SECTION 520

STEEL STRUCTURES

520.1 GENERAL

This work shall consist of furnishing, erecting, and painting structural steel members and elements of structural steel, steel forgings, steel castings, gray iron castings, malleable castings, wrought iron, bronze castings, rolled copper alloy, and other ferrous or nonferrous materials in substantial compliance with the specifications, dimensions, shapes, and design shown on the plans for steel structures and for concrete structures where structural steel is indicated, according to latest AISC specifications.

520.2. REFERENCES

520.2.1 ASTM
A 36
A 47
E 350

520.2.2 AASHTO
M 102 M 108
M 103 M 183
M 105 M 228
M 107

520.2.3 This Publication:
SECTION 139
SECTION 157

520.2.4 Others:
Specifications for Welded Highway and Railroad Bridges, American Welding Society

520.3 MATERIALS

Applicable materials specifications are as follows:

520.3.1 Structural steel shall conform with the requirements of AASHTO M 183 (ASTM A 36), unless otherwise specified.

520.3.2 Rivet steel shall conform with the requirements of AASHTO M 228.

520.3.3 Steel forgings shall conform with the requirements of AASHTO M 102, Class C 1.

520.3.4 Steel castings shall conform with the requirements of AASHTO M 103, Grade 65-35.

520.3.5 Gray iron castings shall conform with the requirements of AASHTO M 105, Class 30.

520.3.6 Malleable castings shall conform with the requirements of ASTM A 47. Malleable castings shall be boldly filleted at angles and the arises shall be sharp and perfect.

520.3.7 Wrought iron plates, bars, and shapes shall conform with the requirements of ASTM E 350.

520.3.8 Cast bronze plates shall conform with the requirements of AASHTO M 107, Alloy B.

520.3.9 Rolled copper alloy plates shall conform with the requirements of AASHTO M 108, Alloy No. 1.

520.3.10 Sheet lead shall be of good commercial quality.

520.3.11 Aluminum and aluminum alloy materials shall conform with the ASTM or Aluminum Alloy Designation shown on the plans.

520.3.12 Paint shall conform with applicable requirements of Section 157, Paint. All steel members shall be painted with one coat of red lead and two coats of aluminum paint, unless otherwise specified.

520.4 CONSTRUCTION REQUIREMENTS

520.4.1 Structural material, either plain or fabricated, shall be stored at the bridge shop above the ground on platforms, skids, or other supports. It shall be kept free from dirt, grease, and other foreign matter and shall be protected from corrosion. These requirements shall apply to fabricated material stored prior to shipment, as well as to the unfabricated material stored at the shop.

520.4.2 Rolled material, before being laid off or worked, shall be straight. When straightening is required, it shall be done by methods that will not produce fractures or otherwise injure the metal. The metal shall not be heated unless permitted by the ENGINEER. The heating shall not be a higher temperature than that producing a dark cherry red color. After heating, the metal shall be cooled slowly. Following the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of fracture. Sharp kinks and bends shall

be cause for rejection of the material. Finished members shall be true to line and free from twists, bends, and other deformities.

520.4.3 Workmanship and finish shall conform with current standard shop practices. Shearing, flame cutting, and chipping shall be done carefully and accurately. Sheared edges of plates more than 5/8 inch in thickness and carrying calculated stress shall be planed for a depth of 1/4 inch. Re-entrant cuts shall be filleted before cutting.

520.4.4 Steel or wrought iron may be flame cut, provided a smooth surface is obtained. Flame cutting by hand shall be done only when approved by the ENGINEER, and the surface of such cuts shall be made smooth by planing, chipping, or grinding.

520.4.5 Shop inspection of structural steel does not relieve the CONTRACTOR of responsibility for fabrication errors. Errors discovered in the field shall be corrected by the CONTRACTOR without expense to the OWNER.

520.4.6 The inspector shall furnish 8 copies of a shop inspection report covering fabrication and inspection of all structural steel items, including a report on the interpretation of the radiographs when applicable.

520.5 WELDING

520.5.1 General Welding of steel shall be confined to such details as shown on the plans or authorized by the ENGINEER and shall conform to the specifications for Welded Highway and Railway Bridges of the American Welding Society. Shop shall remove all slag from shop welds before shipment.

