

SPECIFICATION

Of the Manner of Constructing Whipple's Patent Iron Arch
Truss Bridge Superstructures,

For

Each Superstructure to consist of a plank and timber flooring, supported by two or more trusses of wrought and cast iron, and, in cases of bridges with sidewalks, an iron railing three feet high on the outside of each sidewalk.

The trusses to be composed of cast iron arches and connecting blocks, and wrought iron chords, uprights and diagonals; and the flooring of iron needle beams, pine joists and oak planking, as shown on the plans exhibited at the letting.

The truss arches to consist of straight pieces, diverging and widening horizontally, from a width of about 1-12 the length of the piece, in the middle, to about $\frac{1}{2}$ the height of the truss (and rather more in short trusses) at the end of the arch, each widening in proportion as it pitches downward from a horizontal position. In trusses from 55 to 75 feet in length, the arch is to contain 7 pieces, meeting at angles of 82 degrees, the ends being beveled 4 degrees, so as to form a joint, with a deflection of 8 degrees from one piece to the next contiguous. In trusses from 75 to 100 feet in length, the arch is to contain 9 pieces, with ends beveled 3 degrees at the joints, giving 6 degrees angle of deflection from piece to piece, or such other angle of deflection as may be directed by the Resident Engineer in charge of the work.

The extremities of the arch are to be formed into feet resting on the abutments with a flat bearing of 11 to 13 inches from heel to toe, and have a firm connection with the ends of the chords by having the endmost links left open at the connection, and after passing through the feet from heel to toe, secured by screw nuts at the toe; in which case, the portion of the rod where the screw thread is cut, is to have at least 3-8 inch greater diameter than the rest of the chord.

The ends of the arch castings at the joints are to be so shaped as to form vertical holes for the uprights to pass through, and afford horizontal bearings for the nuts of the uprights on the upper, and for the eyes of the diagonals on the under side, the holes being so placed that the plane of the arch joint may cut the center of the uprights about two inches below the upper side of the castings.

The depth or width of arch castings (towards the center of the general curvature) is to be not less than 1-18 the length of the pieces respectively, unless a compensating increase be made in the cross sections of the pieces; which cross sections, multiplied by the natural sine of the inclination of the pieces respectively from the vertical, are in all places to give products of not less than one square inch for each 90 square feet of bridge floor supported by the trusses respectively, not including the coping under the trusses and railing; and in trusses supporting less than 10 feet width of flooring each, the cross sections of the arch castings, multiplied as above stated, are to give products of not less than one square inch to every 70 square feet of flooring, and to have not less than half an inch in thickness of iron in any part, and not less than 7-8 inch in thickness within 3 inches of the joints.

No wedging of the arch joints will be allowed. The ends of the pieces must be planed by machinery, or accurately hand-dressed, as may be directed by said Engineer.

Near the outer or upper corner of the joints are to be projections of about 3-4 of an inch in length and depth, and $\frac{1}{2}$ to 2 inches in width, cast on one piece, and extending into the angles of the contiguous piece, to assist in keeping the ends in place.

Each piece of the arch casting is to have at least 4 cross bars connecting the side portions; the end ones being 5 to 6 inches wide, and of a depth, at the upright hole, not less than 1-5 the width of castings at the point of location; the others at uniform distances between the former, and in section equal to 1-3 that of the longitudinal parts of the castings.

For the forms and proportions of the cross-bars, and for other particulars not here specified, as well as for the better understanding of these specifications generally, reference is had to the drawings, and to instructions and directions of the Engineer in charge of the work.

The connecting blocks are to be of cast iron; the end portions, where the links go on, to be about 2½ inches deep, with a cross section nowhere less than 24 times the cross section multiplied by the diameter of the iron in the chords, and divided by the width of the connecting block. The edges of the blocks to be fitted to the semi-circular ends of the links.

The central portion of the block is to be so enlarged as to admit of the holes for the uprights and diagonals, and not allow of being cut or fractured in that part without an area of section or fracture at least 20 per cent greater than the cross section of the block where it receives the links of the chords.

The lengths of connecting blocks are to be, for those next the ends of the truss, such that the endmost links of the chord may run parallel from their connections with the feet of the arch, and connect on the ends of the block, the next succeeding links being inside of the former, and so on to the middle of the truss, with the two links of each pair parallel, or nearly so, and the blocks diminishing in length successively by about twice the diameter of the iron in the links.

