

SPECIFICATIONS

GOVERNING THE CONSTRUCTION OF THE

PROPOSED BRIDGE OVER BUFFALO BAYOU

Connecting Marsh Street of the Second Ward with Hill Street of the Fifth Ward.

G. M. LANOUE, CITY ENGINEER, HOUSTON, TEXAS.

GENERAL DESCRIPTION.

The proposed structure shall consist of one swing span three hundred and two (302) feet over all, six bents of trestled spaced twenty feet centres on Hill Street side, and four bents of trestle spaced twenty feet centres on Marsh Street, Second Ward. The arrangement of several bents, swing-span and piers, will be indicated on the drawings.

The floor plank on the swing span shall be three inches thick, extending across and completely covering the lower chord of span. The floor plank shall project three inches beyond the center of hand railing. The ends of the projecting plank to be sawed to line. Each plank will be spiked to each supporting stringer, which in turn shall rest on the transverse floor girder or sidewalk bracket.

Floor plank on the trestle approaches shall be of the same quality of lumber as that on the swing span, projecting three inches beyond the center of hand-railing, and the projecting ends of plank sawed to line.

The floor stringers on the swing span and trestle approaches shall consist of twelve lines of 4" x 14", and three lines of 3" x 14" on each walk.

On each side of the roadway will be placed a six inches by eight inches wheel guard, resting on 3" x 8" shims, both bolted to the floor with 3/4" bolts. The shims will be spaced about every five feet throughout the entire length of structure.

On the swing span, and on the outside of the foot-walks, there will be a metallic railing of sections and heights as indicated on the drawings.

Outside of the foot-walks of the trestle approaches will be a wooden railing of the dimensions and height as shown in the drawings.

The clear distance between the flooring of the swing span and the flooring of the trestle approaches shall not exceed one inch. The stringers in the end panels of the swing span shall increase in length from the side towards the center of the roadway, and shall come within 1/2" of the arc of the circle described by the swing span while in motion. The stringers of the end bents of the trestle approaches immediately next to the end panel of the swing span shall decrease in length from the side towards the center of roadway, and come within 1/2" of the arc of the circle described by the swing span while in motion. The flooring at these points shall be made to conform with the arc of the required circle described by the swing span while in motion, with the opening between them not to exceed the amount above specified.

PROPORTION OF PARTS.

The sections required in the construction of the swing span are all given on the general sketch and maximum strain diagram.

The rivets connecting the parts of any member must be so arranged that the maximum shear shall in no case exceed 9,000 pounds per square inch; nor shall the pressure on the bearing surface (diameter of rivets X thickness of plate) exceed 15,000 pounds per square inch. In field riveting the maximum shear shall in no case exceed 7,500 pounds per square inch.

The pressure on the bearing surface of pins (diameter of pins X thickness of plate) shall not exceed 15,000 pounds per square inch. The sizes of all pins are given on the maximum strain diagram and general sketch of swing span.

DETAILS OF CONSTRUCTION.

Heads of all eye bars shall exceed the body of bar by at least 40 per cent. The heads shall be put on the bar by the latest approved process used in connection with the manufacture of steel eye-bars. The pin holes shall be in the center of head, and in center line of bar, and fit the pins within 1-32". All eye-bars of the same length shall be so bored that when piled on each other a pin at each end will enter the holes at the same time without force.

Eye-bars shall be free from flaws and perfectly straight before holes are bored.

All screw ends of rods shall be upset, and wherever indicated rods are to have turn buckle adjustments.

All pins shall be turned straight and smooth and fit the pin holes within 1-32".

All pin holes must be bored at right angles to the axis of the member.

The positions of the several members attached to a pin shall be such as to produce the least bending moment, and all vacant spaces filled with filling rings.

The lower cords shall be packed as narrow as possible. When bent loops shall be used they shall fit the pin closely throughout its semi-circumference. The distance from center of pin to fork of eye shall be about $2\frac{1}{2}$ diameters of pin.

