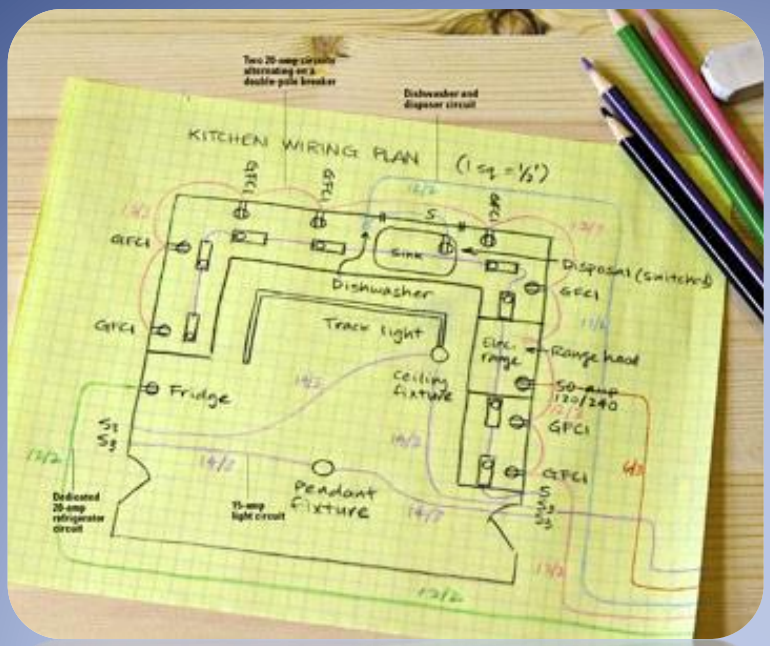

STUDY PROJECT ON ELECTRICAL WIRING AND DESIGNING

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INTRODUCTION

Electricity is the flow of electrical power or charge. It is a secondary energy source which means that we get it from the conversion of other sources of energy, like coal, natural gas, oil, nuclear power and other natural sources, which are called primary sources. Power transmission is the large scale movement of electricity at high voltage levels from a power plant to a substation. Whereas power distribution is the conversion of high voltage electricity at substations to lower voltages that can be distributed and used by private, public, and industrial customers. A substation is a part of an electrical generation, transmission, and distribution system. Substations transform voltage from high to low, or the reverse, or perform any of several other important functions. A plan is drawn at a specific scale, and it is a diagram or listings of several steps. It shows all the details of resources and timings to accomplish an objective. The electrical plan is sometimes called as electrical drawing or wiring diagram. It is a type of technical drawing that delivers visual representation and describes circuits and electrical systems. It consists of symbols and lines that showcase the engineer's electrical design to its clients. In short, an electrical plan describes the position of all the electrical apparatus.

In this study project I have learnt about

- How electricity travels from electricity generation power plant tour house, which is transmission and distribution of electricity.
- Different type of substations
- Components of substation and single line diagram of substation.
- Electricity at house
- Applicable Indian standards for electrification
- Calculations related sub circuit in the house
- Single line diagram of electrical plan of house in Auto CAD.

Aim of project

Purpose of doing a study project on designing and electrical wiring was to gain knowledge on electrical system and how electrical layout is made, learning software AutoCAD and learning about standard electrical codes.

