Conceptual Design of Electrical Systems

SBS5397 Final Year Project 1

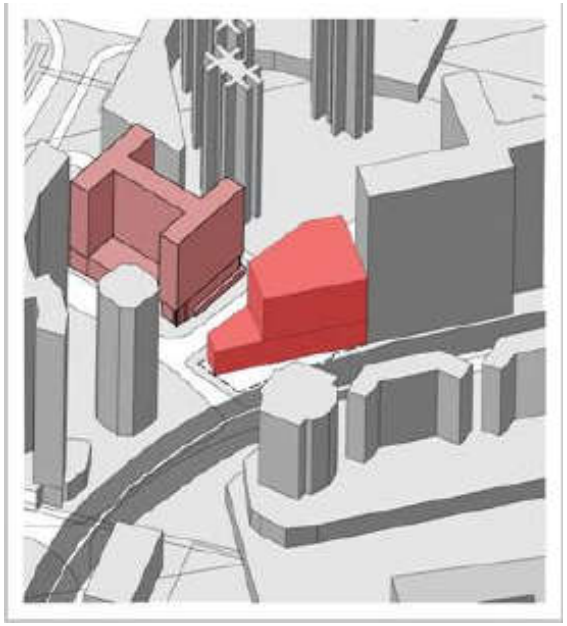
(BSE Conceptual Design)

Scope of Work

1. Site investigation report
   - What are the existing site conditions?
   - Based on the existing site conditions, what are the possible constraints and options on the building design?
2. Business plan proposal (Technical feasibility study)
   - What are the client's needs and objectives?
   - What are the plant room requirements?
   - What are the pros and cons of using a particular system?
   - What is your suggestion to clients? Why?
   - What are the procurement method and organizational structure that suits this building project?
3. Progress report
   - What are the preliminary design considerations of the major electrical system of your building?
   - What is the schedule? What is the budget?
4. Final report (Preliminary design)

Site Investigation Report

- How does the surrounding environment impact on the electrical system design of your building?

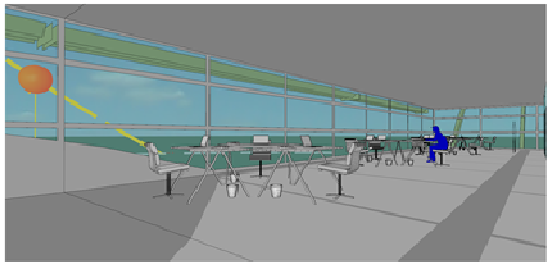


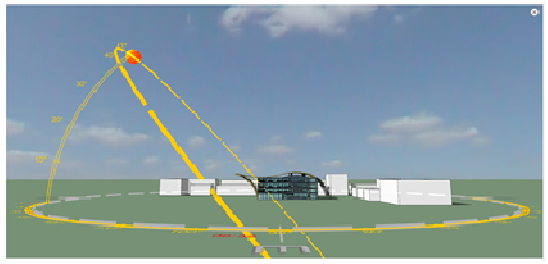
Think about:

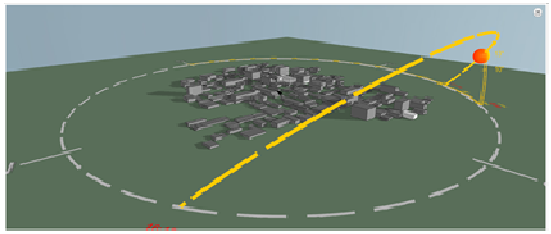
- The path for the electrical equipment to access into the building
- The location of the transformer rooms and generator rooms
- The direction of the chimney outlet of emergency generator

Site Investigation Report

- How does seasonal and diurnal microclimate impact on the electrical system design of your building?
- Sunpath diagram







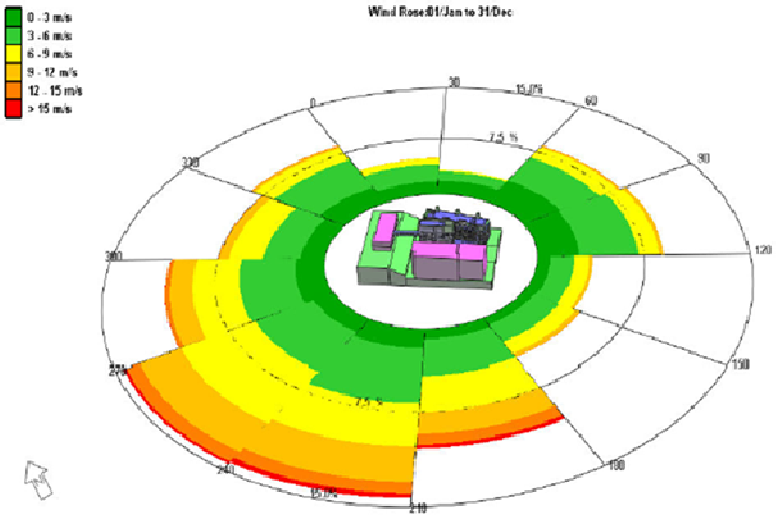
Sun Path diagrams, 21st July (LHS) & 12th December (RHS), taken from IES model

Think about:

- The possibility of using daylight by appropriate lighting control
- Any shadowing from nearby buildings?
- Any serious solar gain that discourages daylighting?

Site Investigation Report

- Wind rose diagram



Wind rose diagram, 31st December, taken from IES model

Think about:

- The directions of the fresh air intake, exhaust air outlets, and chimney outlet of the emergency generator

Business Plan Proposal

- What is the important information that the client should know?
  - Building description
  - Scope of work of building services installation,
  - What are the client's needs and objectives?
    - Any special functions of the building affecting the electrical services system operation? Any automation and control systems, etc.?
    - Any target on BEAM Plus award? How many credits can be obtained?
    - Any energy consumption target? Any sustainable features?

	Overall	SA	EU	IEQ	IA	
Platinum	75%	70%	70%	70%	3 credits	(Excellent)
Gold	65%	60%	60%	60%	2 credits	(Very Good)
Silver	55%	50%	50%	50%	1 credit	(Good)
Bronze	40%	40%	40%	40%	-	(Above Average)

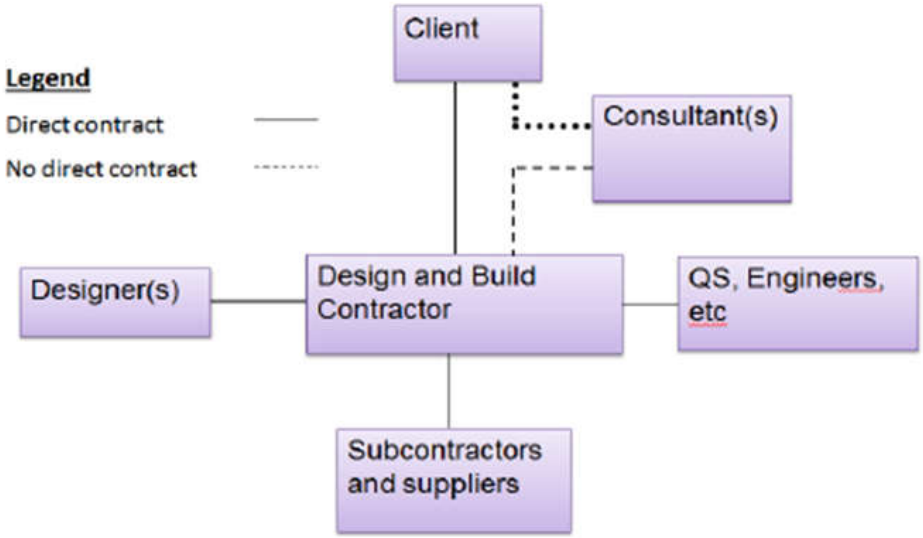
Business Plan Proposal

- What is the initial statement of requirements?

