ST. XAVIER'S COLLEGE
(AUTONOMOUS)
5, Mahapalika Marg, Mumbai - 400 001,
INDIA.
✆ 2262 0661/65

7.1.6: QUALITY AUDITS ON ENVIRONMENT AND ENERGY

❖ **Electrical Safety Reports**

- Electrical Safety Report
  Auditor: Prakash Electricals, Mumbai
  (Combined 2-phase report: 15th Nov. 2019 & 21st Apr. 2020)
- Inspection Report for Electrical Safety & Fire Audit
  Auditor: Friends Electricals, Mumbai
  (21st April 2020)

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ELECTRICAL SAFETY REPORT

Prakash Electricals, Mumbai
15th Nov. 2019 & 21st Apr. 2020

Electrical Safety Report For St. Xaviers College, Mumbai2019-2020

This report provides electrical energy usage issues/risk, and related recommendations for its improvement.

Prasad Gore

CONTENTS

INTRODUCTION:

This electrical safety audit has been carried out to understand the level of risk for usage of existing electrical infrastructure. All relevant standards has been considered during preparation of this report. Standards update at regular interval as per technology, and hence it is difficult for an older infrastructure complying with recent standards, however this report suggest for an up-gradation to all areas where risk of using old topology is high.

This audit was not carried comprehensively, ie. No test /calculations/simulation were done. It was only focused on general assessment. All testing/calculations required are provided in respective sections.

This report was prepared in two phases, in 1st phase complete inspection was carried out and safety requirements were recommended. 2nd phase is still in progress where important-urgent safety requirements are fulfilled and important-not urgent requirements are in progress .This report can be treated as final reporting.

We hope you will find our recommendations beneficial to improve your electrical safety.

ACKNOWLEDGMENT

We are very much thankful to **St. Xaviers College**, for giving us an opportunity to work for safety issues at their college.

Our special thanks to Team for their cooperation and good response to our requirements.

Many Thanks.

Regards,

Prasad Gore

STUDY DETAILS

Work Description	
Customer Name	**St. Xaviers College, Mumbai**
Client Representative	**Father Ambrose**
Auditor	**Prasad Gore**
Study Duration 1st Phase	**11/10/2019 TO 24/10/2019**
REPORT SUBMISSION 1st Phase	**SUBMITTED ON 15/11/2019**
Rectification Duration 2nd Phase	**25/11/2019 TO 20/03/2020**
REPORT SUBMISSION 2nd Phase	**SUBMITTED ON 21/04/2020**
Report Prepared By	**Mr. Prasad Gore**

STANDARDS CONSIDERED IN PREPARATION OF THIS REPORT

NEC 2011

NFPA 70E

IEC 60287-1-1 Electric cables - Calculation of the current rating - Current rating equations (100 % load factor) and calculation of losses - General

IEC 60364-1 Low-voltage electrical installations - Fundamental principles, assessment of general characteristics, definitions

IEC 60364-4-41 Low-voltage electrical installations - Protection for safety - Protection against electric shock

IEC 60364-4-42 Low-voltage electrical installations - Protection for safety - Protection against thermal effects

IEC 60364-4-43 Low-voltage electrical installations - Protection for safety - Protection against overcurrent

IEC 60364-4-44 Low-voltage electrical installations - Protection for safety - Protection against voltage disturbances and electromagnetic disturbances

IEC 60364-5-51 Low-voltage electrical installations - Selection and erection of electrical equipment - Common rules

IEC 60364-5-52 Low-voltage electrical installations - Selection and erection of electrical equipment - Wiring systems

IEC 60364-5-53 Low-voltage electrical installations - Selection and erection of electrical equipment - Isolation, switching and control

IEC 60364-5-54 Low-voltage electrical installations - Selection and erection of electrical equipment - Earthing arrangements and protective conductors