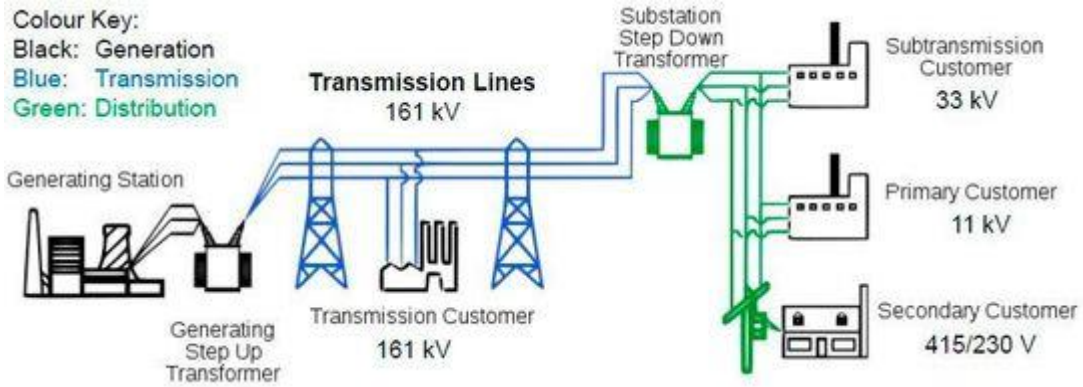
Concepts

Transmission to distribution

Electrical power transmission involves the bulk movement of electrical energy from a generating site, such as a power station or power plant, to an electrical substation where voltage is transformed and distributed to consumers or other substations.

The interconnected lines that enable the movement of electrical energy are known as a “transmission network,” and these form an electrical power transmission system—or, as it is more commonly known, the power grid.

