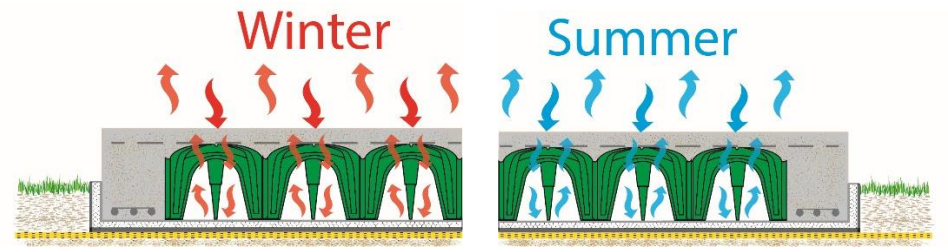
Wollongong Energy Efficiency

Building a Sustainable Tomorrow

NatHERS Assessment Findings Report

Based on

Cupolex' slabs' Thermal Performance



Client: Cupolex Australia

CUPOLEX®

Prepared by: Jacob Guarnaccia, Wollongong Energy Efficiency

***Note, this assessment is based using the Cupolex system.**

Introduction

The purpose of this report is to demonstrate the difference between a standard 225mm Waffle Pod slab, a Cupolex slab and a Cupolex slab with a thermal blanket.

The two dwellings have been simulated as per the NatHERS software.

- Climate Zone 24
- Canberra, ACT 2600

Climate Zone 24 is within a colder climate, the goal for these dwellings is to meet the heating requirements.

Both dwellings were rated using the most recent version of the software,

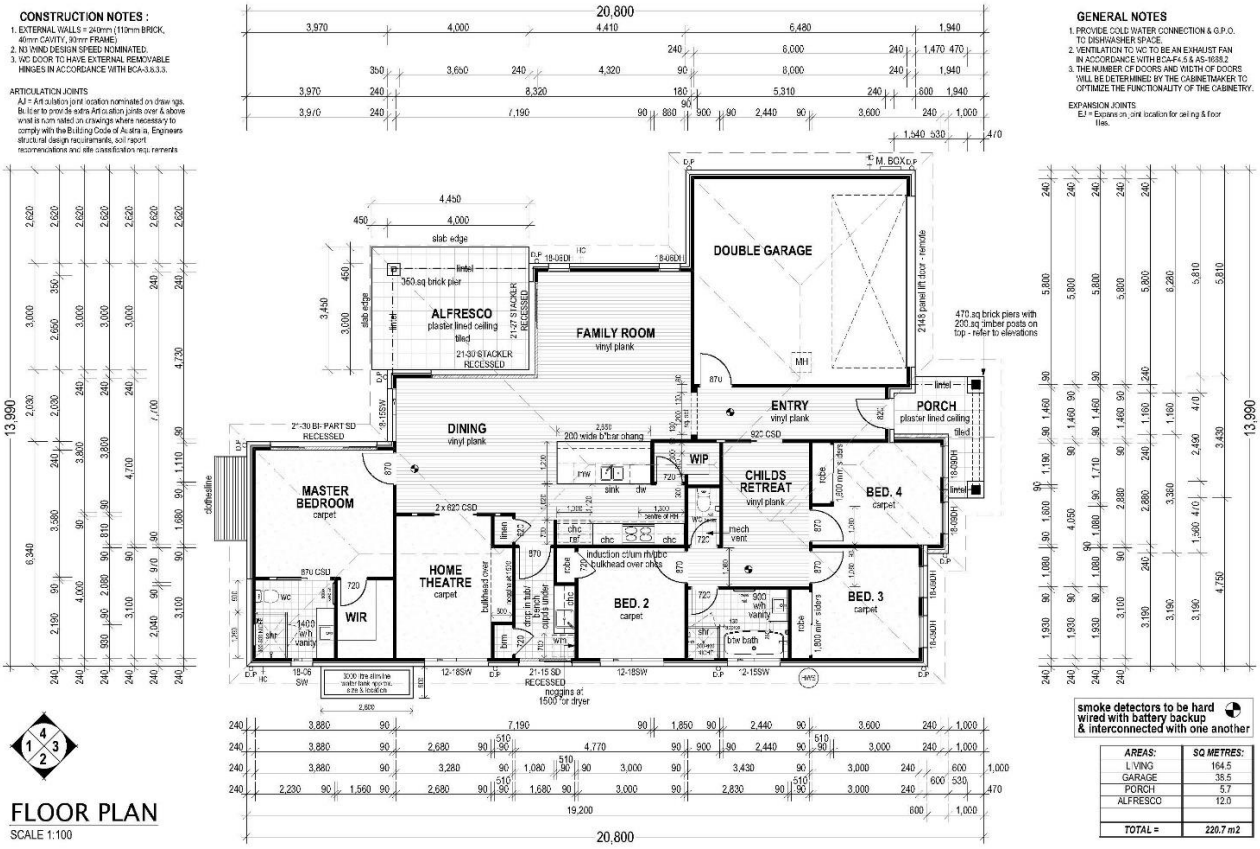
- FirstRate5, version 5.5.3a.

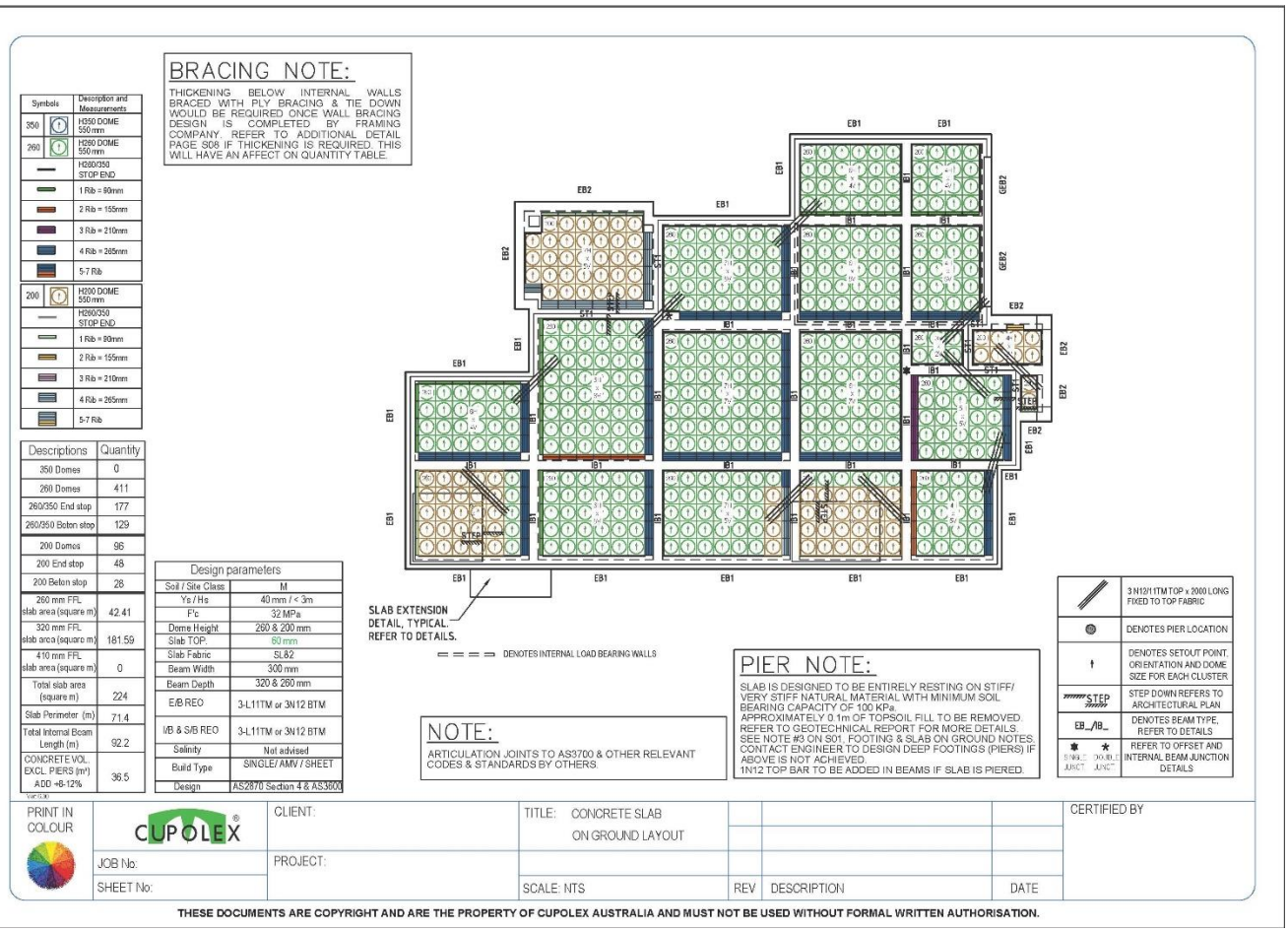
The NatHERS simulation was adhere to, ensuring the most accurate result.

