THE UNIVERSITY OF SYDNEY

Facade Standard

Design, Engineering, Planning & Sustainability

University Infrastructure

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Contents

1 Purpose

The Facade Standard sets out the University of Sydney's minimum requirements for the design and construction of Facade Systems. It ensures new and refurbished Facade Systems are fit-for-purpose, made from durable good-quality materials, contain no or minimal environmentally harmful substances, and require minimal maintenance.

Applicable requirements documented in Workplace Health and Safety legislation, Disability Discrimination legislation, State Environmental Planning legislation, Commonwealth and State legislation, National Construction Codes (NCC), the Building Code of Australia (BCA) and Australian and New Zealand Standards (AS/NZS) are the minimum and mandatory compliance requirements.

Where any ambiguity exists between this standard and the mandatory requirements then:
a. The highest performance requirements must apply.
b. Applicable requirements must follow this order of precedence:
    1. Workplace Health and Safety legislation
    2. Safety in Design legislation
    3. Disability Discrimination legislation
    4. State Environmental Planning and Assessment legislation
    5. All other Commonwealth and State legislation
    6. NCC, BCA and PCA
    7. AS/NZS
    8. This standard and other University of Sydney standards.

2 Scope

This standard describes minimum requirements for design, installation, and maintenance of Facade Systems for buildings and spaces owned, operated, maintained and/or managed by the University of Sydney.

It applies to:
a. New building construction except Agricultural and Industrial construction
b. Refurbishment including external walls and internal insulation
c. Recladding of existing buildings
d. Any facade remediation work e.g., cladding, window replacement, waterproofing and sealing.

The standard applies to all planners, project managers, consultants, contractors, sub-contractors, tenants, managing agents and University staff involved in the design, construction and maintenance of existing, new, and proposed University buildings and facilities.

The standard provides:
a. A reference document to enable consistency with the design and engineering objectives
b. Details of the minimum performance requirements for planning, architectural design, and maintenance
c. Support of the University vision for the built environment and best practice.

The standard addresses key objectives:
a. Quality design which responds, enhances, and complements the environment
b. Appreciation of the heritage context and cultural history of the campuses
c. Value for money in all aspects of the project
d. The design of low maintenance buildings and environments
e. Longevity of construction approach to design
f. Standardization of key flashing and ancillary details
g. Flexible design, to future proof building usage for expansion or adaption to new uses
h. Safety in design.

All Facade Systems provided or specified by designers, consultants, staff, and contractors must conform to this standard.

Where specific applications are not explicitly covered, or ambiguity exists, the intent of the design standard must be satisfied. In such cases a return design brief must be provided for review and approval by the issuer of this standard or their appointed delegate, who must have relevant technical competence in the subject matter. Additional more stringent requirements may apply on a project-specific basis dependent upon risk management and insurance requirements.

3 Glossary of Terms

3.1 Abbreviations

Abbreviation	Definition
AAMA	American Architectural Manufacturers Association
ABCB	Australian Building Codes Board
ACP	Aluminium Composite Panel
AS/ NZS	Australian Standards/ New Zealand Standards
ASTM	American Society for Testing and Materials
BCA	Building Code of Australia
BMU	Building Maintenance Unit
BS EN	British Standard European Norm
CCTV	Closed-circuit Television
COS	Central Operations Services
DGU	Double Glazed Unit
DLP	Defects Liability Period
FRL	Fire Resistance Level
GBCA	Green Building Council of Australia
ITP	Inspection Test Plan
NABERS	National Australian Built Environment Rating System
NATA	National Association of Testing Authorities
NCC	National Construction Code
OC	Occupation Certificate
O&M	Operations & Maintenance (Manual)
PCA	Principal Certifying Authority
PC	Practical Completion
QA	Quality Assurance
SHGC	Solar Heat Gain Coefficient
UI	University Infrastructure
VESDA	Very Early Warning Aspirating Smoke Detection
VMU	Visual Mock-Up

VOC	Volatile Organic Compounds
WHS	Work Health & Safety

3.2 Definitions

Term	Definition
Atrium	A space within a building that connects two or more storeys and is enclosed at the top by a floor or roof (including a glazed roof structure)
Back Pan	Metal sheets forming the internal sealed layer of a curtain wall spandrel panel or a cladding system
Condensation	The formation of moisture on the surface of a building element or material because of moist air encountering a surface which is at a lower temperature
Curtain Wall	A non-loadbearing and usually aluminium-framed glazed external wall system
Cavity Barrier	A component used to close concealed spaces and prevent penetration of smoke or flame to restrict the movement of fire within a building
Cladding	A non-structural material used as the exterior covering to an external wall
Deemed-to-Satisfy Provisions	Provisions which are deemed to satisfy the Performance Requirements
Deemed-to-Satisfy Solution	A method of satisfying the Deemed-to-Satisfy Provisions
Design Life	Life to first major maintenance. A maintenance project is considered major when the value of the project is above 50% of the project value
Drainage	A system whereby water is drained off a building component by natural or artificial means
Facade	A non-loadbearing external wall system that can be a curtain wall or a cladding
Flammability Index	The index number as determined by AS 1530.2
Flashing	A thin impervious material placed in construction to prevent water penetration between different elements
Green Star	The building sustainability rating scheme managed by the Green Building Council of Australia
Heat Soak Test	A test used to minimize the risk of spontaneous breakages of toughened glass caused by nickel sulphide inclusions
Mullion	A vertical member separating panels and windows within a facade system
Performance Requirement	A requirement which states the level of performance which a Performance Solution or Deemed-to-Satisfy Solution must meet
Pressure Equalisation	A condition of fluid pressure equilibrium between two zones that functions by blocking all forces that can drive water across a barrier
R-Value	The thermal resistance of a component calculated by dividing its thickness by its thermal conductivity, expressed in $m^2.K/W$
Smoke Flashing	A component used to close concealed spaces and prevent penetration of smoke
Solar Admittance	The fraction of incident irradiance on a wall-glazing construction that adds heat to a building's space
Spandrel	The opaque part of a facade in curtain wall construction which is commonly adjacent to, and integrated with, glazing
Transom	A horizontal member separating panels and windows within a facade system

4 Roles and Responsibilities

This standard is issued by UI. It is approved and signed off by the Chief University Infrastructure Officer. UI is responsible for maintaining the standard and keeping it up to date.

5 Technical Requirements

5.1 Introduction

This section outlines minimum technical requirements that must be incorporated within the design, construction, and maintenance of facade systems. These requirements are not intended to contradict or replace any aspects of Building Code or Australian Standard compliance; however, they are considered 'best practice' and are to be adopted as mandatory.

5.2 Facade Systems

5.2.1 Curtain walls

General:

a. Panelised curtain wall systems must be used instead of stick systems unless prior approval is granted from UI.
b. Curtain wall panels are to be assembled and glazed in the factory.
c. The number of different curtain wall systems on a project must be optimised to reduce interfaces and complexity.
d. All facade joints and other cavities within the systems should be pressure equalised, with a drained and ventilated air gap.
e. Wherever glass performs the role of a barrier it must be Grade A laminated safety glass. A barrier is defined as any element intended to prevent people from falling or to prevent access to an area. For example, glass spanning from floor to ceiling must prevent people from falling from the building. In the case of double-glazed units, the internal glass panel must be laminated.
f. Replacement of glazing units must be possible without the need to dismantle the primary framing members.