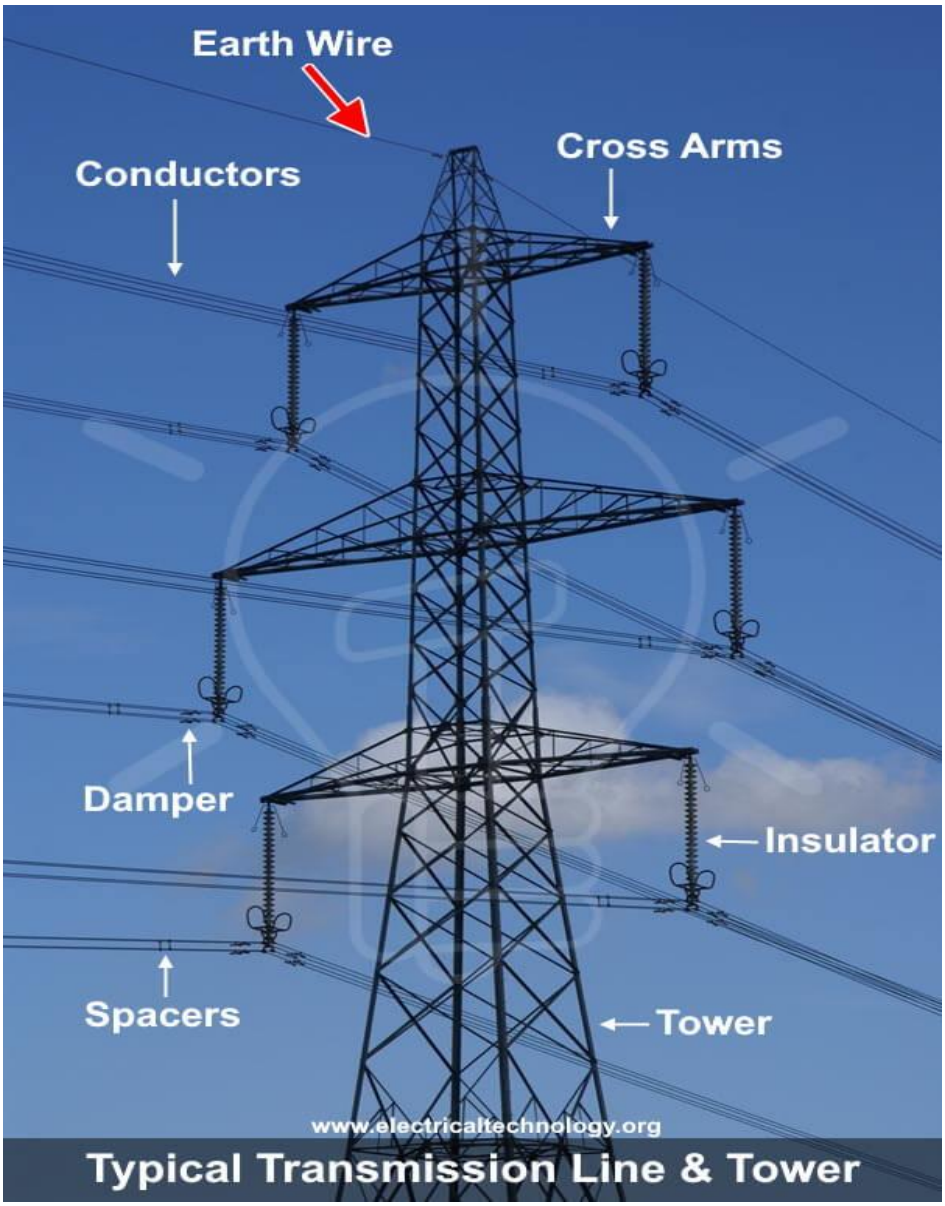
Primary transmission



When it is generated at a power station, electrical energy will typically be anywhere between 11kV and 33kV. Before it is sent to distribution centers via transmission lines, it is stepped up using a transformer to a voltage level that can be anywhere between 100kV and 700kV or more, depending on the distance that it needs to be transmitted; the longer the distance, the higher the voltage level.

The reason electrical power is stepped up to these voltage levels is to make it more efficient by reducing the I2R losses that take place when power is transmitted. When voltage is stepped up, the current reduces relative to the voltage so that power remains constant, thus reducing these I2R losses.

This stage is known as primary transmission—the transfer of a large quantity of electrical power from the initial generating station to the substation via overhead electrical lines. In some countries, underground cables are also used in cases where transmission takes place over a shorter distance.



Substation

A substation is an electrical system with high-voltage capacity and can be used to control the apparatus, generators, electrical circuits, etc. The Substations are mainly used to convert AC (alternating current) to DC (direct current). Some types of substations are tiny in size with an inbuilt transformer as well as related switches. Other types of substations are very huge with different types of transformers, equipment, circuit breakers, and switches.

Types of Sub Stations

The different types of substations mainly include Step-up Type Substation, Step-down Transformer, Distribution, Underground Distribution, Switchyard, Customer Substation, and System Station.

Step-up Type Substation

This type of substation gets the power supply from a near producing facility. It uses a large power transformer for enhancing the voltage level for transmitting to the remote locations. In is substation, the power transmission can be done by using a transmission bus to transmission lines. This substation can also be a knock on the incoming power which is received by the generation plant. The received power can be used to supply power to the operation of apparatus in the plant. A substation includes circuit breakers for switch generation as well as transmission circuits in & out of service as required.

Customer Substation

This type of substation works as the major source of power supply for one specific business client. The business case, as well as the requirements of technical, highly depends on necessities of customers.

System Stations

This substation includes the huge amount of power transfer across the station and it is called as a system station. These stations only offer no power transformers while others do voltage exchange as well. Typically, these stations supply the end-points to the transmission lines creating from switchyards & supply the electrical energy for circuits that supply transformer stations. They are important to long-term consistency. These stations are strategic services as well as very costly to build as well as to maintain.

Distribution Type Substation

Distribution type substations are placed where the main voltage distributions are stepped-down to supply voltages to the consumers using a distribution network. The voltage of any two phases will be 400 volts, and the voltage between neutral and any phase will be 230volts.

Step-down Type Substation

This type of substation is placed at different points in an electrical network. They can connect different parts of the network and that are a source of sub-transmission or distribution lines. This type of substation can change the transmission voltage to a sub-transmission voltage (69kV). The converted voltage lines can provide a source for distribution substations. In some cases, power is tapped from the line of -transmission line to utilize in an industrial capacity along the way. Or else, the power will supply to a distribution substation.

Underground Distribution Substation

Installation of a substation in urban centers requires large space, but generally, they don't have a place to install the substation. To overcome this problem, installing the substation underground decreases requirement of space and the surface area can also be used for other constructions like buildings, shopping malls, etc. The main concept of the underground substation is to offer the best conventional substation by reducing the space occupied above land.

Switchyard

The switchyard is the mediator among the transmission as well as generation, and equal voltage can be maintained in the switchyard. The main purpose of this is to supply the generated energy from the power plant at the particular level of voltage to the nearby transmission line or power grid.

