

CHAPTER No. 18

STEEL AND IRON WORK

SPECIFICATION NO. 18-1--General Specifications

1. Steel, wrought iron, and cast iron, used in steel and iron work shall conform to requirements laid down in specification nos. 3-19, 3-18 and 3-17 respectively. The sources from which these materials as well as rolled sections are obtained shall always be subject to the approval of the Executive Engineer. Work shall at all times be neatly, soundly and perfectly finished, strictly in accordance with drawings and other contract specifications. Materials finish contract specifications.
2. All smith work shall come clean and sound from the anvil, not burnt or injured in any way. All bends shall be made cold wherever possible. Where, in order to bend angles, tees or other rolled sections which will be subject to direct stress, it is necessary to use heat, they shall be annealed subsequently in every case (except that of girder web stiffeners). Any piece which has become over-heated, strained, unsound, imperfect, or reduced in section shall be replaced by a sound one. Smith work annealing.
3. All exposed edges shall be finished square and smooth by filling, milling or planing. Ends of straps, when exposed, must be finished to an octagonal or semi-circular shape as directed and filed smooth. After fabrication, work shall be cleaned of all scale, rust and foreign or deleterious matter of every sort and kind with wire brushes, if necessary, and oiled and or painted as and where specified. Finish.
4. Punching of holes $1/6$ inch (1.5 mm.) larger than the nominal diameter of the rivet will be permitted up to $3/4$ inch (20 mm.) thickness of metal, or wherever thickness of the metal is equal to or less than the diameter of the rivets plus $1/8$ inch (3 mm.) or where reaming or drilling of the holes is not specifically laid. All punching shall be accurately done. Drifting to enlarge unfair holes will not be allowed. If the holes must be enlarged to admit the rivet, they shall be reamed. Poor matching of holes will be cause for rejection. All burrs left by punching or drilling shall be removed before assembly. Holes.
5. All bolts and nuts are to be made in accordance with British Standard Specification No. 916--1953 and unless shown or specified otherwise, the bolt heads and nuts are to be hexagonal. All nuts are to fit hand-tight. The head and shank of every bolt shall be forged from the solid, the shank must be truly cylindrical and the head concentric. Washers are to be supplied in all cases where Bolts and nuts.

SPECIFICATION NO. 18-1—General Specifications

the combined thickness of the members to be connected is less than the unthreaded portion of the bolt. Steel or wrought iron tapered washers shall also be provided for all heads and nuts bearing on bevelled surfaces. For black bolts a clearance of 1/32nd inch (0.75 mm.), 1/6th inch (1.5 mm.) and 1/8th inch (3 mm.) shall be allowed for holes up to 3/8 inch (10 mm.), 1 inch (25 mm.) and over 1 inch (25 mm.) in diameter respectively.

Rivets.

6. All rivets shall conform to specification no. 3.23. Unless otherwise specified, the dimensions on the drawings refer to the diameters of the cold rivet. Each rivet shall be of sufficient length to form a head of the standard dimension. For rivets of diameters of 5/8th inch (15 mm.) and upwards, the diameter of the rivet before being heated shall not be less than the diameter of the hole it is intended to fill by more than 1/6th (1.5 mm.) inch. Before rivetting is commenced, every alternative hole in the joint shall be tightly bolted up so as to draw the parts firmly together and ensure tight rivetting. Bad rivetting is very often due to inadequate bolting up. Rivets shall be heated to a red heat from head to point when inserted and must be upset immediately in the entire length so as to fill the holes completely.

All loose rivets and rivets with cracked, badly formed, or deficient heads or with heads which are unduly eccentric shall be cut and replaced. Recupping and caulking will not be allowed. Flattened rivets heads shall be made where clearances are required. Rivets shall be cut out when required by the Executive Engineer for examination or test, and replaced by new ones, such work being done by the contractor with the rates. In cutting out rivets, care shall be taken not to injure the adjacent metal. If possible, they shall be drilled out. In the alternative the heads will be cut off and rivets drifted out.

After rivetting, each rivet shall be tested by being tapped with a light hammer say about 8 oz. (225 grams) hammer to ensure that each rivet is tight. Slack rivets give a hollow sound and a jar. Rivets not passed are to be painted white and shall be replaced at once, care being taken not to disturb adjacent rivets.

Cleaning piling painting.

7. All steel and iron work with the exception of reinforcement for cement concrete, and work to be embedded in brickwork or masonry, shall, on completion, be scrapped free from rust, and scaled with steel wire brushes, cleaned and thoroughly oiled or painted as laid down in specification no. 16-3.

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8. Where steel and iron work has been fabricated from rolled steel bars, plates or sections, it shall be measured by the standard weight of these sections without taking into account the rolling margin as specified in Specification No. 3-19 for structural steel. The weight of rivets, bolts and nuts used shall be added and no deduction will be made for metal removed from holes; provided, however, that whenever the finished work can be weighed, it shall be measured by its actual weight.

Measurements.

9. The rate for erection includes the supply of all derricks and tackle necessary to hoist iron or steel work into place. The contractor is responsible that the tackle is of requisite strength and that work is properly secured during construction. The Sub-Divisional Officer may call upon the contractor to strengthen any staging, tackle or lashing if he considers it necessary, but nothing in this clause shall mean that he is responsible for the safety of either the work or the labour, for which the contractor is solely responsible.

Tackle responsibility for safety.

SPECIFICATION NO. 18-2—Steel Work (Ordinary)

General.

1. This specification applies to steel work like joists, flats, tees, angles and channels etc., which may be either fixed independently with out connecting plates or fixed with angle cleats or other connecting plates as in case of hip and jack rafters, common rafters and purlins.

