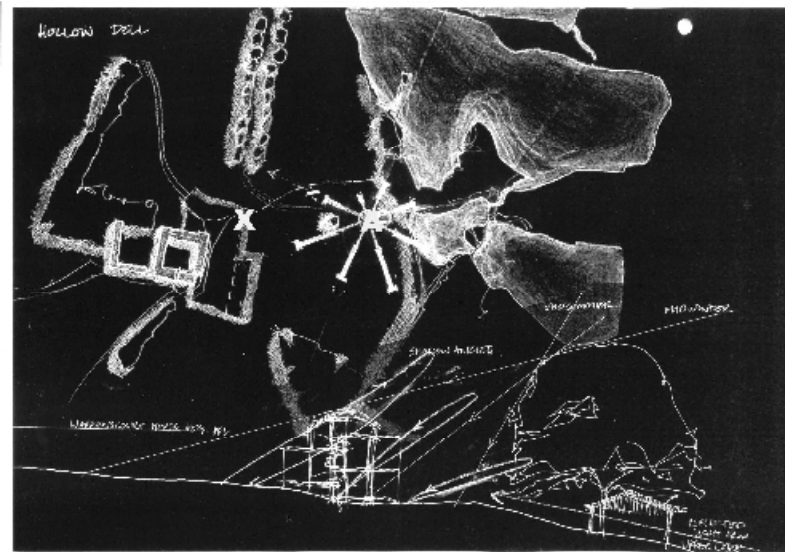
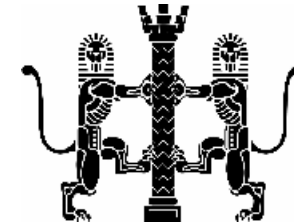


# Sally Starbuck Gaïa Ecotecture



Site Study Preferred location at windrose



**Better ideas**

... **'Su\_stain\_age'** ...

sustainable stone age, which technique will go on to define our epoch?

- *“The Stone Age did not end because we humans ran out of stones. It also follows that the Oil Age will not end because we ran out of oil.” Paul Hawken*
- *“You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete.” Buckminster Fuller*

# Resilience- anticipating change- forecasting & future scenario planning



Ecology shows, it is healthy for any system to foster diversity

**Robust**, cross- disciplinary approach and broad vocabulary  
to explore many different solutions  
to address, by avoidance, mitigation or adaptation,  
each change; future challenge or opportunity

# Environmentally, socially and economically, sustainable development



*Passivhaus* brand



single-number criteria



technical methodology

- A universal solution / appropriate in buildings beyond the private house/ owner-occupier homes? Concerns incl.:

(a) affordability

- capital costs,

- primary energy/ running costs

(b) reliance on

- petrochemically derived raw materials,

- **rare** earth minerals

- fossil fuels

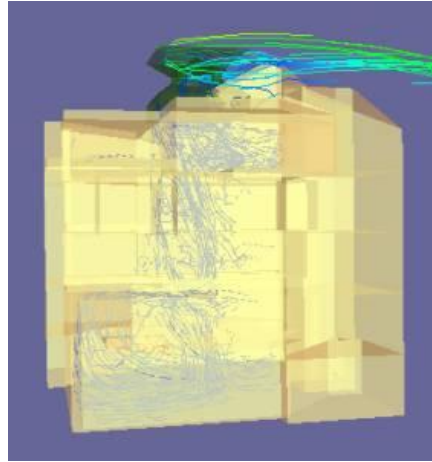
Jevons' Paradox; increased efficiency does not reduce consumption: Norwegian houses larger floor area per person - kWhr/yr per capita continues to increase - no Nett gain!

# Communication, education and training; Continuing Professional Development



- **Quality** assurance
- to retain relevance,
- open employment opportunities
- reduce costs,
- hone professional skills, expertise & methods,
- Research practice not at clients' expense

# Multidisciplinary integrated design teamwork including Post Occupancy Evaluation



## Navan CU, 5 storey timber bldg, nat vent strategy

- Cooperation proven most stable (of all different strategies for development), if the consequences, or future, loom large enough [Axelrod 1984].
- Participation / involvement of building users for best performance & comfort
- *Unlikely for transient cohort ('outcome-free' = unstable scenario)*

# Indoor air quality



Natural ventilation with specific provision for extract ventilation  
(including option of passive stack designed in accordance with BRE IP 13/94)

or Mechanical ventilation with heat recovery (MVHR):

- In both, openable windows and doors provide **purge** ventilation.
- 10mm gap under internal doors to permit **cross-ventilation** between rooms
- Background ventilators at min 1.75m above FFL
- Cooker hood at 650 to 750 mm above hob surface [**re-circulating or not**, subject to taste!]

