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### APPLICATIONS

The two photographs above make a strong statement about the application of steel windows, both stylistically and pragmatically. Steel windows are "at home" in any home, and equally suitable for commercial buildings, churches, schools, hospitals and public buildings. Steel windows cannot be placed in a design pigeonhole because their narrow sightlines, strength and proven durability have served architects for hundreds of years. And so every page of this guide reveals typical (or not so typical) steel window projects expressing the sharp aesthetic differences from classic Tudor homes to Frank Lloyd Wright inspired public structures; from renovated offices in Raleigh, to a noted university campus in Pasadena and a studio in Manhattan. There are specialized solutions for commercial structures, fire rated installations, and customized entrances.

This manual provides a comprehensive guide for the selection of many varieties of steel window products, whether fixed or ventilated; hot-rolled or cold-formed; commercial, light or heavy intermediate sections; and fire rated products. Industry specifications are available from the Institute at our web site or upon request.



Generations of architects have selected windows for use in virtually every conceivable setting – in traditional structures and the most contemporary buildings. Architects worldwide have relied on the unique, timeless qualities found only in steel windows to create buildings which can evoke classic, old-world themes or bold, challenging statements that propel us into the future. Here are a few reasons why you will want to specify steel windows on your next project...

# NARROW SIGHTLINES

No other quality is more readily associated with steel windows than this attribute. Ironically, the sense of gracefulness and minimal space derives from the massive strength of the material itself. This aesthetic virtue cannot be duplicated in aluminum, wood or plastic – such sightlines can belong only to steel windows.

#### STRENGTH

Steel windows are stronger than any alternative material. By direct comparison, they are three times stronger than aluminum.

This advantage permits the use of immense glass lites, often in spectacular openings.

Hardware fastened to steel windows will not pull out, and ventilators will not distort or rack with age.

# VERSATILITY

Steel windows have been used in municipal buildings, museums, churches, private homes, commercial buildings, schools and universities, terminals, manufacturing facilities, hospitals, retail stores, institutions and detention facilities. Windows, doors and window walls can be used on the exterior and often are used as interior elements as well.

#### EXTENSIVE LIFE CYCLE

Because steel windows are inherently more durable than almost any material used in construction, their life cycle is unsurpassed. Steel windows can remain highly functional after three generations and are often replaced only to make use of new glazing, finishing or ventilator technology.

#### FIRE RATING

Simply stated, window frames cannot be fire rated if they are not built from steel. Steel window manufacturers offering fire rated designs provide independent laboratory fire labels with their products. Fire rated windows are not confined to fixed lites. They can be fabricated in casement designs as well as projected, double hung and slider ventilator configurations.

#### THERMAL PERFORMANCE

The thermal performance of steel windows is frequently compared to aluminum "thermal break" windows. Independent lab tests conducted twenty years ago remain highly relevant and reveal much about U-Value and R-Factor comparisons of these two window materials and designs.

1" insulating glass of a given size performed

to a U-Value of .52. A ventilated heavy intermediate steel window of equivalent dimensions glazed with 1" insulating glass performed at U=.64. Performance of an aluminum thermal break window of equal dimensions with identical glazing and similar ventilator section was only marginally improved with a U-Value of .62.

Such negligible differences have led many architects to conclude total window performance should always be considered, rather than the coefficient of heat transfer for the frame material alone.

The advent of aluminum thermal break designs caused some controversy in this regard. Because heavy intermediate steel sections have five times the thermal resistance of a typical aluminum extrusion, they do not require thermal breaks to achieve similar test results. Aluminum extrusions, however, transfer heat more efficiently and are therefore prone to sweating. Thermal breaks have been the most expedient method for reducing heat transfer and the sweating phenomenon in aluminum windows. Since steel windows are less susceptible to condensation, thermal breaks are unnecessary. It should be noted that interior condensation is not an index of total window performance. Any window material or interior wall surface can be made to sweat where humidity is allowed to exceed prudent levels.

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#### **CASEMENT WINDOWS**

Casement or side-hung ventilators which swing outward, have hinges, locking handles, sill operators, or simplex hardware as required by project specifications. Ventilators may also be designed to open inward and have hinges, simplex hardware and a sill pull.

