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ENHANCEMENT OF LOAD STABILIZATION USING ELECTRICAL LAYOUT

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Abstract

Now a day's the world is depend on electricity. The electricity is generated by various natural resources. The various supply sources are single phase and three phase supply.The single phase supply is used to supply the power to light load Where as the three phase supply is used to supply the power to the heavy load area (i.e Industries, commercial, Institution). During the power distribution to the various load area to sustain the quality of power is most important for the equipments to perform in effect. But there are some power quality functional issues which are affecting the quality of power in various scenario.Among various power quality issues voltage variation is a major issue. The one of the main reason for this voltage variation is unbalanced loading condition .It will affect the voltage in commercial, industrial and institutional building during unstable loading condition .In order to overcome this issues ,have to provide proper electrical layout. This paper completely elaborates about various power quality issues and layout process.

Keywords:Power Quality;Voltage Variation;Unbalanced Load;Electrical Layout.

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1. INTRODUCTION

Now a day’s all are completely depends on electricity. It occupies a major role in all part. There are many Industries, Institutes and commercial loads which run with the help of electricity. To maintain the quality of power in large loading area is important. Loading area which has constant voltage that signifies the quality of power delivered to the load is good. In modern developed society delivering and maintaining quality of power in large loading area is most important. Much industrial and commercial equipment are very sensitive during power disturbance which will occur during nonlinear loading condition.Major power quality issues are voltage sag, voltage swells, switching transients, impulses, notches flickers, harmonics, etc.

Quality power is maintained by installing power quality meters or digital fault recorders at certain locations of power consuming area so that the various power quality events can be recorded and stored in the form of sampled data for frequent analysis. Power Quality may defined as “a set of electrical boundaries that allows equipment to function in its intended manner without significant loss of performance or life expectancy”[1]. To rectify the voltage related power quality problems two ways are followed. The earliest way is, to install the separate transformer inside the industry to boosting up the voltage and the next way is to constructing proper electrical layout in the large load area during the time of starting. If the building is not secured by these two ways, this leads to various voltage related issues. This paper completely demonstrates the various power quality issues and electrical layout process for the large load areas.

II. POWER QUALITY

Power quality ideally creates a perfect power supply that is offered pure noise free sinusoidal wave shape as well as it maintains the voltage and frequency within the tolerance limit. There are two terms known in power systems about the quality of power that are good power quality and poor power quality. Good power quality used to describe a power supply that is available within the voltage and frequency tolerances and also it has pure noise-free sinusoidal wave shape. All equipment are designed based on power quality standards [9].

III.IMPACT OF POWER QUALITY PROBLEMS

The common power quality problems and its consequens are described as follows

3.1 Voltage sag

Short duration under-voltages are called “Voltage Sags” or “Voltage Dips”. Voltage sag is reduction in the supply voltage magnitude followed by a voltage recovery after the short period of time [2]. Excessive network loading, loss of generation, incorrect transformer taps set and voltage regulator malfunctions, causes under voltage. Loads with a poor power factor or a general lack of reactive power support on a network also contribute to various voltage related issues. Under voltage also indirectly lead to over loading problems in equipment [3].

3.2 Very Short Interruption

Total interruption of electrical supply for duration from few milliseconds to one or two seconds.

3.3 Long Interruption

Total interruption of electrical supply for duration greater than one to two seconds.

3.4 Voltage Spike

Voltage spikes are the opposite of dips –a rise that may be nearly instantaneous (spike) or takes place over a longer duration(surge).These are most often caused by lightning stikes and arcing during switching operations on circuit breakers /contactors (fault clearance ,circuit switching ,especially switch off of inductive load)[4].

3.5 Voltage Swell

The Voltage swell is defined as an increase to between 1.1 and 1.8pu in rms voltage or current at the power frequency for duration from 0.5 cycles to 1 minute. The major causes for voltage swell are start/stop of heavy loads badly dimensioned power sources.The major consequences are data loss, flickering of lighting and screens, stoppage or damage of sensitive equipment.These consequences occur because of too high voltage [5].

3.6 Voltage Fluctuation

The variation ranges from 0.1% to 7% of nominal voltage with frequencies less than 25Hz. The most important effect of this power quality problem is variation in the light output of various lighting sources commonly termed as flicker [6].