The rivets used shall be $\frac{5}{8}$ ", $\frac{3}{4}$ " and $\frac{7}{8}$ " in diameter. The pitch of rivets shall not exceed 6", nor be less than three diameters of rivet.

The rivet holes shall be so accurately spaced and punched that when the several parts forming a member are assembled the holes shall be exactly opposite each other, and a rivet when heated and 1-16" less than holes can be entered freely.

No drifting of holes will be allowed. Rivets when driven shall completely fill the holes and have full and round heads concentric with body of rivet, and be in full contact with the surface of the parts joined, or wherever necessary they shall be counter-sunk.

Wherever practicable, rivets shall be machine driven. No loose or defective riveting will be allowed.

No reliance will be placed on abutting joints. Web plates shall be spliced by a plate on each side of web. In splicing the joints in the top and bottom chords stiff members, suitable splice angles will be used in connecting the flanges in addition to the plates splicing the webs.

All abutting surfaces shall be planed to an even bearing, and be in exact contact throughout.

All finished and turned surfaces shall be coated with white lead and tallow. Pins and pin holes will receive a similar coating.

Built members when finished shall be free from twists and bends or open joints.

Thickness of plates at the ends of posts connecting with top chord at point "G" and "E," shall not be less than $\frac{3}{8}$ ".

Batten plates shall be placed as near the end of stiff members as possible, and shall be in length not less than $1\frac{1}{2}$ times the depth of member to which they are attached. They shall be in the end posts, top and bottom chord of the same thickness as the lacing bars. The thickness of the batten plates on the 6", 7" and 9" post marked "Hh," shall be $\frac{1}{4}$ ".

The size of lacing bars on the different members is given on the sketch and maximum strain diagram. Their inclination towards the axis of the member shall not be less than 60 degrees.

All bolts through wood shall be provided with cast washers under head and nut. The use of one or more washers under head or nut to make up for any deficiency that might exist in length of thread, will not be permitted.

The cresting shall be of the thickness and design indicated on the sketch.

At each end of the swing span there will be a suitable name plate, giving the names of the contractor, mayor, members of the Board of Public Works, and the City Engineer.

QUALITY OF MATERIAL.

All compressive or stiff members, details, counter and lateral rods, webs and flanges of beams, shall be built of soft steel. Rivets shall also be of the same material.

All eye-bars shall be made of medium steel.

All pins of high steel.

SOFT STEEL.

"Specimens from finished material for test, shall have an ultimate strength from 54,000 to 62,000 pounds per square inch; elastic limit, one-half the ultimate strength; minimum elongation,

26 per cent. in 8"; minimum reduction of area at fracture, 50 per cent. This grade of steel to bend cold 180 degrees flat on itself, without sign of fracture on the outside of the bent portion."

MEDIUM STEEL.

"Specimens from finished material for test shall have an ultimate strength of 60,000 to 68,000 lbs. per square inch; elastic limit, one-half the ultimate strength; minimum elongation, 20 per cent. in 8"; minimum reduction of area at fracture, 40 per cent. This grade of steel to bend cold 180 degrees to a diameter equal to the thickness of the piece tested, without crack or flaw on the outside of the bent portion."

HIGH STEEL.

"Specimens from finished material for test shall have an ultimate strength of 66,000 to 74,000 lbs. per square inch; elastic limit, one-half the ultimate strength; minimum elongation, 18 per cent. in 8"; minimum reduction of area at fracture, 35 per cent. This grade of steel to bend cold 180 degrees to a diameter equal to three times the thickness of the test piece, without crack or flaw on the outside of the bent portion."

CAST IRON.

The cast iron must be of the best quality of a tough grey metal.

All castings shall be smooth, well shaped, free from cinders, air holes and other imperfections.

TIMBER.

The lumber in the flooring, stringers, caps, wheel-guards, sway-bracing, and wooden hand railing, shall be of long leaf yellow pine heart lumber.

All timber to be sawed true, full size from end to end, and free from sap, worm holes, or any other defect that would be liable to impair its durability or strength.

Timbers used in the construction of the wooden hand railing shall be dressed. The width of the floor plank to be from 8" to 12".