11kv Substation

The main purpose of the 11kv substation is to gather the energy which is transmitted at high- voltage from the producing station, then lessens the voltage to a suitable value for local distribution & provides amenities for switching. This substation includes isolator, lightning arrester, step-down transformer, CT metering, circuit breaker, and capacitor bank.

220 kV Substation

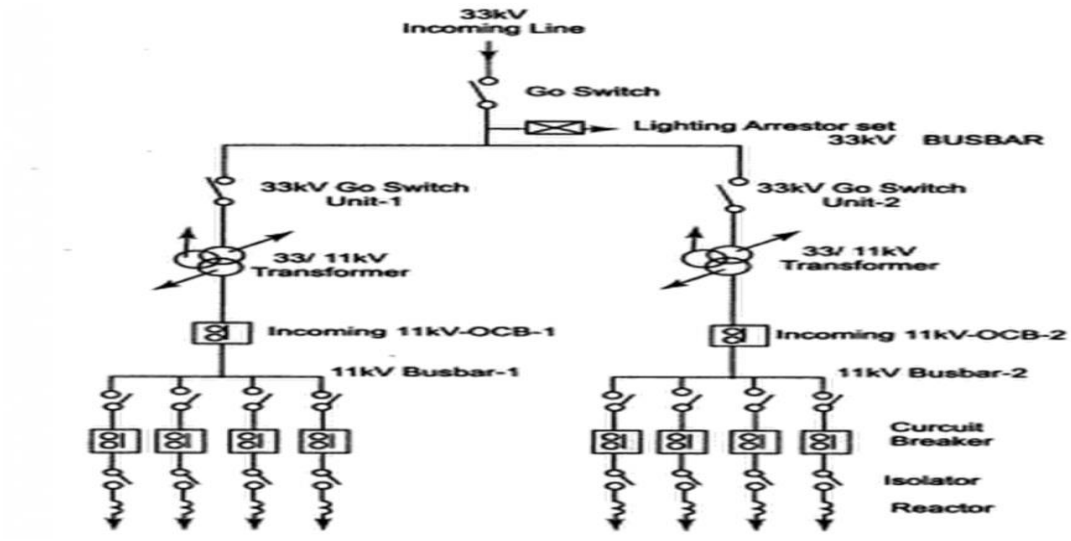
Here, the 220kVA substation is the power-capability utilized by the step-down transformer in the substation, and it illustrates the highest apparent power a step-down transformer can provide. The received voltage level of this substation will be 220kV.