3.7 Hormonic Distortion

Voltage or current waveform are non sinusoidal shape during harmonics distortion .The wave form corresponding to the sum of different sine wave-with different magnitude and phase frequencies are multiples of power system frequency [7].

3.8 Voltage Unbalance

A Voltage variation in a three phase system is changes in voltage magnitudes and phase angle in entire network system

3**.**9 Methods for power quality problem correction

- Proper designing of the load equipment
- Applications of passive, active and hybrid harmonic filters.
- Proper designing of the power supply system.
- Applications of voltage compensators.
- Use of uninterruptible power supplies.
- Reliability on stand by power [8].

IV. ELECTRICAL LAYOUT DESIGN PROCESS

For all building construction or remodeling building project, the occupant must have a concept for a new design, and subsequently the designer can produce a set of building plans, these plans convey all the required information to the local inspection authority and associated building trades so that remodeling can takes place. Because commercial and industrial building contains a number of electrical systems these plans include specific electrical design and additional documentation to verify that the designing conforms to all required building codes.

Electrical layout is a type of technical drawing that shows information about power and lighting for an engineering or architectural project. It consists of lines, symbols, dimensions and notions to accurately convey an engineering design to the workers who install electrical system on the jobs [9].

An electrical design goes through several important stages of development. First the designer must understand the scope of the project. Then the designer defines and designs each component (such as general office areas, specialized machinery, and power distribution equipment) to recognized industry standards. Finally these individual components are compiled to form the final presentation for the design.

4.1 Types of Electrical Diagram

The electrical diagrams are classified into three types. They are described as follows,

4.1.1 One Line Diagram

It is a simplified way to represent a three phase power system. It does not show exact electrical connection of circuit. A single line to represent all the three phases shows ratings and sizes of electrical equipment [9].

4.1.2 Wiring Diagram

The different types of wiring diagram are as follows.

Schematic Diagram

Schematic electrical wiring diagrams are different from other electrical wiring diagrams, because they show the flow of the circuit rather than the physical layout of any equipment. A schematic is best described as an impression of the circuit and wiring then a genuine representation. Schematic can be used for general information about the flow of the current but should not be relied upon to examine and repair a circuit. These are symbols that accurately show the function of equipment within the circuit, however, these symbols do not look like the equipment.The system flow is shown by aseries of horizontal and vertical lines much like a normal electrical wiring diagram. However, in this case the lines show the flow of the system rather than the wire in the system.It is an electrical wiring diagram aimed more at designers and electricians who work with the theory of the circuit. Schematic will not be ideal for anyone who plans on working on the circuit [9].

Wiring Diagram

A wiring diagram is a most common form of electrical wiring diagram. Unlike a schematic, it is concerned with the connections between the difference part of the circuit and part of the entire electrical system. Wiring and equipment on the wiring diagram is carefully laid out to show the approximate the location of equipment in the circuit and thus, within the home. This makes it for more useful us a reference and guide for anyone wanting to work on the homes electrical. The components within the circuits are represented by a series of pictorical and these accurately resemble the components within the system so they can be easily identified. While the horizontal and veritical lines of the schematic shoew the circuits flow lines in a wiring diagram instead represent the physical wiring of the circuit [9].

Pictorical

The least useful of the main electrical wiring diagram is the pictorical diagram and for this reason alone, it is not commonly used. It makes no attempt to be an accurate representation of the circuit but concentrates on the components in the circuit. Without precise knowledge the average home owner wouldn’t be able to use it effectively [9].

4.1.3 Ladder Diagram

Electrical ladder drawings are still one of the common and reliable tools used to troubleshoot equipment when it fails.As with any good troubleshooting tool, one must be familiar with its basic features to make the most of the diagram in the field.There are typically two distinct part of a ladder drawing:

- Power component
- Control component

The power portion consist of items such as the motor, motor starter contacts and overloads, disconnect(s) and protective devices(fuses and circuit breakers) [9].

4.2 Project Scope

Every electrical designing has unique requirements, depends on the scope of the project. The project scope is determined by the customer's requirements and the type of the structure that the customer will occupy. For example, if the project requires new electrical systems for an existing building then the electrical designer works to incorporate all the new electrical wiring into the existing system. The designer must evaluate the existing electrical system to ensure that existing electrical systems can accommodate new additional electrical loads that will be imposed on them. When the design is for a new proposed facility, then the scope of the project is much greater. Electrical designs for these types of projects require and entirely new electrical system design [9].

