

Electrical Services Systems – Electricity Supply, Load Estimation and Power Distribution



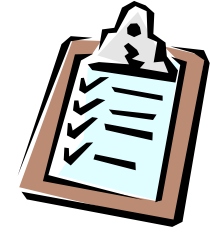
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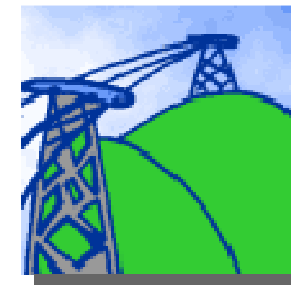
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Contents



- Electricity Supply
- Electricity Tariffs
- Load Estimation
- Plant Rooms
- Electrical Distribution

Electricity Supply



- Power companies in Hong Kong
 - CLP Power (CLP) 中華電力有限公司
 - <http://www.clpgroup.com/>
 - HK Electric Investments Limited (HEC) 港燈電力投資有限公司
 - <http://www.hkelectric.com/>
 - Both are investor-owned, publicly listed
 - Government monitors through the “Scheme of Control Agreements” (SCA) 管制計劃協議

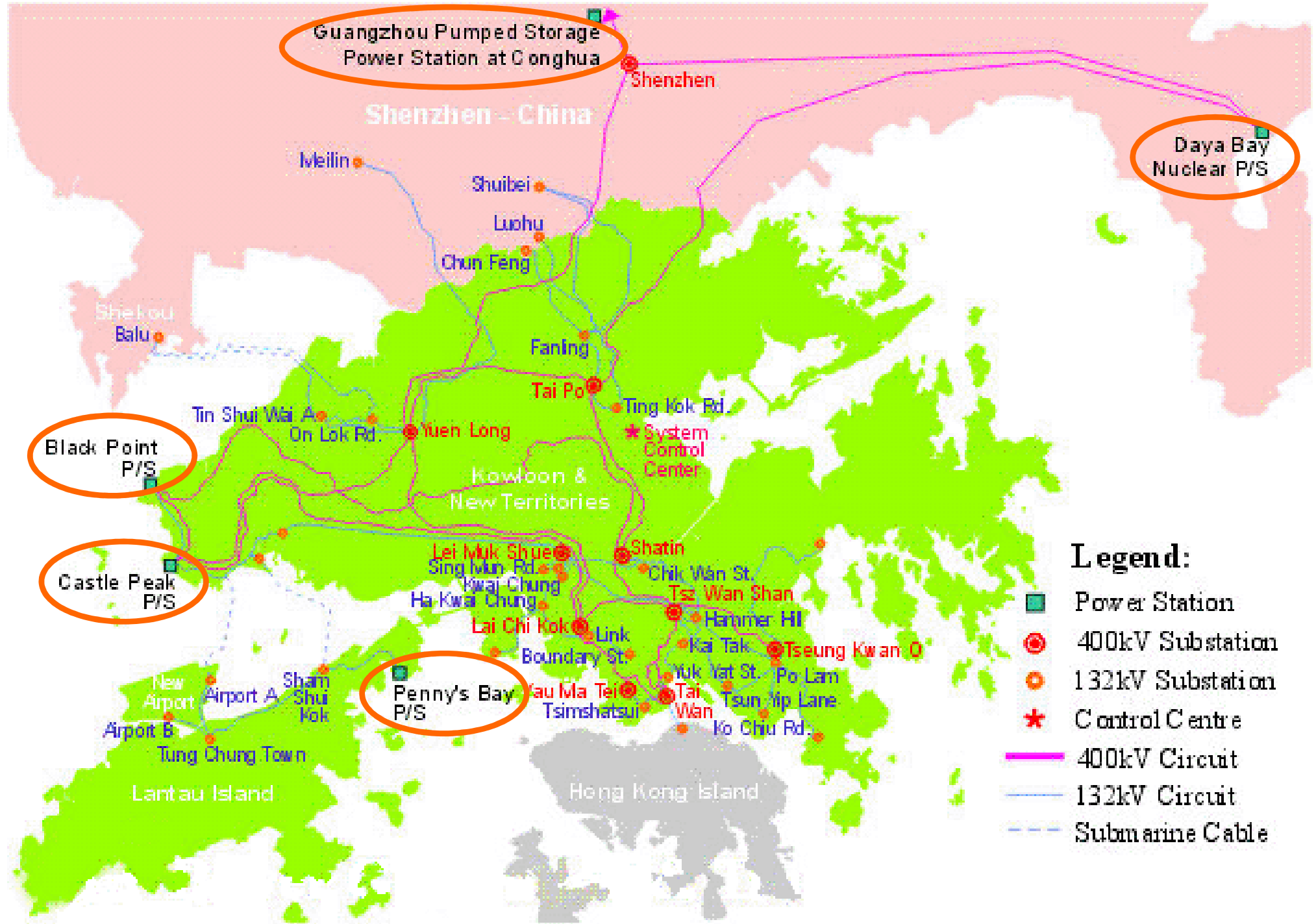
(See also: Hong Kong: the Facts: Water, Power and Gas Supplies

http://www.gov.hk/en/about/abouthk/factsheets/docs/wp%26g_supplies.pdf)

Demarcation of electricity supply systems between CLP and HEC



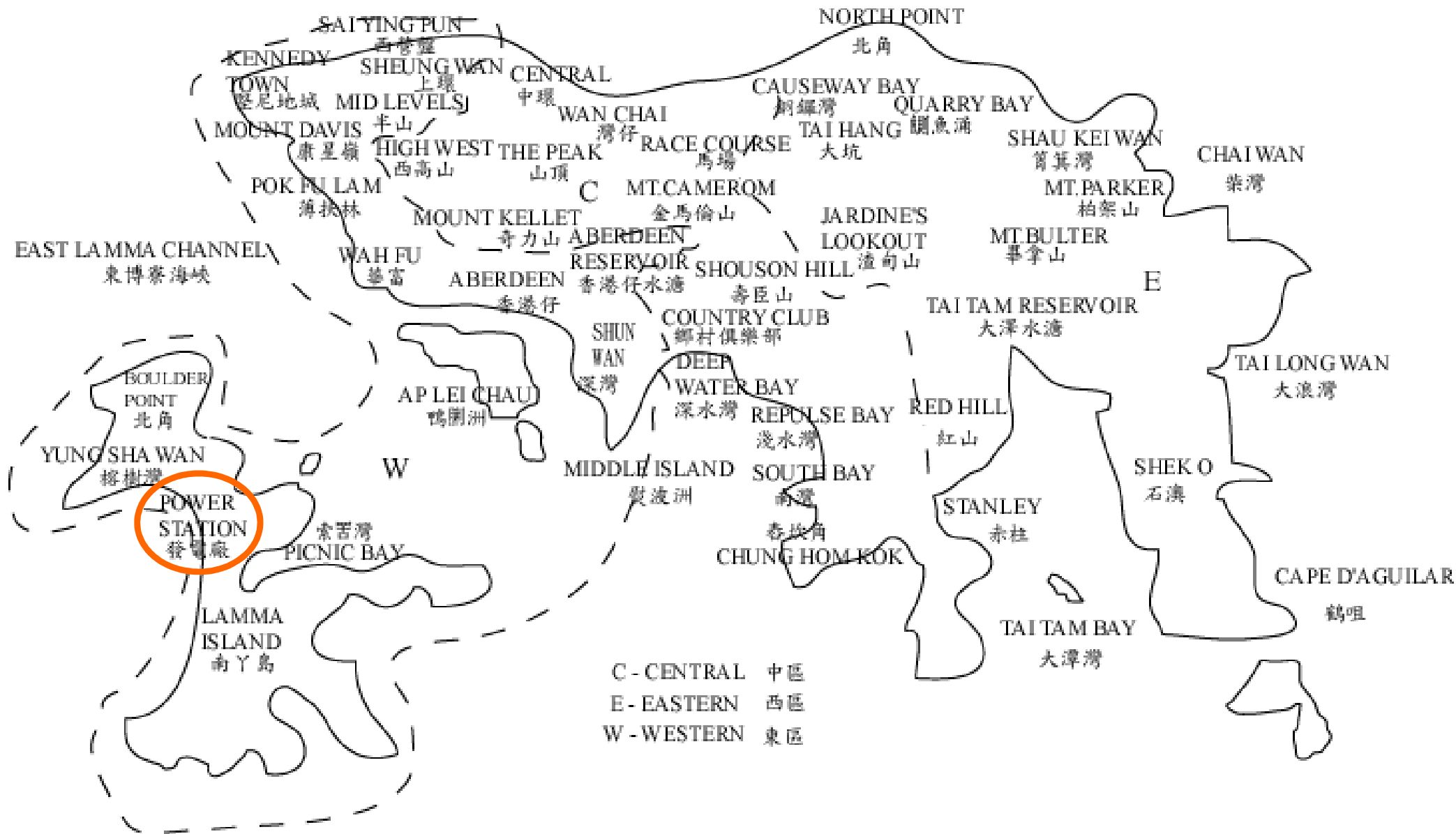
CLP Power Generation & Transmission Network



- Legend:**
- Power Station
 - ⊙ 400kV Substation
 - 132kV Substation
 - ★ Control Centre
 - 400kV Circuit
 - 132kV Circuit
 - - - Submarine Cable

(Source: <http://www.chinalightandpower.com.hk/>)

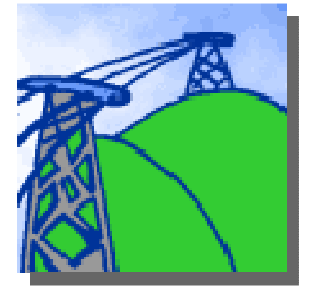
Areas served by HEC



Q: What is the main difference of customer characteristics of CLP and HEC?

