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**GUIDE FOR ELECTRICAL LAYOUT IN
RESIDENTIAL BUILDINGS**

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**BUREAU OF INDIAN STANDARDS
MANAK BHAVAN, 9 BAHADUR SHAH ZAFAR MARG
NEW DELHI 110002**

Indian Standard

GUIDE FOR ELECTRICAL LAYOUT IN RESIDENTIAL BUILDINGS

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Indian Standard

GUIDE FOR ELECTRICAL LAYOUT IN RESIDENTIAL BUILDINGS

0. FOREWORD

0.1 This Indian Standard was adopted by the Indian Standards Institution on 7 June 1968, after the draft finalized by the Power Installation and Maintenance Sectional Committee had been approved by the Electro-technical Division Council.

0.2 Use of electrical appliances, both portable and fixed, has now become very common and popular. The optimum benefits from the use of electricity can be obtained only if the installation is of sufficient capacity and affords flexibility in the use of electrical fittings and appliances. The necessity, therefore, of providing adequate number of socket-outlets should be fully appreciated.

0.3 An important consideration in planning any electrical layout is safety. However, besides safety, other considerations, such as efficiency, convenience and provision for future increase in load should also be kept in mind while planning the electrical layout in any building.

0.4 The rise in annual consumption of electrical energy in residential buildings along with the trends in the development of use of new electrical appliances has been kept in mind while preparing this guide. Although this guide has been written to apply to new installations, but it would be equally applicable to electrical modernization of existing residences.

0.5 Proper level of illumination is an important factor to be considered while planning electrical layout for a building. This guide gives recommendations on illumination levels in different parts of a residential building. The illumination data given are based on IS : 3646 (Part II)-1966*.

0.6 This guide is intended to be of assistance to architects, engineers, builders, electrical contractors and the owners of the residences in planning and designing a residence in such a way as to obtain maximum advantage of electricity.

0.7 For the purpose of deciding whether a particular requirement of this standard is complied with, the final value, observed or calculated,

*Code of practice for interior illumination: Part II Schedule for values of illumination and glare index.

expressing the result of a test or analysis, shall be rounded off in accordance with IS : 2-1960*. The number of significant places retained in the rounded off value should be the same as that of the specified value in this standard.

1. SCOPE

1.1 This guide prescribes, for single family dwellings, the electrical installations needed to provide satisfactory facilities by the use of electricity. While this guide is primarily intended to apply to single family dwellings, the criteria are also applicable to the individual dwellings of multi-family residences in so far as the latter are self-contained.

1.2 This guide is applicable for low voltage systems up to 250 V both ac and dc.

1.3 This guide does not include methods of installing the prescribed electrical facilities.

2. TERMINOLOGY

2.0 For the purpose of this guide, the following definitions shall apply.

2.1 Apparatus — Electrical apparatus including all machines, appliances and fittings in which conductors are used or of which they form a part.

2.2 Appliance — An energy-consuming device or equipment (other than a lamp) fixed or portable, in which the electrical energy is converted into light, heat, motion or any other form of energy or substantially changed in its electrical character.

2.2.1 Appliance for Building-in — An appliance intended to be installed in a cupboard, fitment or sink unit, in a prepared recess in a wall, or in a similar situation.

2.2.2 Hand-Held Appliance — An appliance held in the hand or carried on any part of the body during normal use.

2.2.3 Light Electrical Appliance — An appliance having a loading not exceeding 5.0 kW, and in case of its being motor-operated having a motor of rating not exceeding 750 W intended for use on circuits in which the operating voltage does not exceed 250 volts.

2.2.4 Stationary Appliance — An appliance intended to be fixed to its supporting surface or used in one place.

2.2.5 Transportable Appliance — An appliance which may be moved from one place to another while in service and which is intended for connection to the supply by means of a plug and socket.

*Rules for rounding off numerical values (*revised*).

2.3 Cable — A length of single-insulated conductor (solid or stranded) or two or more such conductors, each provided with its own insulation, which are laid up together. The insulated conductor or conductors may or may not be provided with an overall mechanical protective covering.

2.3.1 Flexible Cable — A cable containing one or more cores, each formed of a group of wires, the diameters of the cores and of the wires being sufficiently small to afford flexibility.

2.3.2 Flexible Cord (Flex) — A flexible cable having conductor of cross-sectional area up to and including 4 mm². Two flexible cords twisted together are known as 'Twin flexible cord'.

