Specifications for the construction of a steel and concrete bridge over Queens Road at Motor Parkway in the Borough of Queens.

1. The work shall consist of furnishing all labor and material for excavating for the footings of the columns and retaining walls, safeguarding these excavations with timber or other shoring; constructing the footings and retaining walls; furnishing and manufacturing the steel for columns and bridge; erecting same into place, furnishing all necessary machinery to do this, constructing the concrete deck and concreting around the girders and columns; removing all form work and false work, backfilling around footings of columns and walls and cleaning up the site of work after completion of the work.

2. The plans are an essential part of these specifications and form the basis for the bid for the contract. The contractor shall furnish the engineer with three prints of each working drawing, prepared by him. These working drawings shall be approved by the engineer before any work is started. The engineer will check these drawings but his failure to detect errors shall not release the contractor from responsibility for perfect work. Figured dimensions shall govern over scale measurement. The plans as finally approved must be strictly adhered to, unless otherwise authorized by the engineer.

3. Wherever any feature of the work is not set forth fully in these specifications or shown on the plans, the work shall be done in accordance with the best modern practice. If the plans and specifications seem to conflict, the engineer shall interpret the meaning and his interpretation shall be final.

4. Ample facilities shall be furnished at all times to the engineer and his assistants for inspecting the work. The engineer shall have authority to reject and have removed and replaced at the expense of the contractor any material or workmanship which has not been inspected or which is not in accordance with the specifications. No work shall be done nor any material replaced unless properly inspected, unless otherwise authorized by the engineer. This he may do at any time prior to the final acceptance of the work.

5. The contractor shall furnish at his own cost and expense all transportation, labor, tools, machinery, false work and appliances of all kinds necessary for completing in the best manner the work called for. The contractor shall provide at his own expense all necessary permits for making street openings and storing materials, He shall also comply with any ordinances and regulations that may apply. The contractor shall at all times provide adequate passage for traffic and not obstruct same in any manner.

6. The engineer will furnish all necessary grades, lines, and points but the contractor shall check them at his own expense and be responsible for their correctness. He shall also preserve all stakes street bounds and bench marks established by the engineer.

7. All labor and materials of every description shall be of the best of their respective kind. The engineer shall be afforded every facility for ascertaining and determining the skill andcompetency of such labor and examining and inspecting and testing any material he may deem necessary. Whenever the contractor is not present on the work the engineer or his assistant will give orders to the superintendent or foreman and these orders shall be complied with implicitly. The contractor shall provide for the engineer all necessary assistance, except engineering assistance, when required to do so.

8. The work shall be prosecuted at all times with such force as to assure the completion of the work within the specified time as the engineer may deem necessary.

9. Should postponement or delay be caused by the precedence of other contracts executed before the execution of this contract, or by work undertaken along the line of this contract by any legal authority no claim for damages therefore shall be allowed.

10. All losses or damages arising out of the nature of the work to be done under this agreement or from any unforseen or unusaal difficulties which may be encountered in the prosecution of same, or from action of the elements, shall be sustained by the contractor.

11. The contractor shall be responsible for all losses and damages which may be done to property or injuries to workman employed by him or to any other person and persons caused by the performance of this contract or by his carelessness or the carelessness of his men. During the progress of the work the contractor shall place proper guards and lights around the site of the work to prevent accident. The contractor shall be responsible for all losses and damages that may occur from any negligence on his part or his agent.

12. Foundations

The contractor shall excavate to the elevation shown in the plans for column footings and abutment. These excavations shall be of such dimensions to permit forms to be placed therein and if found necessary to shore up the sides of the excavtion with sheeting and bracing. If the excavation discloses unsuitable, soft or spongy material the contractor shall remove and replace it with good acceptable material and compact same thoroughly by ramming or as directed by the engineer. The cost of excavation and shoring when necessary shall be included in the price bid for the scheduled items.

13. If however, after inspection

(and if necessary tests are to be made) which shows the subsoil is not compact enough to sustain safely 2½ tons per square foot, piles shall be driven of such lengths and at such spacing as determined by the engineer. The engineer will also determine the nature of the tests. The piles shall be cut off at such elevation so that they protrude into the concrete 9 inches. The piles will be paid for per lineal foot of pile driven and left in place. This price shall include the cost of making the tests. The piles shall comply with specification given hereinafter.

