CLIMATE AND HUMAN COMFORT

COMFORT

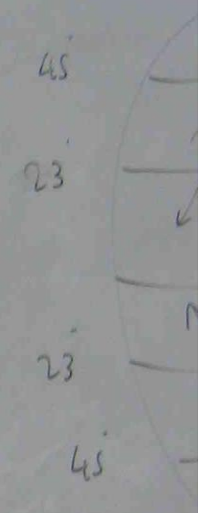
DIFFERENCE BETWEEN PREVAILING WEATHER CONDITION AND COMFORT CONDITION

↑

GLOBAL THERMAL BALANCE

HEAT ABSORPTION & DISSIPATION ⟷ COMFORTABILITY.

FLOW OF WIND ASSISTS HEAT DISSIPATION.



CLIMATE QUALITIES

TEMPERATURE — DRY BULB TEMPERATURE (DBT) — MEASURE OF THER
STATE

HUMIDITY
- → ABSOLUTE HUMIDITY (AH)
- → RELATIVE HUMIDITY (RH)

→ WET BULB TEMPERATURE (WBT)

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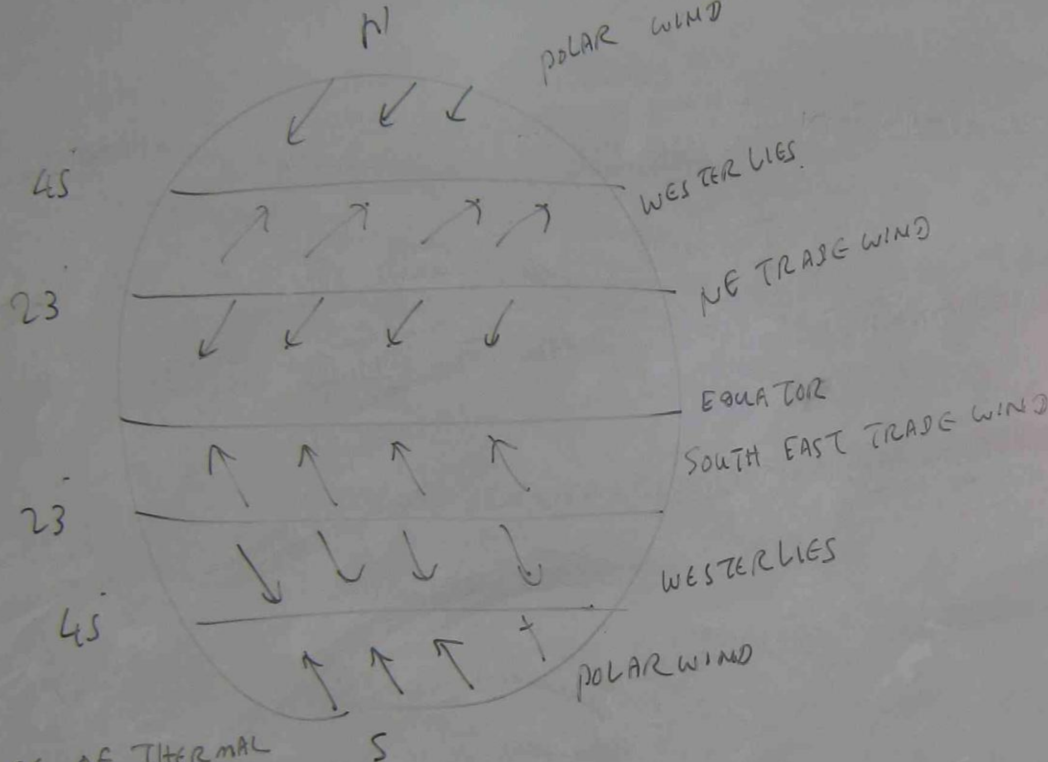


— MEASURE OF THERMAL STATE

WET BULB TEMPERATURE (WBT)

$\boxed{DD = N\ (T_b - T_a)}$

DD = HEATING DEGREE DAY

N = NO. OF DAYS IN MONTH

T_b = BASE TEMPERATURE

T_a = AMBIENT TEMPERATURE

$\boxed{\text{HOT HUMID}}$

SUMMER $dBT = 30^\circ C \rightarrow 35^\circ C$

$dBT = 25^\circ C \rightarrow 30^\circ C$

$RH = 70\% \rightarrow 80\%$

WINTER

WARM → HOT DAYS ($25^\circ C \rightarrow 30^\circ C$)

MID NIGHT ($15^\circ C \rightarrow 20^\circ C$)

)

HT)

HOT ARID ZONE

SUMMER – VERY HIGH DAY TIME TEMPERATURE

35°C → 40°C

HOT NIGHTS (20°C → 25°C)

LOW RELATIVE HUMIDITY (20 → 35%)

WINTER – WARM TO HOT DAYS (18°C → 25°C)

COOL TO COLD NIGHTS (5°C → 13°C)

TEMPERATE ZONE

SUMMER – dBT (30 → 35°C) (DAY)

dBT (13°C)

HUMIDITY (30% → 40%)

WINTER – COOL → COLD (10°C → 15°C)

COLD NIGHTS (2°C → 7°C)

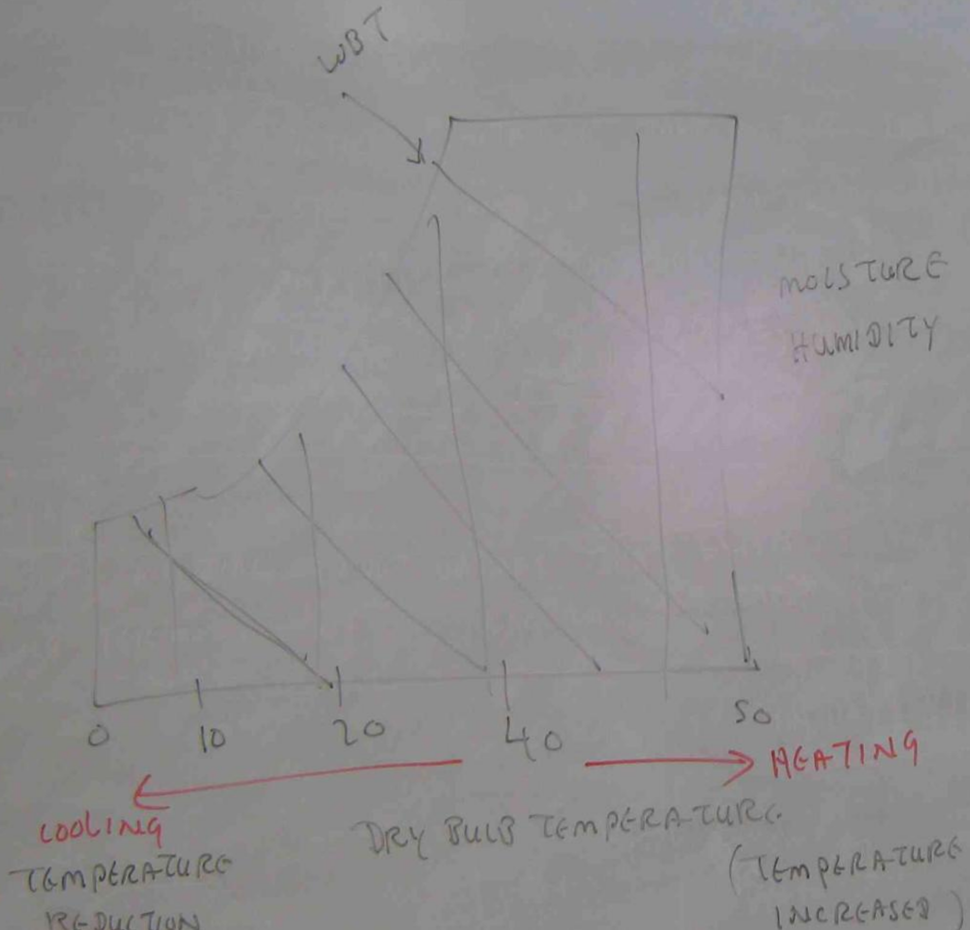
THERMAL COMFORT

COMFORT WITHIN BUILDING IS CONTROLLED BY 4 MAJOR FACTORS

- AIR TEMPERATURE
- RADIANT HEAT
- HUMIDITY
- AIR FLOW

BASIC PSYCHROMETRIC

COMFORT IS ALSO DEPENDENT ON TEMPERATURE AND HUMIDITY.