2.3.3 Non-detachable Flexible Cord — A flexible cord so connected to the appliance that it may only be removed with the use of tools.

2.4 Cut-Out — Any appliance for automatically interrupting the transmission of energy through any conductor when the current rises above a predetermined amount, and shall also include fusible cut-out.

2.5 Earth — A connection to the general mass of earth by means of an earth electrode. An object is said to be 'earthed' when it is electrically connected to an earth electrode; and a conductor is said to be 'solidly earthed' when it is electrically connected to an earth electrode without intentional addition of resistance or impedance in the earth connection.

2.5.1 Earth Continuity Conductor — The conductor, including any clamp, connecting to the earthing lead or to each other those parts of an installation which are required to be earthed. It may be in whole or in part the metal conduit or the metal sheath or armour of the cables, or a special continuity conductor, cable or flexible cord incorporating such a conductor.

2.5.2 Earth Wire — A conductor connected to earth and usually situated in proximity to the associated line conductors.

2.6 Insulated — Insulated shall mean separated from adjacent conducting material or protected from personal contact by a non-conducting substance or an air space, in either case offering permanently sufficient resistance to the passage of current or to disruptive discharges through or over the surface of the substance or space, to obviate danger or shock or injurious leakage of current.

2.7 Rated Input — The power input assigned to the appliance by the manufacturer and marked on it. It is understood that the rated input refers to the input in watts or kilowatts at normal operating conditions.

2.8 Fuse — A device that, by the fusion of one or more of its specially designed and proportioned components, opens the circuit in which it is inserted when the current through it exceeds a given value for a sufficient time. The fuse comprises all the parts that form the complete device.

2.8.1 Rewirable Fuse — A fuse in which the fuse-element consists of a wire which may be replaced when necessary.

2.8.2 Cartridge Fuse-Link — A fuse-link having a totally enclosed container usually cylindrical, provided at its two ends with metal contacts, the shape of which varies according to the type of fuse.

2.9 Live — An object is said to be 'live' when a difference of potential exists between it and earth.

2.10 Switch — A manually operated device for closing and opening or for changing the connection of a circuit.

2.10.1 Cord Operated Ceiling Switch — A switch for mounting on a ceiling or suitable overhead surface and operated by means of a cord or the like.

2.10.2 Double-Pole Switch — A switch with two poles, the poles being mechanically coupled together.

2.10.3 Flush Type Switch — A switch for mounting behind or incorporated with a switch plate, the back of the plate being flush with the surface of the wall or switch box.

2.10.4 One-Way Switch — A switch capable of making and breaking a single circuit only.

2.10.5 Push-Button Switch — A switch operated by a push-button.

2.10.6 Semi-recessed Switch — A switch for mounting with its base partially sunk into the surface of a wall or enclosure.

2.10.7 Single-Pole Switch — A switch with one pole.

2.10.8 Surface Type Switch — A switch provided with a seating so that when mounted, it projects wholly above the surface on which it is mounted.

2.10.9 Tumbler Switch — A switch operated by moving an actuating member called dolly in a plane perpendicular to the base of the switch.

2.10.10 Two-Way Switch — A switch having three terminals per pole or phase and commonly used to control a load from two positions.

2.11 Switch Plate — A plate designed for covering a flush type switch and box.

2.12 Switch Box — A box intended to contain a switch and to be recessed into or mounted on a wall.

2.13 Plug — A device carrying three metallic contacts in the form of pins, intended for engagement with corresponding socket contacts and arranged for attachment to a flexible cord or cable.

2.14 Socket Outlet — A device carrying three metallic contacts designed for engagement with corresponding plug pins and arranged for connection to fixed wiring.

2.15 Shuttered Socket-Outlet — A socket-outlet having provision for screening its line and neutral socket contacts automatically with a shutter when they are not in engagement with the corresponding plug pins.

2.16 Socket Contact — Metallic contacts in the socket-outlet which engage with the pins of the plug.

2.17 Usable Wall Space — All portions of a wall, except that occupied by a door in its normal open position, or occupied by a fireplace opening, but excluding wall spaces which are less than 1 m in extent measured along the wall at the floor line.

3. EXCHANGE OF INFORMATION

3.1 Before starting wiring and installation of fittings and accessories, information should be exchanged between the owner of the building or architect or electrical contractor and the local supply authority in respect of tariffs applicable, types of apparatus that may be connected under earth tariff, requirement of space for installing meters, switches, etc, and for total load requirements of lights, fans and power.