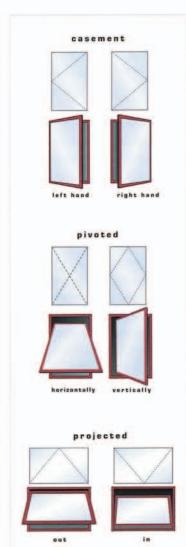
(a) Hinges shall be extension or close type, friction or non-friction type, made from steel, stainless steel, or bronze with non-ferrous pins or steel pins with non-ferrous bushings or washers. Two hinges are provided per ventilator, except for ventilators exceeding 5'6" in height, which are supplied with three hinges or two hinges and a midpoint closing mechanism.

(b) A single locking handle, manufacturer's standard, shall be furnished for each ventilator except for ventilators exceeding 5'6" in height, which are supplied with two point locking devices or two individual locking handles.

(c) When underscreen operators are specified, they shall be in accordance with manufacturer's standard, and non-friction type hinges shall be furnished.

(d) Locking handles and underscreen operator housings shall be manufacturer's standard design. They shall be attached securely to the windows with brass or other corrosionresisting screws.

(e) Adjustable friction limit devices may be used instead of friction hinges.



#### PROJECTED WINDOWS

Projected-out ventilators shall have top rail sliding downward and the bottom rail swinging outward and upward. Projected-in ventilators shall have bottom rail sliding upward and the top rail swinging inward and downward.

(a) Each ventilator is balanced on two heavy steel side arms attached securely to the ventilator and to the frame, and two non-ferrous friction shoes sliding in the channel of the jamb frame sections which shall hold the ventilator firmly in open positions. As an option, ventilators may be balanced on 4 bar steel hinge assemblies. Supporting arms and hinge assemblies shall be concealed when ventilator is closed.

(b) Projected-in ventilators shall be provided with locking handles or spring catches. Projected-out ventilators shall be provided with locking handles or manufacturer's standard under-screen operator when specified. If the locking rail of ventilator is more than 6'6" above floor level, hardware designed for pole operation shall be furnished. Ventilators exceeding 4'8" in width are supplied with two locking handles.

(c) Locking handles, spring catches, and underscreen operator attachments shall be manufacturer's standard design. They shall be attached securely to the windows with brass or other corrosion-resisting screws.



# DOUBLE AND SINGLE HUNG WINDOWS

Double hung ventilators can be raised and lowered within a double channel frame, the bottom unit within the inner channel and the upper unit within the outward channel (upper unit to be lowered for maintenance purposes by the release of retaining angles located at the bottom of each upper ventilator). Positioning of ventilators in the frame controls the amount of ventilation. Closing requires both units to be fully extended and locked at the horizontal center rail. Single hung ventilator requires that the upper exterior unit be non-operable, and that the lower unit be operable.

(a) Each ventilator shall have one sash balance attached securely to each jamb of the ventilator and to the frame which shall hold the ventilator firmly in an open position. Fusible links (if required) shall be fastened at the head of each balancer of the lower ventilator so that the ventilator may close automatically in case of fire.

(b) Ventilators shall have a sweep lock at the horizontal center rail. Furnish two sweep locks for ventilator exceeding 3'2" in width.

(c) Sweep locks and lift handles shall be the manufacturer's standard design and shall be attached securely to the windows with brass or other corrosion-resisting screws.

#### **AWNING WINDOWS**

Awning windows provide simultaneous operation for large areas of outward opening ventilators. Ventilators linked in unison are activated and controlled by means of a detachable crank handle at the sill. For windows where sills are out of reach, remote controls can be provided for manual or electrical operation. Windows shall be made from heavy intermediate materials and construction as described on pages 8 and 9 under windows from hot-rolled sections.

#### FINISHES

At one time, the concern over rusting deterred some architects from designing



with steel windows. Not today. Modern technology enables manufacturers to produce windows which will remain virtually rust-free. Members of the Institute can provide a variety of factory applied, corrosion inhibiting finishes including: galvanizing, powder coatings, urethane enamels and more. And factory finishes are not just durable, they're beautiful to look at as well. There are virtually no limitations on color selection when factory finishing—
manufacturers are able to supply color coatings to match any color provided by the architect.

