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Electrical earthing play major role to importance of discovery For mankind

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Abstract - Electricity was born to serve man, its master. But with the current scenario of several mishaps and lack of preventions, there has been a strange and undesirable role reversal. The human body has chances of severe damage in case an electric current of 5 mill amperes passes through it within a rapid time span. In such a case if a person touches an appliance, which has heavy currents flowing through it, with his bare hands there are high chances of this encounter being fatal. The electrical potential of the Earth is considered to be zero. Hence on connecting the electrical channels of any appliance to the Earth, its potential would become zero too. This is the main concept behind Earthing, which is a process bonding noncurrent bearing parts of an electrical device or the neutral summit of the electrical organization to the earth through wires possessing minor resistance to flow of current.

***Key Words*:** Electrical Earthing, earth & soil, voltage, current, lightning strokes, direct strokes, return strokes.

I. INTRODUCTION

Electricity was an ever important discovery for mankind. Be it basic necessities to exquisite designs – electricity has a major role to play in every sphere of our lives. Several technological advancements in the type of appliances have come to the fore, and this keeps on increasing day after day. Earthing means to connect electrical system to earth or soil in such a manner as it ensures an immediate discharge of electrical energy without any danger. It is the most essential part of electric work which must be provided to protect from any mishap. It saves human life from sudden electric shock. When proper earthing is done in building, it saves building of thunder effects i.e. from fall of natural cloud lighting.

1.1 Electrical Earthing without earthing

To warrant that all pieces of equipment in use by the occupants of a building are at earth potential, thus safeguarding them from electric shocks through direct contact. To protect electrical apparatus from getting damaged due to weighty currents along electrical lines. To sustain stable voltages in three phase circuits even under unstable load state. To protect tall buildings from getting harmed under lightning.

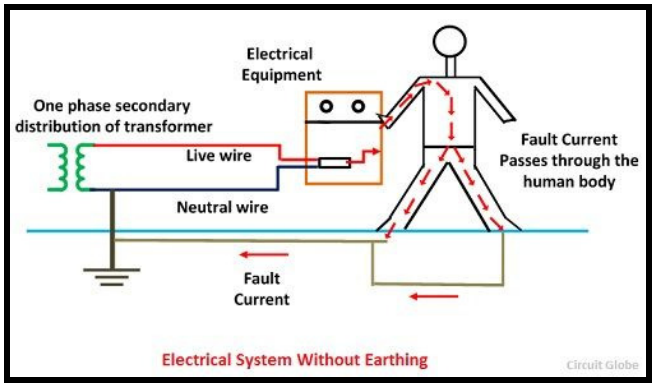

Figure 1:- Electrical system without earthing

1.2 Electrical earthing in earthed appliance

The current flows from a higher to a lower potential. Any electrical appliance or any electricity line which has been connected to the earth is now at zero voltage. In the case of any overloading of current, the immediate discharge of electrical energy takes place to the ground, without harming the appliance or the user. Even if the insulation of the equipment fails, if it is earthed, the appliance is safe enough.

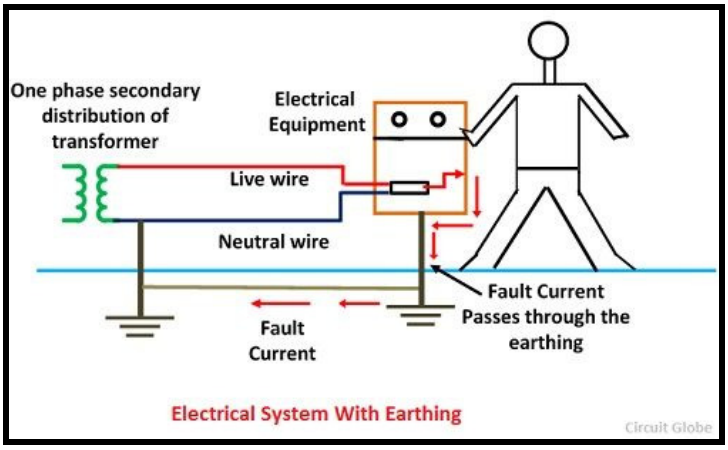

Figure 2:- Electrical system with earthing

II PURPOSE OF EARTHING

In general earthing is not provided in building at the time of electrical fittings either due to ignorance/carelessness or to save expense on earthing.

1) To save human life from danger of electric shock or death.
2) To protect building, machinery and appliances under fault condition.
3) To ensure that all exposed conductive parts do not reach a dangerous potential.
4) To provide safe path to dissipate lighting and short circuit currents.
5) To maintain the line voltage constant to prevent over current or excessive voltage on the appliances or equipments.