14. After completion of the concrete work and removal of the forms and false work the contractor shall refill the excavation where necessary with good selected material to grade in a workmanlike manner. The material not used for refilling shall be removed from the work by the contractor at his own cost and expense.

15. Between retaining walls, on streets and elsewhere as ordered and when found necessary filling must be brought up to elevations shown on plans with selected material. All filling shall be done in layers6" thick and each layer thoroughly rammed or flushed as directed.

Concrete

16. All concrete shall be made 1 part of cement, 2 parts sand, and 4 parts broken stone or gravel; except as otherwise specified.

17. Broken stone shall be approved traprock, dense fine grained blue limestone or granite broken into roughly cubical or pyramodical pieces. Broken stone which contains dust, loam, clay organic matter or other improper substances shall not be used.

18. Broken stone used for concrete on the bridge floor shall be the run of the crusher that will pass through a screen with circular openings 1¼" in diameter, and retained in a screen with openings 1/8" in diameter. Gravel shall be equal in quality to North Shore Long

Island gravel, shall be clean and sound and of the sizes herein specified for broken stone.

19 Broken stone used for concrete in column footings and abutments shall be the run of the crusher that will pass through a screen with circular openings 2¾" in diameter and retained in a screen with openings ¼" in diameter. Gravel shall be composed of similiar sizes and as otherwise specified before.

For the purpose of determining the proportions of the materials for concrete, each bag of cement will be considered as containing 9/10 cubic foot, and the other ingredients shall be measured by an approved method.

Only clean fresh water shall be used for concrete, just enough water shall be added to the concrete where reinforcement or wire mesh is used to make it flow freely around the steel and mesh. It should not be so much however so that the cement is washed away from the sand. It should be of a mushy consistance. The concrete in the foundations and abutments and retaining walls should have just enough water to form a medium or quaking mass.

Unless permitted to be mixed by hand, concrete shall be mixed in approved mechanical batch mixers, so constructed and operated that the ingredients of the concrete may be accurately measured and thoroughly mixed. Enough water shall be added during the mixing to bring the concrete to the required consistency, which generally shall be such that the concrete may be pored into place without causing the separation of the stones from the mortar. When concrete is mixed by hand the broken stone or gravel shall be spread on a tight platform in a bed about 6 inches deep and shall be thoroughly wetted. The cement and sand shall be mixed dry on a suitable platform, until the mixture has a uniform color. This mixture shall be spread evenly on the bed of wet stone, water added, and the entire mass turned until

each piece of stone is entirely coated with mortor, and a concrete produced which is uniform and of the consistency herein specified for machine mixed concrete. When a comparatively dry concrete is required it shall be mixed to such a consistency as may be directed.

Concrete shall be mixed only in such quantity as is required for the work in hand, and any that has set sufficiently to require retempering shall not be used. Any concrete in which the water has separated from the solid matter shall be satisfactorily remixed before being placed. The concrete shall be so deposited in the work as to prevent the separation of the stone from the mortor. It shall be deposited in as nearly a continuous operation as practicable and shall be tamped or spaded with suitable tools to expel air bubbles and produce a dense and compact mass. When the operation of placing concrete is interrupted the concrete in the work shall, if required, be confined by suitable temporary forms or bulkheads. When concrete is to surround reinforcing metal, structural steel or wire netting , it shall be so deposited as to work closely around such material. When a comparitively dry concreet is used it shall be deposited in horizontal layers not exceeding 6 inches in depth and solidly tamped.

When fresh concrete is to be laid on or adjoining concrete already set, the surface of the latter shall be thoroughly cleaned, washed, and roughened, and coated with a grout of neat cement before the fresh concrete is deposited.

The Contractor shall provide all necessary forms and centres for shaping concrete wherever used. They shall be true to the required shapes and sizes, strong enough and so secured in place as to withstand all operations incidental to placing the concrete, and watertight, and the faces against which the concrete is to be placed shall be satisfactorily smooth and clean. Timber used informs and centres for exposed faces of concrete shall be seasoned stock.