3.2 While planning an installation, consideration should be taken of the anticipated increase in the use of electricity for lighting, general purpose socket-outlet, kitchen, heating, etc. It is essential that adequate provision should be made for all the services which may be required immediately and during the intended useful life of the building, for the householder may otherwise be tempted to carry out extension of the installation himself or to rely upon use of multiplug adaptors and long flexible cords, both of which are not recommended. A fundamentally safe installation may be rendered dangerous, if extended in this way.

3.3 Time Schedule — Electrical installation in a new building should normally begin immediately on the completion of the main structural building work. For conduit wiring system, the work should start before finishing work like plastering has begun. For surface wiring system, however, work should begin before final finishing work like white washing, painting, etc. Usually, no installation work should start until the building is reasonably weatherproof, but where electric wiring is to be concealed within the structures, the necessary conduits and ducts should be positioned after the shuttering is in place and before the concrete is poured, provision being made to protect conduits from damage.

4. GENERAL REQUIREMENTS

4.1 General — All fittings, accessories and appliances shall conform to the relevant Indian Standards wherever available. A list of Indian Standards applicable for the purpose of this guide is given in Appendix A.

NOTE — As far as the appliances are concerned, this guide applies only for light electrical appliances.

4.2 Installation

4.2.1 Wiring — Any one of the following types of wiring may be used in a residential building. All wiring shall be installed in accordance with IS : 732-1963*.

- a) Wood casing wiring,
- b) Batten wiring,
- c) Rigid steel conduit wiring,
- d) Rigid non-metallic conduit wiring, and
- e) Tough rubber sheathed or PVC sheathed wiring.

4.2.2 Fitting and Accessories — All electrical fittings and wiring accessories shall be installed in accordance with IS : 732-1963*. Particular attention is drawn to 4 and 5 of IS : 732-1963*.

4.3 The system should provide ease of access to fittings for maintenance and repair and for any possible modification to the system. Modifications to the system shall be done only by licensed electrical contractors licensed under the Indian Electricity Rules.

5. ENERGY METERS, MAIN SWITCHES AND CUT-OUTS

5.1 It is recommended to have two distinct circuits, one for lights and fans and the other for high wattage (power) appliances.

5.2 Energy meters shall be installed at such a place which is readily accessible to both the owner of the building and the authorized representatives of the supply authority. These should be installed at a height where it is convenient to note the meter reading; it should preferably not be installed below 1 m from the ground. The energy meters should either be provided with a protective covering, enclosing it completely except the glass window through which the readings are noted or should be mounted inside a completely enclosed panel provided with hinged or sliding doors with arrangement for locking it.

5.3 Isolation and Protection — Means for isolating the supply to the building shall be provided immediately after the energy meter and near to the point of commencement of supply. The main switch controlling the supply to the building should be readily accessible to the consumer.

5.3.1 The fuses or any other protective device used in the installation should be capable of interrupting any short-circuit current, that may occur, without danger.

*Code of practice for electrical wiring installations (system voltage not exceeding 650 volts) (revised).

5.4 As far as possible the insulated cable connected to the live line of the supply should be of red, yellow or blue colour while that connected to the neutral should be of black colour.

5.5 All switches shall be installed on the live lines only and never on the neutral.

6. EARTHING

6.1 Means shall be provided for proper earthing of all apparatus and appliances in accordance with IS : 3043-1966*.

6.2 An earthing conductor shall be installed along with circuit conductors. The earthing conductor may be uninsulated but where it is provided with an insulated covering, the covering shall be finished to show a green colour.

6.3 All portable appliances and other plug-in appliances shall be earthed by the use of 3-pin socket-outlets.

6.4 Radio Sets — From the point of view of good reception, it is recommended that radio sets should be earthed through an electrode different from that of the main earth system for other electrical appliances. However, if it is not possible to have separate earth electrode, radio sets may be earthed through the main earth system.

7. SUB-CIRCUITS

7.1 Types of Sub-Circuits — The sub-circuits may be divided into the following two groups:

- a) Light and fan sub-circuit, and
- b) Power sub-circuit.

7.1.1 After the main switch, the supply shall be brought to a distribution board. Separate distribution boards shall be used for light and power circuits. Branch distribution boards shall be provided with a fuse on the live conductor of each circuit while neutral conductor of each circuit shall be connected to a common link capable of being disconnected individually for testing purposes. One spare circuit of adequate capacity shall be provided on each branch distribution board. A typical distribution scheme is shown in Fig. 1.

