FRAMELESS GLASS DESIGN

Norfab – JCU Townsville: 13.52mm Toughened Laminated

FRAMELESS GLASS DESIGN

Glass is used to make dramatic statements in architecture. Its smooth surface, clean and angular lines feature and complement interiors and exteriors either on its own or in combination with other building materials or elements. Glass design is about emphasising its remarkable visual aesthetic, transparency, creating that minimalist look with less traditional framing.

Frameless glass is a general term for glass with little to no visible framing members. Most common applications are retail shop fronts where the unimpeded visual display of goods is most important. Frameless glass is also increasingly being installed in residential applications such as shower panels and balustrading where clean glass lines are preferred to framing members. This section highlights the many different frameless glass applications and installations.

Typically minimum glass thickness will be 10mm toughened safety glass, but this depends on the size, application and location of the glazing. Table A shows typical glass thickness by type.

PIVOT DOORS

Pivoting glass doors and associated panels such as sidelites and highlights must be a minimum of 10/12mm toughened safety glass (Please check with AS1288 to determine actual thickness required). These doors are the most common frameless type used in commercial and residential applications. The doors use either a concealed top or bottom self closer mechanism with a pivot point connecting to a discrete metal patch fitting at the top and bottom corners of the door or alternatively, a full width metal door rail can also be used.

CORNER PATCH FITTING DOORS

Shown as Type B combination and Type C doors on Diagram 1.0, patch fittings are simply a bolt through glass metal fitting requiring a corner cutout and hole in the glass. These discrete patches provide a sleek and clean frameless look, ideal for shop displays.

A lock body patch fitting can also be installed. The patch body covers are available in a variety of finishes including anodised, powder coated, plated brass and stainless finishes.

Maximum door sizes using 10/12mm thickness glass is 2400mm x 1000mm. 15mm glass thickness 2400mm x 900mm. Bigger size doors should use a top and bottom full length rail. Please note that wind-loading and other loading considerations may override the sizes and thicknesses noted above. Please check with the appropriate standards.

FULL LENGTH RAIL DOORS

Shown as Type A and combination Type B doors on Diagram 1.0, these metal rails are clamped onto the glass edge. No holes or cutouts required. The main features of the rail are to act as a 'kick plate' to lesson chance of glass breakage and for oversize doors, where the patch fitting is not suited. Rail body covers are available in a variety of finishes including anodised, powder coated, plated brass and stainless finishes.

Type A top and bottom rail toughened entry doors.

Type C top and bottom corner patch toughened entry door.

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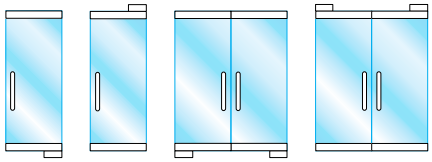
TABLE A: GLASS TYPES FOR FRAMELESS GLASS				
	10mm	12mm	15mm	19mm
Clear	✓	✓	✓	✓
Extra Clear	✓	✓	✓	✓
Grey	✓	✓		
Bronze	✓			
Acid Etched	✓	✓		
SOL-R™ Clear and SOL-R™ Neutral low-E, Neutral Sunergy®	✓			

DIAGRAM 1.0: FRAMELESS PIVOT DOOR AND ENTRY TYPES.

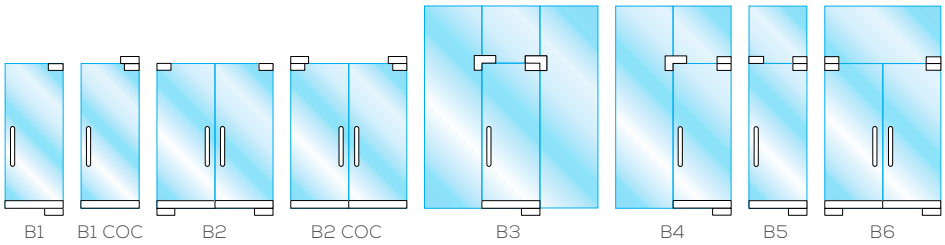
TYPE A:

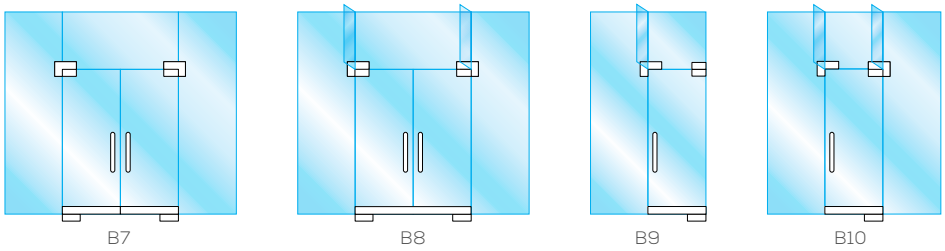
Full length top and bottom rails.



TYPE B:

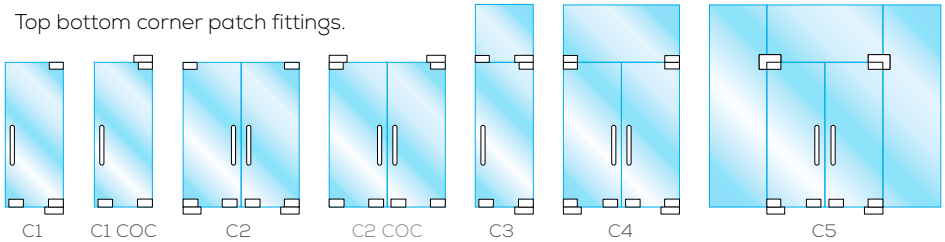
Top corner patch fitting and full length bottom rails

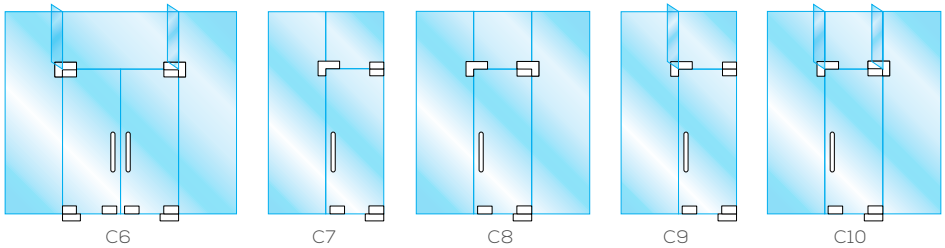




TYPE C:

Top bottom corner patch fittings.





