 429, also in determining extra trench excavation involved in trench widening, and as ordered by the Director in the field. The compensation therefor shall include all required backfilling and the disposal of excess material.

EXCAVATION AND DREDGING FOR STRUCTURES

1212. The unit of measurement for payment for excavation and dredging for structures shall be per cubic yard of actual material removed in accordance with the Contract Plans and the orders of the Director. The measurement shall be made on the neat lines of the structure and no allowance will be made for any excavation necessary to provide for sheeting, bracing or working space. The compensation therefor shall include all necessary sheeting, bracing, pumping, backfilling, disposal of excess material and all work incidental thereto, including providing space for sheeting and bracing.

CONCRETE IN WALLS

1213. The quantity measured for compensation for Concrete in Walls shall be the volume computed within the neat lines shown on the contract plans, or as ordered in the field by the Director, and payment made under this item shall be full compensation for constructing the wall complete in place, including broken stone-drain, weep-holes, longitudinal broken stone and pipe drains in back of wall, cork-board expansion joints, keys, etc. Separate payment will be made for miscellaneous steel reinforcement required. The quantity involved in changes of dimensions, whether increases or decreases shall be paid for in conformity with the requirements of Section 554, with the exception that quantities involved in increased dimensions of footing, piers, or other foundations for walls shall be measured for compensation at the contract unit price for "Additional Concrete in Footings and Piers for Walls," as also provided in Section 554.

EXTRA CONCRETE

1214. The unit of measurement for Concrete, both plain and reinforced, where not specifically covered elsewhere in the contract, shall be per cubic yard measured within the required neat lines and compensation therefor shall include all forms, bracing, finish and other work incidental to make the work complete, as ordered by the Director.

GRAVEL BASE

1215. The quantity measured for compensation shall be the computed volume of new gravel base conforming to the neat lines shown in the "Standards for Construction," on the contract plans or as ordered by the Director in the field. Where new gravel base is required to be placed for all types of street pavement surfacing and for old materials relaid, payment made under this item shall include compensation for the removal and disposal as designated of old pavement materials, however where additional new gravel base is required for old pavement material resurfaced on old gravel base in order to bring the same to the required finished grade, such new gravel base shall be included in the unit prices bid for the respective pavement surfacings.

BROKEN STONE SUB-SURFACE DRAIN

1216. The quantity measured for compensation shall be the computed volume of broken stone placed in the drain, in conformity with the contract plans, or as ordered in the field, and such payment shall be full compensation for trench excavation with the exception that excavation for this item of work required to be done above the top of the broken stone drain that is not included in other items of work will be measured for payment at the contract unit price for Trench Excavation. Compensation for back-filling and disposal of surplus excavation shall conform to the provisions governing Trench Excavation.

ADDITIONAL CONCRETE IN FOOTINGS AND PIERS

1217. The quantity measured for compensation at contract unit price for this item shall be the volume computed to required neat lines and below the grades indicated on contract plans as bottom of footing, and as ordered by the Director in the field. The compensation therefore shall include all necessary forms, bracing finish, and other work incidental to make the work complete.

BRICK MASONRY

1218. Payment made at the unit price bid per cubic yard for brick masonry shall be full compensation for furnishing all material and doing all work necessary to construct brick masonry complete in accordance with the Specifications and Contract Plans. It shall further include the Construction or reconstruction of Brick Masonry when and where ordered by the Director for sewers, manholes, blocking, bulkheads, catch basins, and for other purposes, when not specifically included in other items of work. It shall further include excavation, removal of existing masonry, backfill and disposal of excavated materials.

CHAMBERS, BULKHEADS AND MISCELLANEOUS STRUCTURES

1219. Where lump sum prices are not indicated on the proposal or contained in this contract, for chambers, bulkheads and miscellaneous structures, the quantity measured for compensation shall be the computed volume of masonry shown on the contract plans or ordered by the Director in the field and payment therefor shall be made at the unit prices bid for respective kinds of masonry. Steel reinforcement shall be paid under separate item.

CONCRETE PAVING BASE

1220. The quantity measured for compensation shall be the computed volume of concrete placed in the base for street pavements in accordance with the contract plans or as ordered by the Director in the field. No payment will be made for concrete in excess of the dimensions shown on the contract plans unless ordered to be placed by the Director in the field. Where the thickness of concrete paving base is increased over trenches for sewers, pipe lines and other underground structures, or for any other purpose as may be determined by the Director, compensation for the quantity of such increased concrete as measured between required neat lines shall be included in payment made at the contract unit price per cubic yard for Concrete Paving Base. These requirements shall also apply where additional concrete is required for such purposes under Plain and Reinforced Concrete Street Pavements; provided, however, that a unit price is incorporated in the contract for Concrete Paving Base. Where concrete paving base is required to be placed for all items of repaving with pavement surfacings all types, the payment for concrete paving base shall include compensation for necessary excavation and disposal of excavated materials as designated in the specifications. Payment made under this item shall further include maintenance of the concrete base in conformity with the provisions set forth in Section 1202 for various items of work involved in Street Pavement Surfacing.

Where concrete paving bases are required to be reinforced with steel compensation for all additional labor and expense involved account the furnishing and placing of the steel reinforcement shall be included in the payment made at the contract unit price for Steel Reinforcement.

DITCHING

1221. The quantity measured for payment shall be the computed volume of excavation done in conformity with the provisions of Section 457. Excavated material shall be used for the construction of embankment or berms to assist in the formation of ditches to required neat lines in conformity with orders of the Director. Compensation for disposal of surplus excavation shall be included in the contract unit price for Ditching. However, no payment shall be made under this item, under any circumstances, for ditching that is required to be done for the drainage of trenches, for the carrying off of water in pumping and bailing operations, or for the disposal of water that is required to be done for the proper carrying out of any of the items of work contained in the contract, where such facilities are required for temporary drainage, nor for such ditches remaining after the completion of work which incidentally may be constructed as providing permanent drainage.

CONCRETE MARGINS

1222. Concrete Margins placed in conformity with the Contract Plans or orders of the Director will be measured for compensation in the following manner:
The portion below the bottom of pavement surfacing, at the price bid per cubic yard for Concrete Paving Base; the portion above will be measured for payment at the price bid per square yard for the type of pavement surfacing with which it abuts.

ASPHALTIC CONCRETE PAVING BASE

1223. Measurement and payment for Asphaltic Concrete Paving Base shall be made in the manner provided for concrete paving base as elsewhere stipulated.

SANDSTONE, LIMESTONE, CAST STONE AND GRANITE MASONRY

1224. The unit of measurement for payment for Sandstone Masonry, Limestone Masonry, Cast Stone Masonry, and Granite Masonry shall be per cubic yard of actual masonry placed in accordance with the contract plans or the orders of the Director. The compensation therefor shall include the preparation of all beds, dowelling, mortar joints, pointing and cleaning and all work incidental to the proper completion of the same.

FORM NO. 114.

SQUARE YARD UNITS

Sections 1225 to 1234 inclusive.

ITEMS OF WORK

1225. The following items of work shall be measured and payment shall be made at the unit prices bid per square yard, except as otherwise stipulated herein or shown on the Contract Plans or specified in the Supplementary or Special Specifications.

New Block Stone Surfacing, All Types.
Reclipped Block Stone Surfacing, All Types.
Sheet Asphalt Surfacing, All Types.
New Vitrified Brick Surfacing, All Types.
Asphaltic Concrete Surfacing.
Block Stone Surfacing, All Types.
Vitrified Brick Surfacing, All Types.
Concrete Street Pavements, All Types.
Bituminous Surfacings, All Types.
Repaving with any Type of Surfacing.
Granite Crossings Reset.
Concrete Sidewalks, All Types.
Flagstone Sidewalks.
Flagstone & Brick Sidewalks Relaid.
Waterproofing, All Types.
Cement Gun Work.

PAVEMENT SURFACING ALL TYPES

1226. The quantity measured for compensation for pavement surfacing of respective types shall be the computed area of the pavement surfacing laid on specified base, in accordance with the neat lines shown on the contract plans or as ordered by the Director in the field. No deductions shall be made for manholes or similar structures. Payments made under the respective items shall include compensation for cushions, mortar base, binders, joint fillers and sheeting, all as stipulated in the Specifications. Separate payment will be made for Premoulded Bituminous or Cork Board Filler placed in expansion joints.

REPAVING WITH PAVEMENT SURFACINGS, ALL TYPES, AND OLD SURFACING RELAID.

1227. The quantity measured for compensation for Repaving with Pavement Surfacing of respective types and for Old Pavement Surfacing Relaid shall be computed in conformity with the provisions of the foregoing section; however, payment therefor shall include compensation at contract unit prices per square yard respectively for the removal and disposal of old paving materials, except when otherwise specified.

PLAIN AND REINFORCED CONCRETE STREET PAVEMENT AND REPAVING THEREWITH.

1228. The quantity measured for compensation for Plain Concrete Street Pavement, and for Reinforced Concrete Street Pavement shall be the computed area of the pavement laid in accordance with the neat lines shown on the Contract Plans, or as ordered by the Director in the field. No deduction shall be made for manholes or similar structures. Payments made at the contract unit price for the respective types shall include compensation for all transverse and longitudinal joints, joint plates, dowel bars, dam plates, bulkheads, steel reinforcement, chairs, and other supports for steel reinforcement, the bituminous sealing of joints and cracks,

and the curing, protection, barricading, and cleaning of the finished pavement. Separate payment will be made for Premoulded Bituminous or Cork Board Filler placed in Expansion Joints. Concrete for Reinforcement over trenches shall be paid for in conformity with requirements of Section 1220. Payments made for Plain or Reinforced concrete street pavements shall include compensation for thickened edges wherever required by the Contract Plans or ordered by the Director. Payments made for repaving with Concrete Street Pavements shall include removal and disposal of existing pavement unless otherwise specified.

GRANITE CROSSINGS RESET

1229. The quantity measured for payment shall be the computed area of granite crossing laid in conformity with the contract plans, or as ordered by the Director in the field. Payment therefor shall be full compensation for Re-laying the granite crossing, including the cushion, mortar bed and joint filler conforming to the adjoining pavement surfacing, or gravel base when required.

CONCRETE SIDEWALKS

1230. The quantity measured for compensation shall be the computed area of concrete sidewalks of respective types laid complete in place, in conformity with the contract plans, Standards for Construction, or orders of the Director, and payments made at the contract unit prices for respective types shall be full compensation for laying the sidewalks complete in place, including excavation between the sub-grade and finished surface, the furnishing and placing of broken stone, gravel or cinder base, the construction of joints as specified for the respective types; planks and walks for accomodation of the public and for access to private properties and for the disposal of surplus excavation therefor. Separate payment will be made for Premoulded Bituminous or Cork Board Filler placed in Expansion Joints, and elsewhere, in conformity with the requirements of this Contract.

FLAGSTONE SIDEWALKS

1231. The quantity measured for compensation shall be the computed area of flagstone sidewalk laid in conformity with the contract plans, Standards for Construction and the Specifications and payment made shall be full compensation for furnishing and laying the sidewalk complete in place, including excavation between the subgrade and finished surface, disposal thereof and placing of the broken stone, gravel or cinder base.

FLAGSTONE AND BRICK SIDEWALKS RELAID

1232. Measurement and compensation for flagstone or brick sidewalks relaid shall be made in conformity with the contract plans, standards for construction and the Specifications and payment made shall be full compensation for relaying the sidewalk complete in place, including furnishing and placing required foundation to conform to the proper grade and furnishing new stone or brick to replace the original material, when same is unfit for relaying.

WATER PROOFING

1233. The unit of measurement for payment for water-proofing shall be per square yard of actual amount of water-proofing placed in accordance with the contract plans or as ordered by the Director. The compensation therefor shall include the cleaning and drying of the concrete to be water-proofed.

GUNITE OR SHOTCRETE

1234. The unit of measurement for compensation for gunite shall be per square yard of actual amount of gunite placed in accordance with the contract plans or as ordered by the Director, and the compensation therefor shall include all necessary scaffolding, baffle boards and all drilling and attachments to secure any reinforcement. The reinforcement itself, will be paid for under a separate item.

FORM NO. 114.

LINEAL FOOT UNITS

Sections 1235 to 1252, Inclusive

ITEMS OF WORK

1235. The following items of work shall be paid for at unit prices bid per lineal foot, except as otherwise stipulated herein or shown on the contract plans or specified in the supplementary or special specifications.