Unless otherwise permitted, those surfaces of forms and centres which will be in contact with concrete shall be coated as directed with an approved lubricant; when no lubricant is required such surfaces shall be thoroughly wetted just before the concrete is placed.

The forms and centres shall be left in place until the concrete has set sufficiently to permit their removal without danger to the structure, and until so much of the backfilling or embankment as may be directed has been put in place. No forms or centres shall be struck or removed until permission to do so has been given.

Special care shall be used to secure a smooth and uniform finish to the surfaces of concrete which will be exposed in the completed structure. Immediately after the removal of the forms and while the material is green, patch all broken corners and such parts of the surface where the face has been removed with the removal of forms to bring same to the general level of the surrounding surface. using for this purpose a I : I mixture of cement and sand. All wires, nails, etc., that may be projecting beyond the surface of the concrete shall be cut off at least $\frac{1}{2}$ inch back from the surface and the holes patched with a like mortor.

When all patches have well hardened and in no case less than 48 hours after patching, cut down with suitable tools, all board markings, projections, swellings or lumps, so as to bring the walls and exposed parts to a reasonably straight surface. A reasonably straight surface shall be constructed to be one which will show fair and true when tested with a straight edge.

The rubbing may be done at any time convenient after the rough grinding has been completed. The method of rubbing shall be as follows:

The entire surface is to be thoroughly wet down and kept moist. With carborundum or like abrasive block, grind in amix of I : 2 white portland cement and white sand swabbed on the surface in small patches, the grinding in being done when the material is wet, water being added if necessary to keep the material sufficiently plastic until the grinding operation has been completed. This material shall be ground into the surface untill all voids, lines and wood markings have dissapeared and until all surplus material not used for filling in the above mentioned voids, etc.,has been removed from the surface. Should mark ings appear in spots where the plastic material has been ground in larger quantities, they shall be removed by rubbing lightly with a cork float.

No brush work or mixture of cement shall be applied on this surface after the grinding has been completed and where larger voids appear same will be carefully pointed up with the ground-in material and with a cork float.

The inside corners of all fillets and intersecting planes shall be ground sharp. All outside edges shall be ground off either side and carefully smoothed off and straightened with the cork float.

Whenever it becomes necessary to place concrete under water, it shall be deposited by means of drop-bottom buckets or other approved method. Concrete so deposited shall be carefully spread without tamping.

In freezing weather, until the temperature falls to 28° F. the water used for concrete shall, if directed be heated to an approved temperature, and if so directed, I per cent by weight of salt shall be added to the water for each degree of fahrenheit that the temperature of the air is below 32° F. The other materials for the concrete shall be heated sufficiently to remove all frost and ice.

No concrete shall be laid when the temperature of the air is below 28o F.

Concrete shall be allowed to set for such time as may be directed before being worked or walked upon, or before filling, backfilling or other material is placed upon or against it. It shall not be flooded with water until it has sufficiently set. Concrete shall be carefully protected from injury, from freezing and from drying effects of the sun and wind by covering it with canvas, bagging, hay or other suitable and approved materials. Such protection shall be placed as soon as the concrete is in condition to receive it and except in freezing weather, the covering as well as the concrete shall be kept wet for such time as may be directed.

Concrete around girders and columns

The concrete encasing the girders and columns shall consist of I p. cement, 1½ p. sand and 3 p. gravel equal to the best N. S. A. All gravel shall pass through 3/4" sieve. Enough water shall be added to the mixture to make it flow around the steel. While pouring it shall be well spaded by thrusting a spade down next to the forms.

After removing the forms and when ordered by the engineer the surface of the concrete where indicated on the plans shall be picked with a hand or pneumatic tool adopted for the purpose to give it a rough or stippled finish. The concrete shall not be too green so as not to loosen the gravel.

The concrete around girders and columns shall be reinforced by expanded metal mesh weighing 0.8 lbs. per square foot which shall be carefully placed to prevent concrete from spawling off.

The cost of all concrete and the requirements specified in connection therewith shall be covered by the contract price for the structure in connection with which it is used.