HIGH TEMPERATURE → DISCOMFORT

Low TEMPERATURE

TEMPERATURE FALLS

HUMIDITY INCREASE → DISCOMFORT

DISCOMFORT $\xrightarrow{\text{AIR FLOW}}$ REDUCE HUMIDITY → COMFORT

DISCOMFORT $\xrightarrow{\text{REHEAT}}$ REDUCE HUMIDITY → COMFORT

HUMAN BODY CONSTANTLY GENERATES EXCESS HEAT AT VARYING RATE

PRODUCTION OF HEAT

BASAL METABOLISM

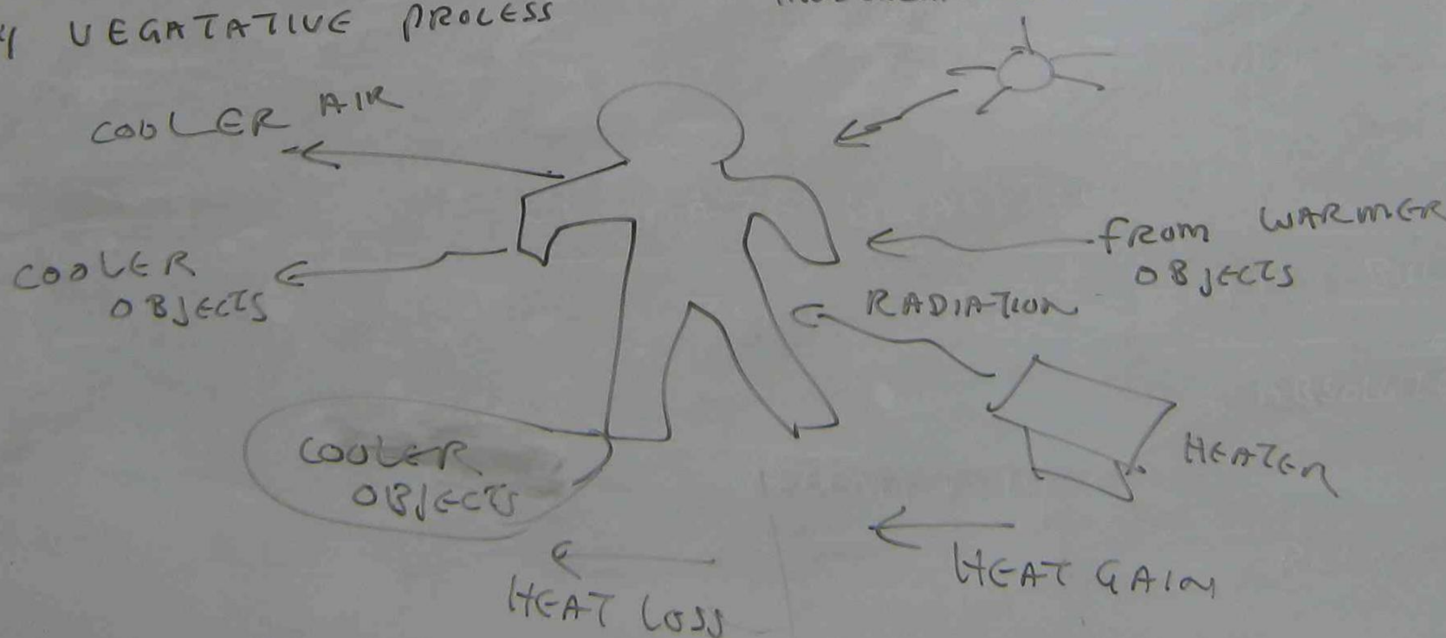
↓

PRODUCTION OF HEAT BY VEGATATIVE PROCESS

MUSCULAR METABOLISM

↓

PRODUCTION OF HEAT BY MUSCULAR ACTIVITIES



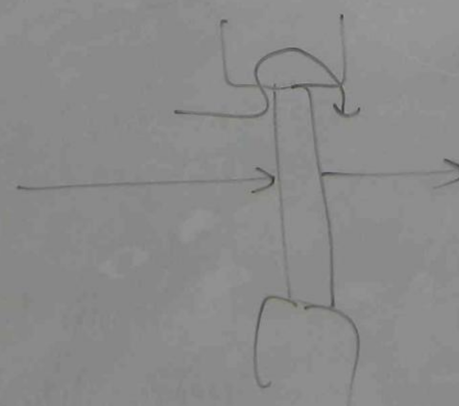
HEAT GAIN = 100 W / PERSON

SKIN TEMPERATURE 31 → 34°C

THERMAL COMFORT LIMIT 35°C

MEAN RADIANT TEMPERATURE

2°C HIGHER THAN DRY BULB TEMPERATURE



TYP

6mm C
ABSOR

6mm

WITH
COATI

2/ WHAT CHANGE IS REQUIRED TO MAKE THE COMFORT
WHEN RELATIVE HUMIDITY IS TOO HIGH ?

— PROVIDE AIR MOVEMENT.

* GLASSES ARE THE MAJOR CAUSE TO TRANSMIT THE HEAT
IN TO THE BUILDING

PERATURE

TYPE OF GLASS	REFLECT (1)	REFLECT (2)	TOTAL REFLECT	TRANSMIT (1)	TRANSMIT (2)
3mm	8	4	12	87	1
6mm GREY HEAT ABSORBING GLASS	6	41	47	39	15
6mm CLEAR GLASS WITH GOLD REFLECTION COATING	48	31	79	9	12

Q. WHAT CHANGE IS REQUIRED TO MAKE THE COMFORT WHEN RELATIVE HUMIDITY IS TOO HIGH ?

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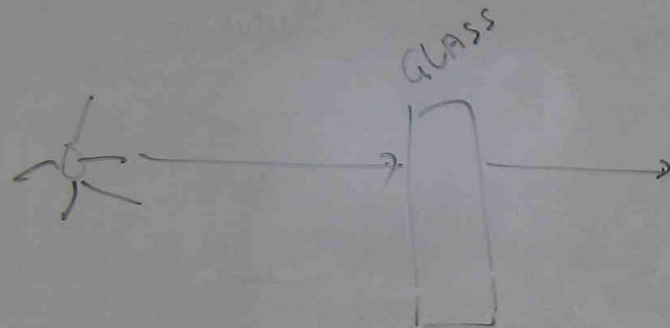
(2)

S

12

SHADING COEFFICIENT



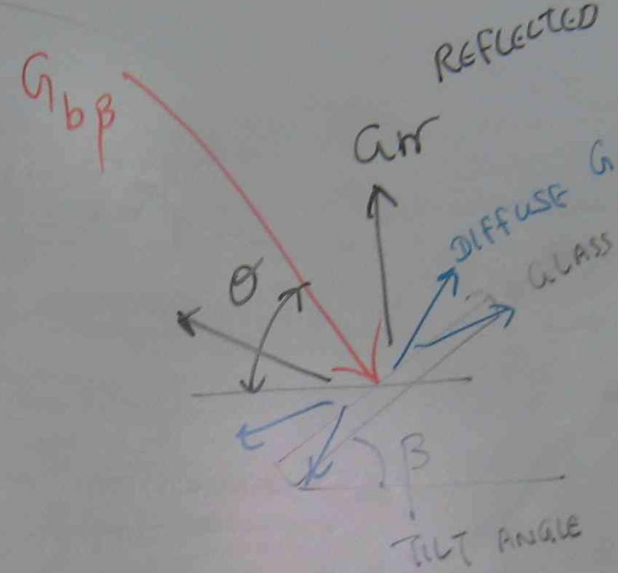
SOLAR HEAT GAIN OF THE GLASS (SHGH)