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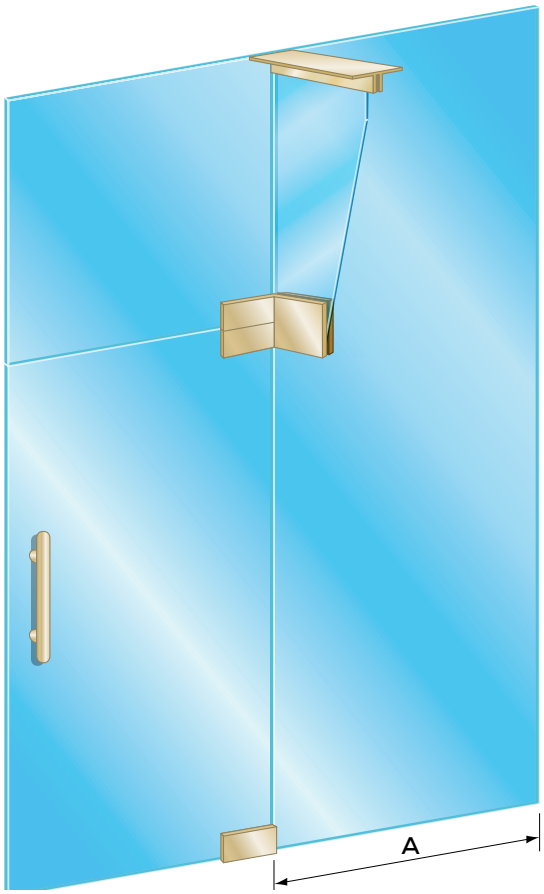
HIGHLITE GLASS FIN DESIGN

Some frameless door entry types require stabilising toughened fins to reduce deflection created by the loads acting on the entry. These include external and internal wind loading, human impact and the motion of the door during operation.

Minimum design requirements are:

- Fins should always be mechanically fixed to the structure by means of a back to back steel or stainless steel fin bracket;
- Structural fins should not be less than 12mm in thickness and should always be toughened (see Diagram 1.2 over page);
- Internal entries – When the width of the sidelite (A) plus the height of the highlite (B) exceeds a total of 1000mm a structural fin is required (see Diagram 1.1);
- External entries – A wind-load design should always be carried out to determine thickness and width of fin.

DIAGRAM 1.1:



Typical cantilevered fin with bolt through back to back stainless steel head mounted fin bracket.

Cantilevered glass with bolt through stainless steel head mounted bracket and 2 way spider fixing for face glass connection.

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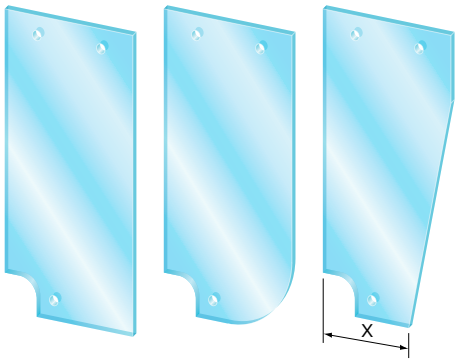
DIAGRAM 1.2: CANTILEVERED FIN DETAIL



With highlite fin designs, (X) must be no less than 2/3 of the fin width required.

CENTRE FIX PIVOT DOORS

This pivot system is used when a larger door width is required. (e.g. greater than 1000mm). The pivot point is moved towards the centre of the door. One point to be aware of is that the door glass will extend out more so than a normal pivoting door when open. Centre fix bottom patch shown is also available in rails.

OFFSET PIVOT DOORS

In this pivot system the pivot centre is not directly under the glass. It is offset to one side allowing the door to swing back 180°, finishing parallel with the sidelite. This pivot system can only work on floor springs or free pivots and additional lock troughs are required to hold the door open in the open position. The offset bottom patch is as shown, but it is also available in rails.

PIVOT DOOR CLOSERS

Self closing concealed overhead closers and floor spring closers are required to prevent the door from opening or shutting forcefully during normal use and high wind situations. Different closer mechanisms or types allow the door to always close (NHO non hold open) to its correct position and stay closed, or stay open at a specific angle (90° HO – hold open at 90° angle). These closers are double action, meaning that the door can swing fully through a 180° angle.

Because of the large variation of door sizes and applications, the closers are manufactured in varying closing strengths. A stronger strength spring action is required with larger doors. The stronger spring prevents the wind from opening the door and forces the door shut. The disadvantage is that the door may be more difficult to open for some people or may contravene disability regulations.

Closers can be installed over the top of the doors in the ceiling in an aluminium transom box (COC – Concealed overhead closer) or in the floor (floor spring).

A door stop is recommended where the door leaf is over 900mm wide. The stop should be located in the 100° position to prevent damage to the COC.

12mm clear toughened door with centre fix pivot

Offset pivot detail.

12mm grey toughened door with offset pivot.

Floor springs require the installer to fix the device inside the floor. Floor springs are generally specified for larger door applications or where a ceiling mounted closer is not possible.

FREE PIVOT DOORS

CASMA SMALL DOOR PIVOT SETS

Pivot doors can be installed without self closers. However, they are only recommended for doors with infrequent use or showcases. It is advisable to use door stops to prevent breakage or damage to walls. An alternative style of free pivoting door patches is the Casma 12790 small door pivot set. These top and bottom patches are suited for 8/10/12mm thickness glass up to 60kg in door glass weight. They are fixed to the head and sill and swing one way only.

Casma offset small door pivot sets.

CD131 PATCH HINGE – SIDE HINGED

Butt type hinge to suit 8/10/12mm glass thickness for glass doors up to 60kg. Maximum size doors 2100mm x 900mm. These doors are only suited for fixing into id jamb framework and swing one way only.

Dorma CD131 hinge – side hinged.

Free pivot door using Casma 12790 door pivot set.

