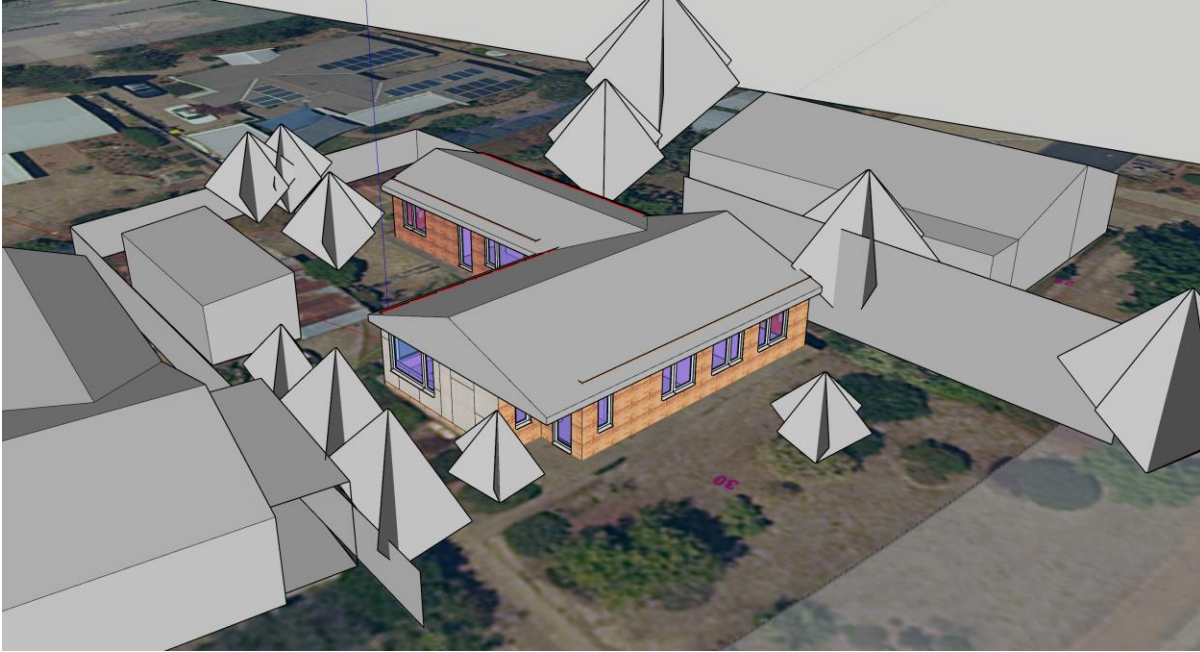




PHPP EnerPHit Feasibility Report for 30 ARCHER STREET DICKSON

This report seeks to review the as built design for the above project to assess if it is feasible to meet the Passive House Institute EnerPHit criteria. It will otherwise highlight the potential improvements that can be made to enhance the health and comfort of the building users as well as the efficiency and cost of operating the building using DesignPH and the Passive House Planning Package (PHPP).

For:

June 2023

Job No: 230620

Revision:-

Written: Tom Hughes

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TABLE OF CONTENTS

SUMMARY	4
INTRODUCTION	6
CRITERIA.....	7
MODELLING	9
MODELLING RESULTS	10
DESIGN ASSESSMENT AND RECOMMENDATIONS	11
CONCLUSIONS.....	20
FURTHER ACTIONS	21

SUMMARY

Tom Hughes was appointed to review the as built design for 30 Archer Street to assess the feasibility of meeting the Passive House EnerPHit criteria. The building was modelled and interrogated using DesignPH and the Passive House Planning Package (PHPP). The report outlines what building design specifications have been considered to meet the EnerPHit criteria.

This report will otherwise highlight the potential improvements that can be made to enhance the health and comfort of the building users as well as the efficiency in operating the building.

Based on the information available and assumptions made, the results show that the building would not achieve the EnerPHit Energy Demand Method (Heating demand below 20 kWh/m²a) without deep changes to the envelope in term of shape (form factor) and specifications.

EnerPHit Energy Demand Verification Sheet

Specific building characteristics with reference to the treated floor area				2 error message(s) in 'Check' worksheet		
				Criteria	Alternative criteria	Fulfilled? ²
Space heating	Treated floor area m ²	139.2				
	Heating demand kWh/(m ² a)	35.98	≤	20	-	No
	Heating load W/m ²	18.00	≤	-	-	
Space cooling	Cooling & dehum. demand kWh/(m ² a)	-	≤	-		-
	Frequency of overheating (> 25 °C) %	0.12	≤	10		Yes
	Frequency of excessively high humidity (> 12 g/kg) %	0.00	≤	20		Yes
Airtightness	Pressurisation test result n ₅₀ 1/h	1.00	≤	1.0		Yes
Moisture protection						
	Smallest temperature factor f _{Rsi} 0.25 m ² K/W	-	≥	0.37	0.17	-
Thermal comfort						
	All requirements fulfilled?					Yes
	U-value W/(m ² K)		≤	1.30		
	U-value W/(m ² K)		≤	1.55		
	U-value W/(m ² K)		≤	1.69		
	U-value W/(m ² K)		≤	0.71		
Non-renewable Primary Energy (PE)	PE demand kWh/(m ² a)	86.31	≤	-		-
Primary Energy	PER demand kWh/(m ² a)	42.67	≤	96	96	
Renewable (PER)	Renew. energy generation (in rel. to projected building footprint area) kWh/(m ² a)	0.00	≥	-	-	Yes

