Principles and methods of building construction(volume 5)

author:

Engineer Mohammad Tayyebi

www.Mohammadtayyebi.com

Famous	:	Tayyebi, Mohammad, 1362
Title and name of the author	:	Principles and methods of building construction /Author: Mohammad Tayyebi
Publication details	:	Tehran, Zarrin andishmand, 1400
Appearance profile	:	5vols, tables, graphs
ISBN	:	V 1:978-622-759161-3. V2:978-622-759163-7. V3:978-622-759164-4. V4:978-622-759165-1. V5:978-622-7591-66-8
Cataloging status	:	Fipa
Topic	:	Buildings --Iran
Topic	:	Construction industry--Iran
Congress Ranking	:	145 TH
Dewey Classification	:	690/02955
National Bibliography Number	:	7601615

Head Office: No. 1182, 5th Floor, Unit 19, Farvardin Building, between Daneshgah and .Abu Reihan St., Enghelab St

Contact number: 09905445006 - 66176087
Website: Andishmandpub.com
Email: Andishmand.pub@gmail.com

Zarrin Andishmand Publishing

Principles and methods of building construction(5)

Author: Engineer Mohammad Tayyebi

Printing: First1400
ISBN: 978-622-7591-66-8

Editor and page votes: Faranak Haji Abdullah
Cover Designer: Reyhaneh ameripoya
Publisher: Zarrin Andishmand Publication

Dedicated to my father

A steadfast mountain and supporter of me throughout my life

Dedicated to my mother

The stone of patience that taught me the alphabet of life

Dedicated to my brothers

Kind companions of my life.

Introduction:

For a long time, shelter has played a vital and decisive role in human life and settlement. Due to the extraordinary progress of man in all sciences, the construction industry is no exception to this rule. In order to have strong and safe structures to protect the lives and property of residents, it must be accompanied by up-to-date knowledge to prevent accidents in buildings. Special attention to the principles and methods of building construction from demolition to joinery are basic and very important issues in the construction industry that in this book (Volume 5) I have tried to mention as much as possible, which are:

Joinery, electrical and mechanical installations of the building, gas piping of the building, flooring and its implementation methods and types of insulation, building facade, skim coat, construction and execution of wooden structures and its components, various applications of wood

and methods of strengthening structures Wooden. I hope to take a very small step in the development of the construction industry by writing this book.

With respect

Mohammad Tayyebi

Table of contents

Chapter 6

Joinery

Building electrical installations

The building is supplied with electricity by the electricity company. Electrical installations provide the electricity needed for lighting, heating and other electrical equipment and appliances for construction and home installations.

Observing safety tips in electrical installations is an important issue. The electrical installation has a branch circuit to supply electricity to the interior of the building. The winding in the circuit of an electrical installation is based on the amount of current it carries. The electrical distribution board in electrical installations has a fuse or breaker that cuts off the circuit if the current in the winding rises.

Electrical systems in electrical installations must be designed by an electrical engineer, but knowing information such as the location of lighting equipment, exits, and locations of power supplies and switches is essential for design engineers and architects to be able to control their performance.

Usually the order of the steps to perform electrical installations in the building is as follows:

Step zero (at the beginning of building design):

Electrical engineers, after receiving the location plans of mechanical facilities and receiving the consumption of various equipment of the facility, as well as receiving the location of equipment inside the unit through interior architects, design, calculate and locate electrical equipment.

The first stage (after plaster and soil):

1- Receiving the electrical plan of the building includes lighting systems, sound systems, electrical outlets, telephone, antenna, iPhone, fan coils, fire control, emergency electricity and room engine.

2- Execution of equipment map on the walls of the building.

3- Drawing a level line on the walls with a level hose or laser level.

4- Grooving the path of the pipes with the grooving machine.

5- Digging the location of the key box with the device.

6- Perforation of ceiling light by the device (in case of false ceiling, it is installed on the support ceiling and the pipe is installed on it).

7- Installing switch boxes and sockets on the wall and aligning them accurately with the alignment.

8- Welding and support to fix the polica pipes that are brought to the inlet and outlet pipes inside the fuse box.