Spandrel panels:

a. Provide a back pan to the rear of spandrel areas of the curtain wall. The back pan must provide a continuous, completely sealed barrier against vapour transmission, air and water penetration. The air gap between the spandrel glass and the back pan must be drained and pressure equalised. The ventilation should be sufficient to prevent condensation on either the internal side of the spandrel glass or the back pan.
b. The thickness and fixing of the back pan must be designed to accept full design loads and allow for thermal expansion.
c. Back pans in exposed or clear glass light boxes must be flat with no visible joints.

5.2.2 Shopfront glazing systems

a. Where unitised curtain wall is not the best option, generally at ground floor level, shopfront systems may be used.
b. Shopfront systems must incorporate a pressure equalised secondary drainage system behind the

weathering seals that is drained to the outside.
c. The edges of the double-glazed units must be ventilated and drained.
d. The connection between mullions and transoms must be fully sealed in accordance with the system specifications.
e. Decorative caps must be mechanically fixed.

5.2.3 Windows

a. Commercial window suites are a minimum requirement for all building types.
b. Dry-glazed pressure equalised systems are required, with a ventilated air gap drained to the outside.
c. DGU glass panels are a minimum requirement.
d. Replacement of glazing units must be possible without the need to dismantle the primary framing members.
e. All hardware must be commercial grade quality as a minimum.
f. All window hardware must be locally available for replacement.
g. Fly screens are required to be commercial grade for operable windows.
h. Automated parts are not permitted without prior approval from UI.
i. Blinds within DGU cavities should be maintenance free, removable and should not reduce the durability of the DGU.
j. Provide devices to restrict window openings as required by the NCC.
k. Window ledges must be treated with anti-roosting/perching devices.
l. Protect window heads with flashings and drip grooves.
m. Aluminium window frames shall, where appropriate, incorporate thermal break technology to minimise thermal bridging effects and heat conductivity through the frame.
n. Any condensation shall be drained or captured until natural evaporation is achievable.

5.2.4 Doors

5.2.4.1 General requirements

a. Doors must have sufficient strength and robustness to withstand the static and dynamic loads that occur during use and must not disengage from its frame under any of the relevant specified loads when open or closed:
    i. Swing doors: swing mechanism, hinges, or pivot, must be sized to accommodate the weight of the door plus a design factor of safety.
    ii. Sliding doors: drivers and opening mechanisms must be sized to accommodate the weight of the doors plus a design factor of safety.
b. External doors exposed to the elements must be waterproof.
c. Automatic doors:
    i. The sensitivity of the motion sensors must be adequate and must not decrease over time.
    ii. The battery required for the operation of the doors in power failure mode must have sufficient autonomy.
d. Ensure compliance with the USYD DDA and Access Standard.
e. All door components and hardware must be locally available.

5.2.4.2 Access control doors and security monitored doors

a. Ensure compliance with the Security Services Standard.
b. All access control doors and security monitored doors should:
    i. Not swing past a 180-degree angle
    ii. Be self-closing
    iii. Have a rebate that doesn't prevent the door from securing. It may require automatic sequencing.
    iv. Be automated

v. Be integrated with the security system.

c. Card readers, intercoms and push buttons can be mounted on bollards, aluminium mullions and walls. They cannot be mounted on curtain walls or doors. The devices must be mounted within a reasonable distance from the entry door to avoid:
   i. A 'crush' scenario
   ii. Confusion as to which door the card reader unlocks or opens.
d. Actuators, auto doors, lifts, roller shutters and gates must:
   i. Be fully integrated with the security system
   ii. Comply with the Security Services Standard.
   iii. This excludes:
      - Accessible internal doors without monitoring requirements
      - Standalone installs
      - Auto doors and actuators on fire trips.
e. Other systems such as key switches or remote controls must not be able to override or bypass the security system. Fire Brigade access can override card readers where this is required.
f. Cameras must:
   i. Be mounted at main entrances at a height no more than 4 metres high. Dedicated CCTV poles can be used where required
   ii. Cover the external vicinity of each entrance/exit to ensure an adequate level of coverage – a CCTV design needs to be peer reviewed by Protective Services (COS) to ensure the coverage is adequate
   iii. Provide a recording sufficient for persons to be identified
   iv. Adequate lighting levels must be maintained to achieve the appropriate recording standards.

5.2.4.3 Glazed doors

a. Grade A safety glass is required. In the case of DGUs both the internal and external panels must be glazed with a Grade A safety glass complying with AS1288. The same standard applies to the adjacent glazed areas.
b. In areas where protection against infraction is required, the doors should be glazed with Grade A safety laminated glass.

5.2.5 Structural sealant

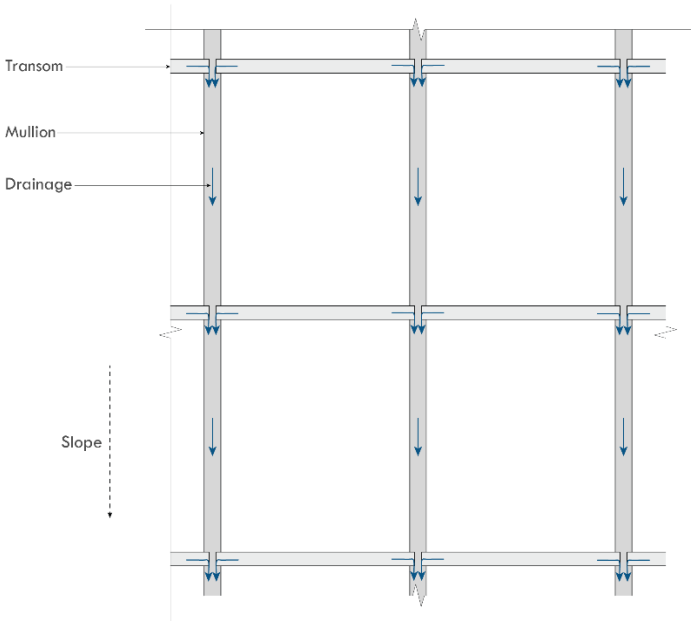
a. Structural sealant must not be the sole means of supporting glass, metal sheet, or any other facade element. Facade elements must be mechanically supported on at least two sides, and the design must be structurally capable of spanning between these captive restraints. Structural silicone must be used to restrain the other sides of glazing panels where they are not supported by any other means.
b. Structural sealant, if used, should be applied in the factory in strict compliance with the sealant manufacturer's recommendations.
c. Onsite re-glazing must be kept to a minimum. A detailed methodology and QA plan must be approved by the sealant manufacturer and the facade subcontractor. The detailed methodology and QA plan must be approved by UI prior to commencement on site.

