



# 建築物電力裝置通用施工指引

Directrizes Gerais para Instalações Eléctricas em Edifícios

General Guidelines for Building Electrical Installations

July 2025

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### Language versions standardization

This document is published in Chinese with English and Portuguese versions. In case of discrepancies between the English and Portuguese versions, the Chinese version shall prevail.

## **1. Introduction**

To ensure the quality of electrical installation works in buildings, CEM has prepared and published the "General Guidelines for Building Electrical Installations " (hereinafter referred to as the "Guidelines"). These Guidelines use both illustrations and text to clearly explain specific installation requirements, aiming to deepen industry professionals' understanding of such requirements and provide practical assistance.

The Guidelines are based on the "CEM Technical Specifications" (NCEM), current local regulations, and international standards in the power industry, and are tailored to Macau's actual power supply environment and customer needs. Through the publication of these Guidelines, CEM hopes to provide the electrical engineering industry with a clear understanding of widely accepted installation practices in Macau, to make the installation and acceptance processes more transparent and efficient, and to further enhance the safety and quality of electrical installations in Macau.

The preparation of these Guidelines was supported by industry professionals and colleagues from various CEM departments, which has helped to improve their quality. However, there may still be mistakes or omissions, and your valuable feedback is welcome to help further refine the Guidelines. CEM will also review and update these Guidelines as necessary, sharing the most updated and suitable installation methods with the electrical engineering industry, with an aim to continuously raise industry standards.

Customer Service Department – Customer Installation Support

July 2025

## **2. Objective**

These Guidelines aim to,

- Provide supplementary notes on the on-site construction requirements of building electrical installations covered in NCEM
- Describe the basic requirements for the connection point to the network (supply point) in building electrical installations
- List the testing and inspection records required to be provided prior to the power supply to new building electrical installations
- Clarify the acceptance standard of CEM for building electrical installations, and provide the electrical engineering industry with common reasons of non-acceptance works

## **3. Application Field and Limitations**

These Guidelines apply to new construction and modification projects for low-voltage electrical installations in buildings. If the modification or upgrade of an electrical installation in an existing building is not fully compliant with these Guidelines due to the existing site conditions or space constraints, the electrical contractor responsible for the project is required to provide an alternative solution for CEM approval in advance.

For the requirements relating to building electrical installations that are not covered in these Guidelines, please refer to the latest version of NCEM and other relevant Macau legislation.

In these Guidelines, terms such as “should,” “must,” or “shall” indicate mandatory requirements; terms such as ‘suggest’ or “recommended” indicate best practice guidelines, and electrical contractors should adjust the specific implementation methods based on site conditions.



#### **4. Definitions**

For other definitions not listed, please refer to the definitions in NCEM C14-100.

##### **Connect**

The linkage of two or more conductors to ensure electrical continuity and current-carrying capacity.

##### **Creepage distance**

The shortest distance between two conductors along an insulating surface.

##### **Connector**

A socketed copper connector for connecting collective lines and service-entrance lines.

##### **Fuse**

As a circuit protection device, when the current exceeds its current rating for a certain period, the heat generated itself will cause the element inside the fuse to melt, thereby disconnecting the circuit to prevent damage to the electrical installations.

##### **Grounding**

The connection of an electrical installation or part of a circuit to earth provides the discharge of fault currents to prevent hazards caused by voltage abnormalities.

##### **Grounding resistance**

The resistance encountered by the current flowing from a grounding system to the Earth.

##### **Label**

A marking that characterizes an electrical installation and provides identifiable information, such as circuit number, supply location, etc.

##### **Busbar**

A conductive structure made of highly conductive metal (common busbars in Macau are made of copper), which is used for distributing electrical energy or connecting branch circuits in building electrical installations.

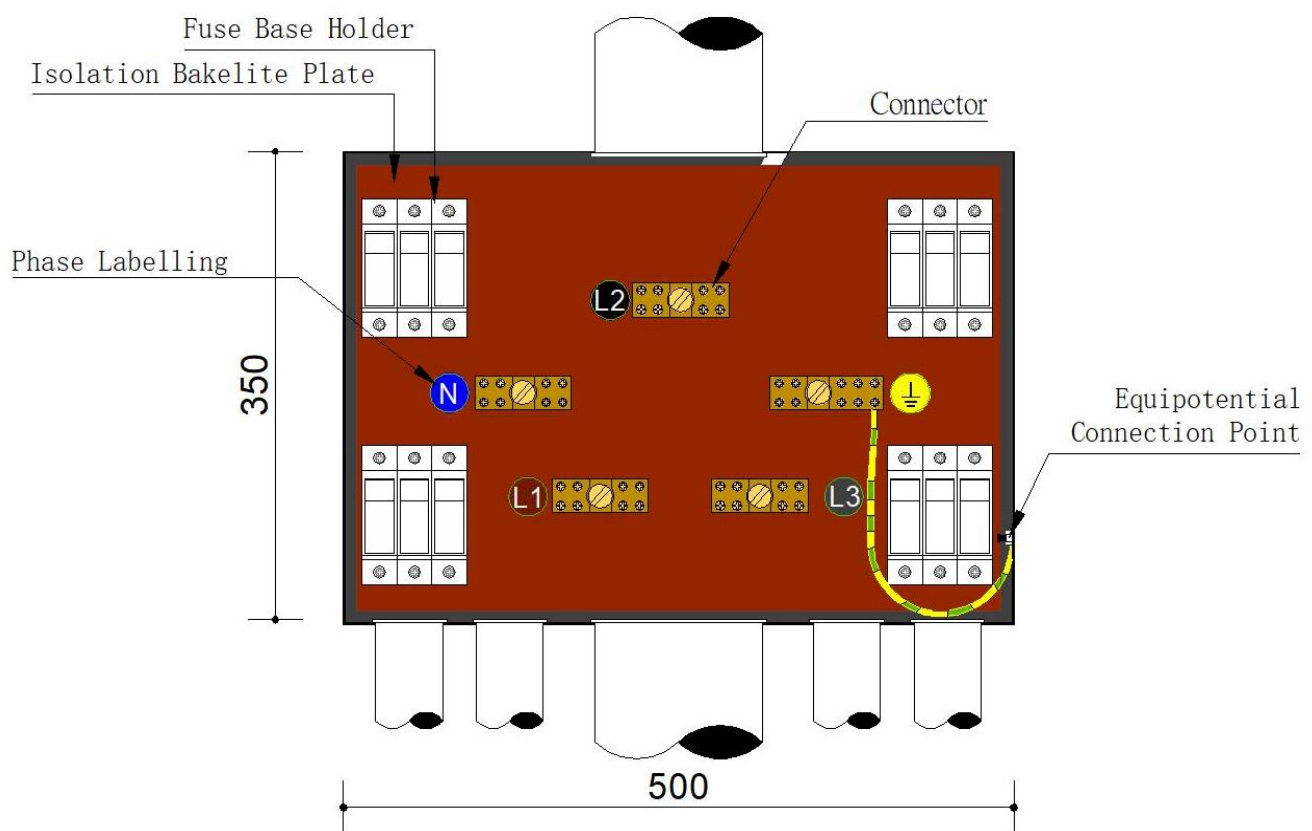
## 5. Specifications and Installation Requirements for Each Type of Installation

### 5.1 Collective Line Distribution Box (CCL)

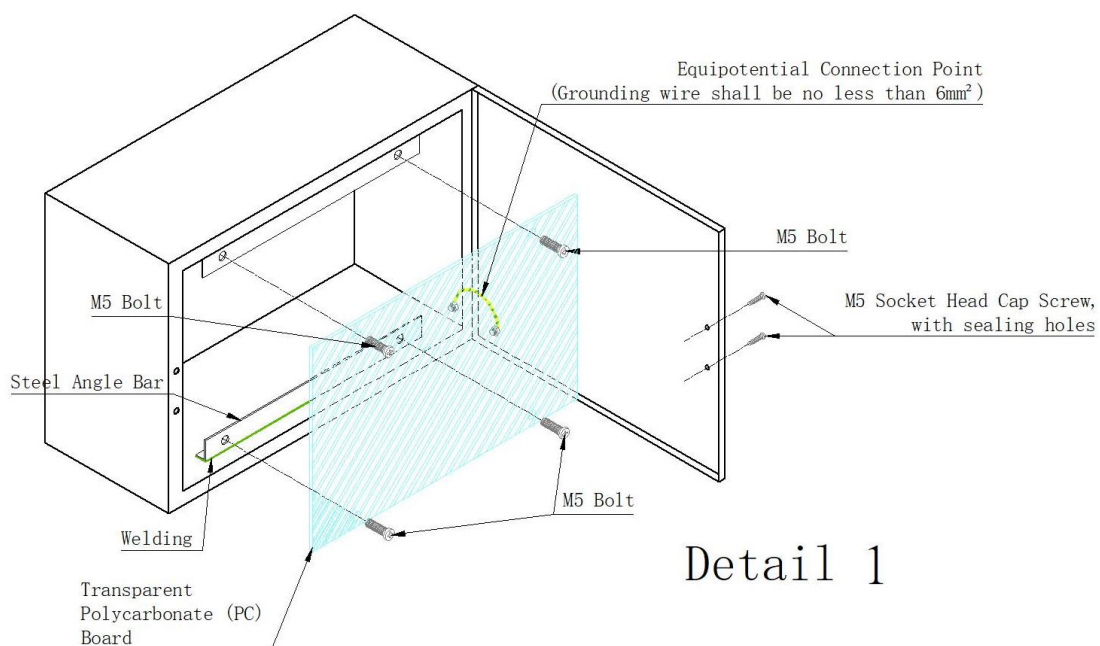
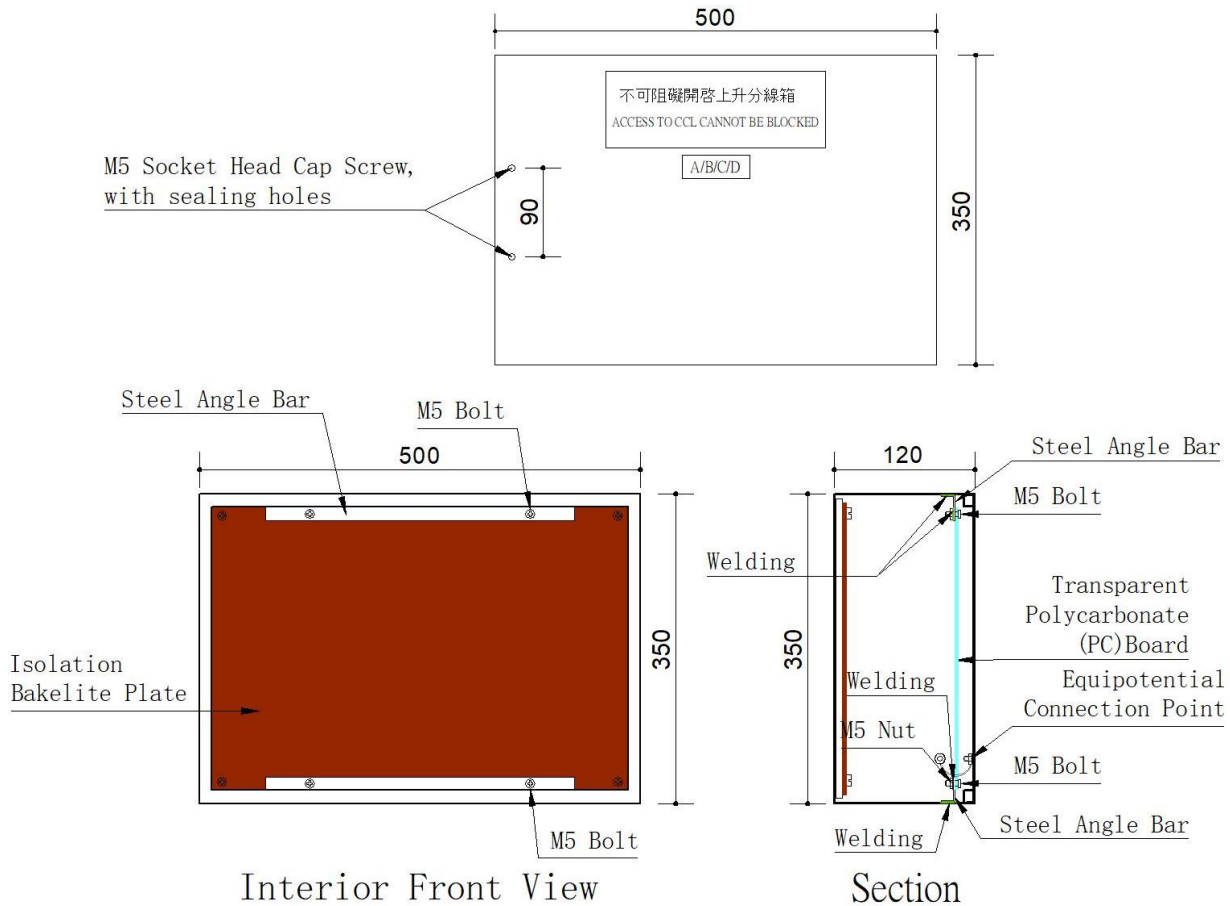
In order to ensure proper circuit arrangement and insulation distance inside the CCL box, the configurations and specifications of the CCL box should meet the following requirements.

#### General Requirements

- Type CCL 500 allows the execution up to four three-phase outgoings or six single-phase outgoings

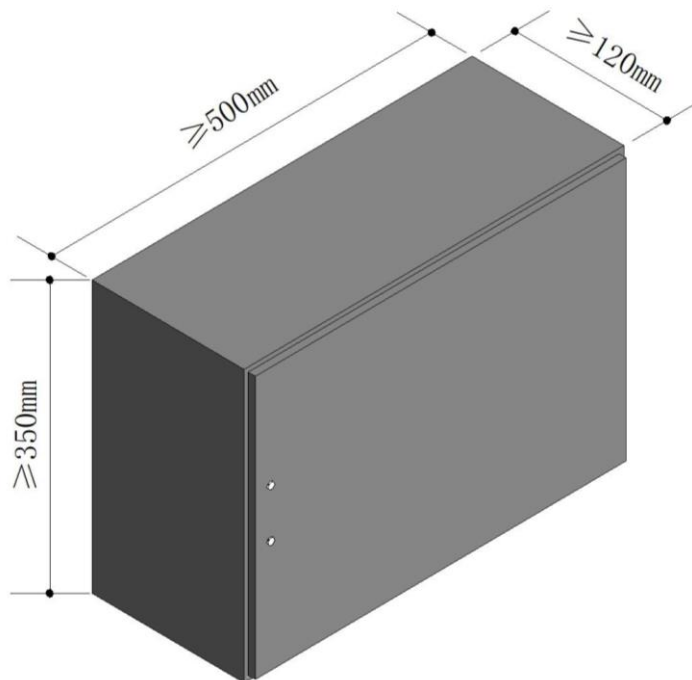


- A transparent polycarbonate (PC) board must be placed at the front of the CCL box and requires tools to remove or install. Steel angle bars for installing the transparent board must be welded to the CCL box.



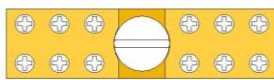
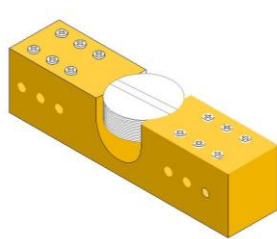
Detail 1

- CCL box inlet and outlet cables should be connected to the box with waterproof cable glands if they are installed in the open wire way. If the cables are installed in the pipe, the connection to the box should be treated with waterproof filler to prevent moisture and dust from entering.
- When installing the CCL box outdoors,
  - All incoming and outgoing cables must be located at the bottom of the box.
  - If there is no waterproof arrangement for the CCL box, it is recommended to use a CCL box with an IP 66 rating.
- The layout of the conductors in the CCL box should not be less than the creepage distance of 6.3 mm for pollution degree 3 in IEC 60664-1.
- For the convenience of engineering workers in reaching the site and carrying out construction work, CCL boxes should be installed between 2 m and 2.8 m above the floor, with the front working space not less than 900 mm, and the hinges shall be opened to 180 degrees (minimum of 90 degrees if two CCL boxes are connected)
- The dimensions of the CCL box can be adjusted according to user distribution and site conditions. Still, its **minimum size** should be 500 mm x 120 mm x 350 mm (L x D x H), and its specific size should be adjusted according to actual use and design.



### Connector

- The connectors shall be strong enough not to deform during the tightening or loosening of the conductors and shall be of adequate size for the collective lines and service-entrance lines.
- When the live and neutral connectors do not have an isolated mounting base, they shall be mounted on a plate of insulating material to ensure insulation from the ground and between phases, while also ensuring the necessary mechanical strength.
- Connectors with different polarities are separated by not less than 30 mm.
- The following are three common examples of connectors used to connect the service-entrance lines and collective lines. The specific dimensions of the connectors and the number of connection holes are determined according to on-site needs.

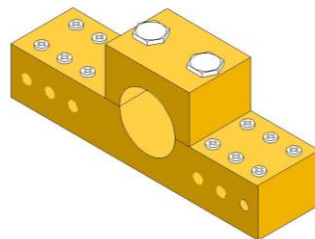


Top View

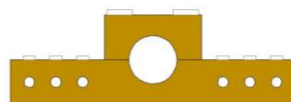


Front View

Example 1

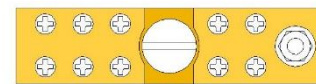
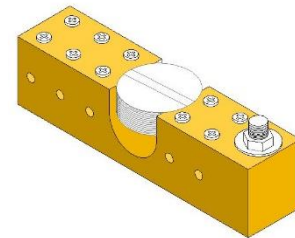


Top View

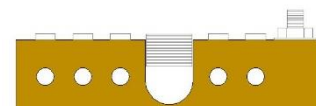


Front View

Example 2



Top View

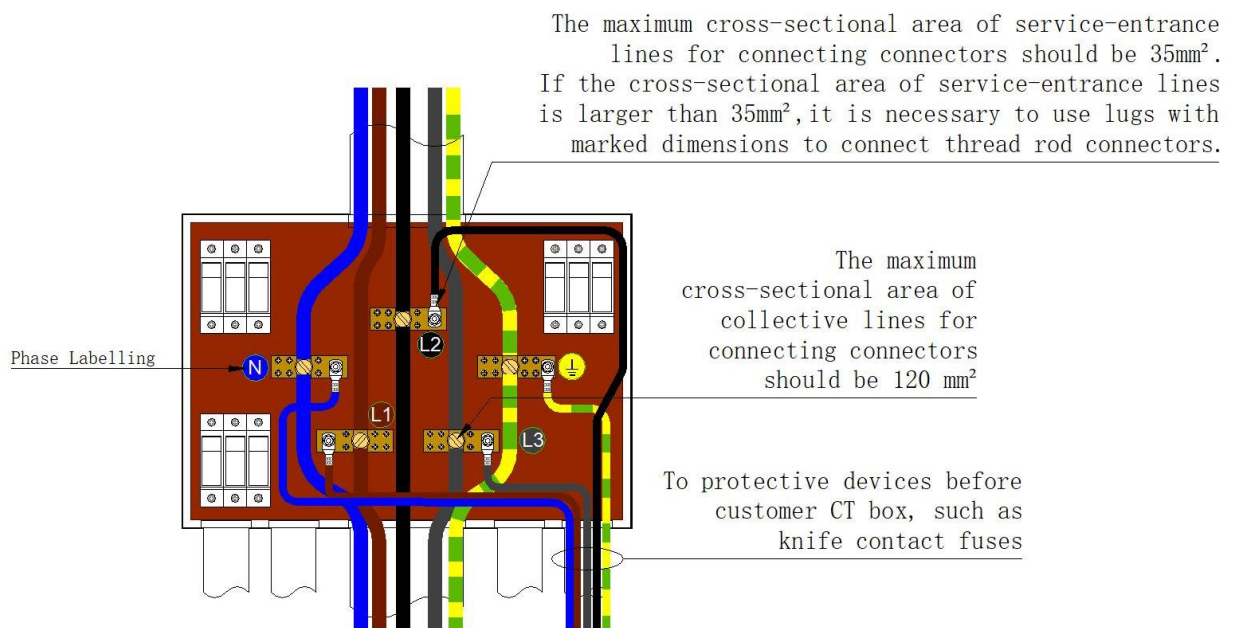
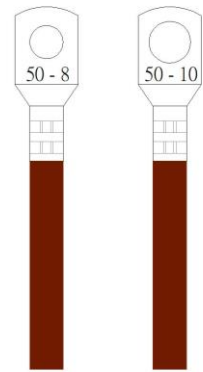


Front View

Example 3

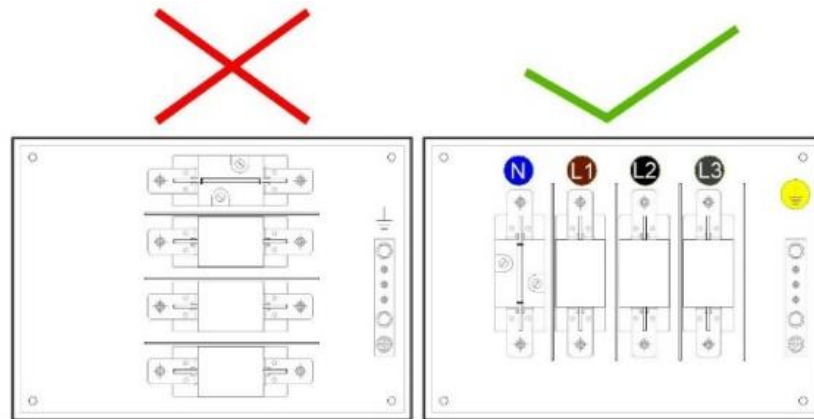
### Collective Line and Service-entrance Line

- It is necessary to ensure that no more than one set of collective lines passes through the CCL box.
- The maximum cross-sectional area of collective lines for connecting connectors should be 120 mm<sup>2</sup>.
- The maximum cross-sectional area of service-entrance lines for connecting connectors should be 35 mm<sup>2</sup>. If the cross-sectional area of service-entrance lines is larger than 35 mm<sup>2</sup>, it is necessary to use lugs with marked dimensions to connect thread rod connectors.
- Collective lines or service-entrance lines must be completely enclosed by the connectors and shall not come into contact with other energized parts except for the connection parts.



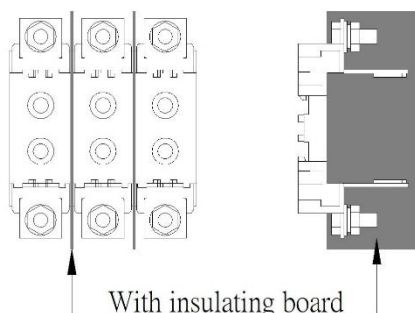
## Fuse

- For the convenience of engineering workers in operation and maintenance, fuses must be installed outside the unit or shop.
- Knife contact fuses should be mounted vertically, not horizontally, to avoid contact with other energized parts during operation.

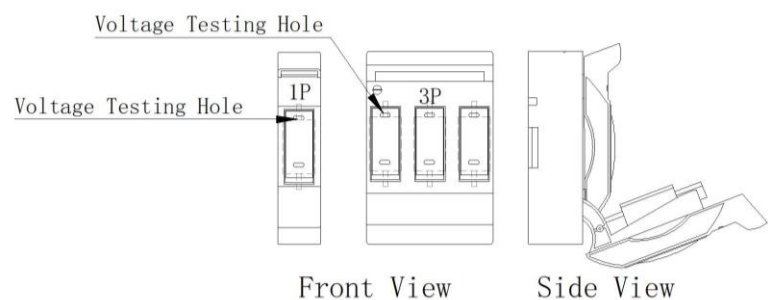


- When using a cylinder fuse, the modular fuse holder must be rated at 63A with dimensions 14 x 51 mm.
- If fuse base holders are used, an insulating board with a thickness of at least 2 mm must be installed between them.
- The following are two examples of commonly used NH-00 knife contact fuse base holders.
  - If knife contact fuse base holders are used, insulating boards with a thickness of at least 2 mm must be installed between the fuses.
  - If modular fuse holders are used, the base must have a built-in pull-out plug design, with a transparent cover on the front surface to check the fuse status and rating, and a voltage testing hole for testing purposes.