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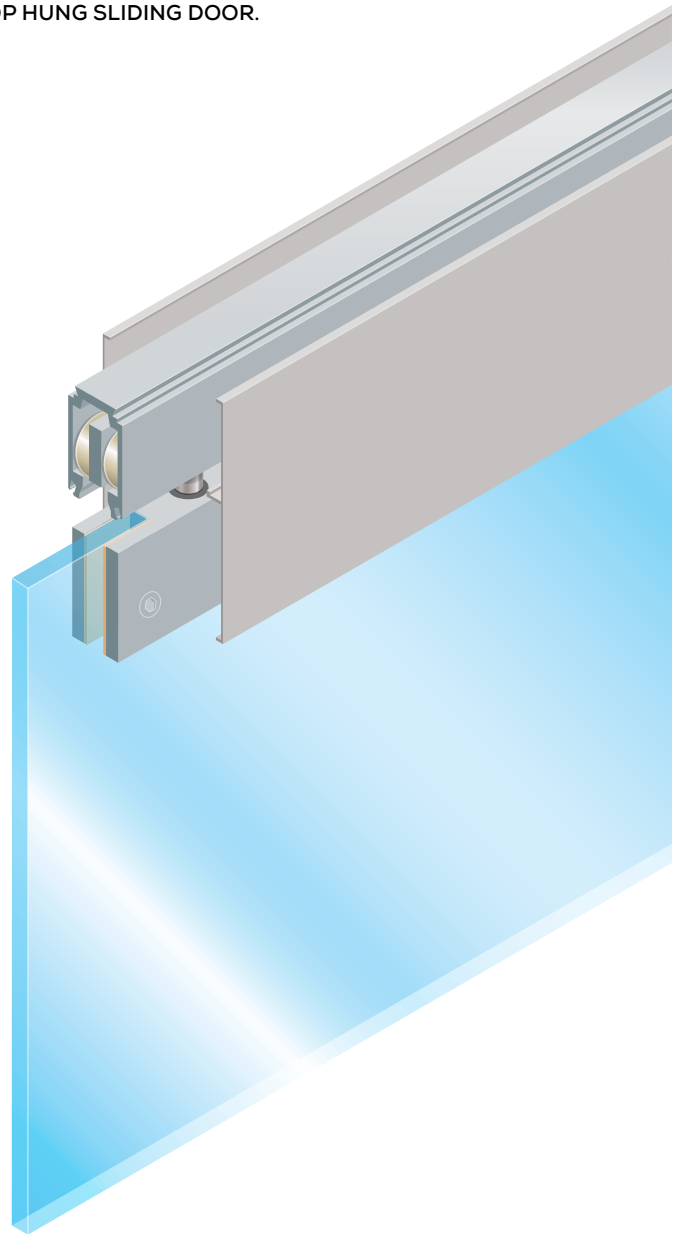
MANUAL SLIDING DOORS

There are two manual sliding systems available:

- Top hung sliding doors – These doors have suspended rollers fitted to a top patch and slide in a track in the ceiling. A floor guide is mounted on the floor at the sliding end of the opening to keep the door plumb;
- Bottom track – These doors have rollers fitted in the bottom of a rail which roll on a continuous bottom track. The top guide is a continuous top channel recessed into the ceiling. Door stops have to be fitted to the top and bottom to stop the doors at full opening and closing.

  The bottom track system has a continuous track running the full length of the opening. This may affect the floor finish and may create a stepping problem. The track will also allow dirt or rubbish to collect and the door panel must be securely locked to prevent direct lifting out of its opening.

TOP HUNG SLIDING DOOR.



Top hung sliding door.

Top hung sliding door.

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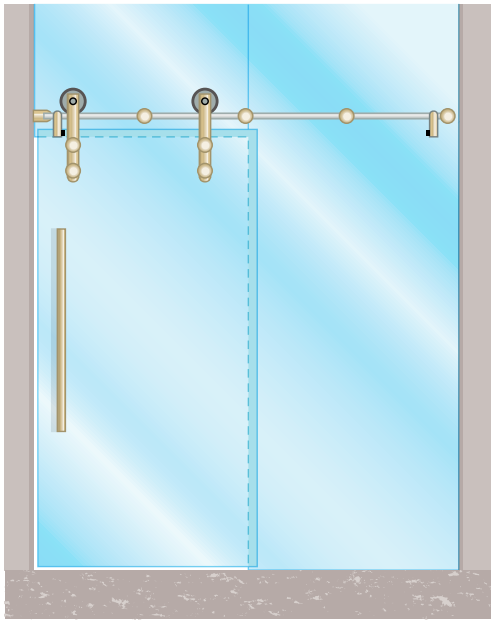
SR SLIDING DOOR SYSTEM

A design alternative to standard top hung and bottom track sliding systems, SR or stainless rod components are made from stainless steel material to suit 10/12mm toughened glass.

Sliding panel door sizes up to 2400mm x 1200mm or 90kg. Glass fixings available in either proud or countersunk flush fittings.



SR sliding door wall mounted.

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BI-FOLD DOORS

These systems provide for the open shopfront look. The panels are hinged together, fold back against each other when opened and stack against the walls at either end of the opening.

STACKING DOORS

These frameless glass door systems have been designed so that shopfronts can be left completely open during trading hours and securely locked after hours. The panels slide in a top track with a roller system and are stacked away in a storage/stacking bay either parallel or at right angles to the main track or in a stacking bay located away from the shopfront line. The stacking bays can also be located in a cupboard so that the panels will be completely out of view. Pivot doors can also be included in the system.

DIAGRAM 1.4: STACKING DOORS.