4.3 Electrical Plan

Depending on the overall scope of the project, a design can include the following components:

- General electrical requirements(e.g., general purpose receptacles)
- Specialized electrical requirements(e.g., specialized office equipment or machinery)
- Lighting systems
- Electrical distribution systems

4.3.1 General Electrical Requirements

General electrical requirements should be defined first on any electrical design project. General electrical requirements are items such as the 120 –volt general receptacle outlets located throughout the commercial or industrial building. These receptacles are usally not specified to serve any particular load but rather are for general purpose use such as for desktop devices, standard wall receptacles, and desktop computer requirement with no special electrical requirements [9].

4.3.2 Specialized Electrical Requirements

Certain projects may include specialized electrical equipments that require separate or dedicated electrical circuitry that serves only the specialized equipment. This equipment may be of the following types:

- Computers and/or network servers

- Photocopiers
- Microwave oven and other lunchroom appliances
- Vending machinens

Because of their electrical load requirements as per the manufactures requirements, these pieces of the equipment may require individual circuitry and special grounding methods [9].

4.3.3 Lighting system

Because of their complexty lighting systems are the part of the designing process that generally requires the greatest amount of time to develop. These systems include all the lighting fixtures and their controls. Lighting systems have very detailed requirements as per the NEC and require documentation showing that the system incorporate all required energy-saving technologies [9].

4.3.4 Distribution system

An electrical distribution system is the installed equipment that provides for the distribution of electrical wiring throughout the facility. It includes the main switchboard, which receives the power socures from the serving utility, and all the associated components such as panelboards that distribute all the required branch circuits throughout the facility. Parts of the process of designing the distribution system is calculating the facilities amperage load and short-circuit values; these calculations determine the total electrical demand requirements of the facility based on the individual parts of the electrical distribution system [9].

4.4 Design Standard Selection

Once each part of the design plan has been defined, the next stage is to design each part to industry recognized standards as well as any additional standards set forth by the local jurisdiction for commercial or industrial occupancies. The primary industry standard is the **National Electrical Code (NEC),** published by the National Fire Protection Association (NFPA). The NEC (Commonly referred to as "the Code") is received every three years and results in the publication of a new edition (e.g., the 2005 NEC or the 2008 NEC).

Although the code is applied on national level, some local jurisdication may have additional standards that exceed the requirements of the NEC or they may use a previous edition of the Code.

For project based on a national template (such as is often the case with retail outlets and fast-food chains), any requirements or adjustments that are necessary to local code requirements should documented in the final plan in a notes section. Please note that only officialy document standards may be enforced, not widespread, unofficial community practices.

Some project will also have additional requirements based on the specific components, such as those including specialized electrical equipment. An electrical designer should always consider manufacture guidelines of our specialized equipment and use the appropriate electrical equipment standards set forth by manufacture for overcurrent protection sizes, specialized grounding requirements, and so forth.these specialized requirements may require that additional specialized wiring practices be observed;when this is the case, these specialized requirements must be documented on the plan.

Designers must also consider the standards of the **National Electrical Manufacturers Association (NEMA),** which includes standards for motor lead identification, transformer terminal markings, plug and receptacle devices, and amperage ratings, and the **Electrical Apparatus and Service Association (EASA),** which provides current and updated information for motors and controls. Designs that include lighting systems must conform to national or state-mandated energy-saving requirements.Designers should consult the **Illuminating and Engineering Society of North America (IESNA)** standards for lights and lighting products and properly document the design to ensure that it meets all the required criteria.

For projects that include new or upgraded parts of distribution sstem served from alocal utility, designers must consider any requirements may dictate the wiring methods and equipment required for the proper distribution from the serving utility to the customer.Calculated load values must reference manufacturer guidelines to ensure that distribution systems will support these loads.

In all cases, designers must have not only solid electrical knowledge and a thorough understanding of the electrical calculations and their necessity, but also awareness of the application of all relevant codes and standards utilized within the electrical industry [9].

4.5 Creating the Electrical Plan

Once the various parts and applicable standards have been determined, the designer begins compiling those parts to form the electrical design and complete a set of plans.