Knife Contact Fuse Base Holder (With isolating board)  
Sample Drawing

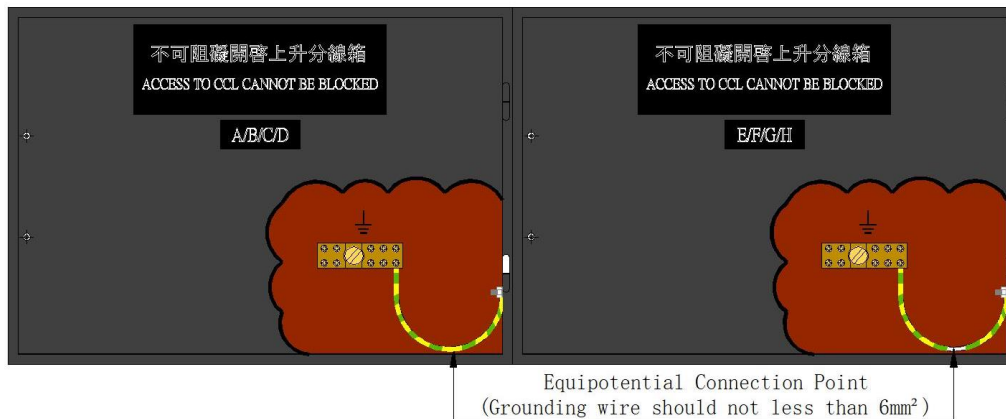


Modular Fuse Holder  
Sample Drawing



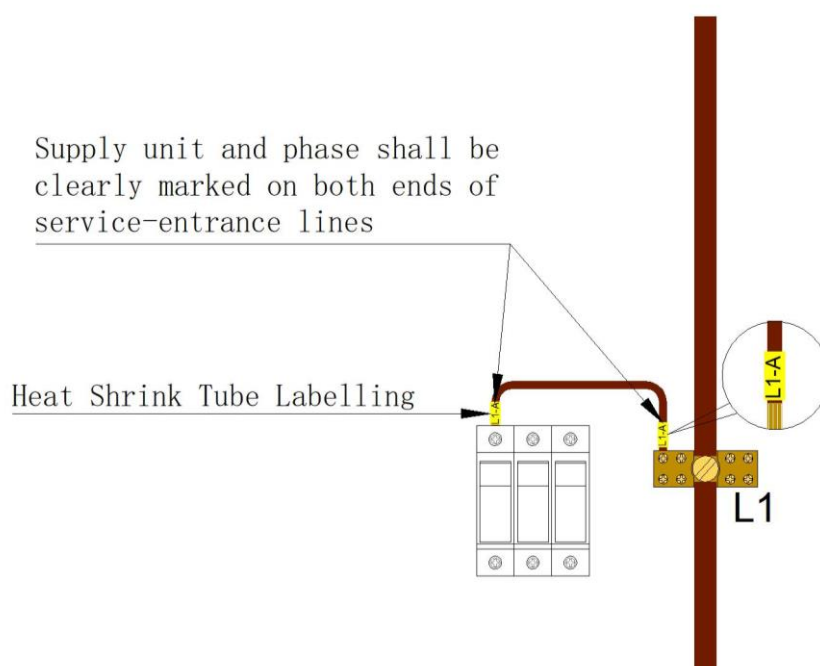
## Earthing

- Non-current-carrying metallic parts of the CCL box must be connected to earth with 6 mm<sup>2</sup> wire or copper braid wire.
- Each CCL box with individual collective lines is protected by an individual grounding connector.



## CCL Box Labelling

- CCL box must be provided with the following label: "ACCESS TO CCL CANNOT BE BLOCKED".
- The service-entrance lines in the CCL box should be equipped with heat shrink tube labelling to indicate the supply unit and phase.



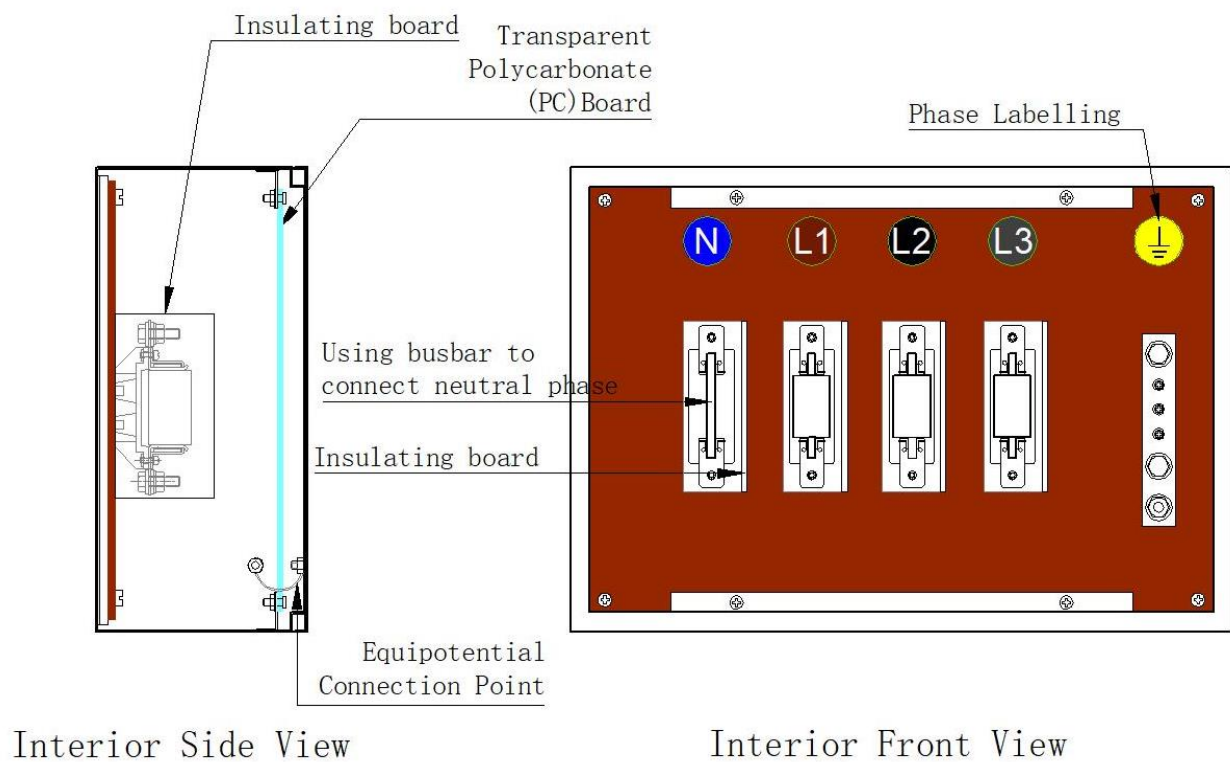


### **CCL Box Types**

The following are three recommendations for CCL boxes based on different usage and scenarios.

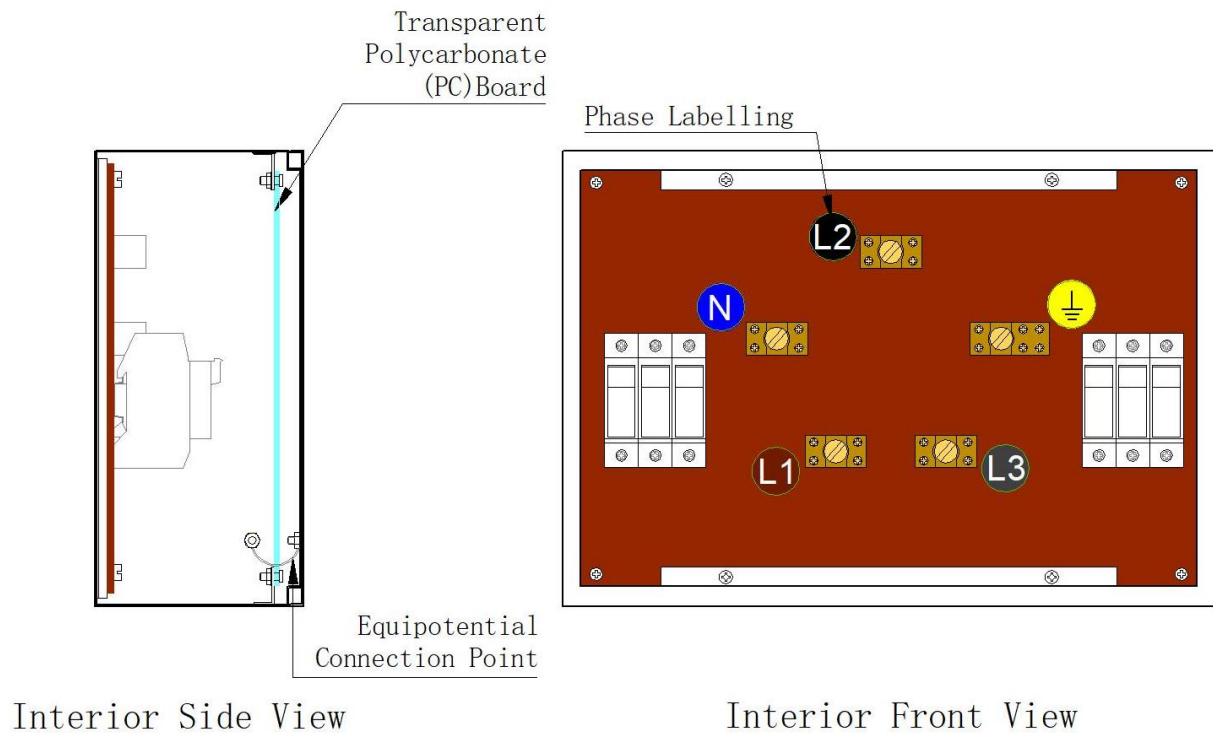
#### **1. CCL Box for installing knife contact fuses**

Using a Pothead installed on the building façade or property wall adjacent to the public right-of-way to supply electricity for a single user, CEM recommends the following option.



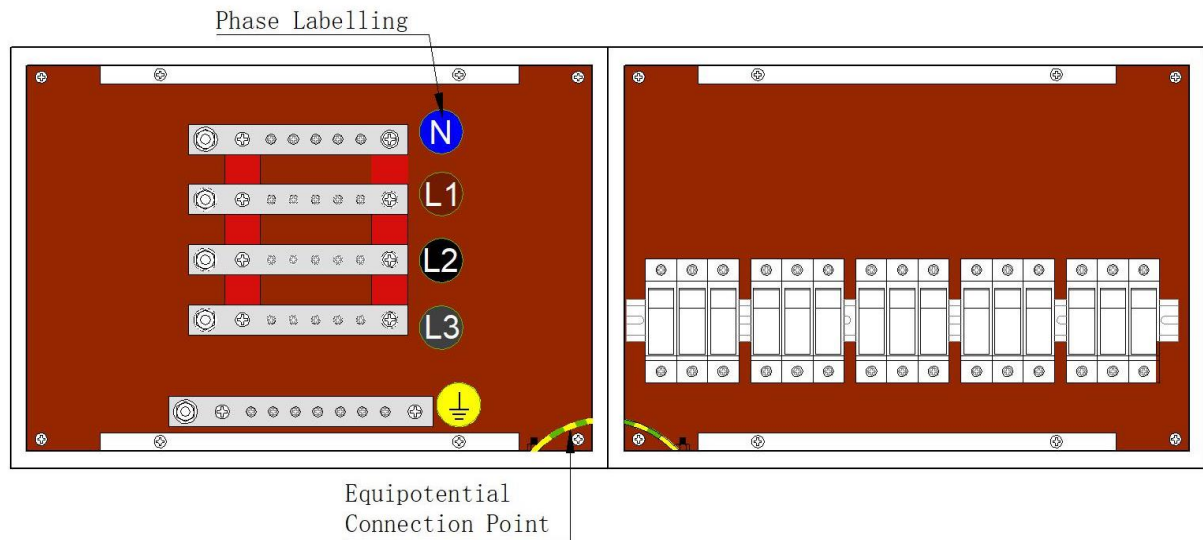
## 2. CCL Box supplied from Pothead shared by two independent users

Using a Pothead installed on the building façade or property wall adjacent to the public right-of-way to supply electricity for two users, CEM recommends the following option.

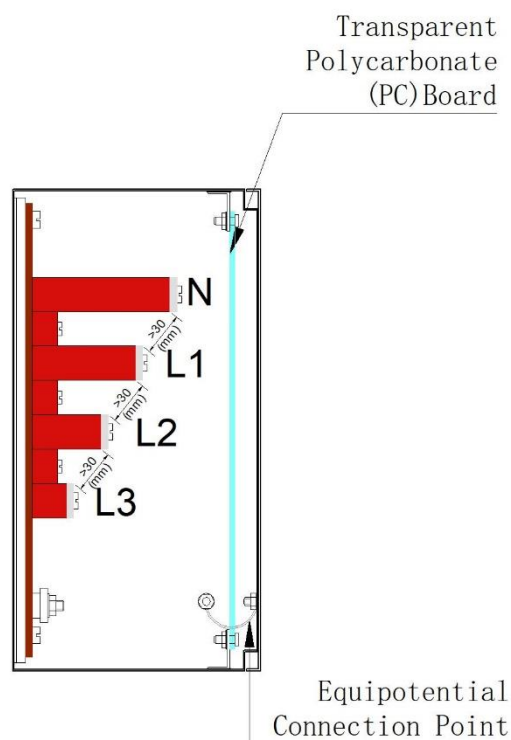


### 3. CCL box for more than four 3-phase users on the floor

Supply to multiple units in a building or using a Pothead installed on the building façade or property wall adjacent to the public right-of-way to supply electricity for multiple users, CEM recommends the following option.



Interior Front View

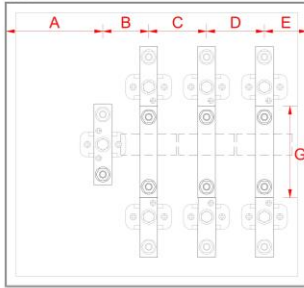


Interior Side View

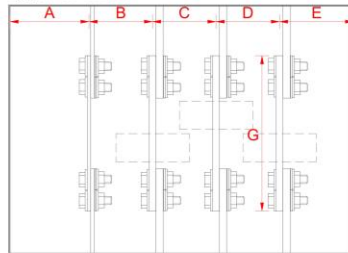
## 5.2 Box or Compartment for Current Transformer

In order to ensure sufficient insulation distance and expandability of the circuit inside the CT box, the configuration and specifications of the CT box should meet the following requirements.

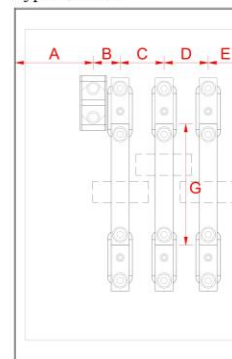
Type: CPTI22 / CPTI62



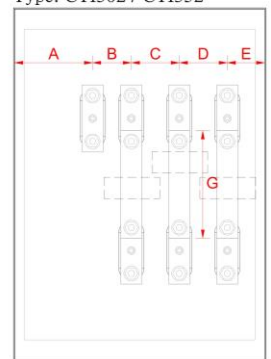
Type: CPTI150



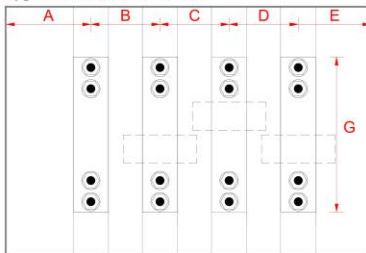
Type: CTI252



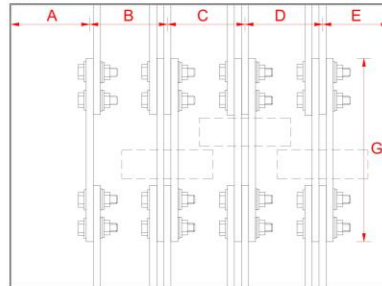
Type: CTI302 / CTI352



Type: CPTI80 / CPTI100

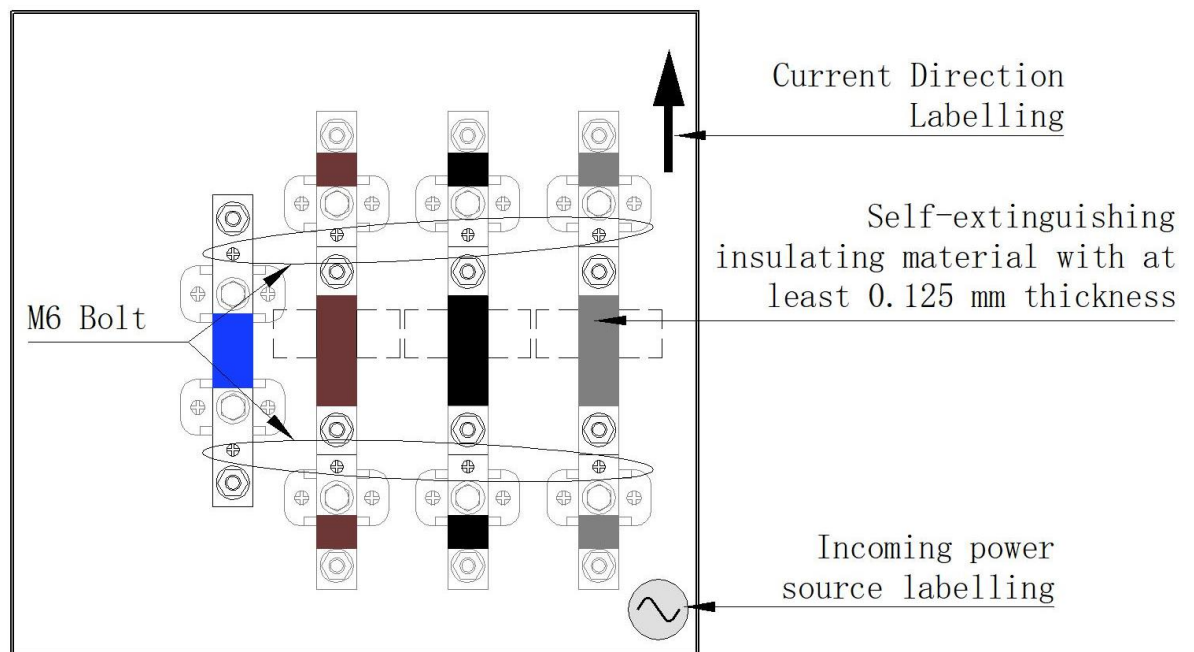


Type: CPTI200 / CPTI250



| Type    | CT Ratio (mm)              | A           | B   | C    | D    | E    | F<br>Depth | G                 |
|---------|----------------------------|-------------|-----|------|------|------|------------|-------------------|
| CPTI22  | 100/5A<br>150/5A<br>200/5A | 59 or 122   | 65  | 82   | 82   | 59   | 190        | 150<br>130<br>130 |
| CPTI62  | 250~600/5A                 | 59 or 122   | 65  | 82   | 82   | 59   | 190        | 150               |
| CPTI80  | 800/5A                     | 77 or 124   | 82  | 82   | 82   | 77   | 190        | 220               |
| CPTI100 | 1000/5A                    | 103 or 130  | 98  | 98   | 98   | 103  | 190        | 220               |
| CPTI150 | 1500/5A                    | 75 or 112   | 90  | 90   | 90   | 105  | 220        | 220               |
| CPTI200 | 2000/5A                    | 75 or 112   | 110 | 110  | 110  | 95   | 220        | 220               |
| CPTI250 | 2500/5A                    | 75 or 112   | 110 | 110  | 110  | 95   | 220        | 260               |
| CTI252  | 100/5A<br>150/5A<br>200/5A | 35.5 or 112 | 38  | 62.5 | 62.5 | 48.5 | 190        | 172<br>152<br>152 |
| CTI302  | 300~400/5A                 | 53 or 112   | 55  | 68   | 68   | 53   | 190        | 152               |
| CTI352  | 500~600/5A                 | 58.5 or 112 | 65  | 82   | 82   | 59.5 | 190        | 130               |

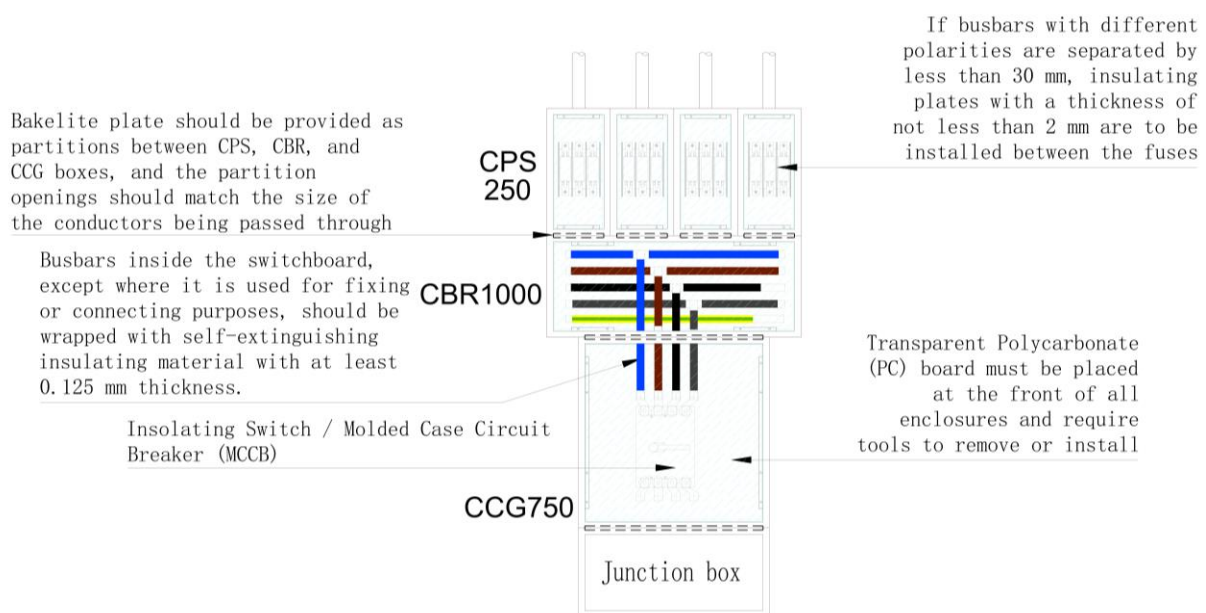
- The CT box should be labelled to demonstrate the incoming power source and current direction.
- Busbars inside the box, except where it is used for fixing or connecting purposes, should be wrapped with self-extinguishing insulating material with at least 0.125 mm thickness.
- The dimensions in Column A above are the requirements of the NCEM and the recommended practice in these Guidelines for the expandability of the equipment in the CT box, and both CT box specifications are acceptable.
- The type of wire used to connect the CT box to the meter shall be VV10x4 mm<sup>2</sup> and the length of the wire shall not exceed 10 m. Each core of wire shall be marked with a clear and wear-resistant number from 1 to 10 along the body of the wire.



### 5.3 Main Collective Switchboard (QC)

In order to ensure that the circuit inside the QC has sufficient insulation distance, the configuration and specifications of the QC should meet the following requirements.

- Insulating boards with a thickness of not less than 2 mm are to be installed between the fuses.
- Busbars inside the switchboard, except where it is used for fixing or connecting purposes, should be wrapped with self-extinguishing insulating material with at least 0.125 mm thickness.
- Transparent polycarbonate (PC) board must be placed at the front of all enclosures and requires tools to remove or install. Steel angle bars for installing the transparent board must be welded to the switchboard.
- Busbars with different polarities are separated by not less than 30 mm.
- Bakelite plates should be provided as partitions between CPS, CBR, and CCG boxes, and the partition openings should match the size of the conductors being passed through.

