



AECB
the sustainable building association

2010 Annual Conference
Celebrating 21 years of the AECB

**Something Old,
Something New**

1-2 October 2010 • WISE Building, CAT

Organised by:

AECB
the sustainable building association

In association with


**Passivhaus
Trust**
The UK Passive House Organisation

AECB

2010 Annual Conference



Dynamic Insulation

for Energy Efficient, Low Carbon Building Envelopes

Mohammed Imbabi

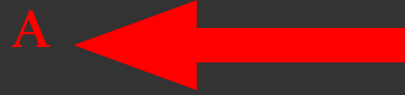
Energyflo Construction Technologies Ltd
Edinburgh, Scotland (UK)

What is dynamic insulation ?

- Dynamic Insulation (DI) is a multi-functional approach to thermal insulation that replaces conventional insulation in the building envelope.
- DI transforms the building envelope into a heat recovery device and fresh air ventilation source.
- DI transforms the building into a sustainable, energy efficient Dynamic Breathing Building, or DBB™.



OUTSIDE
COLD WINTER



SI



$$T_i > T_o$$

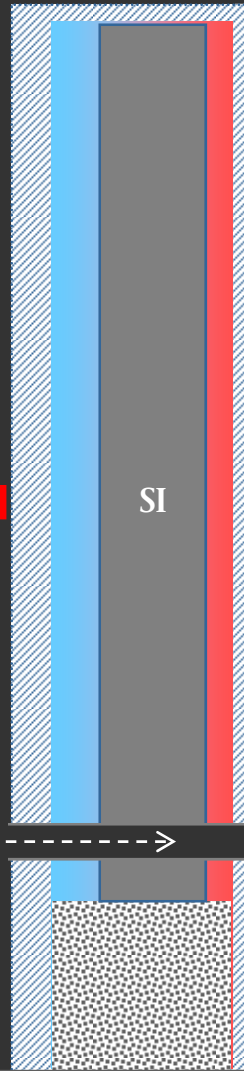
INSIDE
HEATED SPACE

Supply air →

Exhaust air ↑



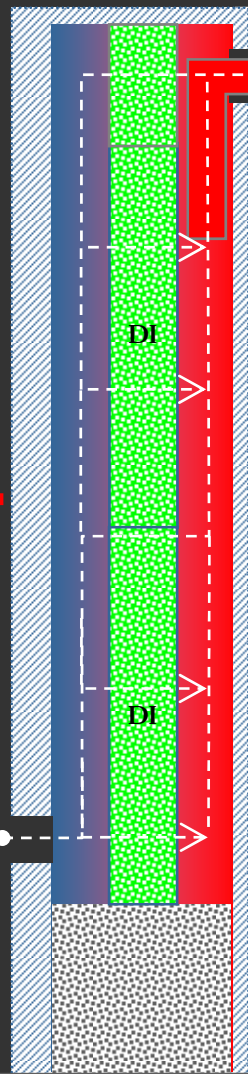
CONVENTIONAL THERMAL INSULATION





OUTSIDE
COLD WINTER

Supply air



$$D = B - C$$

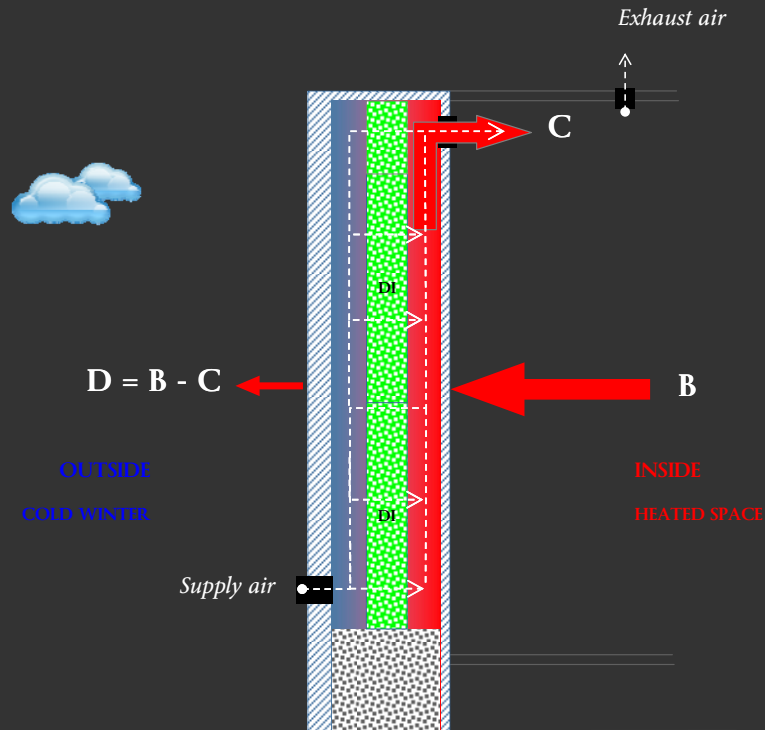
$$T_i < T_{htgsp}$$
$$T_i > T_o$$

Exhaust air

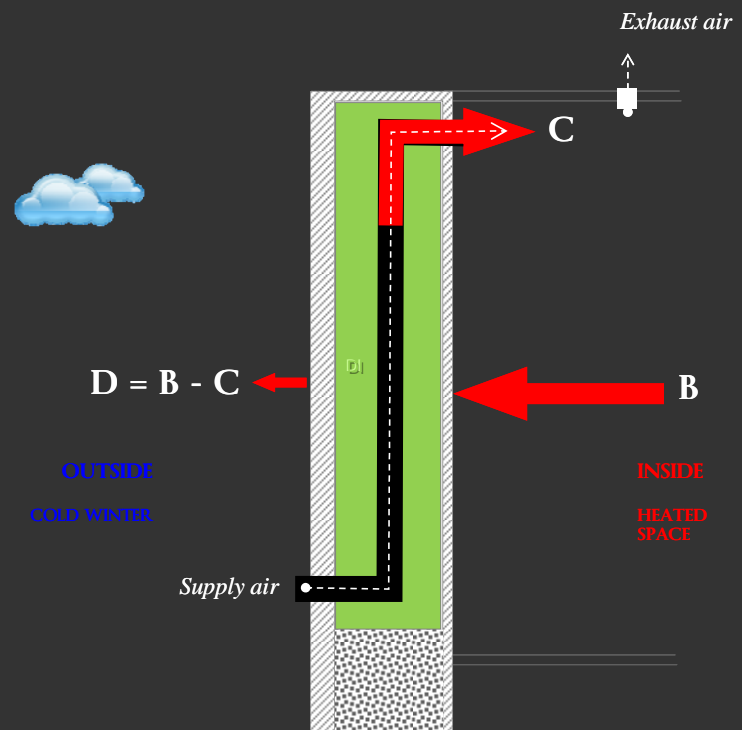


INSIDE
HEATED SPACE

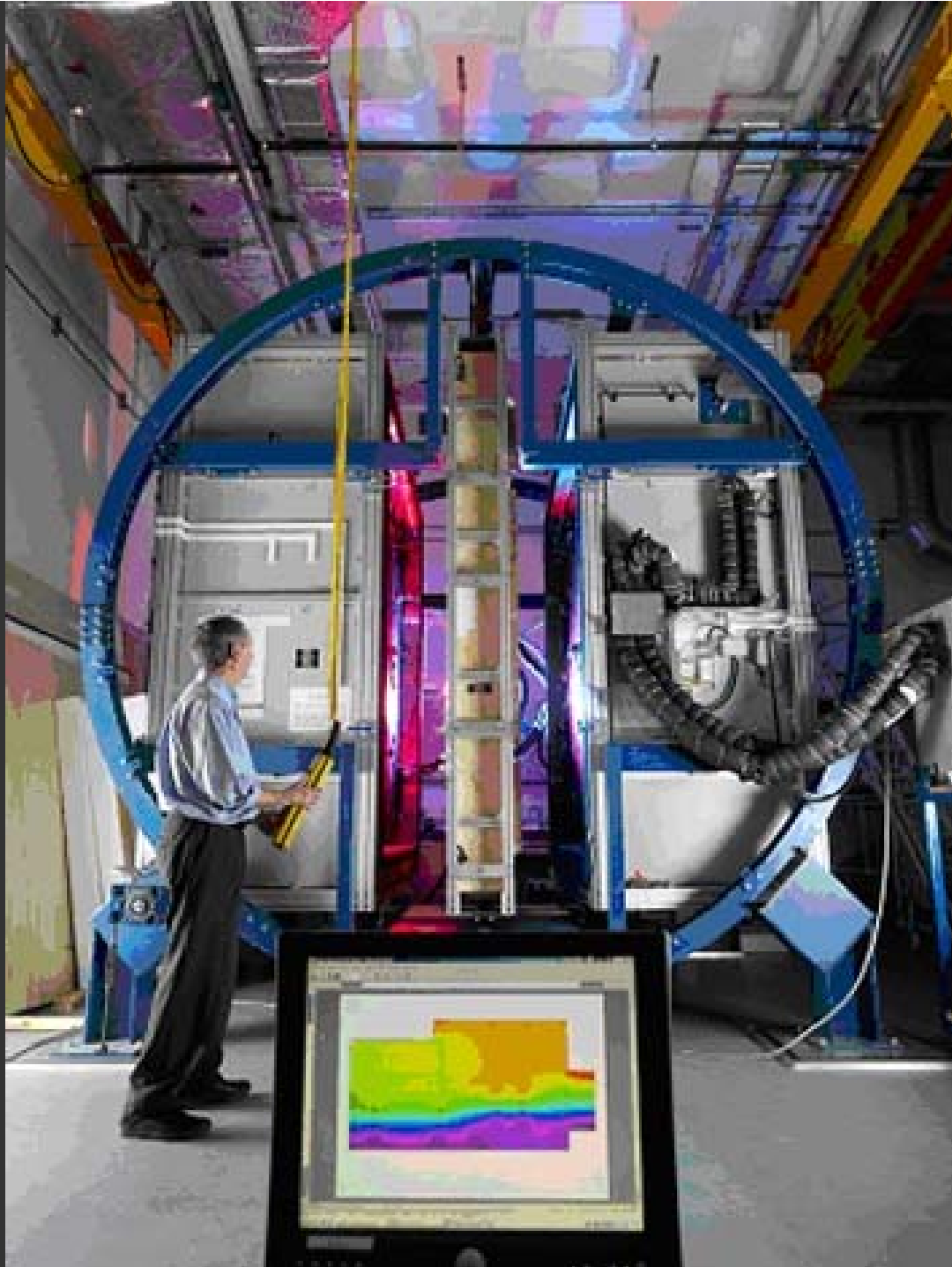
DI 'NORMAL' HEAT RECOVERY MODE



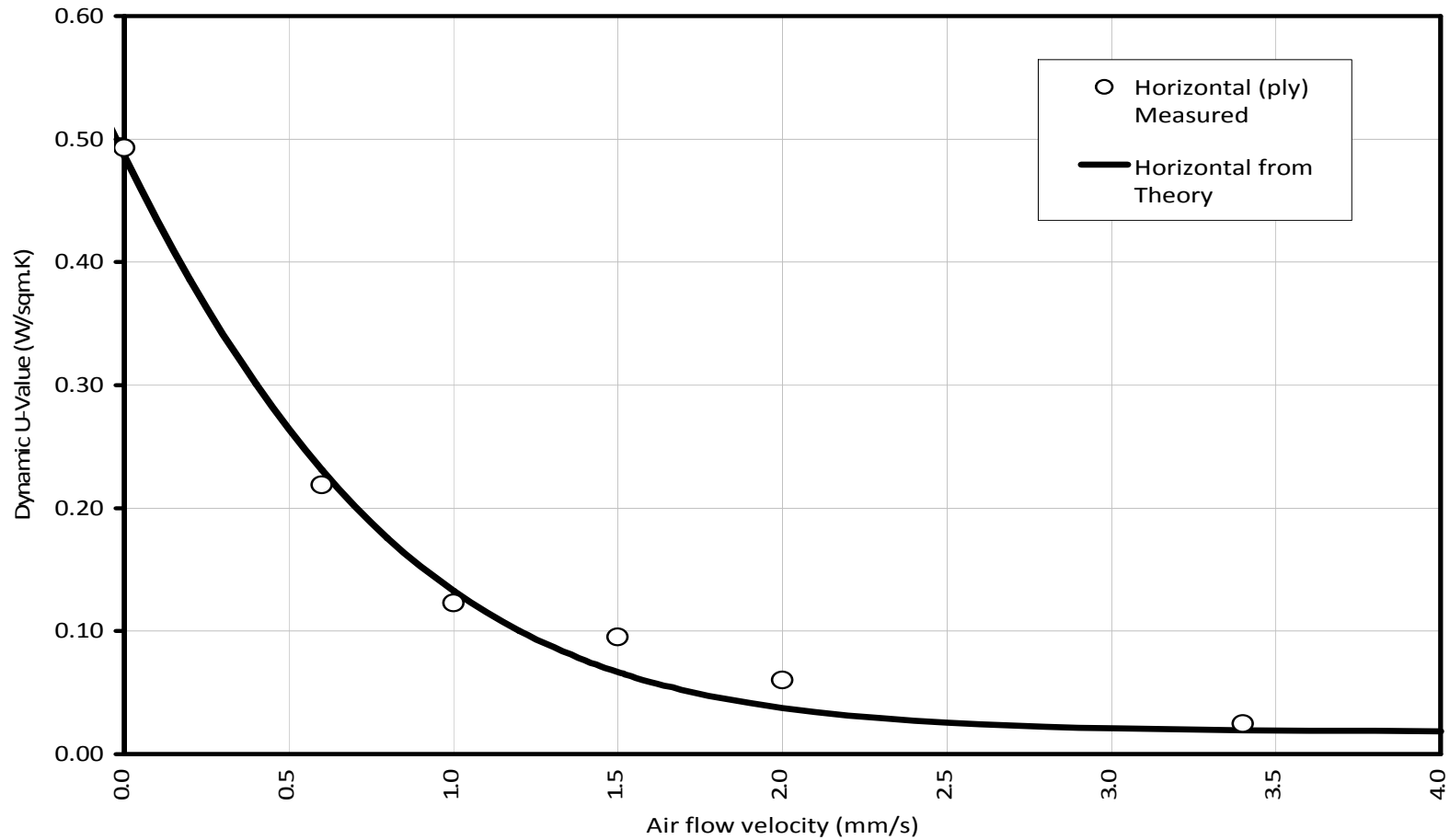
Permeodynamic (TYPE-I)