Steel.

2. Structural steel conforming to specification no. 3.19 shall be used. All tees, angles, channels, flats and joints etc. shall be free from cracks, surface flaws, laminations; rough, jagged and imperfect edges and all other defects.

Steel work.

3. All tees, angles, channels, flats and joists etc. shall be cut square and to correct dimensions, a steel tape being used for measurements. The cut ends shall be dressed perfectly true with hammer, chisel and file. All straightening, shaping to form etc. shall be done by pressure and not by hammering.

Holes bolting.

4. All drilling, punching and bolting wherever necessary, shall be done in accordance with the general specification for steel and iron work.

Measurements.

5. Steel work (ordinary) shall be measured by weight as provided in paragraph No. 8 of specification no. 18.1. Steel work fixed independently without connecting plates shall be measured and paid for separately from steel work fixed with angle cleats and connecting plates.

Rate.

6. The labour rate is for steel work, fixed in position, including cutting, cleaning and hoisting and the provision of all necessary tools, plant and tackle required.

The through rate in addition includes the cost of materials also.

SPECIFICATION NO. 18.3—Structural Steel Work

1. For all important bridge construction, the British Standard Specification for girder bridges parts 2, 4 and 5 (B. E. S. A. Bulletin No. 153—revised 1930) shall be followed. The following abridged specifications shall be followed for other and small structures fabricated at or near the site.

Large contracts
local fabrication.

2. Work shall be carried out strictly in accordance with drawings, no departure being allowed therefrom except under the written authority of the Executive Engineer. Notes or specifications on the drawings supplied by the Executive Engineers are to be construed as superseding or cancelling any clauses of this specification with which they conflict. On all drawings, dimensions shown in figures shall be acted upon in preference to measurements by scale. A large scale drawing supersedes one of a smaller scale.

Drawings.

3. All straightening, levelling and shaping to form etc. shall be done by pressure and not by hammering. All joggles and knees shall be formed by pressure and where practicable in making these, the metal shall not be cut and welded.

Straightening and
shaping to form.

4. All drilling, punching and rivetting shall be done in accordance with the general specification for steel and iron work.

Holes rivetting.

5. Welding shall be done in place of rivetting, where so specified by the Executive Engineer and it shall comply with specifications No. 18.11 to 18.13. When welding is resorted to in place of rivetting, rate shall be reduced as specified in the Schedule of Rates.

Welding.

6. All steel work intended to be rivetted or bolted together, must be in contact over the whole of the surface. Joints which have to take compressive stresses and the ends of all stiffeners shall meet truly over the whole of the butting surface and bear tightly top and bottom. In rivetted work, all parts in contact shall before assembling be painted on each surface with one heavy coat of pure red oxide freshly ground in pure double boiled linseed oil and the surfaces brought in contact while still wet.

Joints parts in
contact.

7. All members shall be so formed that they can be accurately assembled, without being unduly packed, a strained or forced into position and when built, shall be true and free from twists, kinks, buckles or open joints between component pieces. Work shall be kept properly bolted together while it is being rivetted and no drifting shall be allowed except for the purpose of drawing assembled sections together. Slight inaccuracies in the matching of holes may be corrected with reamers, but drifting to

Fitting and
Assembling.

SPECIFICATION NO. 18-3—Structural Steel Work

enlarge unfair holes is prohibited. Failure in any of the above respects will involve the rejection of the defective members.

Columns and stanchions.

8. Columns or stanchions shall be erected truly plumb, and to centres and to level. The base plates shall be wedged clear of the foundations and adjusted where necessary to plumb and to the necessary level. Levelling shall be done with a mark from the top of the column, and sighting on the mark. When adjusted, the base plate or footing shall not be less than 1/2 inch (13 mm.) nor more than 3/4 inch (20 mm.) above the bed. The space in between must then be filled up with neat cement grout.

Laying out.

9. As far as possible, structures shall be drawn out to full size on a level platform, a steel tape and an accurate square being used for laying out. The members shall be drawn in, and the joints arranged as shown in the drawings.

Templates.

10. Wooden templates 1/2 to 3/4 inch (12 to 20 mm.) thick shall be made to correspond to each member and plate and rivet holes marked in them accurately by drilled holes large enough to fit the marking punch accurately. Templates for plates may be made of sheet metal. In the case of repetition work, all templates shall be of steel. For accurate and mass drilling of holes, jigs fitted with drill bushings shall be used.

Erections.

11. Proper derricks and suitable lifting tackles shall be used for erection. Frames shall be lifted at such points that they are not liable to get buckled or deformed. Trusses shall be lifted at two points about 1/3 to 1/4 along each rafter from the ridge. Immediately the frames or trusses are placed in position, they shall be secured against over-turning. Every precaution shall be taken to prevent collapse. Temporary scantlings or pieces of timber shall be lashed to the members suitably to relieve erection stresses. In the case of trusses, all wind bracings shall be placed at the same time as the truss is erected.

Extensions.

12. When extending or remodelling an existing structure, record drawings must not be trusted. Sections shall be made by actual measurements before new work is put in hand as otherwise packing up or other expedients may become necessary in order to make the new work join up accurately with the old.

Finishing.

13. On conclusion of the work and after it has been inspected and passed by the Engineer-in-charge, the work shall be cleaned of all rust, scale and dust and painted as laid down in specification no. 16.3.

SPECIFICATION NO. 18.3—Structural Steel Work

14. Labour rate shall include all forgings, reducing to required size, shape and figure, drilling, tapping, punching, rivetting, filing, cleaning etc., and every description of workmanship that may be necessary to fabricate, hoist, erect and fix in position structural steel work in a good and perfect manner. All necessary tools, plant and tackle required are also included in the rate.

