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The Detailed Study of Services in Different Type of Residential Buildings

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***Abstract*—In a building's entire life-cycle water and electrical energy are considered to be the two major pillar that support human activities in it. Building services are the systems installed in a building to make them comfortable, functional, efficient and safe. They can include Fire safety, HVAC (heating ventilation and air conditioning), Electrical, Plumbing, ICT (information communication technology) etc. The main focus of my study is on plumbing and electrical services. This study deals with the comparison of performance based analysis of services applied on different type of residential building and contain the various type of water demands in a building and determine the quantity of water required and the criteria necessary for the proper selection of electrical power source and distribution system. It cover electrical load calculation and their estimating factor according to the ways of people living their life. Taken under consideration and designed as per NBC (National Building Codes) codal provision.**

***Index Terms*—water demand in building, quantity of water, electrical load calculation.**

I. Introduction

Any building which are required to fulfill our primary needs for shelter, consumption of water and electrical energy is simply unavoidable. Water and electrical energy distribution for human consumption has always been cause for concern for their entire world. Looking to any building and their development the basic needs of water and electricity is very important.

The quantity of water required for a particular building is vary according to daily need of people and it also depend on their way of living. "Plumbing is a system of pipes, drain, fittings, valve and fixtures installed for the distribution of portable water for drinking, heating and washing and waste removal. Plumbing also refers to the skilled trade which installed to maintain it". It involve the assumption of many variable factor and the engineer play an important role in arriving at this quantity of water. While designing the water supply scheme for a particular building it is important to determine the total population living in a building and then the quantity of water required according to their living. During planning of water supply scheme first to determine the various type if water demand of the building and find out the suitable water source for where the demand can be met.

The electricity has become almost an indispensable part of human life. We totally depend on this energy and all gadgets and equipment's run on electricity. "The Electrical unit maintains secondary voltage power distribution system, performing such utility functions as: installation of new electrical circuits; maintenance and repair of building switchboards; repair of indoor and outdoor lighting system and repair of electrical distribution system". The main electrical power supply shall be calculated from the connected load layout of number of fixtures used in a building and by applying appropriate factors. These factors can be determine by load analysis and by combining load progressively because all load must be a common kilowatt (kW) or kilovolt-ampere (kVA) basis. Where,

1KW = 1000 Watt. With the voltage of 240V.

The electricity section of household module of the India present preliminary result. The module is used to project the number of electric appliance in use in the residential building in India. Currently lighting account for approximately 30% of total residential electricity use, followed by refrigeration, fans, electric water heater, and TVs etc.

II. Objectives

1. To study Water quantity estimation.
2. To study water requirement calculation for different type of residential building in liter per capita/day.
3. To study electrical load calculation of building.
4. Comparative analysis of services in EWS (economically weaker section) in PMAY (pradhan mantri awas yojana), Normal plot size 20' x 45' G+1 residence, and luxury high rise building.

III. Methodology and Calculation

- Water quantity estimation:

The quantity of water required for municipal use for which the water supply scheme has to be designed required following data.

Water consumption rate (per capita demand in liter per day per head).

- Population to be served.

Quantity = per capita demand x population

The problem of estimating the quantity of water may be tackled by studying in detail the following three factors:

1. Factors affecting the water demand
2. Fluctuations in demand of water

- Fire demand:

It is the quantity of water required for fighting a fire outbreak. The quantity of water required for fire should be easily available and kept stored in storage reservoir. The minimum water pressure available at fire hydrants should be 1.0 to 1.5 kg/cm^2. The quantity of water required for fire can be found by using some following empirical formula.

- Kuichling's Formula:

$$Q = 3128\sqrt{P}$$

Where Q = amount of water required in liters/minute
P = population in thousands

- National Board of fire under writers formula:

$$Q = 4637\sqrt{P}\ [1 - 0.01\sqrt{P}]$$

The formula gives high fire demand, which is not suitable for Indian condition

For residential building or township generally the following fire demand should be adopted as far as possible Table-1.