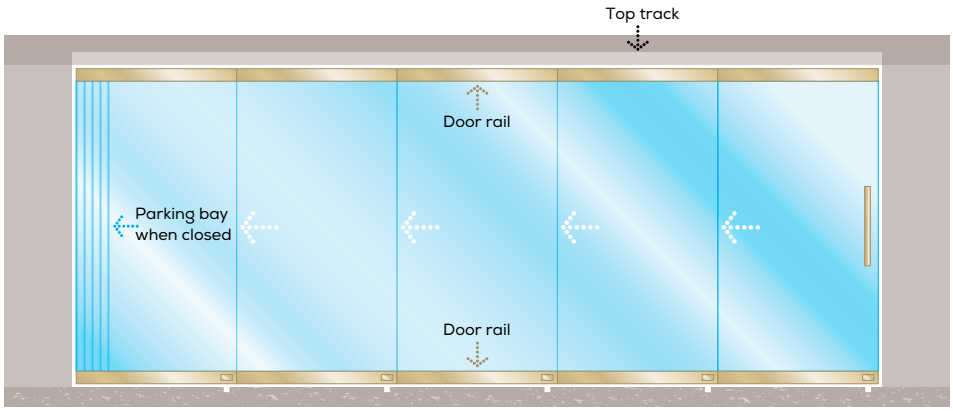
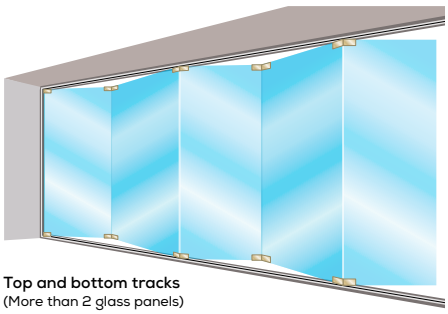
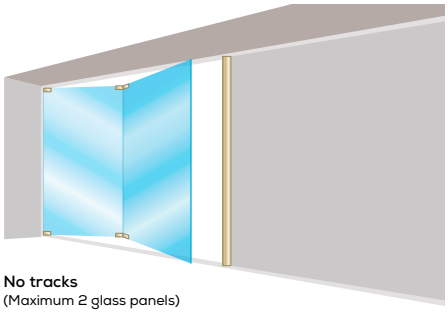


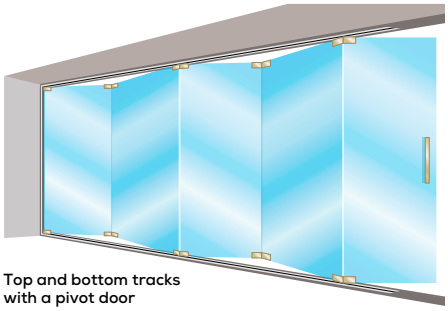
DIAGRAM 1.3: BI-FOLD DOORS.



Top and bottom tracks
(More than 2 glass panels)



No tracks
(Maximum 2 glass panels)



Top and bottom tracks with a pivot door

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GLAZED WALLS – SINGLE TIER

These glazed structures are generally bottom loaded or the glass is dead load supported by the floor. Where there is a large open expanse to be glazed, glass support fins may be required to prevent panels from being blown in or pulled out during high wind load conditions.

FIN SUPPORT

Fins which are silicone glazed to facing panels as shown, provide a four-sided support or fully framed support for these facing panels. Fins are used to prevent glass facing panels from deflecting, breaking or falling out through wind-load pressures. AS1288 requires fins where two edge only supported glazings are insufficient in coping with applicable windloads. Glass fins in most cases must run the full length of the panel height and be channel glazed or mechanically secured depending on the application. Fin thickness and width is determined by wind-load, facing panel size and silicone joint bite size.

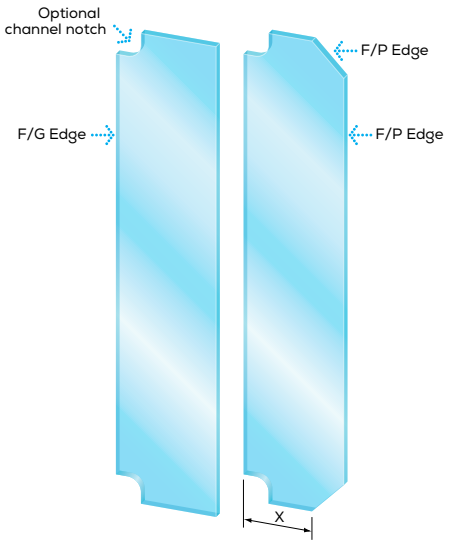
NO FIN SUPPORT

Where fins are not desired for appearance or other reasons, wind-load is a critical factor in determining glass thickness. Areas not subject to wind-load, such as enclosed shopping centres/malls, may in some situations utilise this type of shopfront design.

Single tier shopfront with full height supporting fin.

DIAGRAM 1.5: FULL HEIGHT FIN DESIGN.

With full height fin designs, (X) must be no less than 2/3 of the fin width required.



Single tier shopfront with full height supporting fin.

FRAMELESS GLASS DESIGN

GLAZED WALLS – MULTI TIER

Where openings require multi tiers or levels of glass panels, self supporting structural glass walls are mandatory. There are three types of structural glass glazing methods, suspended, stacked and structural stand-off systems. Designed for glazing large openings in buildings, these systems provide maximum visibility and daylighting. Traditional aluminium mullions or transoms are replaced by thick toughened glass fins or steel tension trusses. These fins and trusses are designed to resist wind load.

SUSPENDED GLASS WALLS

The glass panels are hung from the building structure like a curtain. The top tier panels are connected to the structure by adjustable hangar brackets and subsequent lower panels are connected by metal fittings such as spiders, at their corners. The facade is located into channels at the perimeter and all glass joints and channels are sealed with silicone sealant. The support structure, top tier glass and hangar brackets must be able to sustain the vertical weight of the glass below as well as wind loading.

The adjustable suspension system in conjunction with perimeter channels permits the system to move independently of the building structure. This compensates for construction dimensional variations and overcomes problems associated with building movement, vibration and seismic loads.

The hanging assembly is normally stabilised against wind load by glass fins located and fixed to the support structure with fittings at the corner joints. It is also possible to fix the glass panels to metal mullions, trusses, space frames or other support structures for lateral support. Depending on engineering specifications glass walls as high as 20 metres can be installed.

STACKED GLASS

The opposite of suspended systems, stacked systems allow multiple tiers to be stacked on top of each other. The glass dead load is imposed on the bottom tier panels and to the floor. The glass panels are located into channels at the perimeter and all the glass joints are sealed with silicone sealant. Like suspended systems, the glass facade is stabilised against wind load by fins or other structures. The glass panels are connected by special metal fittings to the glass fins. Depending on engineering specifications a maximum glazed height of 8 metres and no more than 2 tiers are recommended.

