Student Union Building – Sustainability Initiatives

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submission title:	DRAFT 1
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zeidler

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1. Project Team

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2. Introduction

In October 2020 University of Victoria (UVic) retained consulting team lead by Zeidler Architecture to review, design (design development level), and cost (Class C) a number of sustainability initiatives at the Student Union Building located at Gordon Head Campus. These initiatives include:

- Air sealing of the building envelope
- Replacement of the exiting underperforming windows with high performance units.
- Replacement of the existing AHU-1 with a heat pump unit.
- Addition of a heat pump to the return air system from the Radio Station. This waste heat would be reclaimed to preheat domestic hot water. Revisions to ductwork and piping systems will be required

As outlined in the RFP document our mandate was to:

- Review any available drawings and specifications, and previously prepared Energy Study reports.
- Conduct necessary site visit(s) to review the existing equipment and system conditions..
- Prepare preliminary electrical motor equipment schedules.
- Prepare design development drawings and Class C cost estimate.
- Submit draft report for UVic's review and approval.
- Review findings and recommendations with University of Victoria prior to issuance of the Final Report.
- Submission of the Final Report.

3. Project objectives and report organization

The main, identified by the University of Victoria goals for this project were:

- Delivery of a solution allowing to achieve a healthy and safe building for visitors and occupants.
- Incorporation UVic planning principles and policies
- The cost estimate is within budget.

The project is divided into 3 separate reports: architectural (air sealing and windows replacement), mechanical (HVAC upgrades) and electrical (primarily electrical recommendations to accommodate HVAC upgrades) and the organization of the report(s) follows the format outlined below

- Review of the existing conditions and Data Collection
- Discussion
- Recommendations
- Conclusions including Class C Cost estimate.

Review of existing conditions and Data Collection

4. Methodology.

Our review and recommendations are based on information gathered on site on October14 (to review of architectural, mechanical, electrical systems) and on November 03 (to review of architectural systems). During these reviews our team was accompanied by facilities staff who provided required assistance and answers. University of Victoria provided existing drawings, specifications and the following reports:

- Energy Study Student Union Building Report dated July 18, 2012 prepared by Avalon Energy Management
- Student Union Building Energy Review dated March 11, 2020 prepared by University of Victoria

During the course of the projects we reached to:

- Grant Sim, P.Eng from University of Victoria, author of the Energy Review Report, to discuss energy requirements for replacement window and door assemblies.
- Chris Lambert from Kawneer Company Canada Ltd. A s per the review of site conditions Kawneer was the manufacturer and supplier of the newer aluminum frame system.

At the beginning of the project our team was informed that due to COVID-19, current occupancy of the building is approx 30% of the regular level. In result no interviews with staff were planned or conducted instead our team prepared short online survey which generated 21 responses. The received information is discussed in section 8 – Survey.

5. Applicable Codes, standards, policies, guidelines

Codes and Standards

- BC Building Code 2018
- BC Plumbing Code 2018
- BC Fire Code 2018
- Canadian Electrical Code 2018 (CEC).
- Applicable NFPA Regulations
- BC Gas Safety Regulations
- Canadian Standards Association (CSA)
- National Energy Code of Canada for Buildings (NECB)
- American Society of Heating, Refrigeration and Air Condition Engineers (ASHRAE)
- ASHRAE 90.1
- ASHRAE Standards, Guidelines, Handbooks and Design Guides
- Sheet Metal Contractors Association of North America (SMACNA)

University of Victoria policies and guidelines:

- Sustainability Policy

The District of Saanich (the Authority Having Jurisdiction) bylaws:

- Building Bylaw, 2019, NO. 9529
- Green Building Policy 05/219, 2005
- Saanich Official Community Plan, 2008
- Zoning Bylaw 8200, 2003

6. Description of existing building

The SUB (Building #117) was one of the first permanent structures constructed on the campus. The original construction completed in 1963 was followed by 2 major phases: 1974 and 1996 additions The latter also included extensive renovation work at the 1963 building however it appears (as per review of the existing drawings) that the renovation was limited to the interior systems only with no major considerations given to upgrade of the building envelope systems. Refer to Appendix A for further information.

The building is a two-storey structure with partial underground level limited to the footprint of the original building. The building has total area of 69,966 ft2 (6,500 m2) and currently houses mixed functional program including administration services, food outlets, retail, radio station, night club and a theatre. The fenestration elements and systems are of various age and quality with approx. 20 % being single glazed and 80% double glazed.

Photo 6.1 – 1963 construction. Main floor - visible original single pane windows with glass blocks (transom window) above

Photo 6.2 – 1963 construction. Room B011 - visible original single pane windows

Photo 6.3 – 1963 construction. Room B107 - visible original single pane windows in solid concrete jamb.

Photo 6.4 – 1996 renovation. Corridor B201 – Kalwall skylight

Photo 6.5 – 1963 construction. Upper Lounge (Room B110) Visible original single pane transom windows.

Photo 6.6 – 1963, Room B103 – Student Services Centre - visible original single pane (wired glass) in metal frame skylight.

Photo 6.7 – 1974 addition. Visible pressed steel metal door, double pane punched windows and single pane storefront

Photo 6.8 – 1996 addition, Visible Kawneer storefront glazing with steel frame in front to accommodate exterior shading devices.

Photo 6.9 –Kawneer system transom window

Photo 6.10 – looking toward Phase 2 addition with Kalwall and Kawneer skylights in front.

7. Description of fenestration systems.

Majority of the fenestration systems are original to building construction phases. Phase 1 and phase 2 is a combination of single and double pane systems whereas Phase 3 is predominantly storefront, double pane systems. Below is more detail description of the reviewed systems. In order to determine systems supplied by Kawneer we have reached to Kawneer Canada Ltd (Chris Lambert) Refer also to the **Table 1** for summary with applicable thermal transmittance (U) values.

Phase 1 (construction year 1963)

General description — primarily punched window systems.

1. Windows — single pane glazing in solid aluminum frames.
   Glass block in mortar bed natural light panels
2. Doors — single pane glazing in non-thermally broken clear anodized aluminum frame.
3. Skylights — site-built, single pane wired glass in in non-thermally broken metal frame with paint finish

Phase 2 (construction year 1974)

General description — combination of various systems (punched windows, strip windows, storefront glazing) and pressed steel metal frame door and window assemblies.

1. Windows — single pane and double pane glazing in solid aluminum frames.
   Punched windows, strip windows and storefront glazing.
2. Doors — single pane glazing in non-thermally broken clear anodized aluminum frame.
   double pane glazing units in dark bronze anodized aluminum frame - likely Kawneer TriFab 451T.
3. Skylights — site built; single pane wired glass in in non-thermally broken metal frame with paint finish

Phase 3 (construction year1996)

General description — primarily systems manufactured any supplied by Kawneer Canada Ltd.

1. Windows — double pane glazing units in dark bronze anodized aluminum frame.
   Likely Kawneer TriFab 451T.
2. Doors — standard, dark bronze anodized aluminum frame entrance door with single pane glazing.
   Likely Kawneer 190.
3. Skylights — double pane glazing units in dark bronze anodized aluminum frame.
   Possibly Kawneer 2000 Series (to be confirmed)

To confirm presence of Low-E coating (typically expected to be on the 3rd glass surface) Zeidler Architecture performed simple flame reflection test. As per this test, flame reflection from glass surface coated with Low-E, should be discoloured. As per conducted, at random locations, tests all flame reflections appear to be of the same colour indicating NO PRESENCE of Low-E coating. It should be noted however that the test was limited to few random locations at ground floor only and more tests should be conducted to confirm. See also photo 7.1 below.

