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Building and Construction Authority

Aluminium Window

GOOD INDUSTRY PRACTICES



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Aluminium Window - Good Industry Practices

This “Good Industry Practices – Aluminium Window” is part of the CONQUAS 21 Enhancement Series on Good Industry Practices. Windows are major components of buildings.

This guide provides simple and practical tips to users on how good quality fabrication and site installation can be achieved. Common defects associated with aluminium window as well as their causes and preventive measures are also highlighted. Photographs and graphical representations are used extensively in the guide to provide easy reference and better illustration of the practices.

It should, however, be pointed out that this guide is not meant to dictate how aluminium window must be designed and installed. It only serves to illustrate some of the good practices designers and contractors have adopted while designing and installing aluminium window.

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Aluminium Window - Good Industry Practices

	Contents:	Descriptions.
1.	Introduction	Type of windows.
2.	Design	Aluminium window.
3.	Materials Selection.	Extrusion, glass, finishes, hardware, product tests etc.
4.	Manufacturing & Fabrication.	Processes, QA/QC etc.
5.	Protection of Frames.	Type of materials & method.
6.	Delivery & Storage.	Packing and storage on site.
7.	Type of Site Installation.	Method of installation.
8.	Common Defects and Remedies.	Identify and apply method of repair.
9.	Final Cleaning.	Method and procedures.
10.	Handling Over & Maintenance.	Types of maintenance.

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Aluminium Window - Good Industry Practices

1.0 INTRODUCTION ON TYPE OF WINDOWS.



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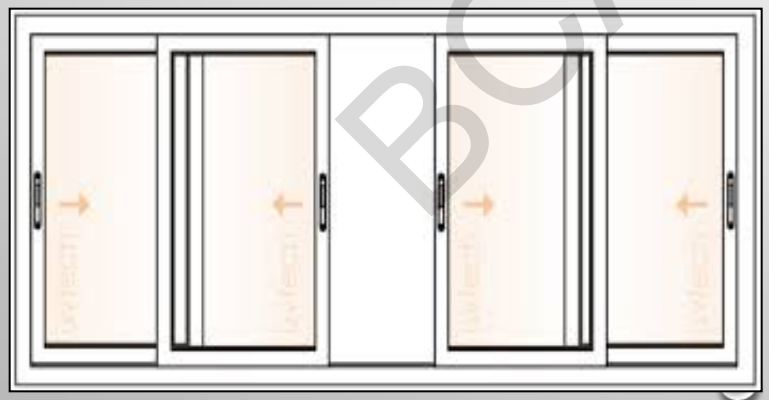
1.0 Introduction on type of windows.

The design of the window system is strictly based on the below:	Descriptions.
Specifications:	
1. Types of window system	Design, window system, profiles, wall thickness etc
2. Hardware & accessories	Dual lock system, stainless steel grade, colour & finishes, sealants etc
3. Finishes to aluminium frame	Powder coat, fluorocarbon coating, AAMA 2604, AAMA 2605 etc
4. Glass type	Colour, combinations, thickness, solar control, low-e coating, Shading co-efficient & U-values, transmittance value
5. Design Load	Singapore standard SS212, wind load.
6. Acoustic requirements	STC 26 ~ 42 grade, acoustic seal
7. Sizes such as height & width	Ease of delivery and access to site
8. Performance laboratory test	SS212 2007 standard

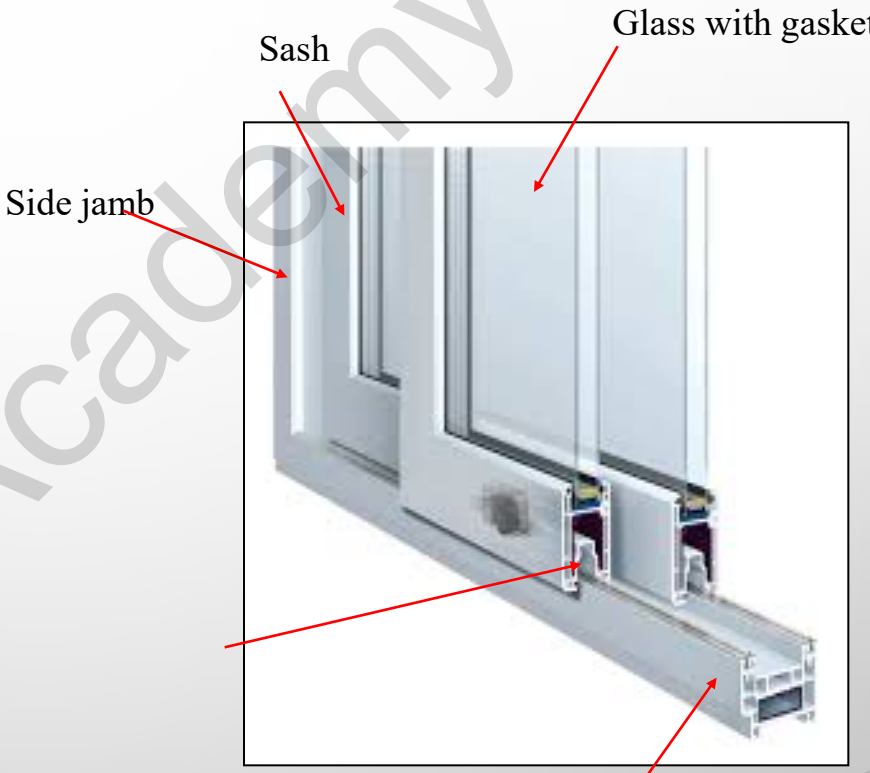
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1.0 Introduction on the type of windows.

	Sliding Window System.
1.	Top Head
2.	Side Jamb
3.	Bottom Track
4.	Vertical sash
5.	Interlock stile
6.	Top rail, bottom rail, sides
7.	Roller, gasket, glazing, lockset etc.



Interlock meeting stile



Sliding bottom track.

Section thru 2 track sliding window.

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1.0 Introduction on type of windows.

Composite Window: Casement cum fixed panel below.



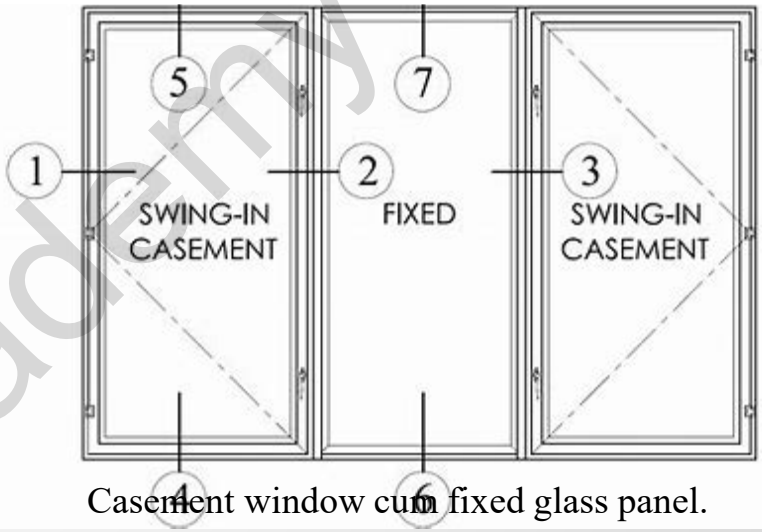
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1.0 Introduction on type of windows.

Casement Window.



4 panels casement window.



Casement window cum fixed glass panel.



4 panels casement cum fixed window.

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1.0 Introduction on type of windows.

Top Hung Window.



3 panels top hung window with fixed below.



Top Hung cum fixed glass window.



Top hung window.

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Aluminium Window - Good Industry Practices

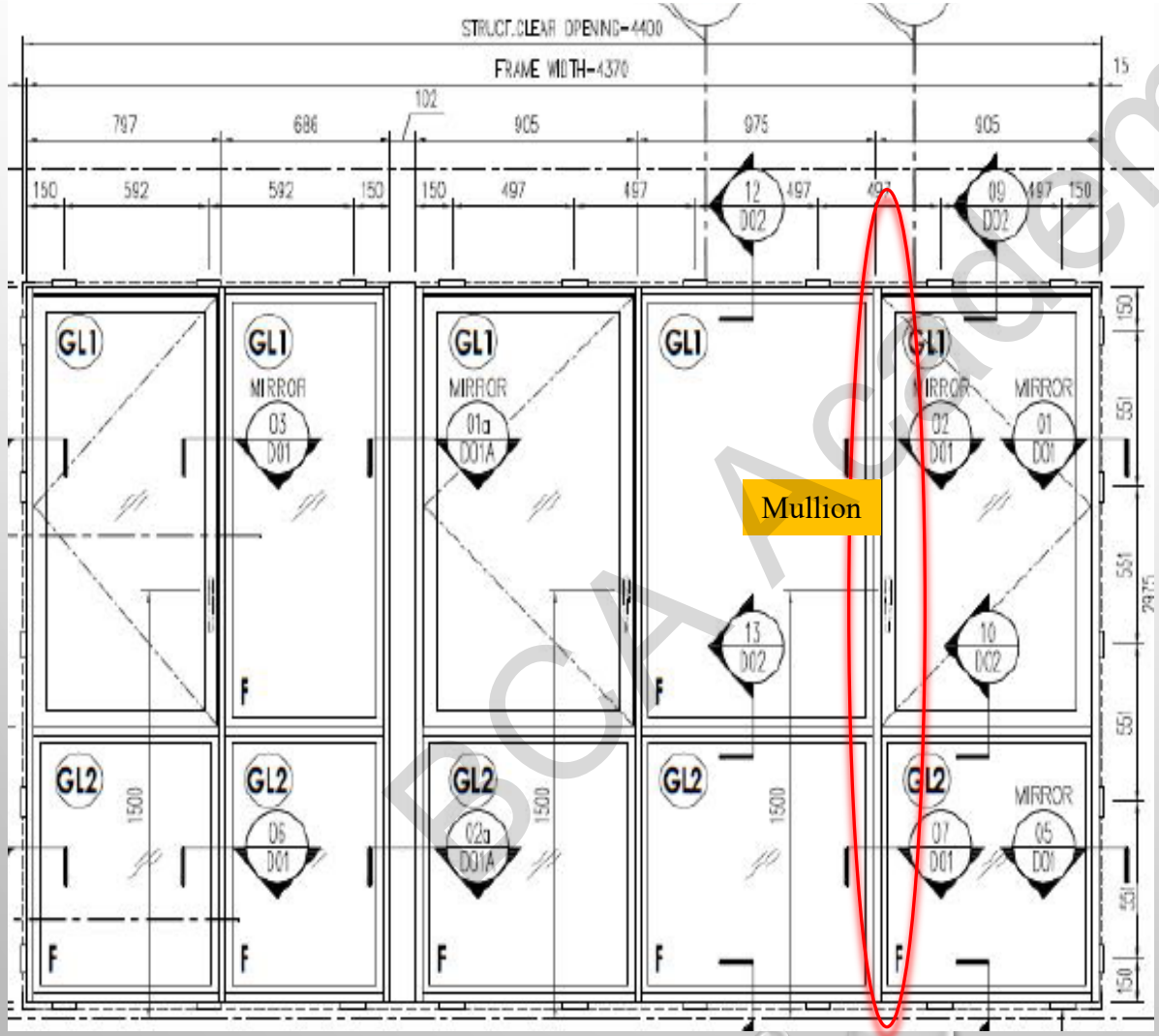
2.0 DESIGN ALUMINIUM WINDOW.



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2.0 Design – Aluminium Window.

2.1 Design Analysis & Calculations.



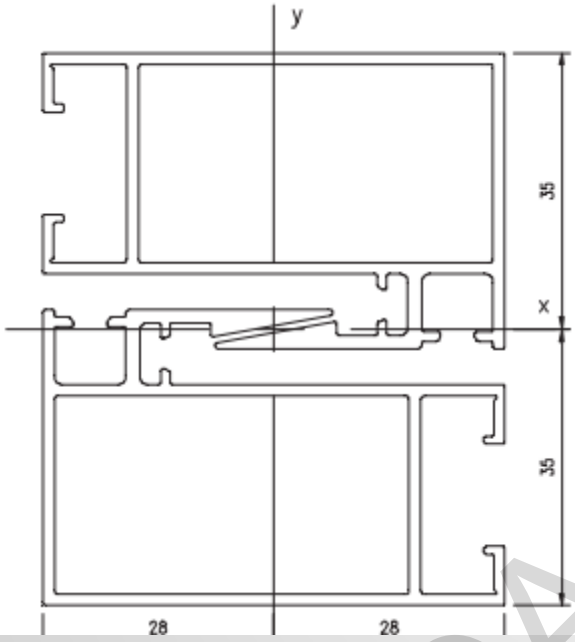
Elevation of Full Height Glass Window

	Engineering Calculations & Analysis
1.	Determine wind load
2.	Profile check
3.	Deflection on mullion

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2.0 Design – Aluminium Window.

2.1b Design Analysis & Calculations.



MASS PROPERTIES (UNIT)	VALUES
Area (mm²) :	653
Perimeter (mm) :	888
Bounding Box – X (mm):	−28 to 28
Bounding Box – Y (mm):	−35 to 35
Centroid – X (mm) :	0
Centroid – Y (mm) :	0
Moments of inertia – X (mm⁴) :	280353
Moments of inertia – Y (mm⁴) :	213887
Product of inertia – XY (mm⁴) :	−2818
Radii of gyration – X (mm) :	21
Radii of gyration – Y (mm) :	18
Principal moments along X–Y (mm⁴)	: 213768 along [0 −1]
Principal moments along Y–X (mm⁴)	: 280472 along [1 0]
Elastic Modulus – Zx (mm³):	I / y-max= 8010
Elastic Modulus – Zy (mm³):	J / x-max= 7778

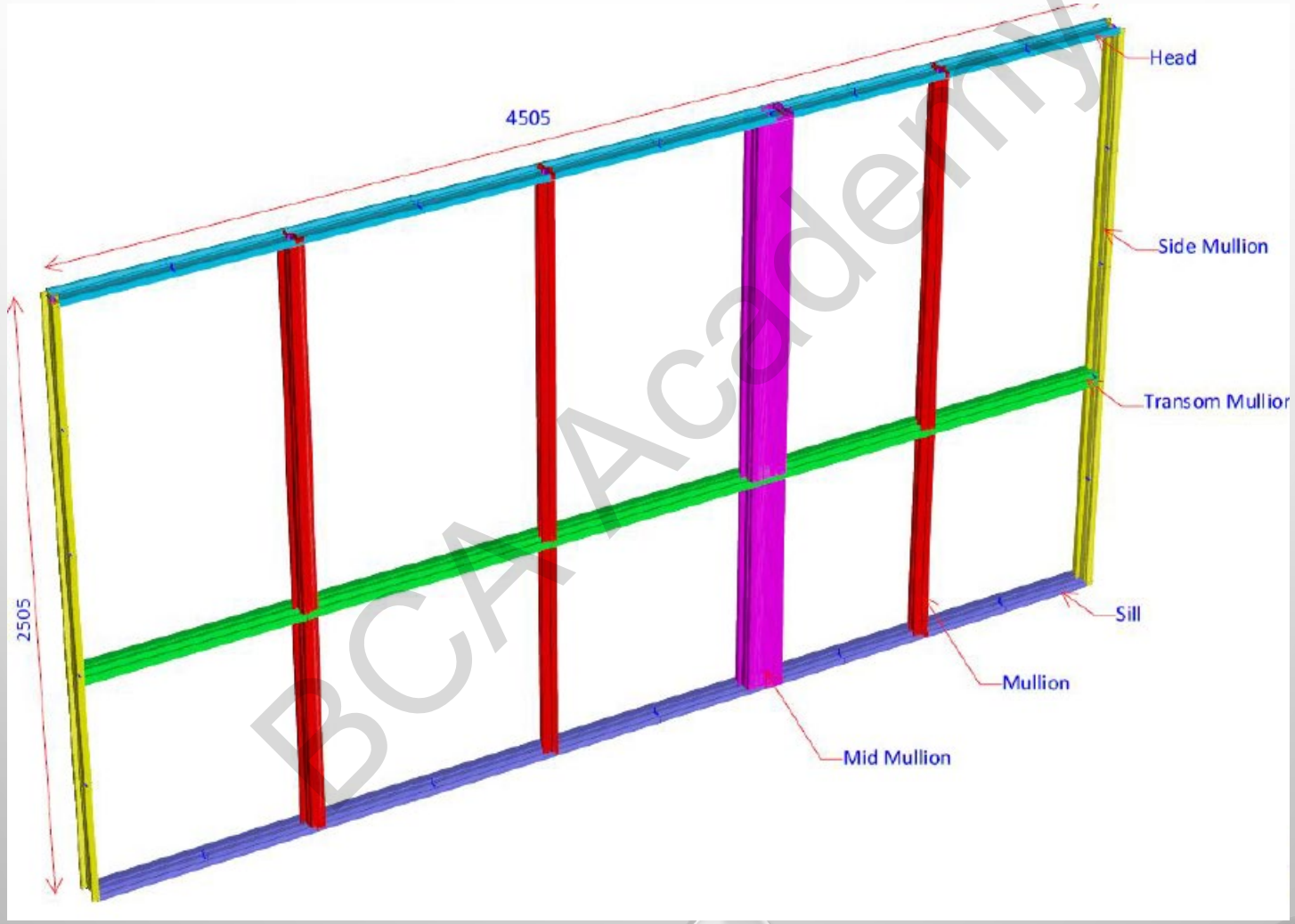
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iV) CHECK CENTRE MULLION DEFLECTION

Permissible mullion deflection	δ	=span/175 =	13.71 mm	
Under wind pressure +ve				
Max. mullion deflection	d_f	=5*w*L^4/(384*E*Ixa) =	12.65 mm	
		<	13.71 mm	OK

2.0 Design – Aluminium Window.

2.1c Design Analysis & Calculations.

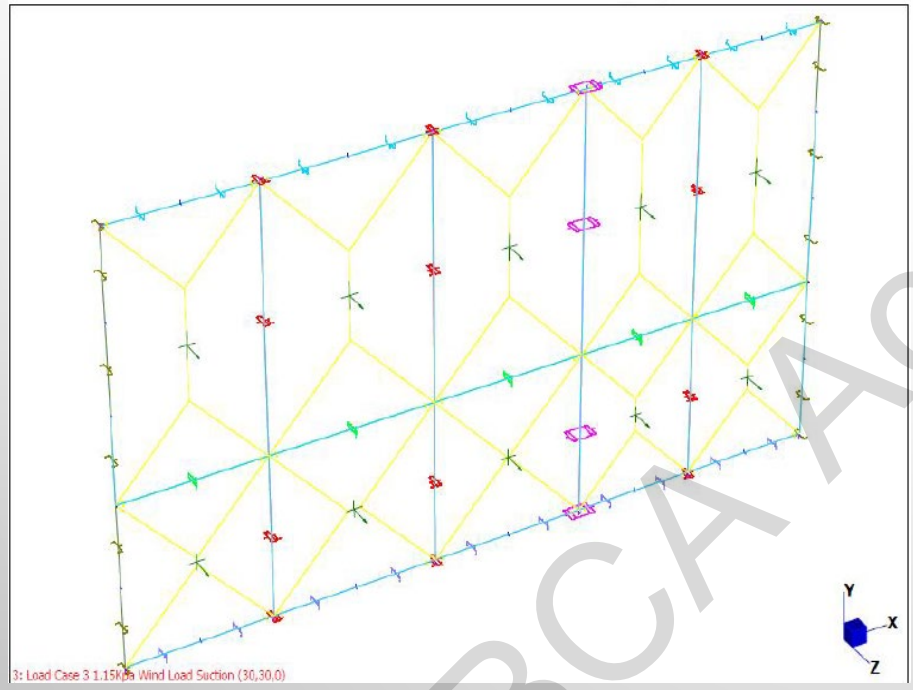


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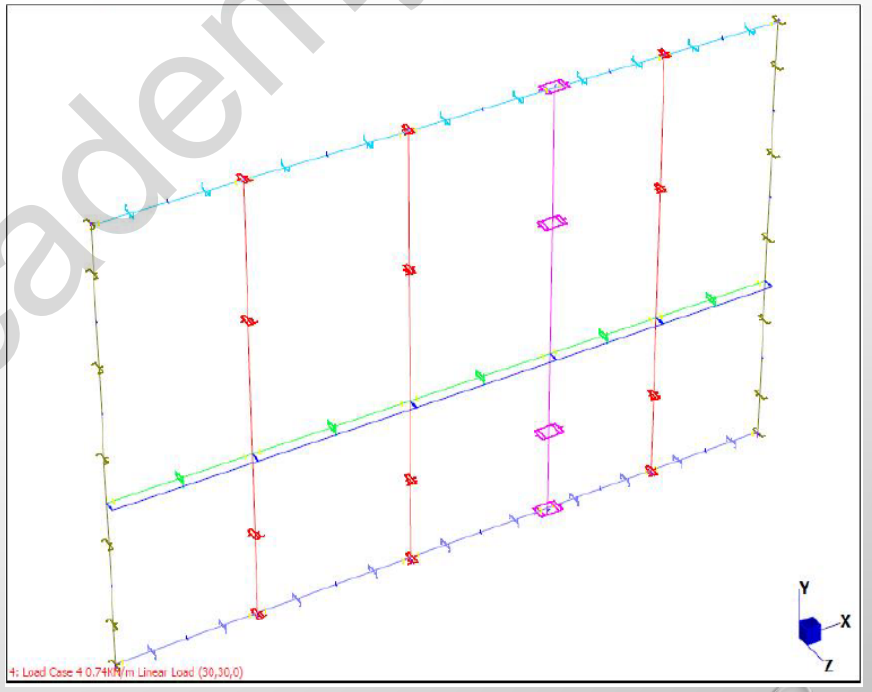
Structure Aluminium Frame Layout.

2.0 Design – Aluminium Window.

2.1d Design Analysis & Calculations.



Structural Layout of Aluminium Frame
4505mm W x 2505mm H
Load case – Wind Load Suction



Structural Layout of Aluminium Frame
4505mm W x 2505mm H
Load case – Linear Load

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2.0 Design – Aluminium Window.

Design of Window System

2.20	Aluminium Fixed Glass Window.
1. Frame	Subject to wind load calculations
2. Glass	Subject wind load calculations, Lateral Load.
3. Design	Constructed in accordance to SS212 – specification for aluminium alloy window.



Fixed full height glass window.

2.20	Fixed Glass Panels.
1.	The top fixed glass panel may adopt a 6mm thick float glass and subject to satisfy the window glass calculation. In most cases, it will pass unless over size.
2.	The below would have to use laminated glass to satisfy the 5th Schedule / Approved Document. Determining the thickness and combinations are subject calculations.

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2.0 Design – Aluminium Window.

Design of Window System

2.3	Casement Window.
1. Frame	Subject to wind load calculations.
2. Glass	Subject wind load calculations.
3. Design	Constructed in accordance to SS212 – specification for aluminium alloy window.



4 panels top hung window

2.30	Casement Window.
1.	Casement window is common and widely usen in both residential and public housing projects.
2.	The advantage is able to provide full open ventilation and light.

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2.0 Design

Design of Window System

2.4	Aluminium Fixed Glass Window.
1. Frame	No check is required
2. Glass	No check is required
3. Design	Constructed in accordance to SS212 – specification for aluminium alloy window.



Top hung window

2.4	Top hung window.
1.	Normal size top hung windows, usually 600mm in height is commonly use for toilet, store room, yard room.

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2.0 Design

Design of Window System

2.5	Aluminium Sliding Glass Window.
1. Frame	Subject to wind load calculations
2. Glass	Subject wind load calculations
3. Design	Constructed in accordance to SS212 – specification for aluminium alloy window.



2 Tracks sliding window

2.51	Sliding window is widely used in both private and public projects.
1.	It is easy to operate by sliding the glass form left to right or the other way.
2.	The opening area is only 50% for a 2-track system and 75% for a -track system.
3.	The sound transmission is value is higher than a casement or top hung window system.

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2.0 Design

Design of Window System

2.6	Aluminium Full Height Glass Window.
1. Frame	Subject to wind load calculations
2. Glass	Subject wind load calculations, Lateral Load.
3. Design	Constructed in accordance to SS212 – specification for aluminium alloy window.



Composite Full Height Window

2.61	Aluminium Full Height Glass Window.
1.	This is classified as full height window system and is commonly adopted for private residential projects.
2.	Better outlook aesthetically, brighter from internally.

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2. Design

2.6 - Type of Aluminium Frame Systems.

There are basically 5 types of window system that are commonly used in the construction industry.

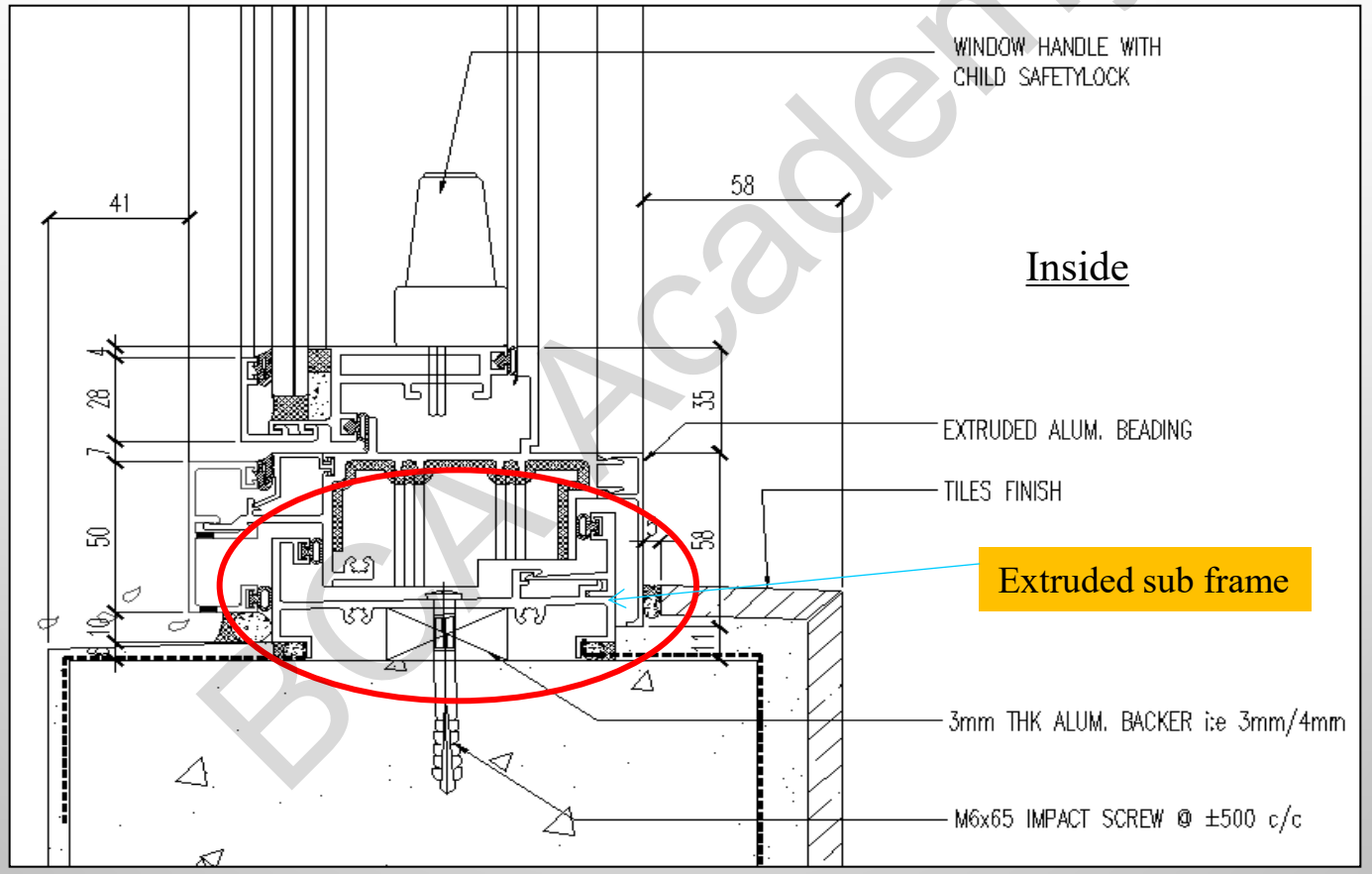
S/no	Type of System	Descriptions
1.	Sub-Frame System	Consist of an extruded aluminium primary frame and install to the structure / wall with impact anchor or anchor bolt. The inner frame will be slot into the primary frame after all wet works are completed.
2.	Cast in Window System	Mandatory required for HDB projects. Install at pre-casting yard.
3.	Fixing Lug System	The method is commonly adopted for ease of installation and cheaper costs.
4.	Sub-Frame Bracket System	For non finishes structure wall. Is a very demanding method which require skilled workmanship and time.
5.	Full Height Window System.	Designed to maximize natural light, enhance architectural aesthetics.

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2. Design

2.6	Type of Framing System.
2.61	Full Sub - Frame System.

Outside



Full sub frame window system – Top Hung window

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2. Design

2.6	Type of Framing System.
2.61	Full Sub - Frame System.

S/no	Type of System	Descriptions
1.	Full - Frame System	The system is designed with a primary extruded aluminium sub frame and anchor to the structure. The main frame will be slot into it when all wet works are completed.
2.		**Advantage**
		The sub frame is designed as a gutter to receive any ingress of water thru the main frame via discharge to the external.
3.		**Disadvantage**
		Need to co-ordinate the details before actual structure works for tolerances.
		This system demand for an extremely high costs versus the type of system.

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2.0 Design

2.6	Type of Framing System.
2.61	Full Sub - Frame System.

Alum sub frame profile



Installed Sub Frame - Window

Alum sub frame profile

Alum sub inner frame profile



Install Inner Frame into sub frame

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2. Design

2.6	Type of Framing System.
2.61	Full Sub - Frame System.

Installed sub frame with plastering completed.





Installed Sub – Frame

Installing Main Frame to Sub-Frame.

Sub Frame System

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2. Design

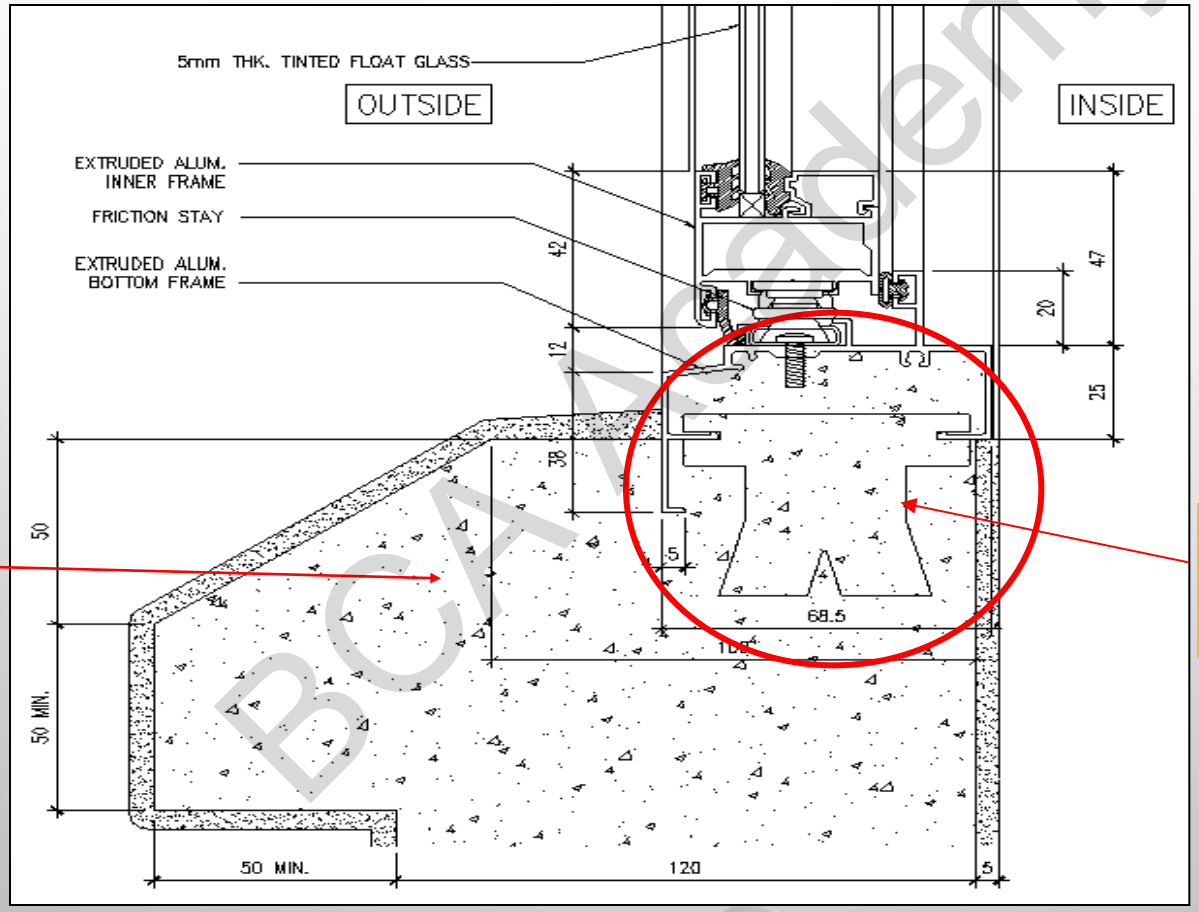
2.6	Type of Framing System.
2.62	Cast In Window System.

S/no	Type of System	Descriptions
1.	Cast - In Window System	The windows will be pre-fabricated as per the approved shop drawings & standby to be installed at the casting yard.
2.		**Advantage**
		Working environment is conducive. No need to deploy manpower at early stage of works. Ability to control workmanship such as grouting etc. Mast production / speed. Eliminate water seepage issue.
3.		**Disadvantage**
		Compact schedule, storage space and finance. Unable to replace frame if is beyond replace.

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2. Design

2.6	Type of Framing System.
2.62	Cast In Window System – HDB Projects.



R.C. precast wall

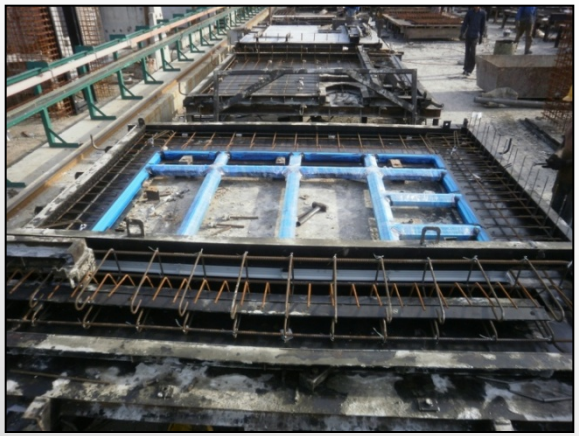
Stainless steel fish tail Bracket @ not more 600mm c/c

Cast in window system – Casement window

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2.0 Design

2.6	Type of Framing System.
2.62	Cast In Window System – HDB Projects.



Window being placed the pre-cast mould. Inspect and ready for concrete casting.



Stainless steel fish tail bracket @ 600mm c/c as per HDB specifications



Completed precast unit

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2.0 Design

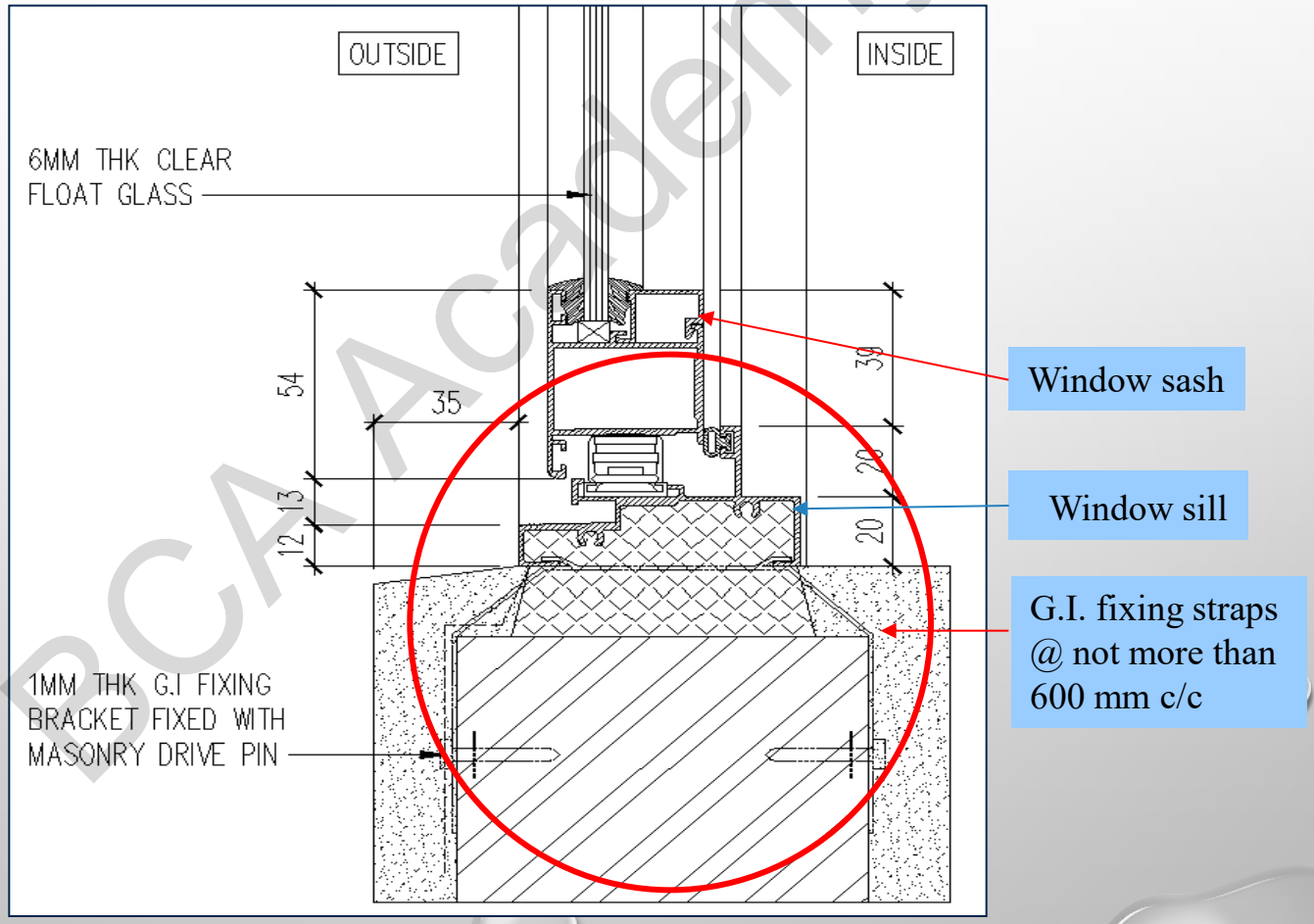
2.6	Type of Framing System.
2.62	Fixing Lugs Window System.

S/no	Type of System	Descriptions
1.	Fixing Lug Window System	This is the most common method and is widely used in the construction industry. The based material is made of 0.8mm thick x 25mm x 150mm (various) G.I sheet.
2.		**Advantage**
		Based materials is available ex stock and is simple produce. Costs of materials, fabrication and installation rate are low as compare to other system. Ease of installation.
3.		**Disadvantage**
		There is no water discharge system within the window.

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2.0 Design

2.6	Type of Framing System.
2.62	Fixing Lugs Window System.



Fixing lug system – Casement window

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2.0 Design

2.6	Type of Framing System.
2.62	Fixing Lugs Window System.

Fixing lugs being spaced
at not more than @ 600mm
on aluminium outer frame.



Fixing lug being secured to
wall with pin & cartridge.



Less 600mm

Less 150mm

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2.0 Design

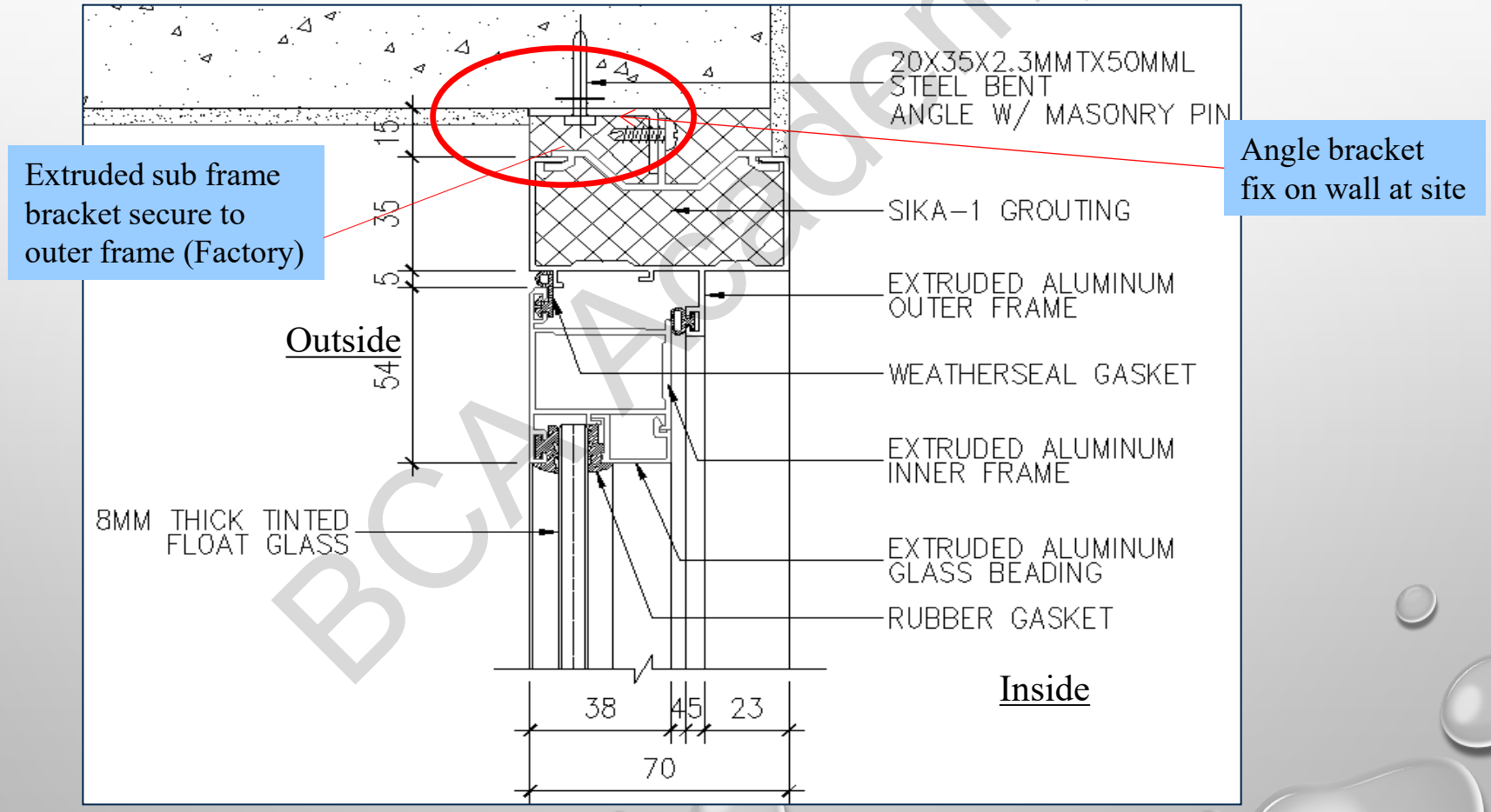
2.6	Type of Framing System.
2.64	Sub – Frame Bracket System.

S/no	Type of System	Descriptions
1.	Sub – Frame Bracket Window System	This system is only adopted if there are no finishes to the structure wall.
2.		**Advantage**
		No wet works are involved.
		Disadvantage
3.		This method require skilled men & experience to work on. Required double handling where 2 stages of installations are required. High costs due and double handling. Rely 100% on silicone sealant applications to prevent water ingress. Alignment difficulties.

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2. Design

2.6	Type of Framing System.
2.64	Sub – Frame Bracket System.



Sub frame bracket system – Top Hung window

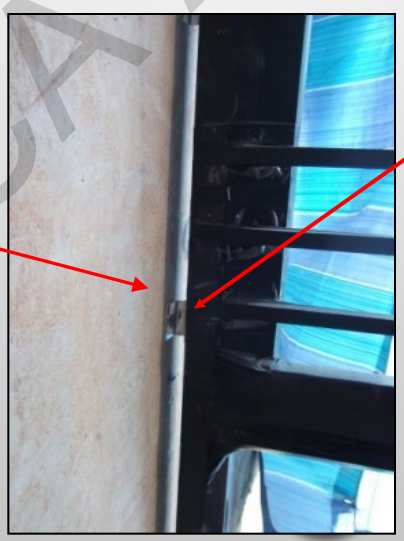
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2.0 Design

2.6	Type of Framing System.
2.64	Sub – Frame Bracket System.

	Sub- frame bracket system.
1.	The primary brackets of angle 25mm x 25mm x 3mm t x 50mmL will fixed on site.
2.	The secondary brackets of the same as above will be pre-fixed to the aluminium outer frame in factory.
3.	Both are to be in alignment as per drawings.

