Chapter 8
Steel And Aluminium Works

8.0. DEFINITIONS (Refer Figure 8.1 for Details)

1. Bead : A single run of weld metal deposited on surface.

2. Butt Weld : A weld in which the weld metal lies substantially within the extension of the planes and the surfaces of the parts joined.

3. Crater : A depression left in weld metal where the arc was broken or the flame was removed.

4. End Crater : A crater at the end of a weld or at the end of a joint.

5. Fillet Weld : A weld of approximately triangular cross-section joining two surfaces approximately at right angles to each other in a lap joint, tee joint or corner joint. It is of two types :

(a) Continuous

(b) Intermittent

6. Fusion Welding : Any welding process in which the weld is made between metals in a state of fusion without hammering or pressure.

7. Non-fusion Welding : A term applied to the deposition, by the Oxy-Acetylene process of filler metal on parent metal without fusion of the latter.

8. Oxy-Acetylene Pressure Welding : Pressure welding in which any Oxy-Acetylene flame is used to make the surface to be united plastic. No filler metal is used.

9. Run : The metal deposited during one passage of the electrode or blow pipe in the making of a joint.

10. Throat thickness : See **Figure 8.1**

11. Weld : A union between two pieces of metal at faces rendered plastic or liquid by heat or pressure, or both. Filler metal maybe used to effect the union.

8.1. MATERIALS

8.1.1. Steel

All finished steel shall be well and cleanly rolled to the dimensions and weight specified by BIS subject to permissible tolerances as per IS:1852. The finished materials shall be reasonably free from cracks, surface flaws, laminations, rough and imperfect edges and all other harmful defects.

Steel sections, shall be free from excessive rust, scaling and pitting and shall be well protected. The decision of the Engineer regarding rejecting any steel section on account of any of the above defects shall be final and binding.

Structural steel work shall conform to the following requirements. The mechanical and chemical properties of the structural steel shall be as per **Annexure 8.1**. The following varieties of steel should be used for structural purposes -

8.1.1.1. S.T. 42 – S: The standard quality of steel designated as S.T. 42-S conforming to IS : 226 shall be used for all types of structures (riveted or bolted) including those subject to dynamic loading and where fatigue, wide fluctuation of stresses and reversal of stresses are involved, as for example crane gantry girders, road and rail bridges etc., It is also suitable for welded structures provided that the thickness of materials does not exceed 20 mm.

8.1.1.2. S.T. 42-W: The fusion welding quality steel designated as S.T. 42-W conforming to IS:2062 shall be used for all types of structures subject to dynamic loading (Wind load is not to be considered as dynamic load for this purpose) where welding is employed for fabrication and where fatigue, wide fluctuation of stresses, reversal of stress and great restraint are involved as for example, crane gantry girders and road and rail bridges.

8.1.1.3. S.T. 42 – 0. The ordinary quality steel designated as S.T. 42 – 0 conforming to IS:1977 shall be used for structures not subjected to dynamic loading other than wind loads where welding is not employed or/and structures not situated in earth quake zones or design has not been based on plastic theory.

8.1.1.4. S.T. 32 – 0: The ordinary quality steel designated as S.T. 32 – 0 conforming to IS : 1977 shall be used for doors, window frames, window bars, grills, steel gates, hand railing, builders hardware, fencing posts, tie bars etc.,

8.1.2. Rivets

Rivets shall be made from rivet bars of mild steel as per IS : 1148 and should conform to the Indian Railways Standard Specifications.

8.1.3. Bolts

These are of two types namely turned & fitted bolts and black bolts. Turned & fitted bolts are turned to exact diameter in automatic lathe. For these bolts, whether in reamed or drilled holes, the same unit stresses are allowed as for rivets. In case of black bolts which are not finished to exact sizes, a lower working stress other than for turned bolts is adopted. They shall conform to IS : 1367 (Technical supply conditions for threaded steel fasteners) and relevant Indian Railway Standard Specifications.

8.1.4 Using Rivets & Bolts : Rivets or Turned and fitted bolts shall be used where the connection such that slip under load has to be avoided. Black bolts may be used very sparingly where the force is carried through the connection without impact vibration or reversal of stresses (unless such reversal is due solely to wind forces)

8.1.5 Electrodes

The electrodes required for metal arc welding shall be covered electrodes and shall conform to IS : 814.

8.2. STEEL WORK IN SINGLE SECTION FIXED INDEPENDENTLY

The steel work in single sections of R.S. Joints, flats, Tees Angles fixed independently with or without connecting plate, is described in the subparas below.

8.2.1 Fabrication

The steel sections as specified shall be straightened and cut square to correct lengths and measured with a steel tape. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of a member.

All straightening and shaping to form, shall be done by pressure. Bending or cutting shall be carried out in such a manner as not to impair the strength of the metal.

8.2.2. Painting

All surfaces which are to be painted, oiled or otherwise treated shall be dry and thoroughly cleaned to remove all loose scale and loose rust. Surfaces not in contact but inaccessible after shop assembly, shall receive the full specified protective treatment before assembly which will involve two or more coats of paint. This does not apply to the interior or sealed hollow sections. Part to be encased in concrete shall not be painted or oiled. A priming coat of approved steel primer i.e. Red Oxide Zinc chrome primer conforming to IS : 2074 or as specified shall be applied before any member of steel structure is placed in position or taken out of workshop.

8.2.3. Erection

Steel work shall be hoisted and placed in position carefully without any damage to itself and other building work and injury to workmen. Where necessary, mechanical appliances such as lifting tackle winch etc., shall be used. The suitability and capacity of all plant and equipment used for erection shall be to the satisfaction of the Engineer.

8.2.4. Measurements

The work as fixed in place shall be measured in running metres correct to a millimeter and weights calculated on the basis of standard tables correct to the nearest kilogram.

Unless otherwise specified, weight of cleats, brackets, packing pieces, bolts, buts, washers, distance pieces, separators, diaphragm gussets (taking overall square dimensions), fish plates, etc., shall be added to the weight of respective items. Payment for holding down bolts and anchor channels shall be made separately. No deduction shall be made for skew cuts. In riveted work, allowance is to be made for weight of rivet heads. Unless otherwise specified, an addition of 3 per cent of the weight of structure shall be made for shop and site rivet heads in riveted steel structures. No deduction shall be made for rivet/or bolt holes (excluding holes for anchor or holding down bolts). Deduction in case of rivet or bolt hole shall however be made if its area exceeds 0.02 sqm.

The weight of steel sheets, plates and strips shall be taken from relevant Indian Standards based on 7.85 kg/m^2 for every millimetre sheet thickness. For rolled sections, steel rods and steel strips, weight given in relevant Indian Standards shall be used.

8.2.5. Rate

The rate includes the cost of all labour and materials including the cost of steel, rivets, bolts and service bolts, required for all the operations described above except painting. This will include only the steel work where single sections are used except steel work with rails. It will exclude the steel work in built up sections, trusses and framed work, where riveting, bolting or welding is involved. Cost of painting primary coat is included in the rate. Unless otherwise specified, the rates include the supply, erection and removal of

scaffodling, machinery, hoisting, gear, derricks, ropes, pulleys, tools, plants and all consumable materials such as coal, oil etc.

8.3. STEEL WORK IN BUILT UP SECTIONS (RIVETTED AND BOLTED)

The steel work in built up sections (Riveted and bolted) such as in trusses, framed work etc., is specified in the subparas below.

8.3.1. Laying Out

A figure of the steel structure to be fabricated shall be drawn on a level platform to full scale. This may be done in full or in parts, as shown on drawings or as directed by the Engineer. Steel tape shall be used for measurements.

8.3.2. Fabrication

Fabrication shall generally be done as specified in IS : 800. In major works or where so specified, shop drawings giving complete information for the fabrication of the component parts of the structure including the location, type, size, length and details of rivets, bolts or welds, shall be prepared in advance of the actual fabrication and approved by the Engineer. The drawings shall indicate the shop and field rivets, bolts and welds. The steel members shall be distinctly marked or stenciled with paint with the identification marks as given in the shop drawings.

Great accuracy shall be observed in the fabrication of various members, so that these can be assembled without being unduly packed, strained or forced into position and when built up, shall be true and free from twist, kinks, buckles or open joints.

Wooden or metal sheet templates shall be made to correspond to each member and position of rivet holes shall be marked accurately on them and holes drilled. The templates shall then be laid on the steel members, and holes for riveting or bolting marked on them. The ends of the steel members shall also be marked for cutting as per required dimensions. The base of steel columns and the positions of anchor bolts shall be carefully set out at the required locations.

8.3.2.1. The steel section shall be straight or be straightened or flattened by pressure unless required to be of curvilinear form and shall be free from twists. These shall be cut square either by shearing or sawing to correct length and measured by steel tape. No two pieces shall be welded or joined to make up for the required length of member.

8.3.2.2. Making Holes: Holes through more than one thickness of material for members, such as compound stanchion and girder flanges shall, where possible, be drilled after the members are assembled and tightly clamped or bolted together. Punching may be permitted before assembly, provided the holes are punched 3 mm less in diameter then the required size and reamed after assembly to the full diameter. The thickness of material punched shall be not greater than 16 mm.

Rivet Holes: The diameter for rivets and black bolts shall be taken as the nominal diameter of a rivet plus 1.5 mm for rivets of nominal diameter less than or equal to 25 mm and 2.0 mm for rivets of nominal diameter exceeding 25 mm, unless specified otherwise. Holes for turned and fitted bolts shall be drilled or reamed large by 0.2 to 8 mm depending upon the dia. of bolts as shown in **Table 8.1.**

TABLE 8.1

HOLES FOR TURNED AND FITTED BOLTS

Bolt diameter	Hole diameter	Bolt diameter	Hole diameter
1.6	1.8	(39)	42
2	2.4	42	45
(2.2)	2.6	(45)	48
2.5	2.9	48	52
3	3.4	(52)	56
(3.5)	4.0	(56)	62
4	4.5	(60)	66
(4.5)	5.0	64	70

5	5.5	(68)	74
6	6.6	72	78
(7)	7.6	(76)	82
8	9.0	80	86
10	11.0	(85)	91
12	14.0	90	96
(14)	16.0	(95)	101
16	18.0	100	107
(18)	20.0	105	112
20	22.0	110	117
(22)	24.0	(115)	122
24	26.0	120	127
(27)	30.0	125	132
30	33.0	(130)	137
(33)	36.0	140	147
36	39.0	(150)	158

Note: 1) All dimensions are in millimetres

2) Diameters in parenthesis are to be treated as second preference.

Holes shall have their axis perpendicular to the surface bored through. The drilling or reaming shall be free from burrs, and the holes shall be clean and accurate. Holes for rivets and bolts shall not be formed by gas cutting process. Holes for counter sunk bolts shall be made in such a manner that their heads sit flush with the surface after fixing.

8.3.2.3.Assembly : Before making holes in individual members for fabrication, steel work intended to be riveted or bolted together shall be assembled and clamped properly and tightly so as to ensure close abutting or lapping of the surfaces of the different members. All stiffeners shall bear tightly both at top and bottom without being drawn or caulked. The abutting joints shall be cut or dressed true and straight, and fitted close together. Before riveting or bolting up finally, the members shall be taken apart and all burrs removed.

Web plates of girders which have no cover plates, shall have their ends flush with the tops of angles unless otherwise required. The web plates when spliced, shall have clearance of not more than 5 mm. The erection clearance for cleated ends of members connecting steel shall preferably be not greater than 1.5 mm. The erection clearance at the ends of beams without web cleats shall not be more than 3 mm at each end but where for practical reasons, greater clearance is necessary suitably designed seating shall be provided.

Column splices and butt joints of struts and compression members depending on contact for stress transmission shall be accurately, machined and close butted over the whole section. In column caps and bases, the ends of shafts together with the attached gussets, angles, channels etc., after riveting together shall be accurately machined so that the parts connected butt against each other over the entire surfaces of contact. Connecting angels or channels shall be fabricated and placed in position with great accuracy so that they are not unduly reduced in thickness by machining. The ends of all bearing stiffeners shall be machined or grounded to fit tightly both at top and bottom.

8.3.2.4.Rivetting: (a) Rivets shall be used, where the connection is such that slip under load has to be avoided.

(b) Preliminaries before riveting : Members to be riveted shall have all parts firmly drawn and held together before and during riveting. Special care shall be taken in this respect for all single riveted connections. For multiple riveted connections, a service bolt shall be provided in every third or fourth hole.

(c) Drifting of holes shall not be permitted except to draw the parts together and the drifting tool so used shall have its maximum diameter not exceeding the nominal diameter of rivet or bolt. Drifting done during

assembling shall not distort the metal or enlarge the holes.

(d) The work shall be got approved from the Engineer before rivetting is commenced. It shall be ensured that the alignment is correct, the vertical plumb, the camber correct with all camber jacks screwed tight where applicable, all joint and cover plates in correct position, service bolts tight and drifts driven and field rivet holes coinciding.

(e) Process of riveting : The riveting shall be carried out by using machines of the steady pressure type. However, where such facilities are not available, hand riveting may be permitted by the Engineer. The rivets shall be heated red hot, care being taken to control the temperature of heating so as not to burn the steel.. Rivets of diameter less than 10 mm may be driven cold. Rivets shall be finished neat, with heads full and of equal size. The heads shall be central on shanks and shall grip the assembled members firmly. All loose, burnt or badly formed rivets with eccentric or deficient heads shall be cut out and replaced. In cutting out rivets, care shall be taken so as not to injure the assembled members. Caulking and recapping shall not be permitted. All surplus materials round the rivet heads shall be removed by chipping after the rivets have cooled.

(f) For testing rivets, a hammer weighing approx. 0.25 kg. shall be used and both heads of the rivet (specially the machine head) shall be tapped. When so tested, the rivets shall not give a hollow sound and a jar. Where so specified, other tests shall be carried out to check the soundness of rivet. All rivets heads shall be painted with approved steel primer paint within a week of their fixing.

(g) All tightened up, recapped or recauked rivets or rivets with split heads shall be replaced.

(h) Loose rivets and rivets not passed shall be painted white on head and shall be replaced at once, care being taken not to disturb the adjacent rivets.

(i) Counter sunk rivets shall be inspected after chipping heads and no unnecessary chipping shall be permitted.

(j) With the prior approval of Engineer, for rivet holes made in places where it is impossible to rivet effectively, the hole may be fitted with a machine or turned bolt and the end of the bolt hammered down over the tightened nut to prevent the latter working loose.

(k) Tools and plants will not be supplied by the Railway, unless definitely specified. The contractor shall also arrange free of cost the coal required for heating the rivets and will erect and maintain all staging as necessary. He will also do all petty repairs to snaps and other tools which may be supplied to him by the Railway.

8.3.2.5. Bolting: (a) The nominal length of the bolt shall be the distance from the underside of the head to the farther end of the shank. The nominal diameter of the bolt shall be the diameter at the shank above the screwed threads. Bolts, nuts and washers shall be thoroughly cleaned and dipped in double boiled linseed oil, before use. The linseed oil should be supplied by the Contractor and nothing extra shall be paid for this. All bolt heads and nuts shall be hexagonal unless specified otherwise. The screwed threads shall conform to IS : 1363 and the threaded surface shall not be tapered. The bolts shall be of such length as to project at least two clear threads beyond the nuts when fixed in position, and these shall fit in the holes without any shake. The nuts shall fit in the threaded ends of bolts properly.

(b) Where necessary, washers shall be tapered or otherwise suitably shaped to give the heads and nuts of bolts a satisfactory bearing. The threaded portion of each bolt shall project through the nut at least two threads. In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a washer of sufficient thickness under the nuts to avoid any threaded portion of the bolt being within the thickness of the parts bolted together.

(c) Where there is a risk of the nuts being removed or becoming loose due to vibrations or reversal of stresses, these shall be secured from slackening by the use of lock nuts, spring washers or as directed by the Engineer.

(d) Where turned and fitted bolts are required to be used in place of rivets, these shall be provided with washers not less than 6mm thick, so that the nut, when tightened, shall not bear on the unthreaded body of the bolt. Tapered washers shall be provided for all heads and nuts bearing on levelled surfaces. The threaded portion of the bolt shall not be within the thickness of the parts bolted together. The faces of bolt heads and nuts abutting against steel members shall be machine finished.

8.3.3. Erection

8.3.3.1 Steel work shall be hoisted and erected in position carefully, without any damage to itself other structures and equipment and injury to workmen. The method of hoisting and erection proposed to be adopted by the contractor shall be got approved from the Engineer in advance. The contractor, however shall be fully responsible for the work being carried out in a safe and proper manner without unduly stressing the various members. Proper equipment such as derricks, lifting tackles, winches, ropes etc., shall be used.

8.3.3.2 The work may be erected in suitable units as may be directed by the Engineer. Fabricated members shall be lifted at such points as to avoid deformation or excessive stress in members. The structure or part of it placed in position shall be secured against over-turning or collapse by suitable means.

During execution, the steel work shall be securely bolted or otherwise fastened and when necessary temporarily braced to provide for all loads to be carried safely by the structure during erection including those due to erection equipments and their operations. The steel work shall be placed in proper position as per approved drawing. Final riveting or permanent bolting shall be done only after proper alignment has been checked and confirmed.

8.3.3.3 Trusses shall be lifted only at nodes. The trusses above 10 m in span shall not be lifted by slinging at two mid points of rafters, unless temporarily braced by a wooden member of a suitable section. After the trusses are placed in position, purlins and wind bracings shall be fixed as soon as possible.

The end of the truss which faces the prevailing winds shall be fixed with holding down bolts, and the other end kept free to move. In case of trusses of spans up to 10 m the free end of the truss shall be laid on lead sheet or steel plate as per design and the holes for holding down bolts shall be made in the form of oblong slots so as to permit the free movements of the truss end. For large spans the truss shall be provided with proper bearings as per design.

8.3.3.4 Columns and stanchions shall be erected truly vertical with the necessary cross bracing etc., and the base shall be properly fixed with the foundation concrete by means of anchor bolts etc., as per drawing.

8.3.3.5 Anchor bolts to be placed in the concrete foundation should be held in position with a wooden template. At the time of concreting, anchor bolt locations shall be provided with suitable timber mould or pipe sleeve to allow for adjustment which shall be removed after initial setting of concrete. The spaces left around anchor bolts shall be linked to a stopping channel in the concrete leading to the side of the pedestal and on the underside of the base plate to allow the spaces being grouted up after the base plate is fixed in position along with the column footing. Grouting shall be of cement mortar 1:3 (1 cement : 3 coarse sand) or as specified.

8.3.3.6 Bedding of Column, Stanchions Etc., : Bedding shall not be carried out until the steel work has been finally levelled, plumbed and connected together. The stanchion shall be supported on steel wedges and adjusted to make the column plumb. For multi-storeyed buildings, the bedding shall not be done until sufficient number of bottom lengths of stanchions have been properly lined, levelled and plumbed and sufficient floor beams are fixed in position. The base plates shall be wedged clear of the plumbed and sufficient floor beams are fixed in position. The base plates shall be wedged clear of the bases by M.S. wedges and adjusted where necessary to plumb the columns. The gaps under the base plate which may be up to 25 mm shall then be pressure grouted with cement grout.

With small columns, if permitted by the Engineer, the column base shall be floated on a thick cement grout on the concrete pedestal. The anchor bolt holes in the base plate may be made about 10 to 15 mm larger than the bolts. In such cases suitable washers shall be provided.

8.3.4. Painting

Before the members of the steel structure are placed in position or taken out of the workshop these shall be painted as specified in para 8.2.2. Subsequent coat or coats of paint shall be applied after all the members are finally fixed in position.

8.3.5 Measrements:- Provisions in Para 8.2.4 will apply.

8.3.6 Rate

The rate for the item shall include the cost of all labour and materials including the cost of steel, rivets, bolts and service bolts required for all the operations of the work as described above except painting of final coats. Cost of painting primary coat is included with rate. Purlins and wind bracings shall be paid for separately as steel work in single sections. Cleats, when forming part of

the trusses, shall be paid for under this item. When the cleats are required to be manufactured and erected for an existing truss, payment for the same shall be made as steel work in single sections. The rates include the supply erection and removal of scaffolding, machinery, hoisting gear, derricks, ropes, pulleys, tools, plants and all consumable materials such as coal, oil etc. Painting of the final coat / coats of the steel work shall be paid for separately.

8.4 STEEL WORK IN BUILT UP SECTION (WELDED)

The steel work in built up sections (welded) such as trusses, framed work etc., has been described in the subparas below.

8.4.1 Laying out - It shall be as specified in para 8.3.1.

8.4.2 Fabrication, Erection & Painting

8.4.2.1. Straightening, shaping to form, cutting and assembling, shall be as per para 8.3.2. as far as applicable, except that the words “riveted or bolted” shall be read as “welded” and holes shall only be used for the bolts used for temporary fastening as shown in drawings.

8.4.2.2. Welding : Welding shall generally be done by electric arc process as per IS : 816 as it is economical. Where electric supply is not available, generators shall be arranged by the contractor at his own cost unless otherwise specified. Gas welding shall only be resorted to using oxyacetylene flame with the specific approval of the Engineer. Gas welding shall not however be permitted for structural steel work. Gas welding requires heating of the members to be welded along with the welding rod and is likely to create temperature stresses in the welded members. Precautions shall therefore be taken to avoid distortion of the members due to these temperatures stresses.

The work shall be done as shown in the shop drawings which should clearly indicate various details of the joint to be welded, type of welds, shop and site welds as well as the types of electrodes to be used. Symbol for welding on plane and shops drawings shall be according to IS : 813.

As far as possible every effort shall be made to limit the welding that must be done after the structure is erected so as to avoid the improper welding that is likely to be done due to heights and difficult positions on scaffolding etc., apart from the aspect of economy. The maximum dia of electrodes for welding any work shall be as per IS : 814. Joint surfaces which are to be welded together shall be free from loose mill scale, rust, paint, grease or other foreign matter, which adversely affects the quality of weld and workmanship.

8.4.2.3. Precautions: All operations connected with welding and cutting equipment shall conform to the safety requirements given in IS : 818 for Safety requirements and Health Provision in Electric and gas welding and cutting operations.

8.4.2.4. **Operation**, Workmanship and Process of “Welding are described in **Annexure 8.2.**

8.4.2.5. Inspection and testing of welds shall be as per IS : 822.

8.4.2.6. **Assembly** : Before welding is commenced, the members to be welded shall first be brought together and firmly clamped or tack welded to be held in position. This temporary connection has to be strong enough to hold the parts accurately in place without any disturbance. Tack welds located in places where final welds will be made later shall conform to the final weld in quality and shall be cleaned off slag before final weld is made.

8.4.2.7. **Erection :** The specifications shall be as described in para 8.3.3. except that while erecting a welded structure adequate means shall be employed for temporary fastening of the members together and bracing the frame work until the joints are welded. Such means shall consist of erection bolts, tack welding or other positive devices imparting sufficient strength and stiffness to resist all temporary loads and lateral forces including wind. Owing to the small number of bolts ordinarily employed for joints which are to be welded, the temporary support of heavy girders carrying columns shall be specially checked. Different members which shall be fillet welded, shall be brought into as close contact as possible. The gap due to faulty workmanship or incorrect fit if any shall not exceed 1.5 mm. If gap exceeds 1.5mm or more gap occurs locally the size of fillet weld shall be increased at such position by an amount equal to the width of the gap.

8.4.2.8. **Painting :** Before the members of the steel structures are placed in position or taken out of the workshop these shall be painted as specified in para 8.2.2.

8.4.3. Measurements

The mode of measurements shall be the same as specified in para 8.2.4. except that

weight of welding material shall not be added in the weight of members for payment and nothing extra shall be paid for making and filling holes for temporary fastening of members during erection before welding.

8.4.4. Rate

The rate shall include the cost of all labour and materials involved in all the operations described above and as described in para 8.3.6.

8.5. COLLAPSIBLE GATES (For details refer Figure 8.2)

8.5.1. Types & Components : These shall be of approved manufacture and shall be fabricated from the mild steel sections. The gates shall consist of double or single collapsible gates depending on the size of the opening. These shall consist of vertical double channels each 20 x 10 x 2 mm at 10 cm centres braced with flat iron diagonals 20 x 5 mm and top and bottom rails of T-iron 40 x 40 x 6 mm @ 3.5 kg/m with 40 mm dia. ball bearings in every fourth double channel, unless otherwise specified. Wherever collapsible gate is not provided within the opening and fixed along the outer surface. T-iron at the top may be replaced by flat iron 40 x 10 mm.

The collapsible gate shall be provided with necessary bolts and nuts, locking arrangement, stoppers and handles. Any special fittings like spring, catches and locks, shall be so specified in the description of item where so required. The gate shall open and close smoothly and easily.

8.5.2. Fixing

T-iron rails shall be fixed to the floor and to the lintel at top by means of anchor bolts embedded in cement concrete of floor and lintel. The anchor bolts shall be placed approximately at 45 cm centres alternatively in the two flanges of the T-iron. The bottom runner (T-iron) shall be embedded in the floor and proper groove shall be formed along the runner for the purpose. The collapsible shutter shall be fixed at sides by fixing the end double channels with T-iron rails and also by hold-fasts bolted to the end double channel and fixed in masonry of the side walls on the other side. In case the collapsible shutter is not required to reach the lintel, beam or slab level, a Tee-section suitably designed may be fixed at the top, embedded in masonry and provided with necessary clamps and roller arrangement at the top. All the adjoining work damaged in fixing of gate shall be made good to match the existing work, without any extra cost.

8.5.3. Painting

All the members of the collapsible gate including T-iron shall be thoroughly cleaned off rust, scales, dust etc., and given a priming coat of approved steel primer i.e. red oxide zinc chrome primer conforming to IS : 2074 or as specified before fixing them in position.

8.5.4. Measurements

The height and breadth shall be measured correct to a cm. The height of the gate shall be measured as the length of the double channels and breadth from outside to outside of the end fixed double channels in open position, of the gate. The area shall be calculated in square metres, correct to two places of decimal.

8.5.5. Rate

The rate shall include the cost of all labour and materials involved in all the operations described above.

8.6. M.S. SHEET SLIDING SHUTTERS (Refer Figure 8.3A)

8.6.1. Types & Components:- These shall be manufactured as per drawings and specifications. These shall be fabricated from mild steel sheets. The shutters shall be double or single leaf shutter as specified. The shutters shall be fabricated of specified size of M.S. angle iron frame diagonally braced with the same size of M.S. angle and riveted together with 3 mm gusset plate at junction to form a rigid frame M.S. sheet of 1 mm thickness or as specified shall be fixed to the frame with rivets, as approved by the Engineer. These shall also be provided with top and bottom guide rails of specified size angles or T-irons and 25 mm diameter pulley or with 25 mm diameter ball bearing at the bottom and guide back with steel pulleys at the top. The shutters shall also be provided with locking arrangement, handles, stoppers, holdfasts and other fittings as specified in the description of the item.

The guide rails shall be sufficiently long and continued along the wall on both ends so that the sliding shutters can rest against the walls, giving full opening when so required.

8.6.2. Fixing

The guide rails shall be fixed to the floor by means of anchor bolts embedded in the floor. The steel section at the top shall be suitably supported from the walls. Two channel sections shall be suitably fixed

vertically below the extreme clamps in the wall and floor to avoid the shutter from going out of the supports at top and bottom. A suitable clamping arrangement will be provided at either end of the opening to avoid the shutters from rolling back into the opening. All the adjoining work damaged in fixing shall be made good to match the existing work.

8.6.3. Painting

All members of the sliding shutters including fittings shall be thoroughly cleaned of rust, scales, dust etc., and given a priming coat of approved steel primer i.e. Red oxide chrome primer conforming to IS : 2074 or as specified before fixing them in position.

8.6.4. Measurements

The height and breadth shall be measured correct to a cm. and its area for payment shall be calculated in square metres correct to two places of decimal. The height of the shutter shall be measured from outside to outside of the guide rail and width outside to outside of the shutter including the vertical position channels in sides, when closed.

8.6.5. Rate

The rate shall include the cost of all labour and materials involved in all the operations described above.

8.7. M.S. SHEET SIDE HUNG SHUTTERS (REFER FIGURE 8.3B)

8.7.1.Types & Components:- These shall be manufactured as per drawing and specifications. These shall be fabricated from mild steel sheets and angle iron. The doors shall be provided as double leaf shutters unless otherwise specified. The shutters shall be fabricated with frame of M.S. angle 40 x 10 x 6 mm @ 3.5 kg/metre and two diagonal braces of the same section as shown in **Figure 8.3B** unless otherwise specified. The frame shall be riveted and/or welded at the junctions. Wherever riveting shall be done 3 mm gusset plate shall be provided at the junctions. M.S. sheet of 1 mm thickness, shall be fixed to the frame with rivets as approved by the Engineer.