Rate.

The through rate in addition shall cover the cost of material including gusset plates, rivets, bolts and nuts, etc. and all wastage.

SPECIFICATION NO. 18.4—Gratings**General.**

1. This specification applies to iron grated doors, framed grills, gratings, M.S. ladders made of either wrought iron or mild steel.

Gratings.

2. In making the gratings the ends of square bars shall not be reduced to a section less than that which will just allow their insertion into a circular hole of diameter equal to the side of the bar. When placed in position in its frame, before rivetting the end of each bar must project to length equal to the diameter of this hole to admit of a proper rivet head being formed. Any flimsy fixing either by a reduction in the section of the bar or by improper rivet head shall cause the bar to be rejected and may make the completed grating liable to rejection. Welding may be done in place of rivetting if approved by the Engineer-in-charge.

Rate.

3. Through rate for fixed gratings, grills, ladders includes the cost of angle iron and M.S. bars, cutting to size, forging, rivetting and fixing in position including cleaning. The through rate for iron grated doors in addition includes the cost of pintle hinges, locking arrangement and other special steel fittings. The labour rate includes only the labour charges of these items.

SPECIFICATION NO. 18.5—G.I. Sheet Garage Doors

- | | |
|---|-----------------------------|
| <p>1. G.I. sheet garage door shall consist of G.I. sheet 22 gauge (0.800 mm.) or as specified, rivetted or welded to $1\frac{1}{2}$ inch \times $1\frac{1}{2}$ inch \times $\frac{1}{4}$ inch (40 mm. \times 40 mm. \times 6 mm.) angle iron frame along the sides and diagonally braced. The shutters shall be fixed to the walls by means of pintles embedded in cement concrete 1:2:4 blocks, 9 inch \times 9 inch \times 6 inch (22.5 cm. \times 22.5 cm. \times 15 cm.) size. The bottom guides of 2 inch \times 2 inch \times $\frac{1}{4}$ inch (50 mm. \times 50 mm. \times 6 mm.) T-iron shall be provided in the form of quadrants so that shutters slide over them by means of 1 inch (25 mm.) diameter steel pulleys. The guides shall be sunk in floor in cement concrete 1:2:4 with their flat top flush with the ground.</p> | <p>Description.</p> |
| <p>2. The measurement shall be taken for the shutter of the garage doors in superficial area.</p> | <p>Measurements.</p> |
| <p>3. Through rate includes the cost of G.I. sheets, gusset plates, angle iron, bottom guides, pintles including bolts and nuts, rivets, hooks, pulleys, locking arrangements and handles, cement concrete 1:2:4 for embedding the guides and the cost of labour required for all the operations included in para above including cutting, rivetting, fixing in position, cleaning and all wastage. The labour rate includes only the labour charges of these items.</p> | <p>Rate.</p> |

SPECIFICATION NO. 18.6—G.I. Sheet Sliding Shutters

Description.

1. G.I. sheet sliding shutter shall consist of double leaf shutters made out of G.I. sheet 22 gauge (0.800 mm.) or as specified rivetted or welded to $1\frac{1}{2}$ inch \times $1\frac{1}{2}$ inch \times $\frac{1}{2}$ inch (40 mm. \times 40 mm. \times 6 mm.) angle iron frame, running on all sides and diagonally braced. The leaves shall slide within top and bottom guide rails of $1\frac{1}{2}$ inch \times $1\frac{1}{2}$ inch \times $\frac{1}{2}$ inch (40 mm. \times 40 mm. \times 6 mm.) angle iron with 1 inch (25 mm.) diameter steel pulleys at bottom and guide hooks at the top. The shutters shall be provided with locking arrangements, handles and stoppers.

Fixing.

2. The guide rails shall be fixed to the floor at bottom and to the slab at top by means of steel hold-fasts embedded in the cement of floor and slab. The hold-fasts shall be approximately 18 inches (45 cm.) apart. The guide rails shall be sufficiently long and taken into chases in the wall on both ends so that the sliding shutters can get into the chases, giving full opening when so required.

Measurements.

3. The sliding shutters shall be measured in superficial area by multiplying the height from outside to outside of the guide rails and the combined width of the two leaves.

Rate.

4. The through rate covers the cost of material such as G.I. sheets, gusset plates, angle iron, hold-fasts, pulleys, handles and locking arrangement, bolts and rivets etc. for the complete length of guide rails including all wastage and the cost of labour required for all the operations included in paras 1 and 2 above. Labour rate includes only the labour charges of these items.

SPECIFICATION NO. 18.7—"Chick" Hooks

1. If ordered, the contractor shall build in iron "chick" hooks into the inner face of all exterior verandah walls at a level of 6 inches (15 cm.) above the top of lintels or arch openings. This shall be done whilst the work is in progress and not driven in after completion of the wall.
2. The hooks shall be made from $\frac{3}{8}$ inch (10 mm.) diameter rod. The end to be inserted into the wall shall be ragged or splayed, and shall be of such a length as to allow of at least 6 inches (15 cm.) being inserted into the wall. The projecting lug shall stand out 1 inch (25 mm.) from the finished face of the wall or plaster and shall be $1\frac{1}{2}$ inches (40 mm.) deep. All hooks shall be placed in a straight line, and the projections and depths shall be uniform throughout.
3. Unless otherwise directed, three hooks should be provided for each arch opening. In the case of lofty arches, if desired by the Engineer-in-charge, pulleys shall be fixed into the wall above the centre hook with rawl-plugs.