For consistency purposes, the dwellings in this project were simulated with,

- R2.5 to external walls,
- R6.0 to the ceiling
- R2.5 to the roof.
- All windows are standard single glazed.

Dwelling 1:


CONSTRUCTION NOTES :
1. EXTERNAL WALLS = 240mm (110mm BRICK, 40mm CAVITY, 90mm FRAME)
2. N3 WIND DESIGN SPEED NOMINATED.
3. WC DOOR TO HAVE EXTERNAL REMOVABLE HINGES IN ACCORDANCE WITH BCA-3.8.3.3.
ARTICULATION JOINTS
AJ = Articulation joint location nominated on drawings. Builder to provide extra Articulation joints over & above what is nominated on drawings where necessary to comply with the Building Code of Australia, Engineers structural design requirements, soil report recommendations and site classification requirements
GENERAL NOTES
1. PROVIDE COLD WATER CONNECTION & G.P.O. TO DISHWASHER SPACE.
2. VENTILATION TO WC TO BE AN EXHAUST FAN IN ACCORDANCE WITH BCA-F4.5 & AS-1668.2
3. THE NUMBER OF DOORS AND WIDTH OF DOORS WILL BE DETERMINED BY THE CABINETMAKER TO OPTIMIZE THE FUNCTIONALITY OF THE CABINETRY.
EXPANSION JOINTS
EJ = Expansion joint location for ceiling & floor ties.
20,800
DOUBLE GARAGE
ALFRESCO
plaster lined ceiling
tiled
FAMILY ROOM
vinyl plank
ENTRY
vinyl plank
PORCH
plaster lined ceiling
tiled
DINING
vinyl plank
MASTER BEDROOM
carpet
HOME THEATRE
carpet
WIR
WIP
CHILDS RETREAT
vinyl plank
BED. 4
carpet
BED. 2
carpet
BED. 3
carpet
470 sq brick piers with 200 sq timber posts on top - refer to elevations
smoke detectors to be hard wired with battery backup & interconnected with one another
AREAS: SQ METRES:
LIVING 164.5
GARAGE 38.5
PORCH 5.7
ALFRESCO 12.0
TOTAL = 220.7 m2
FLOOR PLAN
SCALE 1:100