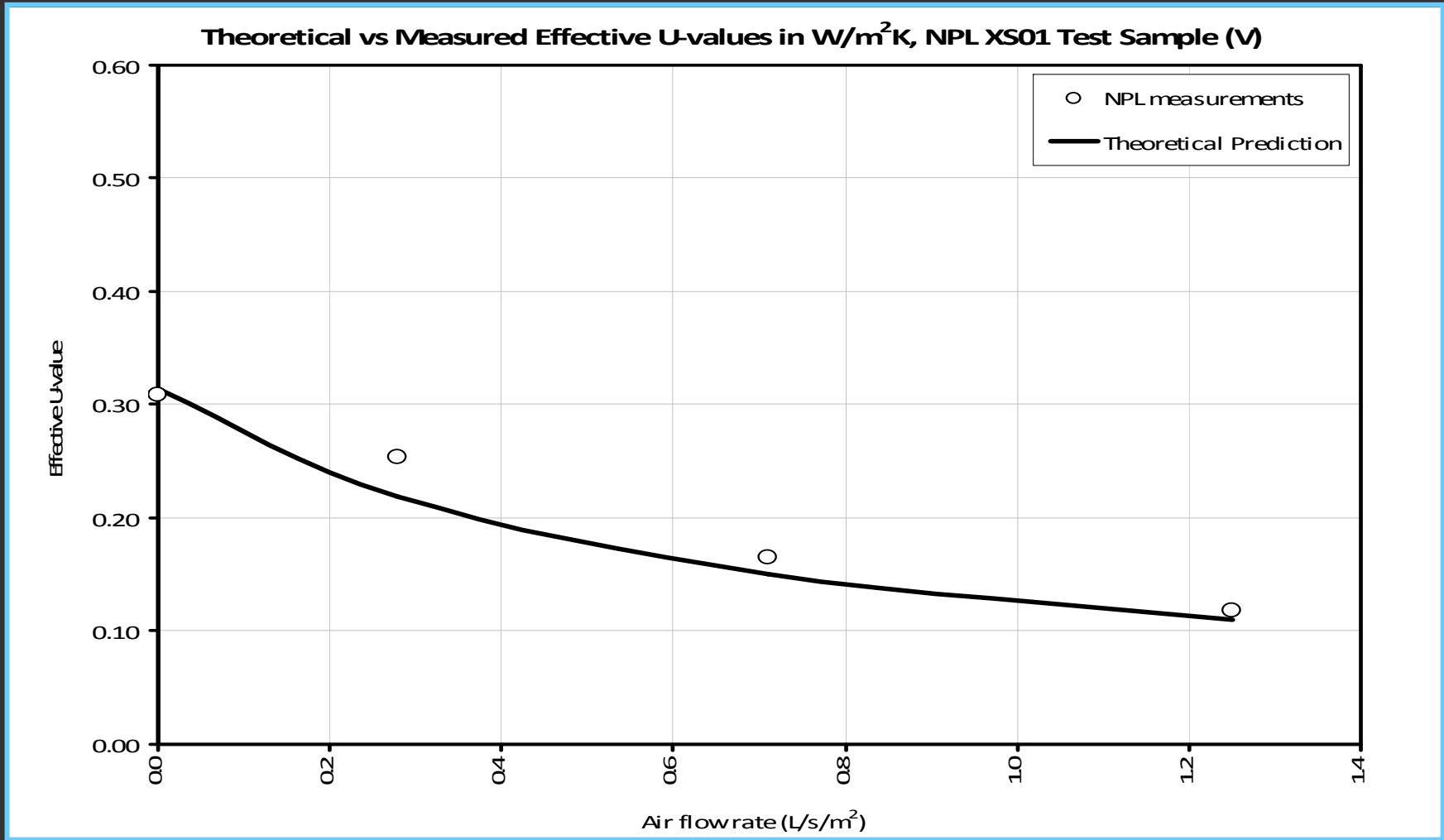
Parietodynamic (TYPE-II)



Theoretical vs Measured Dynamic U-Values, NPL EF04 Test Sample (V)



TYPE-I PERMEODYNAMIC U-VALUE CURVE



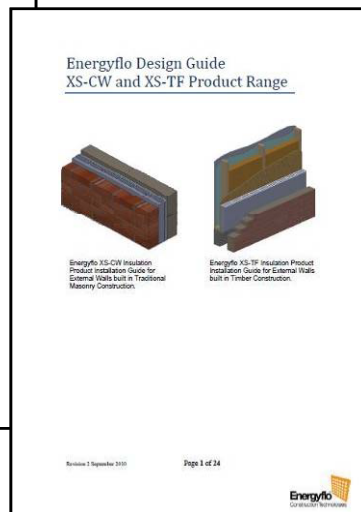
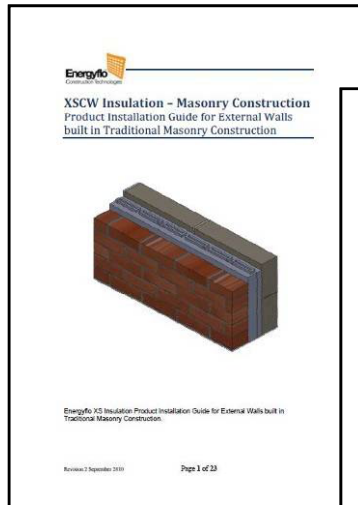
TYPE-II PARIETODYNAMIC U-VALUE CURVE

SAP-Q dynamic R-value calculator

INPUTS		OUTPUT
Envelope	1 Cell selected ¹	EF03
		R_c (m ² K/W) = 3.900
	2 Build method ²	OFF-SITE
	3 R_i (m ² K/W) ³	0.150 <<
	R_e (m ² K/W) ³	0.400 <<
HVAC system	4 System Type ⁴	MEV
	5 Supply Ducts ⁵	UNEXPOSED
Air flow rate	6 v_a (L/s/m ²)	1200 <<

27.973
 $R_{dynamic}$ (m²K/W)

1. R_c is the thermal resistance, in the absence of air flow, of the dynamic insulation cell that has been selected in step 1.
2. The available options will vary with cell choice, for example EF models don't include an OFF-SITE option - impact of IP.
3. R_i and R_e are added to the calculation R_{static} , but then subtracted from the result to yield $R_{dynamic}$. Only apply to IES cells.
4. MEV applies to all Mechanical Extract Ventilator systems, OTHER to over-the-roof flow, PTV, BTE, etc. > impact of IP.
5. UNEXPOSED is an option for systems (e.g. MEV) where an air supply duct runs through unheated space - impact of IP.



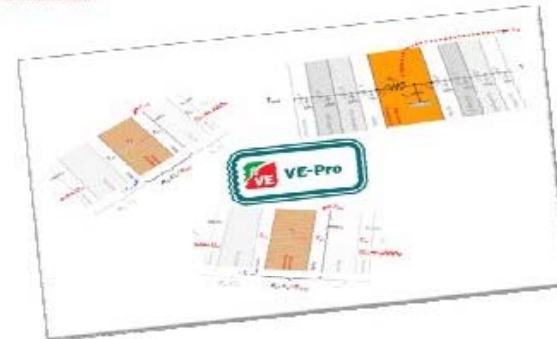
Environment & Sustainability Consulting Services

Energyflo Dynamic Insulation:

IES <VE> Workflow Methodology
for Part L2 & EPC Compliance

INTEGRATED ENVIRONMENTAL SOLUTIONS LIMITED
International Sustainability Consulting
Developers of the IES <Virtual Environment>