TABLE I
UNITS FOR MAGNETIC PROPERTIES

S. No.	Type of building	Water requirements
1	For town having low building	2200 liters/minute
2	For town having higher building	4500 liters/minute
3	For costly market and public places	7650-13500 liters/minute
4	For three storied colonies	Up to 27000 liters/minute

- Factors affecting per capita demands:

The annual average demand of water varies widely in Indian cities. It may be vary from 100 to 360 liters/day/person. Following are the main factors which affect the per capita demand of the city.

- Climate conditions
- Size of the city
- Living standard of the people
- Quality of water
- Industrial and commercial activities
- Cost of water
- Pressure in distribution system
- System of sanitation
- System of supply
- Metering and method of charging

- Fluctuations in demand of water:

1. Average daily per capita demand:

= Quantity required in 12 months / (365 x population)

If average demand is supplied at all the time, it will not be sufficient to meet the fluctuations.

2. Maximum daily demand = 1.8 x average daily demand

3. Maximum hourly demand of maximum day i.e. Peak demand

= 1.5 x average hourly demand
= 1.5 x maximum daily demand / 24
= 1.5 x (1.8 x average daily demand) / 24
= 2.7 x average daily demand / 24
= 2.7 x annual average hourly demand

Fig. 1. Hourly variation of the rate of consumption

Seasonal variation: the demand peak during summer. Firebreak outs are generally more in summer, increase demand. So, there is seasonal variation.

Daily variation: depends on the activity. People draw out more water on Sundays and festivals days, thus increasing demand in these days.

Hourly variation: are very important as they have a wide range. During active household working hours i.e. from six to ten in the morning and four to eight in the evening, the bulk of the daily requirement is taken. During other hours the requirement is negligible.

To meet all the fluctuation, the supply pipes, services reservoirs and distribution pipes must be properly proportioned.

The water is supplied by pumping directly and the pumps and distribution system must be designed to meet the peak demand. As the population decreases, the fluctuation rate increases.

- *Water consumption norms for residential apartment houses (flats)*

There are minimum three reference documents to be followed by a planner or engineer to arrive on a water consumption statement in India. NBC codes (national building codes), IS codes published by bureau of Indian standard, and local municipal board norms are shown in Table-2.

TABLE II
WATER DEMAND FOR RESIDENTIAL APARTMENT HOUSES (FLATS)

Reference documents	NBC norms	IS Codes norms	Local building
Water required lpcd (liter per capita/day)	135 lpcd	150 lpcd	172.5 lpcd

- *Water requirement calculation for different type of residential building in liter per capita/day*

1. For EWS (economically weaker section) in PMAY (pradhan mantri awas yojana)

Per capita demand according to their living standard = 135 lpcd.
Population per flat = 5 max. People
Quantity required per flat = per capita demand × population

= 135 liter × 5 = 675 liter water per day
Total quantity required = no. of flat × quantity required/ flat
= 832 × 675 = 5, 61,600 liter water per day
Water required at a time of fire:
Kuichling's Formula:
$Q = 3128\sqrt{P}$
Where Q = amount of water required in liters/minute
P = population in thousands
$=3128\sqrt{4160}$ = 2, 01,750 liter/minute

2. For Normal plot size 20' x 45' G+1 residence

Per capita demand according to their living standard = 155 lpcd.
Population = 7 people
Quantity = per capita demand × population
= 155 liter × 7 = 1085 liter water per day
Water required at a time of fire:-
Kuichling's Formula:
$Q = 3128\sqrt{P}$
Where Q = amount of water required in liters/minute
P = population in thousands
$=3128\sqrt{7}$ = 8,275 liter/minute

3. For luxury high rise building

Per capita demand according to their living standard =230 lpcd.
Population per flat: 20 - 2BHK = 5, 45 - 3BHK = 7, 16- 4BHK = 9 people max.
Total population = 580 people maximum.
Per capita demand according to their way of luxury living = 230 lpcd
Quantity required = per capita demand × population
= 230 liter × 580 = 1, 33,400 liter water per day
Water required at a time of fire:
Kuichling's Formula:
$Q = 3128\sqrt{P}$
Where Q = amount of water required in liters/minute
P = population in thousands
$=3128\sqrt{580}$ = 76,633 liter/minute