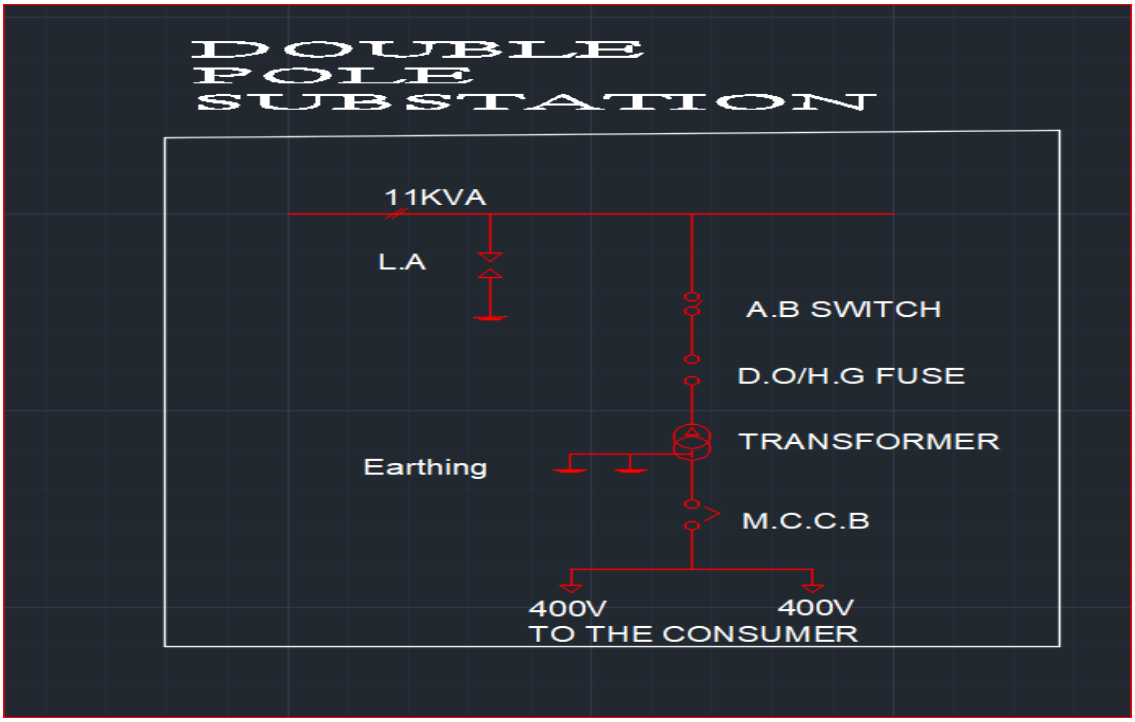
132 kV Substation

The 132kV is the rating of the step-down transformer, which has a 132kV primary voltage. Generally, these transformers are employed in transmission type substations where the voltage has to be stepped-down to additional distribution.

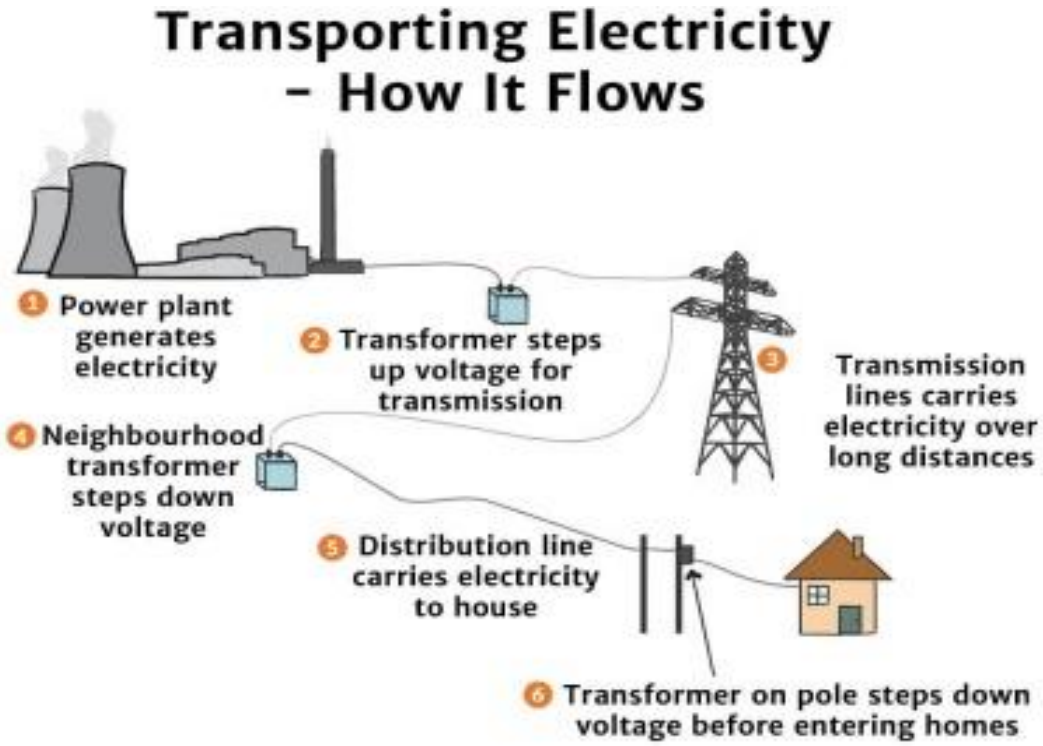
Similarly, some of the substations are classified based on the nature of duties, service rendered, operating voltage, by importance and design.