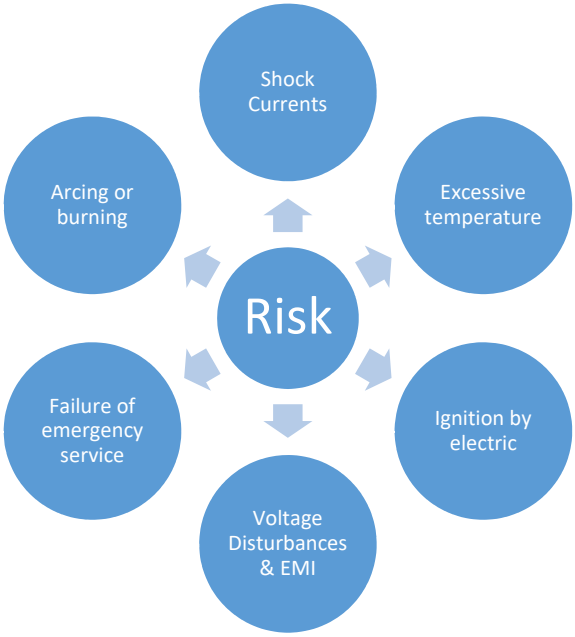
IEC 60364-5-55 Low-voltage electrical installations - Selection and erection of electrical equipment - Other equipment

IEC 60364-5-56 Low-voltage electrical installations - Selection and erection of electrical equipment - Safety services

IEC 60364-6 Low-voltage electrical installations - Verification

SECTION 1 - PROTECTION FOR SAFETY

Synopsis -This section deals with risk to person, livestock & property while utilising electrical energy.



1.A – PROTECTION AGAINST ELECTRIC SHOCK

According to standards, hazardous live parts shall not be accessible and accessible conductive parts shall not be hazardous live.

IEC publication 60479 defines four zones of current-magnitude / time-duration, in each of which the pathophysiological effects are described (see Fig.1).

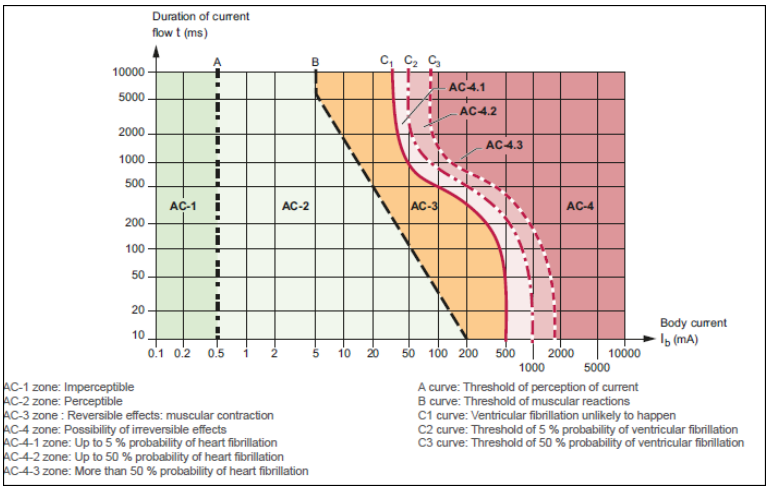


Fig 1- time/current effect when pass through left hand to feet.

1.A.1 - SITE OBSERVATIONS

In case of fault and normal operations, an exposed conductive parts of installation shall not be hazardous live.

1. It is observed that earth conductor has been taken from utility. And suggest the TN earthing system. Same earthing conductor is looped and provided to entire building.
2. No continuity test carried out for earth conductor, there is no data for Zs = Impedance in ohms of the fault loop.
3. No testing of Insulation resistance of any cable or component.
4. Damaged and old switch and sockets are in operations.
5. Isolator, MCB & Fuses are used for disconnection in case of fault.
6. At entrance of physics lab, switchgears has been installed.

1.A.2 - POSSIBLE RISK

1. Locations such as water-cooler, socket-outlets, lab instruments, carrom board lights (excluding extra low voltage and double insulation equipment) etc, can have hazardous touch potential in case of fault.
2. Live conductor of old cables having high possibility of degradation and are exposed, can come in direct contact with person. (eg batten wiring inside some of areas)
3. Similar risk is present where old/damaged sockets and switches are in operations.
4. Due to unintentional contact/touch, there is shock possibility where switchgears are not provided with barriers/ enclosure.

