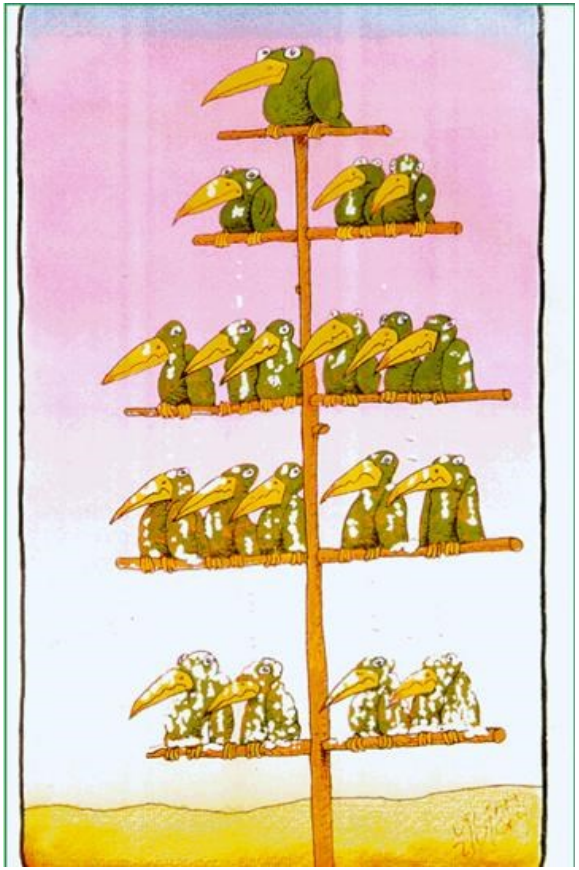
INTRODUCTION TO HEAT LOAD



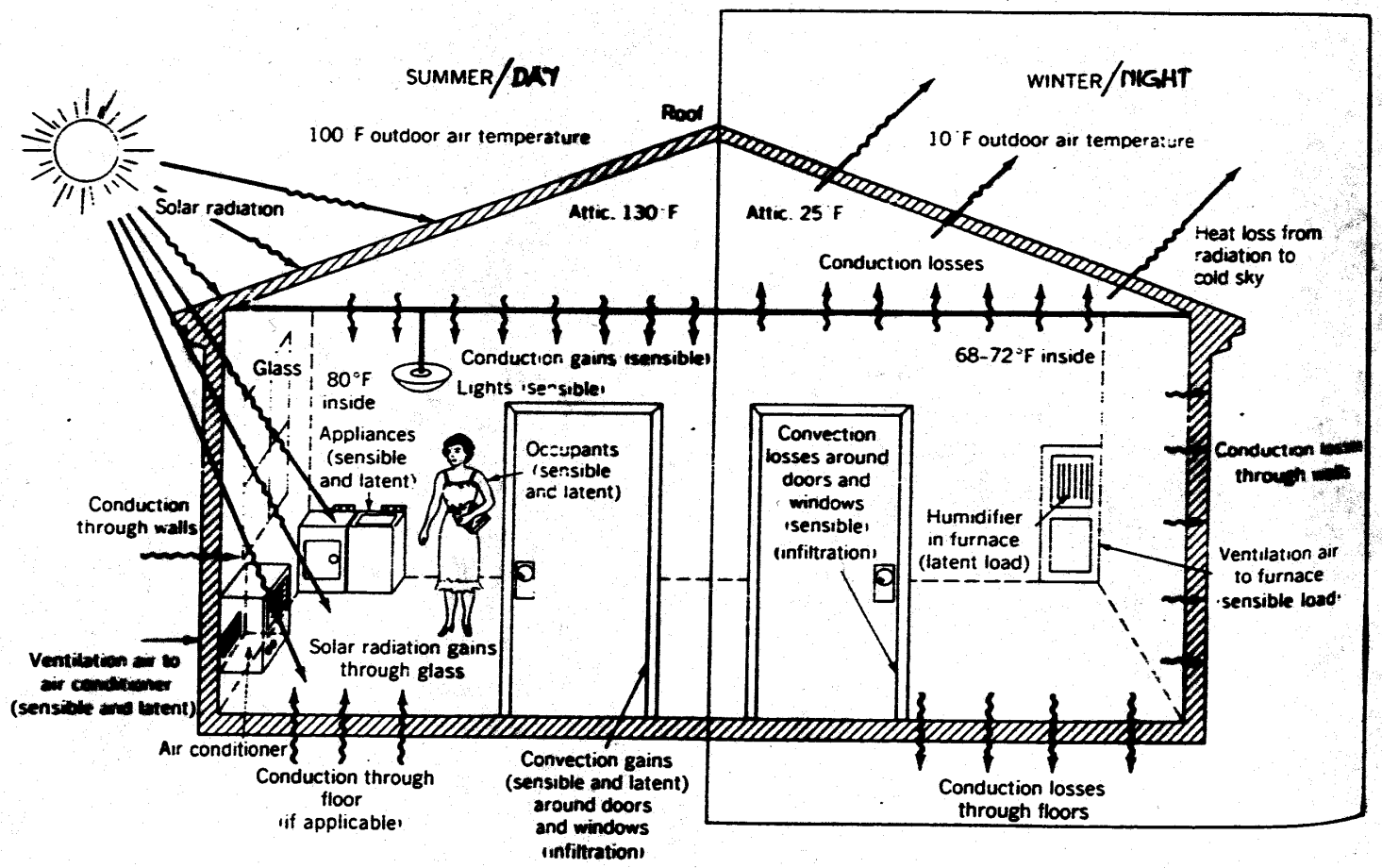
TOPICS COVERED

- **INTRODUCTION**
- **DESIGN CONSIDERATIONS**
- **DEFINITIONS/CONCEPT/FORMULA**
- **THE FORM**
- **LOAD COMPONENTS**
  - External (Skin)
  - Internal
  - Others
- **HEAT CLASSIFICATION**
  - Room Sensible/Latent
  - Effective Room Sensible/Latent
  - Effective Room Total
  - Grand Total Heat
  - Refrigeration Load

ARM AND LEG MOVEMENT
OPERATE SERIES OF FINS

DESIGN CONSIDERATION

- **Design conditions**
  - internal/external
- **Orientation of building**
- **Use of space**
- **Dimension of space**
- **Ceiling height**
- **Columns and beams**
- **Construction materials**
- **Surrounding condition**
- **Windows**
- **Doors**
- **Stairways, Elevators & Escalators**
- **People**
- **Lighting**
- **Motors, appliances**
- **Ventilation**
- **Operation hrs.**


SUMMER/DAY
WINTER/NIGHT
100 F outdoor air temperature
Roof
10 F outdoor air temperature
Solar radiation
Attic. 130 F
Attic. 25 F
Heat loss from radiation to cold sky
Conduction losses
Glass
80°F inside
Conduction gains (sensible)
Lights (sensible)
68–72°F inside
Appliances (sensible and latent)
Occupants (sensible and latent)
Convection losses around doors and windows (sensible) (infiltration)
Conduction through walls
Humidifier in furnace (latent load)
Ventilation air to furnace (sensible load)
Ventilation air to air conditioner (sensible and latent)
Solar radiation gains through glass
Air conditioner
Conduction through floor (if applicable)
Convection gains (sensible and latent) around doors and windows (infiltration)
Conduction losses through floors

DEFINITIONS

- **AIR CONDITIONING**
  - A process which heats, cools, cleans and circulates air and control its moisture content. This process is done simultaneously and all year round

DEFINITION

- **SENSIBLE LOAD**
  - Results when heat entering the condition space that caused the Dry Bulb (db) to increase
- **LATENT LOAD**
  - results when moisture entering/leaving the space causes the humidity to increase/decrease

LETS LOOK AT THE HEAT LOAD FORM

LOAD COMPONENTS

- PSYCHROMETRIC LOAD
  - ALL SENSIBLE
  - ALL LATENT
  - COMBINATION
- PHYSICAL LOAD
  - EXTERNAL LOAD
  - INTERNAL LOAD
  - OTHER LOAD (EQUIP./DUCT/etc.)