5.2.6 Bolted glass and glass structure

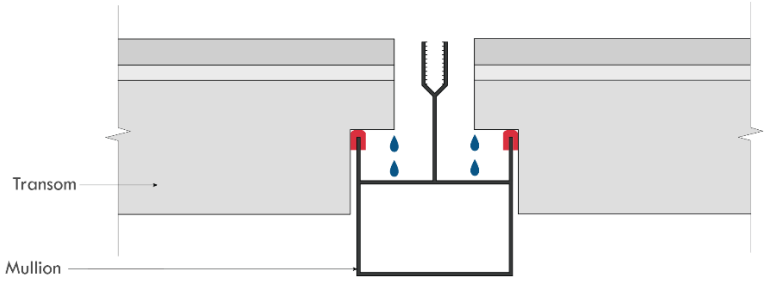
a. All glass panels must be laminated.
b. Where glass elements support other components, the glass structure must be engineered to stay in place in case of breakage of any of its glass components.
c. Avoid the use of toughened glass as much as possible. Where toughened glass cannot be avoided, provide evidence of Heat Soak Test for each glass panel. The Heat Soak Test process must comply with BS EN 14179-1 standard.

5.2.7 Skylights

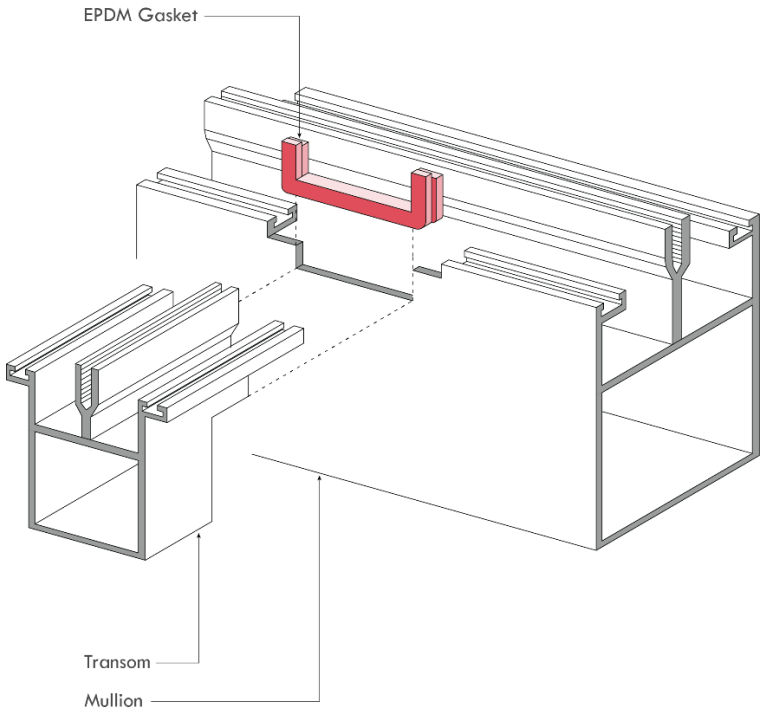
a. A skylight glazing system must be specifically designed for horizontal (or near-horizontal) applications and therefore include a secondary drainage system. A secondary drainage is a complete drainage pathway, below the glass level, that collects and drains any water passing through the external weather seal. In such a system, the water collected in the transoms cascades down into the mullions and are drained externally (refer to Figures 1, 2 and 3 below).
b. The secondary drainage must be tested onsite prior to applying the external sealant to ensure the system functions correctly.
c. A minimum angle of 5 degrees with the horizontal is required to avoid any water retention and dirt build up.
d. A balance must be achieved between maximising natural daylight and minimising glare.
e. Solar gain should be reduced with high solar protection glass, for example: a frit or graphic on the glass, or as an interstitial layer within the glazing system.
f. Glass panels must be supported on all four sides, laminated, and heat strengthened.
g. Maintenance and cleaning:
    i. For safety purposes, glass panels must be designed to be trafficable. However, maintenance or cleaning methodologies must not necessitate walking on the glass.
    ii. Walkways and integrated lifeline harness systems should be included as part of the overall skylight maintenance system.
    iii. Use self-cleaning surfaces wherever possible.
    iv. In areas where a smoke detection is required a VESDA system must be used. Coordinate with the Fire Services to ensure the VESDA system is integrated with the skylight system and access for maintenance is properly considered. Refer to Essential Fire Safety Measures standard.



Skylight glazing system: Plan view of the secondary drainage
Figure 1



Skylight glazing system: Section - mullion/transom assembly
Figure 2



Skylight glazing system: Perspective - mullion/transom assembly
Figure 3

5.2.8 Glazed balustrades

a. Minimum height of 1200mm is required, or 1800mm for external terraces.
b. In situations where fixed climbable objects, such as planters or furniture, are within 1m of the balustrade, the minimum height is 1800mm.
c. Apply crowd load requirement in all areas susceptible to over-crowding.
d. Only use Grade A safety laminated glass.
e. Select a moisture-resistant interlayer for external application with exposed edges.
f. Cappings and handrails must not be in direct contact with the glass or induce any stress within the glass panel.
g. Provide a handrail where required by the NCC.
h. In instances where there is a glazed balustrade with handrail and the glass is cantilevered from the floor, the handrail must be fixed to the main building structure or a substructure and not to the glass.
i. Any external structure must be stainless steel Grade 316 as a minimum or agreed otherwise by UI.
j. Fixings:
    i. Prevent loosening of fixings due to movements, vibrations, or any other actions.
    ii. Only allow movement in the direction in which components are intended to move e.g.,

thermal expansion or differential movements.
   iii. Detail the glazed balustrade fixing system to prevent water ingress.
   iv. External fixings must be stainless steel Grade 316 as a minimum.
   v. Avoid direct contact between the glass panels and its metallic fixings. The interlayer must be designed to withstand the pressure applied by the fixings.
k. The design must allow for glass replacement.

5.2.9 Internal full height glazing (including Atrium)

a. Wherever glass performs the role of a barrier, it must be a Grade A laminated safety glass. A barrier is defined as any element intended to prevent people from falling or to prevent access to a specific area. For example, glass spanning from floor to ceiling must prevent people from falling from the building. In case of double-glazed units, the internal glass panel must be Grade A laminated safety glass.
b. Applied graphics or frit must be provided where privacy is required. Glazed partition heights must be coordinated with adjacent door heads and frames.
c. Glazed partitions must have a hob where the floor finish adjacent comprises a resilient sheet material such as sheet vinyl to accommodate appropriate coving.

5.2.10 Claddings

5.2.10.1 General requirements

a. Cladding systems are to be open joint, and pressure equalised. The air gap behind the cladding panels is to be drained and ventilated. The internal screen, preferably a back pan, is to be fully sealed and designed to resist 100% of the wind load.
b. Cappings and flashings are also to be fully pressure equalised and drained.
c. Conduct a site water test to assess the waterproofing of the internal skin, before installing the cladding panels.
d. At ground level and accessible upper terraces & balconies, ensure appropriate impact resistance to avoid any dents or other damages.
e. All panels must be mechanically fixed.
f. Allow for oversize or slotted hole fixings to permit thermal expansion of the cladding in both directions without oil-canning or buckling.
g. Cladding panels to be fixed with a torque that allows for thermal expansion.
h. Cladding panels shall not have any irregularities such as oil canning, waves, buckles and other imperfections when viewed from any angle equal or above 30 degrees to the true plane of the panel, with any natural light exposure condition.
i. The selected system must allow the replacement of damaged or broken elements without removing adjacent panels.