Primary bracket can be an angle or extruded profiles.

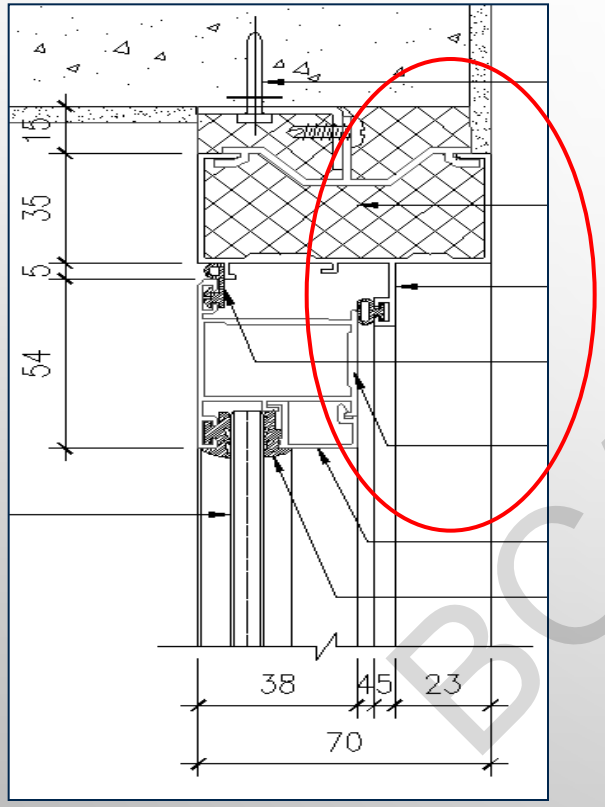




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2.0 Design

2.6	Type of Framing System.
2.64	Sub – Frame Bracket System.



Vertical section thru window



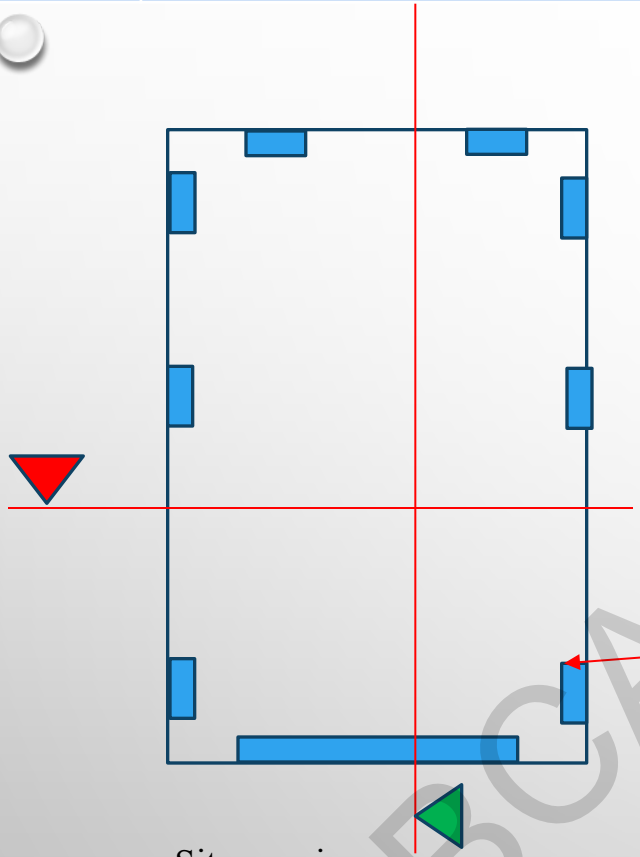
Extruded secondary bracket to outer frame



Fixing of primary bracket on wall

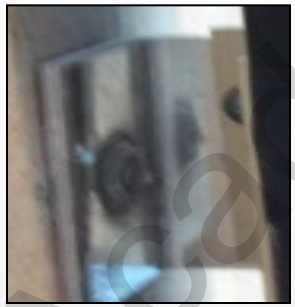
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2.6	Type of Framing System.
2.64	Sub – Frame Bracket System.



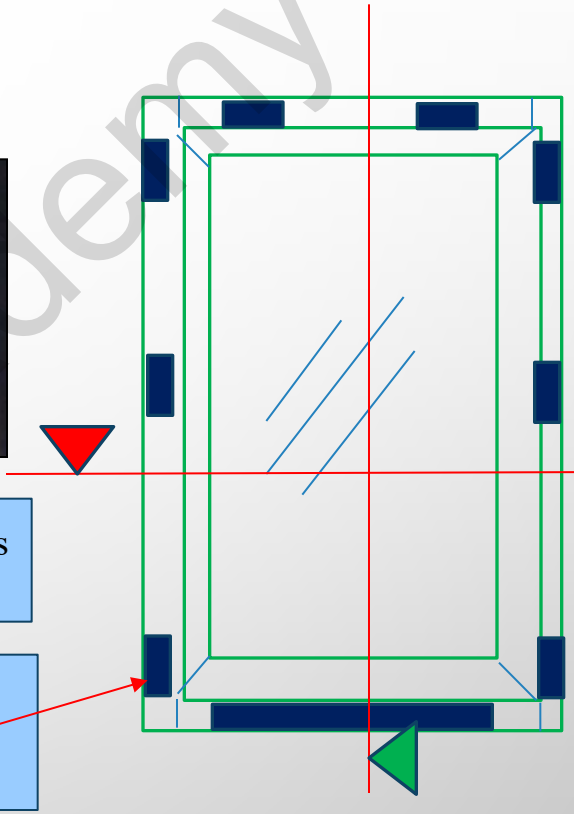
Site opening

Primary brackets
to be installed
align & level as secondary
brackets on outer framings



primary brackets
L-shape angle

Secondary
brackets
Extruded profile



Frame assembly - Factory

Secondary brackets
on outer/inner frame
pre fabricated



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Aluminium Window - Good Industry Practices

3.0 MATERIALS SELECTION.



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3.0 Materials Selection

3.0	Materials Selection	
1.	Aluminium Extrusions	BS EN 755 Grade 6063 T5, T6. Profile Type, Shapes, Sizes & Wall Thickness.
2.	Finishes - Coating	Powder / Fluorocarbon coating. Colour - Colour Code. Standard to compliances. Specular Value.
3.	Types of Glass	Colour, Tonality of Glass. Brand Name. Country of Origin. Performance Data.
4.	Operating & Bearing Devices.	Lock set, Roller, Stainless Steel Stays Cam Handle, Wind Block, Gaskets, Silicones Sealant etc.
		Visual Mock Up Unit. Operation & Endurance Test. Performance Mock up Unit.

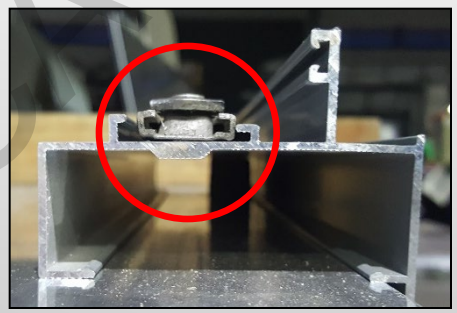
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3.0 Materials Selection

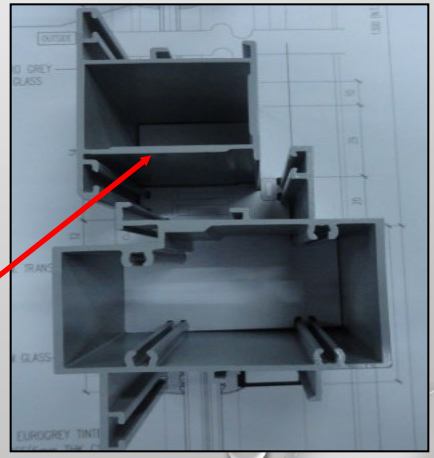
3.1 Aluminium Extrusion	Descriptions.
Extruded aluminium member	Grade 6063 – T5 (Medium strength, common)
	Grade 6063 – T6 (Medium strength but with a much higher Tensile & Yield strength.
	Grade 6061 – T5
Standard	EN 755 Standards (BS 1474)
1. Member sizes, profiles, thickness	Subject to design to wind load and specification. EN 1991 1-1 2002 part 1-1



Cut profile of window sash



Adequate wall thickness to receive fixings of screws.



Section thru' outer / inner.

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3.0 Materials Selection

3.1	Aluminium Extrusions - Grade.
1.	Commonly known as an architectural alloy, Alloy AA6063 provides a good balance of extrudability and mechanical properties.
2.	Its excellent extrudability alloys allows film walled hollow shapes, intricate solids, and other shapes that are usually difficult to extrude with satisfactory finish, to be produced more easily.
3.	It responds well to polishing, chemical brightening, anodizing and dyeing.
4.	It is light weight as compare to compare to steel.
5.	It also has a high degree of resistance to corrosion.
6.	Is easy to produce and fabricate.
7.	It is the most suitable material grade to be used in the building industry.
8.	Able to be design for external façade use and able to withstand high wind load conditions.
9.	Able to have options of colour finishes to surface.

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3.0 Materials Selection

3.1	Aluminium Extrusions – Selection.
1.	Determine the window system to be adopted.
2.	Select the appropriate profiled to be used, size, shape, wall thickness in accordance to the specifications. Design and develop new dies if deemed necessary to satisfy the design concepts.
3.	Compute the costs versus budget.
4.	Compute the engineering calculations and analysis of profiles.

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Common window profiles



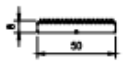
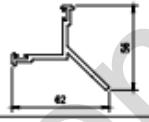
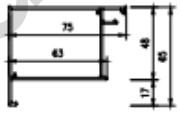
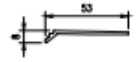
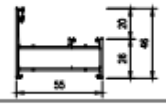
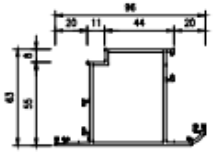
Custom made profiles



Extruded aluminium profiles

3.0 Materials Selection

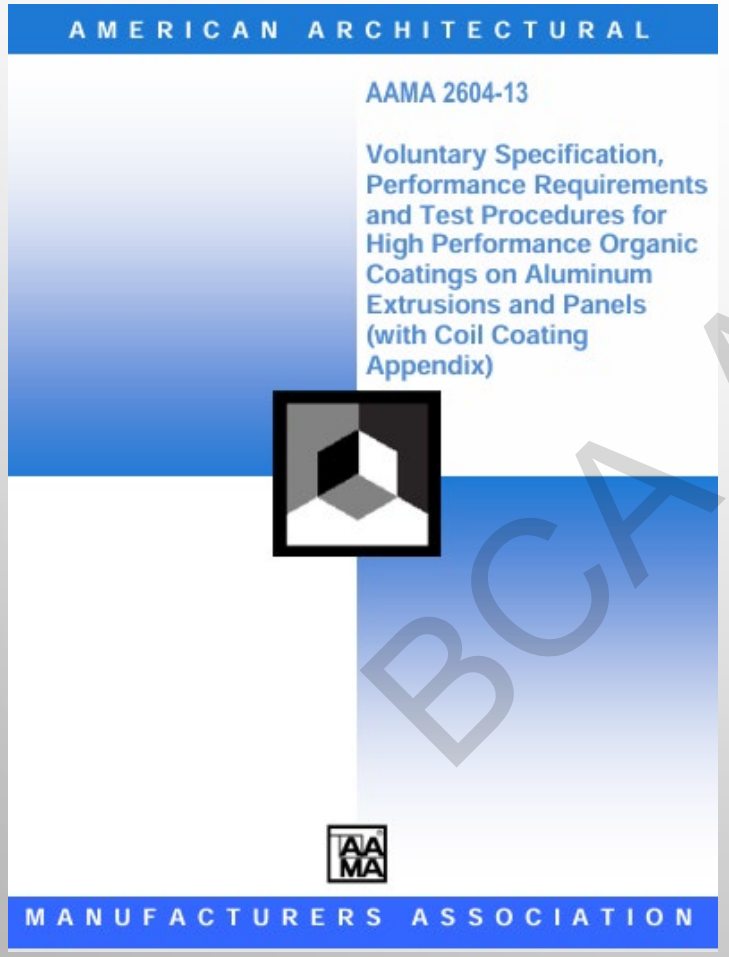
3.1	Aluminium Extrusions
s/no.	Descriptions
1.	It is a good practice to produce a tabulation list of extrusions to be used for a project.
2.	This is to track to ensure that all required profiles are in order as any missed will hinder the production and assembly process.
3.	All required information pertaining to the weight, colour, colour code, girth areas sizes of profiles are clearly provided for ease of reference.

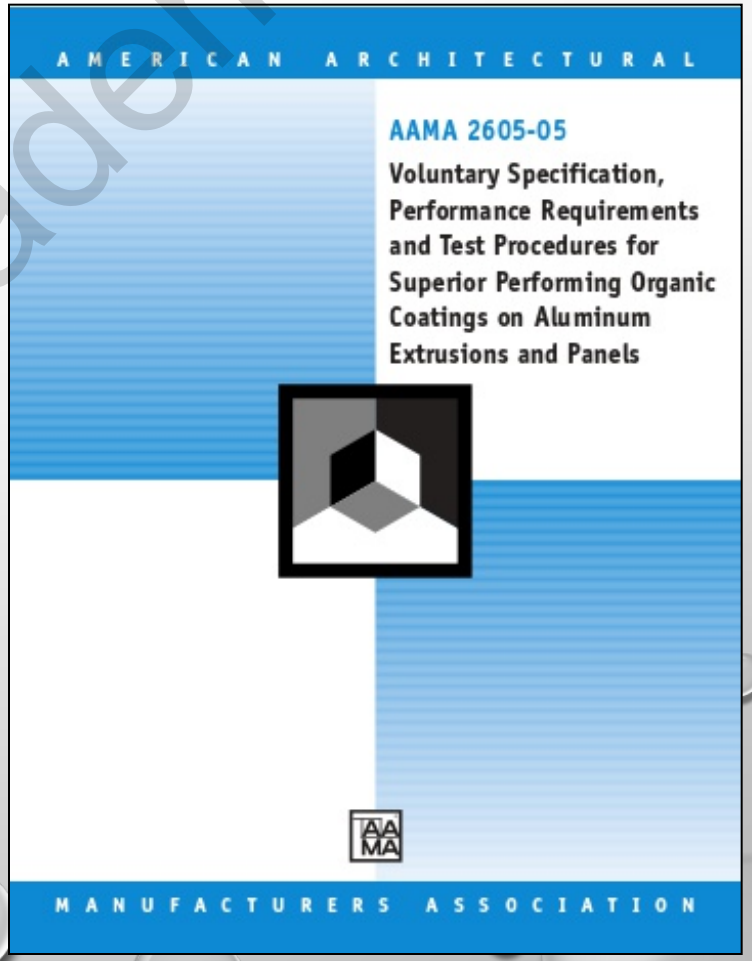
ITEM	DIE NO.	DIE DRAWING	DESCRIPTION	ALLOY TEMPER	FINISH	COLOR
14	AL-A10		ALUM EXTRUDED WASHER	6061-T6	ANODIZED	
15	AL-A08		ALUM EXTRUDED FIN	6063-T5	PVDF 2	COLOR SUBJECT TO FINAL APPROVED COLOR CHART
16	AL-A16		ALUM EXTRUDED SETTING BLOCK	6063-T5	PVDF 2	COLOR SUBJECT TO FINAL APPROVED COLOR CHART
17	AL-A17		ALUM EXTRUDED SILL COVER	6063-T5	PVDF 2	COLOR SUBJECT TO FINAL APPROVED COLOR CHART
18	AL-A18		ALUM EXTRUDED PENEL	6063-T5	PVDF 2	COLOR SUBJECT TO FINAL APPROVED COLOR CHART
19	AL-A19		ALUM EXTRUDED SETTING BLOCK	6063-T5	PVDF 2	COLOR SUBJECT TO FINAL APPROVED COLOR CHART
20	AL-A20		ALUM EXTRUDED OUTER FRAME	6063-T5	PVDF 2	COLOR SUBJECT TO FINAL APPROVED COLOR CHART
21	AL-A21		ALUM EXTRUDED WINDOW SASH	6063-T5	PVDF 2	COLOR SUBJECT TO FINAL APPROVED COLOR CHART
22	AL-A22		ALUM EXTRUDED SASH BEADING	6063-T5	PVDF 2	COLOR SUBJECT TO FINAL APPROVED COLOR CHART

BCA Academy

3.0 Materials Selection

3.2	Powder coating & Fluorocarbon coating.
1.	Based on AAMA Standard – America Architectural Manufacturers Association.





BCA Academy

3.0 Materials Selection

Type of Finishes / Coating.

3.2	Powder Coating & Fluorocarbon Coating.
1.	Based on AAMA Standard – America Architectural Manufacturers Association.

Type of Finishes	Standard	Descriptions.
1. Powder coating	AAMA 2603	5 years warranty
2. Powder coating	AAMA 2604	10 years warranty - Mid tier architectural specification
3. Powder coating	AAMA 2605	10 / 15 years warranty - Highest architectural performance
4. Fluorocarbon coating	AAMA 2605	10 years warranty – Highest performance exteriror specification in the architectural industry

BCA Academy

3.0 Materials Selection.

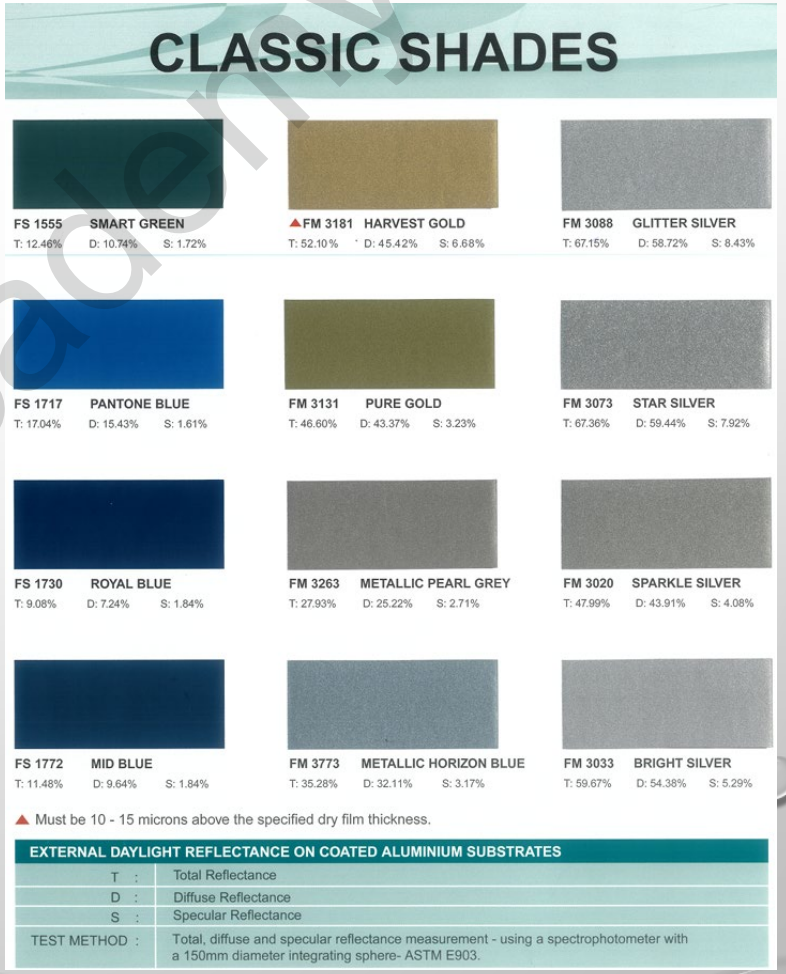
3.2 Powder coating – Colour Chart



3.0 Materials Selection.

3.2 Fluorocarbon coating – Colour Chart





BCA Academy

3.0 Materials Selection.

3.2	Type of Coatings / Finishes – Instrument & Equipment for Testing.
1.	The spray coated finishes of both powder coat and fluorocarbon coating will not be 100% the same colour from every batch of coating.
2.	Batches of paint / powder produced may varies in colour tonality, particularly metallic finish paint, such as metallic gold, silver metallic etc.
	Use of spectrophotometer to check the acceptance tonality.



Sample comparison between original based and production panel.

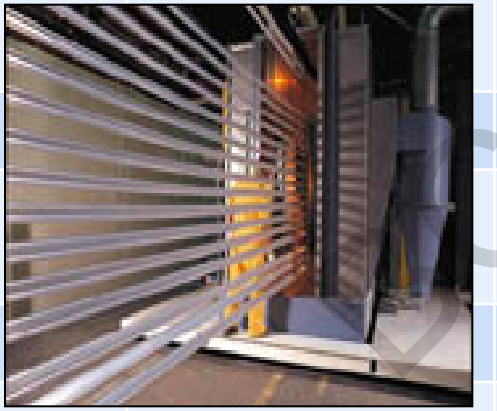


Checking colour tonality / acceptance measurement. Portable Color Spectrophotometer.

Acceptable reading is E 2-3 – Small difference, visible if viewed side by side.

BCA Academy

3.0 Materials Selection.

3.2	Type of coating	Descriptions
1.	Fluorocarbon coating	This is a high-performance exterior specification.
		Complying to AAMA 2605 standard
	(佛碳)	Substrates are treated in various stages of cleaning, degreasing, chemical immersion, washing, drying before conveyor to furnace for spraying.
		Based materials is fluoropolymer resins (PVDF2)
		Categorize as 2 coats, 3 coats, 4 coats system with micron thickness of +/- 30, +/- 40 and +/- 50 respectively.
		Recommended for use external architectural products.
		Good resistant to moisture, weathering, ozone & UV radiation.
		Available in wide range of colours.
		Surface finish is in matt.
		10 years warranty for fading etc.

BCA Academy

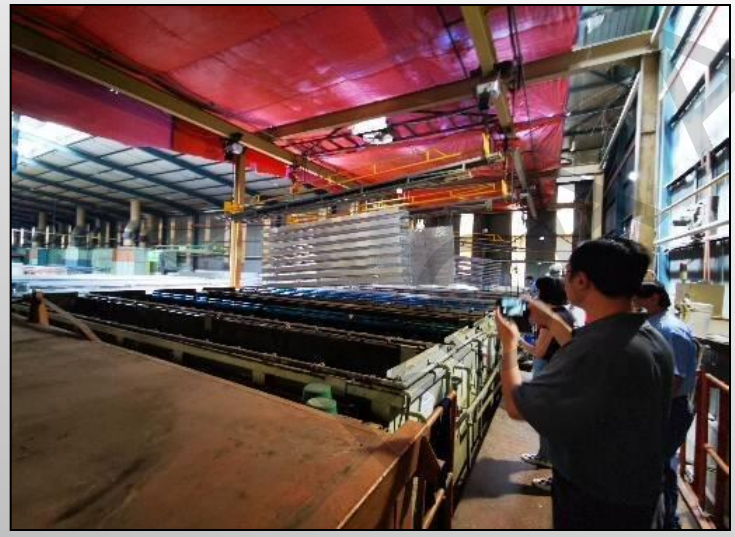
3.0 Materials Selection.

3.2	Type of coating	Descriptions
1.	Powder coating	This is a mid high-performance exterior specification.
	（粉末涂层）	Complying AAMA 2604, AAMA 2605 standards.
		Substrates are treated in various stages of cleaning, degreasing, chemical immersion, washing, drying before conveyor to furnace for spraying.
		Based materials is modified polyester resins.
		Categorize under +/- 60 microns ≤ 75 microns
		Recommended use for the architectural products.
		Available in a wide range of colours, non metallic.
		Surface finish is semi glossy +/- 60.
		10 years warranty on fading, dis-colouration etc.
		Costs is cheaper as compared with fluorocarbon coating.

BCA Academy

3.0 Materials Selection

3.2	Types of finishes – Powder coating & Fluorocarbon coating.
1.	Daylight Reflectance Value.
2.	The Daylight Reflectance of Materials - Exterior Building
3.	Selected powder / fluorocarbon coating are to comply to “Specular Reflectance” not exceeding 10% - BCA circular 27th Jun 2016.



Extrusions are dipped into various tanks to rinses and chemical treated via air dry.



Cladding or extrusions being jigged and move into the furnace for coating.

Academy

3.0 Materials Selection

3.2	Types of finishes – Powder coating & Fluorocarbon coating.
	Reflectance value – Specular value cannot exceed 10%.

BCA Academy

LEA HIN CO. (POWDER MANUFACTURERS) PTE LTD
293, Alexandra Road, Singapore 159940
Tel: 65-64756198 Fax: 65-64736185 E-mail: sales@leahinpowder.com

OXYPLAST

fax
OXYPLAST

To: Whom It May Concern
From: Peter Wong
Co:
Fax:
Date: 30 April 2021

Type of Coating / Finishes: % Specular Reflectance Value.

Not exceed 10%

To Whom It May Concern,

Re: % Daylight Reflectance of Oxyplast Colours

	% Total Reflectance	% Diffuse Reflectance	% Specular Reflectance
APR/80169/CS40 GREY	14.7	11.1	3.6

Note: The above data are average % reflectance values obtained from readings at 400-700nm wavelength range (visible light); detailed results available upon request. Measurements are done with reference to ASTM E903-12 test method using a spectrophotometer with 152mm diameter

3.0 Materials Selection

Standard AS 1288 – 2006 (Glass in Buildings – Selection ad Installation).

3.3	Glass Type	Descriptions
1.	Annealed Glass	Non treated glass, float glass.
2.	Heat strengthened glass	Processed glass – Heat Treatment
3.	Tempered glass	Processed glass – Heat Treatment
4.	Heat soaked	To eliminate spontaneous breakage
5.	Laminated glass	Safety glass – sandwiched by PVB interlayer
6.	Double glazing	2 pieces of glass separated by spacer
7.	Low-E glass	Reduces heat transfer
8.	Solar control glass	Block and reduces incoming heat to indoor
9.	Ceramic frit	Glass coated with paint
10.	Frosted / acid etched	Sand blasting or acid apply to rough surface
11.	Wire glass	Safet glass

BCA Academy

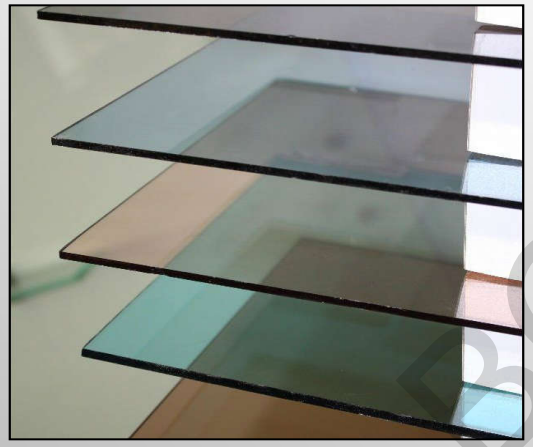
3.0 Materials Selection

3.3	Type of glass.	Description of glass.
1.	Annealed Glass	Blue tinted, Grey tinted, Green tinted, Bronze tinted, Blue green tinted, clear, extra clear glass.
2.	Selection of Glass is based on the followings:	Brand – Country of Origin
2a.		**Manufacturers / Suppliers**
2b.		Glass colour, tonality, combinations, thickness, Low-E coating, Solar control coating etc.
2c.		Performance data such as -Shading co-efficient & U value
2d.		Acoustic requirement
		Delivery schedule
		Minimum quantity
		Limitation on production of glass sizes

BCA Academy

3.0 Materials Selection

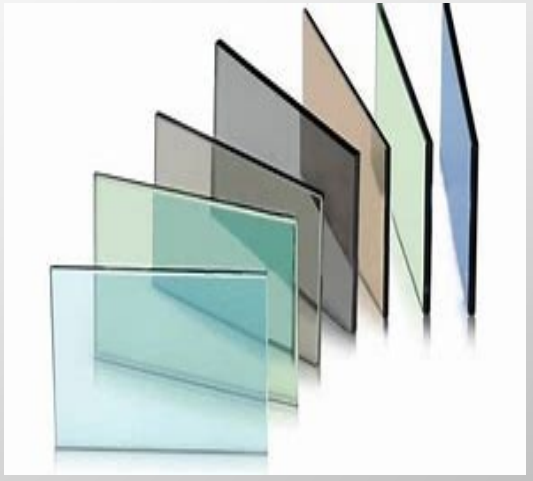
3.3	Types of coated glass.
1.	Reflective coated glass
2.	Low-E coated glass
3.	Solar control glass



Types of Low-E glass.



Low-E performance glass /
Solar Control Glass.



Range of tinted glass.

BCA Academy

3.0 Materials Selection

3.3 Glass Performance Data.

INDOFLOT AND PANASAP

INDOFLOT & PANASAP

Type Of Glass	Standard Thickness (mm)	Light Characteristic			Energy Characteristic				Solar Factor (%)	Shading Coeficient	U Value W/m²K
		Transmittance (%)	Reflectance Out (%)	Reflectance In (%)	Transmittance (%)	Reflectance (%)	Absorption (%)	Ultra Violet Transmission (%)			
Indoflot Clear (FL)	2	91	8	8	88	8	4	79	90	1,03	5,9
	3	90	8	8	86	8	6	71	87	1,00	5,8
	4	90	8	8	84	8	8	67	86	0,99	5,8
	5	89	8	8	82	7	11	64	85	0,97	5,8
	6	89	8	8	80	7	13	61	83	0,96	5,7
	8	88	8	8	77	7	16	56	81	0,93	5,7
	10	87	8	8	74	7	19	52	79	0,91	5,6
	12	86	8	8	70	7	23	49	77	0,88	5,5
	15	83	8	8	66	6	28	43	73	0,84	5,5
	19	81	7	7	61	6	33	38	69	0,80	5,3
Panasap Bronze (BRFL)	5	56	6	6	57	6	37	22	67	0,77	5,8
	6	51	6	6	52	6	42	18	63	0,73	5,7
	8	42	5	5	44	5	51	12	57	0,65	5,7
Panasap Dark Grey (DGFL)	3	39	5	5	52	6	42	55	63	0,73	5,8
	4	29	5	5	44	5	51	49	57	0,65	5,8
	5	21	5	5	37	5	58	45	52	0,59	5,8
	6	16	5	5	31	5	64	41	47	0,55	5,7
Panasap Green (GNFL)	5	72	7	7	45	6	49	22	58	0,67	5,8
	6	69	7	7	41	5	54	18	55	0,63	5,7
	8	63	6	6	33	5	62	12	49	0,57	5,7
	10*	57	6	6	28	5	67	9	45	0,52	5,6
	12	52	6	6	24	5	71	6	42	0,48	5,5
Panasap Euro Grey (GEFL)	5	51	6	6	51	6	43	24	62	0,72	5,8
	6	45	5	5	46	5	49	20	58	0,67	5,7
	8	36	5	5	37	5	58	14	52	0,59	5,7
	10*	28	5	5	29	5	66	10	46	0,53	5,6
	12	22	5	5	23	5	72	7	42	0,48	5,5
Panasap Blue Green (BNFL)	5	67	6	6	46	5	49	26	58	0,67	5,8
	6	62	6	6	41	5	54	22	55	0,63	5,7
	8	55	6	6	33	5	62	16	49	0,56	5,7
Panasap Dark Blue (DHFL)	6	58	6	6	45	5	50	29	58	0,67	5,7
	8	50	5	5	37	5	58	23	52	0,60	5,7
	10*	43	5	5	30	5	65	18	47	0,54	5,6
	12	36	5	5	25	5	70	15	43	0,50	5,5
Panasap New Dark Blue (DHNFL)	5	50	6	6	41	5	54	26	55	0,63	5,8

BCA Academy

3.0 Materials Selection.

3.3 Glass – Monolithic Acoustic Value



MONOLITHIC ACOUSTICAL DATA

The performance data below applies to monolithic glass. Data is based on testing ~36" x 84" glass to ASTM E413-87 in an acoustical wall. *OITC is estimated based on this test. Glass size and glazing system will affect STC rating. The monolithic glass is one lite of glass.

Monolithic Glass Construction	STC	OITC*	Frequency (Hz)																	
			100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
			Sound Transmission Loss (dB)																	
1/8" overall - 1/8" glass	30	25	19	17	18	21	23	22	24	27	28	30	30	32	34	35	36	33	26	30
1/4" overall - 1/4" glass	31	29	23	25	25	24	28	26	29	31	33	34	34	35	34	30	27	32	37	31
3/8" overall - 3/8" glass	34	32	26	27	27	30	32	31	34	35	36	35	33	30	30	35	38	41	46	48
1/2" overall - 1/2" glass	36	33	26	30	26	30	33	33	34	36	37	35	32	32	36	40	43	46	50	51

6mmt glass – 31 STC reading

BCA Academy

3.0 Materials Selection.

3.3 Glass – DGU Acoustic Value

32mm DGU consist of 10mmt glass + 12mm airspace + 10mmt glass – 37 STC reading



INSULATING ACOUSTICAL DATA

Viracon Acoustical Glass is made from combinations of various glass types along with acoustical window frames to help you effectively reduce sound transmission from airplanes, trains, vehicles and other unwanted noises. The performance data below applies to an insulating unit constructed with two plies of glass and an air or argon filled space. Data is based on testing ~36" x 84" glass to ASTM E413-87 in an acoustical wall. *OITC is estimated based on this test. Glass size and glazing system will affect STC rating.

The **STC (Sound Transmission Class)** rating is a single-number rating system for interior building partitions and viewing windows used to categorize acoustic performance. Its original intent was to quantify interior building partitions not exterior wall components. As a result it is not recommended for glass selection of exterior wall applications since the single-number rating was achieved under a specific set of laboratory conditions.

The **OITC (Outside-Inside Transmission Class)** rating is used to classify acoustic performance of glazing in exterior applications.

Insulating Glass Construction	STC	OITC*	Frequency (Hz)																
			100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
			Sound Transmission Loss (dB)																	
1/2" overall - 1/8" glass, 1/4" airspace, 1/8" glass	28	26	26	21	23	23	26	21	19	24	27	30	33	36	40	44	46	39	34	45
5/8" overall - 1/8" glass, 3/8" airspace, 1/8" glass	31	26	26	23	23	20	23	19	23	27	29	32	35	39	44	47	48	41	36	43
1" overall - 1/4" glass, 1/2" airspace, 1/4" glass	35	30	27	24	29	22	22	25	30	33	35	38	40	42	42	37	37	43	46	49
1" overall - 1/4" glass, 1/2" **argon** space, 1/4" glass	35	29	32	29	28	22	20	25	30	33	37	40	43	45	44	39	40	45	49	52
1" overall - 1/4" glass, 9/16" airspace, 3/16" glass	37	30	32	26	25	20	24	29	33	34	38	41	43	46	46	42	36	43	48	53
1-1/8" overall - 5/16" glass, 1/2" airspace, 5/16" glass	37	32	26	24	25	31	24	32	32	35	37	39	39	38	36	38	42	44	46	49
1-1/4" overall - 3/8" glass, 1/2" airspace, 3/8" glass	37	32	29	23	23	29	31	34	34	35	36	36	35	35	36	40	43	47	49	48
1-1/2" overall - 1/4" glass, 1" airspace, 1/4" glass	37	30	22	19	27	23	31	30	35	35	36	39	41	42	41	36	37	46	51	56
1-1/16" overall - 1/4" glass, 1/2" airspace, 5/16" glass	38	33	30	24	29	26	29	33	34	36	39	41	41	40	38	37	39	43	46	48
1-1/4" overall - 1/4" glass, 3/4" airspace, 1/4" glass	38	31	27	23	28	21	27	29	34	35	37	41	43	45	44	39	39	46	49	52
1-1/8" overall - 1/4" glass, 1/2" airspace, 3/8" glass	39	34	28	26	32	29	29	31	35	37	38	39	41	43	41	40	41	44	47	49
1-3/16" overall - 5/16" glass, 1/2" airspace, 3/8" glass	39	34	29	26	26	31	30	37	36	37	39	39	40	37	35	39	43	46	48	49
1-3/8" overall - 1/4" glass, 3/4" airspace, 3/8" glass	40	33	30	23	31	28	33	37	39	40	41	39	38	38	39	39	40	47	51	53

BCA Academy

3.0 Materials Selection.

3.3 Glass – Laminated Glass Acoustic Value

32mm DGU consist of 6mmt glass + 1.52mmt PVB Interlayer + 3mmt glass – 37 STC reading



LAMINATED ACOUSTICAL DATA

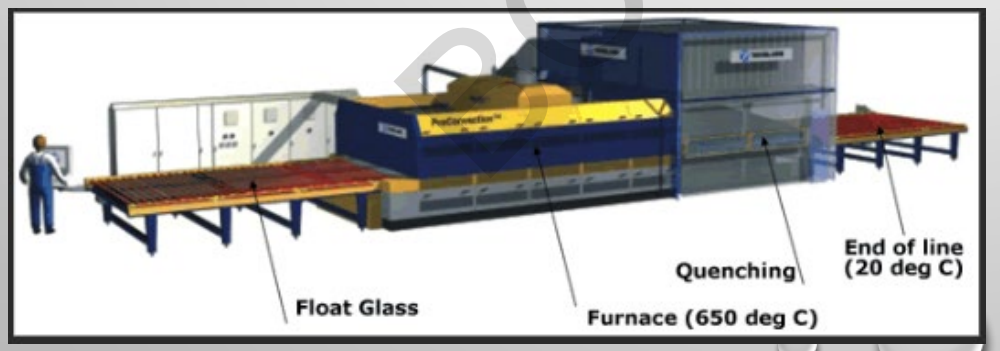
The performance data below applies to laminated glass units constructed with two plies of glass and an interlayer. Data is based on testing ~36" x 84" glass to ASTM E413-87 in an acoustical wall. *OITC is estimated based on this test. Glass size and glazing system will affect STC rating.

Laminated Glass Construction	STC	OITC*	Frequency (Hz)																
			100	125	160	200	250	315	400	500	630	800	1000	1250	1600	2000	2500	3150	4000	5000
			Sound Transmission Loss (dB)																	
1/4" overall - 1/8" glass, .015" PVB, 1/8" glass	33	30	27	23	27	24	27	28	29	31	33	35	35	35	33	31	32	37	41	45
3/16" overall - S/S glass, .030" PVB, S/S glass	35	31	29	29	29	25	27	29	29	31	32	34	34	34	34	35	33	36	39	41
1/4" overall - 1/8" glass, .030" PVB, 1/8" glass	35	31	25	26	28	27	29	29	30	32	34	35	35	36	36	35	35	38	43	46
1/4" overall - 1/8" glass, .045" PVB, 1/8" glass	35	31	24	27	27	28	28	29	30	32	34	35	36	36	37	36	35	38	43	46
5/16" overall - 1/8" glass, .060" PVB, 1/8" glass	35	31	25	25	26	29	28	30	30	32	34	35	35	36	36	36	36	39	43	46
3/8" overall - 3/16" glass, 0.15" PVB, 3/16" glass	36	32	27	25	26	30	31	31	33	35	35	35	35	33	33	37	41	44	48	51
3/8" overall - 3/16" glass, .030" PVB, 3/16" glass	36	33	27	27	27	30	31	31	33	34	35	36	36	35	34	37	41	45	49	52
3/8" overall - 1/4" glass, .030" PVB, 1/8" glass	36	33	27	28	26	30	31	31	32	34	35	36	36	35	35	36	40	44	48	51
1/2" overall - 1/4" glass, .015" PVB, 1/4" glass	36	32	25	25	27	30	32	32	34	35	35	35	33	32	35	40	43	46	49	51
9/16" overall - 1/4" glass, .075" Storm, 1/4" glass	36	35	27	30	30	31	31	33	32	33	34	35	35	34	36	40	43	45	47	47
9/16" overall - 1/4" glass, .090" SGP, 1/4"glass	36	34	31	30	29	31	32	33	33	34	35	35	34	32	34	37	40	42	44	47
7/16" overall - 1/4" glass, .060" PVB, 1/8" glass	37	33	27	28	27	30	31	31	33	35	36	37	37	37	36	37	41	44	48	51
9/16" overall - 1/4" glass, .100" StormGuard, 1/4" glass	37	35	32	31	30	31	33	34	34	34	35	36	35	35	37	41	44	47	49	51
1/2" overall - 1/4" glass, 030" PVB, 1/4" glass	38	34	25	29	28	30	33	33	34	36	37	37	37	36	37	41	45	48	51	53
1/2" overall - 1/4" glass, .045" PVB, 1/4" glass	38	34	26	30	27	30	33	33	34	36	37	38	37	36	37	41	45	48	51	54
9/16" overall - 1/4" glass, .060" PVB, 1/4" glass	39	34	26	29	28	30	33	33	35	36	37	38	38	37	38	41	44	47	51	54
3/4" overall - 1/2" glass, .030" PVB, 1/4" glass	39	36	31	35	33	33	34	36	36	37	36	35	34	39	41	46	48	50	52	56
5/8" overall - 3/8" glass, .030" PVB, 1/4" glass	40	36	29	30	28	32	34	35	36	38	38	38	36	38	42	46	49	52	55	57
13/16" overall - 1/2" glass, .060" PVB, 1/4" glass	41	36	29	30	29	32	35	35	37	38	38	38	37	41	44	48	50	53	56	56

BCA Academy

3.0 Materials Selection

3.3	Heat Strengthened Glass.
1.	Float glass is sent to the furnace for heat treatment at a temperature of +/- 650 degree Celsius.
2.	It undergoes a “slower annealing process” than tempered glass and hence, has a lower compressive strength versus tempered heat treated glass. Glass is weak in tension but has a very high compressive strength .
3.	Heat strengthened glass is approximately 2 times stronger than float glass of the similar thickness.
4.	Heat strengthened glass is strongly recommended to be used at spandrel area of façade wall.
5.	It has a less wavy appearance than full tempered glass.



Designation: C 1048 – 04

Standard Specification for
Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass[1]

RCA Academy

3.0 Materials Selection

3.3	Tempered Glass.
1.	Float glass is sent to the furnace for heat treatment at a temperature of +/- 650 degree Celsius.
2.	It undergoes a “rapid annealing process” and hence, provides a very high surface and edge compression in the glass.
3.	Heat strengthened glass is approximately 4 to 5 times stronger than float glass of the similar thickness.
4.	The disadvantage of tempered glass is that it is prone to have spontaneous breakage, due to impurities, such as nickel sulphide etc.
5.	One approach to minimize spontaneous breakage is to send the glass for further Heat Soaked Treatment.



Designation: C 1048 – 04

Standard Specification for
Heat-Treated Flat Glass—Kind HS, Kind FT Coated and Uncoated Glass[1]

BCA Academy

3.0 Materials Selection.

3.3	Glass – Heat Soaked Treatment.
1.	Heat soaked – To minimize the risk of spontaneous breakage in full tempered glass that is caused by nickel sulfide inclusions.