- The nature of duties based substations are step-up, primary grid substation, step-down.
- The service rendered based substations are service rendered which includes a transformer, switching and converting substations.
- The operating voltage based substations are high voltage, extra high voltage, and ultra-high voltage substations.
- The importance based substations are grid and town substations.
- The design based substations are indoor, outdoor, foundation mounted and pole mounted substations.





Electricity at house



Methodology

Electricity travels in a circle. It moves along a “hot” wire toward a light or receptacle, supplies energy to the device (called a load), and then returns along the “neutral” wire (so-called because under normal conditions it’s maintained at 0 volts, or what is referred to as ground potential) to the source. This complete path is a circuit.

In house wiring, a circuit usually indicates a group of lights or receptacles connected along such a path. Each circuit can be traced from its beginning in the service panel or subpanel through various receptacles, fixtures, and/or appliances and back.

IS: 4648 - 1968 Guide for electrical layout in residential buildings.

SUB-CIRCUITS

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

a) Light an fan sub-circuit, and

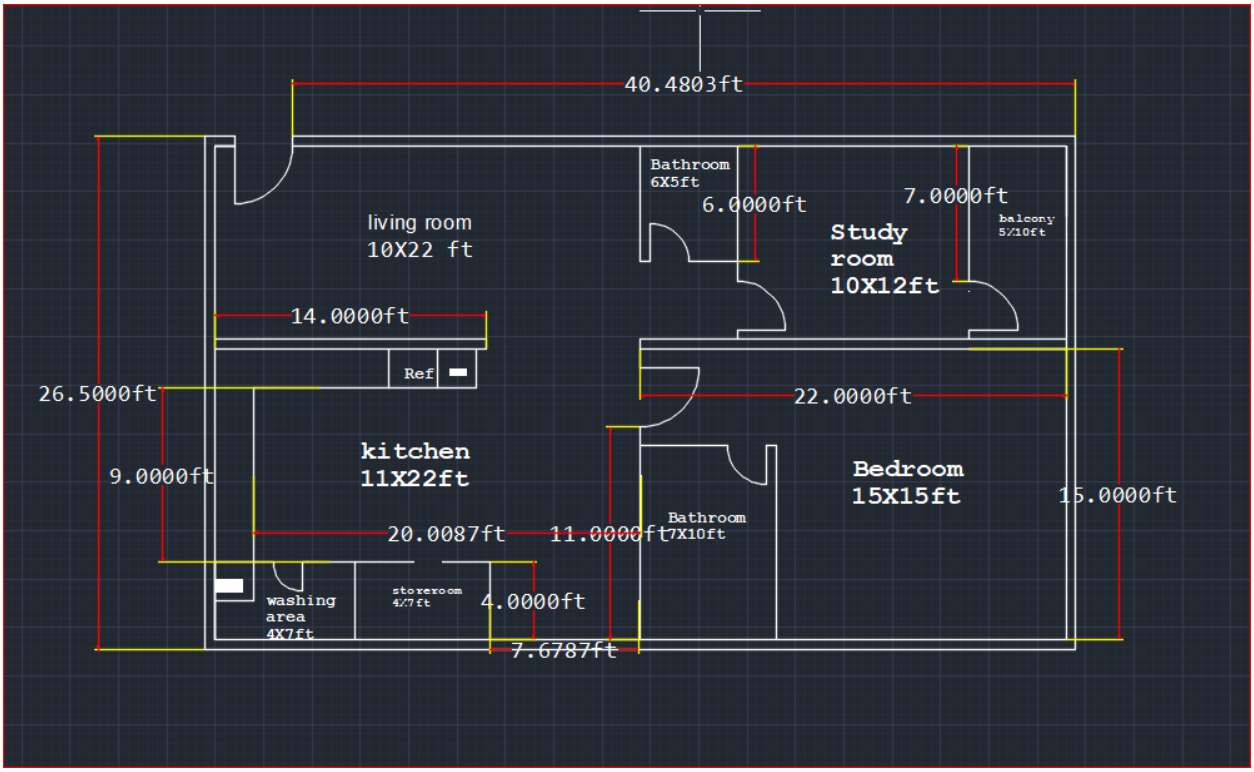
b) Power sub-circuit.