7.2 Light and Fan Sub-Circuit — Lights and fans may be wired on a common circuit. Each sub-circuit shall have not more than a total of ten points of lights, fans and 5A socket-outlets. The load on each sub-circuit shall be restricted to 800 watts. If a separate circuit is installed for fans

*Code of practice for earthing.

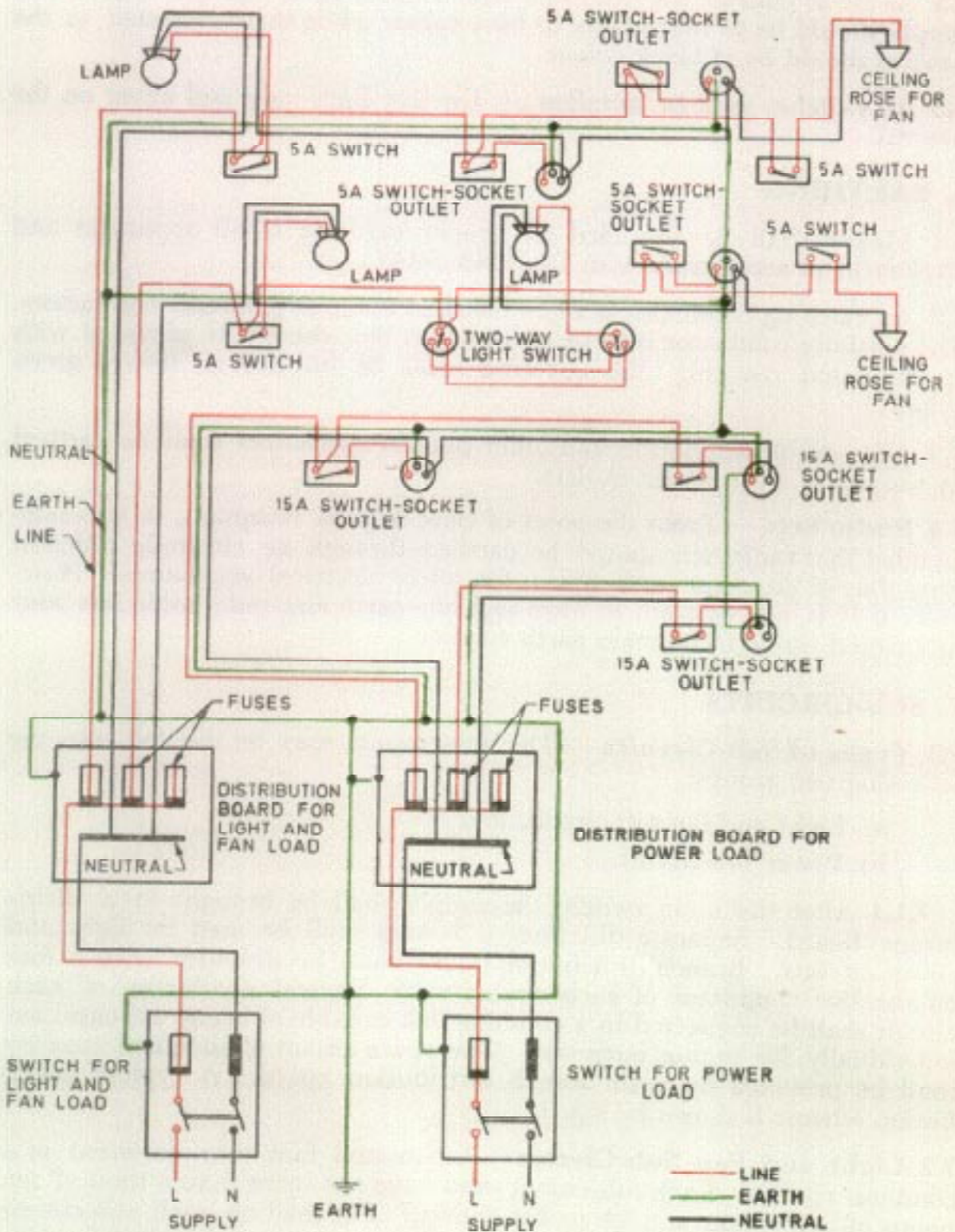


FIG. 1 WIRING DIAGRAM OF A TYPICAL DISTRIBUTION SCHEME IN A RESIDENTIAL BUILDING WITH SEPARATE CIRCUITS FOR LIGHTS AND FANS AND FOR POWER APPLIANCES

only, the number of fans in that circuit shall not exceed ten. It is recommended to provide at last two lighting sub-circuits in each house so that in case of a fault in one sub-circuit, the whole house is not plunged in total darkness. It is also recommended that a separate lighting sub-circuit be utilized for all external lighting of steps, walkways, driveways, porch, carport, terrace, etc, with a master double-pole switch for the sub-circuit in addition to the individual switches.