EnerPHit (retrofit): Component characteristics						
Building envelope to exterior air ¹ (U-value) W/(m ² K)	0.24	≤	-			-
Building envelope towards ground (heat loss/load) kWh/(m ² a)		≤	-			-
Wall w/int. insulation in contact w/exterior air (U-value) W/(m ² K)	-	≤	-			-
Flat roof (SRI) -	45	≥	-			-
Inclined and vertical external surface (SRI) -	45	≥	-			-
Windows/Entrance doors (U _{w,d,installed}) W/(m ² K)	1.00	≤	-			-
Windows (U _{w,installed}) W/(m ² K)	-	≤	-			-
Windows (U _{w,installed}) W/(m ² K)	-	≤	-			-
Glazing (g-value) -	0.35	≥	-			-
Glazing/sun protection (max. solar load) kWh/(m ² a)	162	≤	-			-
Ventilation (effective heat recovery efficiency) %	85	≥	-			-
Ventilation (humidity recovery efficiency) %	0	≥	-			-

¹ Without windows, doors and external walls with interior insulation
² Empty field: data missing; '-': No requirement

I confirm that the values given here have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.	EnerPHit (Energy demand method Classic)	No
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However, the building would meet the EnerPHit Component Method with retrofit of insulation to the existing envelope, replacement high performance triple glazed windows/doors, achieving air tightness of 1.0 air changes per hour (ACH) and use of mechanical heat recovery ventilation. All of these measures are detailed in the Modelling Results section.

EnerPHit Component Method Verification Sheet

Specific building characteristics with reference to the treated floor area				2 error message(s) in 'Check' worksheet		
				Criteria	Alternative criteria	Fulfilled? ²
Space heating	Treated floor area m ²	139.2				
	Heating demand kWh/(m ² a)	35.98	≤	-	-	-
	Heating load W/m ²	18.00	≤	-	-	-
Space cooling	Cooling & dehum. demand kWh/(m ² a)	-	≤	-	-	-
	Frequency of overheating (> 25 °C) %	0.12	≤	10		Yes
	Frequency of excessively high humidity (> 12 g/kg) %	0.00	≤	20		Yes
Airtightness	Pressurisation test result n ₅₀ 1/h	1.00	≤	1.0		Yes
Moisture protection	Smallest temperature factor f _{Rsi=0.25} m ² K/W	-	≥	0.37	0.17	-
Thermal comfort	All requirements fulfilled?					Yes
	U-value W/(m ² K)		≤	1.30		
	U-value W/(m ² K)		≤	1.55		
	U-value W/(m ² K)		≤	1.69		
	U-value W/(m ² K)		≤	0.71		
Non-renewable Primary Energy (PE)	PE demand kWh/(m ² a)	86.31	≤	-		-
Primary Energy Renewable (PER)	PER demand kWh/(m ² a)	42.67	≤	96	96	Yes
	Renew. energy generation (in rel. to projected building footprint area) kWh/(m ² a)	0.00	≥	-	-	-

EnerPHit (retrofit): Component characteristics				
Building envelope to exterior air ¹ (U-value) W/(m ² K)	0.24	≤	0.3	Yes
Building envelope towards ground (heat loss/load) kWh/(m ² a)		≤	14.4	-
Wall w/int. insulation in contact w/exterior air (U-value) W/(m ² K)		≤	0.5	-
Flat roof (SRI) -	45	≥	-	-
Inclined and vertical external surface (SRI) -	45	≥	-	-
Windows/Entrance doors (U _{w, installed}) W/(m ² K)	1.00	≤	1.08	Yes
Windows (U _{w, installed}) W/(m ² K)	-	≤	1.13	-
Windows (U _{w, installed}) W/(m ² K)	-	≤	1.23	-
Glazing (g-value) -	0.35	≥	0.34	Yes
Glazing/sun protection (max. solar load) kWh/(m ² a)	162	≤	-	-
Ventilation (effective heat recovery efficiency) %	85	≥	75	Yes
Ventilation (humidity recovery efficiency) %	0	≥	-	-

¹ Without windows, doors and external walls with interior insulation
² Empty field: data missing; '-': No requirement

I confirm that the values given here have been determined following the PHPP methodology and based on the characteristic values of the building. The PHPP calculations are attached to this verification.

EnerPHit (Component method) Classic? ☐

The build-ups modelled have been optimised for cost to minimise labour for installation and maximise the use of the existing structure whilst the building is occupied. If higher performance and increased durability is demanded then greater deconstruction can be planned, however, at greater cost and requiring the occupants to move out during construction.

INTRODUCTION

Passivhaus buildings are modelled and designed to achieve high levels of health and comfort with very low energy consumption. This is achieved by the building envelope being appropriate for the building in its climate. The envelope must ensure that the building is free of cold (and mould) and hot spots, draughts and unhealthy air –precisely what every building should provide for the people who use them.

In the Australian context particular attention is paid to stress testing the building to minimise the risk of overheating and ensuring that there are strategies to manage this are designed into the building. This is critical to a resilient building in a warming and less stable climate.

The design principles of Passive House must be used together to ensure the building works as a complete system. It is important to understand that these principles are working together to manage the heat loss and gain in separating the indoor environment from the outdoor environment. The primary principles are continuous insulation, quality windows and doors, airtight construction, heat recovery ventilation and thermal bridge free design.

Energy modelling of the building using the Passive House Planning Package (PHPP) informs the design from concept to completion. This energy model allows the design and build team to understand how each principle impacts the performance.

An important design principle is the building orientation, how the building is positioned relative to the movement of the sun through the seasons. The amount of area of windows and their orientation is significant to the performance of the building. However, there are buildings where the orientation is less than ideal, this is where the PHPP is able to optimise the design to ensure the same level of performance is achieved for any building on any site.

Insulation slows the heat flow in and out of the building envelope and minimises the energy needed to keep the internal temperature stable. A key principle is to design appropriate levels of continuous insulation for the building in its climate. Insulation needs to be installed without any gaps between wind tight layers inside and out to ensure it works as designed.