1.A.3 - STANDARD REQUIREMENTS

1. There shall be automatic disconnections in case of fault complying below relationship,
   Zs * Ia <= Uo * Cmin
   Where,

   Zs= the impedance in ohms (Ω) of the fault loop.

   Ia = is the current in amperes (A) causing the automatic operation of disconnecting device within the time 400 mSecond for final circuit upto 32A, and 5 Second for circuit over 32A

   Uo= nominal AC rms or ripple-free DC line voltage to Earth

   Cmin = is the minimum voltage factor to take account of voltage variations depending on time and place, changing of transformer taps and other considerations-

2. Socket-outlets & mobile equipment (upto32A) shall be protected with 30mA RCD.
3. Socket outlets except dwelling complying pt 1 above shall not be required to have RCD, however RCD is considered additional protection and always recommended.
4. Every socket-outlet for household and similar use shall be of the shuttered type and, for an AC installation, shall be complying Indian standard.

1.A.4 - RECOMMENDATIONS

1. Carry out earth loop impedance and continuity testing for all sockets.
   Action Taken- New 12 nos of earth pit has been made and testing has been done to make sure that each socket has been provided with earthing. – Reference Document- Earthing Testing Report
2. Provide 30mA RCD with no risk of unwanted tripping & proper cascading of RCD shall be done.

Action Taken- All important feeders such as labs has been protected with RCD. – Reference Document- Earthing Testing Report

3. Old /damaged batten wiring system, shall be replaced with conduit wiring system.
Action Taken- Work is in progress and shall be completed as per availability of class rooms.

4. Old /damaged switch-socket shall be replaced with new one complying present Indian standards. Note : Old means, component near to its end of life. Eg- Switch may have 1 million mechanical life cycles. **Action Taken- Work is in progress and shall be completed as per availability of class rooms.**

1.B – PROTECTION AGAINST THERMAL & FIRE RISK

1.B.1 - SITE OBSERVATIONS

1. Cables/switchgears are old and physically looks degraded, possibility to have low insulation resistance.
2. Circuits are protected with B curve, at some locations with C curve, some locations with isolator & fuses.
3. At some locations cables and equipment are passing through wooden structures.
4. In labs, heaters/centrifuge m/c are kept on in absence of persons.
5. In library cable conduits/luminaire are laid near bookracks.
6. All wiring is laid in surface casing and caping system.
7. Almost in every offices, papers are kept near switch-sockets. And many plugs are not inserted properly.
8. In hostel, extension boards are used and many of them seems to have poor quality.
9. Overloaded sockets found in hostel rooms.
10. It seems that no maintenance has been carried out wrt switchgear connection tightness.
11. There is no assessment documents wrt appropriate selection of cables, switchgear and equipment/ Machine installation.
12. Many Air-Condition plug-socket's mating is improper.

1.B.2 - POSSIBLE RISK

1. A leakage current of 300mA magnitude in humid dust can generate enough arc energy to ignite nearest flammable/ combustible material. Point 1 & 2 above indicate high possibility of leakage current of this magnitude passing without disconnection protection.
2. Overloaded sockets and lack of maintenance can originate sparks.
3. Point1,2 can originate sparks and degraded cables/casing caping with no fire resistance quality can propagate fire. And high risk areas are labs, library & hostel.
4. Lab equipment if not erected as per manufacturer's recommendation and condition mentioned in point 4 above can be hazardous.

1.B.3 - STANDARD REQUIREMENTS

1. All electrical machine shall be erected as specified by manufacturer to avoid danger of short circuit and its temperature rise during normal operation/fault is known and cause no danger to adjacent material.

