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Report Name	Energy and Thermal Modelling Assessment – ESD001
Project	Chief Mechanical Engineer's Building (CME) – Redfern
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This Consultants Advice Notice (CAN) is prepared to provide a short summary of the Computational analysis undertaken to evaluate Energy and Thermal Assessment for the proposed Refurbishment of the heritage building Chief Mechanical Engineer's Building (CME) – Redfern, located at 505 Wilson Street Redfern, NSW, 2015.

This is a preliminary assessment of the existing heritage building fabric and seeks to inform the design with respect to only the building envelope thermal performance requirements.

1 Introduction:

The assessed part of the proposed development is located in climate zone 5 and has been assumed to be classified as Class 5 Office.

The scope of the analysis and interpretation of conditioned and unconditioned spaces are based on the review & interpretation of the architectural drawing plans and elevations of the proposed development (prepared by CCG Architects dated 07/11/2022). Please refer to **Appendix A** for definition of the thermal envelope and assumed extent of the conditioned spaces. The Conditioned office space in Energy assessment is modelled with a standard air conditioning system and does not consider any potential energy savings from mixed mode operation where the system could be switched off when outdoor conditions are favourable.

Furthermore, due to the early stage of design and the available information, the following model has utilised high level assumptions. It should be noted that the results provided are solely for the purposes of evaluating the existing building fabric performance and **is only a relative assessment between several options**. It is an investigation undertaken to provide advice if the reasonable upgrades to building fabric are required in order to have improved energy and thermal performance. The results should not be used for quantifying actual predicted energy consumption for the Chief Mechanical Engineer's Building - Redfern project.

METHODOLOGY

The energy modelling is undertaken in IESVE 2021.3.1.0. The modelling is undertaken as per guidelines of NCC 2019 Section J Specification JVb Modelling parameters for operational profiles, internal gains, occupant density and equipment gains. The mechanical system is modelled as a standard unitary system having a COP/EER of 3.1.

2 Building Geometry and Fabric Properties

The model was created using the geometry based on the documentation supplied by the architect are at a scale of 1:1 in the model with the orientation of the building accurately represented in the models.

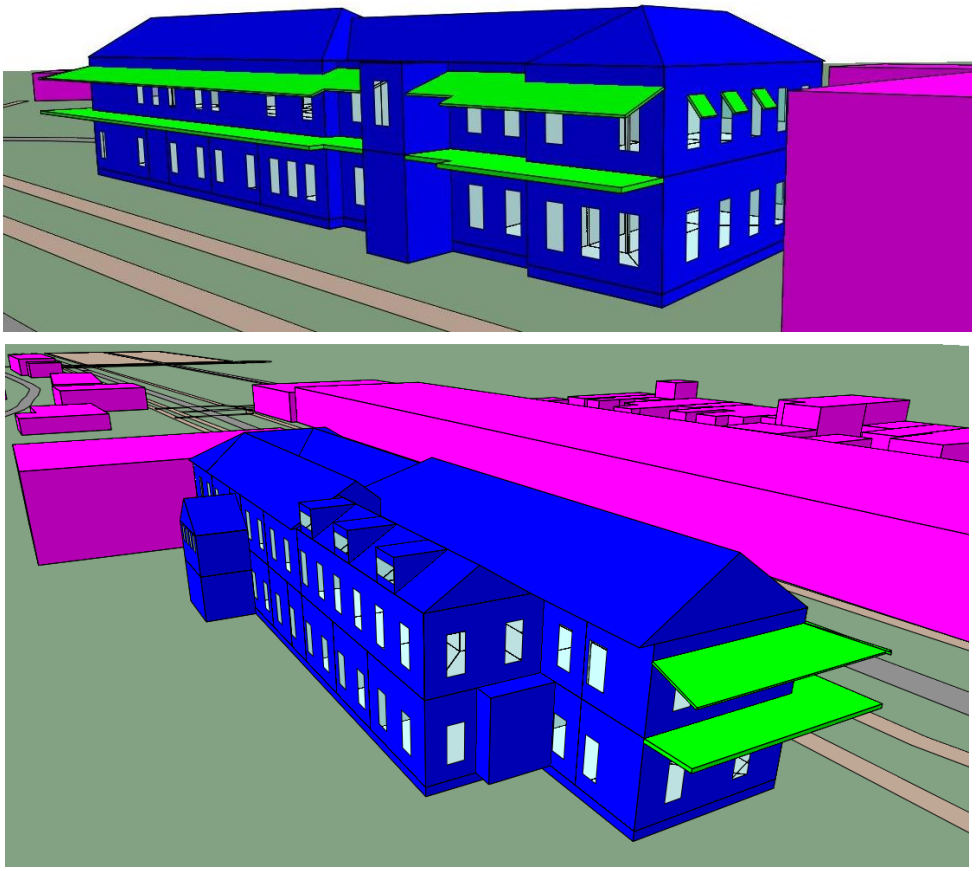

Figure 1: Chief Mechanical Engineer's Building IES VE 3D simulation model

The Chief Mechanical Engineer's Building is a heritage building where it is desired not to have modifications made to the building walls, such as addition of thermal insulation; There have been examples of poor modifications that prevent adequate ventilation of the fabric and lead to structural problems. It can be assumed that the walls are double brick with an air cavity but in the absence of known thermal performance and without destructive testing/investigation, it is assumed that the external wall only meets the minimum NCC 2019 Section J Deemed -to-Satisfy (DtS) building fabric performance requirement. This is an acceptable assumption for the purpose of this relative assessment where other factors can be tested and the opaque wall fabric is assumed to be consistent between reference and proposed scenarios.