Alternatively the diagonal bracing may be replaced by one horizontal and two cross flats 30 x 6 mm unless otherwise specified.

The outer frame shall be provided with cleats made of section 40 x 40 mm and bent in the shape of angle cleats with one arm 150 mm long and the other arm 50 mm long and fixed to the angle iron frame of the door with two 12 mm dia bolts and nuts, For doors up to 2.40 m height, two angle cleats per door shall be provided.

The cleat shall have a vertical leg of 150 mm which shall be fixed with frame and horizontal leg of about 50 mm which shall be provided with a hole of 24 mm dia and fixed in the projected pin of the pin clamp.

8.7.2. Fittings and Fixtures

The shutter shall be fixed to the wall masonry with four pin clamps (pintles) where the height of the shutter is up to 2.4 m. Each pin clamp shall consist of 50 x 6 mm flat iron 45 cm long bent and forked at one end and provided with 20 mm diameter. M.S. pin on the other. The pin shall be firmly riveted or welded to the pin clamp, the other end of which shall be embedded in masonry by means of cement concrete block 40 x 20 x 20 cm of 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm normal size). It shall be so placed that bottom pin shall face towards and Top pin downward in order that the gate may not be removed by lifting over pins.

One hook with eye 45 cm long of 10 mm diameter shall be provided for each shutter to keep it fixed in open position. The hook shall be fixed in wall masonry with wooden block and the eye shall be fixed on 6 mm thick M.S. plate as staple and fixed in the shutter frame with rivet or weld.

A cement concrete block 15 x 10 x 20 cm in 1:2:4 (1 cement : 2 coarse Sand : 4 Graded Stone aggregate of 20 mm nominal size) mix shall be embedded in the floor or at junction of two shutters so that door shutters, open only on the outside and not on the inside. The shutters shall also be provided with locking arrangement and two handles of the shape and pattern as approved by the Engineer.

8.7.3. Painting

All the members of the door including angle iron shall be thoroughly cleaned off rust, scales, dust etc., and given a priming coat of approved steel primer i.e. Red Oxide Zinc primer conforming to IS : 2074 or as specified before fixing them in position.

8.7.4. Measurements

The width and height of shutters shall be measured to the nearest cm. The area shall be calculated in square metre correct to two places of decimal.

8.7.5. Rate

The rate shall include the cost of all labour and materials involved in all the operations described above. Nothing extra shall be paid for cement concrete blocks or wooden blocks nor anything deducted for these from the measurement of the masonry wall.

8.8. ROLLING SHUTTERS

8.8.1. General :

8.8.1.1 Rolling shutters shall conform to IS : 6248. These shall include necessary locking arrangement and handles etc., These shall be suitable for fixing in the position, which may be one of the following as specified

1. Fixture on the inside, above bottom of lintel, with guides on the inside face of wall.
2. Fixture on the outside, above bottom of lintel, with guides on the outside face of wall.
3. Fixture on the outside, below bottom of lintel, with guides on the outside face of wall.
4. Fixture under the lintel, with guides on the jambs.
5. Fixture on the inside, below bottom of lintel, with guides on the inside face of wall.

The door shall be either of push and pull type or operated with mechanical device supplied by the manufacturer. Shutters up to 10 sq. metre shall be of push and pull type and shutters with an area of over 10 sq. metre shall generally be provided with reduction gear operated by mechanical device with chain or handle. If bearings are specified for ease of operation, these shall be paid for separately.

8.8.1.2. Shutter : The shutter shall be built up of inter-locking lath section formed from cold rolled steel strips. The thickness of the sheets from which the lath sections have been rolled shall be not less than 0.90 mm for the shutters up to 3.5 metre width and not less than 1.20 mm for shutters above 3.5 m width. Shutters above 9 metres in width should be divided in 2 parts with provision of one middle fixed or movable guide channel or supported from the back side to resist wind pressure. The lath section shall be rolled so as to have interlocking curls at both edges and a deep corrugation at the centre with a bridge depth of not less than 12 mm to provide sufficient curtain of stiffness for resisting manual pressures and normal wind pressure. Each lath section shall be a continuous single piece without any welded joint. When interlocked, the lath sections shall have a distance of 75 mm rolling centres. Each alternate lath section is fitted with malleable cast iron or mild steel clips securely riveted at either ends, thus locking the lath section at both ends and preventing lateral movement of the individual lath sections. The clips shall be so designed as to fit the contour of the lath sections.

8.8.1.3. Spring:- The spring shall be of coiled type. The spring shall be manufactured from high tensile spring steel wire or strips of adequate strength conforming to IS : 4454 Part I.

8.8.1.4. Roller and Brackets: The suspension shaft of the roller shall be made of steel pipe conforming to heavy duty as per IS : 1161. For shutter up to 6 metre width and height not exceeding 5 metre, steel pipes of 50 mm nominal bore shall be used. The shaft shall be supported on mild steel brackets of size 375 x 375 x 3.15 mm, for shutters up to a clear height of 3.5 metre. The size of mild steel brackets shall be 500 x 500 x 10 mm for shutters of clear height above 3.5 m and up to 6.5 m. The suspension shaft clamped to the brackets shall be fitted with rotatable cast iron pulleys to which the shutter is attached. The pulleys and pipe shaft shall be connected by means of pre-tensioned helical springs to counter-balance the weight of the shutter and to keep the shutter in equilibrium in any partly open position

8.8.1.5. When the width of the opening is greater than 3.5 mtr, the cast iron pulleys shall be inter-connected with a cage formed out of mild steel flats of at least 32 x 6 mm and mild steel dummy rings made of similar flats to distribute the torque uniformly. Self aligning two row ball bearings with special cast iron casings shall be provided at the extreme pulley and caging rings shall have a minimum spacing of 15 mm and at least 4 number flats running throughout length of roller shall be provided.

8.8.1.6. In case of shutters of large opening with mechanical device for opening the shutter the roller shall be fitted with a purion wheel at one end in contact with a worm fitted to the bracket plate, caging and pulley with two ball bearings shall be provided.

8.8.1.7. Guide Channel : The width of guide channel shall be 25 mm and the minimum depth of guide channels shall be as follows :

Clear width of shutters	Depth of guide channel

Up to 3.5 m	65 mm
3.5 m up to 8 m	75 mm
8 m and above	100 mm

8.8.1.8. The gap between the two legs of the guide channels shall be sufficient to allow the free movement of the shutter and at the same time close enough to prevent rattling of the shutter due to wind.

8.8.1.9. Each guide channel shall be provided with a minimum of three fixing cleats or supports for attachment to the walls or column by means of bolts or screws. The spacing of cleats shall not exceed 0.75 m. Alternatively, the guide channels may also be provided with suitable dowels, hooks or pins for embedding in the walls.

8.8.1.10. The guide channels shall be attached to the jambs, plumb and true either in the over-lapping fashion or embedded in grooves, depending on the method of fixing.

8.8.1.11. Cover: Top cover shall be of mild steel sheets not less than 0.90 mm thick and stiffened with angle or flat stiffeners at top and bottom edges to retain shape.

8.8.1.12. Lock plates with sliding bolts, handles and anchoring rods shall be as per

IS : 6248.

8.8.2. Fixing

8.8.2.1 The arrangement for fixing in different situations in the opening shall be as per IS : 6248.

8.8.2.2. Brackets shall be fixed on the lintel or under the lintel as specified with rawl plugs and screws, bolts etc., The shaft along with the spring shall then be fixed on the brackets.

8.8.2.3 The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound with ropes etc., The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and cover frames shall then be fixed to the walls through the plate welded to the guides. These plates and bracket shall be fixed by means of steel screws bolts, and rawl plugs concealed in plaster to make their location invisible. Fixing shall be done accurately in a workman- like manner so that the operation of the shutter is easy and smooth.

8.8.3. Measurements

The actual area of rolling shutters shall be measured in square metres correct to two places of decimals. The width shall be measured as the width of the shutter including portions hidden in the guide channels and height shall be measured as the length of the shutter from the bottom of the locking plate to the top of the laths including portion above the opening. The area shall be calculated in square metres correct to two places of decimal.

8.8.4. Rate

The rate shall include the cost of materials and labour involved in all the operations described above including cost of top cover and spring except ball bearing and mechanical device of chain and crank operation, which shall be paid for separately.

8.9. ROLLING GRILLS

8.9.1 General :

(a) Rolling grill is meant to provide visibility or ventilation or both though the degree of protection and safety is less as compared to a rolling shutter. In the situations where a certain amount of ventilation combined with safety is required, rolling shutter-cum-grill may be provided in which the rolling shutter may have rolling grill portion either at the top or at the bottom or at both places. The rolling grill portion may also be provided in the middle of the shutter. The total height of the grill portion in all the segments of rolling shutter-cum-grill shall not exceed 1.0 m and the height of the grill portion in any individual segment shall not be more than 0.5 m.

(b) Rolling grills are similar in design, construction and operation to rolling shutters and all he provisions of para 8.8 shall be applicable to rolling grills which shall also conform to IS : 6248.

8.9.2. Shutters

Rolling grill shutter and the rolling grill portion of the rolling shutter-cum-grill shall be fabricated with 8 mm diameter mild steel round bars. Straight bars and bars bent to the required profile are placed alternatively and held in position with 20 mm wide and 5 mm thick mild steel flat links. Straight bars shall be spaced not exceeding 150 mm centre to centre and the bars bent to required profile shall be placed symmetrically between two consecutive straight bars. Unless otherwise specified or directed by the Engineer, bars placed alternately with

straight bars shall be bent to form a corrugated profile such that the pitch of the corrugation is 100 to 120 mm and the depth of corrugation is 80 to 100 mm. All the bent bars shall have uniform profile. Straight bar along with the adjoining bent bars on both sides shall be held in position by passing the bars through holes in the links. Each link shall have three holes and the length of the links shall be such that the distance from the centre of the hole to the nearest edge of the flat is not less than the diameter of the hole. The corner of the links shall be rounded. All links shall be of uniform size and shape. The spacing of the links measured along the straight bar shall be of uniform size and shape and shall be the same as centre to centre distance between two consecutive crests/troughs of the bars bent to the required profile. Each bar and link shall be a continuous single piece without any joint.

8.9.3. Measurements and Rate

The measurements and rate shall be as specified in paras 8.8.3. and 8.8.4 respectively. In case of Rolling Shutter-cum-Grill, where the area of the grill portion is half or less than half the area of opening, it shall be measured and paid as rolling shutter and where the area of grill portion is more than half the area of opening, it shall be measured and paid as rolling grill.

8.10. STEEL DOORS, WINDOWS, VENTILATORS AND COMPOSITE UNITS (Refer Figure 8.4)

8.10.1 General

(a) Hot rolled steel /sections for fabrication of steel doors, windows, ventilators and fixed lights including shapes, weights and designations of the sections shall be as per IS : 7452. **Annexure 8.3** indicates the purpose or the situation where the sections are normally used. Tolerance in thickness of the sections shall be + 0.2 mm. The steel doors, windows, ventilators and composite units shall be got fabricated in a workshop approved by the Engineer.

(b) Steel doors, windows, ventilators and sashes shall conform to Indian Standard Specification No. IS 1038. The type, over all sizes, side opening position of steel doors, windows and ventilators shall be specified as per details given in IS 1038. The provision of a thresh hold or tie bar etc at the bottom of the door frame shall also be specified. Unless otherwise specified, the weight of the different rolled steel sections used for the manufacture of doors, windows, and ventilators shall not be less than those specified in IS 1038.

(c) Standard sizes and their designation

The overall sizes of standard doors, windows and ventilators as per IS:1038 are derived after allowing a clearance of 1.25 cm on all the four sides for purpose of fitting them into “modular” openings (i.e. openings with the principal dimensions in multiples of the 10 cm module) In the case of doors, if threshold at bottom of door opening is not to be provided as is the present general practice, there will be no need for a gap of 1.25 cm at the bottom and the height of steel door may be 1.25 cm instead of 2.5cm less than the height of modular opening. The standard sizes of openings prescribed for doors, windows and ventilators are the following :

For	Standard Sizes of openings	
	Heights (cm)	Widths (cm)
Doors	210	60, 80 and 120
Windows	90,120 and 150*	60,100, 120, 150 and 180
Ventilators	60	60, 80, 100, 120, 150 and 180

(Note:- * Windows 150 cm in height are with fixed light above).

Doors, windows and ventilators are designated by a sequence of symbols denoting their width, type and height respectively. The width and height are indicated in terms of the number of modules and the type through a combination of two of the following letters of the alphabet.

	Letter	Denoting
i)	H	With horizontal glazing bars
	N	Without horizontal glazing bars
ii)	C	Centre-hung shutters
	S	Side-hung shutters
	T	Top-hung shutters

F Fixed glass panes.

A few examples of standard designations are (a) Door 12 HS 21, (b) Window 12 HS/12 and (c) Ventilators 12 HF 6, as illustrated in **Figure 8.4** in the form of a combination of the three which is jointly designated as –

12 HF 6 / 12 HF 6

12 HS 21 / 12 HS 12

(**d) Fittings :** The following are the minimum items to be supplied with steel doors, windows, and ventilators:-

i) Frames and Shutters (including coupling sections, weather bars etc as required)

ii) Projecting hinges for shutters

iii) Lugs or other fixing device as necessary

iv) One peg stay for each window shutter and top-hung ventilator shutter

v) One spring catch, cord eye and pulley and 2 sets of pivots for each centre-hung ventilator shutter

vi) One handle for each window shutter

vii) One door handle for each door shutter

viii) Lock plate, with locking arrangements for each door

ix) Glazing clips (where necessary)

x) Two drop-bolts for each door (for the first closing shutter in double leaf doors)

The handle for window shutters shall have a "two point" nose, with a striking plate on the fixed frame to engage it either in the fast position or in a slightly open position, when the handle is turned. The fittings under items (iv) to (vii) and (x) shall be of brass, bronze or other non-ferrous metal mentioned in IS:1038, notwithstanding steel being mentioned in some cases as a permitted alternative.

e) Tolerance in Size : The steel doors and windows shall be according to the specified sizes and design as indicated in (c) above. The actual sizes of doors, windows and ventilators shall not vary by more than + 1.5 mm from those given in the drawing.

8.10.2. Fabrication

8.10.2.1. Frames : Both the fixed and opening frames of Hot rolled steel shall be made of sections which have been cut to length and mitred. The corner of fixed and opening frames shall be welded to form a solid fused welded joint conforming to the requirements given below. All frames shall be square and flat. The process of welding adopted shall be flash butt welding or metal arc welding or any other suitable method. The section for glazing shall be tennoned and riveted into the frames and where they intersect the vertical tie shall be broached and horizontal tie threads through it, and the intersection closed by hydraulic pressure. equirements of welded joints for steel products:-

(i) Visual Inspection Test - When two opposite corners of the frame are cut, paint removed and inspected, the joint shall conform to the following:

(a) Welds should have been made all along the place of meeting the members and tack welding shall not be permitted.

(b) Welds should have been properly grounded and

(c) Complete cross section of the corner shall be checked up to see that the joint is completely solid and there are no cavities visible.

(ii) Micro and Macro Examinations

From the two opposite corners obtained for visual test, the flanges of the sections shall be cut with the help of a saw. The cut surface of the remaining portions shall be polished, etched and examined. The polished and etched faces of the weld and the base metal shall be free from cracks and reasonably free from under cutting, overlaps, gross porosity and entrapped slag.

(iii) Fillet Weld Test

The fillet weld in the remaining portion of the joint shall be fractured by hammering. The fractured surfaces shall be free from slag intrusion, porosity, crack penetration defects and fusion defects.

8.10.2.2. Door : The hinges shall normally be of 50 mm projecting type. Non-projecting type hinges may also be used if approved by the Engineer. The hinge pin shall be of electro-galvanized steel or aluminium alloy of suitable thickness and size. Door handles shall be approved by the Engineer. A suitable latch lock for door open-able both from inside and outside shall be provided.

In the case of double doors, the first closing leaf shall be that the left hand leaf with locking of the door from the push side. The first closing shutter shall have a concealed steel bolt at top and bottom. The bolts shall be so constructed as not to work loose or drop by its own weight.

Single and double shutter door may be provided with a three way bolting device. Where such device is provided in the case of

double shutters, concealed brass or steel bolts shall not be provided.

8.10.2.3. Windows

(a) For fixed windows, the frames shall be fabricated as per para 8.10.2.1.

(b) Side hung windows

For fixing steel hinges, slots shall be cut in the fixed frame and hinges inserted inside and welded to the frame at the back. The hinges shall normally be of projecting type with thickness not less than 3.15 mm and length not less than 65 mm and width not more than 25 mm. Non projecting type hinges may also be allowed if approved by the Engineer. The diameter of hinge pins shall not be less than 6 mm. The hinge pin and washer shall be of galvanized steel or aluminium alloy of suitable thickness.

For fixing hinges to inside frame, the method described above may be adopted but the weld shall be cleaned, or the holes made in the inside frame and hinge riveted.

The handle of side hung shutters shall be pressed brass, cast brass, aluminium or steel protected against rusting and shall be mounted on a steel plate. Thickness of handle shall not be less than 3 mm in case of steel or brass and 3.5 mm in case of aluminium. The handle plate shall be welded, screwed and/or riveted to the opening frame in such a manner that it should be fixed before the shutter is glazed and should not be easily removable after glazing.

The handle shall have a two point nose which shall engage with a brass or aluminium alloy striking plate on the fixed frame in a slightly opened position as well as closed position. The boss of handle shall incorporate a friction device to prevent the handle from dropping under its own weight and the assembly shall be so designed that the rotation of the handle may not cause it to unscrew from the pin.

The height of the handle plate in each type of standard windows will be as specified. Otherwise it shall be at a height of 3/8 of the height of shutter, from its bottom. The strike plate shall be designed and fixed in such a position in relation to the handle that with the later bearing against its stop, there shall be adequately tight fit between the casement and outer frames.

In case where no friction type hinges are provided, the window shall be fitted with peg stays which shall be either of black oxidized steel, pressed or cast brass or as specified, 300 mm long with steel peg and lacking brackets. The pegs stay shall have three holes to open the side hung casement in three different angles. The peg stay shall be of minimum thickness 2 mm in case of brass or aluminium and 1.25 mm in case of steel. Where specified, Side hung shutters fitted with friction hinges shall also be provided with a peg stay.

If specified, side hung shutters may be provided with an internal removable fly proof screen in a 1.25 mm thick sheet steel frame fitted to the outer frame of the shutter by brass turn buckles at the jamb, and brass studs at the sill to allow the screen being readily removed. The windows with removable fly proof screen shall be fitted with a through-the-screen level operator at the sill level to permit the operation of the shutter through an angle of 90^0 without having to remove the fly proof screen. The lever shall permit keeping the shutter open in minimum three different positions.

8.10.2.4. Ventilators

(a) Top Hung Ventilators - The steel butt hinges for top hung ventilators shall be riveted to the fixed frame or welded to it at the back after cutting a slot in it. Hinges to the opening frame shall be riveted or welded.

Top hung ventilators shall be provided with a peg stay with three holes which when closed shall be held tightly by the locking bracket. The locking bracket shall either be fitted to the fixed frames or to the window.

(b) Centre Hung Ventilators - Central hung ventilators shall be hung on two pairs of brass or aluminium cup pivots as specified, riveted to the inner and outer frames of ventilators to permit the ventilator shutter to swing to an angle of approx 80^o. The opening portion of the ventilators shall be so balanced that it remains open at any desired angle under normal weather conditions.

8.10.2.4.1. A black oxidized steel spring catch approved by the Engineer shall be fitted in the centre of the top of the centre hung ventilator, for the operation of ventilators. The spring catch shall be secured to the frame with M.S. screws and shall close into a mild steel or malleable iron catch plate riveted, screwed or welded to the outside of the outer window frame bar.

8.10.2.4.2. A black oxidized cord pulley wheel in galvanized mild steel brackets shall be fitted at sill of the centre hung window with mild steel screws or alternatively welded together with a mild steel or malleable iron cord-eye riveted or welded to the bottom

inter frame bar of the window in a position corresponding to that of pulley.

Removable fly-proof screen may be provided as specified in para 8.10.2.3.(b). This shall be fitted with a through-the-screen operator to enable operating and keeping the shutter open in minimum three different positions.

8.10.2.5. Composite Units: Composite units consist of a combination of two or more units of doors, windows and ventilators etc., as the case may be. The different units shall be coupled by using coupling sections K-11B or K-12B (Ref. **Annexure 8.3**) as the case maybe.

Wherever the ventilators, windows and doors shall be coupled with a coupling section, mastic cement shall be applied between the junction to make the joint water tight.

8.10.3. Glazing

8.10.3.1. Specifications described in para 7.2.9. shall apply. The glass panes shall have square corners and straight edges. The glass pane shall be so cut that it fits slightly loose in the frames. In doors, windows and clerestory windows of bath, WC and lavatories frosted glass panes shall be used which shall weigh not less than 10.00 kg/$m^2$for 4 mm thick glass.

8.10.3.2. Glazing shall be provided on the outside of the frame unless otherwise specified. Putty of approved make conforming to IS : 419 shall be used for fixing glass panes. Putty shall first be applied between glass panes and glazing bars. Putty shall then be applied over the glass pane, which shall stop 2 to 3 mm from the sight line of the back rebate to enable the painting to be done up to the sight line to seal the edge of the putty to the glass. The oozed out putty shall be cleaned and putty cut to straight line. Quantity of putty shall not be less than 185 gm/metre of glass perimeter. Putty shall be painted within 2 to 3 weeks, after glazing is fixed to avoid its cracking.

Note : Putty may be prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding boiled linseed oil to the mixture to form a stiff paste and adding varnish to the paste at the rate of 1 litre of varnish to 18 kg of paste.

8.10.3.3. Four glazing clips may be provided per glass pane for a size larger than 30 cm x 60 cm for all types. Where the glass panes size exceed 80 cm x 200 cm, 6 glazing clips shall be used. In case of doors, windows and ventilators without horizontal glazing bars, the glazing clips may be spaced according to the slots, in the vertical members, provided the spacing does not exceed 30 cm, otherwise the spacing shall be 30 cm.

Note : Where large size glass panes are required to be used or where the door or window is located in heavily exposed situation, holes for glazing clips have to be drilled prior to fabrication as it cannot be done at any later stage. Use of glazing clips shall be specified while placing the order.

8.10.3.4. Where specifically stipulated, fixing of glass panes may be done with metal or wooden beading instead of with putty. Where beadings are proposed to be used, the manufacturers shall be intimated in advance to drill holes for hard screws. Usually beads shall be fixed with screws spaced not more than 10 cm from each corner and the intermediate not more than 20 cm apart. When glass panes are fixed with wooden or metal beading having mitred joints, a thin layer of putty shall be applied between glass panes and sash bars and also between glass panes and the beading. Where metal beading is specified extra payment shall be made on this account unless specified otherwise.

8.10.4. Finishing

(a) All steel surfaces shall be thoroughly cleaned of rust, scale and dirt. Where so specified, the steel surfaces shall be treated for rust proofing by the hot dip, zinc spray or electro galvanizing process. A priming coat of approved steel primer i.e. red oxide zinc chrome primer conforming to IS: 2074 or as specified shall be given. The fabricated steel door, windows, ventilators and composite units shall be inspected in the factory and approved by the Engineer before priming coat is applied.

(b) Final finishing coat shall be given to the doors, windows and ventilators after they are erected and fixed in final position. The rate shall be exclusive of final finishing coats but shall include the priming coat.

(c) In case of galvanized doors, windows and sashes, their surface shall be treated with copper acetate solution or other approved mordant solution to ensure proper adherance of the paint, unless the galvanised surface has weathered adequately at the time of final painting. Non-ferrous parts and working parts such as handles, stays, catches, handle pins, hinges / pins, etc shall not be painted. Treatment with the mordant solution is not included in the rate and shall be paid for separately.

8.10.5. Fixing (Refer Figure 8.5)

8.10.5.1. Steel, doors and windows shall be so stacked as to keep them in true shape without damage. Doors, windows and ventilators shall be fixed as described below:

8.10.5.2. Metal doors, windows and ventilators may be required to be fixed to either masonry openings (including brick, concrete, stone and marble) or timber openings or steel work openings.

a) Masonry openings – Masonry openings may either be rebated or flush and in either case, they may have either external rendering applied or be 'fair-faced' (that is, without external rendering). It is usual for stone or marble masonry to be fair-faced.

b) Timber openings – Timber openings are invariably rebated.

c) Steelwork openings – Steelwork openings vary in detailed design but shall be so designed that the outer frame of the door, window or ventilator frame sections overlap a steel surface either externally or internally.

Opening may be flush or rebated as shown in the drawings. Where openings are flush and with a rendered finish a clearance of 1.25 cm shall be provided between the steel frame and opening (**Figure 8.5)**. In case of external masonry finish "fair faced" and with rebated jambs, a minimum 1.25 cm clearance between frame and opening shall be provided (**Figure 8.5**). Opening in steelwork shall be so designed that the outer flange of the door, windows, or ventilator frame section over-laps the steel surface by 10 mm (**Figure 8.5**).

Note: As mentioned in Para 8.10.1 (c) the sizes of Indian Standard doors, windows and ventilators, are designed for modular opening 1.25 cm larger all round than the doors, windows etc., This gap of 1.25 cm is for the purpose of fixing of doors, windows etc., In masonry openings, the gap is filled up with mastic cement and plaster after the door or windows is fixed in position. In the case of steel or timber modular openings, extra steel or timber fillets will be necessary to cover this gap of 1.25 cm.

8.10.5.3. Fixing in Masonry Openings

(a) Fixing with Lugs

(i) Doors, windows and ventilators unit, shall not be "built in" as the work proceeds but opening shall be left out and frames fitted afterwards so that the minimum specified clearance between opening and unit frame is left around. The size of the opening shall first be checked and cleared of obstruction, if any. The position of the unit and fixing holes shall be marked on the jamb. Necessary holes shall be made in the masonry and lugs not less than 10 cm long 15 x 3 mm size fixed in cement concrete blocks 15 x 10 x 10 cm size of 1:2:4mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size). The frames of units shall be set in the opening by using wooden wedges at the jamb, head and sill. Wedges shall preferably be placed near the points where a glazing bar meets the frames and be plumbed in position.

(ii) After it, the frame shall be fixed with the lugs with 20 mm long and 6.3 mm dia G.I. counter sunk machine screws and nuts. In case of flush opening which are rendered smooth, wedges shall be removed and gap between unit and the jambs shall be filled with cement mortar (see **Figure 8.5**)

(iii) In case of flush jamb with external "fair faced" finish the gap between the opening and frame shall be filled with mastic from inside till it oozes out on external face. The oozing mastic shall be cleaned and flush pointed. The internal gap shall be filled with mastic to about 1/3rd depth and the rest with cement mortar (**Figure 8.5**).

(iv) In case of rebated jambs and jambs finished 'fair faced' externally, the mastic shall be freely applied to the inside channel of frame, jamb and sill, so as to ensure a watertight joint. After the unit is firmly tied in position surplus mastic shall be cleaned and flush pointed, as shown in **Figure 8.5.**

(b) Fixing with screws and plugs

In R.C.C. work where lugs cannot be embedded due to reinforcement bars etc., and in dressed stone and Marble surrounds, rawl plugs or other approved metallic fasteners may be fixed in proper position and frame fixed to them with 60 mm galvanized wood screws of designation 10.

8.10.5.4. Fixing in Wood Works Opening: Openings in wood work are normally rebated and approved mastic or rubber linings shall be applied to jambs, sill and channel before fixing in position. The frame shall be set in opening using wooden wedges as specified in para 8.10.5.3. and fixed to the opening with 60 mm galvanized wood screws of designation 10. Extra timber fillets of hard wood to match the adjoining work shall also be provided around the frame to close the extra gap between opening and frame (Refer **Figure 8.5**)

8.10.5.5. Fixing in Steel Work Opening: Before placing the unit frame in position approved mastic shall be applied as

specified in para 8.10.5.3. (a.iv) and a mild steel or hard wood fillet shall be provided around the frame to close the extra gap between opening and frame. The unit shall be fixed to the opening with fixing clips or with nuts and bolts as shown in the drawings or as directed by the Engineer. (Refer **Figure 8.5**)

8.10.5.6. Fixing of Composite Units: The fixing procedure for composite units shall generally be as described under paras 8.10.5.1. to 8.10.5.5 except that :

Where large units shall be formed by coupling individual units together (with coupling sections) the mullions and transoms shall be bedded in mastic to ensure water tightness. Mastic shall be applied liberally to the channels of the outside frame sections before assembly and after coupling. All oozing out mastic shall be cut out neatly. If there is a cross joint of mullion and transome, the shorter coupling unit shall run through unbroken. Mullions normally project 2.5cm at head and sill into the surround; transomes also project 2.5cm into surround and where appropriate they shall be cut.