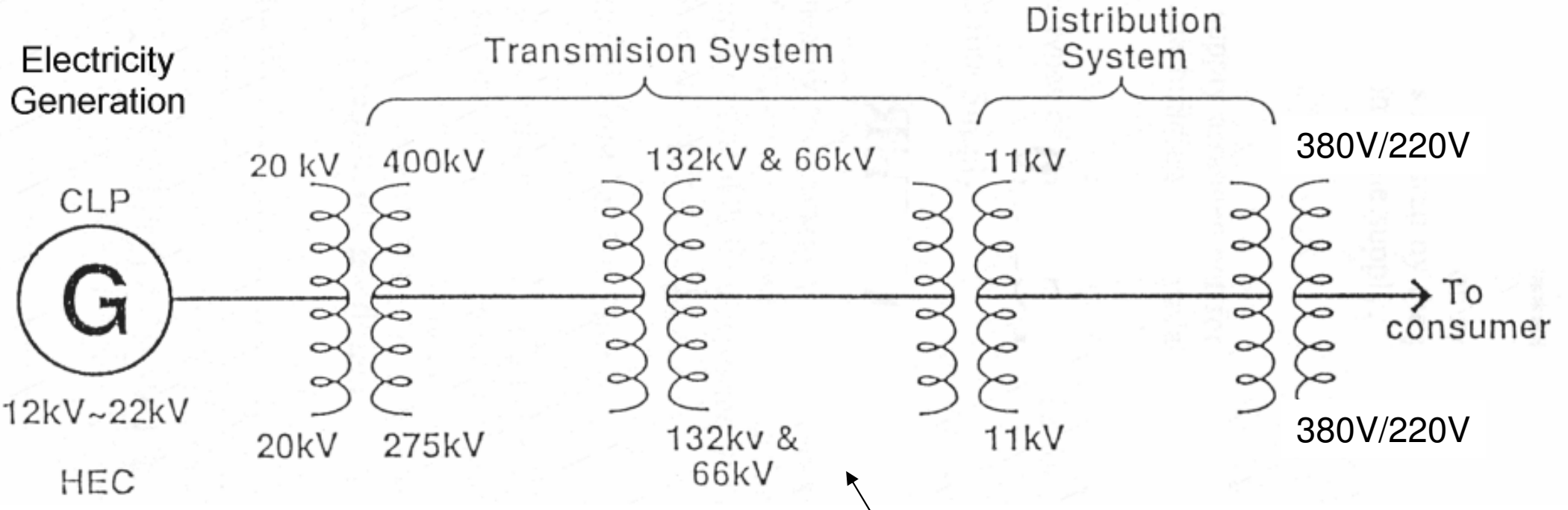
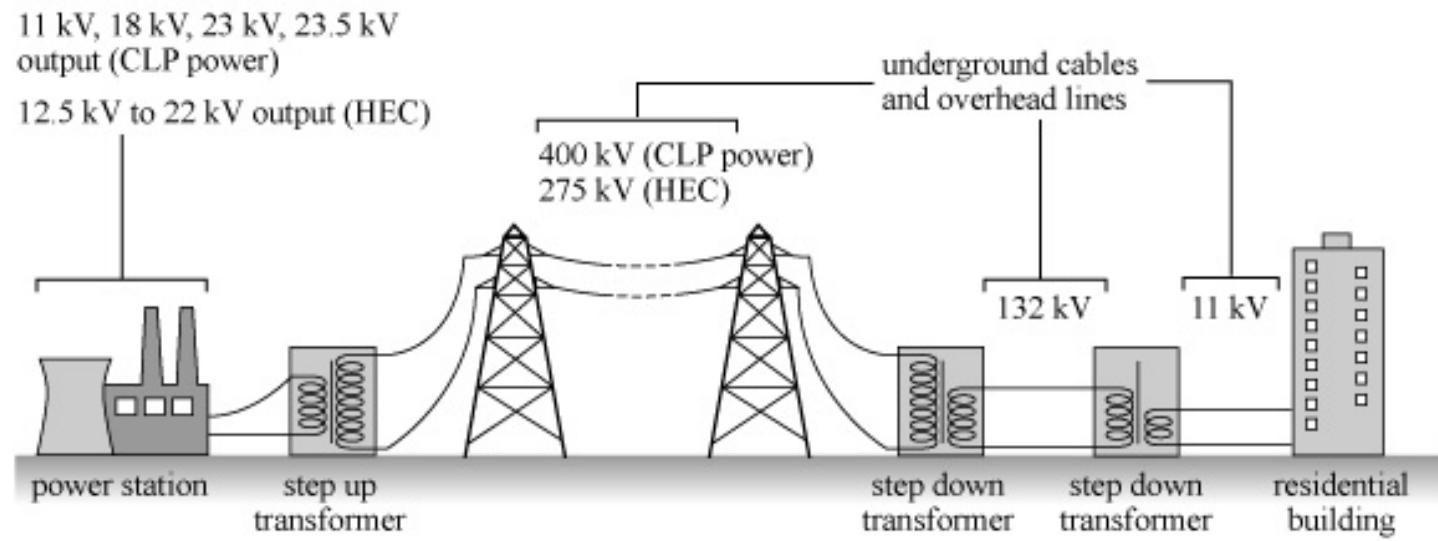
(Source: <http://www.hec.com.hk/>)

Electricity Supply



- Electricity supply process
 - Fuels – imported from overseas
 - Generation – power generation at power plants
 - Transmission – through high voltage lines
 - Distribution – consumer supply (lower voltage)
- CLP's transmission system is also connected to Guangdong (export and import of electricity)
 - Export to some Shenzhen industrial areas
 - Import from Nuclear Power Station at Daya Bay and pumped Storage Power Station at Conghua

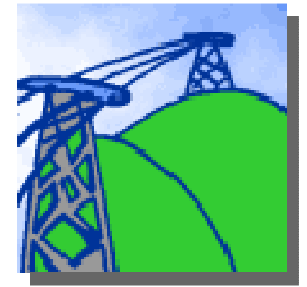
- CLP's power stations:**
- Black Point (2,500 MW)
 - Castle Peak (4,108 MW)
 - Penny's Bay (300 MW)



- HEC's power station:**
- Lamma Island (3,757 MW)

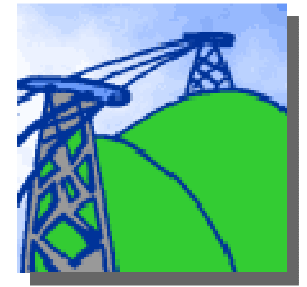
Q: Do you know why the transmission system is at higher voltages?

Electricity Supply



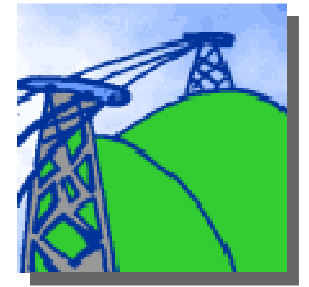
- Supply voltage and frequency
 - Alternating current (A.C.) system at 50 Hz
 - Single phase: 220 volts
 - Three phase:
 - Low voltage (LV):- 220/380 volts (3 phase 4 wire)
 - High voltage (HV):- 11 kV, 22kV, 132 kV
 - Limits of fluctuation
 - Voltage:
 - 220 volts and 220/380 volts: plus or minus 6%
 - 11 kV, 22kV and 132 kV: plus 10% or minus 2.5%
 - Frequency: 50 Hz – plus or minus 2%

Electricity Supply



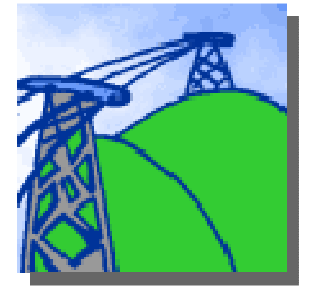
- Three types of incoming supply
 - Low voltage cable supply
 - When the demand is low (< 240 kVA or < 400 A, 3-phase) & nearby network has adequate capacity
 - Normally, a 4-core aluminum LV cable of 400 A
 - 11 kV high voltage cable & LV supply
 - 11 kV/380 V transformer(s) & HV panels are needed
 - 11 kV incoming supply
 - When load is extremely high and/or security of supply is desirable; require HV switch room

Electricity Supply



- Active power (useful or real power)
 - Time average of instantaneous power when the average is taken over a complete cycle of an A/C waveform, expressed in Watt (W)
 - For single phase, $P = V I \cos \phi$
 - For balanced three-phase, $P = \sqrt{3} V_{\text{ph-ph}} I \cos \phi$
- Apparent power
 - For single phase, $AP = V I$
 - For three phase, $AP = \sqrt{3} V_{\text{ph-ph}} I$

Electricity Supply



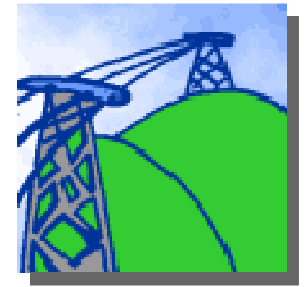
- Power factor

- The ratio of the apparent power in a circuit (V.A) to the useful power (W) if the voltage and current are sinusoidal
- Power factor = kW/ kV.A

- Connected load

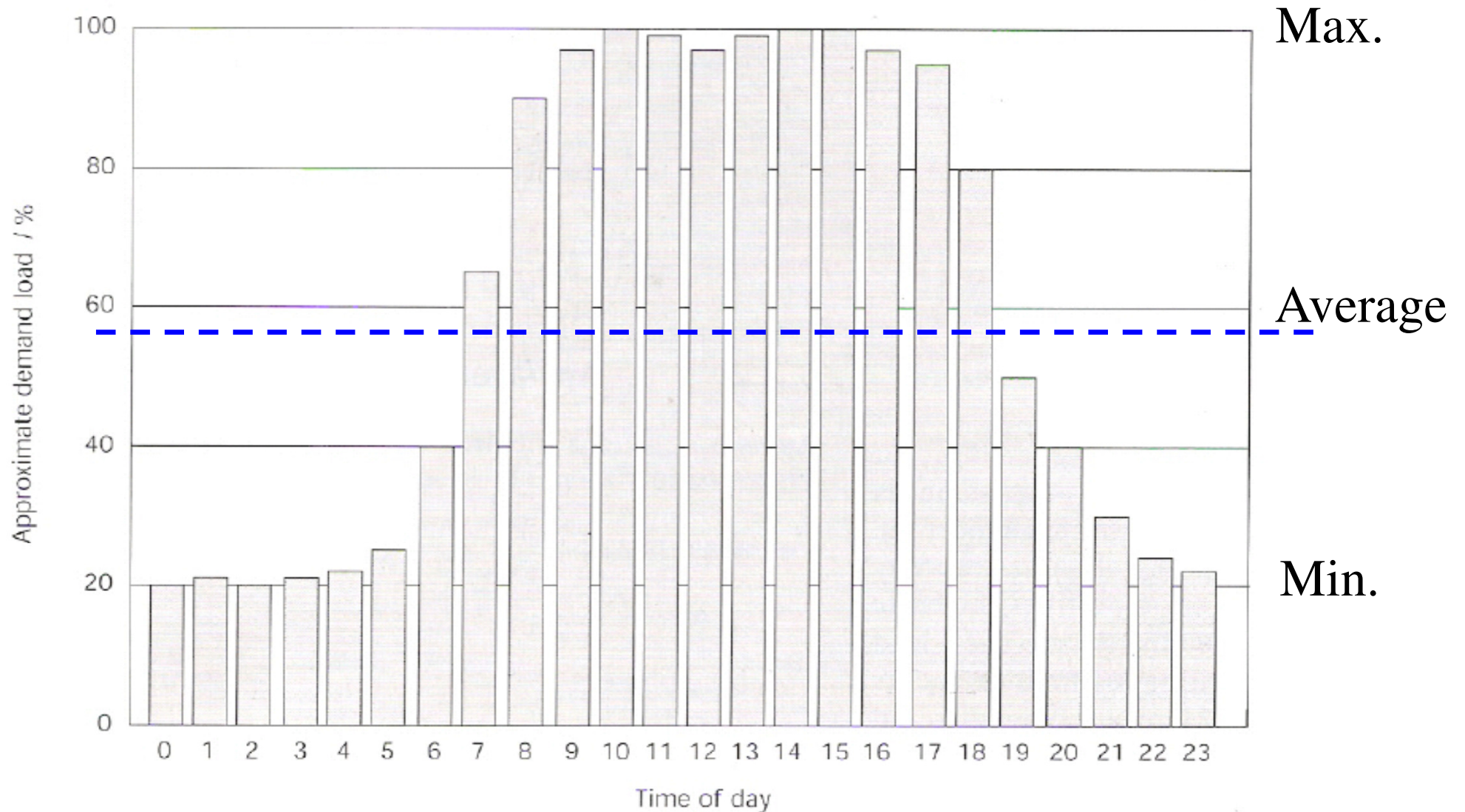
- Sum of all the loads connected to the electrical system, usually expressed in watts

Electricity Tariffs



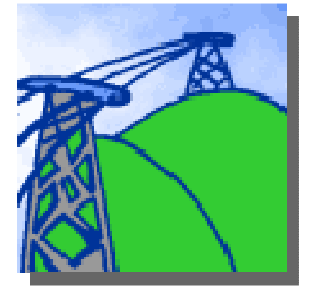
- Electricity tariffs = costing systems that a power company follows to bill the consumers
- Basic terms
 - Maximum demand (in kVA or kW)
 - Max. load requirements of the system attained over a specified interval (e.g. 15 min, 30 min., 60 min.)
 - Average demand (in kW)
 - Power consumed (kWh) during a period (day, month, year) and then averaged by the duration

Typical load profile for an office building



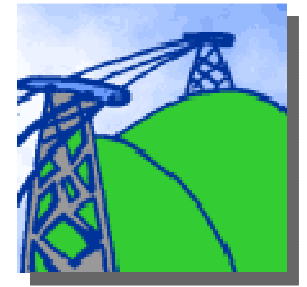
Q: Do you know how the load profiles affect the operation of power companies?