2.1 Implementation of earthing in housing

1) The size of the earth pit should normally be 1500 mm X 1500 mm X 3000 mm.
2) Low earth resistance is required to give effective earthing protection to electrical fittings.
3) Dry earth has more resistance whereas moist earth has less resistance.
4) The location of earth pit should be such where the soil has reasonable chances of having moisture. If possible earth plates or pipes should be located near water tap, water drain or rain water pipe.
5) Electric earthing may be either pipe or plate earthing.
6) Normally GI pipe (2.5 inch diameter) or plate (500 mm X 500 mm X 10 mm) is used but if the soil is corrosive then copper pipe or plate should be used.
7) Use Double GI Strip size 30 mm X 10 mm to connect GI Plate to System Earthing.
8) A mixture of Wood Charcoal Powder, Salt and Sand, all in equal part, must be filled in the earth pit around earthing pipe or plate. The purpose of coal and salt is to keep wet the soil permanently.
9) The position of the earth plate or pipe when fixed should be clear from all building foundations.
10) A masonry enclosure should be made over earth pit.
11) Entrance, pavement and roads should be avoided for locating earth pit.
12) Inside building in addition to all electrical appliances, all switch boxes, meter boxes etc. should be earthed also.

2.2 Mechanism of lightning discharge

When a charged cloud passes over the earth, it induces equal and opposite charge on the earth below. Fig. shows a negatively charged cloud inducing a positive charge on the earth below it. As the charge acquired by the cloud increases, the potential between cloud and earth increases and, therefore, gradient in the air increases. When the potential gradient is sufficient (5 kV/cm to 10 kV/cm) to break down the surrounding air, the lightning stroke starts. The stroke mechanism is as under:

(i) As soon as the air near the cloud breaks down, a streamer called leader streamer or pilot *streamer* starts from the cloud towards the earth and carries charge. The leader streamer will continue its journey towards earth as long as the cloud, from which it originates, feeds enough charge to it to maintain gradient at the tip of leader streamer above the strength of air. If this gradient is not maintained, the leader streamer stops and the charge are dissipated without the formation of a complete stroke. In other words, the leader streamer will not reach the earth. The leader streamer being unable to reach the earth as gradient at its end cloud not is maintained above the strength of air. It may be noted that current in the leader streamer is low (<100 A) and its velocity of propagation is about 0·05 % that of velocity of light. Moreover, the luminosity of leader is also very low.
(ii)In many cases, the leader streamer continues its journey towards earth. As the leader streamer moves towards earth, it is accompanied by points of luminescence which travel in jumps giving rise to stepped leaders. The velocity of stepped leader exceeds one-sixth of that of light and distance travelled in one step is about 50 m. It may be noted that stepped leaders have sufficient luminosity and give rise to first visual phenomenon of discharge.
(iii) The path of leader streamer is a path of ionization and, therefore, of complete breakdown of insulation. As the leader streamer reaches near the earth, a return streamer shoots up from the earth. The action can be compared with the closing of a switch between the positive and negative terminals; the downward leader having negative charge and return streamer the positive charge. This phenomenon causes a sudden spark which we call lightning. With the resulting neutralization of much of the negative charge on the cloud, any further discharge from the cloud may have to originate from some other portion of it.

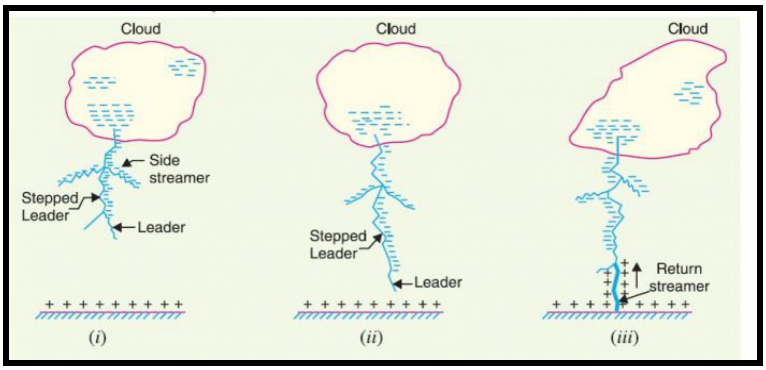

Figure 3:- Lightning discharge occurs

The following points may be noted about lightning discharge:-

a) A lightning discharge which usually appears to the eye as a single flash is in reality made up of a number of separate strokes that travel down the same path. The interval between them varies from 0·0005 to 0·5 second. Each separate stroke starts as a downward leader from the cloud.
b) It has been found that 87% of all lightning strokes result from negatively charged clouds and only 13% originate from positively charged clouds.
c) It has been estimated that throughout the world, there occur about 100 lightning strokes per second.
d) Lightning discharge may have currents in the range of 10 kA to 90 kA.

III CONCLUSIONS

Earthing resistance and earth surface potential distribution are the main parameters characterizing electrical properties of the earthing system. Electrical parameters of the earthing system depend on both soil properties and earth electrode geometry. The behavior of the earthing system for high transient currents should be considered. Very high current values diminish earthing resistance due to the strong electric field between the earth electrode and the soil, while fast current changes increase earthing impedance due to earth electrode inductance. The earthing impedance is, in this case, a superposition of both these events.

Lightning discharge is a deadly but often avoidable hazard. If the proper precautions are taken the threat of this hazard can be greatly reduced. Through education people can raise their awareness and understanding of lightning strikes, therefore reducing their risk of injury or death. The impacts of lightning vary greatly between developed and less developed countries. The two priorities in less developed countries to achieve a decrease in lightning deaths and injuries are protecting people working in labour-intensive agriculture and providing lightning-safe dwellings, buildings, and vehicles. Data from global lightning detection networks can help identify areas with the highest density of lightning.

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