

## **BBSE3002 Applied Research Project – Project List 2003/2004 (HN Lam)**

### 1. Geothermal heat pump systems for air conditioning applications

The earth can be used a heat source or heat sink for a geothermal heat pump system. Environmental friendliness, high efficiency and excellent reliability are the main merits of a geothermal heat pump system. The objectives of the project are to investigate, using computer modelling and simulation, the technical and economic performance of such a system for air conditioning purposes under Hong Kong climatic conditions.

### 2. Desiccant-aided air conditioning systems

Desiccants can be used to absorb moisture in the air. An air conditioning system which uses a desiccant material to help handle the latent load will have a higher efficiency if waste heat is available for desiccant regeneration. The project aims at the study of how a desiccant-aided air conditioning system will perform by using computer modelling and simulation. A small desiccant wheel may also be used for experimentation.

### 3. Drainage flow in sanitary pipework

The flow of drainage discharge in sanitary pipework is often more complicated than most people think because of the presence of air flow. Any virus present in the drainage discharge can be carried by the air stream inside the pipework and affect building occupants if it leaks out into the living areas. The main objectives of the project are to investigate the interactions of liquid and air flow producing aerosols, and the resultant pressure fluctuations under different modes of operation which may induce loss of trap water seal.

### 4. Intelligent monitoring and control for HVAC systems

Artificial intelligence methods such as fuzzy logic and genetic algorithms can be used to design autonomous algorithms for system monitoring and control. The project aims at the design and implementation of an intelligent monitoring and control system for a variable-capacity heat pump in order to achieve optimal efficiency. A computer-based development environment with an open protocol for networked communication will be employed for the investigation.

### 5. Renewable energy source based on combined wind turbine and photovoltaic systems

There are initiatives from the government as well as the private sector which aim to promote the more widespread use of renewable energy generating devices. The integration of photovoltaic solar cells with wind turbines has a high potential for useful practical implementation. The objectives of the research project are to investigate the design of hybrid solar and wind systems for optimised electricity generation in buildings and the implementation of such systems in the urban areas of Hong Kong.

## **Final Year Projects (2003/2004)**

Please contact Dr Yuguo Li, tel. 2859 2625

### **1. Development and Analysis of a PCO-based Personalized Ventilator**

Providing adequate ventilation in buildings is always a challenging task. Most of us enjoy some control over our own environment if available. Personalized ventilation systems have been developed elsewhere. The essential idea of this project is to develop a portable personalized ventilator using the effective photo-catalytic oxidization technique. Analysis of the proposed design based on mass transfer and fluid dynamics is to be carried out. The objectives are to propose, construct and evaluate an effective PCO-based personalized ventilator design.

Design,  
experimental and analytical

### **2. CFD study of air flow design in a hospital ward for effective virus transmission control**

Air flow design in hospital wards has been a popular topic during the 2003 SARS outbreak in Hong Kong. Ventilation design in a few hospital wards in Hong Kong have been suggested to be responsible for some of the large SARS outbreaks in Hong Kong, e.g. the 8A ward in the Prince of Wales Hospital. In this study, you will expect to use the computational fluid dynamics simulation to study a typical hospital ward configuration. Effective design needs to be developed. If time permits, you may wish to carry out some experimental studies in the full-scale SARS ward test room available in the Building Services Laboratory.

Computational and experimental

### **3. Development of breathing thermal manikins for studying hospital virus transmissions**

Thermal manikins are simply a model of human body with appropriate heat distribution, so they can be used in thermal comfort and air flow studies. A number of simple thermal manikins have already been constructed in the Building Services Laboratory for studying hospital ward air conditioning systems. The objectives of this project are to construct a thermal manikin with the ability of breathing and to study a typical air conditioning system setting using the new breathing thermal manikins in the full-scale SARS ward test room.

Experimental and analytical

### **4. Experimental study of air flows in human noses**

When one breathes air, particles and pollutants in the air are also inhaled. The human noses are acted as an “air conditioner” for the human body. Human nose filters the air pollutants and adjust the air temperature and humidity of the inhaled air to be supplied further downstream to the human lungs. The filtration of particles in the human noses is associated with the air flow pattern in the airways. This project will aim to understand the steady inspiratory flows in human noses. If time permits, you will also look at the particulate deposition patterns experimentally.