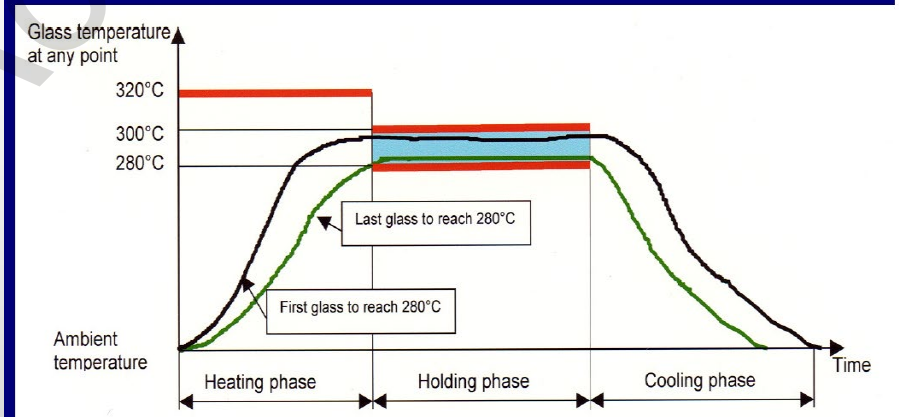
Heat Soak Test

EN 14179-1



Heat soak process cycle

EN 14179

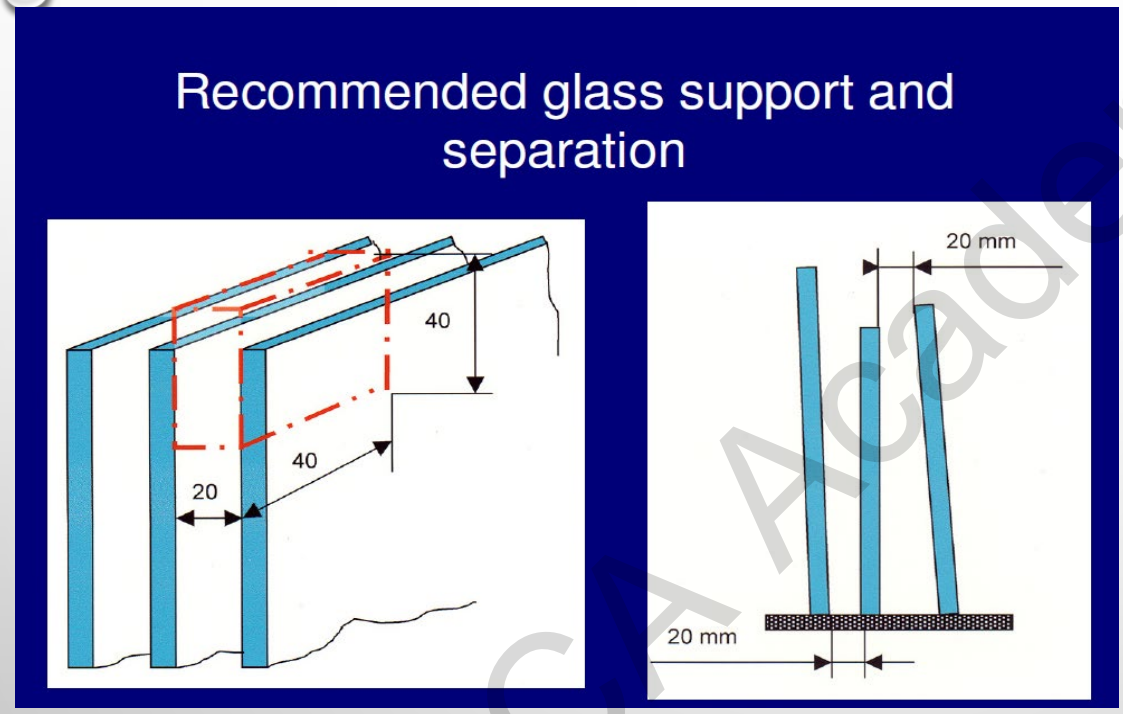


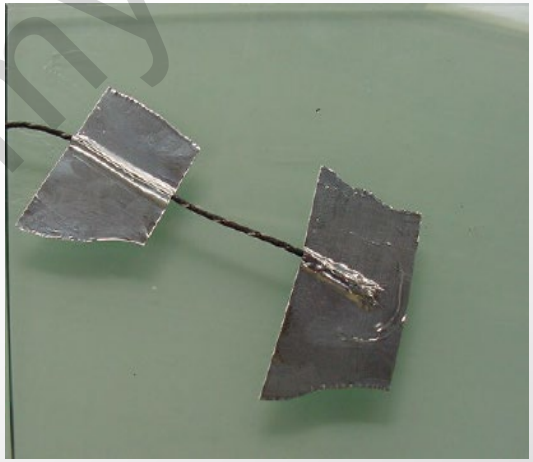
To minimize the risk of spontaneous breakage in fully tempered glass caused by nickel sulfide inclusions.

BE Academy

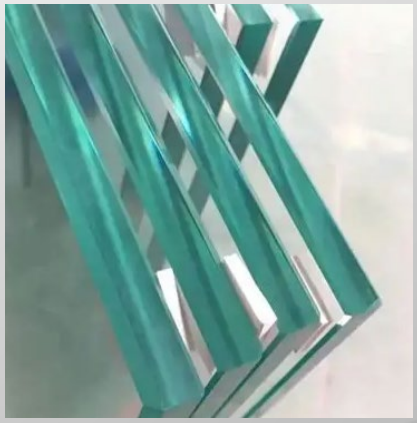
3.0 Materials Selection.

3.3 Glass – Heat Soaked Treatment.





Thermocouple on glass

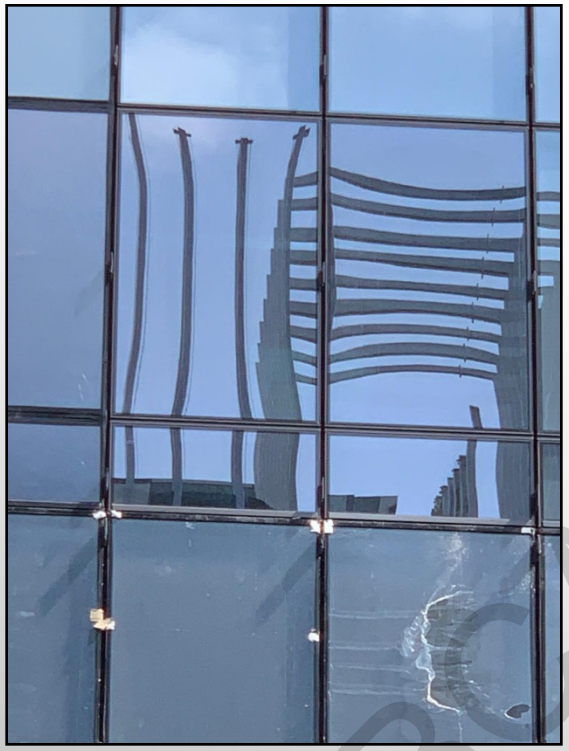


Spacer of glass

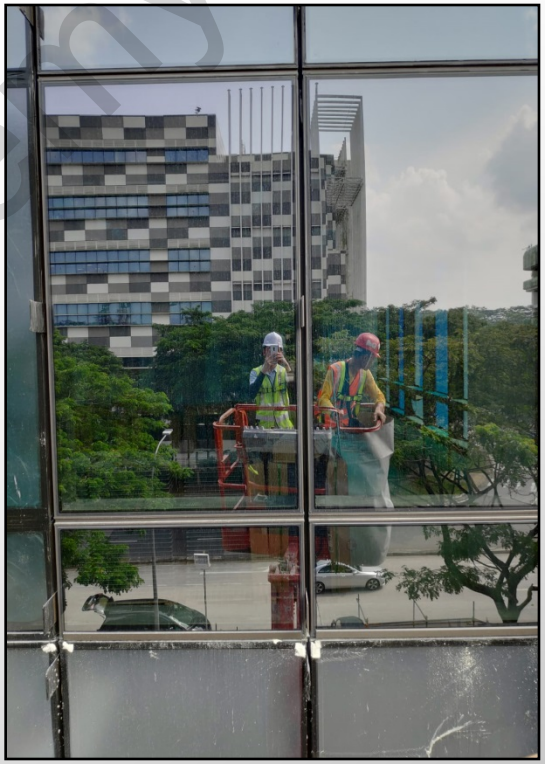
BOA Academy

3.0 Materials Selection.

3.3 Glass – Visual Appearance After Installed – Distortion



Waviness / distorted on glass surface is observed from the external of the façade.



External view of the glass façade is acceptable.

BCA Academy

3.0 Materials Selection.

3.3 Glass – Visual appearance after installed – Distortion.

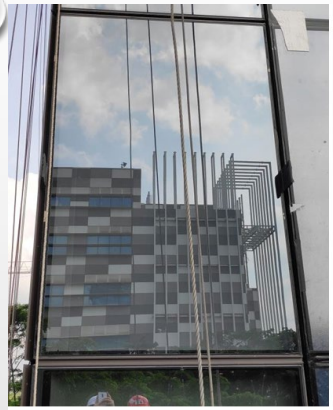




Photo taken in accordance to ASTM-C1036 (Fig. 1) inspection criteria at 3 to 4 meters distance at 90° angle

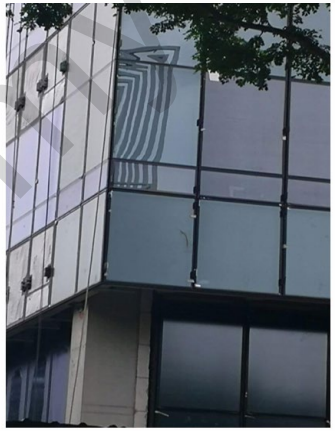


Photo taken with mobile/zoom from 23 meters at approx. 30° inclined angle



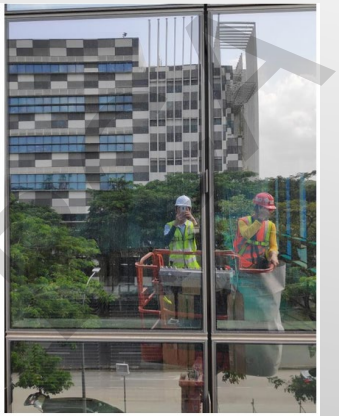


Photo taken in accordance to ASTM-C1036 (Fig. 1) inspection criteria at 3 to 4 meters distance at 90° angle

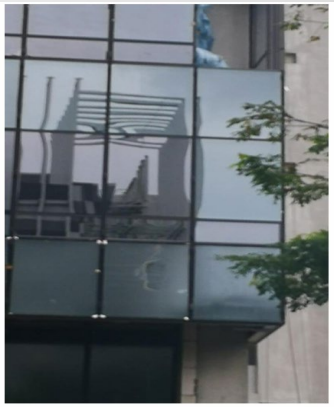


Photo taken with mobile/zoom from 23 meters at approx. 30° inclined angle

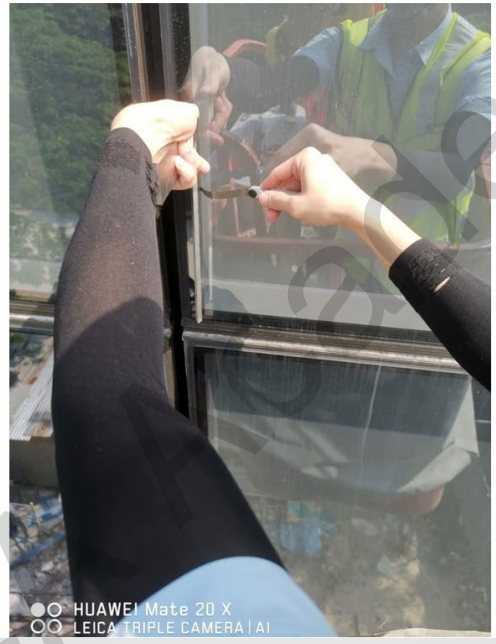
KA Academy

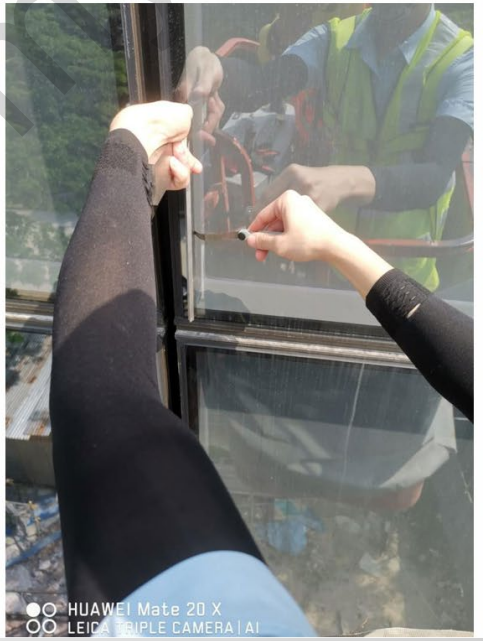
3.0 Materials Selection.

3.3 Glass – Verification of Glass Distortion.



Stainless steel L square ruler – 300mm L and stainless steel feeler gauge.





Place the long length of the L shaped angle against the glass surface. Insert the feeler gauge in between gap and record the dimension.

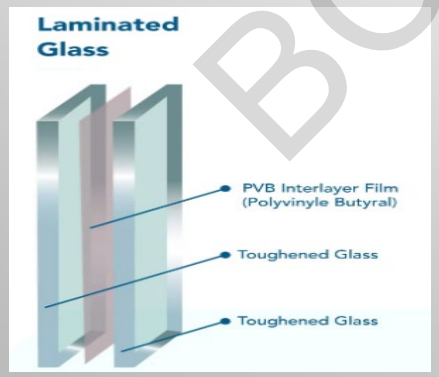
BCA Academy

3.0 Materials Selection.

3.3	Laminated Glass.
1.	Is a process of sandwiching 2 pieces of glass in between a piece (or 2) of PVB clear interlayer.
2.	PVB interlayer comes in standard thickness of 0.38mm, 0.76mm 1.52mm etc.
3.	Higher grade such as Sentry Glass products is 5 times the strength and also 100 times more stiffen than the normal type of PVB (polyvinyl Butyral a- a clear thermoplastic resin). Thickness 0.89mm, 1.52mm, 2.28mm, 2.53mm.
4.	Laminated glass is classified as safety glass.
5.	Laminated glass has a better value acoustic value than DGU.

Designation: C1172 – 09

Standard Specification for
Laminated Architectural Flat Glass[1]

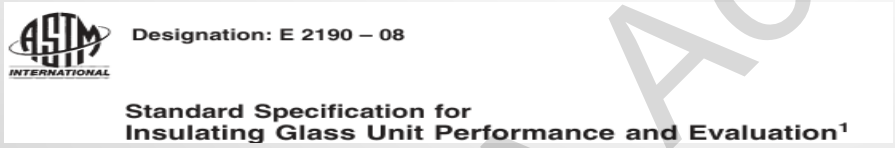




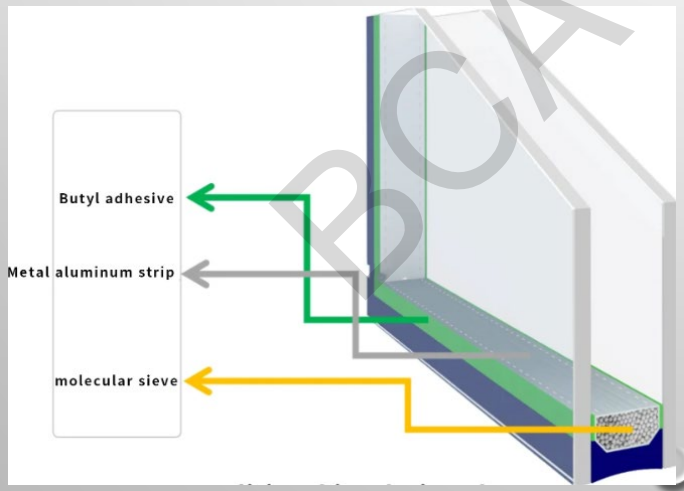
BCA Academy

3.0 Materials Selection.

3.3	Insulated Glazed Unit – Double Glazed Unit.
1.	It is a process of placing 2 pieces of glass with an aluminium spacer desiccant in between and sealing the perimeter with structural seal.
2.	DGU is good for energy efficiency.
3.	Noise reduction – multi layered glass dampens external sound vibrations.
4.	Condensation control – keep inner glass pane at a more consistent temperature & prevent moisture from forming on the interior surface.


Designation: E 2190 – 08

Standard Specification for
Insulating Glass Unit Performance and Evaluation[1]



Double Glazed Formation


Double Glazed Unit

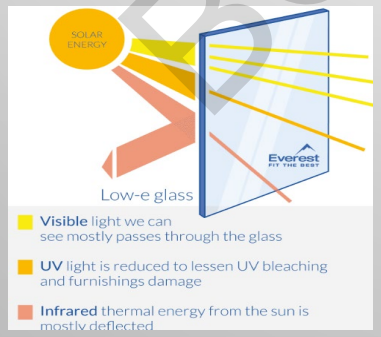
BCA Academy

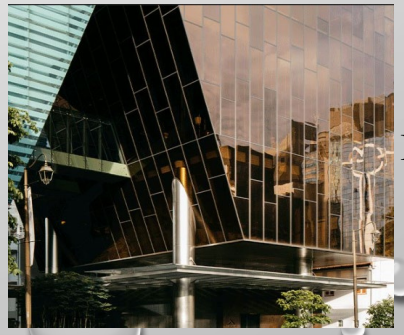
3.0 Materials Selection.

3.3	Low – Emissivity Glass.
1.	Low-E glass is a energy efficient glass that has microscopically thin coatings applied to its surface, which minimizes the infrared and ultraviolet light that passes through while allowing visible light to enter.
2.	The coating reflects heat and thereby keeping the internal cool.
3.	Very good performance Low-E glass has a very low Shading co-efficient and U values.
4.	The disadvantages are high costs and possible difficulties in getting replacements in the future due to production or supply issues.
5.	Advantage is the glass will give an aesthetic good outlook and allow energy savings.

RCA Academy

Low-E Glass

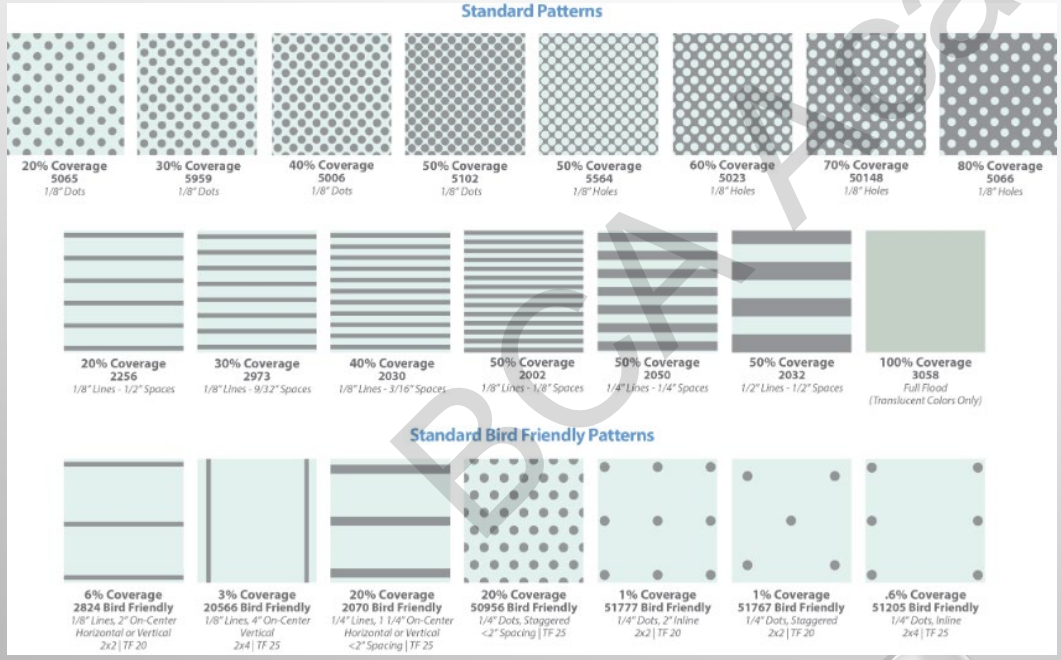




Low-E Glass Facade

3.0 Materials Selection.

3.3	Ceramic frit Glass.
1.	The surface #2 of the glass is applied with layers of paint finish and sent to the furnace for adhesion.
2.	There are wide range of colours available to choose from, commonly are white and grey.
3.	Frit patterns such as pokka dots, squares, oval shapes etc, are commonly used.



Various Patterns and Design



Colour Chart

RCA Academy

3.0 Materials Selection.

3.3	Frosted Glass.
1.	A mechanical process uses high speed machine to blast sand against the glass surface to roughen.
2.	Disadvantage is maintenance issue as any stains on it is not washable and not able to be cleaned off.



Frosted Glass

The glass is opaque on one surface and is rough.
Easily stained – finger print, oil, dust, dirt
Removal of stain is difficult.

The glass is opaque on one surface
but it is much smoother than sand blast finish
Stains can be easily washed &
removed.



Acid Edge Treated Glass

3.3	Acid Etched Glass.
1.	Hydrofluoric acid is used to corrode the surface #2 of the glass surface.
2.	The smooth surface is easy to clean and wash.
3.	As hydrofluoric acid is strictly controlled, only available overseas.

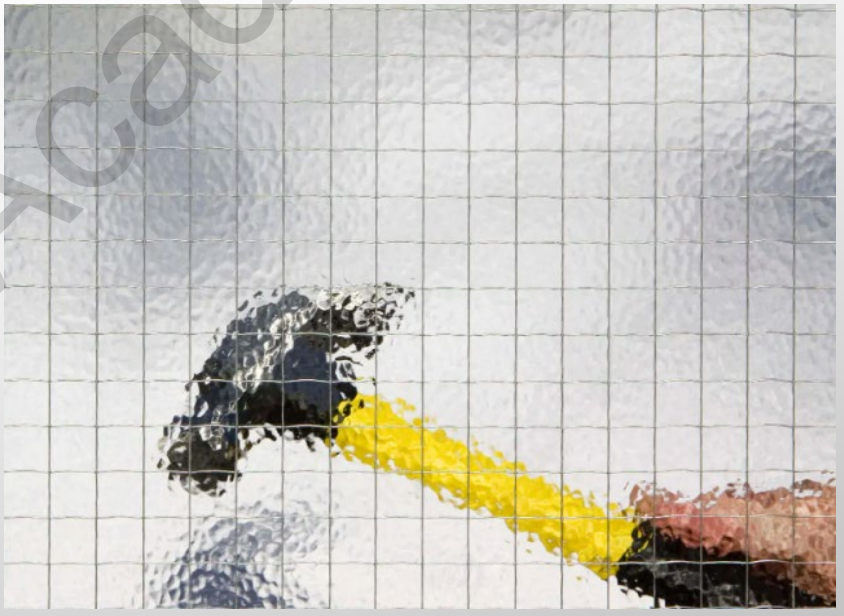
BCA Academy

3.0 Materials Selection.

3.3	Wire Glass.
1.	It is classified as safety glass and is recommended to use it for windows in mental hospital, old folk homes etc.



Wire Glass



BCA Academy

3.0 Materials Selection.

3.3	Glass Logo.
1.	It is a good industry practice to provide logo on glass surface to ease the tracking / identifying the type of glass that was used after a period of time.
2.	Whether it is tempered logo, heat strengthened logo, laminated glass logo.
3.	There are standard norms to locate the logo, on external glass surface, either on left / right hand bottom corner.

BCA Academy



Glass Logo is upside down



Glass Logo

3.0 Materials Selection

4.0	**Opearting & Bearing Devices – Window.**
	Standard / Miscellaneous Items – Brackets, screws, anchor bolts, G.I. sheet etc.
1.	**Accessories & hardware for window.**
2.	Stainless steel compliance BS EN 10088
3.	Aluminium profies compliance to EN755 (euro code)
4.	**General items:**
5.	Fixing lugs produced from G.I. sheet – install window frames.
6.	Hot dipped galvanized steel brackets, sleeves.
7.	Anchor bolts – galvanized finish
8.	Stainless steel screws
9.	Spray paint
10.	Putty

BCA Academy

3.0 Materials Selection.

4.0	Operating Devices & Bearings for Windows	Description of Hardware & Accessories.
	Type	**Hardware / accessories**
1.	**Casement window**	Stainless steel friction stay
2.		Stainless steel friction stay with control bar
3.		Cam handle / cam handle with key
4.		Dual locking system / multi point lock
5.		Child care lock
6.		Stainless steel restrictor
7.		Wind block
8.	**Sliding window**	Crescent lock / key
9.		Nylon rollers
10.		PVC stopper

BCA Academy

3.0 Materials Selection.

4.0 Operating & Bearing Devices – Casement & Top Hung Windows.



a. Stainless steel friction stay



b. Stainless steel restrictors



c. Cast alloy cam handle



e. Casement guider



d. Locking device – dual lock

BCA Academy

3.0 Materials Selection.

4.0	Operating & Bearing Devices - Friction stay – Casement & top hung windows.
1.	Stainless steel friction stay is used to secure both the outer and inner frames to facilitate the opening of the window glass panel.
2.	It consists of a wide range of products from various manufacturers.
3.	Need to select a suitable and reliable product based on compliance to SS212 standard.
4.	Selected product must be tested and proven product with compliance to SS212 standard.



Stay – open 90 degree with Minimum edge distance



Standard stay – open at 90 degree with gap of 210mm

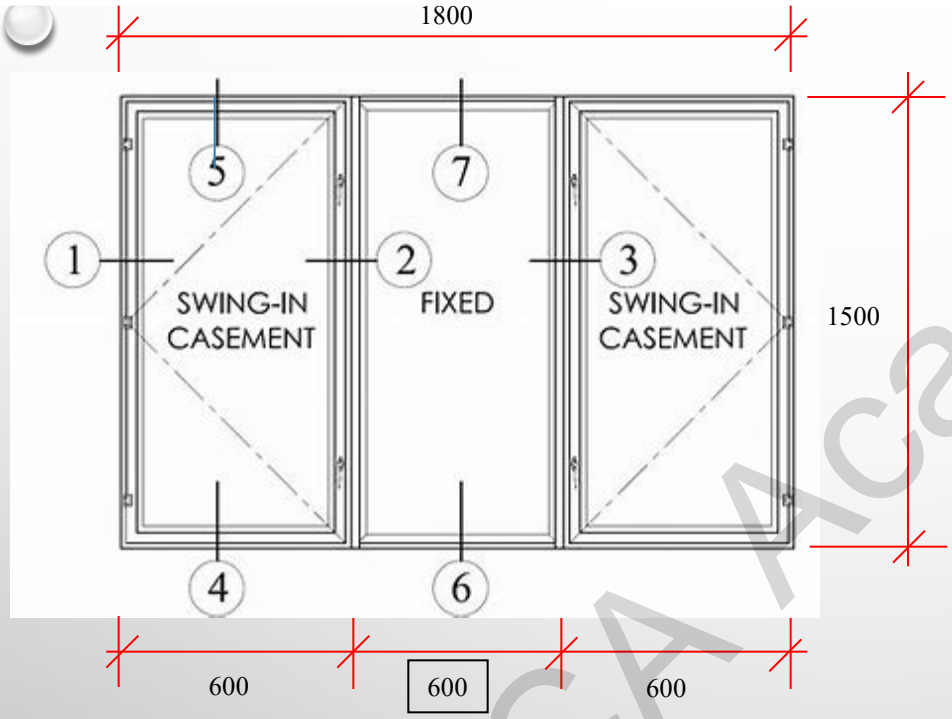


Stay with Press Button Control – Open at 30degree, lock.
Press to release to full 90 degree.

BCA Academy

3.0 Materials Selection.

4.0	Determine the weight of frame/glass/hardware to select type of friction stay.



	Calculation of weigth of frame & glass	
	Aluminium inner frame	Weight
1.	Inner frame CA100	
1a	(0.6 x 2) + (1.5 x 2)	4.2kg
2.	**Glass**	
2a	0.6 x 1.50 = 0.9 x 20kg/m2	18 kg
3.	**Hardware**	
3a	Handle, lockset	1.0kg
4.	**Total:**	
4a	Total weight of a single alum glass panel 1a+2a+3a	23.2kg

	Note:
1.	Besides the weight, the maximum width of a single panel is restricted to 900mm w.

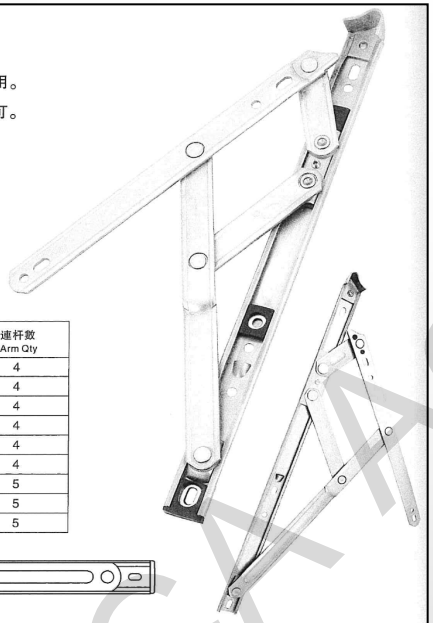
BCA Academy

3.0 Materials Selection – Casement/top hung

4.0 Operating & Bearing Devices - Stainless Steel Friction Stay – Casement / Top Hung Windows.

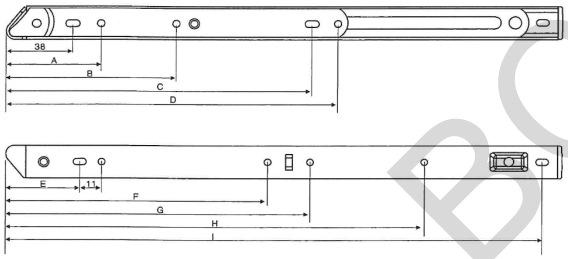
左右角仔型鉸鏈 Left and Right Handed Friction Stay

- ◆選用優良的(304#)不銹鋼制造。
- ◆五萬次嚴格開關測試後仍能操作正常，確保恒久耐用。
- ◆可調節角度，祇需要把定位滑塊調節至所需角度即可。
- ◆左右角仔型鉸鏈分左右方向。
- ◆質量符合新加坡SS212:1998和香港房署標準。
- ◆符合中國建築工業行業JG/T127-2007標準。
- ◆產品隨着技術的改進，某些參數會有所變化。



鋁窗規格
Sash Size

型號 Description	窗最高(mm) Max.Vent Height in/mm	窗最寬(mm) Max.Vent Width in/mm	窗最重(kg) Max.Vent Weight Kg	開窗角度 Opening Angle ±2°	連杆數 Arm Qty
08	850	500	20	58±2°	4
10	1000	600	24	87±2°	4
12	1500	700	28	87±2°	4
14	1500	700	33	87±2°	4
16	1600	700	36	87±2°	4
18	1600	800	43	87±2°	4
20	1800	800	48	87±2°	5
22	1800	900	50	87±2°	5
24	1800	1000	52	45±2°	5

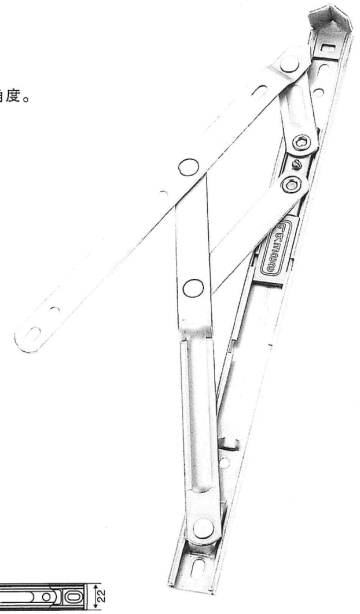


客户安装尺寸 The Installation Dimensions(mm) 單位：mm

型號規格	A	B	C	D	E	F	G	H	I
10	58	—	123.5	135.5	36	190	217	—	260
12	58	—	207	219	36	215	242	—	304
14	58	—	224	236	36	238.5	265.5	304.5	348.5
16	58	—	244	256	36	266.5	293.5	358.5	402.5
18	58	—	260	272	36	288	315	411	455
20	58	157	271.5	284.5	36	309	336	442.5	504
22	58	173	299	312	36	345	372	491	553
24	58	195	324	327	36	203	230	535	597

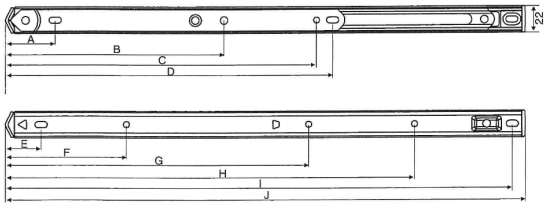
帶按掣鉸鏈 Friction Stay With Press Button Device

- ◆選用優良的(304#)不銹鋼制造。
- ◆五萬次嚴格開關測試後仍能操作正常，確保恒久耐用。
  多角度定位，開到固定角度時自動定位，按下按掣，
  可繼續開到下一個固定角度，再按下按掣，可開到最大角度。
- ◆質量符合新加坡SS212:1998和香港房署標準。
- ◆符合中國建築工業行業JG/T127-2007標準。
- ◆產品隨着技術的改進，某些參數會有所變化。



鋁窗規格
Sash Size

型號 Description	窗最高(mm) Max.Vent Height in/mm	窗最寬(mm) Max.Vent Width in/mm	窗最重(kg) Max.Vent Weight Kg	開窗角度 Opening Angle ±2°
12	1500	600	22	30° /60° /90°
14	1500	700	28	30° /60° /90°
16	1600	700	35	30° /60° /90°
18	1600	800	40	30° /60° /90°
20	1800	1000	43	30° /60° /90°



客户安装尺寸 The Installation Dimensions(mm) 單位：mm

型號規格	A	B	C	D	E	F	G	H	I
12	75	—	198	211	31	210	237	—	299
14	93	—	215	228	31	234	261	300	343
16	114	—	235	248	31	261	288	353	397
18	132	—	251	264	31	283	310	406	450
20	57	157	271.5	284.5	31	304	331	437.5	499

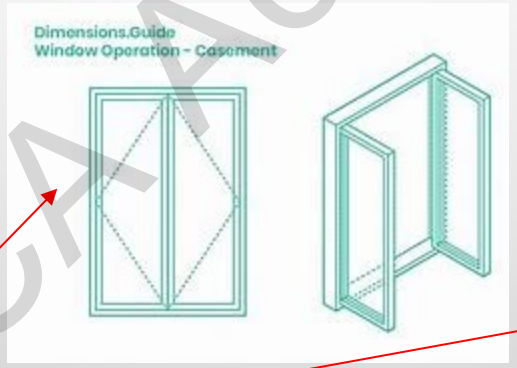
BCA Academy

3.0 Materials Selection – Casement / Top Hung.

4.0	Operating and Bearing Devices – Casement Window.
	Wind Block.
1.	The wind block is installed to the mid-centre on both vertical outer frames.
2.	Need to be installed when window height exceeded 1.20m H
3.	The block is designed to resist buckling when the member is subjected to wind load.



Part view of an casement window
- installed with wind block.





Wind block – resist buckling when subject to wind load.

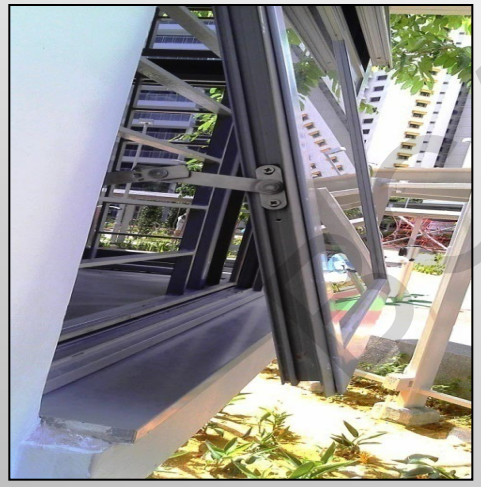
Operating and Bearing Devices for Casement Window.

BCA Academy

3.0 Materials Selection – Casement / Top Hung.

4.0	**Operating & Bearing Devices - Stainless Steel Restrictor – Casement Window.**
1.	Stainless steel restrictor is used when a casement or top hung is beyond the extreme width or height.
	Safety child lock
2.	A safety child lock is used as a safety aspect to prevent children from pushing open the window.

CCA Academy



Stainless steel restrictor – restrict the opening angle.



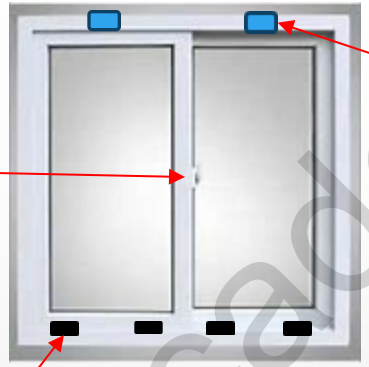
Safety child lock – with key.

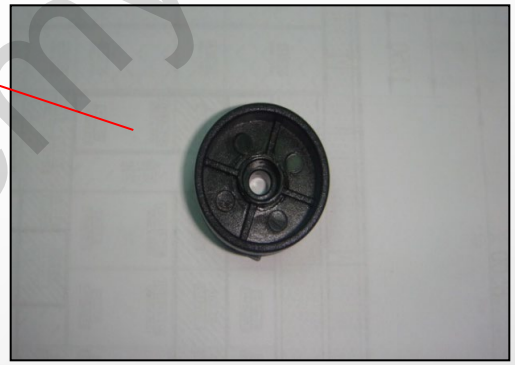
3.0 Materials Selection – Sliding Window.

4.0 Operating and Bearing Devices – Sliding Window.



e. Crescent lock for sliding window





f. Nylon stopper – sliding window

Operating and Bearing devices.



g. Sliding window roller



h. Location of stoppers

BCA Academy

3.0 Materials Selection – Aluminium Window.

4.0 Operating & Bearing Devices - Full size Visual Mock Up Sample.



Typical full size mock up sample



Typical full size mock up sample

BOK Academy

3.0 Materials Selection – Aluminium Window.

4.0 Operational & Endurance Test – Operating / Bearing Devices Test Report.

Test Report No. 7191069252-MEC13-02-DL
dated 27 Sep 2013

PSB Singapore

TEST RESULTS:

Endurance of Fastener or Hardware (E.9 Test 8)

Sample Reference		Number of cycles: Initial	10,000	20,000	30,000	40,000	50,000	SS 212 : 2007 Requirements
Observation		No visual damage is observed.						No visual damage to the fastener / hardware shall be detected.
Ease of fastener operation	Torque applied on fastener to close the sash (Nm)	2.9	2.9	2.9	2.9	2.9	2.9	10 maximum
	Torque applied on fastener to open (release) the sash (Nm)	3.1	3.1	3.1	3.1	3.1	3.1	
Ease of movement of sash	Force to initiate movement (N)	68.7 (open) 74.6 (close)	55.9 (open) 68.7 (close)	45.1 (open) 68.7 (close)	45.1 (open) 68.7 (close)	37.3 (open) 62.8 (close)	37.3 (open) 62.8 (close)	80 maximum (area of sash = 0.90 m^2)
	Force to sustain movement (N)	63.8 (open) 63.8 (close)	39.2 (open) 49.1 (close)	34.3 (open) 45.1 (close)	31.4 (open) 45.1 (close)	29.4 (open) 39.2 (close)	29.4 (open) 39.2 (close)	

Results: Passed.

Remarks: (1) No visual damage is observed.
(2) The tophung window remains operable (open, close & lock) after 50,000 cycles of endurance test.

David Li
Associate Engineer

Ong Khay Beng
Engineer
Building
Mechanical Centre

Results on the endurance / operational test.

Test Report No. 7191069252-MEC13-02-DL
dated 27 Sep 2013

PSB Singapore

APPENDIX: PHOTOS TAKEN DURING TEST



Figure 1: Endurance of fastener or hardware

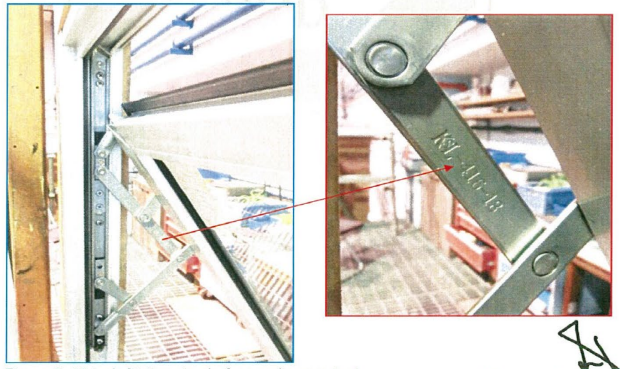


Figure 2: 18 inch friction stay before endurance test

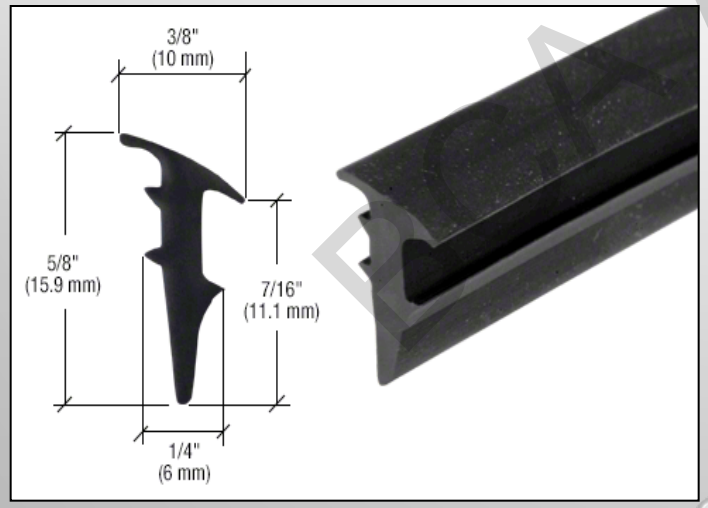
Page 3 of 7

Product is reviewed after endurance test.

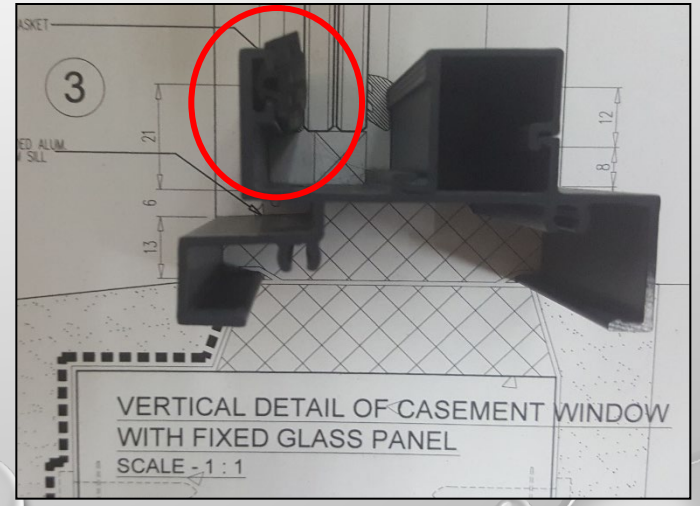
Operating and Bearing devices – Test report

3.0 Material Selection.

4.0	Operating & Bearing Devices – Gasket for Window.
1.	Gasket is manufactured in various size, shapes, thickness as per the design requirements / specifications.
2.	Materials commonly used and in compliance to specifications are as below:
3.	Neoprene
4.	Santoprene – offers superior resistance to UV rays, ozone & extreme weather.
5.	EDPM (Ethlylene Propylene Diene Monomer)



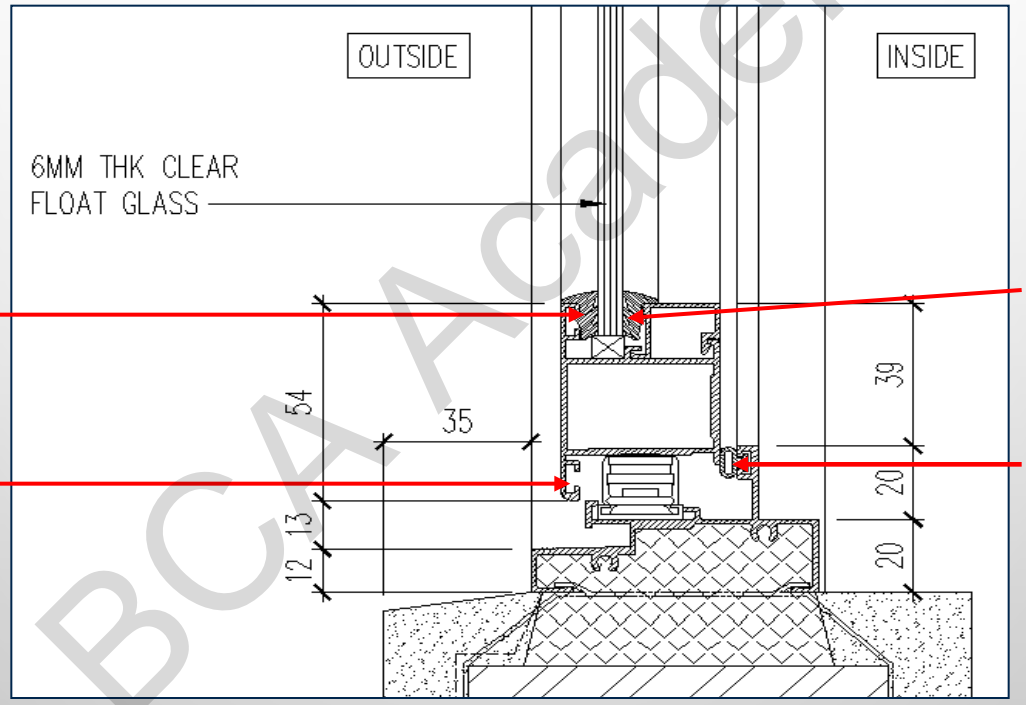
Profile of Gasket.

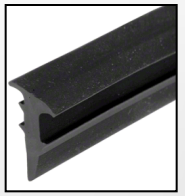


RA Academy

3.0 Material Selection

4.0	Opearating & Bearing Devices – Gasket for Window.
1.	Gasket is part of the key role in the window system as it helps to compress the inner and outer frame tightly to permit the transmission of sound and also prevent water ingress.