We also reviewed most of the, accessible from ground level, Kawneer system IGU's for presence of Argon. Test was limited to confirmation of presence of gas insert holes in spacers. As per our observations, most of the IGU's are Argon filled. Similarly, as above the test was limited to few random locations at ground floor only and more tests should be conducted to confirm. See also photo 7.1 below.

As per provided to us information typically presence of Argon is a strong indicator of Low-E coating however this particular glazing systems may have been installed prior to introduction of Low-E coating (Argon infill was introduced earlier). Further investigation is strongly recommended.

Other related observations.

1. Phase 1 – most windows are set in the original concrete jambs. These jambs are an attractive architectural feature however are monolithic concrete elements approx. 100mm wide and 400mm deep and are contributing to thermal discomfort in the rooms. This is largely due to heat loss through thermal bridging effect.
   See also photo 7.3 and 7.4 below.
2. As per review of the existing drawings the exterior tubular steel structure on south and west side of the building was originally designed to provide support to an exterior awning/shading device (see Photo 7.5) It was noted, however that the structure is not being used as intended allowing the strong south /east sun to penetrate the building interior (see Photo 6.8). This in combination with low(er) performing glazing (no Low-E coating) appears to be contributing to overheating in number of rooms.

	Photo 7.1 South facing window. Reflection on the 3rd surface (indicated by an arrow) of the same colour as the other surface indicating no Low-E coating. This contributes to overheating of the rooms.

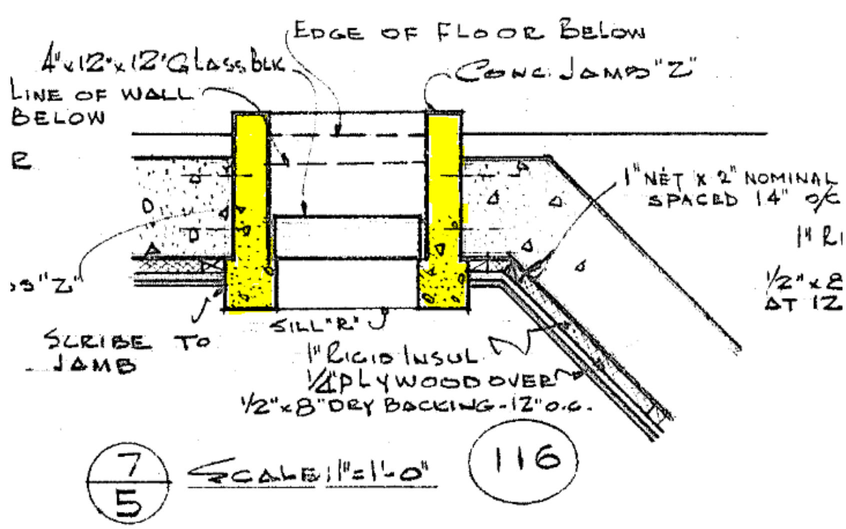
	Photo 7.2 Plugs in glazing spacer indicate presence of Argon in the IGU's
	Photo 7.3 – phase 1 existing concrete window jambs

Photo 7.4 – phase 1 existing concrete window jambs

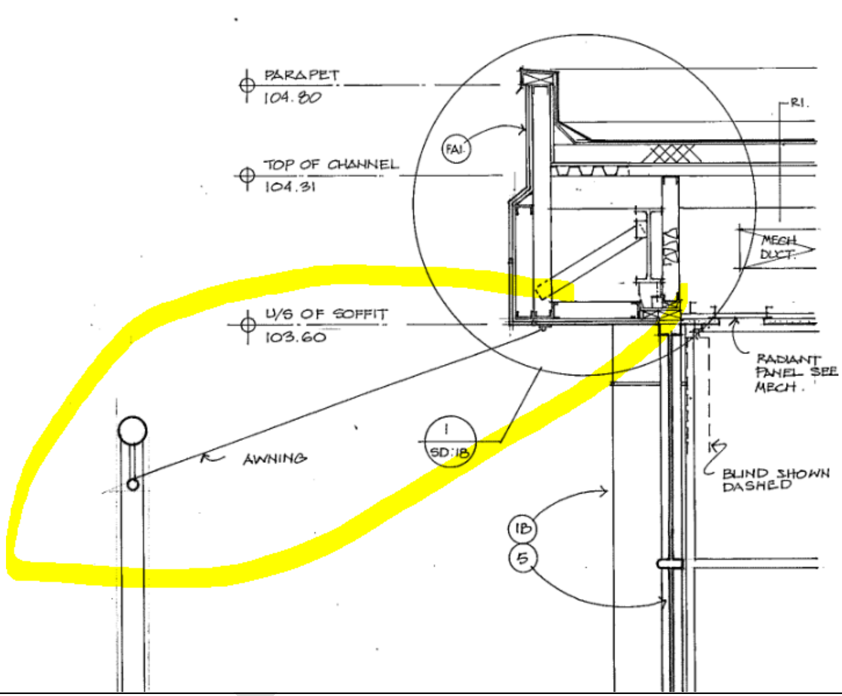


Photo 7.4 – phase 1 existing concrete window jambs

Table 1- description of existing systems - U values based on document 2017 ASHRAE Handbook—Fundamentals (SI)

U value approx. 100% or more higher than currently required
U value approx 50% higher than currently required.

Construction Year	**Construction type**	**Window systems**	**Estimated U value (*) W/(m2·K**	**Door systems**	**Estimated U value (*) W/(m2·K**	**Skylight systems**	**Estimated U value (*) W/(m2·K**	**Comments**
1963 – original building	Reinforced concrete with 1" thick rigid insulation on the interior side of the wall assemblies	Operable and fixed. ¼" thick single pane glass in non-thermally broken aluminum frame Decorative glass blocks transoms.	7.01 – single/ operable 6.38 – single / fixed 3.40 – glass blocks	Non-thermally broken aluminum frame with ¼" thick single pane glass vision panels	7.01 - door with more than 50% of glazing	¼" thick single pane glass in aluminum frame (non-thermally broken		Jambs are solid monolithic concrete blocks.
1974 Addition	Steel floor and roof assemblies on solid masonry walls	Combination of single and double pane glass in aluminum frame (both thermally broken and non-thermally broken).	7.01 – single/ operable 6.38 – single / fixed 3.18 – double / fixed	Non-thermally broken pressed steel door assemblies with single pane (wired) glass panels.	3.38 - single door 3.22 - double door	Kalwall system. Kawneer system - double pane glass in thermally broken aluminum frame.		
1996 Addition and Renovation	Predominantly steel framed structure; portions framed with steel on steel roof assemblies on load bearing masonry walls.	Kawneer storefront system - double pane glass in thermally broken aluminum frame	3.18 - fixed	Kawneer storefront system – single pane glass in (non-thermally broken) aluminum frames.	7.01 - door with more than 50% of glazing	Kawneer system - double pane glass in thermally broken aluminum frame.		Possibly no Low-E coating Possibly no Argon filled.

Table 2 - ASHRAE 90.1 2018 requirements for new doors, windows and skylight for Climate Zone 4

	U value W/(m2·K	SHGC	VT/SHGC
Opaque Doors / Swinging	< 2.10		
Opaque Doors / Non-swinging	< 1.76		
Windows Metal framing, fixed	< 2.15	< 0.36	> 1.10
Windows Metal framing, operable	< 2.61	< 0.36	> 1.10
Metal framing, entrance door	< 3.86	< 0.36	> 1.10
Skylights (0% to 3% of roof)	< 2.84	< 0.40	

Definitions:

U **thermal transmittance** — heat transmission in unit time through unit area of a material or construction and the boundary air films, induced by unit temperature difference between the environments on each side (Btu/h·ft2·°F).