BRACING NOTE:
THICKENING BELOW INTERNAL WALLS BRACED WITH PLY BRACING & TIE DOWN WOULD BE REQUIRED ONCE WALL BRACING DESIGN IS COMPLETED BY FRAMING COMPANY. REFER TO ADDITIONAL DETAIL PAGE S08 IF THICKENING IS REQUIRED. THIS WILL HAVE AN AFFECT ON QUANTITY TABLE.
Symbols
Description and Measurements
350 H350 DOME 550 mm
260 H260 DOME 550 mm
H260/350 STOP END
1 Rib = 90mm
2 Rib = 155mm
3 Rib = 210mm
4 Rib = 265mm
5-7 Rib
200 H200 DOME 550 mm
H260/350 STOP END
1 Rib = 90mm
2 Rib = 155mm
3 Rib = 210mm
4 Rib = 265mm
5-7 Rib
Descriptions Quantity
350 Domes 0
260 Domes 411
260/350 End stop 177
260/350 Beton stop 129
200 Domes 96
200 End stop 48
200 Beton stop 28
260 mm FFL slab area (square m) 42.41
320 mm FFL slab area (square m) 181.59
410 mm FFL slab area (square m) 0
Total slab area (square m) 224
Slab Perimeter (m) 71.4
Total Internal Beam Length (m) 92.2
CONCRETE VOL. EXCL. PIERS (m³) ADD +8-12% 36.5
Design parameters
Soil / Site Class M
Ys / Hs 40 mm / < 3m
F'c 32 MPa
Dome Height 260 & 200 mm
Slab TOP. 80 mm
Slab Fabric SL82
Beam Width 300 mm
Beam Depth 320 & 260 mm
E/B REO 3-L11TM or 3N12 BTM
I/B & S/B REO 3-L11TM or 3N12 BTM
Salinity Not advised
Build Type SINGLE/ AMV / SHEET
Design AS2870 Section 4 & AS3600
SLAB EXTENSION DETAIL, TYPICAL. REFER TO DETAILS.
DENOTES INTERNAL LOAD BEARING WALLS
NOTE:
ARTICULATION JOINTS TO AS3700 & OTHER RELEVANT CODES & STANDARDS BY OTHERS.
PIER NOTE:
SLAB IS DESIGNED TO BE ENTIRELY RESTING ON STIFF/ VERY STIFF NATURAL MATERIAL WITH MINIMUM SOIL BEARING CAPACITY OF 100 KPa. APPROXIMATELY 0.1m OF TOPSOIL FILL TO BE REMOVED. REFER TO GEOTECHNICAL REPORT FOR MORE DETAILS. SEE NOTE #3 ON S01. FOOTING & SLAB ON GROUND NOTES. CONTACT ENGINEER TO DESIGN DEEP FOOTINGS (PIERS) IF ABOVE IS NOT ACHIEVED. 1N12 TOP BAR TO BE ADDED IN BEAMS IF SLAB IS PIERED.
3 N12/11TM TOP x 2000 LONG FIXED TO TOP FABRIC
DENOTES PIER LOCATION
DENOTES SETOUT POINT. ORIENTATION AND DOME SIZE FOR EACH CLUSTER
STEP DOWN REFERS TO ARCHITECTURAL PLAN
EB_/IB_ DENOTES BEAM TYPE, REFER TO DETAILS
REFER TO OFFSET AND INTERNAL BEAM JUNCTION DETAILS
PRINT IN COLOUR
CUPOLEX
CLIENT:
JOB No:
PROJECT:
SHEET No:
TITLE: CONCRETE SLAB ON GROUND LAYOUT
SCALE: NTS
REV
DESCRIPTION
DATE
CERTIFIED BY
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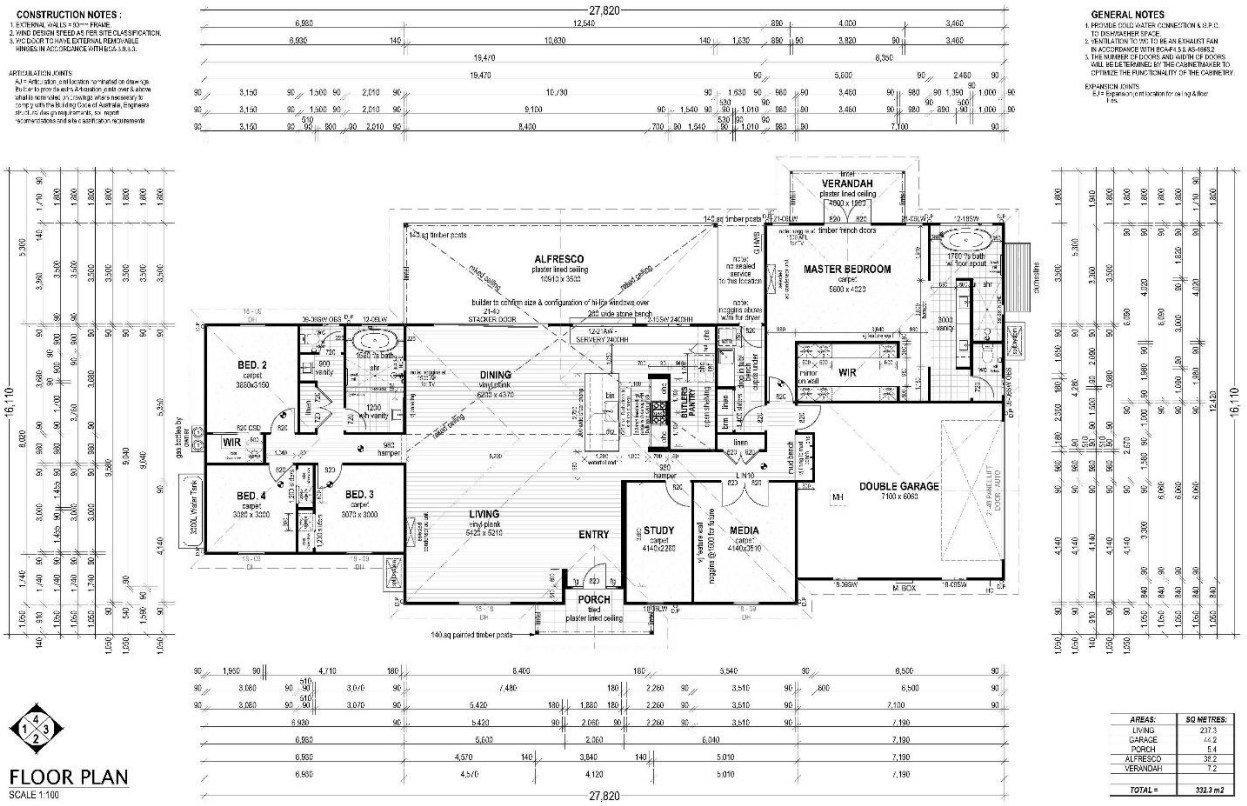
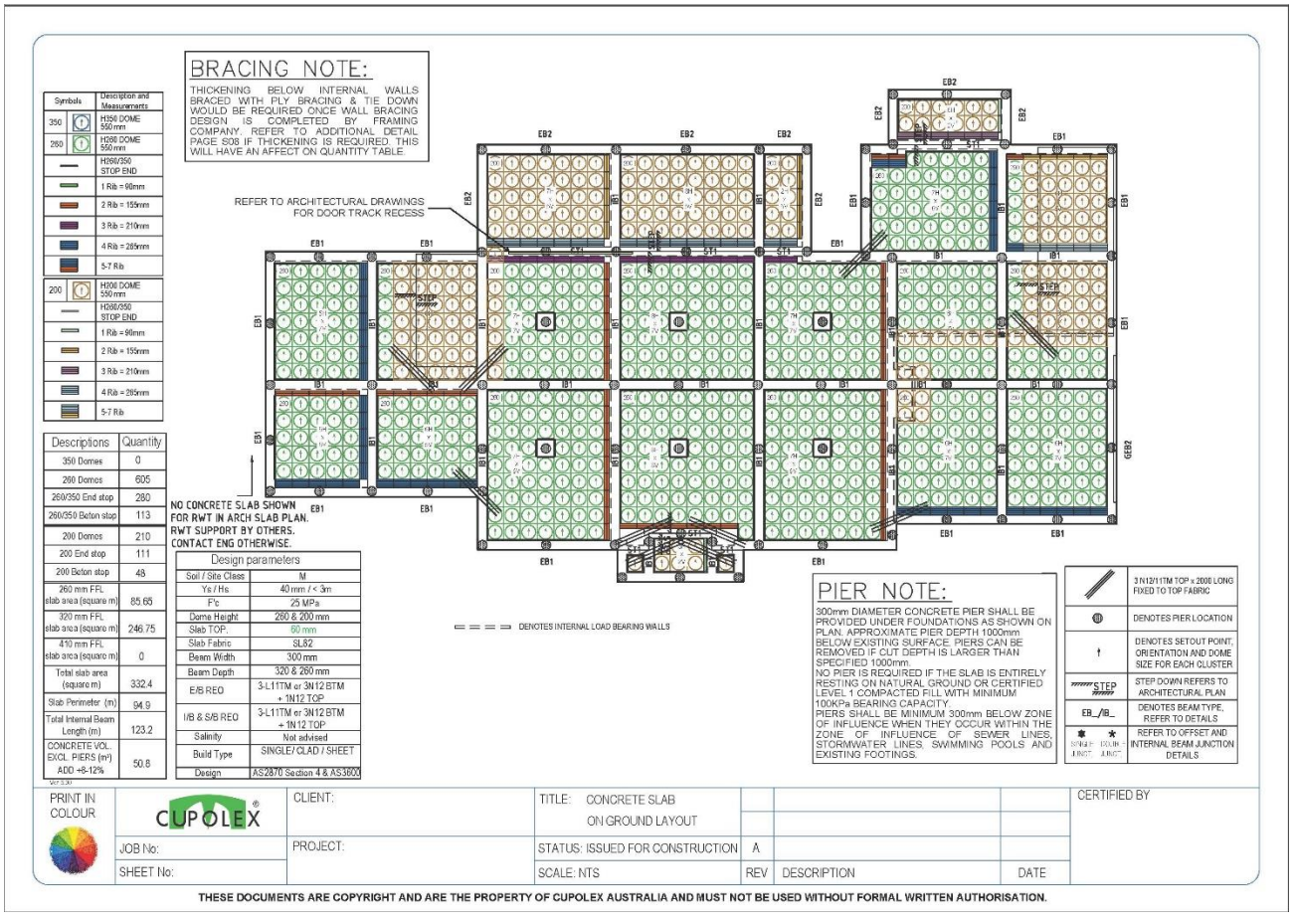
Dwelling 2:


CONSTRUCTION NOTES :
GENERAL NOTES
27,820
ALFRESCO
plaster lined ceiling
10613 x 3532
VERANDAH
plaster lined ceiling
7600 x 1827
MASTER BEDROOM
carpet
5600 x 4220
WIR
BED. 2
carpet
3600x3150
BED. 4
carpet
3080 x 3200
BED. 3
carpet
3070 x 3000
DINING
vinyl plank
6203 x 4370
LIVING
vinyl plank
6425 x 5210
ENTRY
STUDY
carpet
4140x2200
MEDIA
carpet
4140x2510
PORCH
tiled
plaster lined ceiling
DOUBLE GARAGE
7100 x 6060
16,110
FLOOR PLAN
SCALE 1:100
AREAS:
SQ METRES:
LIVING 237.3
GARAGE 44.2
PORCH 5.4
ALFRESCO 38.2
VERANDAH 7.2
TOTAL = 332.3 m2


BRACING NOTE:
THICKENING BELOW INTERNAL WALLS BRACED WITH PLY BRACING & TIE DOWN WOULD BE REQUIRED ONCE WALL BRACING DESIGN IS COMPLETED BY FRAMING COMPANY. REFER TO ADDITIONAL DETAIL PAGE S208 IF THICKENING IS REQUIRED. THIS WILL HAVE AN AFFECT ON QUANTITY TABLE.
REFER TO ARCHITECTURAL DRAWINGS FOR DOOR TRACK RECESS
NO CONCRETE SLAB SHOWN FOR RWT IN ARCH SLAB PLAN. RWT SUPPORT BY OTHERS. CONTACT ENG OTHERWISE.
DENOTES INTERNAL LOAD BEARING WALLS
PIER NOTE:
300mm DIAMETER CONCRETE PIER SHALL BE PROVIDED UNDER FOUNDATIONS AS SHOWN ON PLAN. APPROXIMATE PIER DEPTH 1000mm BELOW EXISTING SURFACE. PIERS CAN BE REMOVED IF CUT DEPTH IS LARGER THAN SPECIFIED 1000mm.
NO PIER IS REQUIRED IF THE SLAB IS ENTIRELY RESTING ON NATURAL GROUND OR CERTIFIED LEVEL 1 COMPACTED FILL WITH MINIMUM 100KPa BEARING CAPACITY.
PIERS SHALL BE MINIMUM 300mm BELOW ZONE OF INFLUENCE WHEN THEY OCCUR WITHIN THE ZONE OF INFLUENCE OF SEWER LINES, STORMWATER LINES, SWIMMING POOLS AND EXISTING FOOTINGS.
Symbols
Description and Measurements
H356 DOME 550 mm
H286 DOME 550 mm
H266/350 STOP END
1 Rib = 90mm
2 Rib = 155mm
3 Rib = 210mm
4 Rib = 265mm
5-7 Rib
H206 DOME 550 mm
H266/350 STOP END
1 Rib = 90mm
2 Rib = 155mm
3 Rib = 210mm
4 Rib = 265mm
5-7 Rib
Descriptions
Quantity
350 Domes 0
266 Domes 605
266/350 End stop 280
266/350 Beton stop 113
206 Domes 210
206 End stop 111
206 Beton stop 48
260 mm FFL slab area (square m) 85.65
320 mm FFL slab area (square m) 246.75
410 mm FFL slab area (square m) 0
Total slab area (square m) 332.4
Slab Perimeter (m) 94.9
Total Internal Beam Length (m) 123.2
CONCRETE VOL EXCL. PIERS (m³) ADD +8-12% 50.8
Design parameters
Soil / Site Class M
Ys / Hs 40 mm / < 3m
F'c 25 MPa
Dome Height 260 & 200 mm
Slab TOP. 60 mm
Slab Fabric SL82
Beam Width 300 mm
Beam Depth 320 & 260 mm
E/B REO 3-L11TM or 3N12 BTM + 1N12 TOP
I/B & S/B REO 3-L11TM or 3N12 BTM + 1N12 TOP
Salinity Not advised
Build Type SINGLE/ CLAD / SHEET
Design AS2870 Section 4 & AS3600
3 N12/11TM TOP x 2000 LONG FIXED TO TOP FABRIC
DENOTES PIER LOCATION
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DENOTES BEAM TYPE, REFER TO DETAILS
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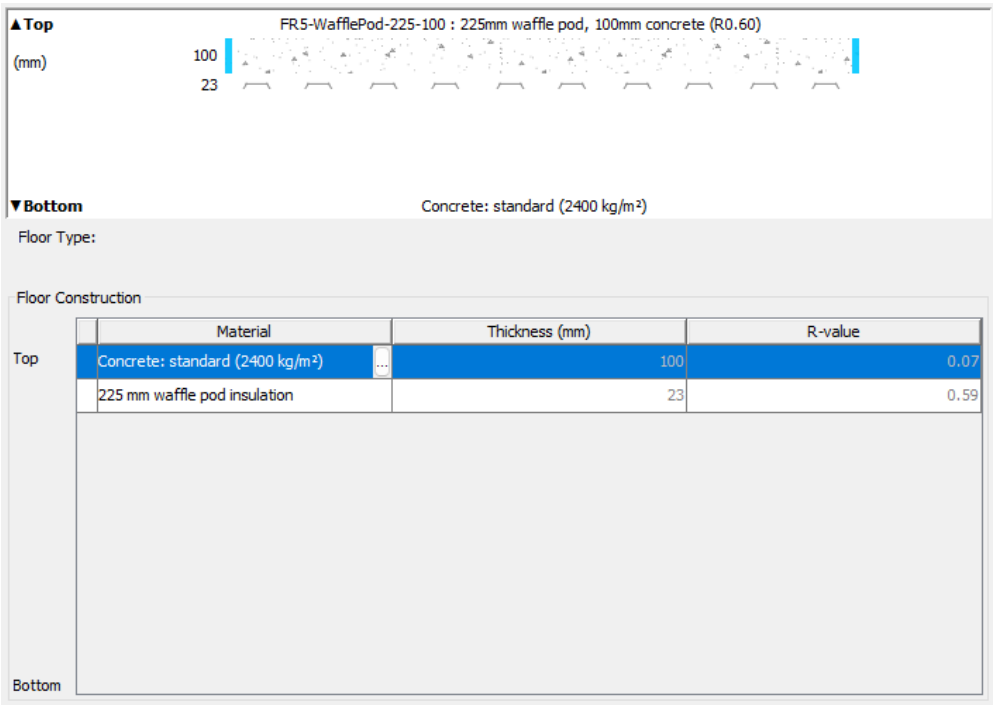
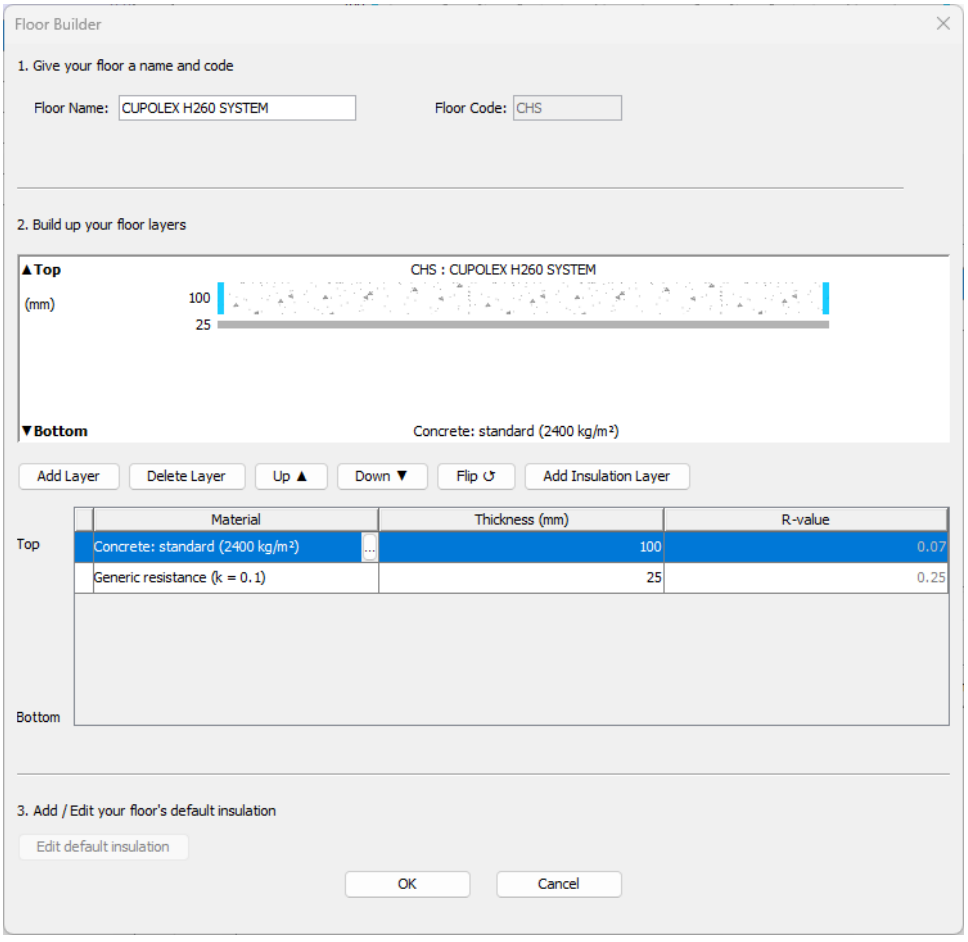
Modelling of Slabs:

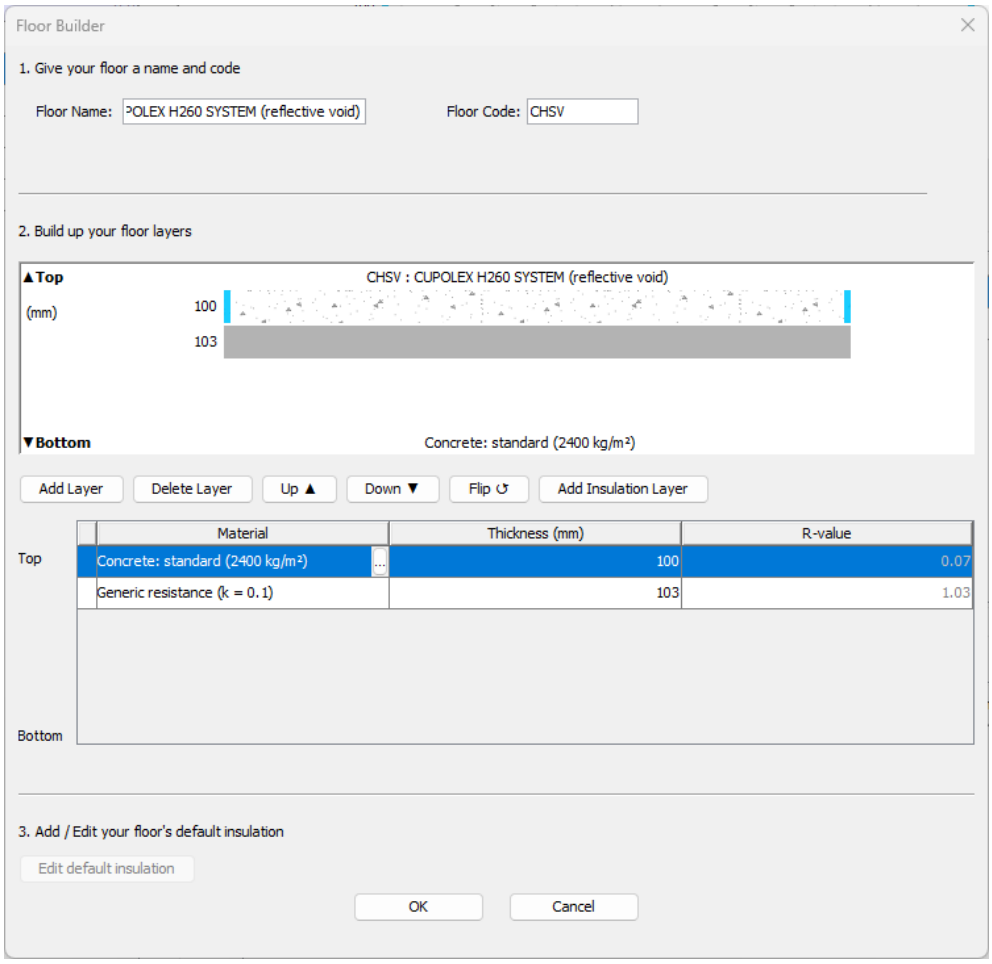
225mm Waffle Pod:



Cupolex H260 with non-reflective void slab:



Cupolex H260 with reflective void slab:



The R-value of the Cupolex slabs are based on the Fricker's report dated 25/06/2020 which was conducted as per to AS/NZS 4859.1&2:2018.

The R-value of the earth has been subtracted from the Fricker's report as it is not typical to show this as per the NatHERS software calculations.

<u>An average of the summer and winter R-values on the Fricker's report was used to show the average R-value of the slab year round.</u>

Results of Dwelling 1:

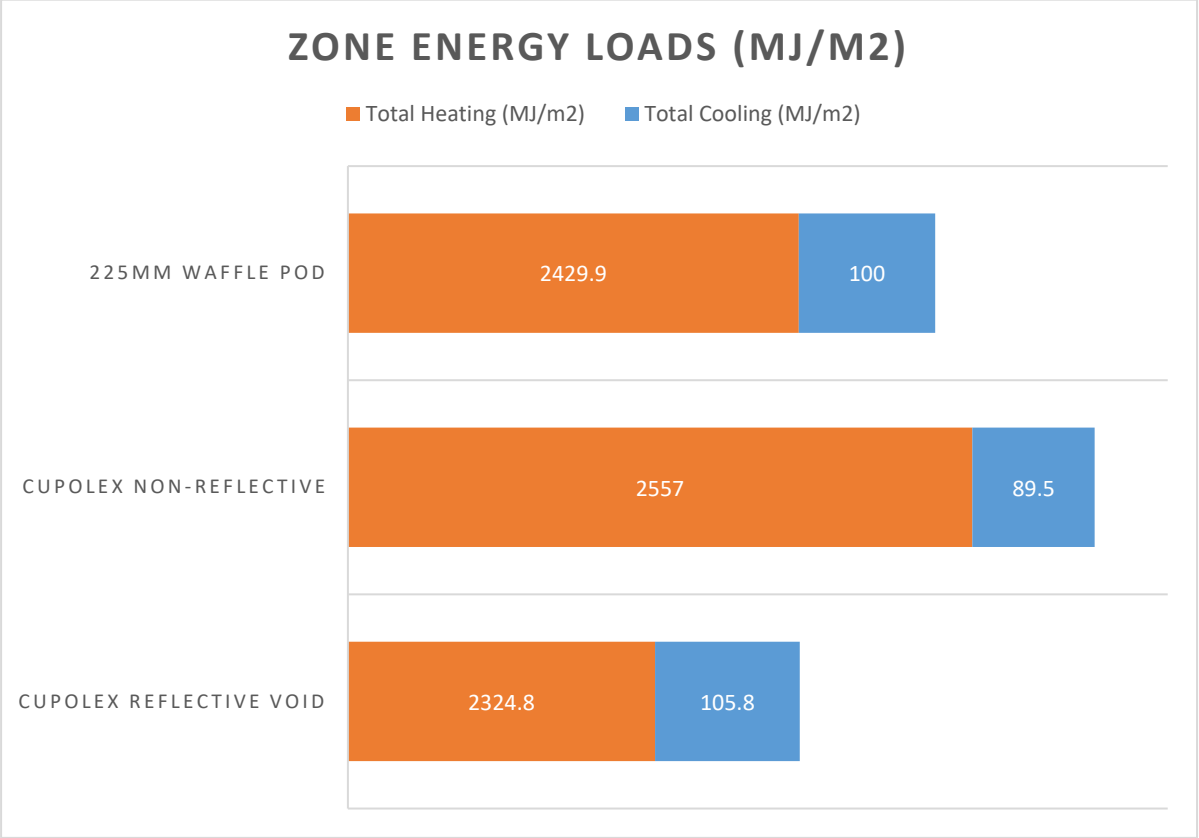


Table 1

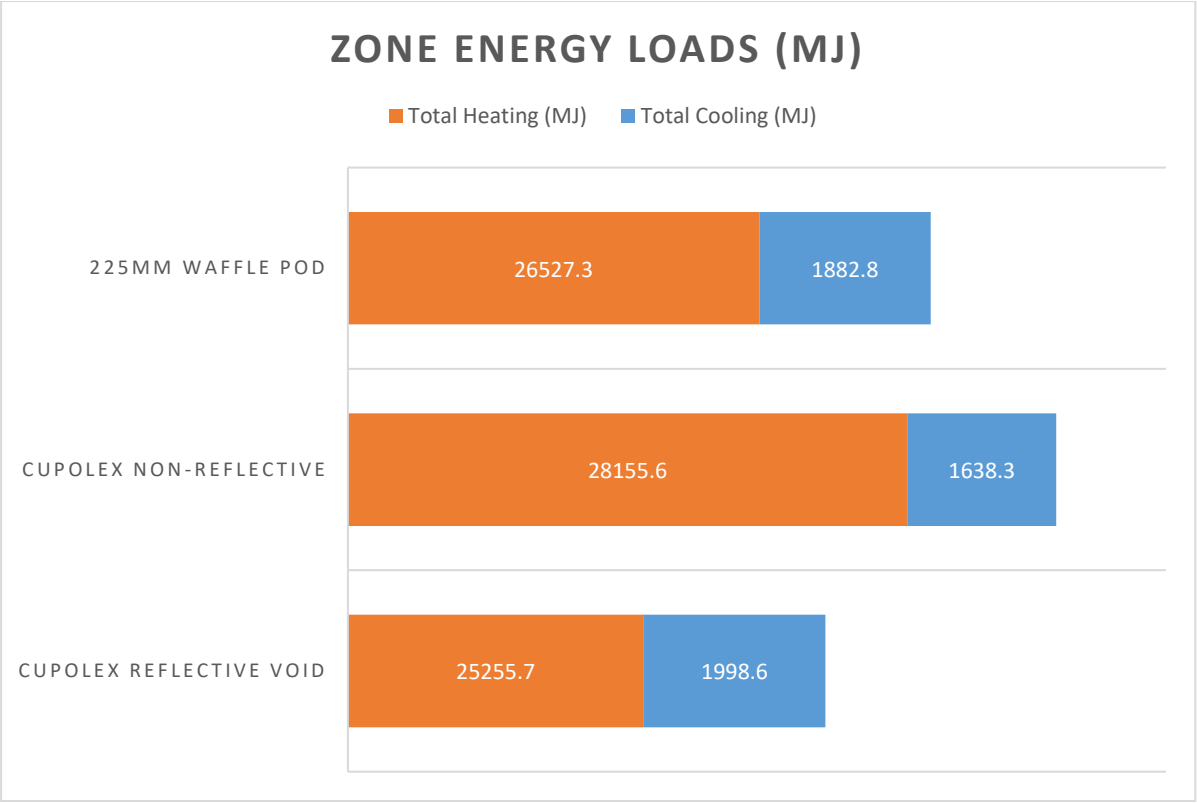


Table 2

Results of Dwelling 2:

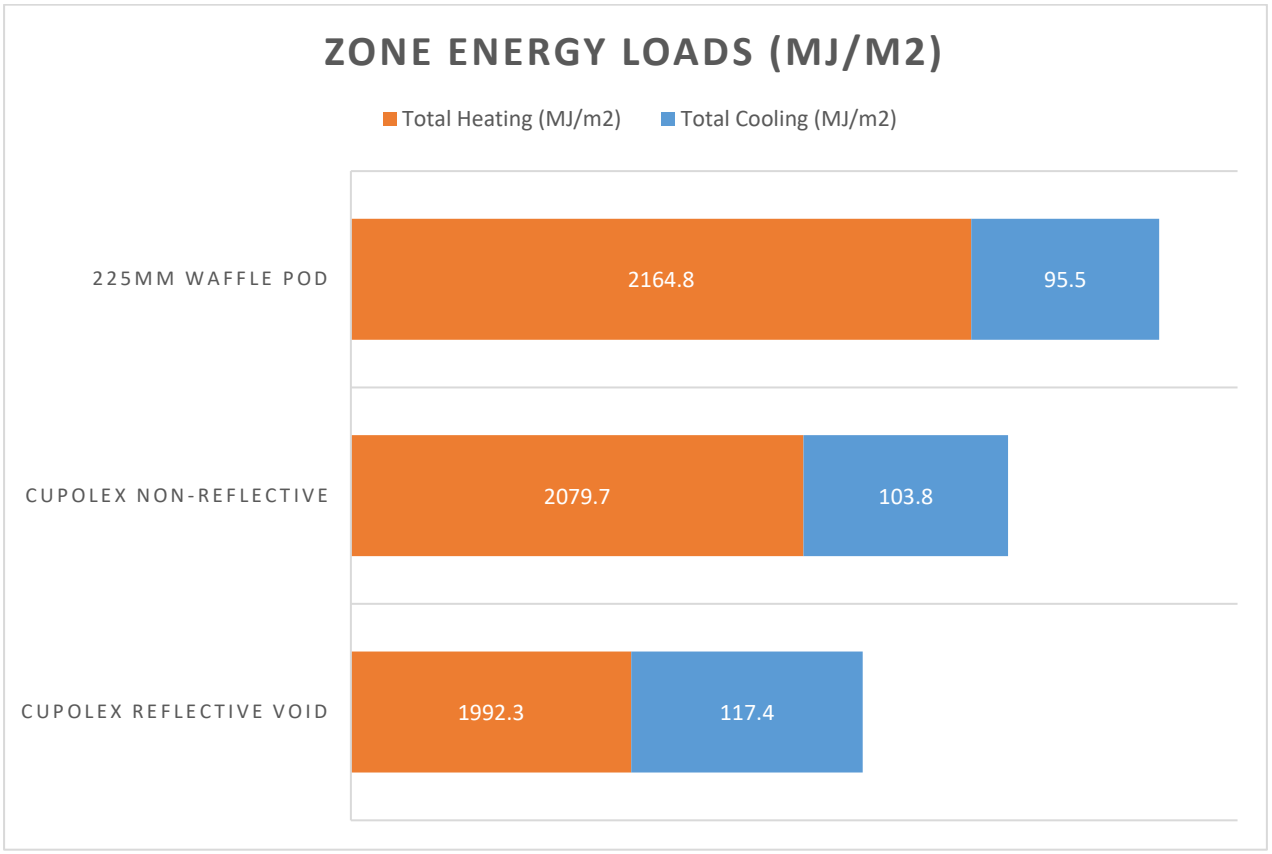


Table 3

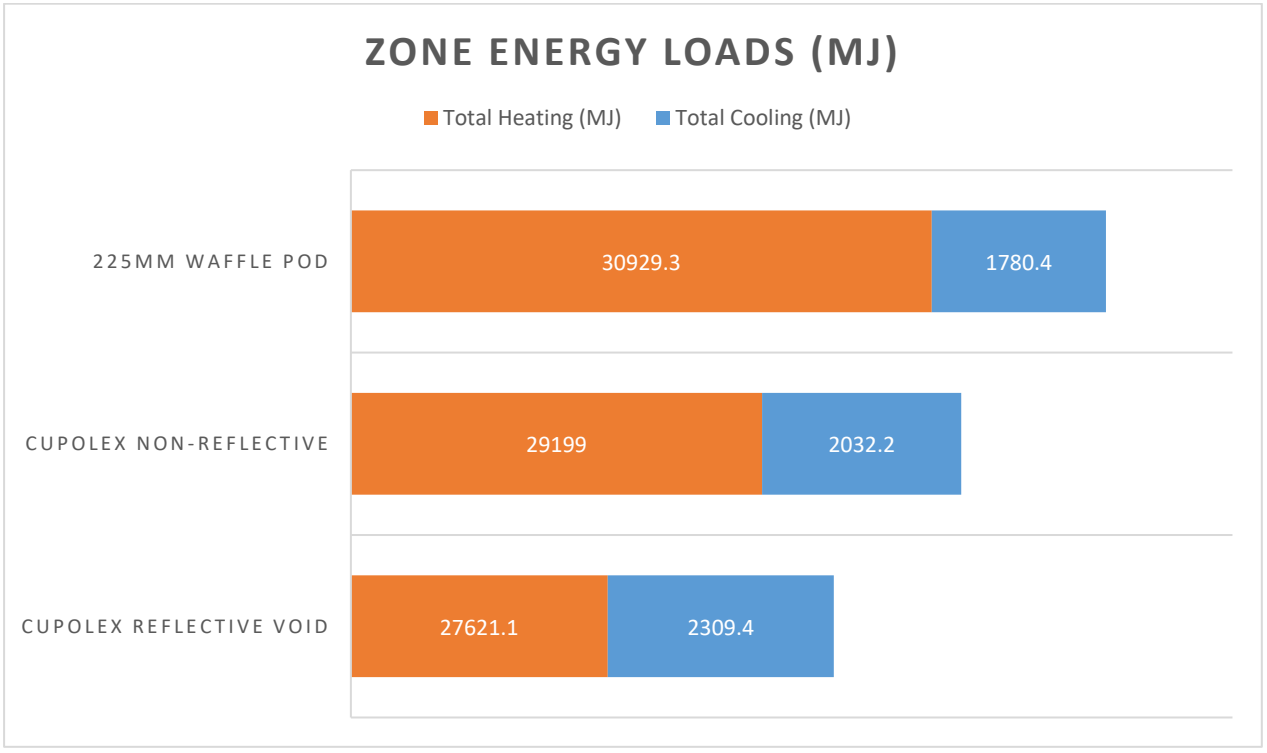


Table 4

Breakdown of Results:

Table 1 and Table 3 (Zone Energy Loads (MJ/m2) shows the energy required to heat and cool based on the square metres of the dwelling.

Table 2 and Table 4 shows the energy required to heat the entire dwelling.

Therefore, based on the heating and cooling requirements, the Cupolex slab with a reflective void has the best performance compared to the waffle pod & non reflective Cupolex slab. The reason is due to the higher R-value compared to the other slabs which allows the dwelling to retain heat in the colder climate.

On the other hand, the non-reflective Cupolex slab has the best cooling result due to it having a low R-value.

OVERALL "TOTAL R" (THERMALLY BRIDGED) THERMAL PERFORMANCE CALCULATIONS TO AS/NZS 4859 Parts 1 & 2:2018

The following calculations by James M Fricker Pty Ltd are based upon:

a) AS/NZS 4859.1:2018 "Thermal insulation materials for buildings. Part 1: General criteria and technical provisions",

b) AS/NZS 4859.2:2018 "Thermal insulation materials for buildings. Part 2: Design",

c) the Australian Institute of Refrigeration Air-conditioning & Heating (AIRAH) Handbook (Edition 5, 2013), and (if necessary) the ASHRAE Fundamentals Handbook.

AS/NZS 4859.2:2018 is a referenced document in NCC2019 & NCC2022.

Initial results report Total R for each thermal path. These results are combined by area weighting and isothermal planes method to deduce **Overall Surface Total R**. This is per AS/NZS 4859.2:2018 Clause 4.3 – *"A total resistance associated with a construction of materials, computed or measured over an area sufficient to be fully representative of the element of construction, and specified as a Total R-value, including surface film resistances and thermal bridging."*

Total R-values are based on product in-service conditions in accordance with AS/NZS 4859.2:2018 including the alteration of insulation Material R for temperature, and Air Space R for temperature and infrared emittance.

Each calculation result is subject to any specific notes and assumptions listed on the calculation.

If a construction differs from the described system, the thermal resistance may be different.

All calculations were done by James M Fricker, F.AIRAH F.IEAust CPEng NER APEC Engineer IntPE(Aus), Registered Professional Engineer (Victoria PE0005355)

ENGINEERS AUSTRALIA
Chartered Professional Engineer
MEMBER 1179647

JAMES M FRICKER PTY LTD
54 Felix Crescent
Ringwood North VIC 3134 Australia
Mobile: 0414 804 097
Phone: (03) 9879 5744
fricker@optusnet.com.au
http://fricker.net.au

ESTIMATION OF THE THERMAL RESISTANCE OF THE CUPOLEX® H350 SYSTEM (with reflective void above Reflecta Under-Slab)

The following uses the isothermal planes method to estimate the resulting combined R from the main thermal paths through the concrete/void CUPOLEX® system.

These values are used in typical Total R calculations to AS/NZS 4859.1&2:2018 (below).
The only insulating elements in the bare CUPOLEX® system are the reflective voids within the cups.