7.3 Power Sub-Circuit— The load on each power sub-circuit should normally be restricted to 3 000 watts. In no case shall there be more than two outlets on each sub-circuit.

7.3.1 If the load on any power sub-circuit exceeds 3 000 watts, the wiring for that sub-circuit shall be done in consultation with the supply authority.

8. LIGHTING

8.1 Lighting in houses should be regarded as an important aspect of interior decoration and planning of the installation should be based on this conception. Illumination level in different parts of the building shall be in accordance with Table 1. Reference is also invited to IS:3646-(Part II)-1966*.

8.2 A switch shall be provided adjacent to normal entrance to any area for controlling the general lighting in that area. The switches should be fixed on a usable wall space and should not be obstructed by a door or window in its fully open position. They may be installed at any height up to 1.3 m above the floor level.

8.3 Two-way switching is recommended for halls and staircases.

8.4 Switches and bell pushes should preferably be self-illuminating where they are often operated in dark.

8.5 Deep, dark cupboards and larders may be fitted with a lighting outlet, preferably with a door switch.

8.6 Local light fittings in kitchens should be so placed that all working surfaces are well illuminated and no shadow falls on them when in normal use.

8.7 In living and dining rooms if a cover or valance is provided, a lighting outlet should be provided and should have a separate switch.

8.8 In bed rooms it is recommended that some lighting be controlled from the bed location.

*Code of practice for interior illumination: Part II Schedule for values of illumination and glare index.

TABLE 1 RECOMMENDED LEVELS OF ILLUMINATION FOR DIFFERENT PARTS OF RESIDENTIAL BUILDINGS

(Clause 8.1)

LOCATION	ILLUMINATION LEVEL LUX
Entrances, hallways	100
Living room	300
Dining room	150
Bedroom:	
General	300
Dressing tables, bead heads	200
Games or recreation room	100
Table games	300
Kitchen	200
Kitchen sink	300
Laundry	200
Bathroom	100
Bathroom mirror	300
Sewing	700
Workshop	200
Stairs	100
Garage	70
Study	300

8.9 For bathrooms it is recommended to use ceiling lighting with the switch located outside the bathroom or alternatively insulated cord operated switch may be used. However, if the light switch is installed inside the bathroom, it should be out of reach of a person in a bath tub or under the shower.

8.10 Halls opening into bedrooms and staircases should also be provided with night-lighting level in addition to normal lighting level.

8.11 It is recommended that lighting facilities be provided for lighting of all steps, walkways, driveways, porch, carport, terrace, etc, with switches for each provided inside the house at a convenient place. If the switches are installed outdoors, they should be weatherproof.

8.12 Sufficient illumination should be provided in the garages with switches at each normal entrance to the garage and also inside the house.

8.13 Waterproof lighting fittings should be used for outdoor lighting.

9. SOCKET-OUTLETS

9.1 All plugs and socket-outlets shall be of 3-pin type, the appropriate pin of the socket being connected permanently to the earthing system.

9.2 Adequate number of socket-outlets shall be placed suitably in all rooms so as to avoid use of long lengths of flexible cords.

9.3 Only 3-pin, 5A socket-outlets shall be used in all light and fan sub-circuits and only 3-pin, 15A socket-outlets shall be used in all power sub-circuits. All socket-outlets shall be controlled by individual switches which shall be located immediately adjacent to it. For 5A socket-outlets, if desired, be installed at a height of 130 cm above the floor level. In situations where a socket-outlet is accessible to children, it is recommended to use shuttered or interlocked socket-outlets.

9.3.1 In case an appliance requiring the use of a socket-outlet of rating higher than 15A is to be used, it should be connected through a double-pole switch of appropriate rating. In no case shall a socket-outlet of rating higher than 15A should be installed.