SHGC solar heat gain coefficient — the ratio of the solar heat gain entering the space through the fenestration area to the incident solar radiation. Solar heat gain includes directly transmitted solar heat and absorbed solar radiation, which is then reradiated, conducted, or convected into the space.

VT visible transmittance — the ratio of visible radiation entering the space through the fenestration product to the incident visible radiation, determined as the spectral transmittance of the total fenestration system, weighted by the photopic response of the eye and integrated into a single dimensionless value.

8. Survey.

An survey prepared by Zeidler Architecture was distributed to building occupants and by the end of November 13, 2020, 21 responses were received by November 18.

Discussion and Recommendations

9. Discussion.

As per review of the existing information and site conditions it is apparent that following item contribute the thermal discomfort:

1. Phase 1 and phase 2 building area - single glazed units in non-thermally broken metal frames. Majority of the units are original, dated 1963. Although these units are in relatively good condition, they are major contributor to the heat/ gain loss. Priority should be given to replacement of these units with double glazed, thermally broken metal frame units. Preference should be given to units with slim frame profile to maintain the character of the openings. While upgrading the windows consideration should be given to thermal upgrade of monolithic concrete jambs.
2. Phase 3 building area – underperforming double pane Kawneer systems. Although better performing than units noted in item 1 these units due to their area and location (south and west exposure) are major contributor to the thermal discomfort inside the building. As minimum upgrade of glazing should be considered.
3. Lack of vestibules at building main entrances.
4. Lack of exterior shading devices on elevations facing south and west,

10. Recommendations.

Notes:

1. Refer also to Appendix A for additional information.
2. Due to their limited use and highly decorative character, replacement of glass block assemblies is included upgrade options.
3. Due to its relatively good energy performance replacement of the existing Kalwall skylight, is not considered in the proposed upgrades.

Option 1.

1. Phase 1 and phase 2 building area:

    - Replace single pane, non-thermally broken window, door and skylight assemblies with code complaint Insulated Glazing Units (IGU) systems. On the south elevation, the new IGU's should have lower SHGC to reduce heat gain from the sunlight. Size and configuration of units to remain however preference is to have more operable units to provide more natural ventilation.
    - Install thermal insulation on interior face of solid concrete window jambs to reduce thermal bridging.
    - Install vestibules at main entrances to reduce loss/gain of heat.

2. Phase 3 building area:

    - Replace single pane glazing in doors with IGU's. On south and west elevation / in areas with high heat gain retrofit existing storefront system with IGU's with COG = 0.24 or lower and with low(er)SHGC to help reduce heat gain from sunlight.

- On south and west elevations install exterior passive shading devices. Utilize existing steel structures where available and if in sound condition.
- Install vestibules to reduce loss/gain of heat.

Option 2

1. Phase 1 and phase 2 building area.

    - All work noted in Option 1

2. Phase 3 building area.

    - Window, door and skylight frame systems to remain. Replace all glazing with dual pane IGU with COG = 0.24 or lower. On the south elevation the new IGU's to have a much lower SHGC to help reduce heat transfer from the exterior sunlight.
    - Install vestibules at main entrances to reduce loss/gain of heat.
    - Skylights / if Kawneer 2000 Series retrofit with adapter allowing 44mm triple glazed infill / install triple pan glazing.

Option 3

Phase 1, phase 2 and phase 3 building areas:

1. Replace all window, door and skylight assemblies with high performance assemblies with U = 1.8 W/m^2K or lower as indicated in Energy Review Report prepared by Grant Sim, P.Eng. Example combinations for Phase 2 area:

- 1620UT 2" curtain wall with standard aluminum pressure plate, warm edge spacer bars (U = 1.65 W/m^2K)
- 1620UT 2" curtain wall with fiberglass pressure plate, warm edge spacer bars
- 1620UT with triple glazed insulated glass units (U < 1.65 W/m^2K
- Install vestibules at main entrances to reduce loss/gain of heat.

Option 3.1

Phase 1, phase 2 and phase 3 building areas:

Replace all window, door and skylight assemblies with code compliant assemblies.

Part 3 – Conclusions

1. Opportunities and limitations.

In our opinion xxxxxx

.1 xxxxxxxxx

2. Risks and potential mitigation actions.

Risk 1: xxxxxx

Mitigation 1: xxxxxx

Risk 2: xxxxxx

Mitigation 2: xxxxxx

3. Class C Cost Estimate.

Option 1	$ XXX
Option 2	$ XXX
Option 3	$ XXX

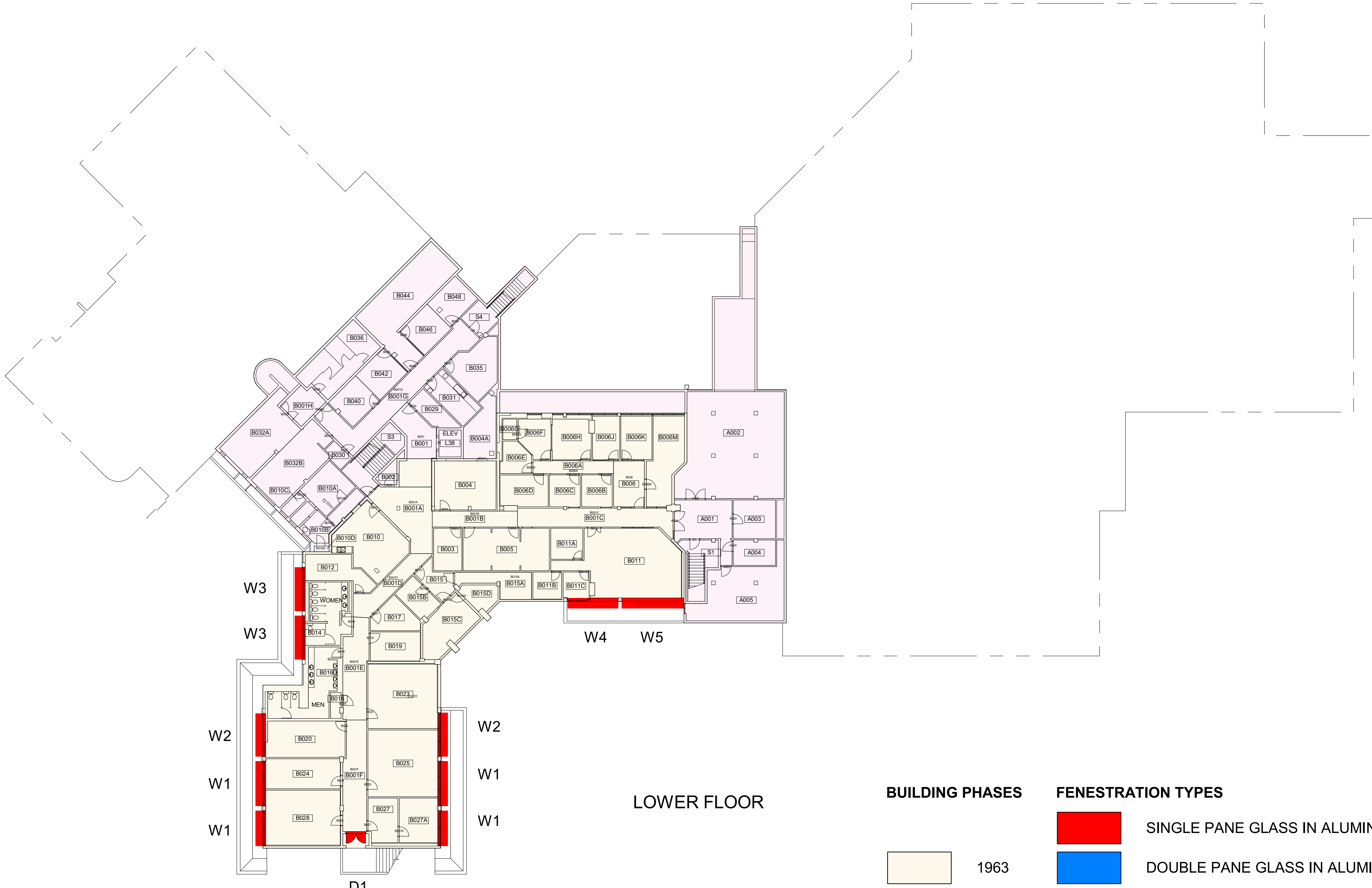
Refer to Appendix C – Class C cost estimate prepared by Advicas Group Consultants Inc for detailed breakdown.