Table 1 summarizes the investigated opaque fabric performance which is in alignment of minimum NCC 2019 Section J Deemed -to-Satisfy (DtS) building fabric requirements and followed by Table 2 summaries the Glazing performance.

Table 1: Opaque Building Fabric Parameters

Building Element	Total System R-value (m^2K/W)	Note
Ceiling/Roof	R_T 3.7, SA≤ 0.45 (Downward)	R_T-value is a total system performance value and **NOT** the insulation R-value. Upward /Downward refers to direction of heat flow. SA refers to maximum solar absorptance of upper surface. Slab on ground is in accordance with NCC 2019 Specification J1.6. If the Ground Floor slab is not in contact with the ground, it is required to achieve a R2.0 m^2K/W total construction.
Suspended Floor	R_T 2.0 (Downward)	
Slab on Ground	R_T 2.0 (Downward)	
External Walls[1]	R_T 1.4	

Please refer to Appendix A for the mark-ups of the building fabrics thermal construction requirements.

Note 1 - External Wall R_T 1.4 is the assumed minimum NCC 2019 Section J Deemed -to-Satisfy (DtS) building fabric performance and may not accurately represent the existing heritage wall performance (which may be double brick with air cavity).

Table 2: Window System Parameters

Attributes	Modelled	Total System U-value (W/m^2K)	System SHGC
External Glazing	Existing Single Glazing	5.8	0.8
	Replacement Double Glazing	3.3	0.6

3 Results and Discussion

The investigation is undertaken step by step by dividing the assessment into 4 scenarios. Each scenario evaluates upgrade of one building element at a time and monitors the influence of that single upgrade on the predicted annual heating and cooling energy consumption (in kWh of electricity). This allows a relative comparison of the proposed upgrades in comparison to the reference case building.

The reference building is set up as base case assuming having no floor and roof insulation with only walls having the assumed minimum NCC 2019 Section J DTS performance and Single glazed windows. Each scenario is built from the reference case having same wall and glazing performance except for Scenario 1.

Reference Case: Walls R1.4 (Same for Scenario 1 -4)

Glazing Uw 5.8 SHGC 0.8 (Same for Scenario 2 -4)

No floor and No roof insulation. (Only Scenario 1)

Scenario 1: Comparison between Single and Double-Glazed windows

Scenario 2: Adding only Floor insulation R2.0 to Reference Case

Scenario 3: Adding only Roof insulation R3.7 to Reference Case

Scenario 4: Adding both Floor R2.0 & Roof R3.7 insulation to Reference Case

Table 3: Heating and Cooling energy Consumption

Scenario	Condition	Space Heating Electricity (kWh)	Space Cooling Electricity (kWh)
	Reference Case	35,294	40,084
Scenario 1	Comparison between Single and Double-Glazed windows	34,429	39,356
Scenario 2	Adding only Floor insulation R2.0 to Reference Case	32,025	41,866
Scenario 3	Adding only Roof insulation R3.7 to Reference Case	32,221	40,562
Scenario 4	Adding both Floor R2.0 & Roof R3.7 insulation to Reference Case	28,951	42,389

Table 4: Comparative Analysis between the reference building and Building fabric Upgrade.

Scenario	Condition	Proposed Improvement Fabric Result (kWh electricity) Space Heating & Cooling Only	Reference Case Result (kWh electricity) Space Heating & Cooling Only	% Improvement in annual Heating/Cooling energy consumption
Scenario 1	Comparison between Single and Double-Glazed windows	73,784	75,378	**2%**
Scenario 2	Adding only Floor insulation R2.0 to Reference Case	73,891		**2%**
Scenario 3	Adding only Roof insulation R3.7 to Reference Case	72,783		**3%**
Scenario 4	Adding both Floor R2.0 & Roof R3.7 insulation to Reference Case	71,340		**5.4%**

4 Conclusion

1. The exisiting heritage building has less than 20% window to wall ratio further noting the speculated historical double brick wall contruction provides the building with good thermal mass. In addition, the overhang on the north façade provides good shading to the long building mass on the nothern orientation.
2. Upgrading the windows to double glazing provides improved energy performance at peak conditions (maximum summer cooling or winter heating) however it may not be advantageous due to the following two factors
    - Considering the percentage improvement, it does not necessarily provide a good return on investment in the whole of life cost analysis. The window-wall ratio is very low and the existing glazing was refurbished around 10 years ago and is in good condition.
    - Noting the heritage aspect of the building it may be worthwhile to maintain the desired heritage façade and its timber sash windows joineries. New DGU panels may not fit in the current timber sashes.
    - The proposed HVAC system will incorporate mixed mode operation so in ideal conditions the windows may be left open, reducing the effectiveness of double glazing.
3. Floor and roof insulation, either individually or combined, provides significant improvement in the thermal performance. It would be beneficial to consider upgrading either of the two due to the following factors
    - Either floor or roof insulation can be installed without impacting the heritage façade. (so long as insulation is installed only between joists to maintain adequate airflow to subfloors to manage moisture)
    - It would be also advantageous for acoustic and thermal comfort.

: Thermal Envelope Mark-Up