DIRECT SOLAR HEAT GAIN (SHG)

(.

$$SC = \frac{SHG}{SHGH}$$

SC - SHADING COEFFICIENT



$G_{b\beta}$ = BEAM IRRADIANCE ON A PLANE OF TILT ANGLE β

G_d = DIFFUSE IRRADIANCE

G_r = REFLECTED IRRADIANCE

θ = ANGLE OF INCIDENCE

TOTAL HEAT GAIN/m^2 $(P) = G_{b\beta}\, SHG(\theta) + G_d \times SHG(90^\circ) + G_r \times SHG$

ENVIRONMENTAL TEMPERATURE

$\frac{1}{3}\, DBT + \frac{2}{3}\, MRT$ LIGHTLY CLOTH PERSON

DBT - DRY BULB TEMPERATURE

MRT - MEAN TEMPERATURE

DRY RESULTANT TEMPERATURE

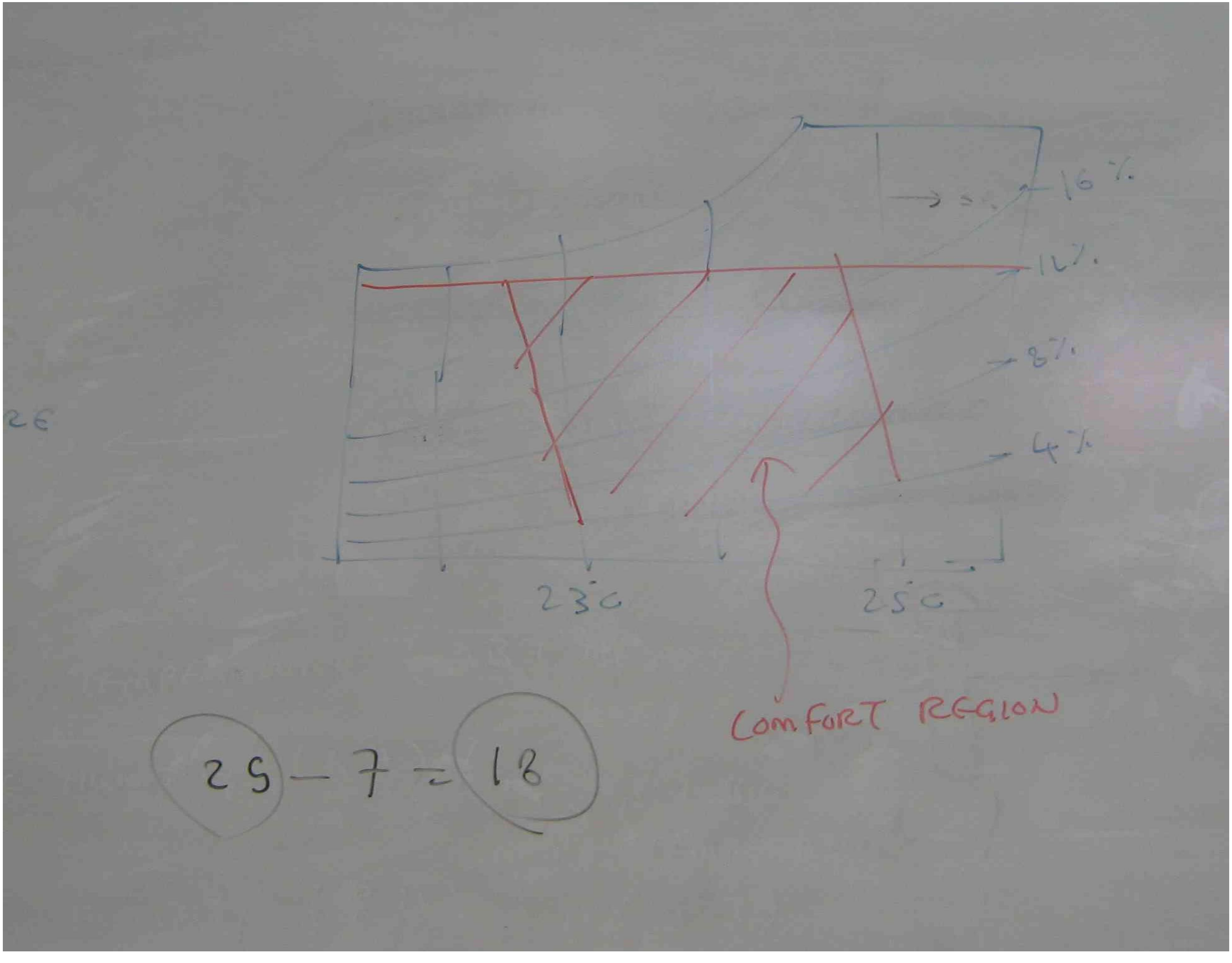
$\frac{1}{2}\, DBT + \frac{1}{2}\, MRT$ ← HEAVIER CLOTHING

THERMAL NEUTRALITY

$$T_n = 17.6 + 0.31\ T_{avg}$$

T_n = THERMAL NEUTRAL TEMPERATURE

$$18.5 < T_n < 28.5^\circ C$$



16%
12%
8%
4%
23°C
25°C
COMFORT REGION
RE
25 − 7 = 18

TYPE OF ACTIVITY	HEAT GAIN (WATT)	Tm REDUCTION (K)
SEATED AT REST	100	0
WALKING	150	2
LIGHT WALK	210	2
MEDIUM WALK	300	4.5
HEAVY WALK	400	7

ACTIVITY 2

1. USE DAILY WEATHER BROADCASTING (OR) THERMOMETER FROM TODAY TO NEXT TWO WEEKS, RECORD THE FOLLOWINGS IN TO TABLE

DAY	SUNNY	CLOUDY	RAINNY	SUN RISE HOUR	SUN SET HOUR	TEMPERATURE
1						
2						
3						
¦						
¦						
14						

YOU NEED TO MENTION THE DATE FOR EXAMPLE 01/02/10 TO 14/02/10 ETC.

2. OBSERVE THE BEHAVIOUR OF YOUR FAMILY MEMBER AND YOURSELF ON ONE HOLIDAY (OR) FOR THE DAY WHEN MOST PEOPLE ARE AT HOME.

FILL IN THE GIVEN TABLE.

YOU DIVIDE THE TIME AND OBSERVE THE MOST ACTIVITY DONE BY THEM.