8.10.5.7 Fixing of Aluminium frames

In case of Aluminium frames, the surfaces shall be anchored in direct contact with the surrounds and shall be protected with two coats of alkali resistant paints, to avoid chemical attack from the materials of surround.

8.10.6. Precautions

Care shall be taken that steel doors and windows etc., are not deformed/damaged during subsequent constructions. Particular care shall be taken that scaffolding does not rest on the steel door /window frames or glazing bars.

All fittings and hinges (projecting hinges) shall be protected, preferably with alkathene sheets so that these may not be damaged during execution of work.

8.10.7. Measurements

The height and width shall be measured correct to 1 mm. The area shall be calculated in square metre correct to two places of decimal. The fixed, side hung and top hung categories shall be measured separately.

All composite units shall first be measured as fixed. Extra shall then be added for side hung, top hung and centre hung portions. The measurements for extra for side hung, centre hung and top hung windows shall be taken from outside to outside of the casement frames.

8.10.8. Rate for Supply and Fixing by the Contractor

Rates shall include the cost of materials and labour involved in all the operations described above excluding two coats of painting but including cost of glazing and priming coat and the cost of projecting hinges in case of side hung doors/windows, plain hinges in case of top/bottom hung windows/ventilators and pivots for centre hung windows/ventilators.

Metal beading and other fittings such as peg stays and casement window fasteners etc. shall be enumerated and paid for separately. Rate shall not include the cost of cement concrete blocks if required for fixing of hold fasts which will be paid for separately.

8.11. T-IRON DOORS, WINDOWS AND VENTILATOR FRAMES (Refer Figure 8.6)

8.11.1 General :

(a) T-iron doors, windows and ventilators frames shall be manufactured from uniform mild steel Tee section. The steel shall be of the grade as provided in para 8.1.1. The frames shall be got fabricated in a workshop as approved by the Engineer.

(b) The sizes of doors, windows and ventilator frames shall be as per drawing or as decided by the Engineer MS tie bar of 10 mm dia shall be welded at bottom of the frame. The size of doors, windows and ventilators shall be calculated so as to allow 12.5 mm clearance on all sides to allow an easy fitting in opening. The actual size of doors, windows and ventilators shall not vary by more than $\pm$2 mm than those shown in the drawings.

The size of T section used for manufacture of doors, windows and ventilators shall not be less than those specified in IS:1038 (See **Figure 8.6**), unless otherwise directed by the Engineer.

8.11.2. Fabrication

The frame shall be constructed using section which has been cut to length andmitred. The corners of the frames shall be butt welded to form a true and right angle. All frames shall be square and flat meeting the requirements stated under para 8.10.2.1. The T section shall be mitre joined and continuously butt welded all along. The requirement of welded joints shall be as specified under para 8.10.2.1.

8.11.3. Fittings

Requisite number of holes shall be made in the frame for fixing of fittings. Detailed arrangements of fixing fittings shall be as shown in **Figure 8.6**. All fittings shall be fillet welded to T-iron frame all along the periphery of contact.

i) Butt hinges shall be fixed to the frame as below:

M.S. flat of size 100 mmx 25 mm x 6 mm will be welded with filet weld all along the periphery of contact on the rear side of the web of T-iron to receive the hinges. Requisite number of holes shall be made in T-iron frame and MS flat for fixing of hinges with counter sunk steel screws as shown in **Figure 8.6**.

(ii) An alternate method of fixing butt hinges can be adopted by fillet welding the hinge to the T-iron frame on three sides. No welding shall be done along the hinge pin to allow free movement of butt hinges as shown in **Figure 8.6**.

8.11.4. Fixing

Fixing procedure for T-iron doors, windows and ventilator frames in masonry opening shall be as described in para 8.10.5. Fixing arrangements of shutters to such frames is shown in **Figure 8.6**.

8.11.5. Measurements

T-iron doors, windows and ventilator frames shall be measured in running metre, along the centre line of the frame correct to a 1 mm and weight calculated on the basis of standard tables. No deduction or extra payment shall be made for making holes and making arrangements for fixing fittings including packing wherever necessary. No deduction will be made for not providing tie bars in case of windows and ventilators.

8.11.6. Rate

The rate includes cost of materials and labour involved in all the operations described above. It shall include the necessary butt hinges and screws for fixing the same with frame or as specified. But it does not include the cost of other door and ventilator fittings.

8.12. PRESSED STEEL DOOR FRAMES (Refer Figure 8.7)

8.12.1. Material

Steel door frames shall be manufactured from commercial mild steel sheet of 1.25 mm thickness conforming to IS : 2062 and fittings conforming to IS : 4351.

Steel door frames with or without fan light shall be made in the profiles indicated in **Figure 8.7** and may be manufactured to suit doors of either type, opening inwards or outwards as directed by the Engineer.

8.12.2. Construction

Each door frame shall consist of hinge jamb, lock jamb, head and if required angle threshold (Refer **Figure 8.7**). These shall be welded or rigidly fixed together by mechanical means. Where no angle threshold is required, temporary base tie shall be screwed to the feet of frames in order to form a rigid unit. Where so specified, base ties shall be of pressed mild steel 1.25 mm thick adjustable to suit floor thickness of 35 or 40 mm and removable, or alternatively, threshold of mild steel angle of section 50 x 25 mm minimum shall be provided for external doors frames.

8.12.3. Fabrication

The pressed steel door frames shall be got fabricated in a workshop approved by the Engineer.

8.12.3.1. Fixing lugs (**Figure 8.7**). There shall be three adjustable lugs with split end tail to each jamb without fan light, and four for jamb with fan light. The head of the fixing lug shall be one of the following lengths:

(a) 95 mm long for use with profile A

(b) 120 mm long for use with profile B

(c) 160 mm long for use with profile C

The head shall be made from flat steel strip 25 mm wide and not less than 1.60 mm thick. The tail of the lugs shall be 200 mm long and shall be made of steel strip no less than 40 mm wide and not less than 1 mm thick.

8.12.3.2. Hinges (**Figure 8.7**) 100 mm mild steel but hinges shall be used. For door frames 89 cm wide and under, three hinges shall be rigidly fixed to one jamb and for frames for door above 89 cm wide, four hinges shall be rigidly fixed to one jamb, if it is a single shutter. Where the height of the door shutter exceeds 2.15 metres, one additional hinge shall be provided for every 0.5 m or part thereof of the additional height.

In all cases the hinges shall be so fixed that the distance from the inside of the head rebate to the top of the upper hinge is 20 cm and distance from top of upper hinge to lower hinge is about 175 cm.

Hinges shall be made of steel 2.5 mm thick with zinc coated removable pin of 6 mm diameter. The space between the two leaves of the hinge when closed shall be 3 mm and the leaf that is not welded to the frame shall

have four counter sunk holes to take No. 10 wood screws.

8.12.3.3. Mortar Guards: Mortar guards as instructed by Engineer shall be provided. These shall be welded to the frame at the head of the frame for double shutter doors to make provision for bolts.

8.12.3.4. Lock-Strike Plate: There shall be an adjustable lock-strike plate of steel complete with mortar guard to make provision for locks or latches complying with the relevant Indian Standards. Lock-strike plates shall be galvanized mild steel and fixed at 95 cm from the head of the frame.

8.12.3.5. Shock Absorbers: For side hung door there shall not be less than three buffer of rubber or other suitable material inserted in holes in the rebate and one shall be located on the centre line of the lock strike plate and the other two at least 45 cm above and below the centre line of the lock strike plate. For double shutter doors, there shall be two buffers of rubber or similar suitable material inserted in holes in the rebate in the lock jamb only at the head and spaced 15 cm at either side of the centre line of the door.

8.12.4. Finish

The surface of door frame shall be thoroughly cleaned, free of rust, mill-scale dirt, oil etc., either by mechanical means, for example, sand or shot blasting or by chemical means such as pickling. After pre-treatment of the surface one coat of approved primer i.e. red oxide zinc chrome primer conforming to IS : 2074 or as specified and two coats of paints as directed by he Engineer shall be applied to the exposed surface.

8.12.5. Fixing

Frames shall be fixed up right in plumb. To avoid sag or bow in width during fixing or during construction phase, temporary struts across the width preventing sides bulging inwards may be provided. Wall shall be built solid on each side and grouted at each course to ensure solid contact with frame leaving no voids behind the frame.

Three lugs shall be provided on each jamb with spacing not more than 75 cm. The temporary struts should not be removed till the masonry behind the frame is set. In case screwed base tie is provided, this should be left in position till the flooring is laid when it can be removed.

After pre-treatment of the surface, one coat of steel primer and two coats of paint as directed by the Engineer shall be applied to the exposed surface.

8.12.6. Measurements

The length shall be measured in running metre correct to a cm along the centre line of the frames.

8.12.7. Rate

The rate shall include the cost of labour and material involved in all the operations described above including one coat of approved steel primer but excluding two coats of final paint.

8.13. TUBULAR TRUSSES

8.13.1. Structural Steel Tube - These shall be of :

1. Hot finished welded (HFW) type or
2. Hot finished seamless (HFS) type, or
3. Electric resistance or induction butt welded (ERS), having carbon content less than 0.03 percent, yield stress of 21.5 kg/mm^2 (YST 22) type. Conforming to the requirement of IS : 1161. The steel tubes when analyzed in accordance with the method specified in IS : 226 shall show not more than 0.06 per cent sulphur, and not more than 0.06 per cent phosphorous.

Tubes shall be designated by their nominal bore. These shall be light, medium or heavy as specified depending upon the wall thickness. The standard sizes and weights of tubes are listed in **Annexure 8.4.**

Tubes shall be clean finished and reasonably free from scale. They shall be free from cracks, surface flaws, laminations and other defects. The ends shall be cut clean and square with axis of tube, unless otherwise specified. IS 806 deals with Code of Practice for use of Steel Tubes for General Building Construction and may be referred to for details.

8.13.2. Minimum thickness of Metals

Wall thickness of tubes used for construction exposed to weather shall be not less than 4 mm and for construction not exposed to weather it shall be not less than 3.2 mm. Where structures are not readily accessible for maintenance, the minimum thickness shall be 5 mm.

8.13.3. Fabrication

8.13.3.1. The component parts of the structure shall be assembled in such a manner that they are neither twisted nor otherwise damaged and be so prepared that the specified cambers, if any, are

maintained. The tubular steel work shall be painted with one coat of approved steel primer after fabrication. All fabrication and welding is to be done in an approved workshop.

8.13.3.2. Straightening: All material before being assembled shall be straightened, if necessary, unless required to be of curvilinear form and shall be free from twist.

8.13.3.3. Bolting: Washers shall be specially shaped where necessary, or other means, used, to give the nuts and the heads of bolts a satisfactory bearing. In all cases, where the full area of the bolt is to be developed, the threaded portion of the bolt shall not be within the thickness of the parts bolted together and washers of appropriate thickness shall be provided to allow the nuts to be completely tightened.

8.13.3.4. Welding : Where welding is adopted, it shall be as per IS : 816.

8.13.3.5. Caps and Bases for columns: The ends of all the tubes, for columns transmitting loads through the ends, should be true and square to the axis of the tubes and should be provided with a cap or base accurately fitted to the end of the tube and screwed, welded or shrunk on. The cap or base plate should be true and square to the axis of the column.

8.13.3.6. Sealing of Tubes: When the end of a tube is not automatically sealed by virtue of its connection by welding to another member, the end shall be properly and completely sealed. Before sealing, the inside of the tubes should be made dry and free from loose scale.

8.13.3.7. Flattened Ends: In tubular construction the ends of tubes may be flattened or otherwise formed to provide for welded, riveted or bolted connections provided that the methods adopted for such flattening do not injure the material. The change of sections shall be gradual.

8.13.4. Hoisting and Erection

Tubular trusses shall be hoisted and erected in position carefully, without damage to themselves, other structures, equipment and injury to workmen.

The method of hoisting and erection proposed to be adopted shall be got approved from the Engineer. The contractor shall however be fully responsible for the work being carried out in a safe and proper manner without unduly stressing the various members. Proper equipment such as derricks, lifting tackles, winches, ropes etc., shall be used.

8.13.5. Measurements

The work as fixed in place shall be measured in running metres correct to a centimetre and their weights calculated on the basis of standard tables correct to the nearest kilogram unless otherwise specified.

Weight of cleats, brackets, packing pieces bolts, nuts, washers, distance pieces, separators diaphragm gussets (taking over all square dimensions), fish plates etc., shall be added to the weight of respective items unless otherwise specified. No deduction shall be made for skew cuts.

8.13.6. Rate

The rate shall include the cost of labour and materials involved in all the operations described above including application of one coat of approved steel primer i.e. red oxide zinc chrome primer conforming to IS : 2074 or as specified.

8.14. FAN CLAMPS (Figure 8.8)

8.14.1. Types

The fan clamp shall be of the following types:

(a) Fan clamp to be fixed during the laying of R.C.C. slab, shall be of type I, as shown in **Figure 8.8**. This shall be made of 16 mm M.S. bar bent to shape with its ends hooked. The overall height of the clamps shall be made to suit the depth of the slab.

(b) Fan clamp for beams shall be of type II as shown in **Figure 8.8**. It shall be similar to fan clamp, type I, except that its height shall be greater depending on the depth of the beam rib.

(c) In case of low ceiling heights, circular cast iron box for ceiling fan clamp, Type III shall be fixed during the laying of R.C.C. slab and shall be as shown in **Figure 8.8**. The size of cast iron box shall be 140 mm internal dia with 73 mm height. The thickness of cast iron rim shall be 4.5 mm Bottom and top lids shall be of 1.5 mm thick M.S. sheet with the top surface hacked so as to ensure proper bonding with the concrete. The lids shall be screwed into the cast iron box by means of 3.3 mm dia round head screws one each at the corners. The box can be of M.S. sheet and the thickness of side walls can be reduced to 3 mm without affecting inner dia of the box. The fan clamp shall be made of 12 mm dia M.S. bar bent to shape with its ends bent as per drawing.

8.14.2. Fixing

Holes for inserting the fan clamps in the positions shown in the drawing or as instructed by the Engineer shall be made in the shuttering after the latter has been fixed in position. After steel reinforcement is tied, fan clamps shall be fixed with their loops truly vertical and at the correct depth from the underside of the slab or beam. The hooked arms and the loop shall be tied to the reinforcement, either directly or through cut pieces of M.S. bars with annealed steel wire 1.6 mm or 1.00 mm thick. The clamp shall neither be disturbed out of position during concreting nor shall it be bent out of shape when shuttering of slabs or beams is removed.

The exposed portion of loops of the clamp shall be given two or more coats of paint, including priming coat of approved steel primer as ordered by the Engineer.

8.14.3. Measurements

Clamps of type I and III shall be counted in numbers. Fan clamps type II, shall be counted and paid for under fan clamps type I, but they shall in addition be paid for their extra height as determined by the depth of the beam.

8.14.4. Rate

The rate per fan clamp shall include the cost of labour and materials involved in all the operations described above. In the case of type 1 and III clamps, the rate shall apply irrespective of the thickness of the slabs.

8.15. MILD STEEL CLAMPS AND RINGS FOR CHICKS

8.15.1. M.S. Clamps

These shall be fabricated from M.S. flat iron 20 mm x 6 mm. One end shall be bent at right angles for 25 cm length and other end shall be tapered to a point. Total length of clamp shall not be less than 15 cm.

These shall be built into the wall masonry, while the work is in progress, so as to project 2.5 cm from the finished surface. These shall be fixed in cement mortar. All clamps shall be fixed in straight horizontal line as shown in drawings or as specified by the Engineer.

8.15.2. M.S. Rings

These shall be made of 6 mm dia bars with 40 mm internal diameter. Their joint shall be well formed or welded together. These shall be provided with a 50 mm forked clamp of 10 x 3 mm M.S. flat iron. It shall be wide at the fork end and pointed on the other end. These shall be fixed in the masonry as specified in para 8.15.1.

8.15.3. Measurements

The M.S. clamps and rings shall be counted in numbers.

8.15.4 Rate

The rate shall include the cost of materials and labour involved in all the operations described above.

8.16. M.S. BARS AND M.S. GRILLS IN WOODEN OR STEEL FRAMES

8.16.1. Fabrication

8.16.1.1 When M.S. round or square bars are to be fixed in wooden or steel frames these are cut into required length to form the required pattern and then fixed as per drawing. In the case of wooden frames the length will be for fixing in the hole 5 cm deep in one frame and right through and flush with outer side of the frame.

8.16.1.2 When M.S. round or square bars are to be fixed to steel frames or in combination with M.S. flats these are to be cut to proper size welded to steel frames or MS flats to form the required pattern. In case of MS flats they should have counter sunk holes to facilitate fixing them to wooden frames with wood screws. Welding is to be done in an approved workshop and not at site.

8.16.1.3. When the grill is to be fabricated mainly with M.S. flats with or without M.S. round or square bars, the flats of required size are cut and bent to form the required pattern and design as per drawing or as directed by the Engineer. The cut and bent flats and bars are then welded by fillet welding all around the width of the flats or circumference of bars which are joined. At corners of flats proper mitred joint forming a right angle shall be provided with welding for full width. Welding is to be done in approved workshop and not at site.

8.16.2. Fixing

8.16.2.1. When M.S. round or square bars are to be fixed to wooden frames the bars shall be passed in to the wooden frame, from the end having a through hole and fixed flush with that end while at the other end it will be 5 cm deep in the hole drilled in the frame. In case of steel frames, the bars will be welded to the steel frame by fillet weld all along the circumference of the bars in an approved workshop and not at site.

8.16.2.2. In case of grill of bars welded to M.S. flat forming the required pattern, the

outer frame of M.S. flats shall be fixed to the wooden frame with wood screws in the counter sunk holes drilled in M.S. flats ensuring that screws are driven with a screw driver (not hammered) till the screws are embedded fully inside flush with the M.S. flats.

In case of fixing to steel frames, M.S. flats of required pattern with or without M.S. round or square bars, the method of fixing will be similar to what is described above.

8.16.3. Welding : Any kind of welding at site shall be permitted only under written orders of the Engineer.

8.16.4. Measurements

The different types of M.S. grills as described in para 8.16.1 will be measured separately and paid for. The length of bars and flats used in grills will be measured correct to a cm and then weights calculated in kg by using standard tables.The weight of complete grill should be weighed at site **and** minimum of the two will be taken for payment.

8.16.5. Rate

The rate shall include the cost of materials and labour required for all the operations described above. Grills of different types mentioned in para 8.16.1 shall be paid for separately.

8.17 ALUMINIUM WORK – GENERAL

8.17.1 Materials

Aluminium alloy standard extruded sections in a wide range of solid and hollow profiles are used in the manufacture of frames, shutters of doors / windows / ventilators, supports for hand railings, curtain wall facings, partitions, structural glazings and similar other applications. Tee / angle sections are used for frame work of false ceiling. The chemical composition and mechanical properties of the extruded sections should comply with the requirements of IS 733, IS 1285 and IS 737. Extruded sections should be procured only from recognised ISO 9002 or equivalent companies.

8.17.2 Anodising

The extrusions are anodised upto 30 Micron in different colours like silver, champagne, bronze and black and are to be tested to see if the anodising conforms to the quality standards laid down in Indian /British Standard Specifications.

8.17.3 Aluminium Work for Doors, Windows, Ventilators and Composite Units

IS 1948 on Aluminium doors, windows and ventilators and IS 1949 on Industrial Alminium Windows were issued in 1961 and not revised since then. Major manufacturers of Aluminium products are however manufacturing extruded sections etc to suit the latest construction practice based on British and International Standards. Hence it may be difficult to procure Aluminium sections to the sizes stipulated in IS codes but the quality of extruded sections as regards the materials and the anodising etc is maintained by the manufacturers to satisfy the requirements of IS Codes. Thus, for procurement of Aluminium doors, windows, ventilators etc a practical approach will be to go in for sections manufactured by reputed ISO 9002 or similar companies whether they are strictly to sizes specified in IS Codes or as specified in British or International Codes. For joining procedure, providing fittings, lugs, method of fixing etc. IS codes may be followed in general with some modification to suit the present day practice.

8.17.4 General Specifications and Tolerances for Aluminium extrusions

Dimensions of the sections manufactured should conform to the relevant IS, British or other International Standards. Standard cut length of sections is 3.66m. The tolerance in cut length is + 5.00 mm upto 6 Metres length of sections and + 7.00 mm for over 6 Metre length sections. Actual weight per metre may vary by $\pm$ 10% of weight as specified depending on functions like tolerance and alloy.

8.18 ALUMINIUM DOORS

8.18.1 Extruded Sections

Dimensions and weight per Metre run of extruded sections to be used for manufacture of doors as laid down in IS 1948 are shown in **FIGURE 8.9**. Reputed manufacturers produce various other types of Extruded sections for use in doors.

8.18.2 Components of Doors and Terminology

IS 1948 has specified the Terminology for different components of the doors and the same have been shown in **FIGURE 8.4**.

8.18.3 Sizes of fabricated doors

As per IS 1948, the sizes of doors specified in the drawings (modular openings) should be reduced by 1.25 cm on all four sides

during the manufacture of doors to enable their fixing easily in the openings in the Masonry. The module of opening in the masonry is of 100mm. In practice while the reduction in width of manufactured door by 2.50 cms as compared to the size of door opening will result in availability of gap of 1.25 cm in each side, reduction in height by 2.50 cms will result in a gap of 2.5cms between the bottom surface of RCC Lintel and the gap of door to be filled by cement plaster which is not desirable. This situation arises due to discontinuation of the old practice of providing a threshold at the bottom of doors. With this proposal, the following will be the desirable position for some sizes of door openings.

Size of Door opening	Size of manufactured door
1200 mm x 2100mm	1175mm x 2087.5mm
800mm x 2100mm	775mm x 2087.5mm
600mm x 2100mm	575mm x 2087.5mm

The door verticals are to be embedded to a length of 50mm in the floor and are not to be counted while framing the door sizes or for payment to the Contractor.

8.18.4 Use of symbols for Designating Doors, Windows and Ventilators

Designated symbols and units as specified in IS 1948 are as under:

a) Width : To be indicated by the number of modules of 100mm each. Only the width of opening is to be specified and not the width of joinery of door.

b) Height : Similar to width

c) Type : To be indicated by alphabets as below.

C= Centre Hung Shuttles

F = Fixed Glass Panes

H = With Horizontal Glazing Bars

N = Without Horizontal Glazing Bars

S= Side Hung Shutters

T= Top Hung Shutters

Thus, Door Designated as 12 HS 21 means Door to be fixed in opening 1200mm wide and 2100mm high with Horizontal Glazing bars and Side Hung Shutters. The size of door will be 1175 mm wide and 2087.5mm high as explained earlier. Doors and Side lights are coupled with only 12 module high window (opening 1200mm; Height of window 1175mm). In windows, since the question of provision of threshold does not arise the height of window will be 25mm, smaller than height of opening with a gap of 12.5mm on both top and bottom.

8.18.5 Glazing

Specifications described in Para 8.10.3.1 will apply. Glass panes shall weigh atleast 7.5 kg/sqm and shall be free from flaws, specks or bubbles. All panes shall have properly squared corners and straight edges. The glass panes shall be so cut that they are slightly loose in the frames.

Glazing shall be provided on the outside of the frames unless otherwise specified. Fixing of glass panes shall be done with Aluminium beading. Fabricator shall drill appropriate holes for screws. Normally the screws are spaced not more than 10 cms from each corner and intermediate screws are not more than 20 cms apart. When the glass panes are fixed with Aluminium beading having mitred joints, epoxy resin or silicon sealant shall be applied between glass panes and sash bars and also between glass panes and the beading. The size of glass panes will depend on the size of doors / windows / ventilators and the number of horizontal glazing bars. All glass panes shall be fixed within the Aluminium framing by use of CP brass or stainless steel screws and the joints sealed with epoxy resin or silicon sealant to make the unit completely water proof. Glazing or caulking compound around the perimeter of glass shall not be permitted. Fixed glass panes shall be supported by setting blocks. For normal size glass panes, glazing clips are not provided. For larger size glass panes provisions in Para 8.10.3.3 will apply. The Aluminum anodised extruded glazing beads or snap beading to be used should be procured only from the manufacturer of Aluminium extruded sections used for fabricating the doors / windows/ ventilators.

8.18.6 Panelling

8.18.6.1 Different Types of Panels

The different types of panels that can be used for aluminium doors shall be as follows:

i) Ply Wood Panels :

Plywood boards used for panelling shall be BWR type or grade as specified under Paras 7.2.2A & 7.2.2B. Each panel shall be a single piece of 9mm thickness for two or more panel construction and 12mm for single panel construction unless otherwise specified.

ii) Block Board Panels

(a) Block boards used for panelling of shutters shall be Grade I (Exterior Grade) bonded with BWP type synthetic resin adhesive as specified under Para 7.2.6.

(b) Each panel shall be a single piece of thickness 12mm unless otherwise specified.

iii) Veneered Particle Board Panels / Prelaminated Particle Board Panels

(a) Veneered particle board / Prelaminated particle board panels used for panelling of shutters shall be exterior grade bonded with BWR type synthetic resin as specified in Para 7.2.3B & 7.2.3C.

(b) Each panel shall be a single piece of thickness 12mm unless otherwise specified.

iv) Fibre Board Panels / Prelaminated Fibre Board Panels

Fibre boards / Prelaminated Fibre Board used for panelling of shutters shall be exterior grade bonded with BWP type synthetic resin adhesive as specified under Para 7.2.8A & 7.2.8B. Each panel shall be a single panel of thickness 12mm unless otherwise specified.

8.18.6.2 Thickness and Tolerance

i) Plywood Panels : Plywood boards are available in thickness ranging from 3 to 25mm. Tolerance in thickness shall be $\pm$ 10% for boards upto and including 6mm and $\pm$ 5% for boards above 6mm thickness.

ii) Block Board Panels: Block board panels are available in thickness ranging from 12 to 50mm. Tolerance in thickness shall be $\pm$ 5% for board upto and including 25mm thick and $\pm$ 2.5% for boards above, 25mm thickness.

iii) Veneered Particle Board / Prelaminated Particle Board: Veneered particle boards are available in thickness ranging from 6 to 50mm and Prelaminated 6mm to 45mm. Tolerance in thickness shall be $\pm$ 5%

iv) Fibre Board Panels/Prelaminated Fibre Board Panels: Fibre boards are available in thickness ranging from 6 to 40mm. Tolerance in thickness shall be $\pm$ 0.3mm

8.18.6.3 Testing

The following stipulations will apply.

i) Plywood : IS 304, IS 328, IS1328

ii) Block Board : IS 3087

iii) Veneered Particle Board : IS3097, IS : 12823 Prelaminated Particle Board

iv) Fibre Board / Prelaminated : IS 12406, IS 14587 Fibre Board

8.18.6.4 Fixing

The specified panels, cut to correct size with minimum 12mm portion to be inserted in the frame, shall be fixed firmly with CP brass or stainless steel screws. The joints between the panels and the members shall be sealed with epoxy resin or silicon sealant to make the unit water tight.

8.18.7 Aluminium Panels

Aluminium alloy sheet conforming to IS 737 and of thickness 1.25mm for use as kick panels and of thickness as specified for other general panels shall be procured from reputed manufacturers. Fixing shall be done as for other types of panels as indicated above.

8.18.8 Fabrication

i) Frames shall be square and flat. Both the fixed and openable frames shall be constructed of sections, which have been cut to length, mitred and mechanically jointed at the corners. Sub-dividing bars of units shall be tenoned and rivetted into frames.

ii) All frames shall have corners welded to true right angles. For jointing hollow sections flash butt welding, argon arc welding or mechanical jointing by inserts shall be used. Gas welding or brazing shall not be done. Concealed screws shall be used for joining the sub-units.

iii) Doors shall be constructed with sections as detailed in the drawing. Unless stipulated otherwise, Hinges shall be non-projecting and of heavy type. If specified or directed by the Engineer floor springs, closers, long grip handles and locks shall be provided. In normal course standard lock with lever handle shall be provided.

iv) For double door, the first closing door shall have a concealed aluminium alloy bolt at top and bottom so constructed as not to work loose or drop by its own weight.

v) Standard projecting or butt hinges as specified or as directed by the Engineer shall be provided which shall be inserted into the frames and riveted. For anodized work suitable aluminium alloy pins shall be used. The Engineer may permit the use of mechanical jointing instead of welding.

vi) Openable shutters shall be provided with continuous neoprene weather strips.