Quality windows must like the rest of the envelope also slow the flow of heat but in addition also manage the solar radiation into the building envelope. Windows are primarily to provide views and daylighting and in doing so provide a connection to the outside. In providing this amenity they must perform well enough to avoid feeling cold when being near them and to ensure that they never develop condensation or mould. They are the most expensive and lowest performance part of the building envelope and so designing windows to achieve the optimum balance of these demands is critical.

An extension of the quality windows design principle is that of shading of windows to manage the solar radiation entering the building. Only with accurate modelling of shading from the building and surrounds combined with accurate frame and glazing performance data is the seasonal performance of windows able to be understood and managed. Windows and shading are critical to managing the risk of overheating of the buildings.

An airtight construction system prevents air leakage that will carry heat and moisture into the building envelope. This is a risk to the health of the people using the building as well as the durability of the building. Moisture that accumulates will lead to mould and decay of the envelope. Airtightness is measured with a blower door test both during and at the completion of construction. The airtightness system must be designed to be continuous. This system not only limits heat loss and moisture movement but also dust, insects and pollution and from the outside. The additional significant benefit is that airtightness also limits noise from outside.

Heat Recovery Ventilation (HRV) provides continuous filtered fresh air for the people in the building and removing stale, moist, odourous air. It does this whilst either recovering the heat from the extract air or removing the heat from the supply air as needed. This system is operated by low power fans and is both quiet enough that it can't be heard and low flow enough that it can't be felt. The continuous low-level ventilation of the building also manages moisture levels (humidity) inside, this is important for both the health and comfort of the people but also the durability of the building envelope.

The final principle of thermal bridge free construction ensures that the heat flow and moisture risk of the building envelope is considered from the earliest design and specification. Thermal bridging occurs whenever there is a change in the building envelope geometry (junctions) and then whenever the insulation layer is interrupted by less insulative materials resulting in more heat flow. Most thermal bridges are able to be designed out and where this is not practicable then they are modelled and accounted for in the PHPP energy model to correct for this difference.

CRITERIA

The EnerPHit criteria were defined and introduced in 2010 for building retrofits. These have been refined, by the Passive House Institute Darmstadt since this time. A building may only be referred to as a EnerPHit if it meets these criteria and the building design and construction is independently verified by a Passive House Certifier.

The document "Criteria for Passive House, EnerPHit and PHI Low Energy Building Standards (Ver10b, May 2022)" outlines all of the processes to be followed and criteria to be met for a building to achieve any one of these standards. There is either the Energy Demand Method or Component Method that can be met to achieve EnerPHit certification.

Table 4 General EnerPHit criteria (always applicable irrespective of the chosen method)

			Criteria ¹	Alternative Criteria ²		
Airtightness						
Pressurization test result n ₅₀	[1/h]	≤	1.0			
Renewable Primary Energy (PER) ³						
			Classic	Plus	Premium	
PER demand ⁴	[kWh/(m²a)]	≤	60 + allowance for larger heating/cooling demand (compared to Passive House)	45	30	±15 kWh/(m²a) deviation from criteria...
Renewable energy generation ⁵ (with reference to projected building footprint)	[kWh/(m²a)]	≥	-	60	120	...with compensation of the above deviation by different amount of generation ⁶

Table 3 EnerPHit energy demand criteria (as an alternative to Table 2)

Climate zone according to PHPP	Heating	Cooling
	Max. heating demand	Max. cooling + dehumidification demand
	[kWh/(m²a)]	[kWh/(m²a)]
Arctic	35	equal to Passive House requirement ¹
Cold	30	
Cool-temperate	25	
Warm-temperate	20	
Warm	15	
Hot	15	
Very hot	15	

Table 2 EnerPHit component criteria

Climate zone according to PHPP	Opaque envelope ¹ against...				Windows (including exterior doors)					Ventilation	
	...ground	...ambient air			Overall ⁴			Glazing ⁵	Solar load ⁶	Min. heat recovery rate ⁷	Min. humidity recovery rate ⁸
	Insulation	Exterior insulation	Interior insulation ²	Exterior paint ³	Max. heat transfer coefficient (U _{D/W, installed})			Solar heat gain coefficient (g-value)	Max. specific solar load during cooling period		
	Max. heat transfer coefficient (U-value)			Cool colours							
	[W/(m²K)]			-	[W/(m²K)]			-	[kWh/m²a]	%	
Arctic	Determined in PHPP from project specific heating and cooling degree days against ground.	0.09	0.25	-	0.45	0.50	0.60	U _g - g*0.7 ≤ 0	100	80%	-
Cold		0.12	0.30	-	0.65	0.70	0.80	U _g - g*1.0 ≤ 0		80%	-
Cool-temperate		0.15	0.35	-	0.85	1.00	1.10	U _g - g*1.6 ≤ 0		75%	-
Warm-temperate		0.30	0.50	-	1.05	1.10	1.20	U _g - g*3.2 ≤ -0.6		75%	-
Warm		0.50	0.75	-	1.25	1.30	1.40	-		-	-
Hot		0.50	0.75	Yes	1.25	1.30	1.40	-		-	60 % (humid climate)
Very hot		0.25	0.45	Yes	1.05	1.10	1.20	-		-	60 % (humid climate)

The Verification page shown above in the Summary section outlines the modelled performance of 30 Archer Street against these criteria and is explained in more detail below. Note that most of the criteria are referenced to m², this is of Treated Floor Area (TFA), a defined useable floor area of the building. This measures the buildings absolute performance and allows direct comparison to any other building anywhere in the world.

30 Archer Street is within the warm-temperate climate. The key criteria for EnerPHit certification using the Energy Demand Method is a Heating Demand of less than 20kWh/m²a to keep the building above 20°C .