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.

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 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 in addition to the individual switches. Double pole switch for the sub-circuit

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. 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.

Floor layout of the project



Calculations

Recommended LUX requirement according to electrical standards

Room	LUX required	Lumens/sq ft
Living room	300	27.87
bedroom	300	27.87
Bathroom	100	9.29
Kitchen	200	18.58
Study room	300	27.87

Room	Lumens/sq ft	Area (sq ft)	lumens	Lights required
Living room	27.87	220	6131	TB=2 Bulb=4
bedroom	27.87	225	6270	TB=1 Bulb=7
Bathroom 1	9.29	30	278	Bulb=3
Kitchen	18.58	242	4496	TB=2 Bulb=4
Study room	27.87	120	3344	TB=1 Bulb=4
Bathroom 2	9.29	70	650	Bulb=3

Room wise load calculation

Living Room

components	NO.	Wattage	Total
Tube lights	2	28	56
Fan	2	75	150
Bulb	4	9	36
5 Aps -3pin socket	5	100	500
AC	1	3500	3500
TOTAL	14		4242

Study Room

components	NO.	Wattage	Total
Tube lights	1	28	28
Fan	1	75	75
Bulb	4	9	36
5 Amps -3pin socket	5	100	500
AC	1	3500	3500
TOTAL	12		4139

Bed Room

components	NO.	Wattage	Total
Tube lights	1	28	28
Fan	1	75	75
Bulb	7	9	63
5 Aps -3pin socket	5	100	500
AC	1	3500	3500
15 Amps -3pin socket	1	1000	1000
TOTAL	16		5166

Bathroom 1 and 2

components	NO.	Wattage	Total
Bulb	3	9	27
Geyser	1	3000	3000
Total	4		3027

Kitchen

components	NO.	Wattage	Total
Tube lights	2	28	56
Fan	2	75	150
Bulb	4	9	36
5 Amps -3pin socket	3	100	300
Oven	1	3000	3000
15 Aps -3pin socket	2	1000	2000
Fridge	1	250	250
Chimney	1	200	200
Mixer	1	1000	1000
Total	17		6992

Balcony

components	NO.	Wattage	Total
Bulb	2	9	18
5 Amps-3 pin Socket	2	100	200
TOTAL	4		218

Washing Area

components	NO.	Wattage	Total
Bulb	1	9	9
Washing Machine	1	2200	2200
TOTAL	2		2209

Store Room

components	NO.	Wattage	Total
Bulb	1	9	9
TOTAL	1		9

LIGHT AND FAN SUBCIRCUIT

COMPONENTS	NO	Wattage	Total
Tube lights	6	28	168
Fan	6	75	450
Bulb	26	9	234
5 Amps -3pin socket	20	100	2000
TOTAL	58		2852

Total no. of light and fan circuit required = (2852/800) =3.5 =4 (round off)

POWER SUB CIRCUIT

COMPONENTS	NO	Wattage	Total
AC	3	3500	10500
Geyser	2	3000	6000
Oven	1	3000	3000
Mixer	1	1000	1000
Fridge	1	250	250
Chimney	1	200	200
Washing Machine	1	2200	2200
15 Amps socket	3	1000	3000
TOTAL	13		26150

Total no. of power circuits required = (26150/3000) = 8.7 = 9 (round off)

Light and fan sub circuit

Sub circuit 1

COMPONENTS	NO	Wattage	Total
Tube lights	2	28	56
Fan	2	75	150
Bulb	4	9	36
5 Amps -3pin socket	5	100	500
TOTAL			742

Sub circuit 2

COMPONENTS	NO	Wattage	Total
Tube lights	1	28	28
Fan	1	75	75
Bulb	9	9	81
5 Amps -3pin socket	5	100	500
TOTAL			684

Sub circuit 3

COMPONENTS	NO	Wattage	Total
Tube lights	1	28	28
Fan	1	75	75
Bulb	10	9	90
5 Amps -3pin socket	5	100	500
TOTAL			693