520.5.2 Welded Steel Girders: Where welding is called for on the plans, welds may be made by an automatic or semi-automatic submerged arc in a deposit of granular or powdered flux using direct current or may be manually welded with shielded metal arc electrodes conforming to American Welding Society Specifications except that E6012, E6013, E6020, E7014, and E7024 electrodes shall not be used.

520.5.3 The fabricator will be required to demonstrate the capability of the electrodes, flux, and procedures he proposes to use for submerged arc welding.

520.5.4 All tension flange butt welds shall be radiographed for the entire length of the joints. The tension area of all web plate butt welds shall be radiographed. If defects found in the above welds indicate the desirability, enough of the compression flange butt welds shall be radiographed to satisfy the ENGINEER of their acceptability.

520.5.5 At the option of the ENGINEER, fillet welds shall be examined by magnetic particle or penetrant dye techniques. One foot in each 10 feet of such welds may be examined; and if defects found indicate the desirability, additional examinations shall be made.

520.5.6 The radiographs, penetrant dye, or magnetic particle inspections shall be made by a qualified operator approved by the ENGINEER using approved equipment in accordance with Appendix E of A.W.S. Specifications for Welded Highway and Railway Bridges. The quality of the welds shall be acceptable under Paragraph 409 and Appendix F of these A.W.S. Specifications.

520.5.7 Defects in welds as shown by the inspections shall be removed by chipping or grinding to sound metal and the resulting cavities shall be rewelded. Welds that have been repaired shall be re-examined by methods initially used to reveal the defects.

520.5.8 All butt welds in flange plates shall be ground smooth with adjacent plates. The entire transition adjacent to butt welds between plates of different width or different thickness shall be ground smooth with adjacent plates, with grinding being done in direction of the stress. This grinding to produce a smooth transition without any trace of undercut or overlap of the weld. Care must be exercised to prevent grinding a depression in the thinner plate for the narrower plate at the junction. If this occurs, the depression must be filled with weld metal and the transition ground smooth.

520.5.9 The CONTRACTOR shall provide all equipment apparatus, supplies, and labor required for making the radiographic tests and magnetic particle or penetrant dye examinations and the cost thereof shall be included in the contract unit price per pound for structural steel. The CONTRACTOR shall turn over the radiograph films to the ENGINEER for interpretation.

520.5.10 The CONTRACTOR shall furnish a certified copy of test reports of all pertinent required tests under the

American Welding Society Specifications made on electrodes of the same class, size, and brand and which were manufactured by the same process and with the same materials as the electrodes furnished. The tests may have been for process qualifications or quality control and shall have been made within one year prior to manufacture of the electrodes furnished. The CONTRACTOR shall furnish 8 copies of the manufacturer's certification that the process and material requirements were the same for manufacturing the tested electrodes and the furnished electrodes.

520.6 JOINTS AND CONNECTIONS

520.6.1 When plans require abutting joints to be milled, the ends of the abutting members shall be accurately faced to provide a full and even bearing when assembled in the structure. When the plans require close joints, the opening between ends of abutting tension members shall not exceed 1/8 inch and the opening between abutting ends of rolled girders at splices shall not exceed 1/4 inch.

520.6.2 End connection angles of floor beams and stringers shall be flush with each other and accurately set to position and length of member. End connection angles shall not be finished unless shown on plans and the finished thickness shall not be less than the thickness shown on the plans. When finishing is authorized by the ENGINEER to remedy faulty assembling and riveting, the thickness shall not be reduced more than 1/16 inch nor shall the rivet bearing value be reduced below design requirements.

520.7 RIVETED PLATE GIRDERS

520.7.1 Plate girders having no cover plates and not to be encased in concrete, the top edge of the web plate shall not extend above the backs of the flange angles and shall not be more than 1/8 inch below at any point. Any portion of the plate projecting beyond the angles shall be chipped flush with the backs of the angles. Web plates in girders having cover plates may be 1/2 inch less in width than the distance back to back of flange angles. Splices in webs of girders without cover plates shall be sealed on the top edge with red lead paste prior to painting. At web splices, the clearance between the ends of the web plates shall not exceed 3/8 inch. The clearance at the top and bottom ends of web splice plates shall not exceed 1/4 inch.