All the iron to be of such kinds, mixtures and qualities as to produce sound and strong castings, equal to the best descriptions of metal used for machinery.

The ends of the chords and the feet of the arches on the abutments are to be covered with a cast iron box to protect them from contact with the earth of the approach.

WROUGHT IRON WORK.

The chords to each arch piece are to be composed of two links of such lengths as to be joined in pairs by the cast iron connecting blocks directly under the arch joints, and connected with the extremities of the arch in the manner before described. The aggregate cross section of the chord to each truss is to contain not less than one square inch for each 120 square feet of bridge flooring (copings not included) sustained by the truss.

The uprights are to be one at each joint of the arch; the middle ones (and more when required) in each truss, to be composed of two rods united into one at the upper end, for that portion which passes through the eyes of the diagonals, the arch, and the nut on the top; with a collar or ring of 7-8 inch square iron welded on just below the eyes of the diagonals, to prevent the latter from sliding down. From 2 to 3 inches below the collar, the two rods diverge at an angle of 10 to 12 degrees, and pass through the connecting blocks outside of the chords. The upper end, or single portion in these uprights, is to be of the same diameter as in the single uprights of the same trusses, and the double portion of 1 5-8 inch iron for sidewalk bridges of spans over 75 feet, and of 1½ inch iron for all other bridges of less than 100 feet span, unless otherwise directed.

Each branch of the double uprights is to have a nut to bear on the upper side of the iron needle beam, and another on the under side of the connecting block, the uprights passing through cast iron thimbles

or washers, intervening between the bottom of the needle beam and connecting block, to afford a bearing for the beam.

The rest of the uprights are to be each formed of a single round bar or rod, with a collar and nut, as above described, at the upper end, and passing through the center of the connecting block, to be secured by a nut on the lower end, and to have an adjusting nut to bear on the top of the iron needle beam. The diameters of the single uprights to be not less than 2 inches for spans of 90 to 120 feet, and 1 3-4 inches for spans of 50 to 90 feet for single roadways without sidewalks. For double roadways and bridges with sidewalks, the size of both single and double uprights to be increased, as may be directed by said Engineer.

The diagonals are to be two, crossing each other in each of the quadrilateral panels of the truss, of 1 1-8 inch round iron in all sidewalk bridges of over 75 feet span, and of 1 inch iron for all other bridges, except when otherwise particularly specified. They are to be formed with a strong eye at the upper end for the upright, and bent near the eye, so that it may fit horizontally upon the collar of the upright, or upon the eye of the diagonal, connecting at the same point. Where the diagonals go on to the uprights, the one running downward towards the center of the truss is to go on last, or above the other; and the bend at the eye is to be close to the outer edge of the collar, or of the other eye upon which it bears.

The lower end of the diagonal is to pass obliquely through the connecting block, with a screw nut at the end for adjustment, the screw being cut at least 8 inches from the end, and to have a diameter $\frac{1}{2}$ inch larger than the rest of the rod.

The nuts on both uprights and diagonals to be hexagonal, and properly proportioned for the purposes intended.

There shall be a pair of diagonal sway rods in each panel of the bridge; those in the end panels to be 7-8, and in the intermediate panels 3-4 inch round iron, and in bridges of 90 to 120 feet span, there shall be two pairs at each end, of 7-8 inch iron. The sway rods are to be connected with the single uprights of the trusses at the upper side of the connecting blocks by eyes through which the uprights shall pass, and in a similar manner to a horn cast on the upper side of the cross rod saddles. The sway rods to have turn buckle adjustment near one end, the screwed portion being enlarged $\frac{1}{2}$ inch.

At the ends of the bridge, the sway rods are to connect by eyes with the screws and nuts uniting the chord with the feet of the arches, or in any other convenient and substantial manner.

The sidewalk railing is to be of wrought iron, except the corner posts, and when not otherwise specified, is to consist of vertical posts of 1 1-8 inch square iron, once in 1 to 5 feet, a bottom rail of 1 inch square iron about 4 inches above the bottom of the posts; a top rail of 1 3-4 inch by $\frac{1}{2}$ inch iron, flatwise on the top of the post, with a strip of 1 inch by $\frac{1}{2}$ inch on the top of the last; and balusters of 3-4 inch square iron, once in 6 inches, dowelled and riveted to and between the top and bottom rails. At the bottom of each post, and crosswise of the railing, is to be a foot piece, 6 to 7 inches long, 2½ inches wide, and half an inch thick, firmly riveted to the bottom of the post, and having two holes, one on each side of the post, and about 3½ to 4 inches from center to center, for bolting down to the wood work with 5-8 inch bolts. On the outside of the railing, the foot plate is to be welded to the lower end of a scroll or ogee brace of 3-4 inch square iron, running up, and riveted to the post about midway of its length.