9- Welding and support to fix the polica pipes that are brought for the inlet and outlet pipes inside the antenna and telephone box.

10- Execution of polyca piping using heat and bending by torch and spring and sealing it with polyca adhesive.

11- Welding and making support for the power tray on the duct marked on the map (these power trays are used to enter the power cables, telephone, antenna, satellite and other electrical equipment needed by the building).

12- Complete cover on the polica pipe that has been worked on the floor of the building. .

13- Installing the fuse box and aligning it in specific places by the map.

14- Installing the antenna and satellite box and telephone and aligning it in specific places by the map.

15.Providing earthing of the building (installing copper plates, wires, coal and salt to set up earthing wells and from there to the tray of electricity and consumers).

16. Steel pipe laying in the conditions specified in the plan (in parking lots, lighting inside the elevator shaft and lighting of the engine house).

All pipes entering the cans should be blocked by pyramid paper to prevent gypsum and cement from entering the pipe.

Second stage (after flooring, tiling and wall whitewashing):

1- Cleaning the key box and cutting the extra pipes on the work.

2- Execution of wiring operations inside the polica pipe (the color of the wires, the diameter of the wires (given by the consultant) and the type of wires (given by the consultant) are selected according to the standard).

3- Carrying out the cabling operation of shielded cable for the speakers and from there to the volumes of the same room and then to the plugs behind the amplifiers.

4- Power cabling from inside the fuse box and passing inside the power tray and from there to under the meter.

5- Cabling the telephone, satellite antenna and iPhone and passing it inside its own tray and tying the cables and from there to their own panels.

6. Connections of wires inside the switch box, fuse box, lights, antenna box, satellite, telephone, fire extinguisher and UPS (installation of UPS power supply devices is related to the responsible companies).

7- Execution of cabling related to the outside of the building and installation of floodlights in the facade.

Third step (after painting and finishing the floor):

1- Close the inside of the switch and socket and align them.

2- Close the terminal on the wires.

3- Installing smoke detectors and their knobs on designated areas.

4- Installing fuses inside the fuse box

5- Installing the video iPhone, closing the sockets and related knobs.

6- Installation of central antenna and related switches

7- Installing eyes (lighting) in stairs and parking lots

8- Installing light eye in services for the central hood (these eyes command the centrifuge after operating the contactor and cause ventilation of services)

9- Installing hidden lights inside the false ceiling and insoles on ceramics.

10- Installation of home engine electrical equipment, which includes the following:

- Installation of electrical panel of the engine room (equipment inside the electrical panel is selected based on the needs of the engine house and is made by the panel maker).
- Install the power tray base on the wall and fix the power tray on it.
- Installation of electric underbound pipe and from there on electric motors, thermostats and other consumers.

- Cabling from the electrical panel and inside the pipe and from there to the electric electro motors, thermostats and consumers.

Earth well

Earth wells are deep holes drilled in the ground where a copper wire is welded to a plate. The plate is placed inside the earth well for more contact with the soil, and it is covered with bentonite material, and the copper wire is pulled out of the earth well, and it will be taken to the test box and connected to all electronic devices. Of course, the circuit we produce must have no potential and the resistance of the electronic circuit must be very low. One of the methods of producing such circuits is the use of earth wells.

Earth system

The earth system means the earth and is called the earth connection system. To prevent electric shock, any electric current must be connected to the ground, and this is called an earth system or earth well. The earthing system protects humans and devices when connected in a circuit or leakage current. The purpose of the earth well is that if the phase and neutral wires are connected, or the electrical circuit is leaking current, we can

transmit this leak to the ground by the earth wire and prevent electric shock and damage to the devices. It is sometimes observed that the body of household consumers is mistakenly connected to iron pipes of water or gas or even to the skeleton of a building, which is very dangerous and deadly.

Nowadays, earthing system is used in many cases in different buildings and places that have electricity, and even in telecommunication and telegraph systems, it is widely used to prevent noise in the network and also, in power transmission systems, use an earth system.