5.2.10.2 Fire requirements

a. Cladding components, insulation, packers, or any other material within the wall build up must be non-combustible in accordance with clause C1.9 of the NCC. This requires the material to be tested in accordance with AS 1530.1, except for the materials permitted under clause C1.9(d).
b. Provide passive closed state cavity barriers between the slab edge and the internal screen of the cladding system at each floor level.
c. Provide intumescent open state cavity barriers within the ventilated cavity of the cladding:
   i. Horizontally at each floor at slab level
   ii. Vertically at the termination of fire walls between fire compartments and the external wall
   i. At the perimeter of all openings within cladding areas.
d. Cavity barriers must:
   i. Be mechanically fixed

ii. Be tight fitting and able to withstand thermal expansion and structural movements without the loss of seal against fire and smoke (for close state cavity barriers only)
iii. Not require any inspection or maintenance

e. In addition to the above requirements, open state cavity barriers must:
   i. Be water resistant
   ii. Maintain a continuous gap behind the cladding panels to allow for drainage and ventilation.
f. Testing required for Cavity Barriers:
   i. Passive close state: the cavity barrier must achieve a fire-resistance level (FRL) not less than the FRL criteria of the floor slab (2-hour fire rating for Class 5 / 9b buildings) when tested in accordance with AS 1530.4 between two fire rated elements.
   ii. Open state: Open state barriers are to be tested in accordance with the fire resistance test method specified in the UK ASFP Technical Guidance Document (TGD 19) and achieve the following as required in the Approved Document B:
      - Minimum 30 minutes' integrity (E 30), and
      - Minimum 15 minutes' insulation (I 15).

5.2.10.3 Natural Stone Cladding

a. Use proven and tested proprietary fixing systems.
b. Each stone panel is to have a minimum of four mechanical fixings.
c. The fixing systems must allow for the replacement of stone panels without having to remove any adjacent panels.
d. Stone panels must be directly fixed to the primary structure and not to a secondary framing system such as a curtain wall frame.
e. Stone panels must not be fixed to doors or any other moving elements.
f. Provide anti-graffiti protection for accessible areas.
g. Ensure that any gasket installed within the joints is adequately fixed.

5.2.11 Awnings

Glazed awnings:

a. Glass panels must be supported on at least three sides.
b. Glass panels must be laminated, and heat strengthened.
c. For safety purposes, glass panels should be designed to be trafficable. However, maintenance or cleaning methodologies must not necessitate walking on the glass.
d. Reduce solar gain with high solar protection glass, for example: a frit or graphic on the glass, or as an interstitial layer within the glazing system.
e. A minimum angle of 5 degrees with the horizontal is required to avoid any water retention and dirt build up.
f. Use self-cleaning surfaces wherever possible.
g. Access to the awning for maintenance must be properly considered within the overall building facade maintenance strategy.

5.2.12 Soffits

a. Each soffit panel must be mechanically fixed.
b. Structural design must be certified to ensure resistance to wind load and any other applicable loads.
c. Do not use any brittle material which can break and fall in pieces.
d. Use water-resistant materials and fixing mechanisms
e. Prevent water from accessing the cavity above the soffit. The cavity must be ventilated and drained.

f. Close off openings that permit entry of insects, reptiles, birds or bats and rodents. A mesh could be used to allow for ventilation of cavities

5.2.13 Louvres

a. Louvres are generally not waterproof, and therefore it is essential to consider that under extreme weather conditions water may reach the internal lining. The design must consider this outcome.
b. Two-stage louvres are required in locations to prevent water ingress into habitable spaces.
c. All louvres must be fixed.

5.2.14 Sun shading elements

5.2.14.1 Introduction

a. The requirement for sun shading systems will be determined by both the compliance requirement to the NCC Section J, and the mandatory credit achievements set within the Green Star Building rating tool (refer to the Sustainability section of this document).
b. All sun shading elements must be fixed or manually operable.
c. The overall building facade cleaning and maintenance strategy must allow access to:
    i. The sun shading elements.
    ii. The facade behind the sun shading elements.

5.2.14.2 Sunshades

a. The structural design of sunshade elements must be certified to ensure resistance to wind load and any other applicable loads.
b. Avoid the use of glass or any other brittle material.

5.2.14.3 Blinds and curtains

a. Comply with USYD Building and Architecture Design Standard.
b. Recessed pelmets must be installed to all perimeter windows and/or curtain walls to allow for installation of window treatments including blinds and/or curtains.

5.2.15 External green walls

a. Green walls should be installed on a removable independent structure.
b. Ensure that green walls are designed with minimum maintenance required.
c. The design should prevent infestation by rats, pests or other vermin.

5.3 Materials

Only new materials and components will be acceptable. These must be of good quality and fit for purpose. Any product procured overseas must be certified as adequate for the Australian climate.

Any proposed recycled materials will need to be considered and approved by UI.

Materials that can be recycled are highly encouraged. End of life needs must be considered for all materials used.

Ensure that the building envelope encompasses responsibly manufactured products according to the Responsible Envelope section of the Green Building Council of Australia rating (refer to Sustainability section, Responsible Envelop).

5.4 Performance requirements

5.4.1 Sustainability

The University is committed to environmentally sustainable design.

Building designs must employ passive design strategies to respond to environmental conditions of the building including orientation, solar access, prevailing winds, and seasonal and diurnal temperature changes.

The performance and quality of the building mass, fabric, internal and external environments must be optimised to achieve high levels of thermal comfort, acoustic comfort, light quality, energy efficiency and to minimise reliance on mechanical ventilation, cooling, and heating.

The performance must be demonstrated by both the compliance to the NCC and a minimum 5 Star rating with the Green Star Building Council of Australia rating tool for new buildings.

5.4.1.1 Green Building Council of Australia rating

The Green Building Council of Australia sets out the criteria that must be met to deliver healthy, resilient, and positive places for people and nature. It aims to meet current and future demands of the built environment with aspirational benchmarks for addressing the key issues of the next decade: climate action, resource efficiency, and health and wellbeing.

All new buildings must achieve a minimum 5 Star rating, and major refurbishments must achieve a minimum 4 Star rating with the Green Building Council of Australia rating tool.

Based on our specific requirements, the University of Sydney has selected a list of criteria, directly affected by facades, that must be met. Below are the selected criteria:

5.4.1.1.1 Verification and Handover (Responsible)

The desired outcome is to ensure that the building has been optimised and handed over to deliver a high level of performance in operation.

Required target: Credit Achievement

5.4.1.1.2 Responsible envelope (Responsible)

The desired outcome is to ensure that the building envelope encompasses responsibly manufactured products.