**Fixing verandahs
when building
walls.**

**Dimensions
fixing.**

**Number big
openings**

SPECIFICATION NO. 18.8—Fan Hooks

The contractor shall fix suitable fan hooks made of $\frac{1}{2}$ inch (16 mm.) diameter and 2 ft. 9 inches (84 cm.) long M.S. bars in R.C.C. slabs or beams as directed by the Engineer-in-charge. The hook shall be fixed to the reinforcement with binding wire. This shall be done before the concreting is started. For fixing hook, opening shall be provided in the shuttering. After placing the hook in position, the gap in shuttering, shall be filled with timber pieces or putty so that there is no leakage of cement concrete and the surface of cement concrete remains unimpaired.

SPECIFICATION NO. 18.9—Window Grills

1. Mild steel bars shall conform to specification No. 3.20 and shall be either round or square as specified. Bars shall be of 5/8 inch (16 mm.) diameter or any other size specified. Flat iron shall conform to specification No. 3.19 and shall be of 1½ inch × ½ inch (40 mm × 6 mm.) size.

Materials.

2. Mild steel bars shall go at least 2 inches (5 cm.) deep into the chowkat at each end. The spacing of bars shall be as shown in the drawings or as specified. When the clear length of bars is 3 feet (1 metre) or more, they shall be suitably braced by flat iron which is screwed on to the chowkat.

Construction.

3. Window grills shall be measured by weight.

Measurements.

4. The through rates for window grills shall cover the cost of steel including wastage and all labour charges for cutting, and fixing in position. Labour rates cover the labour charges for above operations.

Rate.

SPECIFICATION NO. 18.10—Steel Doors and Windows

Rolled steel sections.

1. Doors and windows shall be manufactured from standard rolled steel sections having dimensions and weights conforming to Indian Standard : 1038. Steel shall conform to specification No. 3.19 (Structural Steel) and shall be of category B.¹

Coupling sections.

2. Coupling sections shall be made from mild steel plate 1/8 inch (3.2 mm.) in thickness and shall conform to dimensions given in Indian Standard : 1038.

Fabrication.

3. Frames of doors and windows shall be square and flat. Both the fixed and opening frames shall be constructed of sections which have been cut to length, mitred and electrically flash-welded to true right angles at the corners. Sub-dividing bars and units shall be tenoned and rivetted into the frames.

Size tolerances.

4. Steel doors and windows shall be according to the specified sizes and drawings. The actual sizes shall not vary by more than 1/16 inch (1.6 mm.) from those given in the drawings.

Hinges.

5. The hinges shall normally be of the projecting type and shall be made of steel. The hinges shall be 2-5/8 inch (67 mm.) wide in windows and 2 inch (50 mm.) wide in doors as shown in the sketches. Usually two hinges are required for a window shutter and three for a door shutter. For fixing hinges, slots shall be cut in the fixed frame and the hinges inserted inside and welded to the frame.

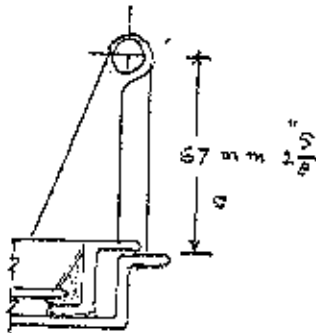


FIG. 18.10(a)
TYPICAL PROJECTING TYPE HINGE
FOR SIDE HUNG SHUTTER.

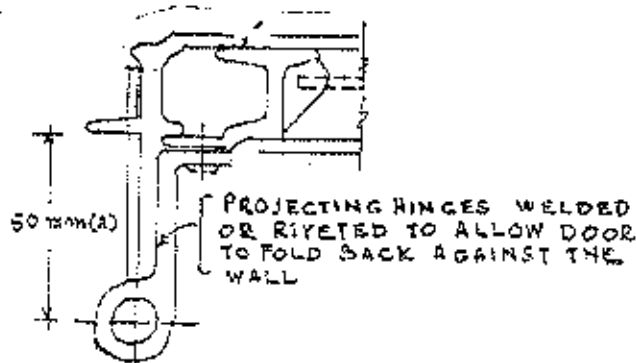


FIG. 18.10(b)
TYPICAL PROJECTING TYPE HINGE
FOR DOOR.

Handles.

6. The handles for doors and windows shall be made of brass (bronze plated) and shall be mounted on a steel handle plate welded to the opening frame in such a way that it can be fixed after the shutter is glazed.

SPECIFICATION NO.18.10—Steel, Doors and Windows

7. The peg stay for windows shall be made of brass (bronze plated) and shall be 12 inches (30 cms.) long complete with leg and locking bracket. The stay shall have holes for keeping the shutter open in three different positions. The peg in locking bracket shall be rivetted or welded to the fixed frame.

Peg stay.

8. The lugs (hold fasts) for fixing the frames to masonry shall be slotted steel adjustable type not less than 4 inch X 5/8 inch X 1/8 inch (100 mm. X 15 mm. X 3 mm.) size as shown in the sketch. The counter-sunk galvanized machine screws and nuts shall be 3/4 inch X 1/4 inch (20 mm. X 6 mm.) size. Every window frame shall have six lugs, two on each side and one each on top and bottom. The number of side lugs shall be increased from two to three if the height of the frame

Lugs.