The posts at the ends of the railing, or at the corners of the bridge, are to be of hollow cast iron, 3 to 4 inches in diameter, and of any neat and comely pattern approved by the Engineer.

The wrought iron work is to be made of the best qualities of American rolled iron, for all parts except sidewalk railings, which may be made of good common English bar iron.

NEEDLE BEAMS.

The trusses are to be connected by cross girders (or needle beams) of wrought iron, one at each upright, and resting upon the eyes of the sway rods at the single uprights, and on cast iron thimbles or washers at the double ones. The cross girders to consist of a vertical web plate $\frac{1}{2}$ of an inch in thickness, with top and bottom flanges each of two angle irons, riveted on with 3-4 inch rivets having 4 inch pitch; the beam to have suitable holes for uprights, and be of such depth, length and form as shall be shown upon the drawings exhibited for letting, or as may be directed by the said Engineer. When required, solid wrought iron beams to be inserted in lieu of vertical web plate beams, and to be so proportioned as to give the requisite cross sections for the variable spans proposed.

FLOORING.

The joists are to be of good pine timber, with a depth equal to about 1-12 of their length between bearings; placed not over 28 inches apart from center to center, nor more than 6 inches from the ends of the plank (or more than 4 inches in case of sidewalk plank), and to have an aggregate thickness in carriage-ways not less than 17, and in sidewalks 1-8 the length of plank or width of flooring supported.

When not otherwise specified, the carriage-ways are to be planked with 2½ inch oak, spiked crosswise upon the joists, with 6 inch cut or wrought spikes, having a cross section not less than one inch to each 5 square feet of plank. Sidewalks to be planked with 2 inch pine plank, spiked with 5 inch spike or nails.

Under each arch truss, just above the flooring, is to be a coping of 2 inch pine plank, not less than 3 feet wide, consisting of 2 strings of plank, one on each side of the uprights and diagonals, and fitted about them so as to bring their edges together at the center of the truss, the outer edges coming just over the ends of the floor plank, and being supported by the cross pieces between the joists on either side of the truss.

In bridges without sidewalks, the outer coping to be 15 inches wide, with a fascia plank of a proper depth, and 1½ inches in thickness under the coping, placed 2½ inches from the outer edge.

On the outside of sidewalks is to be a stringer, 9 or 10 inches deep and 6 inches thick, with its upper side about $\frac{1}{2}$ inch above the sidewalk plank, and surmounted by a coping 3 by 10 inches, beveled about 2 inches by $\frac{1}{2}$ inch on the upper corners, with grooves 3-8 inch wide and 5-16 deep on the under side, about $\frac{1}{2}$ inch from each edge.

Upon this coping, near the center, the railing is to be secured by two 5-8 bolts to each post, passing through coping and stringer, and through the ends of needle beams when practicable. But when this is not convenient, the stringer may be first bolted firmly to the ends of the beams, and the railing bolted only to the stringer and coping. Bolt heads and nuts are in no case to act against wood without suitable iron washers.

All the coping, facing plank and rail stringers to be of good pine timber, planed on the upper and outer surfaces and edges, and painted with at least two good coats of white lead or zinc paint and linseed oil.

All parts of the iron work which are accessible after the work is put together, are to be painted with two good coats of lampblack and boiled linseed oil, or other paints approved by the Engineer in charge, except the under sides of the arch castings, which may be painted only one good coat. Those parts of the trusses not accessible for painting after being put together, are to be thoroughly painted at least one good coat before putting together.

The preceding specifications are intended to be applicable to all bridges upon the general plans here referred to, whether with two or a greater number of trusses.

In all cases, not otherwise specified, trusses are to be placed 19 feet apart between centers; and the center of sidewalk railing, when used, 6 feet from center of truss.

For a more full and perfect explanation of the form and dimensions of all the work, and of the manner of executing it in all its details, plans and bills of timber will be furnished by the said Engineer, who will also give such directions during the progress of the work as may appear to him necessary to have the same done in every respect complete and perfect, on the plan contemplated in the foregoing specifications; and the said directions shall in every respect be complied with.

