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GUZELYURT HOTEL ELECTRICAL PROJECT

Graduation Project
EE- 400

Student: Serdar Çölek (20032004)

Supervisor: Asst. Prof. Dr. Özgür Cemal Özerdem

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1.GRADUATION PROJECT

1.1 Illumination

The term illuminance has been proposed to replace illumination, apparently to show that the word has a technical meaning that should be distinguished from the general term illumination. This is yet another useless complication, with much less reason than the substitution of luminance for brightness. It might even create some confusion with luminance, which sounds similar. Nobody confuses illumination with lumination, and if one does, it is harmless.

1.2 Lighting

Lighting includes both artificial light sources such as lamps and natural illumination of interiors from daylight. Lighting represents a major component of energy consumption, accounting for a significant part of all energy consumed worldwide. Artificial lighting is provided today by electric lights, but previously by gas lighting, candles or oil lamps. Proper lighting can enhance task performance or aesthetics, while there can be energy wastage and adverse health effects of lighting. Indoor lighting is a form of fixture or furnishing, and a key part of interior design. Lighting can also be an intrinsic component of landscaping.

In most optics texts, illumination is either not mentioned, or is given only cursory treatment. The probable reason for this is that illumination involves the psychophysics of the visual sense, which may seem out of place in "straight" physics. However, illumination is not only of considerable practical importance, but its definitions and methods are applicable to the transfer of any kind of radiant energy. The strange units of illumination may be regarded askance, but a basic unit, the candela, is a fundamental unit of the SI system. The theory of illumination involves only the cosine factor for projecting areas, and the inverse-square spreading from a point source. Its practical results are expressed as surface integrals, which can now be done numerically with computer aid. The theory, therefore, is quite simple and easily mastered. Names and definitions often create confusion, however, which this article will strive to overcome.

The results of illumination theory will be applied to two important theorems about the intensity of an image formed by an optical system. One is that the brightness of the image cannot exceed the brigtness of the extended source that is imaged, and the other is that the illumination in the image decreases as the fourth power of the cosine of the angle of the principal ray (the one through the centre of the entrance pupil).

1.3 Aim and Scope of the Graduation Project

Lighting fixtures come in a wide variety of styles for various functions. Some are very plain and functional, while some are pieces of art in themselves. Nearly any material can be used.

Proper selection of fixtures is complicated by the requirement to minimize the veiling reflections of printed material. Since the exact orientation of printed material may not be closed controlled, a visual comfort probability can be calculated for a given set of lighting fixtures.

1.4 Types

Lighting types are classified by intended use as general, localized, or task lighting, depending largely on the distribution of the light produced by the fixture.

- General lighting fills in between the two and is intended for general illumination of an area. Indoors, this would be a basic lamp on a table or floor, or a fixture on the ceiling. Outdoors, general lighting for a parking lot may be as low as 10-20 lux (1-2 footcandles) since pedestrians and motorists already used to the dark will need little light for crossing the area.
- Task lighting is mainly functional and is usually the most concentrated, for purposes such as reading or inspection of materials. For example, reading poor-quality reproductions may require task lighting levels up to 1500 lux (150 footcandles), and some inspection tasks or surgical procedures require even higher levels.
- Accent lighting is mainly decorative, intended to highlight pictures, plants, or other elements of interior design or landscaping.

1.5 Methods

- Downlighting is most common, with fixtures on or recessed in the ceiling casting light downward. This tends to be the most used method, used in both offices and homes. Although it is easy to design it has dramatic problems with glare and excess energy consumption due to large number of fittings.

- Uplighting is less common, often used to bounce indirect light off of the ceiling and back down. It is commonly used in lighting applications that require minimal glare and uniform general illuminance levels. Uplighting (indirect) uses a diffuse surface to reflect light in a space and can minimize disabling glare on computer displays and other dark glossy surfaces. It gives a more uniform presentation of the light output in operation.

- Front lighting is also quite common, but tends to make the subject look flat as its casts almost no visible shadows. Lighting from the side is the less common, as it tends to produce glare near eye level. Backlighting either around or through an object is mainly for accent.

Forms of Lighting include alcove lighting, which like most other uplighting is indirect. This is often done with fluorescent lighting or rope light, or occasionally with neon lighting. It is a form of backlighting.

Soffit or close to wall lighting can be general or a decorative wall-wash, sometimes used to bring out texture (like stucco or plaster) on a wall, though this may also show its defects as well. The effect depends heavily on the exact type of lighting source used.

Recessed lighting (often called "pot lights" in Canada, "can lights" or 'high hats" in the U.S.) is popular, with fixtures mounted into the ceiling structure so as to appear flush with it. These downlights can use narrow beam spotlights, or wider-angle floodlights, both of which are bulbs having their own reflectors. There are also downlights with internal reflectors designed to accept common 'A' lamps (light bulbs) which are generally less costly than reflector lamps. Downlights can be incandescent, fluorescent, HID (high intensity discharge) or LED, though only reflector incandescent or HID lamps are available in spot configuration.

Track lighting, invented by Lightolier, was popular at one point because it was much easier to install then recessed lighting, and individual fixtures are decorative and can be easily aimed at a wall. It has regained some popularity recently in low-voltage tracks, which often look nothing like their predecessors because they do not have the safety issues that line-voltage systems have, and are therefore less bulky and more ornamental in themselves. A master transformer feeds all of the fixtures on the track or rod with 12 or 24 volts, instead of each light fixture having its own line-to-low voltage transformer. There are traditional spots and floods, as well as other small hanging fixtures. A modified version of this is cable lighting, where lights are hung from or clipped to bare metal cables under tension.

A sconce is a wall-mounted fixture, particularly one that shines up and sometimes down as well. A torchiere (tour-she-AIR or tour-SHARE) is an uplight intended for ambient lighting. It is typically a floor lamp but may be wall-mounted like a sconce.The portable or table lamp is probably the most common fixture, found in every home and many offices. The standard lamp and shade that sits on a table is general lighting, while the desk lamp is considered task lighting. Magnifier lamps are also task lighting.

The illuminated ceiling was once popular in the 1960s and 1970s but fell out of favor after the 1980s. This uses diffuser panels hung like a suspended ceiling below fluorescent lights, and is considered general lighting. Other forms include neon, which is not usually intended to illuminate anything else, but to actually be an artwork in itself. This would probably fall under accent lighting, though in a dark nightclub it could be considered general lighting. Underwater accent lighting is also used for koi ponds , fountains, swimming pools and the like.

In a movie theater each step in the aisles is usually marked with a row of small lights, for convenience and safety when the film has started, hence the other lights are off. Traditionally made up of small low wattage, low voltage lamps in a track or translucent tube, these are rapidly being replaced with LED based versions.

1.6 Lamps

Commonly called 'light bulbs', lamps are the removable and replaceable portion of a luminary which converts electrical energy to both visible and non-visible electromagnetic energy. Specialists who work with lighting, carefully avoid energetic units for measuring of the light output of sources of light. For example, instead of Watt per steradian, the special unit candela is used; 1 candela=(1/683) W/steradian. Common characteristics used to evaluate lamp quality include efficiency measured in lumens per watt, typical lamp life measured in hours, and Color Rendering Index on a scale of 0 to 100. Cost of replacement lamps is also an important factor in any design.

1.7 Lumens

We use the same word "light" for electromagnetic radiation of frequencies in the narrow band 4×10^{14} Hz to 8×10^{14} Hz, and also for the psychological sensation produced by it when it impinges on our eyes and excites our visual sense. The energy in physical light can be expressed in watt, which is precisely defined. Its value in producing sensation, the strength of which is called "apparent brightness," is less well defined because of the difficulty in the quantitative evaluation of sensation. Nevertheles, by averaging the responses of many observers, a curve of the relative efficiency of energy at different spectral wavelengths in producing sensation can be determined. The result is called the "Standard Observer," whose spectral sensitivity is plotted at the left. The peak of this curve is at 555 nm, taken as unity, and is down to 0.0004 at 400 nm and 735 nm. The commonly used visual range of 380-760 nm includes a lot of worthless "tail" region. A better statement would be 500-630 nm, showing how narrow the eye's spectral response really is. A quantity called luminous flux, F, is defined that is analogous to energy, but reflects the effectivness of the radiation at producing visual sensation. This unit is the lumen, and at the peak of the photopic (light-adapted) eye's sensitivity, 680 lm = 1 W (some references give 683; the difference is inconsequential). Now we can convert any spectral distribution of energy into lumens with precision, and work with lumens as we would work with energy. It is only necessary to multiply the energy in watts in each small wavelength interval by the visual efficiency, and sum the results, multiplying by 680 or 683 to get the lumens.

It must be carefully recognized that lumens do not measure brightness. Establishing a scale of brightness is a completely different matter, and one that belongs exclusively to psychophysics. All we know is that equal amounts of luminous flux produce equal brightness, and more flux means more brightness, but no more. In fact, brightness is about proportional to the logarithm of the luminous flux (Fechner's Law). Brightness could be defined by the relation $B = k \log(F/F_0)$, where we would have to choose a constant k and a reference luminous flux F_0. Doubling the luminous flux does not double the apparent brightness.

We may proceed as we have done for lumens with any similar weighted energy distribution, or with energy itself, in what follows. Some of the names used, however, are peculiar to illumination and lumens, and should not be used with energy or other radiant quantities. The Latin word lumen, luminis (n.) is one of two words meaning "light." The other is *lux, lucis* (f.). Lumen was often thought of as light coming from the eye, or a lamp, while lux was light coming into the eye, or from the sun or moon. Both these words are used in photometry to name concepts and units.

1.8 Brightness in Images

We have now defined the four main illumination quantities: F, I, E and B, and given the connections between them. It is good to remember that $I = dF/d\Omega$, $E = dF/dA$ and $B = d^2F/dAd\Omega$. We will now look at some important properties of the illuminance of images formed by optical systems. In optics texts, this is usually called "brightness," but we have explained above why this term has been generally replaced by "luminance." The argument can be made rigorous, but we shall be satisfied with a simple demonstration that emphasizes the principal facts.

The reason for this is clear. If the image becomes smaller, so that the same energy is concentrated in a smaller area, the solid angle under which it is illuminated increases proportionately, so the product remains constant. If the image is viewed by the eye so that the entrance pupil of the eye is full, the luminous flux entering the eye will be constant, equal to the image brightness times the solid angle subtended by the eye pupil.

If the image is formed on a diffusing screen, the same total luminous flux will come from a smaller area, which will appear brighter to the eye. A small image of the sun may ignite tinder if its temperature is raised enough, but this does not mean that the actual image has a greater luminance than the surface of the sun, but only that the energy comes from a larger solid angle.

CHAPTER II

2. DESIGN

2.1 Architectural lighting design

Architect lamps lighting design as it applies to the built environment, also known as 'architectural lighting design', is both a science and an art. Comprehensive lighting design requires consideration of the amount of functional light provided, the energy consumed, as well as the aesthetic impact supplied by the lighting system. Some buildings, like surgical centers and sports facilities, are primarily concerned with providing the appropriate amount of light for the associated task. Some buildings, like warehouses and office buildings, are primarily concerned with saving money through the energy efficiency of the lighting system. Other buildings, like casinos and theatres, are primarily concerned with enhancing the appearance and emotional impact of architecture through lighting systems. Therefore, it is important that the sciences of light production and luminary photo metrics are balanced with the artistic application of light as a medium in our built environment. These electrical lighting systems should also consider the impacts of, and ideally be integrated with, daylighting systems. Factors involved in lighting design are essentially the same as those discussed above in energy conservation analysis.

Mathematical modeling is normally used for complex lighting design, whereas, for simple configurations, tables and simple hand calculations can be used. Based on the positions and mounting heights of the fixtures, and their photometric characteristics, the proposed lighting layout can be checked for uniformity and quantity of illumination. For larger projects or those with irregular floor plans, lighting design software can be used. Each fixture has its location entered, and the reflectance of walls, ceiling, and floors can be entered. The computer program will then produce a set of contour charts overlaid on the project floor plan, showing the light level to be expected at the working height. More advanced programs can include the effect of light from windows or skylights, allowing further optimization of the operating cost of the lighting installation.

The Zonal Cavity Method is used as a basis for both hand, tabulated, and computer calculations. This method uses the reflectance coefficients of room surfaces to model the contribution to useful illumination at the working level of the room due to light reflected from the walls and the ceiling. Simplified photometric values are usually given by fixture manufacturers for use in this method.

Computer modelling of outdoor flood lighting usually proceeds directly from photometric data. The total lighting power of a lamp is divided into small solid angular regions. Each region is extended to the surface which is to be lit and the area calculated, giving the light power per unit of area. Where multiple lamps are used to illuminate the same area, each one's contribution is summed. Again the tabulated light levels (in lux or foot-candles) can be presented as contour lines of constant lighting value, overlaid on the project plan drawing. Hand calculations might only be required at a few points, but computer calculations allow a better estimate of the uniformity and lighting level.

Practical lighting design must take into account the gradual decrease in light levels from each lamp owing to lamp aging, lamp burnout, and dirt accumulation on fixture and lamp surfaces. Empirically-established depreciation factors are listed in lighting design handbooks.

2.2 Energy consumption

Artificial lighting consumes a significant part of all electrical energy consumed worldwide. In homes and offices from 20 to 50 percent of total energy consumed is due to lighting (Hawkin, 2000). Most importantly, for some buildings over 90 percent of lighting energy consumed can be an unnecessary expense through over-illumination (Hawken, 2000). Thus lighting represents a critical component of energy use today, especially in large office buildings where there are many alternatives for energy utilization in lighting. There are several strategies available to minimize energy requirements in any building:

- Specification of illumination requirements for each given use area.
- Analysis of lighting quality to insure that adverse components of lighting (for example, glare or incorrect color spectrum) are not biasing the design.
- Integration of space planning and interior architecture (including choice of interior surfaces and room geometries) to lighting design.
- Design of time of day use that does not expend unnecessary energy.
- Selection of fixture and lamp types that reflect best available technology for energy conservation.
- Training of building occupants to utilize lighting equipment in most efficient manner.
- Maintenance of lighting systems to minimize energy wastage.

2.3 Professional Organizations

The Illuminating Engineering Society of North America (IESNA), in conjunction with organizations like ANSI and ASHRAE, publishes guidelines, standards, and handbooks that allow categorization of the illumination needs of different built environments. Manufacturers of lighting equipment publish photometric data for their products, which defines the distribution of light released by a specific luminary. This data is typically expressed in standardized form defined by the IESNA.