Example:

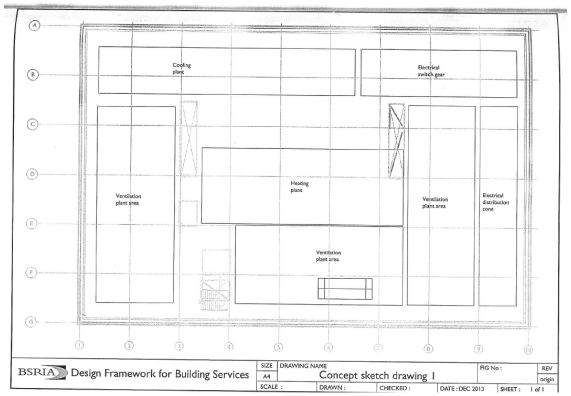
- To cope with the vision of quality education, the design of building services systems of the new academic building is aimed at providing a XXX teaching and learning environment to staff and students. XXX are important criteria in the design of building services systems.
- Procurement method and organizational structure

Example:

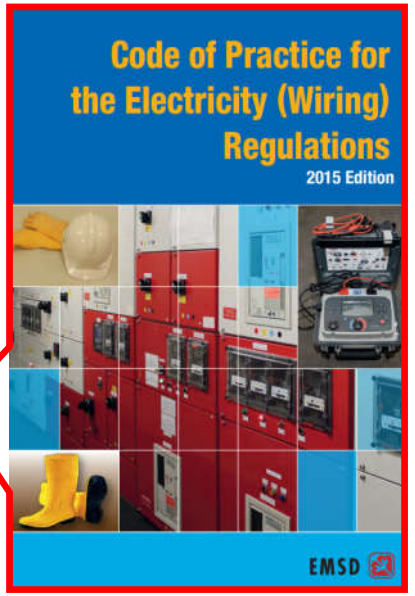


Business Plan Proposal

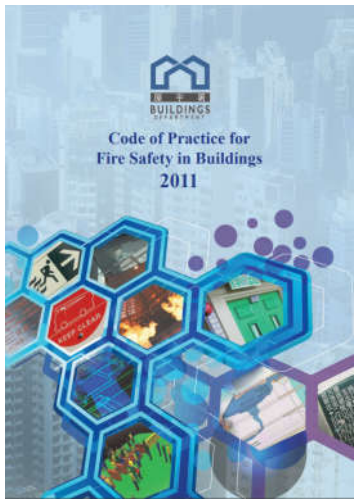
- What are the locations and dimensions of major electrical plant rooms of the building?
  - Transformer room and LV main switchroom
  - TBE room and ELV rooms
  - Generator room
  - Electrical/Meter rooms



- Think about:
  - The statutory requirements
  - How the equipment is accessed into the rooms
  - Which system will be used with justifications
  - How the routing of the cables/busducts is to distribute power to the whole buildings
  - Whether sufficient space is provided for maintenance
  - Whether your decision will provide nuisance to the occupants or environment



Occupancy Density



Section 2 – Provisions of Means of Escape

Subsection B4 – Assessment of Occupant Capacity

Clause B4.1

As a guide to assessing the requirements on means of escape, the following Table B1 should be used as the basis for calculating the occupant capacity of a building or part of a building.

Use Classification	Type of Accommodation	Occupancy Factor (usable floor area in m^2 per person) or otherwise as specified
5b	Libraries	2
	Reading rooms, study rooms	1
	Classrooms of school not covered by the Education Ordinance, lecture rooms	2 or number of seats

ASHRAE ADDENDA

ANSI/ASHRAE Addendum p to
ANSI/ASHRAE Standard 62.1-2013

Ventilation for Acceptable Indoor Air Quality

TABLE 6.2.2.1 Minimum Ventilation Rates in Breathing Zone
(This table is not valid in isolation; it must be used in conjunction with the accompanying notes.)

Occupancy Category	People Outdoor Air Rate R_p		Area Outdoor Air Rate R_a		Notes	Default Values			Air Class
						Occupant Density (see Note 4)	Combined Outdoor Air Rate (see Note 5)		
	cfm/ person	L/s· person	cfm/ft^2	L/s·m^2		#/1000 ft^2 or #/100 m^2	cfm/ person	L/s·person	
Correctional Facilities									
Cell	5	2.5	0.12	0.6		25	10	4.9	2
Dayroom	5	2.5	0.06	0.3		30	7	3.5	1
Guard stations	5	2.5	0.06	0.3		15	9	4.5	1
Booking/waiting	7.5	3.8	0.06	0.3		50	9	4.4	2
Educational Facilities									
Daycare (through age 4)	10	5	0.18	0.9		25	17	8.6	2
Daycare sickroom	10	5	0.18	0.9		25	17	8.6	3
Classrooms (ages 5–8)	10	5	0.12	0.6		25	15	7.4	1
Classrooms (age 9 plus)	10	5	0.12	0.6		35	13	6.7	1
Lecture classroom	7.5	3.8	0.06	0.3	H	65	8	4.3	1
Lecture hall (fixed seats)	7.5	3.8	0.06	0.3	H	150	8	4.0	1
Art classroom	10	5	0.18	0.9		20	19	9.5	2
Science laboratories	10	5	0.18	0.9		25	17	8.6	2
University/college laboratories	10	5	0.18	0.9		25	17	8.6	2
Wood/metal shop	10	5	0.18	0.9		20	19	9.5	2
Computer lab	10	5	0.12	0.6		25	15	7.4	1
Media center	10	5	0.12	0.6	A	25	15	7.4	1
Music/theater/dance	10	5	0.06	0.3	H	35	12	5.9	1
Multiuse assembly	7.5	3.8	0.06	0.3	H	100	8	4.1	1