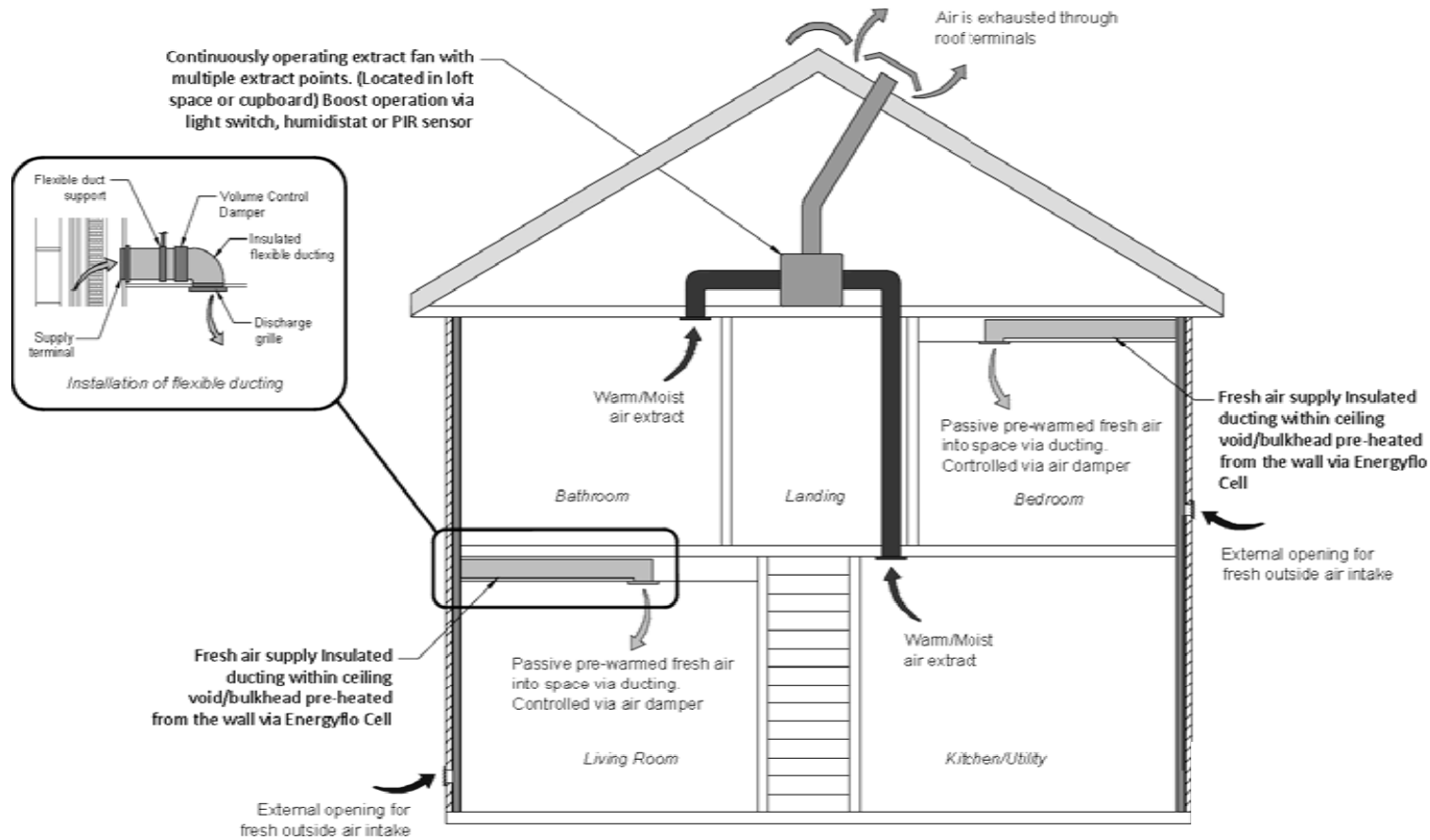
Date: Wednesday 20th September 2010
Strictly Private & Confidential



