



# SUMMER



## Refrigeration and Air conditioning Engineering.

### 3<sup>rd</sup> year – refrigeration and Air conditioning Course

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## COOLING AND HEATING LOAD ESTIMATION

### Lecture -1

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## 1.2 BUILDING SURVEY

### *1.2.1 SPACE CHARACTERISTICS AND HEAT LOAD SOURCES*

- The following physical aspects must be considered
  1. Orientation of building - Location of the space to be air conditioned with respect to:
    - a) Compass points-sun and wind effects.
    - b) Nearby permanent structures-shading effects.
    - c) Reflective surfaces-water, sand, parking lots, etc.
  2. Use of space(s) - Office, hospital, department store, specialty shop, machine shop, factory, assembly plant, etc.

## 1.2 BUILDING SURVEY

- 3. Physical dimensions of space(s) - Length, width, and height.
- 4. Ceiling height - Floor to floor height, floor to ceiling, clearance between suspended ceiling and beams.
- 5. Columns and beams - Size, depth, also knee braces.
- 6. Construction materials - Materials and thickness of walls, roof, ceiling, floors and partitions, and their relative position in the structure.

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## 1.2 BUILDING SURVEY

- 7. Surrounding conditions - Exterior color of walls and roof, shaded by adjacent building or sunlit. Attic space - unvented or vented, gravity or forced ventilation. Surrounding spaces conditioned or unconditioned- temperature of non-conditioned adjacent spaces, such as furnace or boiler room, and kitchens. Floor on ground, crawl space, basement.
- 8. Windows - Size and location, wood or metal sash, single or double hung. Type of shading device. Dimensions of reveals and overhangs.
- 9. Doors - Location, type, size, and frequency of use.

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## 1.2 BUILDING SURVEY

- 10. People - Number, duration of occupancy, nature of activity, any special concentration. At times, it is required to estimate the number of people on the basis of square meter per person, or on average traffic.
- 11. Lighting - Wattage at peak. Type- incandescent, fluorescent, recessed, exposed.
- 12. Motors - Location, nameplate and brake horsepower, and usage.

## 1.2 BUILDING SURVEY

- 13. Appliances, business machines, electronic equipment - Location, rated wattage, steam or gas consumption, hooded or unhooded, exhaust air quantity installed or required, and usage.
- 14. Ventilation – lit/s per person, lit/s per m<sup>2</sup>, scheduled ventilation (agreement with purchaser). Exhaust fans- type, size, speed, cfm delivery.

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- 15. Thermal storage - Includes system operating schedule (12, 16 or 24 hours per day) specifically during peak outdoor conditions
- 16. Continuous or intermittent operation - Whether system be required to operate every business day during cooling season, or only occasionally, such as churches and ballrooms.



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## 1.3 AIR CONDITIONING LOAD ESTIMATE

- The air conditioning load is estimated to provide the basis for selecting the conditioning equipment. It must take into account the heat coming into the space from outdoors on a design day, as well as the heat being generated within the space. A design day is defined as:
  1. A day on which the dry-and wet-bulb temperatures are peaking simultaneously.
  2. A day when there is little or no haze in the air to reduce the solar heat
  3. All of the internal loads are normal.

## 1.3.1 OUTDOOR LOADS

- The loads from outdoors consist of:
  1. The sun rays entering windows provide data from which the solar heat gain through glass is estimated.
  2. The sun rays striking the walls and roof- These, in conjunction with the high outdoor air temperature, cause heat to flow into the space.
  3. The air temperature outside the conditioned space - A higher ambient temperature causes heat to flow thru the windows, partitions, and floors.

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## 1.3.1 OUTDOOR LOADS

- 4. The air vapour pressure - A higher vapor pressure surrounding conditioned space causes water vapor to flow thru the building materials. This load is significant only in low dew-point applications.

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## 1.3.1 OUTDOOR LOADS

- 5. The wind blowing against a side of the building- Wind causes the outdoor air that is higher in temperature and moisture content to infiltrate thru the cracks around the doors and windows, resulting in localized sensible and latent heat gains. All or part of this infiltration may be offset by air being introduced thru the apparatus for ventilation purposes.

## 1.3.1 OUTDOOR LOADS

- 6. Outdoor air usually required for ventilation purposes - Outdoor air is usually necessary to flush out the space and keep the odor level down. This ventilation air imposes a cooling and dehumidifying load on the apparatus because the heat and/or moisture must be removed.

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## 1.3.2 INTERNAL LOADS

- The internal load, or heat generated within the space, depends on the character of the application. Generally, internal heat gains consist of some or all of the following items:
- 1. *People* - The human body thru metabolism generates heat within itself and releases it by radiation, convection, and evaporation from the surface, and by convection and evaporation in the respiratory tract.

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## 1.3.2 INTERNAL LOADS

- 2. Lights - Illuminants convert electrical power into light and heat Some of the heat is radiant and is partially stored.
- 3. Appliances - Restaurants, hospitals, laboratories, and some specialty shops (beauty shops) have electrical, gas, or steam appliances which release heat into the space.
- 4. Electric calculating machines - Refer to manufacturer's data to evaluate the heat gain from electric calculating machines.

## 1.3.2 INTERNAL LOADS

- 5. Electric motors - Electric motors are a significant load in industrial applications and should be thoroughly analyzed with respect to operating time and capacity before estimating the load.
- 6. Miscellaneous sources - There may be other sources of heat and moisture gain within a space, such as escaping steam (industrial cleaning devices, pressing machines, etc.), absorption of water by hygroscopic material (paper, textiles, etc.);

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## 1.3.2 INTERNAL LOADS

- 7. In addition to the heat gains from the indoor and outdoor sources, the air conditioning equipment and duct system gain or lose heat. The fans and pumps required to distribute the air or water through the system add heat;

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# Cooling Load Components