WORKMANSHIP.

All workmanship throughout shall be first class in every particular. All members must be free from twists and bends, and all abutting joints shall be planed in a plane perpendicular to the line of strain and be in exact contact throughout.

PAINTING.

All metal work before leaving the shops shall be thoroughly soaked in boiled linseed oil. Any loose scale or rust must at first be removed.

In riveted work all surfaces coming in contact shall receive a good coating of some metallic paint or pure linseed oil before being riveted together.

All turned or planed surfaces shall be coated with white lead and tallow before members are shipped.

After erection the swing span, turn-table, and that portion of the metal work of the pivot pier exposed shall receive two good coats of paint of a quality and color to be hereafter selected by the City Engineer.

That portion of the metal work of the pivot pier below the surface of the ground shall receive one coat of metallic paint before being placed in position.

The wooden hand railing on the trestle approaches, together with the outside stringers of walk, shall receive one coat of paint of same quality and color as that of the swing span.

TURN-TABLE.

The distance between the centers of web shall be 26' 7 $\frac{1}{2}$ ". The web shall be 7-16" in thickness, and the flange consist of four 6"x 4", 12.3 lbs. angles. The web shall be stiffened at the intervals and in the manner indicated on the drawings of the table, and the girder properly stayed from the center by eight radial struts. The circular girder shall rest uniformly over all the wheels, and be rigidly connected with the trusses by means of the half inch plate as shown in the drawings.

The circular girder and the wheel track shall be true circles.

The rack will be on the outside of the wheel track, and be a complete circle. It shall be secured to the coping by 1 $\frac{1}{2}$ " bolts, 20" long, spaced about every two feet. The lower wheel track, like the rack, will be a complete circle, and secured to the coping by 1 $\frac{1}{4}$ " bolts, 20" long, spaced about every two feet. Between the bottom of the lower track and the top of the coping will be laid a layer of sheet-lead $\frac{1}{8}$ " thick.

The center castings shall be of the thickness and conform to the design indicated on the drawings; the bottom shall be bolted to the piers by $1\frac{1}{4}$ " bolts 20" long.

The position of the pinion will be as indicated in the drawings.

The latches will be operated from the center by means of a lever of the size and design specified on the drawings.

The circular girder shall rest on 42 conical cast wheels, 18" large diameter. The conical cast wheels shall be faced to an exact uniform size and true bevel. The upper and lower wheel tracks shall be faced to a corresponding bevel, and when the span is swung all wheels must turn.

The conical wheels shall be secured in their positions by means $1\frac{1}{4}$ " round rods attached to $\frac{1}{2}$ " circular plates, which in turn shall be connected to the center casting.

The arrangement of the rods throughout the conical wheels, together with the necessary washers and nuts, is explained on the drawings.

All drilling of holes fitting together of the metal shall be done by the contractor.

After the bolts have been placed in position, and all work fitted to its exact position, the remaining space of the holes around the bolt shall be filled with hot lead and sulphur.

One end of the bolt shall have threads turned on it for the attachment of the hexagonal nut of the same thickness as the bolt itself.

The bridge will be swung by hand power, and the sizes of levers, shafts and wheels are given on the drawings.

When the bridge is closed the ends shall rest on four cast wheels 12" in diameter and a 14" face. These wheels shall be attached to the lower chords of swing span, and shall be so designed that the lower portion containing the receptacle for the pin shall be attached to the upper portion of the cast frame by means of bolts, and by the insertion of filling plates of different thicknesses, the wheels can be adjusted to any position caused by the contraction or expansion of the metal in the swing span.

The position of the bed plates on which the end wheels shall rest will be fixed after the swing span is erected and swung into position. They shall be placed in a bed of cement mortar, and at the proper angle to the axis of the bridge.

INSPECTION.

A rigid inspection will be maintained over all material and workmanship in connection with the construction of the proposed bridge.

An inspection of the metal entering into the construction of the swing span and pivot pier may be carried on at the shops.