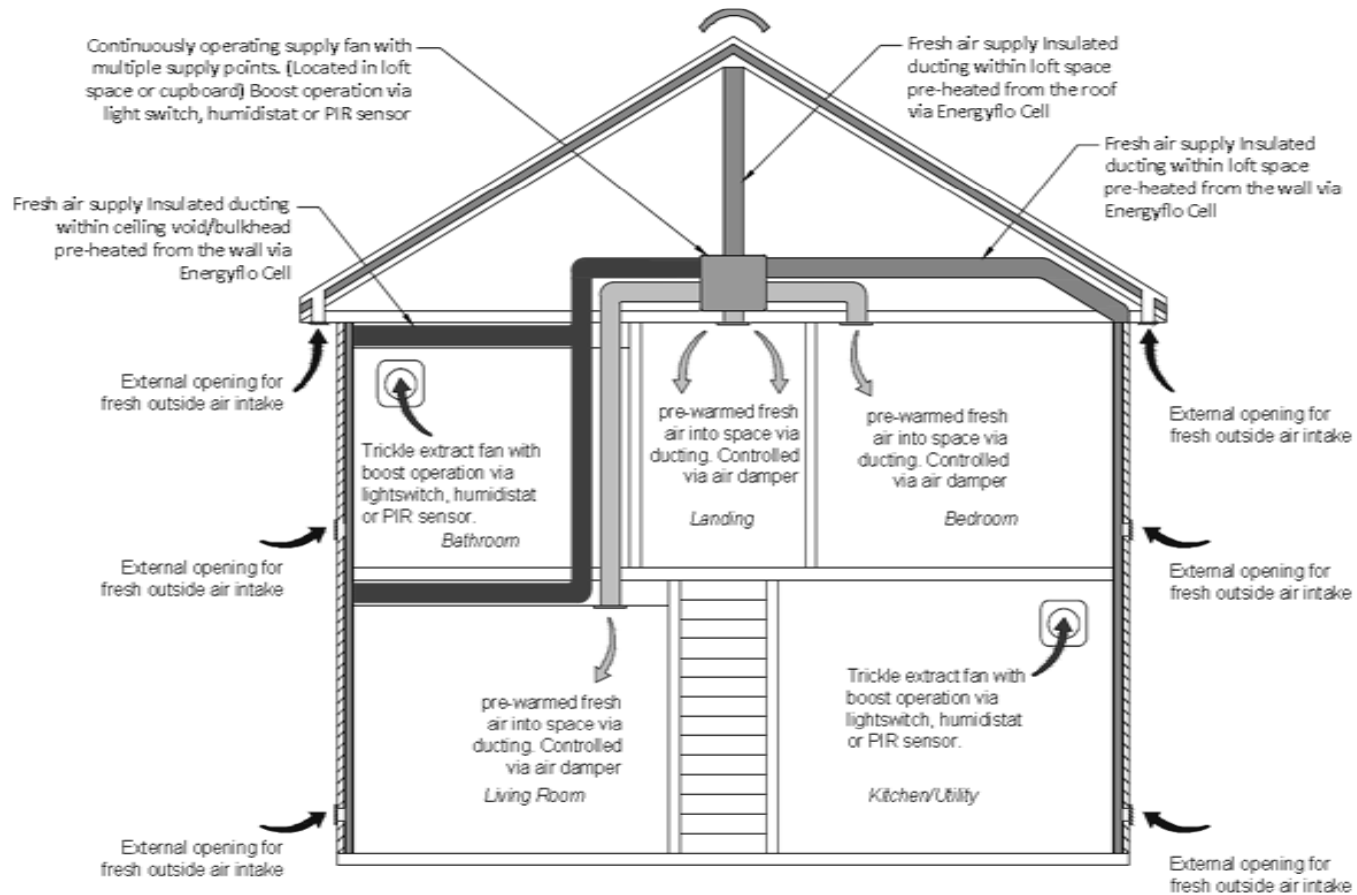
DOMESTIC

COMMERCIAL

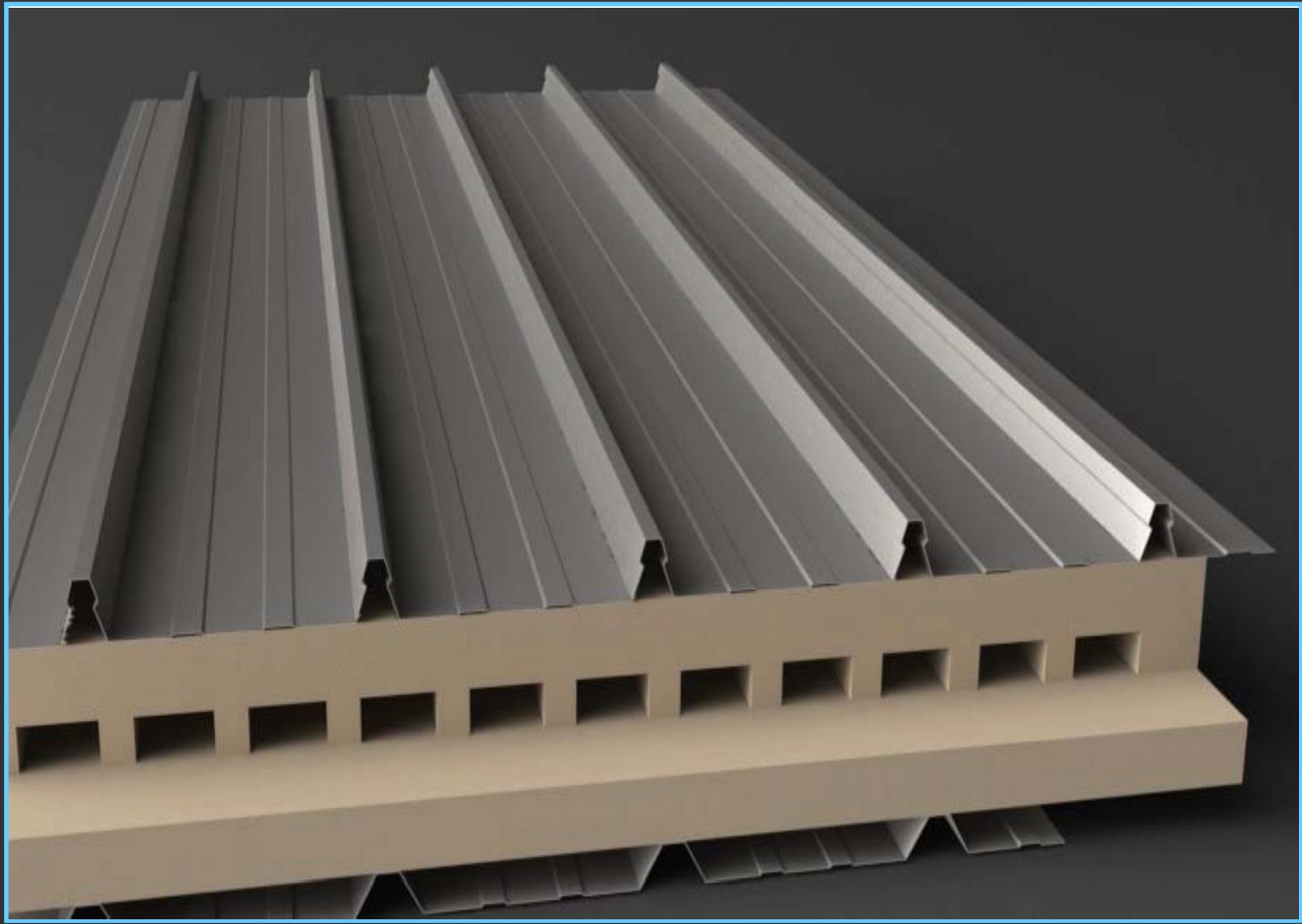
Energyflo® with Mechanical Extract Ventilation (MEV)



Energyflo® with Positive Input Ventilation (PIV)