Experimental and analytical

## BBSE3002 Applied Research Project

Dr. Sam C M Hui

### 1. Energy and Environmental Performance of Green Roofs

Green roofs are plantings that are placed on the roof of a building. This project will investigate the energy and environmental performance of green roofs by studying the thermal and other effects under the local climate and building conditions. The benefits and impacts of green roofs in the urban environment will also be evaluated.

### 2. Improvement of Building Services Systems in Historic Buildings

The building services systems in a building typically last 15 to 30 years. For historic buildings, these systems have to be maintained properly and replaced several times throughout the building's lifetime. This study will examine the important considerations and strategies for improving building services systems in historic buildings. The HKU Main Building will be taken as a case study.

### 2a. Study of Underfloor Plenum Air Conditioning for Historic Buildings

Underfloor plenum air conditioning (UPAC) makes use of a plenum space at a raised floor system to deliver conditioned air in buildings. When it is applied to renovation of historic buildings, it can offer some benefits in flexibility, control and system performance. This study will investigate the design factors of UPAC systems for historic buildings and assess the technical and economic criteria for successful implementation. Real projects in Hong Kong and overseas will be evaluated.

### 3. Analysis of Climatic Data for Sustainable Building Design

Sustainable building design requires careful consideration of local climatic conditions and characteristics. This project aims to analyse the climatic data that are crucial to building design and develop useful information to allow building designers to assess sustainable building. Design tools and computer software will be developed from the study.

### 4. Effects of LCD Monitors on Thermal and Visual Environment in Buildings

LCD (liquid crystal display) monitors are becoming more affordable nowadays and have been steadily growing in popularity in many applications. This project will investigate the effects of LCD monitors on thermal and visual environment in buildings. The power demand, heat generation and lighting design will be studied together with the energy and economic factors.

### 5. Healthy Indoor Environment Inside Lift Cars

During the recent SARS issue in Hong Kong, lift cars have become a major concern for transmission of the disease. This project tries to study the indoor environment inside lift cars and examine the engineering methods to ensure good health and hygiene.

## **BBSE3002 APPLIED RESEARCH PROJECT**

**MICHAEL LEUNG**

**(1) DEVELOPMENT OF INTEGRATED HEAT PUMP TECHNOLOGY TO ENHANCE ENERGY EFFICIENCY AND INDOOR AIR QUALITY**

Integrated heat pump (IHP) technology employs an innovative vapour compression system to supply simultaneous cooling and heating at high energy efficiency. A single IHP system can effectively replace multiple conventional thermal units in a built environment, such as chiller, heat pump and water boiler. In conjunction with advanced ventilation control, an IHP system can offer a total solution for space cooling, space heating, hot water, indoor air quality control and energy conservation. Besides saving in energy costs, significant cost reduction in equipment, installation and maintenance is anticipated. The objective of this project is to develop the IHP technology for optimal system design and control resulting in high system performance and minimal life-cycle costs.

**(2) INDOOR AIR QUALITY CONTROL AND MITIGATION MEASURES FOR PRINTING PLANTS**

Due to the unique operations and processes in the printing industry, the conventional Indoor Air Quality (IAQ) control for general working environments requires modifications to better safeguard the health of the workers. In this project, it is proposed to study the existing IAQ conditions and develop useful Engineering Control Measures for the printing industry in Hong Kong. A Self-Assessment Software Kit will also be developed to facilitate IAQ surveys and audits.

**(3) ENERGY CONSUMPTION INDICATORS AND BENCHMARKS FOR UNIVERSITIES AND POST-SECONDARY COLLEGES**

The objective of this project is to develop energy consumption indicators and benchmarks for universities and post-secondary colleges in Hong Kong. The scope of work includes (1) development of useful energy consumption indicators, (2) surveys on energy consumption for 30 institutes in Hong Kong and (3) statistical analysis to determine the benchmarks.