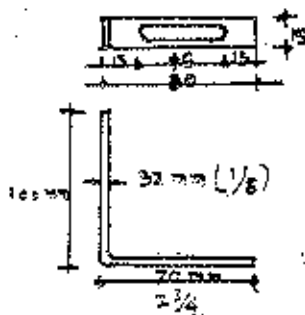


FIG 18.10 (c) SLOTTED REVER-
SIBLE FIXING LUG

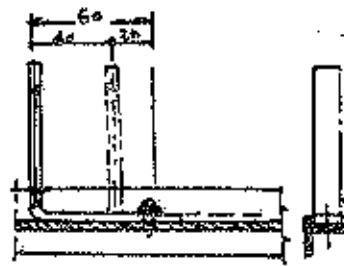


FIG 18.10 (d) FIXING LUG
IN POSITION

exceeds 3 feet (0.9 metre). In case of door frames, 12 lugs shall be provided, four on each side and two each on top and bottom.

9. The steel door shall have kick panels which shall be of 18 S.W.G. (1.25 mm.) mild steel sheet, welded or screwed to the frame and the glazing bar. Strong 6-lever lock operable either from inside or outside shall be provided. However, it is desired to make the lock operable from one side only, then a bolt shall be provided to make the lock inoperable from the other side. In double shutter doors the first closing shutter shall have a concealed brass bolt at top and bottom. It shall be so constructed as not to work loose or drop by its own weight. Single and double shutter doors may be provided with three-way bolting device. Where this is provided in the case of double shutter doors, concealed brass bolts may not be provided.

Special fittings
for doors.

10. Before despatch from the factory, all steel doors and windows shall be thoroughly cleaned of rust, scale and dirt by pickling or

Factory Finish.

SPECIFICATION NO. 18.10—Steel, Doors and Windows

phosphating. They shall then be painted with two coats of ready-mixed paint red lead non-setting primer conforming to Indian Standard : 102. Alternatively where so specified, the steel surfaces shall be treated for rust proofing by hot dip zinc spray or electro-galvanising process, for which extra payment shall be made.

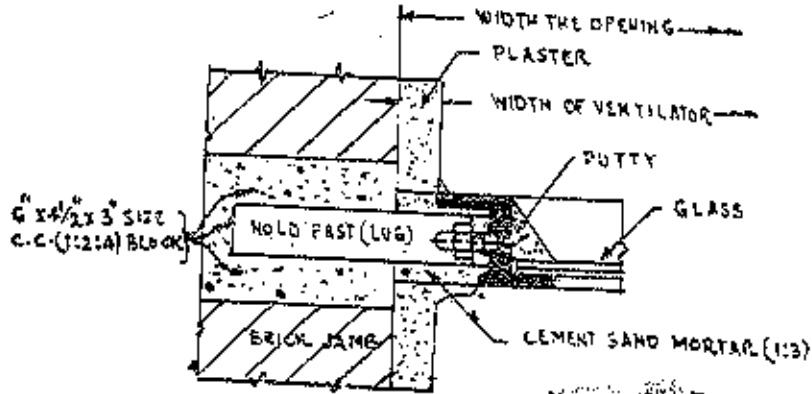


FIG. 18.10(e) MASONRY OPENINGS WITH PLASTER.

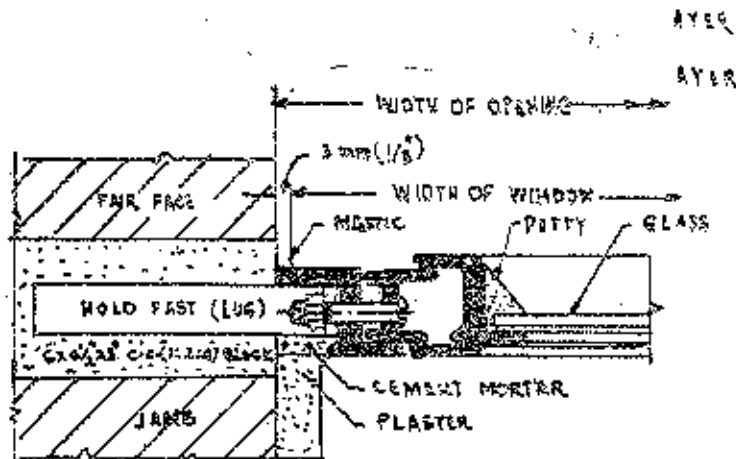


FIG. 18.10(f) MASONRY OPENINGS WITHOUT PLASTER.

SPECIFICATION No. 18.10—Steel Doors and Windows

11. The overall size of masonry openings to which the door or window units are to be fixed shall have a clearance between the frame and opening depending upon whether the opening is plastered or pointed. The plastered opening shall have a clearance equal to the thickness of the plaster coat, while pointed openings shall have a clearance of 1/8 inch (3 mm.) as shown in fig. nos. 18.10(e) and (f).

Size of masonry openings.

12. Doors, windows or ventilators shall be fixed into prepared openings. They shall not be built in as the walls go up as this practice often results in brickwork being brought right up to the frame without any clearance and usually distorts the units and increases the likelihood of damage being done to the units during subsequent building works. Placing of scaffolding on the frames of glazing bars shall on no account be done.

Fixing.

The size of the opening shall first be checked and cleaned of all obstructions. The position of the units in the reveal shall be taken off the drawings and vertical chalk line shall be marked on the reveal at the jambs using a plumb line, at the correct distance from the face of the wall. This chalk line shall also be run along head and sill of the opening.

The fixing hole positions shall be taken from the unit and marked on this chalk line at the corresponding points. In case of masonry, 6 inches \times 4½ inch \times 3 inch (15 cm. \times 11.25 cm \times 7.5 cm.) holes for fixing the lugs hold-fasts shall be cut.

To ensure that all units are set at the appropriate heights in their openings, the datum line for the sill of the door, window or ventilator shall be taken from a fixed point on the wall or from finished floor or ceiling with the help a level.