Electricity Tariffs



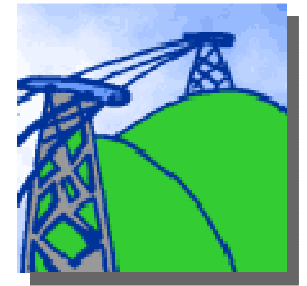
- Basic terms (cont'd)
 - Load factor = ratio of average demand to the max. demand during a period
 - **Example:** A household has a max. demand of 2 kW on a typical day. During the 24-hour period, the energy consumed is 12 kWh, calculate the load factor.
 - Average demand = $12 \text{ kWh} / 24 \text{ hour} = 0.5 \text{ kW}$
 - Therefore, load factor = $0.5 / 2 = \underline{\mathbf{0.25}}$
 - Typical load factors: Office = 0.35; Hospital = 0.7; Domestic = 0.3; Airport = 0.7; Playground = 0.25

Electricity Tariffs



- Basic terms (cont'd)
 - Diversity/Demand factor
 - Ratio of the max. demand of the combined loads of the whole system to the sum of the individual max. demands of various subdivisions of the system (total connected load)
 - Off-peak and on-peak periods
 - Off-peak: 09:00pm to 09:00am + all day Sundays & public holidays
 - On-peak: all other hours

Electricity Tariffs



- Elements of electricity tariffs
 - Demand and energy charges
 - Maximum demand charge (\$/kVA)
 - Apply to large commercial & industrial customers
 - Energy consumption charge (cents/kWh)
 - Fuel clause/cost adjustment
 - Actual cost of fuel less or more than \$700 per 44 gigajoules shall be credited or debited
 - Other charges or rebates
 - Such as energy saving rebate, business relief rebate

CHAN TAI MAN
FLAT 2 5/F BLOCK A
HONG KAM COURT
100 SASSOON ROAD POK FU LAM

2 Service Address ROOM 801
LOK YEE TERRACE
128 BONHAM ROAD

Account Number

0123456789

Date of Bill

30/06/2015

Domestic Tariff

3 From 01/06/2015 to 30/06/2015 for 30 days of consumption

Scheduled Next Meter
Reading Date 31/07/2015

Meter No.	Present Reading	Previous Reading	Units
3033845	19735	19102	633

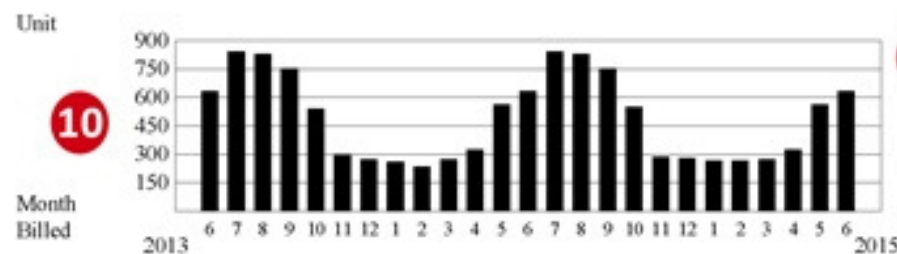
Basic Charge	\$530.94
Fuel Clause Adjustment 32.3 ¢/unit	204.46
Current Month Charge	735.40
Previous Balance	0.94
Balance Carried Forward	-0.34

Last payment of \$629.00 on 15/06/2015. Thank you.
Deposit Amount \$1000.00

Please Pay
This Amount:

9 \$736.00

PPS Merchant Code: 03



11 CO2 emission
per unit of
electricity
consumed

0.79 kg

Per capita
consumption for
HK Electric
domestic customers

170 units / month

12

Do you
know how
to read the
electricity
bill?

1 EASY COMPANY LTD.
3/F
HOEASY CENTRE
215 FUK WA STREET
SHAMSHUIPO KOWLOON

2 註冊客戶及供電地址
Registered Customer & Supply Address
EASY COMPANY LTD.
3/F
HOEASY CENTRE
215 FUK WA STREET
SHAMSHUIPO KOWLOON

5

3 編賬號碼 Account Number
18888-88888-8

Bill Type & Merchant Code No.: 02

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Bulk Tariff

Bill issued on: (DD-MM-YY)
13-10-14

From 14-09-14 to 13-10-14
For 30 days of usage

4 Deposit: **\$180,000.00**

6 電力及需求量費用
Energy & Demand Charges
\$70,189.98

7 燃料調整費
Fuel Cost Adjustment
\$18,698.40

8 其他
Others
-\$0.38

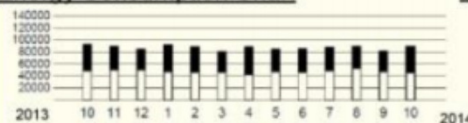
9 Total Amount
\$88,888.00
Due Date
28-10-14

10 Thank you for your payment
\$82,440.00 on
16-09-14

<u>Energy Charge:</u>				
On-Peak	@	70.0¢	43,250 units	\$30,275.00
Off-Peak	@	62.3¢	40,225 units	25,060.18
<u>Demand Charge:</u>				
On-Peak	@	\$68.4	216 kVA	14,774.40
Off-Peak	@	\$26.8	3 kVA	80.40
			Sub-total	\$70,189.98
<u>Fuel Cost Adjustment:</u>				
	@	22.4¢	83,475 units	\$18,698.40
<u>Others:</u>				
Odd Cents Brought Forward				0.08
Odd Cents Carried Forward				-0.46
Total Amount				\$88,888.00

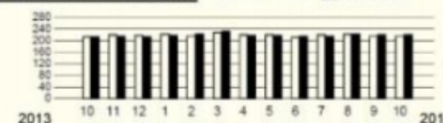
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Energy Consumption Chart



12

Max. Demand Chart □ On-Peak ■ Off-Peak

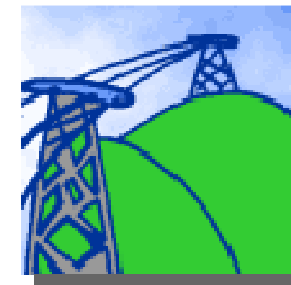


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GREEN PLUS
綠倍動力

Do you know how to read the electricity bill?

Electricity Tariffs



- Types of electricity tariffs (HEC):
 - Domestic *
 - Commercial, industrial and miscellaneous
 - Maximum demand

* Concessionary tariff for the elderly/disabled/single-parent families/unemployed (60% discount for the first 200 units of electricity consumed in a month plus the exemption of the payment of deposit and minimum charge)

HEC Domestic Tariff

Consumption (In Blocks) (1 unit = 1 kWh)	Basic Charge (cents/unit)	FCA (cents/unit)	Net Rate (cents/unit)
For each of the first 150 units	61.0	32.3	93.3
For each of the next			
150 units (151 - 300)	74.9	32.3	107.2
200 units (301 - 500)	88.8	32.3	121.1
200 units (501 - 700)	112.4	32.3	144.7
300 units (701 - 1,000)	126.3	32.3	158.6
500 units (1,001 - 1,500)	140.2	32.3	172.5
From 1,501 units and above	154.1	32.3	186.4

* Super Saver Discount – Customers with consumption not more than 100 units in a month are entitled to receive 5% discount. The Minimum Charge will be \$17.7.

Effective: 1 January 2015

FCA = Fuel Clause Adjustment

HEC Commercial, Industrial & Miscellaneous Tariff (Block Rate Tariff)

Consumption (In Blocks) (1 unit = 1 kWh)	Basic Charge (cents/unit)	FCA (cents/unit)	Net Rate (cents/unit)
For each of the first 500 units	99.3	32.3	131.6
For each of the next			
1,000 units (501 – 1,500)	103.3	32.3	135.6
18,500 units (1,501 – 20,000)	114.4	32.3	146.7
From 20,001 units and above	117.1	32.3	149.4

* The Minimum Charge will be \$39.4.

Effective: 1 January 2015

FCA = Fuel Clause Adjustment

HEC Maximum Demand Tariff (Commercial & Industrial)

<u>Demand Charge</u> (\$/kVA in the month):	Low Voltage	High Voltage
For each of the first 400kVA of maximum demand in the month	48.3	47.3
For each of the next additional kVA of maximum demand in the month	47.3	46.3

<u>Energy Charge</u> (Monthly consumption) (1 unit = 1 kWh)	Basic Charge (cents/unit)	FCA (cents/unit)	Net Rate (cents/unit)
Low Voltage: first 200 units per month per kVA of max. demand*	94.7	32.3	127.0
Low Voltage: each additional unit	90.1	32.3	122.4
High Voltage: first 200 units per month per kVA of max. demand*	94.1	32.3	126.4
High Voltage: each additional unit	89.5	32.3	121.8

* Subject to a minimum of 100 kVA.

Effective: 1 January 2015

FCA = Fuel Clause Adjustment

Example Calculation: HEC Maximum Demand Tariff

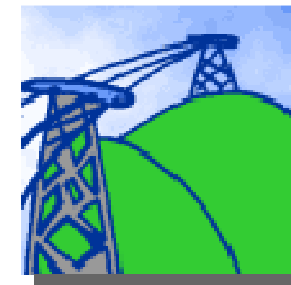
A commercial building with a low voltage power supply from HEC has these demand/consumption in a month. Calculate the electricity charge.

- Maximum demand = 800 kVA
- Consumption = 200,000 kWh

Demand charge	$400 \text{ kVA} \times \$48.3$ $400 \text{ kVA} \times \$47.3$	\$38,240
Basic charge	$(200 \text{ units} \times 800 \text{ kVA/unit}) \times \0.947 $40,000 \text{ kWh} \times \0.901	\$187,560
Fuel adjustment	$32.3 \text{ cents/kWh} \times 200,000 \text{ kWh}$	\$64,600
Total amount =		\$290,400

If the maximum demand is reduced to 600 kVA, what will be the total amount of electricity charge? (Ans.: \$279,100)

Electricity Tariffs



- Types of electricity tariffs (CLP):
 - Residential tariff * (on bimonthly meter-readings)
 - Non-residential tariff (monthly meter-readings)
 - Bulk tariff (consumption > 20,000 kWh)
 - Large power tariff (demand > 3,000 kVA)
 - Ice-storage air-conditioning tariff (charges similar to bulk tariff)

* Concessionary tariff for the elderly (half-price for the first 400 units of electricity consumed in two months plus an exemption of minimum charge); Night water heating rate (energy charge is 54.1 cents per unit); Minimum charge per bill: \$36.00.

(See also: <http://www.clp.com.hk/en/customer-service/tariff>)

CLP Residential Tariff

Energy charge:- (bimonthly)

Total bimonthly consumption block (1 unit = 1 kWh)	Rate (cents/unit)
Each of the first 400 units	80.5
Each of the next 600 units	93.9
Each of the next 800 units	109.7
Each of the next 800 units	140.5
Each of the next 800 units	163.4
Each of the next 800 units	173.8
Each unit over 4200	175.0

Fuel cost adjustment = 27.0 cents/unit

The amount by which the actual cost of fuel is less or more than \$700 per 44 gigajoules shall be credited or debited to the Fuel Clause Recovery Account.

Energy saving rebate:- (total bimonthly consumption of 400 units or less)

Total bimonthly consumption range (1 unit = 1 kWh)	Rebate rate (cents/unit)
1-200 units	17.2 on total consumption
201-300 units	16.2 on total consumption
301-400 units	15.2 on total consumption

Effective: 1 January 2015

* Minimum charge per bill: HK\$36.00

CLP Non-residential Tariff

Energy charge:- (monthly)

Total monthly consumption block (1 unit = 1 kWh)	Rate (cents/unit)
Each of the first 5,000 units	97.0
Each unit over 5,000	96.2

Fuel cost adjustment = 27.0 cents/unit

The amount by which the actual cost of fuel is less or more than \$700 per 44 gigajoules shall be credited or debited to the Fuel Clause Recovery Account.

Energy saving rebate:- (total monthly consumption of 400 units or less)

Total monthly consumption range (1 unit = 1 kWh)	Rebate rate (cents/unit)
1-200 units	17.2 on total consumption
201-300 units	16.2 on total consumption
301-400 units	15.2 on total consumption

Effective: 1 January 2015

* Minimum charge per bill: HK\$36.00

CLP Bulk Tariff (consumption > 20,000 kWh) (Effective: 1 January 2015)

Demand Charge:- (monthly)

<u>On-peak period:</u> (* min. on-peak billing demand: 100 kVA)	
Each of the first 650 kVA	\$68.4
Each kVA above 650	\$65.4
<u>Off-peak period:</u> (9pm-9am + Sundays & public holidays)	
Each off-peak kVA up to the on-peak billing demand	\$0.0
Each off-peak kVA in excess of the on-peak billing demand	\$26.8

Energy Charge (total monthly consumption block) (1 unit = 1 kWh)	Rate (cents/unit)
<u>On-peak period:</u>	
Each of the first 200,000 units	68.8
Each unit over 200,000	67.2
<u>Off-peak period:</u>	
Each unit	61.1

Fuel cost adjustment = 27.0 cents/unit

The amount by which the actual cost of fuel is less or more than \$700 per 44 gigajoules shall be credited or debited to the Fuel Clause Recovery Account.