2. Areas where fire risk exist (electrical items in the vicinity of combustible material), cables/conduit shall conform fire resistance quality.
3. Arc fault detection devices are recommended as a means of providing additional protection against fire caused by arc faults in AC final circuits.
   If used, an AFDD shall be placed at the origin of the circuit to be protected.
   - premises with sleeping accommodation
   - locations with a risk of fire due to the nature of processed or stored materials, i.e. BE2 locations (e.g. barns woodworking shops, stores of combustible materials)
   - locations with combustible constructional materials, i.e. CA2 locations (e-g. wooden buildings)
   - locations with endangering of irreplaceable goods.

1.B.4 – RECOMMENDATIONS

1. RCD gives basic arc protection, however AFDD shall be installed in areas such as library, old wiring circuits, hostel and auditorium. **Action Taken- Work is in progress and shall be completed as per availability of class rooms.**
2. Also rectify remarks shown in photos.

   Action Taken- Work is in progress and shall be completed as per availability of class rooms.

3. Replacement of old wiring shall be undertaken. **Action Taken- Work is in progress and shall be completed as per availability of class rooms.**

SECTION 2 – SELECTION AND ERECTION

2.A – WIRING SYSTEM

2.A.1 - SITE OBSERVATIONS

1. There is no data available regards to size, type of the cable.
2. Somewhere it is seen that fixing of cable ie laying/routing of the cable is improper and hence mechanical stress can damage cable.
3. There is no information of insulation resistance of cable, also old cables are still in operations.
4. There is no data on overload/fault protection device (Relay) for wires.
5. There is no identification of cables.
6. No information of temperature of cable termination/joints.
7. Size and continuity of earthing cable seems an issue.

2.A.2 - POSSIBLE RISK

1. Refer 1.A.2 & 1.B.2

2.A.3 - STANDARD REQUIREMENTS

1. Non-sheathed cables for fixed wiring shall be enclosed in conduit, ducting or trunking. This requirement does not apply to a protective conductor.

2. Wiring systems shall be supported such that they will not be liable to premature collapse in the event of a fire.
3. The installation method selected shall be such that protection against the expected external influences is provided in all appropriate parts of the wiring system. Particular care shall be taken at changes in direction and where wiring enters into equipment.
4. The current, including any harmonic current, to be carried by any conductor for sustained periods during normal operation shall be such that the appropriate temperature limit specified in Table 1 is not exceeded.
5. The appropriate value of current-carrying capacity may also be determined as described in IEC 60287 ,or by test. or by calculation using a recognized method, provided that the method is stated. Where appropriate account shall be taken other characteristics of the load and, for buried cables, the effective thermal resistance of the soil.
6. Provision shall be made for safe and adequate access to all parts of a wiring system which may require maintenance.
7. NFPA 70E requires availability of single line diagram for all electrical system.

Table 1

Type of insulation	Temperature limit[a]
Thermoplastic	70 °C at the conductor
Thermosetting	90 °C at the conductor[b]
Mineral (Thermoplastic covered or bare exposed to touch)	70 °C at the sheath
Mineral (bare not exposed to touch and not in contact with combustible material)	105 °C at the sheath[b, c]

[a] The maximum permissible conductor temperatures given in Table 52.1 on which the tabulated current-carrying capacities given in Appendix 4 are based, have been taken from IEC 60502-1 and BS EN 60702-1 and are shown on these tables in Appendix 4.

[b] Where a conductor operates at a temperature exceeding 70 °C it shall be ascertained that the equipment connected to the conductor is suitable for the resulting temperature at the connection.

[c] For mineral insulated cables, higher operating temperatures may be permissible dependent upon the temperature rating of the cable, its terminations, the environmental conditions and other external influences.

NOTE: For the temperature limits for other types of insulation, refer to cable specification or manufacturer.