NEW YORK STATE CANALS

1871

SPECIFICATION

Of the Manner of Constructing Whipple's Patent
Iron Arch Truss Bridge Superstructures,

For _____

Each Superstructure to consist of a plank and timber flooring, supported by two or more trusses of wrought and cast iron, and, in cases of bridges with sidewalks, an iron railing three feet high on the outside of each sidewalk.

The trusses to be composed of cast iron arches and connecting blocks, and wrought iron chords, uprights and diagonals; and the flooring of iron needle beams, pine joists and oak planking, as shown on the plans exhibited at the letting.

The truss arches to consist of straight pieces, diverging and widening horizontally, from a width of about $\frac{1}{12}$ the length of the piece, in the middle, to about $\frac{1}{4}$ the height of the truss (and rather more in short trusses) at the end of the arch, each widening in proportion as it pitches downward from a horizontal position. In trusses from 55 to 75 feet in length, the arch is to contain 7 pieces, meeting at angles of 82 degrees, the ends being beveled 4 degrees, so as to form a joint, with a deflection of 8 degrees from one piece to the next contiguous. In trusses from 75 to 100 feet in length, the arch is to contain 9 pieces, with ends beveled 3 degrees at the joints, giving 6 degrees angle of deflection from piece to piece, or such other angle of deflection as may be directed by the Resident Engineer in charge of the work.

The extremities of the arch are to be formed into feet resting on the abutments with a flat bearing of 11 to 13 inches from heel to toe, and have a firm connection with the ends of the chords by having the endmost links left open at the connection, and after passing through the feet from heel to toe, secured by screw nuts at the toe; in which case, the portion of the rod where the screw thread is cut, is to have at least $\frac{3}{8}$ inch greater diameter than the rest of the chord.

The ends of the arch castings at the joints are to be so shaped as to form vertical holes for the uprights to pass through, and afford horizontal bearings for the nuts of the uprights on the upper, and for the eyes of the diagonals on the under side, the holes being so placed that the plane of the arch joint may cut the center of the uprights about two inches below the upper side of the castings.

The depth or width of arch castings (towards the center of the general curvature) is to be not less than $\frac{1}{18}$ the length of the pieces respectively, unless a compensating

increase be made in the cross sections of the pieces; which cross sections, multiplied by the natural sine of the inclination of the pieces respectively from the vertical, are in all places to give products of not less than one square inch for each 90 square feet of bridge floor supported by the trusses respectively, not including the coping under the trusses and railing; and in trusses supporting less than 10 feet width of flooring each, the cross sections of the arch castings, multiplied as above stated, are to give products of not less than one square inch to every 70 square feet of flooring, and to have not less than half an inch in thickness of iron in any part, and not less than $\frac{7}{8}$ inch in thickness within 3 inches of the joints.

No wedging of the arch joints will be allowed. The ends of the pieces must be planed by machinery, or accurately hand-dressed, as may be directed by said Engineer.

Near the outer or upper corner of the joints are to be projections of about $\frac{3}{4}$ of an inch length and depth and $1\frac{1}{2}$ to 2 inches in width, cast on one piece, and extending into the angles of the contiguous piece, to assist in keeping the ends in place.

Each piece of the arch casting is to have at least 4 cross bars connecting the side portions; the end ones being 5 to 6 inches wide, and of a depth, at the upright hole, not less than $\frac{1}{5}$ the width of castings at the point of location; the others at uniform distances between the former, and in section equal to $\frac{1}{3}$ that of the longitudinal parts of the castings.

For the forms and proportions of the cross-bars, and for other particulars not here specified, as well as for the better understanding of these specifications generally, reference is had to the drawings, and to instructions and directions of the Engineer in charge of the work.

The connecting blocks are to be of cast iron; the end portions, where the links go on, to be about $2\frac{1}{2}$ inches deep, with a cross section nowhere less than 24 times the cross section multiplied by the diameter of the iron in the chords, and divided by the width of the connecting block. The edges of the blocks to be fitted to the semi-circular ends of the links.

The central portion of the block is to be so enlarged as to admit of the holes for the uprights and diagonals, and not allow of being cut or fractured in that part without an area of section or fracture at least 20 per cent greater than the cross section of the block where it receives the links of the chords.

The lengths of connecting blocks are to be, for those next the ends of the truss, such that the endmost links of the chord may run parallel from their connections with the feet of the arch, and connect on the ends of the block, the next succeeding links being inside of the former, and so on to the middle of the truss, with the two links of each pair parallel, or nearly so, and the blocks diminishing in length successively by about twice the diameter of the iron in the links.