Historically, these plans took the form of handdrawn blue prints, but today most plants are created digitaly using **Computer-Aided Design (CAD)** software tools .Digitized plants are easier to revise and transmit than those drawn with pen and pencil.When printed, digital plans or typically produced on standard sized architectural plan sheets; the most common size sheets are architectural D sheets which are 24 in.*36 in.and architectural E sheets which are 36 in.*48 in.

On the plans, each device should be referenced using the appropriate electrical symbol.Electrical symbols allow for universal recognition of each part by the many persons who will be working on the project to the specifications. The standardized electrical symbols used for building plans are provided by the **American National Standards Institute (ANSI)**

Not all symbols are used on every project, so the specific symbols used on a particular project should be included in a symbols list and attached to the final design.Occasionally the need may arise for a symbol that has not been developed(such as a symbol for a newer energy-saving or energy-management device). In this case, the designer may create a new symbol for the electrical design plan, as long as it is added to the symbols list included with the plan.

Electrical design plans may be included as a separate document within a complete set of building plans.To identifies the electrical plans; each page of the electrical design plan is labeled and numbered: E, E, E, and so forth. Please note that these electrical sheets (often called"E sheets") are not architectural E sheets, which denote a standard size paper.Electrical sheets are generally presented in the following order:

- Exterior electrical site plan

- Interior electriacal power plan
- Interior lighting plan
- Documentation (such as panel schedules,electrical calculations,single line diagrams,and lighting system energy requirements)

The number of electrical sheets required for a project varies based on the amount of required information that each project requires and how much of that information can fit on one page and still provide for a clear, concise understandable set of prints [9].