Door, window and ventilator units shall then be set in its opening by using wooden wedges at jambs, head and sill, and shall be plumbed to the line chalked round the reveal. A spirit-level shall be used to ensure that the frame is square and true and free from any warp and twist. When adjusting to the correct line, the wedges shall be struck with the hammer, care being taken so as not to strike the frame. The wedges shall not be inserted so firmly as to distort the frames, and wherever possible, they shall be placed near the points where a glazing bar meets the frame.

The unit shall be, put in position and the lugs screwed on tight. Every hole in the frame need not be fixed with a lug; some holes are incidental to manufacture (being guide holes for the welding jig) and are not necessarily fixing holes. Lugs shall be placed in the specified positions.

SPECIFICATION No. 18.10—Steel Doors and Windows

The lugs shall then be grouted into their holes with 1:2:4 cement concrete and the wedges round the frame shall be left in position until this cement has hardened and the lugs firmly set. The gap between unit and surround shall then be filled with 1:3 Cement sand mortar [See fig. No. 18.10(e)].

When fixing to surrounds without plaster, the 1/8 inch (3 mm.) clearance round the frame shall be pointed with mastic on the outside [See Fig. No. 18.10 (f)]. This mastic shall be applied after the unit has been fixed into position and before the internal plaster is applied. The mastic shall be applied from inside, squeezed into the channel of the frame until it oozes out through the narrower outside joint. The internal gap shall be filled about one-third with mastic and rest of the space be filled with 1:3 cement sand mortar. The mastic shall then be cut off square outside and smoothed down.

When fixing to surrounds with internal plaster, the plaster shall be applied to surrounds after the lugs have firmly set taking care to keep it clear of hinges and not to bring it too close to the opening frame of casement. Hinges shall be wrapped in gunny bag to prevent plaster from adhering to them or being splashed on them. Before applying the plaster, the joint of unit and the mortar shall be pointed with mastic from the outside.

- Composite units.** 13. Where larger units are formed by coupling individual units together the mullions and transoms shall be bedded in mastic to ensure weather-tightness. The mastic shall be applied liberally to the channels of the outside frame sections before assembling, and the two units being coupled shall be drawn together tight with clamps, the mastic being squeezed out and cut off neatly, when the units shall be screwed together tight.
- Glazing.** 14. Glazing shall be provided on the outside of the frames and shall conform to specification No. 17.9.
- Finishing.** 15. Final finishing coats of paints shall be given at site of work after the doors and windows have been fixed in position. The painting on steel doors and windows shall conform to specification No. 16.3 on 'Painting Iron and Steel Work'. Paint shall not be applied to working parts, such as handle pins, hinge pins and brass fittings.
- Measurements.** 16. Steel doors and windows shall be measured in superficial area out-to-out of frame.
- Rate.** 17. Unless otherwise specified, steel doors and windows shall be arranged departmentally and supplied to the contractor for fixing in position. The labour rate for fixing steel windows in walls includes the

labour charges for cutting of walls for lugs fixing the windows in correct position and level as per details described in this specification, but excludes the cost of cement concrete for embedding the lugs in wall. If concrete is also arranged by the contractor, a slightly higher rate as provided in Common Schedule is payable. The rates do not include the cost of glazing which shall be paid for separately.

SPECIFICATION No. 18.11—Welding (General)

Methods of welding.

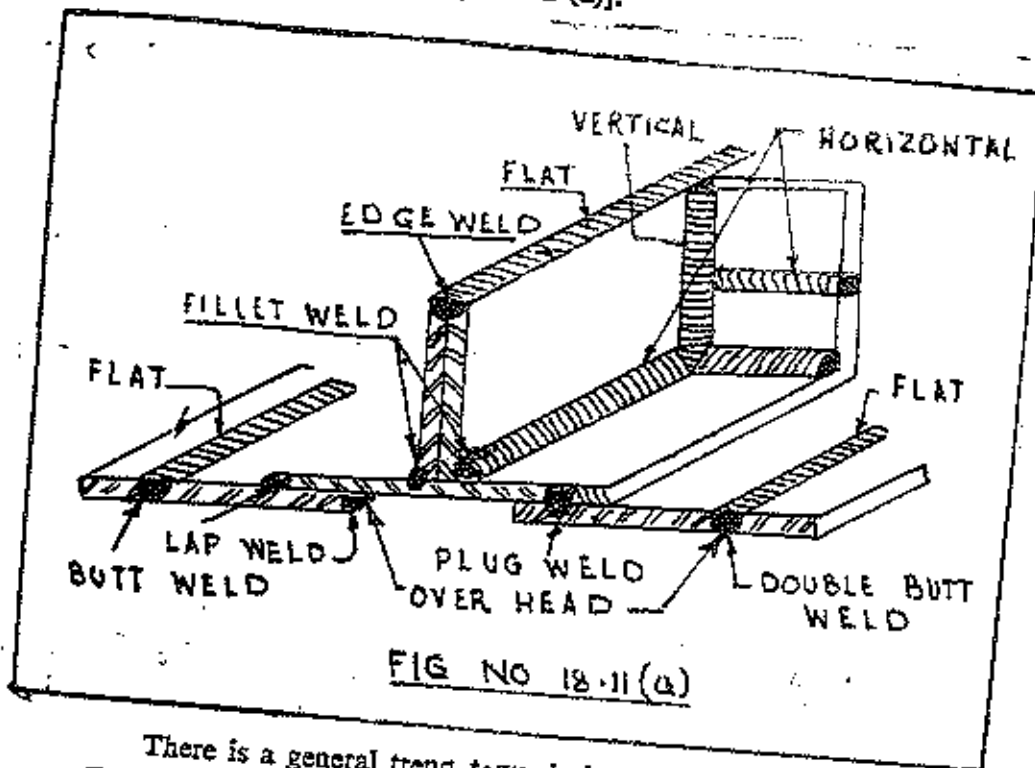
1. Two principal methods of welding as commonly used are :—
 - (i) Metal arc.
 - (ii) Oxy-acetylene.