Natural ventilation; min total equivalent area of **background vents**

$$176,400 \text{ mm}^2 = (35000 + (((5000 \times ((252 - 70) / 10)))) \times 1.4$$

- controllable 'trickle' vents in window frames, amounting to ~ **474mm diameter 'hole in the wall'** ...  
impact on heat energy consumption in cold weather (eg. **when >9 degrees C colder outside**)

# Improved building standards & retrofit



*not piecemeal*

Airtightness eliminates infiltration to improve energy efficiency, but pitfalls exist...

Adequate fresh air for the building also needs to be designed to suit occupancy:

- Mechanical ventilation with Heat Recovery (MVHR),
- MV with Demand Control,

both rely on **grid, maintenance & supply air ducts**

or

- Passive stack or other (possibly hybrid) natural ventilation strategy

**Natural ventilation emits 40% less Carbon Dioxide than MV, in electrical consumption over a 20 year life cycle.** [Danish Teknologisk Institut 2007].

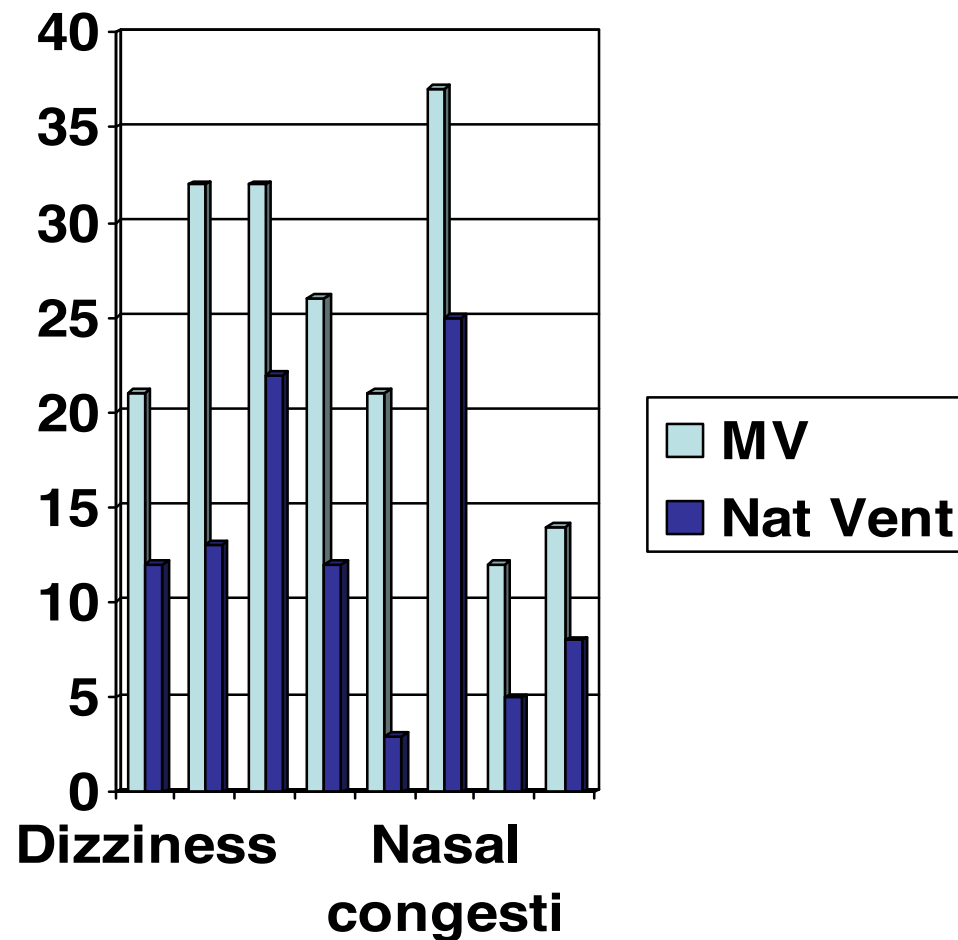
**Fine control** of humidity, air temperature, CO2,  
reduction of outside noise and draughts for the user,  
with security - hardware to suit-  
optimal aperture within the **first 50mm** of opening



