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# Expatiated Description of the Expound analysis of the campus of IET-DAVV Indore

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## Abstract

*In this paper, we have put forward a realistic approach to depress the surcharge of resources circulating within the campus of Institute of Engineering and Technology, Devi Ahilya University (IET-DAVV), Indore, Madhya Pradesh. Looking into the functionality, tenure of its operation and mode of manipulation, usage can be maximized within limited energy and resources. Methods elucidating the solar energy usage, water and waste management are also discussed in this paper.*

**Keywords:** Solar energy, water resources, methods of augmentation.

## Introduction

Engineering dealing with environment helps in examining the remedial measures to conserve and sustain the resources that are being utilised at an exorbitantly higher pace. Engineering aspects concerning hydrology, resource management, energy management are applied to evaluate a effective, efficient and sustainable system. We have suggested an alternative for non renewable resources and fossil fuels for electricity in the form of solar energy. In this document we have analysed the type of energy, quality and quantity of resources.

## Study

The only source of water in IET DAVV is ground water which is also being exploited due to excessive increase in strength of students and building construction within the campus. Circulation of water is carried out by pumps through these overhead or underground water tanks which consumes lot of electricity and puts burden on IET to pay the huge bills of electricity. There is also irregular electricity supply which affects the water circulation within the campus. There is a growing demand of its replacement or a parallel source which can be continuous and at the same time economical too. Thus, this increase in demand has lead to an imbalance between supply and demand of water and electricity too. The water table is going down rapidly due to excessive exploitation which is directly affecting the electricity bills of the institution.

Following data shows the consumption of Energy in the year 2012.

**Campus Dimensions**: i. IET-DAVV campus is enclosed within 43 acres of black cotton soil. ii. Its geo-coordinates are 22 40' 52" N and 75° 52' 51"E. iii. It has 4 educational, 1 administrative, 1 central library, 2 workshops, 2 hostels. iv. I.E.T receives the annual rainfall around 939mm. It has 8 bore holes and 1 pond to maintain and recharge the ground water table. v. Total water demand of IET-DAVV campus is = $55\times10^3$ litres per day.

**Table-1**
**Shows the consumption of electricity in IET-DAVV in last few months**

| Month | Energy consumption |
|---|---|
| April | 152 KVA |
| May | 209 KVA |
| June | 191 KVA |
| July | 191 KVA |
| August | 100 KVA |
| September | 115 KVA |
| October | 102 KVA |
| November | 90 KVA |

Thus total consumption of electricity in IET from above data = 1150 KVA.

**Table-2**
**Shows water storage tank capacity in IET-DAVV**

| Components | Ratio of cost to total cost | Amount |
|---|---|---|
| Solar panel | 0.55 | 2580600 |
| Inverters | 0.08 | 375360 |
| Batteries | 0.22 | 1032240 |
| Control unit | 0.01 | 46920 |
| installation | 0.14 | 656880 |

## Analysis and support

**Solar energy calculation:** The average consumption of electricity in IET-DAVV from above data = 46975.875 kWh

(144 kVA) which is greater than contract demand 100 kVA per month.
Consumption of electricity per year in IET-DAVV.
=46975.875 × 12
=563710.5 kWh

Amount of bill generated per year in IET (@ Rs.7/ kWh) = 563710.5 × 7 = Rs. 3,945,973/-

Average solar energy received per month = 5.16 kWh /$m^2$/day.

Now, built-up area of IET-DAVV = 26259.82 $m^2$.

After examining the college campus it is found that the solar panels can only be installed at the terraces of all the blocks.

**Table-3**
**Shows the ratio of cost of components to total cost for fitting solar panels on the terrace of various buildings**

| Blocks | Present consumption (after 2009) | Past consumption (before2009) |
|---|---|---|
| M block | 7.5×1000 lit | 2.5×1000 lit |
| A block | 5×1000 lit | 5×1000 lit |
| B block | 3×1000 lit | 2×1000 lit |
| D block | 3×1000 lit | 2×1000 lit |
| E block | 3×1000 lit | nil |
| Hostel boys | 30×1000 lit | 30×1000 lit |
| Library | 2×500 lit | 2×500 lit |
| Workshop | 2×500 lit | 2×500 lit |
| Mess | 1500 lit | 1500 lit |
| Total | 55000 litres per day | 45000 litres per day |

Also there are open spaces provided in all the blocks for ventilation. Moreover, average peak sun hours in a day = 3.63 in Indore, MP, India.