The Cooling Demand is set according to the climate as it is made up of the energy used to maintain the building below 25°C also less than 15kWh/m²a (sensible heat energy), as well as the energy used to keep

the humidity below 12g/kg (latent heat energy). The frequency of overheating is only shown when there is no active cooling in the building, it is otherwise assumed that this is managed by the cooling and dehumidification system.

A critical measure of the building performance is the airtightness. This is set to be less than 1.0 air changes per hour at 50Pa (equivalent to a 32km/h wind blowing), this is measured with a blower door test of the building.

Both the Heating and Cooling Demand are set such that the building remains within the hygiene and comfort band of 20-25°C, and less than 12g/kg of absolute humidity for more than 90% of the time with air conditioning (approx. 60% RH at 25°C).

Accordingly, the Moisture Protection criteria is referring to a minimum internal to external temperature ratio that excludes the chance of mould forming when a surface becomes too cold allowing moisture from the air to form on a surface. A dash in this section signifies that dehumidification is required in the building to manage this risk.

In addition to the space conditioning, Passive House limits all other energy use within the building to ensure the design of services and selection of equipment is energy efficient. These other energy sources include hot water heating, lighting, cooking, laundry, consumer electronics.

The total energy demand for the building (for all energy uses) is set by the Primary Energy Renewable (PER) being less than 60kWh/m²a. This is a metric that assumes a future situation of a fully renewable energy grid supply. This takes account of the additional renewable energy that must be generated to account for any required storage and transmission losses before it is used in the building. Accordingly, there is a penalty for energy use when renewable energy is less easily generated in the heating season. This allows the building to be designed with the environmental impact of the energy used to be considered in conjunction with the thermal performance.

In addition to the EnerPHit Classic there are then EnerPHit Plus and Premium Criteria that take into account the addition of any renewable energy that is generated by the project. This is often solar photovoltaic panels on the roof of the building but can be new generation added away from the site be that wind, hydro or photovoltaic.

MODELLING

In order to accurately define the performance of a building a three-dimensional model is built in SketchUp to use the DesignPH plug-in. This accurately generates the areas of the building envelope in its context this is particularly critical to understand the impact of solar radiation and shading on windows and glazed doors. This model is then moved into the PHPP to understand the buildings energy balance and refine the building to most cost effectively achieve the required performance.

The PHPP allows for iteration of the building design in providing immediate feedback to understand the impact of any one measure in achieving the Passive House standard.

The report will also provide suggestions for building optimisation, eg, for avoiding thermal bridges or specifying particular performance of windows. The building design team can then use this information in further design and planning.

If the project is to be certified the building design and specification, DesignPH model and PHPP are then reviewed by the Certifier, this is ideally done prior to construction to obtain a pre-construction letter from the Certifier. Subsequent to construction the details are verified by Certifier using photographic and

documentary evidence as well as the final blower door test to confirm that the air tightness target was achieved. If it is verified as meeting the Criteria then it can be certified by the Passive House Institute.

The EnerPHit PHPP can be used to generate a Step by Step EnerPHit plan that can be pre-certified to provide assurance to that the project owner that it will achieve the desired outcome once completed. This is to ensure that the project is most economical only spending money to upgrade and replace components as they reach the end of their serviceable life.

MODELLING RESULTS

30 Archer Street as planned in the EnerPHit Component Method will limit the **Heating Demand to less than 36kWh/m²a** to maintain the temperature above 20°C. By comparison the existing building would require 365kWh/m²a.

A more realistic existing energy use of 80kWh/m²a has been calculated. This is in only maintaining an average temperature of 11.7°C resulting from only intermittent heating (for the average temperature across the building throughout the heating season).

The EnerPHit **Cooling Demand is less than 2.5kWh/m²a**, again the existing building would use 59kWh/m²a to maintain the temperature below 25°C.

The frequency of overheating (hours above 25°C each year) is 5%, this is generally considered acceptable. It is readily reduced to less than 1% with night time ventilation (or air conditioning).

These results are calculated with the following assumptions:

EnerPHit Criteria		
	EnerPHit Component Method	Existing Building
Heating Demand Temp >20 °C	36kWh/m ² a	365kWh/m ² a
Cooling Demand Temp <25 °C	2.5kWh/m ² a	59kWh/m ² a
Primary Energy Renewable	44kWh/m ² a	318kWh/m ² a
Building Envelope U-values W/m²K	Wall: 0.324	Wall: 1.409
	Floor: 0.418	Floor: 2.076
	Roof: 0.156	Roof: 2.394
Window Installed Average U-value	1.00W/m ² K	5.55W/m ² K
Window g-value (solar gain coefficient)	0.55	0.87
MVHR Efficiency	84.7%	Window ventilation
Airtightness	1.0ACH	15.0ACH

DESIGN ASSESSMENT AND RECOMMENDATIONS

ORIENTATION

The main massing is oriented north-south and has the living areas east and north facing, with service rooms to the south and bedrooms on the West. There is some risk of the bedrooms overheating in the cooling season without solar radiation protection for the windows such as external blinds.

The extension massing into backyard runs east-west with a second living space and bedroom with north orientation and an ensuite at the southeast corner. This section of the building is well oriented for managing solar radiation on the windows with overhead shading adequately managing the direct beam radiation.

WINDOWS

The windows must of course work with the building orientation (and views/privacy) and should achieve the optimum balance between heat loss and solar radiation gain throughout the year. They are the most expensive and the lowest performance part of the building envelope and are critical to the building achieving EnerPHit performance. In the case of 30 Archer Street double glazed windows would not be sufficient to meet the Component requirement. It would require triple glazed windows with an average installed U-value of $<1.00\text{W/m}^2\text{K}$.