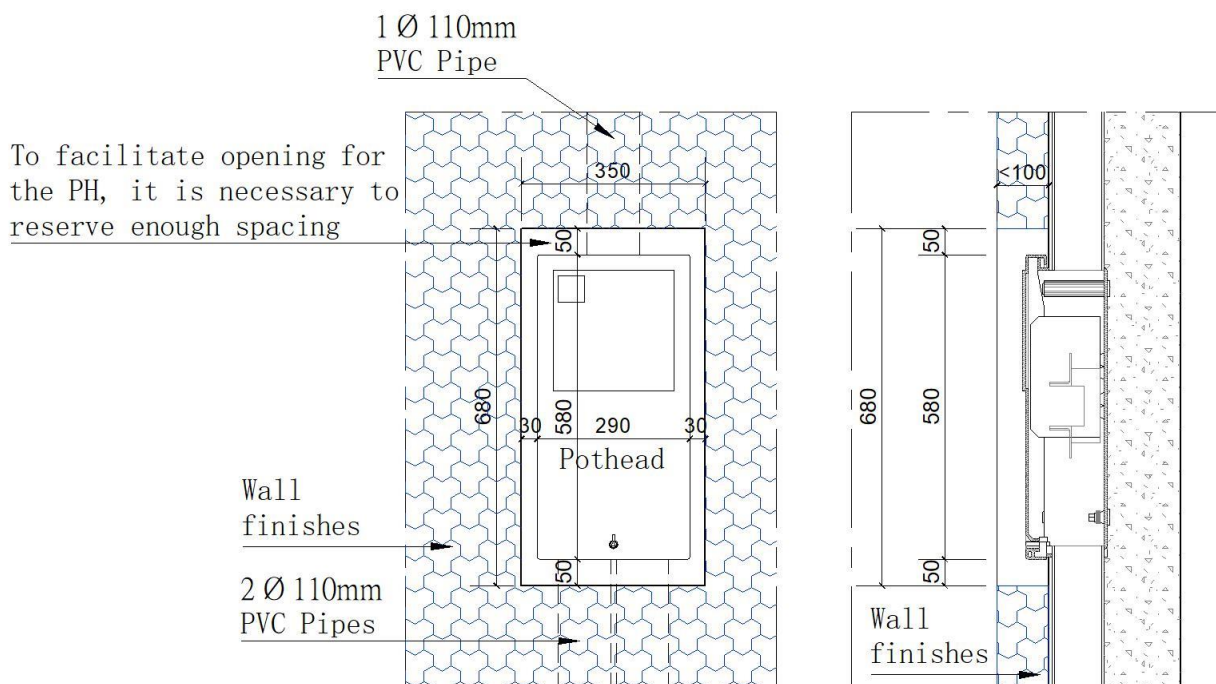


Annex 1 provides typical QC installation locations and connection examples.

### 5.4 Pothead (PH)

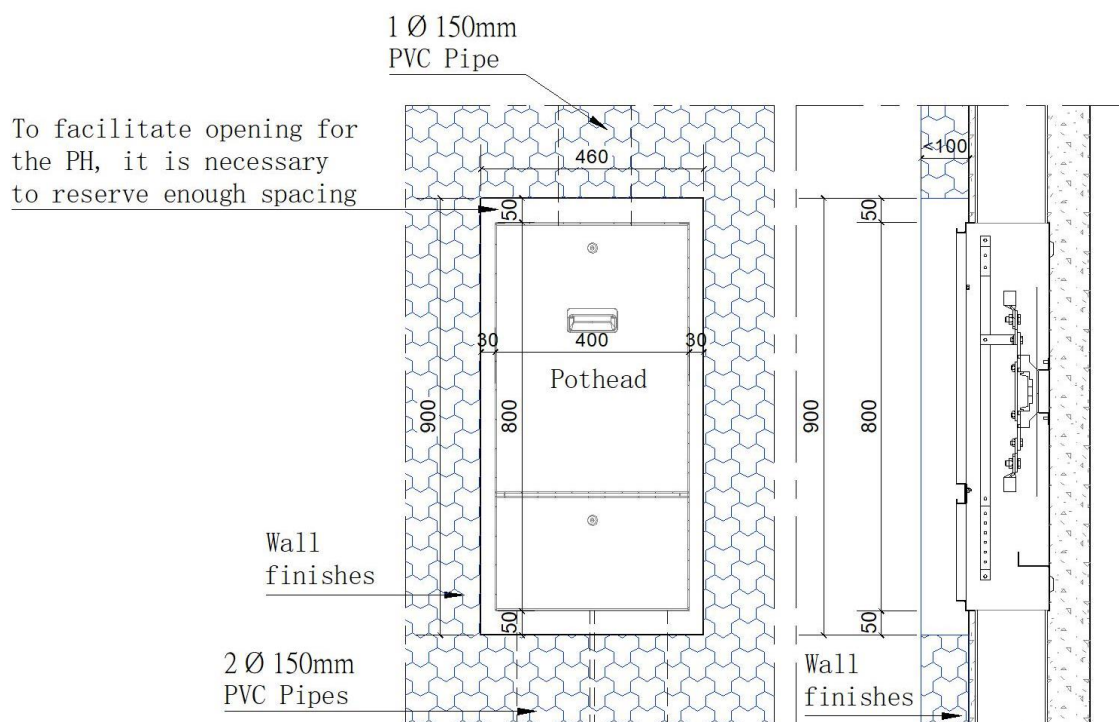
- The connection between the PH neutral wire and the main grounding busbar should be a  $V35\text{mm}^2$  cable.
- Based on the specific design of the network circuit, CEM will notify electrical contractors to use the following Type A or Type B PH.
- Any decorative wall finishes on the outside of the PH must be reserved for a sufficiently large decorative door according to the size of the PH shown in the figures below. The decorative door must be able to open at 180 degrees to allow workers to inspect and maintain at any time, and it must also clearly indicate “CEM PH” and the PH number. Signboards and decorations must not block the PH.
- PH and the wall finishes must be kept at an appropriate distance (shown in the figures below) to ensure PH can be opened.

#### Type-A Pothead :



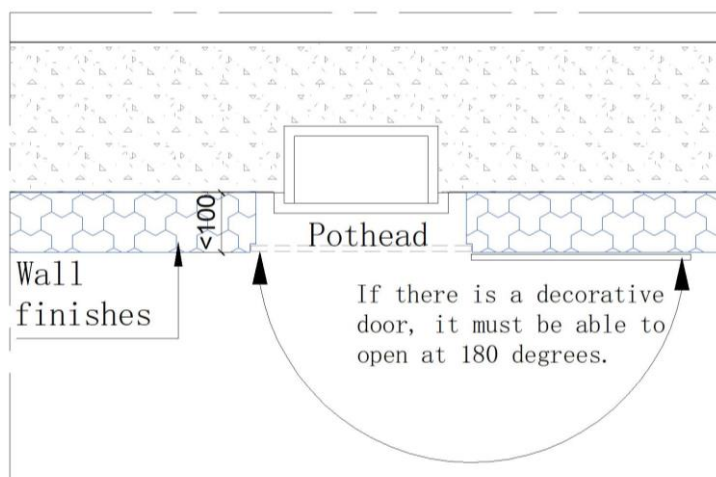
TYPE-A Pothead



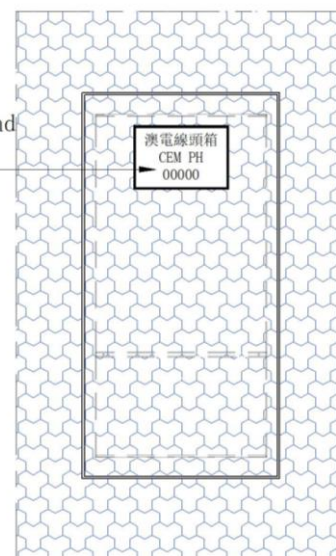
**Type-B Pothead :**

TYPE-B Pothead

Annex 2 provides typical Pothead installation location and connection manhole examples.



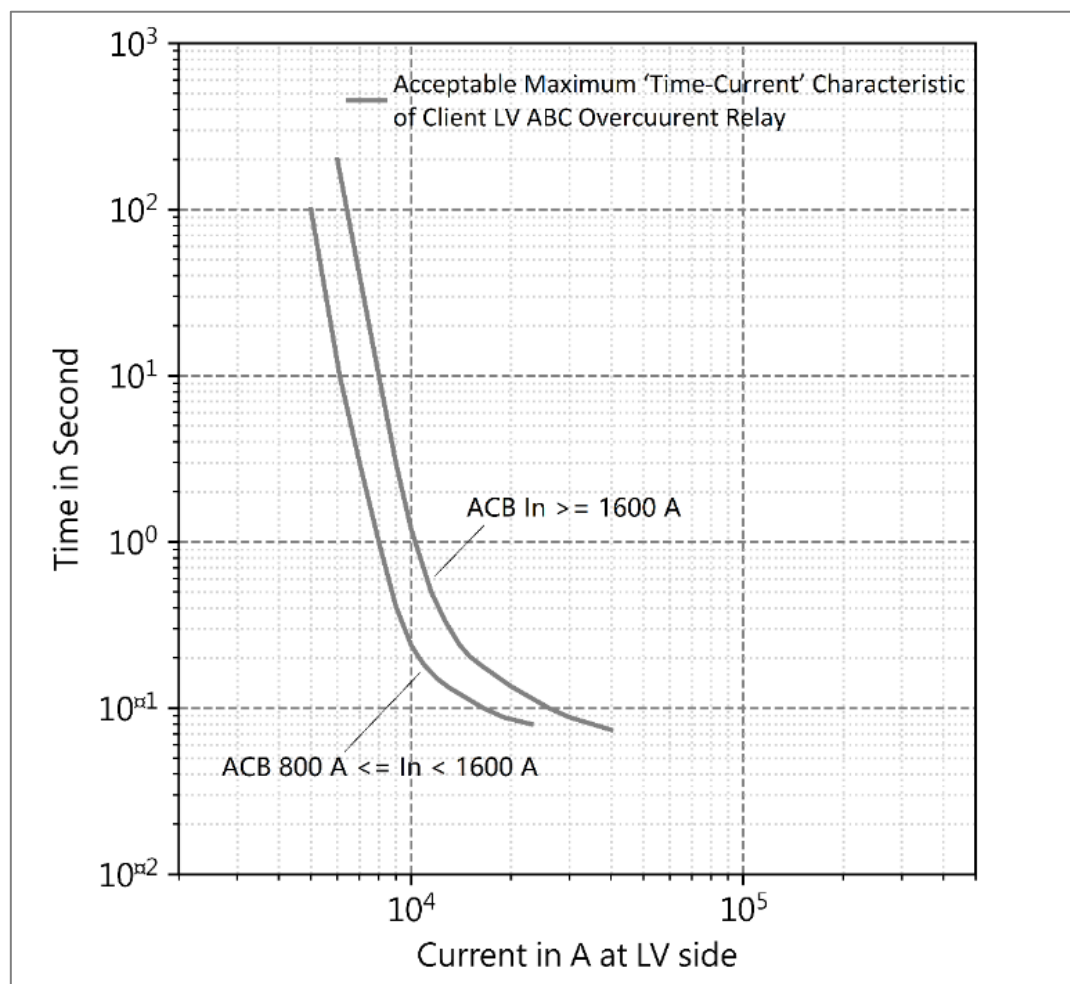
The decorative door must also clearly indicate “CEM PH” and the PH number.





## 6. Specifications and Installation Requirements of Connection Point to Network

- Air circuit breaker (ACB) or molded case circuit breaker (MCCB) directly supplied from the LV network must be four-pole. The rated ultimate short-circuit breaking capacity of ACB must be at least 40 kA, while that of MCB must be 36 kA. The rating of MCCB directly connected to the network must not exceed 800 A.
- The overcurrent protection “time-current” characteristics of air circuit breakers directly connected to the CEM transformer must be compatible with upstream network protection equipment. Their protection settings must be locked with a closed door by CEM without obstructing normal operation buttons, and cannot be changed remotely. The setting values must be clearly displayed on the air circuit breaker and the main low-voltage switchboard panel for inspection at any time.

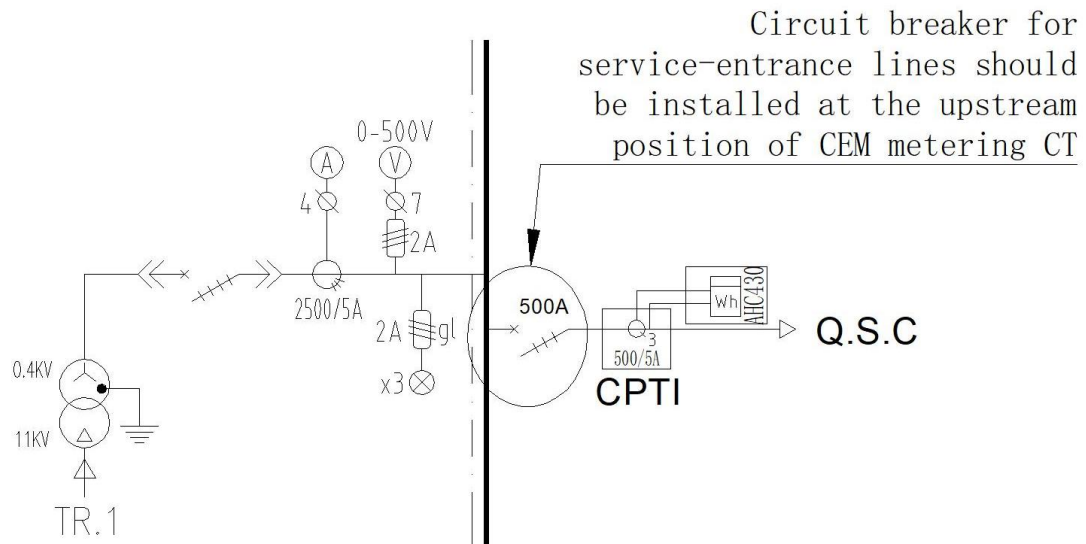


Max. Time for Overcurrent Protection Relay / Current Characteristic Curve

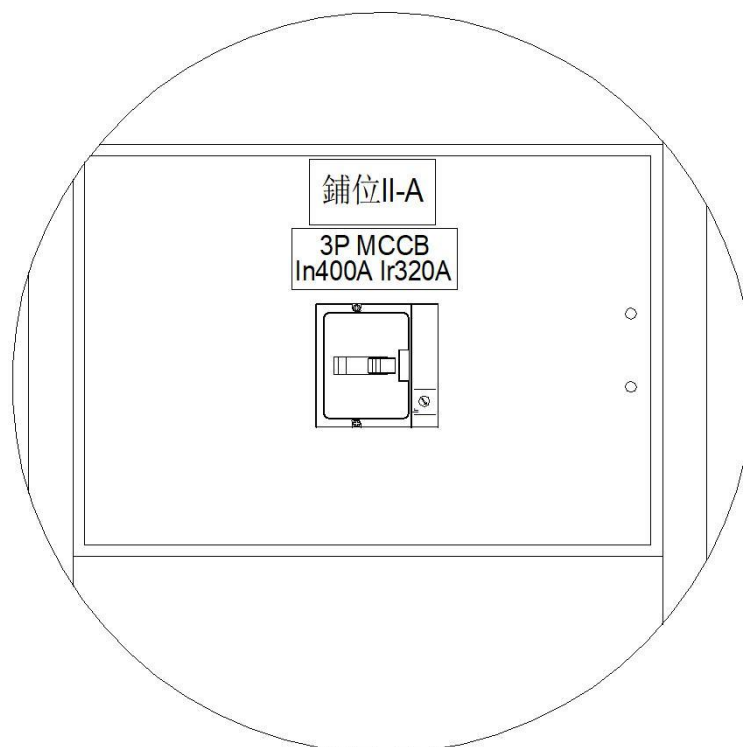
- If the main low voltage switchboard is supplied by more than one CEM transformer, a four-pole circuit breaker must be installed between each pair of main circuit breaker as an interconnection switch, and mechanically interlocked with two relevant main circuit breakers.
- The grounding resistance of buildings should be as low as possible and should not exceed ten ohms under any circumstances. The grounding resistance of the temporary power supply system shall not exceed four ohms, in accordance with Article 113, subparagraph 2 of Administrative Regulation No. 32/2023 “Technical Code for Occupational Safety and Health in Construction Industry”.
- For the network connection of the photovoltaic system to the CEM public network, the project responsible must complete the testing items and submit the report before applying to CEM for acceptance. The format of the report can be found on the CEM website.
- Annex 3 provides the general requirements of network cable laying and connection for the main low voltage switchboard (QG) room.
- Annex 4 provides the arrangement of connection point to the network or collective line on building façade.
- Annex 5 provides connection examples of temporary electrical installations of 34 kVA or less. CEM proposes four methods for connection point to the network based on the incoming cable size.
- Annex 6 provides a template for the low-voltage installation acceptance form. The project responsible for the new building must complete the testing items in the template and submit the report before applying to CEM for acceptance.

## 7. Installation Work Examples

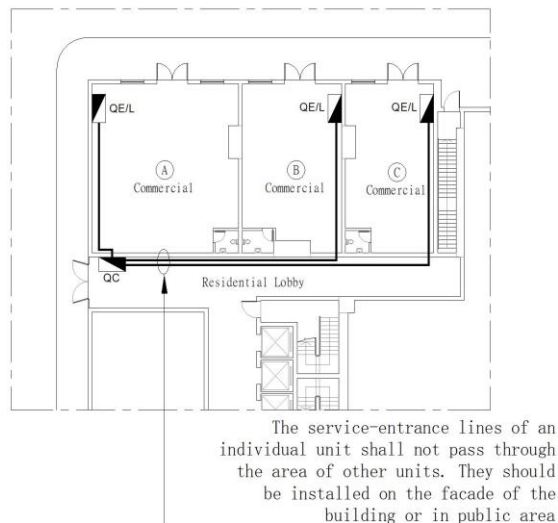
- Example 1 : Circuit breaker for service-entrance lines should be installed at the upstream position of the CEM metering CT.



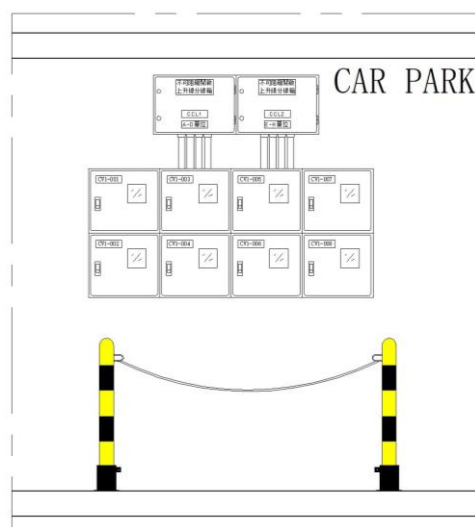
- Example 2 : Label is provided on the circuit breaker of service-entrance line to indicate its nominal current ( $I_n$ ) and overcurrent protection rating ( $I_r$ ), allowing inspection at any time.



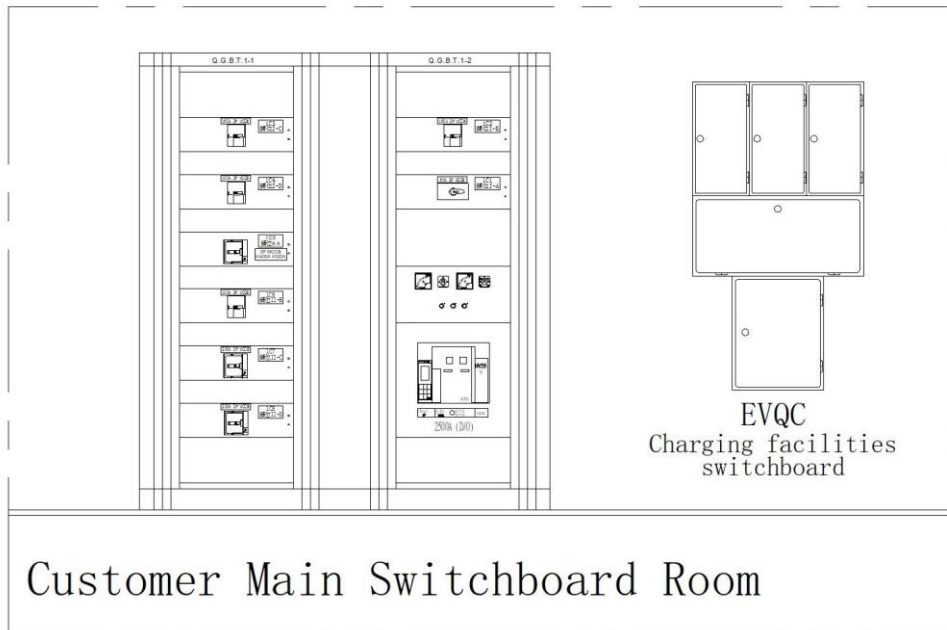
- Example 3 : CEM cable compartment, low-voltage CT boxes or compartments, and their incoming and outgoing busbars should comply with the dimensional requirements specified in these Guidelines. The dimensions of busbars in other parts not specified in these Guidelines should not be less than the DIN43671 standard.
- Example 4 : The service-entrance lines of an individual unit shall not pass through the area of other units. Any public electrical installations and circuits should not be installed within the area of individual units.



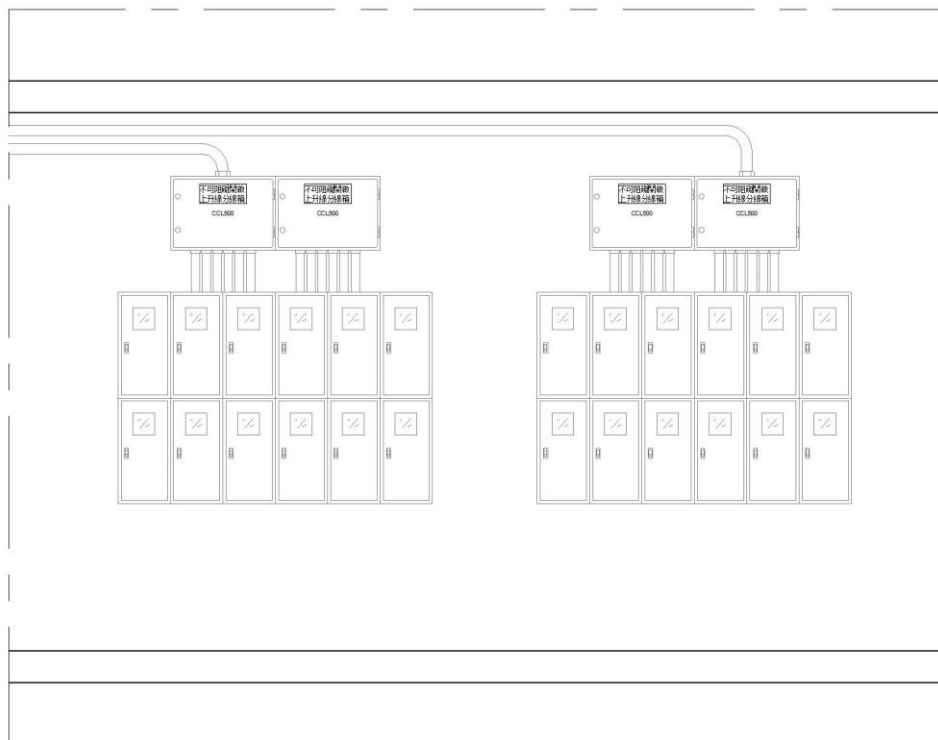
- Example 5 : If the main switchboard or related meters for electric vehicle charging facilities are installed within the parking area, two galvanized steel safety poles connected by a chain and marked with yellow or black labelling must be erected in front of the main switchboard, meter board or box, for clearly demarcating the work area and accessibility for workers.



- Example 6 : If the total power of the charging facilities in the parking is within 1600 kVA, a dedicated main switchboard should be installed, which should be as close as possible to the building supply point.

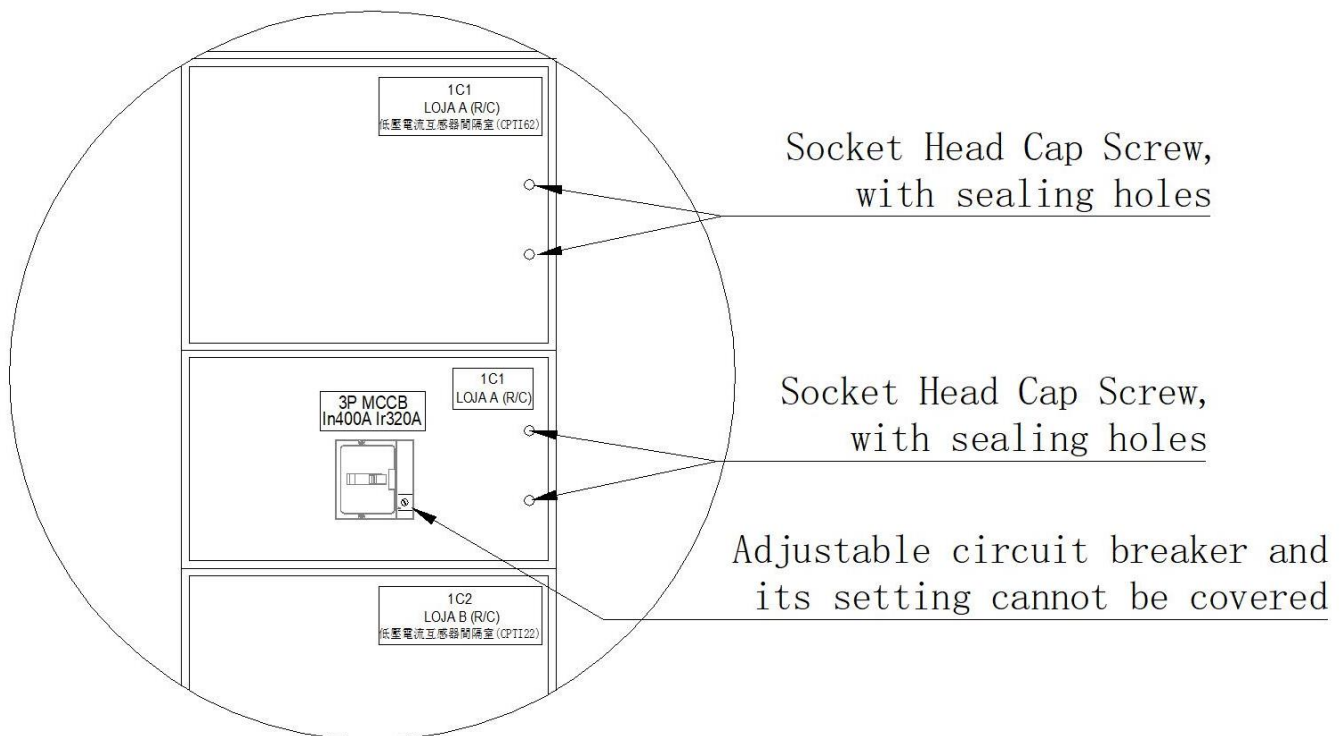


- Example 7 : Meters for each parking place should be located as close as possible to the electric vehicle dedicated switchboard (EVQC), and meters for parking spaces within the same area should also be installed together.