Load Estimation by ADMD Method

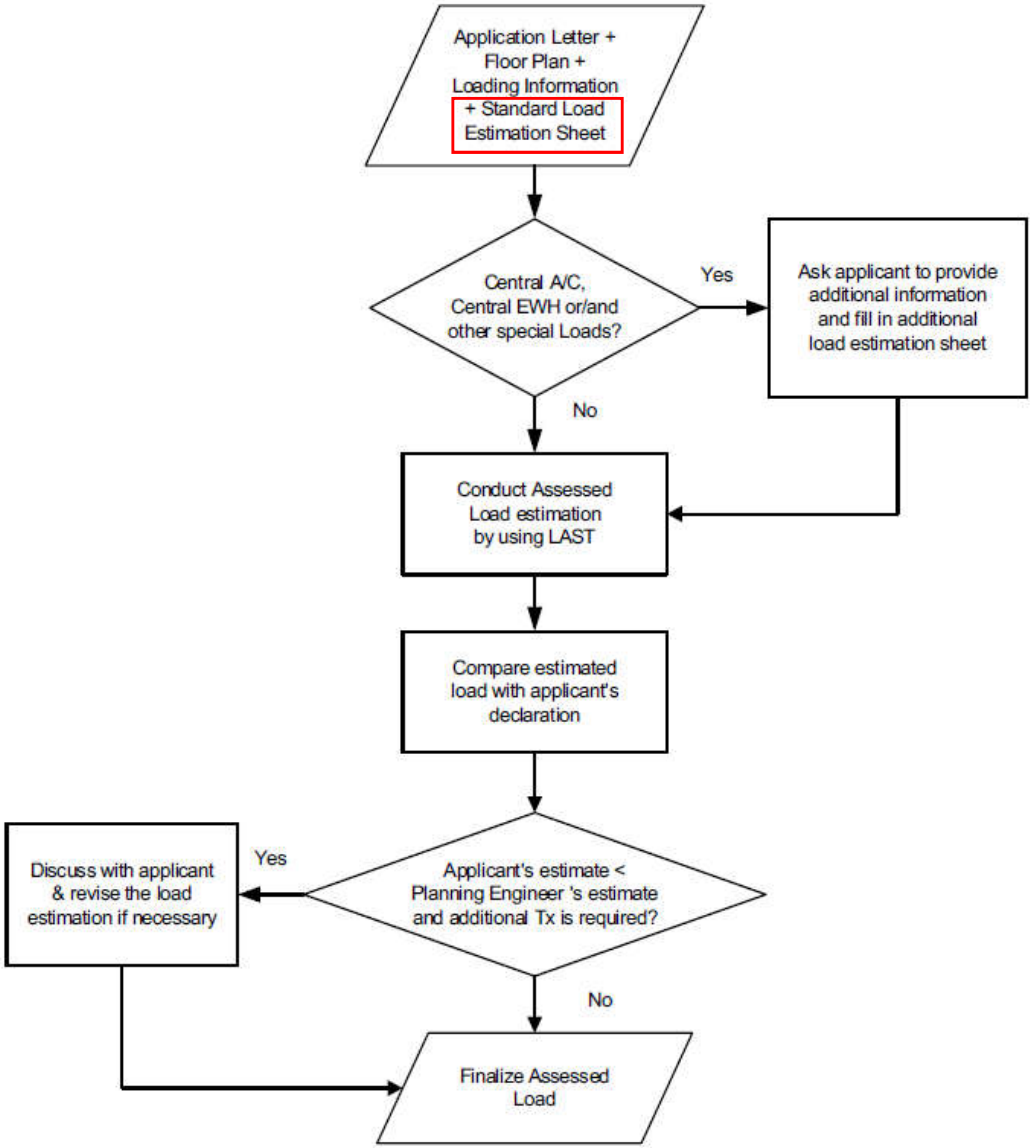
Load Assessment Procedure

Table of Changes

Version	Date	Changes to previous version
Rev. 05	September 2006	General revision. Parameters remain unchanged.
Rev. 06	September 2009	Para 3.3.5 added with ADMD for office (including air conditioning load) revised to 0.26 kVA/m^2. Para 3.6 on MDDF revised.

Load Estimation by ADMD Method

Appendix 9 - Flow Chart for Compilation of Assessed Loads



Load Estimation by ADMD Method

3.1.2 Usable Floor Area

Floor Area is the basic parameter to calculate the loads of developments. Among the existing floor area definitions, Usable Floor Area / Space (UFA), which is defined by Building (Planning) Regulations is adopted for our load assessment purpose.

Definition of Usable Floor Area / Space (UFA):

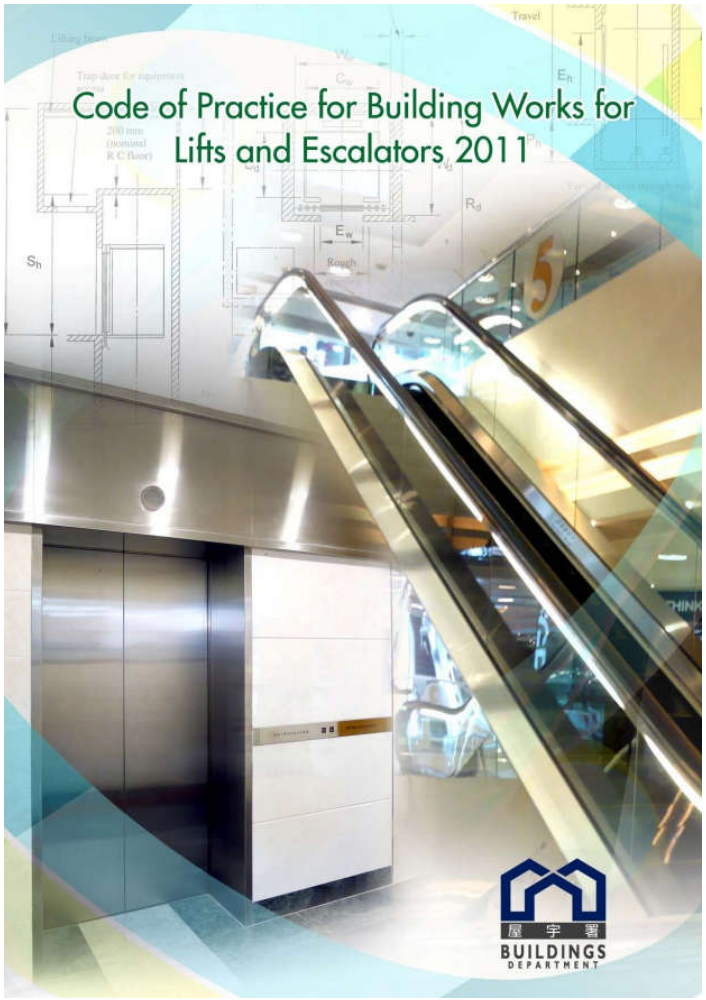
> 'Usable Floor Space' means the aggregate of the areas of the floor or floors in a storey or building excluding any staircases, public circulation space, lift landings, lavatories, water-closets, kitchens, and any space occupied by machinery for any lift, air-conditioning system or similar service provided for the building.

Check number and sizes of staircases, lifts, lavatories, and all plant rooms!

Excluded Areas related to EL Systems

Estimate required number of lifts:

Estimate required dimensions of lift well and lift machine room:



Load Estimation by ADMD Method

Appendix 4 – ADMD Figures for Municipal Developments

Classification	ADMD Figures[1] (kVA/m^2)
General Municipal Development[2]	0.25
School & College[3]	0.25
Hospital & Clinic	0.22
Car Park with Ventilation	0.03

Footnotes:

1. As ADMD figures have not included public services, central air conditioning load and central electric water heating load, individual assessment is required for such loads.

2. General Municipal Development includes Youth Centre, Home for Elderly, Community Centre, Indoor Game Hall, Urban Market Complex, Fire Station, Police Station, Ambulance Depot, etc. The ADMD figures have included non-central air conditioning load and 0.1 kVA/m^2 has to be deducted in case there is central air conditioning system in the development.

3. School & College includes Kindergarten, Primary, Secondary, and Post-Secondary Schools with air conditioning and IT provision and 0.1 kVA/m^2 has to be deducted in case there is central air conditioning system in the development.