All members will be inspected on the ground before placed into the position they are to occupy in the structure. All sections will be carefully measured, and if found to be less than those specified, the members which contain them will be rejected. All work will be done under the supervision of an engineer, whose duty it will be to see that the requirements of these specifications are carried out; but his presence is not to be presumed to release in any degree the responsibility of the contractor or his obligations.

If an inspection is maintained at the shops, the contractor will furnish all facilities for making tests and supervising the workmanship during the progress of the work.

The work at all times during its construction will be under the supervision of the City Engineer or his representative. He shall direct how, and in what part, and what time, the work shall proceed.

In case of any dispute arising in regard to the manner in which the work is to be done, or the interpretation of any portion of the plans or specifications, the decision of the City Engineer shall be final and binding to both parties to the contract.

APPROVAL OF SHOP DRAWINGS.

Before any of the metal entering into the construction of the swing span and pivot pier shall be ordered, a complete set of working drawings will be submitted to the City Engineer for his inspection and approval.

The approval of the City Engineer of the shop drawings will simply indicate that the details are satisfactory. He will not be responsible for any errors that may exist in the calculation of the length of the several members.

Due allowance in time will be granted to the contractor, in addition to the time hereinafter specified for the completion of the work, while the shop drawings are being examined.

The contractor shall furnish, free of all charge, two sets of blue prints of shop drawings.

ERECTION.

The contractor shall furnish all material and labor necessary for the manufacture, erection, transportation, and maintenance of the structure until its final acceptance.

The center castings shall be of the thickness and conform to the design indicated on the drawings; the bottom shall be bolted to the piers by 1½" bolts 20" long.

The position of the pinion will be as indicated in the drawings.

The latches will be operated from the center by means of a lever of the size and design specified on the drawings.

The circular girder shall rest on 42 conical cast wheels, 18" large diameter. The conical cast wheels shall be faced to an exact uniform size and true bevel. The upper and lower wheel tracks shall be faced to a corresponding bevel, and when the span is swung all wheels must turn.

The conical wheels shall be secured in their positions by means 1½" round rods attached to ½" circular plates, which in turn shall be connected to the center casting.

The arrangement of the rods throughout the conical wheels, together with the necessary washers and nuts, is explained on the drawings.

All drilling of holes fitting together of the metal shall be done by the contractor.

After the bolts have been placed in position, and all work fitted to its exact position, the remaining space of the holes around the bolt shall be filled with hot lead and sulphur.

One end of the bolt shall have threads turned on it for the attachment of the hexagonal nut of the same thickness as the bolt itself.

The bridge will be swung by hand power, and the sizes of levers, shafts and wheels are given on the drawings.

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The position of the bed plates on which the end wheels shall rest will be fixed after the swing span is erected and swung into position. They shall be placed in a bed of cement mortar, and at the proper angle to the axis of the bridge.

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If an inspection is maintained at the shops, the contractor will furnish all facilities for making tests and supervising the workmanship during the progress of the work.

The work at all times during its construction will be under the supervision of the City Engineer or his representative. He shall direct how, and in what part, and what time, the work shall proceed.

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He shall assume all risk from flood, accidents to men and material.

He shall in no way obstruct the stream, and shall remove all staging, or any other obstructions or unsightly material that may have been produced by his operations.

Any disorderly, quarrelsome or unskilled employe of the contractor must, on the demand of the engineer, be discharged, and shall not be again employed on the work without his permission.

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SUB-CONTRACTOR.

The contractor shall in no way sub-let the erection of the superstructure or substructure without first obtaining the permission of the City Engineer in regard to the reliability, responsibility, or competency of the parties in question. Even after such permission shall have been granted, and the parties shall have demonstrated their incompetency in conducting their work, or exhibited a quarrelsome disposition, they shall be removed at the instance of the engineer.

The original contractor will be responsible for all acts of the sub-contractors.

TRESTLE APPROACHES.

The spacing of the bents of the trestle approach will be as shown on the profile and plan of location. The thickness of all timbers entering into the construction of the trestle approach is plainly indicated on the drawings.

