

MEINHARDT Consulting Engineers

Training Session to HKU Students
on Typical Building Services

Project Design Process

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Introduction

- **Part A – Design Approach**
 - Form the foundation of work on all projects
- **Part B – Design Process**
 - A logical sequence from inception of the project to completion of Tender Documentation

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Introduction

- **Part A- Design Approach**
 - Client Requirements
 - Engineering Brief
 - Fitness for Purpose
 - Costs
 - Sympathy with Architecture
 - Engineering
 - Coordination of Services with Building Structure
 - Authority Approvals

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Introduction

- **Design Process**
 - Preliminary Calculations
 - Assessment of Alternatives
 - Design Establishment
 - Detailed Design
 - Reporting to Client
 - Final Tender Documentation

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Part A – Design Approach

- **Client Requirement**
 - **Establish and Agree the Client's Requirements**
 - Project Objectives e.g. quality, budget
 - Functional Requirements e.g. intended use of various rooms
 - Technical Requirements if known to suit any special process
 - Any Special Requirements regarding Form of Contracts or Tender Conditions
 - Any Requirements regarding Tender Documentation e.g. makes of equipment
 - Areas of Special Interest where investigations and reports may be required from the Engineer
 - **For major projects, the Client may issue a Development Brief**

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Part A – Design Approach

- **Engineering Brief**
 - **Propose Scope of Services**
 - **Recommend Design Criteria**
 - **Description of Services covering**
 - Discussion on Options available and advantages and disadvantages of each
 - Recommend Option
 - Cost Advice
 - **Sketch Design Layouts**
 - Plantroom Layouts
 - Single Line Service Layouts

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Part A – Design Approach

- **Engineering Brief**
 - Details of Special Investigations such as
 - New Technology and Overseas Developments
 - Flexibility for Tenancy Fit-out
 - Energy Conservation and Waste Heat Recovery
 - Fenestration Studies
 - Fire and Smoke Control
 - If appropriate, the brief should cover the proposed Form of Contract.
 - Obtain Client agreement to the Brief

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Part A – Design Approach

- **Fitness for Purpose**
 - Ensure that our advice is correct and can be supported on functional, technical and economic grounds.
 - Be sensitive to the Client's expressed views and needs
 - Be cautious of accepting a Client's preference on some matter or his appreciation of requirements unless they can be validated with technical investigation.

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Part A – Design Approach

- **Costs**
 - **Capital Costs**
 - Cost targets
 - Return on capital
 - **Operating Costs**
 - Tenants' or proprietors' operating cost
 - After hours usage and payment thereof
 - Operational strategy, manning
 - Maintenance strategy, contract or in-house

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Part A – Design Approach

- **Costs**
 - **Life Cycle Costing**
 - Economic analysis for design options
 - Long term owning and operating costs
 - Estimated annual operating costs
 - **Cost Estimates**
 - On-going process during design development
 - First Cost Indication (usually on a cost per unit basic based on initial architectural sketch plans)
 - Budget Cost (based on preliminary design with reasonable detailed estimation for equipment, piping, ductworks etc.)

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Part A – Design Approach

- **Costs**
 - **Cost Estimates**
 - Cost checks (carried out during design development and tender documentation)
 - Pretender Estimate (further cost check stage and requires a detailed estimate based on tender drawings). If cost increases have occurred, a full reconciliation should be submitted to the Client.

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Part A – Design Approach

- **Sympathy with Architecture**
 - Encourage the Architect to explain his design objectives
 - **Areas requiring special attention:**
 - Location of plantrooms
 - Exposed services
 - Reflected ceiling plan
 - Access panels in walls and ceilings
 - Locations of air intakes and air exhaust grilles
 - Locations of wall switches, thermostats, warning lights and the like

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Part A – Design Approach

- **Sympathy with Architecture**

- **Areas requiring special attention:**
 - Plantroom doors and major access hatches and openings
 - Plantroom layout and requirement for alternative means of escape
 - Provision for fire and smoke control
 - Fire rated escape corridors
- Discuss each of these areas with the Architect to ensure a mutually satisfactory solution is achieved

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AS/NZS1

Part A – Design Approach

- **Engineering**

- **Simplicity**
 - Aim to achieve simplicity in the design
 - Over-sophistication may lead to a costly installation and heavy maintenance commitment
 - Consider the options available and tailor the design to the specific project needs

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AS/NZS1

Part A – Design Approach

- **Engineering**

- **Proven Designs**
 - Adopt proven design wherever possible
 - Innovative design is to be encouraged
 - New ideas and design should be validated by engineering calculation and testing as appropriate

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AS/NZS1

Part A – Design Approach

- **Engineering**

- **Energy Efficiency**
 - Achieve maximum energy efficiency within the cost parameters
 - Energy efficiency is achieved through:
 - Basic system design
 - Sizing of distribution piping and ductwork
 - Selection and configuration of equipment
 - Automatic controls strategy