THEN CALCULATE THE HEAT GAIN

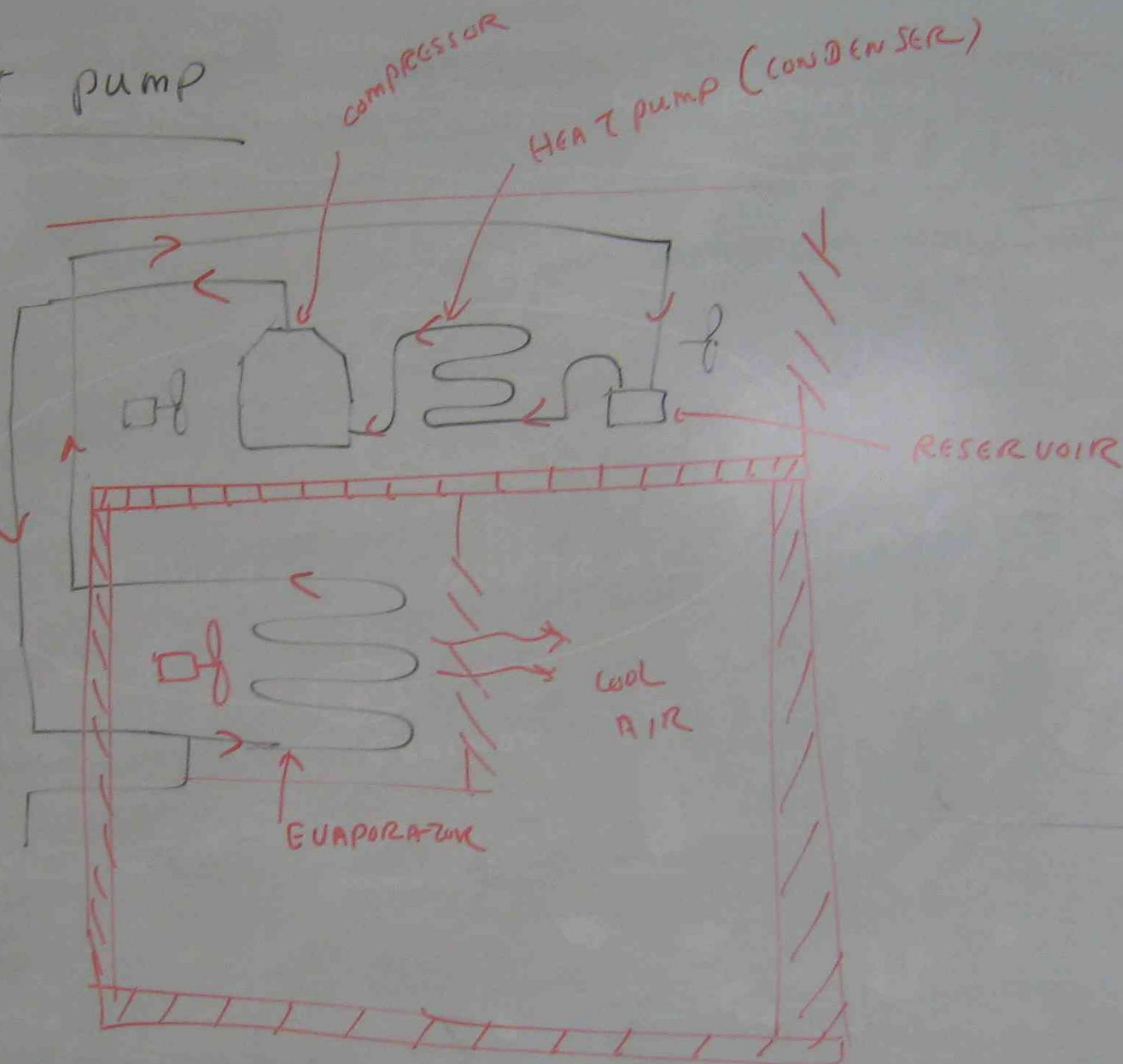
YOU DO NOT NEED TO PRESENT THE ALL ACTIVITIES ; ONLY TOTAL HEAT GAIN FIGURE TO BE SUBMITTED.

FAMILY MEMBER NO.	6 AM → 9 AM					9 AM → 12 NOON					12 NOON → 3 PM					3 PM → 6 PM					HEAT GAIN
	S	W	L	M	H	S	W	L	M	H	S	W	L	M	H	S	W	L	M	H	
1																					
2																					
3																					
↓																					

S - SEATED W = WALKING, L = LIGHT WORK M - MEDIUM WORK

H - HEAVY WORK

HEAT PUMP


COMPRESSOR
HEAT PUMP (CONDENSER)
RESERVOIR
COOL
AIR
EVAPORATOR

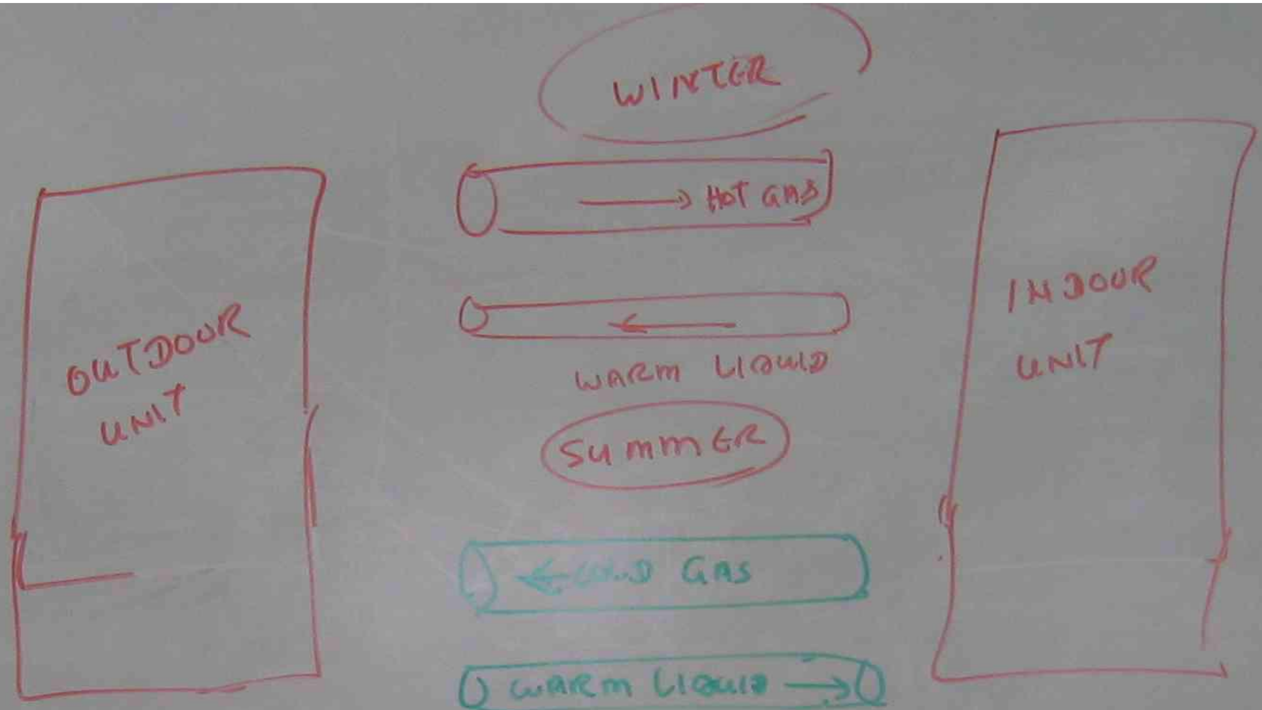
HEAT PUMPS ARE REFRIGERATION MACHINES

REFRIGERATION INVOLVES THE REMOVAL OF HEAT FROM A PLACE WHERE IT IS NOT WANTED AND DEPOSITING IT IN A PLACE WHERE IT MAKES NO DIFFERENCE.