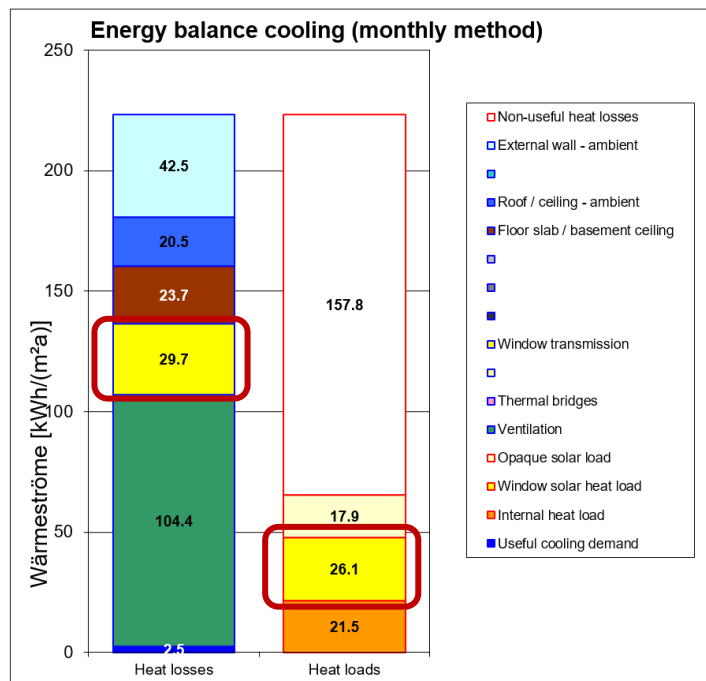
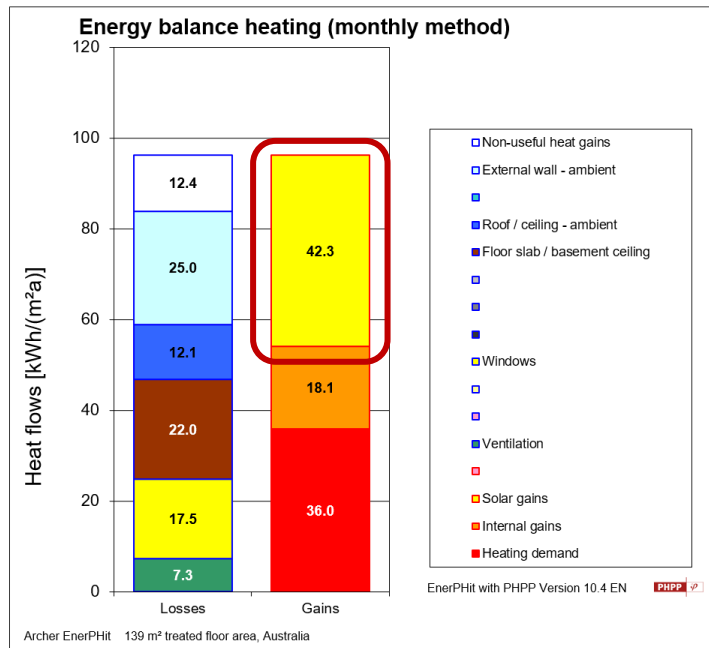
As designed 30 Archer Street has 36m^2 of windows to 139m^2 of TFA which is a 26% glazing ratio. This is not high by contemporary building design standards, however, it is at the upper end of this measure to economically achieve the EnerPHit criteria. It would be ideal to reduce this ratio close to 20%.

Window orientation	Window area	Window U_w installed	Glazing area	Average global radiation
Standard values →	m^2	$\text{W}/(\text{m}^2\text{K})$	m^2	$\text{kWh}/(\text{m}^2\text{a})$
North	15.3	5.35	12.29	604
East	8.7	5.54	7.33	247
South	2.9	5.81	2.57	107
West	9.2	5.79	8.35	376
Horizontal	0.0	0.00	0.00	488
Total or average value for all windows.	36.14	5.55	30.54	414

30 Archer Street glazing areas and orientations

The glazing is providing 42% of the heat gains for the heating season from solar radiation, this is considered to be too great a proportion for a balanced energy load on the building - it will need additional heating when it is cloudy. Note during the heating season the 42.3kWh/m²a gain against the 17.5kWh/m²a heat loss for the windows, 24.8kWh/m²a of free heat.

The cooling season demonstrates an almost equal heat gain to loss which is only possible with the solar controlled glazing (lower g-value).



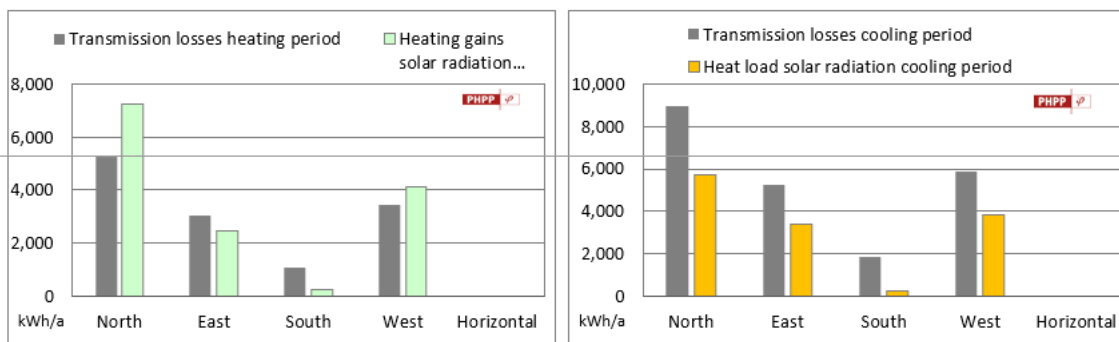
The overall window area could be reduced to increase the building performance and this is unlikely to be overly detrimental to the daylighting within the rooms. The daylighting performance could additionally be modelled to quantify the difference in performance, this is performed in different software. At a minimum I would suggest increasing the sill height of the windows as this has the least impact on views and daylighting and also provides more useable wall space for furniture placement. It is additionally relatively

inexpensive to construct although this change will impact the quite distinct proportions of the windows in the house.