All the iron to be of such kinds, mixtures and qualities as to produce sound and strong castings, equal to the best descriptions of metal used for machinery.

The ends of the chords and the feet of the arches on the abutments are to be covered with a cast iron box to protect them from contact with the earth of the approach.

WROUGHT IRON WORK

The chords to each arch piece are to be composed of two links of such lengths as to be joined in pairs by the cast iron connecting blocks directly under the arch joints, and connected with the extremities of the arch in the manner before described. The aggregate cross section of the chord to each truss is to contain not less than one square inch for each 120 square feet of bridge flooring (copings not included) sustained by the truss.

The uprights are to be one at each joint of the arch; the middle ones (and more when required) in each truss, to be composed of two rods united into one at the upper end, for that portion which passes through the eyes of the diagonals, the arch, and the nut on the top; with a collar or ring $\frac{7}{8}$ inch square iron welded on just below the eyes of the diagonals, to prevent the latter from sliding down. From 2 to 3 inches below the collar, the two rods diverge at an angle of 10 to 12 degrees, and pass through the connecting blocks outside of the chords. The upper end, or single portion in these uprights, is to be of the same diameter as in the single uprights of the same trusses, and the double portion of $1\frac{5}{8}$ inch iron for sidewalk bridges of spans over 75 feet, and of $1\frac{1}{2}$ inch iron for all other bridges of less than 100 feet span, unless otherwise directed.

Each branch of the double uprights is to have a nut to bear on the upper side of the iron needle beam, and another on the under side of the connecting block, the uprights passing through cast iron thimbles or washers, intervening between the bottom of the needle beam and connecting block, to afford a bearing for the beam.

The rest of the uprights are to be each formed of a single round bar or rod, with a collar and nut, as above described, at the upper end, and passing through the center of the connecting block, to be secured by a nut on the lower end, and to have an adjusting nut to bear on the top of the iron needle beam. The diameters of the single uprights to be not less than 2 inches for spans of 90 to 120 feet, and $1\frac{3}{4}$ inches for spans of 50 to 90 feet for single roadways without sidewalks. For double roadways and bridges with sidewalks, the size of both single and double uprights to be increased, as may be directed by said Engineer.

The diagonals are to be two, crossing each other in each of the quadrilateral panels of the truss, of $1\frac{1}{8}$ inch round iron in all sidewalk bridges of over 75 feet span, and of 1 inch iron for all other bridges, except when otherwise particularly specified. They are to be formed with a strong eye at the upper end for the upright, and bent near the eye, so that it may fit horizontally upon the collar of the upright, or upon the eye of the diagonal, connecting at the same point. Where the diagonals go on to the uprights, the one

running downward towards the centre of the truss is to go on last, or above the other; and the bend at the eye is to be close to the outer edge of the collar, or of the other eye upon which it bears.

The lower end of the diagonal is to pass obliquely through the connecting block, with a screw nut at the end for adjustment, the screw being cut at least 8 inches from the end, and to have a diameter $\frac{1}{4}$ inch larger than the rest of the rod.

The nuts on both uprights and diagonals to be hexagonal, and properly proportioned for the purposes intended.

There shall be a pair of diagonal sway rods in each panel of the bridge; those in the end panels to be $\frac{7}{8}$, and in the intermediate panels $\frac{3}{4}$ inch round iron, and in bridges of 90 to 120 feet span, there shall be two pairs at each end, of $\frac{7}{8}$ inch iron. The sway rods are to be connected with the single uprights of the trusses at the upper side of the connecting blocks by eyes through which the uprights shall pass, and in a similar manner to a horn cast on the upper side of the crotch rod saddles. The sway rods to have turn buckle adjustment near one end, the screwed portion being enlarged $\frac{1}{4}$ inch.

At the ends of the bridge, the sway rods are to connect by eyes with the screws and nuts uniting the chord with the feet of the arches, or in any other convenient and substantial manner.