Broken Stone and Pipe Sub-drain.
Terra Cotta Pipe Sewers.
Plain and Reinforced Concrete Pipe Sewers.
Brick Sewers.
Reinforced Concrete Sewers.
Stone Curb.
Stone Radius Curb.
Concrete Curb, All Types.
Concrete Radius Curb, All Types.
Combined Concrete Curb and Gutter.
Marginal Curb.
Depressed Curb.
Sandstone Curb Recut and Reset.
Stone Curb Reset.
Concrete or Timber Curb Barrier.
Concrete Deck Curb.
Cutting Flagstone Sidewalk to Line.
Iron and Steel Fences and Railings.
Wood Fence.
Concrete Piles.
Steel Piles.
Wood Barrier.
Steel Cut by Torch.
Continuous Welds.
Sub-drain for Sewers.
Drilling Holes in Stone or Concrete.
Wire Cable Barrier with Wood Posts.

BROKEN STONE AND PIPE SUB-DRAIN

1236. The quantity measured for compensation shall be the total length of broken stone and pipe sub-drain laid complete in place, in conformity with the Standards for Construction and contract plans or as ordered by the Director in the field, and payment therefor shall be full compensation for the furnishing and placing of necessary pipe specials and connections with existing sewers, and for the required trench work, with the exception that excavation done above the top of broken stone placed that is not included in other items of work will be paid for as Trench Excavation. Payment made under this item shall include required backfilling and disposal of excess material in conformity with Section 429.

SEWERS, ALL TYPES, HOUSE LATERIALS, C. B. CONNECTIONS

1237. The quantity measured for compensation for the construction and reconstruction of sewers, all types, catch basin and inlet connections and reconnections, house laterals, including reconnections and extensions thereof, shall be the total length measured for each type of sewer along the axis or center line, and no deduction shall be made for manholes. Where new sewers intersect, measurement on each shall continue to their intersection, with the exception that where Y branches, slants and spurs are already placed in existing sewers or are required to be placed in a new intersected sewer, measurement for pipe sewers, house laterals of all types, and catch basin and inlet connections, and reconnections, shall be taken from the ends of the "Y" branches, slants or spurs so placed.

MARGINAL CURB OR DEPRESSED CURB	1239. The quantity measured for compensation for Marginal Curb and Depressed Curb shall conform to the stipulations hereinbefore set forth in Section 1238 with the exception that curb drain shall not be considered in the compensation made for Marginal Curb.
SANDSTONE CURB, RECUT AND RESET AND STONE CURB RESET	1240. Measurement and compensation of Sandstone Curb Recut and Reset and Stone Curb Reset, shall conform to the provisions above stipulated in Section 1238, and including removal, storing, re-dressing and re-setting as specified.
CONCRETE OR TIMBER CURB BARRIER	1241. The quantity measured for concrete or timber curb barrier shall be the total length measured along face of barrier, constructed in accordance with the Contract Plans and Specifications, or as ordered by the Director in the field. Payment under this item shall include compensation for excavation, materials, finishing, backfilling, disposal of surplus excavated materials, and restoration of sidewalk disturbed or damaged, including the replacing of all flag pole sockets disturbed, the furnishing and sowing of grass seed, in conformity with requirements of Section 513.
CONCRETE DECK CURB, COMBINED CONCRETE CURB & GUTTER	1242. The quantity measured for compensation for Concrete Deck Curb and Combined Concrete Curb and Gutter shall be the total length measured along the face of curb, constructed in place, in conformity with the Standard for Construction and Contract Plans or as ordered by the Director in the field. The payment therefore, shall be full compensation for all materials, reinforcing, dowels, metallic iron bond coat, curing, protection as specified for Concrete Curb and Concrete Street Paving. Separate payment will be made for Cork Board expansion joints and broken stone drain.
CUTTING FLAG-STONE SIDEWALK TO CURB LINE	1243. The quantity measured for compensation shall be the total length of flagstone cut to curb line as shown on the contract plans, or ordered by the Director in the field. Payment shall be full compensation for the cutting complete in accordance with the lines furnished in the field in conformity with Section 522.
IRON & STEEL FENCE AND RAILINGS	1244. The quantity measured for compensation shall be per lineal foot of iron or steel fence or railing furnished and erected complete in place, in conformity with the "Standards for Construction," contract plans and specifications, or as ordered by the Director in the field. Payment made under this item shall include compensation for supports, attachments, connections and painting the fence or railing in conformity with the specifications for painting structural steel including all newel and lamp posts shown except when otherwise provided.
WOOD FENCE	1245. When a unit price per lineal foot is requested in the proposal, wood fence erected complete in place in the locations shown on the contract plans or as ordered by the Director in the field and in conformity with the specifications and details shown in "Standards for Construction" or as otherwise shown on the contract plans, will be measured for compensation and payment made on the basis of total length of top rail. Payment under this item shall include compensation for painting wood fences, in conformity with the specifications for painting lumber, when so stipulated on the contract plans or in supplemental or special specifications.
CONCRETE PILES	1246. The amount of concrete piles measured for payment shall be the actual lineal feet of piles driven below the cut off plane as shown on the contract plans or ordered by the Director. The compensation per lineal foot shall include all shoring, bracing, and pumping incident thereto. Separate payment will be made for moving Pile Driving equipment.

STEEL PILES

1247. Payment shall be made at price bid per lineal foot for the actual number of lineal feet of steel piles in place, in accordance with the Contract Plans and Specifications, and including splices and caps.

All piles meeting the requirements of the driving formula are subject to test in accordance with the requirements of Sections 618 to 625 of the Contract for Construction. Separate payment will be made for moving Pile Driving Equipment.

WOOD BARRIER

1248. The quantity measured for compensation shall be per lineal foot of Barrier furnished and erected complete in place, in conformity with the "Standards for Construction," Contract Plans and Specifications, or as ordered by the Director in the field. Payment so made shall include compensation for excavation, anchorage, attachments, painting, backfilling around posts and the disposal of surplus excavated material. Measurement for compensation shall be from the outer face to face of end posts. No payment shall be made for openings in the barrier.

STEEL CUT BY TORCH

1249. The measurement for payment for steel cut by torch shall be per lineal foot and shall be the total length of cut measured along each piece of steel cut, allowing a minimum of one-half foot for each complete cut. Compensation therefor shall include cutting any kind or thickness of metal, on any part of the work, and furnishing any equipment, scaffolding or other work necessary.

CONTINUOUS WELDS

1250. Measurement for payment for continuous welds shall be per lineal foot and shall be the actual length of welding done, except that any welds of less than 6 inches be paid for as one-half of one foot and tack welds less than 6 inches center to center will be paid for as continuous welds. Compensation per lineal foot shall include all work and scaffolding necessary to furnish continuous welds, of any cross section, on any part of the work as shown on the Contract Plans or ordered by the Director.

SUBDRAIN FOR SEWER

1251. The quantity measured for compensation shall be the total length of Sub-drain for sewer laid complete in place in conformity with the "Standards for Construction," Contract Plans, the Specifications, or as ordered by the Director, and payment therefor shall be full compensation for the required trench work, and removal and disposal of excavated material.

DRILLING HOLES IN MASONRY

1252. The measurement for payment for drilling holes in masonry shall be the sum of the actual depths of holes drilled as required by the Contract Plans or ordered by the Director. Compensation therefor shall include drilling through reinforcing steel or enlarging holes to miss obstructions. Compensation will be allowed at the unit price bid for holes drilled in new locations when ordered by the Director.

WIRE CABLE BARRIER WITH WOOD POSTS

1252-1/2. Payment made at the contract unit price per lineal foot for the respective types of wire cable barriers with wooden posts, shall be full compensation for furnishing all labor, materials, equipment, tools, creosoting, painting, installation, and work incidental thereto, also all excavation, refilling and disposal of surplus material. Payment shall further include compensation for the removal of existing fences, barriers, trees and miscellaneous material found on the line of work and in the strip between the existing curbs or edges of roadway pavements, and the line of wire cable barrier.

The quantities measured for payment shall be the lineal measurement from center to center line of dead man, or to center of end post where sections end with diagonal brace. No payment will be made for openings left at driveways, steps, intersecting roads or streets or for other purposes.

UNIT ITEMS

Sections 1253 to 1265, Inclusive

ITEMS OF WORK

1253. Unit prices shall be submitted and payment therefor will be made on the basis of a unit price each for the following items of work, except as otherwise stipulated herein or shown on the Contract Plans or specified in Supplementary or Special Specifications and such payment shall be full compensation for the work complete in place, including necessary excavation, sheeting, shoring and bracing, pumping and bailing, disposal of surplus excavated materials as designated and further shall include compensation for incidental work hereinafter noted:

Razing and Removal of Buildings.
Castings.
Brick Manholes.
Catch Basins (All classes and types).
Box Storm Inlets (All types).
Storm Inlets (All classes and Types).
Masonry Structures - Chambers, Outfalls, etc.
Extension of Manholes.
Alterations and Adjustment of Catch Basins, Inlets and Manholes.
Partial Reconstruction of Catch Basins and Inlets.
Placing Additional Weir Plates.
Additional Newel Posts.
Locust Posts.
Lumber in Temporary Structures and Facilities.
Moving Pile Driving Equipment.
Removal of Trees

RAZING AND REMOVAL OF BUILDINGS

1254. The Director reserves the right to grant permission to owners for the removal of any buildings for which prices have been requested in the proposal. No work shall be done on the razing and removal of any building unless written orders are given by the Director and no compensation will be made at the prices bid for said items unless work is required to be done, nor shall any compensation be made for any loss sustained by reason of permission being granted for the removal by the owners thereof, of any or all of the buildings for which prices are contained in this contract.

Payment made at the contract unit prices shall be full compensation for razing and removal of buildings in conformity with the requirements of Section 421, and further, such payment shall be full compensation for garages, lean-to's, outbuildings, and incidental structures when same are indicated on the Contract Plans or in Supplemental Specifications to be included in the item governing main structure.

CASTINGS

1255. All castings required for the construction of manholes, catch basins, storm inlets, box storm inlets and modifications thereof required to be placed in such structures as shown in the Standards for Construction and on the Contract Plans will be furnished by the City, and payment made at the unit price bid for the structures involved shall include compensation for placing of such castings in the structures, including work incidental thereto and the filling with Portland Cement mortar of the top casting where required.

All other castings shown on the Contract Plans shall be furnished and placed by the Contractor and payment therefor will be made in the manner herein stipulated or in Supplementary or Special Specifications.

1237. (Cont.) Where a sewer intersects with a chamber, the measurements shall be taken along the axis of the sewer from the inside of the wall of the chamber. Increasing or decreasing sections of sewers shall be measured for compensation at the unit price bid for the larger size of sewer to which they connect. Where manholes are located at the ends of sewers the measurement shall continue to the center line thereof.

Payment made at the contract unit prices for the respective types of sewers shall be full compensation for all excavation done by the trench or tunnel methods, in conformity with these Specifications, and the Standards for Construction, to the lines and grades shown on the contract plans, the removal and disposal of surplus trench excavation; for sheeting, shoring and bracing to the satisfaction of the Director, for furnishing and laying the different types of sewers, including all branches, slants and spurs, specials and curved pipe indicated on the contract plans or in supplemental or special specifications, and the backfilling of sewer trenches; and further; such payments shall include compensation for making connections, or reconnections to existing sewers, house laterals and catch basins and inlet connections, including necessary specials, the maintenance of service for the connections thus made, the tearing out of old pipes when ordered by the Director, and the reconstruction of the inverts of manholes and all concrete reinforcement for sewers shown on the contract plans, including necessary excavation and disposal of surplus excavation, and for the relaying and replacing of all sidewalk pavements, and the replacing and resetting of curb, disturbed or damaged in the prosecution of the contract, and the temporary repaving of roadways in conformity with the requirements of Sections 448, 449 and 450; however, separate payment for permanent pavement surfacings and bases therefor shall be made in conformity with the requirements of Section 449.

No measurement of pipe sewers required to be removed and relaid in making connections or reconnections for proposed sewers shall be included in the quantities for which payment is to be made under the respective items. Compensation therefor shall be included in payment made for quantities measured in conformity with the provisions of the first paragraph of this section. When sewers are constructed by the tunnel or benching method, all sheeting, shoring and bracing shall be left intact and compensation therefor shall be made in conformity with the provisions of Section 433. Compensation for furnishing and placing of Terra Cotta and Cement discs in bulkheading the ends of all sewers and house laterals 15 inches or less in diameter, and for brick masonry bulkheads 9 inches in thickness in the ends of sewers greater than 15 inches in diameter shall also be included in payment made at the contract unit prices, for respective types of sewers.