Appendices:

Appendix A - Architectural Floor Plans

Window and Door Schedule.

Survey responses.



BUILDING PHASES

	1963
	1975
	1996

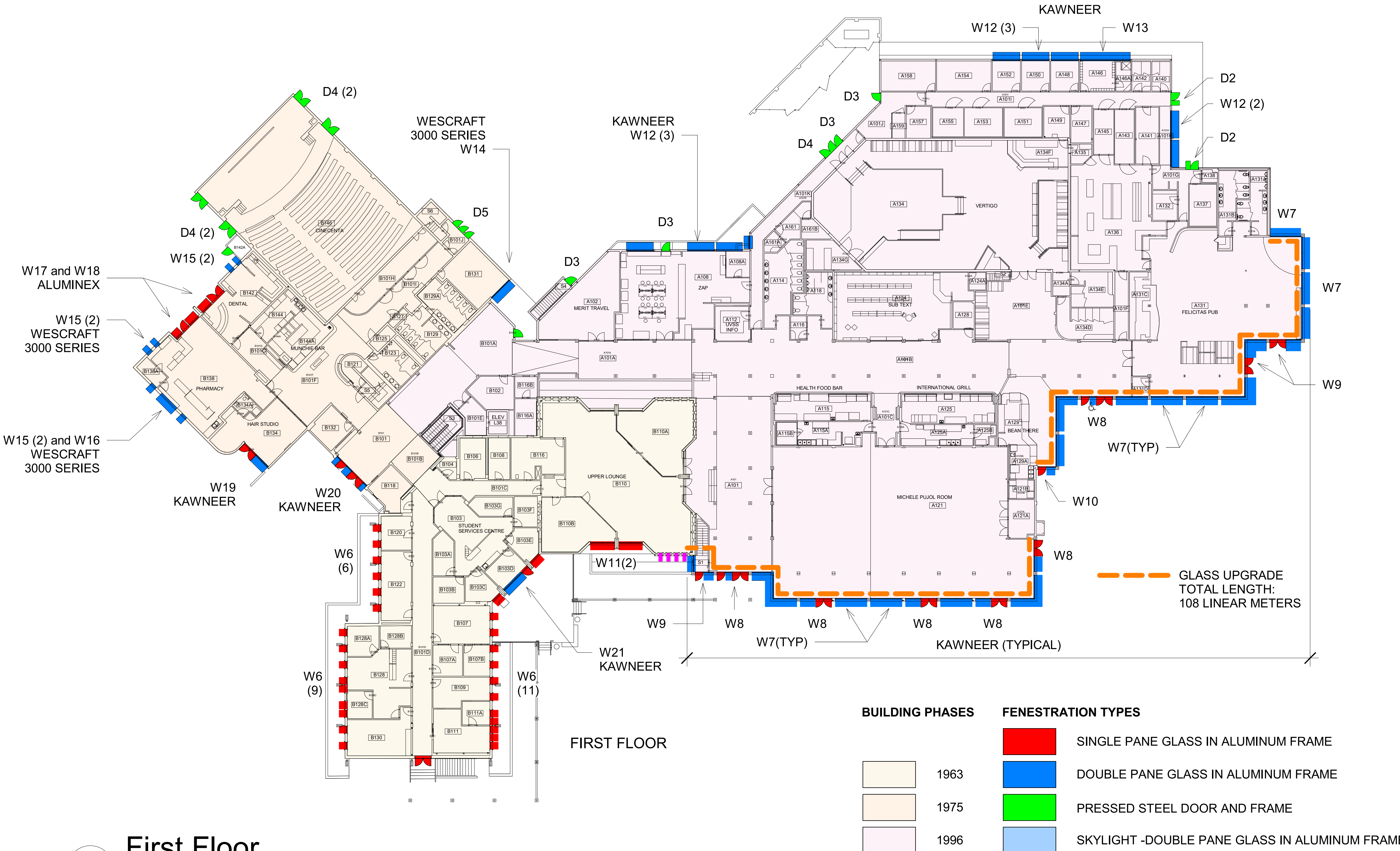
FENESTRATION TYPES

	SINGLE PANE GLASS IN ALUMINUM FRAME
	DOUBLE PANE GLASS IN ALUMINUM FRAME
	PRESSED STEEL DOOR AND FRAME
	SKYLIGHT -DOUBLE PANE GLASS IN ALUMINUM FRAME