The lumber shall be of the quality heretofore specified, and all stringers spiked to caps. The hand railing shall be of dressed lumber, and the 6' x 6' posts shall be bolted to the outside stringers of walk by four $\frac{1}{2}$ " bolts.

All sway-braces will be bolted to caps and piles with $\frac{1}{2}$ " bolts. The manner of sway-bracing the several bents is shown and specified on the drawings.

All bolts shall have cast washers under head and nut. These washers shall not be less than 1" in thickness and $2\frac{1}{2}$ " in diameter.

PILING.

In the trestle approaches the piling used will be 12' x 12' Cypress, and of such length as specified on the profile.

Piles used in the foundations of the piers shall be round, with 10' as the minimum diameter at the small end, and 12' at the large end. They shall be of Cypress, and perfectly straight, and have the bark stripped off before being driven.

All piles shall be of good sound timber and acceptable.

All piles must be driven with a 2,000 lb. hammer, and to such a depth as may be satisfactory to the engineer. They must be driven vertically, and at regular distances apart from centers, both longitudinally and transversely as may be required on the drawing.

In case of a length of pile greater than that specified be required, the piles shall be sawed off square and another placed above and spliced to the lower one in an approved manner. The extra length of pile to be paid the contractor at a price satisfactory to both parties.

All piles, when driven to the required depth, are to be cut off square and horizontal at the proper height given by the engineer.

TIME OF COMPLETION.

The contractor shall complete the entire structure, ready for travel, with the exception of the slight fills at the ends of the trestle approaches, in nine months after the signing of contract.

Due time will be allowed him for delays beyond his control.

MANNER AND TIME OF BIDDING.

Sealed proposals addressed to the City Secretary, will be received up to 12 m. of Monday, November 4, 1895, for the proposed bridge across Buffalo bayou, at the foot of Hill street; said bridge to be built in accordance with the plans and specifications now on file with the City Engineer of the City of Houston. Each bid must be accompanied with a certified check for \$5,000 to secure the execution of the contract, and bond will be required in the sum of \$10,000, with local sureties, for the fulfillment of the contract. The city reserves the right to reject any and all bids.

The plans and specifications are a part of the contract.

Bids not strictly in conformity with the plans and specifications as furnished by the City Engineer, will not be considered.

In addition to their proposals, bidders will submit in a separate and sealed envelope the estimated quantities of material as specified below.

These envelopes will be endorsed, "Estimate of Quantities of the Buffalo Bayou Bridge." They will not be opened at the same time at which the bids are read.

Amount in pounds of metal in the swing span, including the hand-railing.

Amount in pounds of metal in the turn-table and latching device.

Amount in pounds of cast iron in swing span and turn-table.

Weight of bolts, nuts and washers in entire structure.

Amount of lumber, B. M., in the flooring, wheel-guards, caps, sway-braces and hand-railings.

Cubic yards excavation, three piers.

Cubic yards of concrete, three piers.

Cubic yards of brick work.

Cubic yards of masonry, including coping.

SUBSTRUCTURE.

The arrangement of the several piers is indicated on the profile.

PIER No. 1.

Excavation shall be made to the depth indicated by the elevation on the drawings.

The concrete base and brick work above shall rest on round cypress piles, spaced $2\frac{1}{2}$ feet centers, 20 feet long, driven to a firm foundation. The remaining portion of piles shall be sawed off two feet above the the bottom of the pit.

PIER No. 3.

The elevation on the drawings indicate to what depth the excavations for this pier is to be made.

The concrete base and brick work above this pier shall rest on round cypress piles, spaced $2\frac{1}{2}$ feet centers, 20 feet long, driven to a firm foundation. The remaining portion of piles shall be sawed off two feet above the bottom of the pit.

PIER No. 2.

The pivot pier shall be circular in character, and consist of brick and stone, as shown on the drawing.

The inside diameter of the pivot pier will be 32 feet, the coping shall be 33 feet in diameter; the whole to rest on round cypress piles, spread $2\frac{1}{2}$ feet centers and 20 feet long, driven to a firm foundation and cut off at elevation given by City Engineer.