CASE STUDY - LOMOND HOMES



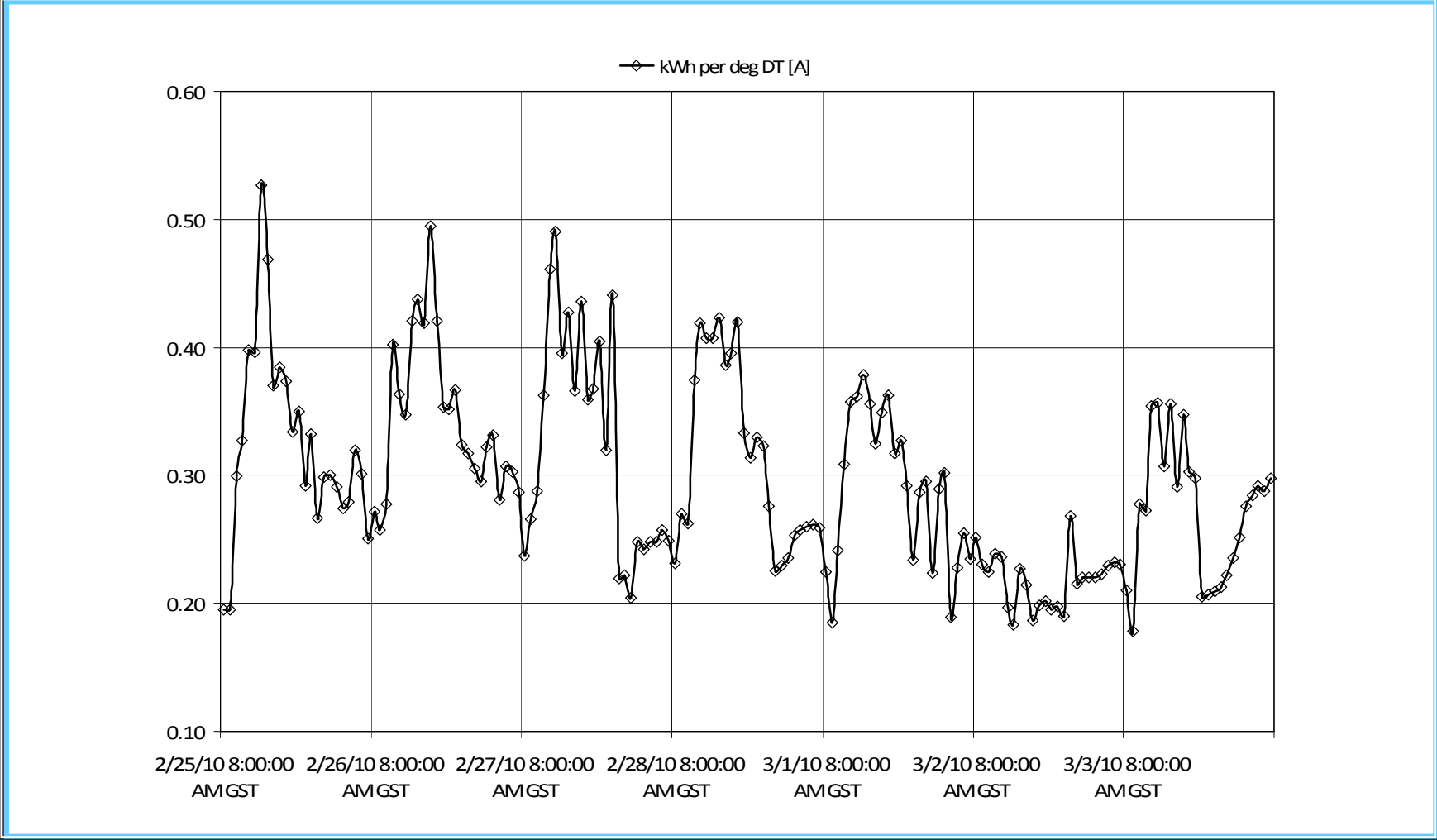
Conventionally insulated house

Dynamically insulated house

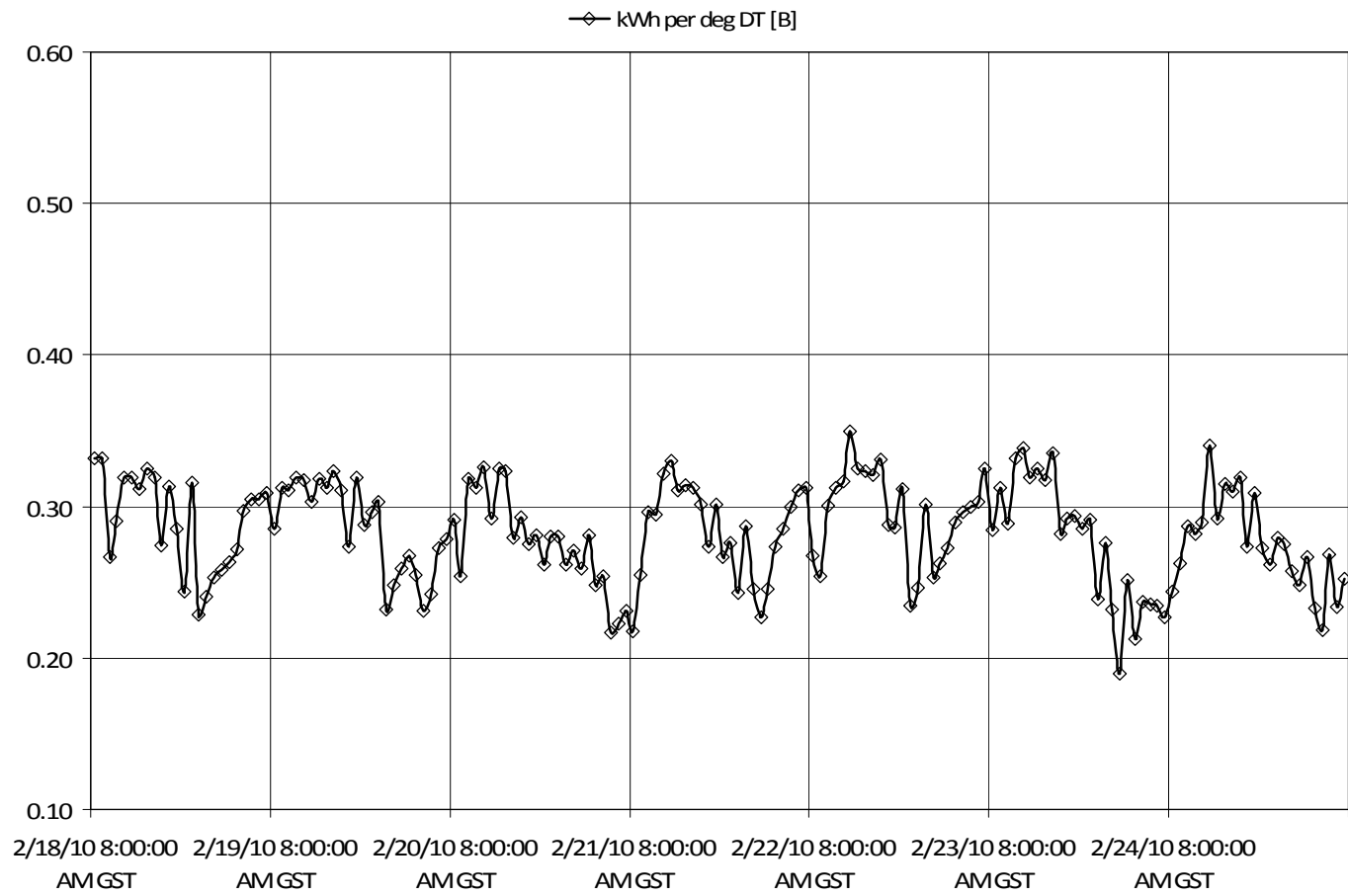
CASE STUDY - LOMOND HOMES



CASE STUDY - AHCC ECO-VILLA (UAE)



CASE STUDY - AHCC ECO-VILLA (UAE)

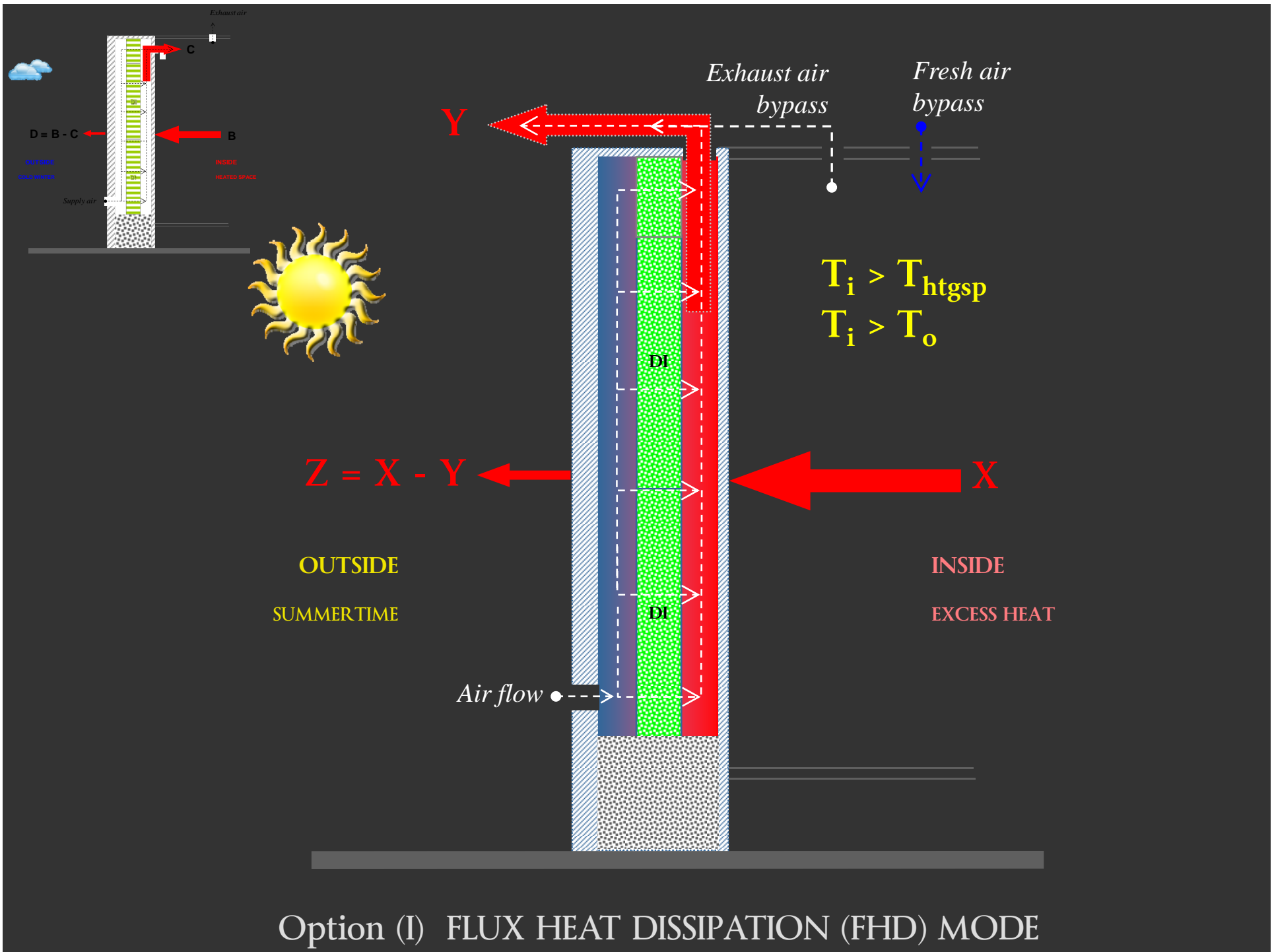


CASE STUDY - AHCC ECO-VILLA (UAE)