Details of construction of aluminium doors are shown in **Figure 8.10A.**

8.18.9 Tolerance

The sizes for doors shall not vary by more than ± 1.5mm.

8.18.10 Fittings

All fittings and fixtures shall be of high quality and as shown in the drawings. The samples of all fittings shall be got approved by the Engineer before fixing. The general details of fittings for doors as prescribed in IS:1948 are given below.

8.18.10.1 Hinges: Cast or extruded aluminium alloy hinges for doors shall be of same type as in the windows but of larger size. Normally the hinges shall be of 50mm projecting type as shown in **Fig. 8.10B** or non projecting type as shown in **Fig. 8.10C**.

8.18.10.2 Handles : Handles for the doors may be of the design as specified.

8.18.10.3 Locks : A suitable lock for doors which can be operated from inside or outside shall be provided. From point of view of security, the lock which can be operated from only one side is better and in case of such locks, a bolt shall be provided to make it impossible to operate from the other side.

8.18.10.4 Bolts

i) In double shutter doors, the first closing shutter shall have a concealed aluminium alloy bolt at top and bottom as shown in **Fig. 8.10D**. It shall be so constructed as not to work loose or drop by its own weight.

ii) Single and double shutter doors may be provided with a three way bolting device as shown in **Fig.8.10E.** Where this is provided in the case of double shutter door, concealed aluminium bolts may not be provided.

8.18.11 Positions of Holes and Number of Lugs per Units

Outer frames shall be provided with fixing holes centrally in the web of the section in the positions indicated in the Figure depicted in IS Code but with lugs in the threshold of the doors omitted. Instead the verticals of doors are embedded to a length of 50mm in the floor.

8.18.12 Fixing Aluminium Doors in position

8.18.12.1 Fixing in opening of brick or stone masonry

(a) Aluminium doors shall be stacked as to keep them in true shape without damage. Doors shall be fixed as described below:

b) The sizes of Indian Standard doors are designed for modular opening of larger width by 1.25cm on both sides and larger height of 1.25cm only on top face. In masonry openings the gap is filled up with mastic cement and plaster after the door is fixed in position. In case of steel or timber modular openings, extra steel or timber fillets will be necessary to fill the gaps. Unlike in case of wooden joinery where the wooden frame is erected first and the masonry alround is constructed later, in this case the size of the opening is exactly same as in case of wooden Joinery but the only difference is that size of the door is reduced to enable fixing of units easily.

(c) Arrangement for fixing door frame with steel lugs is shown in **Figure 8.10F.**

i) Slotted steel adjustable lugs (natural finish) of size 100 x 16 x 3mm shall be as shown in **Figure 8.10G.**

ii) Any steel lug coming in contact with aluminium should be either galvanised or given a coat of bitumen paint.

iii) Before the aluminium doors are fixed in position, a thick shop coat of clear transparent lacquer based on methylate or cellulose shall be applied on aluminium doors, windows etc to protect the surface from wet cement during installation. The lacquer coating shall be removed carefully after plastering etc. complete to the satisfaction of the Engineer without any extra cost.

iv) The size of the opening shall first be checked and cleared of obstruction if any. The position of the fixing holes shall be marked on the jamb. Necessary holes shall be made in the masonry and lugs of size not less than 100mm long and 15 x 3 mm size fixed in cement concrete blocks of size 150 x 100 x 100 mm in 1:3:6 mix (1 cement: 3 coarse sand: 6 graded stone aggregate 20mm nominal size). The frame of units after treating with lacquer coating shall be set in opening by using wooden wedges at jambs head. Wedges shall be preferably placed near the points where glazing bar or other members meet.

v) The wedges should be fixed firmly only when the doors / windows are kept in perfect position and plumb. Later the frames should be fixed with lugs with 20mm long and 6.3mm dia. GI counter sunk machine screws and nuts. Only after ascertaining that the doors are firmly fixed with lugs in the opening, the wedges should be removed very carefully and the gap should be filled with mastic cement and plaster, taking

particular care to see that the plaster done over jambs does not in any way abut the front surface of aluminium door.

vi) After the gaps are filled with mastic cement and plaster and the filling is finally set, still if any crack / gap is noticed / pointed out by the Engineer, the same should be immediately filled with either epoxy resin or silicon sealent.

8.18.12.2 Fixing on Concrete Surfaces:-

i) In this case instead of using lugs to fix the doors the same is fixed with wood screws to the wooden plugs fixed in the concrete surface.

ii) As in earlier case the opening is checked for size etc. The specified treatment is given to the surfaces of aluminium doors and the correct positions for fixing wooden plugs marked on the jamb with respect to the holes provided in the door for fixing screws.

iii) On duly marked points on the jambs, required size of hole shall be made in the concrete and the wooden plug of teak wood of specified size shall be fixed in the hole with rich cement mortar. Units shall be erected after plugs are duly set.

iv) The door should be fixed to the wooden plugs, with the help of galvanised wood screws of size 45 designation.

v) Later the 12.5mm wide gap between the concrete surface and the aluminium unit shall be filled neatly with mastic cement and mortar. Alternatively if approved by the Engineer instead of fixing the units on wooden plugs, the same can be conveniently and firmly fixed with rawl plugs using little longer size screws of designation 10.

8.18.12.3 Fixing in Wood Work openings

Openings in wood-work are normally rebated. Approved mastic or rubber lining shall be applied to jambs, sill and channel before fixing in position. The door shall be set in frame using wooden wedges. The unit shall be fixed using wooden screws designation 10 of suitable length. Extra timber fillets of specified type and size of wood to match the adjoining work shall also be provided around the frame to close the 1.25cm gap between the opening and the aluminium unit.

8.18.12.4 Fixing in Steel-Work Opening

i) Steel surfaces where the aluminium units are to be fixed are cleaned and the exact position of fixing the units is marked on the surfaces with reference to the holes already provided in the units.

ii) Suitable holes are drilled in the steel surfaces so that the clips / bolts used for fixing units can be inserted.

iii) The aluminium unit is then erected in position and fixed temporarily with wooden wedges. The frames are then fixed to the steel surface using clips as shown in **Fig.8.10H** or with suitable nuts and bolts as directed by the Engineer.

iv) Before the clips or the bolts are fully tightened a suitable size mild steel or hard wood fillet is introduced in the 1.25cm wide gap after treating the surface of fillet and jambs with approved mastic.

v) The clips / bolts are then tightened and simultaneously the wooden wedges provided are removed. The gaps if any between the units and steel surfaces shall be filled by suitable / specified mastic or treated as directed by the Engineer.

8.18.13 Measurements

8.18.13.1 Frame work

i) Only after ascertaining that the aluminium doors fixed on site are manufactured by reducing the width by 2.5cm and height by 1.25cm compared to the specified size of openings in the drawings issued for construction, the length of each extruded section used for fabrication of the door shall be measured correct to 1mm. In case the sizes of doors that are manufactured, happen to be the same as sizes specified in the drawings, the theoretical dimensions arrived by reducing the overall sizes may be considered.

ii) The weight of material used shall be calculated on the basis of actual weight of extruded sections used for fabrication and shall be compared with the weights given in the manufacturer's catalogue, subject to the condition that the variation in actual weight should not exceed $\pm$10% compared to the weights specified in manufacturer's catalogue. Payment shall be made for the actual weight of the extruded section. The final weights shall be calculated in kg upto two places of decimal.

8.18.13.2 Glazing: Length and width of opening for glazing inserts shall be measured correct to a cm and area for payment shall be calculated in sqm nearest to 0.01 sqm.

8.18.13.3 Panelling with Different Types of Materials: Same as in Para 8.18.13.2 above.

8.18.13.4 Panelling with Aluminium Sheet: The length and breadth of the panel inserts shall be measured correct to a cm and the area calculated to the nearest 0.01 sqm.

The weights of panel used shall be calculated as under:-

i) As per manufacturer's catalogue

ii) The actual weight of sample of sheet used should be found out and weight of panel actually used. (Actually calculated weight shall be recorded subject to condition that variation in actual weight shall not exceed ± 10% compared to the weight specified in the manufacturers catalogue)

Least of above shall be considered for payment.

The actual weight shall be calculated in kgs to two places of decimal.

8.18.13.5 Fittings : All fittings for doors except hinges and handles shall be enumerated.

8.18.14 Rate

i) The rate shall include the cost of material and labour for all operations described above except the cost of glazing and panelling. It shall include screws, expansion hold fasteners, snap beading including filling with necessary PVC / neoprone felt, cleats etc. The rate does not include the cost of fittings except the hinges and handles.

ii) The rate will include the cost for providing aluminium alloy doors for the openings of all shapes and sizes.

iii) The cost of glazing, panelling and additional fittings shall be paid under separate item, as described herein.

8.198.19 ALUMINIUM WINDOWS – OPENABLE TYPE

8.19.1 Aluminium Alloy Extruded Sections Dimensions and weight per metre run of extruded sections to be used for manufacturing aluminium openable windows as recommended in IS: 1948 are shown in **Fig. 8.11A**. Reputed Manufacturers produce various other types of Extruded Sections for use in Windows.

8.19.2 Components of Windows and Terminology

IS 1948 has specified the Terminology for different components of Windows and the same have been shown in **Figure 8.4.**

8.19.3 General Specifications on tolerance for extruded sections. Refer Para 8.17.4.

8.19.4 Sizes of Fabricated Windows

As per IS 1948 the sizes of windows specified in the drawings should be reduced in size by 1.25cm for all four sides of openings while manufacturing the windows so that fixing the windows in the openings will be easy. Thus if the opening is of width 1000mm and height 900mm, the outer dimensions of the fabricated windows shall be of width 975mm and height 875 mm.

8.19.5 Use of symbols for Designating Windows - Please refer to earlier Para 8.18.4.

8.19.6 Glazing - Please refer to earlier Para 8.18.5.

8.19.7.1 Fabrication - Specifications under earlier Para 8.18.8 (i) to (vi) will apply in the case of windows also. Details of Construction of Aluminium alloy windows in accordance with IS 1948 are shown in **Figures 8.11B to 8.11E.**

8.19.8 Tolerance: Same as prescribed under Para 8.18.9.

8.19.9 Fittings

8.19.9.1 Side Hung Shutters

i) For fixing aluminium alloy hinges, slots shall be cut in the fixed frame and the hinges inserted inside and may be rivetted to the frame. The hinges shall normally be 67mm wide projecting type as shown in **Fig. 8.11F.**

ii) The hinges should be of specified quality preferably with ISI mark manufactured by reputed manufacturers.

iii) The pins for hinges shall be stainless steel of non-magnetic type or of aluminium alloy HR 30. Irrespective of hinges being anodised or not, the aluminium alloy pins shall be anodised to a minimum film thickness of 0.025mm and shall be sealed with oil, wax or lanolin.

iv) Non projecting type hinges as shown in **Fig. 8.11.G** may also be used if specified or permitted by the Engineer.

v) Friction hinges: Working principle of this is shown in **Fig. 8.11.H.** This may be provided for side hung shutter aluminium windows, in which case the windows need not be provided with peg stays which are normally used.

8.19.9.2 Handles – For Side Hung Shutters

i) The handles shall be of cast aluminium of specified quality, manufactured by reputed manufacturers.

ii) The handles shall be mounted on a handle plate welded or rivetted to the opening frame in such a way that it could be fixed before the shutter is glazed.

iii) The handle should have anodised finish with minimum anodic film thickness of

0.015mm. The handle shall have a two point nose which shall engage with an aluminium striking plate on the fixed frame in a slightly open position as well as in a fast position shown in **Fig. 8.11I.**

iv) The height of the handles in each type of side hung shutters shall be fixed in approximate position as shown in **Fig. 8.11J.**

8.19.9.3 Peg Stay

i) The peg stay shall be either of cast aluminium or folded from aluminium alloy sheet. It shall be 300 mm long complete with peg and levelling bracket as shown in **Fig. 8.11K.**

ii) The stay shall have holes for keeping the shutter open for three different positions. The peg and locking bracket shall be rivetted or welded to the fixed frame.

iii) The peg stays shall be provided only when no friction hinges are provided for the shutters.

8.19.10 Weather Bar: When a coupling member is fitted over an external opening shutter the coupling member should incorporate an integrally extruded weather bar as indicated in **Figure 8.11A.**

8.19.11 Position of Holes and Number of Lugs per unit: The position of holes and number of lugs to be provided for windows of different sizes shall be in accordance with IS: 1948.

8.19.12 Fixing Aluminium Windows in Position: Same as explained for doors under Para 8.18.12.

8.19.13 Measurements : As far as applicable same, as prescribed under Para 8.18.13.

8.19.14 Rate

i) Same as prescribed under Para 8.18.14.

ii) Rate shall also include for windows in openings of all shapes including circular, segmental or other shapes and sizes.

8.208.20 ALUMINIUM WINDOWS – SLIDING TYPE

8.20.1 Aluminium Alloy Extruded Sections

IS 1948 has not laid down any guidelines for manufacture of Extruded Sections. Reputed manufacturers produce various types of Extruded Sections for use in Sliding Windows.

8.20.2 General Specification and Tolerances for Aluminium Extrusions Sections: Same as in Para 8.17.4.

8.20.3 Sizes of Windows for Fabrication: Same as under Para 8.19.4.

8.20.4 Glazing: Same as under Para 8.18.5.

8.20.5 Fabrication

i) Same as under Para 8.18.8 (i)

ii) Same as under Para 8.18.8 (ii)

iii) The different types of sliding windows that are in use are:

1) 2/3 Track Sliding window
2) 3/4Track Sliding window
3) 20mm Sliding window
4) 100mm Sliding window
5) 123.45mm Sliding window

iv) Use of these windows has increased in the recent past as they do not occupy either interior or exterior space while opening. Windows are easy to operate.

v) The sliding window of types described under para (iii) above can be manufactured in complete shape using aluminium alloy extruded sections available in the market.

vi) These windows do not require any fittings except the self closing latch normally fixed to the shutter while manufacturing and the knob fixed on the sliding glass panes.

vii) The broad details of the construction of a 3 track sliding window normally used are shown under **Fig.8.12.** However, it should be noted that the length and height of the sliding window shall be reduced by 1.25cm on all four sides from the prescribed length and height of the opening for sliding window shown in the drawing / item of work while manufacturing the window.

8.20.6 Tolerance: Same as under Para 8.18.9.

8.20.7 Position of Holes and number of Lugs per Unit :

In absence of any guidelines issued by IS Code for sliding windows, details prescribed for openable windows can be followed with suitable modifications, wherever necessary.

8.20.8 Fixing Sliding Windows: Same as explained under Para 8.18.12.

8.20.9 Measurements: Same as prescribed under Para 8.18.13. Glazing shall be same as prescribed under Para 8.18.13.2. However the cost of knob fixed in the glass of sliding window glass need not be paid separately.

8.20.10 Rate: Same as prescribed under Para 8.18.14. Also the rate shall include the cost of automatic closing latch provided in the sliding window while manufacturing.

8.21 ALUMINIUM VENTILATORS

8.21.1 Aluminium Alloy Extruded Sections

IS 1948 has laid down the dimensions and weight per metre of Extruded Sections for Ventilators. Details have been given in **Figure 8.13A**. No extruded sections of other sizes and shapes are being made by Reputed Manufacturers. However such Extrusions as are being manufactured for openable window can be used for making ventilators.

8.21.2 Components of Ventilators and Terminology – IS 1948 has laid this down as shown in **Figure 8.4**.

8.21.3 General Specifications and tolerances for Aluminium Extruded Sections : Same as in Para 8.17.4.

8.21.4 Sizes of Ventilators for Fabrication : Same as under Para 8.19.4.

8.21.5 Symbols for Designating Windows : Same as under Para 8.18.4.

8.21.6 Glazing : Same as under Para 8.18.5.

8.21.7 Fabrication :

i) As prescribed under Para 8.18.8(i) to (vi)

ii) Details of construction of aluminium alloy ventilators as prescribed in IS : 1948 is shown in **Fig.8.13B**

8.21.8 Tolerance : Same as under Para 8.18.9.

8.21.9 Fittings

8.21.9.1 Hinges – Top Hung Ventilators

i) Top hung ventilators shall be provided with aluminium hinges of recognised brand or as specified. The hinges shall be either cast or fabricated out of extruded sections and shall be riveted to the fixed rail after cutting a slot in it.

ii) The ventilators shall also be provided with a 300mm long peg stay

iii) The peg stay shall have three holes in different positions for opening the ventilator and when closed shall hold the shutter tightly by the locking bracket, which would be fixed to the frame.

8.21.9.2 Cup Pivots – Centre Hung Ventilators

i) The centre hung ventilators shall be hung on two pairs of cup pivots as shown in **Fig. 8.13C** or on brass or bronze cup pivots which should be either chromium or cadmium plated and riveted to the inner and outer frames of the ventilator to permit the ventilator to swing through an angle approximately 85^{o}

ii) The opening portion of the ventilator shall be so balanced that it remains open at any desired angle under normal weather conditions.

8.21.9.3 Spring Catch – Centre Hung Ventilator

i) The spring catch shall be of specified make and type conforming to relevant IS Specifications and shall be made of either chromium plated or cadmium plated.

ii) The spring catch shall be fitted in the centre of the top bar of the ventilator, for its operation. This spring catch shall be secured (preferably screwed or rivetted) to the frame and shall close into the aluminium catch plate rivetted or welded to the outside of the outer ventilator frame bar.

8.21.9.4 Cord Eye and pulley arrangement – Centre Hung Ventilator

i) Cord pulley wheel shall be of aluminium or cadmium plated brass in an aluminium bracket.

ii) This shall be fitted to the sill of the ventilator, with aluminium or galvanised or cadmium plated steel screws or alternatively, welded together with an aluminium cord eye rivetted or welded to the bottom inner frame bar of the ventilator in a position corresponding to that of pulley.

8.21.10 Position of Holes and Number of Lugs per Unit : The position of holes and the number of lugs should be provided for the ventilators of different sizes in conformation to relevant IS Code.

8.21.11 Fixing Aluminium Ventilators in position : Same as prescribed for doors under Para 8.8.12.

8.21.12 Measurements : Same as explained under Para 8.18.3. Glazing shall be same as explained under Para 8.18.13.2

8.21.13 Rate : Same as prescribed under Para 8.18.14.

8.228.22 ALUMINIUM COMPOSITE UNITS

8.22.1 Aluminium Alloy Extruded Sections

IS 1948 has laid down the dimensions and weight per metre of Extruded Sections for doors, openable windows and ventilators. In addition, reputed manufacturers fabricate other sizes and shapes of extensions which can be used. The extruded section specially

indicated for composite units and IS 1948 are shown in **Figure 8.14A**.

8.22.2 Components and Terminology : IS 1948 has laid down the same as shown in **Figure 8.4.**

8.22.3 General Specification and Tolerances for Aluminium Extrusions sections: Same as under Para 8.17.4.

8.22.4 Sizes of Doors, Windows and Ventilators of Composite Unit for Fabrication

i) Fixing sizes of composite unit for fabrication is a most complex issue as not only the three items like door, window and ventilator are involved but also the width of extruded sections like mullion and transome have also to be accounted for, while deciding the actual fabrication width and height of members and ultimately the composite unit after accounting for the necessary deduction of 1.25 cms from specified size of composite unit before proceeding with the fabrication of the different components of the composite unit.

ii) Consider a 12 module (1200mm) wide and 21 module (2100mm) high door is coupled on its top with a 12 module (1200mm) wide and 6 module (600mm) high ventilator.

iii) This unit i.e. the door coupled with ventilator on top is again coupled by its side with a window 15 module (1500mm) wide and 12 module (1200mm) high which is also coupled on top with a ventilator of 15 module (1500mm) width and 6 module (600mm) height and the shape will be as shown in **Figure 8.14B.**

8.22.5 Symbols for Designating Composite Units: Same as under Para 8.18.4.

IS 1948 has recommended the method of designating the composite unit consisting of door, window and ventilator as described below:

(1) A 12 module wide and 21 module high horizontally glazed side hung door coupled on its two sides with two side hung horizontally glazed windows 6 module wide and 12 module high is designated by the symbol 6HS 12/12HS21/6HS12.

(2) Two 10 module wide and 12 module high horizontally glazed side hung windows coupled side by side with two fixed glass pane ventilators at top each 10 module wide and 6 module high is designated by the symbol.

10 HF6/10HF6

10HS12/10HS12

8.22.6 Glazing : Same as under Para 8.18.5.

8.22.7 Panelling : Same as under Para 8.18.6.

8.22.8 Aluminium Panel : Same as under Para 8.18.7.

8.22.9 Fabrication:

i) Same as prescribed under Para 8.18.8 for doors, Para 8.19.7 for windows and Para 8.21.7 for ventilators. In addition the following requirements for composite units shall be noted.

ii) The doors shall be coupled with windows or side lights with extruded aluminium million coupling bars and transome as shown in the drawings or as directed by the Engineer.

iii) The coupling member should conform to the dimensions shown in **Figure 8.14C or 8.14D.**

iv) Where a coupling member/ transome is fitted over an external opening shutter, the coupling should incorporate an integrally extruded weather bar as shown in **Figure 8.11A.**

8.22.10 Tolerance : Same as under Para 8.18.9.

8.22.11 Fittings : Same as prescribed for doors, windows and ventilators.

8.22.12 Position of Holes and Number of Lugs per unit

i) The position and number of lugs to be provided for a composite unit have been shown in IS 1948 and the same can be followed with certain modifications wherever needed.

ii) In case the lugs are not to be used and only holes are to be drilled the same shall be drilled in the position of lugs as shown in the Drawing in IS 1948.

8.22.13 Fixing Aluminium Composite Unit in Position: Same as prescribed under Para 8.18.12

8.22.14 Measurements : Same as under Para 8.18.13

8.22.15 Rate

i) Same as in Para 8.18.14 and in (ii) of Para 8.19.14.

ii) The rate does not include the cost of mullion bar or transome / weather bar and

the same shall be paid separately under a separate item in running metres.

8.238.23 FLOOR SPRING (HYDRAULICALLY REGULATED)

8.23.1 Type and Size – Typical details are given in **Figure 8.15. It shall be as per IS 6315.**

8.23.28.23.2 Construction and Operational Details

i) The floor springs shall be suitable for fixing to the doors weighing upto 125 kg without use of additional door units.

ii) The floor spring shall operate smoothly and easily without undue delay during the opening and closing operations.

iii) The oil check shall work satisfactorily at all temperatures between 49^{o} and (-) 10^{o} without requiring any other change except by adjustment of the capstan nut.

iv) The speed of the closing door shall be adjustable by means of a suitable controlling device. Tension of the spring shall be increased or decreased by turning the capstan nuts clock-wise or anti-clockwise. For exceptionally low temperature the adjustment in the speed could be made by change in the grade of oil.

v) The shoe shall be fitted to the governing pivot of the floor spring by a square profile so that it stands horizontally parallel with the top cover plate of the floor spring. Provisions shall be made in the shoe for adjusting the door leaf to the final closing position by turning a screw.

vi) When the door is opened at right angle, the door shall stand open till it is pushed to close.

8.23.3 Performance of Floor Spring

i) The closing time of the floor spring shall be easily adjustable between 3 and 20 seconds for which a suitable device to adjust the speed shall be provided.

ii) After being fitted in position the door leaf shall be opened through 90^{o} plus 5^{o} and released. When opened to an angle less than a right angle the door shall swing back automatically.

8.23.3 Workmanship -The floor spring shall be free from all mechanical defects, sharp edges and other surface defects.

8.23.4 Quality Assurance - The floor spring should be with ISI mark for quality assurance.

8.23.6 Fixing

Suitable recess of the required size shall be cut in floor and the floor spring with all its components viz. cover plate, outer box with slide plate etc. shall be embedded in floor.

8.23.6 Measurements - =The floor spring shall be measured in numbers.

8.23.8 Rate

The Rate shall include the cost of labour and material involved in all the operations described above and making good the floor.

8.24 ANODIZED ALUMINIUM ALLOY GRID FOR FALSE CEILING

8.24.1 Material and Anodizing - Same as under Para 8.17.1 and 8.17.2

8.24.2 Aluminium Alloy equal / unequal angles and tees prescribed as per IS Standards.

IS 3908 and IS 3909 may be referred to for details. Reputed manufacturers manufacture other sizes of angles as required.

8.24.3 Fabrication and Fixing in Position

i) The interlocking aluminium alloy grid shall consist of aluminium main “Tee” runners of size 25 x 40 mm and 2.10mm thick or as specified / directed, spaced 1200mm c/c and cross “Tee” of size 24 x 24 mm and 2.10 mm thick or as specified/directed, 1200mm long spaced between the main “Tee” at 600 mm c/c to form a grid of 1200 x 600 mm. Again a secondary cross “Tee” of length 600 mm and size 24 x 24 mm and 2.10 mm thickness or as specified / directed to be interlocked of the centre of 1200 x 600 mm panel to form a grid of 600 x 600 mm.

ii) Main “Tee” runners are to be suspended from ceiling with M.S. level adjusting hangers.

iii) The perimeter support on wall shall consist of aluminium angle of size 25 x 25 mm and 1.60 mm thickness or as specified/directed fixed firmly to the walls with the help of rawl plugs spaced at 230 mm c/c and tightened with 25 mm long cadmium plated screws or as directed.

8.24.4 Measurements

The aluminium Tee or Angle iron sections when fixed in position shall be measured correct to 1mm.

The weight per metre length of used ‘T’ angle sections shall be ascertained by weighing the sample length and the weight thus worked out shall be compared with the weight per metre prescribed by the

manufacturer. However payment shall be made for only the actual weight worked out after ascertaining the weight of sample piece, subject to the condition that the weight per metre ascertained is within the tolerance limit of ± 10% of the weight of section prescribed in the manufacturer's catalogue.

8.24.5 Rate

The rate includes the cost of materials and labour involved in all operations described above except the M.S. Level adjusting hangers and its fixing arrangement which shall be measured and paid separately as described under Para 8.25.

8.25 PROVIDING AND FIXING LEVEL ADJUSTING HANGERS 6 MM DIA M.S. ROD (UPTO 1200 MM LENGTH)

8.25.1 Materials: Mild steel bars shall conform to the relevant IS specifications. These shall be fabricated from MS bar of 6 mm diameter.

8.25.2 Fixing

Necessary holes for expansion hold fasteners as per the architectural drawing shall be made in slab with drilling machine. MS angle 40 x 40 x 5 mm and 40 mm long shall be fixed with hold fasteners 12.5 mm dia and 40 mm long. MS angle and steel rod should be given a priming coal of zinc chromate yellow primer or any other primer as stipulated, complete as per direction of the Engineer.

8.25.3 Measurements - The level adjusting hanger rods shall be measured in Kg.

8.25.4 Rate

The rate shall include the cost of labour and material involved in all the operation described above.

8.26 PROVIDING AND FIXING MACHINE MOULDED ANODISED ALUMINIUM COVERING OVER EXPANSION JOINTS

8.26.1 General : Specifications and material shall conform to requirements as laid in paras 8.17.1 & 8.17.2. The aluminium sheet shall be of approved make and conforming to specification laid in IS: 737. Aluminium sheet of required width and thickness shall be made out of wider sheet duly machine cut. Machine moulded covering may be:

(i) 170 mm wide anodised aluminium sheet 2.5 mm thick.

(ii) 210 mm wide anodised aluminium sheet 2.5 mm thick.

(iii) or of any other width/thickness specified in the description of item.

8.26.2 Fixing

Aluminium sheet shall be machine-holed at required spacing. Staggered holes in the receiving surface will be done with drilling machine and expandable plastic sleeve be provided in the holes. Aluminium sheet shall be fixed with cadmium plated 4 mm dia 30 mm long full threaded screws with 2 mm thick anodised aluminium washer complete as per the direction of as Engineer. Anodising on the aluminium sheet and washer to be 15 micron thick.

8.26.3 Measurements

The length of aluminium sheet covering shall be measured in running metre correct to 1 cm. Payment shall be made for least of weight calculated on the basis of unit weight:

(i) Unit weight specified in manufacturer catalogue.

(ii) Actual weight per sqm.