XI.ELECTRICAL SYMBOL LIST

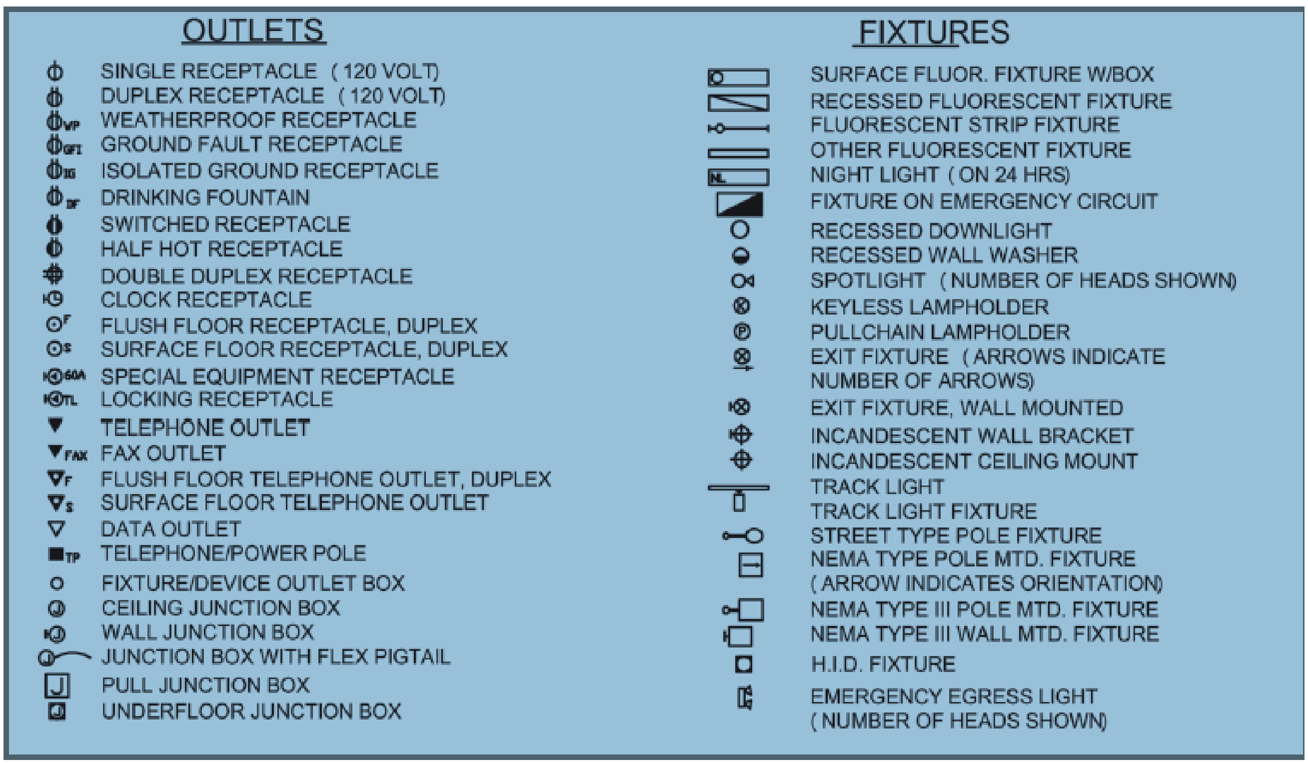

Figure 4.6.1

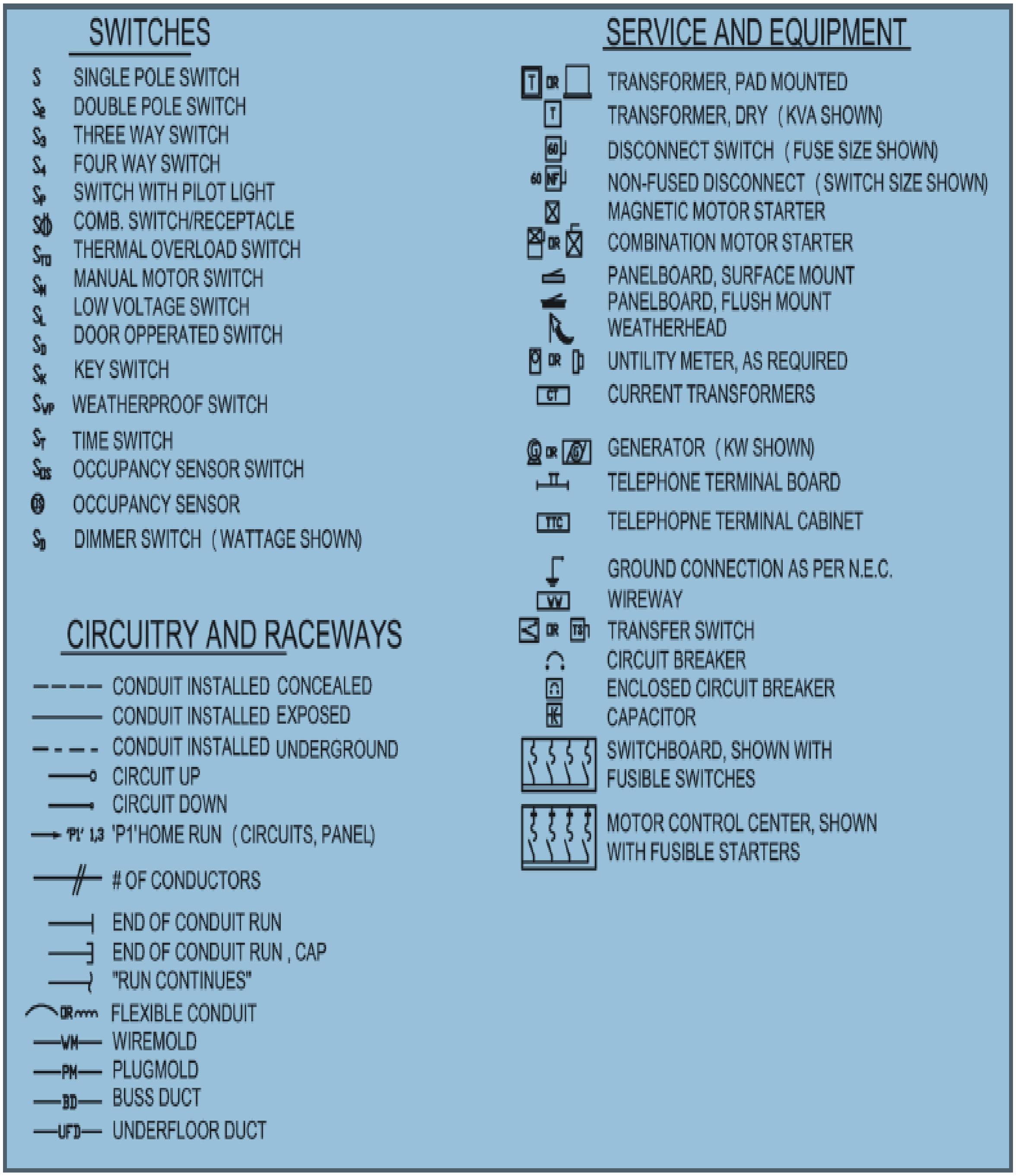

Figure 4.6.2

V. ELECTRICAL LAYOUT CASE STUDY

Let consider the Educational Institution, According to civil structure there will be different types of loads like lab, auditorium, workshop, classrooms, office, and canteen. Normally, load consuming electrical equipments are tubelight, fan, computer, airconditioner, Xerox machine, printer etc. consumption of power is based on the powerfactor of the equipment. Classrooms loading are identified and it drawn as electrical layout. For example 1, if 50 members classroom the layout diagram as follows. The electrical layout of class room is shown in fig 5.1.