JMF Calc: 530f01d

				WINTER R				SUMMER R
Centre Post	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	380mm concrete	380	1.44	0.264	380mm concrete	380	1.44	0.264
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
2%	R sum between isothermal planes			0.898	R sum between isothermal planes			0.898
4 Corners	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	380mm concrete	380	1.44	0.264	380mm concrete	380	1.44	0.264
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
8%	R sum between isothermal planes			0.898	R sum between isothermal planes			0.898
Central Void	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	350mm reflective air void	350	0.19	**1.795**	350mm reflective air void	350	0.83	**0.422**
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
30%	R sum between isothermal planes			2.450	R sum between isothermal planes			1.077
Outer Void	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	70mm concrete	70	1.44	0.049	70mm concrete	70	1.44	0.049
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	310mm reflective air void	310	0.18	**1.762**	310mm reflective air void	310	0.73	**0.422**
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
60%	R sum between isothermal planes			2.445	R sum between isothermal planes			1.105
	Combined R between isothermal planes			**2.084**				**1.072**
	(= 1/(A%/Ra + B%/Rb + C%/Rc + D%/Rd)							

INTERMEDIATE CALCULATION:	**winter**	**summer**
CUPOLEX® H350 Thermal Resistance*, base R =	**R2.10**	**R1.09**

***combined R with 1 metre earth plus top 60mm concrete**

Added R from	**winter**	**summer**
CUPOLEX® H350 + Reflecta Under-Slab	**R1.46**	**R0.45**

TOTAL R VALUES, CUPOLEX® H350	**winter**	**summer**
with bare floor	**R1.64**	**R0.58**
with 6mm carpet and 15mm underlay	**R2.05**	**R0.99**
with 25mm mountain ash floating timber overlay	**R1.80**	**R0.74**

NOTES

Determinations based upon AS/NZS 4859.1&2:2018, Thermal insulation materials for buildings.
Reflecta Under-Slab is a reflective damp-proofing membrane reportedly compliant with AS 2870
If 25mm of extruded polystyrene is used as slab perimeter insulation, edge heat loss will be negligible.

Calculated by James Fricker, F.AIRAH M.IEAust CPEng NER APEC Engineer IntPE(Aus)

Signed: James Fricker

ENGINEERS AUSTRALIA
Chartered Professional Engineer
MEMBER 1179647

Calculation updated 28/02/2024
530_B2.xls

ESTIMATION OF THE THERMAL RESISTANCE OF THE CUPOLEX® H260 SYSTEM (with reflective void above Reflecta Under-Slab)

The following uses the isothermal planes method to estimate the resulting combined R from the main thermal paths through the concrete/void CUPOLEX® system.

These values are used in typical Total R calculations to AS/NZS 4859.1&2:2018 (below).
The only insulating elements in the bare CUPOLEX® system are the reflective voids within the cups.

JMF Calc: 530f01b

				WINTER R				SUMMER R
Centre Post	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	290mm concrete	290	1.44	0.201	290mm concrete	290	1.44	0.201
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
2%	R sum between isothermal planes			0.835	R sum between isothermal planes			0.835
4 Corners	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	290mm concrete	290	1.44	0.201	290mm concrete	290	1.44	0.201
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
8%	R sum between isothermal planes			0.835	R sum between isothermal planes			0.835
Central Void	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	260mm reflective air void	260	0.15	**1.713**	260mm reflective air void	260	0.62	**0.422**
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
30%	R sum between isothermal planes			2.368	R sum between isothermal planes			1.077
Outer Void	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	70mm concrete	70	1.44	0.049	70mm concrete	70	1.44	0.049
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	260mm reflective air void	260	0.15	**1.713**	260mm reflective air void	260	0.62	**0.422**
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
60%	R sum between isothermal planes			2.396	R sum between isothermal planes			1.105
	Combined R between isothermal planes			**2.010**				**1.062**
	(= 1/(A%/Ra + B%/Rb + C%/Rc + D%/Rd)							

INTERMEDIATE CALCULATION:	**winter**	**summer**
CUPOLEX® H260 Thermal Resistance*, base R =	**R2.03**	**R1.08**

***combined R with 1 metre earth plus top 60mm concrete**

Added R from	**winter**	**summer**
CUPOLEX® H260 + Reflecta Under-Slab	**R1.39**	**R0.44**

TOTAL R VALUES, CUPOLEX® H260	**winter**	**summer**
with bare floor	**R1.57**	**R0.57**
with 6mm carpet and 15mm underlay	**R1.98**	**R0.98**
with 25mm mountain ash floating timber overlay	**R1.73**	**R0.73**

NOTES

Determinations based upon AS/NZS 4859.1&2:2018, Thermal insulation materials for buildings.
Reflecta Under-Slab is a reflective damp-proofing membrane reportedly compliant with AS 2870
If 25mm of extruded polystyrene is used as slab perimeter insulation, edge heat loss will be negligible.

Calculated by James Fricker, F.AIRAH M.IEAust CPEng NER APEC Engineer IntPE(Aus)

Signed: James Fricker

ENGINEERS AUSTRALIA
Chartered Professional Engineer
MEMBER 1179647

Calculation updated 27/02/2024
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ESTIMATION OF THE THERMAL RESISTANCE OF THE CUPOLEX® H200 SYSTEM (with reflective void above Reflecta Under-Slab)

The following uses the isothermal planes method to estimate the resulting combined R from the main thermal paths through the concrete/void CUPOLEX® system.

These values are used in typical Total R calculations to AS/NZS 4859.1&2:2018 (below).
The only insulating elements in the bare CUPOLEX® system are the reflective voids within the cups.

JMF Calc: 530f01c

				WINTER R				SUMMER R
Centre Post	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	230mm concrete	230	1.44	0.160	230mm concrete	230	1.44	0.160
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
2%	R sum between isothermal planes			0.794	R sum between isothermal planes			0.794
4 Corners	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	230mm concrete	230	1.44	0.160	230mm concrete	230	1.44	0.160
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
8%	R sum between isothermal planes			0.794	R sum between isothermal planes			0.794
Central Void	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	200mm reflective air void	200	0.12	**1.639**	200mm reflective air void	200	0.47	**0.422**
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
30%	R sum between isothermal planes			2.294	R sum between isothermal planes			1.077
Outer Void	Vertical element	t, mm	k	m².K/W	Vertical element	t, mm	k	m².K/W
	30mm concrete	30	1.44	0.021	30mm concrete	30	1.44	0.021
	70mm concrete	70	1.44	0.049	70mm concrete	70	1.44	0.049
	2mm polypropylene	2	0.25	0.008	2mm polypropylene	2	0.25	0.008
	160mm reflective air void	160	0.10	**1.574**	160mm reflective air void	160	0.38	**0.422**
	Reflecta Under-Slab	0.2	0.2	0.001	**Reflecta Under-Slab**	0.2	0.2	0.001
	1000mm earth	1000	1.6	0.625	1000mm earth	1000	1.6	0.625
60%	R sum between isothermal planes			2.256	R sum between isothermal planes			1.105
	Combined R between isothermal planes			**1.910**				**1.055**
	(= 1/(A%/Ra + B%/Rb + C%/Rc + D%/Rd)							

INTERMEDIATE CALCULATION:	winter	summer
CUPOLEX® H200 Thermal Resistance*, base R =	**R1.93**	**R1.08**

***combined R with 1 metre earth plus top 60mm concrete**

Added R from	winter	summer
CUPOLEX® H200 + Reflecta Under-Slab	**R1.29**	**R0.43**

TOTAL R VALUES, CUPOLEX® H200	winter	summer
with bare floor	**R1.47**	**R0.56**
with 6mm carpet and 15mm underlay	**R1.88**	**R0.97**
with 25mm mountain ash floating timber overlay	**R1.63**	**R0.72**

NOTES

Determinations based upon AS/NZS 4859.1&2:2018, Thermal insulation materials for buildings.
Reflecta Under-Slab is a reflective damp-proofing membrane reportedly compliant with AS 2870
If 25mm of extruded polystyrene is used as slab perimeter insulation, edge heat loss will be negligible.

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Chartered Professional Engineer
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Calculation updated 27/02/2024
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