Load Estimation by ADMD Method

Appendix 6 – Electrical Power Conversion Figures for Typical Chilling Systems

Central Chilling System	Electrical Power Conversion Figures (kW/Tonne Refrigeration)
Packaged air cooled	1.85
Indirect sea water cooled	1.65
Direct sea water cooled	1.45
Direct water cooled	1.45

(C) The unit here is kW of cooling capacity in which:
1 Tonne of Refrigeration = approx. 3.5 kW
It is a different entity from the kW of electricity in column (F)

(D) Please indicate the type of central air conditioning system such as:

- Packaged air-cooled
- Indirect (through heat exchanger) sea water cooled
- Direct sea water cooled
- Direct water cooled (cooling tower)

(E) The coefficient of performance (COP) is the estimated COP for the whole A/C installation.

$$\text{i.e.} \quad \text{COP} = \frac{\text{Cooling capacity of the A/C system (kW cooling) (refer to (C))}}{\text{Electrical power consumption of ALL components of the A/C installation (kW electricity) (refer to (F))}}$$

including: - refrigeration plant such as water chillers, and chilled water pump sets
- heat rejection equipment (condensers/cooling tower/sea water pump sets)
- air-side equipment (AHU/FCU/VAU units/fans)

(F) From the equation in (E) above:

$$\text{(F) in kW} = \frac{\text{(C) in kW}}{\text{COP}}$$

Load Estimation by ADMD Method

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- air-side equipment (AHU/FCU/VAU units/fans)

(F) From the equation in (E) above:

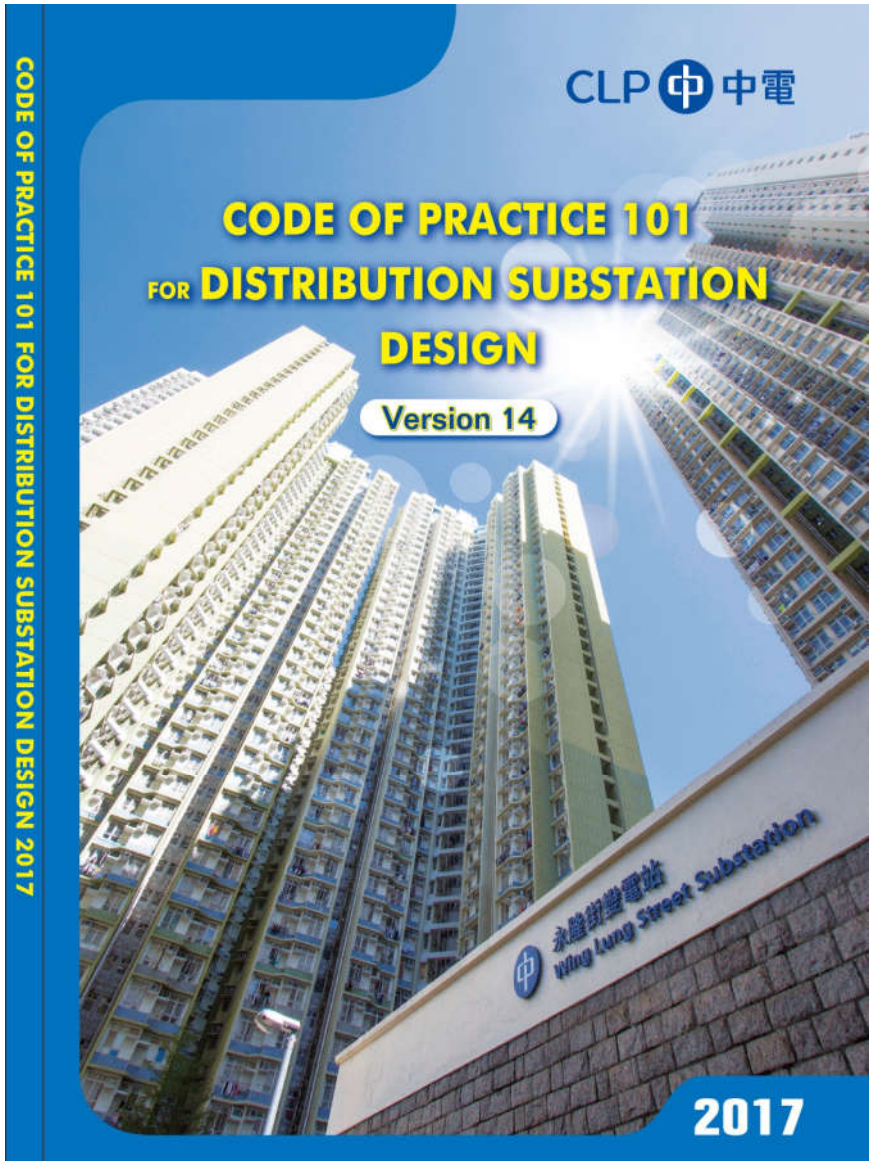
$$\text{(F) in kW} = \frac{\text{(C) in kW}}{\text{COP}}$$

Cooling Load Check Figure
(based on the AIRAH Handbook 3rd edition)

Occupancy	Cooling Load W/m2 (air conditioned area)
Apartments / Residence Night only	100
Apartments / Residence (Insulated & not facing west)	150
Apartments / Residence (un-nsulated & facing west)	200
Auditorium	280
Banks	175
Hairdresser	215
Beauty Shop (consider appliances)	260
Cafeteria	350
Classroom	95
Clinic	190
Clothing Store	165
Computer Room (allow for future expansion)	480
Conference Room	275
Department Store Basement	125
Department Store Main Floor	150
Department Store Upper Floors	125
Factory - light manufacture	275
Factory - Heavy manufacture	490
Food Stores	160
Hotel & Motel Rooms	120
Laboratory	130
Library	150
Mall	135
Medical Offices	185
Milk Bars, Fast Food (count kW of appliances)	270
Office - General (Perimeter)	170
Office - General (Interior)	100
Office - Private	180
Post Office	180
Restaurants	350
Residential - Check Figure	kW=m²/6
Shoe Store	185
Super Market	180
Theatre	280

Only use these figures for preliminary estimates or to check a full load estimate.

Space Requirements of Tx Room



Think about:

- Location of the transformer rooms?
- Dimensions of the transformer rooms (LxWxH)?
- Any adjacent water-related plant rooms?
- Location of the LV main switchroom?
- Dimensions of the LV main switchroom (LxWxH)

Space Requirements of TBE Room

Access Facilities for Telecommunications and Broadcasting Services

Introduction

The world is undergoing a technological revolution and entering the Information Age. Hong Kong is well placed to reap the benefits and maintain our competitive edge in this new era. It is the Government's policy objective to develop Hong Kong into a telecommunications, broadcasting and Internet hub in the Asia Pacific region.

2. To enable occupiers of a building to gain access to the full range of quality broadcasting, telecommunications and Internet services, the Telecommunications Authority has, under section 14 of the Telecommunications Ordinance, granted authorization to fixed telecommunications network services operators and fixed carrier licensees (hereafter referred to as the "Network Operators") to place and maintain telecommunications and broadcasting facilities and cables in the common parts of buildings in private ownership. New Network Operators may be licensed from time to time to provide new telecommunications and broadcasting services.

3. In order to accommodate the telecommunications and broadcasting facilities and cables in buildings, Regulation 28A of the Building (Planning) Regulations (B(P)R) requires the provision of access facilities for telecommunications and broadcasting services in every commercial building, industrial building, residential building (other than a building for residence of a single family) and hotel building in accordance with the design requirements specified by the Building Authority.

4. As there are a number of Network Operators who will provide telecommunications and broadcasting services, it is advisable to consolidate the requirements of access facilities for telecommunications and broadcasting from all the Network Operators during the building planning stage and appoint more than one Network Operator to install block wiring cables in new buildings. The list of Network Operators is given in the Annex to the "*Code of Practice for the Provision of Access Facilities in Buildings for the Supply of Telecommunications and Broadcasting Services*" (CoP) issued by the Office of the Telecommunications Authority (OFTA), which can be downloaded from OFTA's web site at http://www.ofta.gov.hk.

Access Facilities for Telecommunications and Broadcasting Services

5. Pursuant to B(P)R 28A, the design requirements for access facilities for telecommunications and broadcasting services to be provided in buildings are specified in paragraphs 6 to 9 below.

6. The number and size of lead-in ducts, Telecommunications and Broadcasting (TBE) Rooms and vertical riser slots shall be provided in accordance with the requirements specified in Appendix A.

