ÇANKAYA ÜNİVERSİTESİ

Arch 427 Architectural Engineering & Env. Systems

Assignment -3 (final exam & presentation)

Requests:

1. Report:

It is expecting from you to consider the information above and prepare a report which introduces your studio work designed this semester.

The report should have a title page stated your name, lecture's title, project's title, and date.

The structure of the report should have at least three parts.

The first part is the introduction part. In this part, you explain the project's main idea briefly. The site, climate, function, space organisation, building envelope, etc. should be introduced clearly. The explanations will be supported by drawings, sketches, etc.

The second part includes the system definitions of your design. Choose one or more systems among the mechanical systems that you were taught during the lecture and explain

-the reasons of selection,

-working principle of the system,

-the effect on your design strategies

The third part is the conclusion and discussion part. Criticise yourself from the systems perspective and evaluate your design. Indicate the parts that you would like to change on your design based on the requirements of mechanical systems (if any).

The checklist at the attachment will help you to examine your design detailly. Each item at the list should be evaluated, design decisions related with each item is explained and clearly defined in the report.

The reports will be written on an A4 paper in a good structured technical English.

Deliver the report not late than 12 May 2016.

2. Poster Presentation:

On the date of final exam, you are going to submit a poster that includes your design and the technical definitions of mechanical systems that you suggest for your design. This A1 poster presentation should include drawings, sketches, pictures, etc. in order to briefly explain your decisions and suggestions which are listed in the report.

CHECKLIST***

*** this checklist is adapted from the list published in http://www.mech.hku.hk/bse/check.pdf

1. Architecture

Item	Key points
Siting and surroundings	• Thermal environment of surroundings - sunshade, sunlight, wind, reflecting surfaces
Thermal design of outdoor environment	• Effect of plants - shading by trees and plants - wind shielding by trees and plants • Cooling effects by ponds and fountains • Reflection from road or floor surfaces and plants
Shape of the building	• Ratio of envelope surface area to total floor area - usually the smaller the better • Aspect ratio of floor plan - usually the smaller the better • Number of floors and building height - floor-to-floor height, light well's height
Orientation of facades	• Desirable orientation from thermal viewpoint • Optimal strategy of orientation - for the same floor plan, east-west axis is better than north-south one - main wall openings to face south
Design of building plan and section to enhance thermal performance	• Zoning and location of air-conditioned and non-air-conditioned spaces - non-air-conditioned spaces and spaces without occupants may have more exterior walls - plant rooms to be placed on the topmost floor • Appropriate provision for different building functions - hours of using the space - moving of heavy objects by occupants - provision of smoking lounge - provision of store room - spaces with high internal loads (lights, people and equipment) may compensate heat loss at the building envelope • Use of transit areas for thermal buffer zones • Design of wind-shielded area under openings

Thermal insulation and thermal storage of the roof	• Thermal insulation - material selection - thickness - thermal properties (and moisture barrier) • Construction of the roof - double slab - thermal bridge prevention • Treatment on the roof - soil and planting - drainage of rainwater • Sunshade provision • Glare control • Thermal storage - heavy structure (thermal mass) - interaction with thermal insulation

1. Architecture (continued)

Item	Key points
Thermal insulation and thermal storage of the exterior walls	• Thermal insulation - material selection - thickness - thermal properties (and moisture barrier) • Construction of the walls - use of air cavity - ventilation of air cavity - location of thermal insulation - thermal bridge prevention • Sunshade provision - louvres and shading devices • Reduce radiant heat - use of trees for shading and shielding - select materials for glare control - provision of ventilated cavity • Thermal storage - heavy structure (thermal mass) - interaction with thermal insulation

Thermal insulation, air tightness, ventilation properties and daylight properties of windows and doors	• Thermal insulation - Type and construction of window glass: plain glass, insulating glass, reflective glass, tinted glass, double glazing, low-e glass, etc. - window-to-wall ratio - shading coefficient - use of trees, sidewalls, louvres and balcony for shading - use of internal shading devices like blinds and curtains - orientation (south facing is preferable, and if in other directions, the facing angle of window glass may be adjusted) • Air tightness - air leakage properties - shape and design of door openings: double door, automatic door and rotating door • Ventilation (natural) - possibility of windows being opened - openings and path have less resistance to air flow • Daylight penetration - reflective louvre - skylight - design of light wells - light transmission properties of window glass - array of window openings
Glare control of exterior and interior walls	• Solar absorptivity, control of glare from sunlight and artificial lighting