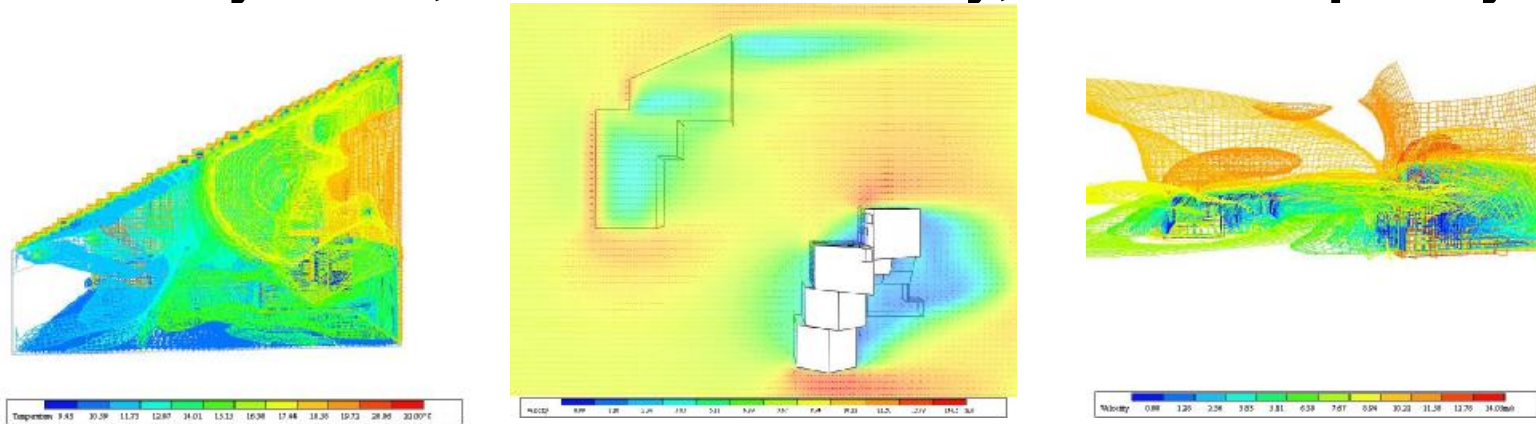


Poor indoor air quality (IAQ) and high ambient noise levels are both factors implicated in **Sick Building Syndrome** [Clancy 2011].

- Symptoms such as fatigue, headache, irritation/ dryness of eyes or ears, reduced concentration and productivity have been shown to arise **more in mechanically ventilated (MV)** than in naturally ventilated spaces [[Meyer et al 2005 &08](#)]
- high levels of **mould in dust** a greater problem in MV rather than naturally ventilated rooms *in following ratios of %:*
  - *Dizziness 21:12*
  - *Concentration problems 32:13*
  - *Fatigue 32:22*
  - *Headache 26:12*
  - *Throat irritation 21:3*
  - *Nasal congestion 37:25;*
  - *Nasal irritation 12:5*
  - *Eye irritation 14:8.*



**‘Dwelling’ is a verb, a *doing-word*, a dynamic system, not steady-state, varies seasonally, with occupancy etc**



*IES modelling, Community Building*

- **Multiple variables** include occupant awareness & behavior
- WHO methods of monitoring IAQ
- eg. labeling internal finishes VOCs for French schools,
- AgBB Germany or all buildings prior to occupation DBBG

**Need for monitored examples & standardised methods;**

BRE publication ...*ref Dr Andy Dingle*

Good Homes Alliance research report - 7 of 400 possible case studies

## WHO Guidelines for indoor air quality: dampness & mould [2009]

- Building standards & Regs ... not sufficiently emphasize ... preventing and controlling excess moisture and dampness and microbial growth
- Well-designed/ constructed/ maintained building ... critical ..., prevent thermal bridges and the entry of ...water. Management ... proper control of temperatures and **ventilation** to avoid excess humidity, condensation .... Ventilation should be distributed effectively throughout spaces, and stagnant air zones should be avoided.
- Building owners are responsible for ... maintenance. The occupants are responsible for managing the use of water, heating, ventilation and appliances ... (v) dampness and mould growth. (to) Local recommendations for different climatic regions ...
- **Dampness and mould may be particularly prevalent in poorly maintained housing** for low-income people. Remediation ... to prevent ... poor health in populations who are already living with an increased burden of disease.