In ancient times, the earth system was not used, and because of this, the electric shock and the damage caused by it were very large and irreparable. Therefore, the main reason is the implementation of the earthing system to prevent electric shock and its dangers. The earth well must be drilled properly and the earth wire must be placed in it so that it does not pose a danger to anyone during the connection.

An electrical circuit is connected to ground for the following reasons

• To maintain security and protection of high-power circuits and the loss of conductor insulation

• To prevent voltage rise between the circuit and ground

• For the path of flow back to the source

• To prevent static electricity increase in flammable materials or repair of electronic equipment

Advantages of using an earthing system

• Protection and safety of manpower

• Protection and safety of electrical devices and equipment

• Eliminate excess voltage

• Prevent contact voltage

• Prevent unwanted voltages and eliminate lightning effects

The reasons for the implementation of earth wells are ground connection (protective) and ground connection (electrical). In a protective earth connection system, the goal is to maintain the safety of the person when working with electrical devices and to secure the device itself. For

example, in your home, electrical appliances such as refrigerators are electrically leaky, and by touching them, you may get electrocuted and the electric current will pass through your body and get out of your feet, in which case the person's safety will be disrupted and the earth system must be installed for it so that both the person and the device do not have problems.

An electrical ground connection system is for the proper operation of electrical devices. For example, a transformer and generator star center at a substation and power plant must be connected to ground, otherwise the ground wire can never be used as a return. For this purpose, we need an earth connection system so that our devices are not damaged.

Depending on the geographical and geological conditions of the place intended for the construction of the well, the type of drilling of this well varies. Due to these reasons, two types of wells will be used:

1)Deep earth well

This method is one of the most common methods for creating wells. High depth will be considered

for drilling this well; Because due to the special feature of this area, more digging is needed and after reaching the wet layer, the copper plate will be considered and the well will be filled.

2) Surface earth well

When it is not possible to drill a deep well, this method will be used to protect electrical equipment. This method will be used in some situations, which we will mention in the following.

The intended area should be uniform and have little roughness.

Suitable for areas that are lower than sea level.

This method will be performed up to a depth of 80 cm and due to its advantages, this method is very popular and seven different methods will be used for this method, which are:

• ROD

• RING

• Claw (radial)

•mixed

• Spiral

• Electrochemical

•network

Execution of earth by deep method

1- Selecting the location of the earth well:

Earth wells should be drilled in places with the lowest levels and the possibility of access to moisture at as shallow depths as possible, or in areas most exposed to moisture and water, such as lawns, gardens and green spaces.

2- Depth of well

Depending on the specific strength of the ground, the depth of the well can be from at least 4 meters to 8 meters and its diameter can be about 80 centimeters. In lands that have lower specific strength due to soil type, such as agricultural soils and clay soils, the depth required for drilling is less, and in sandy and rocky soils that have higher specific strength, it is necessary to dig wells with greater depth. Special devices are used to measure the specific strength of the soil. f we do not reach the moisture to a depth of 4 meters and there is a possibility that we will not reach the moisture at a depth of more than 6 meters, we do not need to

dig a well more than 6 meters. In general, a depth of 6 meters and a diameter of about 80 cm is recommended for drilling wells.

3. - Connect the wire to the copper plate

Connecting the wire to the copper plate is very important and under no circumstances should this connection be established just by using a clamp, sewing the wire to the plate or.. Instead, the wire must be welded to the plate and for more strength, it must be closed and tightened to the plate using 2 wire clamps. To weld copper parts to each other, use brass or silver welding, and if this type of welding is not available, use welding (Cadweld).

4- Digging earth wells

According to the geographical conditions of the region, a well should be dug with a suitable depth and in a suitable place (according to the guide for selecting the location of the earth well).

Dig a groove 60 cm deep from the well to the pylon, also for earth wire inside the building. If the path of the two wires is common, it is better to isolate the path of the two wires. Also, the path of the wires should be the shortest path and the wire of the lightning rod and earth should be as straight as possible without twists and turns, and it should

not have sharp bends, and if the wire needs to be bent, it should be done more than 50 cm in length.

5- Filling the earth well

First, prepare about 20 liters of water and salt solution and pour it into the bottom of the well so that it covers the entire bottom of the well. After 24 hours, we perform the following steps.