1 Lower

1 : 400

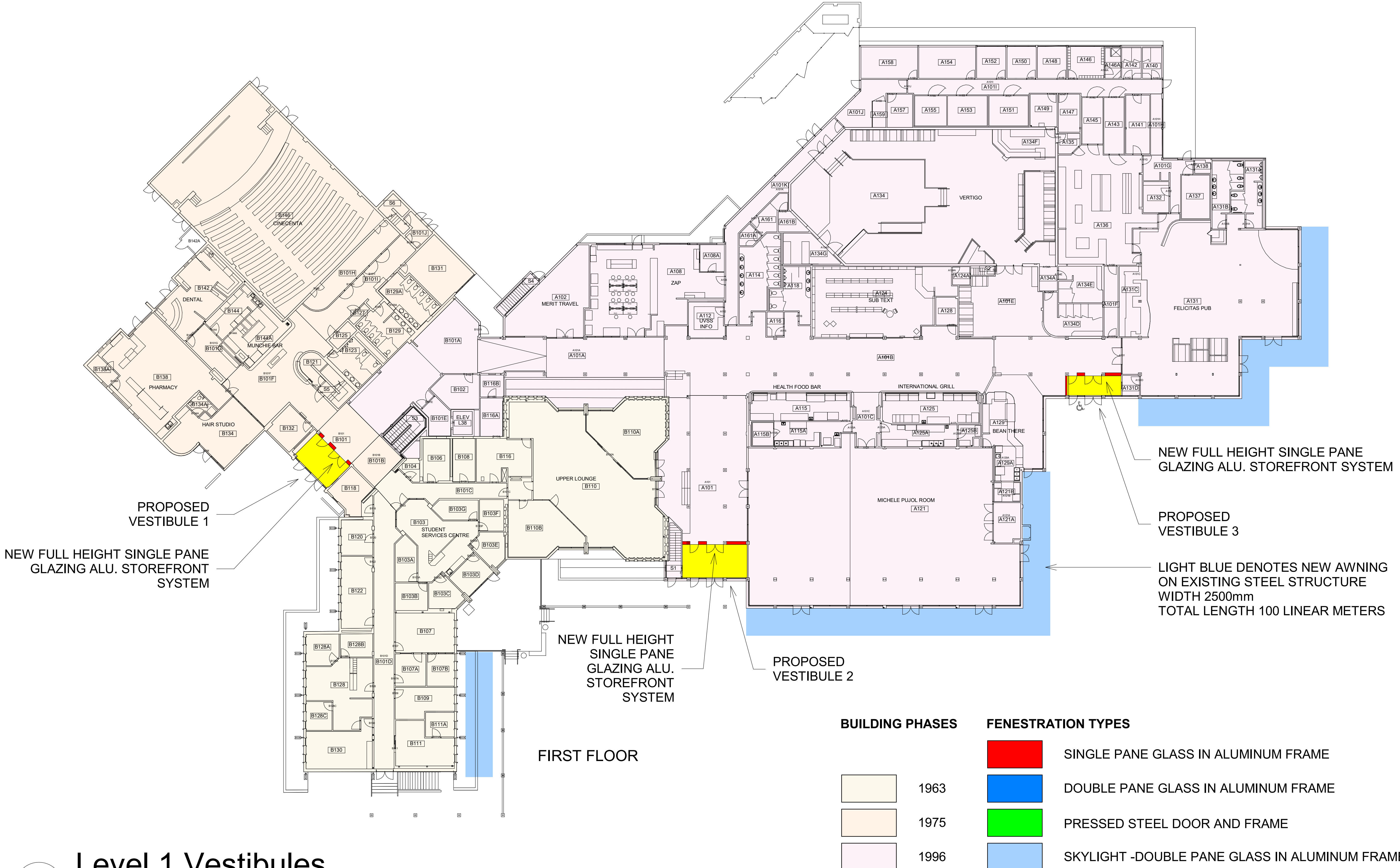
dwg. A101



1 First Floor

1 : 400

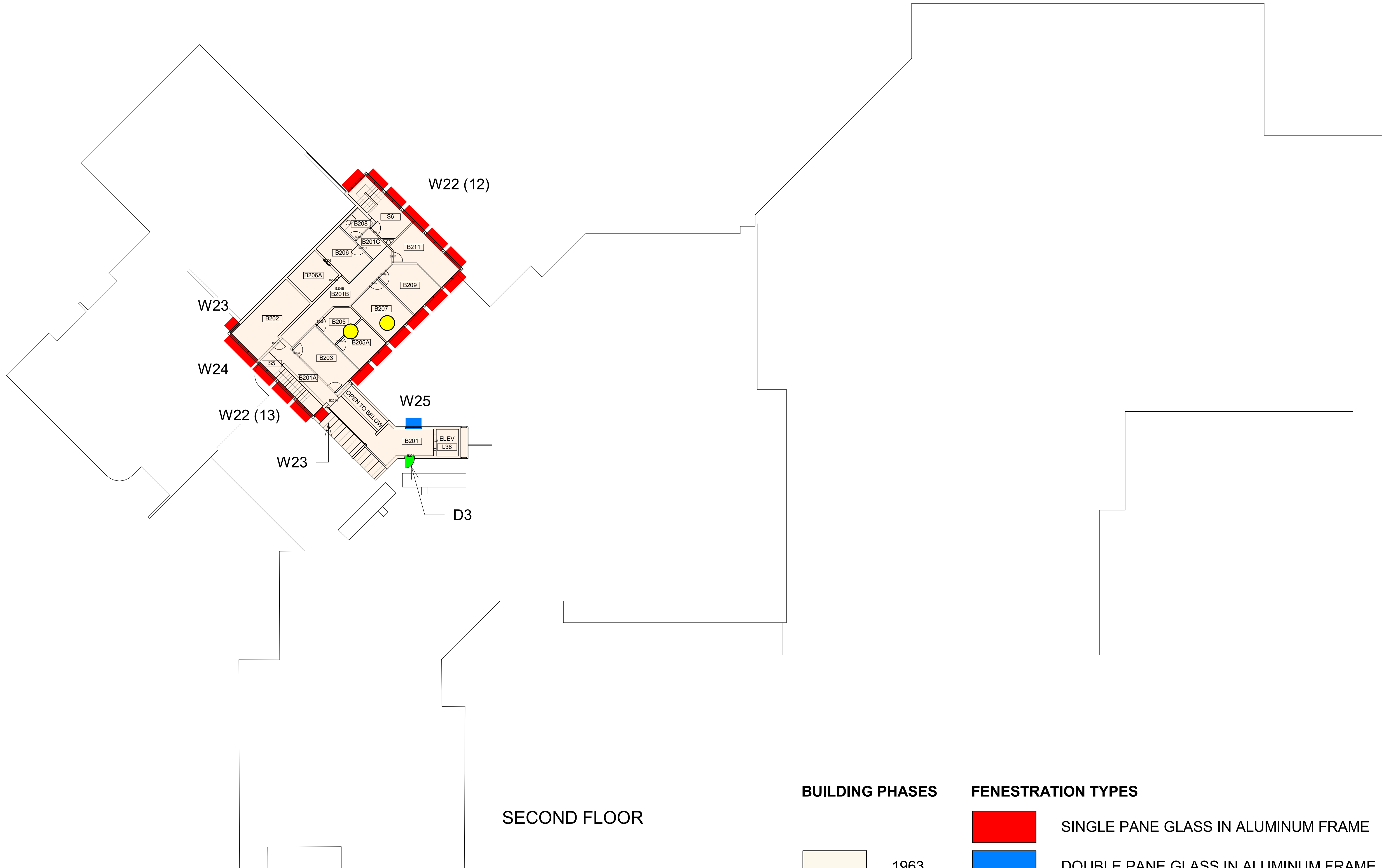
dwg. A102



1 Level 1 Vestibules

1 : 400

dwg. A103



BUILDING PHASES

1963

1975

1996

FENESTRATION TYPES

SINGLE PANE GLASS IN ALUMINUM FRAME

DOUBLE PANE GLASS IN ALUMINUM FRAME

PRESSED STEEL DOOR AND FRAME

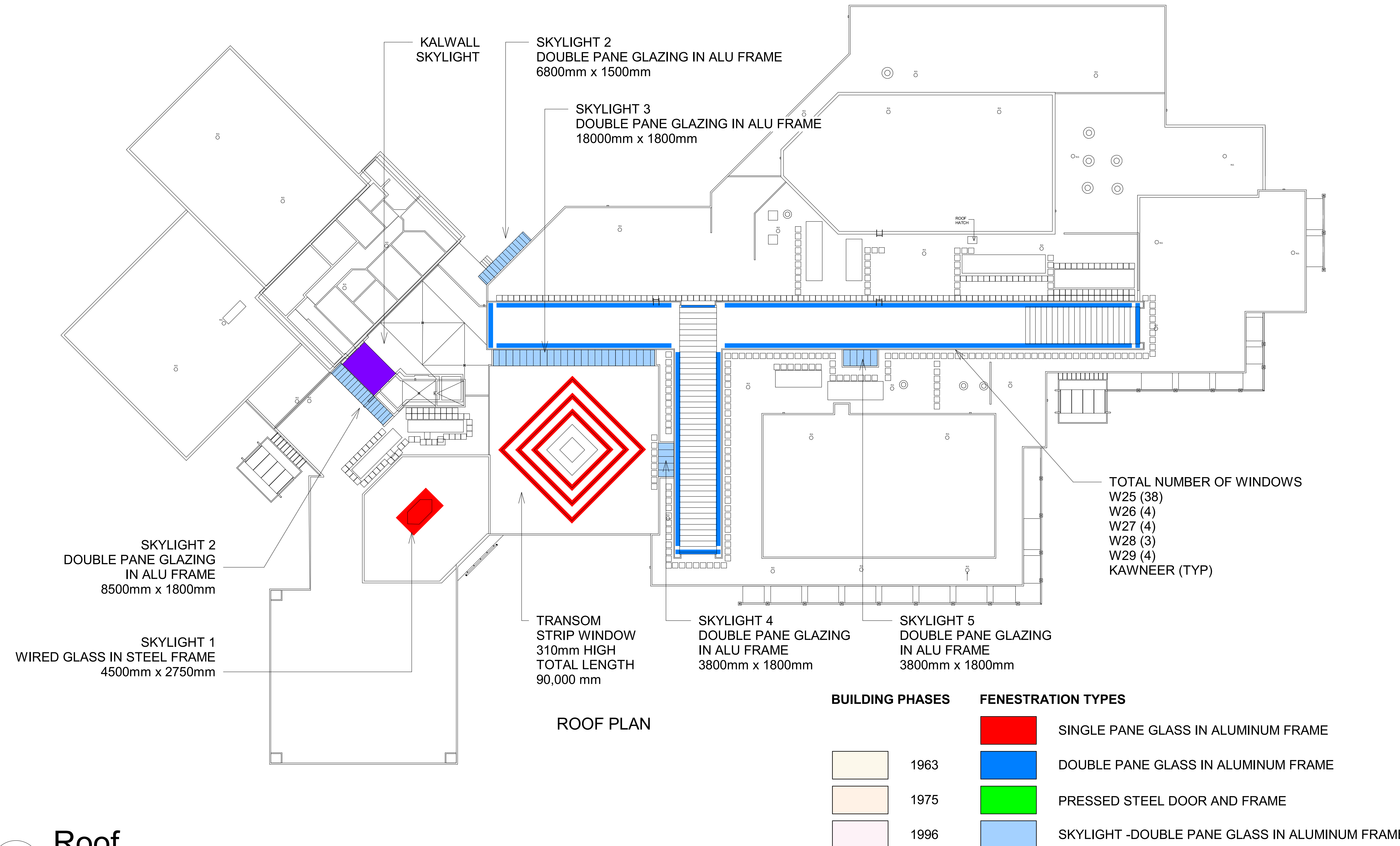
SKYLIGHT -DOUBLE PANE GLASS IN ALUMINUM FRAME