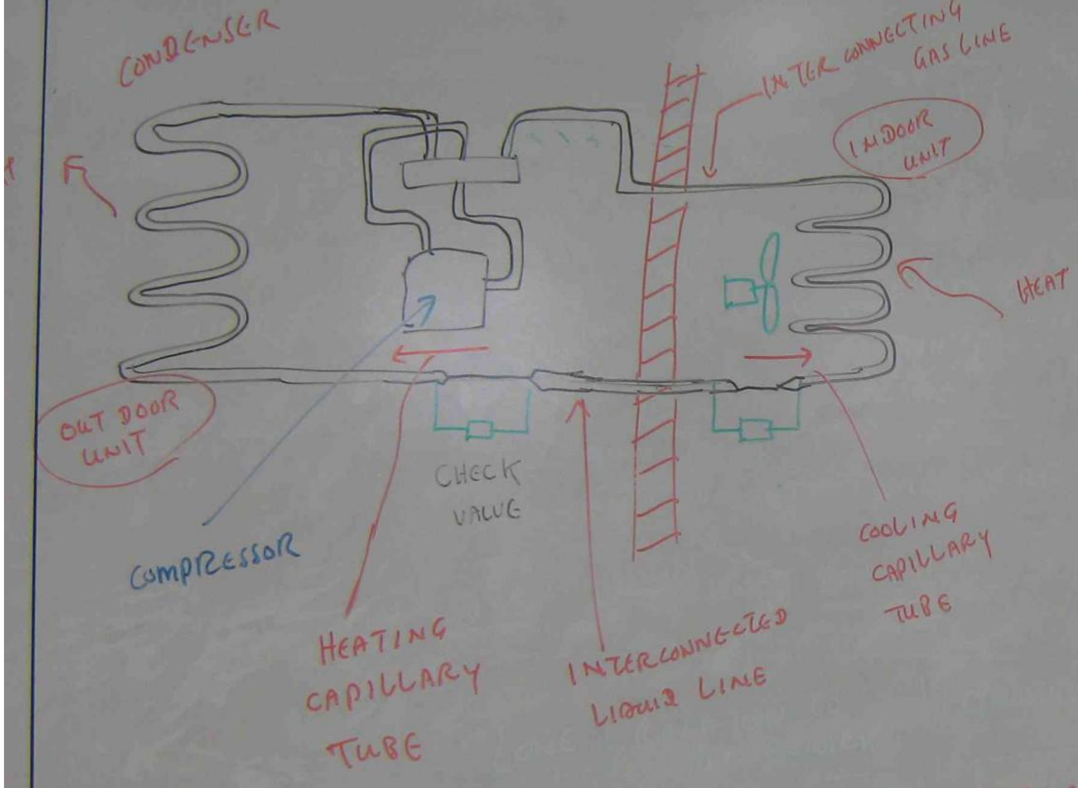
EVAPORATOR → ABSORBES THE HEAT FROM SOUNDING AND FEEDS IT INTO REFRIGERATION SYSTEM

COMPRESSOR - CIRCULATES THE REFRIGERANT.

CONDENSER - EJECT THE HEAT ABSORBED BY REFRIGERANT.



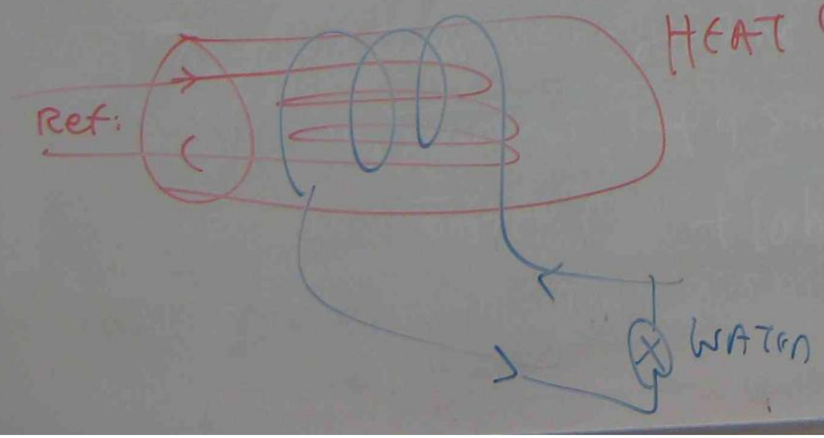
THERMOSTATIC EXPANSION VALVE DIRECTS THE REFRIGERANT TO PARTICULAR DIRECTION

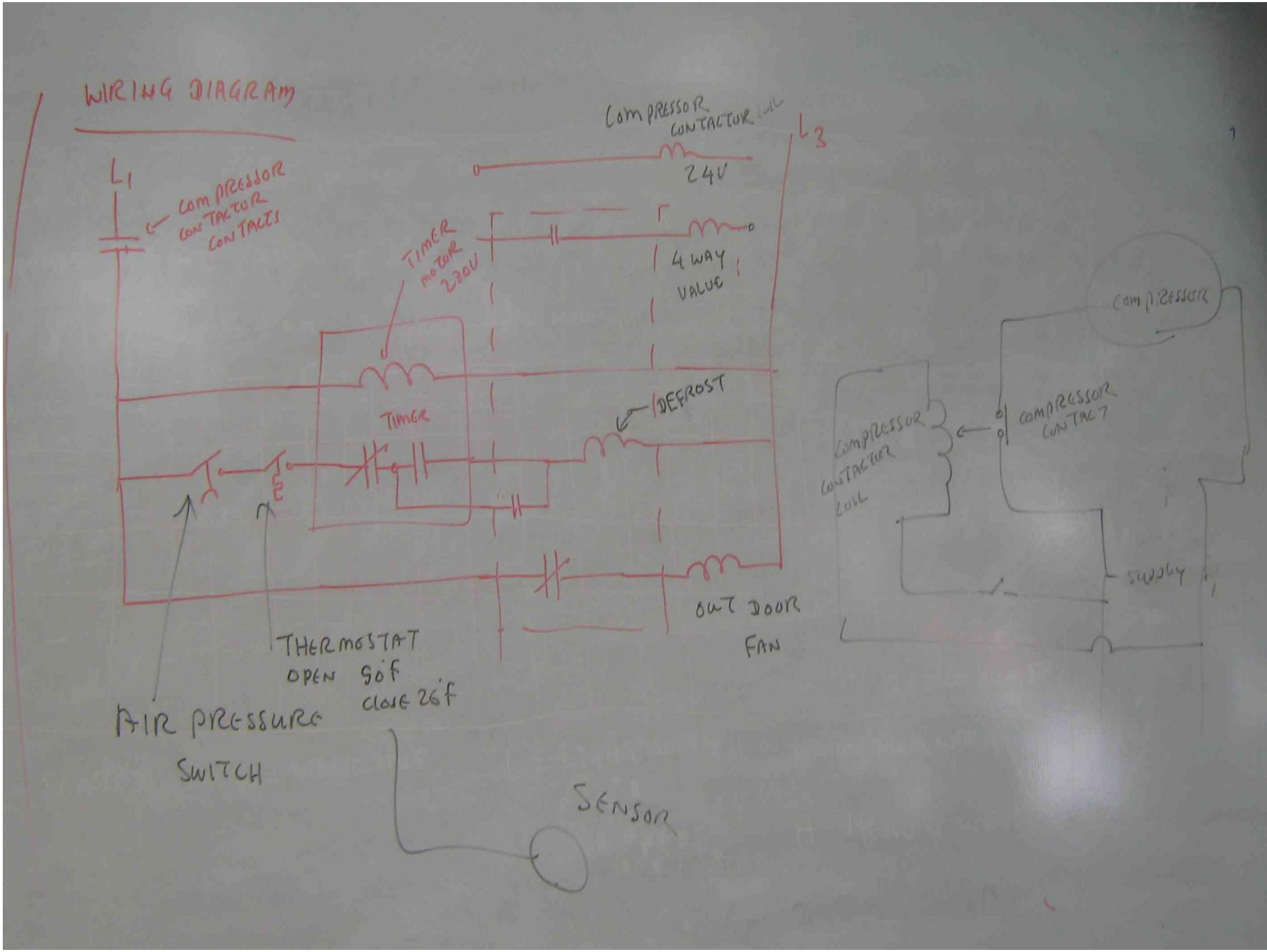


- CAPILLARY REGULATES THE AMOUNT OF THE REFRIGERANT PASSING THROUGH THE SYSTEM. DEPENDING ON SITUATION OF WEATHER, THE VOLUME OF THE REFRIGERANT PASSING THROUGH THE SYSTEM CAN BE REGULATED BY CAPILLARY AND CHECK VALVE