9.4 Socket-outlets shall not be located centrally behind the appliances with which they are used. Socket-outlets shall be installed either 25 cm or 130 cm above the floor as desired.

9.5 It is recommended that 3-pin, 15A socket-outlets may be provided near the shelves, book cases, clock position, probable bed positions, etc.

9.6 Depending on the size of the kitchen, one or two 3-pin, 5A socket-outlets shall be provided to plug-in hot plates and other appliances. Dining rooms, bed rooms, living rooms, and study room, if required, shall each be provided with at least one 3-pin, 15A socket-outlet.

9.7 No socket-outlet shall be provided in the bathroom at a height less than 130 cm.

9.8 A recommended schedule of socket-outlets is given below:

<i>Location</i>	<i>Number of 5A Socket-Outlets</i>	<i>Number of 15A Socket-Outlets</i>
Bed room	2 to 3	1
Living room	2 to 3	2
Kitchen	1	2
Dining room	2	1
Garage	1	1
For refrigerator	—	1
For air-conditioner	—	1 (for each)
Varandah	1 per 10 m ²	1
Bathroom	1	1

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9.9 Multiplug adaptors for connecting more than one appliance to one socket-outlet should not be used.

10. FANS

10.1 All ceiling fans shall be installed in accordance with **5.8.1** of IS : 732-1963*.

10.2 Ceiling fans shall be wired to ceiling roses or to special connector boxes. All ceiling fans shall be provided with a switch besides its regulator.

10.3 Fans shall be suspended from hooks or shackles with insulators between hooks and suspension rods.

10.4 Unless otherwise specified, all ceiling fans shall be hung not less than 2.75 m above the floor.

11. FLEXIBLE CORDS

11.1 Flexible cords shall be used only for the following purposes:

- a) For pendants,
- b) For wiring of fixtures, and
- c) For connection of transportable and hand-held appliances.

11.2 Flexible cords shall not be used in the following cases:

- a) As a substitute for the fixed wiring;
- b) Where cables may have to run into holes through the ceiling, walls, floors, windows, etc;
- c) For concealed wiring; and
- d) If attached permanently to the walls, ceilings, etc.

*Code of practice for electrical wiring installations (system voltage not exceeding 650 volts) (*revised*).

APPENDIX A

(Clause 4.1)

LIST OF INDIAN STANDARDS REQUIRED FOR THIS GUIDE

IS:

- 365-1965 Electric hot plates (*revised*)
- 366-1965 Electric irons (*revised*)
- 367-1965 Electric kettles (*revised*)
- 368-1963 Electric immersion water heaters (*revised*)
- 369-1965 Electric radiators (*revised*)
- 371-1966 Ceiling roses (*first revision*)
- 374-1966 Electric ceiling type fans and regulators (*second revision*)
- 555-1967 Electric table type fans and regulators (*second revision*)
- 732-1963 Code of practice for electrical wiring installations (system voltage not exceeding 650 volts) (*revised*)
- 1169-1967 Electric pedestal type fans and regulators (*first revision*)
- 1287-1965 Electric toasters (*revised*)
- 1293-1967 Three-pin plugs and socket-outlets (*first revision*)
- 1653-1972 Rigid steel conduits for electrical wiring (*second revision*)
- 2082-1965 Storage type automatic electric water heaters (*revised*)
- 2268-1966 Electric call bells and buzzers for indoor use (*revised*)
- 2412-1963 Link clips for electrical wiring
- 2509-1963 Rigid non-metallic conduits for electrical installations
- 2667-1964 Fittings for rigid steel conduits for electrical wiring
- 2994-1965 Electric stoves
- 3010 (Part I)-1965 Appliance-connectors and appliance-inlets (non-reversible three-pin type): Part I Appliance-connectors
- 3412-1965 Electric water boilers
- 3419-1965 Fittings for rigid non-metallic conduits
- 3481-1966 Electric portable lamp stands and brackets
- 3482-1966 Electric saucepans
- 3514-1966 Electric coffee percolators (non-regulator type)
- 3528-1966 Waterproof electric lighting fittings
- 3646 (Part II)-1966 Code of practice for interior illumination: Part II Schedule for values of illumination and glare index
- 3854-1966 Switches for domestic and similar purposes
- 4160-1967 Interlocking switch socket outlet
- 4250-1967 Domestic electric food mixers (liquidizers, blenders and grinders)

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(Page 11, clause 7.2, last sentence) — Delete.

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