HVAC IN HEALTHCARE

Developments in ASHRAE and CIBSE

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- MEMBER OF NHS EKNG

HVAC ISSUES

- IAQ
- INFECTION CONTROL
- ENERGY USE
- RESILIENCE
- CAPITAL COST
- RUNNING COSTS
- SUSTAINABILITY

INFECTION RATES

- In December 2000, Robert Bezell of NBC News reported …'It's a danger of staggering proportions. Every year 1 in 20 Americans – 8 million people – develop an infection, with 88,000 of them dying. The biggest threat : supergerms – resistant to bacteria.'

ASHRAE /ASHE IAQ 2004

- A JOINT CONFERENCE HELD IN TAMPA TO DISCUSS HOSPITAL AIR QUALITY

NIH RESEARCH

- DR FARHAD MEMARZADEH
- CFD AND PRACTICAL STUDIES
- LOOKED AT DIFFERENT AIRFLOW STRATEGIES
- RESULTS USED IN GUIDE

ASHRAE DESIGN GUIDE

- HVAC DESIGN MANUAL FOR HOSPITALS AND CLINICS
- PUBLISHED IN 2003

FOREWORD

- INFORMATIVE
- BACKGROUND
- CASE FOR CONTROLLED VENTIALTION

PURPOSE

- VENTILATION SYSTEM DESIGN
- COMFORT
- ASEPSIS
- ODOUR CONTROL

SCOPE

- HOSPITALS, NURSING FACILITIES, OUTPATIENT
- NEW BUILDINGS, EXTENSIONS,
- CHEMICAL,PHYSICAL, BIOLOGICAL CONTAMINANTS,

DEFINITIONS

- REFER TO LIST FOR SCOPE.
- NON-ASPIRATING DIFFUSER
- 3 CLASSES OF SURGERY…
  - CLASS A
  - CLASS B
  - CLASS C

ADMINISTRATION

- COMPLIANCE REQS
  - NEW BUILD
  - EXTENSIONS
  - PLANT REPLACEMENT/SYSTEM UPGRADES
  - SPACE ALTERATIONS

SYSTEMS AND EQUIPMENT

- COMFORT
- REMOVAL OF CONTAMINANTS
- AIRBORNE INFECTION CONTROL

EMERGENCY POWER

- NFPA 99

HEATING SOURCES

- N + 1 ?
- ONLY MENTIONS HEAT SOURCE – WHAT ABOUT REST OF SYSTEM?

COOLING SOURCES

- NOT MENTIONED
- NO MENTION OF ALTERNATE SOURCES – NOT n+1

FILTRATION

- SPECIFIC – SEE TABLE 5.1

COOLING SYSTEMS AND DRAIN PANS

- REFERS TO APPENDIX C WHICH IS PART OF STANDARD. QUITE SPECIFIC IN PLACES, eg drain levels, trap depths, water carry over.
- THIS SECTION USES METRIC RATHER THAN IMPERIAL UNITS.

HUMIDIFIERS

- BANS RESERVOIR AND EVAPORATIVE TYPES

AIR DISTRIBUTION

- TABLE 5.2 CONCERNS SUPPLY DIFFUSERS
- SPECIFIC TYPES
- NON ASPIRATING FOR OPERATING THEATRES AND PROTECTIVE ENVIRONMENTS (LAMINAR FLOW)

LAMINAR AIR FLOW

- STANDARD PROPOSES A STANDARD DESIGN SOLUTION
- PRESCRIPTIVE APPROACH
- LOCATION OF SUPPLIES AND EXTRACTS
- SPECIFIES DIFFUSER TYPES

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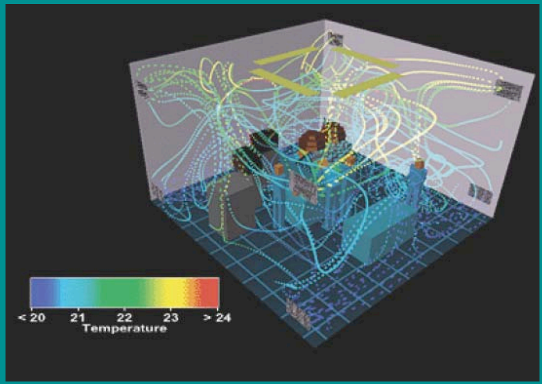

orf.od.nih.gov/docs/OR_ESarticle.pdf

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SPACE VENTILATION

- TABLE 6.1 –TEMPS, HUMIDITY, AIR CHANGE RATES
- THIS IS THE HEART OF THE STANDARD IN TERMS OF VENTILATION
- UNITS ARE MAINLY IMPERIAL
- FAN COILS VIRTUALLY OUTLAWED
- REIRC PERMITTED IN MOST ROOMS – eg ORs can have 4 fresh air and 16 recirc airchanges per hour
- NATVENT not permitted due to pressure requirements, temperature, humidity or airchange rate reqs