520.7.2 End stiffeners of plate girders or rolled beams and intermediate stiffeners for concentrated loads shall be milled or ground to obtain an even bearing against the flange angles or rolled flange. Intermediate stiffeners shall fit sufficiently tight against bottom flanges to exclude water after being painted. Fillers under stiffeners shall fit within 1/4 inch at each end. Flanges of rolled beams, against which stiffeners are to be made to bear, and at splices shall be straightened perpendicular to the web at the location of the stiffener before stiffeners are fitted and at the spliced end before shipment.

520.8 HOLES FOR RIVETS AND BOLTS

520.8.1 All holes shall be either punched or drilled. Shop connections for forming parts of a member composed of not more than 5 thicknesses of metal may be punched 1/16 inch larger than the nominal diameter of the connector whenever the thickness of the metal is not greater than 3/4 inch for strucural steel or 5/8 inch for alloy steel. When there are more than 5 thicknesses or when any of the main material is thicker than 3/4 inch in carbon steel, or 5/8 inch in alloy steel, or when required for field connections, all the holes shall be subpunched or subdrilled 3/16 inch smaller and, after assembling, reamed 1/16 inch larger or drilled from the solid to 1/16 inch larger than the nominal diameter of the connector. All holes in material which is thicker than the nominal diameter of the connectors shall be subdrilled and reamed or drilled from the solid after assembling. The diameter of the die shall not exceed the diameter of the punch by more than 1/16 inch. When holes are enlarged to admit the connectors, they shall be reamed. Holes must be clean cut, without torn or ragged edges. Poor matching of holes will be cause for rejection.

520.8.2 Reamed holes shall be cylindrical, perpendicular to the member, and not more than 1/16 inch larger than the nominal diameter of the connector. Drilled holes shall be 1/16 inch larger than the nominal diameter of the connector. Burrs on the outside surfaces shall be removed. Poor matching of holes will be cause for rejection. Reaming and drilling shall be done with twist drills. Assembled parts shall be taken apart for removal of burrs caused by drilling or reaming. Connecting parts requiring reamed or drilled holes shall be assembled and securely held while being

reamed or drilled and shall be matchmarked before disassembling. The use of tack welding in the shop of riveted beam and girder cover plates or bolted field splice materials for the purpose of drilling or reaming the holes will not be permitted.

520.8.3 Unless otherwise provided, holes in all field connections and field splices of main truss or arch members, continuous beams, plate girders, and rigid frames shall be subpunched or subdrilled and reamed either assembled or through a steel template not less than 1 inch thick or drilled full size either assembled or through a steel template not less than 1 inch thick. Other satisfactory methods approved by the ENGINEER may be used. The assembly, including alignment, camber, accuracy of holes, and milled joints shall be carefully checked before reaming is begun. Unless otherwise authorized by the ENGINEER, each individual truss, arch, continuous beam, plate girder, or rigid frame shall be assembled in the shop before reaming is commenced.

520.8.4 All holes for floor beams and stringer field connections and other connections shown on the plans shall be subpunched or subdrilled and reamed or drilled full size to a steel template not less than 1 inch thick or reamed or drilled full size while assembled. Other satisfactory methods approved by the ENGINEER may be used.

520.8.5 All holes punched or drilled full size shall be so accurately punched or drilled that when assembled and before any reaming is done a cylindrical pin 1/8 inch smaller in diameter than the nominal size of the hole may be entered perpendicular to the face of the member without drifting in not less than 75 percent of the contiguous holes in the same plane. The remaining holes may be reamed not to exceed 1/32 inch to pass the cylindrical pin. Connections not meeting the requirements herein provided may be rejected. The accuracy of subdrilled holes shall be the same as required for punched holes. When holes are reamed, drilled, or assembled, 85 percent of the holes in any contiguous group shall, after reaming or drilling, show no offset greater than 1/32 inch between adjacent thickness of metal.