The International Association of Lighting Designers (IALD) is an organization which focuses on the advancement of lighting design education and the recognition of independent professional lighting designers. Those fully independent designers who meet the requirements for professional membership in the association typically append the abbreviation IALD to their name.

The National Council on Qualifications for the Lighting Professions (NCQLP) offers the Lighting Certification Examination which tests rudimentary lighting design principles. Individuals who pass this exam become 'Lighting Certified' and may append the abbreviation LC to their name. This certification process is one of three national examinations (the others are CLEP and CLMC) in the lighting industry and is open not only to designers, but to lighting equipment manufacturers, electric utility employees, etc. Generally speaking there is no legal or practical requirement for the lighting design team to possess the certifications discussed.

Lighting and Lamps v · d · e	
Incandescent:	Conventional - Halogen - Parabolic aluminized reflector (PAR)
Fluorescent:	Compact fluorescent (CFL) - Linear fluorescent - Induction lamp
Gas discharge:	High-intensity discharge (HID) - Mercury-vapor - Metal-halide - Neon - Sodium vapor
Electric arc:	Arc lamp - HMI - Xenon arc - Yablochkov candle
Combustion:	Acetylene/Carbide - Candle - Gas lighting - Kerosene lamp - Limelight - Oil lamp - Safety lamp - Petromax
Other types:	Sulfur lamp - Light-emitting diode (LED) - LED lamp (SSL) - Optical fiber - Plasma - Electroluminescent wire - Chemiluminescence

2.4 Illumination Calculations

Illumination Project Illumination Calculations

Basement Illumination Calculations

Part 1:

H = 2.6 meter

a : 3,5 m E0 = 50 lüx

Working area 1 meter

Tij lenght (c) = 0,30 meter

(calculations direct illumination and accor flaman lamp has done)

b : 7,6 m h = H – hç – c K =[(0,8*a)+(0.2*b)]/h

h = 2,6 – 1- 0,3 K =[(0,8*3,5)+(0,2*7,6)]/1,3 =

h = 1,3 meter K = 3,33

= 0,52 taken.η According to table 10.3

= 3,5*7,6*50/0,52 = 1064 lümenη = a*b*E0/φ

= 420 lümen. Fot this ;φ40 Watt akkor flaman lamp

Number of lamps n = 3 are calculated.

Part 2 :

H = 2.6 meter

a : 5,45 m E0 = 50 lüx

Working area (hç) = 1 meter

Tij boyu (c) = 0,30 metre

(calculations direct illumination and accor flaman lamp has done)

b : 8,7 m h = H – hç – c K =[(0,8*a)+(0.2*b)]/h

h = 2,6 – 1- 0,3 K =[(0,8*5,45)+(0,2*8,7)]/1,3

h = 1,3 meter K = 4,69

= 0,6 taken.η According to table 10.3

= 5,45*8,7*50/0,6 = 3950 lümenη = a*b*E0/φ

= 720 lümen. For this ;φ60 Watt akkor flaman lamp

Number of lamps n = 6 are calculated.

Illumination Project Illumination Calculations

Basement Illumination Calculations

H = 2.6 meter
a : 3,5 m E0 = 50 lüx
Working area (hç) = 1 meter
Tij lenght (c) = 0,30 meter
(calculations direct illumination and accor flaman lamp has done)
b : 7,6 m h = H – hç – c K =[(0,8*a)+(0.2*b)]/h
h = 2,6 – 1- 0,3 K =[(0,8*3,5)+(0,2*7,6)]/1,3 =
h = 1,3 meter K = 3,33

According to table 10.3 (= 0,52 taken.

(= a*b*E0/(= 3,5*7,6*50/0,52 = 1064 lümen

For 40 Watt akkor flaman lamp (= 420 lümen. According to ;
Number of lamps n = 3 are calculated.

Part 2 :
H = 2.6 meter
a : 5,45 m E0 = 50 lüx
Working area (hç) = 1 meter
Tij lenght (c) = 0,30 meter
(calculations direct illumination and accor flaman lamp has done)
b : 8,7 m h = H – hç – c K =[(0,8*a)+(0.2*b)]/h
h = 2,6 – 1- 0,3 K =[(0,8*5,45)+(0,2*8,7)]/1,3
h = 1,3 meter K = 4,69

According to table 10.3 (= 0,6 taken.

(= a*b*E0/(= 5,45*8,7*50/0,6 = 3950 lümen

For 60 Watt akkor flaman lamp (= 720 lümen. According to ;
Number of lamps n = 6 are calculated.

Part 3:
H = 2.6 meter
E0 = 50 lüx
Working area (hç) = 1 meter
a : 2,6 m Tij lenght (c) = 0,30 meter
(calculations direct illumination and accor flaman lamp has done)
b : 3,6 m h = H – hç – c K =[(0,8*a)+(0.2*b)]/h
h = 2,6 – 1- 0,3 K =[(0,8*2,6)+(0,2*3,6)]/1,3
h = 1,3 meter K = 2,15

According to table 10.3 (= 0,48 taken.

(= a*b*E0/(= 2,6*3,6*50/0,48 = 975 lümen

For 75 Watt akkor flaman lamp (= 930 lümen. According to ;

Number of lamps n = 1 is calculated.

Part 4:
H = 2.6 meter
E0 = 50 lüx
Working area (hç) = 1 meter
a : 4,2 m Tij lenght (c) = 0,30 meter
(calculations direct illumination and accor flaman lamp has done)
b : 2,9 m h = H – hç – c K =[(0,8...

CHAPTER III

3. TYPES OF CABLES

3.1 Electrical Running Cable

Running electrical cable is simple in theory: pull it through holes in the framing from a junction box to the service panel. However, actually getting cable to cooperate can be difficult and time consuming. So it helps to apply some creativity and patience. Double-check with your circuit diagrams before running any cable. Also see if you can double up runs anywhere by pulling two cables at once. In a new house or a major remodeling project, cable and boxes are "roughed-in" before the walls are insulated and drywalled.

NOTE: Insulation can be put up then removed for an inspection, but inspecting needs to be done before the walls are sealed by a vapor barrier and wallboard.

For terms and definitions see Electrical Glossary.Hanging Boxes & Drilling Holes Mount junction boxes for the outlets, lights and switches. Each box should stick out a little past the framing so its front will be flush with -- or set back just a fraction from -- the drywall. You can use a scrap piece of drywall to set boxes out the right distance. Some boxes even have a pre-formed 1/2" reference line for quick installation.Next, drill holes in the framing for the cables. Most rooms have an attic above them or a basement below. Drilling holes so cable runs horizontally through joists is usually easiest. A heavy-duty right-angle drill with a 1" bit is a good tool of choice. Wall holes drilled at about knee-height will be just right. Codes require that holes be 1 1/4" from both edges of studs which puts them right in the middle of a 2 x 4. Where lines are too close to framing edges, add protective metal cover plates to prevent nails from puncturing wires and pipes. Drilling holes through ceiling joists and wall plates will be a bit harder and that's where the right-angle drill is really handy.

3.2 Pulling Cable

The traditional way to pull cable is to start at the last fixture in the run, pull cable to each fixture in the circuit, and continue all the way back to the service panel. To do this, leave the box/spool of cable at the last fixture, unwind enough cable to complete the run and then start pulling it through the holes. Nonmetallic-sheathed cable is used most of the time. It can tangle or bind once in a while. If you feel a lot of resistance while pulling, the cable is probably kinked and needs to be straightened out somewhere along the run. If you're replacing old cable, you can often twist the ends of new and old wires together, wrap them with electrical tape, and pull the old cable out of the wall until the new cable appears.

A special tool called a "fish tape" can also be fed through holes, hooked to new cable, and pulled back to retrieve it. Each time you reach a junction box, pull a couple extra feet of cable through for making connections later. On long runs, you may have to go back to the box/spool a few times to feed more cable through. That's when two people really save time: one feeding cable and one pulling cable. Once the cable reaches the service panel, leave a foot or so of extra length on both the service end and the box/spool end for connecting. After the cable is in place, fasten it to framing with brackets -- called staples -- every 4 1/2', at turns, and where cable enters a box. Also label each cable end with a felt pen or piece of tape to keep them organized. Remember, when the rough-in is done an inspection is needed, so schedule it accordingly to avoid downtime. After the inspection, drywall and paint, you're ready to install the switches, outlets and light fixtures.

The installation of an electrical cable in a building and its subsequent testing are managed by first creating a computer database indicating the type of cable, the location where the cable is to be installed, the performance standard it should meet when installed in that location, and a test regimen to verify compliance with the performance standard. The database is then transferred into a hand held portable test instrument which is placed at the building site and connected to the cable to be tested.

Common types of general-purpose cables used by electricians are defined by national or international regulations or codes. Commonly-used types of power cables are often known by a "shorthand" name. For example, NEC type *NM-B* (*Non-Metallic, variant B*), often referred to as Romex™ (named by the Rome Wire Company, now a trademark of Southwire Company [1]), is a cable with a nonmetallic jacket. *UF* (*underground feeder*) is also nonmetallic but uses a moisture- and sunlight-resistant construction suitable for direct burial in the earth or where exposed to sunlight, or in wet, dry, or corrosive locations. Type AC is a fabricated assembly of insulated conductors in a flexible metallic armor, made by twisting an interlocking metal strip around the conductors. *BX*, an early genericized trademark of the General Electric company was used before and during WWII, designating a particular design of armored cable.

In Canada, type TECK cable, with a flexible aluminum or steel armour and overall flame-retardant PVC jacket, is used in industry for wet or dry locations, run in trays or attached to building structure, above grade or buried in earth. A similar type of cable is designated type MC in the United States.Electrical power cables are often installed in raceways including electrical conduit, and cable trays, which may contain one or more conductors. Conduit may also be rigid or flexible, metallic or nonmetallic, and differentiation from cable may require some investigation of the contents at their termination. Mineral Insulated Copper Clad cable (type *MI*) is a fire-resistant cable using magnesium oxide as an insulator. It is used in demanding applications such as fire alarms and oil refineries. All cables are flexible, which allows them to be shipped to installation sites on reels or drums. Where applications require a cable to be moved repeatedly, more flexible cables are used. Small cables are called "cords" or "flex". Flexible cords contain finer stranded conductors, rather than solid, and have insulation and sheaths that are engineered to withstand the forces of repeated flexing. Heavy duty flexible power cords such as feeding a mine face cutting machine are carefully engineered -- since their life is measurable in weeks. See "Power cord" and "Extension cable" for further description of flexible power cables. Other types of flexible cable include twisted pair, extensible, coaxial, shielded, and communication cable.

Building wire and cable is used in the construction of almost every commercial, industrial, and residential property in the world. Most commonly known as branch circuit wiring in homes and businesses, these products carry electrical current to all external uses of power in a building or dwelling.

The Building Wire and Cable Section develops technical standards and guidelines, influences government affairs and trade issues, collects market data, and develops marketing programs on its products.

3.3 Scope

All types of building wires and cables as identified in the National Electrical Code (NEC), Underwriters Laboratories (UL) standards, Canadian Electrical Code (CEC), Canadian Standards Association (CSA) standards, Mexican Electrical Code (MEC), and Asociación Nacional de Normalización y Certificación del Sector Eléctrico (ANCE) standards.

UL, CSA and ANCE categories of building wire as follows:

UL/CSA/ANCE Standard, Category

- UL 4/C22.2.2 No. 51, Armored Cable
- UL 44/C22.2 No. 38/NMX-J-451-ANCE, Thermoset-Insulated Wires and Cables
- UL 83/C22.2 No. 75/NOM-J-010-ANCE, Thermoplastic Insulated Wires and Cables
- UL 493, Thermoplastic Insulated Underground Feeder and Branch Circuit Cables
- UL 719/C22.2 No. 48, Nonmetallic-Sheathed Cable
- UL 854/C22.2 No. 52, Service Entrance Cables including single, paralleled, or cabled conductors, with XLP insulation, with or without an overall covering, which are NRTL Listed as Type SE, Type USE or USE-2 combined with another NRTL Type on the same wire or cable.

3.4 Cable

- Refers to a collection of two or more strands of wire or conductors. Basically, cable has a "hot" line to carry the current and a "neutral" line to complete the loop. They often have a third wire as that acts as a grounding wire.
- Classified according to the number of wires it contains and their size or gauge.
- All cables are marked with a series of letters followed by a number, a dash and another number. The letters indicate the type of insulation (cord, wire and insulation). The first number indicates the resistance of the wires in the cable, and the number following the dash indicates the number of individual conductors in the cable.
- If the designator "G" follows the series it means that the cable is also equipped with a non-current-carrying ground wire. Hence, the designator USE 12-3/G indicates an underground

cable containing three separately insulated wires capable of carrying 20 amps of current plus a grounding wire.

- The most common jackets are NM-B (Non-Metallic Building Indoor), UF-B (Underground Feed) and BX, which is flexible metallic cable.
- **Two-conductor cable** contains one black wire and one white wire. The black wire is always the "hot" wire and must be fused. The white is always neutral and must never be fused. When current bridges the gap from the 110V hot wire to the neutral, it results in a 110V input to the appliance.
- **Three-cond Fuctor cable** contains a red wire in addition to black and white. The black and .This three-wire circuit is increasingly common in home wiring; it accommodates major 220V appliances, such as ranges and air conditioners.
- **BX cable** is armored metallic cable. It consists of two or three insulated wires individually wrapped in spiral layers of paper. The steel casing acts as a ground wire. There is also a bond wire included in the casing that acts as a ground if the casing breaks.

3.5 Thermostat Cable

- Used in low-voltage control, alarm and communication systems. Most common types are braided, twisted and plastic-jacketed types. All three use solid copper conductors and are twisted and insulated with plastic.
- Although thermostat cable is low voltage, it carries an UL-listing for being flame-retardant, since it is installed in the wall. Wiring used in security alarm and smoke detection systems must be UL-listed.
- Twisted cable, which has no outer braid, is used in doorbells, burglar alarms, intercom telephones and public address systems.
- Braided cable is covered with cotton braid and is used primarily in thermostat controls and other low-voltage, remote control circuits.
- Plastic-jacketed cable is also used in similar low-voltage applications.