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AIR CLEANERS

- UV SYSTEMS NOT MENTIONED
- LOCAL RECIRC HEPAFILTERS NOT MENTIONED – BUT RULED OUT BY BAN ON IN ROOM UNITS

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Airborne infections

- Where are the infections coming from?
- What are they?
- How can we stop them?
- What is the role of ventilation?
- Are our designs right?
- Are our installations right?

DESIGN OBJECTIVES

- What is the design trying to achieve?
- There is no Internationally agreed standard
- There are very big differences between so called advanced countries – Why?
- What about developing countries?
- Ventilation engineers do not have a clear view on modern hospital ventilation requirements

UK PRACTICE

- NHS GUIDANCE – EFFECTIVELY A REQUIREMENT BEFORE PFI- BUT NOT SO NOW.
- HTM 2025 – IN PROCESS OF REVISION
  - FULL FRESH AIR
  - NO RECIRCULATION
  - NATVENT

ENERGY

- RISING COSTS
- FUEL AVAILABILITY
- CARBON EMISSIONS
- KYOTO COMMITMENT
- SUSTAINABILITY
- HEALTH AND WELLBEING

LOW ENERGY HOSPITAL STUDY, 1990

- Gain an understanding of the key functional and comfort related factors that influence energy use.
- Establish an energy datum against which energy saving meassures can be evaluated.
- Examine measures that reduce the energy demand of environmental and process systems at the point of use.
- Determine the grades of energy required to satisfy the reduced energy demand.
- Examine the possibilities for the recovery of heat as a means of offsetting energy demand.
- Consider energy supply options, taking into account fuel characteristics and availability, patterns and grades of residual energy demand and the overall integration of systems.

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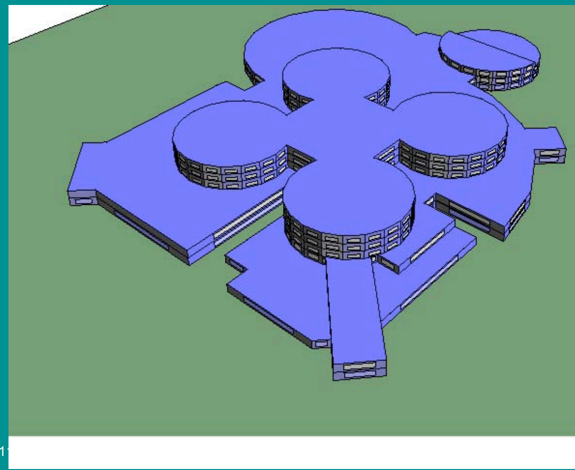

HEAT RECOVERY

- Examination of patterns and grades of energy shows that a large proportion of a hospital demand is for low grade heat.
- Also heat from recovery sources such as exhaust air, refrigeration condensers and from solar energy can provide a substantial part of the low grade heat required.
- Some of the systems for example, run around coils, can be described as dedicated systems. That is, a direct transfer of heat occurs from the exhaust to the supply of a particular ventilation system. In dedicated systems of this type the recovered heat is only useful when there is a demand for that grade of heat within that same system.
- Heat recovery can redirect surplus heat to areas needing heat

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WHY HAVE BOILERS ?

- PART L 2005 REDUCES CARBON EMISSIONS BY 28%
- BUILDING FABRIC KEEPS HEAT IN
- HEAT PRODUCED BY PROCESSES WITHIN – LINACS,MRIs,MEDICAL EQUIPMENT
- OCCUPANCY IS 24 HRS/DAY/365 DAYS/YEAR
- HEAT SURPLUS DUE TO USE OF BUILDINGS
- UK HTM2025 REQUIRES FULL FRESH AIR – THEREFORE BIG AIR HEATING LOAD
- USE HEAT RECOVERY TO GET HEAT BACK FROM EXHAUST AIR

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ENERGY TARGET

- The Minister of State for Health in April 2001 stated target for new hospitals
  - 35 to 55 GJ per 100m³.