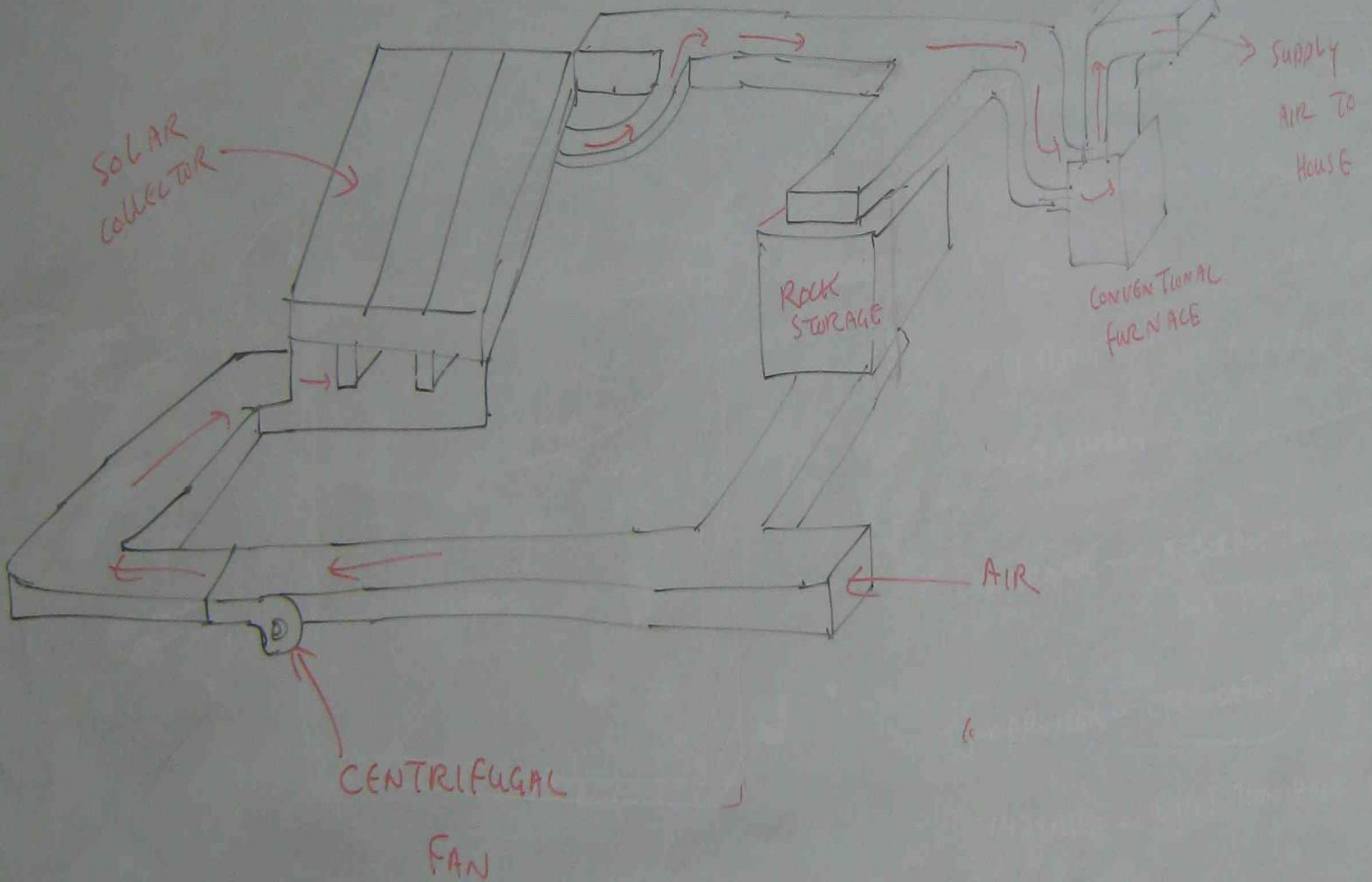
- FOR COMMERCIAL UNITS, HEAT EXCHANGERS EXCHANGE THE HEAT ABSORBED BY THE REFRIGERANT.

HEAT EXCHANGER

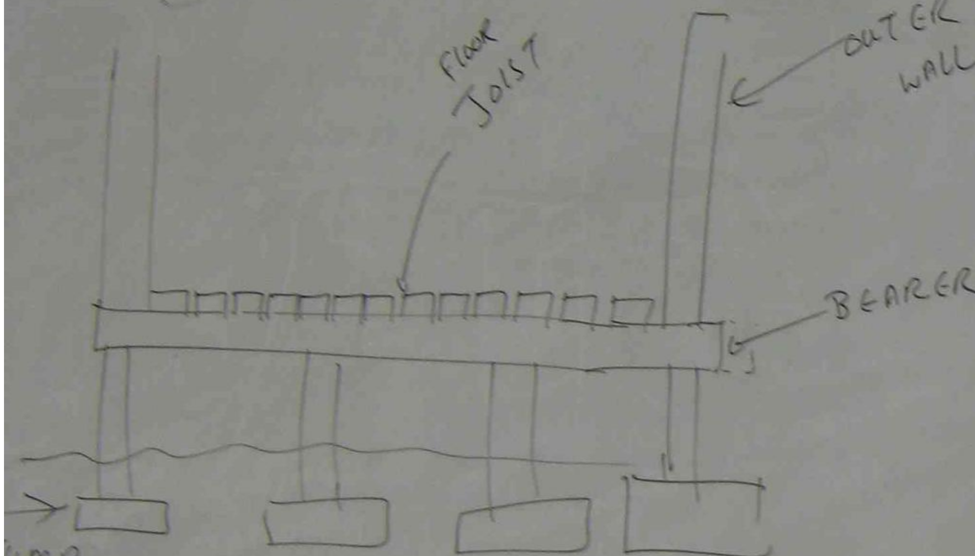



WIRING DIAGRAM
L1
COMPRESSOR CONTACTOR CONTACTS
COMPRESSOR CONTACTOR COIL
L3
24V
TIMER MOTOR 230V
4 WAY VALUE
TIMER
DEFROST
OUT DOOR FAN
THERMOSTAT OPEN 50°F CLOSE 26°F
AIR PRESSURE SWITCH
SENSOR
COMPRESSOR
COMPRESSOR CONTACT
COMPRESSOR CONTACTOR COIL
SUPPLY

SOLAR HEAT AND SPACE HEATING SYSTEM



BUILDING FOOTINGS



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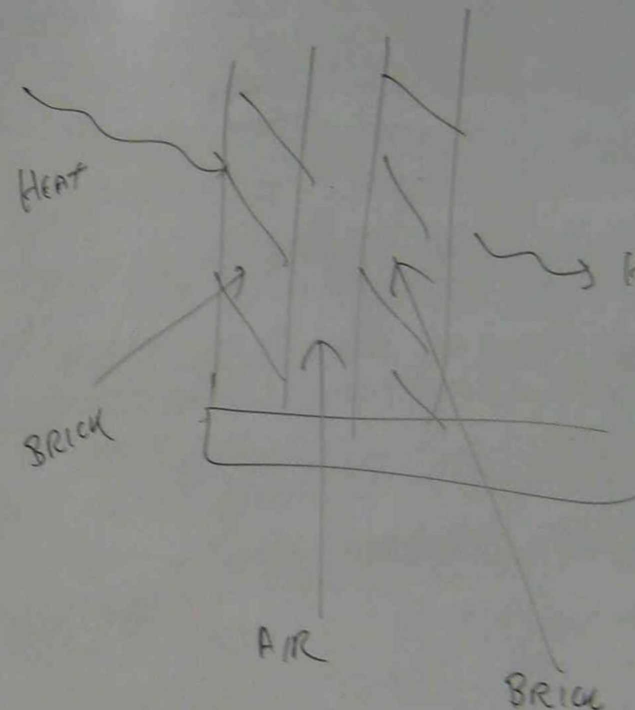
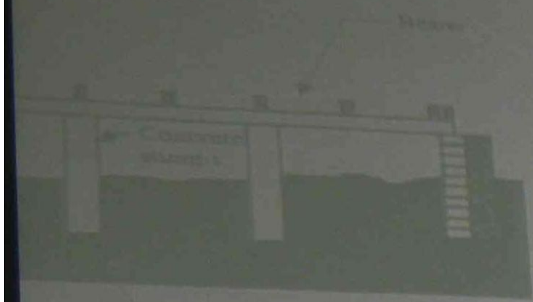
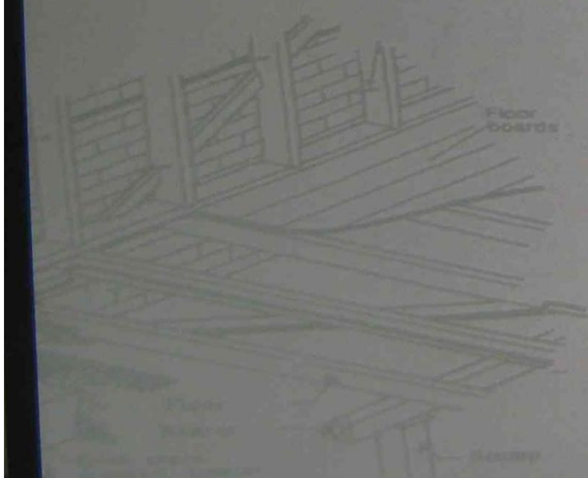