520.9 FABRICATION

520.9.1 Surface of metal in contact shall be cleaned before assembling. The parts of a member shall be assembled, well pinned, and firmly drawn together with bolts before reaming, riveting, or bolting is begun. Tack welding will not be permitted. Assembled pieces shall be taken apart when required for the removal of burrs and shavings produced by the reaming or drilling operation. The member shall be free from twists, bends, and other deformation.

520.9.2 End connection angles, stiffener angles, beam and girder cover plates, and similar parts shall be carefully adjusted to correct positions and bolted, clamped, or otherwise firmly held in place until connected. Tack welding will not be permitted, except on welded cover plates.

520.9.3 Parts not completely connected in the shop shall be secured by bolts to prevent damage in shipment and handling.

520.9.4 Connecting parts assembled in the shop for the purpose of reaming or drilling holes in field connections shall be matchmarked, and a diagram showing such marks shall be shown on the shop drawings.

520.9.5 The size of rivets shown on the plans shall be the size before heating. Rivet heads shall be of standard shape, unless otherwise provided, and of uniform size for the same diameter of rivet. Rivet heads shall be full, concentric with the shank and in full contact with the surface of the member.

520.9.6 Rivets shall be heated uniformly to a light cherry red color and shall be driven while hot, completely filling the holes. Rivet points that are heated more than the remainder of the rivet shall not be driven. When a rivet is ready for driving, it shall be free from slag, scale, or other adhering matter. Any rivet which is scaled excessively will be rejected. Rivets which throw off sparks when taken from the forge shall not be driven. All rivets that are burned, loose, badly formed, or otherwise defective shall be removed and replaced. Any rivet head that is deficient in size or is driven off center shall be removed. Stitch rivets that are loosened by the driving of adjacent rivets shall be removed and replaced. In cutting out defective rivets, care shall be taken not to injure the adjacent metal; and when required, the rivet shanks shall be removed by drilling, the use of a cutting torch will not be permitted. Caulking or recupping of rivet heads will not be permitted. Approved beveled rivet sets shall be used for forming rivet heads on sloping surfaces. Counter-sinking shall be neatly done, and counter-sinking rivets shall completely fill the holes.

520.9.7 Bolted connections shall be used when shown on the plans or authorized by the ENGINEER for connections where it is impracticable to drive rivets. Where bolted connections are required, the bolts used shall be of the type shown on the plans or designated by the ENGINEER. High tensile strength bolts shall conform to the provisions of Section 139.

520.9.8 Turned bolts shall conform to details shown on the plans. The bolt shank shall be 1/16 inch larger than the nominal bolt size, shall be turned to a driving fit, and finished with a finishing cut. The threaded end shall be the nominal bolt size and shall terminate against the shank with a square shoulder entirely outside the hole. The bolts shall be of such length that threads will be entirely outside the hole and will extend entirely through the nuts not more than 1/4 inch. Heads and nuts shall be hexagonal. One-fourth inch nut locks shall be used on all turned bolts.

520.9.9 Ribbed bolts shall have a drive fit. The ribbed shank shall be slightly larger than the nominal bolt diameter with triangular longitudinal ribs. The ribbed shank shall extend entirely outside of the hole. The threaded end shall be the nominal bolt size and shall terminate against the shank with a square shoulder. Heads may be button heads, and nuts shall be hexagonal and recessed on the inside face to receive the shank and permit tightening securely against the connected parts. Ribbed bolts shall be of such length that threads will extend through the nuts not more than 1/4 inch. Self-locking nuts or 1/4 inch nut locks will be required on all bolts.

520.9.10 Unfinished bolts shall be standard bolts with square or hexagonal heads and hexagonal nuts. Bolts shall be threaded to such a length that not more than one thread will be within the grip of the connected parts and bolts shall be of the length that threads will extend through the nut not more than 1/4 inch. One-fourth inch nut locks shall be used on all bolts.

520.9.11 Turned and ribbed bolts shall be driven accurately into the holes without damaging the threads. The heads and nuts shall be drawn tight against the connected parts with a suitable wrench. Heads of drive fit bolts shall be tapped with a hammer while the nut is being tightened. Where bolts are used in beveled surfaces, beveled washers shall be provided to give full bearing to the head or nut.