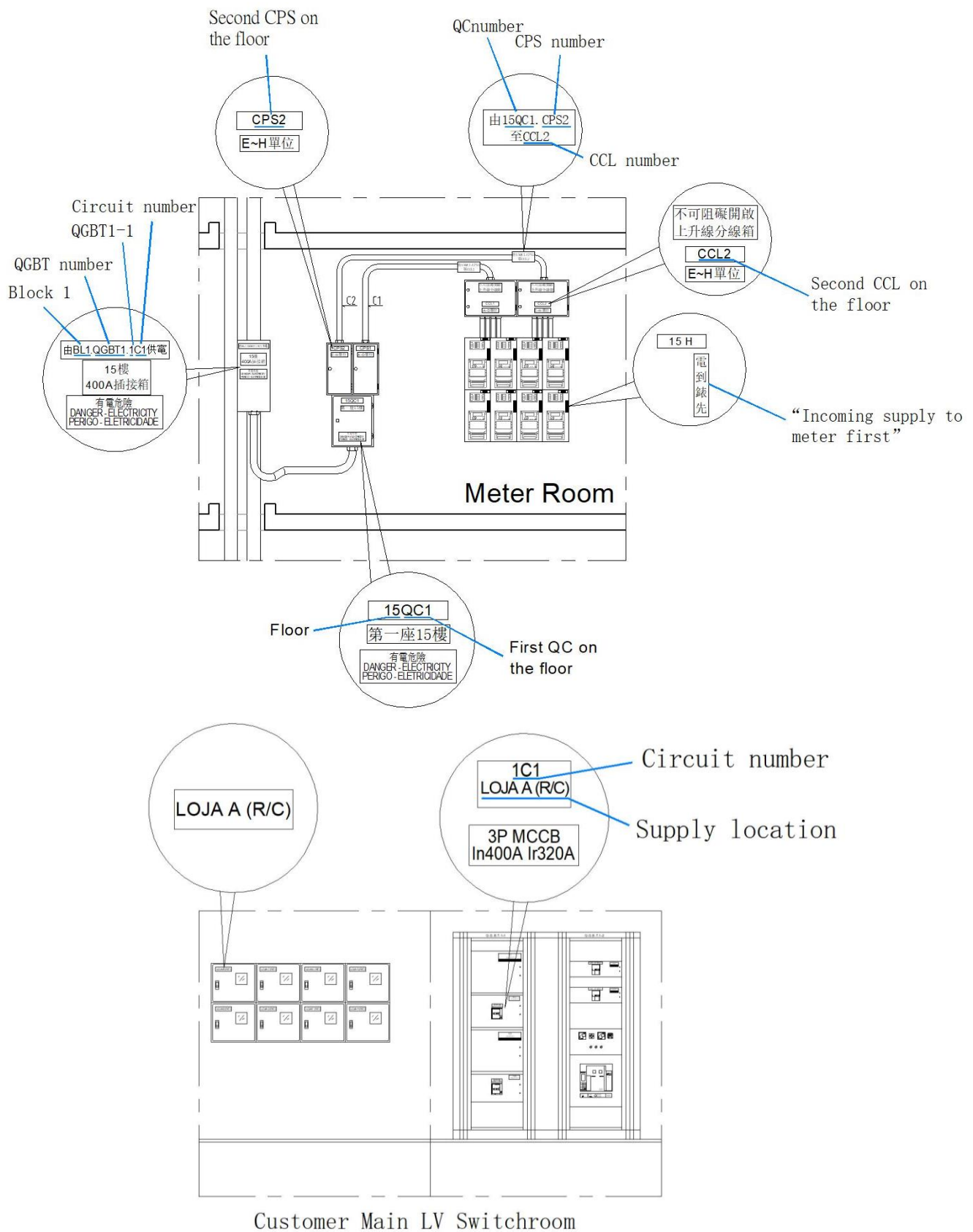


Example 8 : The installation of electric vehicle charging equipment must meet with the related requirements of the 《電動車輛（汽車、摩托車）充電設備及充電櫃防火及電力安全指引》 and 《電動車輛充電設施安全技術指引》.

- Example 9 : The adjustable tripping device and its setting cannot be covered. The trip current setting must be clearly labelled, and the cabinet door of the circuit breaker must be equipped with two socket head cap screws with sealing holes.



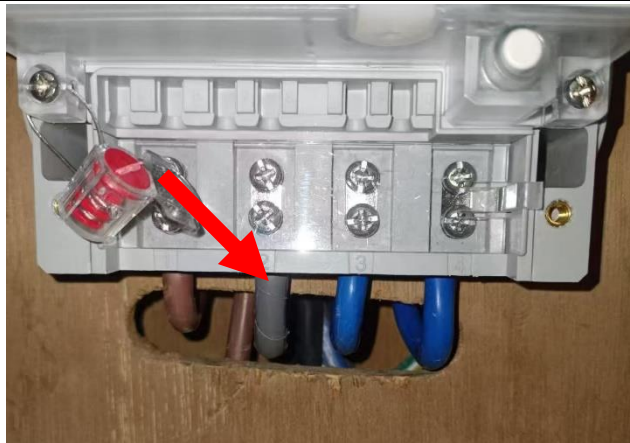
- Example 10 : Legible and durable labels must be provided for each equipment, and the specific number of labels depends on the equipment on-site.





For reference, the following are common examples of **non-acceptance work**.

### Individual Metering Board and Meter Box



Example 11 : ✗ Incorrect color of single phase service-entrance lines



✓ Correct color of single-phase service-entrance lines is brown and blue



Example 12 : ✗ Incorrect color of three-phase service-entrance lines



✓ Correct color of three-phase service-entrance lines is brown, black, grey and blue





Example 13 : ✗ Service-entrance lines of meter installed in open wire way



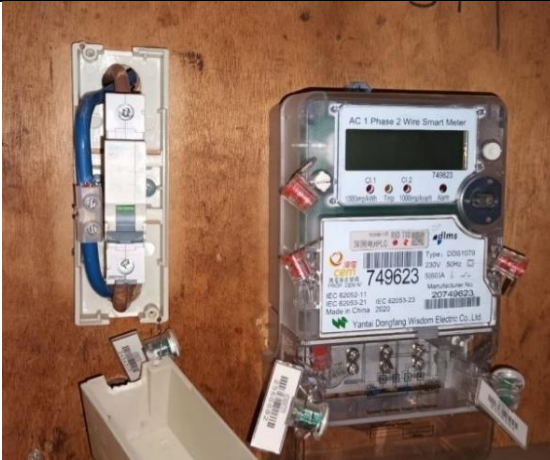
✓ Service-entrance lines of meter should be connected behind the meter board



Example 14 : ✗ Neutral wire incorrectly connected to the Miniature Circuit Breaker (MCB)



✓ Phase wire should be connected to the Miniature Circuit Breaker (MCB)



Example 15 : ✖ The neutral wire shall not have any connections within the meter position



✓ The neutral wire after the meter should go straight to the unit



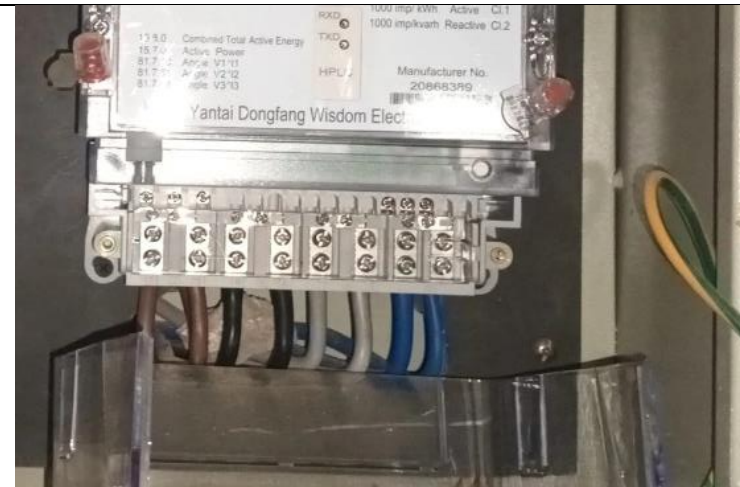
Example 16 : ✖ Opening dimensions of the meter board do not comply with NCEM



✓ Opening dimensions of the meter board must comply with the NCEM



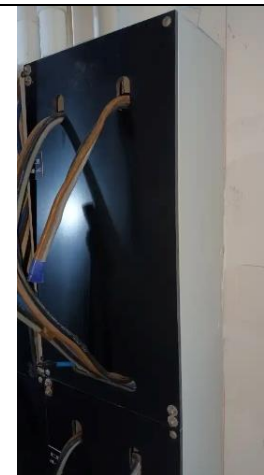
Example 17 : ✗ Incorrect meter wiring sequencing



✓ Correct meter wiring sequencing with clockwise rotation (left to right: brown, black, grey, blue)

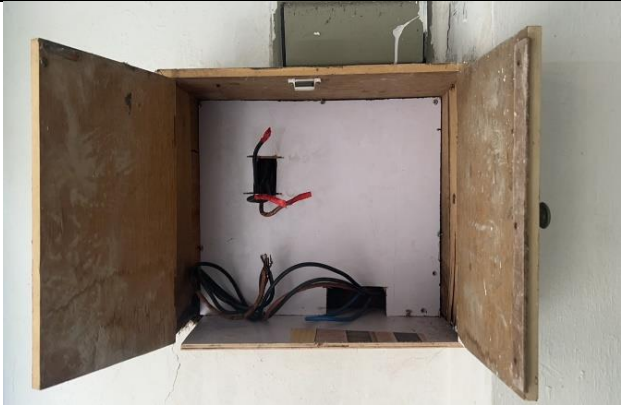
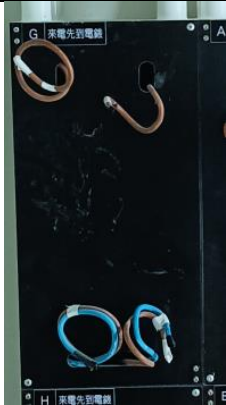


Example 18 : ✗ Meter position and meter board are not securely fixed



✓ Meter position must be mounted in a secure fixed position



|                                                                                                                                                    |                                                                                           |
|----------------------------------------------------------------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------|
|                                                                   |        |
| <p>Example 19 : ✖ The meter board is not Bakelite plate, the openings dimensions do not meet with NCEM no internal cable between MCB and meter</p> | <p>✓ New meter board requires the use of Bakelite plate, with openings that meet NCEM</p> |
|                                                                  |       |
| <p>Example 20 : ✖ No proper identification labelling</p>                                                                                           | <p>✓ “電到錶先” and unit identification labelling must be provided</p>                        |

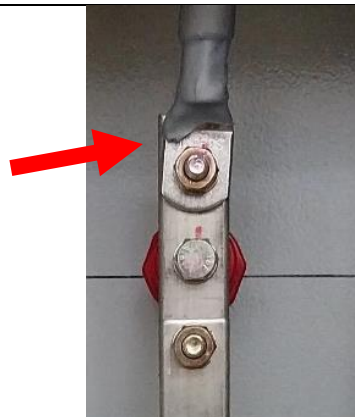
|                                                                                             |                                                                                                                                                                         |
|---------------------------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|            |                         |
| <p>Example 21 : ✖ No legible, durable and properly labelled identification labelling</p>    | <p>✓ Each electrical box must be labelled with legible and durable identification labelling, such as circuit name and box name that are consistent with the drawing</p> |
|           |                                                                                     |
| <p>Example 22 : ✖ Exposed non-current carrying metal parts are not effectively grounded</p> | <p>✓ All exposed non-current carrying metal parts are effectively grounded</p>                                                                                          |



Example 23 : ✖ Incorrect way to connect two cables



✓ Correct way to connect two cables



Example 24 : ✖ The length of the heat shrink tube is too long and poses a risk of poor contact with the circuit



✓ The length of the heat shrink tubes is suitable and should not cover the contact surface of the cable lugs

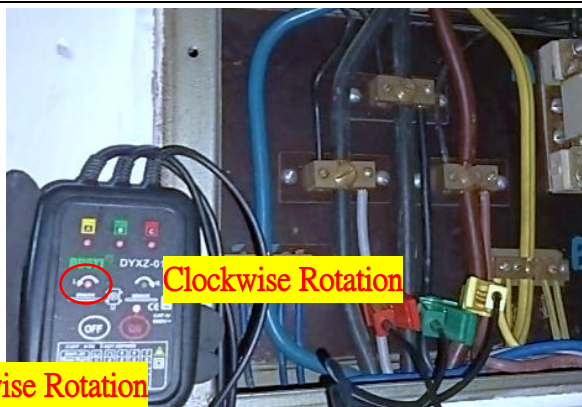
## Collective Line Distribution Box (CCL)



Example 25 : ✗ No fuses were installed during inspection



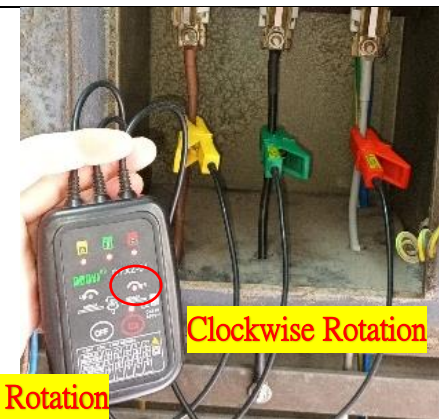
✓ Fuses matching with the subscribed demand is required to be installed during inspection



Anti-clockwise Rotation

Clockwise Rotation

Example 26 : ✗ Incorrect phase sequence of power supply (Anti-clockwise rotation)



Clockwise Rotation

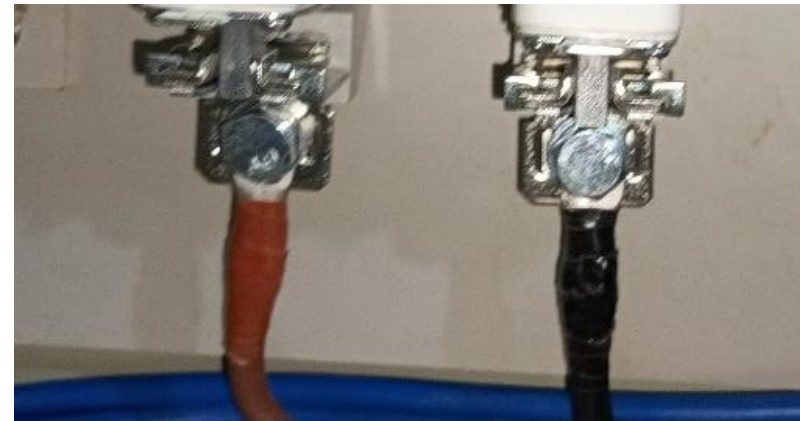
Anti-clockwise Rotation

✓ Correct phase sequence of power supply (Clockwise rotation)





Example 27 : ✗ Lugs are not wrapped with insulating tape



✓ Lugs should be wrapped with insulating tape

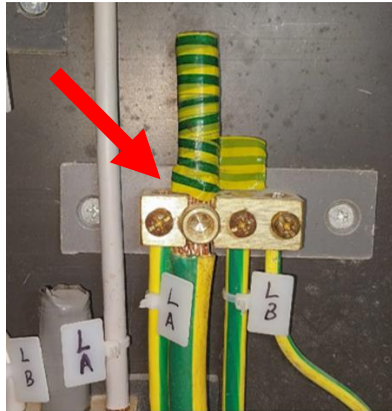


Example 28 : ✗ The lugs of service-entrance lines shall not be pressed against the lugs of other units



✓ The lugs of service-entrance lines from different units should be connected correctly

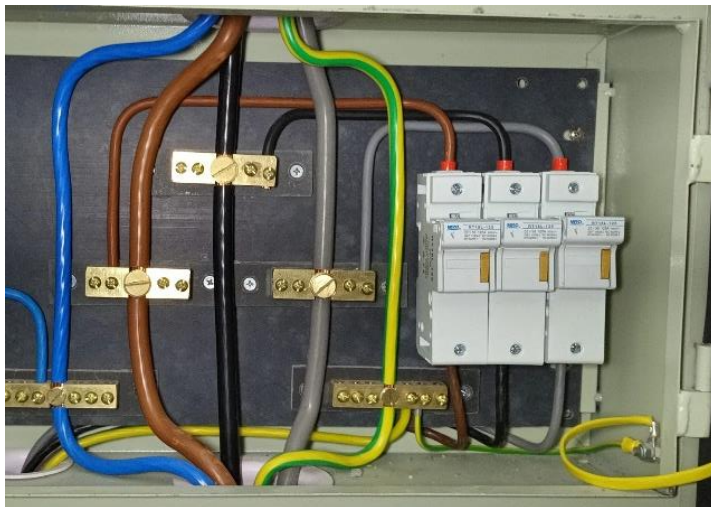




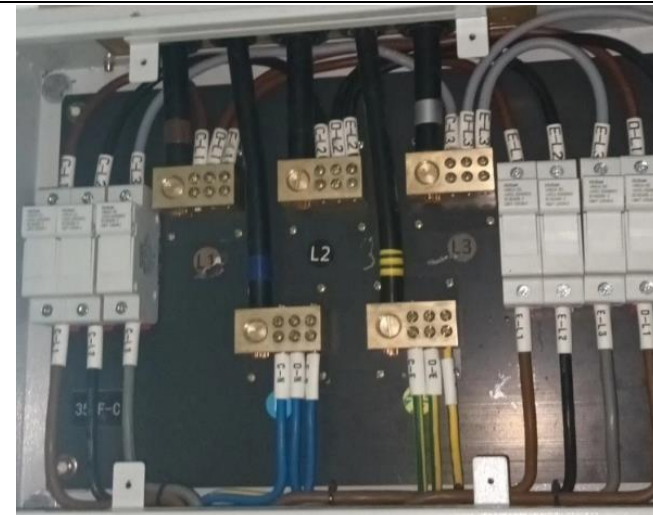
Example 29 : ✗ Connectors are not adequate size for the collective lines



✓ Connectors are adequate size for the collective lines



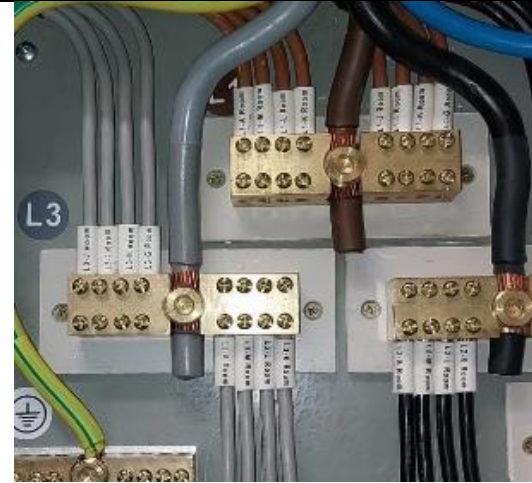
Example 30 : ✗ No proper phase and unit identification labelling



✓ Service-entrance lines must be labelled with clear, easy-to-read, durable phase and unit identification labelling



Example 31 : ✗ Incorrect way to connect service-entrance lines



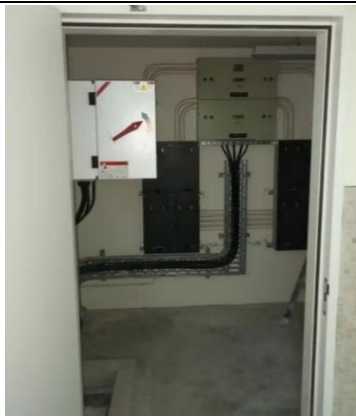
✓ Correct way to connect service-entrance lines



Example 32 : ✗ Incorrect way to install transparent polycarbonate (PC) board

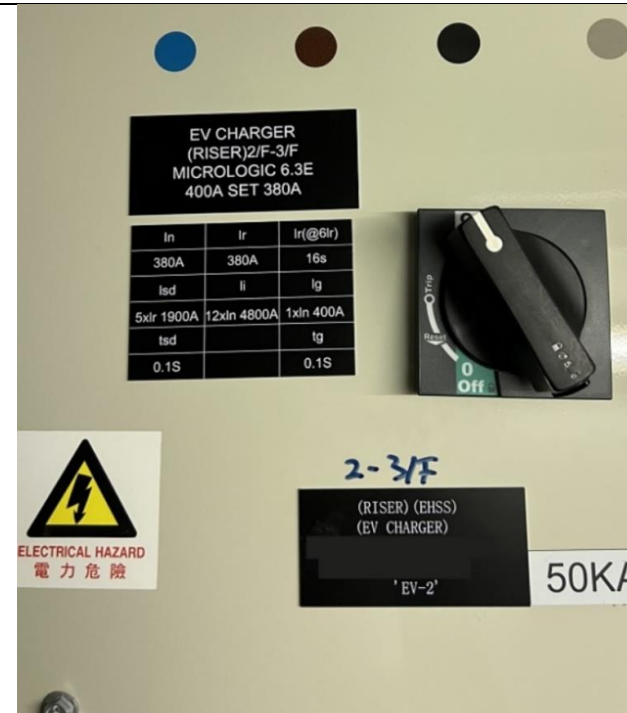


✓ Transparent polycarbonate (PC) board should be fixed with steel angle bars

| Installation Location and Labelling of Electrical Installations                                              |  |                                                                                                |  |
|--------------------------------------------------------------------------------------------------------------|--|------------------------------------------------------------------------------------------------|--|
|                             |  |             |  |
| <p>Example 33 : ✖ No water pipes or condense water facilities shall be placed above electrical equipment</p> |  | <p>✔ Avoid installing equipment that may pose a risk of leakage above electrical equipment</p> |  |
|                            |  |            |  |
| <p>Example 34 : ✖ Inadequate safe operating space for maintenance work</p>                                   |  | <p>✔ For safe maintenance work, the front working space should not less than 900 mm</p>        |  |



Example 35 : ✖ The current setting value of the trip device is not displayed on the cabinet door



✓ Label is provided on the circuit breaker of service-entrance line to indicate its nominal current (In) and overcurrent protection rating (Ir)

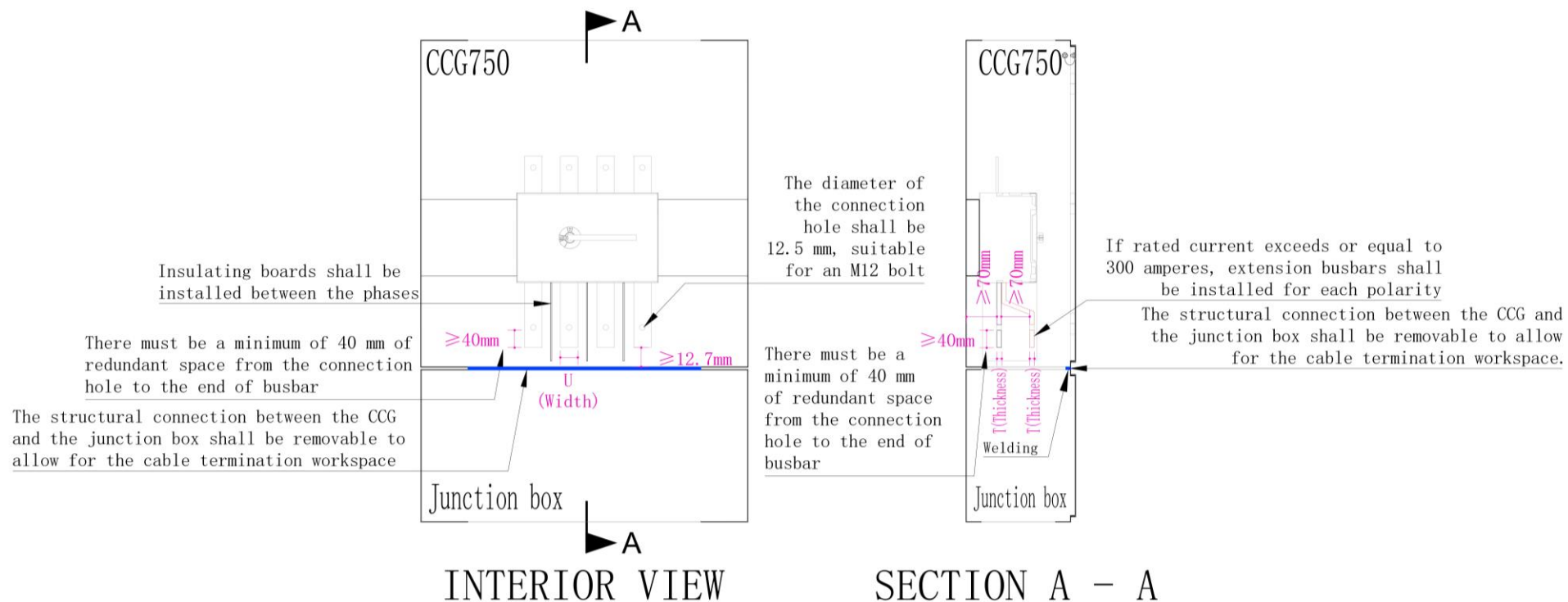
**ANNEX 1****Typical QC Installation Locations and Connection Examples**

To ensure daily maintenance and operation, CEM has established typical QC and connection specifications, so that cables can be smoothly connected to enable the equipment to operate properly and meet the necessary safety conditions.