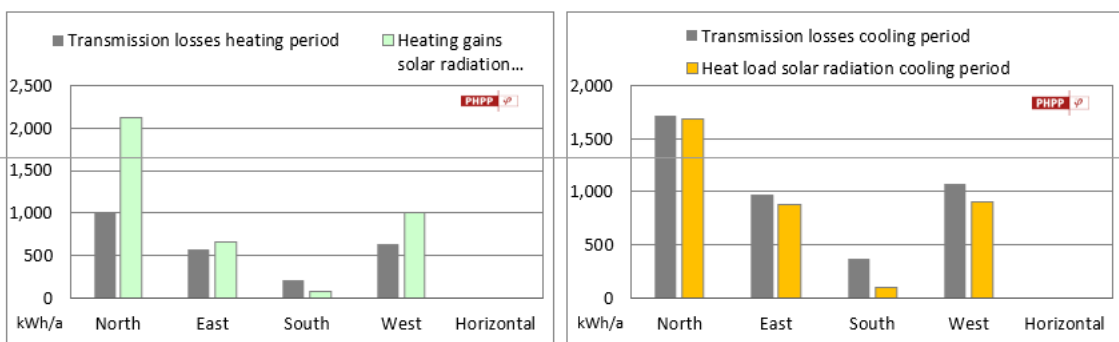
The North glazing is 42% of the total and the South only 8% with East and West making up around 25% each. This distribution is quite reasonable for the Canberra warm temperate climate where minimising heat loss to the South and maximising solar radiation gain to the North is important in the heating season and that the additional gain from the East and West is useful.

It may require blinds for the East and West windows to manage solar radiation intermittently in the shoulder seasons and throughout the cooling season. It is also recommended to add a provision for a blind on the two living space north windows to ensure comfort in being close to these windows in the shoulder and cooling seasons. More detailed analysis will inform these decisions.

The new windows and doors are uPVC frames and triple glazed (TG) with low emission coatings and achieve an overall installed U-value of 1.00W/m²K. This is over 550% better performance than the existing windows.



Existing windows/doors (single glazed with Aluminium frame) heat loss and gain through the heating and summers



New windows/doors (triple glazed with uPVC frame) heat loss and gain through the heating and summers, note the different values on the x-axis.

The new windows/doors reduce the magnitude of the heat loss and gain by some 430%. In the winter they shift the ratio of heat loss to solar gain from 70% to 50% on the North orientation.

The new windows/doors make the heat loss and gain largely equal in the summer. This is in contrast to the existing windows that demonstrate substantially greater heat loss than gain which would seem to be a better situation. However, the magnitude of this heat energy loss and gain is reduced by 450%, that is the new windows are working to control the rate and quantity of heat flow and that equates to a stable indoor temperature over the day and night.

FORM

The massing of 30 Archer Street is relatively elongated and is single level. This form results in a large building envelope surface area relative to floor area.

The ratio of these areas is known as the form factor. The larger the surface area the more heat flow through the building envelope and accordingly a higher level of insulation is needed to meet the Passive House levels of energy demand for heating and cooling.

30 Archer Street has a form factor of 3.7, this is at the higher end of the range (often between 3-4) and largely why it will not achieve the EnerPHit Energy Demand Method. Inherently the massing of the building is inefficient to achieve very low energy use performance and it would not be cost effective to improve this sufficiently.

This situation is why the EnerPHit Component Method was developed to ensure that all buildings regardless of form can be retrofitted to improve the health, comfort and energy use of buildings.

OVERHEATING

Overheating is defined in the Passive House Criteria as the internal temperature being above 25°C. The PHPP then calculates how many hours in a year as a percentage the building is expected to exceed this temperature. It is important to understand that the PHPP is a single zone model and as such is reporting the average temperature of the whole building, that is it does not identify any particular room as being likely to overheat. This is either to be modelled in a dynamic zonal model or is usually able to be realistically managed with consideration of the room orientations and glazing in understand the likely overheating risk.

30 Archer Streets' risk of overheating is effectively removed with the opening of windows in the cooler night time. This is possible with the large day to night temperature difference that the elevated inland location provides.

The stress test for summer comfort demonstrates the even with a 2°C average temperature increase in the summer the building is still able to operate within the 10% limit criteria although this represents some 463 hours above 25°C.

Air conditioning would of course also manage this risk however, it is important to understand that night time purge ventilation easily manages this unwanted heat gain in the building - this is also only during the period January to March.

Stress test for summer comfort

Stress test calc.
EnerPHit with PHPP Version 10.4 EN

PHPP

Influence of use

Basic summer ventilation via windows 1/h
Additional night ventilation via windows 1/h
Use of temporary shading -
Internal heat gains W/m²