Cement

All cement used in the work shall be a high grade Portland cement of well-established and approved brand. It shall be the product obtained by finely pulverising clinker produced by calcining to incipient fusion, an intimate mixture of properly proportioned agillaceous and calcareous substances, with only such additions subsequent to calcining as may be necessary to control certain properties. Such additions shall not exceed 3 per cent. by weight, of the calcined product.

The cement shall have a specific gravity of not less than 3.10 after being thoroughly dried at 212° F. It shall weigh not less than 380 pounds net, to the barrel, 4 bags of 95 pounds each being considered equivalent to the barrel.

The cement shall be dry, finely ground, of uniform color and free from lumps. It shall leave a residue of not more than 8 per cent by weight when passed through a No. 100 sieve and not more than 25 per cent when passed through a No. 200 sieve.

Standard briquettes shall develop within the period specified, tensile strength not less than that shown in the following table:

	Lbs. per Sq. inch.
Neat Cement:	
24 hours	175
7 days (1 day in moist air 6 days in water)	500
28 days (1 day in moist air 27 days in water)	600
Mortar consisting of 1 part cement and 3 parts of Standard Ottawa Sand, by weight:	
7 days (1 day in moist air 6 days in water)	180
28 days (1 day in moist air 27 days in water)	225

The average of the tensile strengths developed at each age by the briquettes in any set made from one sample will be considered the strength of the sample at that age, excluding any results that are manifestly faulty. The average strength of briquettes at 28 days shall be greater than the average strength at 7 days, and if tests are made after 28 days the strength shall be not less than that at 28 days.

Pats of neat cement, when tested for constancy of volume or soundness, shall remain firm and hard and show no sign of checking, cracking, distortion or disintegration.

Unless otherwise required, the cement shall not develop initial set in less than 30 minutes, and shall develop final set in not less than 1 hour nor more than 10 hours. Quick-setting cement of an approved brand shall, if required, be kept on the work in sufficient quantity to provide for any contingency requiring the use of same.

The cement will be subject to such tests as the Engineer may deem necessary, and such tests will be made in accordance with the methods recommended by the Committee on Uniform Tests of Cement of the American Society of Civil Engineers, except that the time of setting will usually be determined by means of the Gillmore needles. In case of dispute as to the time of setting, this test will be made by means of the Vicat needle.

Any cement which shall have been kept in storage after testing for a sufficient time to warrant it, shall be retested. Any prior acceptance shall be considered void and the acceptance or rejection of the cement shall depend upon the results of the latest tests.

The Engineer may at any time rescind the approval of any brand of cement that develops objectionable qualities.

The Contractor shall notify the Engineer of the arrival of the cement on the work, and furnish such facilities as may be required for obtaining samples for testing. Samples will be taken so as to fairly represent the material. The number of packages samples and the quantity to be taken from each will depend upon the importance of the work and the number of tests to be made.

Cement shall be delivered on the work in barrels or approved bags of uniform size with the brand and the name of the manufacturer plainly marked thereon.

It shall be immediately stored in a dry place and carefully protected from the weather. A sufficient stock of cement shall be kept on the work in advance of the necessity for its use to permit of the making of the required seven day tests. Except by written permission, no cement shall used before it has been tested and accepted, and any concrete or masonry which may have been made under such permission with cement that is subsequently rejected, shall be removed and replaced by the Contractor, at his own expense, with concrete or masonry of accepted cement.

The cost of furnishing, storing and incorporating cement in the work and the cost of samples required for testing, shall be covered by the contract prices for the structures or classes of work in connection with which the cement is used.

Sand

Sand shall be composed of grains of clean sharp quartz, not softer than hard limestone. It shall be moderately coarse and preferably made up of grains of varying size not exceeding one-quarter (¼) inch producing a mass with low percentage of voids. It shall not contain in all more than five (5) per cent. by volume of clay, loam, mica, scales, silt, or other objectionable inorganic matter, nor more than one (1) percent of organic matter.

Tests may also be made of the cement and sand used in the proportions of one part cement (1) to three (3) parts of sand, and these tests must show at least 70 per cent. of the strength of the mortor made with the cement and standard sand, or the sand may be rejected.