PHYSICAL LOAD
a) EXTERNAL LOAD (1)

- **Solar heat gain through glass**
  - Direct sun rays pass through glass windows as radiant energy into space.
  - Can be reduced by use of internal/external shading devices, overhangs, or shadows cast by other building

PHYSICAL LOAD
a) EXTERNAL LOAD (2)

- **Solar and transmission gain through walls and roofs**
  - Heat is caused to flow through external walls and roofs by two sources
    - sun rays striking the external surfaces
    - high outdoor air temperatures

PHYSICAL LOAD
a) EXTERNAL LOAD (3)

- **Transmission gains through glass, partition, floors**
  - When an adjacent area is at a higher temperature than the space, heat will flow through windows, ceilings, partitions, or floors by means of transmission

PHYSICAL LOAD
a) EXTERNAL LOAD (4)

- **Infiltration**
  - Wind blowing against the side can cause air from outside to enter space. Caused localised sensible and latent heat gain
- **Ventilation**
  - When outdoor air is introduced DIRECTLY into space, it will appear as load to the space.

PHYSICAL LOAD
b) INTERNAL LOAD (1)

- People
- Power/Motor
- Lights
- Appliances & Equipment

PHYSICAL LOAD
b) INTERNAL LOAD (2)

- **People**
  - Human body generates heat within itself and releases it by radiation, convection and evaporation from the surface (Sensible), and by convection and evaporation in the respiratory tract (Latent)
  - Heat generated depends on temp. and activity level
  - Both Sensible and Latent will enter space

PHYSICAL LOAD
b) INTERNAL LOAD (3)

- **Lights**
  - Illuminants convert electrical power into light and sensible heat.
  - Lighting is either fluorescent or incandescent
- **Motors**
  - Direct heat to space
- **Equipment & Appliances**
  - Computers, Kettle, Refrigerators, Kitchen Equipment

ROOM SENSIBLE HEAT (RSH)

- EXTERNAL LOAD ONLY PRODUCES SENSIBLE LOAD
- INTERNAL LOAD PRODUCES BOTH SENSIBLE AND LATENT
- ROOM SENSIBLE HEAT (RSH) IS THE TOTAL AMOUNT OF ALL THE SENSIBLE HEAT PRODUCE IN THE ROOM ONLY

ROOM LATENT HEAT (RLH)

- SINCE SOME OF THE INTERNAL HEAT LOAD ALSO PRODUCES LATENT HEAT
-
- ROOM LATENT HEAT IS THE TOTAL AMOUNT OF ALL THE LATENT HEAT PRODUCE IN THE ROOM ONLY

ROOM LOADS

- At this point all ROOM LOADS (both Sensible and Latent) components have been considered.
- Adding all the sensible loads = RSH
- Adding all the latent loads = RLH
- Adding both the RSH + RLH = Room Total Heat (RTH)

PHYSICAL LOAD
c) OTHER LOAD

- If there was no heat gained or lost between the coil of the air handling unit and supply terminal ,the temperature of the air leaving the coil would be the same as the temperature of the air entering the room.
- In a real system, however the losses exist as follows;

PHYSICAL LOAD
c) OTHER LOAD

- **SUPPLY**
  - duct heat gain
    - when duct pass through space of higher temp.
  - duct leakage loss
    - loss of supply air due to quality of workmanship, this will result loss in sensible and latent

PHYSICAL LOAD
c) OTHER LOAD

- **SUPPLY AIR**
  - fan heat (draw through)
    - heat from fan motor
  - bypassed outdoor air
    - because the coil is not a perfect cooling device, a portion of the air passes through the coil completely unaltered in temperature and humidity resulting in a sensible and latent loss of supply air

EFFECTIVE ROOM SENSIBLE HEAT (ERSH)

- ERSH IS THE TOTAL SENSIBLE HEAT PRODUCE IN THE ROOM + ALL HEAT GAIN IS SUPPLY DUCT + BYPASS OUTDOOR AIR HEAT (SENSIBLE)

- ERSH = RSH + S.D HEAT GAIN + BYPASS OA

EFFECTIVE ROOM LATENT HEAT (ERLH)

- ERLH IS THE TOTAL LATENT HEAT PRODUCE IN THE ROOM + SUPPLY DUCT LEAKAGE LOSS + BYPASS OUTDOOR AIR HEAT (LATENT)
- ERLH = RLH + S.D LEAK LOSS + BYPASS OA

EFFECTIVE ROOM TOTAL HEAT (ERTH)

- **These loads are called effective since both the coil leaving air temperature and humidity level must be effectively be lower than conditions required at the room in order to absorb the losses along the way and then absorb the room load**
- **ERTH IS THE SUM OF**
  - ERSH + ERLH