CURBS AND RADIUS CURBS, ALL TYPES

1238. The quantity measured for compensation shall be the total length measured along the face of curbs of the types specified, and of radius curbs of respective types, each as set in accordance with the Standards for Construction, Contract Plans, or as ordered in the field by the Director. Payments made at the respective contract unit prices shall be full compensation for the curb complete in place, including all steel reinforcement in place, excavation below curb grade, broken stone drains under, in front of, and in back of curb, backfilling in back of curb, and disposal of excess excavated material, and restoration of sidewalk distrubed or damaged, including the replacing of all flagpoles sockets disturbed, the furnishing and sowing of grass seed, in conformity with requirements of Section 513. The quantity measured for compensation for the different types of radius curb shall include the required tangents at the end of the radius curb where same are required on the contract plans or ordered by the Director in the field.

ADDITIONAL NEWEL POSTS

1262. When shown on the Contract Plans or as ordered by the Director in the field, additional Newel Posts for Iron and Steel fences and railings shall be included for compensation at the unit price per each bid in the Proposal and such payment shall include full compensation for the furnishing and erection of the Newel Posts complete in place including supports, anchorages, connections and paintings thereof in conformity with the specifications for painting steel work.

LOCUST POSTS

1263. Payment made at the unit price bid per each for locust posts shall be full compensation for furnishing and erecting the locust posts complete in conformity with the details shown in the "Standards for Construction" on the Contract Plans or as ordered by the Director in the field and shall include excavation, back-filling, disposal of surplus excavation and, when stipulated on the Contract Plans or in Supplementary Specifications, the peeling of bark above the surface of the ground and painting in conformance with the specifications for painting lumber.

LUMBER IN TEMPORARY STRUCTURES AND FACILITIES

1264. The payment made at the contract price for Lumber in Temporary Structures and Facilities, shall be full compensation for furnishing all labor, materials and tools for construction, taking up, relaying, altering and reconstructing, as might be necessary, all temporary structures and facilities enumerated and described in Section 815, and for the removal and disposal of the materials.

DEDUCTION FOR LUMBER IN TEMPORARY STRUCTURES & FACILITIES

If, for any reason, the Contractor fails to construct any of the temporary facilities required to be constructed under the item "Lumber in Temporary Structures and Facilities," a deduction shall be made from the price bid, for the quantity of lumber which would reasonably be used in such structures, in accordance with the City's standards therefor, at the price bid per M. ft. B. M. for Additional Lumber in Structures and Facilities.

MOVING PILE DRIVING EQUIPMENT

1265. Payment made at the price bid under this item shall be full compensation for moving all pile driving equipment to and from the job, and for all moves from one location to another on the job, as required by the Contract Plans or as ordered by the Director.

Fifty percent of the price bid shall be paid on current estimate after the equipment is on the job and working, and the remainder of the price bid shall be paid on current estimate after all piles are in place, and the equipment removed from the site.

REMOVAL OF TREES

1265-1/2. Payment made at the price bid per each for removal of trees shall be full compensation for removal and disposal of trees when so ordered by the Director and shall include removing the roots to a depth of 4 feet below curb grade or ground level and back filling as ordered by the Director.

FORM NO. 114.

LUMP SUM CONTRACTS
Sections 1266 and 1267

DESCRIPTION

1266. Lump sum contracts are those in which the major portion of the work is paid for at a lump sum bid price, the work included in said price being clearly defined elsewhere in the contract. Unit prices will be bid under this form of contract for additions to or deductions from the amount of work covered by the lump sum price and for additional work when probability of change in the amount of work exists and when such changes can be classified. The work under these items shall be measured as herein specified for similar items of work under unit price contracts.

The same unit prices shall be bid for "Additions to" as for "Deductions from" the lump sum bid and, in computing the total bid, these unit prices shall not be considered.

LUMP SUM

1267. The price bid as a "lump sum" shall be inclusive of compensation for furnishing the necessary labor, materials, tools and equipments to construct complete the structure or structures shown on the contract plans or specified elsewhere in the contract. This price shall also be inclusive of the removal of such existing structures, debris, or materials of any kind, as may be necessary providing of connections to present or for future construction, clearing the site of debris or other accumulations due either directly or indirectly to the operations of the Contractor (cleaning of structure proper) and any other work incidental to the above which may be necessary for the completion of the structure in a workmanlike and satisfactory manner.

MISCELLANEOUS ITEMS
Sections 1268 to 1287, Inclusive

ITEMS OF WORK

1268. The following items of work will be measured for payment by the units and in the manner hereinafter specified.

Additional Lumber, Temporary Structures and Facilities
Sheeting and Bracing Left in Place
Timber Platforms
Timber Construction
Timber Cribs
Timber Piles
Steel Cut by Hacksaw
Tack Welds
Rivets Cut Out
Rivets
Bolts
Turned Bolts
Holes Drilled or Reamed in Steel
Structural Steel
Steel Reinforcement
Casting of all kinds
Bronze
Steel Reinforcement in Paving Base
Special Cement Substituted for Portland Cement
Granulated Slag Borrow
Granulated Slag Backfilling
Extra binder in Asphalt Surfacing
Bituminous (premoulded) Filler
Cork Board Filler
Load Test on Piles
Core Drilled Test Borings
Bituminous Surfacing
Private Water Service Lines
Curb Cocks and Boxes

FORM NO. 114.

ADDITIONAL LUMBER IN STRUCTURES AND FACILITIES

1269. Payment for Work under this item shall be based upon measurements taken daily and entered in the engineers' field books of the actual quantity of lumber used in the structures and facilities described in Section 616 regardless of waste, and the Contractor shall at the close of each day's work check the quantity with the engineers' records. In no case shall lumber used for the same service and accommodation at a given location be measured for payment more than once regardless of shifts in the points or subsequent relaying in the vicinity of the first installation or of the number of times that same shall be required to be taken up and relaid.

Payment made at the contract price per M. ft. B.M. for additional Lumber in Structures and Facilities shall be full compensation for furnishing all labor, materials and tools, and constructing the structures and facilities complete in place, in conformity with the requirements of Section 616, and including all maintenance and replacements made necessary during the progress of the work and removal and disposal of the materials.

SHEETING AND BRACING LEFT IN PLACE IN WRITTEN ORDER

1270. Sheeting, bracing and shoring left in place on written order of the Director shall be measured for payment at the contract unit price per M. ft. B.M., for sheeting and bracing left in place on written order of Director. No payment shall be made at the contract unit price for this item when the Contractor elects to leave sheeting, bracing and shoring in place or when he is unable for any reason to remove the same.

TIMBER CONSTRUCTION. TIMBER PLATFORMS TIMBER CRIBS

1271. The unit of measurement for timber platforms, timber construction and for timber cribs, shall be per M. ft. B.M., of the actual quantity of lumber placed in accordance with the Contract Plans or as ordered by the Director and no allowance shall be made for waste or fitting. Payment made at the respective contract unit prices for such items of work shall be full compensation for dry rubble masonry, for timber cribs and all framing hardware, waste and work incidental to the proper completion of the structure.

TIMBER PILES

1272. Measurement for payment of timber piles shall be per each, of the length called for on the contract plans or as ordered by the Director. No deduction shall be made for the portion of the pile or piles extending above the cutoff plane. The compensation therefor shall include all work incidental to the proper driving of the piles in accordance with the contract plans, the specifications and the orders of the Director, and shall further include any costs, incidental to changing the length of piles previous to driving, should a longer pile be found necessary.

STEEL CUT BY HACKSAW

1273. The measurement for payment for steel cut by hacksaw shall be per square inch and shall be the total number of square inches actually cut, allowing a minimum of one square inch for each complete cut. Compensation therefor shall include cutting any kind or thickness of metal, on any part of the work, and furnishing all scaffolding or other work necessary.

TACK WELDS

1274. The measurement for tack welds shall be the actual number of tack welds made on any part of the work as shown on the Contract Plans or ordered by the Director in the field. Tack welds shall be 2 inches long and of sufficient strength to equal a 1/8 inch triangular weld and shall be not less than 6 inches center to center. Compensation shall include all material, work and scaffolding necessary to furnish tack welds or any part of the work to the satisfaction of the Director.

RIVETS OR BOLTS CUT OUT	1275. The measurement for payment for rivets or bolts cut out shall be the actual number of rivets or bolts, of any size or length, cut out on any part of the work. Compensation therefor shall include all necessary work and scaffolding.
RIVETS FURNISHED AND DRIVEN	1276. The measurement for payment for rivets furnished and driven shall be the actual number of rivets, of any size or length, furnished and driven on any part of the work. Compensation therefor shall include all necessary work and scaffolding.
BOLTS	1277. Measurement for payment for bolts furnished and placed shall be the actual number of bolts placed permanently on any part of the work as shown on the Contract Plans or ordered by the Director. Compensation therefor shall include furnishing and placing new steel bolts with hexagonal nuts and washers as required by the Director; and shall include all necessary scaffolding. When not otherwise provided in the Contract the price bid shall be for steel bolts of any size, shape or description as ordered by the Director for structural purposes exclusive of anchor bolts.
TURNED BOLTS	1278. Measurement for payment for turned bolts furnished and placed shall be the actual number of bolts placed permanently on any part of the work as shown on the Contract Plans or ordered by the Director. Compensation therefor shall include furnishing and placing new turned steel bolts with hexagonal nuts and washers as ordered by the Director and shall include reaming holes in and thickness of metal and all necessary scaffolding. When not otherwise provided in the contract, the price shall be for turned steel bolts of any size, shape or description as ordered by the Director for structural purposes exclusive of anchor bolts.
HOLES DRILLED IN STEEL	1279. The measurement for payment for holes drilled in steel shall be per lineal inch and shall be the total depth of all holes drilled, allowing a minimum of 1/2 inch depth for each hole. Compensation therefor shall include drilling holes on any diameter, in any kind or thickness of metal, on any part of the work, and furnishing all scaffolding or other work necessary.
HOLES REAMED IN STEEL	1280. The measurement for payment for holes reamed in steel shall be per lineal inch and shall be the total depth of all holes reamed, allowing a minimum of 1/2 inch depth for each hole. Compensation therefor shall include reaming holes of any diameter, in any kind or thickness of metal, on any part of the work, and furnishing all scaffolding or other work necessary.
STRUCTURAL STEEL, CASTINGS AND BRONZE	1281. The unit of measurement for payment for Structural Steel, Castings of all kinds and Bronze, unless otherwise specified shall be per pound of actual materials furnished and placed in accordance with the Contract Plans and Specifications or as ordered by the Director, and compensation therefor shall include all painting, shaping, anchorages and all work incidental to the proper erection in accordance with the Contract Plans, the specifications and the orders of the Director. In the determination of the actual materials furnished under the items included in this Section or similar items of work, the Contractor shall submit shipping bills in triplicate for all material shipped to the site of the work, and payment will be made for weights shown thereon providing, however, that no payment will be made for quantities in excess of five (5%) percent more than the estimated weight as determined by the Director.

STEEL REINFORCEMENT

The unit of measurement for steel reinforcement shall be per pound of actual materials furnished and placed in accordance with the Contract Plans and Specifications and as ordered by the Director. Compensation therefor shall include all shaping, anchoring, splicing, spacers and other work incidental to the proper erection of the steel reinforcement.

NEWEL POSTS AND LAMP POSTS

Compensation for newel posts and lamp posts usually will be paid for at the contract unit prices for Fences and Railings at separate contract unit prices per each respectively.

SPECIAL CEMENT SUBSTITUTED FOR PORTLAND CEMENT

1282. When High Early Strength Special Cement is substituted for Portland Cement for mixing Concrete under any of the items of work included in this contract, payment made at the contract unit price per bag for Special Cement Substituted for Portland Cement, shall be full compensation for all additional costs and expenses involved and shall be additional to payment made at the contract unit price for the respective items of work affected. However, no payment shall be made under this item for any type of concrete construction requiring High Early Strength Concrete for which other contract unit prices can be applied.

GRANULATED SLAG BORROW

1283. Payment made at the unit price bid per ton under this item shall be full compensation for furnishing all material and doing all work necessary to place granulated slag in embankment, in accordance with the Contract Plans, the Specifications and where ordered by the Director. It shall also include compensation for weighing the slag in accordance with the following requirements. The quantity measured for payment under this Item shall be computed on the weight indicated by weigh slips furnished in the following manner.

All granulated slag shall be weighed and weight slips signed by the Weighmaster, indicating the net weight of slag delivered in each truck load, and must be given to the representative of the Director designated to receive such slips. The method of weighing and the scales used for weighing slag shall be subject to approval and test by the Director. In the event of disapproval of scales or weights indicated on weighmaster's slips, no further material shall be weighed on such scales until notified in writing by the Director so to do.