* Fill to a height of 20 cm from the bottom of the well with clay or soft soil.

* Mix the required amount (about 450 kg, equivalent to 15 bags of 30 kg) with bentonite with water and make a slurry and pour the resulting mixture to a height of 20 cm from the bottom of the well. The thicker the mixture, the better the quality of work will be. .

* Weld the copper plate to 2 copper wires (score 50). One of these wires will go to the lightning rod on the mast, and the other will go into the building. Therefore, we choose the length of the wires in proportion to the length of the path.

* Place the copper plate vertically in the center of the well

* Fill the area around the copper plate with the prepared grout to the top of the plate.

* Place the perforated plica pipe diagonally in the center of the well and on top of the copper plate and pour sand into the plica pipe to fill 50 cm from the end of the pipe. This pipe is to supply moisture to the bottom of the well and in hot seasons of the year, more water should be injected from this pipe. It should be mentioned that in cases where the earth well is dug in the garden or the bottom of the well has reached moisture or in places where the moisture of the bottom of the well is supplied from the top of the well or from the bottom of the well, there is no need to install pipes.

*After placing the plica pipe at a height of 20 cm from the top of the copper plate, fill it with the prepared slurry.

*Fill the rest of the well up to 10 cm above the well with normal soil with sand or soil and fill 10 cm of the well with sand and gravel to allow rainwater and surface water to penetrate into the well. The well should not be asphalted or filled with cement, especially when the polyca pipe is not used.

* Fill the inside of the drilled grooves with sifted agricultural soil or ordinary soft soil or ordinary soil mixed with bentonite.

6.Installation of busbar and lightning rod

The busbar inside the building should be insulated by the building wall. The diameter and length of the busbar depends on the number of branches inside the building. (All equipment inside the building must be connected to this busbar separately and in parallel.)

If the mast is located on the building, the wire of the ground rod should not be taken from inside the building, but the wire should be pulled outside the building, and also the passage of the ground wire inside the building to the busbar of the building should be insulated.

The ground rod wire is connected to one of the mast bases very tightly. It should be noted that the path of the ground rod must be separate from the cables that go to the end.

Execution of earth by surface method

Execution of earth by ROD method

Materials required

The required materials are the same as the deep method, with the difference that instead of a copper plate, we use steel core rods of 1.5 meters with a diameter of 14 mm and a copper coating.

Execution method

We dig a channel with a depth of 80 cm, a width of 45 cm and a length of X. The length of the channel can be determined in two ways.

A - Measurement of soil specific strength and perform the necessary calculations

B) The experimental method described below.

- If the site has a static mast, the distance between the equipment room and the pylon as well as around the pylon should be used to dig the canal.

- If the pylon is located on the building, drilling should be done considering the machine room and the pylon in a way that the ground has more moisture.

- After preparing the canal, we drive 2 rods at a distance of 3 meters from each other on the ground so that about 15 centimeters of the rods remain outside. Then connect 2 rods with copper cable or power cable and measure the ground

resistance created with an earth meter. If the resistance shown with the device was above 4 ohms, nail another rod 3 meters away from the second rod and By connecting 3 rods together, we measure the resistance of the created ground. Continue this until the measured resistance reaches below 4 ohms. After a sufficient number of rods have been hammered, the wire connected to the copper busbar installed in the machine room is welded to each of the rods.

- To fill the canal, first cover the copper wire with bentonite (in lands that do not have enough moisture) and then fill the canal with sifted agricultural soil or soft soil.

- Measure and record the implemented earth resistance (after filling the canal, the measured earth resistance will decrease and should be less than 3 ohms.)

In cold areas, the depth of the drilled channel, and in general the copper cable route is very important and should not be exposed to frost. The effect of decreasing temperature on increasing the resistance of the earth system is as follows:

Other methods:

Other methods are used in mountainous and rocky areas and special places, which can be prepared according to the case by visiting the place and the necessary measurements.

Execution of earth at heights

The heights of the country can be divided into three categories according to the type of land and soil.

1- Soil heights where it is possible to dig and pound steel core rods.