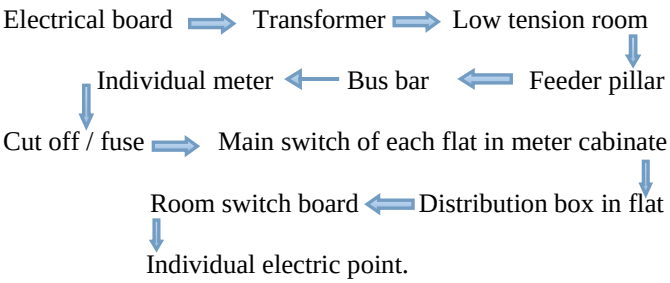
Electrical load calculation for different type of residential building

When beginning to explore the world of electricity and electronics, it is vital to start by understanding the basics of voltage, current, and resistance. These are the three basic building blocks required to manipulate and utilize electricity. At first, these concepts can be difficult to understand because we cannot "see" them. One cannot see with the naked eye the energy flowing through a wire or the voltage of a battery sitting on a table.

TABLE III
ELECTRICAL LOAD CALCULATION FOR INDIVIDUAL FLAT

S. No.	Load Description	Qty.	Load in Watt	Total Load In Watt	Diversity Factor	Final Load in Watt
1	Light Point	14	40	560	0.6	336
2	Fan Point	2	60	120	0.8	96
3	Power Point	6	50	300	0.5	150
4	TV Point	1	300	300	0.6	180
5	Bell Point	1	10	10	0.2	2
	Total			1290		764

- *Flow chart for electrical supply*



- *Electrical load calculation*

1. For EWS (economically weaker section) in PMAY (pradhan mantri awas yojana).

Total load in watt = 764 W
Total load in kilo watt = 764/ 1000 = 0.764 KW
Total no of flat in one floor = 8
Total electrical load on an individual floor
= no. of flat x load on each flat
= 8 x 0.764 = 6.112 KW
Now, total load on an individual block
No. of floor in a block = 8

TABLE IV
ELECTRICAL LOAD CALCULATION FOR G+1 RESIDENTIAL BUILDING

S. No.	Load Description	Qty.	Load in Watt	Total Load In Watt	Diversity Factor	Final Load in Watt
1	Light Point	25	40	1000	0.6	600
2	Fan Point	6	60	360	0.8	288
3	Power Point	12	50	600	0.5	300
4	Tv Point	3	300	900	0.6	540
5	Bell Point	1	10	10	0.2	2
6	Ac Point	3	350	1050	1.5	1575
7	Ceiling Point	35	40	1400	0.6	840
8	Tube Light Point	5	20	100	0.6	60
	Total			5420		4205

TABLE V
ELECTRICAL LOAD CALCULATION FOR 2 BHK FLAT

S. No.	Load Description	Qty.	Load in Watt	Total Load In Watt	Diversity Factor	Final Load in Watt
1	Light Point	15	40	600	0.6	360
2	Fan Point	4	60	240	0.8	192
3	Power Point	8	50	400	0.5	200
4	Tv Point	3	300	900	0.6	540
5	Bell Point	1	10	10	0.2	2
6	Ac Point	2	350	700	1.5	1050
7	Ceiling Point	14	40	560	0.6	336
8	Tube Light Point	4	20	80	0.6	48
	Total			3490		2728

TABLE VI
ELECTRICAL LOAD CALCULATION FOR 3 BHK FLAT

S. No.	Load Description	Qty.	Load in Watt	Total Load In Watt	Diversity Factor	Final Load in Watt
1	Light Point	20	40	800	0.6	480
2	Fan Point	6	60	360	0.8	288
3	Power Point	10	50	500	0.5	250
4	Tv Point	4	300	1200	0.6	720
5	Bell Point	1	10	10	0.2	2
6	Ac Point	3	350	1050	1.5	1575
7	Ceiling Point	22	40	880	0.6	528
8	Tube Light Point	8	20	160	0.6	96
	Total			4960		3939