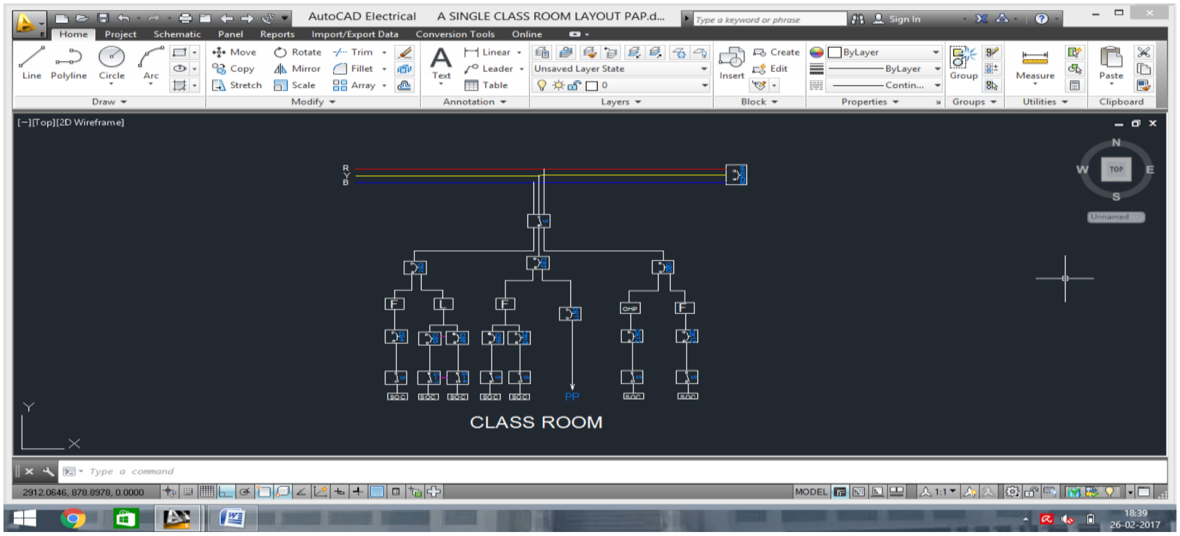

Figure 5.1

Example 2:

Auditorium consist of various load equipments, they are:tubelight,fan,computer,mixer,amplifier,speaker,wireless microphone,focus light,LCD projector,LED light etc. The electrical layout of auditorium is shown in fig 5.2.