520.10 BASE AND CAP PLATES--PINS AND ROLLERS

520.10.1 Ends of columns taking bearing upon base and cap plates shall be milled to true surfaces and correct bevels after the main section of these members and the end connection angles have been fully connected.

520.10.2 Cap and base plates of columns and the sole plates of girders and trusses shall have full contact when assembled. The plates, if warped or deformed, shall be hot-straightened, planed, or otherwise treated to secure an accurate, uniform contact. After being riveted in place, the excess material of countersunk rivet heads shall be chipped smooth and flush with the surrounding metal and the surfaces which are to come in contact with other metal surfaces shall be planed or milled, when required, to secure proper contact. The surfaces of base and sole plates that are to come in contact with masonry shall be rough-finished or hot-straightened when not free from warps or other deficiencies.

520.10.3 When planing the surfaces of expansion plates, the cut of the tool shall be in the direction of expansion. Surfaces of cast bronze bearing plates for sliding contact shall be carefully milled and polish finished. Finishing of rolled copper alloy plates will not be required provided they have a plane with a smooth surface. Surfaces of pedestals and shoes which come in contact with metal surfaces shall be planed and those which are to take bearing upon the masonry shall be rough-finished.

502.10.4 Pins and rollers shall be accurately turned to dimensions and shall be smooth, straight, and free from flaws. Pins and rollers more than 9 inches in diameter shall be forged and annealed. Pins larger than 9 inches in diameter shall have a hole not less than 2 inches in diameter bored longitudinally through the centers. Pins showing defects will be rejected.

520.10.5 Pin holes shall be bored to dimensions, smooth and straight, at right angles with the axis of the member and parallel, unless otherwise required. The diameter of the pin hole shall not exceed that of the pin by more than 1/16 inch for pins 5 inches or less in diameter or 1/32 inch for larger pins. Boring of holes in built up members shall be done after the assembly is completed.

520.10.6 Threads for pins shall conform to the American National Coarse Thread Series, Class 2, free fit, except that the pin ends having a diameter of 1 3/8 inches or more shall be threaded 6 threads to the inch.

520.11 PRE-ERECTION REQUIREMENTS

520.11.1 Each member shall be painted or marked with an erection mark for identification and an erection diagram shall be furnished with erection marks shown thereon. The CONTRACTOR shall furnish as many copies of material orders, shipping statements, and erection diagrams as the ENGINEER may direct. The weights of the individual members shall be shown on the statements. Members weighing more than 3 tons shall have the weights marked thereon. Structural members shall be loaded on trucks or cars in such a manner that they may be transported and unloaded at their destination without being excessively stressed, deformed, or otherwise damaged. Bolts and rivets of one length and diameter and loose nuts and washers of each size shall be packed separately. Pins, small parts, and packages of rivets, bolts, washers, and nuts shall be shipped in boxes, crates, kegs, or barrels. The gross weight of any package shall not exceed 300 pounds. A list and description of the material shall be plainly marked on the outside of each shipping container. When steel is painted in the shop, field rivet heads, field bolt heads and nuts, and abrasions in the original shop coat, due to handling during shipping and erecting, shall be covered with shop paint after the steel is erected.

520.11.2 The CONTRACTOR shall give ample notice to the ENGINEER of the beginning of work, at shop, so that inspection may be provided. No material shall be fabricated before the ENGINEER has been notified. Shop inspection may be waived by the ENGINEER.

520.11.3 The CONTRACTOR shall submit to the ENGINEER five complete sets of blueprints of shop and erection drawings for preliminary approval. One approved set will be returned to the CONTRACTOR with notations. The CONTRACTOR shall then furnish the ENGINEER with 10 sets of the final shop drawings for approval and no fabrication shall be done before approval has been given. No changes shall be made on any drawing without the approval of the ENGINEER. The CONTRACTOR shall furnish the ENGINEER with eight copies of mill test reports covering all structural steel items, including railing.

520.11.4 Structural material, either plain or fabricated, shall be stored above the ground on platforms, skids, or other supports. Such material shall be kept free from dirt, grease, and other foreign matter and properly drained and protected as far as practicable from corrosion. Girders and beams shall be placed upright and shored. Long members shall be supported on skids placed near enough together to prevent injury from deflection.