TABLE VII
ELECTRICAL LOAD CALCULATION FOR 4 BHK FLAT

S. No.	Load Description	Qty.	Load in Watt	Total Load In Watt	Diversity Factor	Final Load in Watt
1	Light Point	25	40	1000	0.6	600
2	Fan Point	8	60	480	0.8	384
3	Power Point	15	50	750	0.5	375
4	Tv Point	5	300	1500	0.6	900
5	Bell Point	1	10	10	0.2	2
6	Ac Point	5	350	1750	1.5	2625
7	Ceiling Point	30	40	1200	0.6	720
8	Tube Light Point	12	20	240	0.6	144
	Total			6930		5750

Total load on an individual block
= no. of floor x load on each floor
= 8 x 6.112 = 48.896 KW no

2. For Normal plot size 20' x 45' G+1 residence

Total load in watt = 4205 W
Total load in kilo watt = 4205/ 1000 = 4.205 KW

3. For luxury high rise building

Total load in watt = 2728 W
Total load in kilo watt = 2728/ 1000 = 2.728 KW
Total no of flat in one floor = 2
Total electrical load on an individual floor
= no. of flat x load on each flat
= 2 x 2.728 = 5.456 KW
Now, total load on an individual block
No. of floor in a block = 10
Total load on an individual block
= no. of floor x load on each floor
= 10 x 5.456 = 54.56 KW

Total load in watt = 3939 W
Total load in kilo watt = 3939/ 1000 = 3.939 KW
Total no of flat in one floor = 3
Total electrical load on an individual floor
= no. of flat x load on each flat

= 3 x 3.939 = 11.817 KW

Now, total load on an individual block

No. of floor in a block = 15

Total load on an individual block

= no. Of floor x load on each floor

= 15 x 11.817 = 177.255 KW

Total load in watt = 5750 W

Total load in kilo watt = 5750/ 1000 = 5.750 KW

Total no of flat in one floor = 1

Total electrical load on an individual floor

= no. Of flat x load on each flat

= 1 x 5.750 = 5.750 KW

Now, total load on an individual block

No. of floor in a block = 16

Total load on an individual block

= no. of floor x load on each floor

= 16 x 5.750 = 92 KW

Total electrical load used in luxury high rise apartment = sum of total electrical load used in 2, 3, 4 BHK apartments = 54.56 + 177.255 + 92 = 323.815 KW.

IV. Analysis and Comparison Results

- Analysis and comparison results for water consumption according to calculation of water requirement the quantity of required water depend on the living standard of people and climatic conditions. According to result of this research it's all depend on the social status of people and also depend on the per capita demand.

Quantity of water required in different type of building

1. For EWS (economically weaker section) in PMAY (pradhan mantri awas yojana) = 5, 61,600 liter water per day water required for the population of 4,160 people.
2. For Normal plot size 20' x 45' G+1 residence = 1085 liter water per day water required for 7 people.
3. For luxury high rise building = 1, 33,400 liter water per day water required for the population of 580 people.

- Analysis and comparison results for electrical load according to calculation of electrical load in kilo watt the amount of electrical energy required is depend on the electrical fixtures used in a flat and their load.

Amount of electrical energy used in a different type of residential building.

1. For EWS (economically weaker section) in PMAY (pradhan mantri awas yojana) = 48.896 KW for 64 flats.
2. For Normal plot size 20' x 45' G+1 residence = 4.205 KW
3. For luxury high rise building = 323.815 KW for 81 flats.

V. Conclusion

Based on above study we can say that during designing any water supply scheme it is necessary to determine the total quantity of water required for any building. It is carefully examine the various types of water demand of the according to living standard of people and various factors which influence the rate of demand of water. And in this report we have also provided an overview of residential electricity consumption and their calculation in India by analyzing data from the calculation of their electrical load of different residential building. And we conclude that water consumption and electricity consumption depend on the living standard of people and also on climatic conditions. A conclusion section is not required. Although a conclusion may review the main points of the paper, do not replicate the abstract as the conclusion. A conclusion might elaborate on the importance of the work or suggest applications and extensions.

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