2- Rocky heights in which it is not possible to dig deep but grooves can be made.

3- Rocky heights

For the first case: one of the methods of drilling wells or hammering ROD can be implemented earth system.

In the second case, we create grooves in the form of stars and claws and put the copper belt inside the grooves and cover the belt with a mixture of soil and bentonite to reduce the resistance.

Note: All connections under the soil should be welded to each other.

The first method :

In rocky lands where it is not possible to dig, we make a canal with construction materials and place a copper belt on the bottom of the canal and fill the canal with bentonite. The length of the channel or channels should be such that the measured resistance is below 3 ohms. To get the desired result, the inside of the canal must be kept artificially constantly moist.

The second method:

The method is grid, in which we first make a checkered grid with copper wire so that the joints are welded together, then with construction materials we place it on a ground with bentonite at a height of 40 cm and cover it up to 20 cm with bentonite. The necessary branches for the pylon and the site and other points are taken from it. The variables x and y depend on the amount of resistance read.

Building interlocking

The need to observe safety measures and prevent the dangers of electric shock such as electric shock, burns and the like are among the most important possible dangers of electric shock.

Many methods and ideas have been proposed to avoid these dangers. By implementing interlocking in buildings, these dangers can be avoided to a great extent.

interlocking in residential buildings

One of the important reasons for the attention of electrical engineers to the interlocking is the widespread use of residential buildings with concrete structures. The method used in the past to make a ground connection and for the lightning system was an independent ground electrode system.

This ground system includes buried metal plate, hammered rod, buried metal belt and cable armor. In this traditional method, the formation of a interlocking is avoided and to protect against lightning, an independent descending system has been created using special conductors and finally it was connected to an independent ground electrode system.

For added protection, a interlocking is also made between the two ground electrode systems. The use of concrete as an electrode is very important and cost-effective to create a connection, although in some cases it may be severely damaged due to

neglect of the concrete in terms of currents associated with short circuits or lightning. The interlocking system has a long life in terms of mechanical strength and does not require high maintenance.

interlocking in order to become potential

The cause of current flow in electric consumers is the potential difference between the two ends of the consumer. If the potential of the two ends of the consumer (R) is the same, then no current flows in the consumer. The interlocking method works in the same way to protect the lives of people against the passage of current.

In this method, if a person touches the metal part of the electrical device to which the phase wire is connected, because the point of contact of the hand with the metal body and the voltage of the person's foot on the ground is potential, so the contact voltage is zero and the current does not pass through a person’s body. In a concrete structure where all the internal components are connected together, if the interlocking is made, the voltage at different points will be the same.

Electrode buried in concrete (Uffer method)

Burying a conductor in concrete so that its contact surface with the soil is high is called the Eufer method. Concrete always retains some moisture, so the electrical conductivity of concrete is better than other types of soil. The basis of Uffer design is based on embedding the earth conductor in concrete. Engineers today are aware of the benefits of Mr. Yofer's discovery. The whole skeleton of a concrete building, despite the steel bars in the building or its foundation with concrete cover, creates an electric earth system with very low resistance.

Another advantage of this method is the use of concrete properties to reduce ground strength. Of course, this method has requirements, such as the copper conductor of the buried ground connection of the ground connection system has a cross section of 25 mm square or the rebar used in the concrete body No. 14. Also, the distance between the conductor inside the concrete and the outer surface of the concrete should not be less than 5 cm.

Given that the purpose of the earth connection is to allow current to flow through the earth electrode instead of the person's body, the purpose

of the interlocking is to reduce the amount of touch voltage. Due to the decrease in contact voltage due to the interlocking, it can be concluded that the simultaneous use of grounding and connection methods prevents the risk of electric shock.

For this purpose, due to the fact that the contact surface of the concrete floor with the ground may be low due to insulation, at least one ordinary ground electrode is connected to the structure interlocking or attach a copper ring that is buried around the building.

Advantages of interlocking:

• The safest way to prevent electric shock caused by indirect contact

• Protection against damage to electronic equipment, telecommunications and automation

• Reduce the effects of static electricity

• Creating parallel paths to direct lightning current to the ground and prevent damage to persons and electrical equipment

Steps of interlocking before concreting:

Execution of building interlocking should be done before concreting and simultaneously with the execution of the building foundation and on all floors of the building.