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AS/NZS1

Part A – Design Approach

- **Engineering**

- **Energy Efficiency**
 - Some examples:
 - Free air cooling, utilize 100% outside air for economy cycle operation when outdoor conditions permit
 - Automatic controls to suit varying cooling and heating loads due to changing load demands
 - Incorporate facilities for optimum start and shut-off of unoccupied areas

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AS/NZS1

Part A – Design Approach

- **Engineering**

- **Reliability**
 - All system designs must be inherently reliable in operation
 - Equipment selection
 - Use equipment of proven field performance
 - Balancing and Commissioning
 - Must be supervised and completed satisfactorily
 - Calibration and Commissioning of Controls

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AS/NZS1

Part A – Design Approach

- **Engineering**
 - **Maintainability**
 - Avoid locating equipment in relatively inaccessible positions
 - Ensure means of access to all equipment that require maintenance
 - Make provision for removal of equipment
 - Provide means for lifting heavy equipment
 - Make provision through the Architect for access panel in ceilings and walls

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AS/NZS1012

Part A – Design Approach

- **Coordination of Services with Building**

Ensure that the building services are coordinated with the building structure, architectural finishes and other services.

 - Ensure the Architect is fully informed on all design proposals
 - Provide the Architect and Structural Engineer progressively with the following information
 - Wall and floor penetrations, plinths
 - External louvres
 - Hoisting requirements, supports and anchor points
 - Combined services reflected ceiling plan

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AS/NZS1012

Part A – Design Approach

- **Authority Approvals**
 - Ensure that designs are developed in close collaboration with all local Authorities
 - **Authorities commonly involved**
 - Electricity Authorities
 - Water Authorities
 - Fire Services Department
 - Building Department
 - Gas Supply Authorities
 - Environmental Protection Department

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AS/NZS1012

Part B – Design Process

- **Preliminary Calculation**
 - Based on architectural concept plans, preliminary calculation should be undertaken to assess the magnitude of the project
 - The following sequences are typical for an air-conditioning system design
 - Identify different types of usage and occupancy such as air-conditioned space, toilets, carparks
 - Assessment of air conditioning cooling load by applying suitable "rules of thumb" (as W/m²)

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AS/NZS1012

Part B – Design Process

- **Preliminary Calculation**
 - The following sequences are typical for an air-conditioning system design
 - Assessment of air conditioning supply air quantities by applying suitable "rule of thumb" (as l/s per m² or l/s per kW)
 - Assessment of ventilation rates for toilets, car parks, kitchens etc.
 - Assessment of heating loads (air conditioning, domestic hot water etc) by applying suitable "Rules of Thumb"

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Part B – Design Process

- **Assessment of Alternatives**
 - Once the preliminary loads have been established, alternative systems should be assessed for suitability.
 - For air conditioning system, some of the following options should be considered.
 - Air-cooled chillers or water cooled chillers
 - Type of machines, centrifugal, screw or reciprocating chillers
 - Combination of chillers
 - All air system or fan coil unit system
 - Central plant or floor by floor air distribution

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Part B – Design Process

• Design Establishment

- Engineered the recommended alternative with emphasis on the following areas
- Plantroom sizes and location
 - Ensure that layouts presented have enough information to substantiate area requirements and preferred plantroom location
- Riser position
 - Nominated with sufficient information to withstand scrutiny

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Part B – Design Process

• Design Establishment

- Ceiling Space
 - Submit a detailed dimensioned cross section of the ceiling space to indicate the required services zone.
- External Louvres
 - Determine the requirements and coordinate with Architect on locations
- Structural Requirements
 - Advise operating weight of major equipment
 - Advise major slab and wall penetrations

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Part B – Design Process

• Detailed Design

- Obtain more information about the building such as occupancy level, internal loads, glazing performance data, structural framing.
- Carry out detailed design calculations such as computational methods for cooling load calculation.
- Selection of plant and equipment
- Detailed drawings commenced showing accurate sizes for ductwork, pipework and equipment.
- Coordination with other disciplines, confirm or advise any changes in the information previously exchanged.
- Obtain Authorities Approval

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Part B – Design Process

• Reporting to Client

- Keep the Client informed on all matters which affect the project, particularly cost-associated matters
- Use the project meetings as a vehicle for keeping abreast with the Client's thoughts.

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Part B – Design Process

• Final Tender Documentation

- The design process culminates in a set of tender documents being compiled
- Include tender drawings and technical specification
- Allow sufficient for internal review before tender issue

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Final Outputs

- A set of tender documents which are technically accurate and well engineered, properly coordinated with all other disciplines and satisfying the requirements of all relevant Authorities.

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