Required target: Credit Achievement

5.4.1.1.3 Clean air (Healthy)

The desired outcome is to minimise the entry of pollutants in the building and provide a high level of fresh air to ensure that levels of pollutants are maintained at acceptable levels.

Required target: Credit Achievement

5.4.1.1.4 Light quality (Healthy)

The desired outcome is to ensure that the building offers good daylight, and its lighting is of superior quality.

Required target: Credit Achievement

5.4.1.1.5 Acoustic comfort (Healthy)

The desired outcome is to provide acoustic comfort for building occupants.

Required target: Credit Achievement

5.4.1.1.6 Energy use (Positive)

The desired outcome is to ensure that the building has low energy consumption.

Required target: Credit Achievement

5.4.1.2 Additional requirements:

Please find below additional requirements:

- Double Glazed Unit (DGU) as a minimum requirement even for low glass to wall ratio to reduce the risks of condensation and improve thermal comfort for occupants.
- Provide a report and thermal calculations prepared by an approved ESD Consultant summarising the methods and findings of thermal performance modelling and confirming that the system meets the requirements of the NCC Section J as well as any other specific requirements.

5.4.2 Fire protection

a. Provide all fire protection to comply with the BCA, Australian Standards, USYD Essential Fire Safety Measures Standard, and any fire engineering report.
b. For buildings with sprinklers, all floors must be separated in accordance with the BCA, with a continuous smoke flashing at slab level.
c. All materials included in the facade build up must be non-combustible according to AS 1530.1 or deemed non-combustible according to the Deemed-to-Satisfy Provisions of NCC Volume One, paragraph C1.9.
d. Cavity barriers must be used to mitigate the spread of fire within concealed cavities.
e. Only use materials that do not give off toxic fumes.

5.4.3 Security

Provide security measures in accordance with the Security Services Standard.

5.4.4 Lightning protection

Provide integrated lightning protection in compliance with the USYD Electrical Standard and relevant regulations.

5.4.5 Lighting

Where external lighting is installed to illuminate the building façade, provide lighting in compliance with the USYD Lighting Standard and relevant regulations.

5.4.6 Signage

Where external signage is to be installed, provide signage in compliance with the USYD Building and Architecture Design Standard and The University of Sydney Signage Manual.

Signage fixings should avoid penetration through the main waterproofing layer of the façade. If penetration is required to secure adequate fixing, approval is required by UI.

5.4.7 Safe use of glass

a. Wherever glass performs the role of a barrier, it must be a Grade A laminated safety glass. A barrier is defined as any element intended to prevent people from falling or to prevent access to a specific area. For example, glass spanning from floor to ceiling must prevent people from falling from the building. In case of double-glazed units, the internal glass panel must be Grade A laminated safety glass.
b. Whenever possible, the use of toughened glass must be avoided. If this is not an option, due to specific technical requirements, request proof that the Heat Soak test has been done on all glass panels in accordance with BS EN 14179-1 standard guidelines.
c. Prevent the risk of fall of toughened glass debris in areas of passage in case of breakage. This requirement can be achieved by incorporating the toughened glass into a laminated glass panel.
d. Where the glass is sloped, it must be supported on 4 sides, laminated and heat strengthened.
e. Conduct a thermal stress analysis to verify that all glazing that are not heat strengthened or toughened are thermally safe and will not be susceptible to heat cracking. Consider shading stresses that might occur from adjacent components and buildings including sun shades, overshadowing and the like. Where analysis indicates thermal cracking may occur use heat strengthened glass.

5.5 Minimum requirements

5.5.1 Structural integrity

5.5.1.1 Structural design

Design the works to withstand all loads in most severe load combinations and accommodate the worst combination of the structure tolerances and movements (including thermal movements). As a result, there must be no cracking, distortion, dislodgement, or excessive deflection.

5.5.1.2 Calculations

Employ the services of an approved registered Structural Engineer to prepare detailed calculations. Submit to UI computations for all facade elements and fixings.
Please note that the entire facade system, including the substructure and fixings should be included in the same report to ensure that all the connections have been calculated.

5.5.1.3 Corrosion

a. Select each material to be compatible with the other materials around it or within its range of

influence. Incorporate separators to prevent bi-metallic corrosion. Prevent direct contact between aluminium components and cement-based surfaces.

b. Ensure superior protection against corrosion in areas such as:
    i. Unwashed external areas and sheltered parts of the facades.
    ii. Ventilated cavities.
    iii. Elements that have been closed up and cannot be readily accessed.

5.5.1.4 Fixings

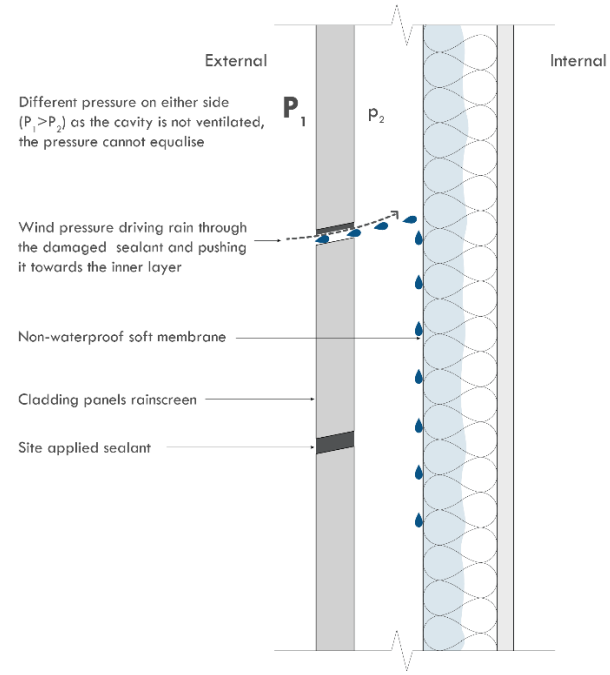
a. Provide allowance for:
    i. The worst combination of tolerances and movements that may occur.
    ii. Any reduction in fixing capacity due to their spacing or specific location such as proximity to edge.
b. Prevent loosening of fixings due to movement, vibration, or other actions.
c. Only allow movement in the direction in which components are intended to move e.g., thermal expansion or differential movements.
d. Allow for adjustment by small increments in all directions.

