



ENERGY

THERMODYNAMICS (science of heat flow)

FIRST LAW: **ENERGY CANNOT BE CREATED OR DESTROYED** only converted

SECOND LAW: **ENERGY** (heat) **TRANSFERS FROM A HIGHER TO A LOWER GRADE** (hotter to cooler)

ENERGY

ENERGY FLOWS: conduction, convection, radiation

HEAT FLOWS: add evaporation, metabolic

CONDUCTIVITY: characteristic of a material "**k**"

CONDUCTANCE: property of a body (GIVEN THICKNESS) "**C**" ($1/R$)

RESISTIVITY: reciprocal of k ($1/k$) for a material "**R**"

RESISTANCE: COMBINED resistances of **all the components of the body** (includes the materials, surface air films and air spaces)

GREENHOUSE/GLASSHOUSE EFFECT

Glass characteristics: transparent to shortwave, opaque to long
(Can be used for summer protection)
Generates heat, higher than outside temperatures...

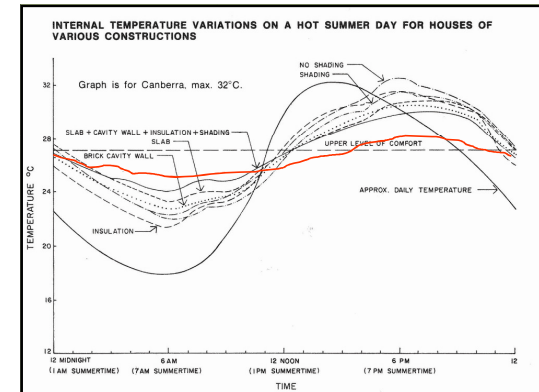
PASSIVE HEAT SOURCES

Sun (direct)
Indirect
Occupants
Lighting
Equipment
Ground

constant

AGSO Cbra 1m ave 13-15° C
USGS 6m 20' ave 12° C

heat exchange
geothermal



**Climate conditions – human comfort conditions
= control task**

**Control task – passive system controls
= active system controls**

If building heat inflows and outflows are other than zero, then you need heat input or removal (heating or cooling)

These can be passive or active

Passive (solar) design of buildings can **ELIMINATE** heating and cooling

Passive Design Principles

1. **Orientation** to the equator (sun)
2. **Glazing** maximised to the sun (north/south)
minimised to west and shaded
shaded to south and east
single glazing 5mm min
3. **Thermal mass** internally, maximised (ultra mass)
including hugging the earth heavily (infinite mass)
4. **Insulation** complete external barrier (roofing,
structure, walls, floor and foundations)

Cross Ventilation

Shading

