



Kshatij 2014
the techno-management fest



KRYOTECH

PROBLEM STATEMENT



Indian Institute Of Technology, Kharagpur

PREAMBLE: INDIA as a whole in recent times have witnessed un-precedent growth in construction of large buildings in the Commercial and IT park domain. This development has put a lot of stress on the scarce natural resources like power and clean water. India is fast reaching a situation, where its buildings would account for 40% of total national electrical power consumption and 20% of total fresh water consumption. Air Conditioning system for these buildings consumes almost 50% of the total building electrical power (average for round the year operation). With an objective to promote “Energy Efficient Building Design – for a sustainable Future”, young engineers across the country are encouraged to design the AC system for a typical IT – Park considering the broad data furnished below. Engineers are encouraged to do a thorough analysis of the yearly heat load profile, suggest systems and technologies with a single point agenda of “minimum year round energy conservation for the AC system”.

While working out the system, care should be taken that overall energy consumption of the entire building should also work out to be a minimum.

INPUT CONDITIONS BASED ON WHICH THE AC SYSTEM HAS TO BE DESIGNED:

AREA TO BE AIR CONDITIONED: The building consists of 5 floors, each floor having area (required to be conditioned) of 20,000 sqft. Hence total area required to be conditioned is 1,00,000 sqft.

Orientation: The 4 walls of the building are on a perfect North, South, East, West orientation. Please consider a rectangular building having 200 ft length along the North and South direction and 100 ft length along East and West direction. Consider a total height of 14 feet for each floor, of which 10 ft is below false ceiling and 4 ft is above false ceiling.

Building Construction and heat load parameters: All the exposed walls shall be of standard 10 inch brick construction having $\frac{1}{2}$ inch inside and outside plaster resulting in an overall U factor of 0.36 BTU/Hr/Deg. F sqft. Each of the exposed wall area shall have 30% exposed glass (30% of wall area below false ceiling). Glass shall have a U value of 0.5 BTU/Hr/ Deg. F sq. ft. and Solar Heat Gain Factor (SHGF) of 0.35.

Consider floor below and upper as air conditioned, except for the top most floor, for which consider a U value of 0.1 BTU/Hr/Deg. F sqft. for the exposed roof. No heat gain is required to be considered from the ground below the ground floor.

Occupancy: 50 sq ft per person occupancy for each floor (i.e. 400 persons per floor). Consider 100% occupancy from 09:00 hrs to 18:00 hrs. and 50% occupancy (distributed equally for all floors) from 18:00 hrs to 09:00 hrs. Consider normal office working activity for all occupants.

Light & Equipment Load: Total consider 3 watt / sqft during 09:00 hrs to 18:00 hrs, and 50% or 1.5 watt / sqft for all floors (from 18:00 hrs to 9:00 hrs).



Building operation: 24 x 7

Location & Ambient Condition for design (Deg. F): KOLKATA – West Bengal India, 100 / 83 DBT / WBT for summer and 90 / 84 DBT / WBT for Monsoon. No separate provision for heating / humidity control is required to be considered. In side conditions to be maintained at 75 Deg. F DBT +/- 2 Deg. F and RH 55% (without any specific control). For year round variation of weather data, please refer attached annexure.

Design Fresh air: As per ASHRAE Std 62.1 (2007) (which can be varied with occupancy).

Electricity Tariff Structure: 2 options are available: a) Fixed tariff rate of Rs 5.00/- Kwhr throughout the day b) Variable tariff rate of Rs 5.00/- from 6:00 to 17:00 hrs, Rs 7.5/- from 17:00 hrs to 22:00 hrs and Rs 3.5/- from 22:00 to 6:00 hrs.

It is important to note that only a single tariff structure a) or b) as mentioned above can be considered for the entire building as a whole.

Service water availability: Available in good quality and quantity.

Piped LPG or oil or waste heat is not available at site.

Content of the report to be submitted by each group of engineers participating in the contest:

- Summary of heat load calculation for all floors with internal loadings worked out at peak condition.
- Estimated variation of cooling load for the building considering seasonal variation, occupancy and internal load variation as per data furnished in the problem statement.
- Detailed description of the AC system considered for the building with capacities and types of cooling system, pumping system and Air Handling system considered. Logic for sizing and each type of equipment must be clearly spelt out.
- Detailed analysis of year round energy consumption needs to be furnished with as much back-up data as possible.
- Schematic layout of the AC system considered needs to be furnished.
- A technical report on innovative ideas that have been considered in your design.