The steps to do the interlocking are as follows:

Execution on the foundation: On the foundation of the building, all communication ties must be interlocked. ties is the axis that connects all the columns of the building.

Execution in columns: In all floors, columns located in the corners of the building, one of the stair columns, and engine room and every 20 meters of the length and width of the building, the intelocking network must be connected to each other.

Interlocking Conductor

The Interlocking conductor is a string of copper wire, a belt, a number of rebars and a metal beam or column that is placed on the roofs and columns according to the Interlocking design.

Copper interlocking conductor:

If copper wire is used for interlocking, the cross-sectional area of the copper interlocking

conductor should not be less than 6 mm2. It is not necessary to use a cross section of 25 mm and also the main cross section should not be less than half the cross section of the largest protective conductor in electrical installations. Copper wires or belts must be connected to the existing rebars of the structure.

To do this, connections must be made every 6 meters using combustion welds (combustion or exothermic) or suitable screw clamps, and also in the distance between screw clamps or welds, they must be connected to the structural rebars with the help of ordinary reinforcement wire.

Also, in all branches, including three-way and four-way, copper wires should be connected using combustion welding so that their electrical resistance is minimized and has sufficient mechanical strength.

Note that when two heterogeneous metals are placed next to each other, due to their different chemical properties, they form an electric cell and cause the metal to corrode at the joint for a long time. Copper and iron have the same rule, but due to their close chemical properties, the resulting cell is very weak.

Run on ceilings:

On the roof of buildings, ties and metal beams around the roof, around the elevator, one of the ties or metal beams in the bathroom, toilet, kitchen, and other spaces where the floor is usually poured water, as well as ties or metal beams in The length and width of the building, at least every 20 meters, interlocking must be done.

Run on the roof of the building:

On the roof of the building (the last roof) all the ties and metal beams, such as the foundation, interlocking must be done.

Connection of copper interlocking conductor to the rebars in the structure

There are two ways to connect a copper conductor to the rebars in a structure:

Method one: Use a U-Type clamp

One of the types of clamps that are used to connect the wire to the earth rod is U-Type clamp, which is very important in designing clamps due to the mechanical strength of the clamp and corrosion resistance. These fasteners are designed in terms of dimensions and thickness in such a

way that it has high mechanical strength. Another application of this clamp is to connect the wire to the rebar.

There is a type of clamp called a bimetal clamp. The part where the rebar is placed is made of iron and the part where the copper conductor is placed is made of copper. The reason for this is to prevent corrosion.

The second method: the use of combustion welding

The equipment required to use combustion welding is exactly the same as the practical work of connecting three-way and four-way copper wire, and the difference is in the type of mold.

Rebar interlocking conductor:

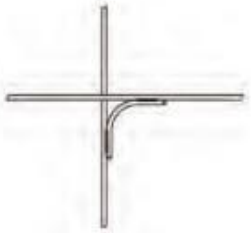
Instead of copper wire, rebar can be used for interlocking. The interlocking rebar can be one of

the main rebars in the ties or columns of the structure or additional rebars that have been added to the main rebars of the structure. Execution of this interlocking should not damage the technical structure of the structure. The diameter of the rebar should not be less than 8 mm and if the cross-sectional area of the main conductor of the building phase is 95 mm or more, the diameter of the rebar shall be increased to 10 mm.

All components of the interlocking network must be connected through a secure electrical connection in such a way that the electrical resistance at the junction is minimized. By welding, a secure connection is formed between the rebar parts.

Welding of rebars at a crossroads:

According to the figure, using a vertical bend, interlockingt welding can be done at the intersection of two rebars.



Welding rebar in one corner:

Welding rebar in a corner is similar to welding a crossroads.

Welding at a three-way intersection:

The following figure shows the interlocking welding for a three-way path.

Welding of ties bars with foundation to column:

In this type of welding, like three-way welding, the connection between the ties rebar and the foundation to the column is done.