Glazing gasket inserted in factory.

Glazing gasket inserted in factory but to provide break off at weep holes location.

Glazing gasket inserted on site.

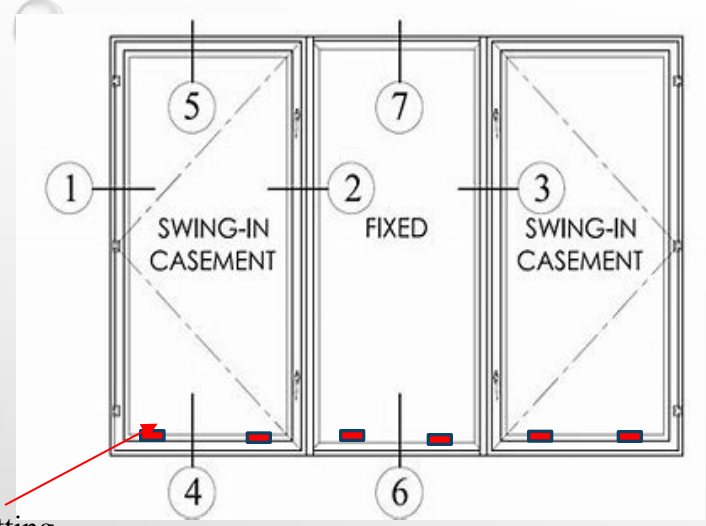
Glazing gasket inserted in factory.

Typical section details of window sill.

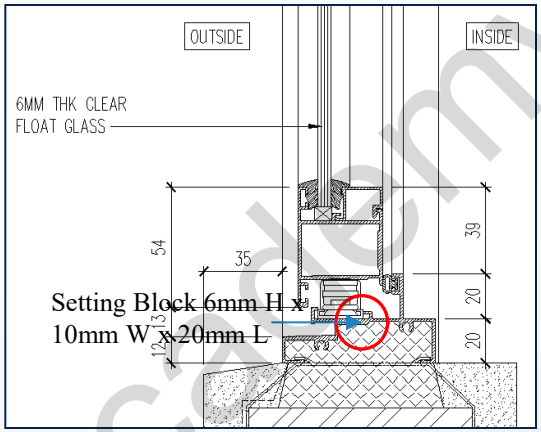
BCA Academy

3.0 Material Selection

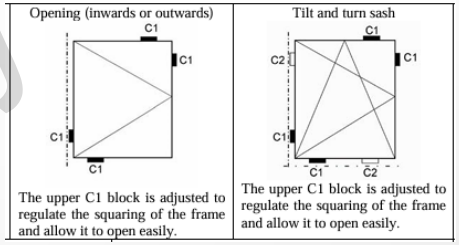
4.0 Setting Block – To Support Glass Weight & Position.



Setting block location



Window – Setting Block.



To regulate the squareness of frame.

4.0	Setting Block.
1.	Setting block is used to support the glass weight uniformly.
2.	Material is EDPM and has a shore A hardness 80A – 90A.
3.	The setting block's positioning is always ¼ from both the left and right edges.
4.	The width and height is calculated depending on the width, height and weight of the glass panel.

BOA Academy

3.0 Material Selection

4.0	Type of Silicone Sealant.	Descriptions.
1.	Weather seal silicone sealant	External use, water tight
2.	Polyurethane sealant	Internal usage
3.	Acrylic sealant	Internal / paintable
4.	Structural silicone sealant	External / internal
5.	Non bleed weather silicone sealant	External, weather seal







Type of silicone sealant.

***Dow Corning*® 791 Silicone Building Sealant**

COLOR	CRT	SGE	2 GAL PAIL	4.5 GAL PAIL	DRUM
Black	MTS	MTS	MTO	MTS	SS
Bronze	MTS	MTS	MTO	MTO	NS
Camel	MTS	MTO	MTO	MTO	MTS
Gray	MTS	MTS	MTO	NS	MTO
Limestone	MTS	MTS	MTO	MTO	MTO
Precast White	SS	MTS	MTO	MTO	MTO
White	MTS	MTS	NS	MTO	NS

Availability:

MTS/SS: Typically a stocked item

NS: No inventory available and lead time varies based on product/size

MTO sausages: 3-day lead time, 2-cases minimum, standard pricing

MTO pails: 3–4-week lead time, 18-pail minimum, standard pricing

Key: MTS = Made to Stock **SS** = Safety Stock **MTO** = Made to Order **NS** = Non-Stocked • = Not Available

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3.0 Material Selection

4.0 Silicone Sealant - Colour Chart



TREMCO SEALANTS COLOUR CHART

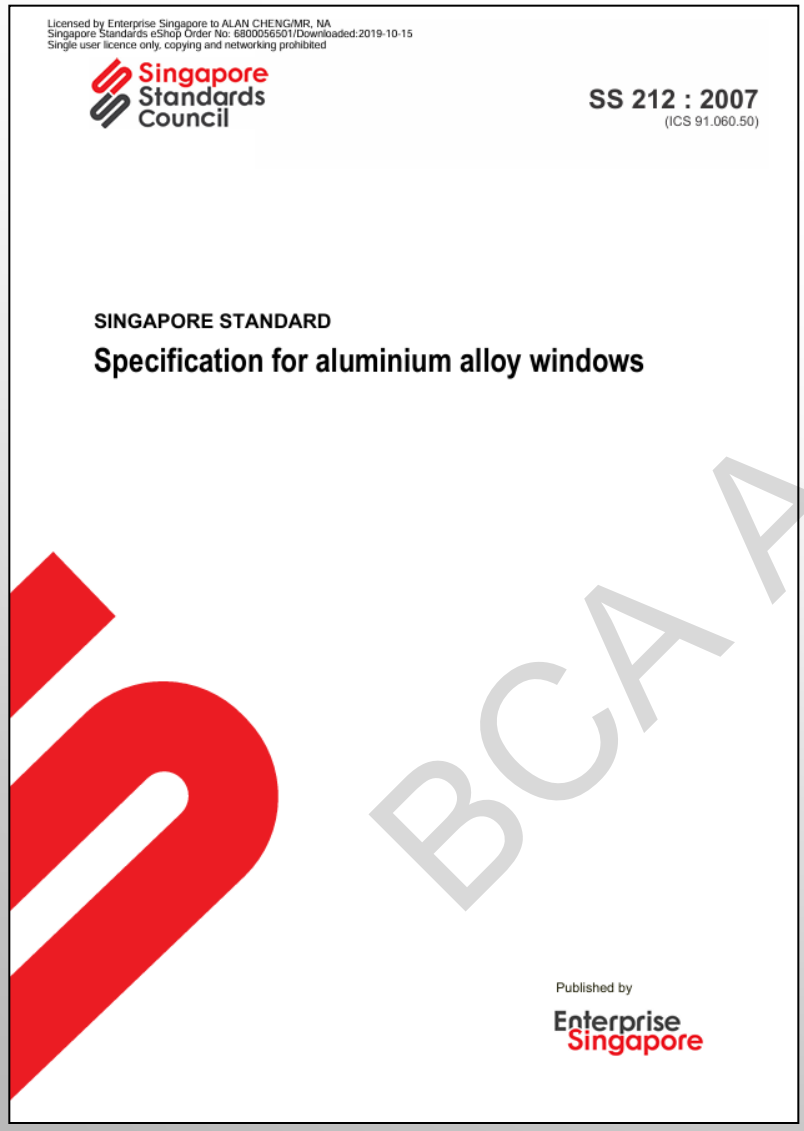
SG300	SG555	SG556	SG557	SG558	SG559
Alu Grey	Traffic White *(previously known as White)*	Pure White *(previously known as White)*	Traffic White *(previously known as White)*	Traffic White (M) *(previously known as White)*	Traffic White *(previously known as White)*
Warm Black *(previously known as Black)*	Casteel Grey *(previously known as Grey)*	Mid Grey *(previously known as Grey)*	Warm Grey *(previously known as Grey)*	Warm Grey (M) *(previously known as Grey)*	Mid Grey *(previously known as Grey)*
	FS Grey	Bronze	Signal Black *(previously known as Black)*	Black (M) *(previously known as Black)*	Black
	Signal Black *(previously known as Black)*	Signal Black *(previously known as Black)*			Oak

NOTE: Colours shown are approximate and may not reflect the shade precisely. Different lighting conditions can influence colour appearance, for truer colour, please view in daylight. Please contact Tremco Customer Service for more information.

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3.0 Material Selection

4.0 Performance Test Window – SS212 : 2007



SS 212 : 2007
Aluminium Alloy Windows

Performance Test on Window

	Sequence of Test
1.	Air leakage test
2.	Water tightness test
3.	Structure performance test
4.	Repeat water test
5	Proof load test

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3.0 Material Selection

4.0 Performance Test Window – Air Leakage Test Report.

PSB Singapore

2. Test Sample

The casement window system to be tested having an overall size of 1500mm(H) x 950mm(W) and having an overall area of 1.43m² shall be installed onto our curtain wall test chamber, where external face of the test sample will face inwards, creating a pressure chamber around the test sample (see Figure 1 for details).

3. Sample Installation

The test sample shall be mounted and sealed onto TÜV SÜD PSB curtain wall chamber at 60 Tuas South Street 1 premises in the same manner and by the same fixings that are intended to attach to the building structure. The support frame is similar stiffness to that supporting building.

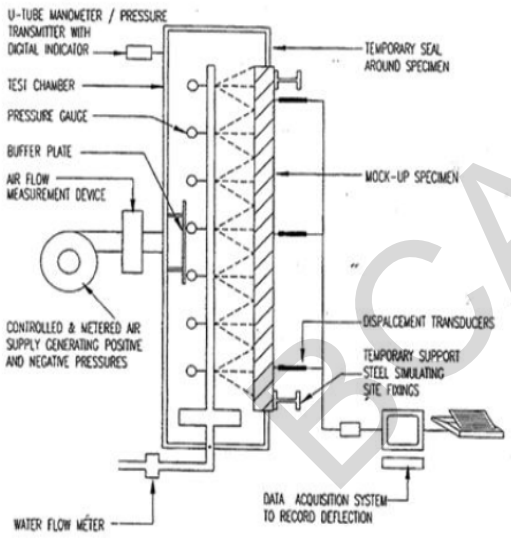


Figure 1 - General arrangement for test set up.
(Exterior of test specimen facing inwards of chamber)

4. Testing Requirements

The tests shall be conducted with reference to Singapore Standards for Aluminium Alloy Windows SS 212: 2007 Specifications. The test parameters and criteria are as follows:

Positive Design Pressure (Pa) : + 1310

Negative Design Pressure (Pa) : - 1310

4.1 Air Leakage

Test	Referencing SS 212: 2007 Test Parameters	Referencing SS 212: 2007 Test Parameters
Air leakage	a. 3 pulses of 500 Pa are applied, and each pulse are maintained for 3 seconds b. Unlock, open, close and lock vent for 5 times. c. Positive pressures are applied in steps of 50, 100, 150, 200, 250, 262 Pa d. Leakage readings are obtained for each pressure step.	**Non Air-con condition** Opening light: Air leakage shall not exceed: 10 m³/hr/m

The air leakage rate through the test chamber will be measured by a calibrated flow meter connected in the air pressure line with the test pressure as tabulated above. This shall be used as the initial leakage rate. The sealing film or tape shall then be removed from the test sample and the total air leakage rates determined. The air leakage through the test sample shall be the difference between the initial and total readings.

It is an accepted practice to report the total air leakage rates if the sample and test chamber of the total air leakage rate is less than the allowable rate.

BCA Academy

3.0 Material Selection

4.0 Performance Test Window – Air Leakage Test Report.

Test Report No. 7191371059 - MEC26-ELI
Date:2 February 2026

6. DETAILS OF TEST RESULTS:

6.1 AIR LEAKAGE TEST (DATE TESTED:19/1/2026)

Perimeter: L = 9.18 m

Test Pressure (Pa)	Chamber Leakage (m^3/hr)	Chamber + Window Leakage, Q (m^3/hr)	Operable Leakage, Q/L (m^3/hr/m)	SS212 Requirement
50	0	0.764	0.083	**Non-aircon condition** **Operable Leakage** Shall not exceed: 10 m^3/hr/m
100	0	6.872	0.749	
150	0	10.435	1.137	
200	0	16.035	1.747	

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3.0 Material Selection

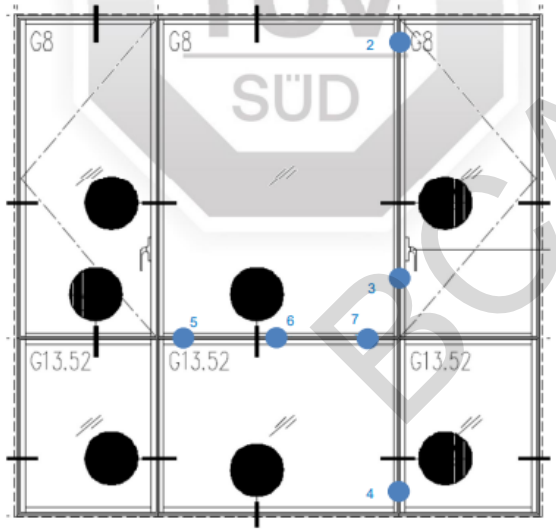
4.0 Performance Test Window – Water Test and Result.

Test Report No. 7191371059 - MEC26-ELI
Date:2 February 2026

6.3 STRUCTURAL PERFORMANCE TEST
(DATE TESTED: 19/1/2026)

Points	Displacement of casment window under pressure (mm)						Residual deflection(mm)	
	Span	Test pressure		Relative deflection		SS212 Spec.	980 Pa	-1220 Pa
		980 Pa	-1220 Pa	980 Pa	-1220 Pa			
2	2630 (Mullion)	2.265	-3.116	5.856	7.485	≤21.04	0.096	-0.155
3		7.605	-10.087				0.160	-0.313
4		1.233	-2.089				0.000	-0.159
5	1190 (Transom)	7.494	-9.969	0.370	0.624	≤9.52	0.099	-0.285
6		7.599	-10.272				0.083	-0.267
7		6.965	-9.328				0.064	-0.290

Note: '-' sign represents movement at opposite direction.





A1. Overview of mock up specimen



A2. Transducers on mock up specimen



A3. Watertightness test

3.0 Material Selection.

4.0	Performance Test SS212: 2007 – Window System.
1.	Air Leakage Test
2.	Water Tightness Test
3.	Structural Performance Test
4.	Repeat Water Test
5.	Proof Load Test



Steel chamber



Window installed - Side



Window installed - Elevation



Water spray on façade.

Academy

3.0 Material Selection.

4.0 Performance Test Report – SS212 : 2007

PERFORMANCE TEST

OF

ALUMINIUM FULL HEIGHT CASEMENT WINDOW SYSTEM

WITH REFERENCE TO SS 212 : 2007

FOR

THE BOTANY PROJECT

TESTED FOR: Alliance (S) Pte Ltd
53 Loyang Way
Singapore 508746
Attn: Mr. Jeffery Tan

PREPARED BY: David Li
Testing Officer

APPROVED BY: Bay Yuan Li
Manager
Building Group
Real Estate and Infrastructure - Mechanical Centre

David Li
Testing Officer

Bay Yuan Li
Manager

TÜV SÜD PSB

ilac-MRA

Accredited Laboratory SAC-SINGLAS

LA-2007-0380-A LA-2007-0386-C
LA-2007-0381-F LA-2010-0464-D
LA-2007-0382-B LA-2018-0702-B
LA-2007-0383-G LA-2018-0703-G
LA-2007-0384-G LA-2020-0747-L
LA-2007-0385-E

The results reported herein have been performed in accordance with the terms of accreditation under the Singapore Accreditation Council. Inspections/Calibrations/Tests marked "Not SAC-SINGLAS Accredited" in this Report are not included in the SAC-SINGLAS Accreditation Schedule for our inspection body/laboratory.

SUMMARY OF TEST AND TEST RESULTS

Project: The Botany

Design Wind Load: +900 Pa ; -1150 Pa

Items	Test Parameters	SS 212 : 2007 Requirements	Results
Air Leakage Test	a. Apply 3 pre-load of 500 Pa and maintain for 3 second each. b. Open, close & lock all windows 5 times. c. Apply positive pressures in steps of 50, 100, 150 & 200 Pa. Leakage readings are obtained for each pressure step.	**Reference to SS 212 : 2007** (Non-aircon condition) Operable leakage shall not exceed: 10 $m^3/hr/m$.	Passed
Watertightness Test	a. Open, close & lock vent 5 times. b. Positive air pressure is applied in 3 steps at 0, 90, 180 & 270 Pa for a duration of 5 minute each, except for 0 Pa is 15 minutes. c. Record all points of water leakage.	**Reference to SS 212 : 2007** (Severe condition) No water leakage up to test pressure at a water spray of 4 l/min/m^2.	Passed
Structural Performance Test	a. Pre-load of 500 Pa and maintain for 10 seconds. b. Take residual reading after 3 - 5 minutes; then zero transducers. c. Apply positive design pressure of 900 Pa. d. Take maximum deflection reading after 10 seconds. e. Take residual deflection after 3 - 5 minutes. f. Repeat (a) to (e) for negative pressure of -575 Pa (pre-load) & -1150 Pa (design load).	**Reference to SS 212 : 2007** Mullion/transom deflection: shall not exceed span/125 : 2-3-4 Mullion: 2260/125: 18.08 mm 5-6-7 Transom: 1190/125: 9.52 mm	Passed
Proof Load Test	a. Apply 150% of positive pressure of 1350 Pa and maintain for 10 seconds. b. Take residual deflection after load is reduced to zero. c. Repeat procedure for negative pressure at -1725 Pa.	**Reference to SS 212 : 2007** No breakage, permanent damage to panels, fasteners or anchors shall occur.	Passed

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4.0 MANUFACTURING AND FABRICATION PROCESSES.

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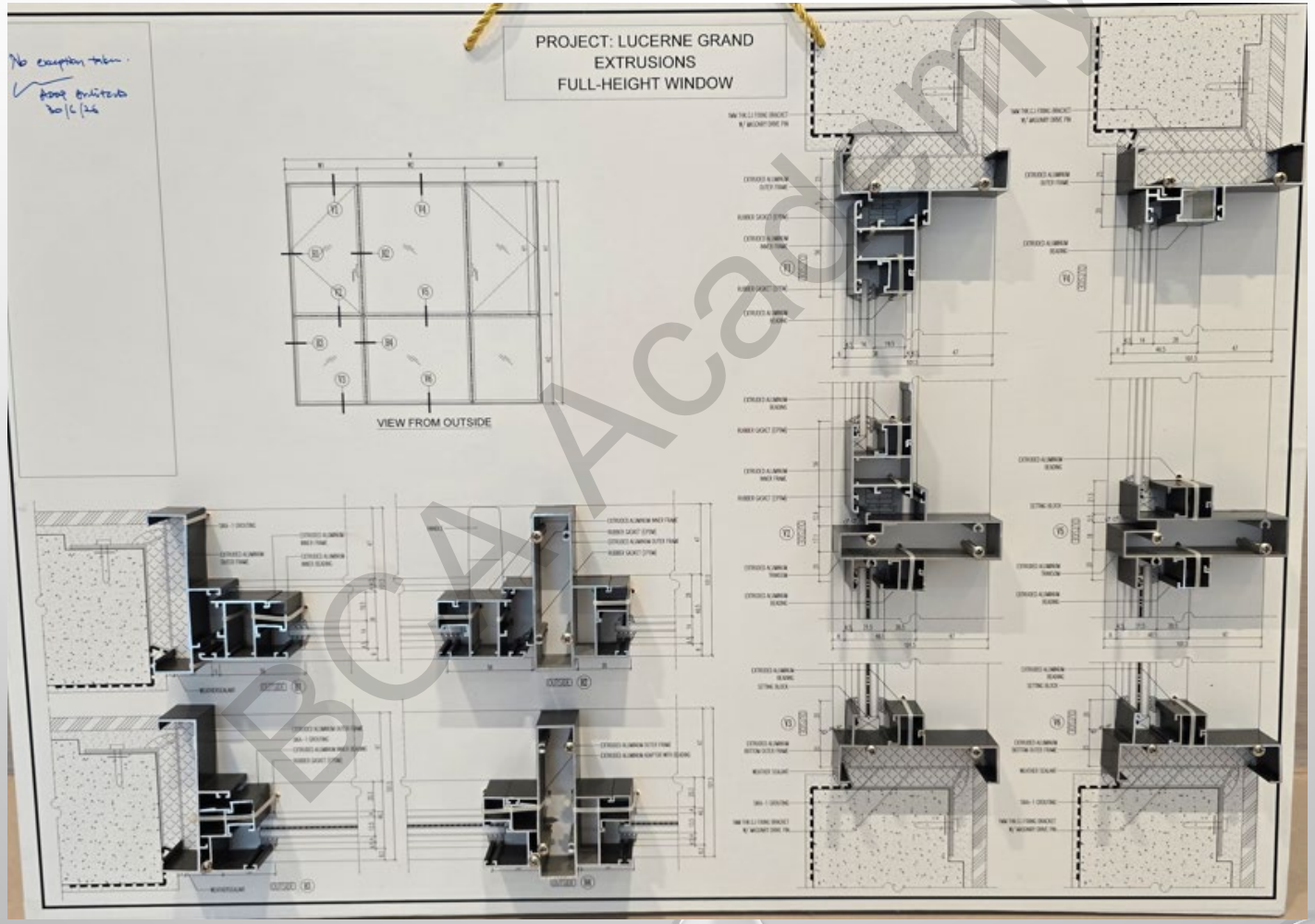
4.0 Manufacturing and Fabrication Processes.

4.0	Manufacturing & Fabrication Processes.
1.	Manufacture of aluminium window is in accordance to approved shop drawings & cutting lists.
2.	Check incoming materials / hardware / accessories versus purchase order.
3.	QA/QC check on coated extrusions / mill finish – micron thickness.
4.	Input into system, storage, ready to draw out.
5.	Cutting, notching, milling, drilling, punching.
6.	Assembly of units and inner frames.
7.	Install hardware and accessories.
8.	QA/QC check – quality, dimensions and workmanship.
9.	Final cleaning and protection.
10.	Schedule for delivery to site.

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4.0 Manufacturing and Fabrication Processes.

4.0 Manufacturing and Fabrication Processess.



BCA Academy

Extrusions Sample Board - Approval

4.0 Manufacturing and Fabrication Processes.

4.0. Sample board – Hardware, accessories and colour sample..



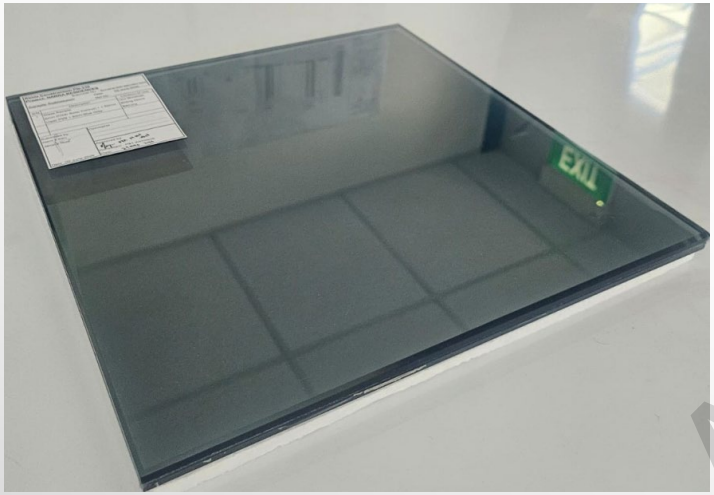


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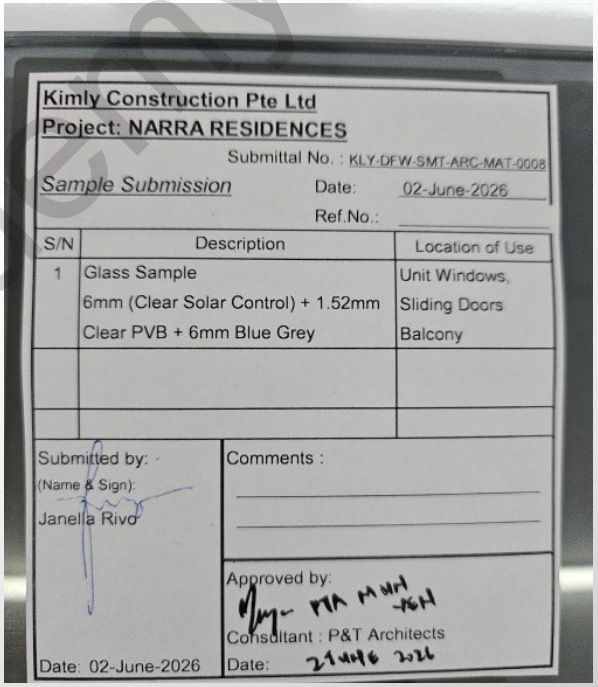
Hardware, Accessories & Powder Coat Colour Sample Board - Approval

4.0 Manufacturing and Fabrication Processes.

4.0 Glass sample – Approval and specifications.



Approved Glass Sample:



Kimly Construction Pte Ltd
Project: NARRA RESIDENCES
Submittal No. : KLY-DFW-SMT-ARC-MAT-0008
Sample Submission
Date: 02-June-2026
Ref.No.:

S/N	Description	Location of Use
1	Glass Sample 6mm (Clear Solar Control) + 1.52mm Clear PVB + 6mm Blue Grey	Unit Windows, Sliding Doors Balcony

Submitted by:
(Name & Sign):
Janella Rivo
Date: 02-June-2026

Comments :

Approved by:
Consultant : P&T Architects
Date: 2/6/26

Glass Sample – Approved & signed off by the Architect.

PERFORMANCE DATA

Type	Glass Description	Light Factor %			Solar Heat Gain Coefficient	Shading Coefficient	U-Value (W/㎡·K)	
		Trans	Ref (Out)	Ref (In)			Winter Night	Summer Day
1	6mm Euro Grey + 1.52mm Clear PVB + 6mm Clear	43	5	5	0.54	0.63	5.40	4.89
2	8mm Euro Grey(824036 #2)	14	7	10	0.36	0.41	5.06	4.64
4	6mm Euro Grey(824036 #2) + 1.52mm Clear PVB + 6mm Clear Low-E(#4)	19	8	13	0.35	0.40	3.66	3.08
6	8mm Euro Grey(Acid Etched #2)	*	*	*	*	*	5.75	5.19

Approved Glass Technical Data

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4.0 Manufacturing & Fabrication Processes.

4.0 Powder Colour Chart – Selection.



4.0 Manufacturing & Fabrication Processes.

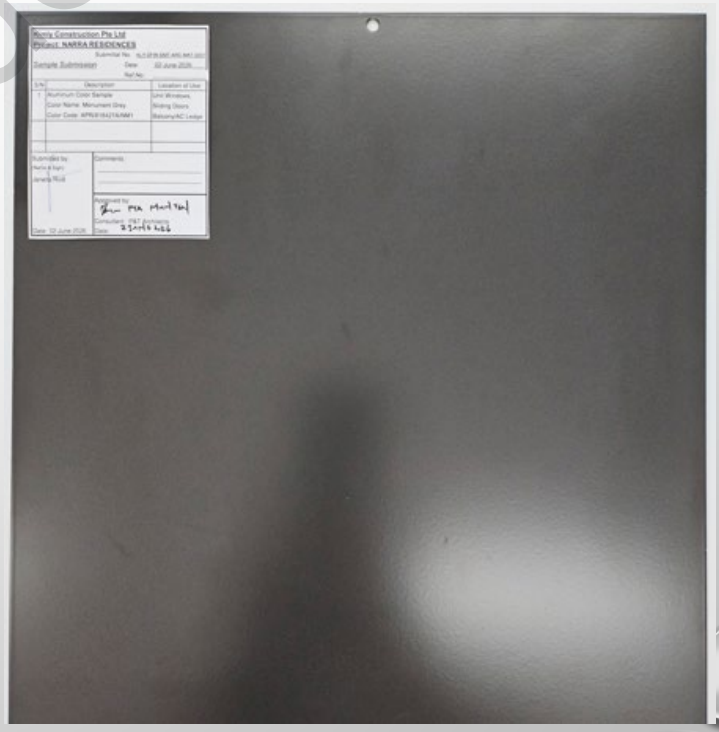
4.0	Powder Coat / Flourocarbon Coating - Sample Comparison / Approval.
1.	Physical sample – powder coat colour.
2.	Micron thickness check.



Colour sample



Colour Code

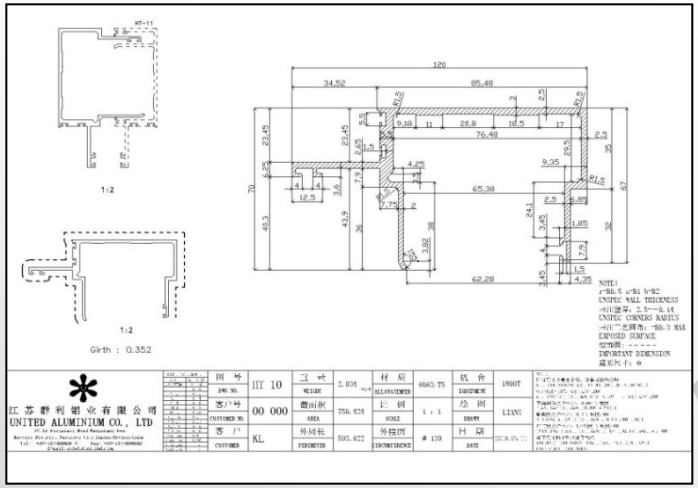


Powder coat sample – Approved & signed off by the Architect.

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4.0 Manufacturing & Fabrication Processes.

4.0 Checking of Incoming Extrusions.



Die drawing of profile.



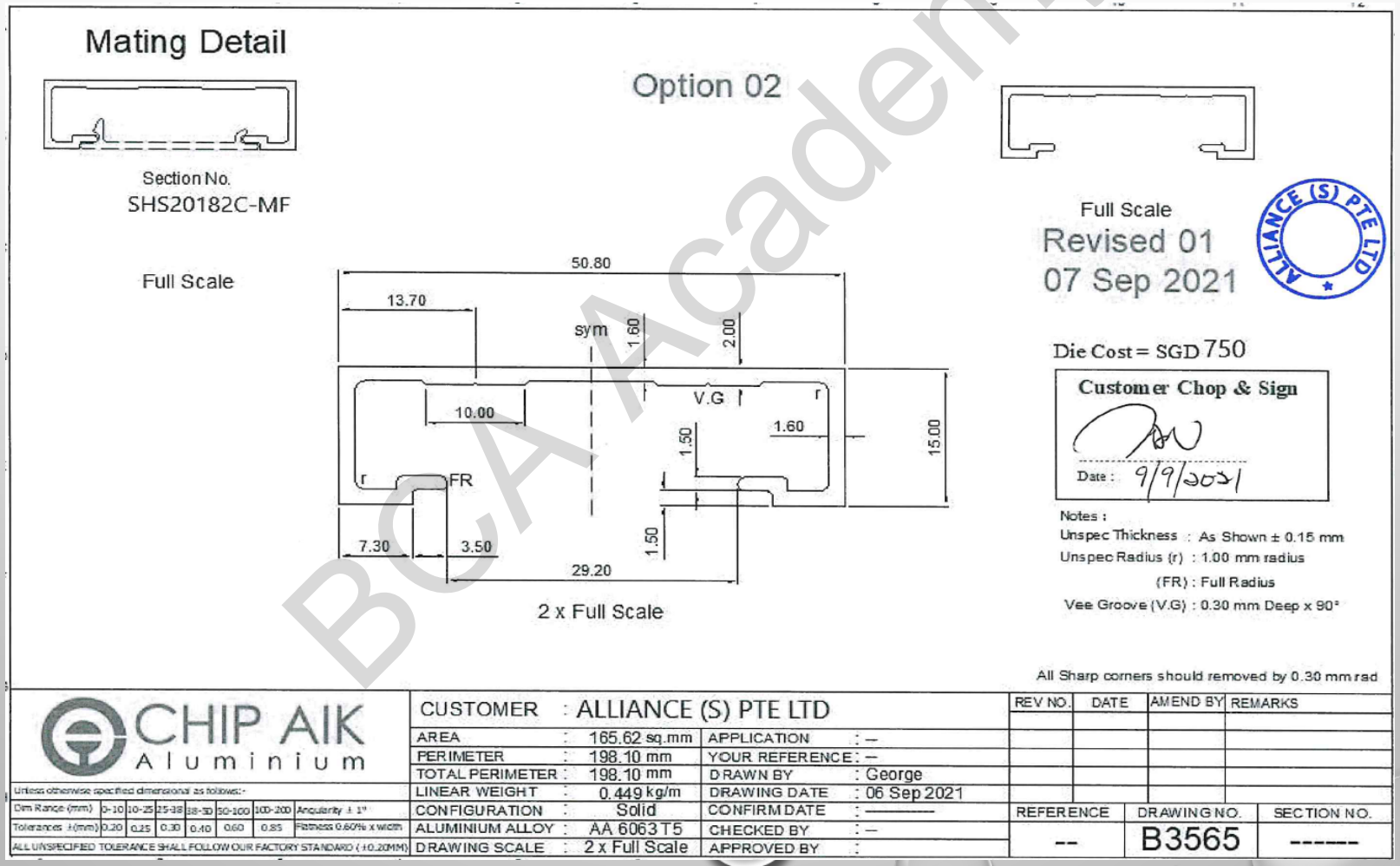
Actual extrusion profile

	Description of check.
1.	Shape, alignment, warp and finishes.
	Wall thickness of profile.
	Powder / Fluorocarbon coating – micron thickness.
	Properties test - Tensile test, chemical composition, yield strength.
	Brinell hardness test - profile

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4.0 Manufacturing And Fabrication Processes.

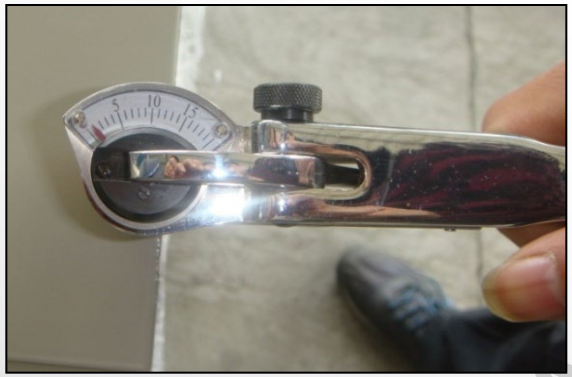
4.0 Checking of Incoming Extrusions – Die Drawing.



BCA Academy

4.0 Manufacturing And Fabrication Processes.

4.0	Types of Testing Equipment – Hardness Test, Caliber for Wall Thickness, Coating Thickness Instrument.

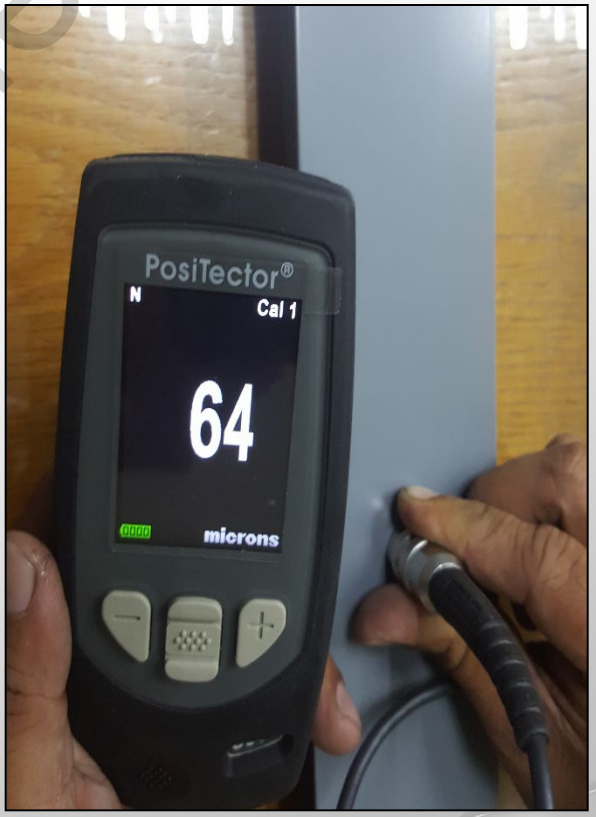


Gauge meter – hardness test





Digital caliber – test wall thickness



Coating Thickness Instrument – Testing of coating thickness .

BCA Academy

4.0 Manufacturing & Fabrication Processes.

4.0	Check on In-coming Extrusions on Powder Coat Finish.
1.	The surface coating was found to be easily peeled off.
	This batch of materials will be 100% checked.





	Defects and Reject.
1.	Degreasing, chemical pre-treatment, rinse and dry.
2.	Sample for testing.

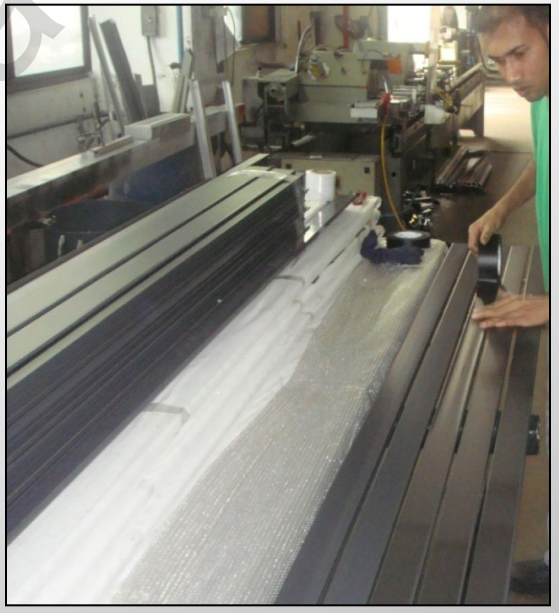
BCA Academy

4.0 Manufacturing & Fabrication Processes.

4.0	Protection Tapes – Frame and Glass.
1.	Inner frames will be protected with adhesive PVC tape (70 microns) prior to commencement of fabrication and storage.
2.	This is to prevent scratch of surface during handling.



Powder coat is peeled off.

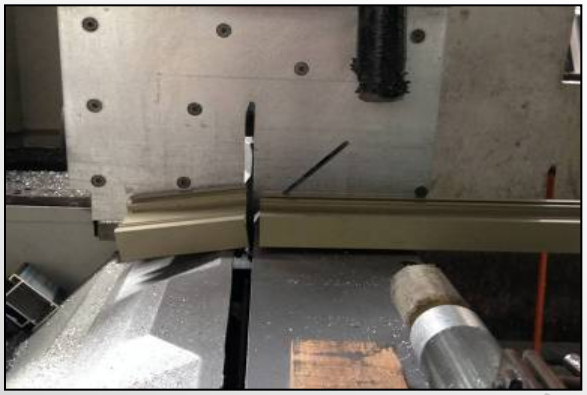


Provide protection to surfaces of profiles before cutting / fabrication.

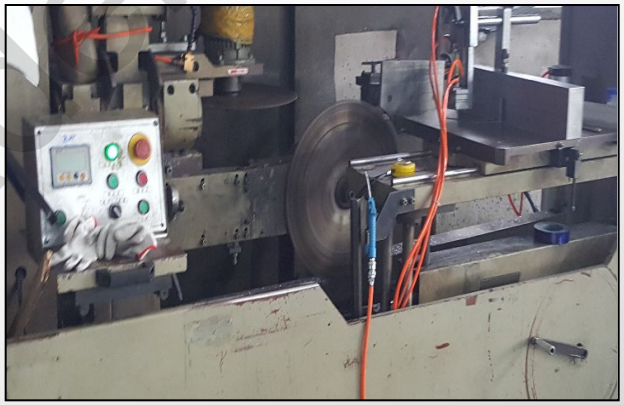
P&A Academy

4.0 Manufacturing & Fabrication Processes.

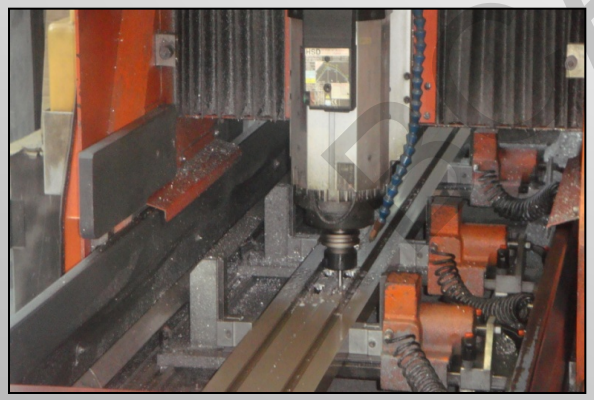
4.0	Machineries – Production.
1.	Inner frames will be protected with adhesive PVC tape (70 microns) prior to commencement of fabrication and storage.
2.	This is to prevent scratch of surface during handling.



Double cutting machine



Milling of profile



Multiple milling / drilling

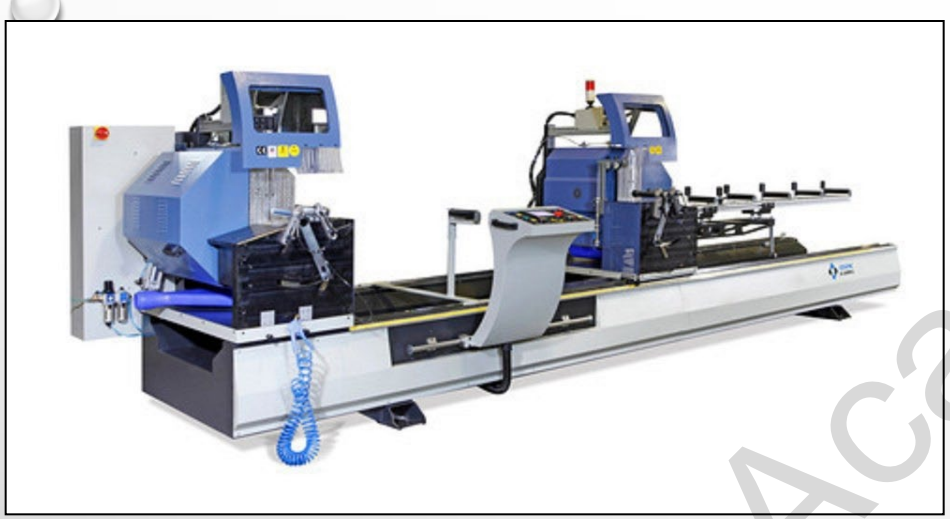


Punching of profile

BA Academy

4.0 Manufacturing & Fabrication Processes.

4.0 Machineries – Production.



CNC cutting machine



End milling machine

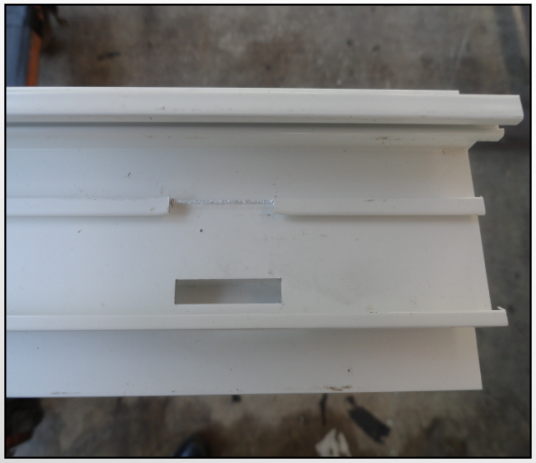


Crimping machine

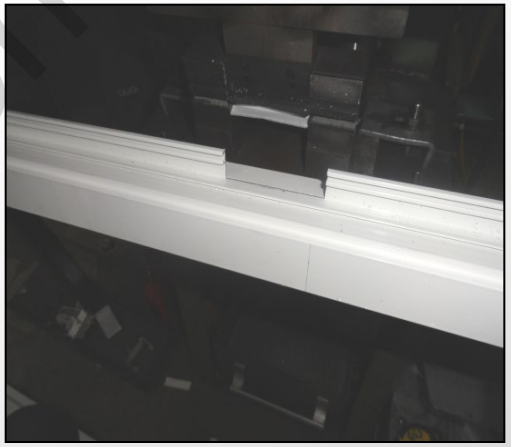
BOA Academy

4.0 Manufacturing & Fabrication Processes.

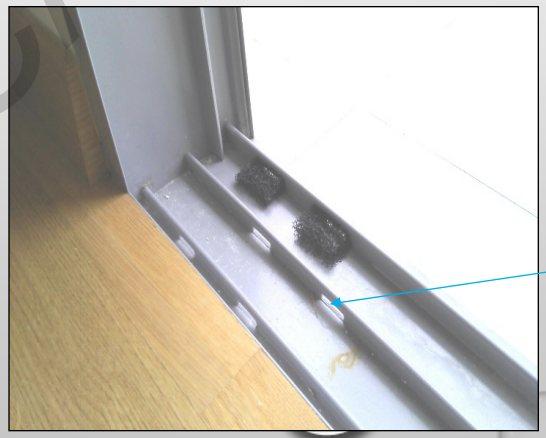
4.0 Cutting, Milling & Punching Processes – Sliding Window.