8.26.4 Rate

Rate includes the cost of material land labour involved in all the operations described above. It shall include screws, plastic sleeves etc. complete.

8.27 ALUMINIUM CURTAIN WALL SYSTEM /CLADDING

8.27.1 General

(1) The type of work is not an ordinary job which can be executed by the Contractors doing the general building works but this is a specialised job.

(2) These structures are designed for the following effects:

(a) Permanent Deformation, thermal expansion

(b) Wind and seismic load

(c) Air and water infiltration or leakage

(d) Lateral deflection per floor height

(3) Normally for executing such works, the design of the system is prepared by the specialized firm and then the same is submitted to the department/architect for approval and only after detailed scrutiny and checking design calculations and drawings, the design is accepted and the firm is asked to take up the job.

8.27.2 Specification for Materials used for Curtain Wall

(1) **Glazing** : As specified in the description of the item or as described under Para 8.18.5.

(2) **Framing system** : Aluminium anodized extruded sections manufactured by reputed manufacturers for all types of members like brackets, mullions, transome etc.

(3) **Sealant** : As specified in the item or silicon sealant.

(4) **Insulation :** 50 mm thick glass wool of minimum density48 kg/cum sandwiched with black polythene sheet 100 micron on one side and aluminium foil of 100 micron on the other side or as specified by manufacturer at spandrel area. The surface after fixing insulation shall be plain without any distortion.

(5) **Heat Reflective** : As specified. Brown or Grey Colour of any **Toughened Glass** shade approved by the Engineer.

8.27.3 Aluminium Alloy Extruded Sections – Manufactured and supplied by reputed companies.

In absence of specific extruded sections available conforming to BIS Specifications, extruded sections manufactured by reputed companies are used on works.

8.27.4 Main Components

Main Components of the Curtain Wall System are shown in **Figure 8.16 A**

8.27.5 General Specification and Tolerances for Aluminium Extrusions Produced by manufacturers - Same as under Para 8.17.4

8.27.6 Glazing - Same as under Para 8.18.5

8.27.7 Panelling - Same as under Paras 8.18.6 and 8.18.7

8.27.8 Scope of Work

8.27.8.1 Preliminary Requirements

(i) The Contractor shall design, test, fabricate, deliver, install and guarantee all construction necessary to provide a complete curtain wall system for the proposed building, all in conformity with the drawings as shown.

(ii) Specification and all relevant construction regulations including providing any measures that may be required to that end, not withstanding any omissions or inadequacies of the drawings.

(iii) The curtain wall system shall also include the following activities/ elements.

(a) Metal frames, glass glazing, spandrels, ventilators, finish hardware, copings, metal closure, windows etc.

(b) All anchors attachments, reinforcement and steel reinforcing for the systems required for the complete installations.

(c) All thermal insulation associated with the system.

(d) All fire protection associated with the system.

(e) All copings and closure and metal cladding to complete the system.

(f) All sealing and flushing including sealing at junctions with other trades to achieve complete water tightness in the system.

(g) Isolation of dissimilar metals and moving parts.

(h) Anticorrosive treatment on all metals used in the system

(i) Polyester powder coating of aluminium sections.

(iv) The Contractor shall also be responsible for providing the following:

(a) Engineering proposal, shop drawings, engineering data and structural calculations in connection with the design of the curtain wall system.

(b) Mock-ups, samples and test units.

(c) Performance testing of the curtain wall framing and glazing assembly.

(d) Co-ordination with the work of other trades.

(e) Insulation with glass wool 48 kg/cum at spandrels area.

(f) Protection.

(g) All final exterior and interior cleaning and finishing of the curtain wall system.

(h) As built record drawings and photographs.

(i) Guarantees and warranties.

(j) All hoisting, scaffolding, staging and temporary services.

(k) Conceptualising and design of a suitable maintenance system for curtain glazing.

(v) The water tightness and structural stability of the whole curtain wall system are prime responsibility of the contractor. Any defect or leakage found within the guarantee period shall be sealed and made good all at the risk and cost of the contractor.

(vi) The curtain wall system shall be designed to provide for expansion and

contraction of components which will be caused by an ambient temperature range without causing buckling, stress on glass, failure of joint sealants, undue stress on structural elements or other detrimental effects, specific details should be designed to accommodate thermal and building movements.

8.27.8.2 Design Requirements

(i) Curtain wall shall comply with all government codes and regulations, building bye-laws, if any.

(ii) All curtain walling, individual aluminium and glass components and all completed work shall be designed and erected to comply with the requirements given in (iii) below:

(iii) **(a) Basic Requirement :** The basic design and architectural requirements shall consist of the size of window, net glass area, ventilator, configuration of widows and spandrels to be retained. However the contractor may propose alternatives on the construction details provided that all basic functional and architectural requirements are fulfilled.

(b) Quality Consideration and other Activities

The contractor while submitting the detailed design calculations should submit the following information on the quality of materials to be used and other aspects as detailed below:-

(1) Metal quality, finishes and thickness

(2) Glass quality, coating and thickness and manufacturer's brand names.

(3) Aluminium extruded sections including mullions and transomes together with structural calculations and manufacturer's brand name and also the name of agency proposed for fabrication work.

(4) Arrangement and jointing of components.

(5) Field connections especially mullion to mullion and transome to mullion.

(6) Fixing and anchorage system of typical wall unit together with structural calculations.

(7) Drainage system and provision in respect of water leakage in the curtain wall system.

(8) Provisions for thermal movements

(9) Sealant and sealing methods.

(10) Glazing Method.

(11) Wind load and seismic load and any other specific load considered in the design.

Design concept over lightning protection link-up system of the curtain wall for connection and incorporation into the lightning conductor system of the building (Lightning conductor system of the building to be done by any other agency).

The maximum permissible structural tolerances of the building that the system has been designed to accommodate in case these tolerances exceed those specified in the specification.

(c) Tolerances : Any parts of the curtain wall, when completed, shall be within the following tolerances :

(1) Deviation from plumb, level or dimensioned angle must not exceed 3 mm per 3.5 m length of any member, or 6 mm in any total run in any line.

(2) Deviation from theoretical position on plan or elevation, including deviation from plumb, level or dimensioned angle must not exceed 9 mm total at any location.

(3) Change in deviation must not exceed 3 mm for any 3.5 m run in any direction.

(d) Samples : The contractor shall also submit samples ofaluminium extruded sections, mullion and transome sections in lengths of 300 mm with the same finish and workmanship as per the tender proposals and 300 mm x 300 mm samples of glass (samples to include exposed screws and other exposed securing devices if any).

(e) Ancillary Requirements to be fulfilled by the Contractor

The contractor/sub-contractor shall submit a maintenance manual for the curtain wall system covering of all metal parts, glass and finish etc.

During detailed design scrutiny and also during the actual execution of the work, any additions and extra provisions that will have to be made as per theoretical requirements or site conditions shall be implemented and executed by the contractor at his own cost, without claiming any thing extra under any circumstances.

8.27.9 Execution of Work

8.27.9.1 Performance Testing

To be done at the cost of the Contractor with copies of Test Reports to besubmitted to the Engineer.

(i) Mock-up units shall be constructed by the Contractor and tested to determine the structural stability as well as air and water infiltration or leakage at glazing beads and all other joints designed into the face of the building.

(ii) Tests of wind pressure, lateral deflection per floor height and water tightness shall be conducted on the mock-up limit in a recognized Testing Laboratory to prove the satisfactory functioning of the curtain wall system. Record of Tests and of Drawings of the System should be made available to the Railway by the Testing Laboratory.

8.27.9.2 Fabrication and Erection

The Grid for the Curtain Walls System shall be fabricated as per approved drawing. Care should be taken to see that any gap between its frame and support and the frame itself is sealed with Silicon Sealants. Finish of grid frame shall be eitherandoised, organic coating, baked enamel finish or as specified in the item of work. Care should be taken to see during erections that the curtain walls system is not deformed or damaged.

A typical curtain wall system with the position of main members like mullions, transome glazing etc is shown to **Figure 8.16 B.**

8.27.10 Performance Guarantee

Normally, performance guaranty for a period of 5 years should be insisted upon to cover the cost of rectification of defects noticed during the guarantee period.

8.27.11 Measurements

(i) The breadth and height of the finished work including the openable window shall be measured in metres and net quantity for payment calculated in Sqm up to two places of decimal.

(ii) The area to be considered for the payment shall be the net area of the exterior face of the curtain wall as fixed including the operable windows if any as part of the curtain wall system.

8.27.12 Rate

The rate shall includes the cost of all operations described above including the cost of materials labour, design, shop drawings, erection and testing of mock-up test unit, fabrication, erection, finishing scaffolding and undertaking of performance guarantee.

8.27.13 Cladding Material (Aluminium Composite Panel)

Product Composition of shall be as below :

8.27.13.1 Aluminium Composite Panel shall be of total thickness of 4mm (Tolerance of +/- 0.2mm); comprising of aluminium skin of 0.5mm with Kynar 500 PVdF (Poly Vinyl Di Flouride) paint + 3.0mm LDPE based core material + 0.5mm aluminium skin with service coat; bonded together by calendaring process.

ACP of total thickness 3mm (Tolerance of +/- 0.2mm) will comprise of aluminium skin of 0.3mm with Kynar 500 PVdF (Poly Vinyl Di Flouride) paint + 2.4mm LDPE based core material + 0.3mm aluminium skin with service coat; bonded together by calendaring process.

8.27.13.2 Aluminium Skins – outer & inner, should conform to 3003 grade, having a Temper of H-16, sourced from standard aluminium producers, adopting Direct Casting Method, resulting in better bonding of aluminium molecules.

(i) Tensile Strength of Skin – 165 N/mm^2 (minimum)

(ii) Thickness of Skin : 0.5mm (+/- 0.03mm)

8.27.13.3 LDPE Core – Non-toxic low density Polyethylene core 3mm thick, having a Density Range of 920 kg/m^3 to 960 kg/m^3; Raw material sourced from IPCL 040 Grade.

8.27.13.4 Thickness of **self adhesive Peel-off/Protective Foil** – 80 microns, tested to withstand at least 45 days exposure to local weather conditions without loosing original peel off characteristics or causing stain/damages on coated surface of Aluminium Composite Panel.





8.27.13.5 Coating Properties – (As per AAMA 2605/620)

Coil Coating Method – 3 Steel Roller Based; simultaneous Two Coat – Two Bake / Three Coat - Three Bake; depending on color/shade or RAL/Pantone no.

Coating Thickness -

(a) For Exterior Applications (PVdF) :

(i) Front Coil : 25µ - 30µ in PVdF Including Primer (PVdF Paint : 18–20 microns + Primer : 6-8 microns)

(ii) Back Coil : 4µ - 7µ Polyester Coating

(b) For Interior Applications (Modified Polyester/Polyester) :

(i) Front Coil : 15µ - 18µ in Polyester Coating

(ii) Back Coil : 4µ - 7µ Polyester Coating

8.27.13.6 Tensile Strength of Aluminium Skin –

(a) AA 3003 series - 165 N/mm^2 (minimum)

(b) AA 3105 series - 185 N/mm^2 (minimum)

8.27.13.7 Density of LDPE-CORE : 920Kg/m^3 - 980 Kg/m^3 (Non–Toxic Grade Polyethylene)

8.27.13.8 Adhesive Film - Made from Ethylene Co Polymer

8.27.13.9 Color Choice - Color choice shall be as per selection of the Railways

8.27.13.10 Product Quality & Warranty

(i) PVdF coated panels to carry a 10 years warranty on weather durability, UV color fading, corrosion, chalking, etc. Panels shall be manufactured and tested extensively as per AAMA Standards.

(ii) Aluminium Coil is sourced from standard manufacturer as per IS – 737:1986.

(iii) AA 3003 is IS:31000 and AA 3105 is IS:51300

8.28 STRUCTURAL GLAZING

8.28.1 Specification for materials to be used - Para 8.27.2 will apply

8.28.2 Aluminium Alloy Extruded Sections

BIS Codes have not laid down the standards. Reputed companies manufacture extruded sections of different types and unit weights.

8.28.3 General Specification and Tolerances for Aluminium Extrusions - Same as under Para 8.17.4

8.28.4 Glazing - Same as under Para 8.18.5

8.28.5 Scope of Work - Same as under Para 8.27.8

8.28.6 Execution of Work

(i) Same as under Para 8.27.9

(ii) Though both the systems i.e. curtain wall system and structural glazing are very much similar, still the type and shape of aluminium extruded sections that are used in this case are totally different.

(iii) Another noted difference between the two systems is that in elevation the structural glazing looks as total glass surface without any beading visible externally, whereas in case of curtain wall system the cover plate used on the surface is clearly visible in elevation.

(iv) A large quantity of sealant has to be used for the execution of the work of structural glazing with the result the cost per sqm. of structural glazing works out to be much on higher side.

(v) There is also a slight difference in the actual fabrication of the two systems though quantity of materials required for execution in both the cases is same except the quantity of sealant.

(vi) A typical structural glazing system with the position of main members like mullion, transome, glazing etc., are shown in **Fig. 8.17**.

8.28.7 Performance Guarantee - Same as under Para 8.27.10

8.28.8 Measurements - Same as under Para 8.27.11

8.28.9 Rate - Same as under Para 8.27.12

8.29 ALUMINIUM STAIRCASE RAILINGS AND BALUSTER

8.29.1 Materials

Aluminium extruded railing section and baluster section shall comply with the chemical composition and mechanical proposals as laid down in Para 8.17.1

8.29.2 Hand Rails

There are supported on Balusters. Type of Hand Rail shall be as specified in the item. A few typical Hand Rail sections are given **Fig. 8.18.A.**

8.29.3 Baluster

Balusters are out of specified Aluminium section. Usually it is circular/ square

aluminium rod or of designer pattern as shown in **Fig. 8.18.B**.

8.29.4 Fabrication and Fixing

8.29.4.1 Baluster for specified railing height are cut from the stipulated aluminium section. These are properly embedded in slab/step while its casting. Before concreting work is started it shall be checked that balusters is truly in position and are vertical and top of all the balusters are in proper line. Aluminium channels, square fillet or round fillet as specified in the item shall be run connecting top of all the balusters, either by soldering, argon arc welding, wooden screwing as may be applicable **Fig. 8.18.C**.

8.29.4.2 Specified extruded railing section is cut for the required length. The railing section is fixed on the top of square/round fillet as specified in the item by soldering, brazing etc. Precaution shall be taken to avoid distortion of member. Gap of any sort shall be filled with silicon sealant.

8.29.5 Measurements

Length of each member (I) Baluster (ii) Hand rail, (iii) Channel square fillet/circular fillets shall be measured correct to a cm and payment shall be worked out in running metres correct to two places of decimals.

8.29.6 Rate

Rate includes the cost of material and labour involved in all the operations described above. It shall include cleats, silicon sealant etc.

ANNEXURE 8.1

MECHANICAL PROPERTIES OF STEEL

Annexure 8.1
(Para No.8.1.1)

MECHANICAL PROPERTIES OF STEEL

Steel Designation	Class of Steel Product	Nominal thickness/dia mm	Tensile strength kg/f/mm²	Yield stress min. kg/f/mm²	Percentage elongation gauge minimum length 5.65 √so*
ST-42-W and ST-42-S	Plate sections (For example, angles, tees, beams, channels etc.) and flats	Below 6 mm only bend test shall be required.			
		6 mm and upto 20 mm	42 to 54	26	23
		Over 20 mm upto 40 mm	42 to 54	24	23
		Over 40	42 to 54	23	23
	Bars (round square and Hexagonal)	Below 10 only bend test shall be required			
		10 mm and upto 20 mm	42 to 54	26	23
		Over 20 mm	42 to 54	24	23
ST-42-0	Plate sections (For example, angles, tees, beams, channels etc.) and flats	Below 6 only bend test shall be required			
		6 mm and above	42 to 54	26	23
	Bars (round square and Hexagonal)	Below 10 mm only bend test shall be required			
		10 mm and above	42 to 54	26	23
ST-32-0	Plates sections (for example beams, channels etc.) & flats	Below 6 m only bend test shall be required 10 mm and above	32 to 44	—	26
	Bars (round square and Hexagonal)	Below 10 only bend test shall be required 10 mm and above	32 to 44	—	26

*SO—Where so is cross sectional Area of test piece.

CHEMICAL COMPOSITION OF STEEL

Steel Designation	Max percentage		
	Carbon	Sulphur	Phosphorous
ST-42-W	0.23	0.06	0.06
ST-42-S	* 0.25/0.28	0.06	0.06
ST-42-0	—	0.07	0.07
ST-32-0	—	0.07	0.07

* Note : 0.25 for thickness or dia 20 mm and below, 0.28 for thickness or dia over 20 mm.

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ANNEXURE 8.2

WELDING PROCESS

(a) The work shall be positioned for downward welding wherever possible.

(b) Arc length voltage and amperage shall be suited to the thickness of material, type of groove and other circumstances of the work. The welding current and electrode sizes for different types of joints shall be as per IS : 9595.

(c) The sequence of welding shall be such as will avoid undue distortion and minimize residual shrinkage stresses. Recommendation of IS : 9595 shall be followed.

Process of Welding - The electrode manipulation during welding shall be such as to ensure that :

(1) The parent metal is in a fused stage when the filler metal makes contact with it.

(2) The weld metal does not overflow upon any un-fused parent metal forming

overlapping.

(3) The parent metal is not under-cut along the weld toes.

(4) The following metal floats, the slag, the oxides, and the gas bubbles to the surface behind the advancing pool. In case any of these requirements is unattainable by manipulation, the current shall be adjusted or the electrode size changed.

Each time the arc is started the electrode shall be moved in such a way that the fusion of base metal at the starting point is assured. At the completion of a run the movement of electrode shall be slowed down to fill the arc crater.

After every interruption of the arc except at completion of a run, the arc shall be restarted ahead of the previous deposit and then moved back to fill the crater or such alternative technique shall be used as will ensure complete filling of the crater, or complete fusion between the new and old deposit and the base metal at the point of junction, and result in continuity of weld. Before welding operation is completed, all traces of slag shall be removed from the deposit, by chipping if necessary, and the deposit and the adjoining base metal shall be wire brushed and cleaned at all points. The requirements shall apply not only to successive layers, but also to successive beads, and to the over lapping area where a junction is made on starting a new electrode.

(5) The welds shall be free from cracks, discontinuity in welding and other defects such as (i) under-size (ii) over-size, (iii) under-cutting and (iv) over-cutting in the case of fillet welds and defects (ii), (iii) & (iv) in the case of butt welds.

All defective welds which shall be considered harmful to the structural strength shall be cut out and re-welded. In case of welded butt joints in steel of thickness up to 50- mm the weld joint shall be subjected to radiographic examination as described in IS : 1182.

All welds shall be cleaned of slag and other deposits after completion. Till the work is inspected and approved painting shall not be done. The surface to be painted shall be cleaned of spatter, rust, loose scale, oil and dirt.

ANNEXURE 8.3

SHAPES, WEIGHTS AND DESIGNATIONS OF ROLLED STEEL SECTIONS

Desig-nation	Wt. in kg/m	Situation of Use of Section
T2	1.036	Horizontal-glazing bars for doors and sashes, horizontal glazing bars for door side lights, sub-dividing bars for fixed light, vertical glazing bar for ventilators, sash bars for window, ventilators and door where metal aluminium or wooden beading is used for fixing glasses.
T3	1.14	Vertical glazing bar for EZ 7 frame
T6	0.839	Horizontal glazing bar for standard windows and ventilators
F2	1.46	Inner frames for open-in-windows
F3	2.28	Outer frames for open-in-windows
F5	1.55	(a) Inner and middle frames in centre-hung ventilators (b) F5 is some times used as inner frames for open-out windows. Also used as inner frame for bottom hung ventilators. (c) F8 is also used as outer frame for bottom hung ventilators.
F4B	2.28	Central mullion (meeting bar for shutters) for windows using F7D as inner frames, outer frames for open-in-windows in rainy areas, subdividing bars for open-in-windows and top-hung ventilators.
F7D	1.419	Inner and outer frames for windows and top hung ventilators, for outer frames for centre-hung ventilators and outer frames for door sidelights.
FX6	2.52	Inner frame for doors,
FZ7	1.90	Used as outer frame for industrial sashes. Also used for outer frame for wooden doors.
FX8	1.92	Outer frames for doors.
FZ5	2.52	Inner frames for doors
K11B	1.80	(a) Vertical coupling mullion for standard windows. (b) Can be used as horizontal coupling bar when open-able windows are to be coupled above fixed ones or between two fixed windows. (c) Can also be used as horizontal coupling mullion where windows are not exposed to weather.
K12B	2.30	Horizontal coupling mullion, also known as weather bar, (Especially used when the coupled unit is exposed to rain).

ANNEXURE 8.4

STEEL TUBES FOR STRUCTURAL PURPOSES

Nominal Bore (mm)	Outside Diameter (mm)	Class	Wall thickness (mm)	Weight (kg/m)
15	21.3	H	3.25	1.43
20	26.9	H	3.25	1.90
25	33.7	M H	3.25 4.05	2.46 2.99
32	42.4	M H	3.25 4.05	3.15 3.86
40	48.3	M H	3.25 4.05	3.61 4.43
50	60.3	L-2 M H	3.25 3.65 4.50	4.57 5.10 6.17
65	76.1	L M H	3.25 3.65 4.50	5.84 6.53 7.92
80	88.9	L M H	3.25 4.05 4.85	6.86 8.48 10.10
90	101.6	L M H	3.65 4.05 4.85	8.82 9.75 11.60
100	114.3	L M H	3.65 4.50 5.40	9.97 12.40 14.50
110	127.0	L M H	4.50 4.85 5.40	12.20 14.60 16.20
125	139.7	L M H	4.50 4.85 5.40	14.90 16.20 17.90
135	152.4	L M H	4.50 4.85 5.40	16.40 17.70 19.50
150	165.1	L M H	4.50 4.85 5.40	17.80 19.20 21.20
150	168.3	L M H-1 H-2	4.50 4.85 5.40 6.30	18.10 19.60 21.70 25.30
175	193.7	L M H	4.85 5.40 5.90	22.60 25.00 27.30
200	219.1	L M H	4.85 5.60 5.90	25.70 29.40 31.00
225	244.5	H	5.90	34.20

L means Light M means Medium H means Heavy

RECOMMENDED LIST OF TESTS ON MATERIALS AND WORKS

Material	Test	Field/ Labora-tory Test	Text Procedur e	Minimum Quantity of material for carrying out the test	Frequency of testing
Steel	(a) Tensile Strength (b) Bend test	Labora-tory	IS:1599	20 Tonne	Every 20 Tonne or part thereof

MECHANICAL PROPERTIES OF STEEL

Annexure 8.1

Steel Designation	Class of steel Product	Nominal thickness/dia mm	Tensile Strength Kg/f/mm2	Yield Stress Min. Kg/f/mm2	Percentage Elangation Gauge Minimum Length 5.65 so
ST-42-W and ST-42-S	Plate section (For example,angles, tees, beams, channels etc.) and flats	Below 6mm only bend test shall be required. 6 mm and upto 20 mm Over 20 mm upto 40 mm Over 40	42 to 54 42 to 54 42 to 54	26 24 23	23 23 23
	Bars (round square and Hexagonal)	Below 10 only bend test shall be required 10 mm and upto 20 mm Over 20 mm	42 to 54 42 to 54	26 24	23 23
ST-42-O	Plate section (For example,angles, tees, beams, channels etc.) and flats	Below 6mm only bend test shall be required. 6 mm and above	42 to 54	26	23
	Bars (round square and Hexagonal)	Below 10 only bend test shall be required 10 mm and above	42 to 54	26	23
ST-32-O	Plate section (For example,beams, channels etc.) & flats	Below 6mm only bend test shall be required. 10 mm and above	32 to 44	-	26
	Bars (round square and Hexagonal)	Below 10 only bend test shall be required 10 mm and above	32 to 44	-	26

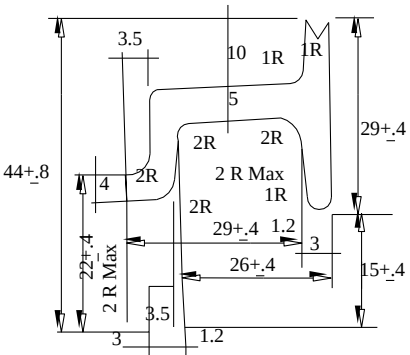
'SO - Where so is cross sectional Area of test piece.