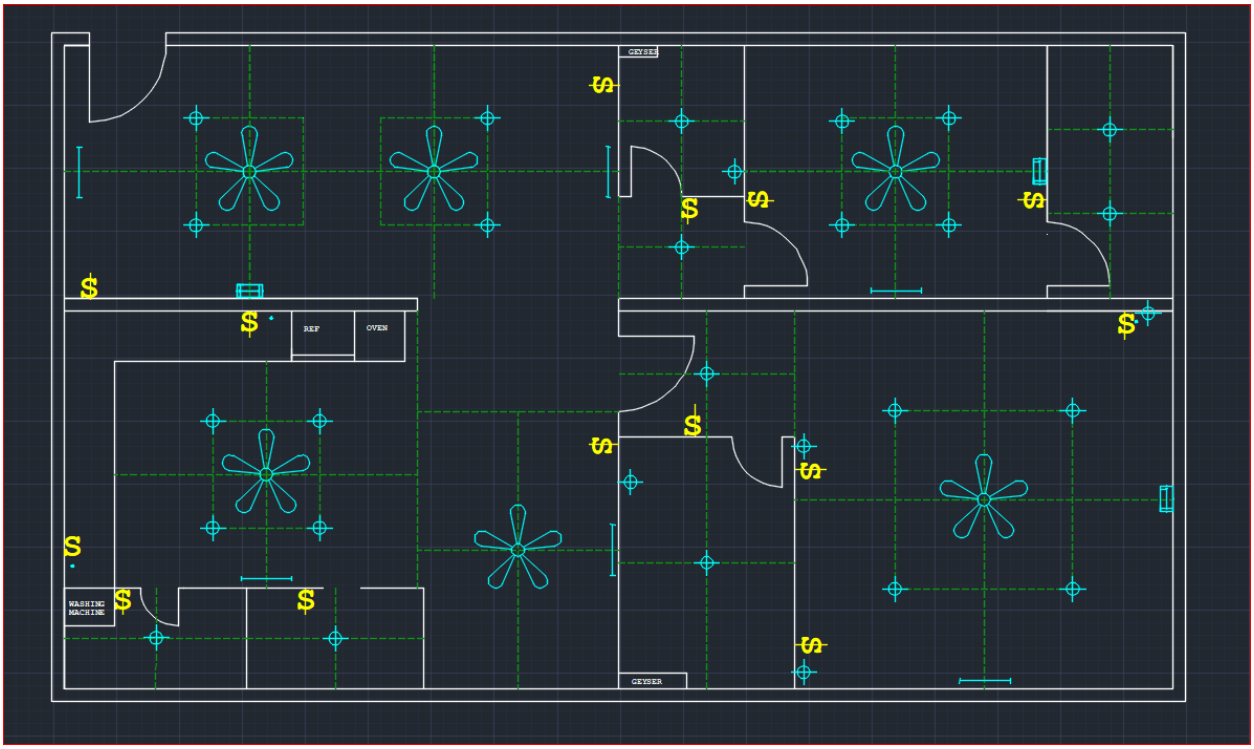
Sub circuit 4

COMPONENTS	NO	Wattage	Total
Tube lights	2	28	56
Fan	2	75	150
Bulb	6	9	54
5 Amps -3pin socket	3	100	300
TOTAL			560

POWER SUB CIRCUIT

Sub circuit No.	COMPONENTS	NO	Wattage	Total
1	AC	1	3500	3500
2	AC	1	3500	3500
3	AC	1	3500	3500
4	GEYSER	1	3000	3000
5	GEYSER	1	3000	3000
6	15 Amps Socket	3	1000	3000
7	Oven	1	3000	3000
8	Washing Machine Chimney	1 1	2200 200	2400
9	Fridge Mixer	1 1	250 1000	1250
Total				26150

Result Design



Future Scope

In upcoming semesters I will read all the standard code for electricity, rectify errors in the above design and make 3D electrical plan in Auto CAD. This will improve my electrical designing knowledge.