Punching of profile – weep hole



Punching – joining of transom for connection of members

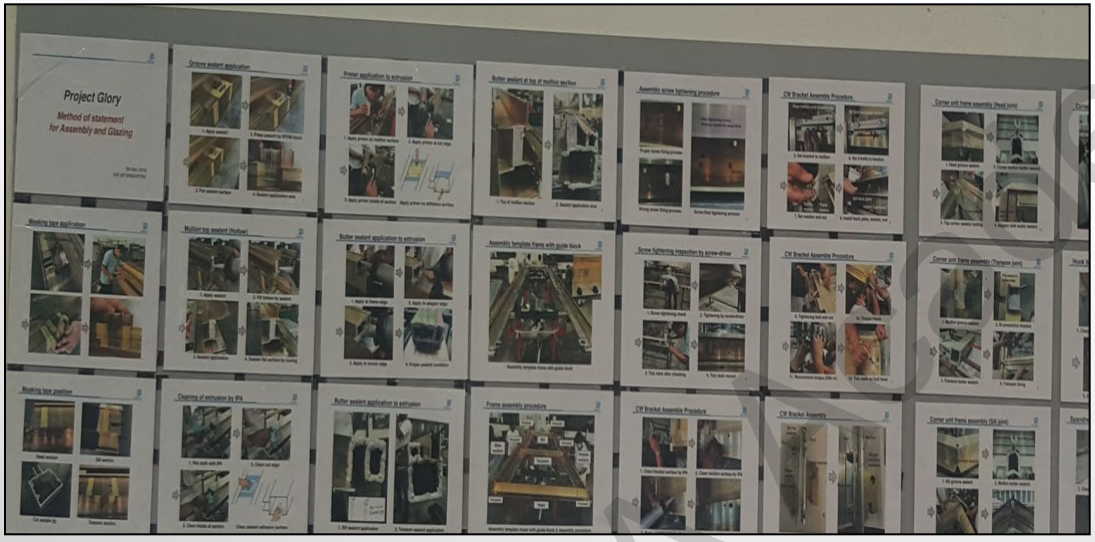


Weep holes on sliding bottom track to discharge water.

BCA Academy

4.0 Manufacturing & Fabrication Processes.

4.0 Mock Up Samples / Duty Personnel Chart.



Photos on Sample of Typical and Non Typical assembly joints – for ease of understanding and guidance.



Physical samplings.

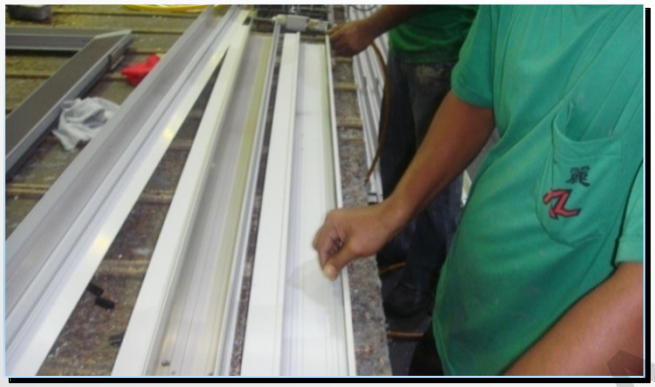


Designated personnel – Task for respective job.

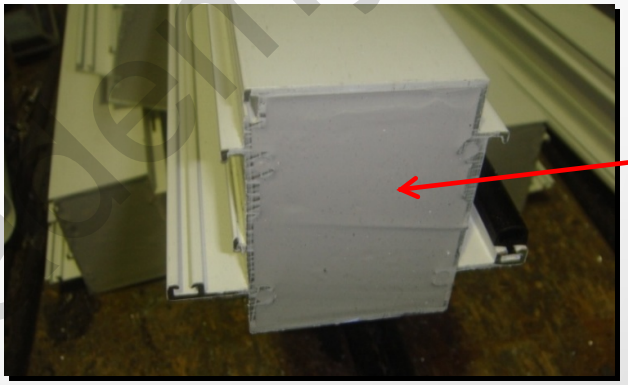
BCA Academy

4.0 Manufacturing & Fabrication Processes.

4.0 Inserting Gaskets & End Sealing with Silicone Sealant / Sealant pad.



Insert weather seal gaskets before assembly



End of transom is fully sealed with weather seal / silicone sealant.





Sealant pad may also be used to seal between joint members

BCA Academy

4.0 Manufacturing & Fabrication Processes.

4.0 Assembly of members with ending sealings to prevent water ingress.



Transom is seal before joining



Joining of vertical / horizontal





Joint is sealed with weather silicone sealant to prevent seepage through mechanical joints. 100% check is required.

BCA Academy

4.0 Manufacturing & Fabrication Processes.

4.0 Assembly of members with ending sealings to prevent water ingress.



Joining of vertical / transom member

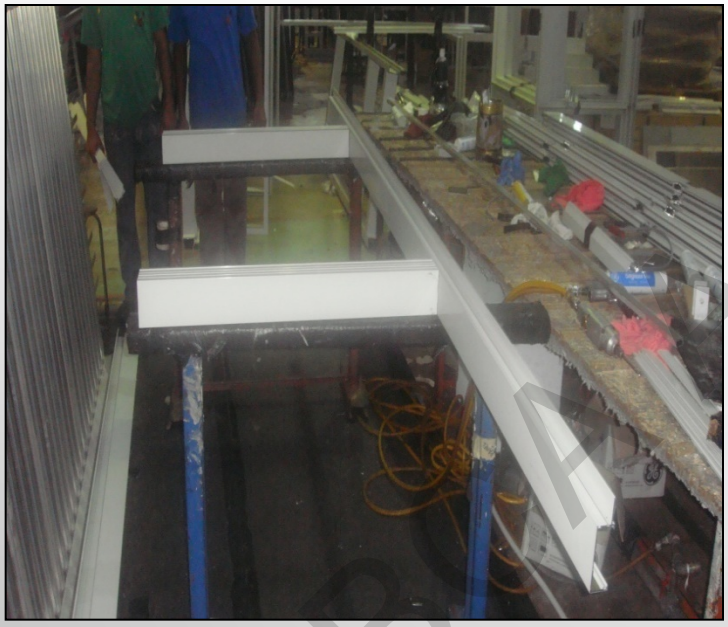


Screw head is treated with silicone sealant

Academy

4.0 Manufacturing & Fabrication Processes.

4.0 Process on the Assembly of Full Window Frame.



Partial assembled frame



Complete assembly of framing

BIA Academy

4.0 Manufacturing & Fabrication Processes.

4.0 Process of assembly of full frame.







Fully assembled frame outer frame

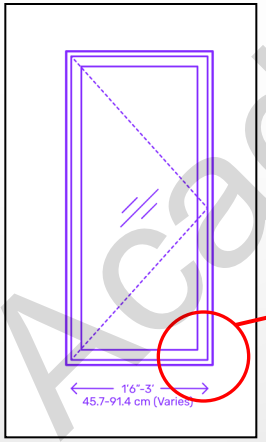
Academy

4.0 Manufacturing & Fabrication Processes.

4.0 Assemble and Crimping of Inner Frame – Casement / Top Hung Window.



Cut surface to be dipped with silicone sealant before crimping.



Ensure joint is flat



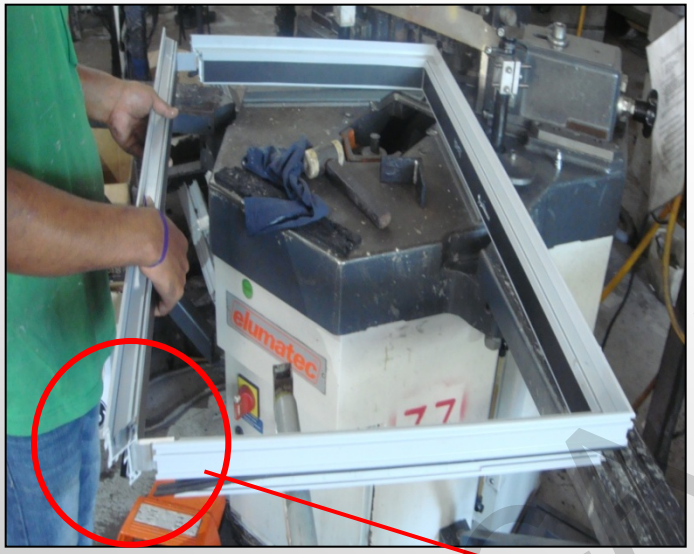
Inner frame is being assembled by crimping machine.

Assembly of inner frames – crimping process.

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4.0 Manufacturing & Fabrication Processes.

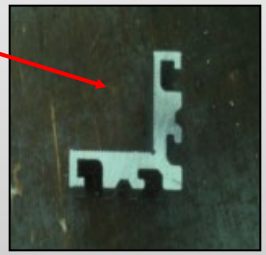
4.0 Assemble and crimping of inner frame – casement / top hung window.



Cramping of inner frame with spigot.



Fully assembled inner frame.



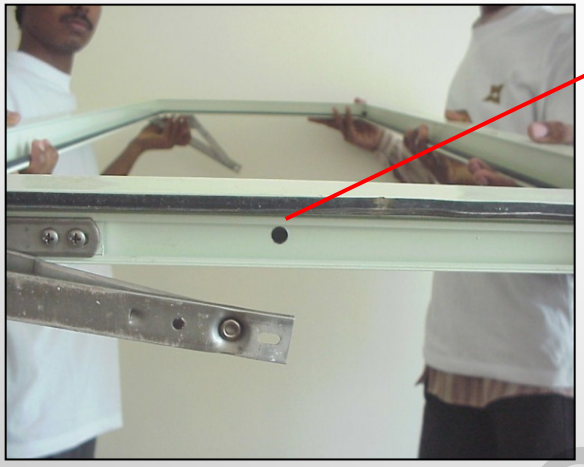
Extruded spigot.

This is the one of the conventional & common method of assembly of inner frame.

BCA Academy

4.0 Manufacturing & Fabrication Processes.

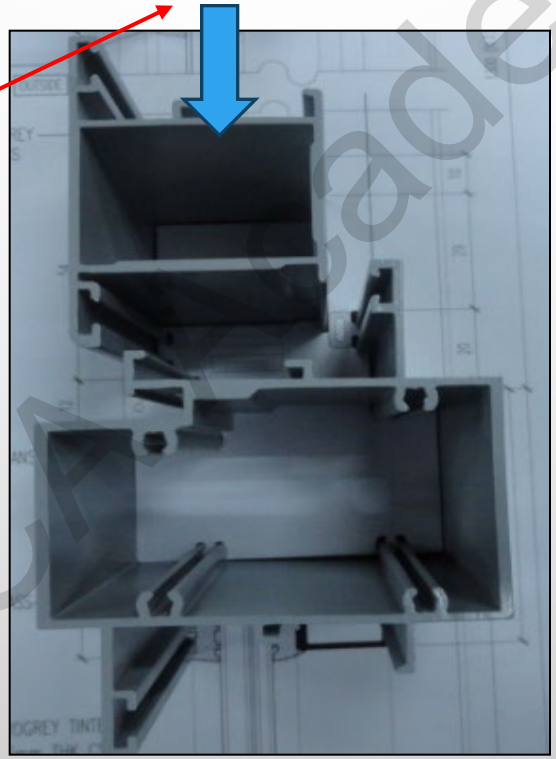
4.0 Water Discharge Provisions – Weep Holes for Casement & Sliding Windows.



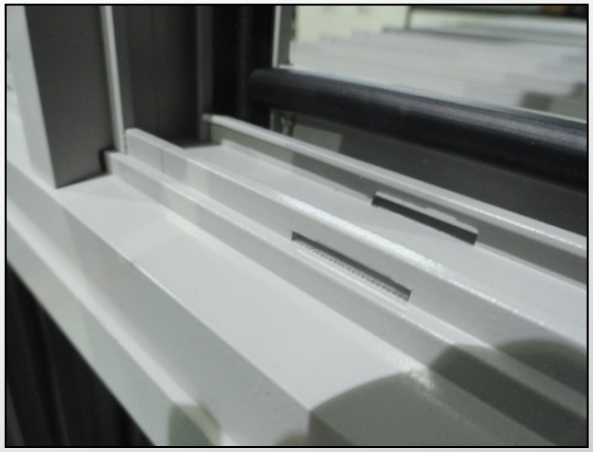
Provide 6mm diameter hole at the base of the bottom sash.

This is to allow water to drain off – water seep through gaskets and joints.

Water seep down from here.



Section through transom and casement window inner.



Punching of weep holes for water discharge to prevent overflow.

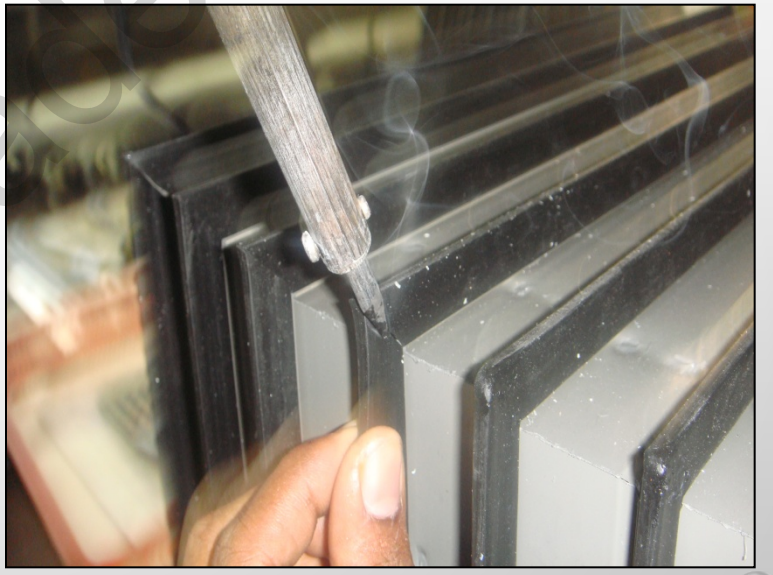
BCA Academy

4.0 Manufacturing & Fabrication Processes.

4.0	Soldering of Gaskets on Inner Frame.
1.	Gaskets is a key important member of a window system.
2.	Ensure gaskets are compatible to achieve design requirements.



Seal joints between members with silicone sealant



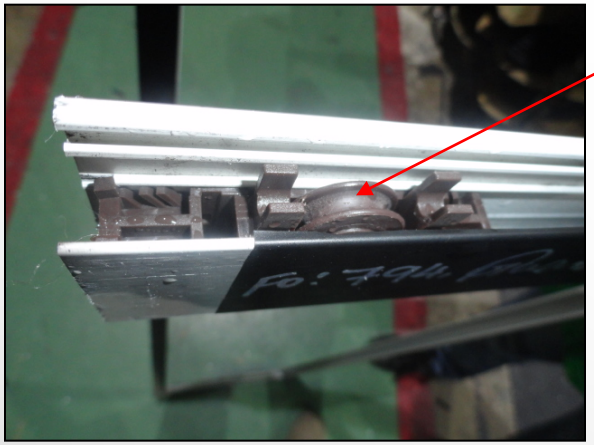
Soldering of gaskets to ensure no gaps

1. Gaskets play an important role in the performance of the window system.
2. Ensure the correct type of materials is to be used – EDPM. (Ethylene Propylene Diene Monomer)

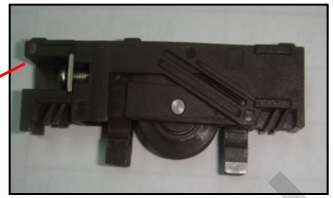
BC Academy

4.0 Manufacturing & Fabrication Processes.

4.0 Sliding Window – Install Hardware & Accessories.



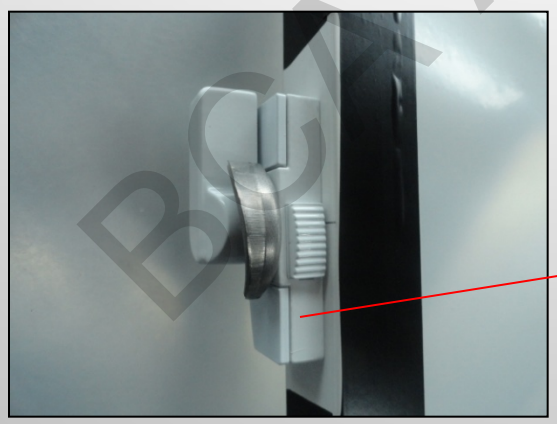
Insert of roller – sliding window



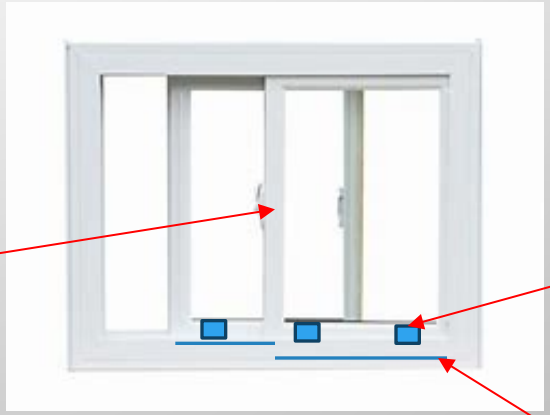
Nylon roller



Insert of mohair –sliding window



Crescent lever lock

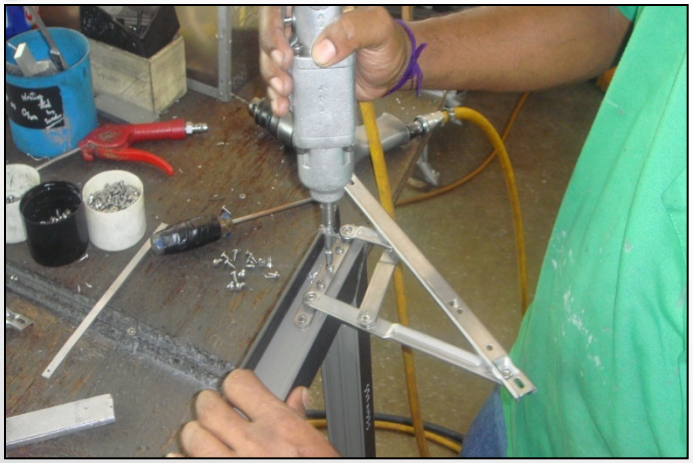


2 panel sliding window

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4.0 Manufacturing & Fabrication Processes.

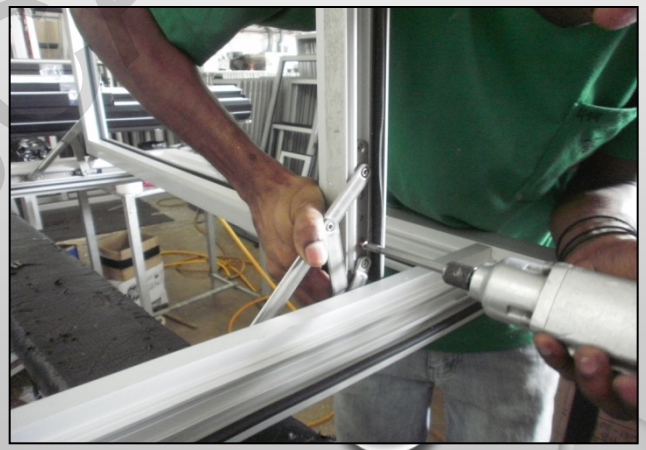
4.0 Casement Window – Install Hardware & Accessories.



Fixing of friction stay to inner frame.



Assemble of inner to outer frame.

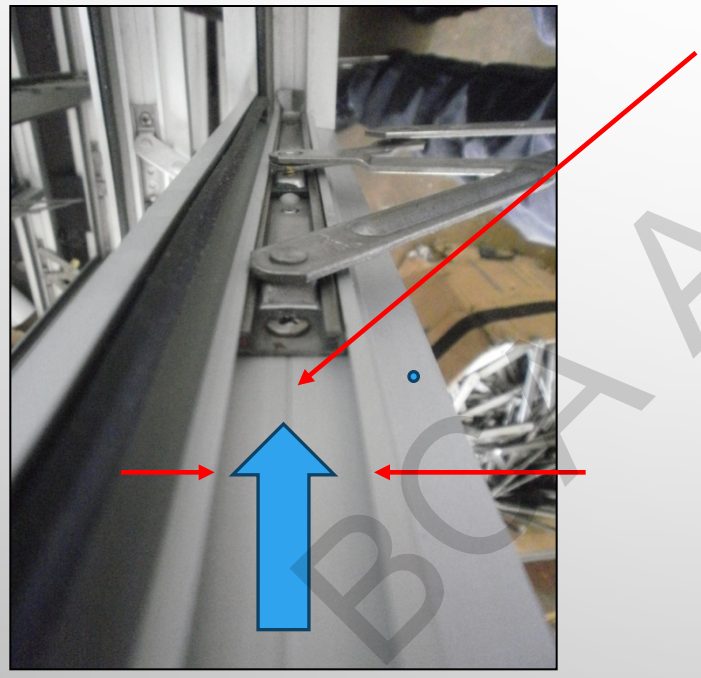


Secure friction stay to
inner sash and outer frame.

BCA Academy

4.0 Manufacturing & Fabrication Processes.

4.0	HDB Safety Feature Window System.
1.	HDB safety feature system – System designed with gutter to prevent falling windows.



Profile to prevent falling
Friction stay – safety feature

Safety feature – design of channel to engage the housing of the stainless steel friction stay to prevent falling off.

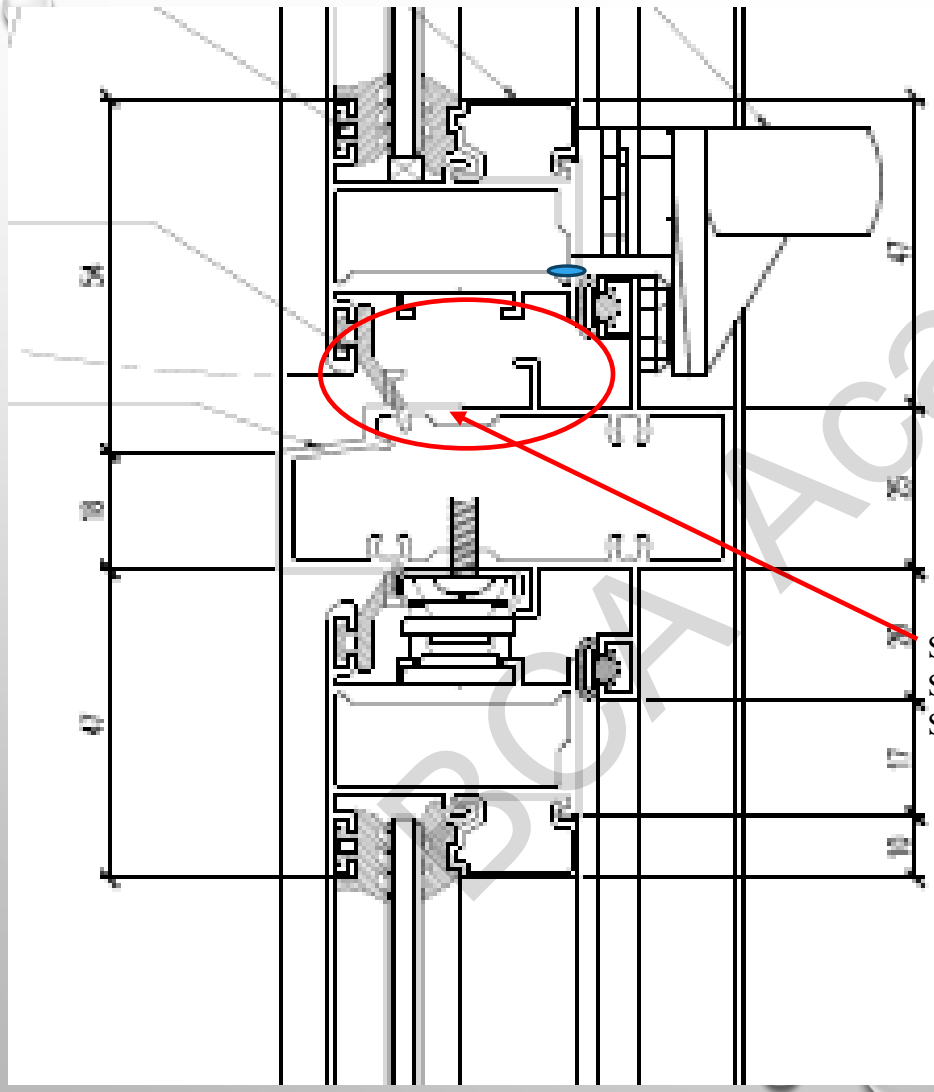


Fixing of cam handle to inner sash

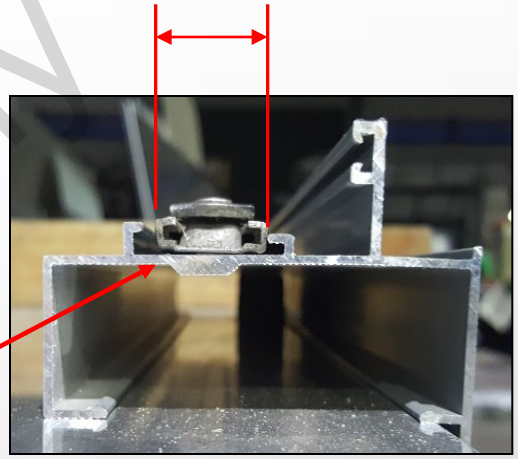
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4.0 Manufacturing & Fabrication Processes.

4.0 HDB Safety Feature Window System.



Direct place on gutter, no slot in.



Standard window system.



Safety Window System.

BCA Academy

4.0 Manufacturing & Fabrication Processes.

4.0 Casement Window – Completed for Final QA/QC Check.



Frame ready for QA/QC Inspection before applying protection tapes over.



Final QA/QC check on dimensioning. Quality finishes.

4.0 Manufacturing & Fabrication Processes.

4.0	Quality Assurance / Quality Check - Guide.	Tolerances.
A.	Window frame	
1.	Length	+/- 1.5mm
2.	Straightness	+/- 1.5mm
3.	Accuracy on angles	+/- 2 degree
4.	Accuracy on sides	+/- 1mm
5.	Accuracy of diagonals	+/- 2mm
6.	Source: National Productivity and Quality Specification (NPQS)	
B.	Glass	Tolerance.
1.	Height	+/- 2mm
2.	Width	+/- 2mm
3.	Straightness of edges	+/- 1mm
4.	Tolerances on insulating glazed unit	BS 5713
5.	Source: National Productivity and Quality Specification (NPQS)	

BCA Academy

Aluminium Window - Good Industry Practices

5.0 PROTECTION.



BOA Academy

5.0 Protection of Frames.

5.0	Protection of Frames.
1.	Is a normal standard practice to protect the extrusion surfaces during the incoming.
2.	Provide black adhesive tape on the surface of the extrusions to prevent scratches before actual fabrication.
3.	Blue adhesive tape is mainly used to protect glass surface.







PVC black adhesive tape of 70 microns thickness.
Tapping of frame.

PVC blue adhesive tape for wrapping / glass protection..

BCM Academy

5.0 Protection of Frames.

5.0 Cleaning and Provide Adhesive Protection Tapes to Frames.



Cleaning of frame prior tap over with adhesive protection sheet.

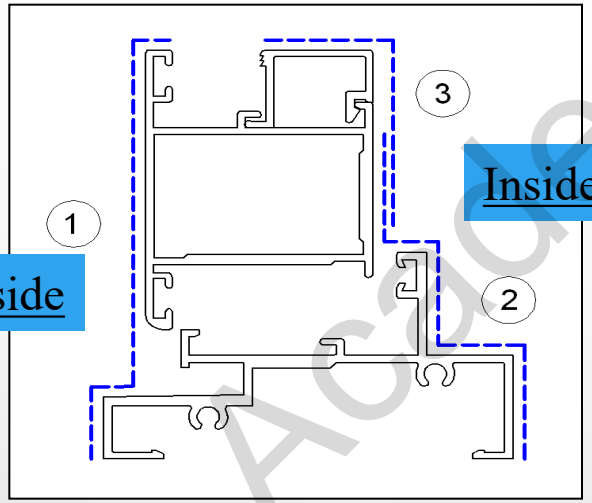


Applying protection tape on frame prior delivery. Frame corners are further wrap with cardboard protection.

5.0 Protection of Frames.

5.0	Protection of Frames to Facilitate Glazing Works in Advance.

Protection layer **1** to be remained upon wet works completed.



Protection layer **3** to remove when glazing.

Protection layer **2** to remained upon internal wet works completed.

(5.3 a)

	Protection of Frames.
1.	The 1st and 2nd layer of the protection tapes will stay input until stage of cleaning and handover period.
2.	The 3rd layer is to be removed to facilitate glazing works.
3.	After glass is installed, apply a new protection over as per layer 3.

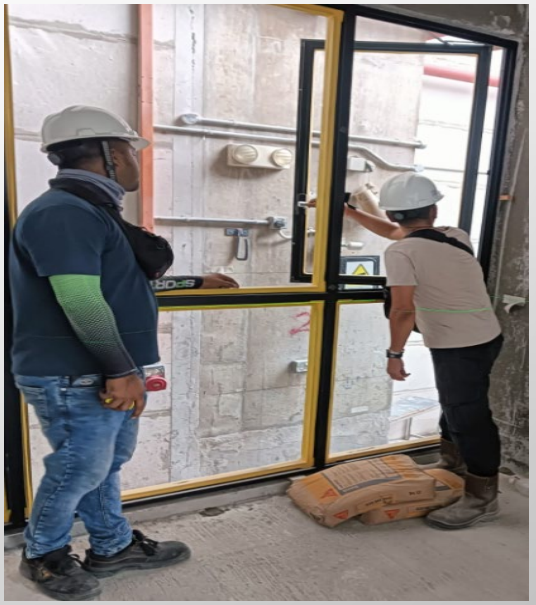
BCA Academy

5.0 Protection of Frames.

5.0	Differentiate Protection Tape to Ease of Glazing Works.
1.	The white protection is to be retained and removed before handling over.
2.	The yellow tape is to distinguish installer for removal before glazing works.
3.	Upon completion of glazing works, apply new adhesive tape over.
4.	All protection tapes will only be removed before QA/QC inspection.



Yellow tape is for removal to facilitate glazing works.

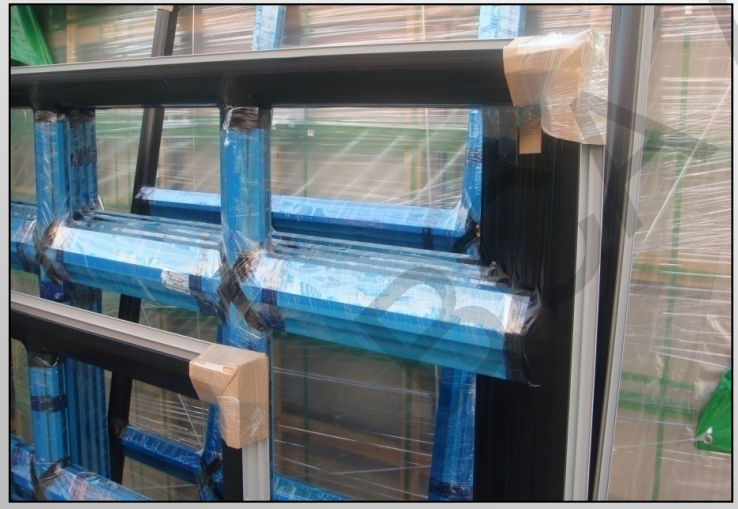


Black tape is to be remained until all other wets works are completed.

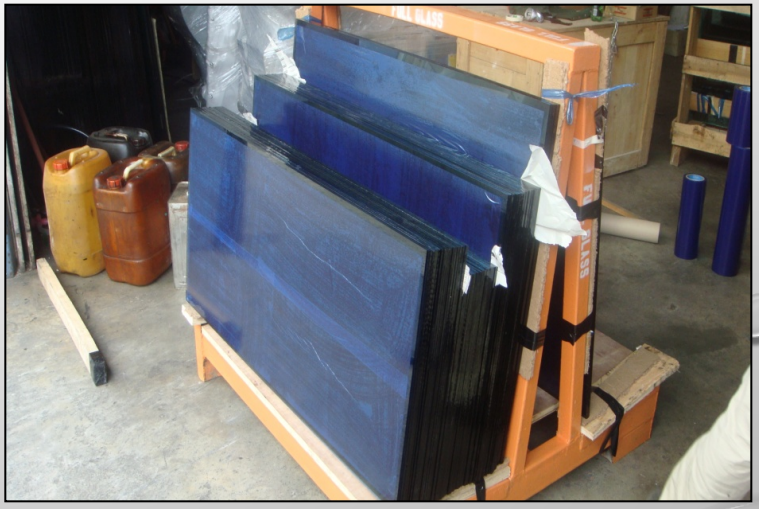
BCA Academy

5.0 Protection of Frames.

5.0	Protection to Glass.
1.	All fabricated windows shall be protected with pvc adhesive film with cross wrap between members.
2.	Corners are also provided with corner carboards to prevent knocking during handling and delivery.
3.	All glass edges shall be grinded (hand / machine) for ease of handle.



Corners are further protected
to prevent damages during handling .



Glass panels are provided with adhesive
protection film prior delivery to site.

Academy

5.0 Protection of Frames.

5.0 Types of Protections to Glass & frames.







Adhesive Blue Protection Sheet



Corrugated Polypropylene Sheet

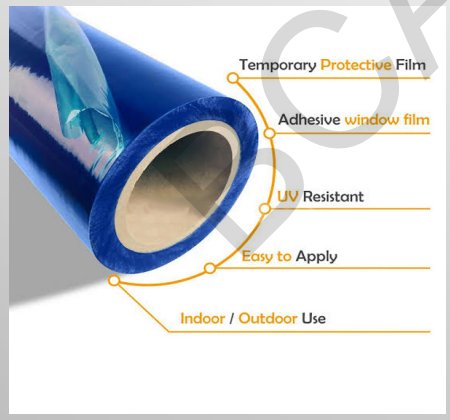


Water-based acrylic co-polymer emulsion coating

LCA Academy

5.0 Protection of Frames.

5.0	Protection Tapes to Glass Surface.
1.	There are basically 3 types of protections to glass, generally adopted in the building industry.
2.	PVC adhesive protection tapes.
3.	Norm and commonly used.
4.	Disadvantage is short life span of only 5 months from date of application.
5.	The glass surface has to be cleaned before applying adhesive tape over the glass surface.
6.	The costs is the most economical as compare to the other 2 types





Adhesive Blue Protection Sheet

BCA Academy

5.0 Protection of Frames.

5.0 Types of Protections to Glass & Frames.



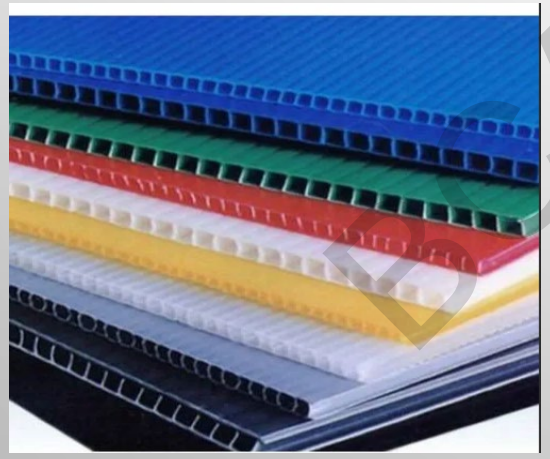
Standard PVC adhesive protection tape to Glass.



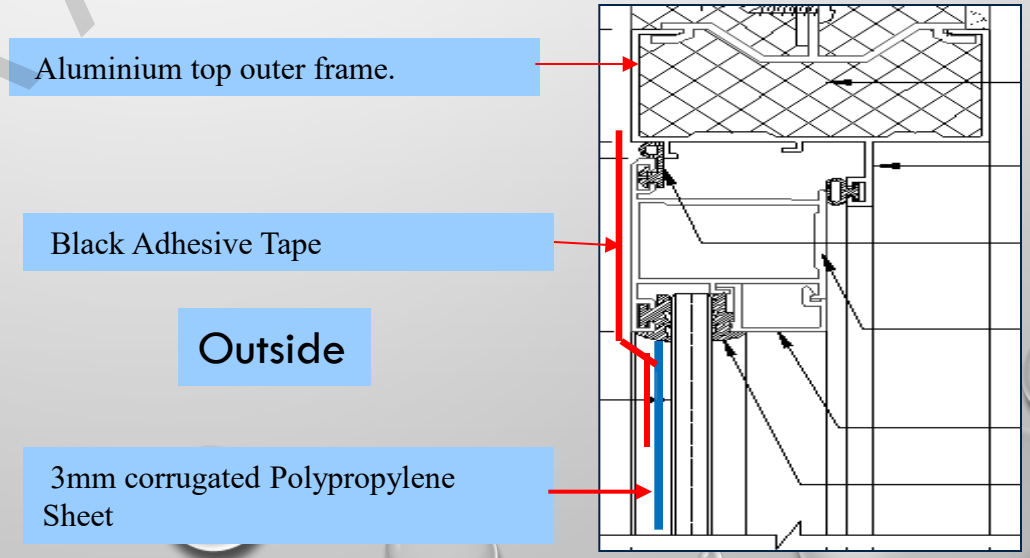
3mm thick corrugated polypropylene sheet to glazing.

5.0 Protection of Frames.

5.0	Protection Tapes. – Corrugated Polypropulene Sheet.
1.	The 2nd option is to use corrugated polypropylene sheet.
2.	The board is 3mm thick and non-adhesive, hence need the adhesive tape to stick on. If the tapes fail, then will invite water, dust, moisture to tarp within.
4.	The life span is depending on the adhesive black tape.
5.	The environment and glass surface has to be cleaned and free from dust to allow the pvc adhesive tape to work.
6.	Cost is mid range as compared to the 2 types.



Corrugated Polypropylene Sheet



BCA Academy

5.0 Protection of Frames.

5.0	Protection Tapes – Water Based Coat.
1.	Protection to glass surface using "Water Based-Acrylic Co-polymer Emulsion Coating".
2.	Is easy to apply and also easy to remove.
3.	Costs is the most expensive as compared to the other 2 types.
4.	Life span is maximum 18 to 20 months. (Heavy Duty Type)



Protection tape falling off after 3 – 5 months.



Glass being protected with 2 coats of water-based acrylic co-polymer emulsion coating.



Water-based acrylic co-polymer emulsion coating

BCA Academy

5.0 Protection of Frames.

5.0	Protection Tapes – Water Based Coat.
1.	Ensure the glass surface is clean and free from dust before applying the coat.
2.	The system required 2 coats.
3.	1st coat – curing time is 90 minutes
4.	2nd coat – curing time is 120 minutes



Dip roller over the liquid and roll over the glass surface



Single coat application.



Site application @ yard.

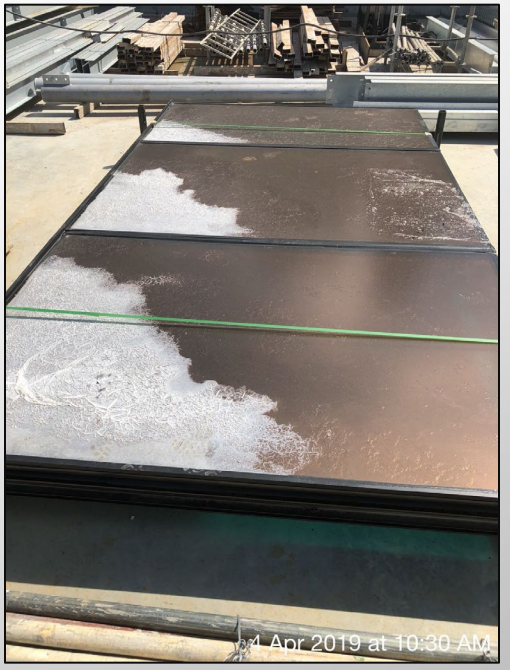
CA Academy

5.0 Protection of Frames.

5.0	Types of Protections to Glass & Frames.
1.	Application of each coat must be strictly adhered to the manufacturer's recommendations and instructions.







Window glass panel was fully applied with 2 layers of protective coatings and cured – in house application prior delivery.

Application did not comply to manufacturer's recommendation or cleaning is not carried out accordingly.

BCA Academy

5.0 Protection of Frames.

5.0	Procedure of removal of coating on glass surface.
1.	Dip a clean white cloth into a pail of clean water and rinse.
2.	Use the wet cloth and rinse the surface of the protection at the corner.
3.	You may peel off the edge of the protection after about 10 minutes of rinsing.
4.	Repeat the sequence and will easily be peeled off. It may need a 3 to 4 attempts if it the façade is exposed to weather for a longer duration.
5.	Glass surface is clean and only requires generally cleaning with clean water.
6.	Take a shorter time to remove versus the adhesive protection tape.



Application at casting yard.


Sample of peeling off.

BTA Academy

5.0 Protection of Frames.

5.0 Types of Protections to Glass & Frames.

DOW

Technical Data Sheet

DOWSIL™ 650+ Protective Peelable Coating

Packaging Information

DOWSIL™ 650+ Protective Peelable Coating is available to customers in 20 kg pail, 60 kg drum, and 160 kg drum packages. Please contact your local Dow sales office to obtain the relevant information.

Features & Benefits

- Formulated for protection of façade glazed systems and panels including, but not limited to, glass, and metals.
- Easy removal by peel off from the substrate without leaving any residue (after curing 7 days @ 23±2°C, 50% R.H.)
- No damage and penetration to the substrate
- Good protection performance to the substrate
- Compatible with common DOWSIL™ glazing sealants
- Low VOC formulation
- Excellent peel-off capability even under long UV and weather exposure
- APEO free, more environmentally friendly
- Provides excellent protection for up to 18 months.[1]

[1]Depending on application and environmental condition

Applications

- DOWSIL™ 650+ Protective Peelable Coating is a waterborne peelable acrylic coating for temporary protection application. It is suitable to many substrates including glass, metal, and plastics. It offers temporary protection against dust, stain, grease, and even weld slag. It can easily be peeled off when the protection is no longer required. There is no damage to the surface and there is no residue left on the substrate.

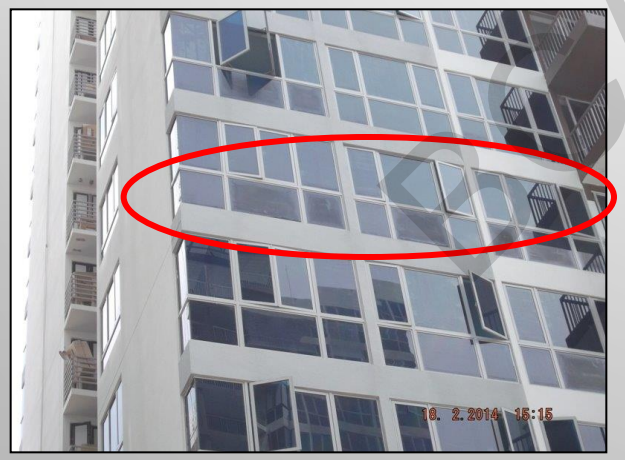


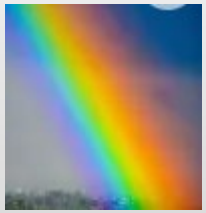
20kg, 60kg & 160kg
5 to 6 m2 kg1

BCA Academy

5.0 Protection of Frames.

5.0	Damaged on Glass Surface.
1.	Glass has been manufactured for a long time and is not fresh and hence, not recommended to go for coatings, such as Low-E, Solar Control etc.
2.	Improper storage at warehouse, especially weather conditions such as winter or summer time.
3.	No spacer between each piece of glass during packing.
4.	Chemical weathering is the gradual breakdown of a glass surface caused by environmental moisture, water and atmospheric gases.