# Internal finishes

- Capacity of building ... materials to **absorb and release moisture** has a significant effect on indoor humidity fluctuations ... (with) consequences for moisture damage and dampness.
- **Moisture buffering effects are especially strong at low ventilation rates** (Kurnitski et al., 2007)
- ... recent general trend has been towards buildings with significantly **lower moisture capacity**, ..., together with generally reduced ventilation rates...prevalence of...problems

# Quality of indoor environment & life

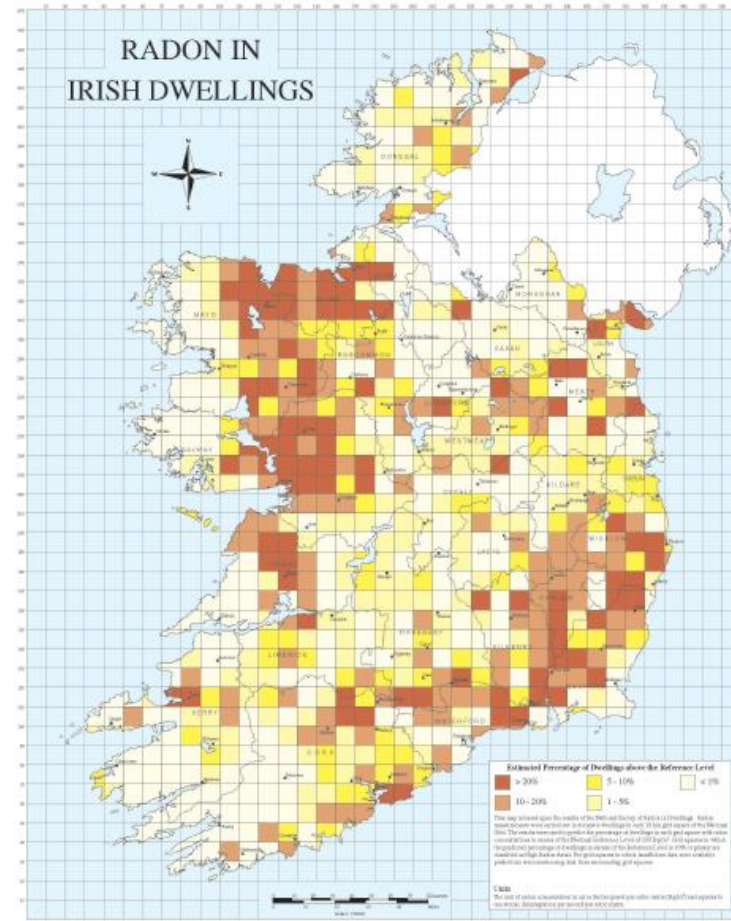
Respiratory diseases;

- 271 respiratory deaths per year in Ireland have been attributed to poor housing conditions alone [Clinch Healy 1999] = to road or by suicide.

Chronic Asthma to Lung cancer

~ 1/8th of all lung cancer deaths in Ireland are of **non-smokers** and attributed by RPII to Radon gas

- Since 2004's smoking ban in public & workplaces, this activity **concentrated within private homes** now typically **10 x more airtight**.



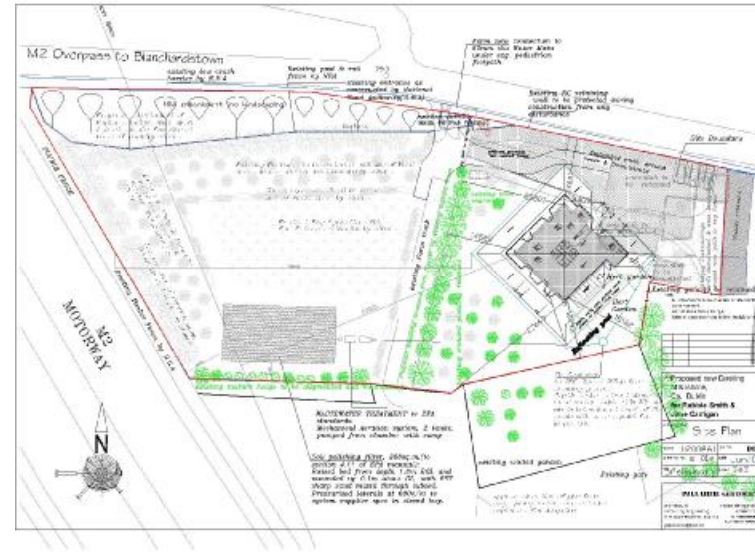
**Case study** of a family home and workplace situated close to **airport flightpath**, beside **high tension power lines**, **motorway and heavily trafficked road**.