1

Second Floor

1 : 400

dwg. A104

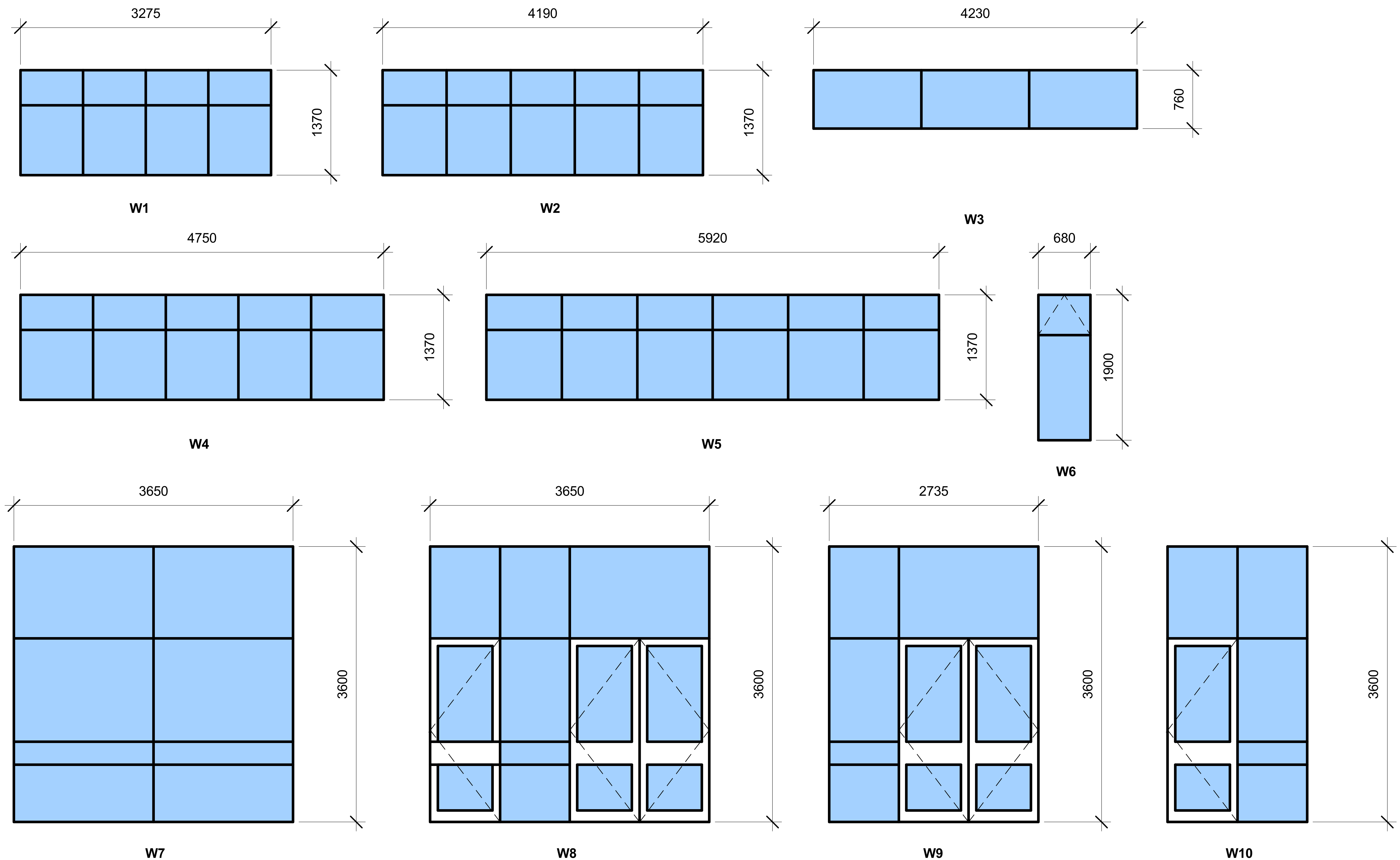


1

Roof

1 : 400

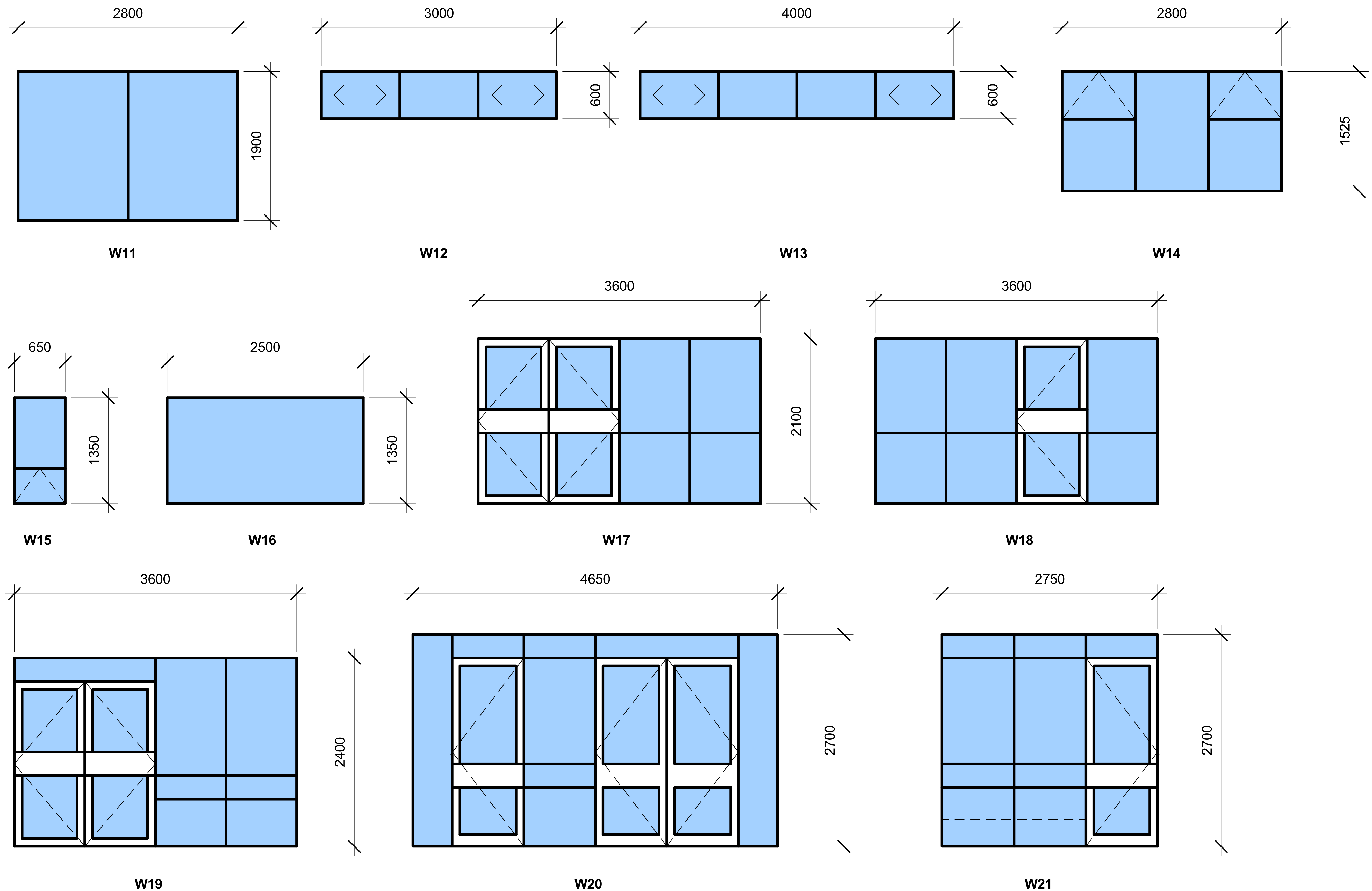
dwg. A105



WINDOW SCHEDULE 1

1 : 50

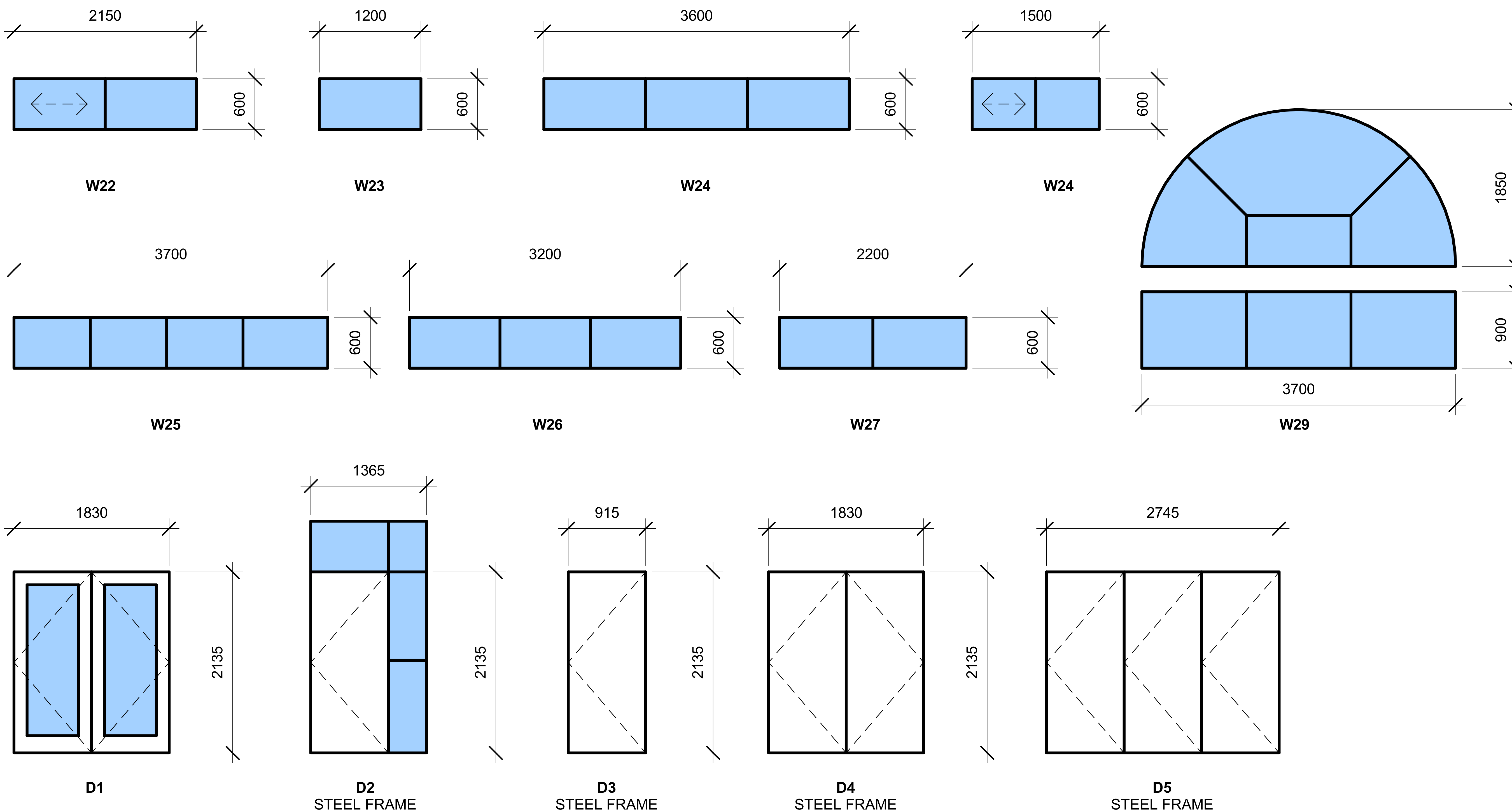