The installation specifications of the QC are as follows.

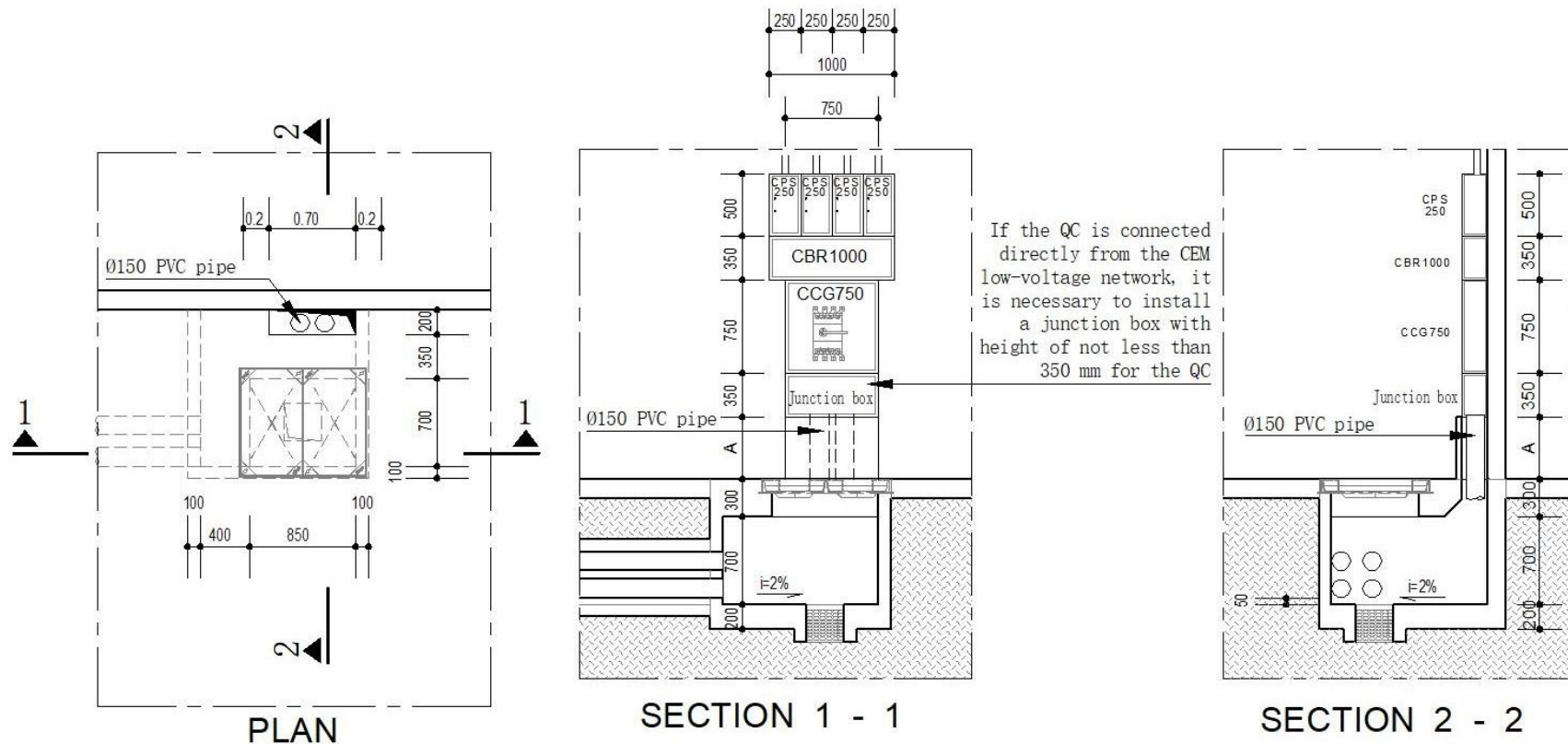
- In order to ensure the CEM cable lugs can be matched, the width, thickness, and number of extension busbars should be determined by the isolating switch rating, as shown in the table below.
- The diameter of the connection holes on the extension busbars shall be 12.5 mm, suitable for an M12 bolt, and there must be a minimum of 40 mm of redundant space from the connection hole to the end of the busbar.
- Insulating boards shall be installed between the extension busbars with different polarities.
- The clearance between the backboard of the CCG and the extension busbars must be at least 70 mm to facilitate the installation and removal of incoming cables and bolts. If the insulating switch rating of the connection point to the network exceeds 300 A, front and rear extension busbars should be installed with 70 mm between them.
- The structural connection between the CCG and the junction box shall be removable to allow for the cable connecting workspace.
- The installation height of QC should be located above the flood proofing elevation defined by DSSCU.
- If the QC is connected directly from the CEM LV network, it is necessary to install a junction box for the QC with a height not less than 350 mm to avoid obstruction of the circuit connection.



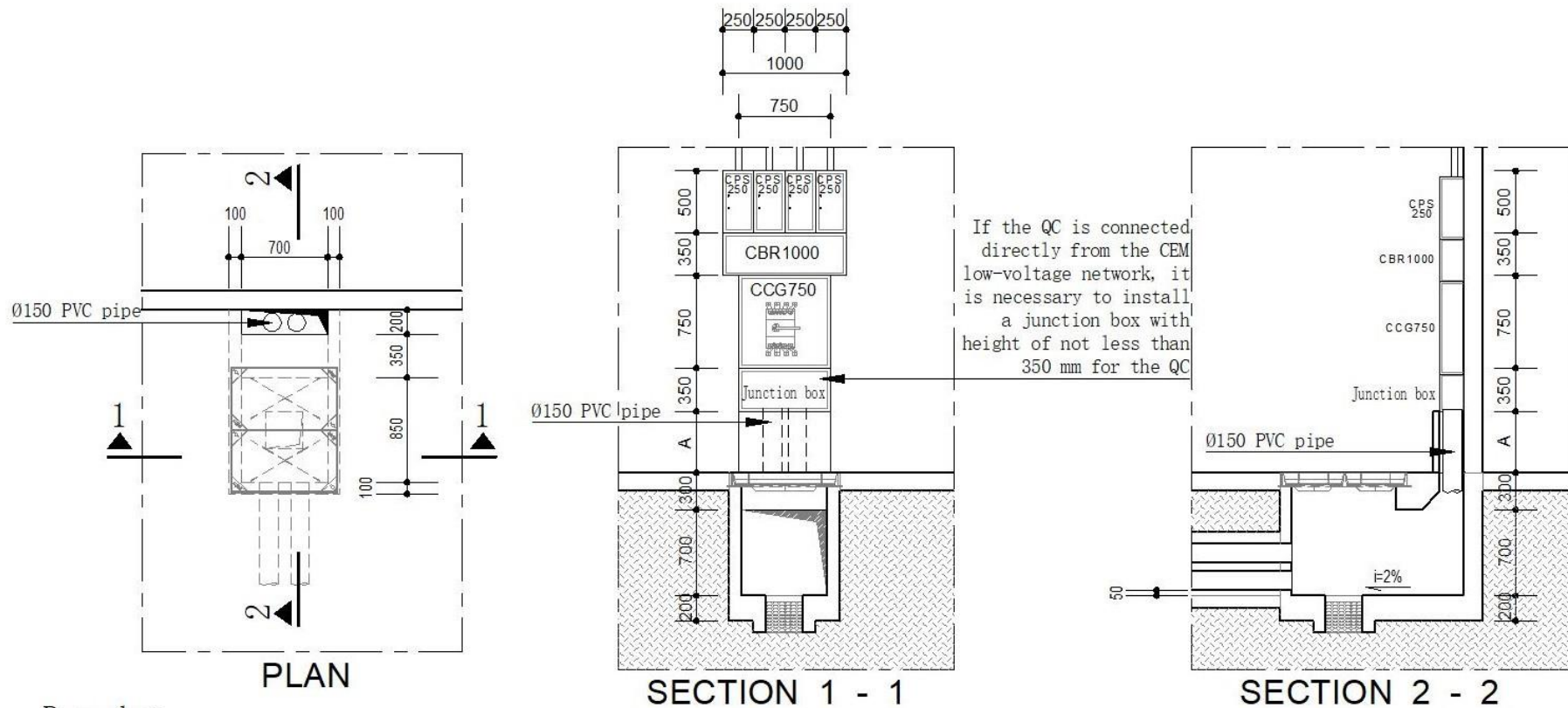


| $I_n$ (Nominal current) (mm) | No. of extension busbars for each polarity | U (Width) | T (Thickness) Line | T (Thickness) Neutral |
|------------------------------|--------------------------------------------|-----------|--------------------|-----------------------|
| $I_n < 300A$                 | 1                                          | 25        | 5                  | 5                     |
| $300A \leq I_n \leq 600A$    | 2                                          | 30        | 8                  | 5                     |
| $600A < I_n \leq 800A$       |                                            | 40        | 8                  | 5                     |
| $800A < I_n \leq 1000A$      |                                            | 50        | 8                  | 5                     |
| $1000A < I_n \leq 1250A$     |                                            | 60        | 8                  | 5                     |



**Detail drawing of horizontal connection manhole :****Remarks:**

- A= If the building is located in a low-lying flooding area (as defined by MSAR Government). QC box must be installed above the Government regulated mean sea level of 4.21 meters. Typical installation height in non-low lying flooding areas is 600 mm above ground level.

**Detail drawing of vertical connection manhole :****Remarks:**

- A= If the building is located in a low-lying flooding area (as defined by MSAR Government).  
 QC box must be installed above the Government regulated mean sea level of 4.21 meters.  
 Typical installation height in non-low lying flooding areas is 600 mm above ground level.

**ANNEX 2****Typical Pothead Installation Location and Connection Manhole Examples**

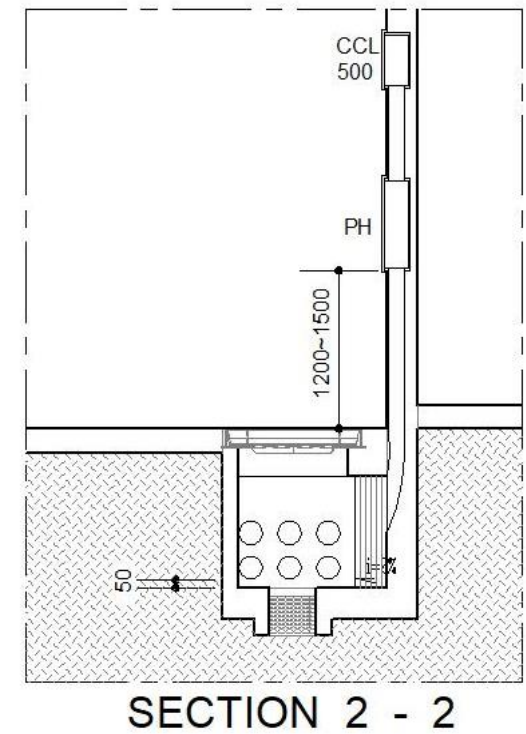
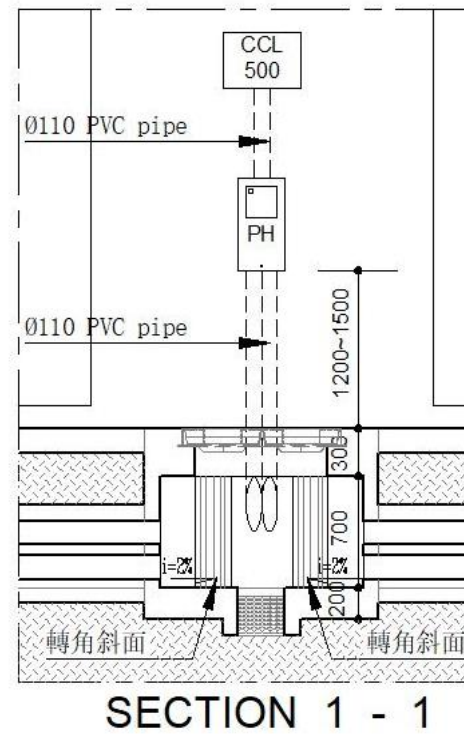
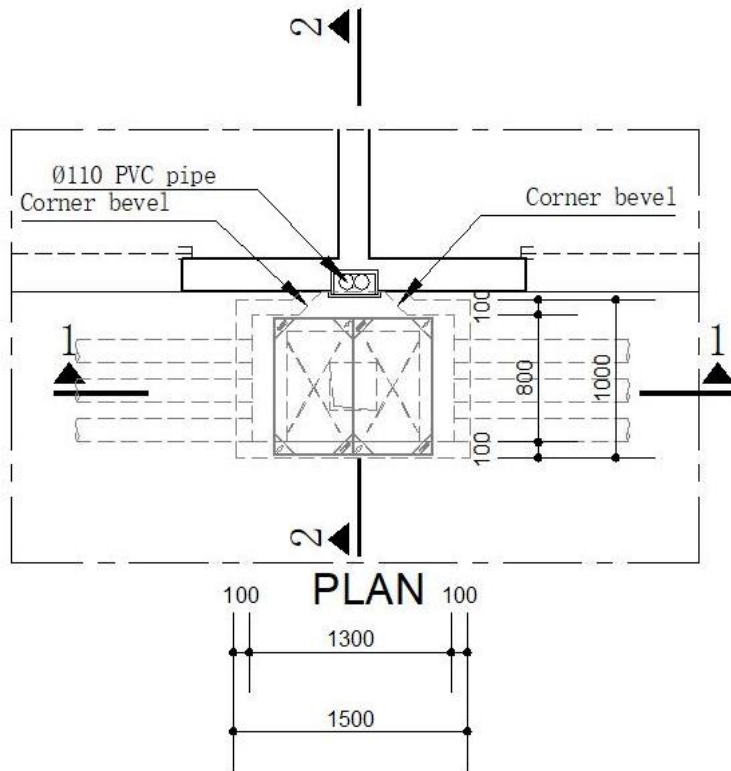
CEM provides specifications for the installation and connection manhole of Pothead to ensure smooth cable laying and provide clear installation guidelines for electrical workers.

- Potheads are normally installed at least 1.2 m above the ground. If the building is located in a low-lying flooding area (defined by the MSAR Government), its installation height must be approved by CEM in advance.
- Clients are responsible for the pipe curvature to connect to CEM's connection manhole and cooperate with the excavation works of CEM.
- In order to ensure CEM cables can smoothly pass through the pipe bend to connect with Pothead and ensure a corner bevel at the connection point. The following are the dimensions and specifications of incoming cables by CEM.

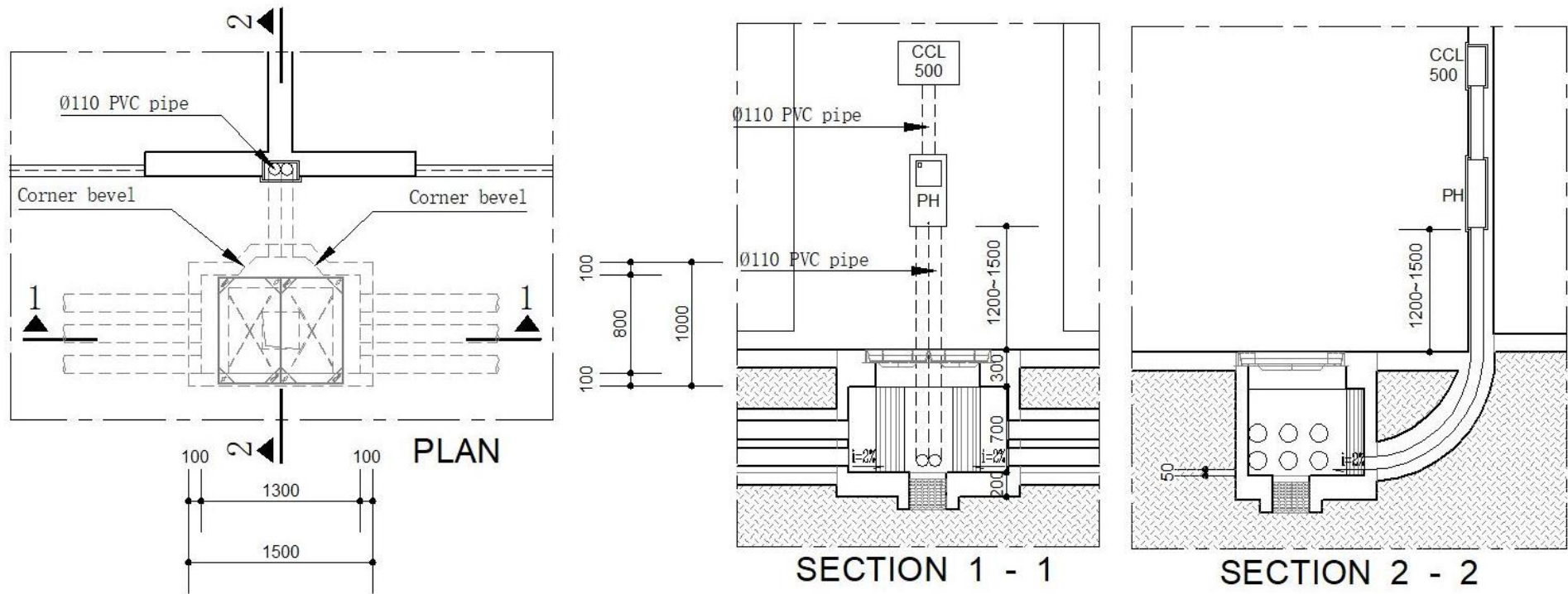
Typical Type-A PH :                      XAV 3x150+70 mm<sup>2</sup>

Typical Type-B PH :                      LXAV 2(3x120+70) mm<sup>2</sup>

- PVC tubing should be installed continuously without any connection in the middle, so that the cable routing operation will not be obstructed.
- Customers are required to install the grounding wire and copper rod by themselves and can coordinate the specific installation position with CEM according to the site conditions. The diameter of the grounding copper rod should not be less than 12.5 mm, and it should comply with BS 7430 or GB/T 50065-2011, GB/T 50169-2016, or IEC 62561-2 and other similar grounding standards.

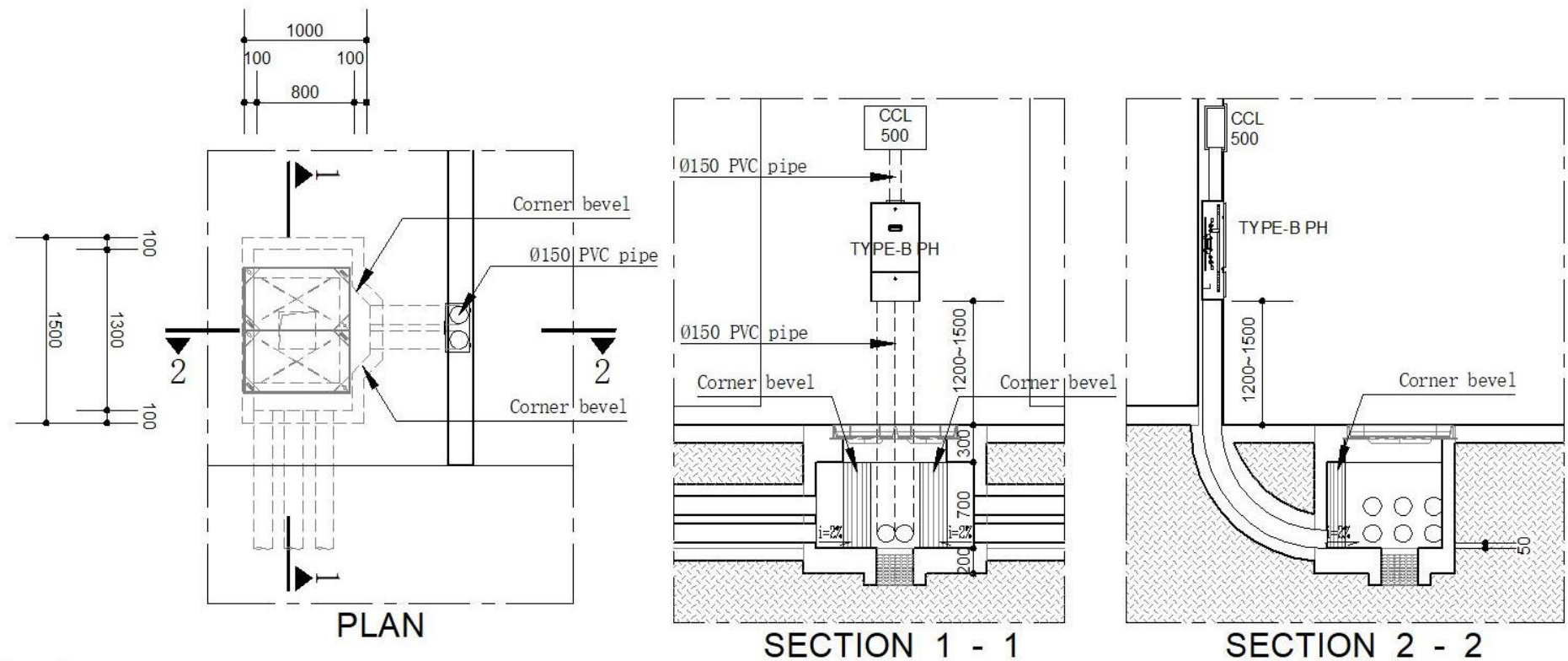
**Typical Type-A Pothead Connection Manhole Diagram (Case 1) :****Remarks:**

If the PH is located in a low-lying flooding area, its installation height must be approved by CEM in advance.

**Typical Type-A Pothead Connection Manhole Diagram (Case 2) :****Remarks:**

If the PH is located in a low-lying flooding area, its installation height must be approved by CEM in advance.