Multi-tier suspended glass facade system using 10mm green toughened glass.

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STRUCTURAL STAND-OFF SYSTEMS

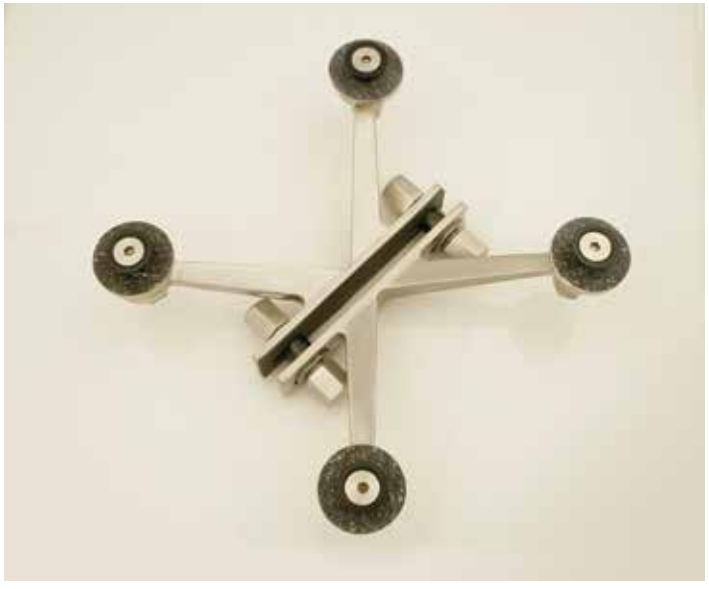
Stainless steel stand-offs or spiders are fixed to building support structures such as concrete columns, steel mullions and posts or metal/cable truss systems. This method allows the glass to be cantilevered off the support structure. The system can allow for an unlimited height in glazing provided that there are intermediary structural supports at given spans.

STRUCTURAL FITTINGS – SPIDERS

Used in glass wall and canopy openings, spider point fixings are primarily designed to connect multiple tiers or panels of glass. Spider fixings are also used in high wind load areas where conventional silicone and glass fin support are not sufficient to cope with loadings.

TYPICAL SPIDER FITTINGS.

Two way spider fixing.



Four way spider fixing.

Multi tier structural stand-off system glass facade using 30.56mm thick Cyclone resistant multi-laminated glass connected to bolt through stainless steel point fixings, fixed to stainless steel full height supports behind glass.

Multi tier structural stand-off system glass facade using four way spider fixing bolted off stainless steel fins – 12mm grey toughened glass .

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STRUCTURAL BALUSTRADING

Structural glass balustrading or barriers refers to systems which generally have few vertical or horizontal supports, where the glass has to be a safe and structurally sound component of the building.

There are many variations around what type of glass is permitted for glass balustrades or barriers let alone for structural barriers per Section 7 AS1288-2021 Glass in buildings – selection and installation. Foremost with AS1288-2021 edition is that monolithic toughened safety glass is not allowed as a barrier protecting falls equal to or greater than 5m. Another requirement is that barriers protecting a difference in levels equal to greater than 1000mm shall have a structural interlinking handrail so that in the event of breakage, the handrail will sustain the required loading. Section 7 provides many different examples and self help tables to determine what is acceptable with a interlinking hand rail.

Where no handrail is specified (with a fall greater than 1m) an engineering certification will be required for adequacy of not just the glass but the method of fixing the glass. Typically for these 'no handrail' applications, a toughened laminated glass with a stiff interlayer such as SGP is specified. Often thicker layers of SGP is required e.g., 2.28mm or 3.04mm thickness. This type of glass/interlayer make-up provides the best option for post breakage behaviour by limiting the amount of outward deflection of the glass where there is a failure of all glass lites in the laminated make-up.

12mm clear toughened glass bottom grouted cantilevered.

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DIAGRAM 1.6:

Structural glass balustrade with no handrail utilising high strength SGP interlayer. Where fall is greater than 1m engineering certification will be required for adequacy of not just the glass but the method of fixing the glass.

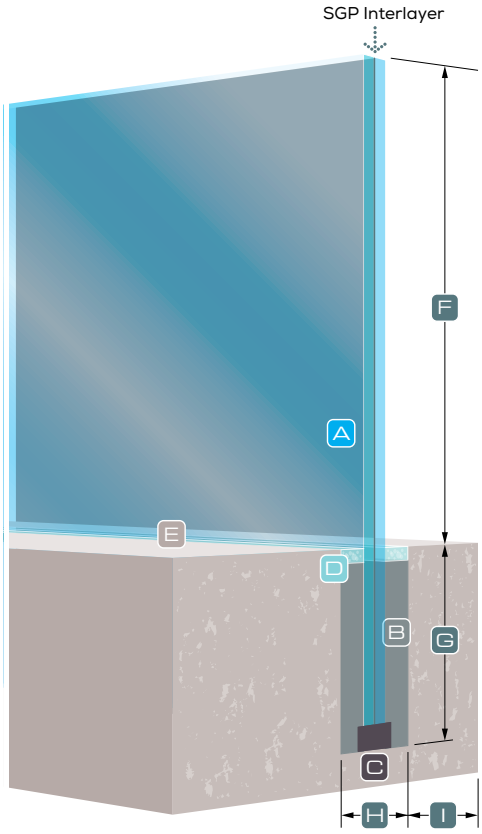
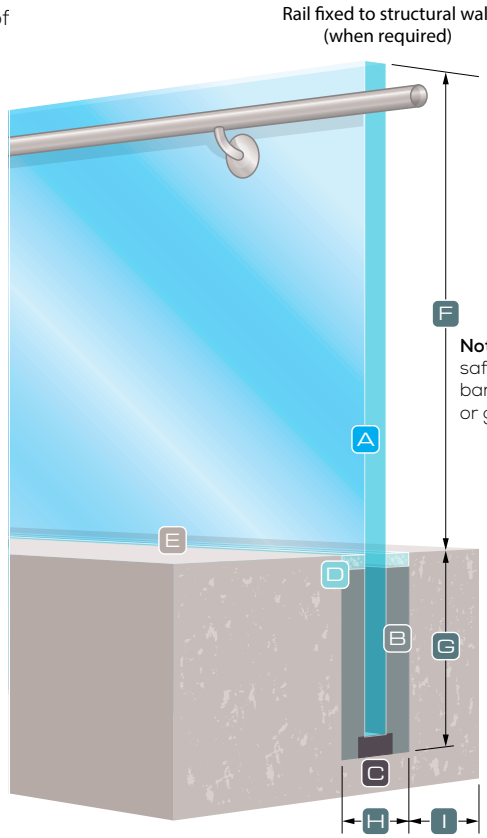


DIAGRAM 1.7:

Structural glass balustrade with handrail.