CLP Large Power Tariff (demand > 3,000 kVA) (Effective: 1 January 2015)

Demand Charge:- (monthly)

<p><u>On-peak period:</u></p> <p>Each of the first 5,000 kVA</p> <p>Each kVA above 5,000</p> <p>(Minimum on-peak billing demand: 50% of the highest on-peak billing demand under Large Power Tariff during the "Summer Months" of the immediately preceding 12 months.)</p>	<p>\$120.3</p> <p>\$115.3</p>
<p><u>Off-peak period:</u> (9pm-9am + Sundays & public holidays)</p> <p>Each off-peak kVA up to the on-peak billing demand</p> <p>Each off-peak kVA in excess of the on-peak billing demand</p>	<p>\$0.0</p> <p>\$33.9</p>
<p><u>Billing demand shortfall:</u></p> <p>(There is no charge if on-peak billing demand or off-peak billing demand is not less than 3,000 kVA. The shortfall will be based on the difference between 3,000 kVA and the higher of on-peak billing demand and off-peak billing demand.)</p> <p>Each kVA short of 3,000 kVA</p>	<p>\$120.3</p>

CLP Large Power Tariff (cont'd)

Energy Charge (total monthly consumption block) (1 unit = 1 kWh)	Rate (cents/unit)
<u>On-peak period:</u> Each of the first 200 units per kVA of on-peak billing demand Each unit in excess of above	51.7 49.7
<u>Off-peak period:</u> Each unit	41.9

Fuel cost adjustment = 27.0 cents/unit

The amount by which the actual cost of fuel is less or more than \$700 per 44 gigajoules shall be credited or debited to the Fuel Clause Recovery Account.

CLP Large Power Tariff (cont'd)

High Load Factor Rider (HLFR): (for Bulk Tariff, Large Power Tariff, and Ice-Storage Air-Conditioning Tariff customers)

- (a) average monthly total consumption per kVA of average monthly "Maximum Billing Demand" in the preceding 12 months is higher than 500 units per kVA
- (b) HLFR provides lower charges for energy consumption over 500 units per kVA of "Maximum Billing Demand" in the month
- (c) Reduction in the energy charges:
 - Each of the 501st unit to 600th unit per kVA of "Maximum Billing Demand": 5.2 cents per unit
 - Each unit over 600 units per kVA of "Maximum Billing Demand": 10.5 cents per unit

High Voltage Super Demand Rider (HVSDR): (for Large Power Tariff customers)

- (i) the on-peak demand or off-peak demand, whichever is higher, is not less than 35,000 kVA; and
- (ii) supplied at 33kV and above and/or through a dedicated supply from CLP 132kV primary substation.

CLP Charges under High Voltage Super Demand Rider (HVSDR)

Demand Charge:-

<u>On-peak period:</u> (* min. on-peak billing demand: 100 kVA)	
Each of the first 5,000 kVA	\$111.1
Each kVA above 5,000	\$105.9
<u>Off-peak period:</u> (9pm-9am + Sundays & public holidays)	
Each off-peak kVA up to the on-peak billing demand	\$0.0
Each off-peak kVA in excess of the on-peak billing demand	\$31.8

(Minimum on-peak billing demand: 50% of the highest on-peak billing demand under Large Power Tariff during the "Summer Months" of the immediately preceding 12 months.)

Energy Charge (total monthly consumption) (1 unit = 1 kWh)	Rate (cents/unit)
<u>On-peak period:</u>	
Each of the first 200 units per kVA of on-peak billing demand	49.6
Each unit in excess of above	47.5
<u>Off-peak period:</u>	
Each unit	39.8

Fuel cost adjustment = 27.0 cents/unit

The amount by which the actual cost of fuel is less or more than \$700 per 44 gigajoules shall be credited or debited to the Fuel Clause Recovery Account.

Load Estimation



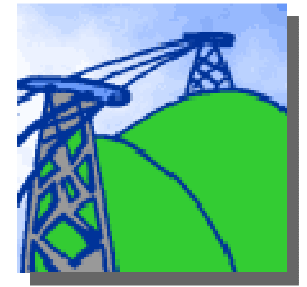
- Objectives

- Ensure loading demands are estimated accurately
 - What happens if they are “under-estimated”?
 - Normal business operations suffer; residents are inconvenient
 - What happens if they are “over-estimated”?
 - Under-utilised capacity and investment

- Important factors

- Load research data (statistics from power company)
- Design margin (e.g. to cater for future load growth)
- Checking & monitoring at each design stage
- Obtain info from the client or users (e.g. by questionnaire)

Load Estimation



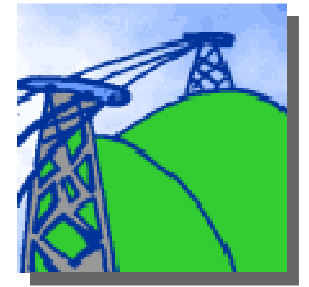
- Preliminary stage

- Estimate total loading so as to:
 - Plan the transformer (Tx) & main switch room
 - Apply to power company for supply
- Based on rough info or past experience
- Important to know the loads of other BSE systems

- Detail design stage

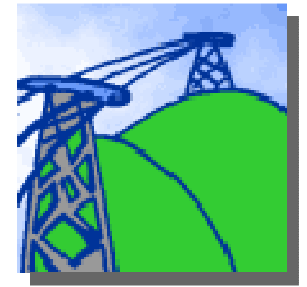
- Update the estimate w/ more accurate info
- Detail design e.g. protective device & circuiting

Load Estimation



- Electrical load within most commercial buildings can be arranged into the following broad categories:
 - Lighting
 - Small power and special user equipment
 - Heating, ventilating and air-conditioning (HVAC) equipment
 - Lifts and escalators

Load Estimation

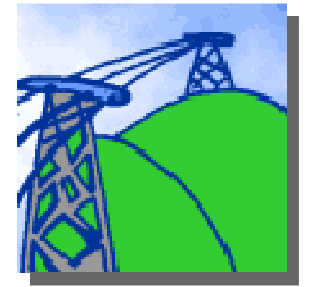


- General considerations:
 - Usable floor area (UFA) (m²)
 - Follow Building (Planning) Regulations
 - Development information
 - Floor area usage, public services, any special loads
 - Load capacity/density (W/m² or kVA/m²)
 - Public services
 - Assessed independently
 - Such as public lighting, lift, water pump, fire services, lobby air conditioning

Minimum design load capacities for lighting and small power requirement for various types of building

Building type	Minimum load capacity (W/m²)
Office	60
School	30
Residential building	30
Hospital	25
Hotel	25
Church	15

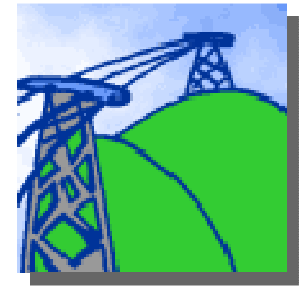
Load Estimation



- Code of Practice 215: Load Assessment Procedure (from CLP) (available from Moodle)
 - Guidelines for load assessment
 - Residential
 - Commercial
 - Industrial
 - Data centre
 - Municipal
 - Mixed development diversity factor (MDDF)
 - Central air conditioning load
 - Other special loads
 - Apply after diversity maximum demand (ADMD) figures

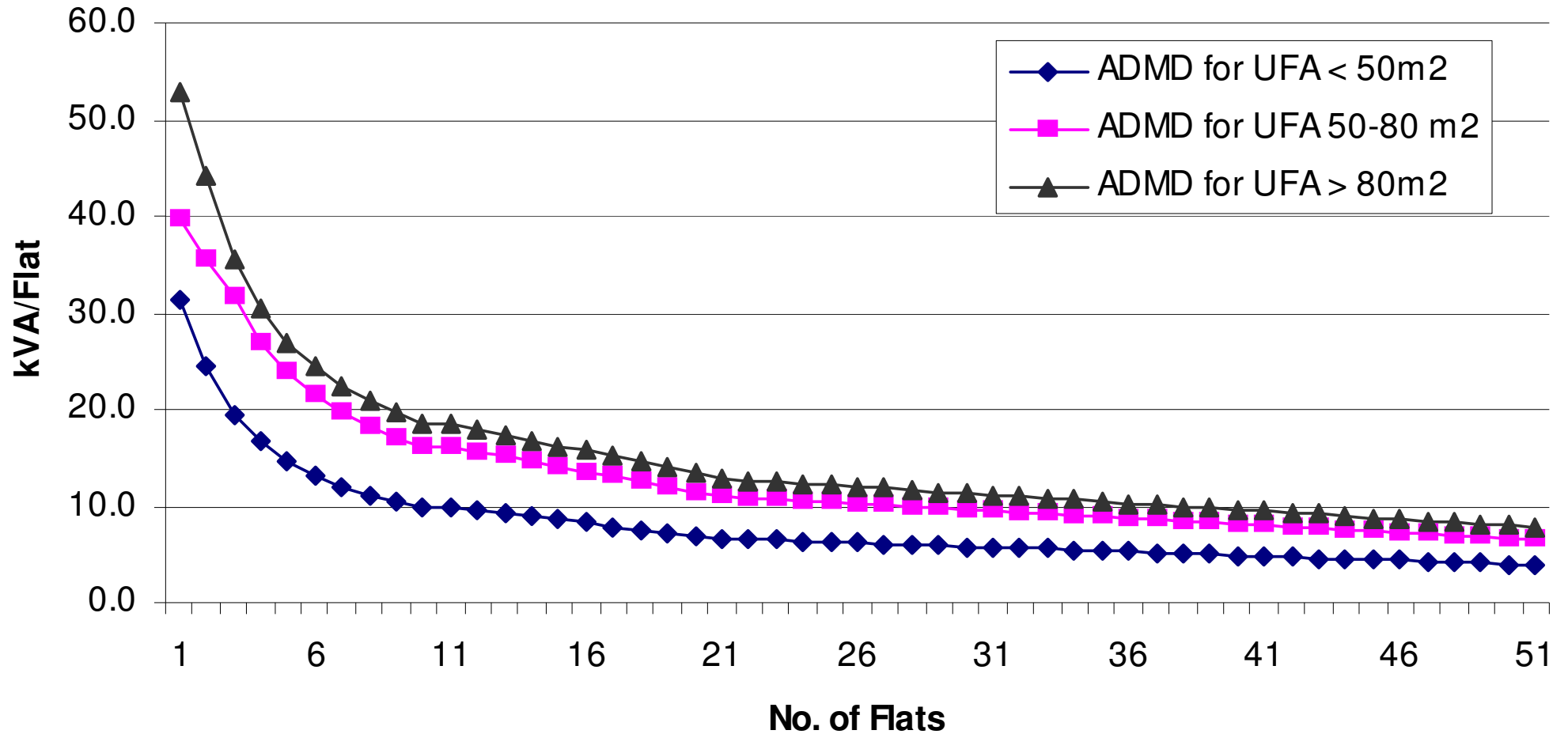
Diversity for mixed usages (e.g. domestic-commercial)

Load Estimation



- After diversity maximum demand (ADMD)
 - Load densities derived by dividing the aggregate load by the corresponding UFA or flat nos.
 - Cover most typical cases; for special situation, designer/planning engineer may exercise his own discretion to adjust the load estimates
 - ADMD is for planning supply Tx capacity, it may not be suitable for designing customer raising mains and lateral mains

ADMD figures for Residential Development



What is the effect of load diversity on the kVA/flat data?