Glass surface damaged - rainbow effect

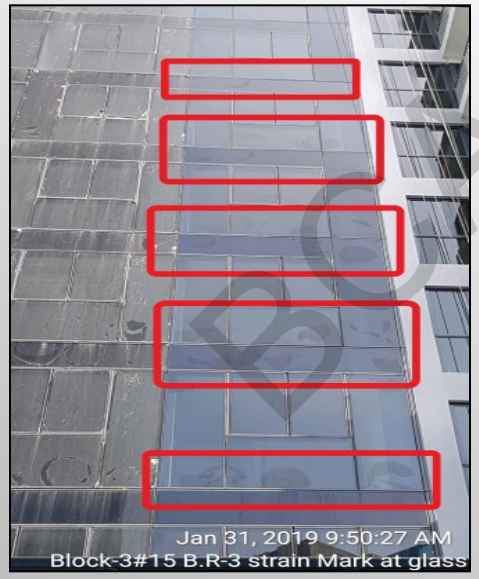


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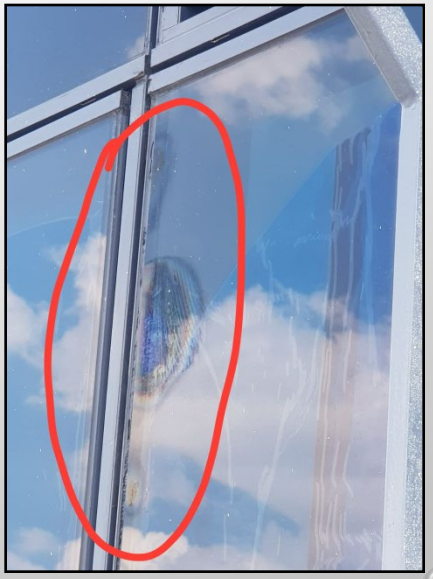
5.0 Protection of Frames.

5.0	Glass defects – Rainbow effect.
1.	The life span of the PVC adhesive tape is maximum of 5 months.
2.	Polishing of glass is an option, subjective to the seriousness of the damage.
3.	In most cases, rainbow effect appearance is not able to be polished away.
4.	Likelihood is over polished and caused the appearance to be distorted at a distance viewing.

BQA Academy



Rainbow effect appearance.



Very badly damaged surface.

5.0 Protection of Frames.

5.0	Protection of works.
1.	Extra care must be taken while carrying out dismantling of scaffolding, stagging and working platform to minimize damage to other works.
2.	Avoid or provide adequate protections if hacking works is deemed required.
3.	Proper instructions, supervision and planning are important to avoid abortive works and waste of time.
4.	Workers are to be educated and learn to take care of themselves as well as other parties' items.



Outer frame being damaged.



External hacking / damage frame.

5.0 Protection of Frames.

5.0	Protection – Common Defects.
1.	These are common abortive costs being found on site.
	The right bottom photo indicated that the installation works were in-completed and without protections.
2.	The bottom left photo shows that the transom member was damaged by a heavy object, inconsiderate behavior.



Transom member damaged.



Cement bags stacked on to bottom frame, sagging and out of alignment.

A Academy

5.0 Protection of Frames.

5.0	Frames Being Damaged by Others on Site.
1.	The photo on the bottom right corner indicated that due to the non compliance of the corridor width, the plastered wall was hacked to satisfy the requirements.
2.	There were no sign of effort to carry the protection to the window frame, causing the damaged beyond repair, thus have to replace with a new set.



Aluminium bottom outer frame being damaged by hard object during hoisting process.



Plastered wall was hacked off, due to clearance – Alum frame damaged.

BCA Academy

5.0 Protection of Frames.

5.0	Protection.
1.	This installed window were damaged during the hoisting of heavy materials to the roof level.
2.	It was not able rectified and hence, the entire window frame were had to cut out, constituting extensive abortive costs and time.



Window frame being damaged during hoisting of materials.

QA Academy

Aluminium Window - Good Industry Practices

6.0 DELIVERY, STORAGE AND HANDLING.



BCA Academy

6.0 Delivery, Storage and Handling

6.0	Delivery of Materials.
1.	All goods must be inspected as per the QA/QC requirements before labelling it prior delivery to site.
2.	Proper packing and documentation will ease the site personnel on the smooth loading of materials and inspection.
3.	Plan schedule of delivery against the actual progress of works plus a cross reference to the master programme.
	If damaged / incomplete frames were found, acknowledged the discrepancies on the "Delivery Order" for record.
4.	**Storage space.**
4a.	Sheltered place and suitable for unloading.
4b.	Safe, clean and stable flat ground to sustain the load of heavy vehicles.
4c.	Ease of access, distribution of materials and is non heavy traffic route.
4d.	Safe guard storage space with lock to prevent any lost of materials etc.
4e.	Proper and adequate lighting – especially located in the basement.
4f.	Ensure proper ventilation.

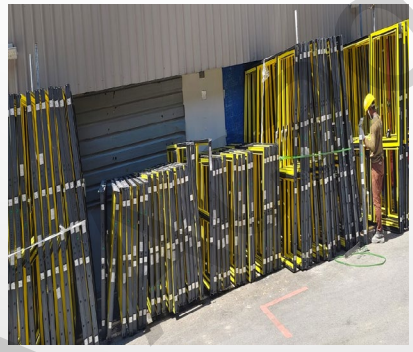
BCA Academy

6.0 Delivery, Storage and Handling

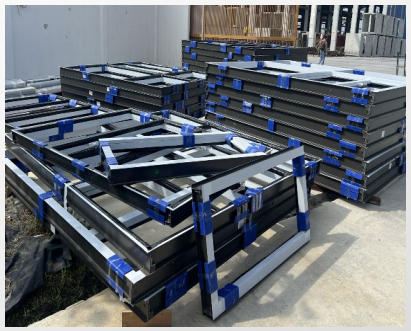
6.0	Storage Space.
1.	Ensure housekeeping on a weekly basis.
2.	Materials should be kept away from the ground with timber crates to ease handling and housekeeping.



Improper storage of materials on site.



Frames are stacked in a mannerly order on site prior installation.





Materials storage with crates.



Proper wrapping and stacked.

6.0 Delivery, Storage and Handling

6.0	Storage Space.
1.	Ensure housekeeping on a weekly basis.
2.	Materials should be kept away from the ground with timber crates to ease handling and housekeeping.



Frames stacked on steel crates on site prior installation.



Easy to locate frames.



Frames packed in timber crates for delivery to site.



Fabricated frames – clear labelling and wrapped.

BOA Academy

6.0 Delivery, Storage and Handling

6.0	Delivery of Materials.
1.	The delivery of frames has to comply to the delivery schedules as provided by the project in advance.
2.	The “Requestion of Delivery Form” has to state clearly on the sequence of loading of the goods to be delivery, the first to load up will be the last to unload at site storage.



Materials packed on timber crates for ease of unloading.



Materials packed on timber crates for ease of unloading on site via hoist to respective floors before installation.

Academy

6.0 Delivery, Storage and Handling

6.0	Delivery of Materials.
1.	Glass being delivered to site with proper shelter and protection.
2.	It should be stacked above ground and lean the top edge of glass against the wall with cardboard sheet or rubber pad.
3.	Delivery of glass panel should be packed with spacer in between each piece and secured tight and proper.
4.	Goods should be packed proper on steel racks and wrap with protection film for stable and safe delivery.



Use glazing glove during handling and glazing works.



Use sucker to carry glass for heavy and large glass.

CGK Academy

Aluminium Window - Good Industry Practices

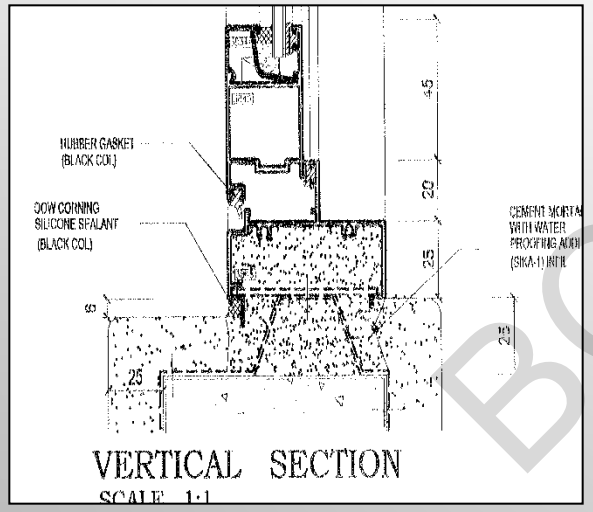
7.0 INSTALLATION METHOD.



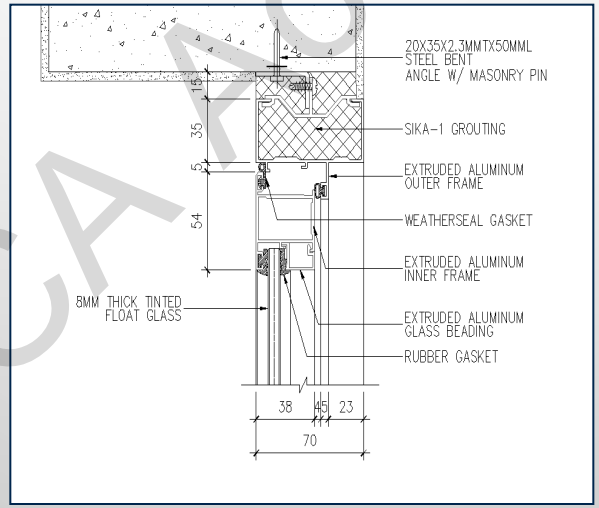
BCA Academy

7.0 Installation Method.

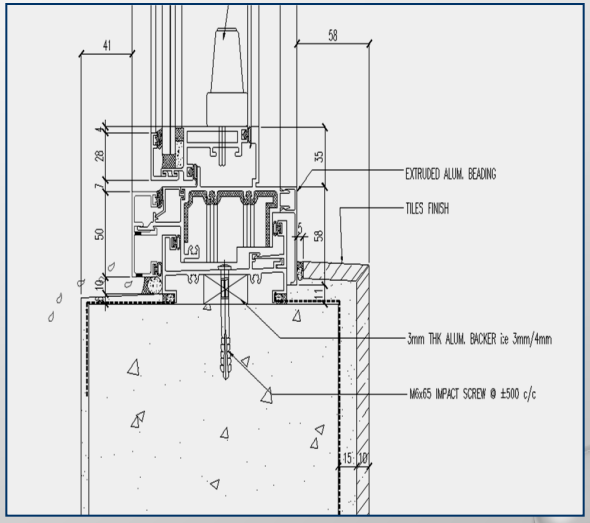
7.0	Installation Method - Fixing on Site.
1.	There are 3 types of installation methods commonly adopted as below:
2.	Fixing Lug System
3.	Sub-Frame Bracket System
4.	Full Sub-Frame System



a. Lug system



b. Sub frame bracket system



c. Full sub frame system

BCA Academy

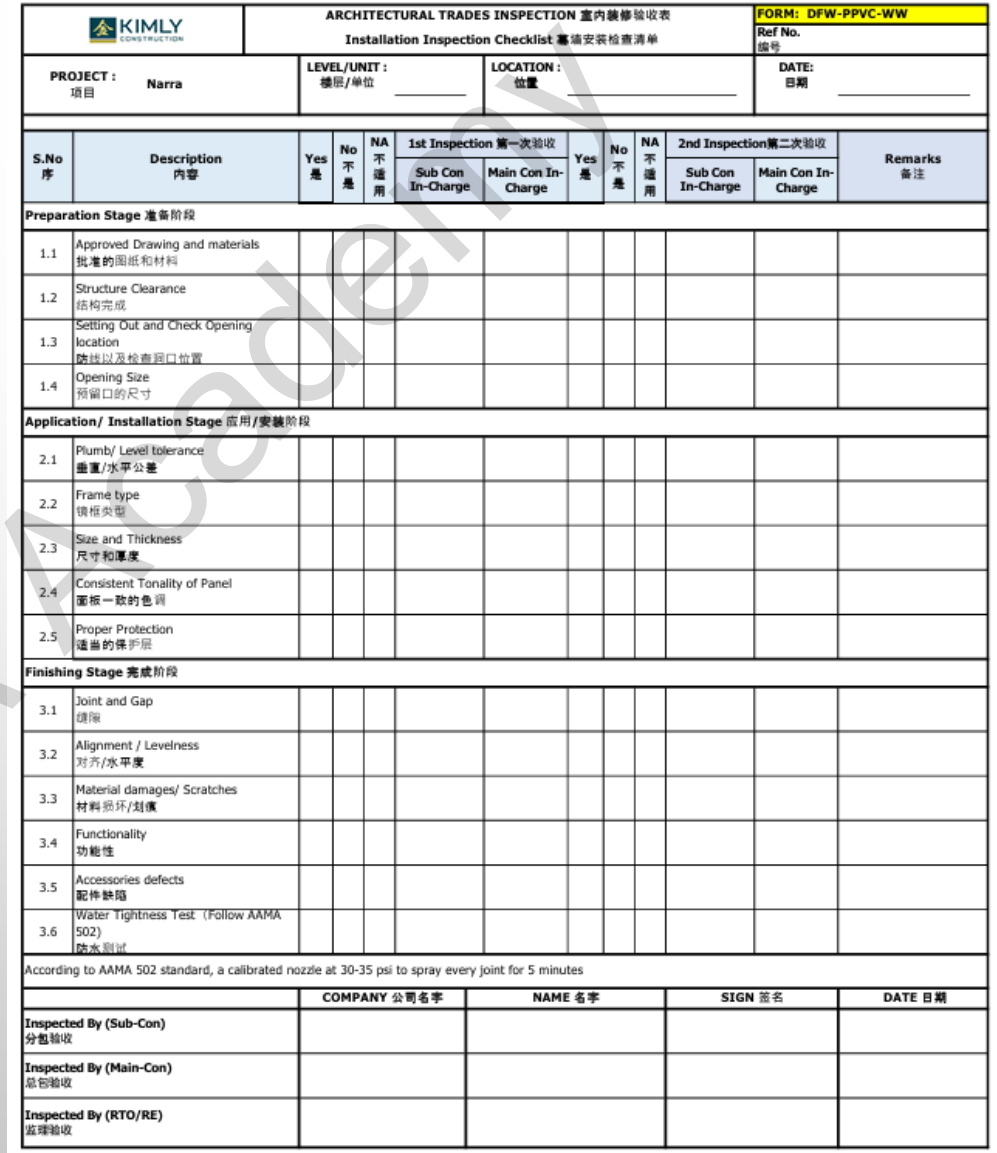
7.0 Installation Method.

7.0	Basic Requirements for Installation of Aluminium Window.
1.	Close co-ordination between the Main Contractor and follow up on the progress of the structural / architectural works are critical.
2.	Pre-monitoring and site checks between structural openings and approved shop drawings are important to ensure that there are no discrepancies to avoid any abortive works when necessary.
3.	Any discrepancies found will be reported to the Main Contractor to advise and solutions while follow up with administrative documentations.
4.	Request for reference setting out plan and datum level.
5.	Request for appropriate storage.
6.	Provide Method of Statement prior start installation.
7.	Conduct Trade Demonstration on the Installation of Windows.
8.	Provide Inspection form to ascertain the required standard.
9.	100% check on grouting works – for crack, shrinkage, holes, compact etc.
10.	100% check on waterproofing applications.

BCA Academy

7.0 Installation Method.

7.0	Inspection Form.
1.	Standard Site Inspection Form – a. Installation of Window. 2. Grouting works. 3. Water proofing works. 4. Field water test.



KIMLY CONSTRUCTION

ARCHITECTURAL TRADES INSPECTION 室内装修验收表

Installation Inspection Checklist 幕墙安装检查清单

FORM: DFW-PPVC-WW

Ref No. 编号

PROJECT : 项目 Narra | LEVEL/UNIT : 楼层/单位 _____ | LOCATION : 位置 _____ | DATE: 日期 _____

S.No 序	Description 内容	1st Inspection 第一次验收 Yes 是	No 不是	NA 不适用	Sub Con In-Charge	Main Con In-Charge	2nd Inspection 第二次验收 Yes 是	No 不是	NA 不适用	Sub Con In-Charge	Main Con In-Charge	Remarks 备注
Preparation Stage 准备阶段												
1.1	Approved Drawing and materials 批准的图纸和材料											
1.2	Structure Clearance 结构完成											
1.3	Setting Out and Check Opening location 防线以及检查洞口位置											
1.4	Opening Size 预留口的尺寸											
Application/ Installation Stage 应用/安装阶段												
2.1	Plumb/ Level tolerance 垂直/水平公差											
2.2	Frame type 镜框类型											
2.3	Size and Thickness 尺寸和厚度											
2.4	Consistent Tonality of Panel 面板一致的色调											
2.5	Proper Protection 适当的保护层											
Finishing Stage 完成阶段												
3.1	Joint and Gap 缝隙											
3.2	Alignment / Levelness 对齐/水平度											
3.3	Material damages/ Scratches 材料损坏/划痕											
3.4	Functionality 功能性											
3.5	Accessories defects 配件缺陷											
3.6	Water Tightness Test（Follow AAMA 502) 防水测试											

According to AAMA 502 standard, a calibrated nozzle at 30-35 psi to spray every joint for 5 minutes

	COMPANY 公司名字	NAME 名字	SIGN 签名	DATE 日期
Inspected By (Sub-Con) 分包验收				
Inspected By (Main-Con) 总包验收				
Inspected By (RTO/RE) 监理验收				

BCA Academy

7.0 Installation Method.

7.0 Basic Equipment and Tools for Installation of Aluminium Window.



NURON BX 4-22 CORDLESS CONCRETE NAILER





ROTATING LASER LEVEL



TIMBER SHIMS



PD-S LASER METER



MEASURING TAPE

BCA Academy

7.0 Installation Method.

7.0	Preparation works – Before Site Installation of Windows.
1.	Review the approved setting layout plan versus the approved window shop drawings.
2.	Ensure datum level and reference grids are clearly indicated.
3.	Verify the structural openings for any discrepancies. Request Main Contractor to hack or backfill to the required sizes in advance, before actual delivery of materials to site.
4.	Is a common practice to spray affected location of hackings with red paint.

BCA Academy



Verify window sizes



Provision of rebates for fixing lugs



RC base for support



Spray red paints on location for hacking

7.0 Installation Method.

7.0	Preparation works prior installation.
1.	Ensure that the height of the r.c. kerb is provided adequately to facilitate the proper installation of windows and grouting.
2.	There were cases where window installers were to install the window frames despite that the kerb was not being casted. This will result in improper infill of grout and create a bad bonding.
3.	R.C. beam that were under casted, is to be back filled with approved method to avoid future defects and abortive costs.



Co-ordination – verify site measurement before fabrication.



No co-ordination between M&E & Archi works.



Under provision of r.c. kerb to facilitate the installation of window frame.

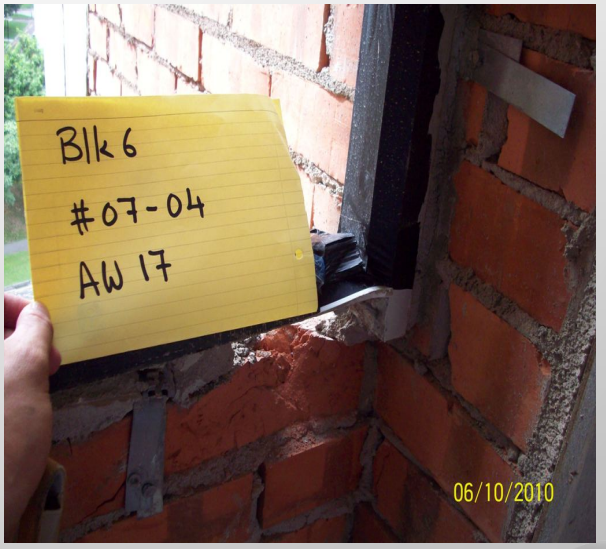
BCA Academy

7.0 Installation Method.

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No co-ordination between M&E services and architectural works.



Rectification of infill was not in compliance with MOS.

GA Academy

7.0 Installation Method.

7.0	Preparation Works Before Installation of Windows..
1.	Transfer datum level beside the opening and verify dimensions.
2.	Transfer grid reference on slab and wall beside opening, verify dimensions.



Verify opneing



Transferred of level.



Verifying grid reference.



Setting position based don reference grid..

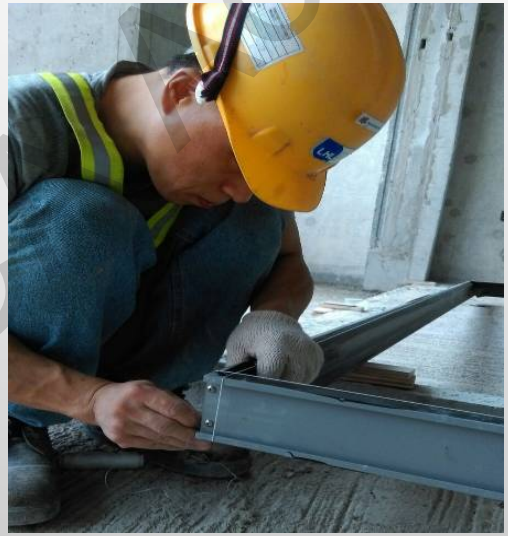
BOA Academy

7.0 Installation Method.

7.0	Installation Requirements – Sliding Window.
1.	Window frames with large sizes such as 2.80m and above is recommended to be sub divided into small modules for the ease of delivery, handling and access by means of passenger transportation.
2.	The weak part is the joints between modules and will have to be treated at site with weather seals to prevent water ingress during heavy downpour.



Ensure fixing lugs are spaced not more than 600 mm c/c.



Ensure joining of frames on site are seal with weather seal.



Pre-drilled holes for site assembly.

SC Academy

7.0 Installation Method.

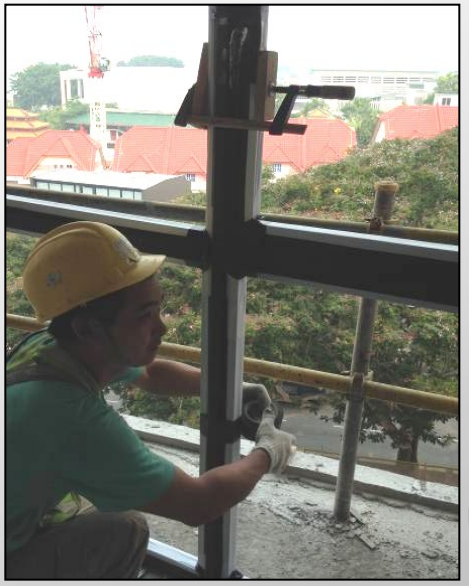
7.0	Installation of Aluminium Frame.
1.	Sealing of interlocking modules with weather silicone sealant.
2.	Use F clamp to secure tight of interlock mullions until excessive silicone sealant were squeezed out.



Caulk joining frames with weather seal.



Seal also the top of adjoining mullions

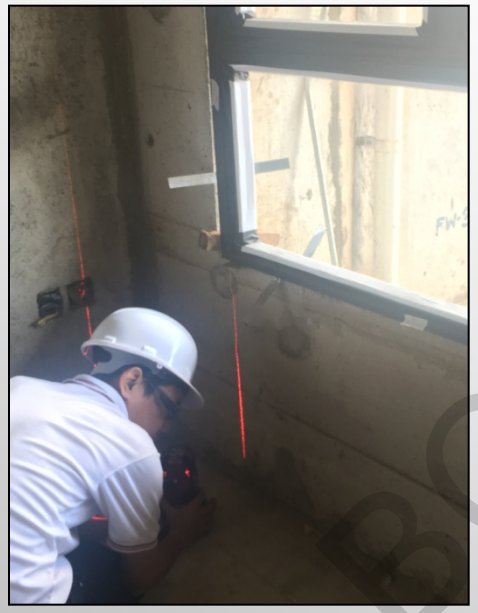


Secure with F clamp upon applying with seal

BCA Academy

7.0 Installation Method.

7.0	Installation of Aluminium Frame.
1.	Submit Method of Statement for the Installation of Window.
2.	A Trade Demo is carried out and witnessed by the Consultants, RE, RTO and Main Contractor.



Setting out alignment with auto laser



Verify vertical alignment against the frame.



Installation in accordance to setting reference grids and level.

BCA Academy

7.0 Installation Method.

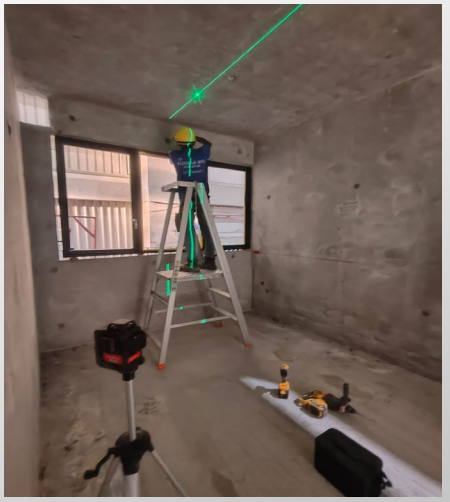
7.0	Installation of Aluminium Frame.
1.	Submit Method of Statement for the Installation of Window.
2.	A Trade Demo is carried out and witnessed by the Consultants, RE, RTO and Main Contractor.



Verifying in / out alignment.



Verify in / out alignment.



Reference lines o guide for during frame installation.

LCA Academy

7.0 Installation Method.

7.0	Installation of Aluminium Frame.
1.	Window frame installation was completed pending final inspection, before grouting works and water proofing applications.



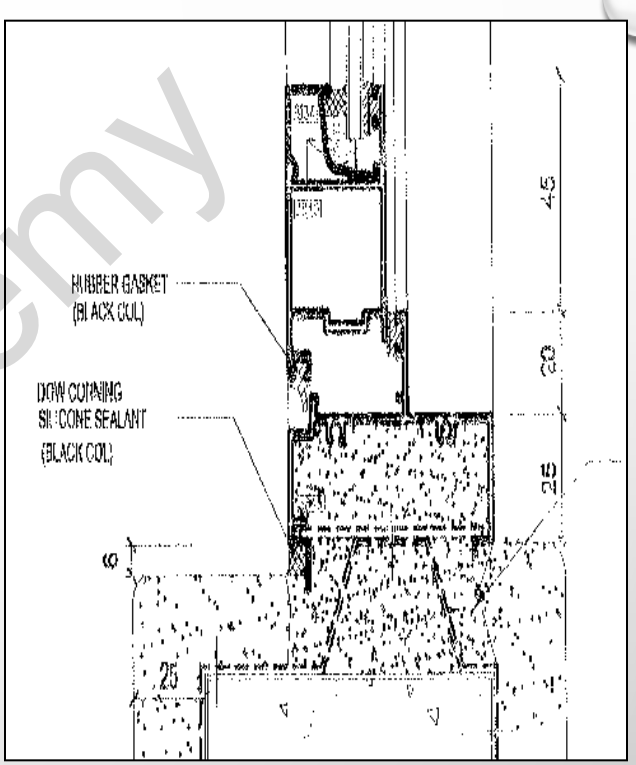
Full window frame positioned without grouting.



Installation of window frames at Pre-Cast yard.

7.0 Installation Method.

7.0	Fixing Lug System.
1.	Ensure that the reference grids and datum level are transferred to the respective opening for verification of dimensions.
2.	Install outer frame with +/- 450mm L x 24mm x 0.8mm thick galvanized steel lug being slotted in via secured to the concrete / wall with power nails.
3.	Timber shims shall be used to shim the window frame temporary in position, before securing by power nails progressively.
4.	Repeat the sequence of fixing as per item 3. until are completed.
5.	Check datum level and position at various steps with laser to ascertain alignment and level.
6.	Record all readings in the Inspection Form.



Vertical section thru window.

BCA Academy

7.0 Installation Method.

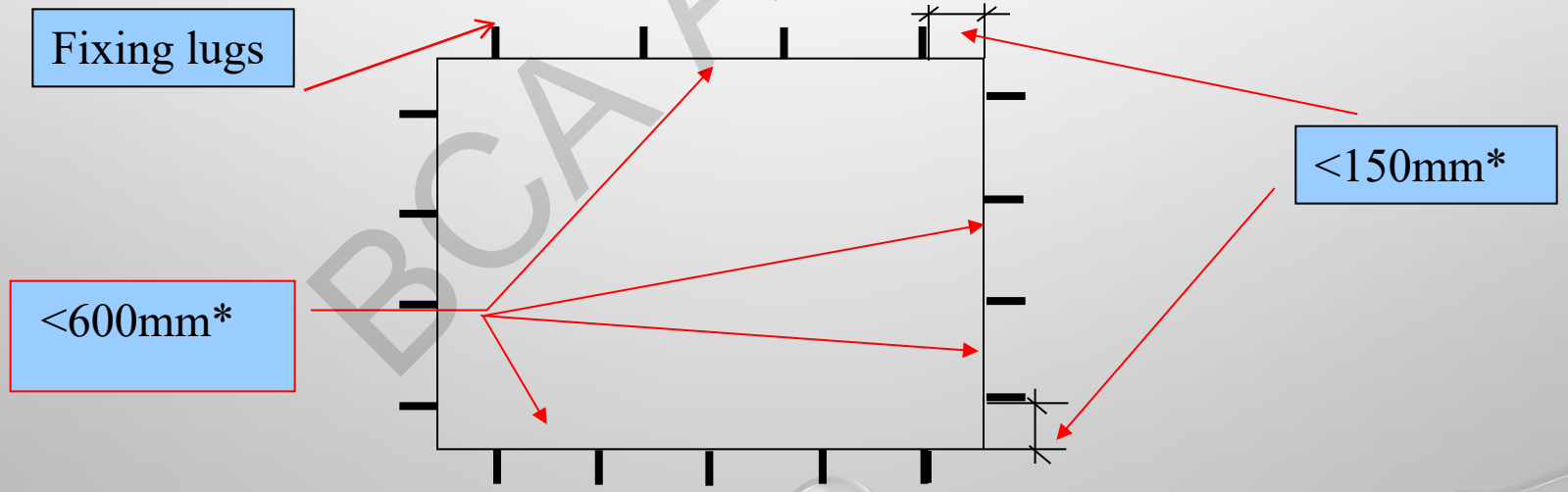
7.0 Installation of Aluminium Frame.



Plumb to check alignment



Using spirit level or auto laser level to check verticality



Position of fixing lugs

BCA Academy

7.0 Installation Method.

7.0	Installation of Aluminium Window.
7.	Grout the gaps between the wall and frame at the 4 corners, plus fixing lug positions to secure before grouting the next day.
8.	Check the grouts for any cracks, holes, hollowness and shrinkage the next day.
9.	Repair and make good if works in item 8 above is not acceptable.
10.	Apply K11water proofing applications around the perimeter of the window and allow for curing.



Secure with ramset gun / pin & cartridge



Check vertical alignment



V-shape timber wedge to shim the frame

BCA Academy

7.0 Installation Method.

7.0	Installation of Aluminium Window.
1.	Process of installation of window frame.

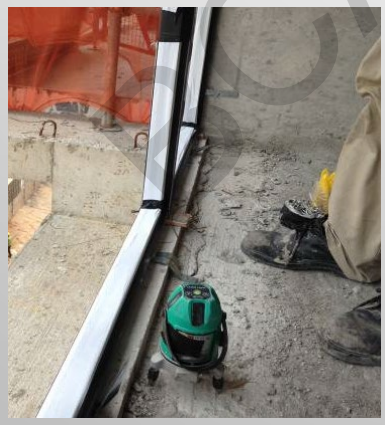




Setting and checking of window in / out position & alignment.



Verify level of installed window with pulled string.





SCA Academy

7.0 Installation Method.

7.0	Installation of Aluminium Window.
1.	Process of installation and verifications of compliance.



Ramset the power drive pin / nails on the lug to the wall.

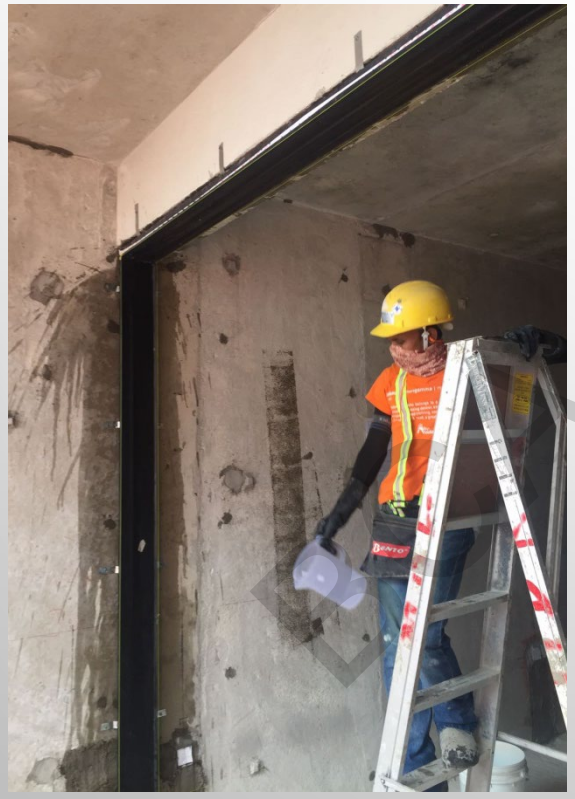


Ensure that the fixing lug is bend beyond the edge of frame to facilitate the ease of base coat &plastering..

BCA Academy

7.0 Installation Method.

7.0	Grouting Works.
1.	Preparation works before grouting to frames.



GIP - Wet the wall prior grouting.

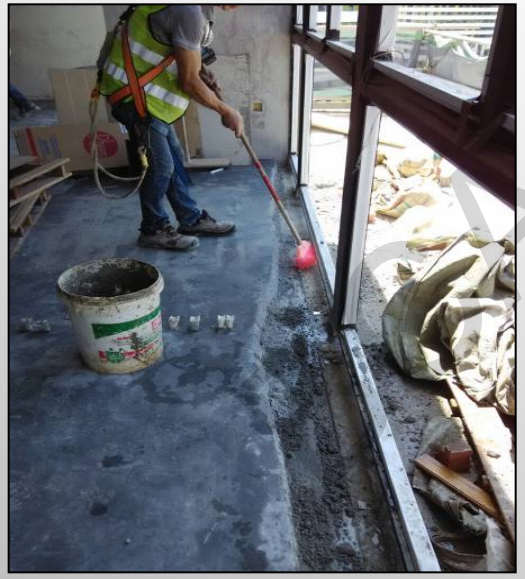


Sweep clean the area of fixing and pour clean water over before grouting.

Academy

7.0 Installation Method.

7.0	Grouting Works.
1.	It is a good practice to clear the dust and any rubbish around the perimeter of the structure before grouting works is carry out.
2.	Splash water at locations of grouting to wet the areas.
3	This will provide a good bonding between the grouting and structures.



Sweep the ground, clear debris before grouting works.



Wet the floor / slab for approximately 10 mins before grouting works

A Academy

7.0 Installation Method.

7.0	Grouting Works.
1.	Use waterproof plaster system (water & additives) and add dilute of 1 part of Sika- 1 with 10 parts of clean water in a pail / container and mixed thoroughly with an electric mixer, until is completely uniform.
2.	Place a long aluminium rectangular box section along the external of gap between the bottom frame and structure and secure with custom made steel bend rod.
3.	Insert the grouting gun nozzle into the mixed system and extract the amount until the chamber is filled.
4.	Place the nozzle to the gap and pump in the grout until excessive grouts are flown out.
5.	Repeat the process until all gaps are filled up.
6.	Check the verticality and position during the grout process and final.
7.	Use a tool to knock against the frame randomly for unfilled locations.
8.	Repeat item 5 and 6.

BOA Academy

7.0 Installation Method – Grouting Works.

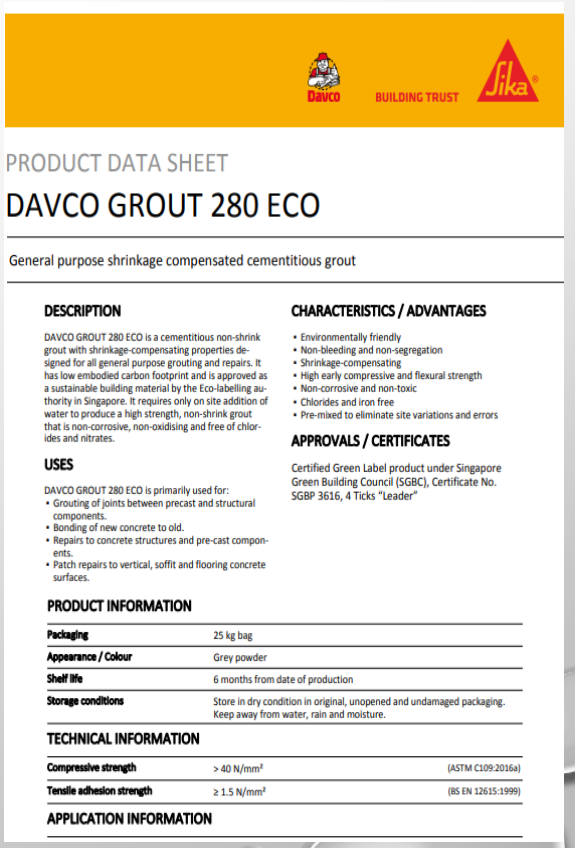
7.0	Grouting Works.
1.	Add Sika to grouting mixtures.



Sika waterproofing compound



Measuring waterproofing compound for mixing.



PRODUCT DATA SHEET

DAVCO GROUT 280 ECO

General purpose shrinkage compensated cementitious grout

DESCRIPTION

DAVCO GROUT 280 ECO is a cementitious non-shrink grout with shrinkage-compensating properties designed for all general purpose grouting and repairs. It has low embodied carbon footprint and is approved as a sustainable building material by the Eco-labelling authority in Singapore. It requires only on site addition of water to produce a high strength, non-shrink grout that is non-corrosive, non-oxidising and free of chlorides and nitrates.

CHARACTERISTICS / ADVANTAGES

- Environmentally friendly
- Non-bleeding and non-segregation
- Shrinkage-compensating
- High early compressive and flexural strength
- Non-corrosive and non-toxic
- Chlorides and iron free
- Pre-mixed to eliminate site variations and errors

APPROVALS / CERTIFICATES

Certified Green Label product under Singapore Green Building Council (SGBC), Certificate No. SGBP 3616, 4 Ticks "Leader"

USES

DAVCO GROUT 280 ECO is primarily used for:

- Grouting of joints between precast and structural components.
- Bonding of new concrete to old.
- Repairs to concrete structures and pre-cast components.
- Patch repairs to vertical, soffit and flooring concrete surfaces.

PRODUCT INFORMATION

Packaging	25 kg bag
Appearance / Colour	Grey powder
Shelf life	6 months from date of production
Storage conditions	Store in dry condition in original, unopened and undamaged packaging. Keep away from water, rain and moisture.

TECHNICAL INFORMATION

Compressive strength	> 40 N/mm²	(ASTM C109:2016a)
Tensile adhesion strength	≥ 1.5 N/mm²	(BS EN 12615:1999)

APPLICATION INFORMATION

BC Academy

7.0 Installation Method – Grouting Works.

7.0	Grouting Works.
1.	Mix the sika and waterproof plaster system for approximately 3 to 5 minutes with an electric mixer, until the mixture uniform and is in light grey colour.



Adding appropriate volume of waterproof compound into cement mix.



Electric mixer - mix 3 in 1 grout.

CT Academy

7.0 Installation Method – Grouting Works.

7.0	Grouting works.
1.	Ensure grouting is fully inserted in between gap and compacted.
2.	Use trowel to insert into the grout and push to compact the fillings.



Grouting process – caulking gun sucked grouts in and pump into the gap between mansory and frame.

Improvised metal rod C- clamp



Using a alum box and c clamp to secure as backing to prevent excessive grouts to flow out and stay compact.

B Academy

7.0 Installation Method – Grouting Works.

7.0	Grouting Works.
1.	The curing time for the grout is a minimum, a day.
2.	Check on the grouted frame the next day to ascertain any hollowness, cracks, holes and shrinkage. Repair / redo the works if any of the above items are not in order.



Grouting to frame in progress. Sequence is always bottom up.

When is fully filled, check alignment and level With auto laser. Any excessive grouts will be removed.



Ensure excessive grouts are flow out before using a trowel to make good.

Return the next day to check for cracks, pin holes, de bounding and also alignment.

BCA Academy

7.0 Installation Method – Grouting Works.

7.0	Grouting Works.
1.	Improper gap for grouting and wrong infill on large gap width.



Gap is more than 190mm, unable to grout , hence, required cast back to prevent potential water seepage.



Infill gap with bricks between vertical frame and concrete wall was improper and resulted in water seepage via staining the internal wall.

12. Improper provisions for proper grouting to frames..

BCA Academy

7.0 Installation Method – Waterproofing.

7.0	Grouting Works – Waterproof Applications.
1.	Application of K11 waterproofing.

Davco BUILDING TRUST

PRODUCT DATA SHEET

Davco K11 Slurry 613

Two component flexible cementitious waterproofing system

DESCRIPTION

Davco K11 Slurry 613 is a flexible two component cementitious waterproofing system. The two components designed with combination of polymeric micro compound, will react chemically after mixing to form a hard and elastic film which bonds tenaciously to most concrete or masonry substrate to protect against possible ingress of water.

USES

- Interior and exterior waterproofing and damp-proofing of concrete wall (to be plastered over).
- Repairing and waterproofing underground masonry subjected to waterhead and moisture seepage.
- Levelling or smoothing waterproofing compound of the underground walls before laying of bituminous sheets/liquid membrane and concrete repair works.
- Sealing fine hairline cracks in concrete structure that is not subjected to movement.
- Concrete water tanks, fountains, wet kitchen, bathroom, toilet, balcony, planter boxes, lift pit and RC gutters.

CHARACTERISTICS / ADVANTAGES

- Economical
- Non-toxic
- Protection against concrete carbonation and penetration
- Non corrosive to steel or iron
- Easy to mix and apply

PRODUCT INFORMATION

Packaging	Part A Part B	20 kg powder 9 L liquid
Appearance and colour	Part A Part B	Grey powder Milky white liquid
Shelf life	6 months from date of production	
Storage conditions	Stored properly in original, unopened and undamaged sealed packaging in dry conditions. Protect from direct sunlight, rain, water and moisture.	
Density	1.8 kg/l (mixed)	

TECHNICAL INFORMATION

Tensile strength	~ 0.9 N/mm²	(ASTM D412:06a, Dumbell A test piece)
Tensile strain at break	> 40 %	(ASTM D412:06a, Dumbell A test piece)
Water absorption	< 7.5% compare to control	EN 1504-2



Cement based compound + additives



Mechanical mix for 3 to 5 minutes thoroughly

BCA Academy

7.0 Installation Method – Waterproofing.

7.0	Grouting applications.
1.	Application of K11 waterproofing over grouted areas.



Application of waterproof system in between frame and masonry.





Complete application of waterproof system around perimeter of frame.

2 layers of applications is required, curing time is 2 – 3 hours per application.

BCA Academy

7.0 Installation Method – Waterproofing.

7.0	Grouting Works – Waterproofing Applications.
1.	Application of K11 waterproofing at Pre Cast Yard – PPVC Prefabricated Prefinished Volumetric Construction.



Application of K11 waterproofing at the casting yard.

BA Academy

7.0 Installation Method – Waterproofing.

7.0	Grouting Works – Waterproofing Applications.
1.	Application of K11 to wall and structure wall.





Condition 1.
75mm width application is Recommended for concrete Finished by the manufacturer.

Condition 2.
100 mm width application is recommended by the manufacturer.

Application of K11 waterproofing on perimeter of window frame.

SCA Academy

7.0 Installation Method – Waterproofing.

7.0	Grouting Works – Waterproofing Applications.
1.	These are examples of poor workmanship on grouting and if unattended, will have potential water ingress.



Shoddy grouting works.
Repair from outside.



Timber wedging not removed.
return the next day to pull out
and back fill fully.



Hollow found after grouted..

BCM Academy

7.0 Installation Method – Waterproofing.

7.0	Grouting Works – Waterproofing Applications.
1.	These are examples of poor workmanship on grouting and if unattended, will have potential water ingress.
2.	Due poor supervision and unskilled workmen.



Improper application of K11 waterproofing.



Shrinkage of grout – gaps / holes.



Improper infilled of grout.

BCA Academy

7.0 Installation Method – Waterproofing.

7.0	Grouting Works – Waterproofing Applications.
1.	These are examples of poor workmanship on grouting and if unattended, will have potential water ingress.
2.	Due poor supervision and shoddy workmanship.
	Improper method of construction and materials used for the casting of r.c. kerb.



Non provision of r,c, kerb, instead stuff in bricks as replacement.

Will result in potential water seepage.

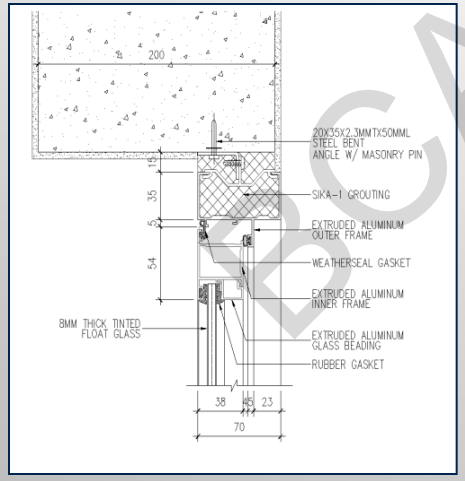


Unacceptable water proof application.