GRANULATED SLAG BACKFILLING

1284. Payment made at the unit price bid per ton for Granulated Slag Backfill shall be computed in conformity with requirements of Section 1283 governing Granulated Slag Borrow and includes the disposal of surplus excavated material displaced by the slag backfilling.

EXTRA BINDER IN ASPHALT SURFACING

1285. Payment made at the unit price bid per ton for Extra Binder in Asphalt Surfacing shall be full compensation for furnishing and placing binder for street pavement in excess of the material required in conformity with Section 557. Compensation therefor shall include the weighing of binder and the delivery of weight slips for each truck load to the representative of the Director designated to receive same. Said weight slips shall indicate the net weight of binder delivered on each truck load and shall be signed by the Weighmaster. The method of weighing and the scales used for weighing binder shall be subject to approval and test by the Director. In event of disapproval of scales or weights indicated on Weighmaster's slips, further weighing of binder on such scales shall cease until notified in writing by the Director that the scales have been approved.

BITUMINOUS FILLER COARK BOARD

1286. The unit of measurement for payment for Premoulded Bituminous Filler and Cork Board Filler in expansion joints shall be per Square foot of the actual amount of Filler placed in Street and Sidewalk pavement in accordance with the Contract Plans, Standards for Construction or as ordered by the Director.

LOAD TEST ON PILES

1287. Payment made at the unit price bid per each under this Item shall be full compensation for furnishing all material and doing all work necessary to make complete load tests on concrete or steel piles in accordance with Specifications.

The piles to be tested shall be chosen by the Director and cast in place piles may be tested at an earlier time than 30 days after pouring at the option of the Director.

CORE DRILLED TEST BORINGS

1288. Payment made at the unit price bid per lineal foot for core drilled test borings shall be full compensation for core drilling test borings at the locations ordered by the Director and to the depths required, regardless of classification of materials, and in accordance with all the requirements of the specifications, and including compensation for lumber in temporary structures and facilities.

BITUMINOUS SURFACINGS

1289. Where Bituminous Surfacing is specified to be paid for by weight, payment made at the unit price bid per ton for the specified type of surfacing, shall be full compensation for furnishing all material, labor, tools, equipment and other facilities necessary to place the surfacing in accordance with the specifications for the respective types; and for weighing the materials delivered in accordance with the requirements of Section 1285. It shall further include removal and disposal of existing pavements where required.

CURB COCKS AND CURB BOXES.

1290. Payment made at the unit price bid per each under this item shall be full compensation for furnishing all material and doing all work necessary to install new curb cocks and new curb boxes, including 3 feet of pipe of the same size and of the same quality or better than the existing pipe, in accordance with the specifications and when ordered by the Director Excavation, backfill and sidewalk repairing shall be included under this item.

PRIVATE WATER SERVICE LINES.

1291. Payment made at the unit price bid per lineal foot under this item shall be full compensation for furnishing all material and doing all work necessary to reconstruct or replace private water service lines between the supply line in the street and the property line, when and to the extent ordered by the Director, exclusive of that required with curb cocks and boxes. Excavation, backfill and sidewalk repairing, shall be included under this item.

CITY OF PITTSBURGH
DEPARTMENT OF PUBLIC WORKS
BUREAU OF ENGINEERING

STANDARDS FOR CONSTRUCTION.

Sheet No.	DESCRIPTION
1.	Assembly of New Standard Sewer Castings
2.	Weights of Standard Sewer Castings
3.	Weights of Obsolete Sewer Castings
4.	Catch Basin Layout and Gutter Sumps
5.	Catch Basin, Type 1 (Large Orifice)
6.	Catch Basin, Type 3 (Small Orifice)
7.	Catch Basin and Storm Inlet, Type 4 (Gutter Grating)
8.	Catch Basin and Storm Inlet, Type 5 (Basket Grating)
9.	Catch Basin, Type 6 (Open Mouth with Grating)
10.	Storm Inlet, Type 1 (Large Orifice)
11.	Storm Inlet, Type 2 (Large Orifice with extension for future Stench Chamber)
11-A	Storm Inlet, Type 2 - Method of Constructing Slot in Brick Work.
12.	Storm Inlet, Type 3 (Small Orifice)
13.	Storm Inlet, Type 6 (Open Mouth with Grating)
14.	Storm Inlet, Type 7 (Small Basket Grating)
15.	House Laterals
16.	Concrete Reinforcement for Sewers
17.	Excavation Lines and Trench Repaving for Sewer Construction
18.	Manholes over Terra Cotta Pipe Sewers
19.	Manholes over Concrete Pipe Sewers
20.	Brick Sewers and Manholes over Brick Sewers
21.	Iron Fence, Type 3 Assembly
22.	Iron Fence, Type 3. Details of connections.
23.	Iron Fence, Type 3 and 4. Standard Newel Post
24.	Iron Fence, Type 4. Assembly
25.	Iron Pipe Hand Railing
26.	Wooden Steps
27.	Wood Fence and Wood Barrier
28.	Iron Fence Type 2. Assembly
29.	Iron Fence, Type 2. Newel Post
30.	Iron Fence, Type 2. Intermediate Post
31.	Temporary Loading Platforms, Cross and Side Foot Walks.
32.	Temporary Roadway Crossings, for Streets, Ways and Driveways
33.	Sidewalk Pavements. Arrangement and construction.
34.	Brick Manhole for Water Lines.

CITY OF PITTSBURGH
DEPARTMENT OF PUBLIC WORKS - BUREAU OF ENGINEERING
ASSEMBLY OF NEW STANDARD SEWER CASTINGS

APPROVED (sgd.)Carl M. Vetter-1-6-37 DESIGNING ENGINEER

APPROVED 1-6-37(sgd.)John D.Stevenson ENGINEER IN CHARGE, B OF E.

APPROVED (sgd.) John J. Croak CHIEF ENGINEER, D P W

APPROVED (sgd.) F.M. ROESSING D I R E C T O R - DPW.

	TYPE	FRAME	LID	STENCH PLATE	WEIR	GRATING	HOOD
CATCH BASINS							
Straight Curb - 4' 6" Weir - Stench Chamber	1	48	47	17	8		
6' Radius Curb - 5' 0" Weir - Stench Chamber	1	49	47	17	9		
12' Radius Curb - 4'8" Weir - Stench Chamber	1	50	47	17	51		
Straight Curb - 3' 0" Weir - Stench Chamber	3	11	2	17	12		
Gutter Grating - Stench Chamber	4	19		17		20	
Basket Grating - Stench Chamber	5	69		17		68	
Combination Grate-Open Mouth - Stench Chamber	6	60	--	17		42	66
STORM INLETS							
Straight Curb - 4' 6" Weir	1	48	47		8		
6' Radius Curb - 5' 0" Weir	1	49	47		9		
12' Radius Curb - 4' 8" Weir	1	50	47		51		
Straight Curb - 4' 6" Weir - Future Stench Chamber	2	48	47	67	8		
6' Radius Curb - 5' 0" Weir - Future Stench Chamber	2	49	47	67	9		
12' Radius Curb - 4' 8" Weir - Future Stench Chamber	2	50	47	67	51		
Straight Curb - 3' 0" Weir - Future Stench Chamber	3	11	2		12		
Gutter Grating	4	19				20	
Basket Grating - 13" Frame	5	15				16	
Combination Grate - Open Mouth	6	60				42	66
Basket Grating - 9" Frame	7	63				62	

MANHOLES		
Checkered Top - 13" deep - Use with Blockstone Pavement	23	25
Checkered Top - 9" deep - Use with Asphalt, Brick or Concrete Pavement	26	25
Checkered Top - 6" deep - Use in Sidewalks	65	25
Manhole Steps.....Castings No. 64		

-238-

CITY OF PITTSBURGH
DEPARTMENT OF PUBLIC WORKS - BUREAU OF ENGINEERING
WEIGHTS OF STANDARD SEWER CASTINGS

Approved: (sgd) 1-6-37 Carl M. Vetter
Designing Engineer

Approved: 1-6-37 John D. Stevenson (sgd.)
Engineer in Charge, B of E.

Approved: (sgd) John J. Cronk
Chief Engineer, D P W

Approved: (sgd.) F. M. Roessing
D i r e c t o r - D P W.

Casting No.	Description	Drawing No.	Weight in Pounds Std.	Max.	Min.
2	Filled Cover for Catch Basin and Storm Inlet,Type 3.	M77	77	81	73
8	Plain Weir-straight Curb-for Catch Basin Type 1 and Storm Inlets, Types 1 and 2.	M84	127	133	121
9	Plain Weir-6' Rd.Curb-for Catch Basin Type 1 and Storm Inlets, Types 1 and 2.	M85	150	158	142
11	Frame-Straight Curb-for Catch Basin and Storm Inlet, Type 3.	M73	318	328	308
12	Plain Weir-Straight Curb-for Catch Basin and Storm Inlet - Type 3.	M73	91	96	86
17	Stench Plate for Catch Basins, Types 1,3,4,5 and 6	M74	280	294	266
19	Frame for Catch Basin and Storm Inlet, Type 4	M75	692	713	671
20	Grating Cover for Catch Basin and Storm Inlet,Type 4	M75	232	244	220
23	Frame - 13" deep for Manholes.	M76	722	744	700
25	Checkered Cover for Frames Nos. 23, 26 and 65	M76	205	216	194
26	Frame - 9" Deep for Manholes.	M76	555	572	538
42	Grating Cover for Catch Basin and Storm Inlet,Type 6	M75	232	244	220
47	Filled Cover for Catch Basin, Type 1 and Storm Inlets, Types 1 and 2	M84	99	104	95
48	Frame-Straight Curb for Catch Basin Type 1 and Storm Inlets, Types 1 and 2	M84	586	604	568
49	Frame - 6' rad.Curb-for Catch Basin, Type 1 and Storm Inlets, Types 1 and 2	M85	572	589	552
50	Frame - 12' Rad.Curb-for Catch Basin, Type 1 and Storm Inlets, Types 1 and 2	M85	575	592	558
51	Plain Weir-12' Rad.Curb for Catch Basin Type 1 and Storm Inlets, Types 1 and 2	M85	135	142	128
60	Frame for Combination Open Mouth Catch Basin and Storm Inlets, Type 6	M86	474	488	460
62	Grating Cover - Basket Frame for Storm Inlet,Type 7	M73	61	64	58
63	Basket Frame - for Storm Inlet, Type 7	M73	103	108	98
64	Cast Iron Manhole Step	M74	12	13	11
65	Frame - 6" Deep for Manholes	M76	270	283	257
66	Hood Castings for Catch Basin and Storm Inlet,Type 6	M86	225	236	214
67	Stench Plate - Storm Inlets, Type 2	M74	143	150	136
68	Grating Cover - Basket Frame for Catch Basin and Storm Inlet, Type 5	M125	141	149	134
69	Basket Frame for Catch Basin and Storm Inlet, Type 5	M125	420	433	407

CITY OF PITTSBURGH
DEPARTMENT OF PUBLIC WORKS - BUREAU OF ENGINEERING
WEIGHTS OF OBSOLETE SEWER CASTINGS
(NOT STANDARD)

Approved (sgd.) 1-6-37 Carl M. Vetter
Designing Engineer

Approved 1-6-37 John D. Stevenson (sgd.)
Engineer in Charge, B of E.

Approved (sgd.) John J. Croak
Chief Engineer, D P W

Approved (sgd.) F.M. Roessing
D i r e c t o r - D P W.