2. Heating, Ventilating and Air-conditioning (HVAC)

Item	Key points
Overall planning	• Suitable zoning strategy to prevent unnecessary losses - zoning of air-conditioned and non-air-conditioned spaces - zoning for spaces with different air change rates - zoning for spaces with different air-conditioning hours • High efficient operation of system equipment • Zoning for spaces with different conditions: temperature and humidity, lighting density, air cleanliness, occupant density and equipment used • Zoning for spaces with different load characteristics - peak hour, load lagging • Balance of building air pressure - positive and negative air pressure • Sources of energy - consider local energy structure and form of energy available
Indoor environment	• Design indoor temperature and humidity - setting of design conditions - use of thermal comfort index - reset conditions at night, before and after occupying hours - reset according to actual outdoor conditions - setting of control tolerance bands • Outdoor fresh air rate - minimum outdoor air requirement - primary fresh air cooling • Lighting power density - setting of design maintained illuminance • Changeover of heating and cooling, and period of air-conditioning - optimize the design and review the necessity • Distribution of air (and temperature) - air supply method and location, return air location

System and equipment	• Reduce energy losses from inappropriate mixing - setting of perimeter and interior zones - effective air supply method (avoid cooling and reheat) • Matching of load characteristics - for design of cooling and heating plants - heat recovery method • Correct use of multiplying factors - safety factor of climatic conditions (in load calculation), equipment and systems; diversity factor
Heat/cold source system	• High efficient operation of equipment (by good management) - efficient part load operation - number and division of multiple equipment - use of thermal storage method - setting of chilled and condensing water temperatures • Heat recovery from waste heat and exhaust air - utilization of heat sources: exhaust air, transformers, motors, lighting, gas burning, warm discharged water • Use of heat pumps • Total (and sensible) heat exchanger • Waste heat and condensing boilers • Use of natural energy sources - primary fresh air unit to use night ventilation - solar thermal utilization - use of river or sea water for cooling • Thermal storage to cut down peak load and increase efficiency of heat recovery equipment - water or ice thermal storage - use of latent heat - thermal storage by system equipment • Cogeneration system

2. Heating, Ventilating and Air-conditioning (HVAC) (continued)

Item	Key points
Load distribution and transmission systems	• Prevent losses during transmission - thermal insulation of piping and ducting - minimize air leakage - decrease local flow resistance • Reduce space loads - water-cooled lighting fixture (if needed) - reduce energy losses from inappropriate mixing - better control of latent loads • Decrease of running power - use variable air volume (VAV) method - use variable water volume flow (VWV) method - use larger temperature difference - use low-temperature air supply system - use of booster fans and pumps - fans and pumps specific to part load operation - straightening and shortening of air ducts - alternate energy transmission method - close loop for water distribution systems - lowering of water or air flow velocities - better thermal insulation for pipes and ducts
Ventilation systems	• Reduce transmission energy - prevent excessive ventilation - shut down ventilation when not needed - control of ventilation rate at part load conditions - use of localized ventilation method - use of air-conditioning to replace high volume ventilation (e.g. for transformer and plant rooms) - utilization of natural ventilation - use air cleaners - multiple fans to handle a large flow capacity • Reduce ventilation load - decrease outside air when preheat or pre-cool is needed - control of fresh air (from number of people or use CO_2 analysis) - use of primary fresh air unit - use of night ventilation - use of total heat exchanger - transfer of exhaust air from plant room to car park - use of exhaust air from cooling tower - decrease of ventilation rate during peak load
Control systems	• Control of indoor environment (computer automatic control) - setting of temperature and humidity control (response to outdoor) - control of outdoor fresh air • Control of the operation of equipment - optimal start-stop - capacity control on the number of equipment running - control of water and air flow rates - operation forecast control - demand control - peak-cutting control

Use of natural energy	• solar energy • geothermal energy • wind energy • use of energy in soil (temperature and underground water)
Use of energy from waste heat and exhaust	• heat recovery from exhaust air • heat recovery from waste products • heat recovery from discharged water

4. Lighting Installations

Item	Key points
Lighting installations	• Design of illumination levels - suitable zoning and appropriate level for each zone • Lighting system - general lighting and localized (task) lighting - direct and indirect lighting methods - on-off method and circuitry design • Lighting control (by computer methods) - manual control - occupant-sensing control - lighting level sensing control - time-schedule control • Energy-saving equipment (and their cleaning and maintenance) - energy efficient lighting system and luminaires • Light-sensing control - daylight-activated lighting control - control system to maintain appropriate illumination level

6. Plumbing and Drainage

Item	Key points
Cold water supply and drainage	• Necessity of cold water supply - selection of rooms and locations for cold water supply • Load estimation and equipment capacity sizing - correct and accurate loads - suitable capacity (with safety and diversity factors) • Reduce pumping energy - shortening of piping network and system - open loop and close loop systems - booster method • Maintenance of appropriate water pressure • Equipment - energy-saving (water-saving) equipment and system - correct type and size • Water recycling systems - feasibility of using them, their economics and reliability • Rainwater utilization
Hot water supply	• Necessity of hot water supply - selection of rooms and locations for hot water supply • Conditions of hot water supply - flow rate of hot water supply - temperature of the hot water • Hot water supply system - design of storage tank or pond - specific boiler - central supply method and local supply method - thermal insulation properties - use of solar thermal energy - shortening of water piping network - heating method - thermo-siphon for circulation • Heat recovery from waste water