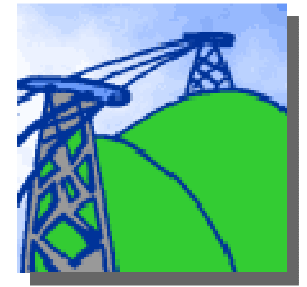
(Source: CLP's COP 215 Load Assessment Procedure)

Load Estimation



- Load evaluation by power company
 - Architect/Engineer/Developer submit application
 - For typical categories, planning engineer of power company assesses the load estimation using the database Load Assessment Programme (LAST)
 - Compare the declared load with assessed load
 - If declared load $>$ assessed load, justification is needed
 - After finalising the total load, determine the nos. of transformer and transformer bays

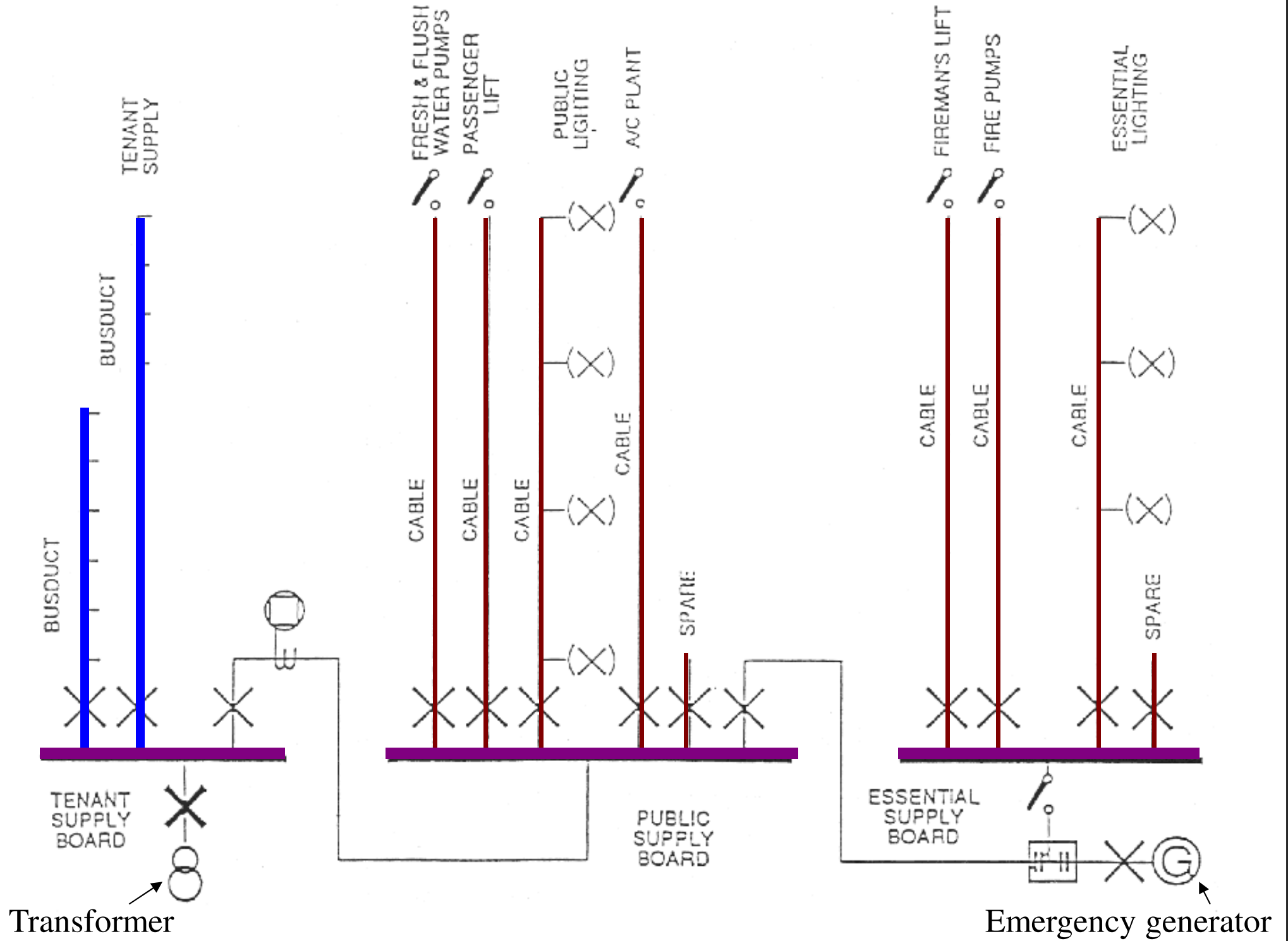
Plant Rooms



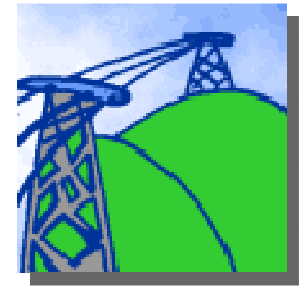
- Space planning and design for major plants:
 - Transformer (Tx) room (substation)
 - Main switch room
 - Emergency generator room
- Other plant room space:
 - Meter rooms or space
 - Fuel tank room (fuel for emergency generator)
 - Pipe duct or space for vertical risers
 - Other switch rooms or control rooms

Tenant

Landlord

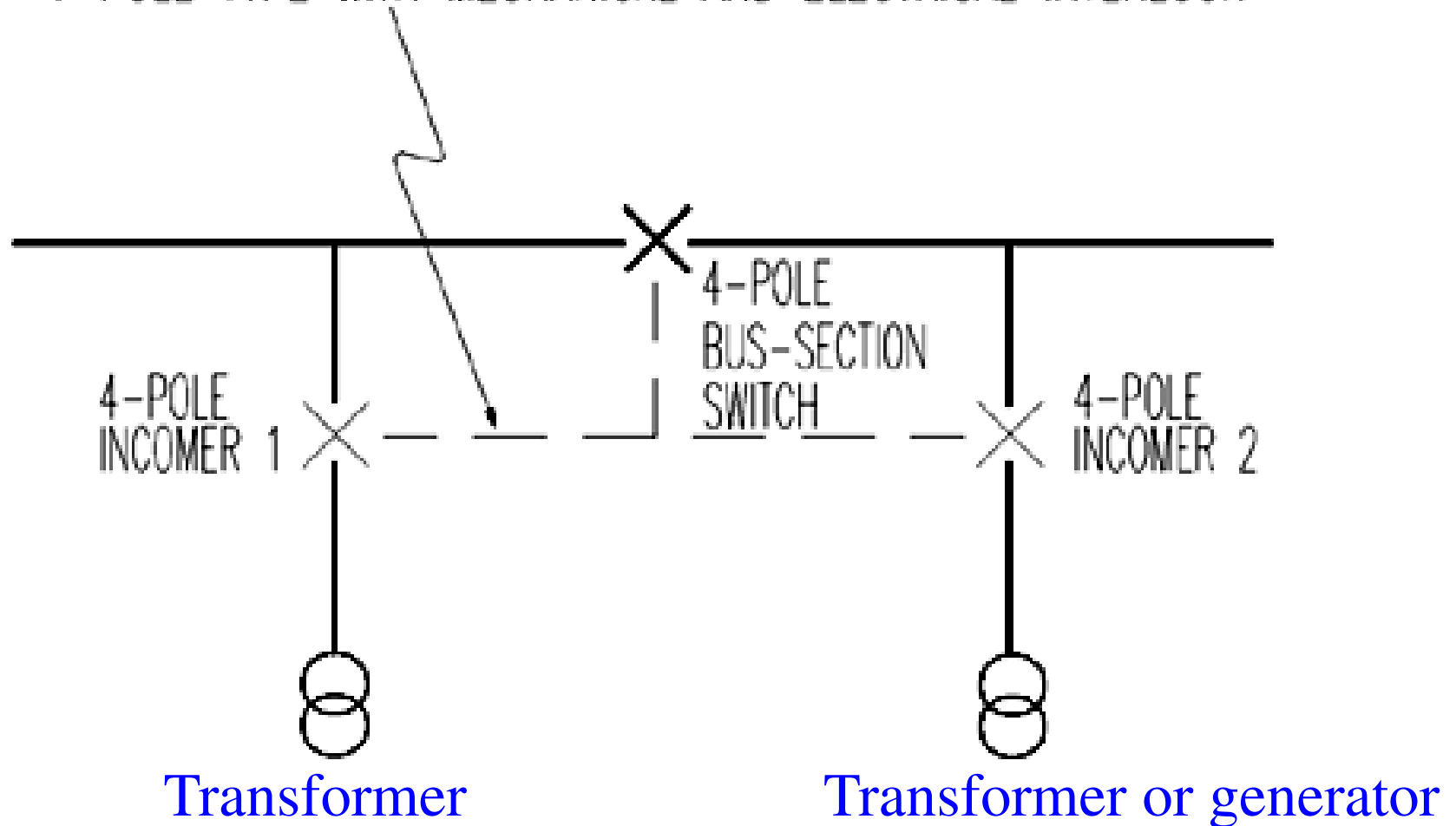


Plant Rooms



- Tenant supply – energy consumed by each tenant; monitored by separate energy meter
- Landlord supply:
 - Non-essential supply: plumbing and drainage, passenger lifts, air-conditioning plant, public lighting
 - Essential supply: fire protection/detection system, fireman's lifts, essential lighting, PABX system, building management system, important computer room

INTERCONNECTION CIRCUIT BREAKERS BETWEEN
2 OR MORE SUPPLY SOURCES SHALL BE OF
4-POLE TYPE WITH MECHANICAL AND ELECTRICAL INTERLOCK

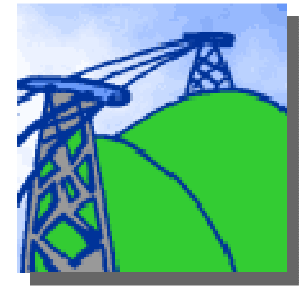


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ARRANGEMENT OF INTERCONNECTION CIRCUIT BREAKERS BETWEEN TWO OR MORE SUPPLY SOURCES

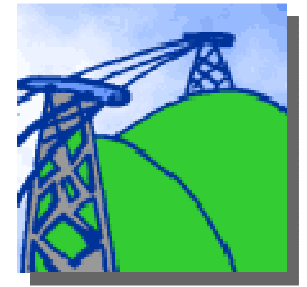
Source: HEC's Guide to Connection of Supply

Plant Rooms



- Three situations for transformer (Tx) location:
 - Ground-floor (G/F) Tx room
 - Basement Tx room
 - Upper floor Tx room
- Must follow the technical requirements of the power company and statutory bodies
 - See HEC's "Guide to Connection of Supply", CLP's code of practice, & Supply Rules

Plant Rooms



- General requirements for transformer (Tx) room
 - Proper access & size
 - Minimum headroom (for equipment & delivery)
 - Fire services installation
 - Space for maintenance/removal
 - Next/Close to main switch room
 - No expansion joint & other engineering services
 - Independent ventilation
 - Floor 150 mm > outside (prevent flooding)
 - Generally, no more than 3 Tx in one room

Plant Rooms



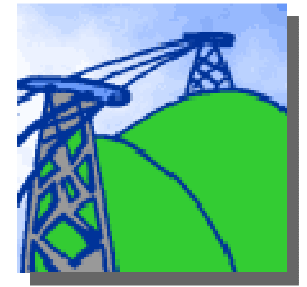
- Additional requirements for B/F Tx room
 - No oil-filled type Tx
 - A separate & independent staircase to G/F
 - Also a protected lobby
 - Sum pit w/ sump pumps
 - Extract water when flooding
 - Hoist beam with pulley for 8,000 kg
 - Damp proof course (prevent moisture)