Noise reduction from outside to inside building

Ecological impact was reduced by bio-diverse, living roof.



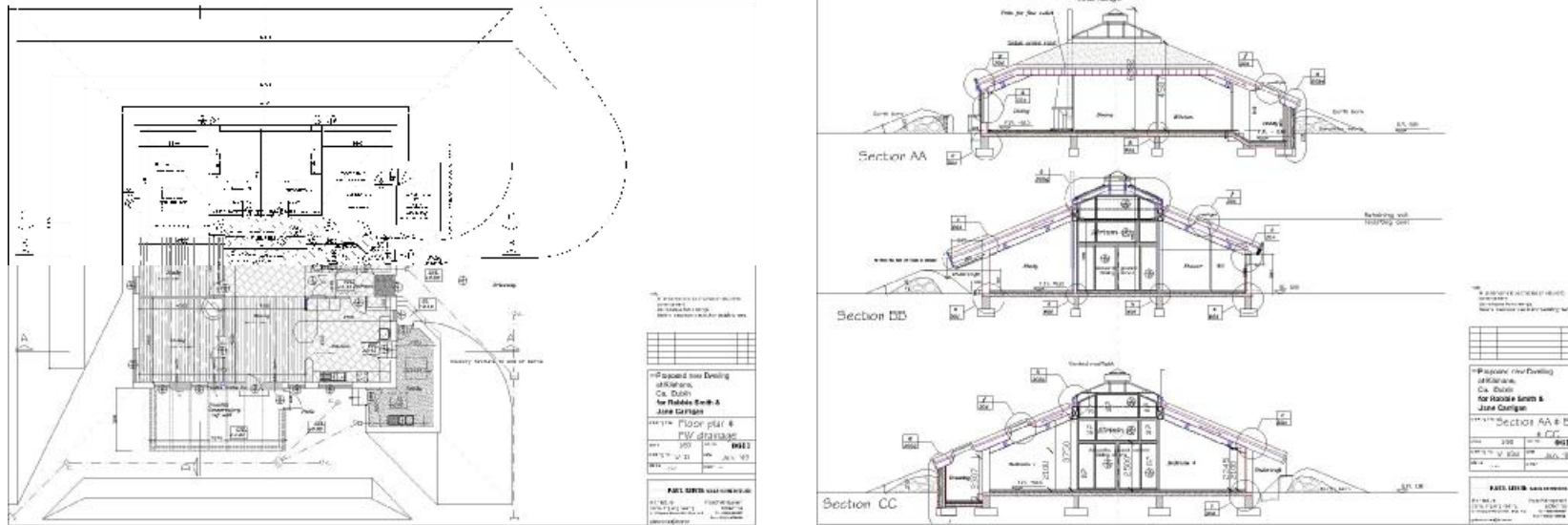
# Design strategy to minimise primary energy (embodied & consumption)



Performance of innovative design assumptions has now been tested:

- Passive-solar design, naturally ventilated,
- &
- acoustically-insulating dense **timber** fabric, **earth roof** and **landscaped berms**

Post occupancy evaluation (POE) of the building's performance in use -**communication** of the strategy to/ **management** by/ or **training** for, building users



Internal comfort conditions have been measured;

- electro-magnetic field (**EMF**) **shielding**,
- aircraft and traffic **noise/ vibration attenuation** tested simultaneously with
- indoor air quality (**IAQ**) for protection from toxins inside & out

