

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.

Definition	s (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	s (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



By WhiteSpade

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The heat (loss or gain) during a

day is about #____?

situation is # ____?

The heat flow rate in this

B. Btu,

D. Joule

C. Btu/hr

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U value calcul-

Calculations

U value

ation

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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 U Overall coefficient of heat transmission - Ability of a construction assembly to transfer heat, including air films When will · Lowest weather temperature • At night (no solar) • the peak heating No internal gains • Ignore loads thermal mass

· Highest weather temper-

(window orientation) •

Ignore thermal mass
 To size the heating/cooling

equipment, ducts, etc.

ature • Maximum solar gains

Maximum internal heat gains

Appropriate	erris 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/c-	proposed system.
ooling	
energy	

Thermal Gradient	
Thermal Gradient Calculation Example Here's an example of a simple wall section with the thickness of each n provided (Outdoor = 0 C; and Indoor = 20 C):	naterial
Step 1: Determine what units are being used Step 2: Make a chart of all the materials in it to chart include columns for Resistance of Find out air space Resistance - effective Find out interior and exterior surface coe Step 3: Calculate the total R value and U valt Step 4: Calculate the overall heat flow Q. Step 5: Calculate the temperature change for Step 6: Draw or sketch a section for thermal	he assembly. In each layer. emissivity fficient ue. r each layer.

U=

0F

U=1/Sum<

	through windows pt2	
n Example th the thickness of each material	Heat flow by infiltration	qv =
what units are being used at of all the materials in the assembly. In olumns for Resistance of each layer, see Resistance - effective emissivity rand exterior surface coefficient he total R value and U value. he overall heat flow Q. he temperature change for each layer, etch a section for thermal gradient	Latent Heat by Infiltration or Ventilation	qlat
	Simple heat loss calculation	tota Qwa Qini
1/Sum <r>=Btu/h ft²</r>	Annual Energy Estimation	E he ×(24 hea
	Annual Energy	Efue
<r></r>	Estimation pt2	
	F2 (this is not U-value)	hea abo
	Eheating:	Ann Btu
<r> where R = area stud of sample + on % area ins of</r>	UAref : average building HDD: the degree temperature	e day
δ AT^4 where ε = of surface	k: heating system U = U-factors of	
ub1 + 1/εsub2 - 1	ft2 F) Q = rate of heat	flow
x deltaT	SHGC= solar heat ga Et= total incident irrad deltaW is found on th	
x deltaT	in-out (right side Efuel: Amount o V: heat value of	f fuel

Calculations (cor	nt)
Heat loss through slab- on-grade floors	q= F2 x P x deltaT
Heat flow through windows	q = UA(Tin - Tout)
Heat flow through windows pt2	q = A <i>SHGC</i> Et
Heat flow by infiltration	qv = V x 1.08 x ΔT
Latent Heat by Infiltration or Ventilation	qlatent = 4840 x V x ΔW
Simple heat loss calculation	total heat loss = Qwin + Qwalls + Qdoor ++ Qinfiltration
Annual Energy Estimation	E heating = UAref \times (HDD) \times (24) / k where UAref = Q heat loss / Δ T
Annual Energy Estimation pt2	Efuel = Eheating / V
F2 (this is not U-value)	heat loss coefficient from above (Btu/h-ft-F)
Eheating:	Annual heating energy in Btu
building HDD: the degree temperature k: heating system U = U-factors of to ft2 F) Q = rate of heat to SHGC= solar heat Et= total incident	window assemblies (Btu/h flow (Btu/hr) at gain coefficient

calcul- ation [Btu/hr ft ² 0F]	
U value with frames [Btu/hr ft² 0F]	U=1/Sum <r> where R = Rstud % area stud of sample + Rinsulation % area ins of sample</r>
Emissivity	Qemit = $\varepsilon\delta$ AT^4 where ε = emissivity of surface
Air Space	1/E= 1/εsub1 + 1/εsub2 - 1
Heat Flow (q) [BTU/hr]	q = u x A x deltaT
Thermal Gradient [BTU/hr]	q = u x A x deltaT

C

happen? When will

the peak

cooling

happen?

calculate
Peak
heating/cooling
loads

Why do we need to

loads

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Last updated 25th October, 2022.

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