Plant Rooms



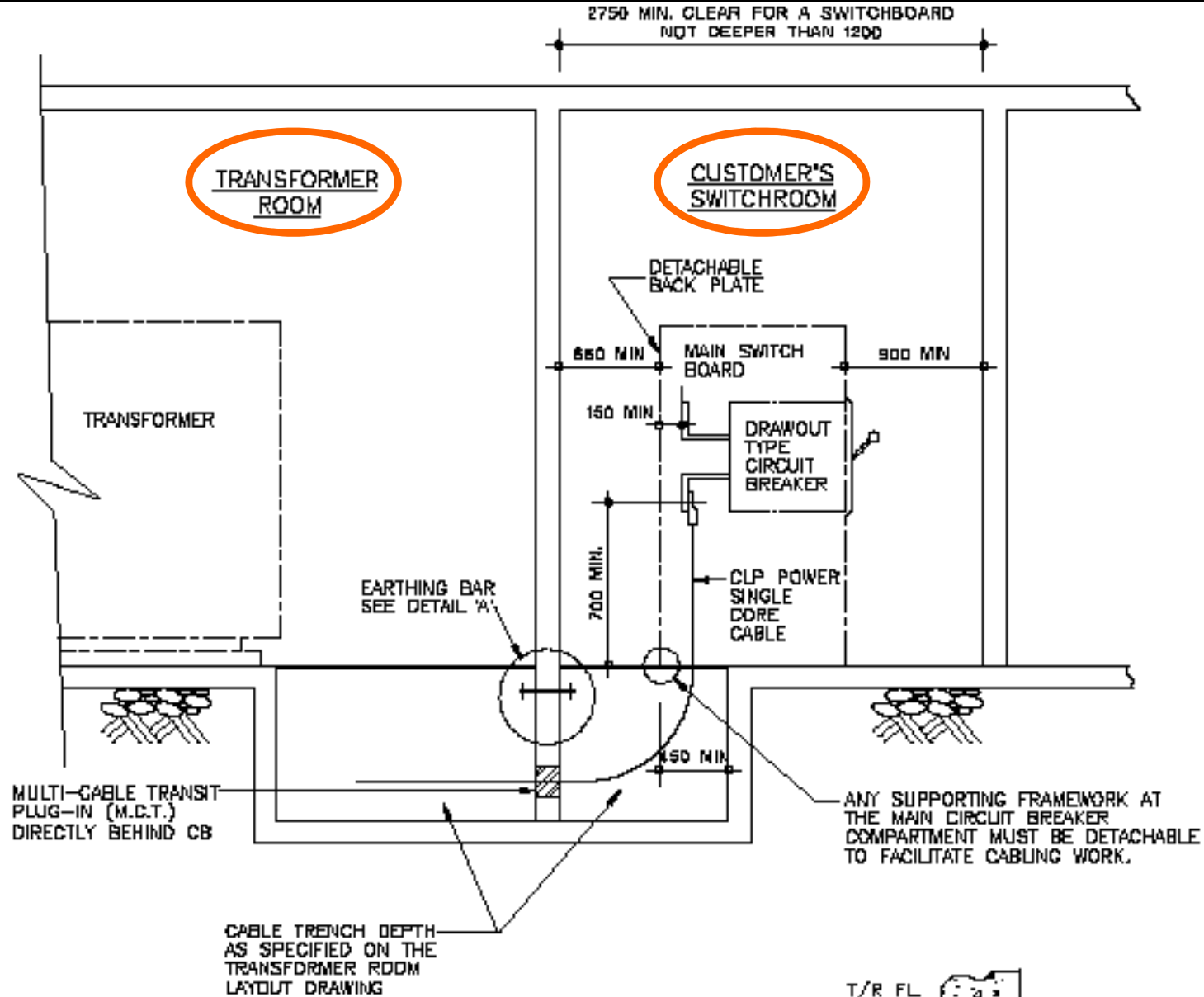
- Additional requirements for upper floor Tx room
 - Accessible from a public area (e.g. car park)
 - Also a protected lobby
 - A separate cable duct w/ 2 hour fire-rated for HV cable and accessible from public area
 - Or an independent cable riser room
 - Lifting beam & trolley
 - For $T_x > 5/F$ or 17 m, a lift shall be provided

Plant Rooms

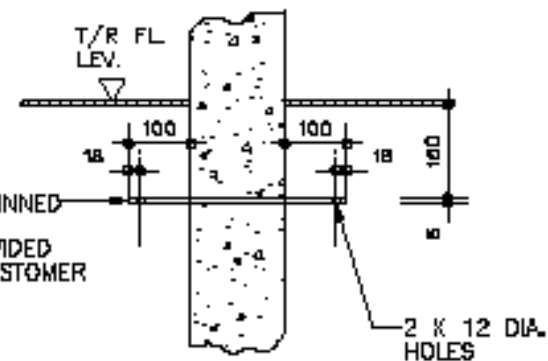


- Major equipment in Tx rooms
 - Power transformer(s) [@ max. 1500 kVA]
 - 11 kV switchgear (ring main unit, RMU)
- Other equipment *
 - LV switchboard
 - LV capacitor bank
 - Battery & charger
 - Marshalling boxes
 - Meter panel

(* See layout drawings in: CLP, 2014. *Code of Practice 101 for Distribution Substation Design*, Version 13, CLP Power Hong Kong Limited, Hong Kong.)

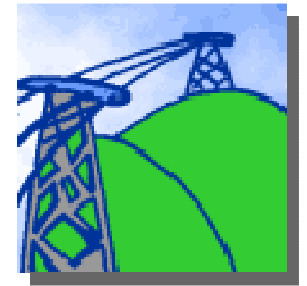


ONE 38mm x 6mm TINNED COPPER BAR BONDING TERMINAL TO BE PROVIDED AND INSTALLED BY CUSTOMER

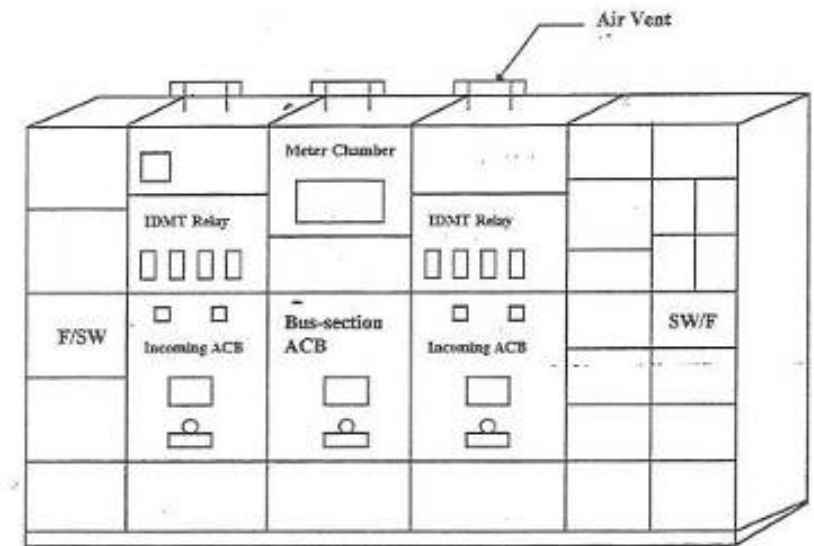


DETAIL 'A'

Plant Rooms

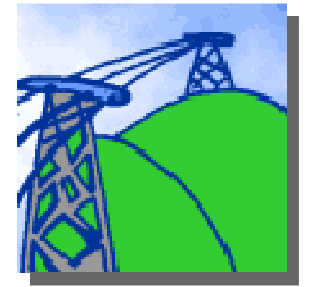


- Main Switch Room: major considerations
 - Position
 - Access
 - Dimensions
 - Working space
 - Routing of outgoing circuits
 - No other services
 - Ventilation & illumination



Cubicle-mounted Switchboard

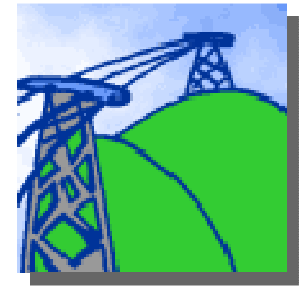
Plant Rooms



- Main switchboard
 - Receive & distribute the electrical power
 - Fault protection & coordination (circuit breakers)
 - Power factor correction
 - Metering
 - Construction, such as:
 - Assembly method
 - Mechanical protection

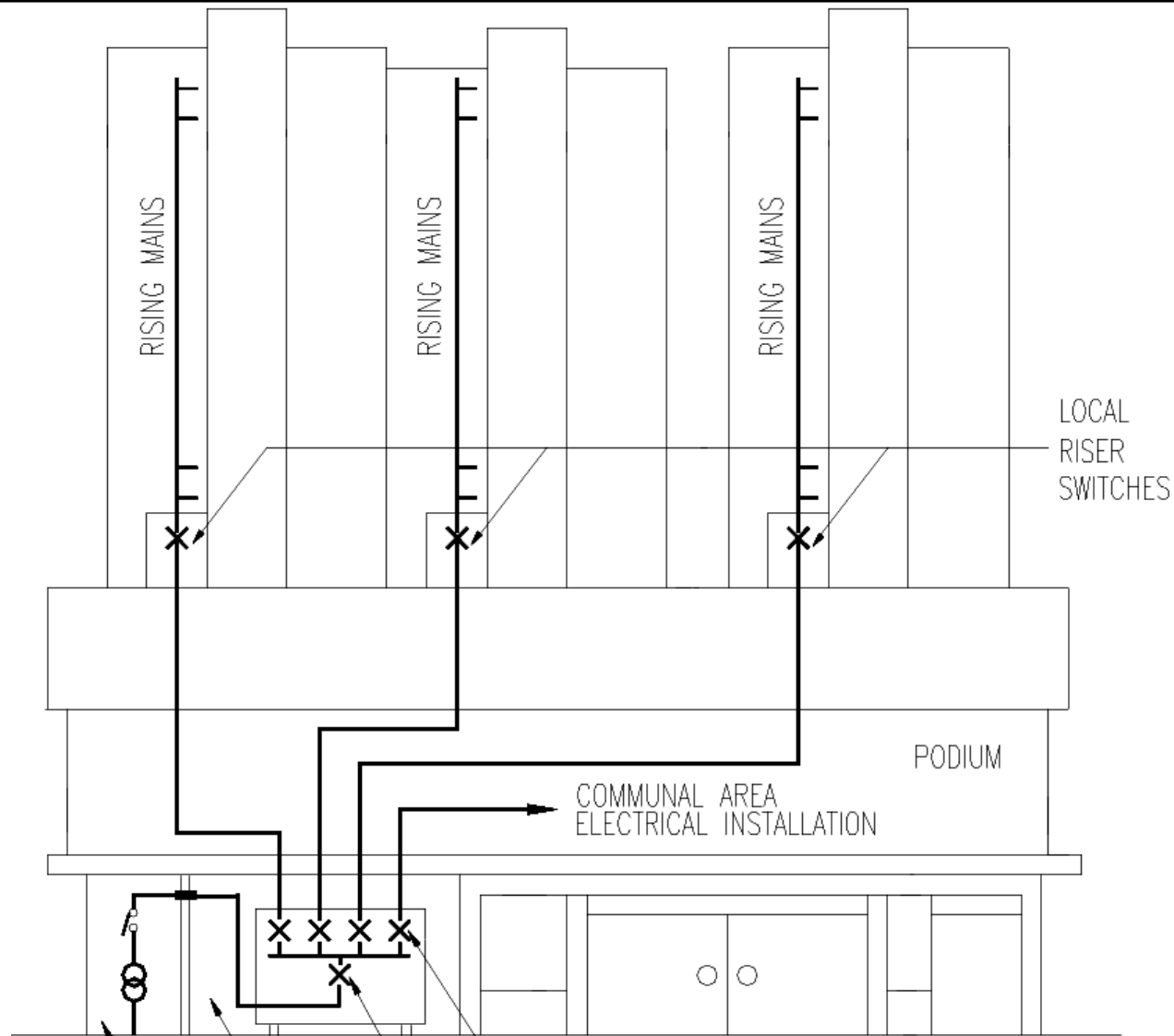


Electrical Distribution



- Distribute electricity throughout the building
 - 3-phase 4-wire tee-off for buildings > 4 floors
 - Separate riser earthing conductor
 - Metering arrangements (e.g. multiple tenants)
 - Switching and isolating
- Types of rising mains
 - Cable system (up to 800 A)
 - Busduct or busbar trunking system

Main switch/local riser switch arrangement



Source:
HEC's Guide
to Connection
of Supply

TX. RM.

MAIN SW. RM.