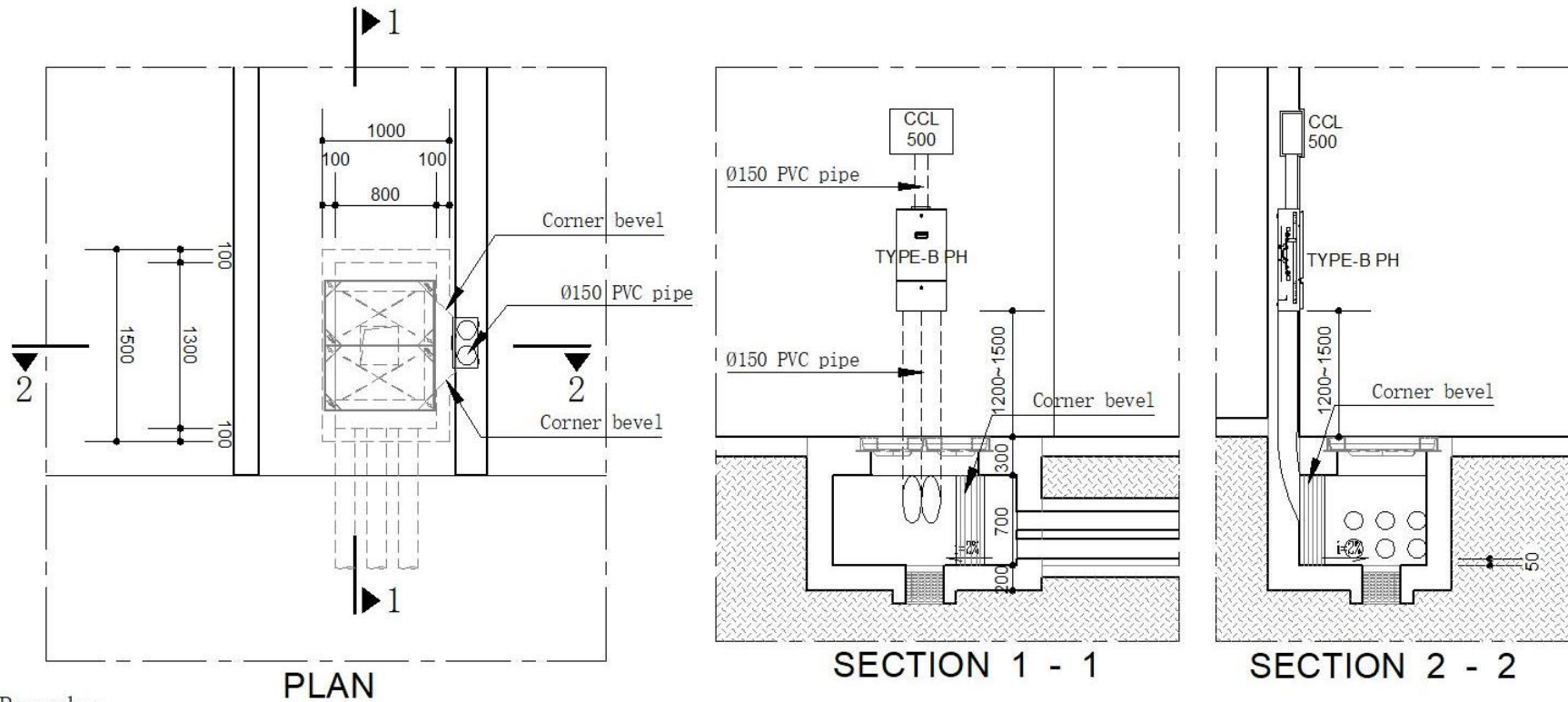


**Typical Type-B Pothead Connection Manhole Diagram (Case 1) :****Remarks:**

- If the PH is located in a low-lying flooding area, its installation height must be approved by CEM in advance.
- If it is not possible to install PVC pipe in the Type-B pothead outlet due to the onsite conditions, a cable trunking or covered cable tray can be installed instead. The surface of the cable trunking or covered cable tray shall be cement plastered, and the inlet and outlet of the PH should be equipped with appropriate measures to prevent the intrusion of foreign objects.



### Typical Type-B Pothead Connection Manhole Diagram (Case 2) :



Remarks:

- a. If the PH is located in a low-lying flooding area, its installation height must be approved by CEM in advance.
- b. If it is not possible to install PVC pipe in the Type-B pothead outlet due to the onsite conditions, a cable trunking or covered cable tray can be installed instead. The surface of the cable trunking or covered cable tray shall be cement plastered, and the inlet and outlet of the PH should be equipped with appropriate measures to prevent the intrusion of foreign objects.

**ANNEX 3****General Requirements of Cable Laying and Connection for Main Low Voltage Switchboard**

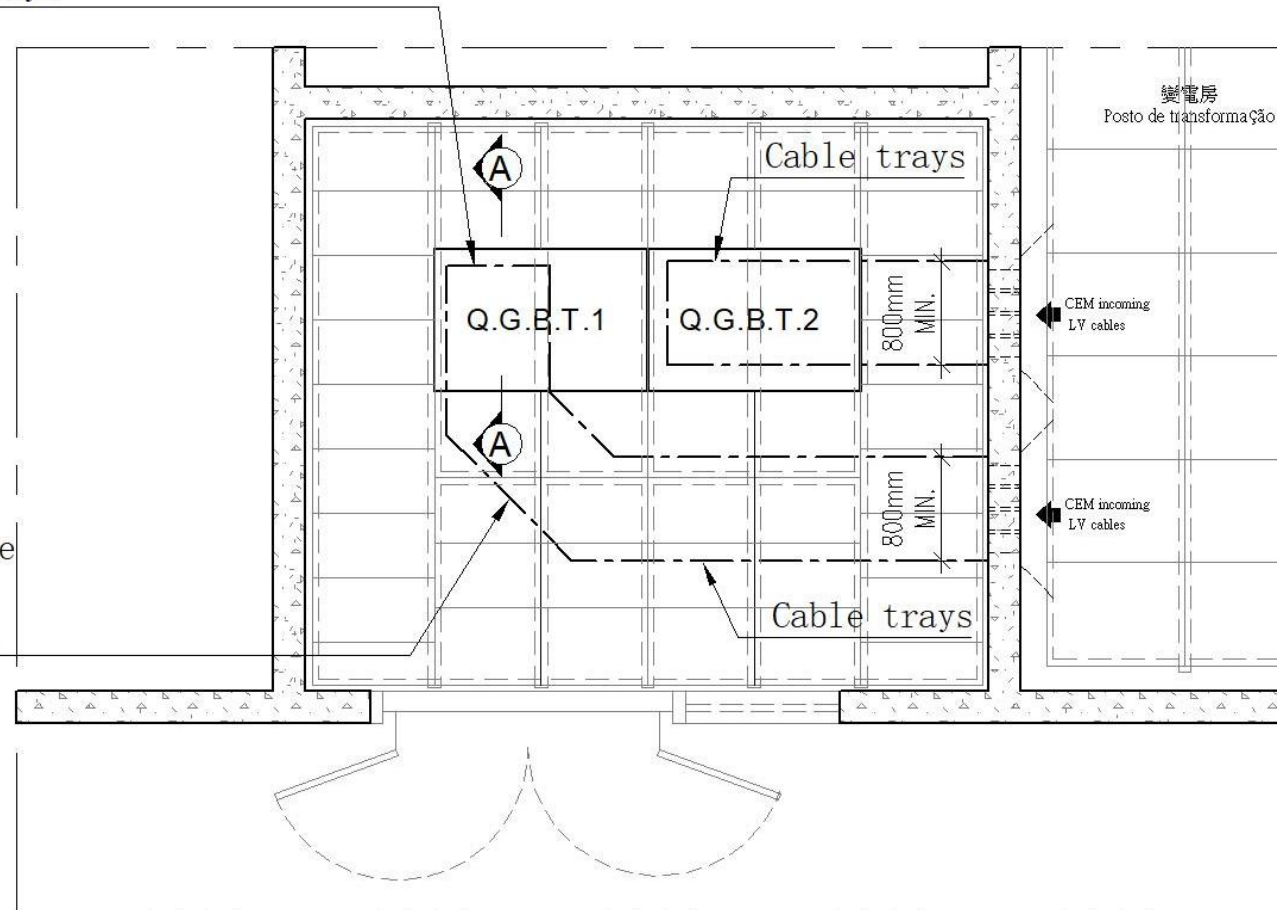
In order to ensure that CEM incoming cables can be easily laid and maintained, CEM has established the following requirements of cable laying and cable connections for main low voltage switchboard (QG).

**Cable Laying**

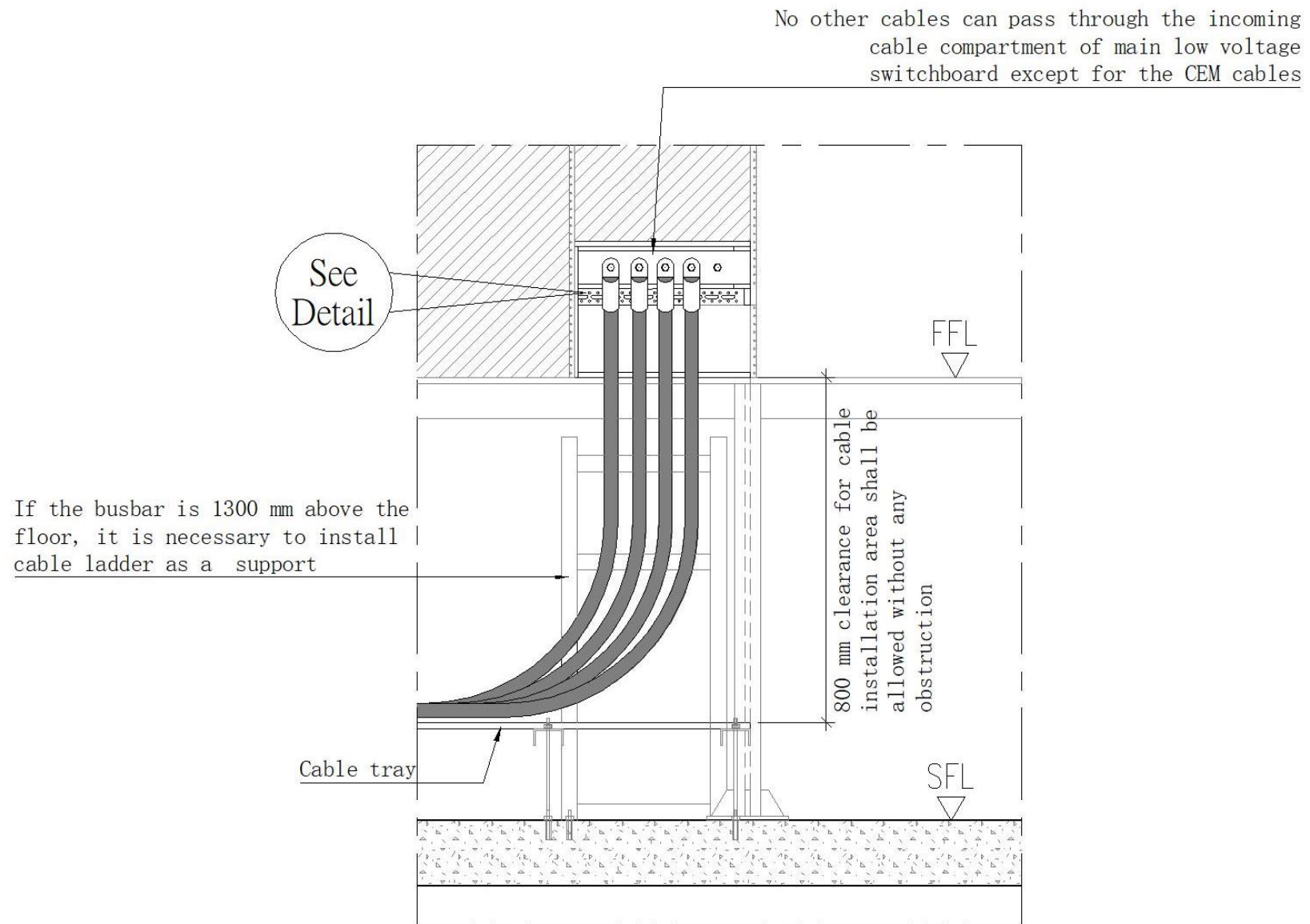
- Cable trays used to support CEM cables must not be covered by other cable trays.
- The width of the cable trays shall not be less than 800 mm, and each bending of cable trays shall not be less than 45 degrees to ensure smooth laying of the cables.
- The finished surface of the platform shall be at least 800 mm from the cable tray. If the installation height of the cable pit is insufficient, the installation of the cable tray can be exempted, but a clearance of 800 (width) x 800 (height) mm<sup>2</sup> shall still be maintained for cable laying.
- If the busbar is 1300 mm above the floor, it is necessary to install a cable ladder as a support.
- No other cables can pass through the incoming cable compartment of main low voltage switchboard except for the CEM cables.

Cable trays used to support CEM cables must not be covered by other cable trays

Each bending of cable trays shall not be less than 45 degrees



Plan View

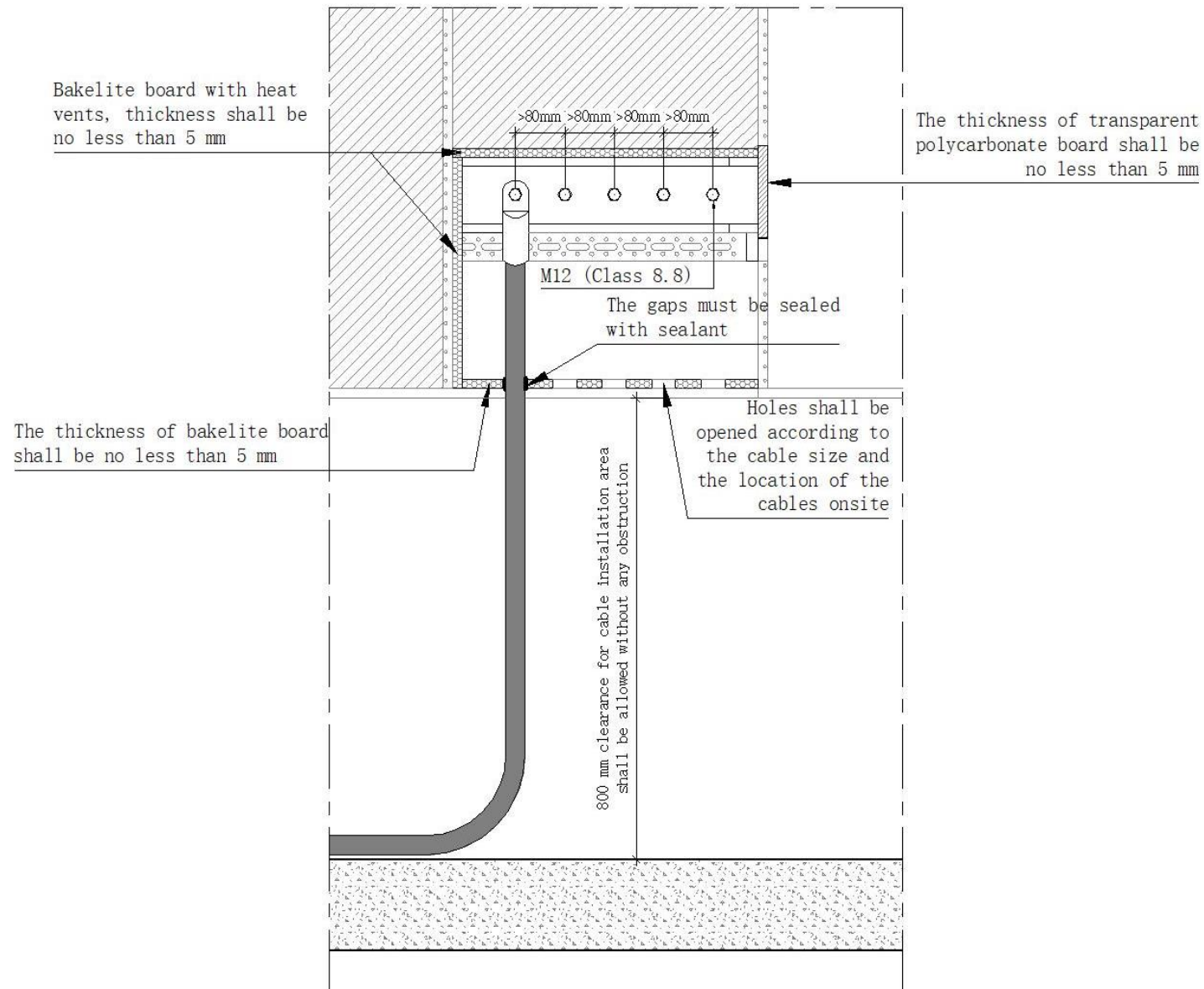


Section A - A

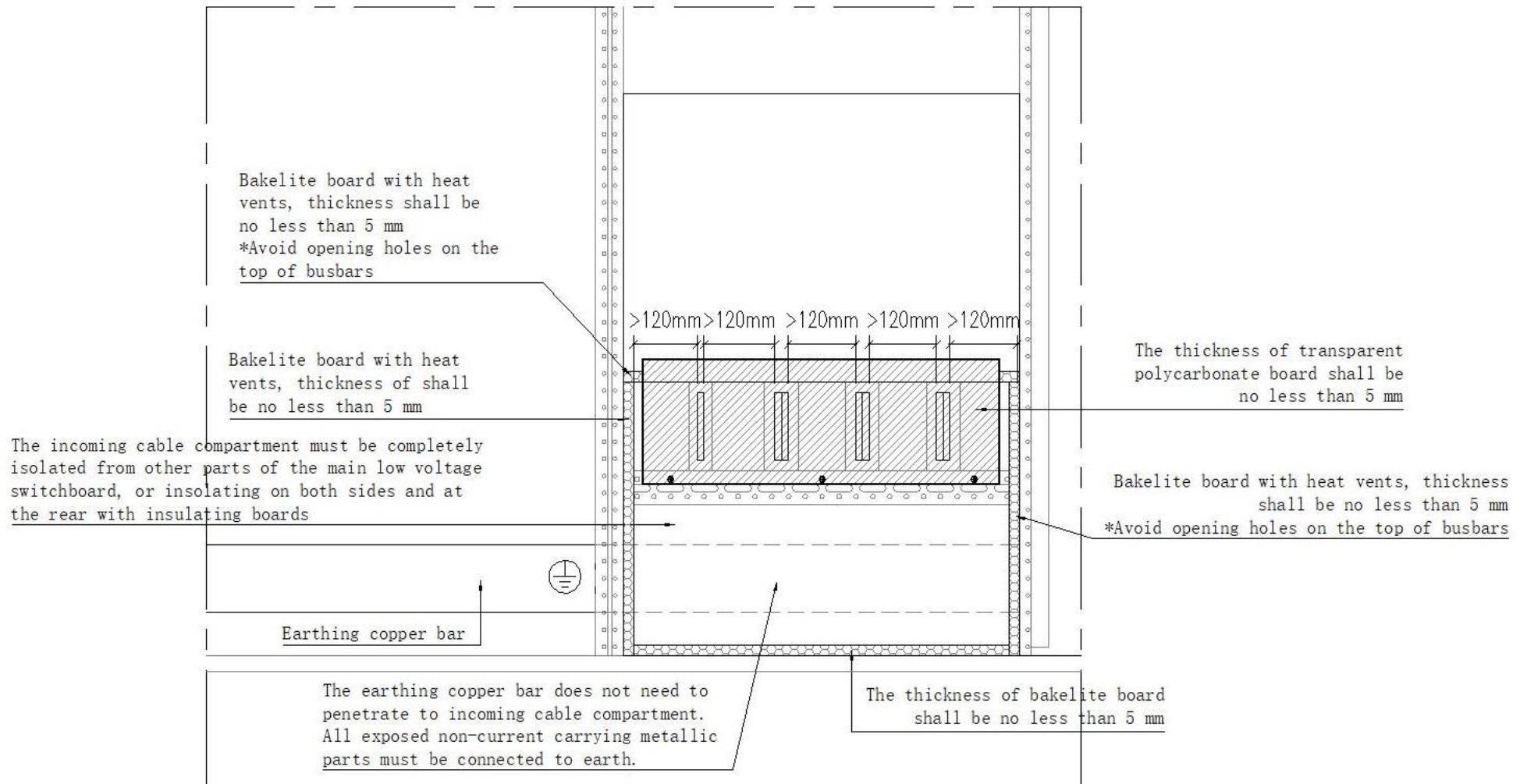
**Cable Connection**

- The incoming cable compartment should be completely isolated from other parts of the main low voltage switchboard, or insulated on both sides and at the rear with Bakelite plates. The thickness of the Bakelite plates and transparent polycarbonate (PC) board should not less than 5 mm.
- The cable inlet of the equipment must be drilled according to the cable size and location of the cables onsite, and the gap between the cable and the equipment must be sealed with sealant.
- The earthing busbar does not need to penetrate to the incoming cable compartment, but it is still necessary to ensure that all exposed non-current-carrying metallic parts are connected to earth.
- The distance between cable connection holes should not less than 80 mm, and the connection holes must be suitable for M12 (Grade 8.8) bolts.
- Busbars with different polarities are separated by not less than 100 mm.
- Each phase busbar for CEM cables in the incoming cable compartment should be equipped with five cable connection holes. When replacing the air circuit breaker, if the original busbars were designed with six cable connection holes, six holes must still be retained after replacement.

## Detail

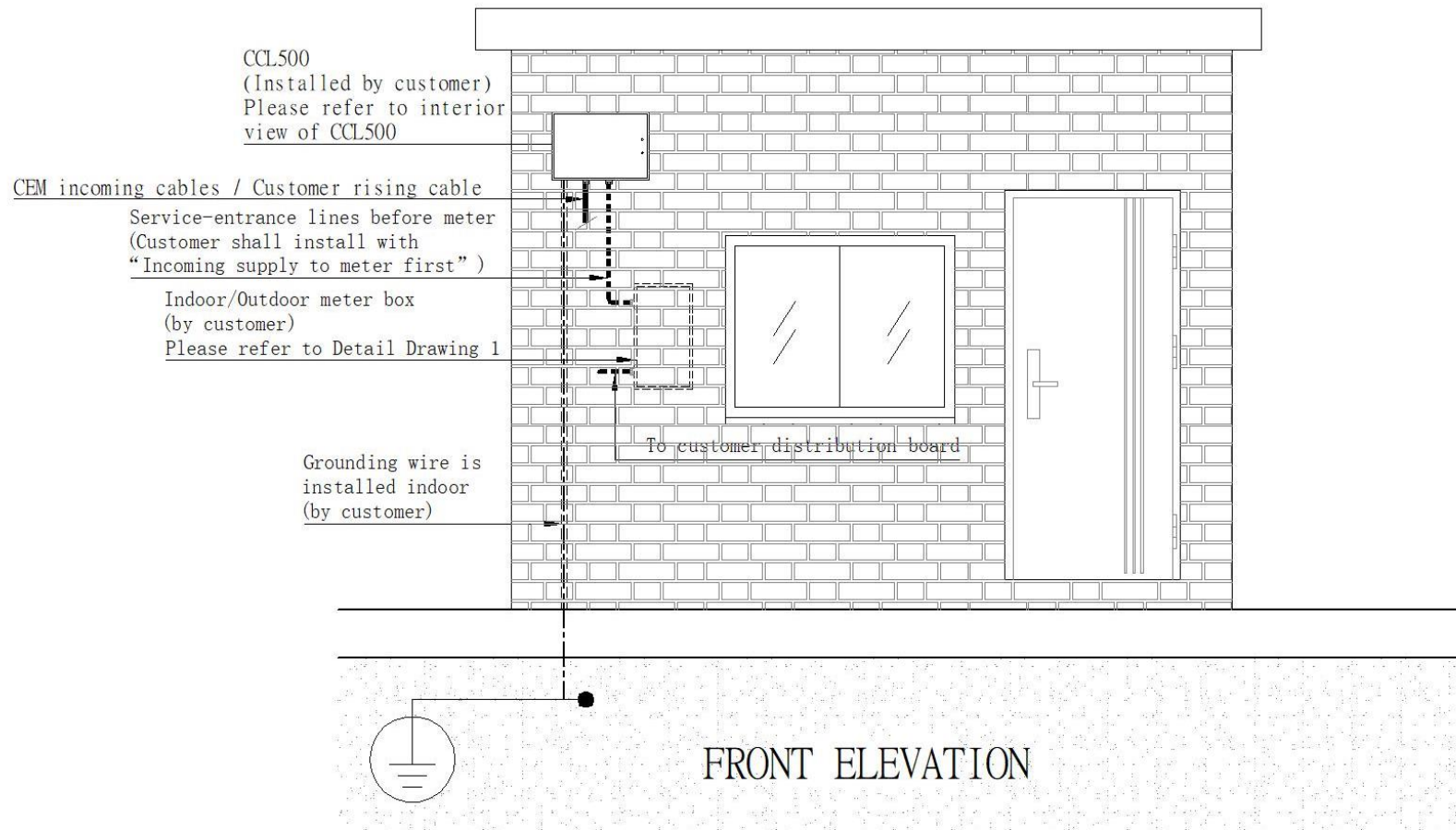






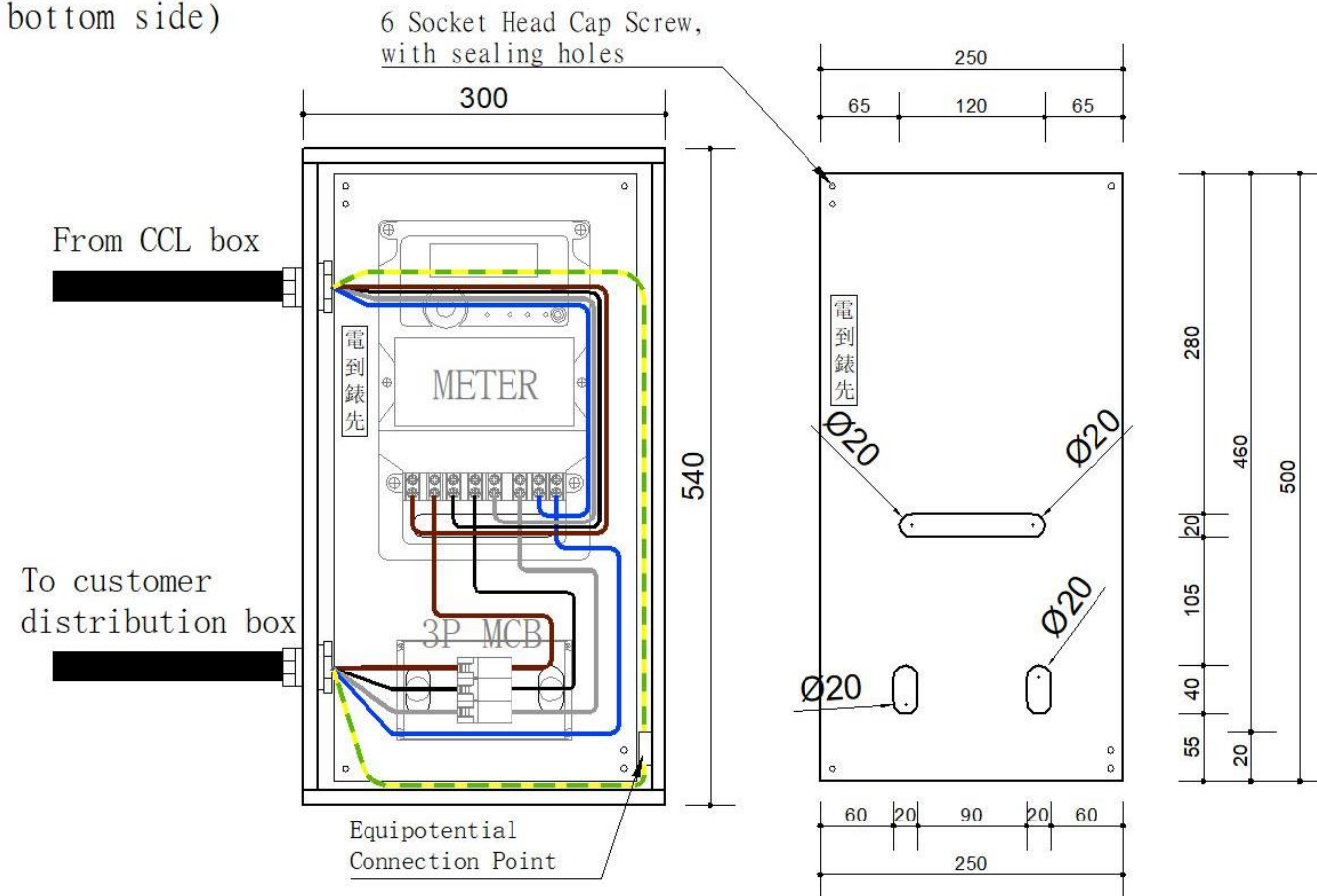
**ANNEX 4****Arrangement of Connection Point to Network or Collective Line on Building Façade**

The following is the arrangement of connection point to the network or collective line on the building facade, to ensure the operability and safety of the power supply.