CHAPTER IV

4. TYPES OF LAMPS AND LIGHTNING

A lamp is an energy converter. Although it may carry out secondary functions, its prime purpose is the transformation of electrical energy into visible electromagnetic radiation. There are many ways to create light. The standard method for creating general lighting is the conversion of electrical energy into light.

4.1 Type of Light

Incandescence

When solids and liquids are heated, they emit visible radiation at temperatures above 1,000 K; this is known as incandescence. Such heating is the basis of light generation in filament lamps: an electrical current passes through a thin tungsten wire, whose temperature rises to around 2,500 to 3,200 K, depending upon the type of lamp and its application. There is a limit to this method, which is described by Planck's Law for the performance of a black body radiator, according to which the spectral distribution of energy radiated increases with temperature. At about 3,600 K and above, there is a marked gain in emission of visible radiation, and the wavelength of maximum power shifts into the visible band. This temperature is close to the melting point of tungsten, which is used for the filament, so the practical temperature limit is around 2,700 K, above which filament evaporation becomes excessive. One result of these spectral shifts is that a large part of the radiation emitted is not given off as light but as heat in the infrared region. Filament lamps can thus be effective heating devices and are used in lamps designed for print drying, food preparation and animal rearing.

4.2 Electric discharge

Electrical discharge is a technique used in modern light sources for commerce and industry because of the more efficient production of light. Some lamp types combine the electrical discharge with photoluminescence. An electric current passed through a gas will excite the atoms and molecules to emit radiation of a spectrum which is characteristic of the elements present. Two metals are commonly used, sodium and mercury, because their characteristics give useful radiations within the visible spectrum. Neither metal emits a continuous spectrum, and discharge lamps have selective spectra. Their colour rendering will never be identical to continuous spectra. Discharge lamps are often classed as high pressure or low pressure, although these terms are only relative, and a high-pressure sodium lamp operates at below one atmosphere.

4.3 Types of Luminescence

Photoluminescence occurs when radiation is absorbed by a solid and is then re-emitted at a different wavelength. When the re-emitted radiation is within the visible spectrum the process is called fluorescence or phosphorescence. Electroluminescence occurs when light is generated by an electric current passed through certain solids, such as phosphor materials. It is used for self-illuminated signs and instrument panels but has not proved to be a practical light source for the lighting of buildings or exteriors.

4.4 Evolution of Electric Lamps

Although technological progress has enabled different lamps to be produced, the main factors influencing their development have been external market forces. For example, the production of filament lamps in use at the start of this century was possible only after the availability of good vacuum pumps and the drawing of tungsten wire. However, it was the large-scale generation and distribution of electricity to meet the demand for electric lighting that determined market growth. Electric lighting offered many advantages over gas- or oil-generated light, such as steady light that requires infrequent maintenance as well as the increased safety of having no exposed flame, and no local by-products of combustion.

During the period of recovery after the Second World War, the emphasis was on productivity. The fluorescent tubular lamp became the dominant light source because it made possible the shadow-free and comparatively heat-free lighting of factories and offices, allowing maximum use of the space. The light output and wattage requirements for a typical 1,500 mm fluorescent tubular lamp is given in table 46.1

Table 46.1 Improved light output and wattage requirements of some typical 1,500 mm fluorescent tube lamps.

Rating (W)	Diameter (mm)	Gas fill	Light output (lumens)
80	38	argon	4,800
65	38	argon	4,900
58	25	krypton	5,100
50	25	argon	5,100 (high frequency gear)

By the 1970s oil prices rose and energy costs became a significant part of operating costs. Fluorescent lamps that produce the same amount of light with less electrical consumption were demanded by the market. Lamp design was refined in several ways. As the century closes there is a growing awareness of global environment issues. Better use of declining raw materials, recycling or safe disposal of products and the continuing concern over energy consumption (particularly energy generated from fossil fuels) are impacting on current lamp designs.

4.5 Performance Criteria

Performance criteria vary by application. In general, there is no particular hierarchy of importance of these criteria.Light output: The lumen output of a lamp will determine its suitability in relation to the scale of the installation and the quantity of illumination required.

Colour appearance and colour rendering: Separate scales and numerical values apply to colour appearance and colour rendering. It is important to remember that the figures provide guidance only, and some are only approximations. Whenever possible, assessments of suitability should be made with actual lamps and with the colours or materials that apply to the situation.

Lamp life: Most lamps will require replacement several times during the life of the lighting installation, and designers should minimize the inconvenience to the occupants of odd failures and maintenance. Lamps are used in a wide variety of applications. The anticipated average life is often a compromise between cost and performance. For example, the lamp for a slide projector will have a life of a few hundred hours because the maximum light output is important to the quality of the image. By contrast, some roadway lighting lamps may be changed every two years, and this represents some 8,000 burning hours.

Further, lamp life is affected by operating conditions, and thus there is no simple figure that will apply in all conditions. Also, the effective lamp life may be determined by different failure modes. Physical failure such as filament or lamp rupture may be preceded by reduction in light output or changes in colour appearance. Lamp life is affected by external environmental conditions such as temperature, vibration, frequency of starting, supply voltage fluctuations, orientation and so on. It should be noted that the average life quoted for a lamp type is the time for 50% failures from a batch of test lamps. This definition of life is not likely to be applicable to many commercial or industrial installations; thus practical lamp life is usually less than published values, which should be used for comparison only.

Efficiency: As a general rule the efficiency of a given type of lamp improves as the power rating increases, because most lamps have some fixed loss. However, different types of lamps have marked variation in efficiency. Lamps of the highest efficiency should be used, provided that the criteria of size, colour and lifetime are also met. Energy savings should not be at the expense of the visual comfort or the performance ability of the occupants. Some typical efficacies are given in table 46.2.

Table 46.2 Typical lamp efficacies

Lamp efficacies	
100 W filament lamp	14 lumens/watt
58 W fluorescent tube	89 lumens/watt
400 W high-pressure sodium	125 lumens/watt
131 W low-pressure sodium	198 lumens/watt

4.6 Main lamp types

Over the years, several nomenclature systems have been developed by national and international standards and registers. These lamps have three important advantages over other lamps. First, they produce cool light —they don't produce heat. Second, they are long-lasting, burning for up to ten times as long as incandescent lamps. Third, they are much more cost-effective because they produce three to four times as much light for each unit of electricity. The disadvantage to fluorescent lamps is that they produce a light with a green-blue cast that is unflattering and harsh. While some fluorescent lamps are made with coloration that is designed to soften and warm the tones produced, most interior designers avoid these types of lamps because the light they emit is never as soft and natural as that emitted from incandescent lamps. Fluorescent lamps are preferred for commercial use, where their long life, cool operation, low operating cost, and high efficiency are important, such as in large offices, stores, or apartment building hallways.What does all this mean to you? It means that in most residential rooms you should opt for the warm, natural look of incandescent lamps. Use incandescent lamps in living rooms, dining rooms, dens and bedrooms. Where might you use fluorescent lamps in the home? At one time, because of their narrow shape, fluorescent lamps were the only logical candidates for strip lighting — the hidden lighting that you would place under a shelf where you need particularly strong, focused light. As such, they became standard for lighting kitchen work surfaces, being suspended under upper kitchen cabinets, and they are still frequently used for this purpose.

Because of their bright light, even illumination and low operating costs, fluorescent lamps are also frequently used in rooms that require a lot of even lighting and where mood isn't quite so important, such as workshops, garages, and laundry rooms. Even so, you can see that most of the lamps you'll be using in residential design will be incandescent. For the most part, fluorescent lamps are used in work places, whether at home, in an office, or in another work situation. The light they produce is harsh, but that also means that it's perfect for when you need to see details clearly, such as when you're performing open-heart surgery, or doing needlepoint, or making sushi. Fluorescent lights have gotten a bad rap — for quite some time they were not favored because their very rapid flickering was blamed for tiring the eyes and other problems. But today, there are updated fluorescent lamps from which you can choose, some of which even fit into a regular fixture, just like an incandescent bulb. These are designed to have a long life, and can last up to eight years. According to the U.S. Department of Energy, people are using incandescent and fluorescent lamps about the way you'd expect: Of residential households, 98 percent use incandescent, 42 percent use fluorescent. Of commercial buildings, 59 percent use incandescent, 92 percent use fluorescent. Because fluorescent lights consume approximately 75-85 percent less electricity than incandescent lights, you can see why it's important to consider using these for places where a great deal of light is needed much of the time, such as in hospitals, offices, and other workplaces.

4.7 Electrical Installing Light Fixtures

There are no hard-and-fast steps for installing light fixtures. Most new lights have diagrams and instructions which you should read over at least once before you get started. In an add-on situation, you can run a new circuit. Or, you can draw power from an existing circuit. But too many devices can constantly trip a breaker so figure the circuit's load capacity before adding a light. A big installation battle is just getting fixtures mounted properly. Normally, an extra cross brace is nailed up during the framing process. If you're retro-fitting, you may have to tear out some wallboard to add extra bracing, or settle for locating the fixture's box on the nearest stud or joist.

Retro-fitting Recessed Lights

Hanging Ceiling Fans

Mounting Track Lighting

Electrical Glossary for terms and definitions.

4.8 Retro-fitting Recessed Lights

Usually recessed lights are installed after framing and before drywall. Sometimes that step is forgotten or you may want to retro-fit a recessed light to enhance a room's lighting scheme. For this project, we purchased a recessed fixture with a mounting bracket designed to fit through the hole. Use the light's housing as a guide to mark the hole. Then use a keyhole saw to cut the hole.

NOTE: Remember, your circuits and some of these steps will probably be different. Keep insulation at least 3" away from recessed lights, unless light is marked "I.C." (Insulated Ceiling) to avoid overheating and fire. Mark the location of the fixture. We ran incoming power directly to the light fixture then ran cable down to the switch to make a loop. To mount the light, slip the frame brackets up into the opening. Position the fixture to set flush with the bottom of the wood framing. Fasten the frame to the joists by pounding in the metal teeth on its supporting arms. Use small mounting clips included with the light to fasten it slightly recessed from the surface of the drywall. Paint the area before putting in the reflector shield and bulb if you can. Then snap the shield into place.

4.9 Hanging Ceiling Fans

How a ceiling fan is mounted depends on the model. Always follow the manufacturer's instructions. We'll describe a few ways to mount a fan, but almost all of them need a special ceiling fan-rated junction box anchored to a ceiling joist. Determine the location of the fan, usually in the center of the room. If you can't alter the location to be next to a joist, nail up a cross brace between the joists.Nail up a junction box so it will set flush with the ceiling drywall. Then run the incoming power cable, leaving about 1' of extra cable for connections. Hang drywall if needed at this point. Careful of the electrical cable, cut out around the outside edges of the box then finish anchoring the drywall.Use a step ladder to rest the fan on and fasten the mounting bracket to the junction box. Connect the respective cable and fan wires together, securing each pair with a wire connector.Lift the fan into position (make sure the decorative cover is on), fasten it to the mounting bracket, and slide on the decorative cover.

4.10 Mounting Track Lighting

Track lighting can add beauty and flexibility to a room's design scheme and it's fairly easy to install a new fixture on a finished ceiling. Orient the track so the bulbs will face objects you want to light at about a 30° angle.If you aren't replacing an existing ceiling light, you'll have to install a new junction box and run switched power to the box on a new cable. Usually, a light kit will have connecting wires, but you can also make them. Cut a piece of cable long enough to tie in with the source cable and reach the track terminals. Strip the cable and connect each wire to its source cable mate. Cap the connections with wire connectors and fold them in the box. Feed the wire ends through the fixture's mounting plate and fasten it to the box. Feed the ends through the track opening at the terminals. Secure the track to the ceiling, either by screwing into the ceiling joists or using molly/toggle bolts. Hook up the ground wire to the fixture's base plate. Strip the hot and neutral wires and secure them to the respective track terminals. Then attach each light fixture onto the track. Follow the manufacturer's instructions, but some fixtures snap on and others attach with a bracket.

CHAPTER V

5. TYPES OF SWITCHES

5.1 Rocker Switches

These are common across all accessory ranges. All switches are rated at 250v 20amps except parts 14 and 15, which are rated at 250v 6A AC. Manufactured from brass or aluminium, finished to either complement or match the cover plates. Neons are red with red trim or green with black trim. Key switches are white or black. Red interiors are available for special applications such as essential supply. Alternative combinations can be supplied.

5.2 Toggle Switches

All are rated at 250v 20amps, except the bell push which is rated at 250v 6A AC. Manufactured from brass or aluminium, finished to either complement or match the cover plates. Palace toggles are not available to match PDB (suggest PB for matching), LB (suggest AB for contrast), W and CW (suggest SBC for contrast), Profile (suggest SC or SBC), AS, SDB or DG (suggest SB).

5.3 Dimmers

Dimmers (S2) Rotary dimmers, suitable for use with tungsten lighting are push on/push off switch dimmers which act at any pre-selected brightness setting. They have 2 way switching that may be used with a normal 2-way switch elsewhere. Larger gang dimmer units are available to special order and quotation. Note that transformers supplying low voltage lamps should be toroidal or laminate construction.Some electronic transformers are not compatible,please check with the transformer manufacturer which types of dimmers are compatible with their electronic transformers.

5.4 Socket Outlets

Socket outlets are based on the same modular principle as the matching grid switch system. They can be installed and aligned separately as the socket interiors are mounted on an adjustable grid within the box. Switched socket outlets have double insulated rockers. Red interiors are available for special application, eg essential supply. Red neons are available on switched sockets. All units will fit boxes to BS4662 with a minimum depth of 35mm. 2amp and 5amp socket outlets are designed to BS546. 13amp switched socket outlets have double insulated rockers. All 13amp sockets comply with BS1363.

5.5 Fuse Connection Units

Cable outlets have a bushed hole, a cord clamp and 3 way terminal block, suitable for up to 1.5mm flexible cable.

5.6 Telecom Outlets

Series 2 shuttered telephone line jack outlets are designed to British Telecom standards and are suitable for connecting to master unit for connection as first socket to direct exchange lines and private branch exchange lines (PBX or PABX), and for secondary units as extension sockets for connecting on the same line and in parallel to master units.All units have integral printed circuits and are suitable for up to 6 way connections; they also include a cable tie and a termination tool.The units are fitted with a 601A jack socket compatible with 431A and 631A plugs, which have a right hand locking latch.