CHEMICAL COMPOSITION OF STEEL

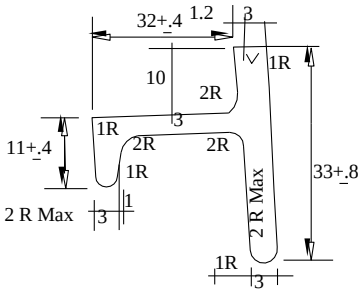
Steel Designation	Carbon	Max percentage Sulphur	Phosphorous
ST-42-W	0.23	0.06	0.06
ST-42-S	* 0.25/0.28	0.06	0.06
ST-42-O	-	0.07	0.07
ST-32-O	-	0.07	0.07

Note : 0.25 for thickness or dia 20 mm and below,0.28 for thickness or cver 20 mm

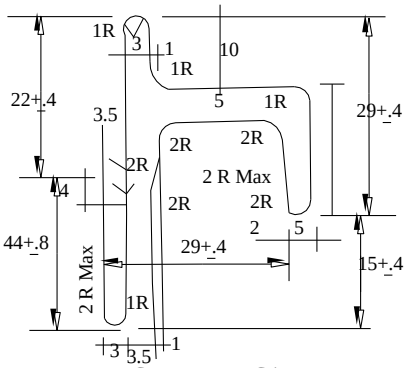
SHAPES



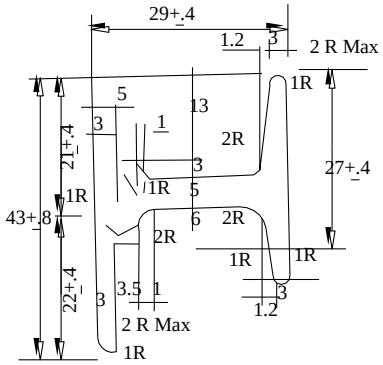
WEIGHT 2.52 KG/M
F X6



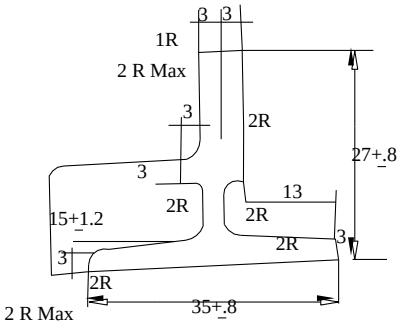
WEIGHT 1.30 KG/M
E Z7



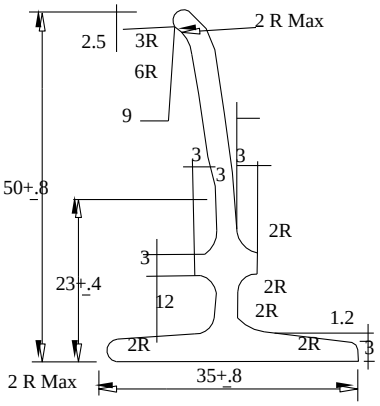
WEIGHT 2.52 KG/M
F Z5



WEIGHT 2.31 KG/M
FX8



WEIGHT 1.80 KG/M
K118

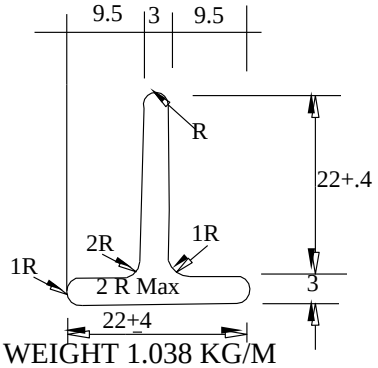


WEIGHT 2.30 KG/M
K 12B

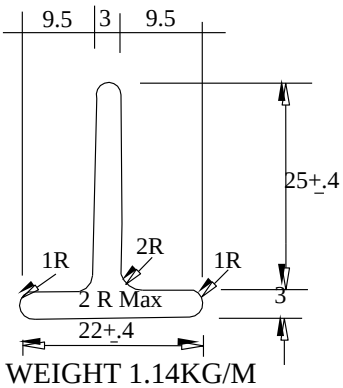
All dimensions are in mm

Drawings not to Scale

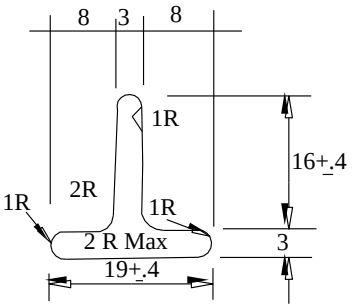
SHAPES



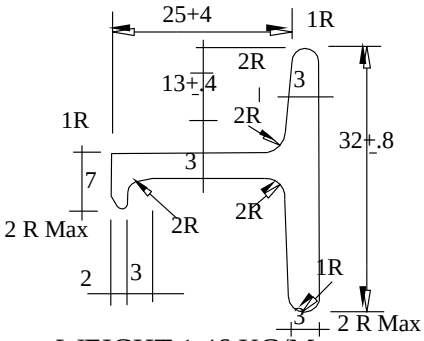
WEIGHT 1.038 KG/M
T2



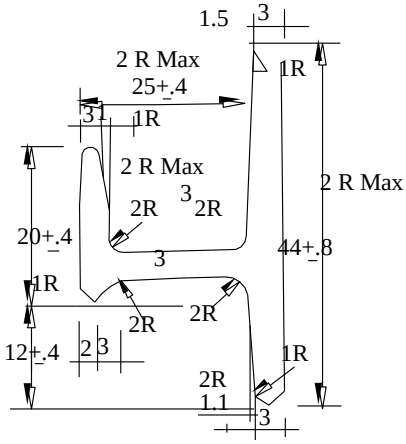
WEIGHT 1.14KG/M
T 3



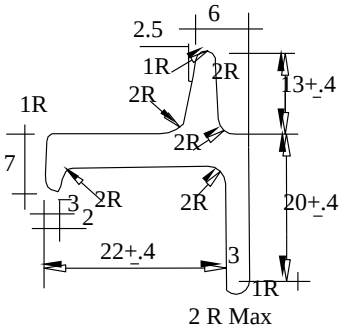
WEIGHT 0.839 KG/M
T 6



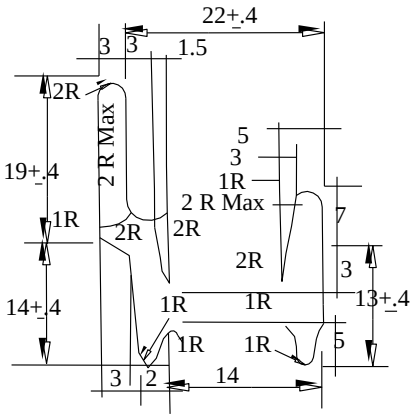
WEIGHT 1.46 KG/M
F 2



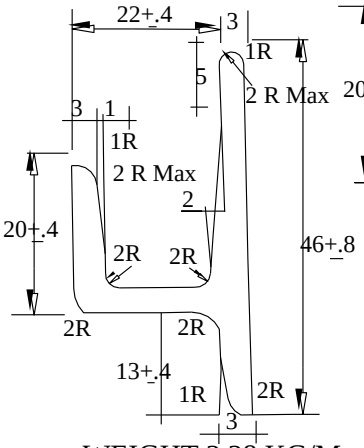
WEIGHT 2.28 KG/M
F 3



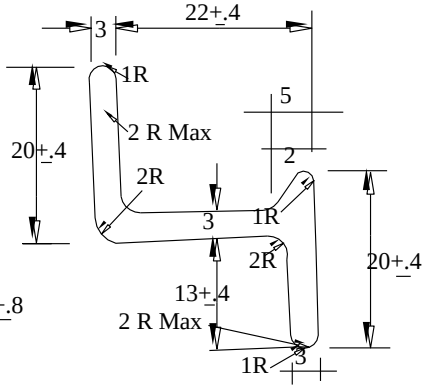
WEIGHT 1.55 KG/M
F 5



WEIGHT 1.92 KG/M
F 8



WEIGHT 2.28 KG/M
F 4B



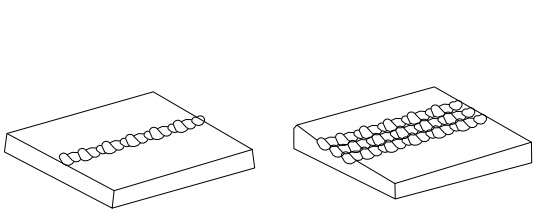
WEIGHT 1.419 KG/M
F 7D

All dimensions are in mm

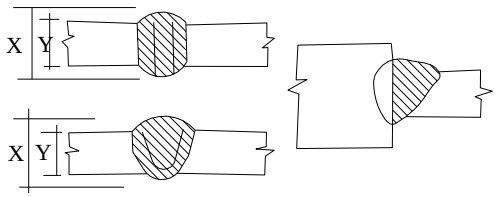
Drawings not to Scale

WELDS AND RIVETS

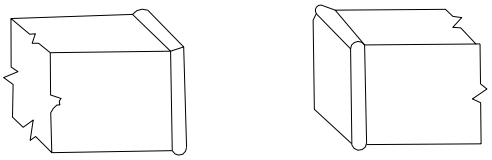
FIGURE 8.1



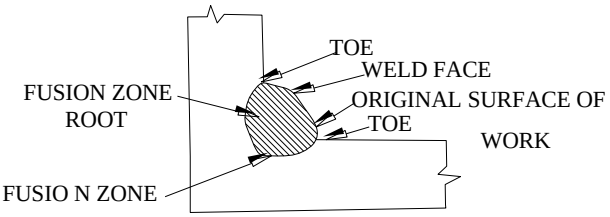
A. BEAD WELDS



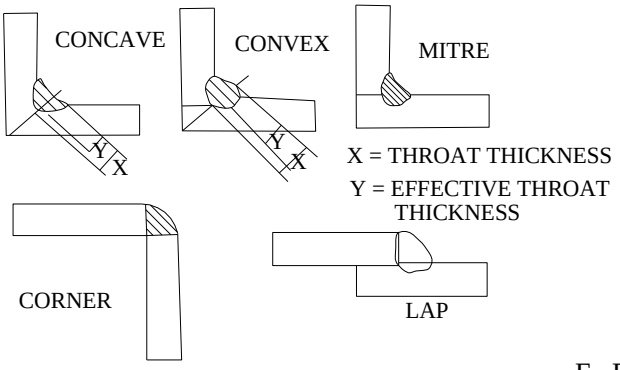
B. BUTT WELDS



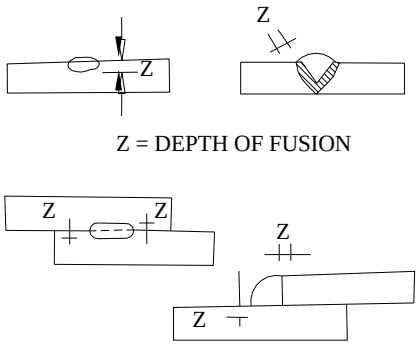
C. PLAIN BUTT JOINT



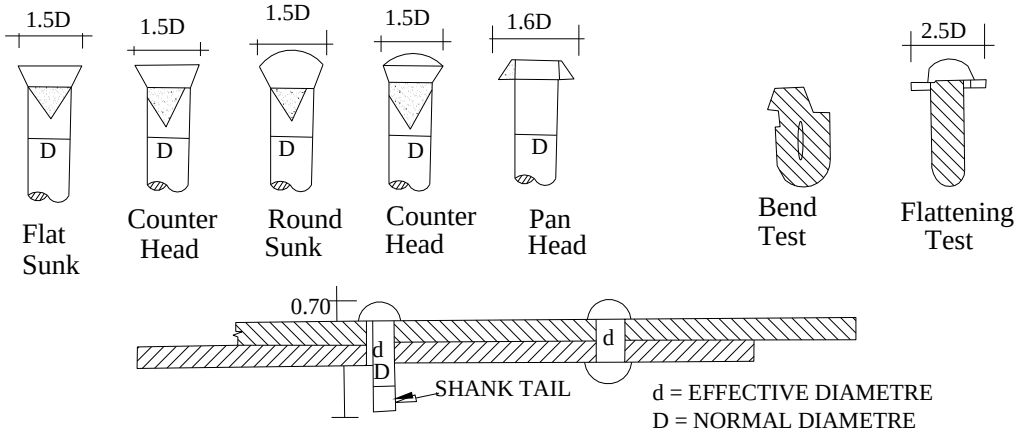
D. FILLET WELD



E. FILLET WELDS



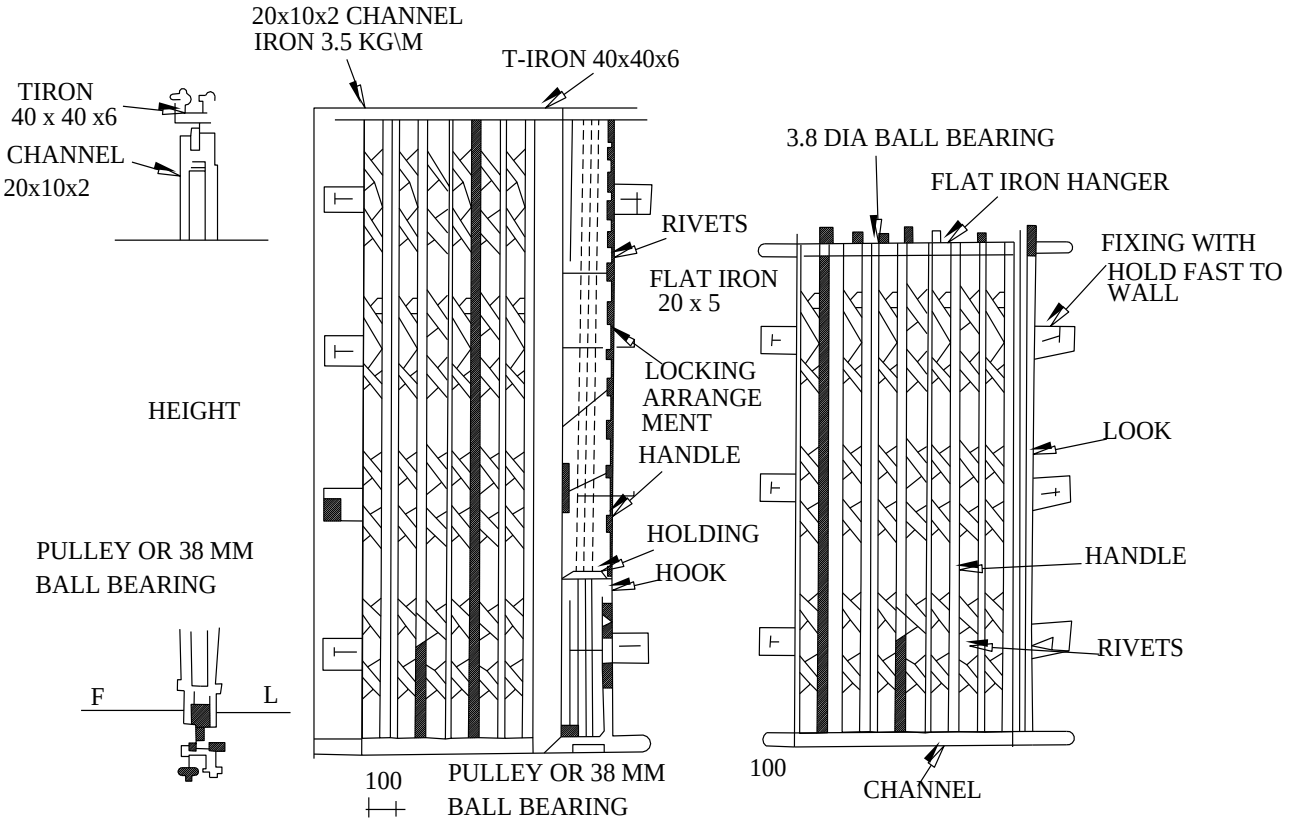
F. FUSTION PENETRATION



G. RIVETS

COLLAPSIBLE STEEL GATE

FIGURE 8.2



All dimensions are in mm Drawings not to Scale

FIG. 8.3 MS SHEET SLIDING SHUTTERS

FIGURE 8.3 A & B

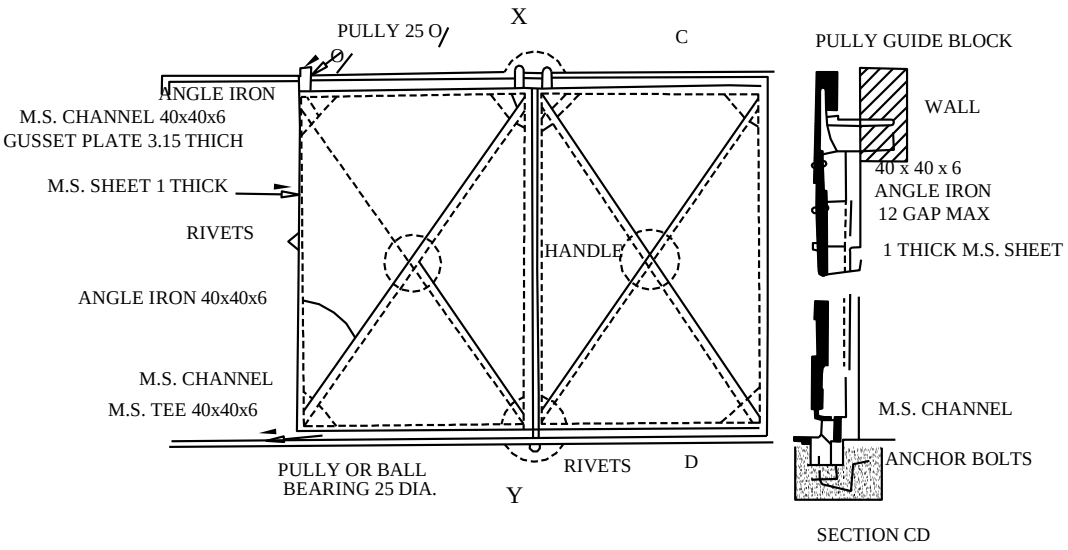
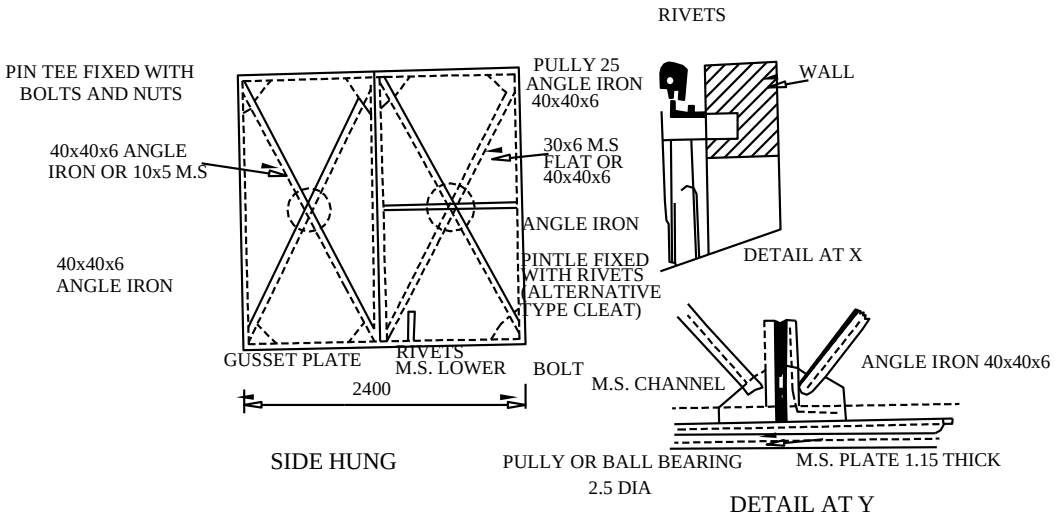


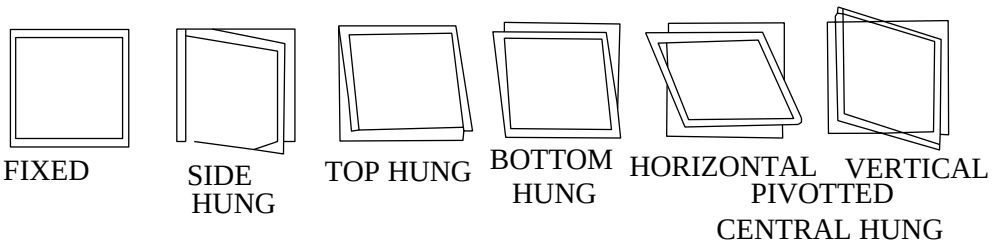
FIG. 8.3B MS SHEET SLIDE HUNG SHUTTERS

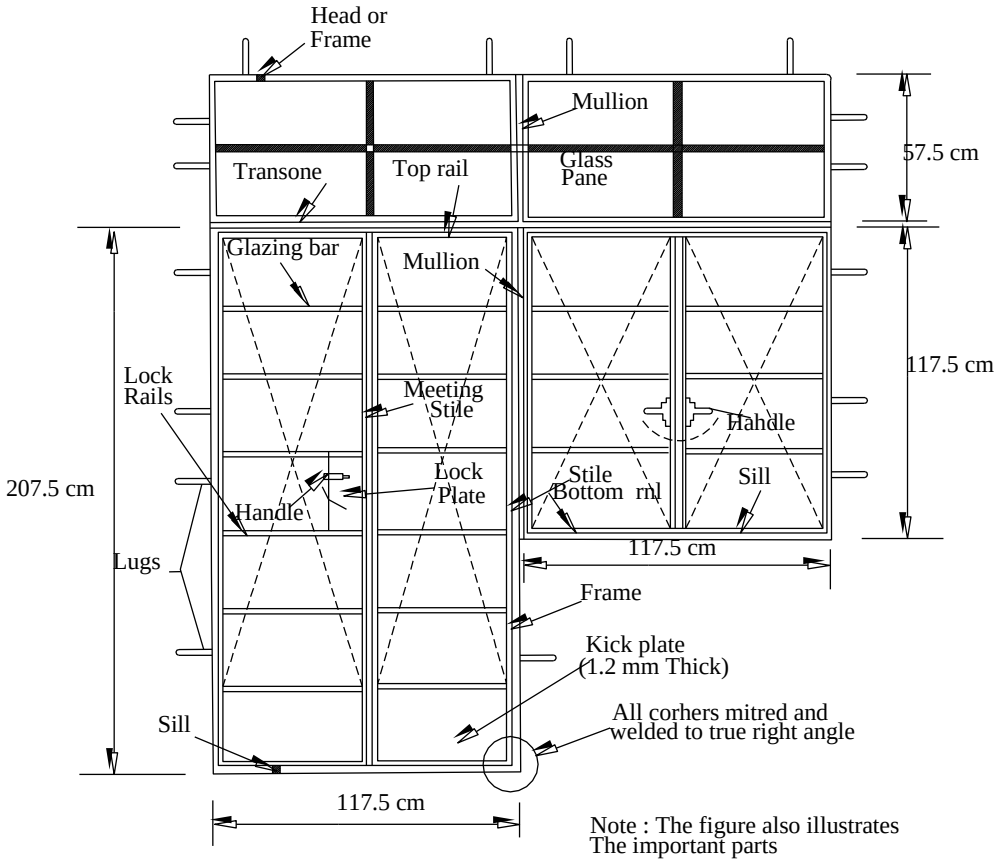


All dimensions are in mm Drawings not to Scale

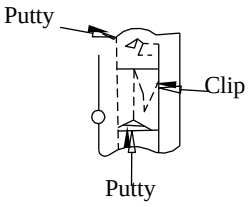
STEEL DOORS, WINDOWS & VENTILATORS

FIGURE 8.4

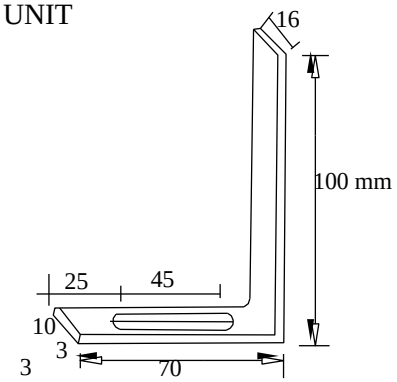




COMPOSITE UNIT



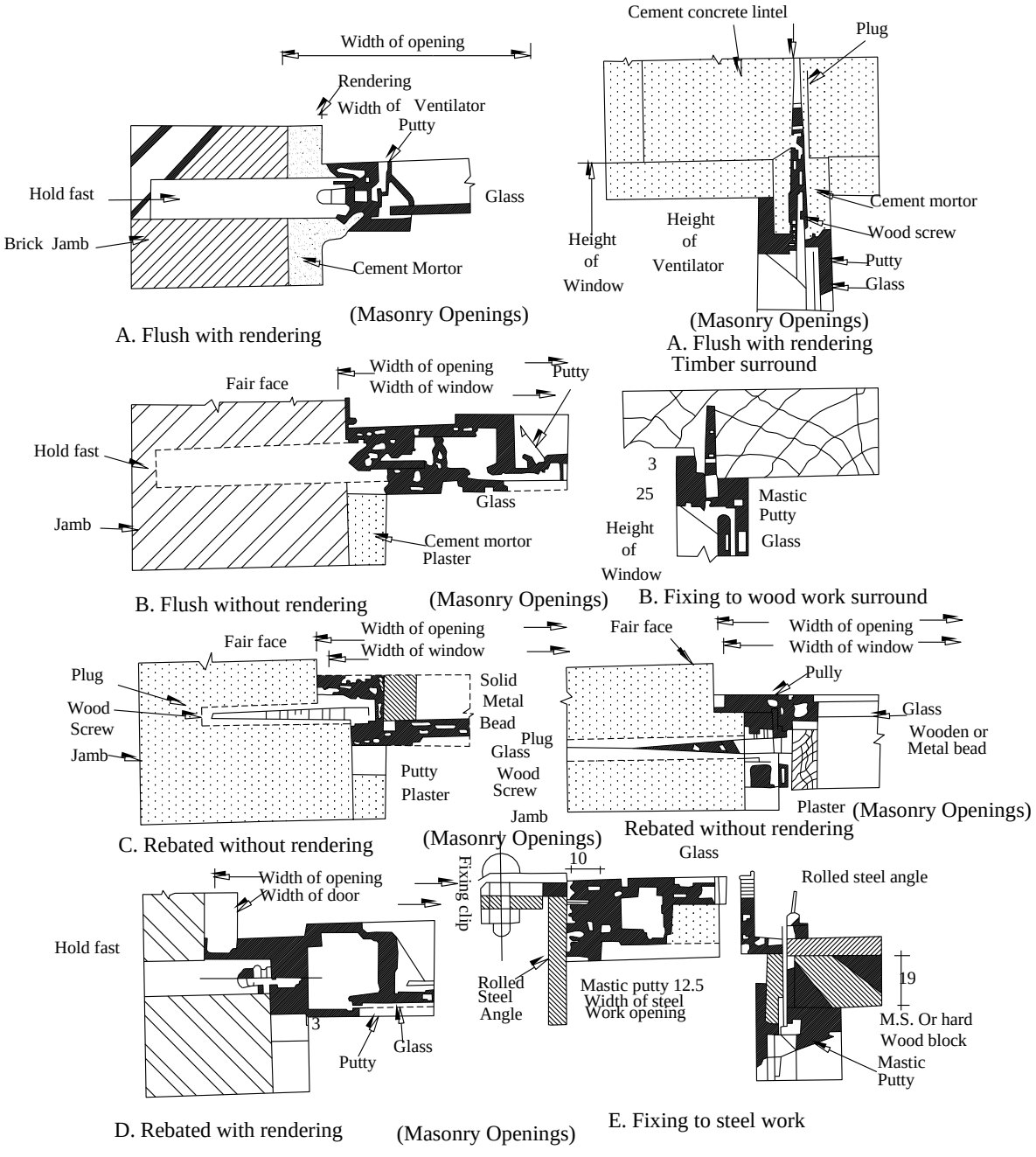
GLAZING CLIPS



SLOTTED LUG

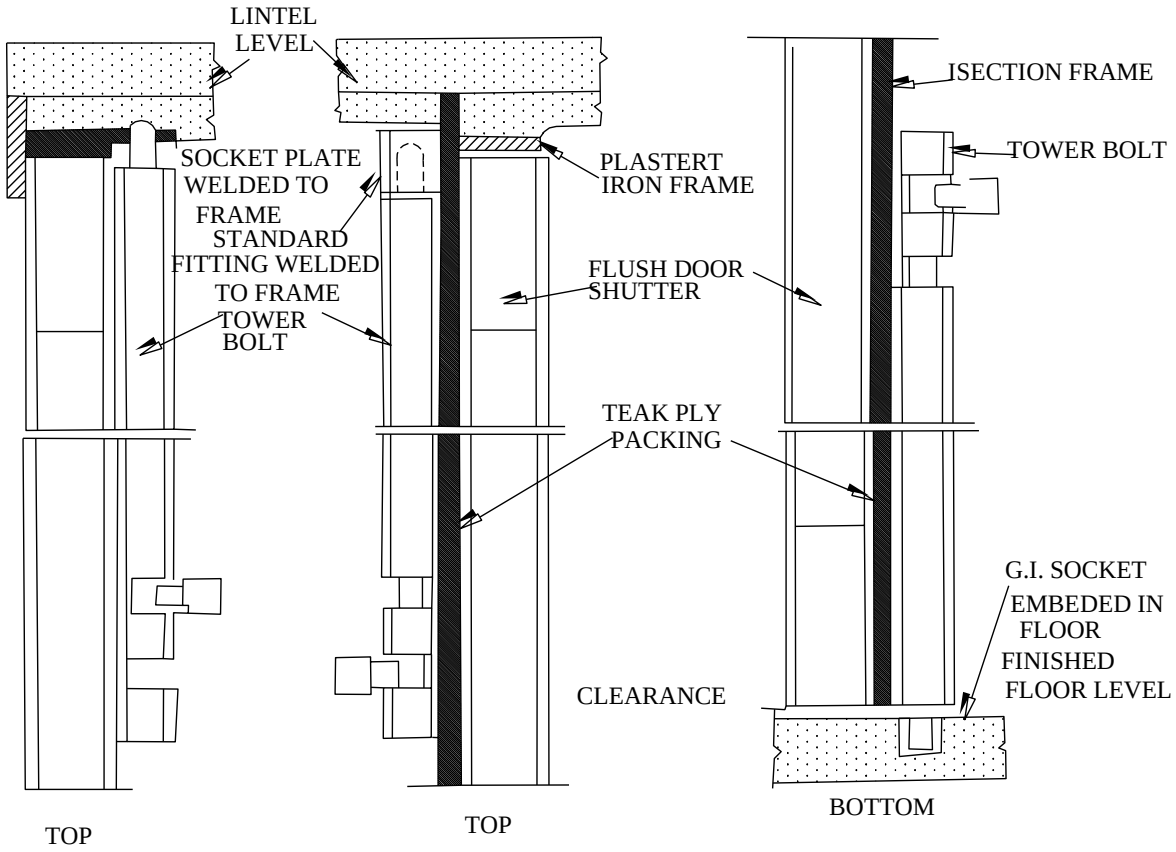
FIXING OF STEEL DOORS, WINDOWS & VENTILATORS