Structural Steel

The structural steel shall be medium steel and rivet steel made by the open hearth process and shall conform to the latest revised Standard Specifications for Structural Steel for Buildings adopted by the American Society for Testing materials, and such tests as may be required shall be made in accordance therewith and at the places hereinafter specified.

The chemical and physical properties of the steel shall be as follows:

Properties considered.	Medium Steel	Rivet Steel
Phorphorus (maximum).....	0.06 per cent.	0.06 per cent
Ultimate tensile strength, pounds per Sq. Inch.....	55,000-65,000	48000-58,000
Yield point (minimum) pounds per sq. in.....	½ ult. tens. str.	½ ult. tens.str
Elongation, per cent. in 8 inches (minimum)	(1,400,000 (ult. tens. str.	1,400,000 (ult. tens.str
Character of fracture.....	Silky	Silky
Cold bend without fracture.....	180° to diameter of 1 thickness	180° flat.

All finished material shall be free from injurious seams, flaws, and cracks, and have a workmanlike finish.

When steel is inspected at the mill or shop, all pieces (except plates which vary in weight more than 2½ per cent from that specified, shall be rejected; when steel is not inspected until it is delivered on the work, such variation in weight will be sufficient cause for rejection when in the judgment of the Engineer the safety of the work will be impaired thereby.

All structural steel shall be in accordance with the plan and approved shop drawings. All details not shown on the plan, and all workmanship and finish shall be equal to the best current practice in similiar work for buildings.

Anchor bolts and expansion bolts shall be furnished where required and set in place as directed. When holes are drilled in masonry or concrete for such bolts, the holes shall be washed clean and the bolts shall be firmly embedded in a mortar composed of equal parts of cement and sand, unless other material is shown on the plan.

Test specimens and every finished piece of steel shall be stamped with melt or blow number, except that small pieces may be shipped in bundles securely wired together, with the melt or blow number on a metal tag attached.

The required tests and inspections of structural steel shall, if directed, be made at the mills and shops by authorized inspector. The Contractor shall notify the Engineer of the mills and shops which are to supply the steel, sufficiently in advance to enable him to arrange for such tests and inspections and the mills and shops shall afford every facility for making the same.

If it is decided not to make the tests and inspections at the mills, then mill certificates showing the properties of each melt of which the steel is made will be accepted for consideration.

The Contractor will be required to furnish complete copies of shipping invoices with each shipment of steel.

Steel will not be accepted until the required inspector's reports or mill certificates are received. All tests, inspections, reports, and certificates are for the information of the Engineer, and he shall not be precluded on account thereof from requiring or making any further tests which he may deem necessary.

The Contractor shall prepare complete and accurate shop drawings of all steel work, and no shop work shall be done until such drawings shall have been approved. The Contractor shall furnish the Engineer with 3 complete sets of prints of the approved shop drawings.

All steel shall be thoroughly cleaned of scale, rust, oil and dirt. The amount of structural steel paid for as such will be all structural steel placed in the work in accordance with the plan or directions, except any excess greater than 2½ per cent above the weight required.

The contract price for structural steel shall cover the cost of all labor and materials required to furnish, fabricate, ereet same, to furnish all test pieces, to prepare and furnish prints of shop drawings and to drill holes for and set anchor and expansion bolts, where required all as specified.

STEEL REINFORCEMENT BARS

Steel here for reinforcing concrete shall be of such shape as to afford an approved mechanical bond with the concrete at frequent intervals and to insure intimate contact between the steel and concrete.

The Contractor shall indicate the type of bars proposed to be used, and if required shall furnish samples thereof, and he is cautioned not to place the order for the bars until the type has been approved.

Each bar shall have a net cross sectional area equivalent to that designated on the plan or required, or it shall be the commercial size of the approved type of bar having a net cross sectional area next larger than that designated or required.

Reinforcement bars will be rejected if their actual weight varies more than 5 per cent from their theoretical weight, as shown by the manufacturer's table.