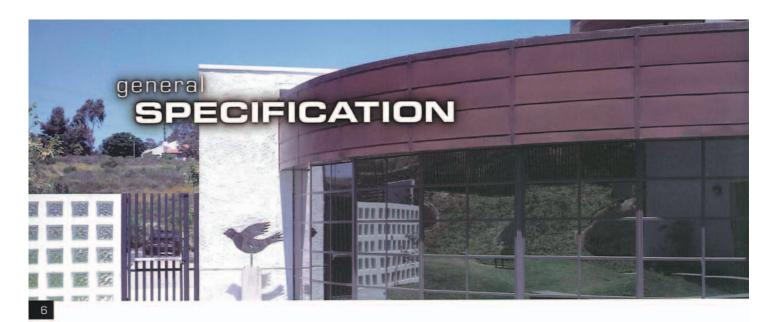
AVAILABLE OPTIONS — Members of the SWI are capable of customizing their products to meet architect's finish requirements

#### a) PRE-TREATMENT.

- Galvanizing. All steel, except screens, shall be properly cleaned and:
  - Hot dip galvanized
     (ASTM A 123) and/or
     electrogalvanizing (ASTM B633)
     or equivalent standards.
- II. Bonderizing. All steel, except screens shall be properly cleaned and:
  - 1. Zinc coated, phosphate treated.

 b) PRIME COAT. Properly treated and prime painted with manufacturer's standard prime paint.

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c) FACTORY FINISHES. Prime painted with manufacturer's standard prime paint, followed by a color coat of manufacturer's standard finish paint. Color of finish paint to be selected by the architect from manufacturer's standard colors.

Install windows into prepared openings,

#### INSTALLATION

prepared by others, in strict accordance with approved shop drawings. Set units plumb, level and true to line, without warp or rack of frames or ventilators. Anchor units securely to surrounding construction with approved fasteners. The exterior joints between the windows, trim and mullions shall be properly sealed watertight with an approved sealant and neatly pointed. Attach ventilator hardware and adjust ventilators to operate smoothly, free from twist and be weathertight when closed prior to field glazing. Ventilators remain closed and locked during glazing. The field painting of windows must be performed prior to installation and shall include paint coverage to all surfaces of the frame and ventilator. On factory finished windows, repair any abraded area of the factory finish. Cleaning of masonry and other exterior or interior surfaces prior to installation is recommended. The General Contractor is responsible for

protection of the windows and related materials during storage on the job and during and after installation, and for any protection required due to cleaning of adjacent materials. Window installer shall leave the surfaces clean and the General Contractor shall be responsible for final cleaning.

#### GLASS AND GLAZING

Glass contractors must make templates and check all measurements from the completed window and not from the window shop drawings. Windows can be prepared for either glazing compound or manufacturer's standard metal bead glazing. Factory glazing may be available, consult individual manufacturers. Steel window frames are designed to complement watertight glazing systems. The use of weep holes through glazed areas to drain accidental moisture is not recommended. Weep holes admit wind driven moisture to an otherwise dry glazed surface and create a source for air infiltration.

# ACCESSORIES

Manufacturing members of the SWI can supply a wide range of accessories for installation and operation of steel windows. They include: insect screens, associated components such as trim and mullions, mechanical operators, and anchor clips. In addition to manufacturers standard designs, custom or modified designs can be supplied by individual manufacturers. Inquire with individual manufacturers for designs.

- (a) Anchor clips and mullions necessary for installation of windows and hardware for operation of the ventilators, including fasteners required for attaching such items to the window, shall be provided by the window manufacturer.
- (b) Screws, shields, plugs or other fastenings into the building construction and sealant material for metal to metal joints within the window opening are furnished by the window installer.
- (c) Furnishing and application of perimeter caulking between windows and building construction shall be the responsibility of the appropriate subcontractor as required under the caulking sections of the specification.
- (d) Insect screens screen frame shall be of formed electro-galvanized steel having a minimum thickness of 0.032", or of formed or extruded aluminum having a minimum thickness of 0.040". Screens shall be rewirable with 18"x 14" mesh cloth of bronze, 18"x 16" mesh cloth of aluminum, or fiberglass. The nominal diameter of the cloth shall be not less than 0.0113" for



bronze and 0.011" for aluminum. Wire cloth shall be held taut with removable spline. Screens with sliding or hinged wicket shall be furnished where required. Screens shall be the removable type, held in place by clips.