2.A.4 – RECOMMENDATIONS

1. Prepare electrical layout i.e. single line diagram which shall consist information about identification of cable, its protective device, its connected load and type. **Action Taken- Work is in progress and shall be completed as per availability of class rooms.**
2. Wherever it seems that cable may suffer mechanical damage provide suitable covers. **Action Taken- Work is in progress and shall be completed as per availability of class rooms.**
3. Thermal scanning of electrical connections shall be carried out. **Action Taken- Work is in progress and shall be completed as per availability of class rooms.**
4. Carry out insulation resistance test of cables. **Action Taken- Work is in progress and shall be completed as per availability of class rooms.**
5. S= sqrt(I^2t)/ k, this formula shall be used for earthing conductor size

2.B – ISOLATION & PROTECTION SYSTEM

2.B.1 - SITE OBSERVATIONS

1. There is no information available for any protection devices for any circuit. And it is obvious that none of the present protection devices are well coordinated mutually.
2. Expensive instruments, machines (Such as computers) are running without any calculated protection requirement.
3. There is no Surge protecting devices installed at any part of the installation.
4. Lightning arrestor not seen.

2.B.2 – POSSIBLE RISK

1. As protection reliance level is unknown, there possibility of overloading and degradation of cable, which may lead to short circuit.
2. Protection from overvoltage and lightning power surge is not available, which can damage sensitive load and also risk of fire is possible.

2.B.3 - STANDARD REQUIREMENTS

1. A protective device shall be provided to break any overcurrent in the circuit conductors before such a current could cause a danger due to thermal or mechanical effects detrimental to insulation, connections, joints, terminations or the surroundings of the conductors. The protection against overload current and the protection against fault current shall be co-ordinated.
2. Risk assessment of overvoltage of atmospheric nature shall be done and suitable Surge Protection Device (SPD) shall be installed.

2.B.4 – RECOMMENDATIONS

1. Recommendation stated in 2.A.4.1 shall repeat.
2. Install surge protection Device.

SECTION 3 – OTHER

1. Every item of equipment shall comply with the relevant requirements of the applicable Indian/IEC Standard, appropriate to the intended use of the equipment. – In hostel many extension board were not having IS marking. **Action Taken- Work is in progress and shall be completed.**
2. Except where there is no possibility of confusion, a label or other suitable mean of identification shall be provided to indicate the purpose of each item of switchgear and control gear- This shall be done.
3. Periodic inspection shall be carried out without dismantling, or with partial dismantling. as required, supplemented by appropriate tests and measurements to provide for:
   (i) The safety of persons and livestock against the effects of electric shock and bunts
   (ii) Protection against damage to property by fire and heat arising from an electrical installation
   (iii) Confirmation of correct rating and setting of protective devices
   (iv) Confirmation of correct rating and setting of monitoring devices

(v) Confirmation that the installation is not damaged or deteriorated so as to impair safety
(vi) The identification of installation defects and non-compliances with the requirements of the relevant standards

4. EQUIPMENT END OF LIFE REPORT- Whether residual life assessment or life extension programme is undertaken. – Undertake this programme, so as to understand end of life of all equipment to avoid a catastrophic failure. (eg very old FANs, Lab Machines etc) **Action Taken- Work is in progress and shall be completed as per availability of class rooms.**
5. ELECTRICAL INSPECTOR REPORT --- **This is yearly activity and taken care of by electrical contractor.**
6. ISSUANCE OF WORK PERMIT --- **This is under preparation.**
7. PPM SCHEDULE & REPORT SIGNING AUTHORITY ---- **Action Taken- Work is in progress and shall be completed as per availability of class rooms.**
8. PROJECT SITC DOCUMENTS --- **Old installation and hence Not Available for review**
9. STANDARD COMPLIANCE OF EQUIPMENT USED --- **Old installation and hence Not Available for review**
10. CONDITION OF TOOLS --- Not Available for review
11. ELECTRICAL SAFETY TRAINING --- Not Available for review
12. ELECTRICAL ACCIDENT INVESTIGATION REPORT ---- Not Available for review
13. FIRE & LIFE SAFETY PLAN DOCUMENT --- Not Available for review
14. PREVIOUS SAFETY REPORT --- Not Available for review
15. ANY KIND OF ELECTRICAL INCIDENT IN PAST & ITS ROOT CAUSE --- Not Available for review
16. ACCIDENT PREVENTION PROGRAMME --- **Action Taken- Work is in progress and shall be completed as per availability of class rooms.**

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ELECTRICAL INSPECTION & FIRE AUDIT REPORT

Friends Electricals, Mumbai

21st Apr. 2020

FRIENDS ELECTRICALS

GOVT.LICENCED CONTRACTOR

Deals in Electrical Installation & Maintenance

All kinds of B.E.S.T., Reliance Energy, M.S.E.B.Jobs & Power Saving Advisor.