BENCHMARKING –Current hospitals

- Large Hospitals (greater than 25,000m3)
- Low Consumption Less than 70 Medium Consumption 70 to 80
- High Consumption … Above 80

CALCULATING VOLUME UNCLEAR

- ERICs
- EnCode 2005
- This EXCLUDES untreated space such as:-
  - ceiling voids
  - Risers
  - Plant rooms
  - Non-heated, non ventilated stores
- Volume EXCLUDES ceiling voids unless ceiling is not insulated (and therefore void is heated).

REAL ENERGY CONSUMPTION MUST INCLUDE SYSTEM LOSSES

- Ductwork distribution and plant losses + 10%.
- Commissioning, Balancing + 10%.
- The plant duties are therefore +20% of the room calculated

THERMAL SIMULATION

- The computer model has information on the construction of the building – the floor, walls, windows, roofs and internal partitions. Each element of the of the construction – plaster, blockwork, concrete, glass etc – has physical properties which enable the programme to calculate:-
- thermal insulation
- rates of heat flows
- thermal energy stored in the structural mass
- amount of solar radiation (solar gain)

THERMAL SIMULATION

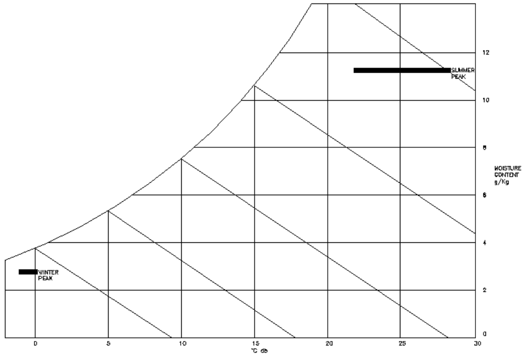
- The building services engineering systems are also described:-
- type of heating
- natural ventilation
- mechanical
- type of cooling
- lighting
- electrical power.

HOURS OF USE

- Each department has occupancy profiles which establish the times at which engineering systems operate, when occupants use rooms, the set point, and permitted control band which systems follows.

WEATHER DATA

- The simulation then uses actual weather data compiled into a “typical year” to model operation of the computer generated building from midnight on 1st January to midnight on 31st December.
- CIBSE has produced a number of test years to use, including predicted climate change effects



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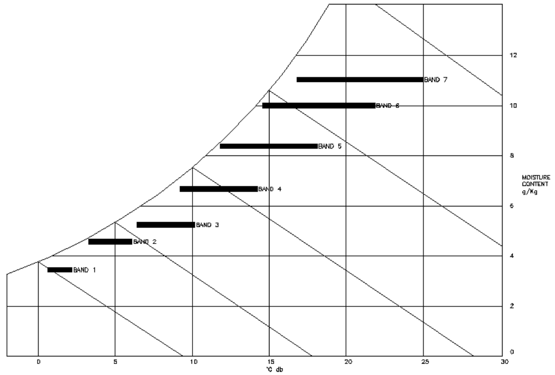

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Annual energy (at point of use) and CO2 output

- Gas19098 MWh = 68760 GJ
- Electricity16169 MWh = 58208 GJ (of which 2232 is from CHP)
- **Annual Carbon Emissions (allowing for CHP benefit)**
- Gas = 3,850,000kg
- Electricity = 8,3789,24kg
- TOTAL12,228,924 = 12,229, Metre Tonnes C02.
- This equates to 6473 kg C02/100m3

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The tables summarise the energy used in the hospital on a monthly basis under the following headings:-

- Heating
- Cooling
- Humidification
- De-humidification
- Ventilation re - heating
- Ventilation re – cooling
- Hot Water
- Catering
- Electrical Power incl. medical equipment
- Lifts
- Lighting

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GJ/m3

Total Energy	35267
Total Area	69961
kWh/m2	504
GJ/100m3	**67.04**

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CONCLUSIONS

- JOIN THE CIBSE HEALTHCARE GROUP
- JOIN ASHRAE TC 9.6

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