Summer climate

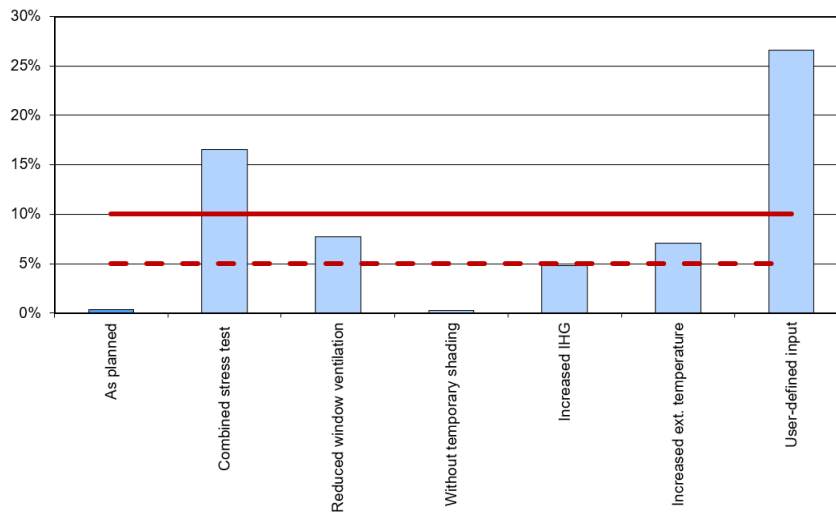
Summer temperature increase K

Results

Frequency of overheating K/h
Overheating degree hours K
Daily indoor temperature fluctuation K

	As planned	Combined stress test	Reduced window ventilation	Without temporary shading	Increased IHG	Increased ext. temperature	User-defined input
Basic summer ventilation via windows 1/h	0.00	0.00	0.00	0.00	0.00	0.00	
Additional night ventilation via windows 1/h	0.30	0.10	0.00	0.30	0.30	0.30	0.30
Use of temporary shading -	90%	80%	90%	0%	90%	90%	90%
Internal heat gains W/m²	2.5	3.1	2.5	2.5	4.9	2.5	4.5
Summer temperature increase K	0.0	1.5	0.0	0.0	0.0	2.0	3.0
Frequency of overheating K/h	0.38%	16.59%	7.75%	0.28%	4.83%	7.09%	27%
Overheating degree hours K	8	1600	569	6	298	463	3824
Daily indoor temperature fluctuation K	2.2	2.1	2.0	2.0	2.5	2.0	2.4

Frequency of overheating



Archer EnerPHit 139 m² treated floor area, Australia

PHPP

EnerPHit with PHPP Version 10.4 EN

U-VALUES

The calculations of all the opaque elements (floor, wall and ceiling) all of the building envelope U-values have been calculated in the PHPP in accordance with the methodology of EN ISO 6496.

Description of building assembly						Assembly no.
Wall Brick Veneer						01ud
Orientation of building assembly (or Rsi) 2-Wall		Interior insulation?				
Adjacent to (or Rse) 1-Outdoor air		U-value supplement [W/(m²K)]				
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Brick clay	1.000					110
Cavity (Insulation layer)	0.039					40
Wall Studs (insulation layer)	0.039	Hardwood studs 450ctr/x2 nogs	0.180			90
PB	0.250					10
Percentage of sec. 1:	86%	Percentage of sec. 2:	13.7%	Percentage of sec. 3:		
Heat transmission resistance coefficients						Total thickness [cm]: 25.0
Interior R _{si} : 0.13 m²K/W						U-value [W/(m²K)]: 0.327
Exterior R _{se} : 0.04 m²K/W						

Description of building assembly						Assembly no.
Ceiling						02ud
Orientation of building assembly (or Rsi) 1-Roof		Interior insulation?				
Adjacent to (or Rse) 3-Ventilated		U-value supplement [W/(m²K)]				
Area section 1	λ [W/(mK)]	Area section 2 (optional)	λ [W/(mK)]	Area section 3 (optional)	λ [W/(mK)]	Thickness [mm]
Insulation layer	0.049					195
Ceiling Joists (insulation layer)	0.036	Hardwood joists 600ctr	0.180			90
Air cavity	0.120	Ceiling battens	0.130			20
PB	0.250					10
Percentage of sec. 1:	90%	Percentage of sec. 2:	10.0%	Percentage of sec. 3:		
Heat transmission resistance coefficients						Total thickness [cm]: 31.5
Interior R _{si} : 0.10 m²K/W						U-value [W/(m²K)]: 0.156
Exterior R _{se} : 0.10 m²K/W						

Description of building assembly						Assembly no.	
Floor Timber on piers						04ud	

Orientation of building assembly (or Rsi)		3-Floor		Interior insulation?			
Adjacent to (or Rse)		3-Ventilated		U-value supplement [W/(m²K)]			

Area section 1	λ [$\Omega/(\mu K)$]	Area section 2 (optional)	λ [$\Omega/(\mu K)$]	Area section 3 (optional)	λ [$\Omega/(\mu K)$]	Thickness [mm]
Floor Joists (insulation layer)	0.036	Hardwood joists	0.180			90
Softwood T&G flooring	0.130					20
Percentage of sec. 1:	86%	Percentage of sec. 2:	10.0%	Percentage of sec. 3:		

Heat transmission resistance coefficients		Total thickness [cm]:	11.0
Interior R_{si} :	0.17 m²K/W	U-value [W/(m²K)]:	0.419
Exterior R_{se} :	0.17 m²K/W		

Description of building assembly						Assembly no.	
Floor Concrete raised slab						05ud	

Orientation of building assembly (or Rsi)		3-Floor		Interior insulation?			
Adjacent to (or Rse)		2-Ground		U-value supplement [W/(m²K)]			

Area section 1	λ [$\Omega/(\mu K)$]	Area section 2 (optional)	λ [$\Omega/(\mu K)$]	Area section 3 (optional)	λ [$\Omega/(\mu K)$]	Thickness [mm]
Concrete rubble filled slab	0.033					75
Percentage of sec. 1:	100%	Percentage of sec. 2:		Percentage of sec. 3:		

Heat transmission resistance coefficients		Total thickness [cm]:	7.5
Interior R_{si} :	0.17 m²K/W	U-value [W/(m²K)]:	0.409
Exterior R_{se} :	0.00 m²K/W		

JUNCTIONS AND THERMAL BRIDGES

A thermal bridge is an element or location of the building envelope with less insulation, or reduced insulation performance, relative to the adjacent areas of the thermal envelope. This means the element or location provides a “bridge” for heat to move through the building envelope. This is of course heat flow out of the building in the winter and into the building during the summer.