BCA Academy

7.0 Installation Method.

7.0	Sub Frame Bracket System.
1.	This system is applicable for unfinished wall type of works.
2.	It demands for accuracy in the construction of openings, both horizontal and vertical.
3.	It demands for a very skilled installation team to perform the work.
4.	Required datum level and reference grid.
5.	Fix the primary brackets.
6.	Align the secondary brackets in contact with primary.





BCA Academy

7.0 Installation Method.

7.0	Installation procedure.
14.	The external is using weather silicone sealant via the internal may be the similar type can choose acrylic sealant, paintable type.
15.	The system is solely dependable on the external weather seal and therefore, the method and application has to be 100% compliance.
16.	The speed of installation is extremely slow as it demand for double handling installation.
17.	Apparently, the costs is also much higher than normal window system which is much more simplified.
18.	Both external and internal alignment are issue which required to be addressed before start work.
19.	Will require to produce different sizes of window to cater for the misalignment.

BCA Academy

7.0 Installation Method.

7.0 Sub – Frame Bracket System.



Check level with sprit level of the installed bottom window frame.



Apply sealant at bottom edge.



Fixing of frame.



HPS anchor fixing.

BCA Academy

7.0 Installation Method.

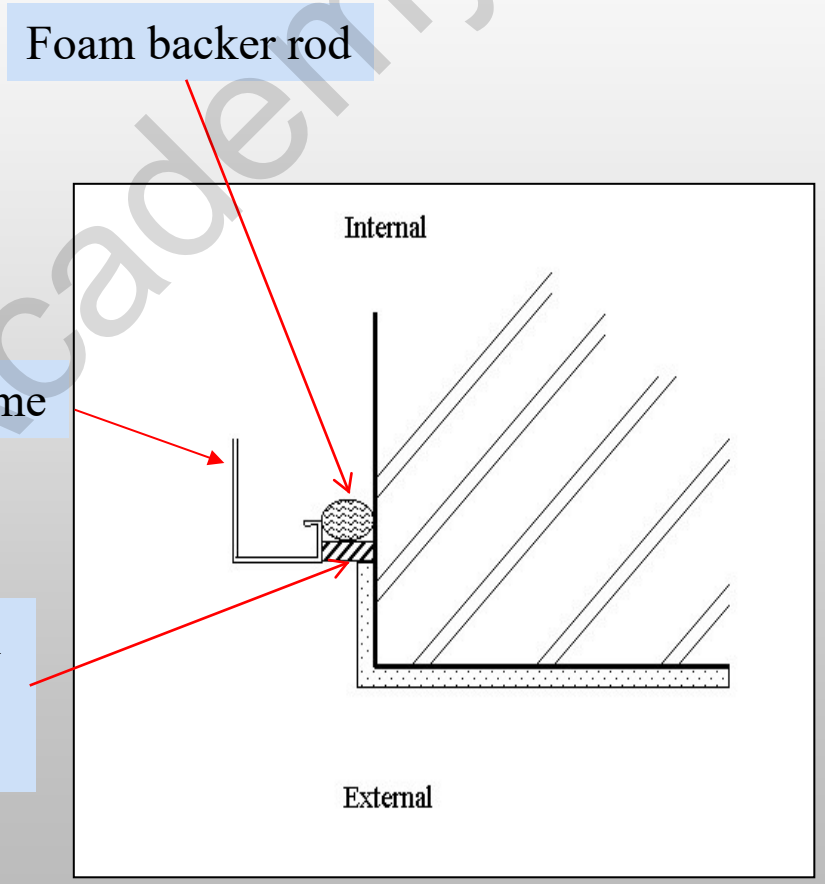
7.0 Sub – Frame Bracket System.



Install bottom frame and seal the gap with silicone sealant.



Protection with masking tape

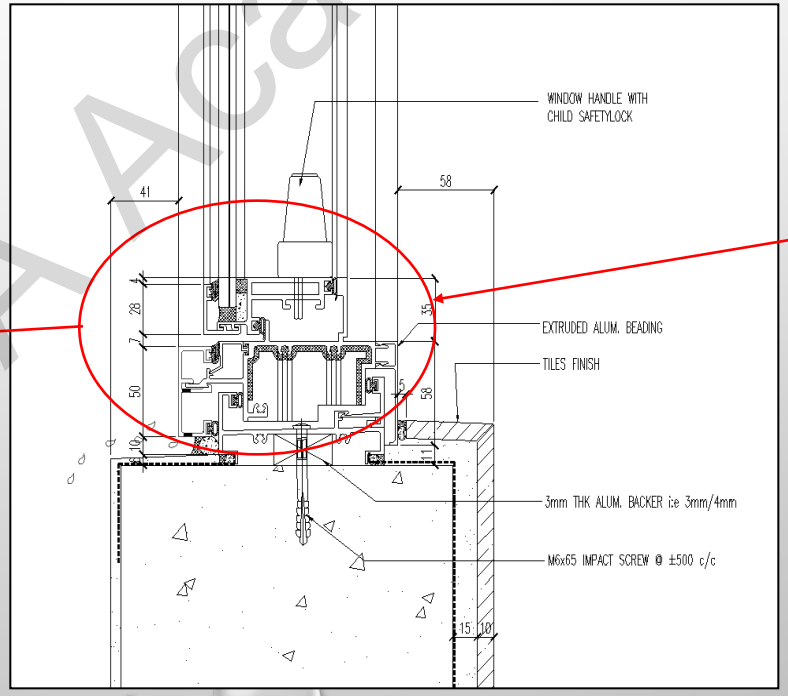


BCA Academy

7.0 Installation Method.

7.0	Full Sub – Frame System.
1.	The system calls for main sub-frame system to be installed frist and allow other wet works to proceed concurrently.
2.	Refer to the earlier topic 7 for the complete installation procedures.





Extruded aluminium sub frame – installed with HPS anchor

Full sub frame system.

BCA Academy

7.0 Installation Method.

7.0	Glazing Works.
1.	Remove the 3rd protection tape (in yellow) from the main frame.
2.	Sanp off the glazing beads, 2 horizontal and 2 vertical.
3.	Clear bottom glass pocket with an electric vacuum.
4.	Apply weather silicone sealant to the inner corners of the glass pocket.
5.	Place setting blocks at ¼ from both edge of frame. Size of setting is determine by calculation, normal window is 6mm thick x 25mm wide.
6.	Check glass thickness versus approved shop drawings, with a laser gauge.
7.	Physical check on glass edges on chipped, scratches, logo position, surface positioning and particularly Low-e and Solar control glass.
8.	Check correct type of glazing gaskets or silicone sealant to be used.
9.	Place the glass sucker on the glass surface and apply the pressure on the pump before pull out.
10.	Carry the glass and load into the glass pocket via resting on setting blokcs.
11.	Insert gaskets into gap between glass and frame.

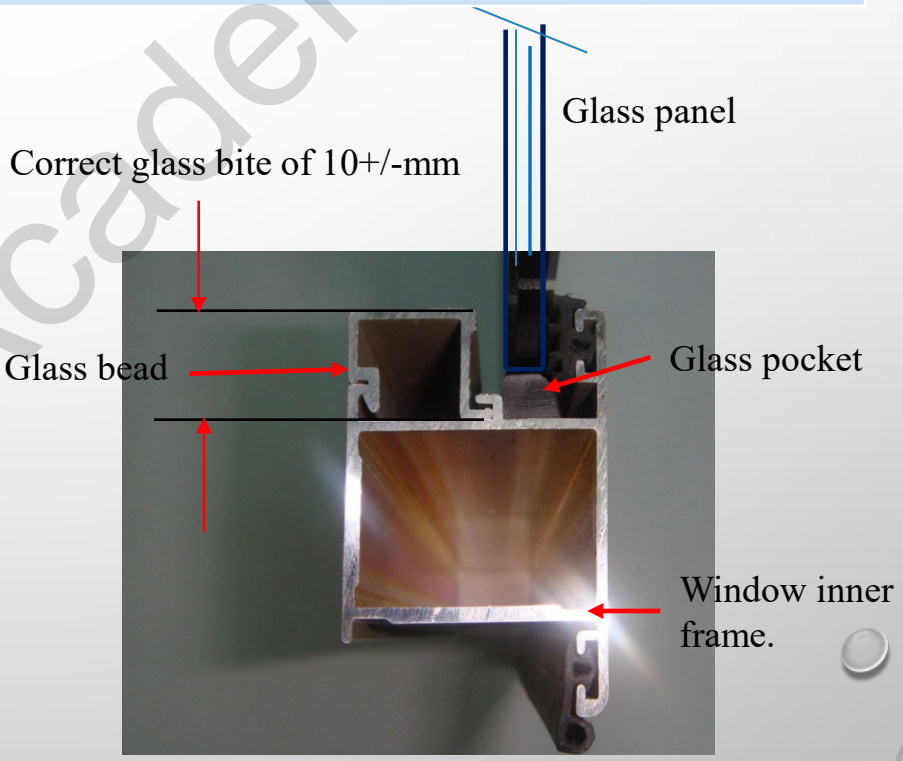
BOA Academy

7.0 Installation Method.

7.0	Glazing Works.
1.	Before glazing, ensure to check that the glass delivered are the correct type, such as thickness, combinations, the logo position, the coating surface and besides, check for any defects before arranging for site installation.



Laser gauge meter to measure glass thickness.



Adequate glass bite & correct and the correct Size of setting block.

LCA Academy

7.0 Installation Method.

7.0	Glazing Works.
1.	Remove protection tape item. 3 (yellow colour adhesive tapes)
2.	Remove glazing beads – top 2 pieces and sides 2 pieces.
3.	Vacuum and clean off dirt, debris before placing setting blocks into it, ¼ from both edges.
4.	Place the glass sucker on the glass surface and apply pressure and lock.
5.	Carry and load the glass into the glass pocket via sitting glass block.
6.	Adjust to position and snap on the glazing beads, insert gasket in between.



Inserting glass panel



Secure of beading


Secure of horizontal beading


Insert block to secure glass



7.0 Installation Method.

7.0 Glazing Works.



Application of silicone sealant to glass.



Use custom made tool to achieve consistent / desire surface finish.



Preparation of gasket insert.



Gasket to be inserted and tool to tightness.

BCA Academy

7.0 Installation Method.

7.0. Glazing Works – Sliding Window in Production Floor.



Step 1 – Insert gasket to glass.



Step 2 - Gasket is inserted progressively.



Step 3 – Assemble of outer frame.

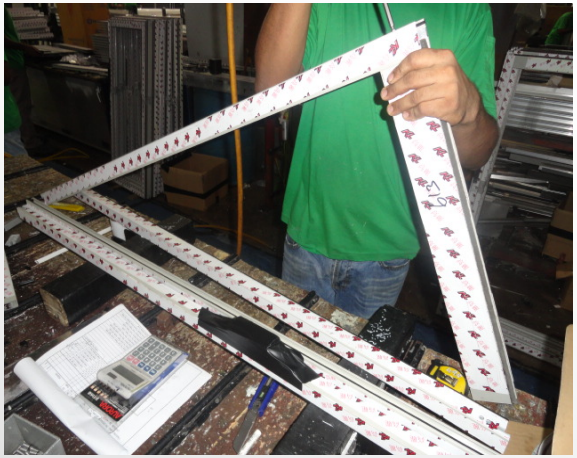


Step 4 – Full insertion of gasket to glass.

BCA Academy

7.0 Installation Method.

1. Glazing Works – Sliding Window in Production Floor.



Step 1 – Assemble L – shaped frame.



Step 2 – Assemble L – shaped frame & join the other L-shape frame.



Step 3 – Frame ready to receive glass.



Step 4 – Insert U gasket to glass.

EGA Academy

7.0 Installation Method.

7.0	Glazing Works.
1.	It is not a good practice to install the outer frame without the inner frame together.
2.	Outer frame is fully grouted – The inner frame, being secured with top and bottom stainless-steel stays, will not be able fix to the outer frame as it has been grouted.
3.	The stainless-steel self tap screws will eventually loosen after a series of open and close actions.



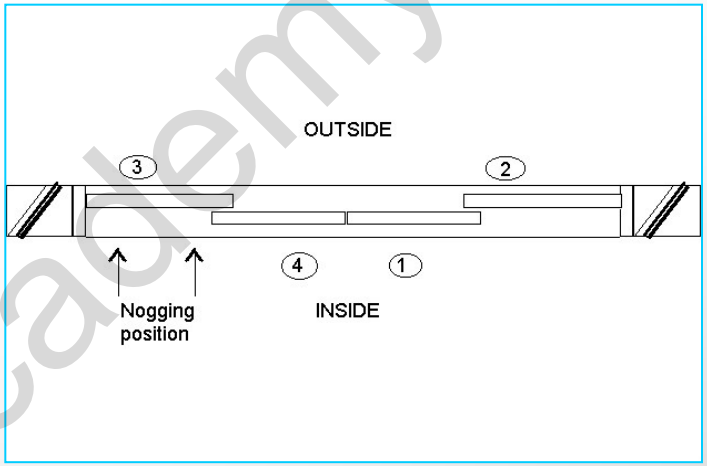
4.	**Recommend to produce both the inner and outer frames together.**
5.	All hardware, locking devices, gaskets, stainless steel stays and alignment are to be pre-fixed in factory.

Academy

7.0 Installation Method.

7.0 Glazing Works – Sliding Window.





Sequencing of installation of inner sliding panels.



Insert sliding inner



Bottom sliding track



Top sliding inner

BCA Academy

7.0 Installation Method.

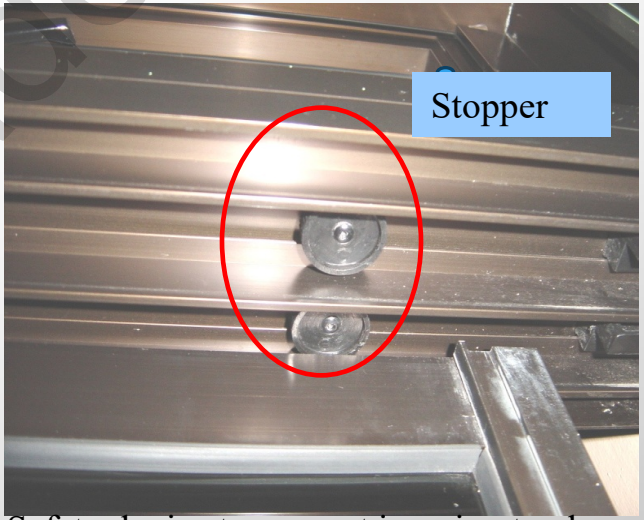
7.0	Glazing Works – Installing Hardware & Accessories.
1.	HDB standard requirements – Impact anchors to further secured.
2.	PVC stopper beneath top sliding track to prevent jumping track and fall off.





Safety HPS anchor bolts - HDB.

Additional impact anchors are further required to secured the frames, despite that it had already been hold on by the stainless-steel fishtail fixing lugs.



Safety device to prevent jumping track.

This safety device is required under SS212. The purpose is to prevent fabrication error, shoddy site installation that will the inner frame being dislodged due to alignment issue.

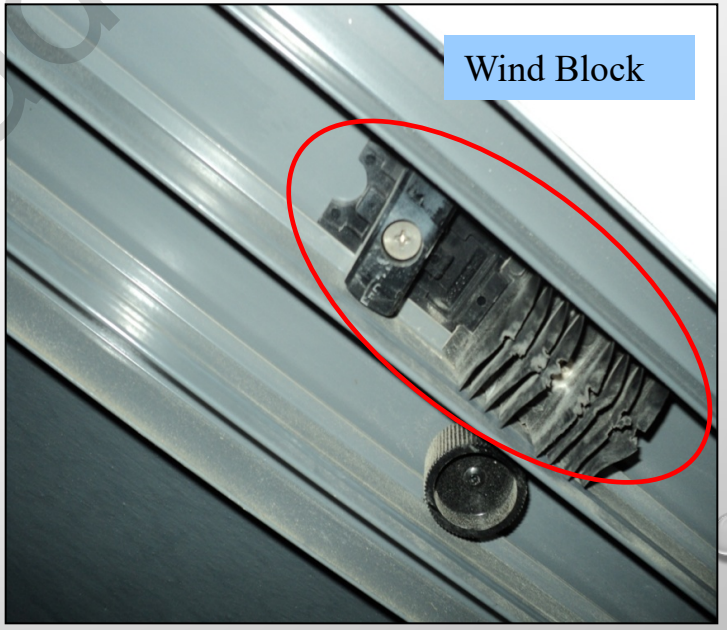
BCA Academy

7.0 Installation Method.

7.0	Glazing Works – Installing Hardware & Accessories.
1.	Wind Block to top underneath and bottom surface of sliding track @ interlocking vertical members to resist noise travel into the internal.
2.	PVC stopper beneath top sliding track to prevent jumping track and fall off.



Window stopper to prevent jump track and Fall off.



Wind block install on top track to reduce sound transmission, noise, particular windows that are facing MRT tracks and highway.

BCA Academy

7.0 Installation Method.

7.0	Glazing Works – Installing Hardware & Accessories.
1.	Recommended to install the dual locking device to the inner frame without the actual physical cam handle / latch and slide lock , particularly special or custom make type.
2.	To avoid damage before handling over.
3.	Manufacturer may not entertain if the minimum quantity is not met.
4.	Delivery lead time is long, to allow a % of spare.



Installation of casement handle.



Installation of latch lock to window frame.

BCA Academy

7.0 Installation Method.

7.0	Glazing Works – Field Water Test.
1.	Field water tests based on Conquas and AAMA 501.2 standards.

Minimum sampling - 1000m2 (GFA) – min. 20 samples and max. is 100 samples.(conducted by BCA)

Self field test – 25% min samples (declared by Qualified Person)

Conquas 21 Standard – Test Parameter

1) Water intensity : 300mm / hr
2) Wind Pressure : 240 Pa
3) Nozzle inclination : 90 degree to window
4) 1 sample = 2m length of joint
5) Distance from nozzle to wall : 200mm
6) Spray duration : 10 minutes
7) No sign of leakage using BCA's window water tightness test method.

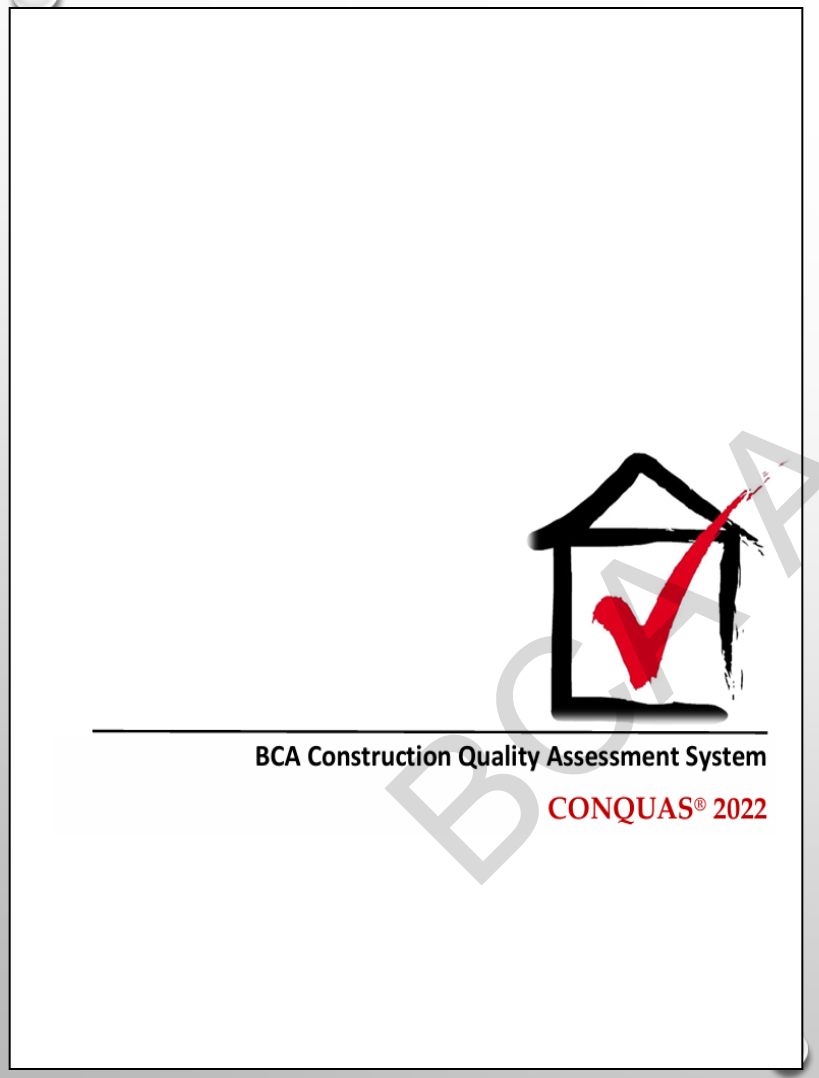
AAMA 501.2 Field Water Test – Test Parameter

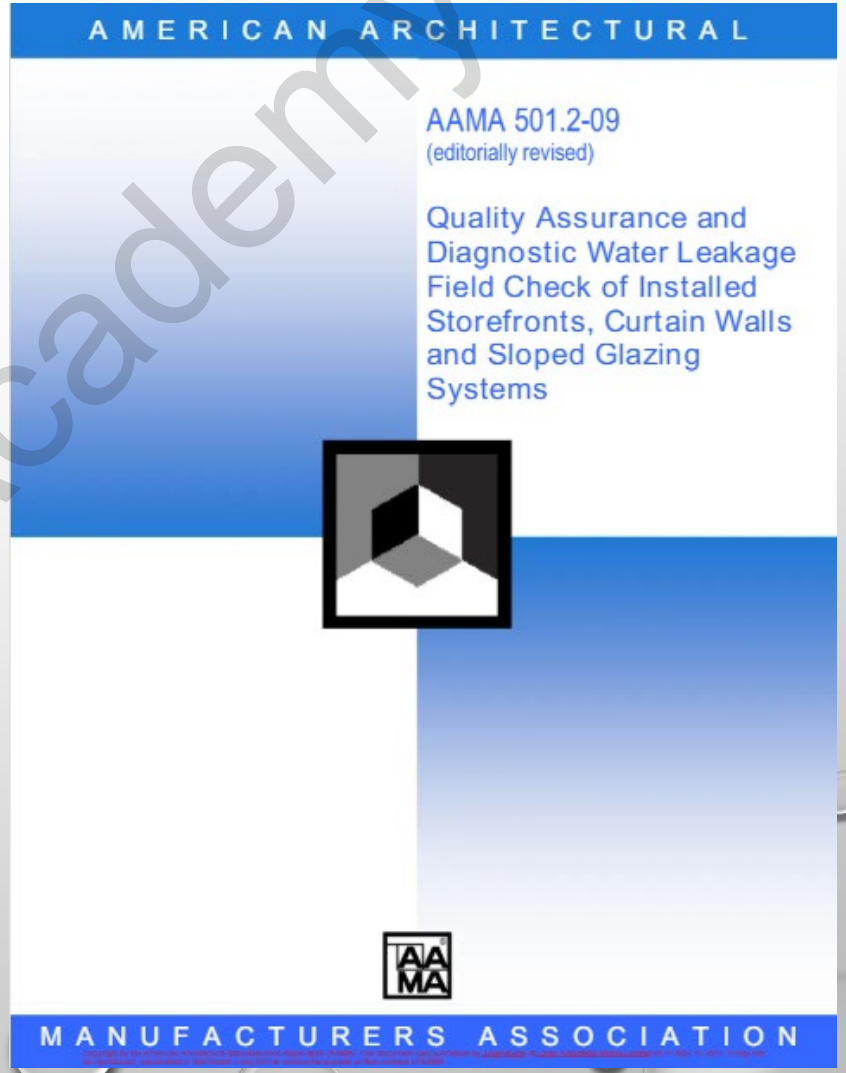
1) Nozzle diameter : 1brass nozzle 18mm dia.
2) Water pressure : 30 to 35 psi
3) Nozzle inclination : 90 degree
4) 1 Sample : 6 reference units to be tested & allowance is make for 2 further tests
5) Distance from nozzle to wall : 300mm
6) Spray duration : 5 minutes
7) No sign of leakage as view from internal.

BCA Academy

7.0 Installation Method.

7.0 Glazing Works – Field Water Test.





BCA Academy

7.0 Installation Method.

7.0 Glazing Works – Field Water Test Equipment.



Water pressure gauge.



Electric water pump.



Heavy duty water hose.



Water flow meter.

BCA Academy

7.0 Installation Method.

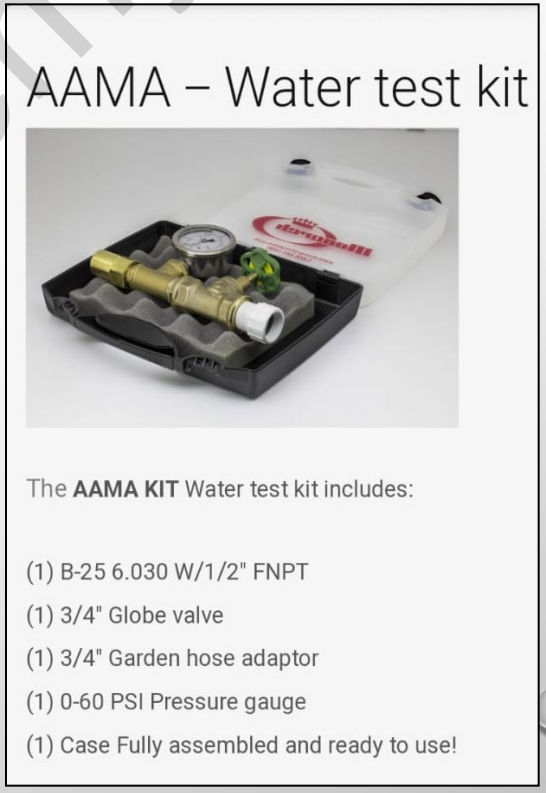
7.0 Glazing Works – Field Water Testing Kit.



Electric pump – Filter from water tank



Custom made extension of nozzle



Approved water test kit

FCA Academy

7.0 Installation Method.

7.0	Glazing Works – Testing Standard and Procedures.
1.	Field water test in accordance to AAMA 501.2 Test Method.
2.	Water supply has to be adequate to facilitate the test.
3.	Testing pressure is 31 ~ 35 psi.
4.	Spray water horizontally to window at a distance 300mm from left to right for 5 minutes and record any sign of seepage from inside.
5.	Repeat above but in vertical spray.



Water supply to hose – using AAMA
501.2 standard.



Horizontal spray – using AAMA 501.2 standard.



Vertical spray – AAMA 501.2 standard.

BC Academy

7.0 Installation Method.

7.0 Glazing Works – Field Water Test.



ASTM 501.2 Field water test –
nozzle position at horizontal groove joint.



ASTM 501.2 Field water test –
nozzle position at vertical groove joint.

BCA Academy

7.0 Installation Method.

7.0	Glazing Works – Field Water Test – AAMA 501.2 Standard.
1.	If there is no sign of leakage after sprayed, it will be recorded as “No Leakage”.
2.	If there are leakage during the test, stop immediately and register the location of seepages.
3.	Allow the specimen to dry up before attempting to rectify.



ASTM 501.2 Field water test – nozzle position at groove joint.

	Reasons of Failure.
1.	Due to alignment.
2.	Gasket with no proper compression.
3.	Weak joints of members.
4.	Adjustment of hardware.



Water seepage is observed to overflow from the sash / transom.

SCA Academy

7.0 Installation Method.

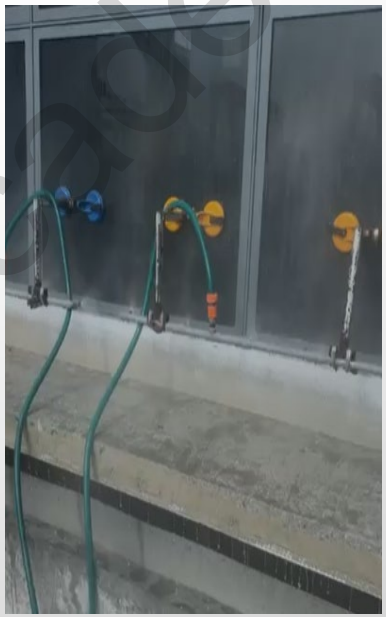
7.0	Glazing Works – Field Water Test AAMA 501.2 Standard.
1.	Custom make testing apparatus and equipment.



Custom made test Equipment.



Self test in factory.



Actual test on Window.



Actual test on Window.

BC Academy

7.0 Installation Method.

7.0	Glazing Works – Field Water Test AAMA 501.2 Standard.
1.	Water test and records.

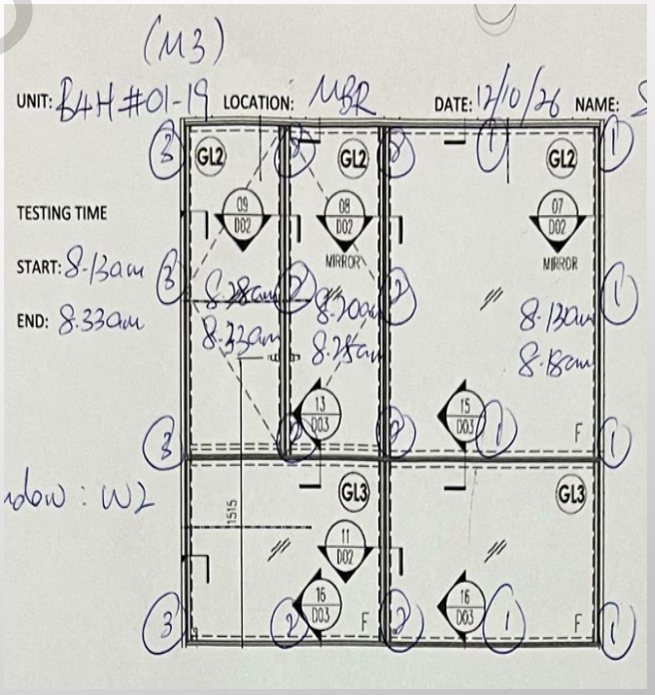


Field water test - unit



Conducting field water test.

Internal observation..



Record of water test..

Field water test for PPVC at casting yard..

BCA Academy

7.0 Installation Method.

7.0	Glazing Works – Field Water Test AAMA 501.2 Standard.
1.	Custom make testing equipment and apparatus.



Conducting field water test in 501.2 method of test.



Compressor Pump.



Water collection tank for recycle.

7.0 Installation Method.

7.0	Glazing Works – Field Water Test – Conquas Standard.
	Engage 3rd party to conduct the field water as per the Conquas criteria.





Field water test - Conquas Standard.

Building and Construction Authority

We transform the Built Environment Sector and shape a liveable and smart Built Environment for Singapore

The assessment is based on the sampling guidelines table as set out below:

Sampling Guidelines Table					
	Items	GFA per Sample	Min Sample	Max Sample	Remarks
1	Internal Finishes	500 m²	50	150	For Non-Residential Project & Public Mixed Development Project with Non-Residential GFA exceeding 50%
1a	Internal Finishes	70 m²	90	800	For all Private Residential Project & Mixed Development Project with Residential component. For Public Mixed Development Project with Residential GFA exceeding 50%
1a(i)	Internal Finishes (Tier 2a)	-	90	1,440	50% Sampling (50% coverage for all units): Max Principal samples: 640 Max Service samples: 640 Max Circulation samples: 160
1a(ii)	Internal Finishes (Tier 2b)	-	90	2,160	100% Sampling (100% coverage for all units): Max Principal samples: 1000 Max Service samples: 1000 Max Circulation samples: 160
1b	Internal Finishes	70 m²	90	600	For Public Residential Project
2	External Wall	-	100%	-	100% of the blocks or units
3	External Work	-	1	-	1 for each type of external work
4	Roof	-	50%	-	Minimum 50% of the blocks or units
5a	Field Window Water-tightness Test (WTT)	-	20	100	Conducted by BCA. A sample is defined as 2m length of joint. 5% of total number of window panels or 5% of total curtain wall area, whichever is applicable For PPVC project, maximum 30% of the test samples will be from factory

CA Academy

7.0 Installation Method.

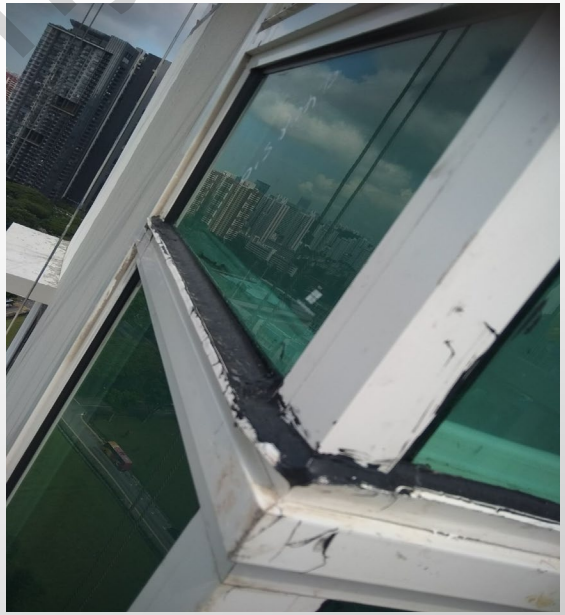
7.0	Glazing Works – Field Water Test AAMA 501.2 Standard.
1.	Test results with ingress of water.



Water seep through bottom sill after 3 minutes, gasket loose, no compression, cam handle is also loose.



Water over flow through bottom sill, gasket is not tight, no compression.



Sealed with silicone sealant to stop seepage

BCA Academy

7.0 Installation Method.

7.0	Glazing Works – Field Water Test AAMA 501.2 Standard.
1.	Test results with ingress of water.



Sign of water seepage through the bottom sill and mullion during site field water test.



Major seepage through full height window during field water test.

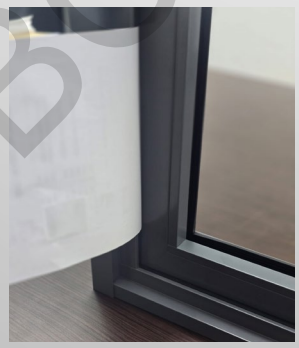
BCA Academy

7.0 Installation Method.

7.0	Glazing Works – Field Water Test AAMA 501.2 Standard.
1.	Self test of window before field water test.
2.	Ensure alignment is in order.
3.	Engage dual lock device to ensure is tight.
4.	Gaskets joints are all sealed and tight.
5.	Insert A4 70 grams paper in between the outer and inner as per the photo at the bottom left.
6.	Close the window and engage the lock.
7.	Unable to pull the paper if the close window fully tight.



Open window insert paper

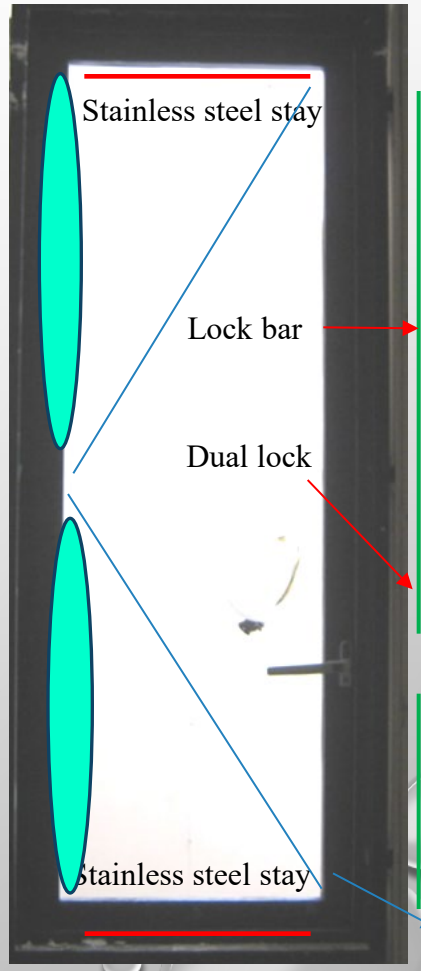


Close window

Insert paper to the compression of gasket between outer and inner frame.

Insert paper in between outer & inner frame

Wind block



Casement window

BCA Academy

Aluminium Window - Good Industry Practices

8.0 COMMON DEFECTS AND REMEDIES.



BCA Academy

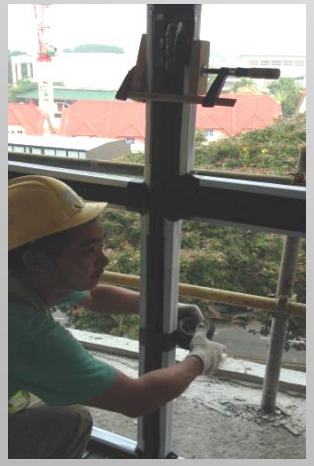
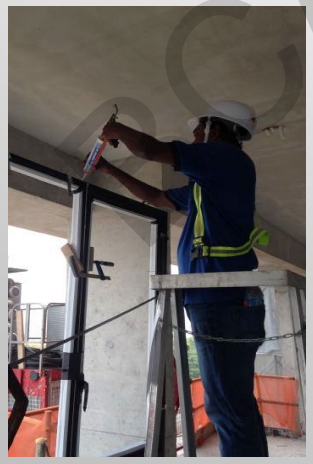
8.0 Common Defects and Remedies.

8.0	Common Defects are caused by the followings:
1.	Costing / Budgeting.
1a.	Under priced / incorrect assumption of specifications, statutory requirements etc.
2.	Design.
2a.	Due to the poor design of the window system.
2b.	Use of improper materials and hardware.
3.	Fabrication.
3a.	Machineries and equipment.
3b.	Improper production supervisions that led to poor quality control.
3c.	Use of improper materials, such as stainless steels, anchors, silicone etc.
4.	Site Installation.
4a.	Inexperienced site representative, poor planning etc.
4b.	Poor supervisions and co-ordinations
4c.	Unskilled installation team

BCA Academy

8.0 Common Defects & Remedies.

	Things to do before field water test.
1.	Ensure that the returns on the rear of mullions is cleaned from dust and oil, before applying both with weather silicone sealant before snapping together.
2.	The top of the combined mullions is open and hence, is important to seal the rectangular hollow with based foam via silicone sealant.
3.	Ensure that grouting is fully compact and waterproofing is applied 75mm/ 100mm wide and fully overlapping the grout area and wall.
4.	Check all joints are fully sealed.
5.	Check gaskets are in compression state, engage the dual locking device to ensure opening and closing of window panels are tight.




RCA Academy

8.0 Common Defects and Remedies.

8.0	Casement window - water ingress, over flow.
1.	Defect, water seepage were caused by improper checked on the window before field water test.
2.	Checked the functionality such as: a. Locking device b. Friction stay alignment c. Gasket conditions, joints, compression ability d. Joints or all corners, inner and outer frames e. Alignment
3.	The defect below can be easily avoided if the above was carried out in advance.





BCA Academy

8.0 Common Defects and Remedies.

8.0	**Fixed Glass Window - water ingress, over flow.**
1.	Refer to the shop drawings on details.
2.	Checked the functionality such as: Gasket conditions, joints, compression ability Joints or all corners, inner and outer frames (possible caused)
3.	Silicone sealant works. (possible caused)
1.	<u>Solution:</u>
2.	Remove glazing to reseal joints and pockets with silicone sealant.

BCA Academy



Water seep through grouting.



Water seep through poor corner joints.

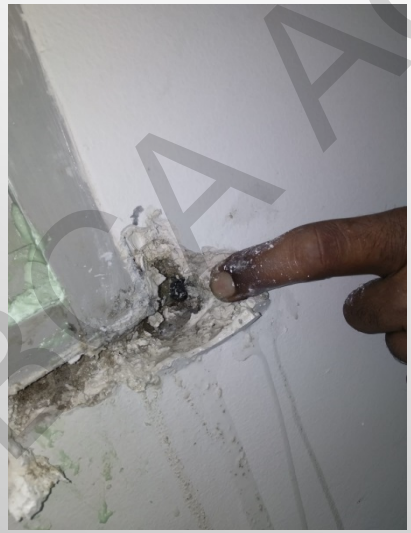
8.0 Common Defects and Remedies.

	Sliding and casement windows – water seepage.
1.	Excessive water seepage from the bottom corner of the aluminium window sill.
1a.	The system steel framings, rectangular box sections to support the window framing were found to have contained uncontrolled of water inside.
2	Solution:
2a.	Drilled holes to discharge the water, hacked when required, grouted and re-sealed with weather silicone sealant.

BCA Academy



Poor treatment between alum frame and plastering.



Same as photo on the left.



Poor joint details.



Non compatible materials – weather seal.

8.0 Common Defects and Remedies.

8.0	**Full Height Window – water seepage through kerb.**
1.	Excessive water seepage were found at the timber skirting / parquet floor.
2.	Removed skirting and hacked holes through the kerb and found to have newspaper inserts, roughed cement grout, etc.
	The kerb will only be casted after the window frames are installed.
3	<u>Solution:</u>
3a.	Remove kerb, re-grouted, applied water proofing to reinstate.

BCA Academy







8.0 Common Defects and Remedies.

8.0	**Incomplete builder's works.**
1.	The non application of sealers to the external block wall will result in water seepage at a later stage.
2.	The infilled of cement mortar to voids and gaps will have cold joints, water seepage may occur through plastered.
3.	**Solution:**
3a.	Request the Main Contractor to make good.

BCA Academy



Water seepage through hollow block joints.



Poor infill of grout on kerb – result in water seepage.

8.0 Common Defects and Remedies.

8.0	Poor Provisions of Structural Openings.
1.	The structural openings were found to be much bigger than required.
2.	It was measured as more than 70mm gap, which makes it quite impossible to grout a good job. Create a cold joint and potential seepage.
3.	Solution:
2a.	Request the Main Contractor to infill with timber formwork, cast in-situ concreting.

Academy





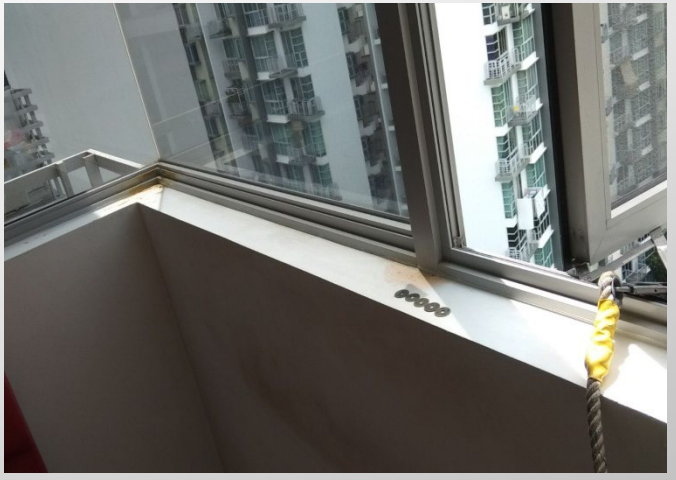
Over provision of grouting gap between window frame and wall.

8.0 Common Defects and Remedies.

8.0	**Poor Provision of Kerb and Wall.**
1.	The upstand kerb construction were infilled with incorrect materials.
2.	There is no proper bonding between infilled and grouting.
3.	Potential seepage is definite.
4.	<u>Solution</u>:
4a.	Request the Main Contractor to re-work with the correct method and materials.



Incorrect concrete kerb constrcution – lead to potential seepage via damage internal parquet.



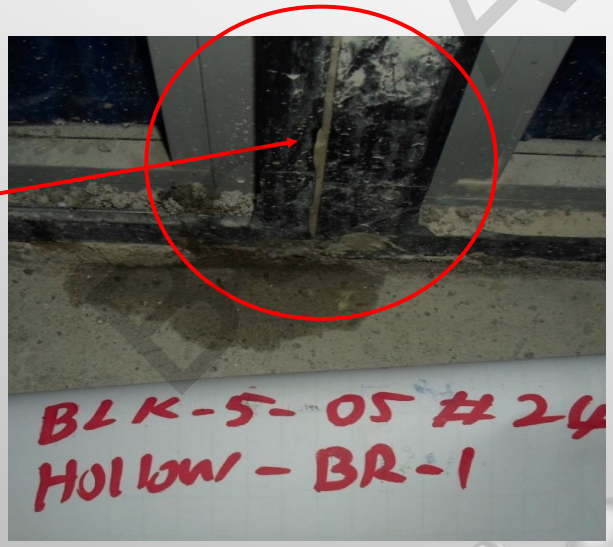
Dampness in the internal of wall – due to seepage through window

Academy

8.0 Common Defects and Remedies.

	Poor Joints and Control of Casting on Structure Wall.
1.	The assembled of the window frames together were not sealed properly that resulted in water seepage.
2.	The structure wall was observed to have a major crack besides the window frame, potential seepage.
3.	<u>Solution:</u>
3a.	Remove bead and re-seal. Drill hole from concealed frame and infill grout.
3b.	Request the Main Contractor to rectify to the acceptable standard.