Casting No.	Description	Drawing No.	Weight in Pounds Std.	Max.	Min.
21	Frame for Box Storm Inlet, Type 2	M 75	188	198	178
22	Grating Cover for Box Storm Inlet, Type 2	M 75	83	87	79
24	Filled Cover for Manhole Frames, Nos.23 and 26	M 76	220	231	209
27	Frame 5" Deep for Manholes	M 76	229	241	217
28	Filled Cover for Frame No. 27	M 76	103	108	98
29	Removable Cover for Manhole Trap	M 76	98	103	93
30	Frame for Manhole Outlet Trap	M 76	144	151	137
31	Frame for Box Storm Inlet, Type 1	M 66	436	449	423
32	Plain Weir for Box Storm Inlet, Type 1	M 66	46	48	44
33	Filled Cover for Box Storm Inlet, Type 1	M 66	63	67	59
41	Frame for Catch Basin and Storm Inlet, Type 4, and Box Storm Inlet, Type 4	M 75	703	724	682
52	Removable Trap Cover for Catch Basin, Type 2.	M 84	58	61	55
53	Trap Frame for Catch Basin, Type 2.	M 84	188	197	179
54	Grating - Combination Grate-Open Mouth Inlet	M 86	305	314	296
55	Frame-Combination Grate-Open Mouth Inlet,Type 1.	M 86	490	505	475
56	Hood 10"-Combination Grate-Open Mouth Inlet, Type 1	M 86	130	137	123
57	Hood 8"-Combination Grate-Open Mouth Inlet, Type 1	M 86	115	121	109
58	Frame-Combination Grate-Open Mouth Inlet, Type 2	M 86	612	630	594
59	Hood-Combination Grate-Open Mouth Inlet,Type 2.	M 86	114	117	111
61	Curb Castings-Combination Grate-Open Mouth Catch Basin, Type 6	M 86	125	131	119
15	Basket Frame for Catch Basin and Storm Inlet, Type 5	M 74	564	581	547
16	Grating Cover for Catch Basin and Storm Inlet, Type 5	M 74	77	81	73
18	Stench Plate for Catch Basins, Types 1 and 5, (Old Types)	M 74	444	458	430

CITY OF PITTSBURGH

ALL DEPARTMENTS

SUPPLEMENTS TO AND REVISIONS OF THE

STANDARD SPECIFICATIONS FOR MATERIALS

AND CONSTRUCTION DATED NOVEMBER, 1938

A

N

D

ADDENDA TO THE GENERAL CONTRACT CONDITIONS

EDITION OF JULY, 1955

REVISED - MARCH, 1962

CITY OF PITTSBURGH

DEPARTMENT OF PUBLIC WORKS

SUPPLEMENTS TO, AND REVISIONS OF THE STANDARD SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION, DATED NOVEMBER, 1938, AND ADDENDA TO THE GENERAL CONTRACT CONDITIONS, EDITION OF JULY 1955

****

INDEX TO CONTENTS

Continued .....

SUPPLEMENTS TO, AND REVISIONS OF THE STANDARD
SPECIFICATIONS FOR MATERIALS AND CONSTRUCTION

****

INDEX TO CONTENTS (CONTINUED)

PARTS OF CONTRACT

1. All work under this Contract shall be done in accordance with the General Contract Conditions, Edition of July 1955,and the Standard Specifications for Materials and Construction, dated November 1938, together with the Supplements and Revisions hereinafter set forth, except as otherwise stipulated and provided on the Contract Plans, or in Supplemental or Special Specifications for this contract. In the event of confliction, the instrument of latest date shall govern.

INSPECTION COSTS (Revision of Section 103)

2. In addition to the transportation costs, the Contractor will be required to defray subsistance expenses for inspection services where the City representative travels outside the limits of Allegheny County in an amount not exceeding $15.00 per day. In all other respects the requirements of Section 103 of the Standard Specifications for Materials and Construction shall apply.

PORTLAND CEMENT - GENERAL (Revision of Section 104) (Rev. 4-1954)

2-A Portland Cement shall meet the requirements of the following A.S.T.M. Specifications with all subsequent additions and amendments thereto:

(a) Portland Cement (Non Air Entraining) shall conform to A.S.T.M. C-150, Type I or Type III; or A.S.T.M. C-205, Type IS, unless otherwise specified by the Director.

(b) Portland Cement (Air Entraining) shall conform to A.S.T.M. C-175, Type IA or Type IIIA; or C-205, Type IS-A, unless otherwise specified by the Director.

STEEL REINFORCEMENT - GENERAL (Addendum to Section 144)

3. Unless otherwise specified, or approved in writing by the Director, or indicated on the Contract Plans, all reinforcing bars shall be an approved type of deformed bars.

COMMON MASONRY BRICK (Revisions to Section 169) (Rev. 3-1949)

4. The Contractor shall use Common Masonry Brick, conforming to the following requirements for catch basins, inlets, manholes, sewers and other brick masonry, except as otherwise stipulated on Contract Plans, or in Supplemental specifications.

Common Masonry Brick shall meet the standard specifications and tests for Building Brick, Grade SW, adopted by the American Society of Testing Materials, Serial Designation C62-44, with all subsequent amendments and additions thereto adopted by said Society, except as may be specified hereinafter.

The brick shall be 2 1/2" in thickness, 3 3/4" in width and 8" in length; individual bricks shall not vary from the standard size by more than 1/8" in depth or width, and 1/4" in length. The brick shall be of

COMMON MASONRY BRICK (Cont.)

uniform color and texture for any one contract.

Brick shall be rejected for the following causes by visual inspection; off-size, off-color, over-burned, under-burned, unclean, misshapen, kiln-marked, chipped, cracked, warped, containing particles of lime, or other defects that would impair their serviceability in a structure.

If during the process of visual inspection, the percentage of brick rejected exceeds 5% of the brick inspected, the total shipment shall be rejected, although physical test requirements are satisfactory.

COMMON MASONRY BRICK (Revisions to Section 169) (Cont.)

Common Masonry Brick to be used in the above mentioned underground structures, may be dumped from trucks at the owner's risk, as all chipped or spalled brick will be rejected, if in the opinion of the Director it will impair the structure.

Failure to meet any of the foregoing requirements shall be sufficient cause for rejection of shipment and cancellation of Contract.

CLAY SEWER PIPE (Revision of Section 171)

5. All sewer pipe and specials shall be of the best quality of salt glazed vitrified clay sewer pipe of the hub and spigot pattern, and shall conform to the A.S.T.M. Specifications and Tests for Standard Clay sewer Pipe as set forth in Serial Designation C-13-44-T, and all amendments and additions thereto adopted by said Society.

6. REINFORCED CONCRETE PIPE AND R. C. PIPE SEWER

JOINTS (Superseding Requirements of Section 173)

The ends of tongue and groove pipe shall be of such design that the pipe when laid together in proper alignment, shall butt together on both the inside and outside when a diameter of the tongue end of one pipe is in any position of the circle with respect to the diameter of the groove and of the adjoining pipe, and the inside of the pipe shall form a smooth and uniform interior surface.

JOINTS (Superseding Requirements of Section 540)

When reinforced concrete pipe of the bell and spigot type are furnished, the joints shall be bituminous joints conforming to the requirements given for Terra Cotta Pipe Sewers.

When reinforced concrete pipe is furnished in the beveled tongue and groove type, the joints shall be made in conformity with the following:

The interior recess of the joint shall be thoroughly cleaned and pipes forced together as much as possible, with the following maximum openings between ends permitted.

For pipes 48" or less in diameter, not over 3/4"; for pipes above 48" to 66" in diameter, not over 1"; for pipes 66" in diameter, not over 1 1/4". This is a tolerance only and the Contractor shall make every effort to have all joints closed.

The entire joint for the whole inner circumference and the top half, above springing line, on the outside of the pipe, shall be wetted

TEST CORES IN CONCRETE PAVEMENT OR BASE (Revision of Sec. 571) Cont.

and at the rate of $10.00 per core; such expense shall be deducted from any payments due to the contractor.

MISPLACED STEEL REINFORCEMENT (Revision of Sec. 573) (Rev. 3, 1949)

19. Where the Director approves the request of the Contractor for payment of construction with Misplaced Reinforcement at an adjusted price, payment shall be made in conformity with the following table:

Distance off normal position in relation to top of pavement	Amount to be deducted per square yard of pavement
0" to 1"	Nothing
1" to 2"	10% of Bid Price
2" to 3"	15% of Bid Price
3" to 4"	20% of Bid Price
Above 4"	25% of Bid Price

Test cores shall be taken for at least each 500 square yards of concrete pavement at locations determined by the Director. The area of the entire section of concrete between longitudinal and transverse joints shall be taken as the area of concrete street pavement represented by any one test core showing misplaced reinforcement, and additional cores shall be drilled in adjoining slabs in a longitudinal direction until cores within the permitted tolerance are found. Additional cores shall be at the expense of the Contractor and at the rate of $10.00 per core and such expense shall be deducted from any payments due the Contractor. If Reinforcement is found to be less than 3/4" below the surface, the slab between longitudinal and transverse joints must be removed and replaced.

ADDITIONAL LUMBER IN STRUCTURES AND FACILITIES (Addendum to Sec. 616)

20. The Director shall have the right to order such "Additional Lumber" to remain without additional compensation to the Contractor.

Any temporary Lumber Structures and Facilities required under Sec. 615 of the Specifications for access to private properties and ordered by the Director to remain, shall be measured for payment under the Item "Additional Lumber in Structures and Facilities".

21. CAST IRON WATER PIPE WORK (Revision of Sec. 631, 632 and 640) (Rev. 3, 1949)

2-C MAJOR WORK TO BE DONE (Revision) (Rev. 3,1949)

The work to be done on water mains and their appurtenances, including but not limited to laying, relaying, raising and/or lowering, consists of furnishing all materials, labor, tools and equipment and completing all parts of the work together with all the required appurtenances and

2-C MAJOR WORK TO BE DONE (Cont.)

connections complete, and making ready for service, including the digging, draining, sheeting, shoring, protecting and backfilling of excavations; the furnishing and setting of all special castings, gate valves, fire hydrants, air valves, plugs, caps and other appurtenances, the building of all manholes, vaults and concrete blocking, the making and connecting up of all branch connections, drains, blowoffs and services, and furnishing of all materials for same, also the testing of all pipe in place, the thorough mechanical remming of the backfilling in tranches, the repairing and repaving of streets, the removal of all surplus material promptly, and all else necessary for the proper completion of the work, in accordance with the contract plans, working drawings, these detail specifications and all other requirements of this contract.

4-C RELAYING (Revision) (Rev. 3, 1949)

Relaying shall be understood to consist of the installation of new water pipe lines, using new materials and the reconnecting to the new pipe lines of all mains and/or water service connections which are not required to be otherwise disturbed.

Payments made at the unit price bid per lineal foot for "Relaying Cast Iron Water Pipe" shall be full compensation for furnishing all material and doing all work incidental thereto as defined above and including the furnishing of all materials, labor, tools and equipment and completing all parts of the work together with all the required appurtenances and connections complete, and making ready for service, including the digging, draining, sheeting, shoring, protecting and backfilling of excavations; the furnishing and setting of all special castings, gate valves, fire hydrants, air valves, plugs, caps, and other appurtenances, the building of all manholes, vaults and concrete blocking, the making and connecting up of all branch connections, drains, blowoffs and services, and furnishing of all cast iron material for same, also the testing of all pipe in place, the thorough mechanical reamming of the backfilling in tranches, the repairing and repaving of streets, the removal of all surplus materials promptly, and everything necessary for the proper completion of the work, in accordance with the contract plans, working drawings, these detail specifications and all other requirements of the contract.

The City of Pittsburgh will install corporation cocks without charge. The Contractor shall remove, where directed, all existing pipes, appurtenances and specials and deliver such removed materials and stack the same at a designated yard of the Department of Water in accordance with the drawings and provisions of this contract. The cost of such work being included in the price submitted under the item for "Relaying Cast Iron Water Pipe".

Separate payments will be made for the adjustments or renewals of water service lines.

5-C RAISING OR LOWERING (Revision) (Rev. 3, 1949)

Raising or lowering shall be understood to consist of the use of existing materials in pipe lines and the changing of same, together with all connecting main pipe lines and services, from the present or old grade to the new grades with at least four (4) feet depth of cover in accordance with the drawings and provisions of this contract.

Payment made at the unit price bid per lineal foot for "Raising or Lowering Cast Iron Water Pipe" shall be full compensation for doing all work incidental thereto as defined above in Paragraph 4-C. Separate payments will be made for the adjustments or renewals of water service line.

5.1-C PRIVATE WATER SERVICE LINES (Superseding Sec. 632) (Rev. 3-1949)

Payment for everything required for the raising or lowering of water service lines from the present or old grade to the new grades with at least four (4') feet depth of cover will be made at the unit prices bid per lineal foot for raising and lowering water service lines. The unit price bid per lineal foot for this work shall include the reconnecting of the service line to the street main together with any new material and labor required therefor, such as set forth in Paragraph 4-C above.

When ordered by the Director, the Contractor shall reconstruct or replace private water service lines from the supply line in the street to private property with at least four (4') feet depth of cover to the extent ordered by the Director in accordance with the Specifications and regulations of the Department of Water. The new pipe line shall be of the same size or larger than the existing pipe and shall be double "X" lead, or copper pipe "K" grade, unless otherwise ordered by the Director.

Where lead pipe is used the pipe should not be stretched tightly to ferrule but should be bent into an extended "S" shape to allow for any future settlement of the street main or ground movement.

Where "Type K" Soft copper tubing is used, the joints are to be made with flanged type union couplings with proper flange coupling and "S" bend at the ferrule.