If the additional heat flow in the winter is sufficiently large this results in cooler spots on the inside of the building envelope which then cools the air increasing the local relative humidity above the threshold where mould can grow. In the cool climate context of 30 Archer Street this is a risk that needs to be managed.

Wherever the walls junction with the ceiling or floor (or window/door) there is likely to be a thermal bridge. This is due to both the structure needed to junction the elements together as well as the interruption or change of insulation material around this junction. In an EnerPHit these junctions need particular attention as the building has originally been designed to work quite differently and these are some of the most difficult and large quantity junctions to manage.

30 Archer Street is an all-timber frame construction and so is relatively easily able to be adapted to meet this principle albeit that these junctions were designed to facilitate air movement for drying (cavity ventilation) rather than continuous insulation. These two functions are almost opposite in what they are designed to achieve in terms of air movement. This means that other strategies must be adopted to manage the change in the way the building envelope is able to work when this cavity ventilation is removed/ or limited.

A difficult junction is the wall to ceiling/roof where the rafter is sitting on the top plate of the wall and does not allow sufficient height to allow adequate insulation below the roofing. This junction is likely able to be managed with high density insulation batt at the perimeter of the ceiling until sufficient roof to ceiling height allows for the R6.0 batt. This would be improved further with a formed baffle to hold the batt in position and mitigate the impact of any windwash derating the insulation at this vulnerable point.

The existing rubble slabs to the wet areas will need to be either reduced in height (with drainage re-made) or removed and replaced with framed flooring (with drainage re-made) to allow for insulation to be added. If the wet areas were not planned to be updated then it may be possible to add flanking insulation to the exterior of the slab edges and request an allowance for this from the certifier.

The brick chimney is no longer serving a useful function and would also ideally be removed, at a minimum to below the line of the ceiling insulation and again the floor slab thermal bridge mitigated with flank insulation of the rubble slab to ground level.

All of the thermal bridges would need to be modelled in 2D finite element software to both develop the optimal solution to minimising these and then to quantify them to correct the energy model for certification. These models would need to have detailed drawings to document the constructions as well as photographic records of the as retrofitted situation for certification.

The modelling at present has allowance for 15% additional heat loss from thermal. In applying the Component Method the critical part of managing thermal bridges is ensuring that the fRsi or minimum internal surface temperature (to external temperature ratio) is sufficient to mitigate the risk of mould formation.

VENTILATION AND AIRTIGHTNESS

A balanced heat recovery ventilation (HRV) system would need to be installed and this is likely best by locating the unit in the laundry and routing the supply and extract ducts in a dropped ceiling in the hallway and potentially some bulkheads. Alternatively, there is sufficient space in the roof to build an enclosed space however this is then very challenging for maintaining the airtightness system.

All junctions in the building envelope also need to be planned to ensure that a continuous air tightness system is possible to construct. This is often reviewed by the red pen test, drawing a continuous line on the plan/section and detail drawings and then planning a construction sequence that is efficient and effective. Once details of junctions are resolved planning the airtightness/insulation in combination with thermal bridging analysis can be considered.

At this time it has been assumed that the airtightness would be achieved with the existing plasterboard as the primary system and then tape/caulk and potentially spray applied airtightness sealing to achieve the 1.0ACH target. This is achievable, albeit inconvenient with the occupants living in the building during these works. If this approach is adopted it is strongly recommended that a WUFI analysis is conducted to confirm the building envelope will remain sufficiently dry to avoid moisture damage without the use of a dedicated air (vapour control) membrane internally.

The use of a dedicated air (vapour control) membrane would certainly be a more durable and assured approach to achieve the airtightness target and has other significant benefits, however would certainly require the building to be vacant for the installation of this system (as well as the replastering). The further benefits include greater moisture control of the building envelope and the addition of a service cavity to allow routing of new electrical/data and plumbing without disturbing the continuity of the insulation and airtightness system.

CONCLUSIONS

The feasibility study of 30 Archer Street demonstrates that it could achieve EnerPHit certification using the Component Method and this would reduce the Heating Demand to around 36kWh/m²a around 90% reduction (if heating to 20°C). This assumes that the airtightness target of 1.0ACH was achieved. If not achieved the building would only be certifiable as a Low Energy Building, still with excellent performance and health and comfort benefits but a different level of certification.

As such my advice is to plan on the occupants vacating the building during the retrofit and the use of a dedicated air (vapour control) membrane for the benefits outlined. I believe this will be the most cost-effective way to achieve the EnerPHit standard as it significantly de-risks achieving the criteria and should achieve the best outcome for the building and occupants.

The further critical component to achieve the EnerPHit standard is that of specification of the windows and doors to meet the required average installed U-value of <1.00W/m²K. Whilst there are suppliers in Australia who can meet this standard often they are procured from Europe and this is both cost and time competitive, either option will likely have a minimum four month lead time.

FURTHER ACTIONS

A further detailed study could be undertaken that will assesses the accuracy of some of the assumptions made in this report concerning the details of the as built structure and existing conditions of materials. This is best done in conjunction with a preferred builder. This will expedite any planning, cost/benefit analysis of the preferred approaches/outcomes and resolve a far more realistic assessment to determine the financial viability of the project.

This will need to include supplier quotes for the critical components of windows and doors as well as HRV to understand the performance and cost of these.

A sensitivity analysis of the glazing will need to be undertaken to understand the optimum cost/benefit of the glazing used particularly in terms of area/orientation, U-value, g-value and shading elements.

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