5.5.2 Weatherproofing and pressure equalisation

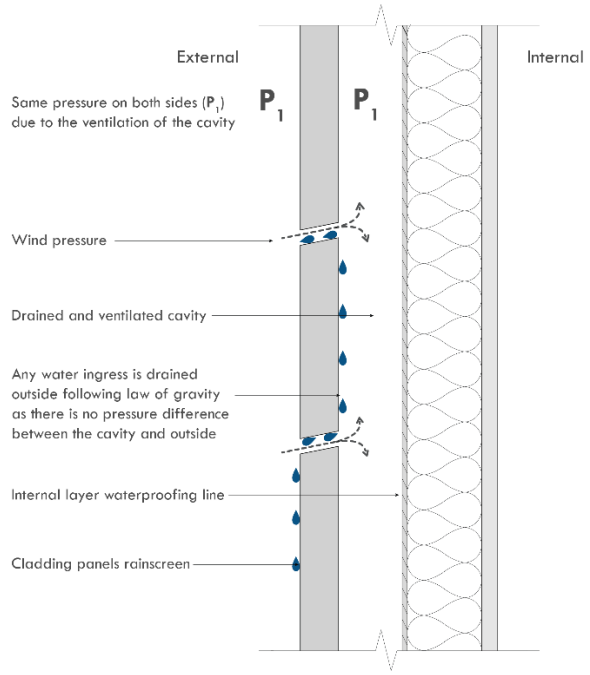
The weatherproofing of all systems and joints must be pressure equalised, incorporating the following features:

a. A rain-screen to prevent most of the water from entering the ventilated and drained cavity.
b. An internal barrier that is waterproof, air sealed and designed to resist the full wind load. This allows the effective pressurisation of the cavity. The system must be designed so that water penetrating the cavity does not reach the internal barrier.
c. A cavity between rain-screen and the internal barrier. This cavity must be:
    i. Sufficiently ventilated to the outside so that there is no air pressure difference between both sides of the rain-screen.
    ii. Drained so that any water entering the cavity flows by gravity to the outside.

The figures below illustrate the pressure equalisation principle in cladding by presenting two types of cladding systems: a face-sealed system that is not pressure equalised (Figure 4) and a pressure equalised system (Figure 5).



Face Sealed – No Pressure Equalisation
Figure 4



Pressure Equalisation Principle
Figure 5

5.5.3 Thermal expansion

All facade components must accommodate thermal expansion and contraction. This includes:

a. Sufficient space to expand,
b. Fixings specifically designed to either carry the deadload or allow for movements in one or two directions depending on their positioning,
c. Control fixing torque to ensure that fixed components can expand.

5.5.4 Differential movements

All facade components must accommodate differential movements of the building structure. This includes:

a. Sufficient space to move.
b. Fixings specifically designed to either carry the deadload or allow for movements depending on their positioning.
c. Control fixing torque to ensure that fixed components can move without restriction.

5.5.5 Flatness

Cladding panels, spandrel panels or any other metallic flat surface shall not have any irregularities such as oil canning, waves, buckles, and other imperfections when viewed from any angle equal or above 30 degrees to the true plane of the panel, with any natural light exposure and conditions.

5.5.6 Interfaces

a. Co-ordinate the alignment of the facade design and installation with the ceiling, windowsill,

internal linings, partitions, and floor finishes.

b. Facade elements shall be engineered for acoustic interface of internal partition and building fabric selected to achieve acoustic requirements.
c. Include all interfaces with other facades, different curtain wall systems and roofs in shop drawings. These details must incorporate a minimum of two weather barriers following the principle of pressure equalisation.

5.5.7 Penetrations

a. Penetration of the facade must be avoided where possible.
b. The pressure equalised principle must be applied to the waterproofing detail of the penetration. This means a minimum of two weather barriers with a drained and ventilated air gap in between.
c. A detailed design of the proposed penetration must be submitted to UI for approval.

5.5.8 Vibration

All fixings to be vibration proof under deadloads, imposed loads, wind loads and thermal movements.

5.5.9 Noise control

Design the facade elements ensuring that they do not creak, rattle, whistle or make any other noises because of thermal and structural movements or wind pressure.

Provide a Wind Noise Desktop Assessment to identify any potential noise generator. Undertake wind tunnel testing for further analysis if required following the Desktop Assessment.

Refer to the Sustainability section of this standard. There is a credit achievement requirement for the Acoustic comfort (Healthy) criteria within the Green Star rating framework.

5.5.10 Reflectivity

Select materials to suit immediate natural environment for reflectivity (day-light exposure, reflection of other adjoining buildings).

Refer to the Sustainability section of this standard. There is a credit achievement requirement for the Light quality (Healthy) criteria within the Green Star rating framework.

5.5.11 Glare

Select materials to suit immediate natural environment for glare (day-light exposure, reflection of other adjoining buildings).

Refer to the Sustainability section of this standard. There is a credit achievement requirement for the Light quality (Healthy) criteria within the Green Star rating framework.

5.5.12 Condensation

Provide compliance with FP6.1 condensation and water vapour management in a sole-occupancy unit of a Class 2 building or a Class 4 part of a building as required by the NCC.

Minimise condensation as much as practically possible and ensure ventilation and drainage of any area where condensation may occur.

Prevent internal water vapour from migrating through the wall build up if it can be confined behind an impermeable layer. As an example, if there is a pressure equalised cladding system with a back pan ensure that there is a vapour barrier behind the internal lining to prevent the water vapour from inside the building to migrate through the wall and condensate at the back of the back pan.

5.5.13 Corrosion

a. Select each material to be compatible with the other materials around it or within its range of influence. Incorporate separators to prevent bi-metallic corrosion. Prevent direct contact between aluminium components and cement-based surfaces.
b. Ensure superior protection against corrosion in areas such as:
    i. Unwashed external areas, or sheltered parts of the facades.
    ii. Ventilated cavities.
    iii. Elements that have been closed up and cannot be readily accessed.
c. Prevent tea stains on stainless steel elements with minimum maintenance.

5.5.14 Infestation

Design the works to resist attack or infestation by micro-organisms, fungi, insects, spiders, reptiles, birds or bats and rodents.

Close off openings in the cladding or any other part of the facade that permit entry of insects, reptiles, birds or bats and rodents.

6 Design Life

All primary structures of the building must be designed to comply with AS1170 and all other relevant standards and provide a 100-year design life unless otherwise approved. Refer to USYD Building and Architecture Design Standard.

All facade elements are to be designed for 50 years structural integrity and 25 years design life (life to first major maintenance). A maintenance project is considered major when the value of the project is above 50% of the project value.

All materials shall retain colour integrity and consistency for 25 years.

7 Safety in Design

The contractor must consider risk during the whole design process. A Safety in Design safety report (design risk register, or similar) must be submitted to the relevant UI Project Manager at each of the design phases for every project. Ideally it forms part of a Safety in Design workshop involving all key stakeholders.

Contractors must confirm, so far as it is reasonably practicable, that the facade structure and system components are without risks to health and safety. They also need to demonstrate that the facade Safety in Design assessment has been considered in conjunction with the whole building design and all its elements.

Design risks must be considered for the complete building lifecycle covering construction, operation and maintenance, refurbishments, and de-installation. Safety in Design must be an inherent part of the ongoing maintenance of the building. Safety in Design must consider access for installation, maintenance and/or replacement of facade components.

The Safety in Design report must include the following:

a. Description of each design element.
b. Description of the potential risks and hazards associated with the design element.
c. A low/medium/high risk assessment considering likelihood and consequence.
d. Proposed measures to eliminate risks where practicable.
e. Control measures to mitigate and manage design risks.
f. Nominating responsibilities for managing the design risks.

The following specific considerations must be taken:

i. New buildings over three levels must incorporate the provision of a swinging stage or other approved building access system for facade cleaning and maintenance to be designed in the conceptual stage of design.
ii. Facade and roof materials and fixings must be designed to eliminate the risk of falling if an element was to fail.
iii. Fall protection must be considered in areas where a 1m+ fall risk occurs, with no climbable objects located in the vicinity.
iv. Fall protection must be considered on rooftops or similar, requiring service access to have restraint systems designed by access specialists. For more information refer to USYD Roofing and Guttering Standard.