The use of hard copper tubing with sweat joints and cup joints on lead pipe under the streets are not acceptable.

Payment for reconstructing or replacing private water service lines when ordered by the Director will be made at the unit price bid per lineal foot for this work and shall include the reconnecting of the service line to the street main together with all the new material and labor required therefor, such as set forth in Paragraph 4-C, above.

5.2-C WATER CURB BOXES OR CURB COCKS (Superseding Sec. 631) (Rev. 3, 1949)

Where it is necessary, in the opinion of the Director, to install new water curb boxes, payment for furnishing and installing the same, complete with cast iron cover to the proper pavement grade shall be made at the unit

5.2-C WATER CURB BOXES OR CURB COCKS (Cont.)

price bid therefor.

Where it is necessary, in the opinion of the Director, to install new curb cocks, payment for furnishing and installing the same shall be made at the unit price bid therefor.

The price bid for "Water Curb Boxes" or for "Curb Cocks" shall include full compensation for all materials and labor required, such as set forth in Paragraph 4-C above, for the respective item.

26-C SETTING GATE VALVES AND BOXES (Revision)

Gate valves shall be set by the Contractor upon well supported concrete foundations of specified size where directed. Where concrete supports are required, the blocking under gates shall be so located as not to interfere with the proper placing of the concrete. Around all gate valves shall be placed a box, or manhole of cement laid brick, or concrete, as may be required, resting upon cement laid brick or concrete foundations, and so set to make the covers conform exactly with the grade or slope of the finished surface of the graded or paved roadway or walk; all as shown on plans of standard gate box setting and foundation work, for pipe lines of various sizes, at standard depths.

31-C MATERIALS (Revisions)

The materials to be incorporated in the work shall be the best of their respective kind, and be in harmony with the intent of this contract to secure first-class work. The major materials to be so furnished shall conform to the following requirements:

Cast iron pipe and special castings shall be American Water Works (Class D), Cement Lined, or 250 Class, Bell and Spigot, Centrifugal Cart, Cement Lined Pipe. Hydrants, Gate Valves, Medium Extension Gate Boxes, Frames and Covers for Gate Boxes and Lead shall be in accordance with the Standard Specifications of the Bureau of Water for the purchase of such materials for the current year.

Hemp or Jute shall be equal in quality to American Class B Hemp, and shall be oiled or dry, as the Director shall order. Braided Hemp is required for compound joints.

Leadite shall be equal to the best quality of leadite as furnished by the Leadite Company of Philadelphia, Pa.

Mineralead shall be of the best quality as furnished by the Atlas Mineral Products Company of Pennsylvania, Mertztown, Pa.

Hydrolite shall be of the best quality as furnished by Hydraulic Development Corporation of Boston, Mass.

Heymanite shall be of the best quality as furnished by Michael Hayman & Company, Inc. of Buffalo, New York.

Lumber for boxes or blocking shall be No. 2 Rough White Pine free from knots or other imperfections.

22. BITUMINOUS SURFACING T-50 (Addition) (Rev. 4, 1954)
Type B and Type C

This surfacing shall consist of an asphaltic concrete binder course one and one-half inches (1 1/2") in thickness, and asphaltic concrete surface course one and one-half (1 1/2") inches in thickness after final compression, unless otherwise specified or indicated on the drawings, and constructed on a prepared base course.

The binder course shall conform to the requirements of the Specifications governing the binder course for Sheet Asphalt Surfacing SA.

A. MATERIALS

1. Asphaltic Cement The asphaltic cement shall be the (60-100) penetration grade and shall meet the requirements of the City of Pittsburgh Specifications.

2. Mineral Aggregate The mineral aggregate shall be slag sand or stone sand composed of clean, hard, durable, uncoated particles free from clay or organic material and meet the City of Pittsburgh Quality requirements for such aggregates. The total mineral aggregate shall be uniformly graded from coarse to fine and shall conform to the following requirements by weight when tested with standard laboratory sieves.

Total Per Cent by Weight Passing Square Openings Based on Laboratory Sieves

Material	#200	#100	#50	#20	#8	#4	3/8"	1/2"	3/4"	1"
Binder Coarse						0-15		40-60	90-100	100
Surface Course Type B					0-15	10-30		100		
Surface Course Type C	0-6	0-20	5-35	30-70	70-90	90-100	100			

The filler shall meet the grading requirements as specified by the City of Pittsburgh for asphalt construction.

B. CONSTRUCTION METHODS

1. Composition and Preparation - The coarse aggregate, fine aggregate and the asphalt cement shall be combined in such proportions that the composition by weight of the finished mix shall be as directed, but within the following range limits:

COMPOSITION - BINDER COURSE (JA-1)
(Used with all hot mixes)

Passing Sieve	Retained on Sieve	Per Cent Minimum	Per Cent Maximum
1"			
1/2"	1/2"	25	35
No. 8	No. 8	25	35
Bituminous	—	25	35
		6	9

COMPOSITION - TYPE "B" WEARING COURSE
(Medium Texture)

Passing Sieve	Retained on Sieve	Per Cent Minimum	Per Cent Maximum
1/2"			
No. 8	No. 8	35	50
No. 200	No. 700	40	55
Bituminous	—	2	5
		8	10

COMPOSITION - TYPE "C" WEARING COURSE

(Fine Texture)

Passing Sieve	Retained on Sieve	Per Cent Minimum	Per Cent Maximum
3/8"			
1/8"	1/8"	15	25
No. 200	No. 200	60	75
Bituminous	—	5	10
		9	11

The coarse aggregate and fine aggregate shall be dried and heated in a suitably designed reolving dryer to a temperature of not less than three hundred(300) and not more than four hundred (400) degrees F., as ordered by the Director, to meet weather conditions and the character of the asphaltic concrete course to be placed. The asphalt cement shall be heated to a temperature of not less than two hundred fifty (250) and not more than three hundred (300) degrees F. The required quantities of the various aggregates and filler shall be measured separately and accurately by weight for each batch. The hot asphalt cement shall be weighted separtely with a scale attached to the asphalt cement bucket or measured by an approved matering device. Mixing shall take place in an approved type of twin pug mill mixer and mixing shall continue until an asphaltic concerete mixture is obtained that is uniform and completely coated with hot asphalt cement. The temperature of the completed mixture at the plant shall be from two hundred twenty-five (225) to three hundred (300) degrees F., as ordered by the Director.

2. Laying Preparation of Base, Delivery of Surface Mixture, Equipment and placing surfacing mixture, joints in surface course, testing finished surface and protection of surface course, shall be governed by the City of Pittsburgh Specifications for Bituminous Surface Course JA-1.

23. BITUMINOUS SURFACING ID-2 (Addition) (Rev. 3-49)

This surfacing shall consist of an aspahltic concrete binder course one and one-half inches (1 1/2") in thickness, and asphaltic concrete surface course one and one-half inches (1 1/2") in thickness after final compression, unless otherwise specified or indicated on the drawings, and constructed on a prepared base course.

The binder course shall conform to the requirements of the Specifications governing the binder course for Sheet Asphalt Surfacing - SA.

The ID-2 Surface Course shall meet the following requirements:

A. MATERIALS

1. Asphaltic Cement The asphaltic cement shall be the (60-70) penetration grade and shall meet the requirements of the City of Pittsburgh Specifications.

2. Mineral Aggregates The mineral aggregates shall be slag or stone composed of clean, hard, durable, uncoated particles free from clay or organic material and meet the City of Pittsburgh quality requirements for such aggregates. The total mineral aggregates shall be uniformly graded from coarse to fine and shall conform to the following requirements by weight when tested with standard laboratory sieves.

BITUMINOUS SURFACING ID-2 (Cont.)

2. Preparation of the Base, Delivery of Surface Mixture, Spreading and Finishing Equipment, Placing Surface Mixture, Joints in Surface Course, Checking for Thickness of Surface Course and Protection of Surface Course, shall be governed by the City of Pittsburgh Specifications for Sheet Asphalt Surfacing - SA.

WORK IN RAILWAYS AREA (Addition)

24. Where work is indicated on the Contract Plans to be performed in the area of the Pittsburgh Railways Tracks, this work will not be included in the Contract, but is the responsibility of the Pittsburgh Railways Company, and the Railways Company will pay the cost of all construction within the lines of the Railways area. The Contract shall include, however, one joint plate with dowels where required, adjacent to the Railways area. The other joint plate or plates will be provided by the Pittsburgh Railways Company.

Where items of work similar to those contained in this Contract are required to be done by the Pittsburgh Railways Company, the successful contractor will be expected to enter into an agreement with said Railways Company to perform such work at unit prices not exceeding the respective prices bid for similar items of work under the City Contract. The Pittsburgh Railways Company, however, reserves the right to do any or all work for which they are responsible with their own forces or otherwise.

The Pittsburgh Railways Company will lift their pavement, if any, rails and ties in the existing Railways area of the street and remove same from the site. They will do all necessary grading, preparing sub-grade for the new tracks and roll the sub-base when required to a minimum depth of four (4) inches and to the proper elevations. The Railways Company will assemble the new tracks and place same to proper lines and grades. Where the new track is constructed on steel ties, each rail shall be supported on 8" x 6" concrete blocks spaced about 10 feet apart.

The surfacing outside the rails shall be laid in the Railways area in conjunction with that laid in the shoulder under the City Contract, except where concrete street pavement is required.

The Pittsburgh Railways Company is entitled to any existing blockstone in the area of the track to be replaced. Blockstone from the Railways area shall be lifted separately and kept separate from stone lifted in the City's area.

Rail plaster shall be cured with wet burlap for at least 24 hours prior to the laying of surfacing.

AIR ENTRAINING CEMENT IN CONCRETE PAVEMENTS, CURBS, SIDEWALKS, STEPS AND PLATFORMS (Revision) (Rev. 4-1954)

25. Unless otherwise specified, all concrete for wearing surfaces of slabs of street pavements and for all curbs, sidewalks, steps and platforms shall be air entrained Portland Cement Concrete. The cement shall conform to the requirements of A.S.T.M. C-175, Type IA or C-205, Type ISA. The concrete shall be proportioned as prescribed herein under "Concrete Street Pavements", and shall be designated as Class "P" concrete or Class "PP" concrete.

The air-entraining characteristic may be achieved by adding an approved air-entraining agent by means of an approved automatic metering dispenser.

The concrete, at the time it is placed in the forms shall have a slump of not more than three (3) inches, and an air content of not less than 3%, nor more than 6% by volume.

ASPHALT MASTIC BOARD (Addition)

26. Asphalt Mastic Board used in concrete pavements or sidewalks for construction or contraction joints shall meet the following requirements:

The material shall be Asphalt Mastic Board, approximately 1/8" thick with two (2) outside liners made from .016 inch asphalt saturated craft paper, formed as a trapezoid 2 1/2" in width at the base, 1 1/2" in width at the tope and 1" deep.

The mastic board shall be available in any width, 1/4" less than the pavement depth. Standard lengths shall be ten feet one inch (10' 1") to provide for overlap or other lengths as may be required. Holes shall be punched for standard stake pins at 12" centers, and when required tie bar holes at 2' 6" centers.

RIGIDITY: When a sample of the material is clamped between two blocks so that it cantilevers 18" and placed in a horizontal position with a 500 gram weight on the end of the strip in a room at 77° F., it will not sag more than 1/2" in one hours.

ABSORPTION: When a sample is immersed in water for 24 hours, it shall absorb not more then eight (8) per cent by weight.

BITUMEN: The sample shall contain not less than forty (40) per cent and not more than fifty-five (55) percent by weight of bitumen soluble carbon tetra chloride.

For sidewalk construction, the mastic boam may be furnished in flat strips.

FIBRE EXPANSION JOINT MATERIAL (Addition)

27. This expansion joint material shall be composed of fibre of a cellular nature; uniformly and thoroughly impregnated with a durable asphaltic compound. It shall be available in standard thicknesses of 1/2", 3/4" and 1" and in lengths up to 20 feet and shall meet the following requirements:

The asphalt content shall be not less than 35% and nor more than 50% by weight. The extracted aspahltic compound shall have a standard penetration of not more than 75. The material shall show no disintegration when subjected to ten cycles of alternate freezing and thawing.

When the material has been compressed to 50% of its thickness, repeated five times, it shall return to 75% of its original thickness within one hour after final compression. During the compression test, the extrusion shall be not more than 1/8" and the specimen shall lose not more than 2% by weight of asphaltic compound. A pressure of not less than325 pounds and not more than 500 pounds per square inch shall be required when testing for resilience.