In the first process an electric arc is struck between a metal rod connected to a suitable supply of electrical energy and the surfaces to be joined. The heat of the arc causes the metal rod called the electrode, to melt, and the molten metal is transferred to and fused into the surfaces to be joined.

In the second process an oxy-acetylene torch is played on to the two surfaces to be joined to bring them to the required temperature, and at the same time a metal filler rod is held in the flame and the molten metal from this rod fuses into the surfaces to be joined.

Types of joints.

2. The two principal types of joint are :—
 - (i) Fillet welds—[Fig. 18.11 (a)]
 - (ii) Butt welds [Fig. 18.11 (a)].



There is a general trend towards increasing use of the butt weld. This is a more logical type of joint than the fillet weld. It also gives a more direct transference of load between members, without abrupt changes of section and largely in consequence of this, has a higher resistance to repeated loading than other forms of welding joint. It had another advantage in that it can be examined by X-rays more easily than fillet weld.

SPECIFICATION No. 18.12—Metal Arc Welding

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| <p>1. This specification applies to welding done by the metal arc process, as applied to new and existing mild steel structures.</p> | Scope. |
| <p>2. (a) Parent Metal—All structural steel shall conform to the requirements of specification no. 3.18. Mild steel bars intended for reinforced concrete shall conform to the specification no. 3.20.</p> <p>(b) Electrodes—Electrodes for metal arc welding shall be of the make and size approved by the Engineer-in-charge. They shall conform to Indian Standard: 814.</p> | Material. |
| <p>3. Welding symbols used in drawings shall be in accordance with Indian Standard: 813.</p> | Welding symbols. |
| <p>4. The joint design shall conform to the design requirements specified for butt welds in Indian Standard: 816. For all butt welds, the details, that is, form of joint, angle between fusion faces, gap between parts, finish, etc., shall be arranged in accordance with the provisions included in Indian Standard: 823.</p> | Butt welds. |
| <p>5. Fillet welds shall conform to design requirements specified for fillet welds in Indian Standard: 816 and to the requirements specified in Indian Standard: 823.</p> | Fillet welds. |
| <p>6. (a) The work should be positioned for downward welding wherever practicable.</p> <p>(b) The welding current shall conform with respect of voltage and amperage (and polarity if direct current is used) to the recommendations of the manufactures of the electrode being used. The arc length, voltage, and amperage shall be suited to the thickness of material, type of groove and other circumstances attending the work.</p> <p>(c) The surfaces to be welded and the surrounding material for a distance of at least $\frac{1}{2}$ inch (13 mm.) shall be free from scale, dirt, grease, paint, heavy rust or other surface deposit. A coating of boiled linseed oil may be disregarded.</p> <p>(d) Members to be welded shall held in correct position by bolts, clamps, wedges, jigs or other suitable devices or by tack welds until welding has been completed. Such fastening devices as may be used shall be adequate to ensure temporary safety. Suitable allowances shall be made for warpage and shrinkage.</p> | Workmanship. |

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- (e) Tack welds located where the final welds will later be made shall be subject to the same quality requirements as the final welds. Where tack welds are encountered in the final welding, they shall be cleaned and fused thoroughly with the final weld. Defective, cracked or broken tack welds shall be removed before final welding.
- (f) Freedom of movement of one member of the joint shall be allowed wherever possible. No butt joint shall be welded without allowing one component freedom of movement of the order of 1/16 inch (1.5 mm.).
- (g) The sequence of welding shall be such that where possible the members which offer the greatest resistance to compression are welded first.
- (h) Fusion faces may be cut by shearing, chipping, machining or gas cutting.
- (i) Exposed faces of welds shall be made reasonably smooth and regular, shall conform as closely as practicable to design requirements and shall not at any place be inside the intended cross-sections.
- (j) Welds showing slag inclusions, porosity or lack of proper penetration shall be cut out and rewelded.
- (k) Finished welds and adjacent parts shall be protected with clean boiled linseed oil after all slag has been removed.

Safety precautions.

- 7. (a) Operators of welding and cutting equipment shall be protected from the rays of the arc flame by gloves and by helmets, hand shields, or goggles equipped with suitable filter lenses. Cover glasses in helmets, shields and goggles shall be replaced when they become sufficiently marred to impair the operator's vision.
- (b) Closed spaces shall be ventilated properly while welding or cutting is being done therein.
- (c) Suitable protection against the rays of the arc shall be maintained by the contractor where welding operations might be viewed within harmful range by persons other than the welding operators and supervisors.
- (d) Welders should be provided with such staging as will enable them properly to perform the welding operations.

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For site welding, shelter should be provided to protect welders and the parts to be welded from the weather.