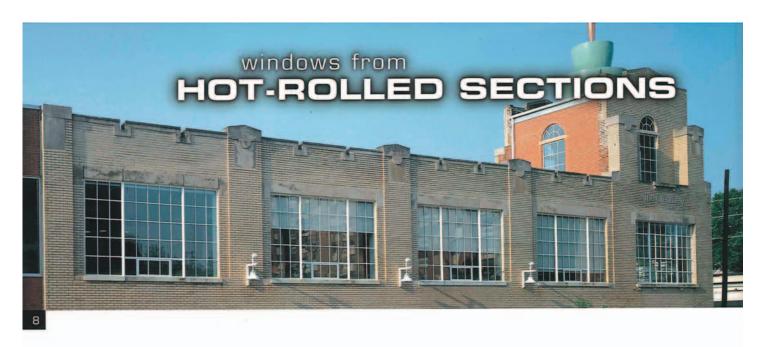
(e) Mechanical operators - (Manual or Electrical Control). Mechanical operators provide for operation of the window ventilators that are inaccessible for normal hand operation, or for group control of several ventilators simultaneously from one central point. Common types of mechanical operators suitable for use with sidewall windows: the torsion lever arm type, tack and pinion type and screw type. Operators can be surface mounted or concealed inwall systems. Consult individual manu-

facturers for details.

(f) Mullions shall be standard tee bar, channel or plate type and not less than 12 gauge thick. Mullions shall be bolted or clipped securely to the window to form a rigid assembly. Mullion covers shall be included as standard. Note: mullions for cold formed windows shall be not less than 20 gauge thick, channel or plate type.



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	Light Intermediate	Standard Intermediate	Heavy Intermediate	Heavy Custom		
Weight Lbs./Lin. Ft.	2.0	3.0	3.5	4.2	•	Minimum combined weight of outside frame and vent frame members in pounds/lineal foot
Depth-Inches	1.00	1.25	1.31	1.50	•	
Casement	Maximum	Maximum Recommended Vent Sizes				Neither ventilator no supporting frame sh
Width	1'-111/4"	2'-3"	2'-6"	3'-0"	•	have depth, front to back, of less than
Height	4'-13/8"	5'-6"	6'-0"	8"-0"	thos	those shown
Projected In or Out						- Dimensions are from center to center of
Width		4'-8"	5'-0"	6'-0"		webs of mixed bars framing the ventilal
Height	1	2'-8"	3'-0"	4'-0"		

# MATERIAL

These windows are made from solid steel sections which have been hot-rolled from new billet steel into carefully designed profiles or shapes to form frame assemblies and ventilator assemblies. There are four types of hot-rolled steel windows, defined and categorized by the weight per lineal foot of the combined frame and vent members. The categories are: Light Intermediate – 2.0; Standard Intermediate – 3.0; Heavy Intermediate – 3.5; Heavy Custom – 4.2.

# CONSTRUCTION

- (a) Window frame and ventilator sections shall be solid, one-piece sections with welded and dressed corners.
- (b) Flanges forming the weathering contacts shall be rolled integral with sections to provide close contact with both inside and outside points of closure.
- (c) Weatherstripped Ventilators.
- All operable windows shall be provided with weatherstripping, such that when tested in the closed and locked position in accordance
- with ASTM E-283 before leaving the factory, the air infiltration shall not exceed 0.37 cubic foot per minute per foot of crack length when subjected to a pressure differential across the window of 6.24 pounds per square foot equivalent to a wind velocity of 50 miles per hour.
- All operable windows shall be provided with weatherstripping, such that when tested in the closed and locked position in accordance

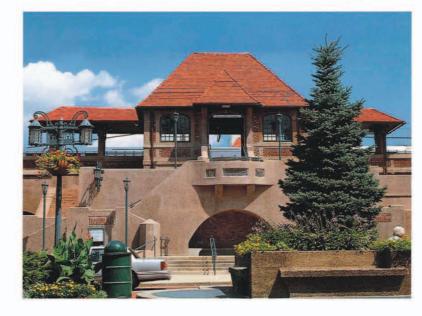


with ASTM E331, no water penetrates for 15 minutes when a window is subjected to a rate of flow of 5 gal./hr./sq. ft. with a pressure differential across the window at 2.86 PSF.