COPING.

All coping shall be 12" in thickness and project over the faces of the piers in the manner and amount specified in the drawings. The tops of all coping stones shall be dressed and bush-hammered to the required levels.

The joints between coping stones shall be thoroughly filled with a grouting of cement mortar.

MASONRY.

The stone work in the pivot pier shall consist of three equal layers of stone, including the thickness of joints, to the height of 3'.

The thickness of joints shall not exceed $\frac{3}{4}$ ".

All beds and joints of stone to be dressed.

The coping and masonry shall be of a good quality of stone or granite, best selected for the purpose.

Samples of stone shall be submitted to the City Engineer for his opinion and approval.

BRICK WORK.

Brick work must be laid with the best quality of hard-burned brick. No bats, cracked or crooked bricks will be allowed in the work. Before being laid the bricks shall be thoroughly

cracked bricks will be allowed in the work. Before being laid the bricks shall be thoroughly soaked in water and be laid in cement mortar with such thickness of joints and style of bond as may hereafter be prescribed by the engineer. Grouting will be substituted for mortar when so ordered, and to such an extent as may be deemed advisable by the engineer.

BRICK WORK

The work shall be submitted to the City Engineer for his opinion and approval before the work is commenced. The work shall be of a good quality of stone or granite, and shall be laid in a good mortar. The joints shall be of a good quality of mortar, and shall be laid in a good mortar. The thickness of joints shall be of a good quality of mortar, and shall be laid in a good mortar.

MASONRY

The work shall be submitted to the City Engineer for his opinion and approval before the work is commenced. The work shall be of a good quality of stone or granite, and shall be laid in a good mortar. The joints shall be of a good quality of mortar, and shall be laid in a good mortar.

CONCRETE

The work shall be submitted to the City Engineer for his opinion and approval before the work is commenced. The work shall be of a good quality of stone or granite, and shall be laid in a good mortar. The joints shall be of a good quality of mortar, and shall be laid in a good mortar.

PIER NO 3

The work shall be submitted to the City Engineer for his opinion and approval before the work is commenced. The work shall be of a good quality of stone or granite, and shall be laid in a good mortar. The joints shall be of a good quality of mortar, and shall be laid in a good mortar.

PIER NO 2

The work shall be submitted to the City Engineer for his opinion and approval before the work is commenced. The work shall be of a good quality of stone or granite, and shall be laid in a good mortar. The joints shall be of a good quality of mortar, and shall be laid in a good mortar.

PIER NO 1

The work shall be submitted to the City Engineer for his opinion and approval before the work is commenced. The work shall be of a good quality of stone or granite, and shall be laid in a good mortar. The joints shall be of a good quality of mortar, and shall be laid in a good mortar.

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CEMENT MORTAR.

Mortar in all cases will be made of one part of the best Portland cement to two parts of clean, sharp San Jacinto sand, well and thoroughly mixed together in a box before the addition of any water, and be used as soon as possible after being mixed. No mortar left over night will, under any circumstances, be allowed to be used. The sand and cement will at all times be subject to the inspection, acceptance or rejection of the engineer.

All quantities to be measured before being mixed.

CONCRETE.

Concrete shall consist of fragments of good, hard, sound and acceptable stone, broken to a size that will pass through a three-inch ring in any direction, thoroughly mixed with cement mortar. The stone will be thoroughly cleaned and free from mud and dirt.

The proportions shall be five parts of broken stone to two parts of clean, sharp San Jacinto sand, and one part of the best Portland Cement.

All quantities are to be measured before being mixed.

The sand and cement shall be mixed dry. When thoroughly mixed, water shall be added and a mortar formed, the broken stones will then be added, and the whole mass thoroughly mixed to the satisfaction of the engineer in charge. The concrete shall then be deposited into its place in layers not exceeding 12" in thickness. It shall then be thoroughly rammed until the mortar flushes to the surface.

We, for the Board of Public Works, approve the foregoing specification :

JOS. F. MEYER, }
CHAS. P. SHEARN, } *Board of Public Works.*