PHYSICAL LOAD
c) OTHER LOADS

- **OUTDOOR OR VENTILATION LOADS**
  - when outdoor air enters the air conditioning system through central air handling apparatus, the resultant sensible and latent loads show up as a load on the coil and not room

PHYSICAL LOAD
c) OTHER LOADS

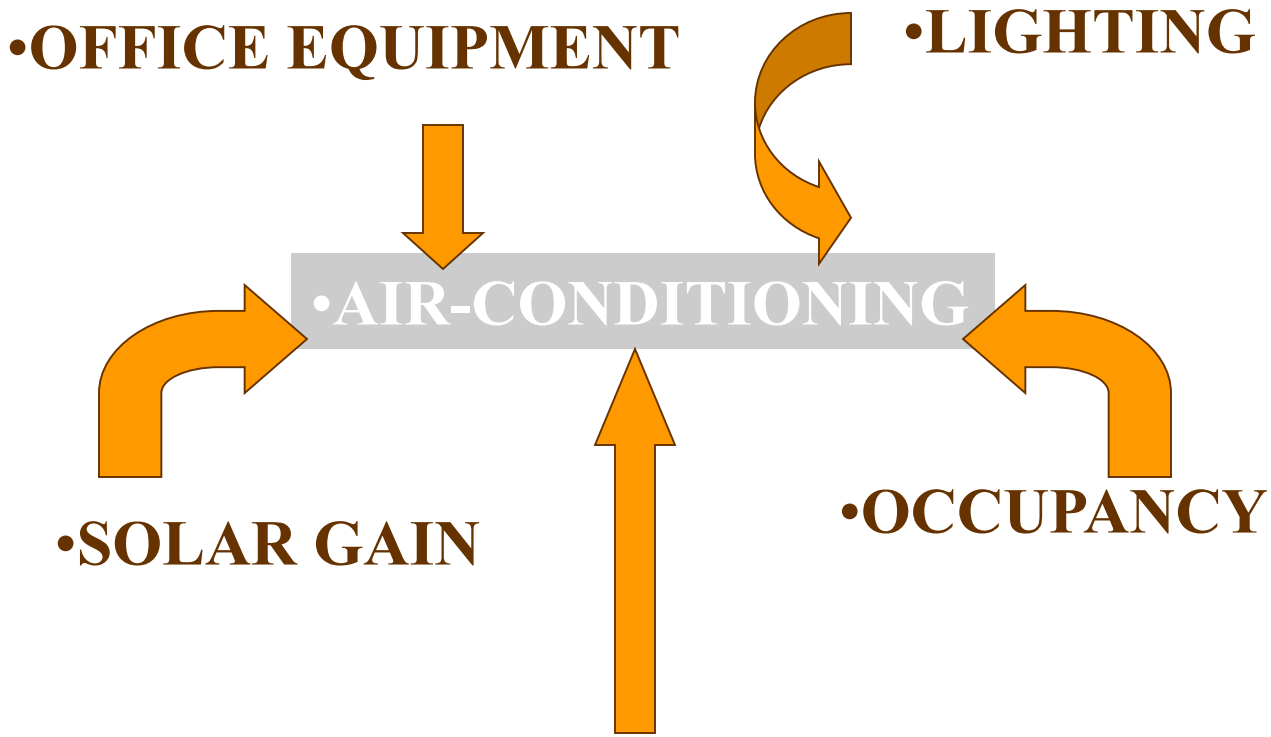
- **RETURN AIR**
  - duct heat gain
    - duct passes through space whose temp. is higher
  - leakage gain
    - duct at negative pressure, an inward leakage of warm moist air possible
  - fan heat (blow through)
    - when using separate return fan of blow thru type

GRAND TOTAL HEAT (GTH)

- The total load seen by the coil in the Central Air Handling Unit.
- Also referred to as Dehumidified Load
- Sum Room Loads + Supply Air Losses + Outdoor Air + Return Air Losses +
- GTH = ERTH + OA + Return Air Heat Gain

REFRIGERATION LOAD

- **Two additional loads are introduced to the refrigeration machine which are not experienced by the coil. They are**
  - Piping sensible heat gain
  - Pumping heat gain


•OFFICE EQUIPMENT
•LIGHTING
•AIR-CONDITIONING
•SOLAR GAIN
•OCCUPANCY
•FRESH AIR (DEHUMIDIFICATION)

NEXT PROCEED TO

PSYCHROMETRIC CHART (PSYCHRO 1)