BACKFILLING TRENCHES (Addendum)

28. All backfill in sewer trenches, water line trenches and other trenches, where backfill is required to be placed in horizontal layers and mechanically temped, shall be deposted in horizontal layers from the top of the trench by hand labor. Depositing any backfill directly from trucks or the use of other power equipment of any kind for this purpose is struicly prohibited.

EXTRA STRENGTH CLAY PIPE (Addition)

29. Where Extra Strength Terra Cotta Pipe is required, all sewer pipe and specials shall be of the best quality of salt glazed vitrified clay sewer pipe of the hub and spigot pattern, and shall conform to the A.S.T.M. Specifications and Tests for Extra Strength Clay Pipe, as set forth in Serial Designation C-200-44-T and all amendments and additions thereto adopted by said Society.

In addition to the name of the manufacturer and plant location, each unit of pipe shall bear the initials "E.S.".

CUTTING CONCRETE (Addition) (Rev. 3-1949)

30. Where vertical cuts are required in concrete sidewalks, paving bases and roadway pavements, the Contractor shall use a mechanically driven concrete cutter for a minimum depth of two (2) inches from the top surface.

STREET MONUMENTS (Addition)

31. Where the nature of an improvement requires existing street monuments to be adjusted in elevation or position, the Contractor shall remove the said monument and castings only after City Engineers have referenced same. The Contractor shall then construct a new monument in the location determined by the Director in accordance with details given below, and reset the monument castings thereon to sidewalk level. Compensation for such work and materials shall be included in payments made under other items of work. The City will furnish the new center pin to be installed in the concrete monument. The center pin is 3 1/8" long, 1/2" diameter and made of bronze.

Street monuments shall be constructed of concrete. They shall be 3' 6" long, with the top not less than 6" x 6" square, bettered 1" to the foot vertically to a depth of 18" and the remaining 2' 0" filled to the whole area of the excavation. The top of the monument shall be set 6" below finished sidewalk grade.

STANDARD PLANS

32. Standard Plans for the Construction of Streets, M-126-A and M-127-A, have become obsolete as of April, 1944, and any reference made in the Specifications to "Standard Plans" shall be considered as referring to and meaning the current Standards for Construction of the Bureau of Engineering, in effect as of the date of this Contract.

RESETTING WATER METERS (Addendum)

33. Where the nature of the improvement requires existing water meters to be adjusted in elevation or position, the Contractor shall reset the meter and its housing complete and reconnect the meter to the existing or relocated service line. The new meter housing shall be built in accordance with standard City practice as shown on Bureau of Water Plan-D241. The Contractor shall make good at his own expense any lose or damage to the meter or any part of the housing.

Full compensation for all labor and materials necessary to excavate to proper size and depth to remove meter and its housing and to install same in new location, connected up to new or existing service line, backfill, remove spoil and all other work required in connection therewith shall be included in the unit price bid therefor.

PLACING SHEET ASPHALT (Addendum)

34. Where Sheet Asphalt Surfacing (all types) is laid, the extent of work shall be so limited that all base course laid in any one day shall be covered with the surface course on the same day.

35. REINFORCED CONCRETE STEPS AND CONCRETE JUMPER WALK (Addition)

DETAILS:

Standard Details for Reinforced Concrete Steps and Concrete Jumper Walk are shown on Standard Plans Nos. D-595, F-6710, H-485, L-355.

CONCRETE

All concrete shall be Class "P", made with air-entraining Portland Cement.

For the entire structure, except precast units, the coarse aggregate shall be medium size (No. 8 to 3/4") designated as "Small Class" in Section 124 of the "Standard Specifications for Materials and Construction", dated November 1938.

For all precast tread and platform units, for "Type 2" steps, the coarse aggregate shall be as follows:

Retained on 1/2" mesh screen	0 to 25%
Retained on 3/8" mesh screen	35 to 65%
Retained on #4 mesh screen	36 to 90%
Retained on #8 mesh screen	90 to 100%

Payment made at the unit price bid for "Concrete Steps Type 1" shall be full compensation for furnishing and placing all concrete, reinforcing steel, wearing surface, expansion joint material, all excavation and disposal of excess material to the line 3 feet felow surface of ground, indicated on standard drawings as the minimum depth of footers at center line of columns.

Payment for construction of Concrete Steps in excess of the 3 foot depth described above shall be made from items providing payment for furnishing and placing "Additional Concrete in Footings and Piers for Walls", "Reinforcing Steel" and "Extra Trench Excavation".

Payment made at unit price bid for "Concrete Jumper Walk" shall be full compensation for furnishing and placing concrete, reinforcing steel, wearing surface, granulated slag base, expansion joint material, all excavation and disposal of excess material.

Payment made at the unit price bid for "Concrete Steps Type 2", shall be the same as payment for "Concrete Steps Type 1", except that payment for precast Stair Tread and Platform units shall be proviced for under a separate item.

Measurement for payment for "Concrete Jumper Walk" and "Concrete Steps Type 1 and Type 2" shall be taken horizontally along center line of "Concrete Jumper Walk" or "Concrete Steps".

Payment made at the unit price bid for "Precast Tread and Platform Unit " shall be full compensation for furnishing and placing all precast tread and platform units, including wearing surface.

35. REINFORCED CONCRETE STEPS AND CONCRETE JUMPER WALK (Addition)

CONCRETE - Continued

Cement mortar shall be one volume Portland Cement and two Volumes sand, as described in Section 544 of the "Standard Specifications for Materials and Construction".

All concrete and cement mortar shall be cured by the burlap and water method as described in Sections 510 and 511 of the "Standard Specifications for Materials and Construction".

Instead of the provisions of Section 503 of the "Standard Specifications for Materials and Construction", requiring a natural finish, immediately after the removal of the forms from the concrete structures, and as curing is commenced, all fins shall be removed from the surfaces to be cured, and all exposed formed surfaces, unless otherwise specified, shall be finished in the following manner:

The surface to be finished shall be saturated with water, after which all holes, pockmarks and other indentations of any kind shall be pointed with cement mortar. After the mortar has taken its initial set, (which ordinarily takes place about two hours after application), the finishing shall be completed by rubbing with carborumndum blocks until all fins, and form marks have been removed and a smooth even fixture has been obtained. During the operations of finishing the concrete as little of the surface as possible shall be exposed, and the portions of the surface being finished shall be kept wet while exposed. The use of small quantities of cement in connection with the rubbing operation will be permitted. Immediately after the completion of the finishing on any portion of the surface, such portion shall be recovered and curing continued.

Cement wash finish will not be permitted.

WEARING SURFACE

All stair treads and the platform areas adjacent to the steps and steps in concrete jumper walks shall be provided with non-slip wearing surface as indicated on the Standard Drawings and conforming with requirements set forth in Section 541 of the "Standard Specifications for Materials and Construction", except that the mirimum thickness shall be 1/4".

CAST RAILING POSTS

Cast Railing Posts shall be cast iron or malleable iron, constructed in accordance with the Contract Drawings and Standard Drawing No. D-595, and neatly finished but not machined. All posts shall be erected in true vertical position and to correct elevation, and the space around the post shall be completely filled with cement mortar sloped so as to drain water away from the post.

35. REINFORCED CONCRETE STEPS AND CONCRETE JUMPER WALK (addition)

CAST RAILING POSTS - Cont.

All patterns and core boxes for the various types of cast iron posts shall be furnished to the contractor by the City of Pittsburgh. The contractor shall pick up the patterns and core boxes at the Division of Bridges' Warehouse, 1909 Howard Street, North Side. After the posts are cast, the contractor shall return the patterns and core boxes in good condition to the above warehouse.

Payment made at the unit price bid for "Cast Railing Posts" shall be full compensation for furnishing and placing all cast iron or malleable iron railing posts, including grouting and painting.

PIPE RAILING AND PIPE POSTS

All steel pipe railing and steel posts shall be 1 1/2" extra heavy Pipe. No pressure test required. Steel pipe posts to be completely filled with cement grout upon erection.

All aluminum pipe for railings shall be 1 1/2" extra heavy pipe having a wall thickness of 0.2000 inch and an external diameter of 1.9000 inches. This pipe shall be made from Aluminum Company of America alloy 61S-T6 or equal.

Except where otherwise indicated on the drawings, railing pipe shall be drilled for 5/16" diameter rivets and riveted to the cast railing posts with soft steel rivets, cold driven.

Ends of aluminum pipe railing to be dipped to a depth of 3 inches in Alumilastic Metallic Compound, as manufactured by Parr Paint and Color Company, of Cleveland, Ohio or equal.

If aluminum pipe railing is run continuous through railing post, the entire area of pipe railing within the post shall be painted with the above Alumilastic Metallic Compound.

Aluminum pipe for posts shall be same as for aluminum pipe for railing. Aluminum pipe posts shall not be filled with cement grout.

Aluminum railing to be wiped clean and free of all paint.

Payment made at the unit price bid for "Double Rail Pipe Railing", shall be full compensation for furnishing all double rail steel or aluminum pipe railing, including riveting and Alumilastic Metallic Compound for aluminum pipe and painting of steel pipe. Pipe railing shall be cut with a pipe cutter. No burning will be permitted. The unit price shall be per foot of railing, including both rails, that is, one foot of railing includes two feet of pipe. Measurement for compensation shall be taken along the top rail including the space taken up by the posts, the measurements being taken to the center line of end and corner posts.

35. REINFORCED CONCRETE STEPS AND CONCRETE JUMPER WALK (addition)

PIPE RAILING AND PIPE POSTS - Cont.

Payment made at the unit price bid for "Posts for Single Rail Pipe Railing" shall be full compensation for furnishing and placing all steel for aluminum pipe posts for single rail welded type railing including all grout and painting of steel posts.

Payment made at the unit price bid for "Single Rail Pipe Railing" shall be full compensation for furnishing and placing the steel or aluminum railing pipe for single rail welded type railing, including welding, and painting of steel pipe. Measurement shall be along the top of the pipe. Pipe railing shall be cut with a pipe cutter. No burning will be permitted.

WELDING

All welding on aluminum shall be done by electric arc method, not employing the use of a welding flux.

Welding on steel shall conform to requirements set forth in Section 606 of the "Standard Specifications for Materials and Construction" dated November 1938.

Welding shall be done by a qualified welder, who has passed the "Test for Welders" required by the City of Pittsburgh.

PAINTING

All cast posts and steel pipe shall be painted in the shop with one coat of "Red Lead Primer", as described in Section 6.5 of the Bureau of Tests "Specifications for Paint Materials".

After erection and welding, all welds and areas where shop paint has been scarred in handling, shall be coated with the above Primer. Where pipe railing is constructed with aluminum pipe, the cast posts shall be given approved field paint as described below.

First field coat shall be of the Blued Aluminum Paint as described in Sections 3.9 and 5.4 of the Bureau of Tests' "Specifications for Paint Materials".

Second field coat shall be of Aluminum Paint as described in Sections 3.9 and 5.2 of above specifications.

Where pipe railing is constructed with steel pipe and cast iron or steel pipe posts, the pipe railing and cast iron or steel pipe posts shall be field painted as follows:

35. REINFORCED CONCRETE STEPS AND CONCRETE JUMPER WALK (Addition)

PAINTING - Continued

First field coat shall be of "Dixon Red Lead Graphite Primer No. 101" or equal.

Second Field coat shall be of "Dixon Silica Graphite Extra Light Green No. 115" or equal.

Compensation for painting is included in payment for railing and posts.

36. PAINTING OF EXISTING BRIDGES, PORTIONS OF EXISTING BRIDGES, REPAIR MATERIAL, REUSED METAL, OR OTHER MATERIAL - (Addition)

REQUIREMENTS

General

Painting of existing bridges, portions of existing bridges, repair material, reused metal, or other material, shall include the cleaning and preparation of the surfaces to be painted, the application, protection and drying of the paint coatings, the protection of pedestrian, vehicular or other traffic upon or underneath the bridge, the protection of all portions of the structure against disfigurement by spatters, splashes and smirches of paint and the furnishing of all tools, tackles, scaffolding, labor and materials, necessary for the entire work.

1. Cleaning

The cleaning and painting of surfaces of material to be painted shall conform to the following specifications:

All surfaces of material to be painted shall be thoroughly cleaned, and be approved by the Director before any paint may be applied thereon.

In general, Method A - Hand Cleaning, may be used. However, Method B - Sand Blast Cleaning, when required, will be specified and shall be used.

a. Method A - Hand Cleaning

All metal shall be cleaned by hand cleaning.