5.7 Data Outlets

D-connectors are 25 pin sockets incorporating female screwlock assemblies for plug retention (plugs not supplied). 31/W: RJ11 (USA/Telecom Erin) shuttered jack socket with Krone IDC terminations, white (W) only. 35/W, 35/B: RJ45 Category 5 shuttered data socket, white (W) or black (B). Supports up to 100Mbps data transmission speeds, IDC terminations. 36/W: RJ45 Category 5 shielded shuttered data socket, white (W) only. Supports up to 100Mbps data transmission speeds, IDC terminations.

5.8 Isolater Switches

Isolator switches are rated at 100A 500V, 50/60Hz to BS5419: 1977 and are available in Satin Stainless Steel.

5.9 Shaver Supply Units

Supplied as a complete unit only. Dual voltage: 115V-230V output. Designed to BS3535:1990. Accepts UK, European, USA and Australian shaver plugs.

5.10 Rocker Switches

Rocker switches are actuated by a standard or dual rocker or paddle.

5.11 Mechanical Safety Interlock Switches

Mechanical safety interlock switches couple a moveable guard door with the power source of the hazard. When the guard door is opened, the power is isolated, ensuring that the machine does not pose a hazard while an operator requires access.

5.12 Fiber Optic Switches

Fiber optic switches route an optical signal without electro-optical and opto-electrical conversions.

5.13 Toggle Switches

Toggle switches are actuated by moving a lever back and forth to open or close an electrical circuit.

5.14 Non-contact Safety Interlock Switches

Non-contact safety interlock switches couple a moveable guard door with the power source of the hazard. For noncontact actuating interlock switches, the guard door is linked to the control circuit contacts via a magnetic or electronic field.

5.15 Electrical Installing Outlets & Switches

Most switches and outlets are installed after mechanical rough-ins, drywall and paint are completed. When you shop for devices like switches and outlets, there are several different types to wade through. Make sure to get the device that works properly with the circuit.The type of switch you install is determined by the circuit's wiring scheme. Outlets are pretty standard, but GFCIs are required in some rooms and box size is another thing to consider.

Sizing Junction Boxes

GFCI Outlets

Single-Pole Switches

Single-Pole Switches

A single-pole switch has two brass screw terminals. Both are hot leads for one incoming and one outgoing line. Those are all the wires that connect to the switch. The neutral wires tie together separately and the ground wires tie together separately in the box.Many new switches include a ground screw; others may not have one. If you have the choice, get a switch with a ground screw terminal. That's where the bare copper or green wire connects. When a switch is at the end of a circuit (one incoming cable), the neutral also becomes a hot lead and connects to a terminal. This type of wiring scheme is often called a switch loop.

NOTE: Install the switch so flipping it UP turns the light ON. This is very important if using a silent, "mercury" switch, because they won't operate properly unless they're installed correctly.

5.16 Three-way Switches

Three-way switches can control one light from two different places. Like switches that operate a light from both the top and bottom of a staircase. A three-way switch has three screws. One screw is colored darker than the other two. It's called the "Common" terminal. The other two screws are called "Traveler" terminals. You can wire two three-way switches and a light in a few different ways. It all depends where the light is located: before, between or after the switches. What we describe is not how all three-way switches are wired. But the following will give you an idea of how they're connected. For simplicity, let's say the light is after both switches. The first box has two cables: one 14-2 incoming from a power source, and one 14-3 outbound to the second box. The second box has that incoming 14-3 cable and an outbound 14-2 cable to the light. In each box, twist all the ground wires together (add a pigtail in each metal box). Screw on a wire connector (and fasten the pigtail to the back of the metal box). Connect the two neutral leads in each box with wire connectors. In the first box, connect the incoming (14-2) hot lead to the switch's "Common" terminal. Connect the outbound (14-3) leads to the two "Traveler" screws. In this case, the traveler leads can be hooked to either terminal. In the second box, hook up the incoming (14-3) hot leads to the switch's travelers screws.

Finally, hook up the outbound (14-2) hot lead going to the light to the "Common" screw. That completes wiring the switches. Complete the circuit by hooking up the light to the neutral, hot and ground leads.

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CHAPTER VI

6. IMPORTANCE OF ILLUMINATION

As global illumination techniques are on the edge of being used in commercial applications, it is getting more and more important to find ways of suitably representing the physical properties of a scene description including the reflectance properties of surfaces and the energy distribution of light sources. Because the reflectance properties of real world surfaces are too complex to be described by a few parameters of some fixed reflection model, a physically-based scene description interface requires a procedural approach, like that available in the RenderMan interface. However, arbitrary procedural descriptions of reflection or emission properties are difficult to handle for Monte-Carlo or finite element style algorithms. Both techniques require some knowledge about the procedural description in order to be implemented efficiently.

In the following sections we describe extensions to the RenderMan interface, which allow for the description of physical properties of scenes. The proposed extensions make information, which is necessary for a correct and efficient implementation, available to the renderer and the global illumination algorithm. We have chosen the RenderMan interface as the base for this work, because it is still the only widely used scene description interface which is powerful enough to describe complex scenes as well as complex reflectance and light source models, due to its use of procedural shaders. Unfortunately, it was not designed for global illumination and lacks the capabilities for a physically-based scene description. Furthermore, it offers no support for advanced global illumination algorithms like Monte-Carlo ray tracing or finite element (e.g. radiosity) techniques. The proposed extensions allow for overcoming these deficiencies.

The presentation in this chapter is organized as follows: We discuss problems and shortcomings of the RenderMan interface for supporting global illumination and advanced rendering techniques.

The following sections discuss the syntactic and semantic extensions to the RenderMan interface for supporting global illumination algorithms. we present the extensions to surface and light source shaders to describe physically-based reflectance and light emission models, and how shaders can make enough information available that an efficiently implementation of global illumination algorithms is possible. We discuss changes to the RenderMan interface in order to allow for post-processing of rendered images by tone-reproduction operators and image filters. We demonstrate the usefulness of the extensions with example shaders and images of RenderMan scenes that use Monte-Carlo ray tracing and wavelet radiosity to compute global illumination.

6.1 Imaging Pipeline

In the current definition of the RenderMan interface, the pixel values computed by the renderer are passed through an imaging pipeline. This pipeline consists of four stages (see Figure 9.1): image filtering, exposure control, image shaders, and quantization. Except for the image shader stage, which applies an image shader to each pixel, the processing model is fixed for all stages and only some parameters can be changed from the RIB interface.

The pixel filter stage receives as input the color and coverage information of pixels and outputs a color value. Its task is to perform filtering on the image. A predefined set of filter functions and their parameters are available from the RIB interface. The exposure control allows for scaling and gamma-correcting the resulting color values. Finally, after the application of the image shaders, the quantization stage applies a fixed and simple quantization algorithm to the color of each pixel, before the values are written to a file or a display device.

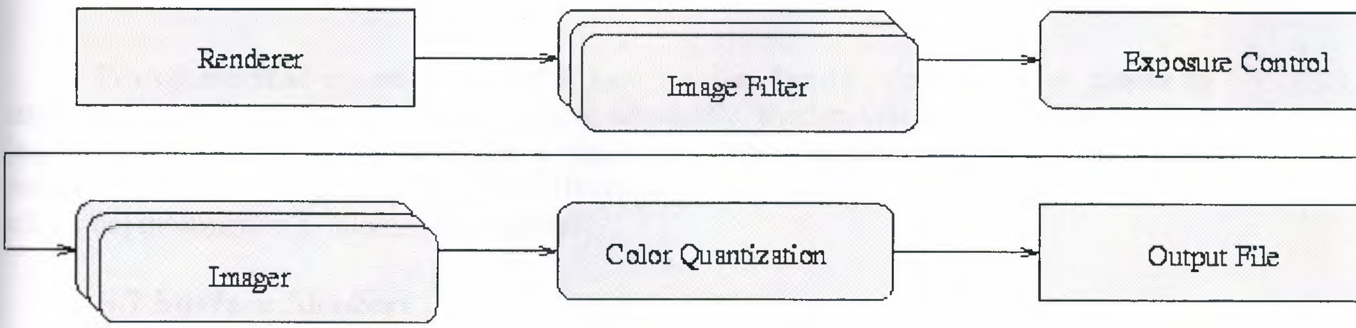

Figure 9.1: The RenderMan imaging pipeline including shader stacks indicated through stacks of rounded rectangles. Instead of these stacks of shaders only a single shader can be used in the standard RenderMan interface. This is still true for expose control and color quantization.

6.2 Global Illumination

At the time the RenderMan interface was developed, global illumination was still in its early development. Furthermore, RenderMan was developed mainly for the animation market and for the REYES rendering architecture, which offers no support for global illumination. In the following we list the problems which make it difficult to support global illumination within the RenderMan framework.

6.3 Units

The RenderMan interface does not define the units for quantities used in the interface. For instance, all color values are unit-less quantities between zero and one. This has several implications: It makes all computations context dependent and may introduce inconsistencies when combining shaders that assume a different environment. Therefore, it is difficult to reuse shader code, or use shaders from existing shader libraries. Even more important, all computations are relative to an implicit unit system imposed by the creator of the scene. All quantities must be converted into this implicit system before being used in a scene. For example, in these environments it is impossible to predict the effects of adding a 100 watt light source to a scene without knowing the overall scale factor of the other light sources.

6.4 Information Hiding

The computations performed by a shader are hidden from the renderer. While this is generally a good idea, in that it keeps the two concepts separate, it does not allow, for instance, the implementation of efficient Monte-Carlo renderers, because they would need information about the shader in order to perform appropriate importance sampling.

6.5 Image filters

In the imaging pipeline, the filter stage cannot be extended in the same way as the reflection model with the use of surface shaders. Filter shaders which would make this possible are not available in the standard RenderMan interface.

6.6 Procedural Shaders

Procedural shaders are a powerful tool for the flexible description of rendering attributes like reflection, emission, and others. Generally, shaders compute one or two values (e.g. emitted or reflected radiance) for a single point on a surface. To support the use of procedural shaders for common global illumination algorithms, the shaders must make additional information available to a renderer.

6.7 Surface Shaders

The surface shader receives illumination information from the RenderMan renderer and performs the integration through use of the `illuminance()` construct. This construct is similar to a while loop in C. The arguments of the illuminance statement specify the directions from which the shader wants to receive illumination, in the form of a cone (axis and angle) at the shaded point. The block of code immediately following the construct is executed for each illumination sample received by the renderer. Within this code, global state variables are available, which provide the direction of the incident illumination and the intensity, again as a unit-less color variable. This concept of procedural shaders poses several problems to global illumination techniques such as Monte-Carlo ray tracing and finite elements. They are discussed in the following sections.

6.8 Monte-Carlo Algorithms

Algorithms using the Monte-Carlo technique require information about the importance of incoming illumination from all directions. The more accurate the information about the importance of illumination is, the better the probability density function p in Equation can be adapted to the importance distribution. This leads to less variance in the result and consequently to better performance for the same level of noise in the resulting image.

The surface shader can provide the information about the importance of illumination in a given direction by an extension to the illuminance construct. In the current definition of the RenderMan interface the construct already specifies a cone, which defines the solid angle from which the surface can receive illumination samples.

If we extend the illuminance statement to include information about the importance of illumination, the renderer can choose the illumination samples accordingly. The representation of the importance should be simple to compute in the shader and should allow for fast sample generation in the renderer. We have chosen to describe the importance distribution as a set of cones with a cosine distribution within each cone, combined with the relative importance of each cone. Because the shading language allows for the overloading of names, we can use the same illuminance construct, which now takes a variable number of arguments

```
illuminance(position, num_cones,
            direction1, angle1,
            exponent1, rel_importance1,
            direction2, angle2, ...)
{ /* calculate BRDF and integrate */ }
```

where `position` specifies at what surface position the illumination should be calculated. The direction $\vec{\omega}_i$ (`directionN`) and the spread angle α_i(`angleN`) describe a cone, while e_i (`exponentN`) is the exponent of the power cosine distribution within cone *i*. With a suitable normalization factor C_i, the importance within a cone $p_i(\vec{\omega})$ is given as

$$p_i(\vec{\omega}) = \begin{cases} C_i\left(\left(\frac{\vec{\omega}\cdot\vec{\omega}_i}{\cos\alpha_i}\right)^{e_i} - 1\right) & \vec{\omega}\cdot\vec{\omega}_i > \cos\alpha_i \\ 0 & \text{otherwise.} \end{cases}$$

This density function has a peak in the direction $\vec{\omega}_i$, and falls to zero at the boundary of the cone. The complete distribution is then given as the sum over all cones weighted by their relative importance r_i(`rel_importanceN`)

A sample shader using this modified illuminance construct to implement the well known Phong reflectance model is given in Figure 9.2.

Figure 9.2: A simple surface shader computing the Phong reflectance model to illustrate the use of the new `illuminance()` construct. Note that the Phong illumination model is not energy conserving for grazing angles, and is therefore inconsistent with physically-based algorithms.

The illumination samples returned by a Monte-Carlo algorithm must be weighted by the inverse of the probability of being chosen. Therefore, the radiance values made available to the shader in the body of the illuminance construct must have been scaled accordingly.

6.9 Generating Reflected Rays

The illuminance construct can also be used to determine the direction of stochastically spawned reflection rays in a Monte-Carlo algorithm for a given point on the surface. The execution of the shader is simply aborted when it has executed the illuminance statement and the renderer has received the importance information. This information can then be used to choose an importance weighted sample direction for the reflected ray.

A similar technique can be used to determine the bidirectional reflection coefficient for a combination of an incoming and an outgoing illumination. This technique also provides the probability of this combination. This kind of information is required by Monte-Carlo algorithms like bidirectional estimators

In order to compute the bidirectional reflection coefficient, the input to the shader consists of a single illumination sample of unit radiance and zero solid angle indicating a delta impulse from the incident direction. Under the assumption that the computations of the shader are linear in the incoming illumination (as they should be, since the radiance equation is linear), the bidirectional reflectance is determined from the outgoing radiance returned by the shader. The probability of the sample can be calculated from the importance information provided by the illuminance statement.

6.10 Finite Element Algorithms

Finite element algorithms use a set of basis functions on surface elements to represent quantities for their computations. For example, classical radiosity uses constant basis functions for the diffuse reflectance factor and the radiosity on a patch. More advanced Galerkin radiosity algorithms use higher order basis functions like polynomials or wavelets.