Note: Monolithic toughened safety glass is not allowed as a barrier protecting falls equal to or greater than 5m.

A. Glass panel (per Section 7 AS1288-2021).

B. Continuous non-shrinkable grout.

C. Neoprene setting block 25mm wide x 10mm high. 100mm long strips at 750mm centres.

D. Silicone topping as required.

E. Concrete channel continues the length of the balustrade. Alternative pressed steel channel may be used.

F. Height of balustrade or pool fence to standard.

G. Depth of recess 90-100mm.

H. Width of recess 50mm.

I. Minimum distance from glazing channel to concrete perimeter – refer structural engineer.

POINT FIXED

This structural balustrade system fixes the glass to concrete hobs, walls, timber and metal framing via bolt through stainless steel point fixings or stand offs. Most intended glazing applications require specialist engineering to determine the following (see Diagram 1.9):

- Glass thickness, type, width of panel (A);
- Number of fixings, diameter size, length of point fixing or stand off and length of fixing rod (B) (see also stand-off detail, Diagram 1.8);
- Minimum distance between holes, hole to glass edge and concrete edge (C);
- Type of hob/structure construction and width to determine adequacy or strength of the hob/structure to take loading imposed by the balustrade (D).

Further to the above, the balustrade must comply to minimum height regulations (E) with no ability to use the backing hob or fixing structure as a climbable mount (F). Gap between glass must be in accordance with minimum regulations (G).

Note:

- Monolithic toughened safety glass is not allowed as a barrier protecting falls equal to or greater than 5m;
- Barriers protecting a difference in levels equal to greater than 1000mm shall have a structural interlinking handrail so that in the event of breakage, the handrail will sustain the required loading;
- Where no handrail is specified (with a fall greater than 1m) an engineering certification will be required for adequacy of not just the glass but the method of fixing the glass.

DIAGRAM 1.8: TYPICAL STAINLESS STEEL POINT FIXING (STAND OFF).

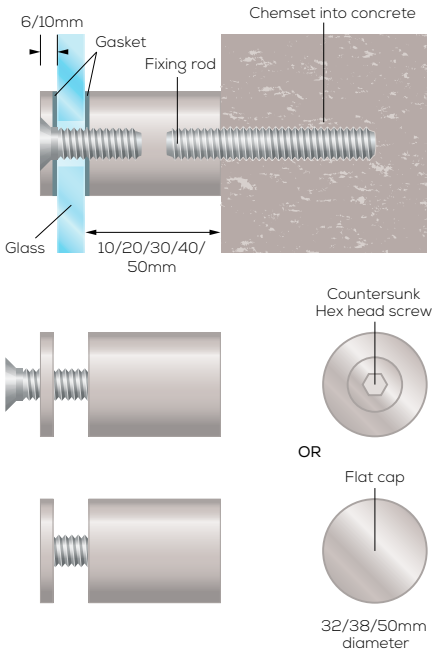
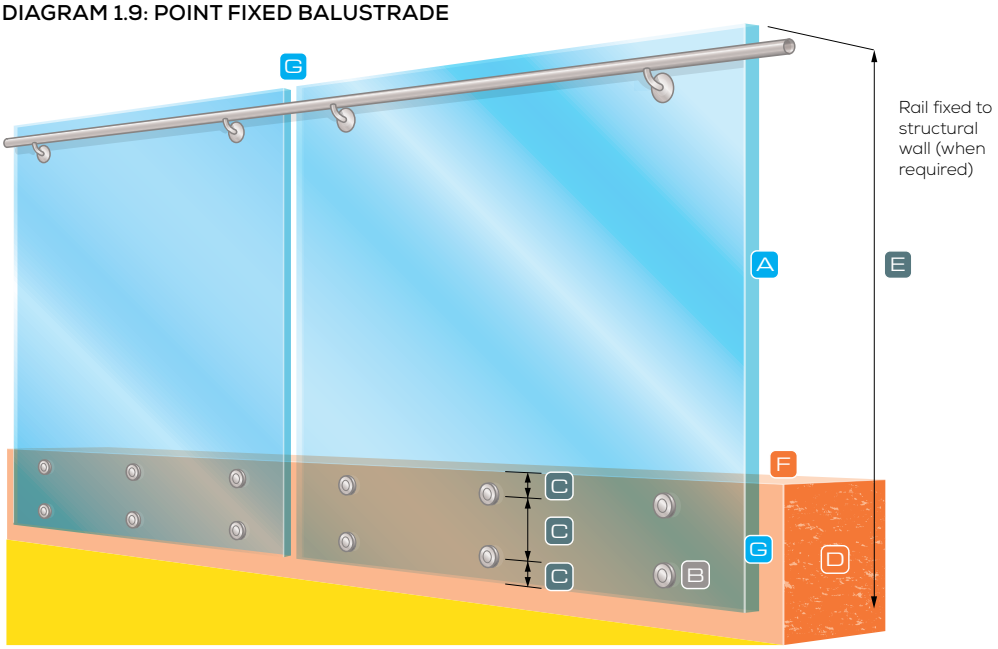


DIAGRAM 1.9: POINT FIXED BALUSTRADE



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Spider fixing 2 edge supported.

Close up detail of spider fixing.

OTHER BALUSTRADING INSTALLATIONS

STUB POST FIXING

Glass panels are bolted together with stainless steel stub posts which are fixed into concrete through core drilled holes or surface mounted.

CLAMP FITTINGS – 2 EDGE SUPPORT

Glass panels are supported by stainless steel clamp fixings to vertical posts on each side. No holes required in glass.