8. (a) No welding work shall be given to a contractor who does not produce satisfactory evidence of his ability to handle the work in a competent manner. Welding by contract.
- (b) The contractor shall employ a competent welding supervisor to ensure that the standard of workmanship and the quality of the materials comply with the requirements as laid in this specification.
- (c) The representative of the Engineer shall have free access to the work being carried out by the contractor at all reasonable times; and facilities shall be provided so that during the course of welding he may be able to inspect any layer of weld metal. He shall be at liberty to reject any material that does not conform to the terms of the specification and to require any defective welds to be cut out and rewelded.
- (d) The representative of the Engineer shall be notified in advance of any welding operations.
- (e) The contractor shall furnish the Engineer-in-charge, with copies of large scale working drawing showing all the joints in mild steel bars that are to be welded in reinforced concrete work. The Engineer or his representative will sign acceptance of the welded joints by initialling them as depicted in the drawings and until acceptance has been so registered, no welded joint shall be rendered inaccessible by the assembly of further reinforcement or by placing of concrete around such joints.
9. (a) Plant:—Welding plant, instruments, and accessories shall conform to the appropriate Indian Standard, if any, and shall be of adequate capacity to carry out the welding procedure laid down. All welding plant shall be maintained in good working order. Welding Equipment and electrode.
- (b) Welding current measurement:—Adequate means of measuring the current drawn on the welding side should be available, either as part of welding plant or by the provision of a portable ammeter.
- (c) Electrodes:—Electrodes should be stored in their original

SPECIFICATION NO. 18-12—Metal Arc Welding

bundles or cartons in a dry place and adequately protected from weather effects. Electrodes which have areas of the flux covering broken away or damaged should be discarded. If electrodes become affected by dampness, but are not otherwise damaged, they may be used only after being dried in a manner approved by the manufacturer, and after undergoing appropriate performance tests, indicating that the electrodes are still satisfactory for use.

Inspection and Testing.

10. Inspection and testing of welds shall be done as laid down in Indian Standard: 822.

Operators.

11. No welder shall be employed in any position, except those who are fully qualified to weld in that position. Qualifications for welders shall be as laid down in Indian Standard: 817. Normally welders shall be tested before commencing the work and at least every three months and whenever the type of electrode is changed.

SPECIFICATION NO. 18.13—Oxy Acetylene Welding

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| <p>1. Generally speaking, oxy-acetylene welding is no longer used for structural work in mild steel, if arc welding plant is available except in the case of relatively thin-gauge material. In designing structures for oxy-acetylene welding, it is recommended that fillet welds be avoided as far as possible and that butt welds be employed wherever practicable.</p> | <p>General.</p> |
| <p>2. This specification covers the use of oxy-acetylene welding with butt joints for structural work in mild steel.</p> | <p>Scope.</p> |
| <p>3. (a) Mild Steel.—Mild steel used for structural members and connections shall conform to the A. S. W. quality specified in specification No. 3.19.</p> <p>(b) Fillet Rods.—Fillet rods shall conform to Indian standard 1278.</p> | <p>Materials.</p> |
| <p>4. Butt joints shall be prepared and welded in accordance with the procedure given in Table No. 1 of Indian Standard : 323. In all cases, the location of the weld and the form and dimensions of the weld surfaces shall be such as will provide for the access for the filler rod to the surfaces to be welded, and enable the welder to see clearly the work in progress.</p> | <p>Butt weld.</p> |
| <p>5. Welding shall be carried out by one of the methods of oxy-acetylene welding as described in Appendix A of Indian Standard : 1323.</p> | <p>Method of Welding.</p> |
| <p>6. (a) The surfaces to be welded and the surrounding material for a distance of at least 1/2 inch (13mm.) shall be freed from scale, dirt, grease, paint, heavy rust or other surface deposit. A coating of boiled linseed oil may be disregarded.</p> <p>(b) Fusion faces may be cut by shearing chipping, machining or machine gas cutting. If the prepared fusion face is irregular, it shall be dressed by chipping, filing or grinding to the satisfaction of the Engineer-in-charge.</p> <p>(c) The pieces to be welded shall be securely held in their correct relative positions during welding.</p> <p>(d) The deposition of the weld metal shall be carried out so as to ensure that :—</p> <p>(i) welds are of good clean metal deposited by a procedure which will ensure uniformity and continuity of weld, and</p> | <p>Workman ship.</p> |

SPECIFICATION No. 18-13—Oxy Acetylene Welding

- (ii) the surfaces of the weld have an even contour and regular finish and will indicate proper fusion with the parent metal.
- (e) Care shall be taken to ensure that full penetration and fusion is obtained into the root of welds. Illustrations of good and defective butt welds are given in Fig. 18.13 (a) and Fig. 18.13 (b) respectively.



FIG. 18-13 (a) GOOD BUTT WELDS

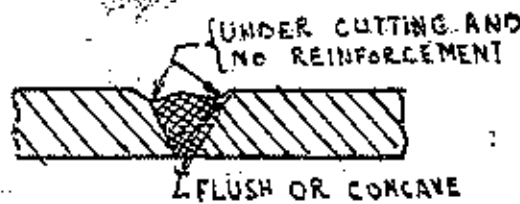


FIG. 18-13 (b) DEFECTIVE BUTT WELD.

- (f) Welds showing cavities or lack of proper fusion shall be cut out and re-welded to the satisfaction of the Engineer-in-charge.
- (g) Care shall be taken to avoid undercutting, and where serious undercutting occurs, the reduction shall be made good by additional weld metal to the satisfaction of the Engineer-in-charge.

SPECIFICATION NO. 18.13—Oxy Acetylene Welding

- (h) Welds and adjacent parts shall not be painted until approved by the Engineer-in-charge. If a protective coating is required then clean linseed oil may be used.
- (i) Welders shall be provided with such staging and if necessary, protection as will enable them to perform the welding operation properly.

7. All welding equipment shall be in good condition and capable of enabling the welder to provide and maintain the correct flame at all times.

Welding equipment.

8. Inspection and testing shall be done as laid down in Indian Standard : 822.

Inspection and testing.

9. No welder shall be employed in any position except those who are fully qualified to weld in that position. Qualification for welders shall be as laid down in Indian Standard : 1393. Normally welders shall be tested before commencing the work and at least every three months.

Operator's qualification.