CODE OF PRACTICE

FOR THE PROVISION OF

ACCESS FACILITIES IN BUILDINGS

FOR THE SUPPLY OF

TELECOMMUNICATIONS AND BROADCASTING SERVICES

About Generator Room

Guidelines on Application for Installation of Emergency Generators

1. Introduction

1.1. This guidance note is intended to spell out the environmental requirements to facilitate developers, architects, consultants and contractors in making applications for installation of emergency generators which are used to provide emergency electricity supply for the premises during main power failure.

1.2. The following outlines the requirements for submitting an application under Air Pollution Control (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations in relation to installing emergency generators as well as any additional mitigation measures that should be taken. The objective is to secure a good planning practice to minimize emissions and ensure good dispersion such that the products of combustion emitted from the emergency generators will not pose a potential pollution to the nearby sensitive receptors.

2. Mandatory Requirements for Installation

2.1. Fuel consumption rate

Emergency generator is generally driven by diesel engine(s). If the occupier of any premises intends to install the associated flue/chimneys for emergency generators consuming a total of more than 25 litres of conventional liquid fuel, he / she shall require to have prior approval from EPD for relevant installations. Application for approval shall be submitted at least 28 days before the commencement of such work. The owners and operators are legally bound to submit such applications under Air Pollution Control (Furnaces, Ovens and Chimneys) (Installation and Alteration) Regulations.

2.2. Specified Process

In case the total power generation capacity of all the emergency generators, physically and electrically connected, in the same premises exceeds 5MW, the establishment is liable to be controlled under a Specified Process licence for the operation. Please refer to Electricity Works in Schedule 1 of the Air Pollution Control Ordinance for relevant requirements.

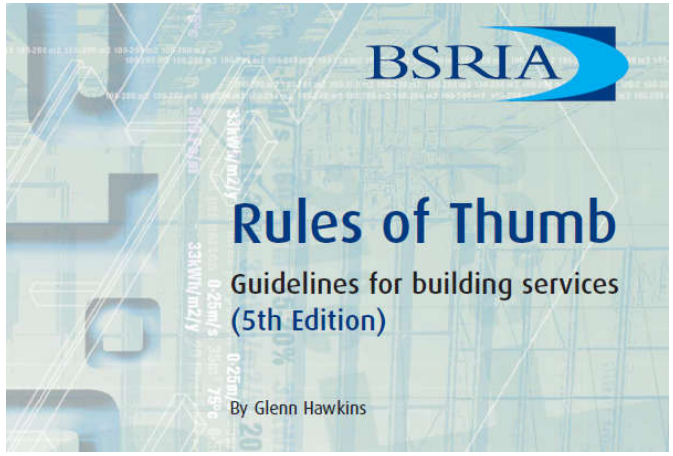
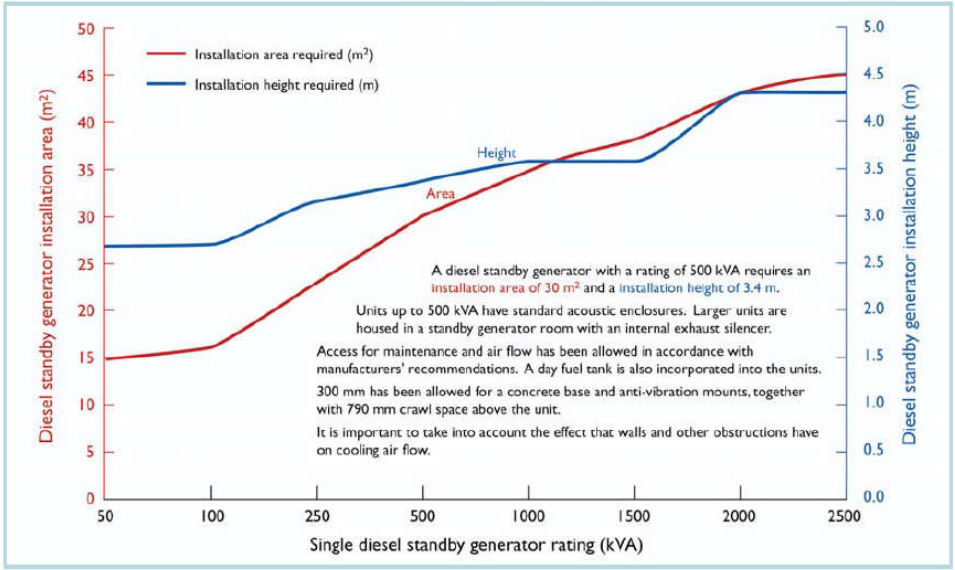