The problem with this approach is that a procedural shader has no knowledge about the representation, and can therefore not compute appropriate values (e.g. mean reflectance over a surface patch). On the other hand, a shader should not have this knowledge, because it should be a generic description of the given BRDF, and cannot anticipate which basis functions might be used by the renderer. Furthermore, the procedural shader computes values only at a single point, while a finite element might be an arbitrary piece of a surface (usually a triangle or quadrilateral, but more general geometries could also be used). One solution to the above problem would be to extend the procedural shaders to calculate the coefficients for a given set of basis functions. This is especially useful for constant basis functions, where special methods are known to compute values in this basis (form factors, mean reflectivity). For higher order basis functions, such methods are generally not available. On the other hand, a special case shader would be restricted to a certain set of basis functions. Furthermore, it is not clear how to describe the area to the shader over which a value in a certain basis should be computed.

A more general solution is to stay with the concept of procedural shaders which compute values only at a single point, and use numerical methods in the renderer to derive the coefficients for a set of basis functions $N_i(x)$ on an element.

Assigning the task for computing the coefficients of the basis functions to the renderer allows for making use of information about the basis functions used by the renderer, and for using appropriate numerical integration techniques. However, this technique has the problem that the renderer has no knowledge about the function being integrated. This makes it difficult to decide about a suitable sampling for the numerical integration. It can result in aliasing artifacts if the sampling is too coarse, or in poor performance if it is too fine.

6.11 Bounds on Shader Values

This problem can be solved by a small extension to the current definition of surface shaders in the RenderMan interface. In addition to the outgoing radiance, the shader can also supply bounds on nearby values. These bounds can be used by the renderer to determine or adjust the sampling for the numerical integration. In the RenderMan interface, a surface shader receives information about the region of the surface being sampled through the global state variables `Du` and `Dv`. Together with the parameters of the sample point $(\mathbf{u}, \mathbf{v})$, they specify the axis-aligned box in the parameter space of the surface that is being sampled. This information is generally used to perform anti-aliasing in shaders.

The current interface is extended by introducing pairs of new state variables, which can be set by the shader. Each pair of variables specifies the partial derivative and a tolerance value. The shader guarantees that the radiance over the given sample region is within the indicated tolerance around the linear approximation given by the radiance value and the partial derivative. For surface shaders, the variables `DCiDu`/`TCiDu` and `DCiDv`/`TCiDv` specify these values for the reflected radiance `Ci` in the u and v direction of the surface, and `DCiDw`/`TCiDw` specifies the change over the outgoing solid angle, specified by `Dw`. These bounds on the partial derivative allow the renderer to decide about the sampling for the numerical integration or whether a given surface patch needs to be subdivided to allow for a better representation of a function in the basis chosen.

6.12 Irradiance

Many of the finite element algorithms used in global illumination today compute outgoing values] or radiance. These values cannot be used with a procedural surface shader, which requires information about the incoming illumination. Because these finite element algorithms have generally lost all information about the directional distribution of the incident illumination, they cannot make incident radiance values available to the shader.

Furthermore, the values computed by these algorithms are generally approximations over larger surface patches. This is accurate enough for computing the global illumination in the scene, but unacceptable for the generation of the final image, where much more detailed information about the BRDF of a surface is required (e.g. using high resolution textures).Both problems can be solved by a small modification to the definition of surface shaders and the values returned by the finite element algorithms.

In addition to the radiance values, received by the shader through the `illuminance()` construct, the renderer makes an irradiance value $E(\mathbf{x}, \vec{\omega})$ [Wm^{-2}] available to the shader. The irradiance E may depend on the outgoing direction $\omega$to allow for algorithms which compute directionally dependent outgoing radiance. This irradiance value can easily be obtained, e.g. from radiosity by dividing through the reflectance coefficient of the surface which was used to derive this value. The shader can then find the radiance reflected into the outgoing direction due to this irradiance term, and can take more detailed information into account (e.g. textures).

6.13 Light Source Shaders

In a classical rendering system there are three different types of light sources: Ambient light, which describes the amount of overall illumination in the scene, local light sources, which have a specific location in the scene (point and area light sources) and directional light sources, which have no position and send light only in certain directions (e.g. parallel light from the sun).

The task of light source shaders is to describe the incident radiance distribution at a receiving point. Each of the three light source types can be described in the shading language. The class of the light source shader is determined by its usage of the `illuminate()` construct to define a local light source, of the `solar()` construct to define a distant light source, or none of the two for an ambient light source. In a physically-based rendering process, there is usually no ambient light source, because the ambient term is calculated as part of the global illumination process. In addition, area light sources are often used to provide a more realistic simulation of real world light sources.

The `illuminate` and the `solar` construct in light source shaders are very similar to the `illuminance` construct of surface shaders. They also describe a directional cone (anchored at a given point in the case of illuminate), in which light is emitted by the light source. The cone may be used to cull points from the illumination calculations. Procedural light source shaders can be used with physically-based global illumination algorithms, if some small changes are made to their definition in the current specification of the RenderMan interface.

The necessary changes are analogous to those for surface shaders. We extend the `illuminate` and the `solar` statements to alternatively accept parameters similar to those for the illuminance statement. This allows for the specification of importance for radiance emitted into scene by a light source shader. This distribution can be used to determine the direction of stochastic sample rays, or to calculate the probability density of choosing a given direction. Similarly, light source shaders also make bounds on nearby values available to the renderer.

6.14 Imaging Pipeline

To perform post-processing of the final image based on physically well-defined units, the current definition of the imaging pipeline of RenderMan must also be modified. There are some extensions to the current definition of the interface that are important in order to support the current state-of-the-art in physically-based rendering.

In the current definition of the RenderMan interface, the imaging pipeline can only execute a set of standard filter algorithms and modify their parameters. This is certainly too restrictive to support more sophisticated algorithms. Currently, image shaders may only operate on the already filtered and gamma corrected pixel values. Furthermore, the shader can only operate on a single pixel.

6.15 Filtering

Filtering is a major step in calculating the final value of pixels, especially in the case of Monte-Carlo sampling. A good interface for global illumination algorithms should therefore support the flexible specification of such filters. This filtering process is usually a multi-stage process: First, the energy distribution may be enhanced by reducing sampling artifacts through an adaptive filtering strategy. While this first step is most useful for Monte-Carlo style algorithms, a tone-reproduction step which converts the radiance values for display is unavoidable for all algorithms. When rendering scenes with physical light sources and reflection functions, the large dynamic range of the input distribution must be matched to the rather small range of intensities displayable with a CRT or color printer. There are different approaches to solve this problem. Some include simpler linear scaling, others use more complex non-linear models.

These filters receive the radiance distribution at the pixels on the image plane as their input, and their task is to convert the radiance values to pixel values suitable for display. No units are imposed on the output of image shaders.

Only a set of predefined filter functions is available in the standard RIB interface. Using the shading language, we define new *filter shaders* so that the support for filtering in the RenderMan interface becomes much more flexible.

To support multiple layers of filtering, we allow for a stack of shaders to perform filtering. Any number of shaders can be pushed on a filter stack. The filter pushed first receives the output of the renderer and its output is the input of the next filter in the stack. A shader is pushed on the stack through the new RenderMan request

```
PushFilter "filter_name" ...
```

The output of the last shader should be values in the unit range. It is further processed by the standard RenderMan imaging pipeline (gamma correction, standard image shaders, and quantization), before it is send to the image file or device. Care must be taken to match the units of the output of one shader to the required input units of the next shader.

6.16 Extensions to the Shading Language

To write filter shaders, a new RenderMan shader class, called *filter shaders*, is introduced together with the concept of *maps*. In contrast to the old image shaders, which are called once for each pixel in the image, a filter shader is called once for the complete image. The image data is made available to the shader through a predefined map, instead of through global state variables. This is necessary because a filter shader may need to access other pixel values or even the complete image to accomplish its task.

The size of the image is passed to the shader in the global state variables `xsize` and `ysize`. Access to the image samples is available through a named map that holds the pixel values, by invoking new map access functions: color image(string map; float x, y, ...);void setimage(string map; float x, y; color c, ...);The function `image()` returns the pixel value of a map and the function `setimage()` allows for changing pixels in the map. Image shaders receive their input in the predefined map ``Cs" and store their result in the map ``Ci".

Although a renderer often works in radiometric units, it is common for image shaders to perform some computations in respect to luminance values. In addition to the functions `photometric()` and `radiometric()`, which convert values to the corresponding units (radiance or luminance, respectively). Other efficient transformations are made available by introducing new functions that integrate over the spectrum, and return the total luminance or radiance:

```
float totalluminance(color c);
float totalradiance(color c);
```

Other maps that are available to the filter shader are `` Oi", which contains opacity information, and ``z", which stores the depth at a pixel location. An implementation can also make other maps available to a shader.

6.17 Explanation of Project Terms in Electrical

Electrical

Glossary of Terms & Definitions

Amp (Ampere)

A unit that measures the strength/rate of flow of electrical current.

Armored Cable

Electrical wires protected by metal sheathing.

Branch Circuits

The circuits in a house that branch from the service panel to boxes and devices.

Breaker

A switch-like device that connects/disconnects power to a circuit.

Buss Bar (also Bus Bar)

Separate, metallic strips that extend through the service panel. Breakers slide onto the "hot" busses and neutral and ground wires screw down in their respective busses.

BX Cable

An old type of armored cable now illegal.

Cable Clamps

Metal clips inside an electrical box that hold wires in place.

Circuit

A continuous loop of current (i.e. incoming "hot" wire, through a device, and returned by "neutral" wire).

Circuit Breaker

The most common type of "overcurrent protection." A breaker trips when a circuit becomes overloaded or shorts out.

Conduit

A protective metal tube that wires run through.

Duplex Receptacle

The commonly used receptacle (outlet). Called "duplex" because it has two plug-in sockets.

Fuses

Removable devices that link a circuit at the fuse box. Fuse connections blow apart and break the circuit if an overload or short occurs.

Fixture

Any permanently connected light or other electrical device that consumes power.

GFCI or GFI (Ground Fault Circuit Interrupter)

A specific type of circuit protection (commonly required in kitchens & bathrooms) that helps safeguard against shocks. GFCI protection can come from an outlet or a breaker.

Ground Fault

Current misdirected from the hot (or neutral) lead to a ground wire, box, or conductor.

Hot, Neutral, Ground

The three most common circuit wires. The hot brings the current flow in, the neutral returns it to the source, and the ground is a safety route for returning current. The ground and neutral are joined only at the main service panel.

Junction (Electrical) Box

A square, octagonal, or rectangular plastic or metal box that fastens to framing and houses wires, and/or receptacles and/or switches.

Knockout

A removable piece of an electrical box or panel that's "knocked out" to allow cable to enter the box.

Lead

The short length of a conductor that hangs free in a box or service panel. (i.e. a wire end)

NM

Nonmetallic-sheathed (plastic).

NMC

Solid plastic nonmetallic-sheathing used in wet or corrosive areas, but not underground (see UF).

Ohm

A unit that measures the resistance a conductor has to electricity.

Pigtail

A short, added piece of wire connected by a wire connector. Commonly used to extend or connect wires in a box.

Romex

A brand name of nonmetallic-sheathed cable made by General Cable Corporation. Often mistakenly used as a collective term for NM sheathed cable.

Rough-In

Installing the boxes, cables, and making "in-wall" connections while the walls are still open. Later, final connections are made and the devices and appliances are installed during the trim-out.

Service Entrance (SE)

The location where the incoming electrical line enters the home.

Service/Supply Leads

The incoming electrical lines that supply power to the service panel.

Service Panel

The main circuit breaker panel (or fuse box) where all the circuits tie into the incoming electrical supply line.

Short Circuit

When current flows "short" of reaching a device. Caused by a hot conductor accidentally contacting a neutral or ground. A short circuit is an immediate fault to ground and should always cause the breaker to trip or the fuse to blow. (also see ground fault)

Travelers

Wires that carry current between three-way and/or four-way switches.

UF (Underground Feeder) cable

Cable designed and rated for underground, outdoor use. Cable wires are molded into solid plastic.

Volt

A unit that measures the amount of electrical pressure.

Watt

A unit that measures the amount of electrical power.

CHAPTER VII

7. GENERAL GUIDELINES

Here are a few typical guidelines that do-it-yourselfers should know about when doing electrical work. These are NOT legal interpretations of the National Electrical Code, so check with your local authority before starting work:

7.1 Kitchens

- All the **kitchen**, breakfast room, pantry, and dining room outlets must be supplied by at least two 20-amp small appliance circuits.
- Outlets above the kitchen counter normally are fed by **both** circuits -- they all cannot be wired to just one circuit. The circuits should not supply any lights or other outlets in the house.

7.2 Appliances

- Separate circuits are needed for built-in **appliances** (i.e. oven, range, disposer, dishwasher, central air conditioner, furnace).
- One 20-amp circuit is needed for the **laundry** outlet within 6' of the machines. An electric dryer requires an additional 240-volt circuit.

7.3 Outlets

- One lighting/convenience **outlet** circuit for every 575 square feet of floor space in a house.
- Any bathroom or garage outlet within 6' of a sink must be GFCI protected. A new code requires **all** kitchen outlets for countertop use to be GFCI protected.
- At least one GFCI outlet is required in an unfinished basement and for most outdoor outlets (exceptions include inaccessible outlets like at a garage ceiling or behind a refrigerator.
- Any point along the bottom of a wall (which is 2' or wider) must be within **6'** of an outlet. The 6' distance cannot be measured across a doorway or fireplace. And the outlet must be within 5 1/2' of the floor. This code cuts down on extension cord use, especially across doorways, fireplaces and similar openings.

7.4 Switches

- A **light switch** must control lighting in every habitable room, hallway, stairway, or garage. The switch can control either a light fixture or a receptacle into which a lamp is plugged.
- In kitchens and bathrooms, the light switch must control a permanently installed light fixture.

CHAPTER VIII

8. CONCLUSION

While the importance of electrical projects being continuously developed our architectural life. They include designing, planing, viewing and electricity using on the plans give us our future. How we grow up the lightning in wide areas with more efficiency.

We've gone through basic theory and major components over the last several articles, so by now you should be fairly comfortable with overall circuitry. Now, we'll cover just a few more common devices and then draw a simple circuit.