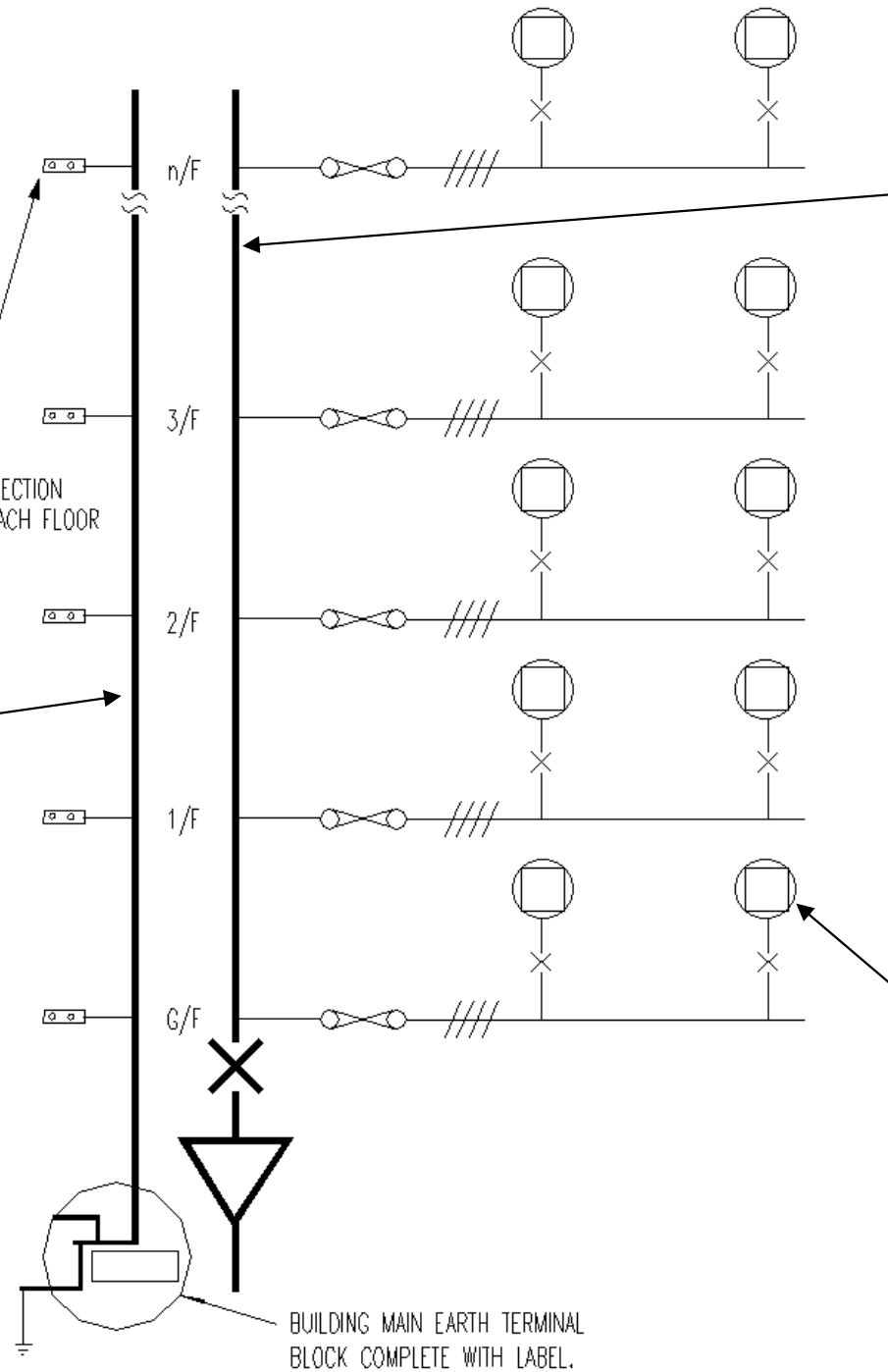
A MAIN SWITCH TO
CONTROL COMMUNAL AREA
ELECTRICAL INSTALLATION

A BUILDING MAIN SWITCH
SHALL BE INSTALLED TO
CONTROL THE WHOLE
INSTALLATION

Source:
HEC's Guide
to Connection
of Supply

Earthing
rising mains

EARTH CONNECTION
BLOCK AT EACH FLOOR



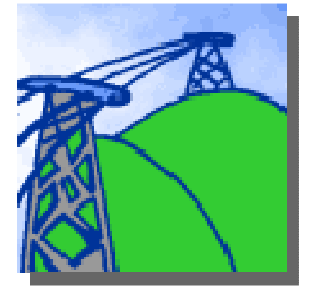
3-phase supply
rising mains

Electricity meter

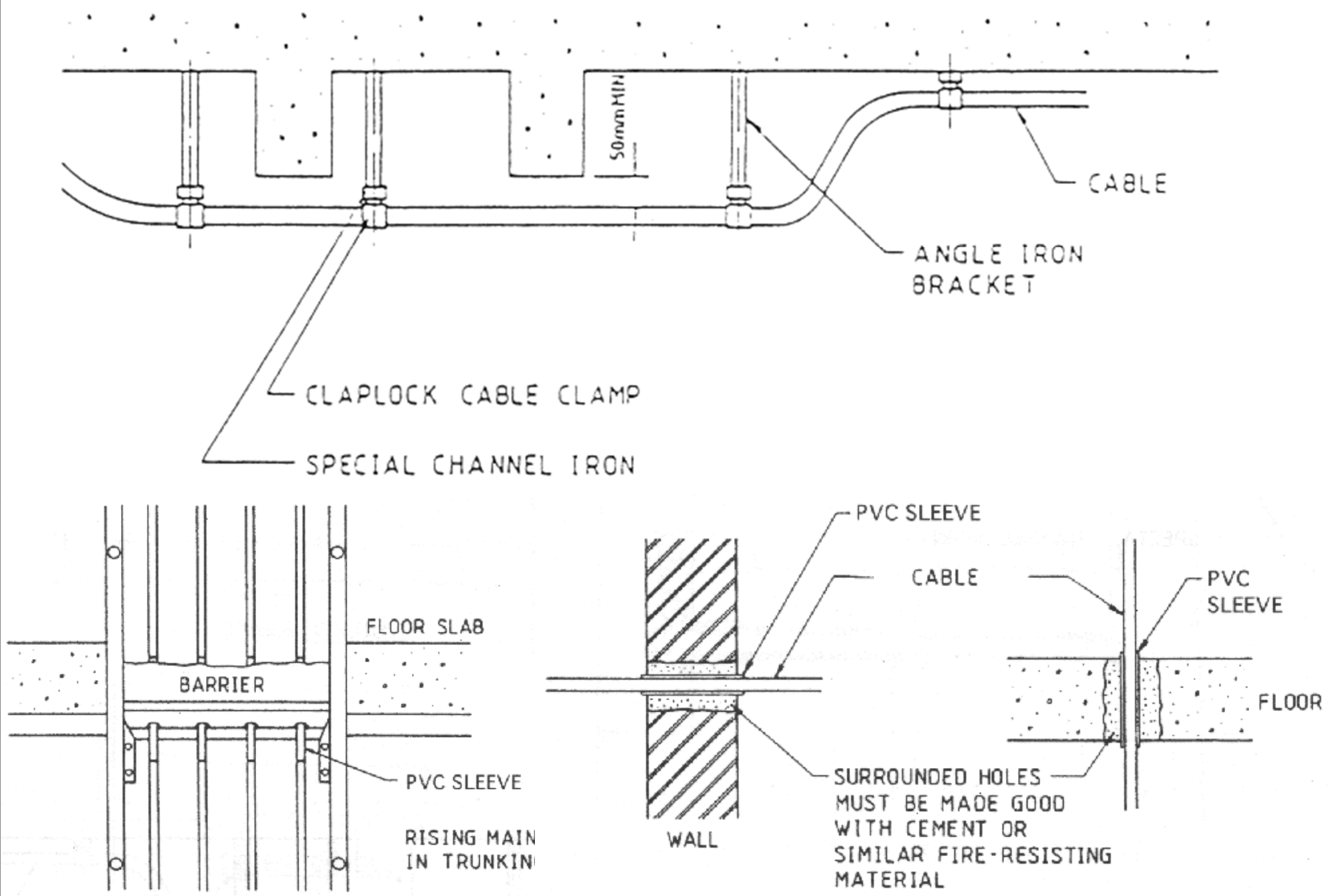
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COMMUNAL RISING MAINS SYSTEM

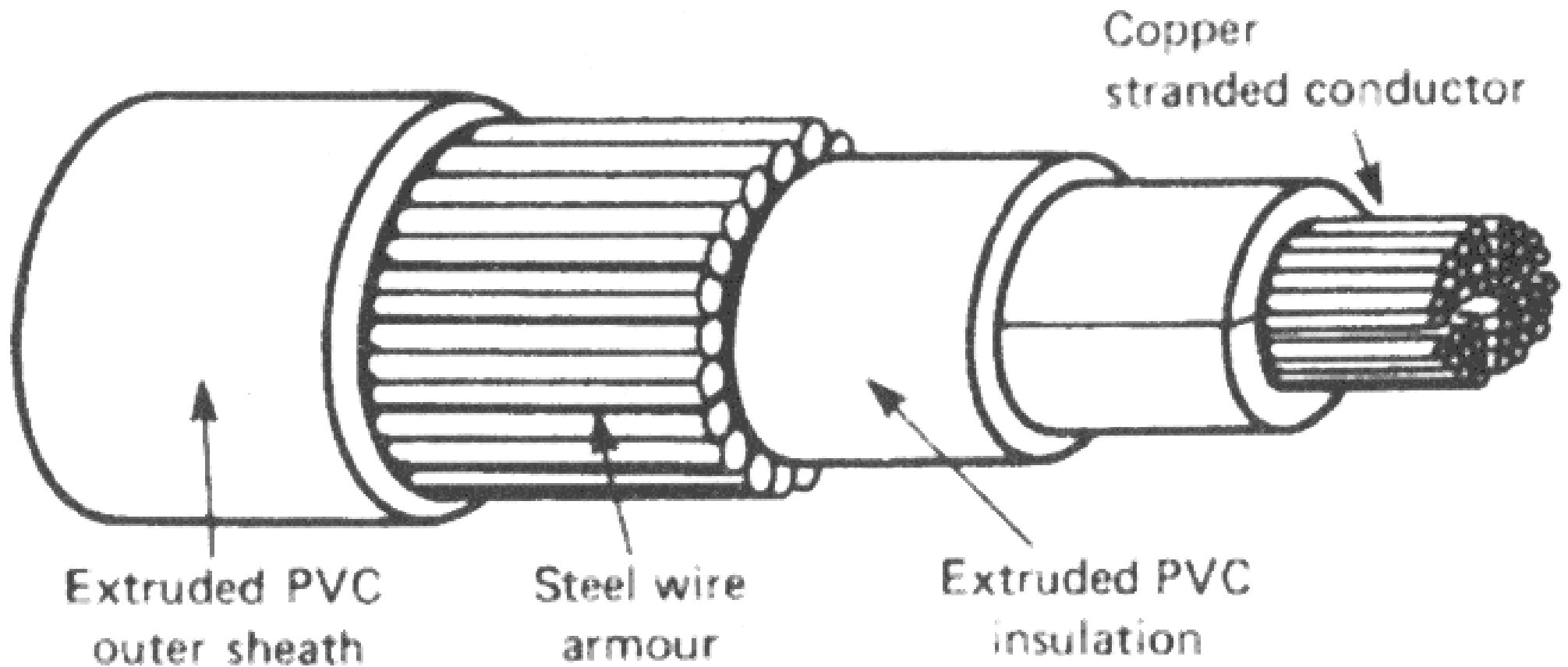
Electrical Distribution



- General requirements of cable system
 - Routing & installation
 - Workmanship: support, spacing, bending, etc.
 - Passing through walls & floors (e.g. fire barriers)
- Types of cable
 - PVC insulated
 - PVC sheathed non-armoured
 - Armoured or metallic-sheathed cable