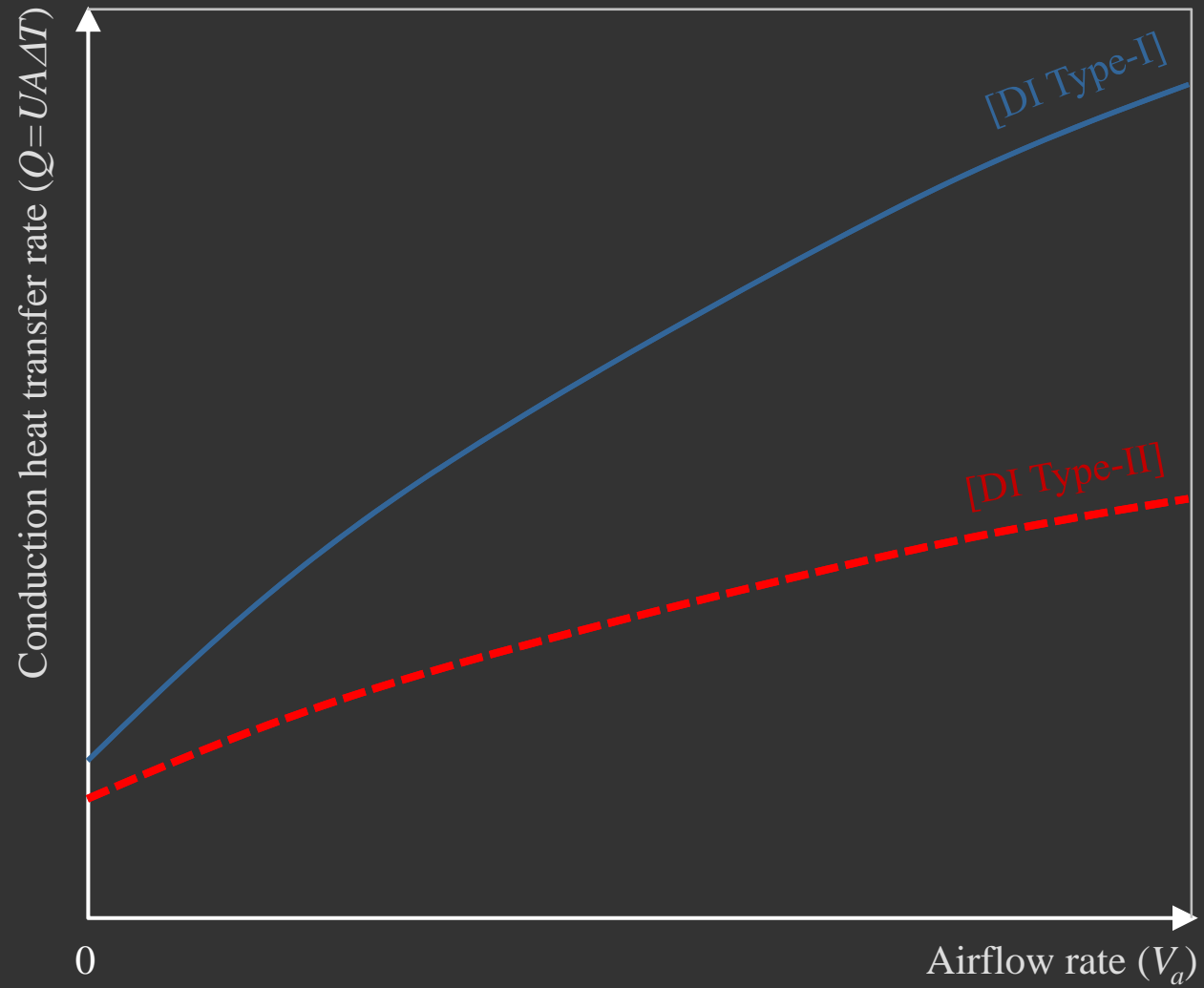
What else can DI do ?

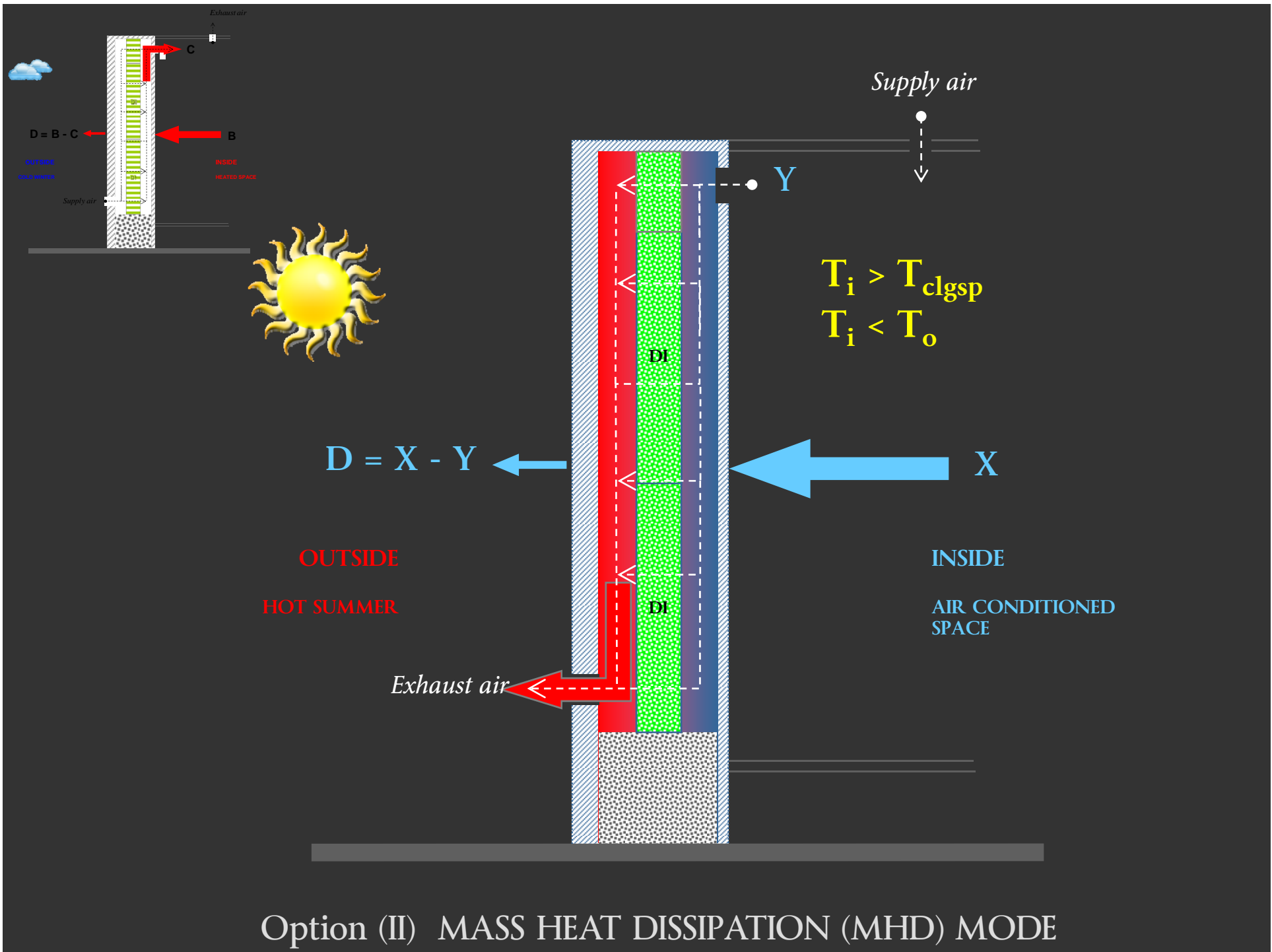
- It can do different things and be used in different ways.
- When it is cold outside it can supply fresh air and reduce building fabric conductance via heat recovery. Similarly, when it is hot outside it can supply fresh air and reduce fabric conductance via coolth recovery.
- DI can also be operated in modes that dissipate surplus heat from the building, either through either FLUX or MASS heat dissipation.

