Residential Passive design

- Passive design is the balancing of heat energy flow without adding extra heating and cooling
- Building envelope is any part of the house that's needs to be kept comfortable

What we need to control for

Temperature average

- Temperature range (daily)
- Temperature range (seasonal)
- humidity
- solar gain
- solar loss
- wind
- internal loads

Orientation in Melbourne

- most windows to the north
- shading to summer sun over heating homes
- adjustable shading to east and west (vertical shading possibly)
- catch the summer breezes and stop winter wind (summer winds come from coast, winter winds come for inland)

Designing the house

- Put living areas to the north as they will be the warmest
- Windows to the north – horizontal shading (adjustable?)
- Windows to the west – vertical (adjustable?)
- windows to the east – vertical (adjustable?)
- south – internal drapes
- Natural Ventilation
  - 5 parts floor to 1-part height
  - outlet need to be the same size, or 25% bigger than the inlet

- most important is the sun path
- thermal mass is more important the more south you go
- in winter, you need to create sunny spots
- 18 degrees off north is the perfect angle
- Balance solid and void to make it comfortable
- Water is good at absorbing and releasing heat. Activate the water to allow for evaporation and cooling throughout the house
- rammed earth is very good at thermal mass

- **R-Value =** resistance value: bigger the better. You want to stop energy escaping
- **U- Value** = transmittance: the smaller the better. You want to stop energy escaping
- **SHGC** = percentage of solar heat that gets in from outside (for residential you want some heat gain inside the building, for commercial you want to avoid it)

R-Value

units: m^2 degC/W
- in different building elements you need to add different strengths of insulation.
- Minimal Overall R-ratings

- Concrete slab on ground
  - Ceiling = R2.2
  - Walls = R1.3
  - Floor = R1.0
- Suspended floor with an open sub-floor space
  - Ceiling = R2.2
  - Walls = R1.7
  - Floor = R0.7

To generate the R value, all the types of resistance needs to be added together
R1.5 in Australia is the equivalent to R8.5 in the states (factor of 5.678)

Thermal Bridge

- Thermal bridge is where the insulation is missing, or there is a gap in insulation
- Heat goes out through the slab, doors and windows

U-value

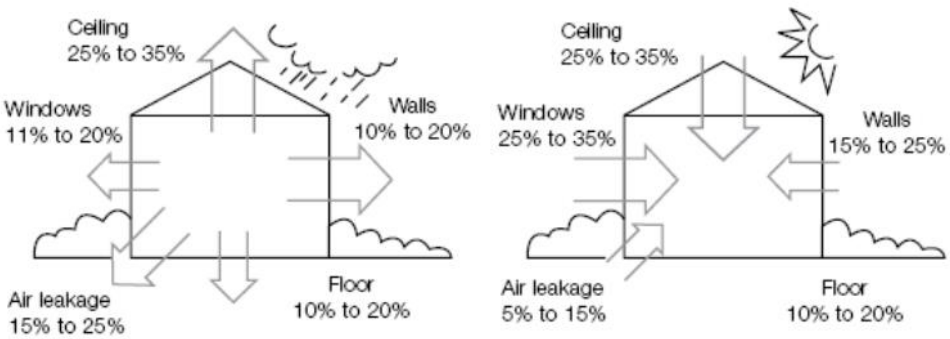
- opposite of resistance
- U value is overall (air to air) thermal conductance for complex construction
- U value is really typical to windows and glazing
- The lower the U value, the better the Resistance
    - To calculate energy loss as heat, the formula is:
        - Energy Loss = U-Value x total area x temperature change

Rule of Thumb:

1. Large areas to the north, small areas to the east and west and minimal areas to the south
2. Double glaze where possible. If limited budget, then just the south
3. The U-value for a window includes the glazing and Framing

Solar Heat Gain Coefficient

- SHGC is the fraction of incident solar radiation admitted through a window
- Expressed as a number between 0 and 1
- The lower a window's solar heat gain coefficient, the less solar hear it transmits (into the house)



Heat losses and heat gains