The electrical projects can be applied in a variety of approaches focusing on building systems/assemblies and can be customized to suit project needs. But regardless of commissioning approach and system focus, it always requires clear definition of performance expectations, rigor in planning and execution, and thorough project testing, operational training, and documentation.

As is expected, energy saving obtained by daylight responsive lighting control system shows differences according to the months and seasons. Energy saving which is only 20% in December increases to 47% in June and July. As seasonal differences are taken into consideration, energy saving which is 21% in winter increases to 35% in spring and 45% in summer. Energy saving in clear days is 35% and it decreases to 16% in overcast days as the daily weather conditions are taken into consideration. It is interesting that, energy saving in mixed days is approximately same as the clear days.

The experimental study yields that, 30% approximate energy saving could be achieved by using daylight responsive lighting control system for the climate conditions, similar to that of Istanbul in Turkey, which has 62% of days are clear for an annual test period. It is also known that, by using high quality lighting equipment provide further savings. Studies like the current one are of great importance to provide the necessary information in order to design the correct automatically controlled lighting system, which has high initial cost. Energy saving is strongly related to the climate conditions of the countries and available daylight level inside of the buildings. Nevertheless energy savings obtained by the automation systems independent from the types of the luminaires, light sources and the other electronical components, could be reach above 30% which is very important in terms of energy saving.

CHAPTER IX

9. REFERENCES

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^ Don't be Dim. Light up your life. Cost comparisons ICLs, CFLs and LEDs

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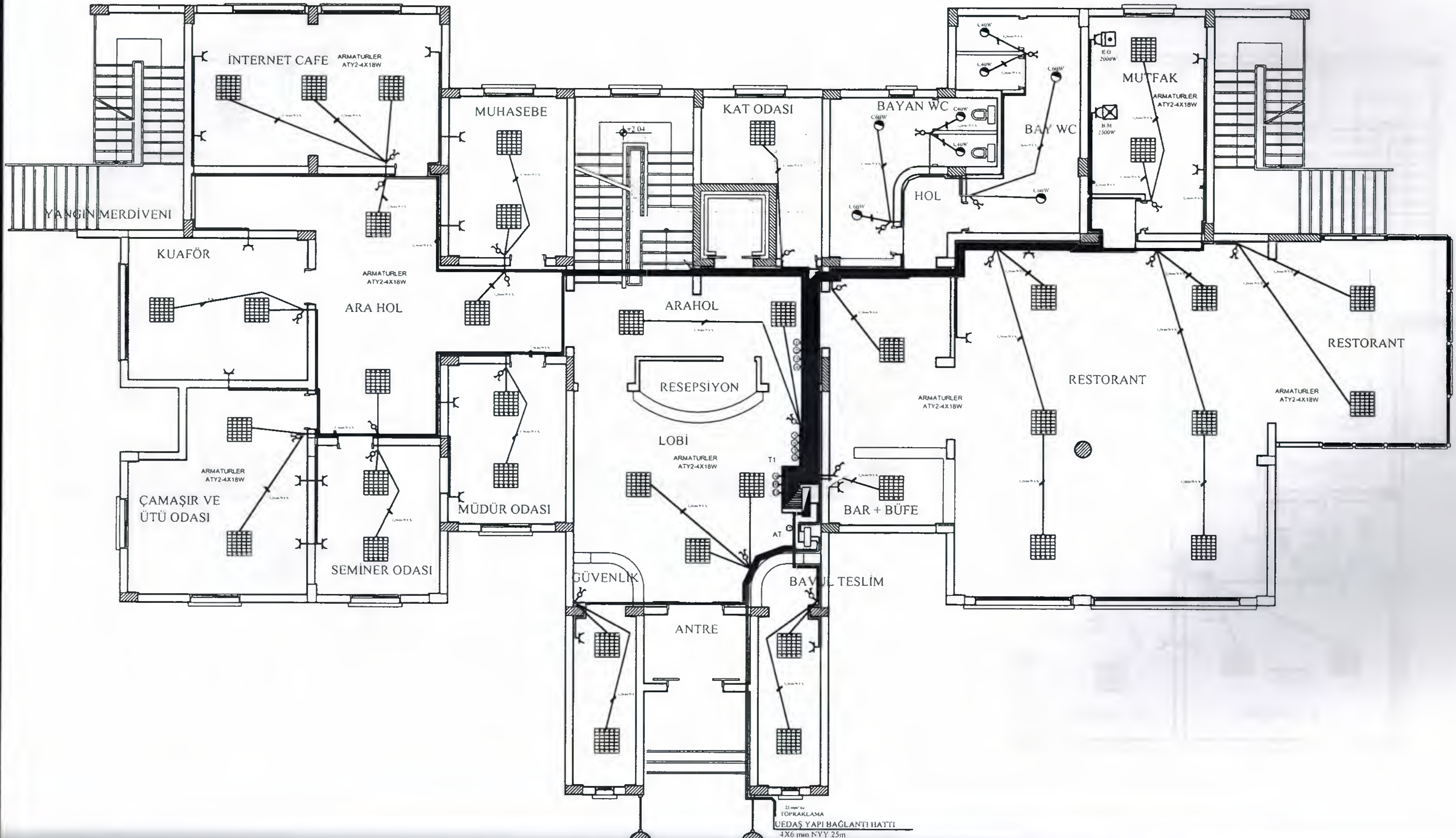
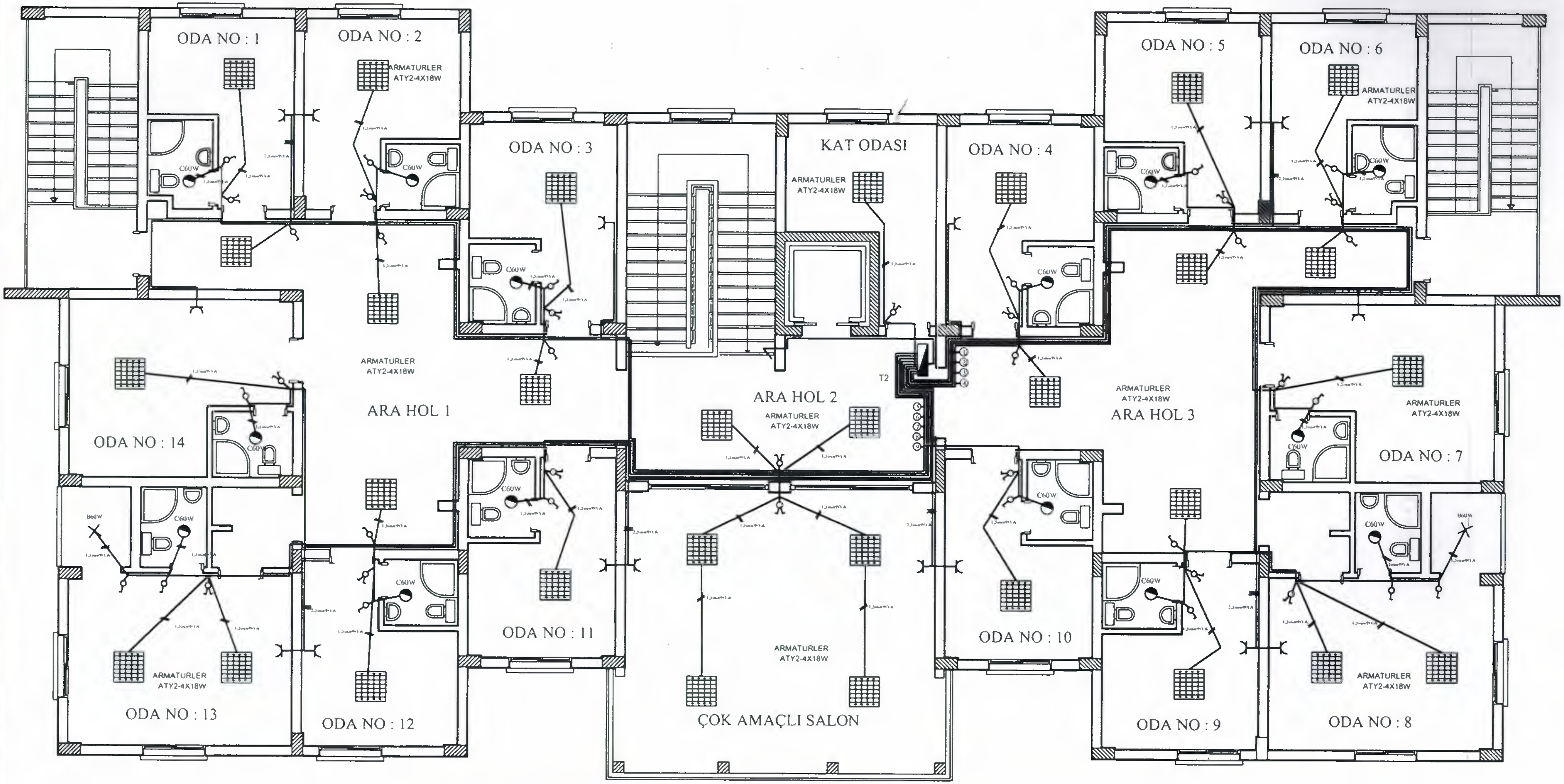


ZEMIN KAT PLANI Ö:1/50



1. KAT PLANI Ö:1/50

AYDINLATMA HESABI
ZEMIN KAT

RESTOURANT

a= 5.70
b=4.81
h=2.6
Q(t)=50lx

$h = H - (1+c) = 2.6 - (1+0.3) = 1.3$

$k = (A*B)/(A+B)*h = (5.70*4.81)/(5.70+4.81)*1.3 = 2.11$

$\zeta = 0.52$

$Q(t) = E.S/\zeta = 50*(5.70*4.81)/0.52 = 2636.5$

$N = Q(t)/Q(a) = 2636.5 / 1450 = 1.76$ n= 2

BIG SIDE(RESTAURANT)

A=8.71
B=9.96
H=2.6

$h = H - (1+c) = 2.6 - (1+0.3) = 1.3$

$k = (A*B)/(A+B)*h = 86.75 / 24.47 = 3.5$ $\zeta = 0.42$

$Q(t) = E.S/\zeta = 50*(86.13)/0.42 = 10253$

$N = Q(t)/Q(a) = 10253 / 1700 = 6$

RESEPSİON

A=5.91
B=6.91
H=2.6

$h = H - (1+c) = 2.6 - (1+0.3) = 1.3$

$k = (A*B)/(A+B)*h = 40.76 / 16.66 = 2.4$ $\zeta = 0.48$

$Q(t) = E.S/\zeta = 50*(40.76)/0.48 = 4245$

$N = Q(t)/Q(a) = 4245 / 850 = 5$ N = 5

İNTERNET CAFE

A=4.26
B=6.26
H=2.6

h=H- (1+c) = 2.6 – (1+0.3)=1.3

k= (A*B)/(A+B)*h = 26.66 /13.67 = 1.95 ζ= 0.30

Q(t)=E.S/ζ= 50*(26.66)/ 0.3 = 4443

N= Q(t)/ Q(a)= 4443/ 1500 = 3 .13 N=3

KAT ODASI

A=3.36
B=4.51
H=2.6

h=H- (1+c) = 2.6 – (1+0.3)=1.3

k= (A*B)/(A+B)*h =(15.15)/ 10.231 = 1.48 ζ= 0.35

Q(t)=E.S/ζ= 50*(15.15) / 0.35 = 2164

N= Q(t)/ Q(a)= 2164 /1500 = 1.44 N=1

MUTFAK

A=2.51
B=4.40
H=2.6

h=H- (1+c) = 2.6 – (1+0.3)=1.3

k= (A*B)/(A+B)*h =11.04/8.98 = 1.22 ζ= 0.25

Q(t)=E.S/ζ= 50*(11.04) / 0.25 = 1062

N= Q(t)/ Q(a)= 1062 / 550 = 2.05 N= 2

ODA NO 1

A=3.26
B=4.26
H=2.6

h=H- (1+c) = 2.6 – (1+0.3)=1.3

k= (A*B)/(A+B)*h =13.88 / 9.77 = 1.42

Q(t)=E.S/ζ=50*(13.88) =1652

N= Q(t)/ Q(a)= 1652 / 1500 = 1.32 N= 1

ÇOK AMAÇLI SALON

A=6.03
B=6.91
H=2.6

h=H- (1+c) = 2.6 – (1+0.3)=1.3

k= (A*B)/(A+B)*h =41.67 / 16.9 = 2.46 ζ=0.52

Q(t)=E.S/ζ=50*(41.67) /0.52 =4006

N= Q(t)/ Q(a)=4006 / 960 = 4.43 N=4

ODA NO 8

A=3.69
B=5.01
H=2.6

h=H- (1+c) = 2.6 – (1+0.3)=1.3

k= (A*B)/(A+B)*h = 18.48 /11.31 =1.63 ζ=0.25

Q(t)=E.S/ζ=50*(18.48)/0.25 = 1776

N= Q(t)/ Q(a)= 1776 /960 = 1.8 N: 2

ODA NO 13

A=3.8
B=4.5
H=2.6

$h=H-(1+c) = 2.6 - (1+0.3)=1.3$

$k=(A*B)/(A+B)*h = 17.1 / 22.2 = 0.77$ $\zeta=0.20$

$Q(t)=E.S/\zeta=50*(17.1)/0.20=4277$

$N= Q(t)/ Q(a)=4277/1800 = 2.36$ N=2

TABLO YÜKLEME CETVELİ

KAT PANOSU İÇİ KURULU W	DİV	TALEP W	Lin no	Sor ad	IŞIK GÜÇ W	PRİZ GÜÇ W	MOTOR GÜÇ W	FAZ GÜÇ DAĞILIMI R W	S W	T W	RST W	SİG. ŞAL.	Kaçak A.mA	AÇIKLAMALAR
			1	1		2500		2500				16		BULAŞIK MAK.
			2	1		2000			2000			16		FIRIN
			3	8	400					400		10		BANYO-WC
			4	5		1500		1500				10		PRİZ
			5	8	576				576			6		AYDINLATMA
			6	5	360					360		6		AYDINLATMA
			7	6		1800		1800				10		PRİZ
			8	7		2100			2100			10		PRİZ
T1			9	7	504					504		6		AYDINLATMA
			10	9	648			648				6		AYDINLATMA
			11	9	648				648			6		AYDINLATMA
			12	2		600				600		10		PRİZ
13636	1	13636	T	68	3136	10500		6448	5324	1864	0	3x32	3X30 mA	TOPLAM
			1	6		1800		1800				10		PRİZ
			2	7	468				468			6		AYDINLATMA
			3	8	540					540		6		AYDINLATMA
			4	4	276			276				6		AYDINLATMA
			5	4		1200			1200			10		PRİZ
			6	6		1800				1800		10		PRİZ
T2			7	9	600			600				6		AYDINLATMA
			8	9	648				648			6		AYDINLATMA
			9	9	612					612		6		AYDINLATMA
7944	1	7944	T	62	3144	4800		2676	2316	2952	0	3x25	3X30 mA	TOPLAM
			1	68	3136	10500		6448	5324	1864	0	3X32		T.1
AT			2	62	3144	4800		2676	2316	2952	0	3X32		T.2
21580	1	21580	T	130	6280	15300	0	9124	7640	4816	0	3x50	300 mA	TOPLAM