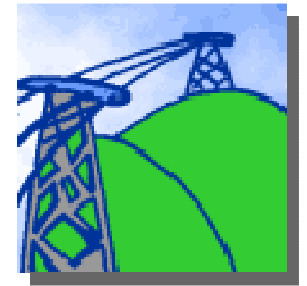


Cable installation details



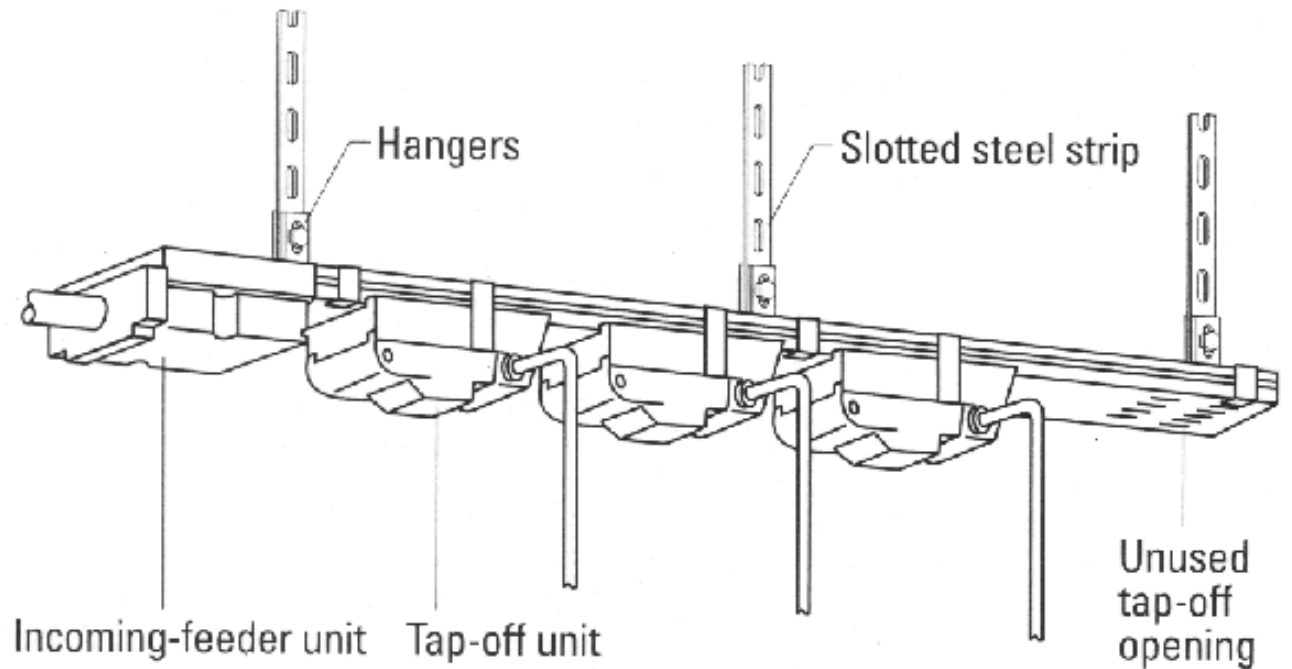
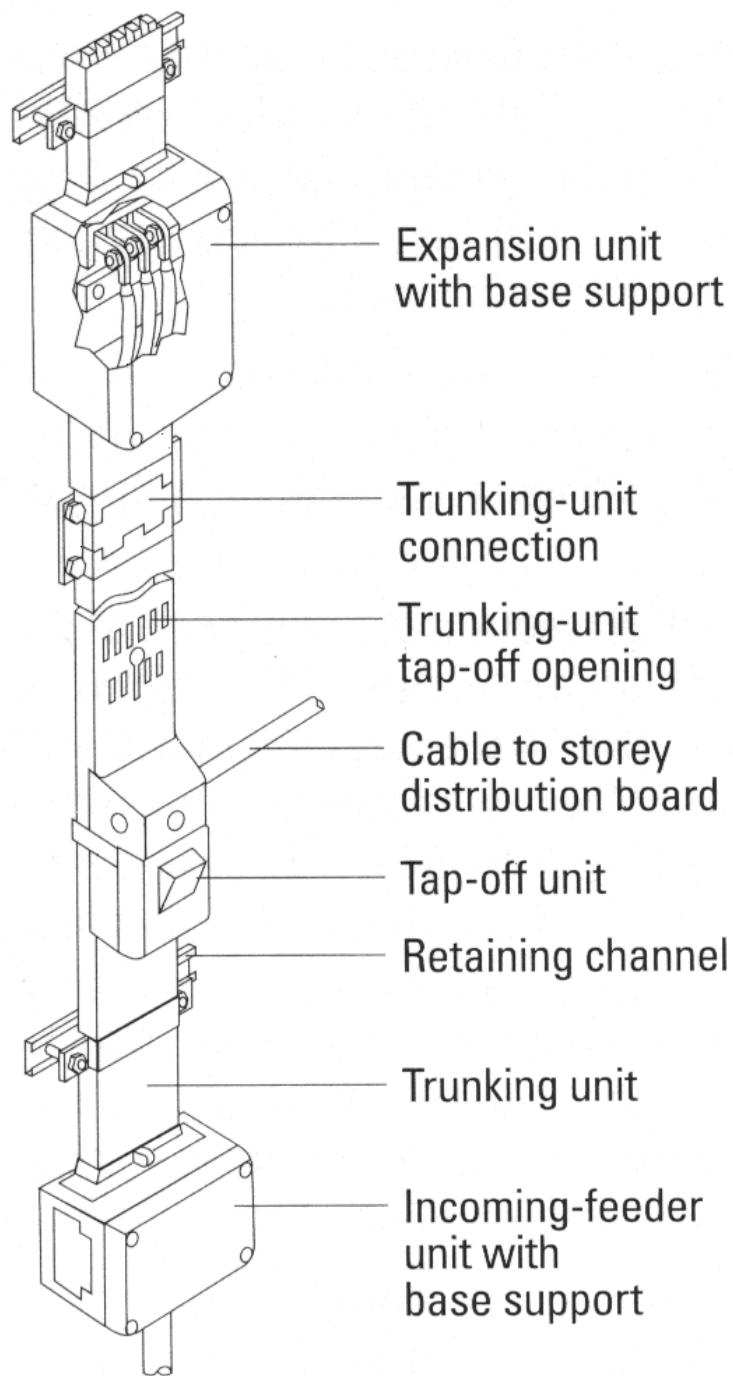
Armoured three phase four wire cable
for laying below ground level

Electrical Distribution



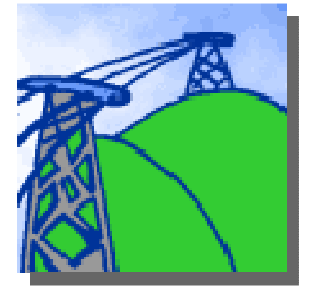
- Busbar trunking installation
 - Vertical
 - Horizontal
- Components
 - Busbar casing
 - Expansion unit
 - Feeder unit
 - Tap-off unit



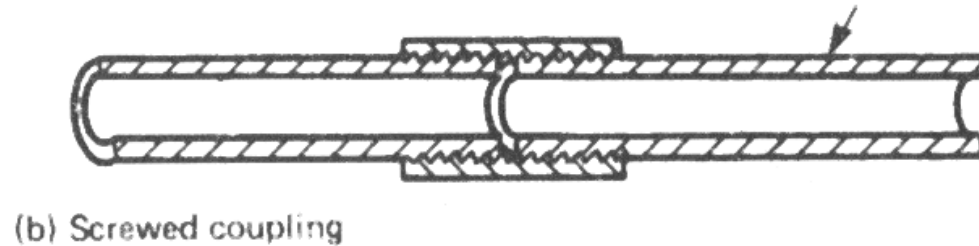
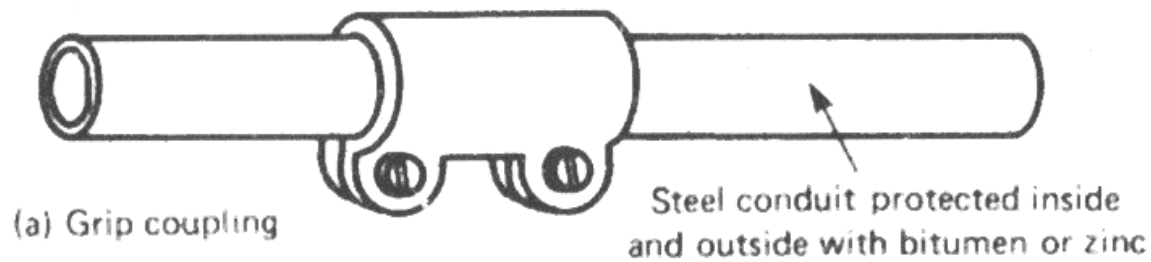
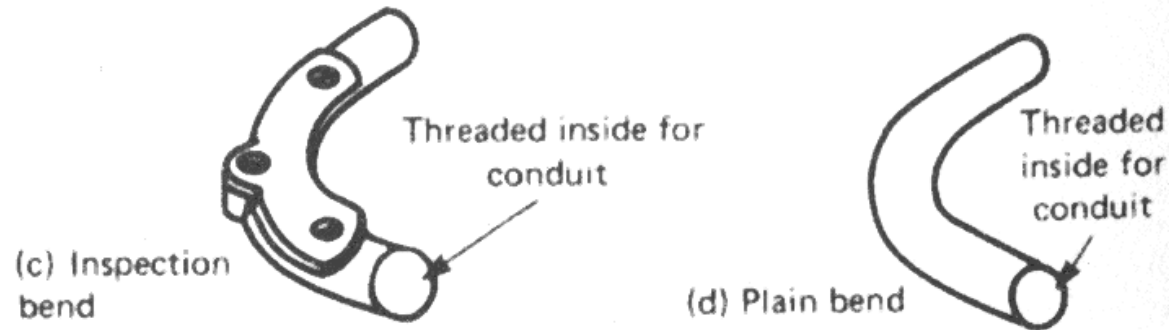
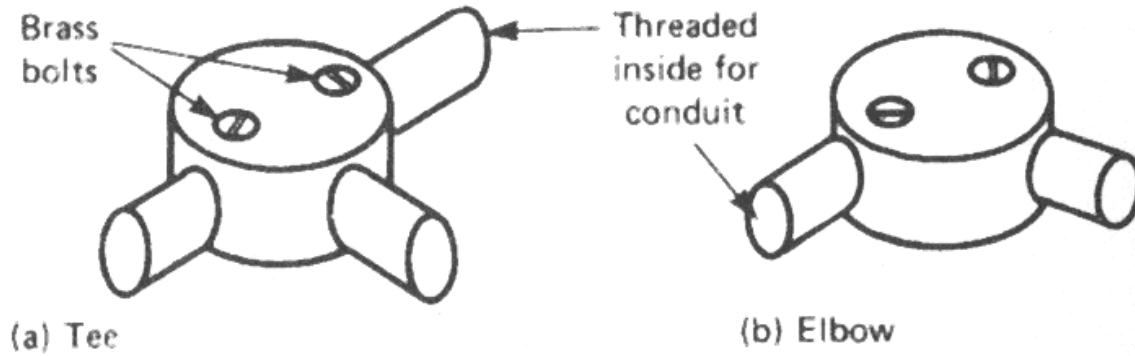


Vertical and horizontal busbar trunking

Electrical Distribution



- Wiring installation enclosure: requirements
 - Enclosures as protective conductors
 - Support of enclosures
 - Fire barrier
- Types of systems
 - Steel conduit
 - Steel trunking
 - Plastic or PVC conduit or trunking



Fittings and coupling for steel conduit



Electrical Distribution

- Factors affecting the choice of wiring system
 - Installation cost (\$\$\$)
 - Purpose and planned duration of the installation
 - Environment factors and installation conditions
 - Type of building construction
 - Flexibility of the system and circuit arrangement
 - Appearance of the finished installation
 - Safety aspect
 - Nature of power supply & type of earthing system

Application of Wiring System

Wiring System	Cable Type	General Use
Surface wiring	1/C PVC/PVC cables with separate cpc; 2/C PVC/PVC cables with cpc; 4/C armored cables	Temporary wiring; Low-cost housing
Conduit wiring - Concealed - Surface	1/C PVC insulated cables	Office, Private housing; Factory; Plant room
Wiring in trunking	1/C PVC insulated cables	Sub-main/lateral main distribution
Risers in communal installation	Bare Cu/Al bars in trunking Armored cables in cable duct	Rising mains for internal power distribution system
Flameproof cable	Mineral-insulated cables	Petrol station, Flammable areas