8 Testing

8.1 Curtain walls and shop front systems

a. Off-site tests:
    i. One prototype for each facade system should be tested in a NATA (or equivalent) accredited facility for structural adequacy and weather tightness. The prototypes must:
        - Have a minimum height of two and a half floors
        - Have a minimum of six glazing modules in width, including corners
        - Include any sun shading elements
        - Include all typical components and features of the system
    ii. If previous tests are to be relied upon, copies of test reports must be submitted. Only reports prepared by NATA (or equivalent) accredited facilities will be accepted. Where proposed systems differ from the tested samples (larger modules, higher wind pressures, different extrusions), submit a project specific report prepared by a facade consultant stating how the previous tests can be relied upon to demonstrate the performance of the system.
    iii. The tested prototypes must be assembled by the same company that will assemble the systems for the project, as the tests also assess the subcontractor's ability to assemble the systems adequately.
b. On-site tests:
    i. Conduct hose testing on random areas of each facade type, as nominated by UI and the Facade Consultant, to demonstrate weather-tightness of installations. A minimum of 10% of each façade type needs to be tested. Tests must be conducted, witnessed, and reported by an Independent Testing Authority.
    ii. All typical components, penetrations and interfaces with other systems or building components must be tested.
    iii. Tests must be performed in accordance with AAMA 501.2 field hose test standard.
    iv. In the event of leaks being detected, the cause of failure should be assessed, then leaks are to be repaired and a re-test carried out.

v. If the cause of failure is likely to impact non tested areas of the facade, those areas should be tested and if necessary rectified and re-tested.
vi. For each leak detected during testing, a further 2 locations in addition to the original test program are to be tested.

8.2 Claddings

a. Performance report:
   i. Provide a FP1.4 Performance Solution Report, outlining the method of demonstrating the weatherproofing of the works, to certify compliance with FP1.4 of the NCC.
b. On-site tests:
   i. Conduct hose testing on random areas prior to installation of the rainscreen cladding to test the waterproofing of the back pan. Tested areas to be nominated by UI and the Facade Consultant. Tests shall be undertaken along the joint lines of the back pan, the interfaces with windows and any other facade systems.
   ii. Tests must be conducted, witnessed, and reported by an Independent Testing Authority.
   iii. In the event of leaks being detected, the cause of failure should be assessed, then leaks are to be repaired and a re-test carried out.
   iv. If the cause of failure is likely to impact non tested areas of the back pan, those areas should be tested and if necessary rectified and re-tested.
   v. For each leak detected during testing, a further 2 locations in addition to the original test program are to be tested.

9 Maintenance and Cleaning

a. Adopt the following design principles to reduce maintenance and cleaning requirements:
   i. Limit the collection of dirt:
      - Use self-cleaning materials where available.
      - Provide sufficient slopes to avoid water ponding.
      - Prevent water dripping around the edges of windows.
   ii. Where facades are exposed to chemical contaminants in the atmosphere (e.g., chemistry buildings) assess and limit impact of these contaminants on facade materials.
   iii. Select products that require minimal maintenance and cleaning, with finishes that are easy to touch-up.
   iv. Ensure superior protection against corrosion in areas such as:
      - Unwashed external areas, or sheltered parts of the facades
      - Ventilated cavities.
   v. Any product procured overseas must be certified as adequate for the Australian climate.
   vi. Replacement parts should be less than 6 months old since manufacture.
   vii. All products must be supported locally with the ability to provide replacement parts for at least a period of 10 years from purchase date.
   viii. Limit the potential for birds to nest.
   ix. Designers must ensure all accessible external walls employ graffiti-resistant finishes.
   x. Avoid cutting materials onsite.
b. Access solutions:
   i. All access solutions must comply with the UI/COS Managing the Risk of Falls Safety Standard and the USYD Roofing and Guttering Standard.
   ii. All new facades must include and incorporate a safe access system for cleaning and maintenance that is fully documented. A hierarchy of controls must be used to determine the most appropriate Safe Working Access System that is suitable for the building type and location. The selected system must always be the lowest risk method that is possible to achieve.
   iii. Rope based Safe Working Access Systems must be avoided unless no other method is practically possible.

iv. Where external elements such as sun shades or external screens are attached to the facade systems, ensure that there is sufficient space to enable cleaning and maintenance of the windows and building fabric without special procedures or processes being required.

c. Early design submission prior to product approval:
   i. Access for maintenance and cleaning must be properly considered within the overall facade design.
   ii. An access strategy for inspection, cleaning, maintenance, and replacement for all facade elements must be provided.
   iii. Ease of replacement and repair must consider:
      - Accessibility.
      - Ability to replace each facade element in isolation without removal or damage to adjacent elements.
      - When practical, select glazing systems that provide the ability to replace facade components from inside the building.
   iv. Life cycle costs and warranties should be provided.
   v. Local availability of parts is preferred wherever possible.
   vi. Local availability of suitably skilled maintenance contractors is critical.
d. Maintenance requirements at completion:
   i. Provide an operation and maintenance manual that includes an easy-to-use maintenance and cleaning schedule.
   ii. Ensure that no specialised chemicals are required for cleaning. High pressure hoses are the preferred option.
   iii. Contractor to organise a maintenance/cleaning handover and demonstration where practical.
   iv. Provide a spares schedule of all facade components and ensure the spares store (as referenced in the Building and Architecture Design Standard) is of sufficient size to accommodate these components.
   v. Where parts may need to be replaced within a specified period, the contractor must supply spare parts at completion.

10 Documentation and Records

10.1 Design Documentation

Prior to commencing construction of new or refurbishment projects, the consultants and contractor must fully investigate and document the requirements of the Facade Systems.

This must include:
a. Provision of a BCA/NCC Compliance Report.
b. Provision of Fire Engineered Performance Solution Report (where applicable).
c. Return Brief defining the systems proposed and any deviations from this standard.
d. Requests for all variations to this standard submitted using the Request for Dispensation Form (CIS-ENG-F001).

This documentation must be provided by the consultants/contractor in both electronic and hard copy formats and approved by UI.

10.2 Completion Documents

At the completion of all projects, the following documentation must be provided by the contractor for all Facade Systems installed or altered as part of the project works:
a. O&M manual(s).
b. Full description of the Facade Systems.

c. As-built drawings (in both PDF and CAD format).
d. Product manufacturer specific information.
e. Warranty schedules for all Facade Systems.
f. Maintenance requirements for all items.
g. Detailed description on how maintenance & replacement is to be undertaken.
h. Authority completion forms and inspection record.
i. Glazing certificates.
j. Proof of Heat Soak Tests for all toughened glass panels.
k. Thermal performance details (Section J).
l. Installers Statutory certificates.
m. Certification of compliance to Australian Standards, The University Standards, and the National Construction Code.
n. Final commissioning records.