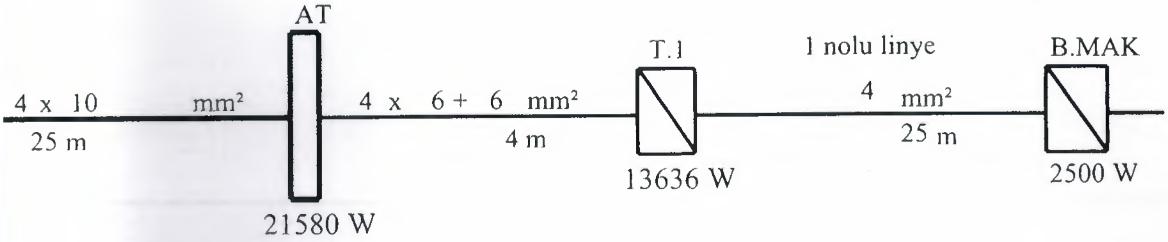
TEDAŞ'A ABONE YAPILACAK YERLERİN GÜÇ DAĞILIM TABLOSU

SAYAÇ PANOSU	KURULU GÜÇ (W)	ABONE CİNSİ	SAYAÇ AMPER	SİGORTA A.Akım	SİGORTA Kesme kap. kA	ŞALTER KARAKTERİSTİK	KAÇAK AKIM RÖLESİ mA	A
AT	21580	Ticari	3x10(50)	3x50	10	T.M.Ş	30 mA	25
	21580							

3x50	300 mA	YANGIN KORUMA RÖLESİ
3x50	T.M.Ş	

NOT: Hata koruma (kaçak akım) rölesi C otomat ile birlikte veya ayrı ayrı kullanılabilir.

GERİLİM DÜŞÜMÜ HESABI



1- KOLON HATTI

KOFRA ---- TÜKETİM CİHAZLARI ARASI

Sayaçla en yüklü linye arası

%e2 = k1 x L x Nt x 10^-7 = 20,6 x 4 x 13636 x 10^-7 = 0,11

%e2 = k1 x L x Nt x 10^-7 = 184,5 x 25 x 2500 x 10^-7 = 1,15

%e2 + %e3 = 0,11 + 1,15 = 1,27 < 1,5 UYGUNDUR.

2- YAPI BAĞLANTI HATTI

İşletmeye ait besleme noktasından (şebeke direği - AG dağıtım panosu) kofraya kadar olan hat.

%e1 = k3 x L x Nt x 10^-7 = 12,40 x 25 x 21580 x 10^-7 = 0,67 < 5 UYGUNDUR

SAYAÇ SEÇİMİ

$$I = \frac{Nt}{1,73 \times U \times Cosj} = \frac{21580}{1,73 \times 380 \times 0,8} = 41,03\ A$$

SEÇİLEN ELEKTRONİK SAYAÇ AKIMI = 3x10(50) A

ISINMA HESABI -- AKIM KONTROLU -- KESİT SEÇİMİ

Nt = Bağlantı Gücü (Talep Gücü)

$$I = \frac{Nt}{1,73 \times U \times Cosj} = \frac{21580}{1,73 \times 380 \times 0,8} = 41,03\ A$$

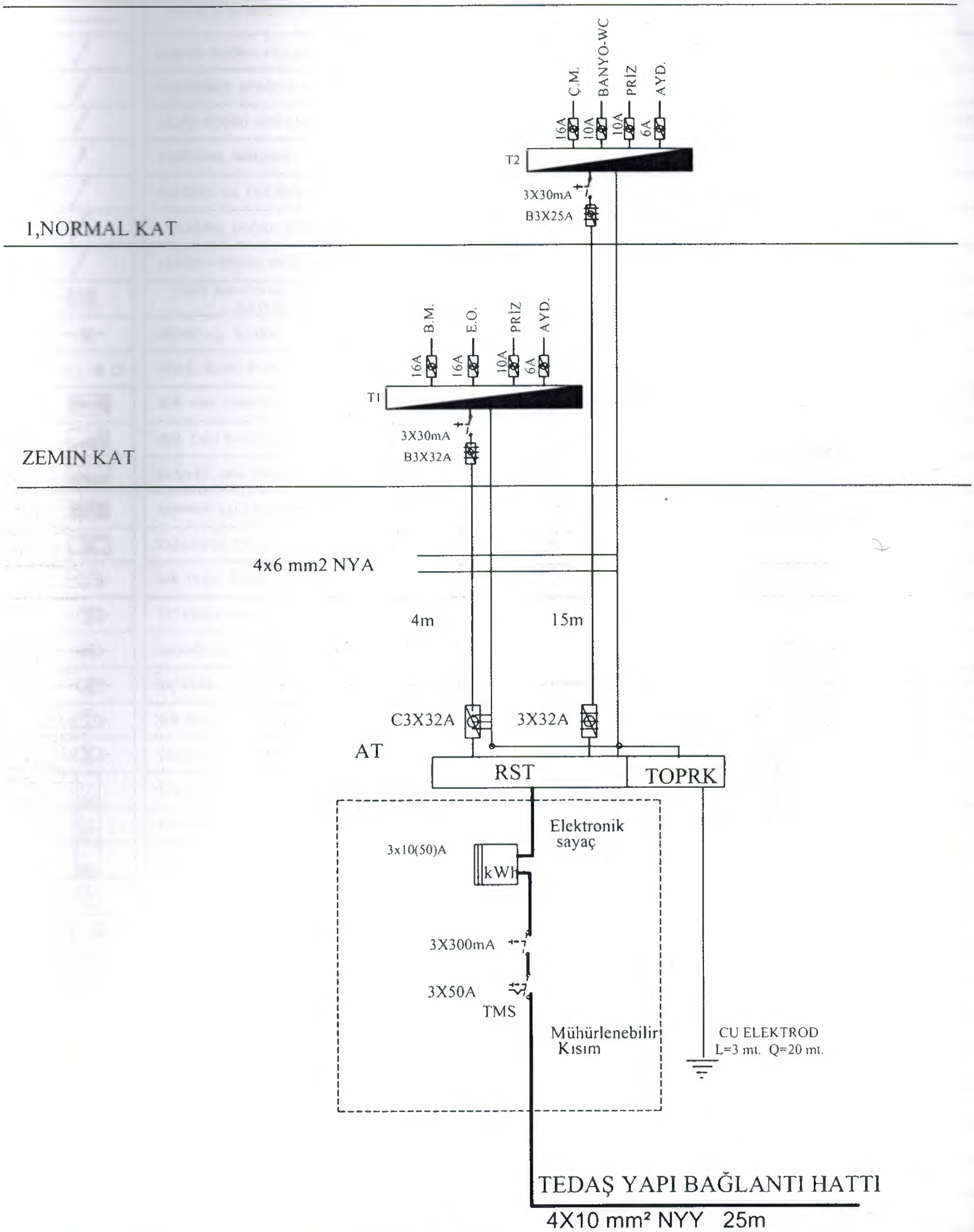
SEÇİLEN KESİT 4 x 10 mm² NYY kablo 77 A taşır.

41,03 A < 77 A UYGUNDUR.

0.6 / 1 kV (PVC) Protodur Y kablosu 3 - 4 toprakta seçilmiştir.

S (KESİT) mm²		2,5	4	6	10	16	25	35	50	70	95	120	150	185
MONOFAZE	k1	295,2	184,5	122,9	74,5	46,5	29,8	21,4	14,9	---	---	---	---	---
TRİFAZE	k3	49,46	30,9	20,6	12,4	7,75	4,96	3,54	2,48	1,77	1,30	1,03	0,826	0,669
MONOFAZE AKIM	A	41	53	66	88	---	---	---	---	---	---	---	---	---
TRIFAZE AKIM	A	36	46	58	77	100	130	155	185	230	275	315	350	400

KOLON SEMASI



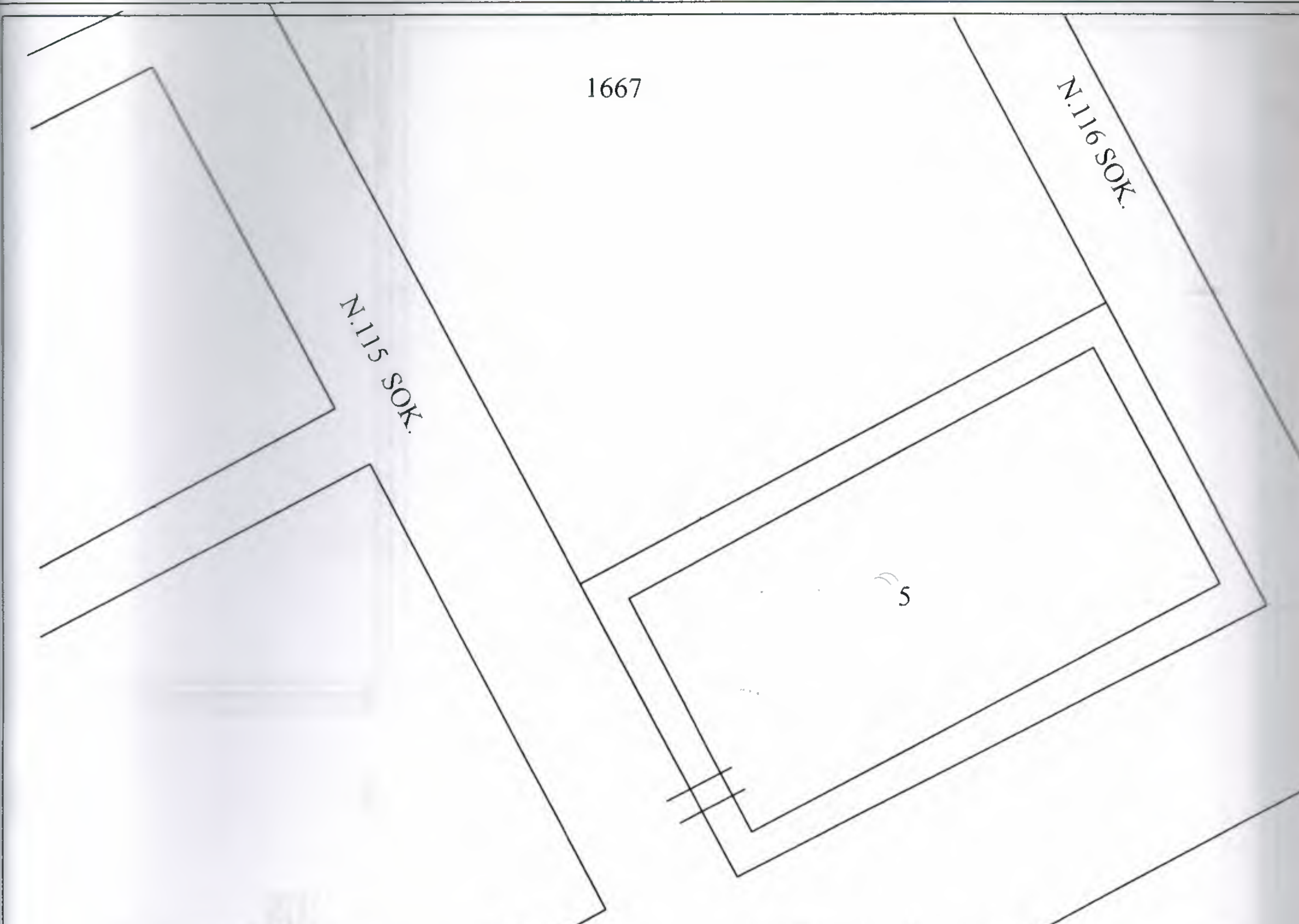
1-Kofrelere yangın koruma şalteri sayaç kolon devrelerine isw hayat koruma eşikli amper değerleri yeterli büyüklükte olan hata akımıkorumalı mühürlenebilir termik manyetik şalterler konulmalıdır.

2-Kat panolarına (tali pano),sayaç panolarından (ana pano) itibaren faz iletkeni kesitinde TOPRAKLAMA iletkeni çekilecektir.