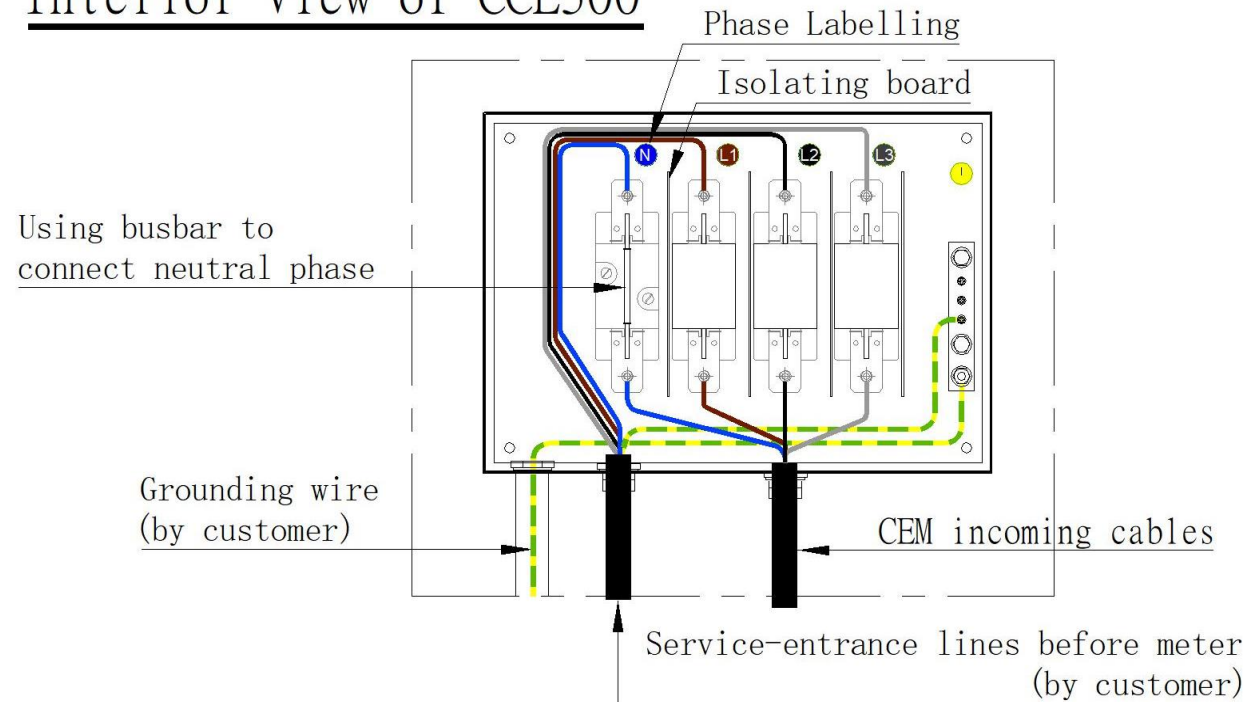


# Detail Drawing 1

Meter box layout and incoming cables arrangement  
(Service-entrance lines to customer distribution box shall located at the bottom side)



## Interior View of CCL500



The following is a note of caution.

1. The customer is required to install a CCL box for knife contact fuses as the connection point to network with the neutral phase connected by a busbar, and it is installed outside the unit or shop.
2. From the above building electrical installation connects to the cable inlet on the upper part of the meter box.
3. The incoming supply goes to the meter first, and then to CEM's miniature circuit breaker (MCB).
4. Lastly, connect to the customer's distribution box with the cable outlet located underneath the meter box.

**ANNEX 5****Connection Examples of Temporary Electrical Installations of 34 kVA or less**

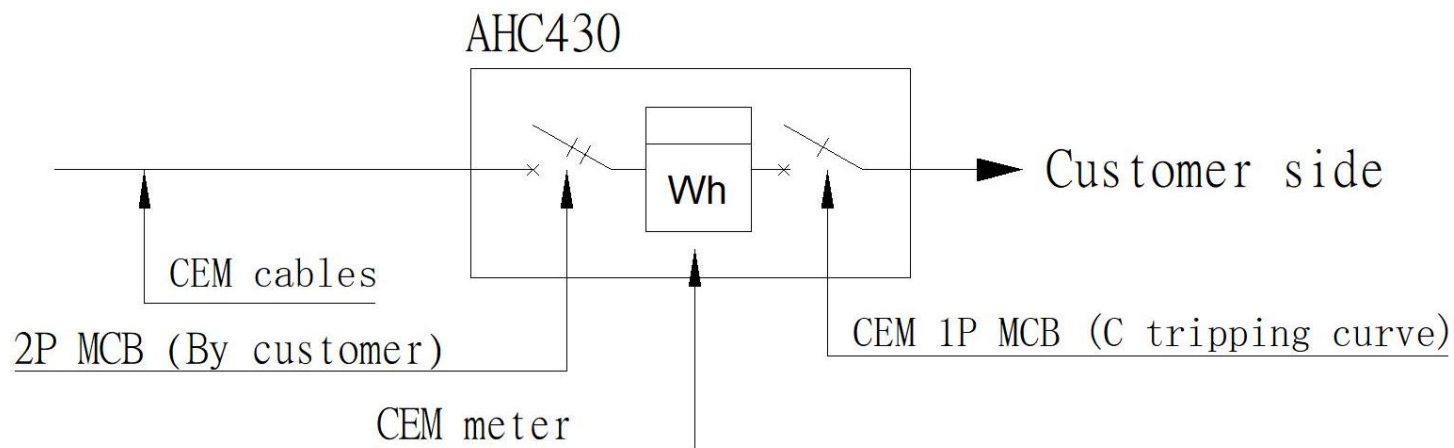
In order to accommodate connection points to the network with a temporary electrical installation of 34.5 kVA or less, CEM has proposed four types of connection points to the network based on the size of the incoming cables. In such a way, various conditions and requirements of the supply system can be fulfilled to ensure operational feasibility and safety of the electrical supply, which are described in detail as follows.

- Based on the specific design of the network circuit, CEM will notify electrical contractors of the approach to be taken.
- The minimum internal dimensions of the CCL box and meter box shall conform to the requirements shown on the attached drawings for each case.
- The meter boards opening shall be of the size shown in the figures for each case, and the meter boards shall be equipped with 6 socket head cap screws with sealing holes, 4 of which shall be mounted opposite each other for CEM locking.

**Case 1 : Single-phase power supply and incoming cables can be directly connected to a two-pole miniature circuit breaker (MCB)**  
**(Temporary Electrical Installation)**

The following is a schematic diagram of the circuit.

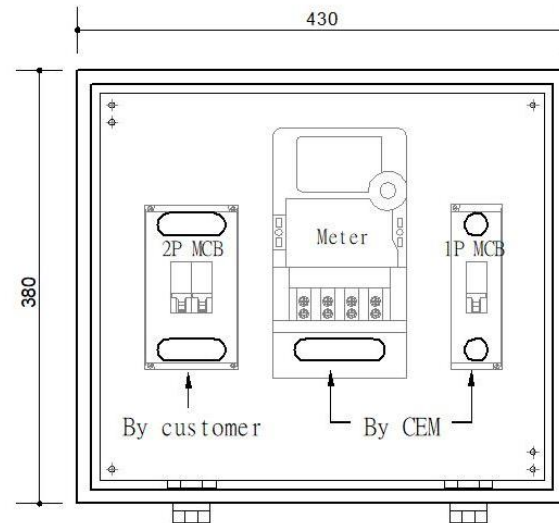
## Schematic diagram



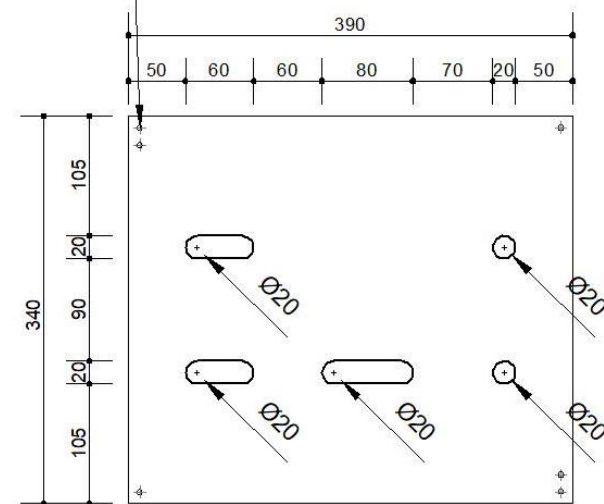
1. The customer is required to install a two-pole miniature circuit breaker (with breaking capacity not less than 10 kA) as the connection point to the network.
2. From the above building electrical installation to the meter, and then connect to CEM's single-pole miniature circuit breaker.
3. Lastly, connect to the customer side.



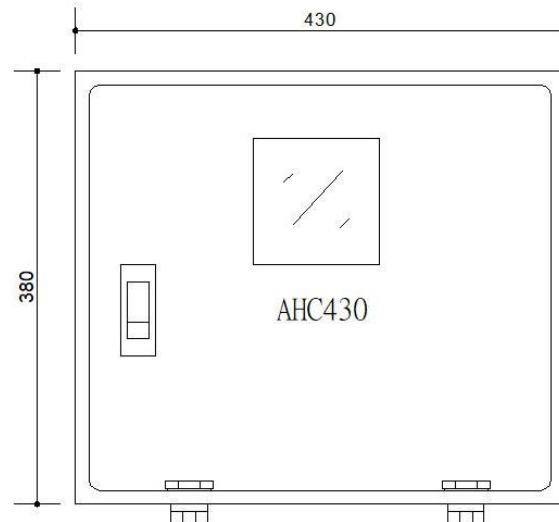
The meter board must be equipped six socket head cap screw, with sealing holes, four of which must be installed on opposite sides.



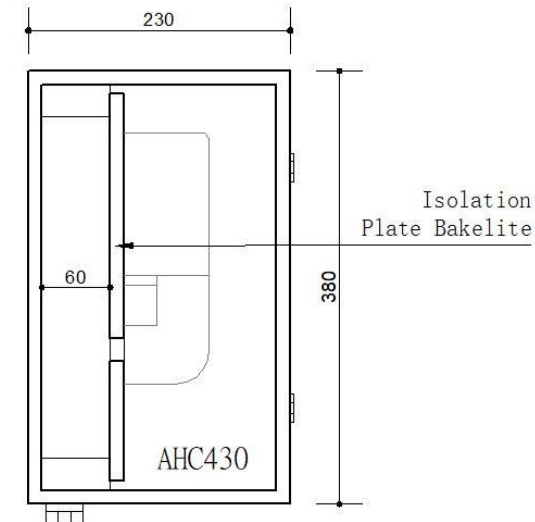
Interior Front View



Openings Requirement



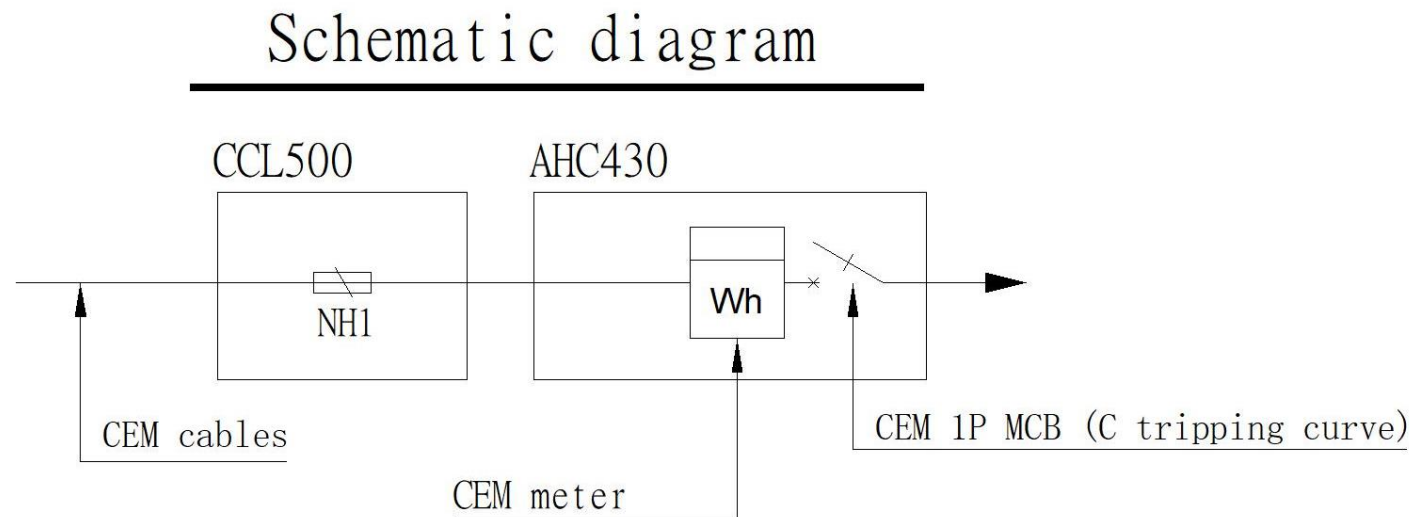
Front View



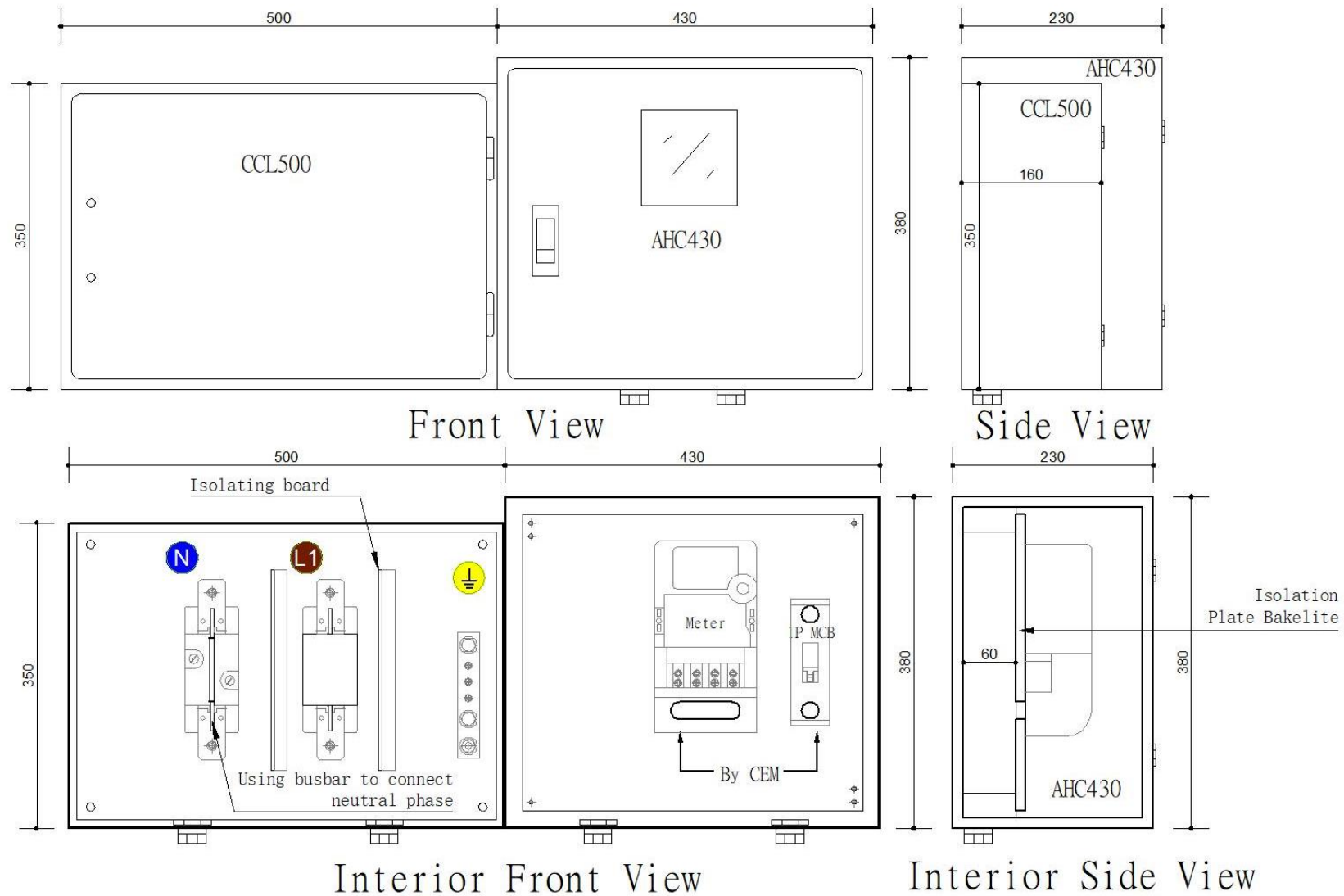
Interior Side View

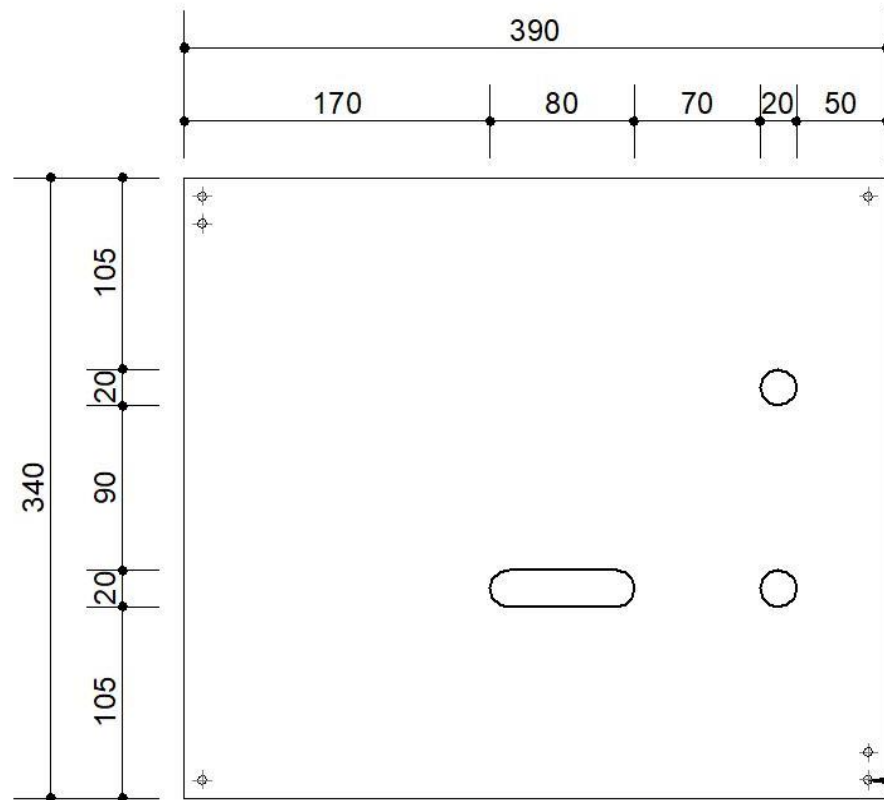
**Case 2 : Single-phase power supply and incoming cables directly connected to the knife contact fuse base holder (Temporary Electrical Installation)**

The following is a schematic diagram of the circuit.



1. The customer is required to install a CCL box for single-phase knife contact fuses as the connection point to the network, with the neutral phase connected by a busbar.
2. From the above building electrical installation to the meter box, with the incoming supply going to the meter first, and then to the CEM single-pole miniature circuit breaker.
3. Lastly, connect to the customer side.





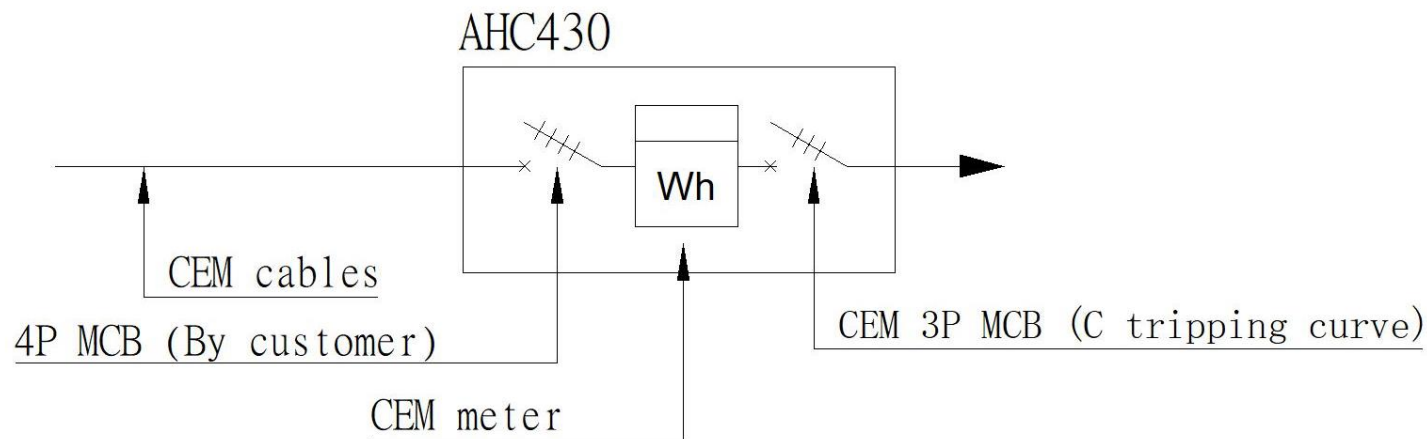
The meter board must be equipped six socket head cap screw, with sealing holes, four of which must be installed on opposite sides.