520.12 ERECTION REQUIREMENTS

520.12.1 Falsework shall be properly designed and substantially constructed and maintained for the required loads. When required, the CONTRACTOR shall prepare and submit to the ENGINEER for approval plans for falsework. Approval of the CONTRACTOR's falsework plans shall not relieve the CONTRACTOR of his responsibility. Falsework which cannot be founded on a footing shall be supported on falsework piling.

520.12.2 All work of erection shall be subject to the inspection of the ENGINEER, who shall be given all facilities required for a thorough inspection of workmanship. Before starting the work of erection, the CONTRACTOR shall inform the ENGINEER as to the method of erection he proposes to follow and the amount and character of equipment he proposes to use, which shall be subject to the approval of the ENGINEER. The approval of the ENGINEER shall not relieve the CONTRACTOR of his responsibility for the safety of his method or equipment or from carrying out the work as herein provided.

520.12.3 Column bases, truss and girder pedestals and shoes, and other masonry bearings shall have a full and uniform bearing upon the substructure masonry. Such bearings shall not be placed on the bridge seat areas of piers or abutments that are improperly finished or irregular.

520.12.4 The shoes and pedestals of truss and girder spans, the bases of columns, and other masonry bearings shall be located to correct alignments and elevations. Unless otherwise provided, shoes and pedestals of truss and girder spans shall be placed on lead sheets of the thickness shown on the plans.

520.12.5 Anchor bolt holes shall be installed at locations and in manner shown on the plans, perpendicular to the plane of the bridge seat. Unless otherwise shown on the plans or authorized by the ENGINEER, anchor bolts placed in

drilled holes shall be set in Portland cement mortar. The mortar shall consist of 1 part cement to 1 part clean,fine grained sand mixed with a minimum of water necessary to set the anchor bolts. Anchor bolts shall be placed in the dry holes to assure satisfactory fit after setting. The bolts shall be set as herein provided. The holes shall be partially filled with mortar so that by uniform even pressure or light blows with a hammer the bolts will be forced into the holes and the mortar will rise to the top of the holes. All excess mortar shall be removed after the bolts have been set. The anchor bolt nut shall rest firmly against the metal shoe or pedestal. Anchor bolts at the expansion ends of spans shall permit the free movement of the span.

520.12.6 Field assembling of the component parts of a structure shall be consistent with standard construction practices to prevent injury to the metal. Members bent or twisted shall be corrected or removed and replaced without expense to the OWNER.

520.12.7 Unless erected by the cantilever method, truss spans shall be erected on blocking so placed as to give the trusses proper camber. The blocking shall be left in place until the tension cord splices are fully connected and all other truss connections pinned or bolted. Rivets or bolts, in splices of butt joints of compression members and in railings, shall not be placed until the span has been swung.

520.12.8 Riveted or bolted field splices and joints for assembling steel members shall be made up with erection bolts and cylindrical erection pins. A sufficient number of erection pins shall be used to align the holes and a sufficient number of bolts shall be used to bring and hold the component parts of the splice or joint in full contact. In assembling and making up splices and connections for main truss and arch members at least 1/2 of the holes shall be filled with pins and bolts. All splices and connections carrying traffic during erection shall be made up with pins and bolts in at least 3/4 of the holes.

520.12.9 Erection bolts shall be of the same nominal diameter as the rivets or field bolts. Cylindrical erection pins shall be 1/32 inch larger than the nominal diameter of the rivets or bolts. High tensile strength steel bolts may be used as erection bolts, provided they are not loosened and retightened.

520.12.10 The straightening of bent edges of plates, angles, and other shapes shall be done by methods not likely to produce fracture or other injury. The metal shall not be heated unless permitted by the ENGINEER, in which case the heating shall not be to a higher temperature than that producing a dark cherry red color. After heating, the metal shall be cooled as slowly as possible. Following the completion of the straightening of a bend or buckle, the surface of the metal shall be carefully inspected for evidence of incipient or other fractures.