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MSME UAN NO. MH19D0003678

196, Ashoka Shopping Centre, 1st floor, L.T.Road, Near G.T.Hospital., Mumbai: 400 001

DATE : 21 April 2020

TO,

The Principal,
St. Xavier's College,
Mumbai- 400001.

SUB : Electrical Inspection Report for Electrical Safety and Fire Audit.

DEAR SIR,

Based on the visit dated 10/12/2019 to your college by Mr. Prakash Gadkar (Electrical Contractor) with Mr. Kamal Hasan (your Representative) & fire Audit Person Mr.Walter N A Nazareth,
Following points were recommended and action taken regarding the same post visit.

1. It is observed that earth conductor has been taken from utility. And suggest the TN earthing system. Same earthing conductor is looped and provided to entire building. We recommend to provide additional earth pits. – ACTION TAKEN- 11 nos of earth pit has been provided and testing has been done to make sure that each socket has been provided with new earthing.
2. Carry out earth loop impedance and continuity testing for all sockets. – ACTION TAKEN- Continuity testing has been done, impedance measurement shall be done later.
3. Provide 30mA RCD with no risk of unwanted tripping & proper cascading of RCD shall be done. – ACTION TAKEN- Important and urgent feeders has been provided with RCD. Rest of the feeders shall be completed in phased manner as soon as possible.
4. Old /damaged batten wiring system, shall be replaced with conduit wiring system. – ACTION TAKEN- This is not compliance to attend immediately hence shall be completed in phased manner as soon as possible.
5. Old /damaged switch-socket shall be replaced with new one complying present Indian standards. . – ACTION TAKEN- This is not compliance to attend immediately hence shall be compieted in phased manner as soon as possible.
6. RCD gives basic arc protection, however AFDD (Arc Fault Detection Device) shall be installed in areas such as library, old wiring circuits, hostel and auditorium. Also In labs, heaters/centrifuge m/c are kept on in absence of persons and hence recommend to

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provide AFDD. . – ACTION TAKEN- This is not compliance to attend immediately hence shall be completed in phased manner as soon as possible.

7. Almost in every offices, papers are kept near switch-sockets. And many plugs are not inserted properly. Recommend to shift papers/switch. ACTION TAKEN- This is not compliance to attend immediately hence shall be completed in phased manner as soon as possible.
8. In hostel, extension boards are used and many of them seems to have poor quality, provide them with proper IS Marked extension boards/ or add properly rated additional fixed type switch boards. . – ACTION TAKEN- This is not compliance to attend immediately hence shall be completed in phased manner as soon as possible.
9. There is no assessment documents wrt appropriate selection of cables, switchgear and equipment/ Machine installation. Prepare electrical layout i.e. single line diagram which shall consist information about identification of cable, its protective device, its connected load and type. . – ACTION TAKEN- This is not compliance to attend immediately hence shall be completed in phased manner as soon as possible.
10. Install surge protection Device. . – ACTION TAKEN- This is not compliance to attend immediately hence shall be completed in phased manner as soon as possible.
11. Expensive instruments, machines (Such as computers) are running without any calculated protection requirement. . – ACTION TAKEN- This is not compliance to attend immediately hence shall be completed in phased manner as soon as possible.
12. At entrance of physics lab, switchgears has been installed, provide barrier fence for the same. . – ACTION TAKEN- This is not compliance to attend immediately hence shall be completed in phased manner as soon as possible.
13. Also rectify remarks shown in photos. . – ACTION TAKEN- This is not compliance to attend immediately hence shall be completed in phased manner as soon as possible.

Regards,

FOR FRIENDS ELECTRICALS

FRIENDS ELECTRICALS MUMBAI

PROPRIETOR
MUMBAI