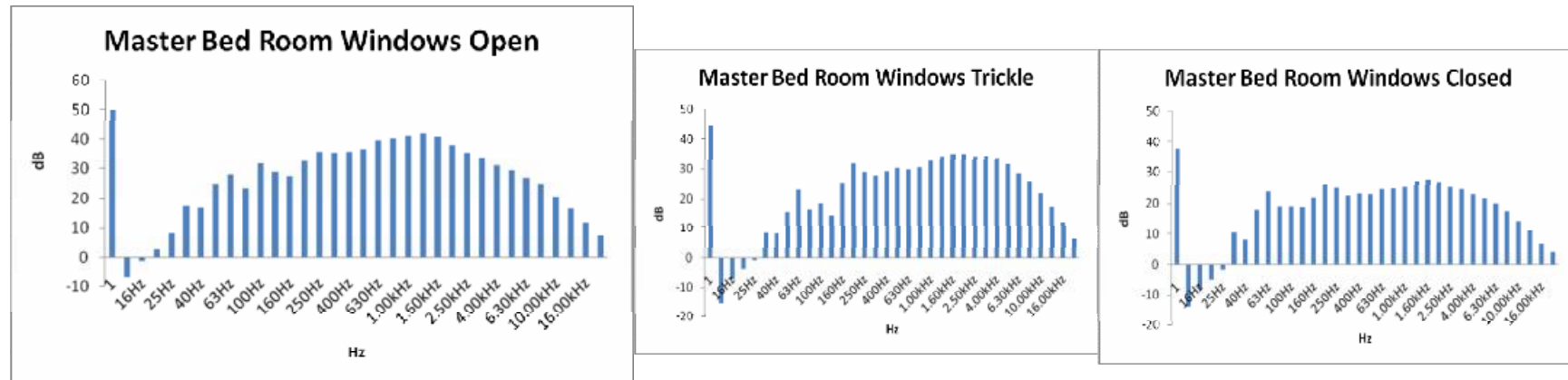


# INDOOR AIR QUALITY TESTING



1. **Trickle venting** while the house is occupied, **reduces** total VOC, CO<sub>2</sub> and total suspended particulate levels.
2. Indoor sources of VOC kept to a minimum: eg cleaning products labelled 'non-toxic' or use baking soda, washing soda crystals, white vinegar and pure lemon juice, all of which are VOC free and can work well for the majority of cleaning tasks. Also when selecting paints consider low-VOC or zero-VOC paint; durable, cost-effective and less harmful to human and environmental health.
3. To control levels of nitrogen dioxide, the gas boiler and wood stove within the house to be properly used and maintained, ongoing.
4. Effective general cleaning of the house should be maintained with frequent surface cleaning of all surfaces and thorough vacuuming, paying particular attention to carpeted areas."

# ACOUSTIC TESTING



- Graphed performance of the fabric, either;
  - re. Specified single dB(A) performance target or,
  - visually/ intuitively.
- **Good acoustic insulation even while Trickle venting**
- Earth berms of the house contribute to abating noise levels at the house itself by approximately 2dB.

# Extract from detail report of acoustic testing

External background noise levels:

- 'planes close overhead on take-off & landing, peaking at 704dBA,
- vehicular traffic on adjacent roads, max. 58 dB(A) to 62 dB(A).

Attenuation by the building fabric, when windows closed was of the order of 22 dB(A) and for trickle venting 20dB(A)...

For aircraft noise, these two attenuation figures become 32dB(A) and 18 dB(A), but noise did vary widely in both noise levels & type.

Measurements inside and outside could be taken simultaneously and synchronised for full analysis.

**Graphed comparative results [on previous slide] are a visual summary, whether assessing the performance of the building fabric against a single dB(A) performance spec. target or intuitively:**

The logarithmic scale of Decibels means that 1dBa is, in fact, a halving of the volume of perceived noise. In the case of road traffic noise, and all other things being equal, a doubling of the vehicle flow volume would be expected to give a 3dB increase in noise level (LEQ).

- The increase in noise level might not be very noticeable to the human ear (but the increase in traffic volume would be visually noticeable).
- Acoustic features such a **tonality** and **impulsivity** are important in noise perception to the human ear.
- Noise/ annoyance relationships to the human ear are clearly based on increase in noise level but equally importantly the type of noise itself.

# Transition; from theory into practice



even in challenging external environments, and increasingly so, human habitat design balancing several variables,

- Daylighting, acoustics, thermal-comfort interplay to **optimise** quality of life for occupants or building users, who remain the ultimate arbiters of success.

# Form language / Timely way of building...