Figure 23: Diesel generators – area and height requirements

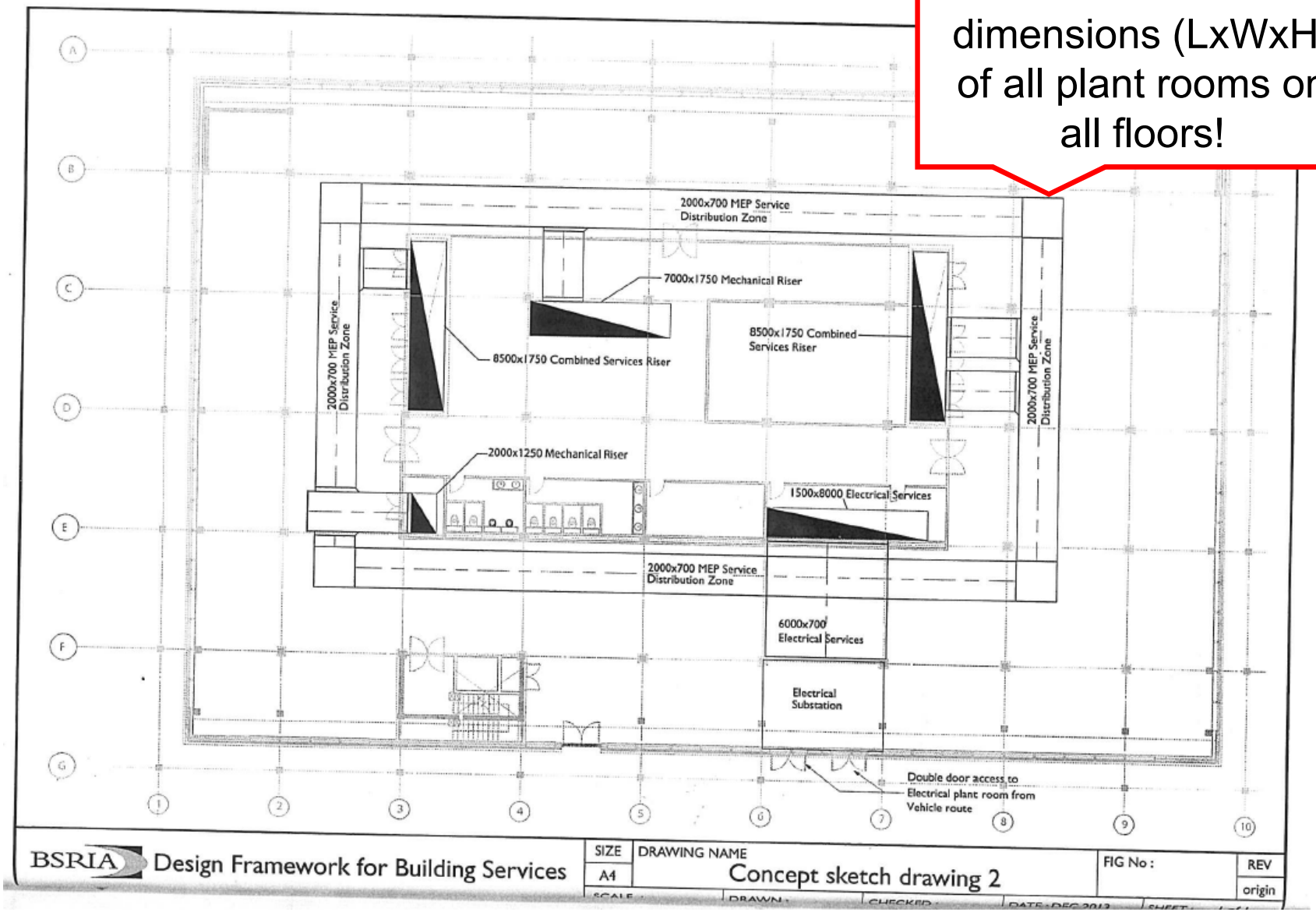


Progress/Final Report

- Show your preliminary design ideas/considerations in words:
  - Design standards (A list of regulations, codes of practice and statutory/voluntary requirements)
  - Estimated electrical loading (by ADMD)
  - Power supply system (CLP or HEC? 1500 kVA transformer?)
  - Plant room allocation (location and dimensions)
  - Power distribution system (main vertical and horizontal routings, cables or busducts?)
  - Emergency power generation system (how to provide backup power)
  - Lighting control strategy
  - Strategy to provide small power system
  - Earthing system (e.g. according to which standard)
  - Lightning protection system (compare different lightning protection systems and explain your decision)
  - Renewable energy system (what system you will consider to adopt)
  - Simple main schematic diagram of the electrical system of the whole building

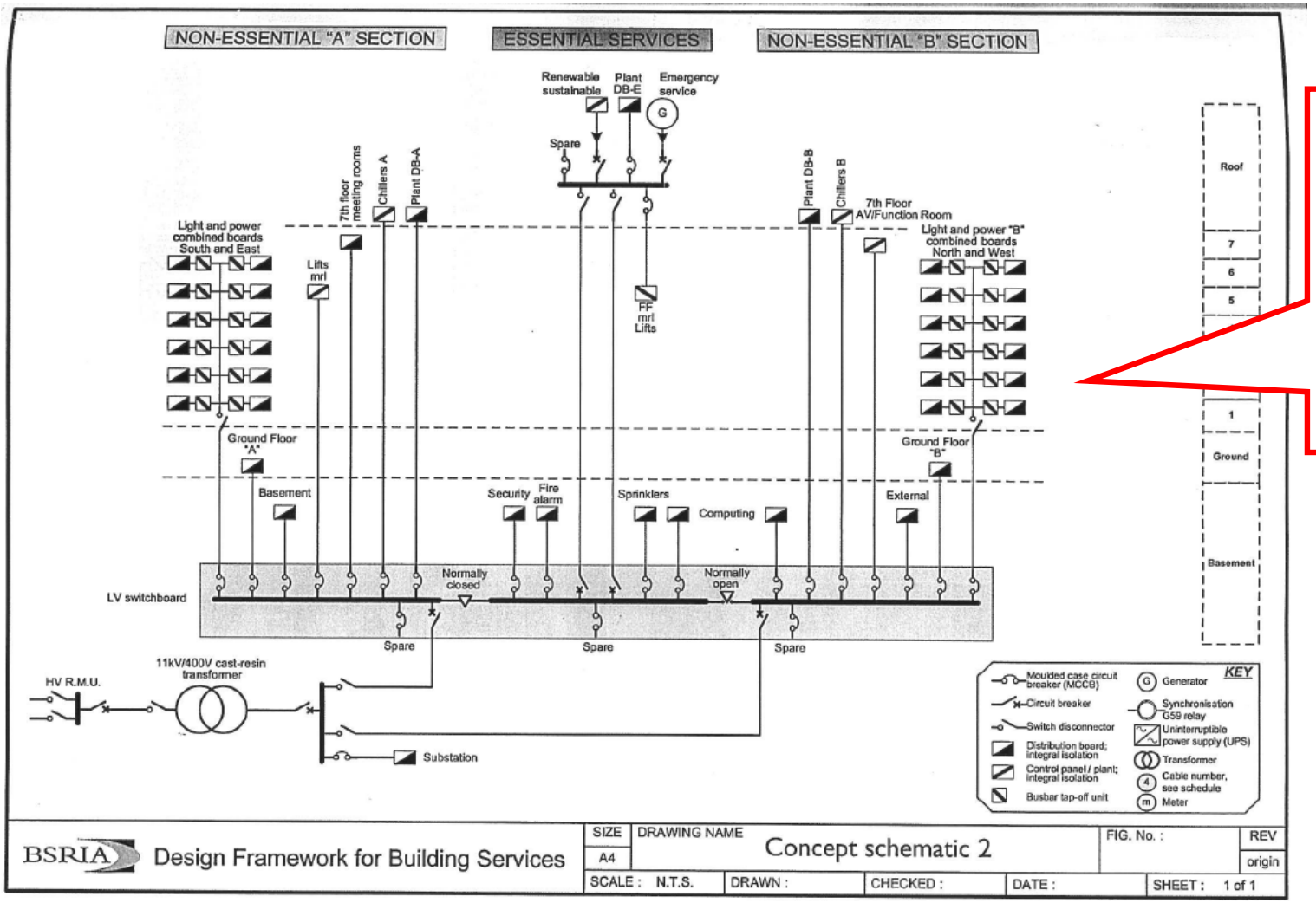
Plant Room Allocation

Show locations and dimensions (LxWxH) of all plant rooms on all floors!