Note: HEAT and COOLTH in the above context are interchangeable.

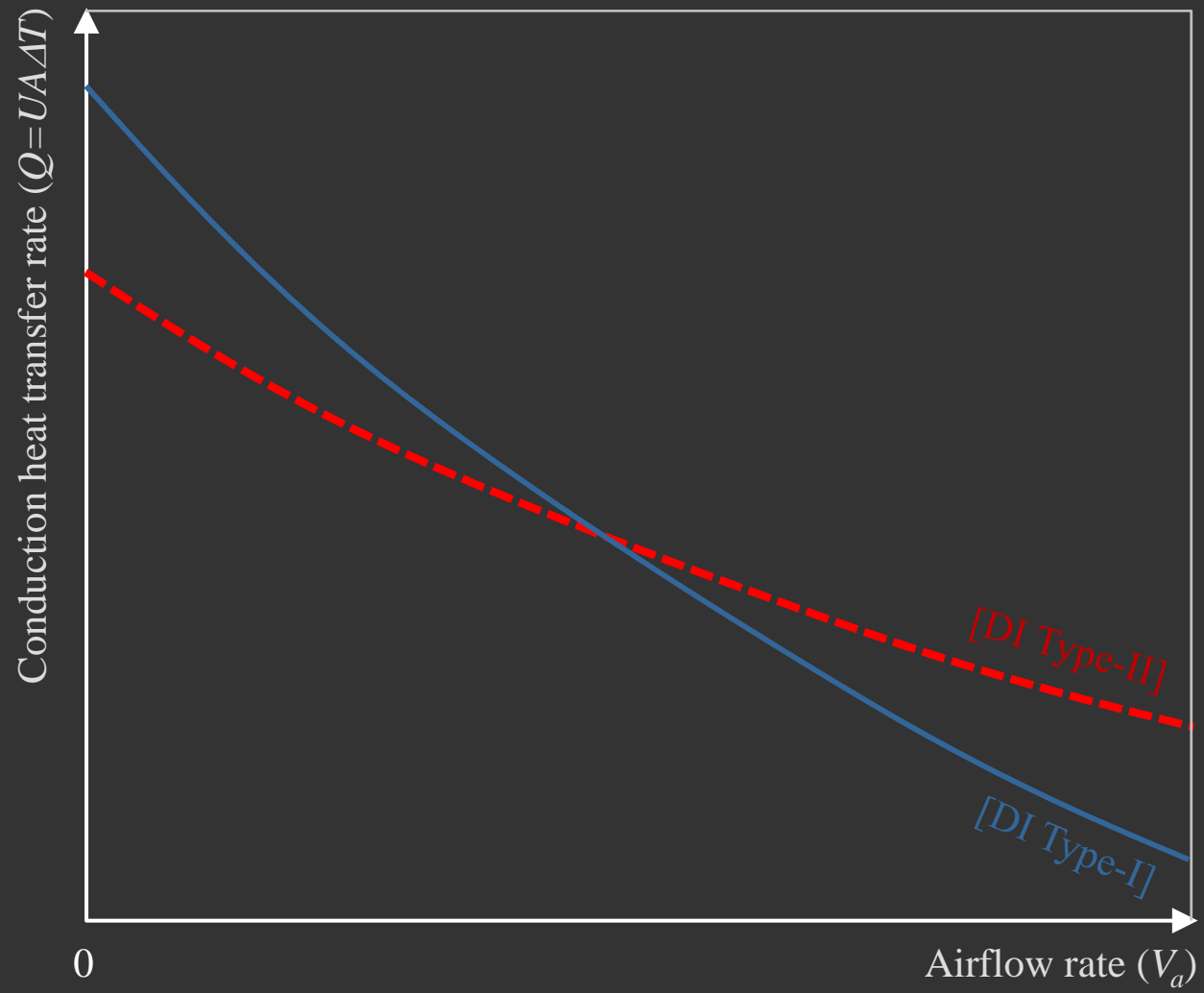


Normalised heat flow through the wall – Option (1)





Normalised heat flow through the wall – Option (2)



Case Study: Generic Small Office

Area total = 317 m², Volume total = 855 m³



*Open
Courtyard*

Dynamic Roof, 85% cell saturation of the net roof area
using 242.5 m² of Energyflo EXStream™ XT02 Type-II
cells, $R_c = 3.967 \text{ m}^2\text{K/W}$ [100% $U_{\text{dormant}} = 0.2 \text{ W/m}^2\text{K}$]

FHD preliminary results

- Winter performance
 - 0.84 L/m²/s fresh air airflow rate;
 - Dynamic U-value of 0.06 W/m²K;
 - Composite U-value of 0.086 W/m²K;
 - Net 57% reduction in roof heat loss.
- Summer overheating in temperate climates (no A/C))
 - $T_i = 32^{\circ}\text{C}$ when $T_o = 24^{\circ}\text{C}$ @ standard ventilation rate;
 - DI bypassed, $T_i = 27.2^{\circ}\text{C}$ @ 2.5 times boost ventilation rate;
 - FHD @ 2.5 times boost ventilation rate = 900 W of cooling;
 - Bypass FA supply is required when using FHD.

MHD preliminary results

- Hot climate performance
 - In hot climates, air conditioning is used to maintain indoor thermal comfort and so the reduction in dynamic U-value is the same as before at 57%;
 - MHD can potentially yield further reductions in energy demand. The exhaust of cold air through the roof can help to counteract direct fabric solar gain. From the work of Lee et al (2009) on ventilated roofs, our initial estimates suggest a 50% reduction in sol-air temperature is achievable;
 - Lastly, MHD will eliminate the risk of interstitial condensation in hot-humid climates.

Conclusions

- The use of DI as a means to delivering low, tuneable U-values in thin construction has been introduced.
- We show how this functionality can be used to enhance building thermal performance across seasons and climate regions.
- We show how the fabric thermal load of a building can be reduced during active heating and cooling seasons, and also how DI can be re-configured to enhance heat dissipation and help maintain thermal comfort.

Conclusions

- Headline performance figures have been presented using case studies to quantitatively illustrate the strengths and limitations of DI.
- FHD and MHD are new ways in which DI can be used:
 - Initial results for FHD suggest a cooling effect can be achieved that may be beneficial in some, if not all cases.
 - The use of MHD in hot climates combines reduced fabric conductance and solar gain.

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