The sidewalk railing is to be of wrought iron, except the corner posts, and when not otherwise specified, is to consist of vertical posts of $1\frac{1}{8}$ inch square iron, once in 4 to 5 feet; a bottom rail of 1 inch square iron about 4 inches above the bottom of the posts; a top rail of $1\frac{3}{4}$ inch by $\frac{1}{2}$ inch iron, flatwise on the top of the post, with a strip of 1 inch by $\frac{1}{4}$ inch on the top of the last; and balusters of $\frac{3}{4}$ inch square iron, once in 6 inches, doweled and riveted to and between the top and bottom rails. At the bottom of each post, and crosswise of the railing, is to be a foot piece, 6 to 7 inches long, $2\frac{1}{2}$ inches wide, and half an inch thick, firmly riveted to the bottom of the post, and having two holes, one on each side of the post, and about $3\frac{1}{2}$ to 4 inches from center to center, for bolting down to the wood work with $\frac{5}{8}$ inch bolts. On the outside of the railing, the foot plate is to be welded to the lower end of a scroll or ogee brace of $\frac{3}{4}$ inch square iron, running up, and riveted to the post about midway of its length.

The posts at the ends of the railing, or at the corners of the bridge, are to be of hollow cast iron, 3 to 4 inches in diameter, and of any neat and comely pattern approved by the Engineer.

The wrought iron work is to be made of the best qualities of American rolled iron, for all parts except sidewalk railings, which may be made of good common English bar iron.

NEEDLE BEAMS

The trusses are to be connected by cross girders (or needle beams) of wrought iron,

one at each upright, and resting upon the eyes of the sway rods at the single uprights, and on cast iron thimbles or washers at the double ones. The cross girders to consist of a vertical web plate 1/4 an inch in thickness, with top and bottom flanges each of two angle irons, riveted on with 3/4 inch rivets having 4 inch pitch; the beam to have suitable holes for uprights, and be of such depth, length and form as shall be shown upon the drawings exhibited for letting, or as may be directed by the said Engineer. When required, solid wrought iron beams to be inserted in lieu of vertical web plate beams, and to be so proportioned as to give the requisite cross sections for the variable spans proposed.

FLOORING

The joists are to be of good pine timber, with a depth equal to about 1/12 of their length between bearings; placed not over 28 inches, apart from center to center, nor more than 6 inches from the ends of the plank (or more than 4 Inches in case of sidewalk plank), and to have an aggregate thickness in carriageways not less than 17, and in sidewalks 1/8 the length of plank or width of flooring supported.

When not otherwise specified, the carriage-ways are to be planked with 2 1/2 inch oak, spiked crosswise upon the joists, with 6 inch cut or wrought spikes, having a cross section not less than one inch to each 5 square feet of plank. Sidewalks to be planked with 2 inch pine plank, spiked with 5 inch spike or nails.

Under each arch truss, just above the flooring, is to be a coping of 2 inch pine plank, not less than 2 feet wide, consisting of 2 strings of plank, one on each side of the uprights and diagonals, and fitted about them so as to bring their edges together at the center of the truss, the outer edges coming just over the ends of the floor plank, and being supported by the cross pieces between the joists on either side of the truss.

In bridges without sidewalks, the outer coping to be 15 inches wide, with a fascia plank of a proper depth, and 1 1/2 inches in thickness under the coping, placed 2 1/2 inches from the outer edge.

On the outside of sidewalks is to be a stringer, 9 or 10 inches deep and 6 inches thick, with its upper side about 1/2 inch above the sidewalk plank, and surmounted by a coping 3 by 10 inches, beveled about 2 inches by 1/2 inch on the upper corners, with grooves 3/8 inch wide and 5/16 deep on the under side, about 1/2 inch from each edge.

Upon this coping, near the center, the railing is to be secured by two 5/8 bolts to each post, passing through coping and stringer, and through the ends of needle beams when practicable. But when this is not convenient, the stringer may be first bolted firmly to the ends of the beams, and the railing bolted, only to the stringer and coping. Bolt heads and nuts are in no case to act against wood without suitable iron washers.

All the coping, facing plank and rail stringers to be of good pine timber, planed on the upper and outer surfaces and edges, and painted with at least two good coats of white

lead or zinc paint and linseed oil.

All parts of the iron work which are accessible after the work is put together, are to be painted with two good coats of lampblack and boiled linseed oil, or other paints approved by the Engineer in charge, except the under sides of the arch castings, which may be painted only one good coat. Those parts of the trusses not accessible for painting after being put together, are to be thoroughly painted at least one good coat before putting together.

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For a more full and perfect explanation of the form and dimensions of all the work, and of the manner of executing it in all its details, plans and bills of timber will be furnished by the said Engineer, who will also give such directions during the progress of the work as may appear to him necessary to have the same done in every respect complete and perfect, on the plan contemplated in the foregoing specifications; and the said directions shall in every respect be complied with.