Poor sealing before assembly of frame





Joints between mullion is not sealed properly, grout is also not compact.

Academy

8.0 Common Defects and Remedies.

8.0	Non-Alignment of Frame / Dented Frame.
1.	Vertical outer frames of the sliding window were found to be buckling.
2.	Solution:
2a.	Depending on the deviation, compressed the frame with fixing screws, replace if is beyond rectification.
2.	Frames were found to have multiple dents after removal of protection tapes.
3.	Solution:
3a.	Patch with metal putty, sand down to desired smooth finish before spray paint. If is beyond repair, may stick on a new bend profile and adhesive on.



Frame observed to be buckling.



Dented frame.

BCA Academy

8.0 Common Defects and Remedies.

8.0	Window Defects – Difficult in Sliding & Difficult in Opening of Window.
A.	Sliding Window.
1.	Norm is protection tapes were removed earlier than schedule of other outstanding wet works.
B.	Casement Window.
2.	Norm is protection tapes were removed earlier than schedule of other outstanding wet works.
3.	Solution:
3a.	Protections should be removed according to the planned schedule.



Cement left over on bottom track



Nylon roller



Bottom track with cement stained.

BCA Academy

8.0 Common Defects and Remedies.

8.0	Window – Joints Between Alum Members – Defect.
1.	Uneven mitre joints between members are critical during the QA/QC, Green Mark, & BCA inspection.
2.	Extrusion tolerance is 1 major factor that caused unevenness.
3.	Production workmanship.
2.	Solution:
3a.	Check profile quality, flatness, tolerance as per specifications.
3b.	If deviates, should be rejected and replace with new batch.
3c.	Periodic check has to be adopted, recommended 1 month.



3.	Solution:
3a.	Unable to solve on site but rather use of sealant to aesthetic the issue of acceptance.

BCA Academy

8.0 Common Defects and Remedies.

8.0	Window – Joints Between Alum Members – Defect.
1.	Uneven mitre joints between members are critical during the QA/QC, Green Mark, & BCA inspection.
2.	Extrusion tolerance is 1 major factor that caused unevenness.
	The crimping process of joining 2 members is another factor to consider.
3.	Solution:
3a.	Check profile quality, flatness, tolerance as per specifications.
3b.	Trail crimping of samples before actual production.
3c.	Periodic check has to be adopted, recommended 1 month.





Beading can be replaced or adjust to the desire to the acceptable flush finish

BCA Academy

8.0 Common Defects and Remedies.

8.0	Glass – Broken Glass & Painting on Glass Defects.
1.	Glass panels were sprayed over with texture coating.
2.	Glass panel was found to have cracked line due to accidental.
3.	<u>Solution:</u>
3a.	Removal of tapes should be well co-ordinated and scheduled.
3b.	Daily briefing to workers on care to other works when carrying duties.



No protection during spray texture coating on External wall.

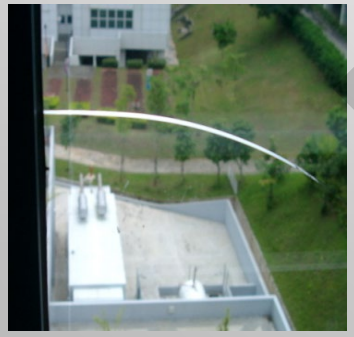


Glass were found to be broken..

GA Academy

8.0 Common Defects and Remedies.

8.0	Glass Defects – Breakage Due to Design, Impact Load, Self Breakage.
1.	Thermal Break on Glass.
2.	Due to improper use of glass type – Design. Use of laminated "float glass" (both lite) and is subject to extensive direct heat.
2b.	Solar heats the centre of glass pane while the edges remain shaded and cool inside the frame. The hot centre expands and places the cooler edges at high tensile strength.
2c.	The surface compressed for heat strengthened glass is between 24 ~ 52 Mpa (ASTM 1048)
3.	<u>Solution:</u>
3a.	Use heat treated glass such as heat strengthened glass.



Thermal stress on glass



Shattered due to presence of impurities



Types of Glass breakage Patterns.

BCA Academy

8.0 Common Defects and Remedies.

8.0	Glass Defects – Breakage Due to Design, Impact Load, Self Breakage.
1.	Spontaneous Breakage.
2.	Quality of glass during the melting and production of float glass.
3.	The presence of impurities such as nickel sulphide.
4.	Spontaneous breakage only occurs to glass that has undergone tempering process.
5.	Solution:
5a.	As of today, there is no solution to it and the next approach is to send the tempered glass for Heat-Soaked treatment.



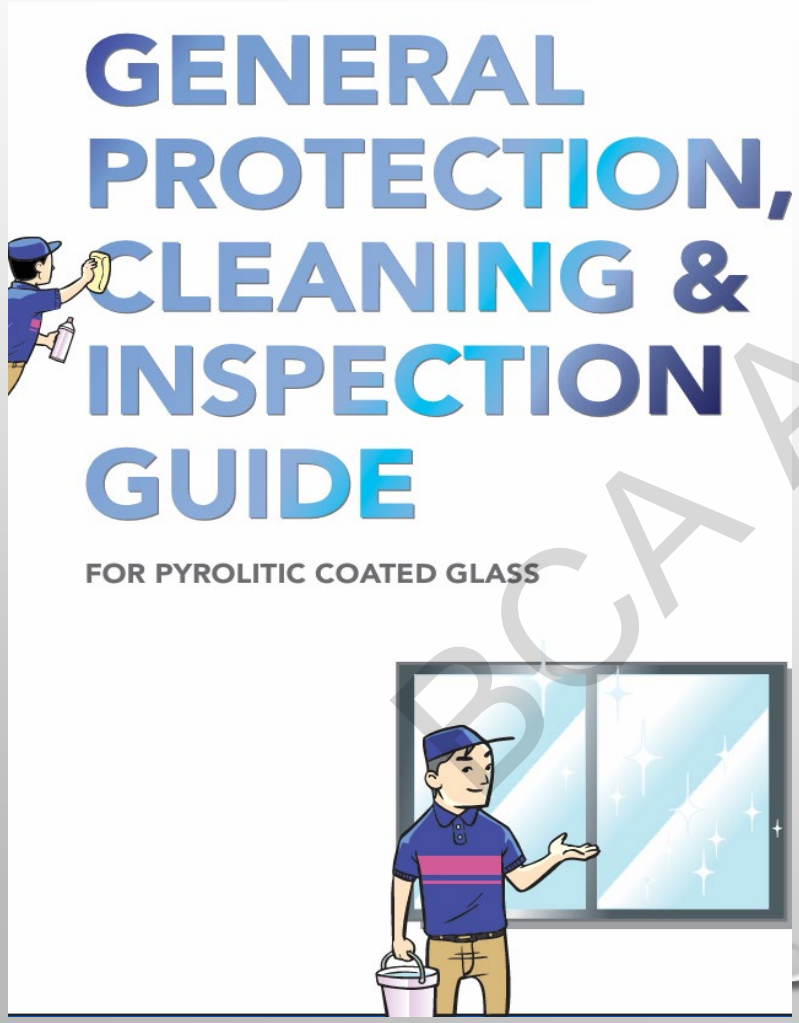




BOE Academy

8.0 Common Defects and Remedies.

General Guide Line For Cleaning of Glass & Inspection Criteria.



GENERAL INSPECTION GUIDELINES

VISION IN GENERAL

At a distance of 3 meters, against a uniform light source AGC's solar control coated glass may show slight variations of color, both in transmission and reflection. These are considered normal and acceptable.

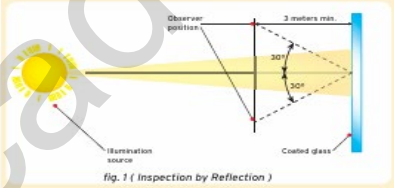


fig. 1 (Inspection by Reflection)

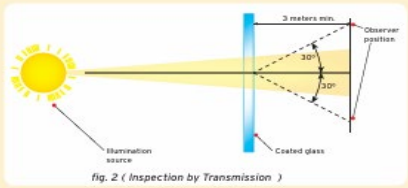


fig. 2 (Inspection by Transmission)

SPANDRELS IN GENERAL

Spandrel areas are to be viewed in reflection at a distance of 4.5 meters with a uniform background and with natural lighting conditions. Color and reflectance may vary slightly within this distance. Pinholes and scratches that are not readily apparent when observed in reflection are acceptable.

PINHOLES IN VISION GLAZING

Pinholes visible from 3 meters and measuring up to 3mm in diameter shall be acceptable. Pinholes with the diameter above 3mm are not acceptable.

SCRATCHES IN VISION GLAZING

Scratches visible from 3 meters and measuring up to 75mm in length shall be acceptable. Scratches over 75mm are generally not acceptable.

GENERAL WARRANTY

Generally, all pyrolitic-coated glass is guaranteed for 10 years from shipment date against peeling, discoloration, color fading and damage from normal weather conditions.

We make no other guarantee or warranty expressed or implied. This guarantee is effective only if the installation of the glass is made in accordance with the standards or code of good practice in force in the market.

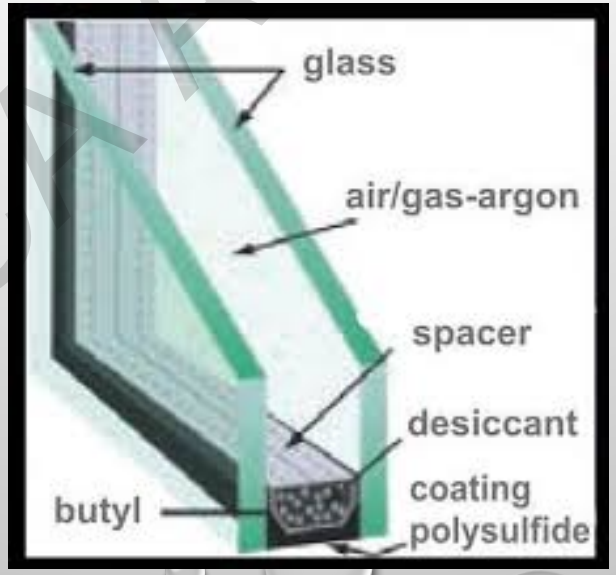
This guarantee shall not apply to scratches or abrasions, which may be caused by abrasive cleansers. Any pyrolitic glass unit failing to comply with the terms of this guarantee will be replaced. This guarantee is limited to replacement of the glass and does not include the cost of removal or installation.
(Conditions apply)

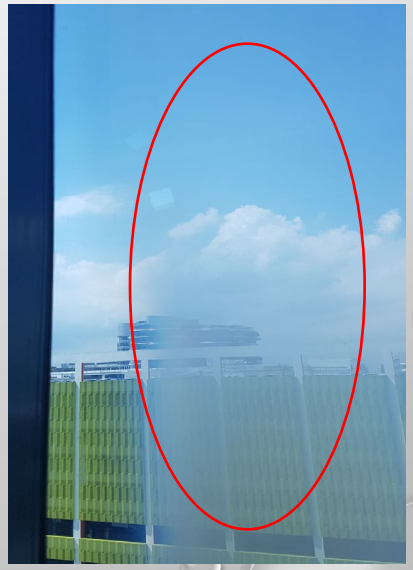
BCA Academy

8.0 Common Defects and Remedies.

8.0	Glass – Double Glazed Unit _ Seal / Coating Defects.
1.	The seal of the double glazed could be damaged or punctured upon arrival from overseas. Expossure to open weather conditions will damage the vacuum and coating on glass.
2.	It could also be possible that the coating was not securely vacuumed during the process of bonding the glass with a spacer via seal.
3.	No solution but to order new and replace.







Internal surface of the DGU glass is found to be foggy – Coating on glass were damaged.

BCA Academy

8.0 Common Defects and Remedies.

8.0	Glass – De-Lamination / Edge Effect.
1.	De-lamination normally be found beside the edges of glass.
2.	Due to the flatness of the glass.
3.	Improper storage of glass and expose to weather.
4.	Uneven bonding of 2 pieces in between PVB interlayer will invite dusts, dirt and moisture trapped within the gap. Eventually grow and expand after a period.
5.	There is no solution or method to eliminate this defect.



De-lamination observed on edge of glass.



Non protection of glass edges.

PCA Academy

8.0 Common Defects and Remedies.

8.0	Glass Scratches – Defects.
1.	Scratch on glass surface is very sensitive.
2.	It depends on how light and deep are the scratches and whether there is possibility to polish instead of replacement.
3.	Over polished will have distorted vision on the inner view, at a distance.
4.	Low-E coated, solar control and reflective are definitely not able to be polished and only solution is replacement. As these are special ordered glass, hence, duration for reproduction is extremely long.







BCA Academy

8.0 Common Defects and Remedies

8.0	Window System - Design Issue.
1.	The window system was designed to have two different members and therefore having two joints.
	Solution:
2.	Unable to rectify and replace.
2a.	May have to re-design and develop.



Poor design leads to multiple joints and unevenness between members.



Gaps between adjoining members – Need to touch up before inspection.

BCA Academy

8.0 Common defects and Remedies.

8.0	Defects – Dented Frames.
1.	Dented frames on site is a common defect.
2.	It depends on how serious is the damage. As per below 2 photos, are able to be rectified.
3.	<u>Solution:</u>
3a.	Remove the glazing bead with a new piece.
3b.	Use timber tool and hammer to knock the return into position to acceptable condition.



Glazing bead was found to be dented.



Return of outer frame was dented.

BCA Academy

8.0 Common Defects and Remedies.

8.0	Damaged to Aluminium Frame.
1.	Damage to frame can be prevented by adopting the correct mindset, think, considerate before carrying out the duties.
2.	The photo on bottom left indicated that the gasket has cracked and broken into small portions.
3.	Solution:
3a.	Repair if possible, if not replace the entire transom member.
3b.	Remove gasket and apply new weather silicone sealant.



Damaged bottom frame, is beyond repair and need new member to be replaced.



BCA Academy

8.0 Common Defects and Remedies.

	Gasket Materials and Poor Workmanship.
1.	PVC gasket were used instead of EDPM type. Shrink after exposed to weather.
2.	Use of colour grey gasket is non warranty from colour change.
3.	Poor workmanship in inserting gasket between glass and frame.
4.	Solution:
4a.	Remove and replace with correct type of gasket and solder.
4b.	Remove and replace grey colour gaskets to black colour EDPM gaskets.







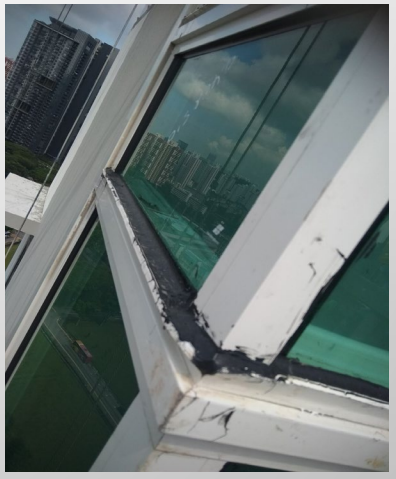
BCA Academy

8.0 Common Defects and Remedies.

8.0	Gasket & Silicone Sealant Defects.
1.	Corner joints of gasket were improperly welded together.
2.	Corner joint of fixed glass panels were poorly sealed, untidy and caused water ingress.
3.	Solution:
3a.	Remove gasket and re-insert new, EDPM and solder together.
3b.	Remove untidy silicone sealant, clean and vacuum dust free before apply new.



Will allow water seepage and penetration of noise.



Poor corner joint.
Untidy silicone sealant joint

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8.0 Common Defects and Remedies.

8.0	Sliding Window – Workmanship – level.
1.	The centre portion of the top outer frame was found to be higher than desired level by approximately 8mm H. Poor workmanship.
2.	When sliding glass panel slide along the track from left and reaches the centre, the panel was dislodged, from the top track, hence, fell down.
3.	<u>Solution:</u>
3a.	Hacked off grout and re-adjust to the correct level.



Inner frame will drop off during to misalignment / sagging of top frame.



Fallen window frame

BCA Academy

8.0 Common Defects and Remedies.

8.0	Damaged to frame & Non Protection to Frames.
1.	Debris, stones, cement were found on sliding window bottom track.
2.	The exposed frame from the internal were not protected and painting brushed over.
3.	Solution:
3a.	Remove debris, vacuum and splash wash the track. Touch up with putty, silicone and re-spray over.
3b.	Wall painting can be easily washed off, is the time and manpower to deploy.

LTA Academy



Sliding window bottom track with cement and debris.



No protection of frame during wall painting.

8.0 Common Defects and Remedies.

8.0	Common defects on aluminium window, such as debris on frame, dented frames etc.



Before installation – dirt and debris must be cleaned.



Sliding window bottom track stained with cement.



Dented bottom outer frame.







In proper removal of protection tape, result in not able to hand over.

BCA Academy

8.0 Common Defects and Remedies.

8.0	Unskilled workman.
1.	Photo below left – Wrong use of materials and shoddy workmanship.
2.	The infill of polyurethan foam is subjective, may need a few attempts as you are unable to see whether the hollow has been fully filled. The infilled will take a while to excess, file and expand. Once excessive flows out, would have to be wiped off immediately, harden after cure.



Caulking width and depth are wide and swallow. Incorrect type of weather silicone sealant.



Polyurethane foam used to eliminate water seepage were left unattended.

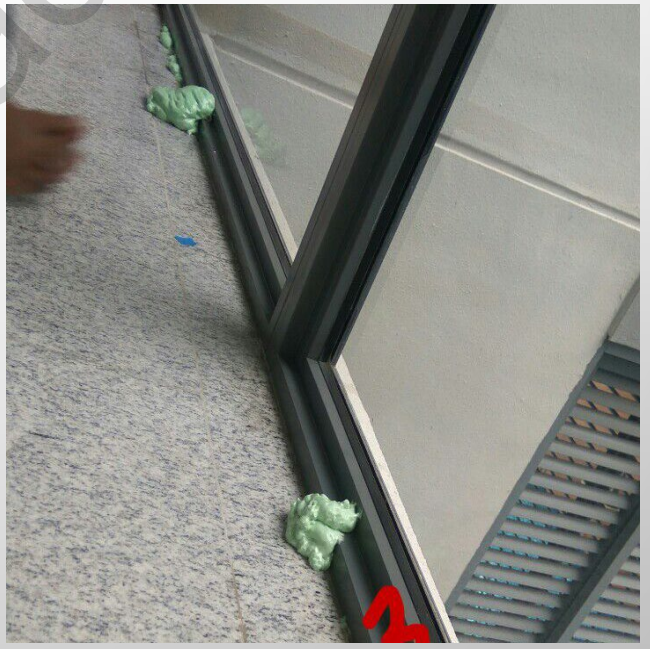
BCA Academy

8.0 Common Defects and Remedies.

8.0	Unskilled workman.
1.	Inexperienced and unskilled in attending to this defect work, which will lead to potential water seepage.
2.	The infill of polyurethan foam is subjective, may need a few attempts as you are unable to see whether the hollow has been fully filled.



Inject polyurethane foam to seal hollowness / gaps.



Inject polyurethane foam until excessive foams have flown out before cleaning with a clean cloth.

BBA Academy

8.0 Common Defects and Remedies.

8.0	Damaged to Hardware.
1.	Common damages are the cam handle which were caused by improper usage and control.
	Recommendation:
1.	Install after all works are completed, before QA/QC inspection.
2.	Spare a certain % during the last procurement.



Broken Cam handle



Scratched Cam handle

CA Academy

8.0 Common Defects and Remedies

8.0	Dented to aluminium surface.
1.	It is quite common to see aluminium frames being dented, particularly only after the removal of the protection tapes.
2.	There is only 1 solution and that is to apply metal putty to the affected area, cure and sand down to the desire smooth surface finish, before applying spray paint over.



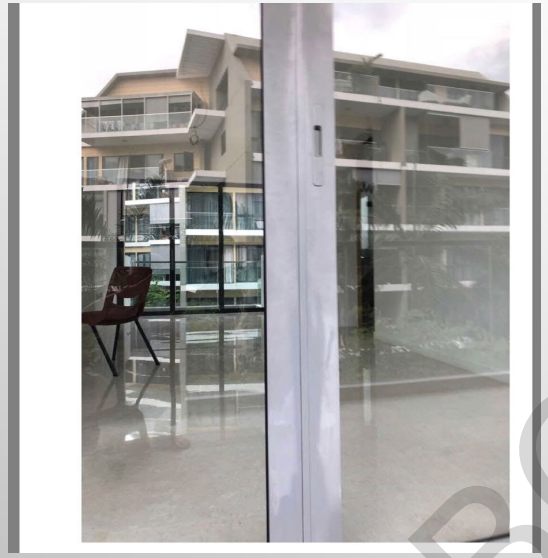


Dented surface were patched with putty, sand down to the desire smooth finish before applying spray paint over.

BCA Academy

8.0 Common Defects and Remedies.

8.0	Defects on powder coating, fluorocarbon coating.
1.	Colour fading, dis-colouration, chalking etc. may occur due to many factors, such as during the process of treatment, the life span of the chemical solutions etc.





Colour fading on powder coating finishes.



Wash with mild detergent and polish.

BCA Academy

8.0 Common Defects and Remedies.

8.0	Basic Materials – Rectification of paint works.
1.	The below are the basic materials to be used to repair paint works.



G 280 fine sand paper



Putty



Putty hardener



Spray paint



19mm Masking tape

BCA Academy

8.0 Common Defects and Remedies.

8.0	Repair works to dented aluminium frame.
1.	Apply metal putty to affected area on a few attempts, to even and sand down with clean water to the desired smooth finish.
2.	Once the putty is completely cure, dry and clean, apply spray paint over the affected area with proper protections.



Putty to dented frame, cure and sand down with water, keep dry before application of paint.



Using fine sand paper to sand down until the surface is smooth.

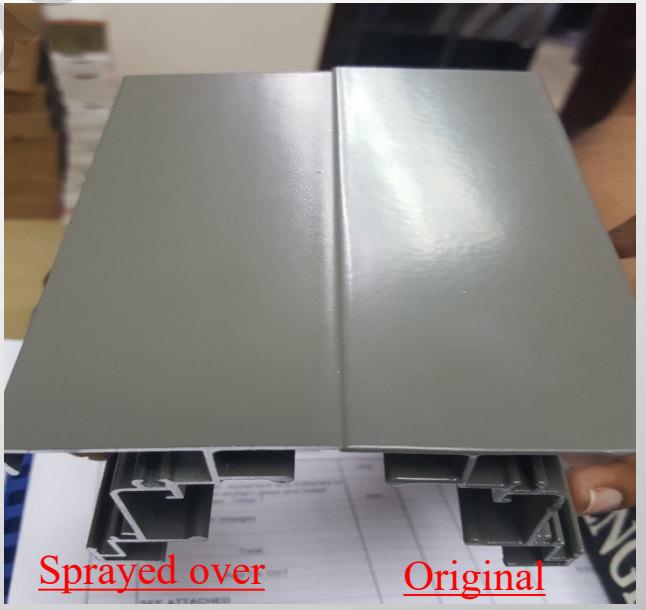
BOT Academy

8.0 Common Defects and Remedies.

8.0	Spray paint over cured putty surface.
1.	Unable to achieve perfect matching of existing colour versus new spray over paint.
2.	May require to spray the entire frame surfaces to achieve uniform colour tonality and finishes.



Touch up works – manual hand spray over powder coat surface.



Comparison between a powder coated surface versus a spray over surface.

Academy

Aluminium Window - Good Industry Practices

9.0 CLEANING.



BCA Academy

9.0 Cleaning.

9.0	Cleaning of Glass – General Guide.
1.	Surface Treatment.
2.	Remove protection tape and conduct a visible check on both glass surfaces for any chip, pinholes and scratch if any.
3.	Remove all visible surface contaminants with clean damp cloth.
4.	Use safety scrapper to remove any contaminants, dirt.
1.	Soaping.
2.	Use pad strip washer to soap area with no acidic diluted cleaning chemical solution.
3.	Only alkaline based chemicals will be allowed to use, to avoid damage to coating surface, sealant, gasket and glass, particularly coated glass.
1.	Cleaning.
2.	Use FaçadeKleen with clean water to wet the glass surface with a Pad Strip Washers.
3.	Use a squeegee with rubber blade to clean the soapy base and repeat with clean water.

BCA Academy

9.0 Cleaning.

9.0	Cleaning of Glass – General Guide.
1.	Use clean damp cloths to wipe off excess water on the edges and surrounding.
2.	Heavy rinsing is not necessary.
3.	Ensure to use cleaning products that are certified for suitable use and approved by relevant authority / body.
4.	Ensure to engage specialist cleaning contractor to carry out the job so that the correct type of washing chemicals, tools and equipment are used.
5.	To avoid unnecessary abortive costs, time and manpower if damages occurs, particularly imported glass, such as Low-E coated glass.





BCA Academy

9.0 Cleaning.

9.0 Finishes & Gaskets Were Damaged After Cleaning.



Partially melted gasket due to improper use of cleaning agent.

Solution is to remove and apply “snap” on new gaskets, respray paint finishes externally.



Damaged gasket & finishes due to the used of unsuitable cleaning agent.

BCA Academy

9.0 Cleaning.

9.0 Scratches on Glass Surfaces & Frames During Cleaning Works.





Gondola to be provided with front rubber rollers to prevent scratches on glass surface during cleaning.

BCA Academy

9.0 Cleaning.

Flat Glass Inspection – ASTM C1036 - C.

9.0 Glass Inspection – Flat Glass Inspection – ASTM C1036 - C

Inspection:

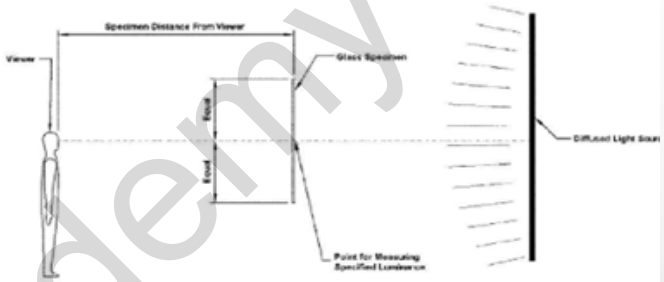
Visual inspection should be done with the naked eye.

The inspector shall place the glass in a vertical position

Inspector shall view through the glass at an angle of 90°

Lighting should be daylight level (**without direct sunlight**) or other uniform backlight that simulates daylight.

View at the distance specified by defect type.



Quality Criteria:

Allowable Point Blemish, (viewing distance 39")

Blemish size <1.2mm (0.05") allowed without restriction.

Blemish size >1.2mm (0.05") <2.0mm (0.10") allowed with a minimum separation of 600mm (24").

Blemish size >2.0mm (0.10") none allowed.

To determine point blemish size, measure height and width of blemish and average. Only the point blemish is to be measured, and not any distortion that may be present.

Allowable Linear Blemish, (viewing distance starting at 160")

Faint or light scratch <75mm (3") allowed.

Medium scratch ≤75 (3") allowed with a minimum separation of 600mm (24")

Medium or heavy scratch >75mm (3") are not allowed

To determine scratch intensity start at 160" and move closer until scratch becomes visible, (refer to table).

Detection Distance	Blemish Intensity
Over 3.3 m (132 in.)	Heavy
3.3 to 1.01 m (132 to 40 in.)	Medium
1 to 0.2 m (39 to 8 in.)	Light
Less than 0.2 m (8 in.)	Faint

BCA Academy

9.0 Cleaning. Coated Vision Glass Inspection – ASTM C1376 - 03.

9.0 Glass Inspection – Coated Vision Glass Inspection – ASTM C1376 - 03

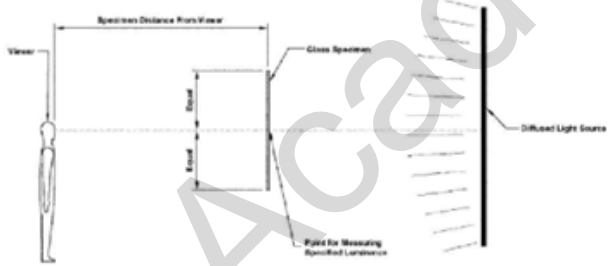
Inspection:

Visual inspection should be done with the naked eye.

The inspector shall place the glass in a vertical position with light in transmission.

Inspector shall view through the glass at an angle of 90° from a distance of 10 ft.

Lighting should be daylight level (**without direct sunlight**) or other uniform backlight that simulates daylight.



If a defect is readily apparent under these conditions apply the following criteria.

Blemish[B,C]	Central Area, in. (mm)[D]	Outer Area, in. (mm)[D]
Pinhole	1/16(1.6) max	3/32(2.4) max
Spot	1/16(1.6) max	3/32(2.4) max
Coating scratch	2 (50) max length	3 (75) max length
Mark/contaminant	2 (50) max length	3 (75) max length
Coating rub	none allowed	length plus width not to exceed ¾ (19)
Crazing	none allowed	none allowed
Corrosion	none allowed	none allowed

The central area is considered to form a square or rectangle defined by the center 80 % of the length and 80 % of the width dimensions centered on a lite of glass. The remaining area is considered the outer area.

BCA Academy

9.0 Cleaning.

9.0 Glass Inspection – Laminated Glass – ASTM C1172 - 03

Inspection:

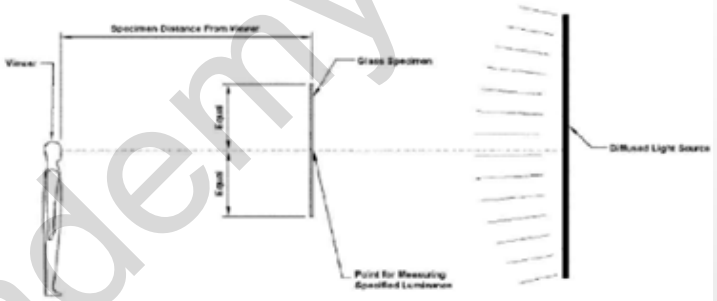
For inspection of individual glass lites refer to ASTM C 1036-06

Coating related defects should be evaluated per ASTM C 1376 – 03.

Visual inspection should be done with the naked eye.

The inspector shall place the glass in a vertical position

Inspector shall view through the glass at an angle of 90°



Lighting should be daylight level (**without direct sunlight**) or other uniform backlight that simulates daylight.

Quality Criteria:

1. Determine approximate lite surface area (ft^2).
2. Determine defect location – central or outer viewing area. (The central area is considered to form a square or rectangle defined by the center 80 % of the length and 80 % of the width dimensions centered on a lite of glass. The remaining area is considered the outer area)
3. Evaluate defect according to the following table.

[C] CE = =covered edge of glass edge bite and EE = exposed edge. (If CE or EE is unknown use CE tolerance.)

Blemish	Up to 25 ft² (2.5 m²)		25 to 75 ft² (2.5 to 7.0 m²)		Over 75 ft² (7.0 m²)	
	Central[A]	Outer[A]	Central[A]	Outer[A]	Central[A]	Outer[A]
Boil (Bubbles)	1/16 (1.6)	3/32 (2.4)	1/8 (3.2)	3/16 (4.8)	1/4 (6.4)	1/4 (6.4)
Blow-in; edge boil	[B]	CE 1/4 (6.4) EE 1/32 (0.8)[C]	[B]	CE 1/4 (6.4) EE 1/16 (1.6)[C]	[B]	CE 5/16 (8.0) EE 3/32 (2.3)[C]
Fuse	1/32 (0.8)	1/16 (1.6)	1/16 (1.6)	3/32 (2.4)	3/32 (2.4)	5/32 (4.0)
Hair, lint (single strand)	light intensity[D]	medium intensity[E]	light intensity[D]	medium intensity[E]	medium intensity[E]	medium intensity[E]
Inside dirt (dirt spot)	1/16 (1.6)	3/32 (2.4)	3/32 (2.4)	5/32 (4.0)	1/8 (3.2)	3/16 (4.8)
Lint-areas of concentrated lint	light intensity[D]	light intensity[D]	light intensity[D]	light intensity[D]	light intensity[D]	light intensity[D]
Separation, discoloration	none	none	none	none	none	none
Short interlayer; unlaminated area chip	[B]	CE 1/4 (6.4) EE 1/16 (1.6)[C]	[B]	CE 1/4 (6.4) EE 3/32 (2.4)[C]	[B]	CE 1/4 (6.4) EE 1/8 (3.2)[C]
Scuff; streak	light intensity[D]	light intensity[D]	light intensity[D]	light intensity[D]	light intensity[D]	light intensity[D]

To establish light and medium intensity for a specific defect, view starting at 11 ft. moving forward down to 36".
Light intensity – Barely noticeable at 36" Medium Intensity – Noticeable at 36" but not 11 ft.

All listed criteria are based on ASTM C 1172 – 03

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Aluminium Window - Good Industry Practices

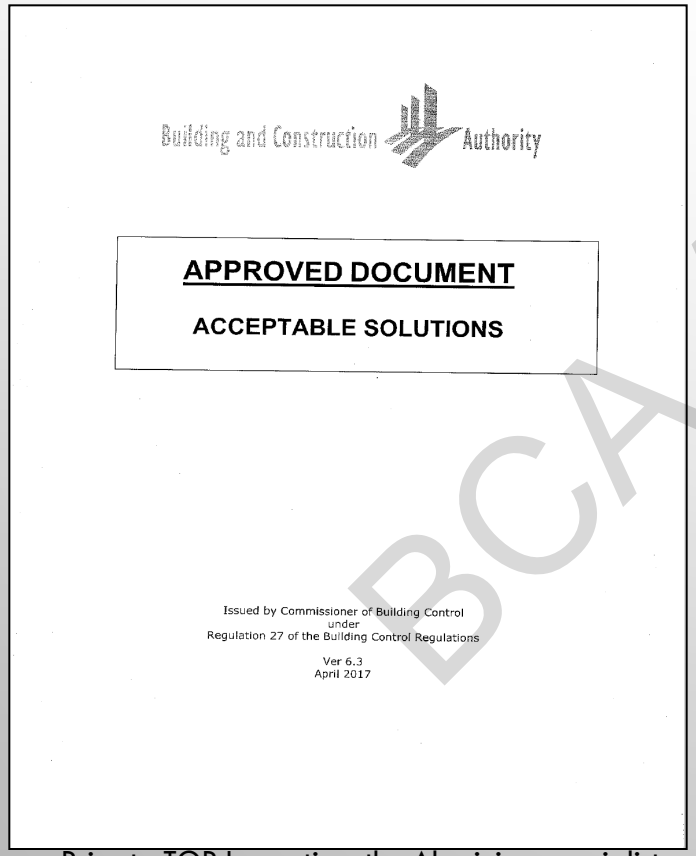
10. HANDLING OVER & MAINTENANCE.



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10.0 Handling Over & Maintenance.

10.0	Document required before TOP
1.	Before TOP inspection, the Aluminium specialist contractor is required to issue a "Letter of Certification" to certify that the design and supply of the window system are in compliance with SS212: 2007 & Approved Document.



Building and Construction Authority

APPROVED DOCUMENT

ACCEPTABLE SOLUTIONS

Issued by Commissioner of Building Control
under
Regulation 27 of the Building Control Regulations

Ver 6.3
April 2017



H Y ENGINEERS PTE LTD
20 Sin Ming Lane, #08-53 Midview City, Singapore 573968
Tel: 6513 5781 Fax: 6513 5782 Email: Admins@hyengineers.com.sg
Company Reg. No.: 201706121W GST Reg. No.: 201706121W

Our Ref: ES2024 27 June 2024

COMMISSIONER OF BUILDING CONTROL
Building and Construction Authority
52 Jurong Gateway Road, #11-01,
Singapore 608550

PROJECT REFERENCE NO. A1720-00005-2018-ST53

PROPOSED CONDOMINIUM RESIDENTIAL HOUSING DEVELOPMENT COMPRISING THE ERECTION OF 10 BLOCKS OF 12-STOREY APARTMENTS (TOTAL: 660 UNITS) WITH COMMON BASEMENT CARPARKS & COMMUNAL FACILITIES ON MK 05 LOTS 04267K, 04268N, 04269X, 04270K, 04271N & 04127P-PT AT SUNSET WAY (CLEMENTI PLANNING AREA) ON LOT (S) 04127P PT, 04267K, 04268N, 04269X, 04270K & 04271N MK05 AT SUNSET WAY

Certification of Compliance to Section N2.1 of Acceptable Solutions of the Approval Documents.

Pursuant to Section N2.1 of the Acceptable Solutions of the Approval Document. I hereby certify that appropriate measures have been taken to minimise the risk of injury to people in the event of spontaneous breakage of glass elements for the glass panels a building located at height of 2.4m or more.

Thank you.

Yours faithfully,

PROFESSIONAL ENGINEER CIVIL LI JUN 5046 SINGAPORE

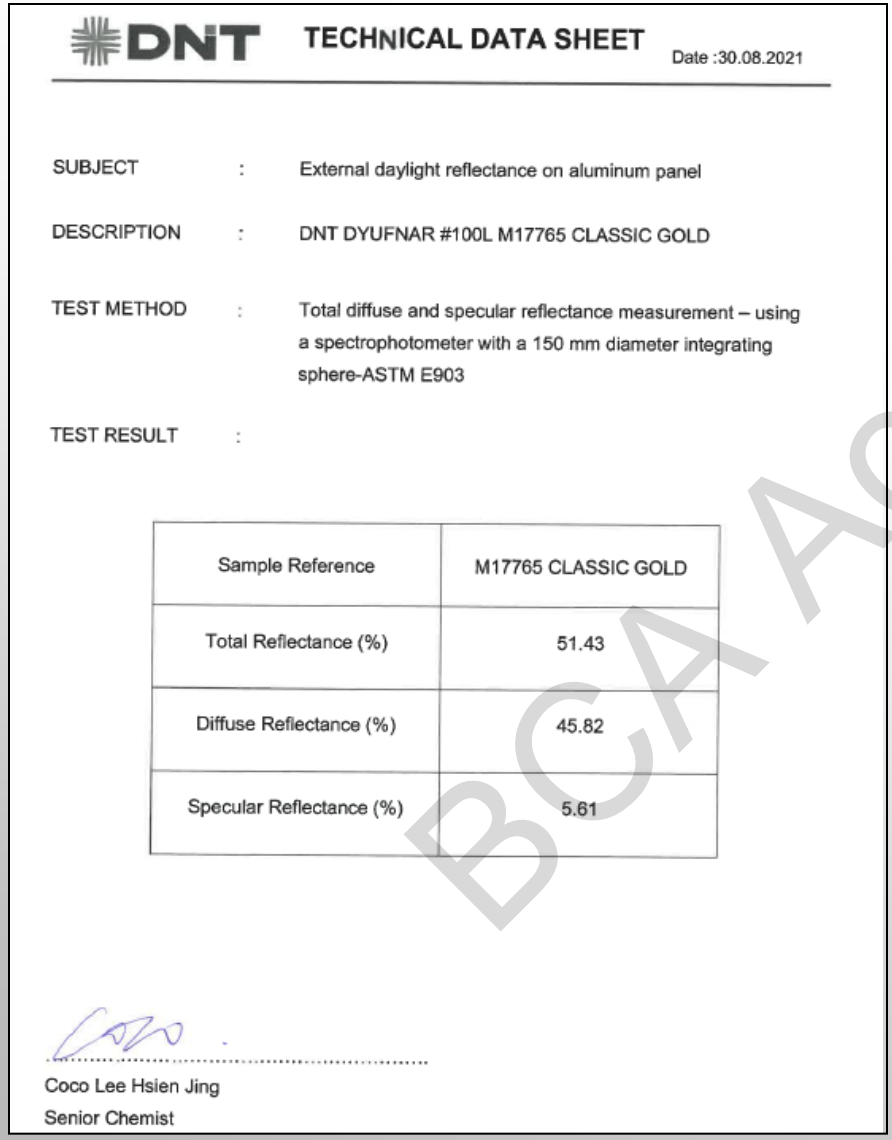
Er. Li Jun
Project Qualified Person (Struct)
H Y ENGINEERS PTE LTD

Feel free to contact the undersigned should there be any enquires.

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Prior to TOP Inspection, the Aluminium specialist contractor is to issue a "Letter of certification" , to certify that the window designed, supplied and installed are in compliance with SS212Standard – Approved Document.

10.0 Handling Over & Maintenance.



DNT TECHNICAL DATA SHEET Date :30.08.2021

SUBJECT : External daylight reflectance on aluminum panel

DESCRIPTION : DNT DYUFNAR #100L M17765 CLASSIC GOLD

TEST METHOD : Total diffuse and specular reflectance measurement – using a spectrophotometer with a 150 mm diameter integrating sphere-ASTM E903

TEST RESULT :

Sample Reference	M17765 CLASSIC GOLD
Total Reflectance (%)	51.43
Diffuse Reflectance (%)	45.82
Specular Reflectance (%)	5.61

Coco Lee Hsien Jing
Senior Chemist

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10.0	Report required before TOP inspection.
1.	Before TOP inspection, it is mandatory for the Aluminium Specialist Contractor to submit the "Report on the External Daylight Reflectance Value to the QP via BCA.
2.	The "Specular Value" has to be ≤10% and the remaining 2 values are not applicable.

10.0 Handling Over & Maintenance.

10.0 Replacement of Glass After Defect Liability Period (DLP)

Replacement of glass : DLP

MEYER BLUE

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1. INTRODUCTION
2. REPLACEMENT OF GLASS
3. RISK ASSESSMENT
4. SAFE WORK PROCEDURE
5. FALL PREVENTION PLAN

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Aluminium Window - Good Industry Practices

10.0	Take Care of Your Windows.
1.	Keep your windows in tip top conditions with 3 easy steps!

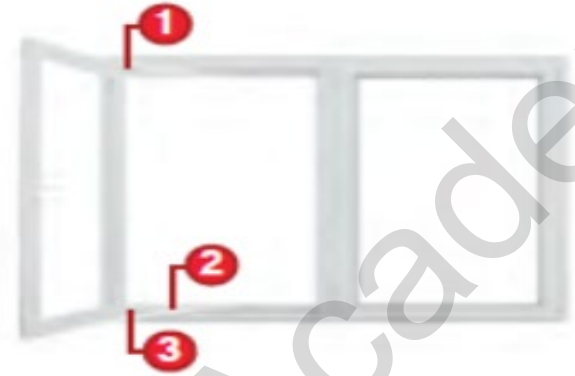


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Aluminium Window - Good Industry Practices

10.0	Take Care of Your Casement Windows.
1.	Check, Clean & Change.

Casement / Side Hung Window

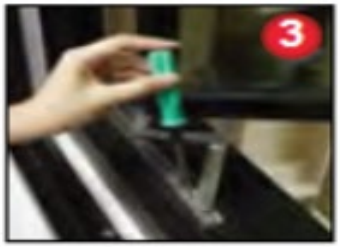




CHECK that fasteners are not rusty or loose



CLEAN and oil joints or moving parts



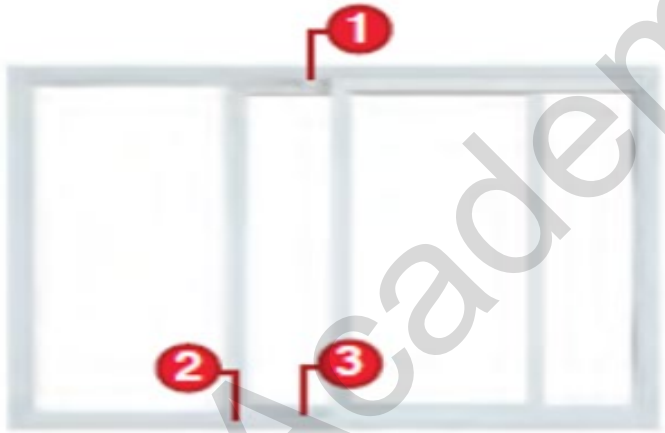
CHANGE all rivets from aluminium to stainless steel by engaging an approved window contractor

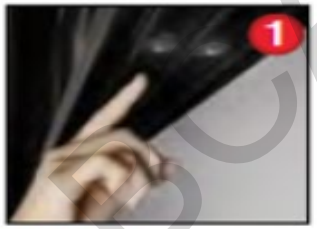
BA Academy

Aluminium Window - Good Industry Practices

10.0	Take Care of Your Sliding Windows.
1.	Check, Clean & Change.

Sliding Window





CHECK
that safety stoppers and angle strips are in their proper places



CLEAN
the tracks and ensure window panels can slide smoothly



CHANGE
worn-out safety stoppers and angle strips by engaging an approved window contractor

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Aluminium Window - Good Industry Practices

"THE END – THANK YOU"

BCA Academy