FIGURE 8.5



T - IRON - DOOR\WINDOW FRAMES

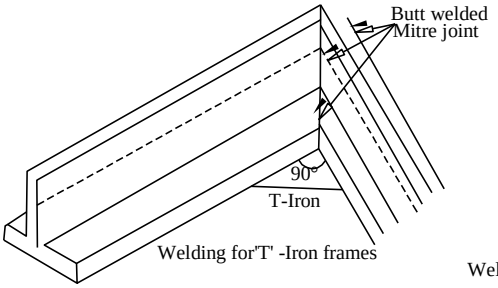
FIGURE 8.6



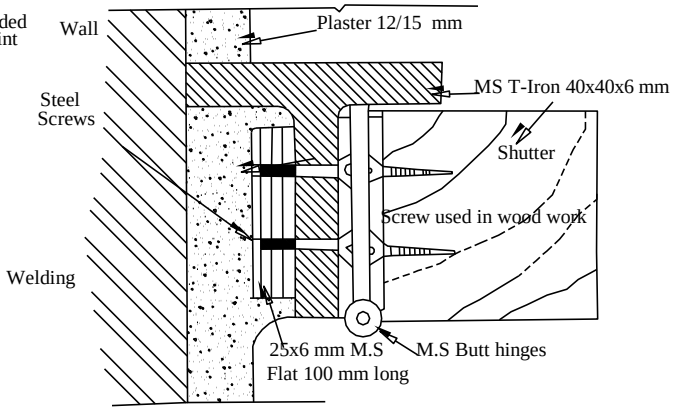
FIXING TOWER BOLTS TO SHUTTERS

T - IRON - DOOR\WINDOW FRAMES

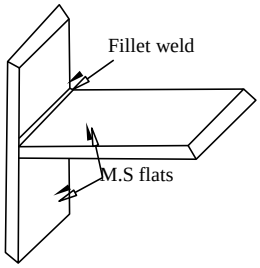
FIGURE 8.6



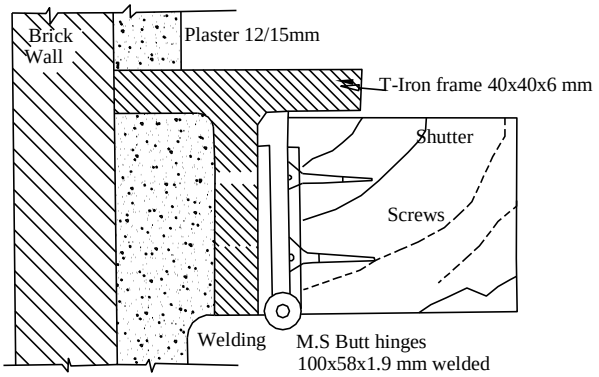
WELDING FOR 'T' -IRON FRAMES
SKETCH A



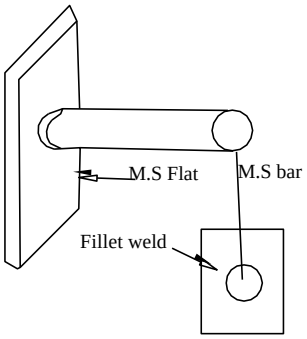
FIXING BUTT HINGES TO T-IRON FRAME WITH M.S. FLAT
WELDED TO FRAME



M.S. FLAT WELDED TO M.S. FLAT
SKETCH B



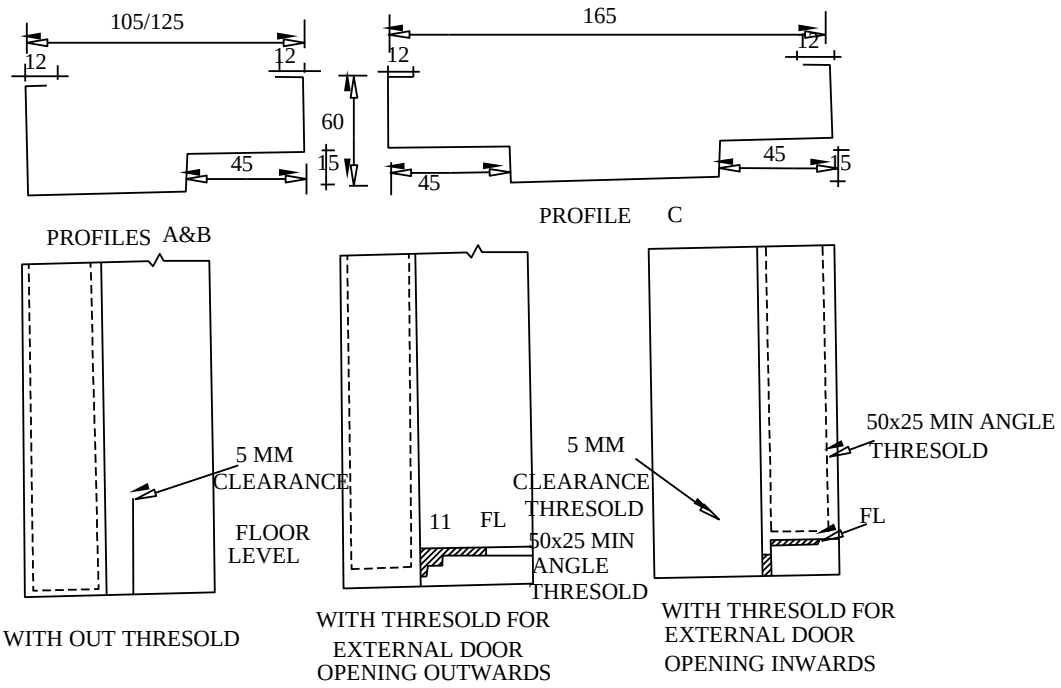
ALTERNATE METHOD OF FIXING HINGES TO 'T' -IRON FRAMES
[DIRECT WELDING THE HINGES TO 'T' IRON FRAMES]



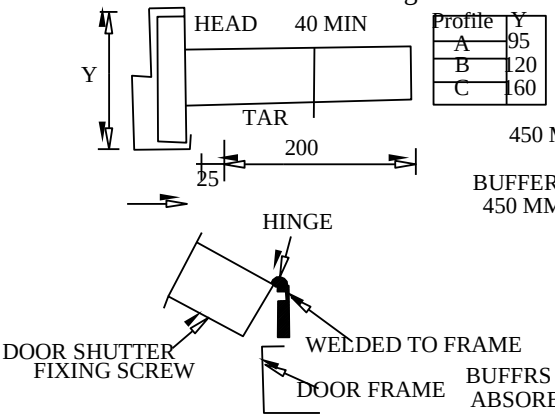
M.S bar welded to M.S Flat

PRESSED STEEL DOOR & WINDOW FRAMES

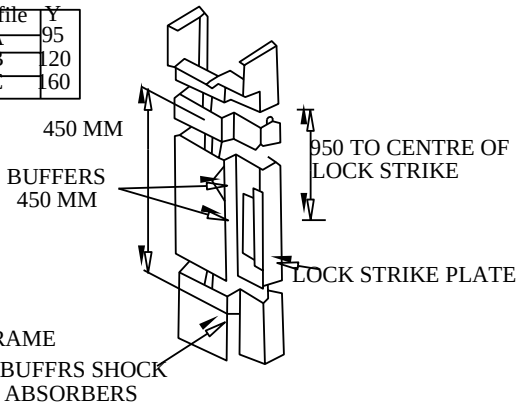
FIGURE 8.7



Arrangeement at base of door frame



Fixing of hinge to the frame



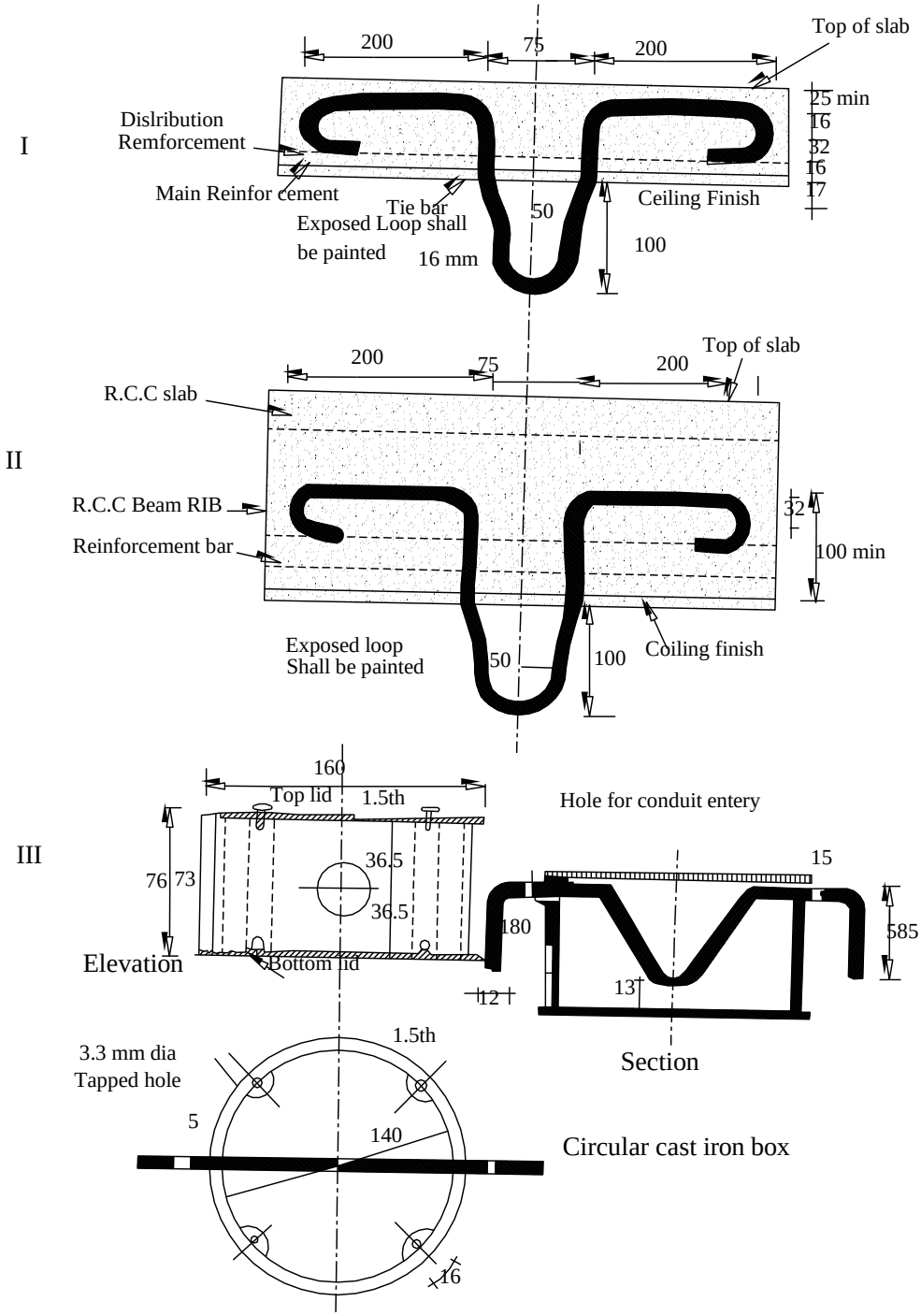
Location of shock absorbers and
Lock strike plate

All dimensions are in mm

Drawings not to Scale

FAN CLAMPS

FIGURE 8.8



PLAN WITHOUT TOP AND BOTTOM LID

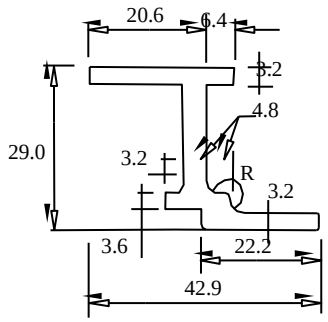
All dimensions are in mm

Drawings not to Scale

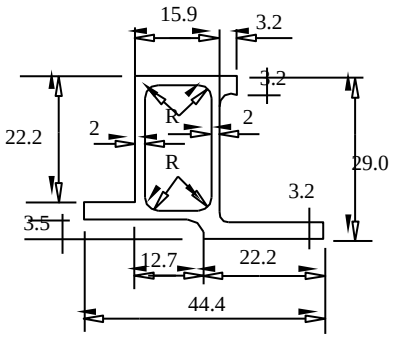
EXTRUDED SECTIONS FOR DOORS
AS PER IS 1948-1961

FIGURE 8.9

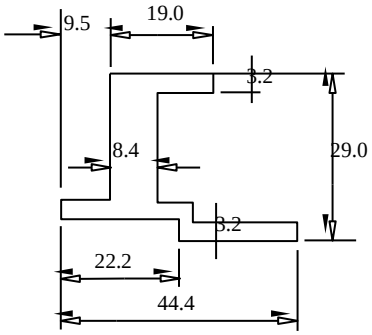
(A) FIXED FRAME
SECTION NO. AL-FXB
WEIGHT :0.805 KG/M



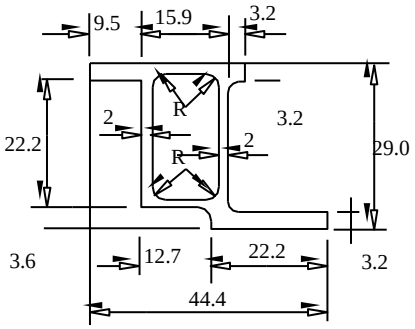
(B) SHUTTER FRAME HOLLOW SECTION
(i) SECTION NO.AL-HFX5
WEIGHT :0.73 Kg/m



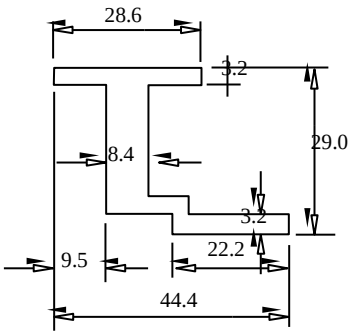
(C) SHUTTER FRAME SOLID SECTION
(i) SECTION NO.AL-FX5
WEIGHT :1.033 Kg/m



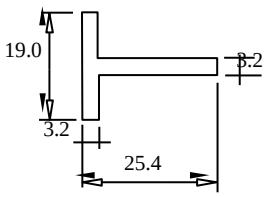
(B) SHUTTER FRAME HOLLOW SECTION
(ii) SECTION NO. AL- HFX6
WEIGHT : 0.73 Kg/m



(C) SHUTTER FRAME SOLID SECTION
(ii) SECTION NO. AL- FX6
WEIGHT : 1.033 Kg/m



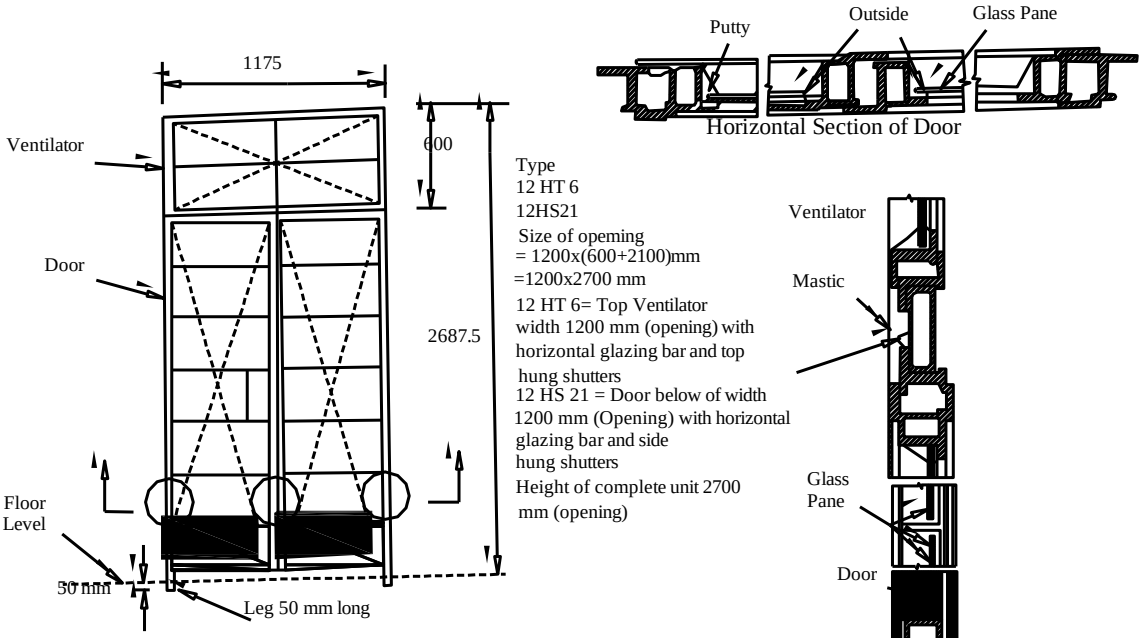
(D) GLAZING BAR
SECTION NO. AL-T 6
WEIGHT : 0.363 Kg/m



All dimensions are in mm

ALUMINIUM DOORS

FIGURE 8.10 A to 8.10 H



Size of Glass (Clearance Allowed)

NOS.	12 HT 6 SIZES	NOS.	12 HS 21 SIZES
	WIDTH x HEIGHT cm		WIDTH x HEIGHT cm
4	54.5 x 24.5	2 9 1	50.5x24.0 50.5x27.5 40.5x27.5

Fig.8.10 A Fabrication of Aluminium Door

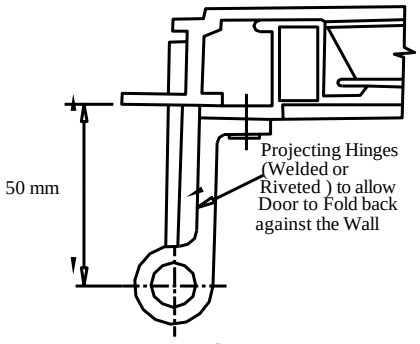


Fig -8.10 B Typical Projecting Type Hinge for Door

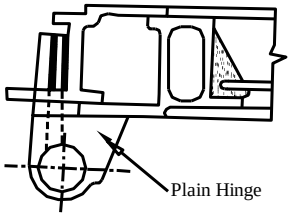


Fig 8.10 C Typical Non -Projection Type Hinge for Door

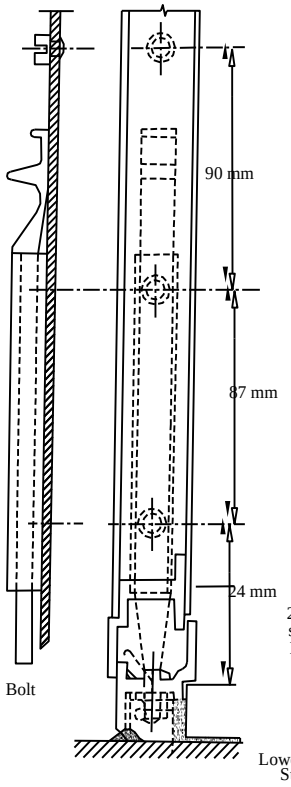


Fig 8.10 D Typical Vertical Bolt for Double Shutter Door

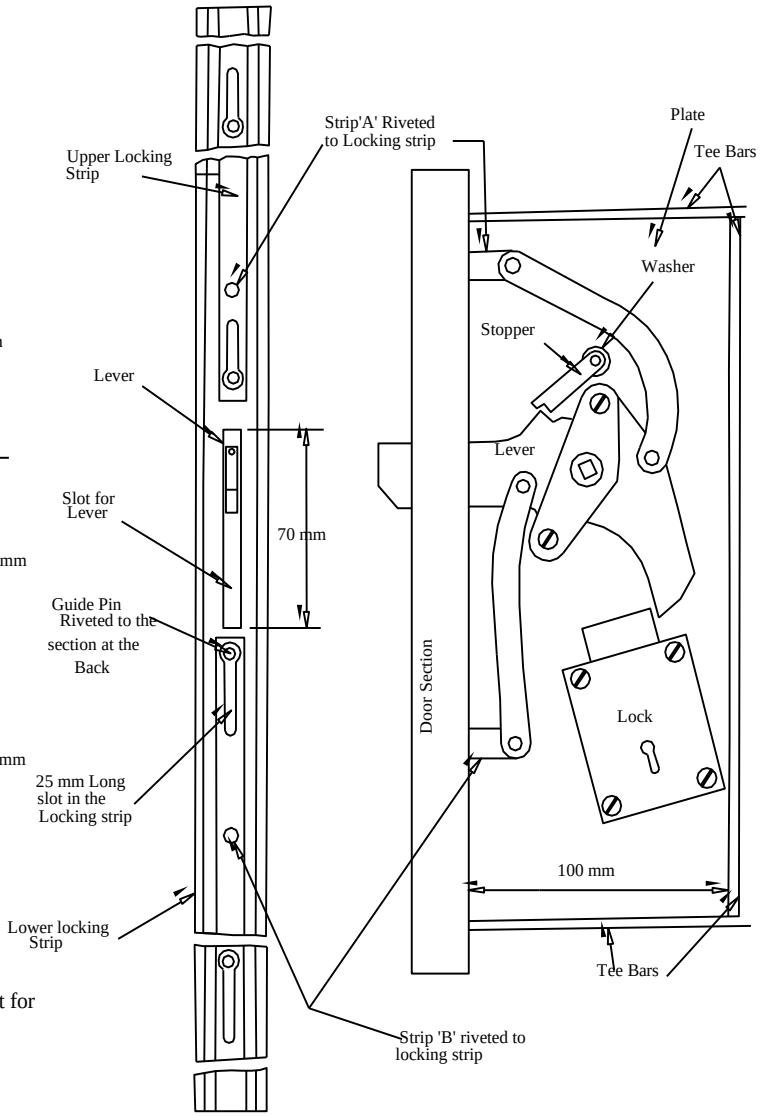


Fig 8.10 E Typical three-Way Bolting Device for Doors

20.35

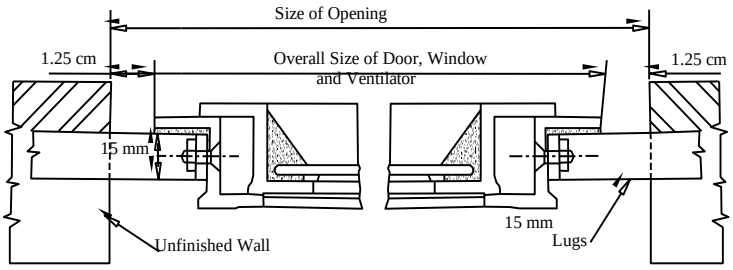


Fig 8.10F Fixing of Aluminium Doors, Windows or Ventilators in opening in Masonry by use of Steel lugs

Fig. 8.10 G Slotted Fixing lug (For Brickwork and Masonry)

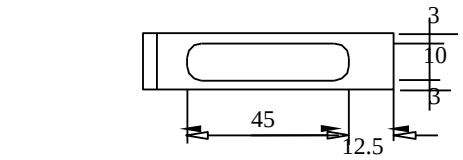
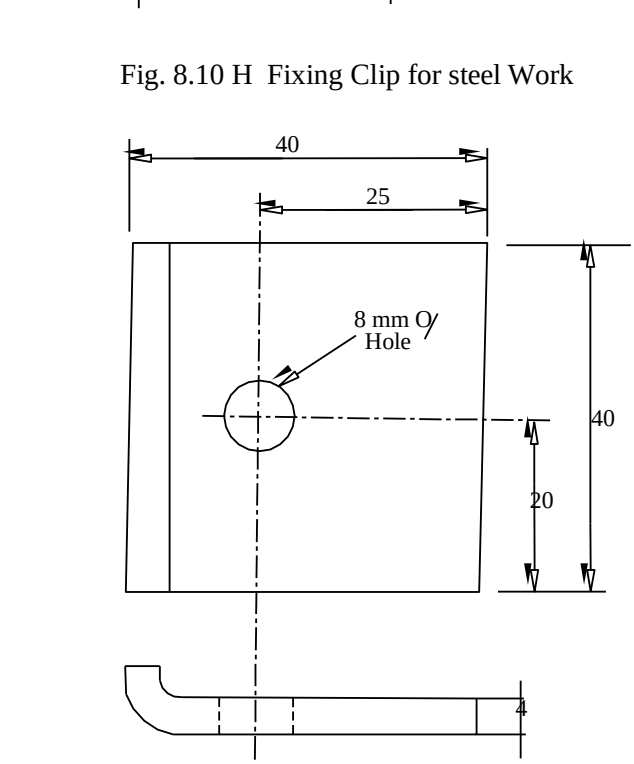
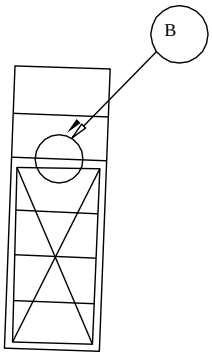
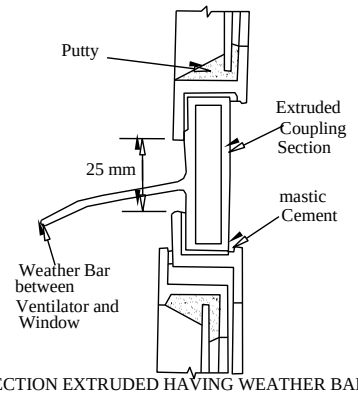


Fig. 8.10 H Fixing Clip for steel Work



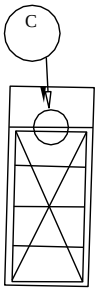
All dimensions are in mm

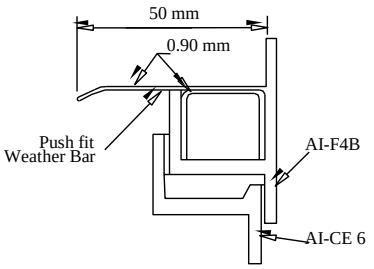




COUPLING SECTION EXTRUDED HAVING WEATHER BAR FITTED VENTILATORS ON TOP OF WINDOW

Fig. 8.11 D Construction details at position 'B' in An Aluminium Window Coupled with Ventilator





WEATHER BAR OVER EXTERNAL OPENING SHUTTER WITH FIXED LIGHT ABOVE

Fig. 8.11 E Construction details at Position 'C' in an Aluminium Window Coupled with Ventilator

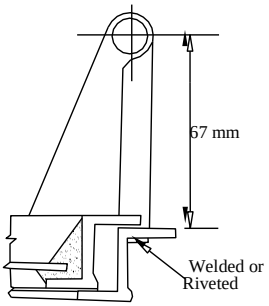


Fig. 8.11 F Typical Projecting Type Hinge for side - Hung shutter

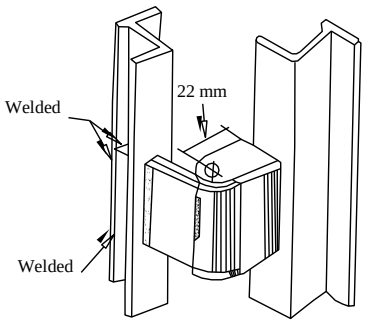


Fig. 8.11 G Typical Non-Projecting Type Hinge For Side - Hung Shutter

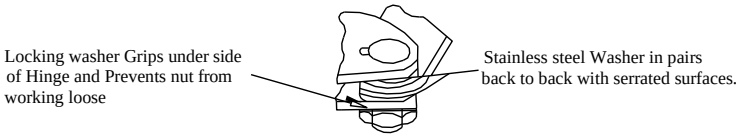
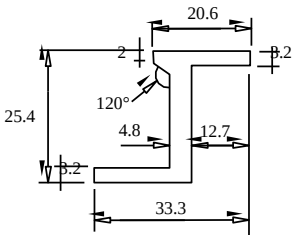


Fig. 8.11 H Illustration Showing Working Principle of Friction Hinges

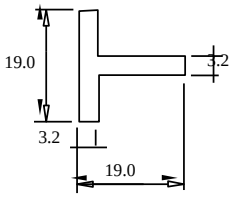
ALUMINIUM WINDOWS - OPENING TYPE

FIGURE 8.11 A to 8.11 K

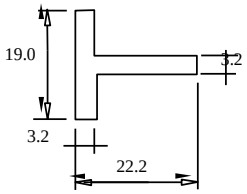
(a) OPENING FRAME
SECTION NO. AL - CF6
WEIGHT: 0.614 Kg/m



SECTION NO. AI-T6
WEIGHT : 0.306 Kg/m

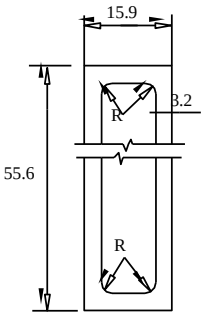


(b) GLAZING BARS
SECTION NO. AI-T7
WEIGHT :0.334 Kg/m

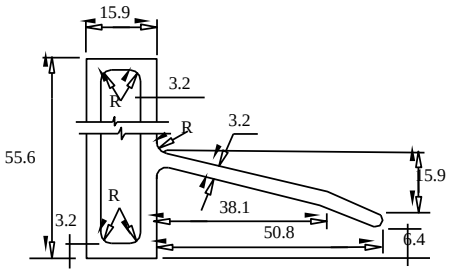


(C) COUPLING MEMBER

COUPLING
SECION NO.AI-HK 11B
WEIGHT : 1.15 Kg/m

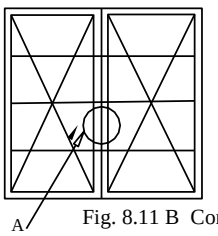


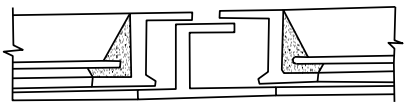
COUPLING WITH WEATHER BAR
SECTION NO. AI-HK 12B
WEIGHT :1.61 Kg/m



All dimensions are in mm

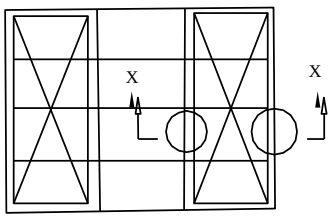
Fig. 8.11 A Extruded Section for Openable Window (As per IS Code)