All steel for reinforcement bars shall be made by the open hearth process, and shall conform to the latest revised Standard Specifications for Steel Reinforcement Bars adopted by the American Society for Testing materials, and such tests as may be required shall be made in accordance therewith, and at the places hereinafter specified. The chemical and physical properties of the steel shall be as follows:

Properties Considered.	Structural Steel Grade		Cold Twisted Bars
	Plain Bars	Deformed Bars	
Phosphorus, maximum Bessemer.....	0.10	0.10	0.10
Open Hearth.....	0.05	0.05	0.05
Ultimate Tensile Strength, pounds per sq. in...	55,000-70,000	55,000-70,000	Recorded only
Yield Point, minimum lbs. per sq. in.	33,000	33,000	55,000
Elongation			

Elongation, minimum per cent in 8 inches	(1,400,000) tens. str	(1,250,000) tens. str.	5 per ce
Cold bend without fracture:	180° to diam. of 1t.	180° to diam of 1t.	180° to diam of 2t
Bars under 3/4 in. in diameter or thickness			
Bars 3/4 in. in diam. or thickness and over	180° to diam. of 1t.	180° to diam of 2t.	180° to diam of 3t

t = Nominal thickness or diameter of bar.

Reinforcement bars shall be rolled from billets of new steel; they shall be straight and free from seams, flaws, cracks, and imperfections of all kinds.

Test pieces 18 inches long may be cut from any of the bars delivered on the work, and the failure of any test piece to meet the specified requirements, or the failure of any bar when being bent, will be sufficient cause for the rejection of all steel from the melt from which the test piece or bar was made.

Bending sheets for steel reinforcement shall be furnished, if required, in which case the reinforcement bars shall not be bent until such bending sheets have been prepared.

Bars shall be delivered in bundles , to each of which shall be securely wired a metal tag with the numbef of the melt from which the bars were made stamped thereon. The bars shall be protected at all times from mechanical injury and from the weather and when placed in the work they shall be free from dirt, scale rust, paint and oil, Bars which are not to be embedded in concrete within a short time after being placed in the work shall, if directed, be immediately coated with a thin grout of equal parts of cement and sand.

The bars shall be bent to the shape shown on the plan and in

conformity with approved templets. When bars are cut and bent on the work the Contractor shall employ competent men and shall provide the necessary appliances for the purpose.

All bars shall be as long as can be conveniently used, accurately bent, placed, spaced and jointed as shown as directed, and they shall be securely held in their required positions by approved devises until the concrete has been placed around them.

All reinforcing steel will be paid for at the bid price which shall include the cost of cutting, binding and placing of same.

-Piles-

If it is decided to use piles under foundation they shall comply with the following specifications.

Piles shall be of white oak, spruce, or yellow pine, sound and free from splits, shakes and other imperfections impairing their strength or durability. They shall be straight, taper uniformly from butt to point and if required shall be barked. Unless otherwise shown on the plan they shall conform to the following dimensions:

Length below cut-off	Minimum diameter at point	Minimum diameter at cut-off
Less than 20 feet	6 inches	10 inches
20 feet to 25 feet	6 inches	11 inches
26 feet to 35 feet	6 inches	12 inches
36 feet to 45 feet	6 inches	13 inches
46 feet and over	6 inches	14 inches

To determine the necessary length of piles to be used in the work the Contractor may be required to drive test piles.

Piles shall be driven without the use of a follower, unless specially permitted.

Pile heads that become split or broomed shall be cut off and the driving continued. Any pile which splits, breaks or drives unsatisfactorily will not be paid for, and it shall be with-drawn or abandoned and another driven in place of it. After being driven, piles shall be accurately cut off at the required elevation.

Bearing piles shall be driven vertically and shall be spaced as directed. They shall be driven to a satisfactory refusal as directed by the engineer.

The amount of piles to be paid for will be the total length below cut-off of all piles remaining in the work in accordancw with directions, and the total length of all piles used only as test piles. Piles driven for temporary use will not be paid for.

The contract price for piles shall cover the cost of all labor and materials required to furnish, drive and cut off the same as specified, of fastening brace piles, and of furnishing and placing all shoes, bands, bars, straps, bolts and other fastenings required, as well as the driving of test holes.

Asphallic concrete pavement

The surface of the concrete on the upper side of the bridge shall be left rough to afford a bond for the asphallic cement pavement to be placed thereon. This pavement shall be 2" thick.