36. PAINTING OF EXISTING BRIDGES, PORTIONS OF EXISTING BRIDGES, REPAIR MATERIAL, REUSED METAL, OR OTHER MATERIAL - (Additon)

1. - Cleaning - Continued

Hand cleaning shall remove all rust, scale, loose paint and dirt by the use of power driven-metal brushes, Scrapers, chisels, hammers or other effective means shall be used as required. Oil and grease shall be removed by the use of gasoline or benzine. Bristle or wood fiber brushes may be used only for removing loose dust. Clinging existing paint film which is to remain in place around areas where cleaning has been completed, shall be smoothed so that the superimposed paint coat or coats will present a smooth appearance.

b. Method B - Sand Blast Cleaning

All metal shall be cleaned by sand blast cleaning. The sand blast shall remove all rust, scale, paint, dirt and other substances down to the bare metal. Special attention shall be given to cleaning of corners and re-entrant angles. Before painting, sand and dust adhering to the metal in corners and elsewhere, shall be removed. The cleaning shall be approved by the Director prior to any painting. The metal shall be painted as soon as practicable after it is cleaned and before rust forms.

2. Paint

The number and kinds of coats shall be as follows:

a. When Method A - Hand Cleaning is used to clean the material to be painted, rivet heads, bolt heads and nuts shall be "spot painted" with one (1) coat of shop coat paint, regardless of whether the metal in these materials is made bare by the cleaning operation. Other surfaces of material to be painted, from which the paint has been removed, in the cleaning operation, shall also be spot painted.

"Spot coat" applied to bridge railing or fence shall be allowed seven (7) days to dry before first coat of paint is applied.

All surfaces to be painted shall receive two (2) full coats of paint plus a "spot coat" as described above.

Paint for the spot coat shall be City, Bureau of Tests Specification 6.5 - "General Shop Coat Red Lead".

The first full coat for all surfaces, except bridge railing, shall be City, Bureau of Tests Specification 7.1 "General-First Field Coat-Brown".

36. PAINTING OF EXISTING BRIDGES, PORTIONS OF EXISTING BRIDGES, REPAIR MATERIAL, REUSED METAL, OR OTHER MATERIAL - (Addition)

2. - Paint - a. - Continued

The first full coat for bridge railing shall be a modification of the General Zinc Chromate Primer - JAN-P-735.

The second full coat shall be composed of 2 pounds of Aluminum Paste 209 or equal, in 1 gallon of City, Bureau of Tests Specification - aluminum Vehicle 5.3.

b. When Sand Blast Method of cleaning is specified, all sand blasted surfaces to be painted shall receive three (3) full coats of paint as follows:

The first coat shall be City, Bureau of Tests Specifications 6.5 "General Shop Coat Red Lead".

The second full coat for all surfaces, except bridge railing, shall be City, Bureau of Tests Specification 7.1 "General-First Field Coat-Brown".

The second full coat for bridge railing shall be a modification of Federal Zinc Chromate Primer - JAN-P-735.

209 The third full coat shall be composed of 2 pounds of Aluminum Paste/or equal, in 1 gallon of City, Bureau of Tests Specification - Aluminum Vehicle 5.3.

Areas of Paint damaged by the contractor shall be repaired by him in accordance with these specifications and in a manner satisfactory to the Director.

3. Painting Conditions

Paint shall not be applied when the temperature of the air or paint is under 45°F., or when the air is misty, or when, in the opinion of the Director, conditions are unsatisfactory for the work. It shall not be applied upon damp or frosted surfaces or when the metal is hot enough to cause the paint to blister, produce a porous paint film or the vehicle to separate from the paint.

Paint shall be applied on a previously applied coat of paint only after that paint is thoroughly dry and hardened.

Material painted under cover in damp or cold weather shall remain under cover until dry or until weather conditions permit its exposure in the open.

36. PAINTING OF EXISTING BRIDGES, PORTIONS OF EXISTING BRIDGES, REPAIR MATERIAL, REUSED METAL OR OTHER MATERIAL - (Addition)

4. Application

Painting shall be done in a neat and workmanlike manner. Paint shall be applied by hand brushes. The coating of paint applied shall be smoothly and uniformly spread so that no excess paint will collect at any point.

Paint shall be thoroughly stirred, preferably by means of mechanical mixers, before being removed from the containers, and is shall be kept stirred while painting is being done.

No paint shall be applied to the surfaces of -

a. Bronze plates and markers.

b. Stone and concrete masonry or superstructures.

The painting of a bridge shall also include the painting of the exposed metal surfaces and underside and ends of steel T-beam, steel beam and metal plate flooring; of metal towers and bents; of metal substructure bracing; or metal encasing of piers and abutments; and of metal railing on wing walls and retaining walls along the bridge approaches.

All small cracks and cavities, such as back of crimped stiffeners, around splice plates, etc., which were not sealed in a watertight manner by the first coat of paint, shall be filled with a pasty mixture of red lead and linseed oil which must be dry before the next coat is applied.

Plain structural steel requiring painting, if not painted in the shop, shall be given the coat of coats of paint in the field as indicated or specified, for shop and field painting.

Surfaces where the bare metal has been exposed shall be immediately cleaned, then spot painted with the shop coat paint, and be repainted with the number of coats of paint specified in the contract.

5. Brushing

Brushes shall perferably be round or oval in shape. If flat brushes are used, they shall be not over three (3) inches wide. The paint shall be so manipulated under the brush as to produce a smooth, uniform, even coating in close contact with the metal or with previously applied paint, and shall be worked into all corners and crevices.

36. PAINTING OF EXISTING BRIDGES, PORTIONS OF EXISITNG BRIDGES, REPAIR MATERIAL, REUSED METAL OR OTHER MATERIAL - (Addition)

5. - Brushing - Continued

In general, the primary movement of the brush shall describe a series of small circles to thoroughly fill all irregularities in the surface, after which the coating shall be smoothed by parallel strokes. The paint shall be well worked into all joints and open spaces.

Note that all paint must be applied with brushes. Spraying is prohibited. The use of "manhelpers" or longhandle brushes will also be prohibited, except where absolutely necessary, as determined and ordered by the Director.

6. Surfaces Inaccessible to Paint Brushes

On all surfaces which are inaccessible to paint brushes, the paint shall be applied with sheepskin daubers made especially for the purpose to insure thorough covering.

7. Removal of Paint

If the painting is unsatisfactory to the Director, the paint shall be removed and the metal or other material thoroughly cleaned and repainted.

Metal coated with impure or unauthorized paint shall be thoroughly cleaned of such paint and be repainted to the satisfaction of the Director at the expense of the contractor.

8. Thinning of Paint

If it is necessary, in cool weather, to thin the paint, this shall be done only by heating the paint in a container placed in hot water or on steam radiators.

9. Basis of Payment

This work will be paid for at the contract lump sum price for painting of existing bridge, portion of existing bridge, repair material, reused metal, or other material, as specified, and as the case may be, which price will include all materials, equipment, tools, labor and work herein specified as required.

10. City, Bureau of Tests Specifications for Paint Materials

5.3 Glyceryl Phthalate Resin Base Type Varnish (Aluminum Vehicle)

Scope. This varnish is a glyceryl phthalate resin varnish of maximum elasticity and durability, and can be used as a paint vehicle for interior or exterior application or as a finish varnish. It is resistant to water and gasoline.

36. PAINTING OF EXISITNG BRIDGES, PORTIONS OF EXISITNG BRIDGES, REPAIR MATERIAL, REUSED METAL OR OTHER MATERIAL - (Addition)

10. City, Bureau of Tests Specifications for Paint and Paint Materials - Continued

5.3 Glyceryl Phthalate Resin Type Varnish (Aluminum Vehicle) - Continued

Scope - Continued

(a) The synthetic resin shall be of the glyceryl phthalate linseed oil type, containing no admixture or uncombined oils. It shall show not less than 35% glyceryl phthalate by quantitative analysis. It shall be free from rosin and rosin derivatives as determined by the Liebermann-Storch method. The acid number shall be a maximum of eight (8).

(b) The volatile thinner shall consist of petroleum hydrocarbons free from toxic hydrocarbons such as benzol. It shall be free from alcohol and ester solvents.

(c) The drier shall be such as to obtain the specified drying properties with a high degree of package stability. It shall be free from rosin and rosin derivatives.

(d) The varnish shall be clear and transparent and the color shall be a maximum of ten (10) on the Gardner Color Standards (1933).

(e) The viscosity shall be between 0.65 and 1.25 poises at 25° C., corresponding to tubes B to E of the Gardner-Holt Air Bubble Viscosimeter.

(f) The flash point of the varnish shall be not lower than 30° C. as determined by the Tag Closed Cup Tester.

(g) The varnish shall contain not less than 50% by weight of non-volatile material.

(h) The varnish shall show no skinning after 48 hours. Section 2.15. (Section 2.15 - Skinning Test). Paint, varnishes, or vehicles shall show no skinning after 48 hours in a one-half (1/2) filled, half pint, tightly closed glass container.

(i) The varnish shall pass the Cold Water Test. Section 2.9. (Section 2.9 - Cold Water Test). Brushed out paint films or flowed out vehicle or varnish films on 28 gauge tin plate panels (3"x5"); dried 72 hours at room temperature; then immersed in distilled water at room temperature for 48 hours; shall show no whitening, dulling, color change,

36. PAINTING OF EXISTING BRIDGES, PORTIONS OF EXISTING BRIDGES, REPAIR MATERIAL, REUSED METAL OR OTHER MATERIAL - (Addition)

10. City, Bureau of Tests Specifications for Paint and Paint Materials - Continued

5.3 Glyceryl Phthalate Resin Base Type Varnish (Aluminum Vehicle) - Continued

Scope - Continued

(i) - Cont. - - loosening, checking, or other visible attack, except at extreme edges, when removed from the water. The paint or varnish shall return to its original toughness and hardness within 2 hours after removal from the water and dried at room temperature.

(j) The varnish shall pass the Hot Water Test, Section 2.10. (Section 2.10 - Hot Water Test). Brushed out paint films or flowed out vehicle or varnish films on 28 guage tin plate panels, (3" x 5"); dried 72 hours at room temperature; then immersed in boiling water at 100° C. for 15 minutes; shall show no whitening, dulling, color change, loosening, checking, or other visible attack, except at extreme edges, when removed from the water. The paint or varnish shall return to its original hardness and toughness within 2 hours after removal from the water and dried at room temperature.

(k) The varnish shall pass the Elasticity Test. Section 2.11. (Section 2.11 - Elasticity (Flexibility Test). Brushed out paint films or flowed out vehicle or varnish films on 28 gauge tin plate panels (3" x 5"); air dried for 24 hours; baked for 24 hours at 100° C.; then suddenly chilled to 0°C. in ice water and quickly bent 180° over a rod having 1/8" diameter, shall show no cracking or injury of the film. The film on bent part of the panel shall show satisfactory adhesion under the knife test. Panels should be thoroughly cleaned and dried before application of the film.

(l) The varnish shall pass the Gasoline Resistance Test. Section 2.12. (Section 2.12 - Gasoline Resistance Test). Brush out paint films or flowed out vehicle or varnish films on 28 gauge tin plate panels (3" x 5"); air dried at room temperature for 48 hours, shall retain their gloss and general appearance after 24 hours immersion in lead free gasoline. After air drying for 4 hours, the film shall have regained its initial hardness and toughness.

(m) The varnish shall set to touch within 4 hours and dry hard and tough within 18 hours.

(n) The varnish shall weigh not less then 7.85 pounds per gallon.

36. PAINTING OF EXISTING BRIDGES, PORTIONS OF EXISITNG BRIDGES, REPAIR MATERIAL, REUSED METAL OR OTHER MATERIAL - (Addition)

City, Bureau of Tests Specification -
6.5 - General Shop Coat - Red Lead

Composition	Percentage	Min.	Max.
Pigment		74	76
Red Lead	75		
Asbestine	25		
Vehicle		24	26
Raw Linseed Oil	95		
Drier and Thinner	05		

The above paint is for general use as a first or shop coat on new steel or iron. It shall be used as a first coat on repainting jobs where only two coats are to be applied. It shall also be used for "Spotting" when desired.

7.1 - General First Field Coat - Brown

	Percentage	Min.	Max.
Pigment		72	74
Red Lead	73-1/2		
Asbestine	24-1/2		
Lamp Black	02		
Vehicle		26	28
Raw Linseed Oil	95		
Drier and Thinner	05		

Note 1. The above paint is for general use over 6.5 when a three coat system is used on new or old work.

11. Zinc Chromate Primer

Modification of Federal Specification JAN-P-735

This paint shall conform to the requirements set forth in JAN-P-735, and shall be manufactured using the suggested formulation shown in that specification with the following exception:

VIZ. 20% of the total vehicle shall be replaced by Raw Linseed Oil.