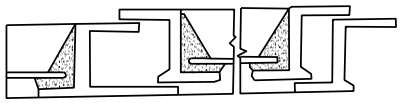




MULLION WITH BOTH SIDES

Fig. 8.11 B Construction details of Location 'A' Marked in a Single Aluminium Window





MULLION WITH FIXED GLASS ON ONE SIDE AND SIDE- HUNG ON OTHER SIDE

Fig. 8.11 C Construction details at section XX in a Single Aluminium Window

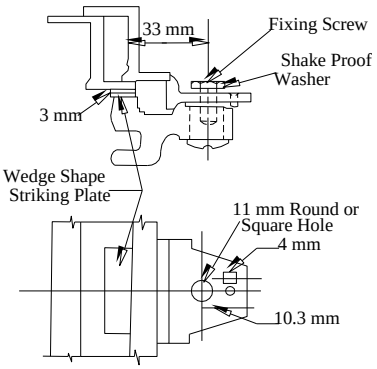


Fig. 8.11 I Typical Handle for side Hung Shutter

In Relation to

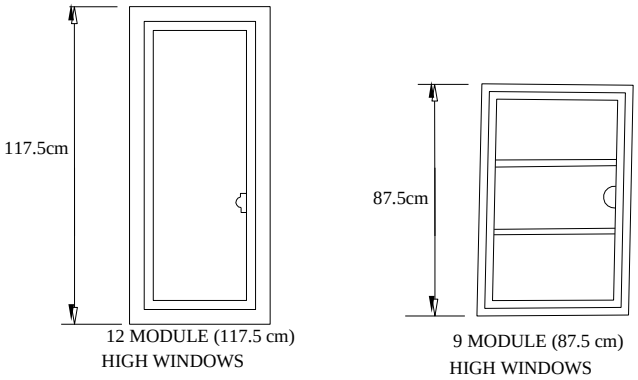


Fig. 8.11 J Showing the position of handle In Relation to Height of "HS" type windows

Plates

H = Withhorizontal glazing bars
S = Side hung shutters

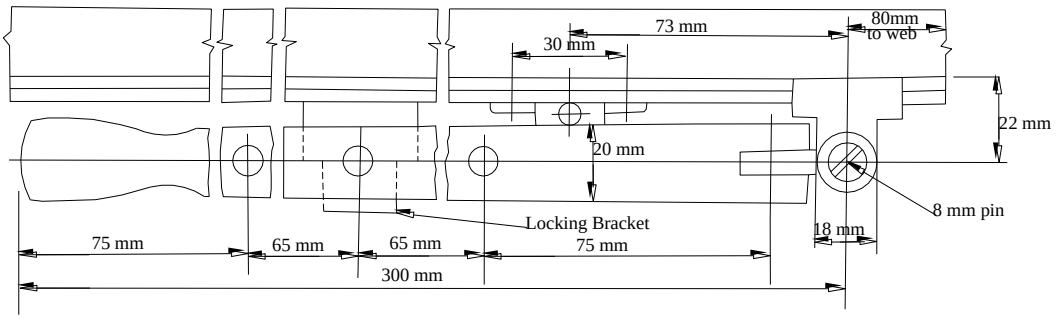


Fig. 8.11 K A Typical peg stay for side - Hung shutters and Top-Hung Ventilators

ALUMINIUM WINDOWS - SLIDING TYPE

FIGURE 8.12

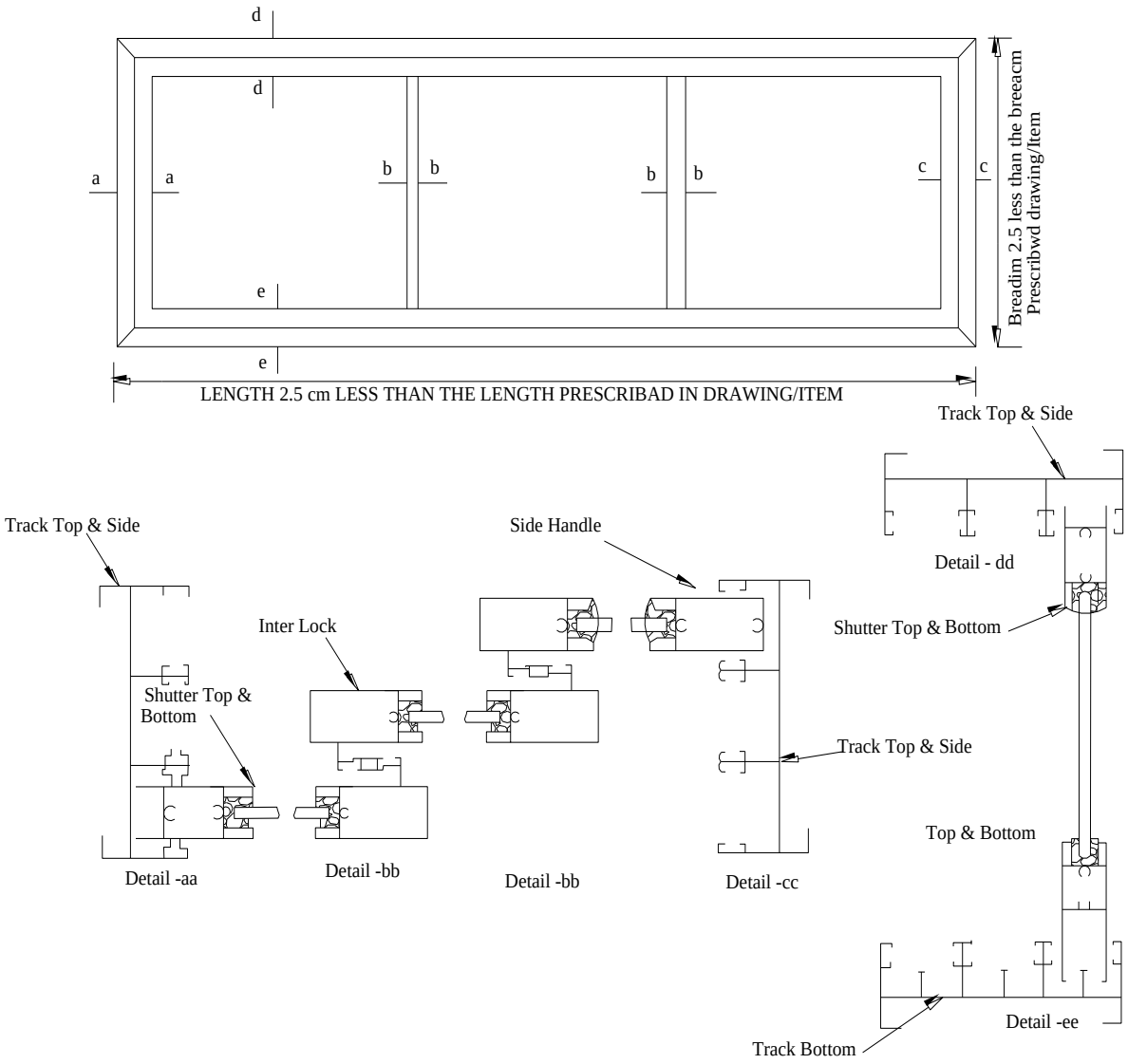
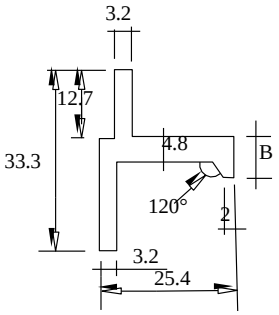


Fig. 8.12 Sliding Window Assembly - 3 Tracks

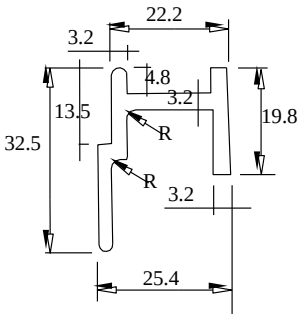
ALUMINIUM VENTILATORS

FIGURE 8.13A to 8.13 C

(A) VENTILATOR BAR
SECTION NO.AI-F5
WEIGHT : 0.614 Kg/m

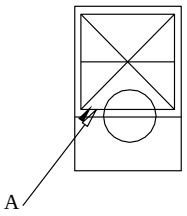


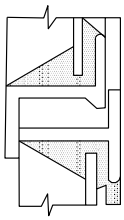
(B) OUTER BAR FOR VENTILATOR
SECTION NO.AI-F8
WEIGHT : 0.63 Kg/m



All dimensions are in mm

Fig. 8.13 A Extruded Sections for Ventilator (As per IS Code)





DETAIL THROUGH BOTTOM OF TOP HUNG VENTILATOR

Fig . 8.13 B Construction Details of Location 'A' Marked at bottom of TOp Hung Ventilator

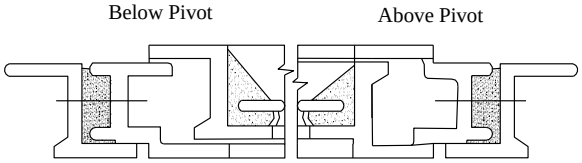
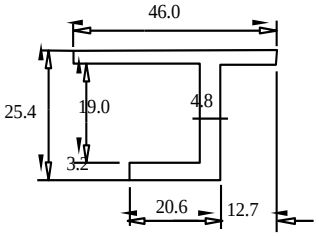


Fig. 8.13 C Details of Horizontal Centre - Hung Ventilator

ALUMINIUM VENTILATORS

FIGURE 8.14 A to 8.14 D

(A) MULLION BAR
SECTION NO.AI-F4B
WEIGHT : 0.837 Kg/m



(B) COUPLING
SECTION NO.AI-HK 11B
WEIGHT : 1.15 Kg/m

Figure shown in 8.11 A

(C) COUPLING WITH WEATHER BAR
SECTION NO.AI-HK 12 B
WEIGHT : 1.61 Kg/m

Figure shown in 8.11 A

Fig. 8.14 A Extruded Section for Composite Units (As per IS Code)

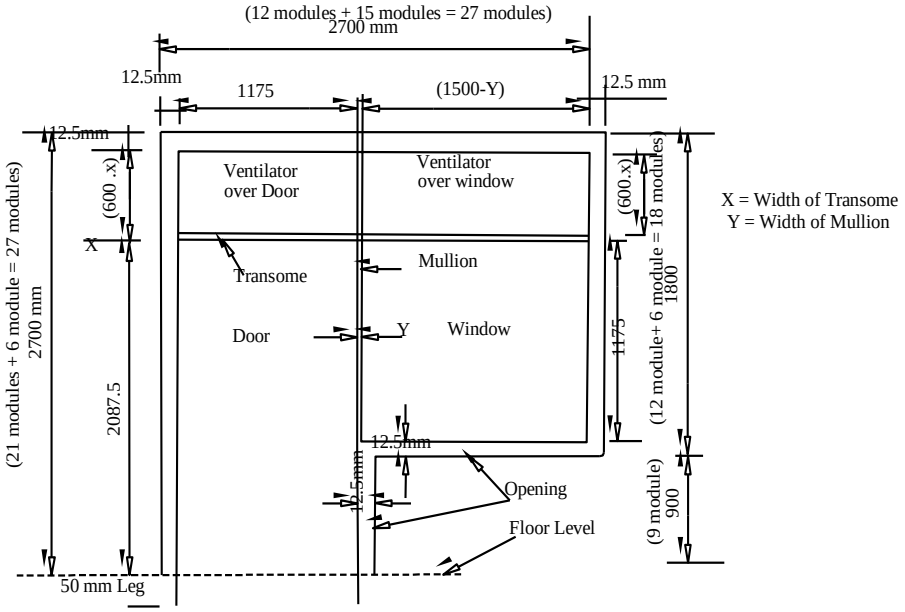


Fig. 8.14 Dimension of the Opening and the Size of Different of Composite Unit to Facilitate Proper Fixing in the Opening

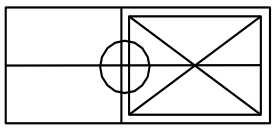


Fig. 8.14 C Coupling Windows side by side making a composite window (See Details in Fig. 8.14 D

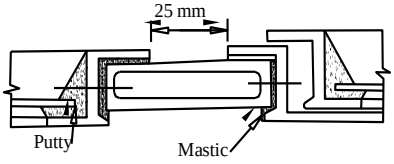


Fig. 8.14 D Coupling Section Extruded for Coupling Windows side by side

All dimensions are in mm

FLOOR SPRING (HYDRAULICALLY OPERATED)

FIGURE 8.15

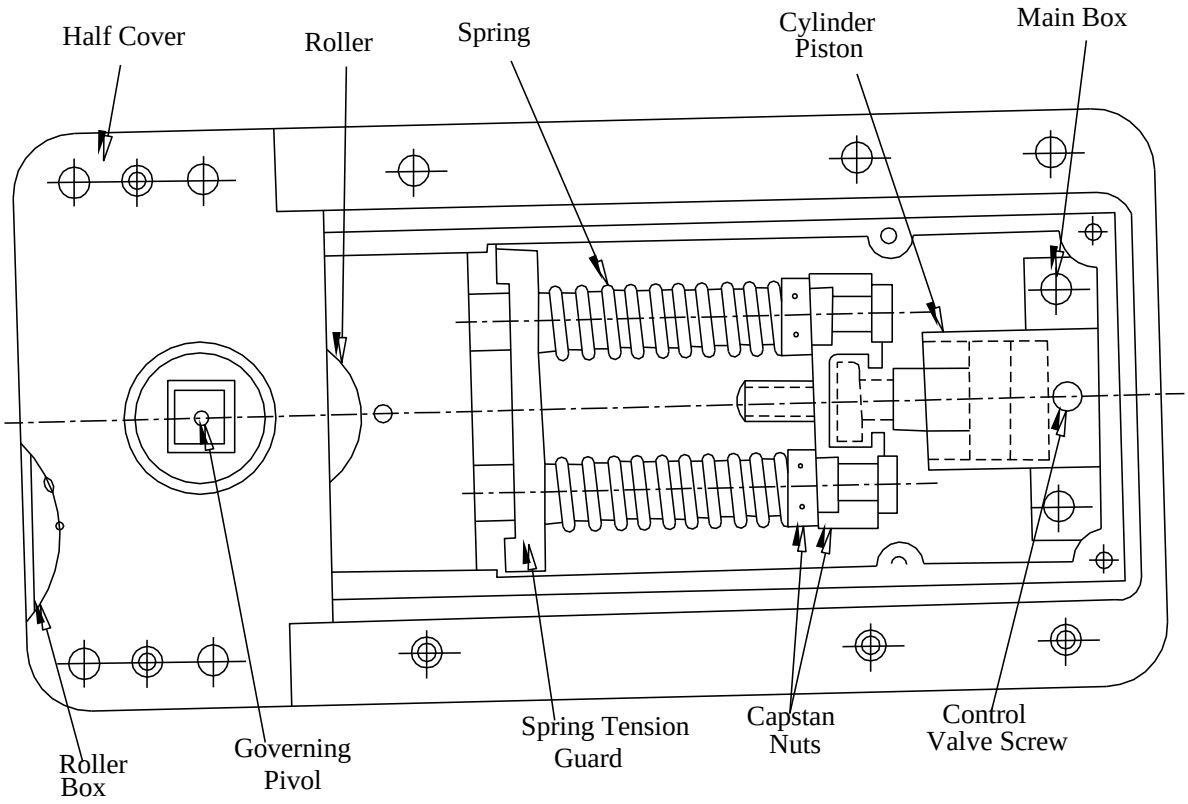


Fig. 8.15 Typical Details of Floor Spring (Hydraulically Regulated)

CURTAIN WALL SYSTEM COMPONENTS

FIGURES 8.16 A

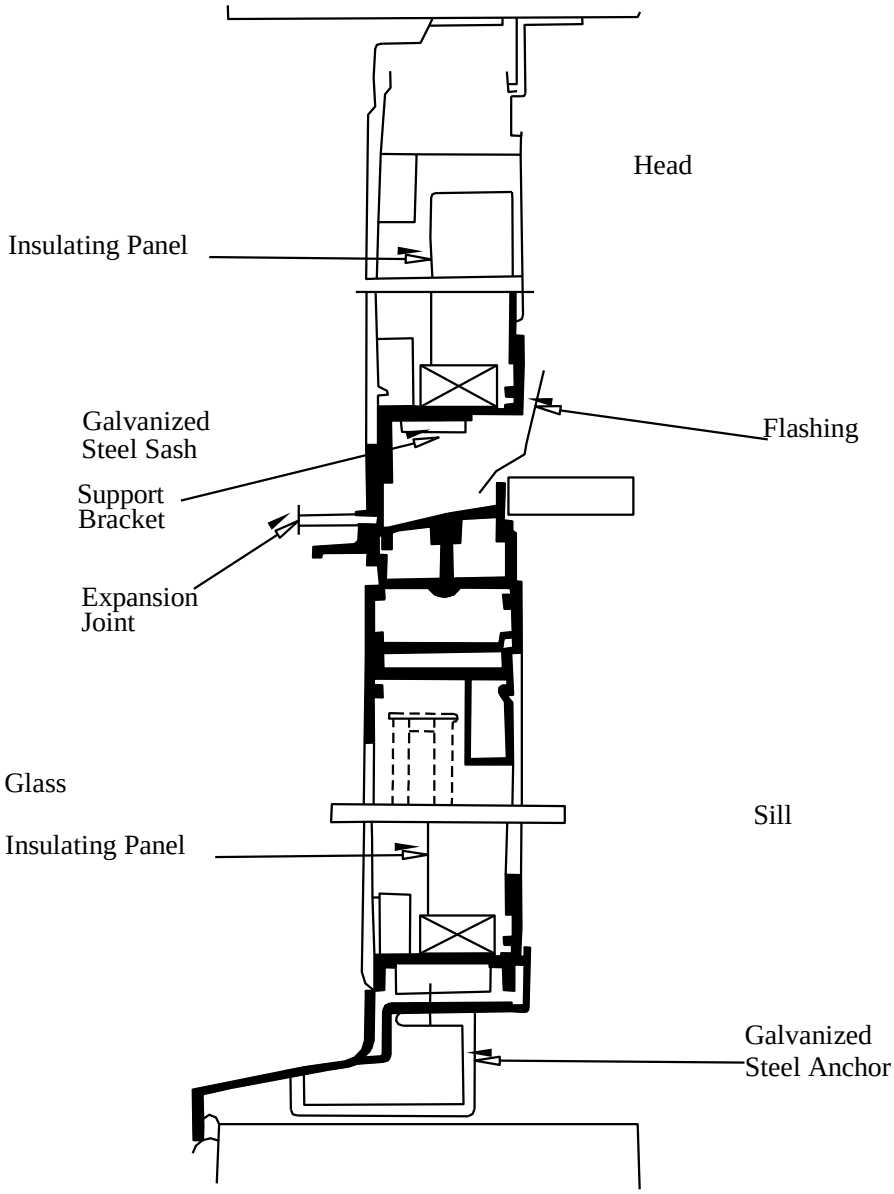


Fig.8.16A Components of curtain wall with window panels

CURTAIN WALL FRAME

FIGURES 8.16 B

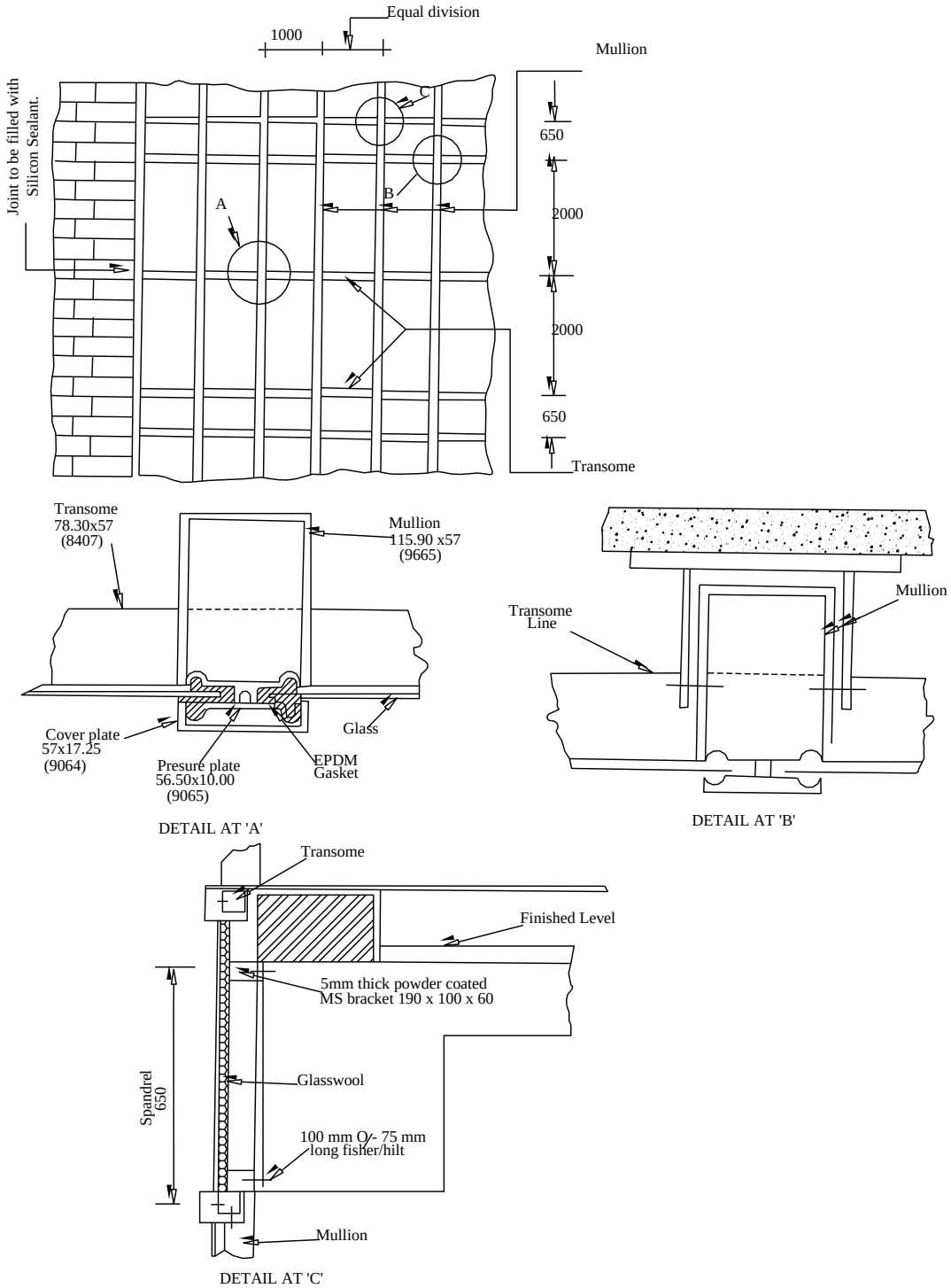


Fig . 8.16 B Aluminium Frame out of Aluminium Extruded Sections in Elevation for Curtain Wall System

ALUMINIUM STAIRCASE RAILINGS AND BALUSTERS

FIGURE 8.18 A to C

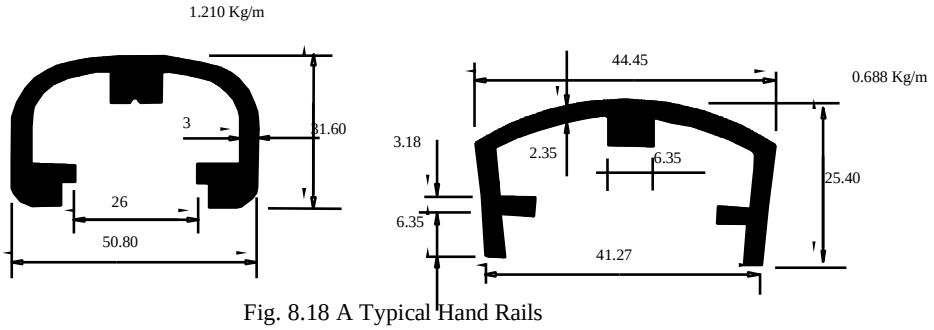


Fig. 8.18 A Typical Hand Rails

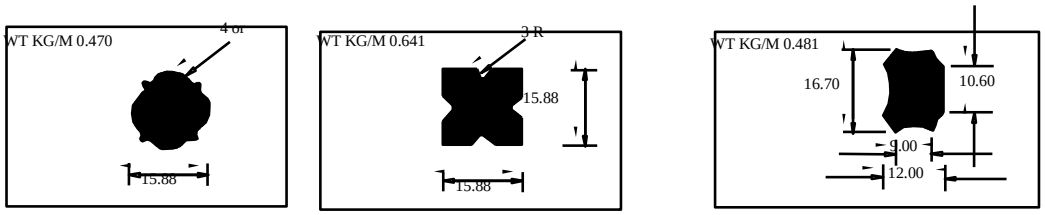
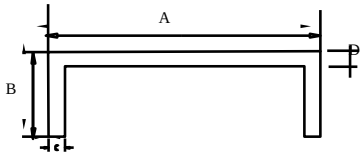


Fig. 8.18 B Typical Baluster



SI. NO.	A	B	C	D	WEIGHT Kg/M.
1	12.00	9.00	0.62	0.62	0.048
2	15.00	12.00	1.10	1.10	0.109
3	54.00	32.00	3.00	3.00	0.907
4	60.00	30.00	4.00	4.00	1.210

All dimensions are in mm

Fig. 8.18 C Channels - Square Fillet

STRUCTURAL GLAZING

FIGURES 8.17

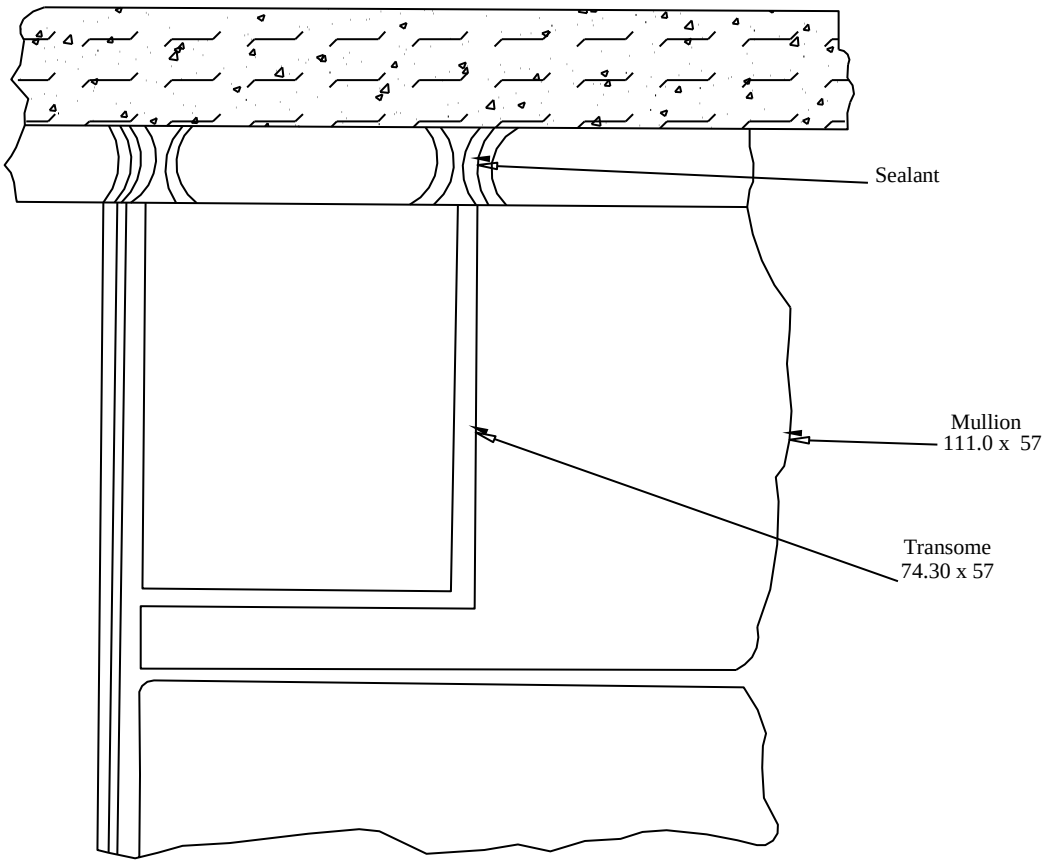


Fig. 8.17 Placement of Mullions and Transome and the Sealant between RCC Surface and Transome in structural Glazing Work