dwg. A106



WINDOW SCHEDULE 2

1 : 50

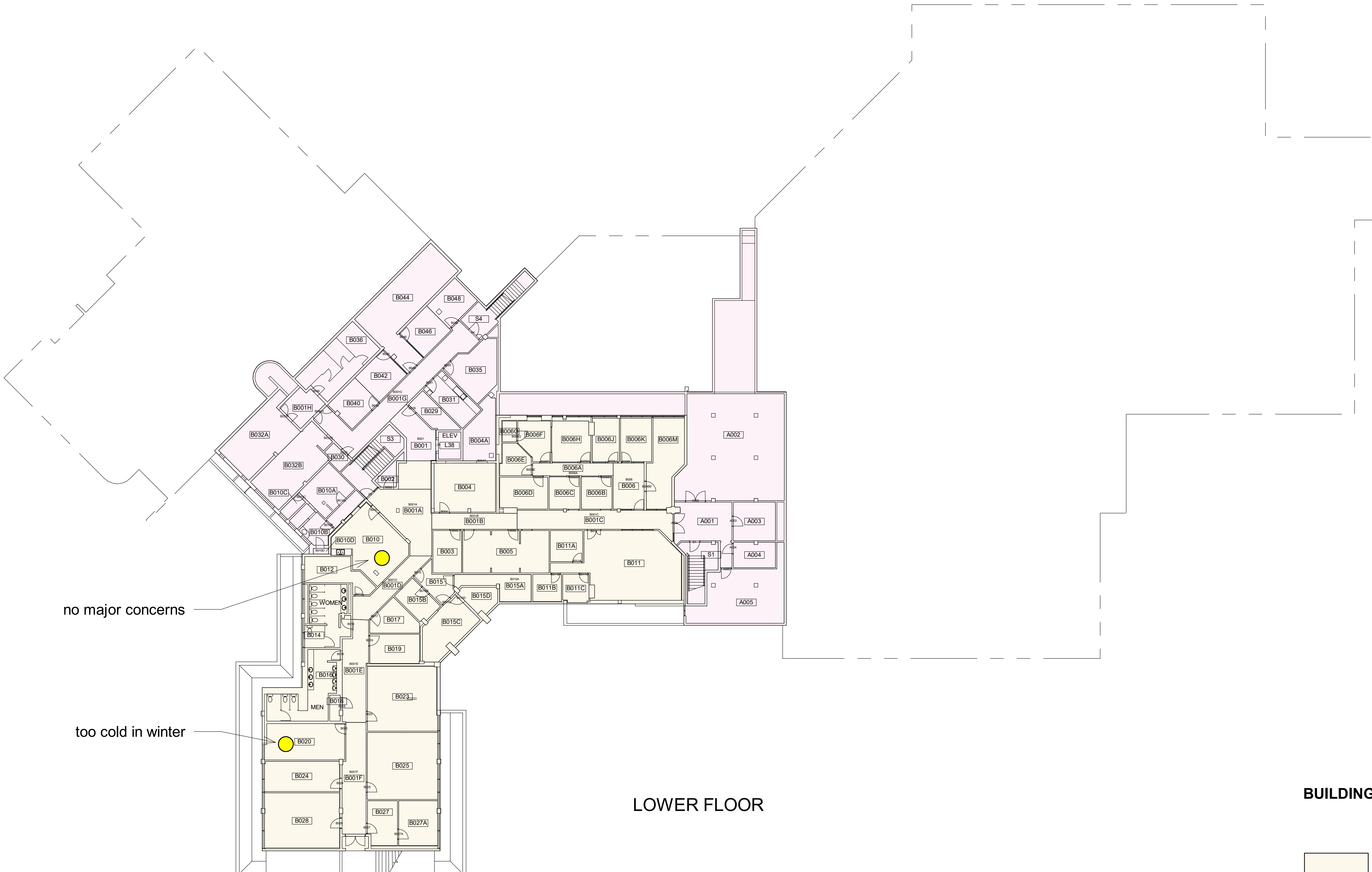
dwg. A107



WINDOW SCHEDULE 3

1 : 50

dwg. A108



BUILDING PHASES

1963

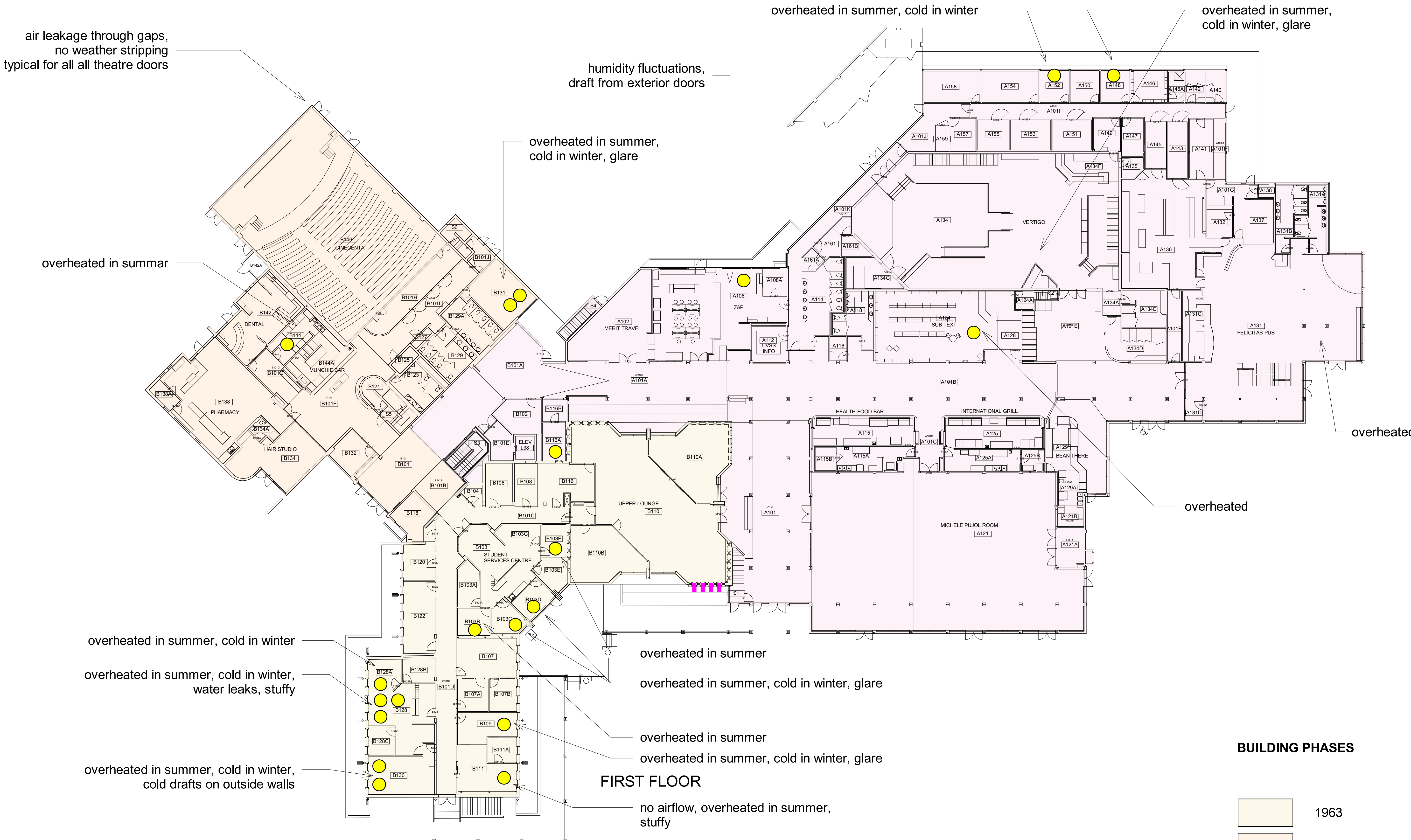
1975

1996

1 Lower Survey

1 : 400

dwg. A109



BUILDING PHASES

1963

1975

1996

First Floor Survey

1 : 400

1

dwg. A110

BUILDING PHASES

1963

1975

1996

1 Second Floor Survey

1 : 400

dwg. A111