- (d) Non-weatherstripped Ventilators.
  - The metal to metal contacts between non-weatherstripped ventilators and frames shall, when ventilators are closed and locked before leaving the factory, be as follows:
  - a.) In side-hung ventilators it shall be impossible to freely insert

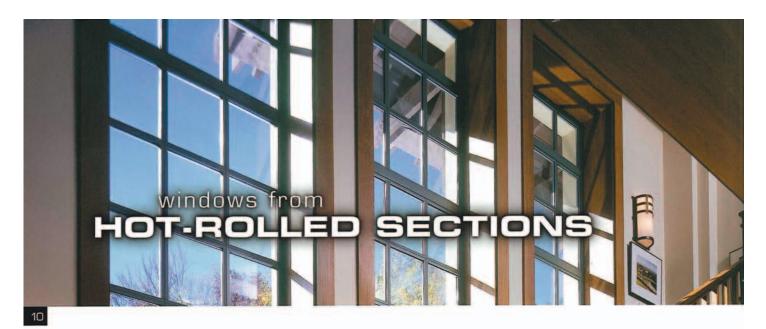
- (without forcing) a steel feeler gauge 2" wide by 0.020" thick between the inside contact of more than 40% of such contacts.
- b.) In projected ventilators it shall be impossible to freely insert (without forcing) a steel feeler gauge 2" wide by 0.031" thick between more than 40% of such contacts.
- c.) The foregoing limits air infiltration to a maximum of 1 cu. ft. per minute per lineal foot of crack length when

- subjected to a pressure differential across the window of 1.56 pounds per square foot equivalent to a wind velocity of 25 miles per hour.
- (e) Muntin bars, except where interrupted by ventilators, shall be interlocked and continuous from head to sill and jamb to jamb except that bars in one direction may be discontinuous if they are securely welded at the intersection. Muntin bars shall be coped, tenoned and riveted, or solidly welded to their outer frames.
- (f) Outside frame members shall be of unequal leg design, to lap masonry by not less than 1/2". To meet special conditions, outside frame members may have equal legs, or equal legs with attached continuous fins.
- (g) The manufacturer will provide a drip member above all open-out, side-hinged ventilators. Bottom perimeter frame member for projected and side-hinged ventilators shall have weep holes or notches leading to the exterior.



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# INDUSTRIAL WINDOWS

#### MATERIAL

Principal members shall be hot-rolled new billet steel. These members shall be nominally 1-3/8" in depth, except that members nominally 1-1/4" in depth may be used provided frame and ventilator corners are welded. Muntin bars to be continuous from head to sill and jamb to jamb. Sections shall be nominally 1/8" in thickness. Applied weathering members shall be hot or cold-rolled low carbon steel, nominally 0.060" thick.

### MAXIMUM VENT SIZES

Industrial Projected and Pivoted Windows Only. The recommended maximum sizes of ventilators shall be 5'0" in width and 2'8" in height, with vertical muntins in ventilators as shown on standard types. Dimensions are taken from center to center of the webs of the fixed bars framing the ventilators.

# CONSTRUCTION

Framing members shall be welded or interlocked rigidly at joints with accurate and close fits. Welded joints shall be dressed on weathering contact surfaces and on exposed surfaces of all windows. Glass rebates shall be not less than 5/16" high and provide for inside glazing. Frame design shall provide for mounting insect screens between ventilators and grille.

# VENTILATORS

- (a) Industrial Projected Refer to projected windows on page 4.
- (b) Casement Vents Refer to casement windows on page 4.
- (c) Horizontally Pivoted Ventilators shall be pivoted nominally 2" above their centers. They shall have locking devices as required by project specifications. Hinges shall be butt or pivot type. Ventilators

shall have cam handles, push bars, or chain control devices for individual operation per manufacturer's standard in steel, iron or die cast metal. Chains shall operate on pulleys, guide brackets, or idlers and be provided with slips or cleats to hold ventilators open in any desired position.

#### MULLIONS

Refer to Accessories - paragraph (f) on page 7.













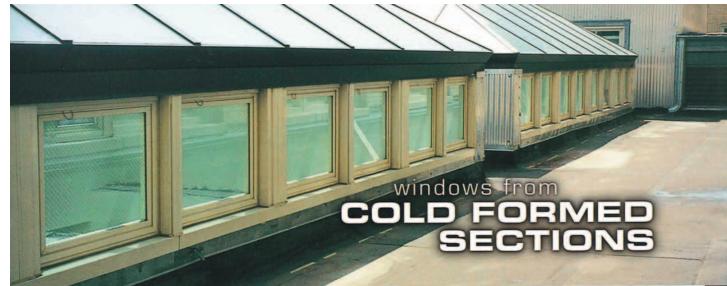
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#### INTRODUCTION

These windows are made by mechanically forming various profiles or shapes from 20 gauge low carbon cold-rolled steel. Various shapes are then combined to form frame assemblies and ventilator assemblies. Windows from cold-rolled steel are defined and categorized as commercial and industrial windows with a minimum combined weight of frame and ventilator of 2.75 lbs. per lineal foot and capable of passing a structural load test of 30 lbs. per square

#### MATERIAL

Sections to be used in the manufacture of these windows shall be composed of ASTM A653 low carbon cold-rolled formed steel

- sections with a thickness of 20 gauge and shall be so constructed that the glass in each window shall lie in the same plane within a tolerance of 1/4". The size of the frame and ventilator members shall be as
- (a) Neither ventilator nor supporting frame shall have depth, front to back, of less than
- (b) Muntins Tee shaped face (min.) 1-1/4".