520.12.11 The results obtained in the field assembling and riveting of the members of a structure shall conform to the requirements for shop assembling and riveting. Field-driven rivets shall be inspected and accepted before being painted. Field riveting or bolting shall be done before the falsework is removed, except for compression chords of trusses, unless special permission to the contrary is given by the ENGINEER. Railings shall not be fastened until the falsework has been removed and all dead load is in place on the span and shall be adjusted to bring the railing to exact line and grade.

520.12.12 Pneumatic hammers shall be used for field riveting. Cup faced dollies, fitting the head closely to insure good bearing, shall be used. Connections shall be accurately and securely fitted up before the rivets are driven. Drifting shall be only such as to draw the parts into position and not sufficient to enlarge the holes or distort the metal. Unfair holes shall be reamed or drilled if permitted by the ENGINEER. Rivets shall be heated uniformly to a light cherry red color and shall be driven while hot. They shall not be overheated or burned. Rivet heads shall be full and symmetrical, concentric with the shank, and shall have full bearing all around. They shall not be smaller than the heads on the shop rivets. Rivets shall be tight and shall grip the connected parts securely together. Caulking or recupping will not be permitted. In removing rivets, the surrounding metal shall not be injured; if necessary, they shall be drilled out. No rivets shall be removed by flame cutting.

520.12.13 Unless otherwise required, bolted splices and field connections shall be fitted up as required for riveted connections with drift pins and fitting-up bolts.

520.12.14 Pilot and driving nuts shall be used in driving pins, details shall be shown on the shop plans. One pilot and one driving nut for each size pin shall be furnished by the CONTRACTOR without charge. Pins shall be driven so that the members will take full bearing on them.

520.12.15 The correction of minor misfits involving unharmful amounts of reaming, cutting, and chipping will be considered a legitimate part of the erection. However, any error in the shop fabrication or deformations resulting from handling and transportation which prevent the proper assembling and fitting up of parts by the moderate use of drift pins or by a moderate amount of reaming and slight chipping or cutting, shall be reported immediately to the ENGINEER and his approval of the method of correction obtained. The correction shall be made in his presence.

520.12.16 Before concrete floor are placed on steel truss or arch spans, the centering under the bridge shall be released and the span swung free on its supports. The operation of placing the concrete in any floor slab shall be continuous between expansion joints, unless otherwise provided on the drawings.

520.13 MEASUREMENT AND PAYMENT

520.13.1 Structural steel and other metal material will be measured by the computed weight, in pounds, based on the details shown on the fabricator's approved shop drawings or from detailed plans prepared by the ENGINEER when shop drawings are not required. Payment will be made at the unit price per pound in accordance with the Bid Proposal. When provided in the the Bid Proposal, structural steel and other metals may be measured and paid for on a lump sum basis.

520.13.2 The CONTRACTOR will be paid only for the material actually installed in the completed structure.

520.13.3 Should the CONTRACTOR, upon his request in writing, be allowed to substitute heavier sections than are called for on the design drawings, the additional weight of such heavier sections will not be paid for.

520.13.4 The ENGINEER may require the CONTRACTOR to furnish scale weights of the metal members. If the scale weight of any member is less than 97.5 percent of the computed weight, it shall be cause for rejection.

520.13.5 The computed weight will be determined as follows:

520.13.5.1 The weight of steel shall be assumed at .2833 pounds per cubic inch. The weight of cast iron shall be assumed at .2575 pounds per cubic inch. The weight of bronze shall be assumed at .3102 pounds per cubic inch. The weight of lead shall be assumed at .4091 pounds per cubic inch.

520.13.5.2 The weight of rolled shapes and plates shall be computed on the basis of their nominal weights and dimensions, as shown on the approved shop drawings, deducting for copes, cuts, and open holes, except that open holes for rivets shall not be deducted.

520.13.5.3 The weight of heads of rivets and bolt elements outside the grip, in place in the finished structure, shall be included in the computed weight.

520.13.5.4 The weight of castings shall be computed according to the net volume of the finished casting as shown on the approved shop drawings, with an addition of 10 percent for fillets and overrun.

520.13.5.5 The weight of weld metal shall not be included in the computed steel weight.