See Diagram 2.0

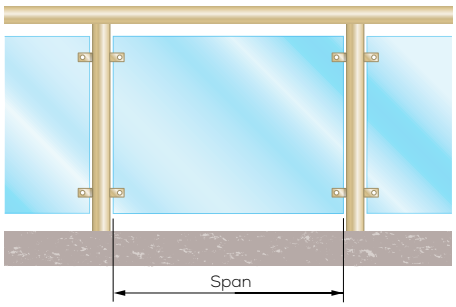
SPIDER FIXING – 2 EDGE SUPPORT

Glass panels are supported by bolt through 2 way stainless steel spider fittings to vertical posts on each side. Provides 2 panel link with flush or proud glass connectors.

CHANNEL GLAZED – 2 EDGE SUPPORT

Glass panels are supported in a channel fixed to vertical posts on each side.

DIAGRAM 2.0: CLAMP FITTINGS - 2 EDGES SUPPORT.



The glazing panels are supported by clamp fittings to vertical posts at each side.

Typical 316 stainless steel clamp fitting – 10/12mm glass.

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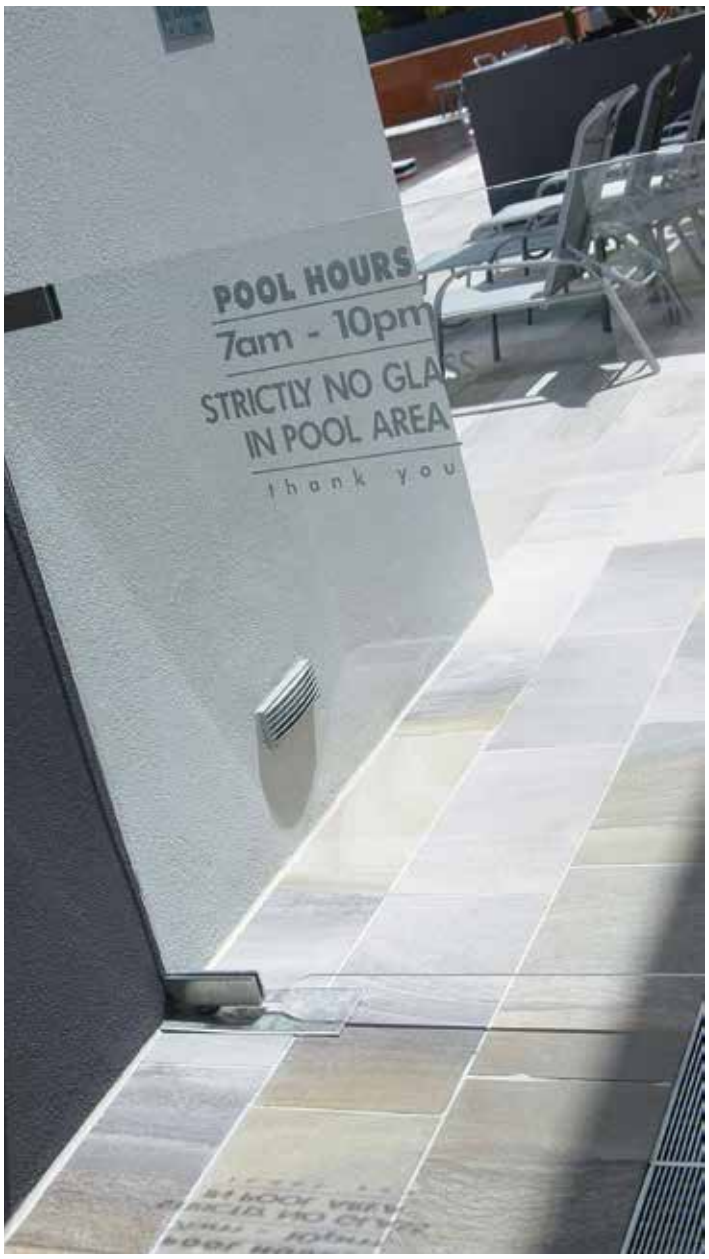
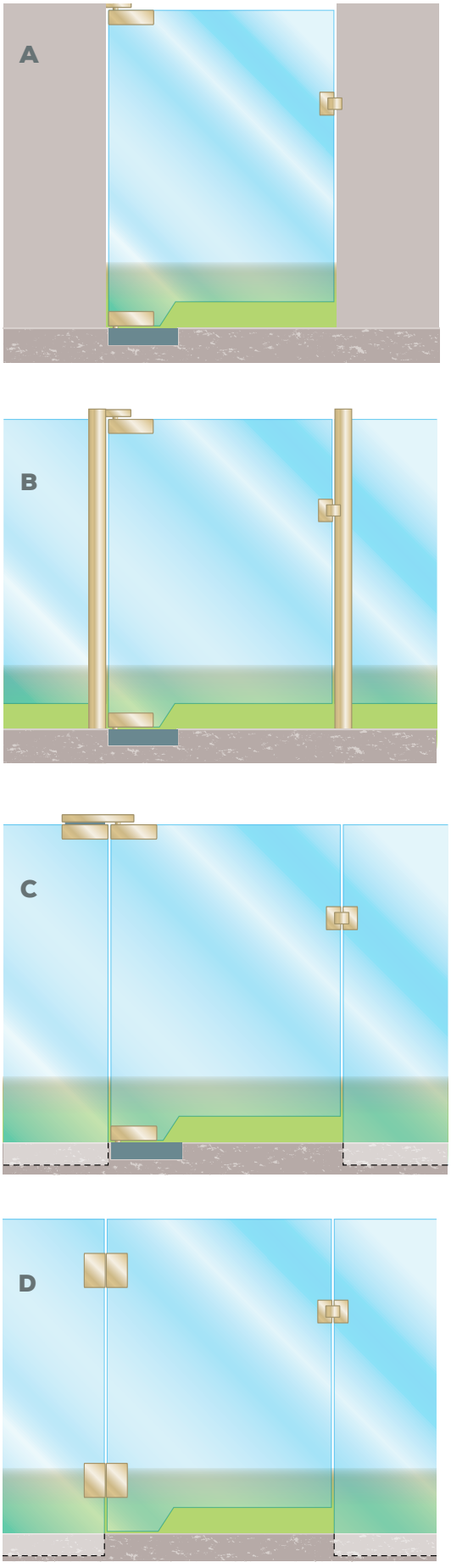
POOL GATES

When gates are required, there are 2 options available. The first option uses corner fixed metal patch fittings with non-hold open floor springs (see diagram 2.1, A,B,C). The floor spring is concealed in the concrete slab. The second option uses self closing hinges without the requirement of a floor spring (see diagram 2.1, D). All options must have latches. All components are subject to relevant codes and regulations.