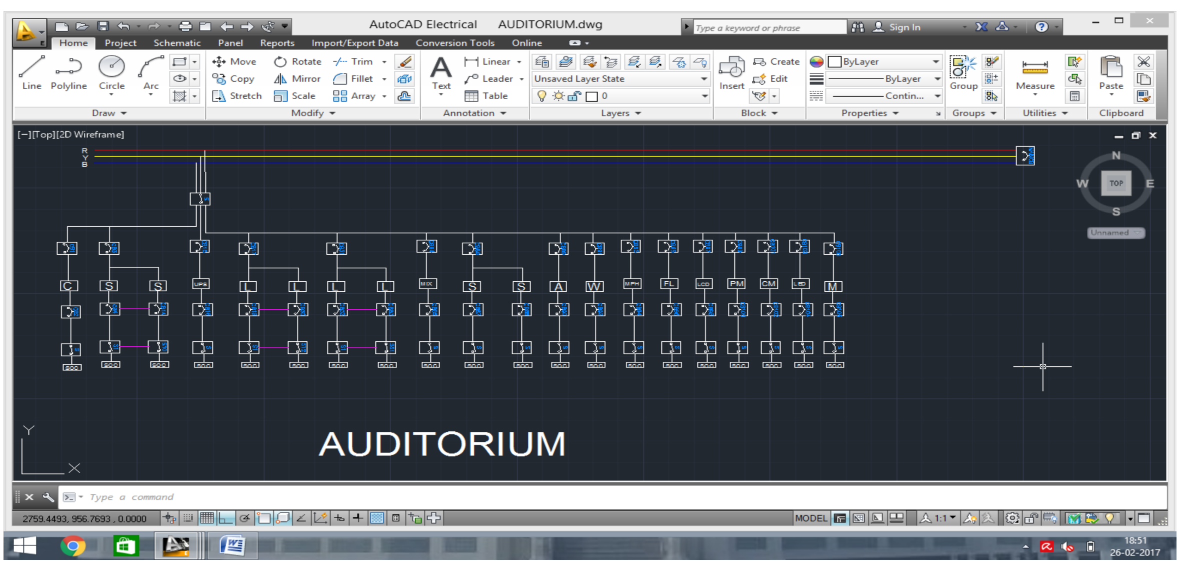

Figure 5.2

Example 3:

Office room consist of various types of load equipments, they are: tubelight, fan, computer, printer, UPS, Xerox machine, decoration light etc.The electrical layout of office room is shown in fig 5.3.

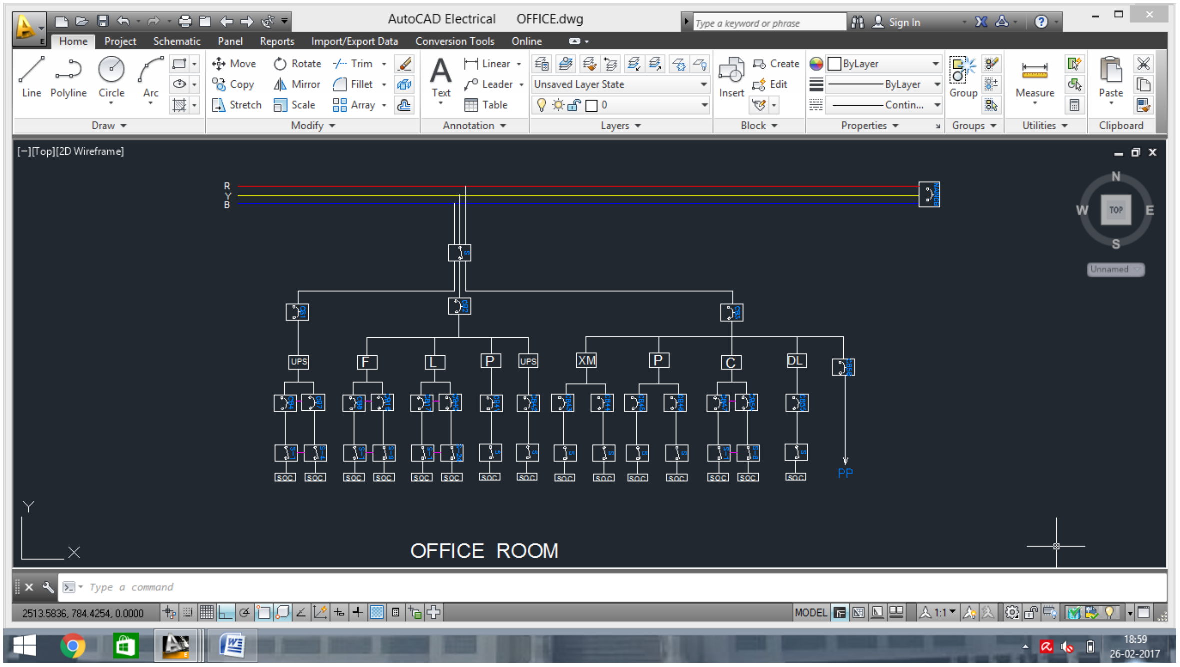

Figure 5.3

VI. CONCLUSION

This paper elobaretely describe about the various loading and the causes for various power quality issues occur during variation in voltage. To rectify power quality issues we have to maintain the voltage with a specified limit. From this paper we have concluded the unbalance loading condition also affect the voltage in various industries or institutions. To avoid this voltage related issues, have to construct proper electrical layout based civil structure. This paper concluded the balanced loading condition occur by proper electrical layout process to enhance the effective operation of electrical utilites in all loading area such as industries and institution.

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