

# AE Concepts Cheat Sheet by WhiteSpade via cheatography.com/166754/cs/34906/

Definitions	
Conduction	It is the transfer of heat through a material
Radiation	It is energy transmitted directly through space
Convection	It is the transfer of heat by the movement of fluids such as air or water
Emissi- vity(ε)	ratio of the radiation emitted by the surface at a given temperature to the radiation emitted by a blackbody at the same temperature.
blackbody	The idealized surface that emits radiation at this maximum rate
Kirchhoff's Law (1860)	At the thermal equilibrium, the power radiated by an object must be equal to the power absorbed.
Heat	It is the form of energy that can be transferred from one system to another as a result of temperature difference.

Definitions (cont)	
Thermo dyn- amics	We can determine the amount of heat transferred using a Thermodynamic analysis alone. It deals with equilibrium states and changes from one to another.
Heat Transfer	It deals with systems that lack thermal equilibrium. It is the science that deals with the determination of the rates of such energy transfers is called heat transfer. Unit is Btu/hr, or Watt (1 W = 3.41 Btu/hr)
Infilt- ration	s the accidental heat loss/gain due to air leaking through the envelope, doors, windows etc.
Ventil- ation	is the deliberate, designed introduction of air into/out of a space required for healthy buildings
Heat Loss(B- tu/hr)	The heat transfer through each element to outdoor in winter season.

Definitions (cont)	
Peak Heating Loads(- Btu/hr)	the amount of heat lost to the outdoor environment at design outdoor and indoor conditions, which must be made up by the HVAC system to maintain occupant comfort.
Annual Heating Energy- (Btu)	The energy consumption during winter heating season. It will consider the heat gains from lights, human activities, appliances, etc.
When will the peak heating loads happen?	Lowest weather temperature • At night (no solar) • No internal gains • Ignore thermal mass
When will the peak cooling loads happen?	Highest weather temperature • Maximum solar gains (window orientation) • Maximum internal heat gains • Ignore thermal mass

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The heat (loss or gain) during a

B. Btu,

D. Joule

C. Btu/hr

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day is about #\_\_\_\_?

situation is # \_\_\_\_?

The heat flow rate in this



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### Appropriate terms and questions (cont)

B. MBtu, D. Joule (heating or cooling) loads for a year will be needed

\_ peak B. MBtu, D. Joule heating loads are documented.

Rsubt Total thermal resistance -Ability of a construction assembly to insulate heat, including air films

> Overall coefficient of heat transmission - Ability of a construction assembly to transfer heat, including air films

· Lowest weather temper-When will the peak ature • At night (no solar) • heating No internal gains • Ignore loads thermal mass happen?

the peak ature • Maximum solar gains cooling (window orientation) • loads Maximum internal heat gains happen?

· Ignore thermal mass

need to calculate Peak heating/cooling

loads

Why do we

When will

U

To size the heating/cooling equipment, ducts, etc.

· Highest weather temper-

#### Appropriate terms and questions (cont)

Why do we To estimate the annual need to energy use by a system so calculate we can tell the building these owners how much it will cost Annual to operate a building with a heating/cproposed system. ooling

### Thermal Gradient

energy

#### **Thermal Gradient Calculation Example**

s an example of a simple wall section with the thick led (Outdoor = 0 C; and Indoor = 20 C):



- Step 1: Determine what units are being used.
  Step 2: Make a chart of all the materials in the asse
  the chart include columns for Resistance of each lay
   Find out air space Resistance effective emissivi
- Find out an space resistance effective emissivity
   Find out interior and exterior surface coefficient
   Step 3: Calculate the total R value and U value.
   Step 4: Calculate the overall heat flow Q.
   Step 5: Calculate the temperature change for each laye
   Step 6: Draw or sketch a section for thermal gradient

### Calculations

U=1/Sum<R>=Btu/h ft2 II value calculation

## Calculations

U value U=1/Sum<R> calculation [Btu/hr ft<sup>2</sup> 0F] U=1/Sum<R> where R = II value with Rstud % area stud of sample +

frames Rinsulation % area ins of [Btu/hr ft<sup>2</sup> sample 0F]

Qemit =  $εδAT^4$  where ε = Emissivity emissivity of surface Air Space  $1/E = 1/\epsilon sub1 + 1/\epsilon sub2 - 1$ 

Heat Flow  $q = u \times A \times deltaT$ 

(q) [BTU/hr]

Thermal q = u x A x deltaT

Gradient [BTU/hr] infiltration Latent Heat Simple heat loss calculation Annual Energy Estimation Annual Energy F2 (this is not U-value) Eheating:

Calculations (cont) Heat loss q= F2 x P x deltaT through slabon-grade floors Heat flow q = UA(Tin - Tout)through windows Heat flow q = ASHGC Et through windows pt2 Heat flow by  $qv = V \times 1.08 \times \Delta T$ qlatent = 4840 x V x ΔW by Infiltration or Ventilation total heat loss = Qwin + Qwalls + Qdoor + ... ...+ Qinfiltration E heating = UAref ×(HDD) ×(24) / k where UAref = Q heat loss / ΔT Efuel = Eheating / V Estimation pt2

UAref: average heat loss rate from a

Btu

heat loss coefficient from

Annual heating energy in

above (Btu/h-ft-F)

building

HDD: the degree days at the reference temperature

k: heating system efficiency

U = U-factors of window assemblies (Btu/h ft2 F)

Q = rate of heat flow (Btu/hr)

SHGC= solar heat gain coefficient Et= total incident irradiance

deltaW is found on the psychometric chat

in-out (right side) Efuel: Amount of fuel V: heat value of fuel

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