# CONSTRUCTION

- (a) Frame and ventilator sections shall be cold formed and members shall be mitered and key cornered.
- (b) A butyl sealant shall be applied and corners shall be mechanically fastened so as to create a close fit.

- (c) Optional weatherstripping.
- 1. All operable windows shall be provided with weatherstripping, such that when tested in the closed and locked position in accordance with ASTM E-283 before leaving the factory, the air infiltration shall not exceed 0.37 cubic foot per minute per foot of crack length when subjected to a pressure differential across the window of 6.24 lbs. per square foot equivalent to a wind velocity of 50 miles per hour.
- 2. All operable windows shall be provided with weatherstripping, such that when tested in the closed and locked position in accordance with ASTM E331, no water penetrates for 15 minutes when a window is subjected to a rate of flow of 5 gal./hr./sq. ft. with a pressure differential across the window at 2.86 PSF.

# HORIZONTAL AND VERTICAL SLIDERS

- (a) Single and double hung sash shall be fully counter-balanced at any desired position by means of adjustable balance mechanisms.
- (b) Horizontal sliding windows shall be operable with single sash or double sash style as specified.



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Fire rated or labeled windows are used in window openings where it is necessary to restrict the spread of fire and smoke within buildings, whether from interior fire or from external fire. The determination as to where a fire rated window is required is governed by the building code and federal and state laws. The architect should follow these codes. Individual manufacturers should be contacted to determine which of their windows meet the fire rated window requirements.

# GENERAL

Only labeled windows shall be used in window openings. The label on 3/4 hour fire windows for wall openings will stipulate testing laboratory. Fire rated windows shall conform to applicable specification of ASTM E163 and NFPA Standard 80.

# GLASS

Only labeled fire protection rated glazing material shall be used in fire windows. The individual glazing material exposed area shall not exceed 1296 sq. in. with no dimension exceeding 54 in. unless otherwise tested. Consult window manufacturer. When continuous glazing angles or channels are used to hold glass in a window, these continuous members must

#### MAXIMUM SIZE OPENING

Heavy intermediate, heavy custom, coldrolled, and industrial windows will be used for openings not exceeding 84 sq. ft. in area with neither dimension exceeding 12 ft. When multiple units are installed, the distance between unprotected vertical steel mullions shall not exceed 7 ft. Standard intermediate types may be used for openings not exceeding 60 sq. ft. in area with neither dimension exceeding 10 ft. When multiple units are installed, the distance between unprotected steel mullions shall not exceed 6 1/2 ft.

# HARDWARE

Operable fire windows shall have manufacturer's standard approved hardware.

#### INSTALLATION

Fire windows must be securely fastened to the wall and be capable of resisting all wind and other stresses for which the window was designed. The window manufacturer is not responsible for fire rating of adjacent walls.







# STEEL CASEMENT

Casement doors can be single or double swing doors fabricated from window sections previously described and may be designed to open in or to open out. Doors can be manufactured from either hot-rolled steel sections or cold-formed sections. These doors offer narrow sightlines and can be used for interior or exterior applications. Hardware availability includes hinges, latching systems, thresholds, closers and door holders. Doors can be designed with custom lock boxes and kick panels. For material, finishes, construction, glazing, installation, and accessories, refer to pages 5 - 7 and 10.

# FORMED, STEEL CONSTRUCTION DOORS

Custom formed steel construction doors and perimeter framing are intended for heavy traffic entrances. Hollow construction doors offer seamless stile faces and design flexibility to accommodate required sightline and hardware concealment. Hot-rolled steel or formed steel muntins are available. Glazing beads are furnished and the door stiles may be filled with an insulating material. Hardware availability includes hinges, latching systems, thresholds, closers and door holders. For material, finishes, construction, glazing, installation and hardware, contact SWI for specifications and manufacturers.





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