## Openings Requirement

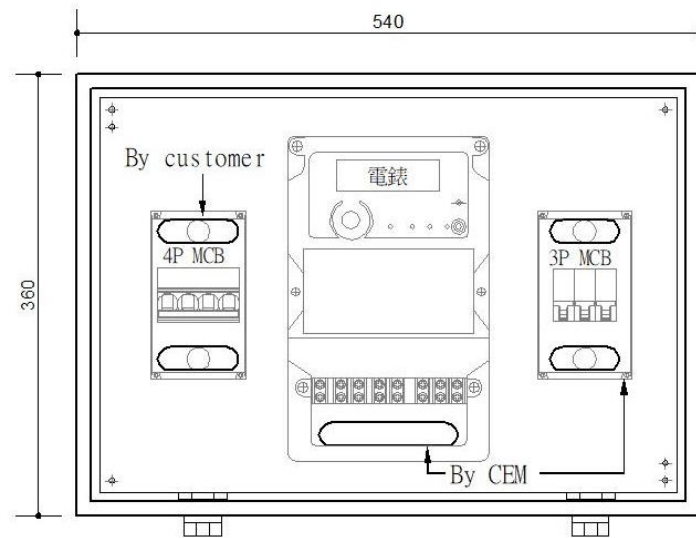
**Case 3 : Three-phase power supply and incoming cables can be directly connected to a four-pole miniature circuit breaker (MCB)**  
**(Temporary Electrical Installation)**

The following is a schematic diagram of the circuit.

## Schematic diagram

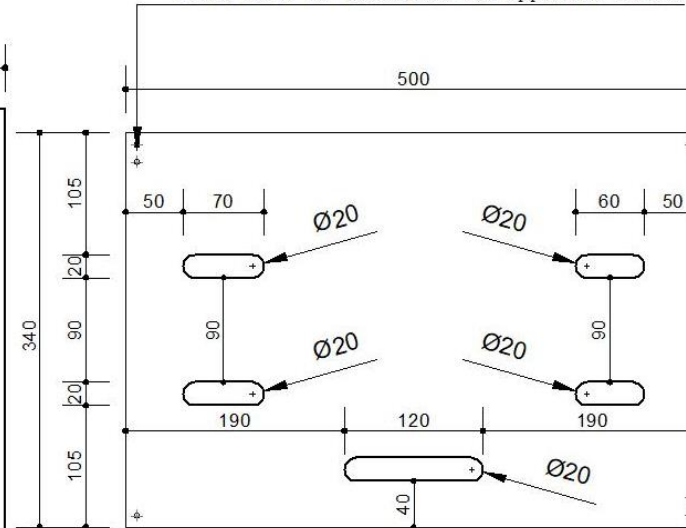


1. The customer is required to install a four-pole miniature circuit breaker (with breaking capacity not less than 10 kA) as the connection point to the network.
2. From the above building electrical installation to the meter, and then connect to CEM's three-pole miniature circuit breaker.
3. Lastly, connect to the customer side.

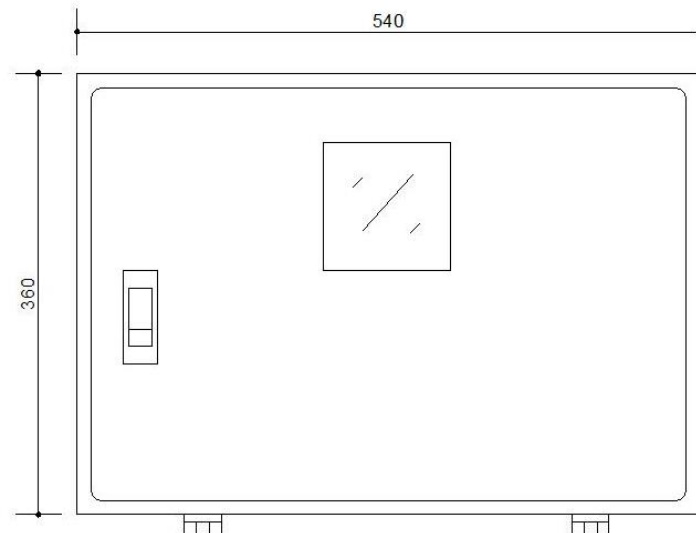


Interior Front View

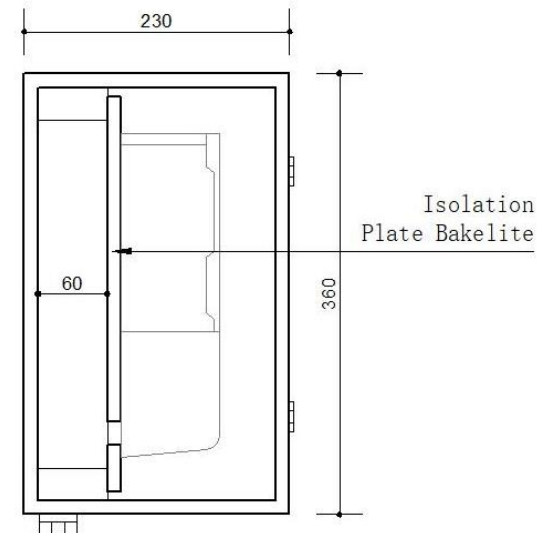
The meter board must be equipped six socket head cap screw, with sealing holes, four of which must be installed on opposite sides.



Openings Requirement



Front View

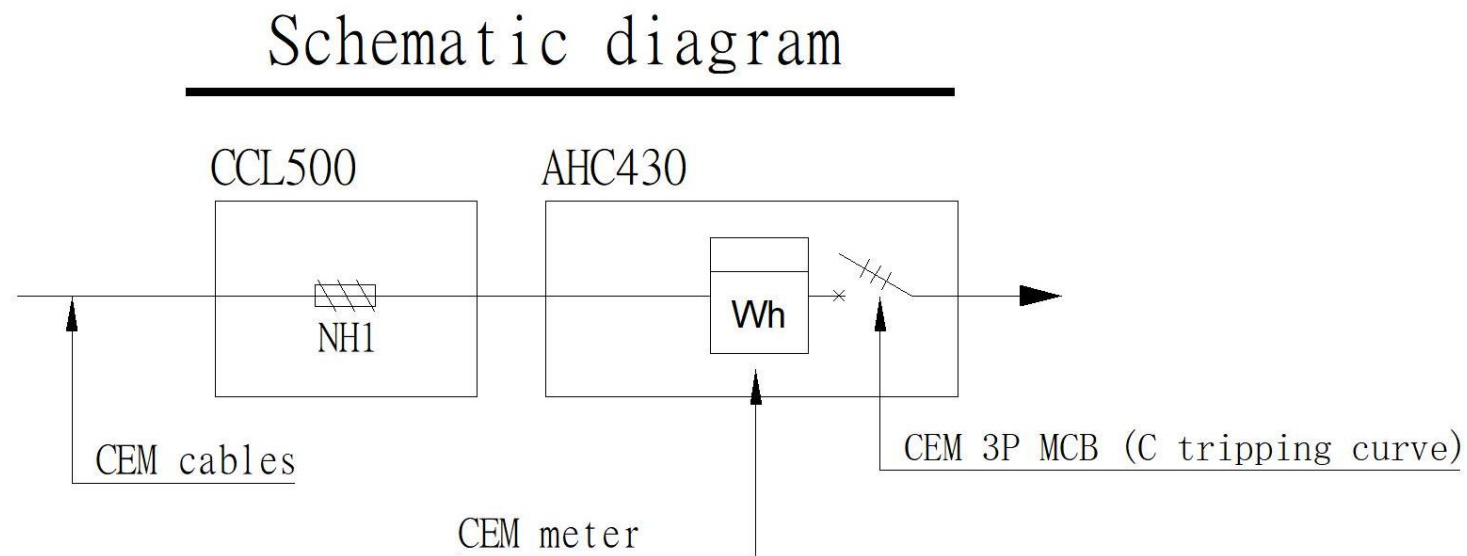


Interior Side View

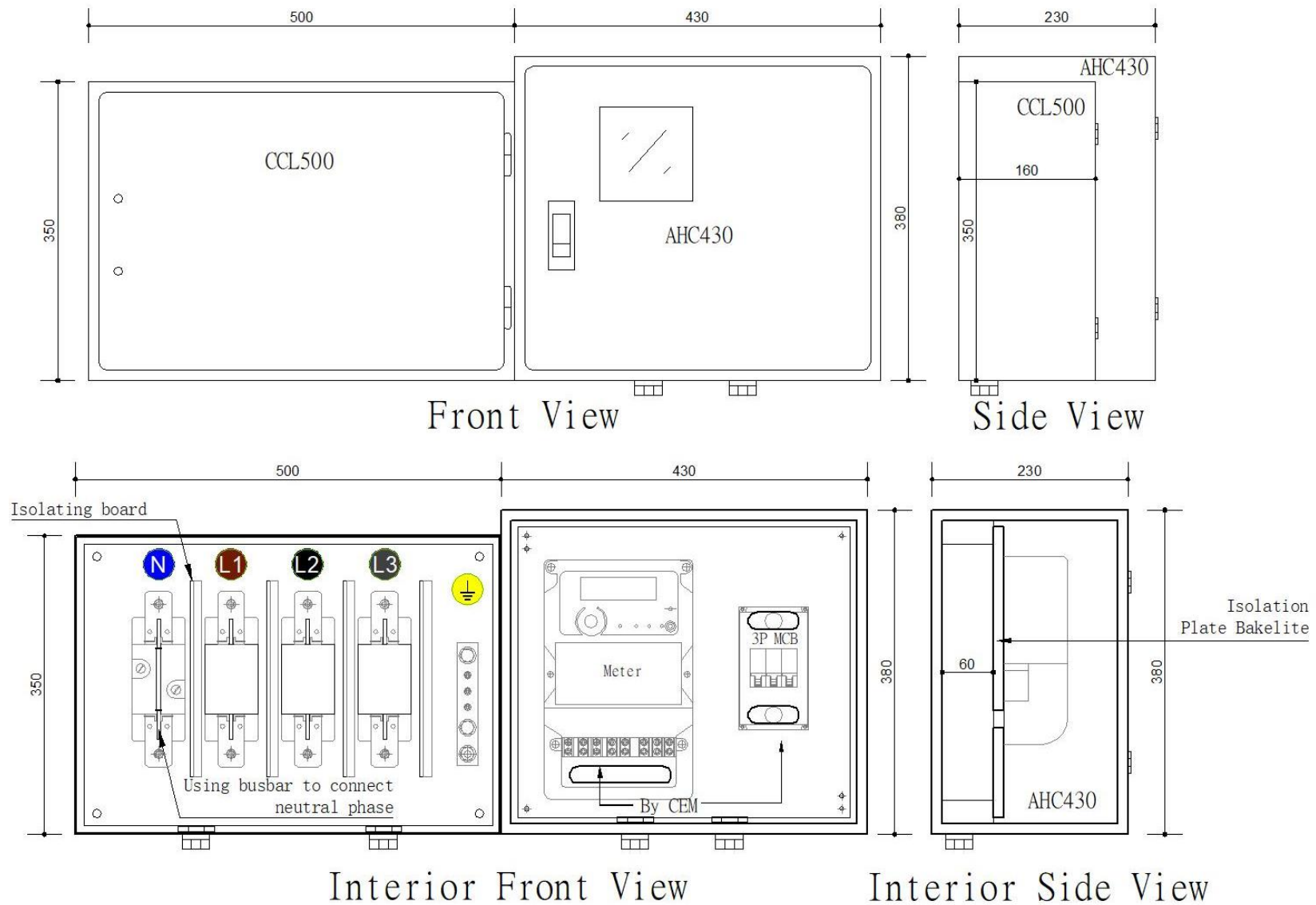


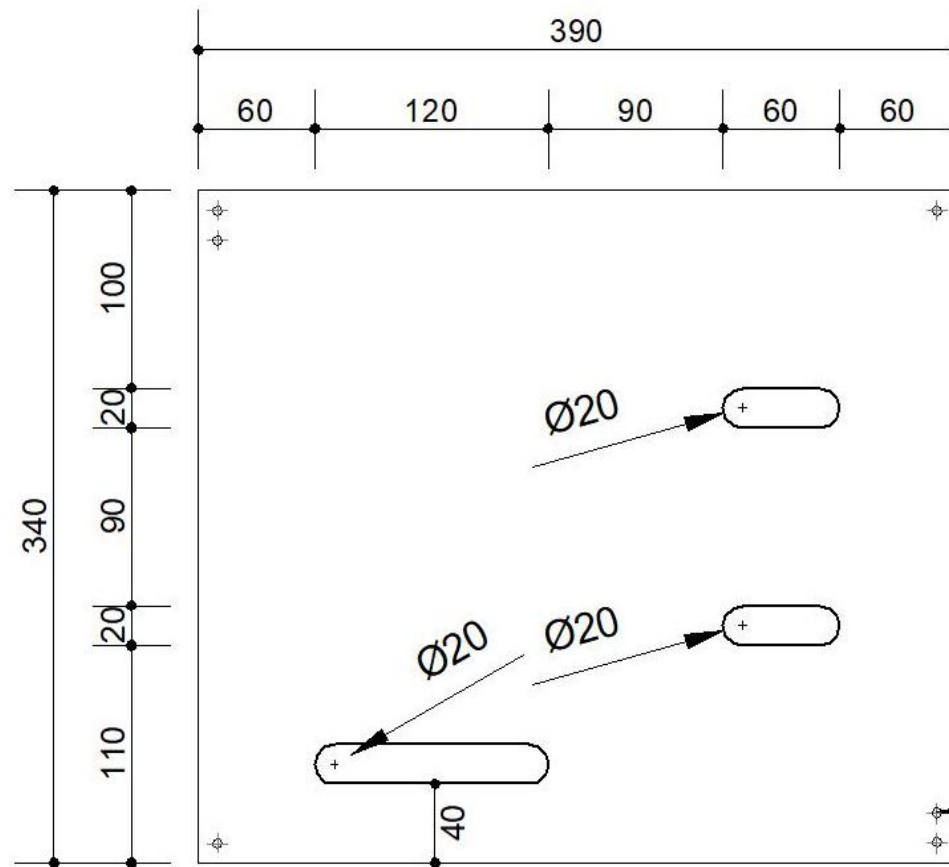
**Case 4 : Three-phase power supply and incoming cables directly connected to the knife contact fuse base holder (Temporary Electrical Installation)**

The following is a schematic diagram of the circuit.



1. The customer is required to install a CCL box for three-phase knife contact fuses as the connection point to the network, with the neutral phase connected by a busbar.
2. From the above building electrical installation to the meter box, with the incoming supply going to the meter first, and then to the CEM three-pole miniature circuit breaker.
3. Lastly, connect to the customer side.





The meter board must be equipped six socket head cap screw, with sealing holes, four of which must be installed on opposite sides.

## Openings Requirement

# Low Voltage Installation Acceptance Form

|                             |  |
|-----------------------------|--|
| <b>Installation Address</b> |  |
| <b>Job Reference Number</b> |  |

## 1. Main Low Voltage Switchboard - QG <Ref No. : >

Please fill in the below with provision of the product acceptance certificate issued by the supplier.

| Inspection Item                                                                                                                                                                      | Fulfill  |
|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| No visible damage to impair safety.                                                                                                                                                  |          |
| Safe access provided.                                                                                                                                                                |          |
| Size and installation of all conductive parts carried out in accordance with the final approval project.                                                                             |          |
| Installation and relationship between all main collective lines or busbars and main LV switchboard carried out in accordance with the final approval project.                        |          |
| Sufficient safety distance between all conductive parts and between conductive parts and non-metallic provided.                                                                      |          |
| Correct phase identification of bus bar and main cables in the main switchboard provided.                                                                                            |          |
| A legible and durable identification label for each main circuit breaker and disconnector provided.                                                                                  |          |
| Suitable locking system provided to prevent two or more supplies in operation parallel.                                                                                              |          |
| All exposed non-live conductive parts effectively earthed.                                                                                                                           |          |
| Main circuit breaker (i.e., ACB) tested and sealed.                                                                                                                                  |          |
| Main LV switchboard compartment with appropriate locks equipped.                                                                                                                     |          |
| A waterproof remote-control device installed on the ground-floor, near the building main entrance or in security counters/rooms, if the switchboard located above the ground -floor. |          |
| Grounding terminal clearly identified and grounding resistance $<10 \Omega$ .                                                                                                        | $\Omega$ |

Remark: Please insert "Not Adaptable" or "N/A" for item(s) that are not applicable.

| Insulation Resistance | L1-L2 | L1-L3 | L2-L3 |
|-----------------------|-------|-------|-------|
| L-L                   |       |       |       |
|                       |       |       |       |
|                       | L1-N  | L2-N  | L3-N  |
| L-N                   |       |       |       |
|                       |       |       |       |
|                       |       |       |       |
| N-E                   |       |       |       |

Remark: Lowest insulation resistance measured between conductors ( $> 1 M\Omega$ ) with test voltage of 500V DC. The instrument should have the measurement range not less than  $20 G\Omega$

Responsible (signed and chopped) : \_\_\_\_\_ Inspection Date : \_\_\_\_\_

## Low Voltage Installation Acceptance Form

### 2. Main Collective Switchboard - QC NCEM 1.62.003 <Ref No. : >

Please fill in the below with provision of the QG acceptance certificate issued by the supplier.

| Inspection Item                                                                                                                                                                                    | Fulfill  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|
| No visible damage to impair safety.                                                                                                                                                                |          |
| Safe access provided.                                                                                                                                                                              |          |
| Size and installation of all conductive parts carried out in accordance with the final approval project.                                                                                           |          |
| Sufficient safety distance between all conductive parts and between conductive parts and non-metallic provided.                                                                                    |          |
| Correct phase identification of bus bar and main cables in the main switchboard provided.                                                                                                          |          |
| A legible and durable identification label for each collective line distribution box (CPS) provided.                                                                                               |          |
| An as built drawing provided to show the power distribution system.                                                                                                                                |          |
| All exposed non-live conductive parts earthed effectively.                                                                                                                                         |          |
| Main circuit breaker (i.e., ACB) tested and sealed.                                                                                                                                                |          |
| Main collective switchboard compartment with appropriate locks equipped.                                                                                                                           |          |
| A waterproof remote-control device installed on the ground-floor, near the building main entrance or in doormen or security counters or rooms, if the switchboard located above the ground -floor. |          |
| Grounding terminal clearly identified and grounding resistance $<10 \Omega$ .                                                                                                                      | $\Omega$ |

Remark: Please insert "Not Adaptable" or "N/A" for item(s) that are not applicable.

| Insulation Resistance | L1-L2 | L1-L3 | L2-L3 |
|-----------------------|-------|-------|-------|
| L-L                   |       |       |       |
|                       |       |       |       |
|                       | L1-N  | L2-N  | L3-N  |
| L-N                   |       |       |       |
|                       |       |       |       |
|                       |       |       |       |
| N-E                   |       |       |       |

Remark: Lowest insulation resistance measured between conductors ( $> 1 M\Omega$ ) with test voltage of 500V DC. The instrument should have the measurement range not less than 20GΩ

Responsible (signed and chopped) : \_\_\_\_\_

Inspection Date : \_\_\_\_\_

# Low Voltage Installation Acceptance Form



## 3. Main Switchroom

| Inspection Item                                                                       | Fulfill  |
|---------------------------------------------------------------------------------------|----------|
| With sufficient lighting, including emergency ones.                                   |          |
| Sufficient width service and maneuvering pass way. (C14-100 4.4)                      |          |
| Entrance/exit free of obstruction.                                                    |          |
| An as built drawing provided to show the power distribution system.                   |          |
| No visible damage to impair safety.                                                   |          |
| A legible and durable identification label for each collective line / riser provided. |          |
| All exposed non-live metallic parts earthed effectively.                              |          |
| Grounding terminal clearly identified and grounding resistance $<10\ \Omega$          | $\Omega$ |

*Remark: Please insert "Not Adaptable" or "N/A" for item(s) that are not applicable.*

Responsible (signed and chopped) : \_\_\_\_\_

Inspection Date : \_\_\_\_\_



# Low Voltage Installation Acceptance Form



## 4. Main Line, Collective Line, Collective Line Distribution Box (NCEM 1.62.002) and Service Entrance Line

| Inspection Item                                                                                                                                       | Fulfill |
|-------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| No visible damage to impair safety.                                                                                                                   |         |
| Electrical continuity of collective line / bus bar guaranteed.                                                                                        |         |
| Installation and relationship between collective lines and customer service-entrance lines carried out in accordance with the final approval project. |         |
| Size and installation of all conductive parts carried out in accordance with the final approval project.                                              |         |
| Correct phase identification of conductive parts provided.                                                                                            |         |
| All exposed non-live metallic parts of collective line distribution boxes earthed effectively.                                                        |         |
| Suitable fuses in the collective line distribution boxes equipped.<br>(NCEM 1.62.002 and NCEM C14-100 5.7)                                            |         |
| A legible and durable identification label for each distribution box provided.                                                                        |         |
| A label: “「不可阻礙開啓上升分線箱」 ACCESS TO CCL CANNOT BE BLOCKED” for each distribution box provided.                                                          |         |

*Remark: Please insert "Not Adaptable" or "N/A" for item(s) that are not applicable.*

Responsible (signed and chopped) : \_\_\_\_\_

Inspection Date : \_\_\_\_\_

# Low Voltage Installation Acceptance Form



## 5. Pothead (NCEM C62-040)

| Inspection item                                                                                                                        | Fulfill |
|----------------------------------------------------------------------------------------------------------------------------------------|---------|
| No visible damage to impair safety.                                                                                                    |         |
| Safe access provided.                                                                                                                  |         |
| Size and installation of all conductive parts carried out in accordance with the final approval project.                               |         |
| Suitable height of installation provided. (NCEM C14-100 Annex 12)                                                                      |         |
| Correct phase identification of conductive parts provided.                                                                             |         |
| Correct sizing of piping and cable between the PH and CCL, or between PH and QC, installed.<br>(VD110+V3x120+120+T70 mm <sup>2</sup> ) |         |
| Grounding terminal clearly identified and grounding resistance <10 Ω.                                                                  | Ω       |
| Labelled with “「不可阻礙開啓線頭箱」 ACCESS TO PH CANNOT BE BLOCKED” for each involved pothead                                                   |         |

*Remark: Please insert "Not Adaptable" or "N/A" for item(s) that are not applicable.*

Responsible (signed and chopped) : \_\_\_\_\_

Inspection Date : \_\_\_\_\_

# Low Voltage Installation Acceptance Form



## 6. Meter Room / Box ( NCEM-62-321 / NCEM C62-323 ) / Panel (NCEM-62-322)

| Inspection item                                                                                                                                               | Fulfill |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------|---------|
| No visible damage to impair safety.                                                                                                                           |         |
| Safe access provided.                                                                                                                                         |         |
| Size and installation of all meter wirings carried out in accordance with the final approval project.                                                         |         |
| The meter panel screws with a hole for CEM to seal (NCEM C14-100 Annex 10).                                                                                   |         |
| Suitable position of metering equipment, free of any obstruction and sufficient working space in front of the meter provided. (NCEM C14-100 Annex 10 and 12). |         |
| A legible and durable address label for each meter position provided. (NCEM C14-100 Annex 10).                                                                |         |
| Correct sizing of cables from and to corresponding meters provided.                                                                                           |         |
| Distance between CT and its corresponding meter location $\leq 10\text{m}$ .                                                                                  |         |
| Correct position and quantity of direct connected meter ( <b>MCB after the Meter</b> ).                                                                       | units   |
| Correct position and quantity of CT connected meter.                                                                                                          | units   |
| Correct sizing of conductors in CT box provided. (NCEM C62-315 and NCEM C62-316) .                                                                            |         |
| Sufficient safe distance between conductors and conductors to non-live conductive parts in CT box provided.                                                   |         |
| All exposed non-live metallic parts of metallic meter boxes and CT box effectively earthed.                                                                   |         |

Remark: Please insert "Not Adaptable" or "N/A" for item(s) that are not applicable.

Responsible (signed and chopped) : \_\_\_\_\_

Inspection Date : \_\_\_\_\_