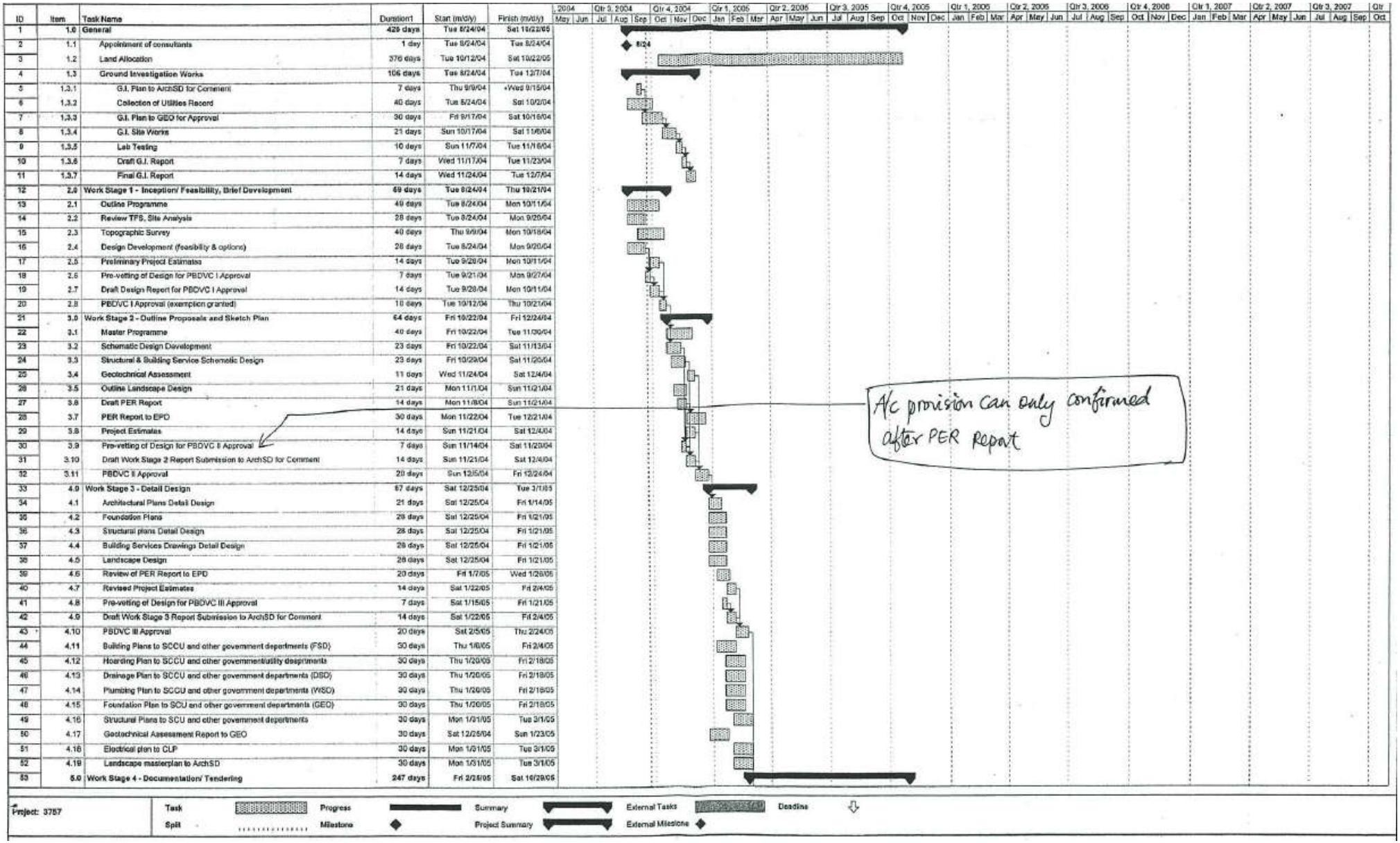
Simple Main Schematic

- Show briefly how the power is distributed, e.g. the separation of landlord (normal and essential) and tenant power supply



No cable sizing or protective device rating is needed

Schedule and Budget



ID	Item	Task Name	Duration	Start (m/d/y)	Finish (m/d/y)
1	1.0	General	425 days	Tue 8/24/04	Sat 10/22/05
2	1.1	Appointment of consultants	1 day	Tue 8/24/04	Tue 8/24/04
3	1.2	Land Allocation	376 days	Tue 10/12/04	Sat 10/22/05
4	1.3	Ground Investigation Works	106 days	Tue 8/24/04	Tue 12/7/04
5	1.3.1	G.I. Plan to ArchSD for Comment	7 days	Thu 9/9/04	Wed 9/15/04
6	1.3.2	Collection of Utilities Record	40 days	Tue 8/24/04	Sat 10/2/04
7	1.3.3	G.I. Plan to GEO for Approval	30 days	Fri 9/17/04	Sat 10/16/04
8	1.3.4	G.I. Site Works	21 days	Sun 10/17/04	Sat 11/6/04
9	1.3.5	Lab Testing	10 days	Sun 11/7/04	Tue 11/16/04
10	1.3.6	Draft G.I. Report	7 days	Wed 11/17/04	Tue 11/23/04
11	1.3.7	Final G.I. Report	14 days	Wed 11/24/04	Tue 12/7/04
12	2.0	Work Stage 1 - Inception/ Feasibility, Brief Development	59 days	Tue 8/24/04	Thu 10/21/04
13	2.1	Outline Programme	49 days	Tue 8/24/04	Mon 10/11/04
14	2.2	Review TPS, Site Analysis	28 days	Tue 8/24/04	Mon 9/20/04
15	2.3	Topographic Survey	40 days	Thu 9/9/04	Mon 10/18/04
16	2.4	Design Development (feasibility & options)	28 days	Tue 8/24/04	Mon 9/20/04
17	2.5	Preliminary Project Estimates	14 days	Tue 9/28/04	Mon 10/11/04
18	2.6	Pre-vetting of Design for PBDVC I Approval	7 days	Tue 9/21/04	Mon 9/27/04
19	2.7	Draft Design Report for PBDVC I Approval	14 days	Tue 9/28/04	Mon 10/11/04
20	2.8	PBDVC I Approval (exemption granted)	10 days	Tue 10/12/04	Thu 10/21/04
21	3.0	Work Stage 2 - Outline Proposals and Sketch Plan	64 days	Fri 10/22/04	Fri 12/24/04
22	3.1	Master Programme	40 days	Fri 10/22/04	Tue 11/30/04
23	3.2	Schematic Design Development	23 days	Fri 10/22/04	Sat 11/13/04
24	3.3	Structural & Building Service Schematic Design	23 days	Fri 10/29/04	Sat 11/20/04
25	3.4	Geotechnical Assessment	11 days	Wed 11/24/04	Sat 12/4/04
26	3.5	Outline Landscape Design	21 days	Mon 11/1/04	Sun 11/21/04
27	3.6	Draft PER Report	14 days	Mon 11/8/04	Sun 11/21/04
28	3.7	PER Report to EPD	30 days	Mon 11/22/04	Tue 12/21/04
29	3.8	Project Estimates	14 days	Sun 11/21/04	Sat 12/4/04
30	3.9	Pre-vetting of Design for PBDVC II Approval	7 days	Sun 11/14/04	Sat 11/20/04
31	3.10	Draft Work Stage 2 Report Submission to ArchSD for Comment	14 days	Sun 11/21/04	Sat 12/4/04
32	3.11	PBDVC II Approval	20 days	Sun 12/5/04	Fri 12/24/04
33	4.0	Work Stage 3 - Detail Design	67 days	Sat 12/25/04	Tue 3/1/05
34	4.1	Architectural Plans Detail Design	21 days	Sat 12/25/04	Fri 1/14/05
35	4.2	Foundation Plans	28 days	Sat 12/25/04	Fri 1/21/05
36	4.3	Structural plans Detail Design	28 days	Sat 12/25/04	Fri 1/21/05
37	4.4	Building Services Drawings Detail Design	28 days	Sat 12/25/04	Fri 1/21/05
38	4.5	Landscape Design	28 days	Sat 12/25/04	Fri 1/21/05
39	4.6	Review of PER Report to EPD	20 days	Fri 1/7/05	Wed 1/26/05
40	4.7	Revised Project Estimates	14 days	Sat 1/22/05	Fri 2/4/05
41	4.8	Pre-vetting of Design for PBDVC III Approval	7 days	Sat 1/15/05	Fri 1/21/05
42	4.9	Draft Work Stage 3 Report Submission to ArchSD for Comment	14 days	Sat 1/22/05	Fri 2/4/05
43	4.10	PBDVC III Approval	20 days	Sat 2/5/05	Thu 2/24/05
44	4.11	Building Plans to SCCU and other government departments (FSD)	30 days	Thu 1/6/05	Fri 2/4/05
45	4.12	Hoarding Plan to SCCU and other government/utility departments	30 days	Thu 1/20/05	Fri 2/18/05
46	4.13	Drainage Plan to SCCU and other government departments (DSD)	30 days	Thu 1/20/05	Fri 2/18/05
47	4.14	Plumbing Plan to SCCU and other government departments (WSD)	30 days	Thu 1/20/05	Fri 2/18/05
48	4.15	Foundation Plan to SCU and other government departments (GEO)	30 days	Thu 1/20/05	Fri 2/18/05
49	4.16	Structural Plans to SCU and other government departments	30 days	Mon 1/31/05	Tue 3/1/05
50	4.17	Geotechnical Assessment Report to GEO	30 days	Sat 12/25/04	Sun 1/23/05
51	4.18	Electrical plan to CLP	30 days	Mon 1/31/05	Tue 3/1/05
52	4.19	Landscape masterplan to ArchSD	30 days	Mon 1/31/05	Tue 3/1/05
53	5.0	Work Stage 4 - Documentation/ Tendering	247 days	Fri 2/25/05	Sat 10/29/05