Floors

Floors may be of [illegible]

Concrete slab

The concrete slab or raft [illegible] supports the whole structure [illegible] as land fills. A slab or raft footing for a commercial building [illegible]

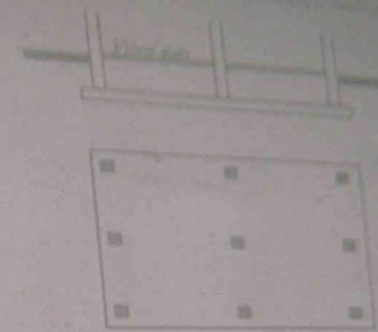


Figure 6: Raft footing for a commercial building

For residential dwellings, concrete slab footings are now the most [illegible] example is illustrated in Figure 7.

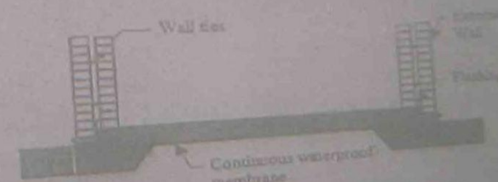


Figure 7: Raft footing for a residential building

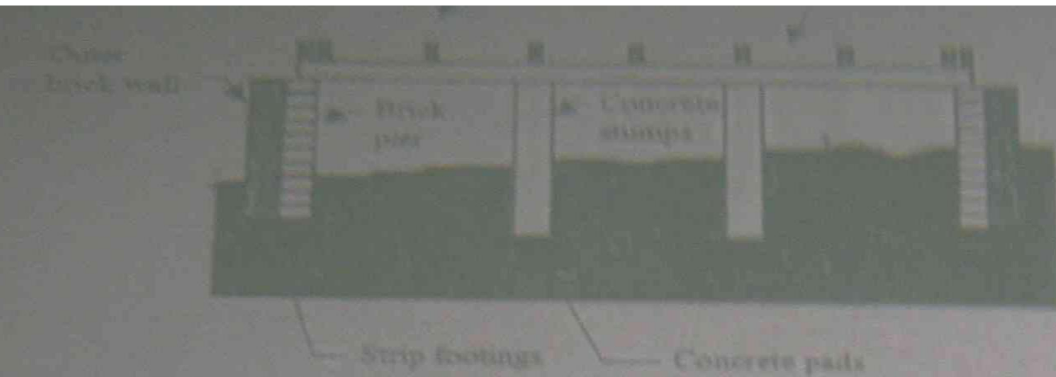


Figure 4: Strip footings in a residential building

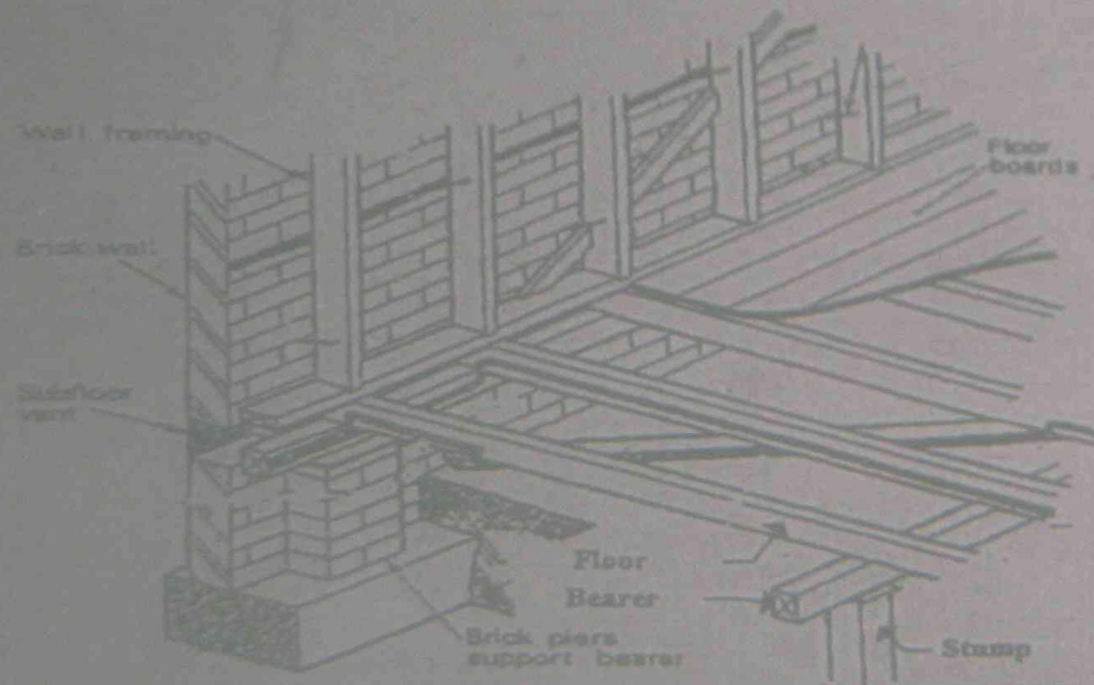
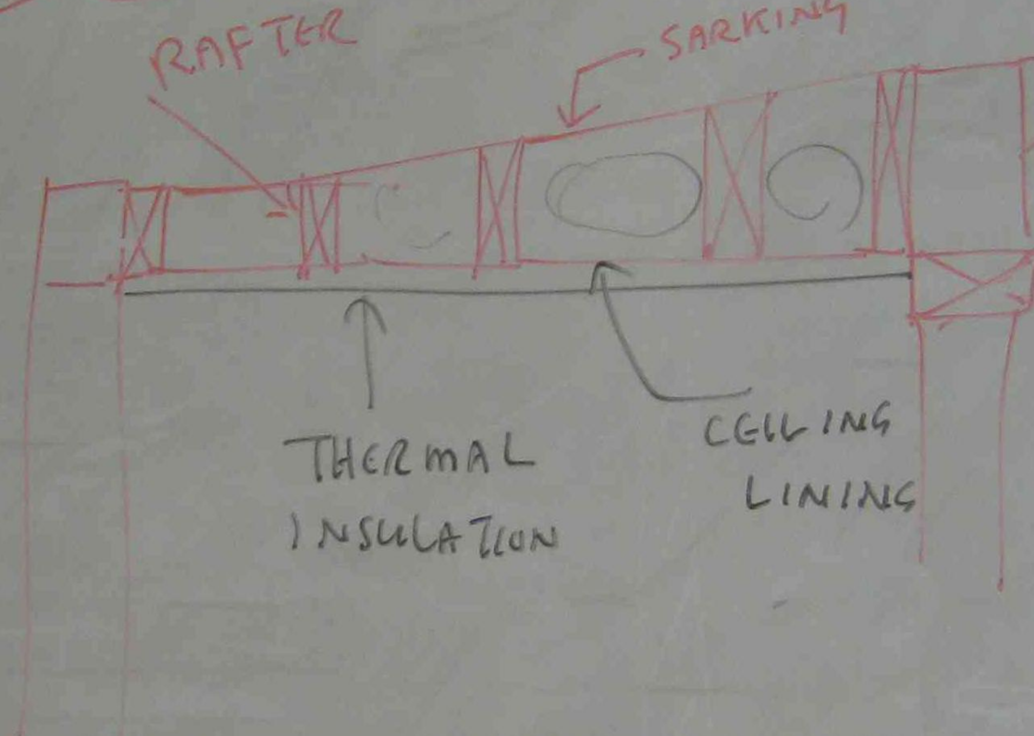