Frameless 12mm clear toughened pool gate with top/bottom corner patches and floor spring.

DIAGRAM 2.1:



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FRAMELESS SHOWER SCREENS

Frameless toughened safety glass can provide an alternative to standard aluminium framed shower screens.

Minimum recommended thickness should be 10mm toughened safety glass.

FIXING METHODS

Subject to AS1288 guidelines, there are two main methods of installing frameless toughened shower screens:

- The recommended method is to mechanically fix the glass with special bolt through plated brass or stainless steel angle brackets;
- A second method is to use an aluminium or plated brass "U" channel which is screw fixed to the wall and floor and the glass is fixed into the channel using structural grade silicone.

TABLE B: MAXIMUM SHOWER DOOR WIDTH/HEIGHT	
WIDTH	**(MM)**
Wall hung doors	600-700
Glass hung doors	550-650
HEIGHT	**(MM)**
Wall & glass hung doors	1850-2100

STRUCTURAL BRACING HEADER BARS

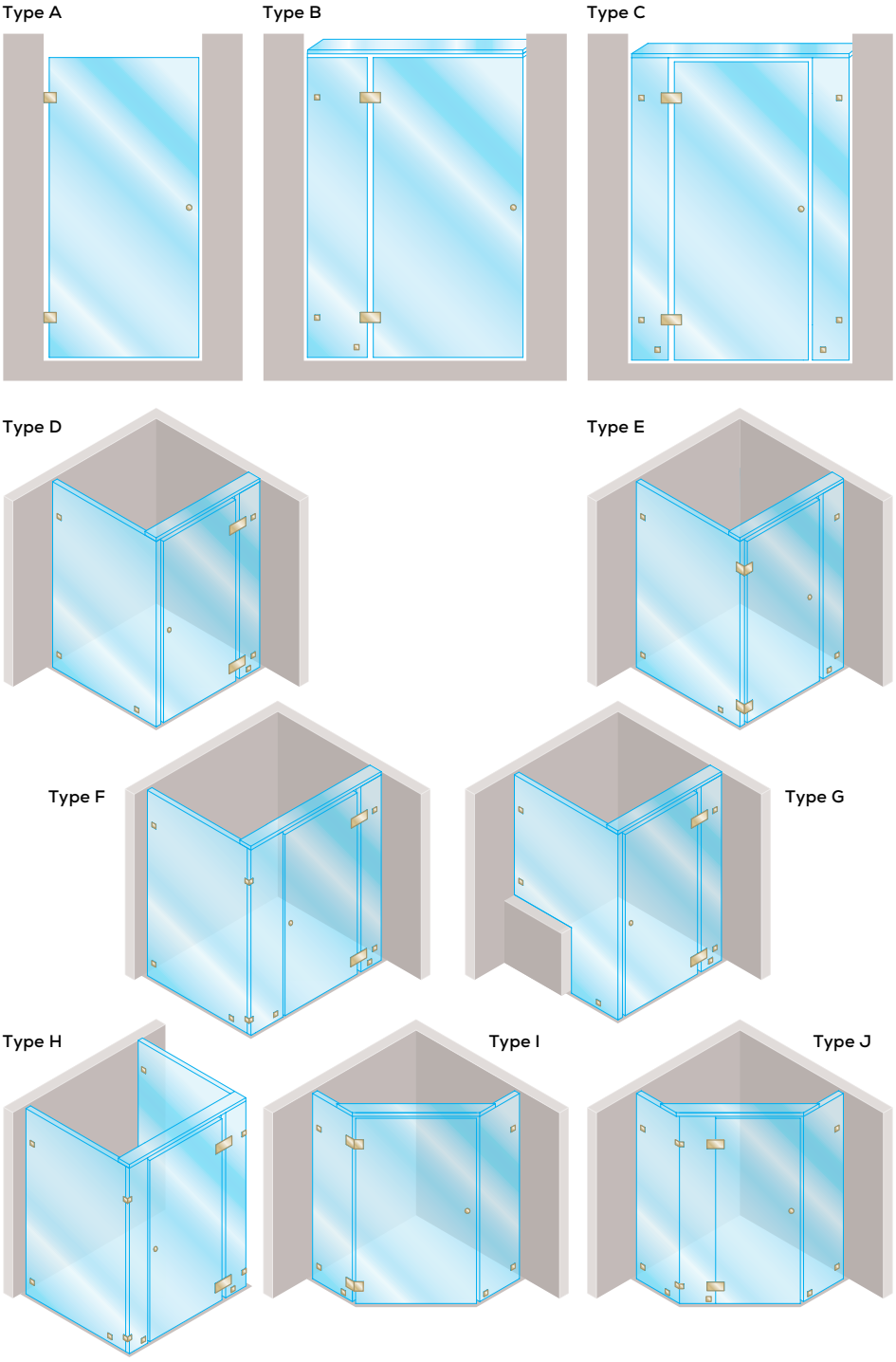
For any glass to glass hinge shower panels and free standing fixed shower panels, structural bracing will be required to reduce excessive deflection of the glass.

OPTIONS INCLUDE:

- 6-10mm toughened glass panel, 100-150mm wide, running the length from sidelite to sidelite or wall to return panel, over the door;
- Metal header bar in the same finish as hinges etc;
- 10mm toughened glass quadrant (as shown right) UV adhesive or silicone fixed to glass and wall.

FRAMELESS GLASS DESIGN

DIAGRAM 2.2: FRAMELESS SHOWER SCREEN TYPES



TYPICAL FRAMELESS SHOWER DOOR HARDWARE

180° glass to glass chrome shower hinge.

Wall to glass shower hinge.