İŞARET LİSTESİ

İŞARET	ANLAMI	İŞARET	ANLAMI
1.5	KUVVETLİ AKIM BESLEME İLETKENİ (KISA ÇİZGİLER İLETKEN SAYISI, RAKAM İLETKEN KESİTİDİR.)		YILDIZ - ÜÇGEN ANAHTARI
	TOPRAKLAMA, SIFIRLAMA BAĞLANTISI İÇİN KULLANILAN KORUMA İLETKENİ		BİR KUTUPLU ANAHTAR
	YERALTI KABLOSU, BÜZ VEYA DÖŞEME İLE BESLEME HATTI		ÜÇ KUTUPLU ANAHTAR VE PAKO ŞALTER
	YUKARI DOĞRU BESLEME		BİR KUTUPLU SERİ ANAHTAR KOMÜTATÖR
	YUKARIDAN AŞAĞIYA BESLEME		BİR KUTUPLU VAEVİYEN ANAHTAR
	AŞAĞI DOĞRU BESLEME		BİR KUTUPLU ARA VAEVİYEN ANAHTAR (DEVİYATÖR)
	AŞAĞIDAN BESLEME		BASMA ANAHTARI (DÜĞME TİPİ ANAHTAR)
	AŞAĞIYA VE YUKARIYA GİDEN HAT		BİR FAZLI NORMAL PRİZ
	YUKARIYA DOĞRU BESLEME		BİR FAZLI TOPRAKLAMALI PRİZ
	AŞAĞIYA DOĞRU BESLEME		ÜÇ FAZLI NORMAL PRİZ
	ÇİZİM KOLAYLIĞI BAKIMINDAN ÇOK İLETKENİN TEK İLETKEN OLARAK GÖSTERİLMESİ		ÜÇ FAZLI TOPRAKLAMALI PRİZ
	SİGORTALI KOFRE		BİR FAZLI ETANŞ PRİZ
• ○ , ■ □	BUAT, KARE BUAT		ÜÇ FAZLI ETANŞ PRİZ
	IŞIK ANA TABLOSU	5x50W	BİR AYDINLATMA ARMATÜRÜNÜN LAMBA SAYISI VE GÜCÜ İLE GÖSTERİLMESİ
	IŞIK TALİ DAĞITIM TABLOSU		AVİZE
	KUVVET ANA TABLOSU		APLİK
	KUVVET TALİ DAĞITIM TABLOSU		ETANŞ ARMATÜR
	KUMANDA TABLOSU		PROJEKTÖR
	BİR FAZLI BUŞONLU SİGORTA	MO	MERDİVEN OTOMATİĞİ
	ÜÇ FAZLI BUŞONLU SİGORTA	M G	MEŞGUL, GİRİLMEZ ARMATÜRÜ
	ANAHTARLI OTOMATİK SİGORTA		FLÜORESANT ARMATÜR (KISA : 20 W ; UZUN : 40 W)
	ÜÇ FAZLI ANAHTARLI OTOMATİK SİGORTA		ETANŞ FLÜORESANT ARMATÜR (KISA : 20 W ; UZUN : 40 W)
	BİR FAZLI BIÇAKLI SİGORTA		KARE VE YUVARLAK FLÜORESANT ARMATÜR
	ÜÇ FAZLI BIÇAKLI SİGORTA		TELEFON PRİZİ
1~ kWh	BİR FAZLI AKTİF SAYAÇ		TELEFON BESLEME HATTI
3~ kWh	ÜÇ FAZLI AKTİF SAYAÇ		YANGIN ALARM İHBAR KLAKSONU
kVArh	ÜÇ FAZLI REAKTİF SAYAÇ		IŞIKLI ÇAĞIRMA LAMBASI
A	AMPERMETRE		KAPI ZİLİ
V	VOLTMETRE VE VOLTMETRE KOMÜTATÖRÜ	220/3-5-8 V	ZİL TRANSFORMATÖRÜ
	GÜÇ TRANSFORMATÖRÜ		KAPI ZİLİ DÜĞMESİ
	AKIM TRANSFORMATÖRÜ (BİR VE ÜÇ FAZLI)		ZİL HATTI
M	MOTOR		VIZILTI
	PARAFUDR	KO	KAPI OTOMATİĞİ
	BİR FAZLI ANAHTAR ŞALTER		KAPI OTOMATİĞİ DÜĞMESİ
	ÜÇ FAZLI ANAHTAR ŞALTER		KAPI OTOMATI HATTI
	OTOMATİK ANAHTAR ŞALTER		HOPARLÖR
	BIÇAKLI ANAHTAR ŞALTER		T.V. ANTENİ
	AŞIRI AKIM RÖLELİ KORUMA ANAHTARI (ÖRNEK : MİNYATÜR KESİCİ)		ANTEN PRİZİ
	TERMİK RÖLELİ KORUMA ANAHTARI		TOPRAKLAYICI
	KONTAKTÖR		TOPRAKLAMA HATTI
D	DUMAN DEDEKTÖRÜ	P	YANGIN İHBAR BUTONU

VAZİYET PLANI Ö:1/10



BAĞLANTI ŞEKLİ :Yapı Bağlantı Hattı 4X10 mm² NYY Kablo İle Yeraltı Tesis Edilecektir.

<u>TESİSATTA UYULMASI GEREKLİ TEKNİK ESASLAR</u>

1-Elektrik iç tesislerinde iletkenler aşağıdaki kesitlerde ve tipte kullnılacaktır
- a-Tali kolon hatları 6 mm² NYA
- b-Priz linyeleri 2,5 mm² NYA
- c-Lamba linyeleri 2,5mm² NYA
- b-Priz sorti hatları 2,5 mm² NYA
- c-Lamba sorti hatları 1,5mm²

2-Elektrik iç tesislerinde iletkenler için aşağıdaki renk kodları uygulanacaktır.

a-Koruma İletkenleri	:Yeşil-Sarı
b-Orta iletkenler ve nötr iletkenleri	:Açık mavi
c-Faz iletkenleri	:Yürülükteki kablo standartlrına uygun olmak üzere faz için ayrı renkler.

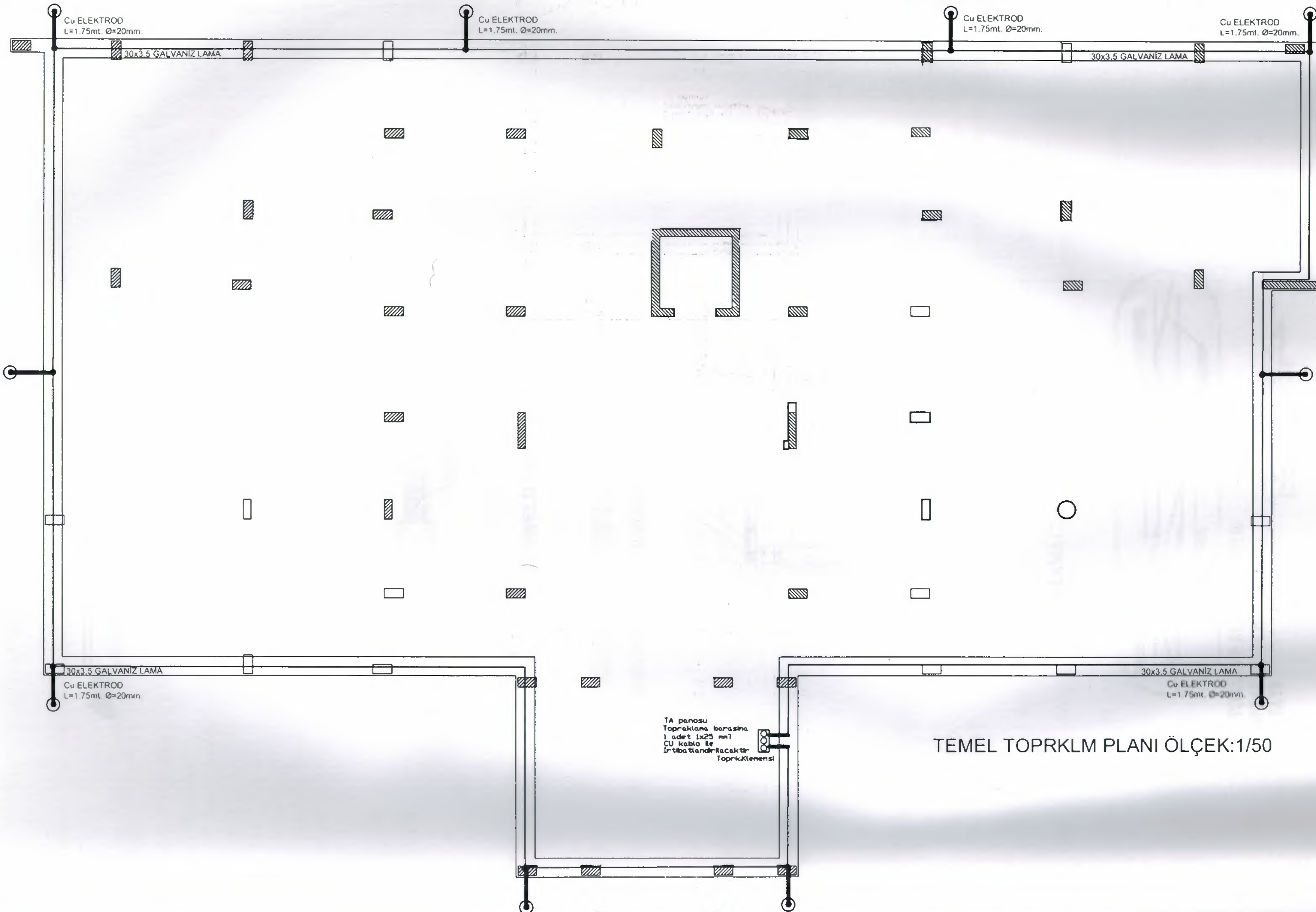
3-Enerji kabloları,kural olarak anma gerilimine bağlı olarak kaldırımın altına
en az, Un< 1kV için 0,73 m
1kV<Un<3 için 0,8m derinliğe tesis edilmelidir.

4-Tesisatta kullanılıcak tüm malzemeler TSE belgeli olacaktır.

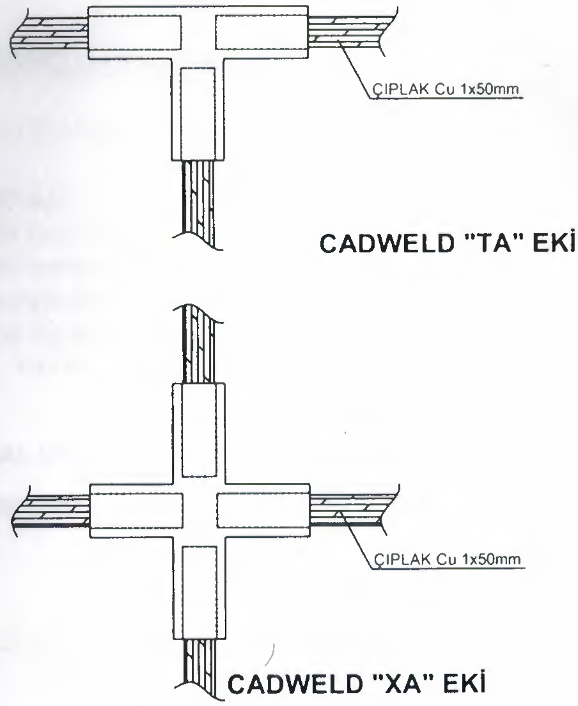
5-Uygulamada Elektrik ve Topraklama tesisatı "Elektrik İç Tesisleri Yönetmeliği" ve "Topraklama Yönetmeliği"ne uygun olacaktır.

<u>DİĞER HUSULAR</u>

Çizilen şebeke tarafımdan tespit edilmiş olu yerinde mevcuttur.Aksi halde doğacak problemlerden mesulum.

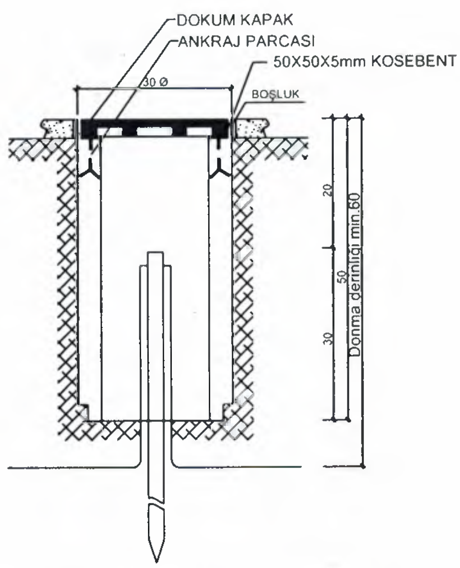


TEMEL TOPRKLM PLANI ÖLÇEK:1/50

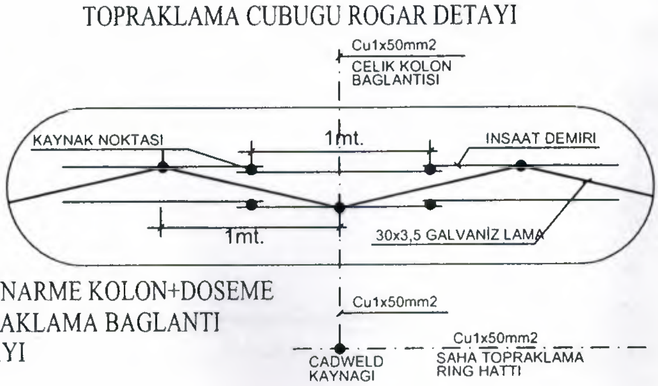


NOT: RING DONMA DERİNLİĞİNİN ALTINDA,
ANCAK EN AZ 60cm. DERİNLİKTE TESİS EDİLECEKTİR.

SAHA RING TOPRAKLAMA BIRLESIM DETAYLARI



TOPRAKLAMA CUBUGU ROGAR DETAYI



BETONARME KOLON+DOSEME
TOPRAKLAMA BAGLANTI
DETAYI

TEMEL TOPRAKLAMASI HESABI

ß = Toprak Özgül Direnci: 100 ohm/m seçildi.
L = Şerit uzunluğu
D = Şerit Çapı (Eşdeğer alan)
lç = Çubuk boyu : 1,75 m seçildi.
Ry = Yatay Topraklama Eşdeğer direnci
Rç = Dikey Topraklama eşdeğer direnci
Re = Toplam Topraklama Eşdeğer Direnci
A = Toplam Şerit alanı : 130 m2 hesaplandı.

a = 20 m temelin eni
b = 30 m temelin boyu

D = 2 X $\sqrt{Alan/\pi}$ = 2 x $\sqrt{a*b/3,14}$ = $\boxed{27,65 \text{ m}}$

Ry = ß / 2D + ß / L = 1,81 + 1 = $\boxed{2,81\ \Omega}$

Rç = ß / 10 x lç = 100 / 10 x **1,75** = Rç = $\boxed{5,714\ \Omega}$

1/Re = 1 / Ry + 1 / Rç = 1 / 2,81 + 1 / 5,714 = $\boxed{1,88\ \Omega}$

1) Tesis 300 mA koruma eşikli röle ile korunursa ;

T.T. Sisteminde UL : 50V olacağından kaçak akım rölesi toprak kaçağı olan 300 mA de çalışacağındn;

Re ≤ 50V / 300x10^{-3} A

Re ≤ 166,67 ohm

1,88 ≤ 166,67 ohm Uygundur.

2) Tesis 30 mA koruma eşikli röle ile korunursa ;

T.T. Sisteminde UL : 50V olacağından kaçak akım rölesi toprak kaçağı olan 30 mA de çalışacağ

Re ≤ 50V / 30x10^{-3} A

Re ≤ 1666,67 ohm

1,88 ≤ 1666,67 ohn Uygundur.