Figure 5: Concrete slab or raft footings

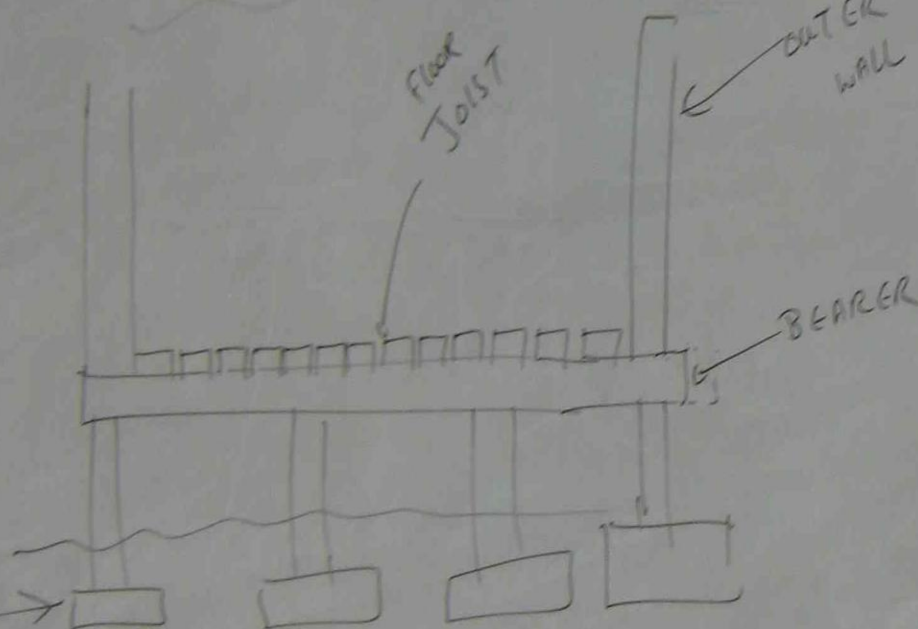
ROOF & CEILING CONSTRUCTION

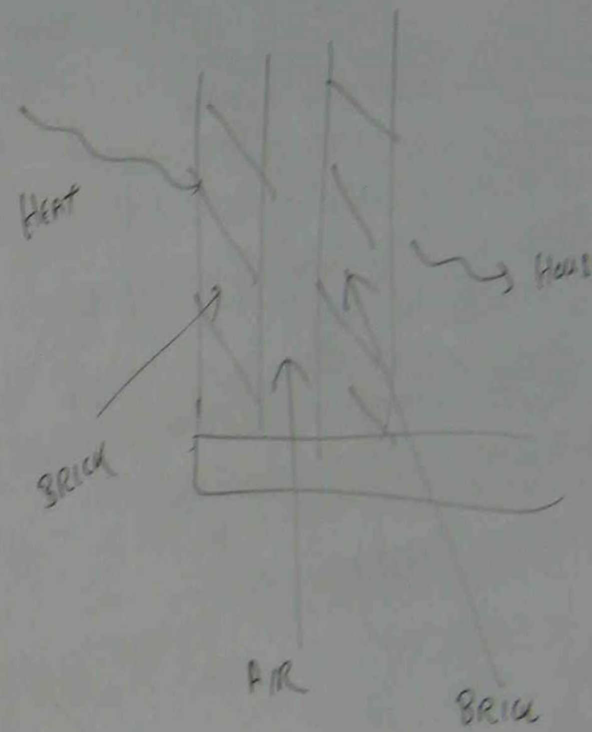
< HEAT GAIN / HEAT LOSS COMPONENTS >



CONSTRUCTION	SUMMER HEAT FLOW	WINTER HEAT FLOW	WITH APPROPRIATE INSULATION ADD
PITCHED ROOF PLASTERED BOARD CEILING	0.76	0.29	REFLECTIVE FOIL SUMMER 1.81 WINTER 0.55 R_2 BULK INSULATION SUMMER 2.76, WINTER 2.29
METAL DECK ROOFING WITH RAKED CEILING	0.43	0.38	REFLECTIVE FOIL + R_2 INSULATION SUMMER 3.137, WINTER 3.067
TIMBER FRAME WITH WEATHER BOARD	0.46	0.46	WITH FOIL 1.685 WITH R_2 2.305
BRICK VENEER	0.45	0.45	WITH FOIL 1.517 WITH R_2 → 2.457
TIMBER	0.39	0.43	
CAVITY BRICK	0.51	0.51	
CONCRETE BLOCK	0.35	0.35	
SINGLE GLAZED	0.166	0.166	
DOUBLE GLAZED	0.312	0.312	

BUILDING FOOTINGS

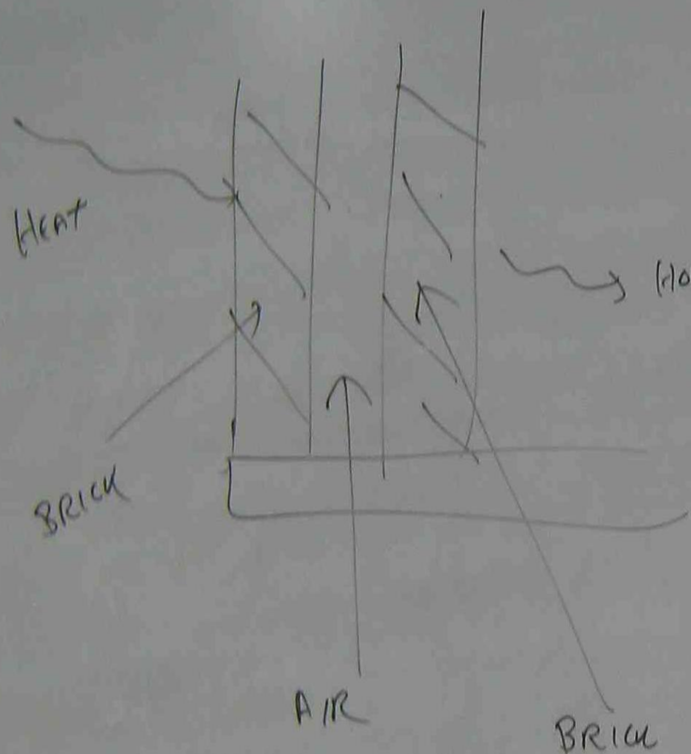


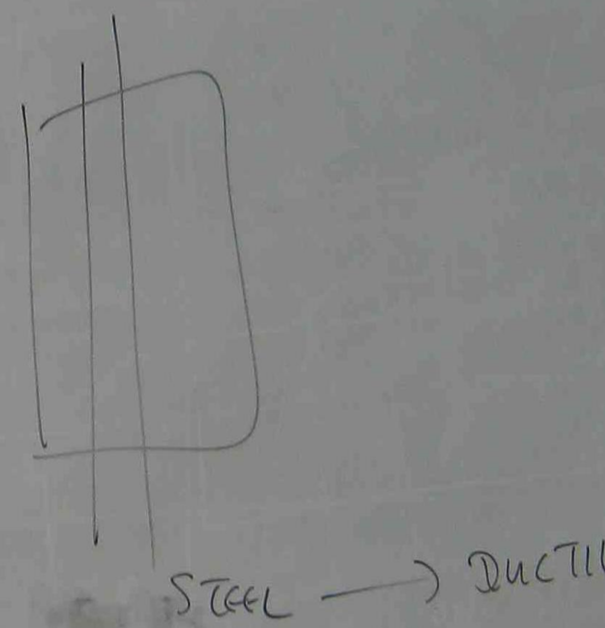


STUMP

TIMBER

CONCRETE


HEAT
HOUSE
BRICK
AIR
BRICK


STEEL → DUCTILE