A/c provision can only confirmed after PER Report

Project: 3757

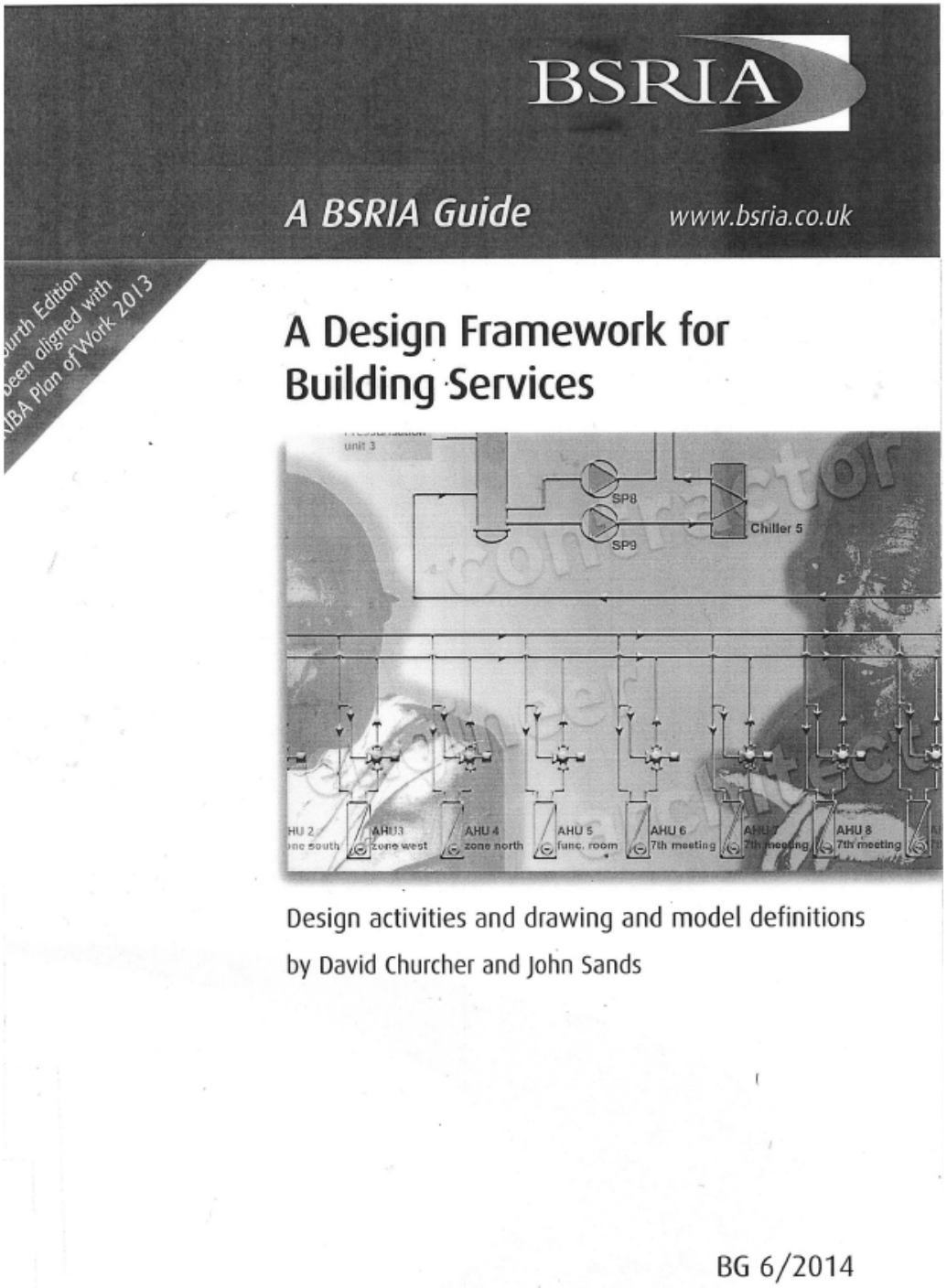
Task · Split · Progress · Milestone · Summary · Project Summary · External Tasks · External Milestone · Deadline

M&E COSTS FOR HONG KONG

BUILDING TYPE	HK$/m² CFA					
	MECHANICAL SERVICES	ELECTRICAL SERVICES	FIRE SERVICES	LIFTS/ ESCALATORS	HYDRAULIC SERVICES	TOTAL SERVICES
DOMESTIC						
Apartments, high rise, public authority standard	- -	600 - 700	150 - 200	300 - 350	900 - 1,100	1,950 - 2,350
Apartments, high rise, average standard	850 - 1,100	1,100 - 1,400	200 - 450	450 - 750	1,500 - 2,200	4,100 - 5,900
Apartments, high rise, high end	1,400 - 1,750	1,400 - 1,750	200 - 450	550 - 850	1,800 - 2,400	5,350 - 7,200
Terraced houses, average standard	1,100 - 1,500	1,150 - 1,450	100 - 200	- -	1,400 - 1,800	3,750 - 4,950
Detached houses, high end	1,100 - 1,900	1,400 - 2,050	100 - 200	- -	1,400 - 1,800	4,000 - 5,950
OFFICE / COMMERCIAL						
Medium/high rise offices, average standard	2,000 - 2,400	1,750 - 2,200	550 - 700	700 - 950	700 - 900	5,700 - 7,150
High rise offices, prestige quality	2,200 - 2,800	2,100 - 2,500	550 - 700	850 - 1,200	700 - 900	6,400 - 8,100
Out-of-town shopping centre, average standard	2,300 - 2,500	1,900 - 2,100	550 - 700	850 - 950	700 - 900	6,300 - 7,150
Retail malls, high end	2,300 - 2,850	2,100 - 2,500	550 - 700	850 - 1,000	700 - 900	6,500 - 7,950

HOTELS						
Budget hotels - 3-star, mid market	2,200 - 2,500	1,900 - 2,200	600 - 850	550 - 750	2,000 - 2,500	7,250 - 8,800
Business hotels - 4/5-star	2,300 - 2,750	2,200 - 2,600	600 - 850	550 - 850	2,300 - 3,000	7,950 - 10,050
Luxury hotels - 5-star	2,300 - 2,750	2,200 - 2,600	600 - 850	550 - 850	2,300 - 3,000	7,950 - 10,050
INDUSTRIAL						
Owner operated factories, low rise, light weight industry	200 - 300	650 - 900	400 - 500	550 - 750	500 - 700	2,300 - 3,150
OTHERS						
Underground/basement car parks (<3 levels)	900 - 1,100	650 - 1,050	350 - 450	350 - 450	400 - 700	2,650 - 3,750
Multi storey car parks, above ground (<4 levels)	350 - 800	550 - 850	350 - 450	350 - 450	400 - 700	2,000 - 3,250
Schools (primary and secondary)	750 - 1,100	1,050 - 1,250	350 - 500	200 - 350	550 - 700	2,900 - 3,900
Students' residences	850 - 1,100	1,800 - 2,100	600 - 850	200 - 350	1,400 - 1,800	4,850 - 6,200
Sports clubs, multi purpose sports/leisure centres (dry sports) with a/c and including FF&E	2,700 - 3,200	2,000 - 2,700	600 - 850	350 - 450	650 - 800	6,300 - 8,000
General hospitals - public sector	3,600 - 4,200	2,600 - 3,150	700 - 950	400 - 600	1,600 - 2,200	8,900 - 11,100

The above costs are at **4th Quarter 2017** levels.



Please refer to this book for more information about conceptual design!