The submission must comply with the USYD Operation and Maintenance Manuals Standard.

This documentation must be provided by the contractor in both electronic and hard copy formats and approved by UI prior to Practical Completion being granted.

11 Assets and Warranties

11.1 Assets

Assets are to be tagged in accordance with the Asset Identification and Labelling Standard for the purpose of maintenance and operation of university assets. For refurbishment projects, the project manager is to provide the existing asset list to the contractor to ensure modified and redundant equipment are captured in the contractors' submitted asset list.

Each asset required to be collected can be found in the Form (COS-ASSET-F001), each asset required to be coded will be identified by a unique equipment code.

The equipment code will be one of the three following types:
a. Virtual asset (This is a concatenation *Building Code - Floor - Room number*).
b. Item count asset (This is a concatenation *Building Code - Floor - Room number*).
c. Unique bar code asset (Unique bar code in the million series number affixed to the asset).

Asset lists are to be submitted prior to practical completion of the project for review and approval by COS.

11.2 Warranties

Warranties are to be provided as certificates as part of the O&M from the supplier of the equipment.

It is the responsibility of the installation contractor to ensure all maintenance and servicing required to the equipment is provided, to ensure warranties are valid at the end of the project DLP.

Select products that do not have a warranty that depends on maintenance and cleaning regimes, unless approved by UI.

Any maintenance and cleaning regimes must have not less than an annual frequency.

The Table 1 below sets out minimum acceptable warranty periods for typical building components.

Written supply and installation warranties must be provided for all building components, materials and systems including but not limited to items listed in Table 1

Table 1 : Warranty Periods

Item No.	Building Component	Warranty Period Minimum number of years from Practical Completion
1	Aluminium curtain walls, windows, doors and associated glass and sealants	12
2	Metal cladding systems	15
3	Glazing – structural system	12
4	Glazing – door system	10
5	Internal aluminium windows and doors	10
6	Automatic doors	5
7	Sub-grade and membrane waterproofing external areas and roofing	20
8	Balustrade systems	10
9	Insulated panel systems	10
10	Roller shutters	8
11	Aluminium coating (Anodised or Power Coated)	15
12	Sealants – Standard	10
13	Sealants – Fire rated	10
14	Door hardware	5
15	Exposed Steelwork painting	7
16	Sun shades	15
17	Louvres	15
18	Stone Cladding	20

12 Operations & Maintenance Manuals

Consultants/designers must include in the project specification detailed requirements for operation and maintenance manuals, including facade systems description, operation procedures, testing and commissioning records, maintenance instructions, product support information and details on the replacement of Facade Systems. Contractors must provide these to the satisfaction of the consultants, designers, and UI. Providing a collection of manufacturers' brochures and catalogues is not acceptable to the University.

The O&M format must be provided as per the USYD Operation and Maintenance Manuals Standard.

Contractors must submit the University designed Asset Management Master Asset Data Capture Spreadsheet (COS-ASSET-F001), designed for recording operational and maintenance activities including materials used, test results, comments for future maintenance actions and notes covering asset condition. Completed logbook pages recording the operational and maintenance activities undertaken for Practical Completion and during the Defects Liability Period must also be provided.

Facilities Maintenance must establish, document, and implement procedures for operation and maintenance of Facade Systems so that they are fit-for-purpose, maintain warranties, perform required statutory maintenance, are safe and comply with the requirements of this standard.

13 Authorisation of Variations

Variations to this standard must only be considered where the University Standard's requirement cannot physically or technically be achieved.

Consultants and contractors must identify and justify requirements of the standard that do not apply to the project, or which need to be varied and these variations must be approved by the issuer of this standard. Formal requests for all variations to this standard must be submitted using the Request for Dispensation Form (CIS-ENG-F001). The issuer of this standard or their delegated authority must review and consider requirements of stakeholders from clients, projects, and facilities management before deciding whether to approve variations. Their formal sign-off is required for acceptance of any non-compliances and departures from this standard's requirements.

14 Quality Control

14.1 Quality Management

a. Facade design to be reviewed by an independent peer facade consultant.
b. Shop drawings must be signed off by UI.
c. Provide a detailed Inspection Test Plans (ITPs) to ensure that all elements of the installation are installed in accordance with the design. The ITPs should include hold points where inspection is required before progressing with the installation.
d. As a minimum, the QA manual shall include the following:
    i. A method statement for each procedure involved in the implementation of the Works, including responsibilities for each procedure
    ii. Hold points in each procedure when quality checks/tests are carried out
    iii. Pass/fail requirements for each check/test
    iv. Non-conformance procedures for each test/check including rectification procedures.
e. Require submitting methodology and reinforced QA regime for onsite re-glazing of structural silicone when replacing glass panels.

14.2 Design Standard Compliance

Compliance with requirements of this standard must be checked throughout the design and construction phases of projects by UI. Any issues or deviations from this standard must be reviewed and approved in writing by the issuer of this standard.

Competent UI consultants and representatives must check compliance with this standard during design reviews and formal site inspections. Any non-conformances with requirements of this standard must be documented and provided to the UI Project Manager for issue to contractors and their consultants.

Project Managers must maintain a formal register of non-conformances and manage close out of outstanding non-conformances. Contractors and their consultants issued with non-conformances must take appropriate corrective actions. The UI Project Manager must ensure:

a. Proposed corrective actions are implemented
b. Close out of non-conformances in relation to this standard is formally approved and signed off by the author of the standard or their delegate.

14.3 Design Standard Certification

Consultants and contractors must certify compliance to the design standard by submitting a company Design Certification Form to the UI Project Manager at each of the following project phases:

a. Design and Documentation
b. Tender
c. Construction.

Notwithstanding UI's internal quality control processes, contractors and their consultants must implement their own robust quality assurance and control procedures to ensure compliance with requirements of this standard.

14.4 Construction Compliance

Consultants and contractors are expected to include ITPs for each Facade System detailing each item that needs to be checked during the installation process. Such check sheets must be completed and verified by the project consultant/contractors, including the identification of any defects and the closing out of such defects.

14.5 Acceptance

The University will only accept projects as complete when all the above have been carried out, submitted, and verified.

The above standards are not an exhaustive list of the relevant requirements. The consultant/contractor must incorporate all relevant standards and Authorities requirements into project specific design, documentation, and installation.

Consideration must be given by the consultant/contractor to the original standard of performance relevant to the construction date of the Facade Systems.

15 Defects and Liability Period

Consultants and designers must include in the project specification detailed requirements for the Defects Liability Period (DLP) following completion of the facade installation.

All maintenance, testing and cleaning of the Facade Systems required in the O&M manual to maintain the warranties must be performed by the contractor during the DLP period. All defects arising during the DLP must be rectified by the contractor.

Prior to completion of the DLP, a final inspection of the installed systems must be carried out by the contractor, UI, COS, and University nominated maintenance contractor, to produce a final list of project defects.

All project defects identified must be rectified by the contractor prior to finalisation of the DLP.

16 Document Amendment History

Revision	Amendment	Commencing
001	First draft not published	March 2015
002	Re-write and publish	September 2022