After determining the total terrace area which was coming out to be 20% of built-up area for the installation of solar panels, the anticipated solar energy received per year at IET-DAVV is calculated as
= 5.16 × (0.20×26259.82) × 365 × 3.63/24
= 1.496x$10^6$ kWh

But maximum efficiency of the solar panel = 15%
Therefore solar power[1] that can be generated in IET-DAVV campus = 2.244 x $10^5$ kWh
Now, cost of solar power per kWh in India = Rs. 11.5/-

Cost of installation of solar panels in IET-DAVV = Rs. 2580600/-

Thus total installation cost of solar electric system[2] in IET-DAVV = Rs.4, 700,000/-

Total amount of energy that could be saved every year = Rs. 1,570,800/-

Thus total installation amount can be recovered in just = 4700000/1570800 = 2.99 or 3 years

The solar panels can work with an efficiency of 90% for 10 years and about 80% for next 15 years. The recommended life of solar panel is 20 to 30 years.

**Water resources:** A part of the infiltrated rainwater[3] moves parallel to the land surface as subsurface flow, and reappears on the surface at certain other points. Such flows are called interflows. Another part of the infiltrated water percolates downwards to ground water and moves laterally to emerge in depression and rivers and joins the surface flow. This type of flow is called the subsurface flow or ground water flow.

**Estimation of Surface Runoff:** Runoff can be estimated by various methods[4]. These can be classified under the following headings:

**Empirical formulae and tables:** Binnie's formula[5] for the calculation of runoff

| Rainfall (mm) | % of runoff |
|---|---|
| 900 | 34 |
| 1000 | 38 |

**Table-4**
**Shows Binnie's Percentages for Computation of Runoff**

| Annual rainfall in (mm) | Runoff % |
|---|---|
| 1. 500 | 15 |
| 2. 600 | 21 |
| 3. 700 | 25 |
| 4. 800 | 29 |
| 5. 900 | 34 |
| 6. 1000 | 38 |
| 7. 1100 | 40 |

By using interpolation 939 mm of rainfall gives 35.5%runoff =33.33 cm/year

The percentages are based on observations on two rivers in Madhya Pradesh.

**Runoff Estimation based on Land Use and Treatment: Coefficients:** The run off 'R' in cm and rainfall 'P' in cm can be correlated as R = KP, where 'K' is the runoff coefficient. The runoff coefficient depends on factors affecting runoff. This method is applicable only for small projects

Usual Values of Runoff Coefficients (K)

| **Type of Area** | **K** |
|---|---|
| Urban Residential | 0.3 - 0.5 |
| Forests | 0.05 - 0.2 |

| | |
|---|---|
| Commercial and Industrial | 0.9 |
| Parks, farms, Pastures | 0.05 - 0.3 |
| Asphalt or concrete pavement | 0.85 |

By considering the value of k=0.4,

Runoff is calculated as; = 0.493.9, =37.36cm /year

**Empirical formulae for flood peak:** De Souza's formulae: Based on studies carried out for catchments
For plains region R= (P-17.8) P/254

Where 'R' and 'P' are runoff and precipitation respectively, both expressed in cm

On substituting the values we have
={(93.9-17.8)×93.9}/254}
=28.135 cm/year.

**Waste Management in IET: A process overview:** Sources of water, Bifurcation of waste, Present situation, Future proposals

**Sources of Waste:** Waste from staff /faculty Housing, Waste from mess, Waste from hostels, Waste from blocks, Waste from workshop

**Bifurcation of Waste:** Sewer water, Toilet waste, Solid waste (Polythene, scrub), Paper waste, Garbage from hostel mess, kitchens, Metal, oil waste from workshop.

**Present Situation:** Majority of waste is generated from hostel area which include sewage from hostels, garbage, refuse from mess and canteen. Girls hostel is built with maximum capacity of around 200. The hostel is full to its capacity with 215 girls residing at present. Boys hostel was built in year 1999 with maximum capacity of 250 students but it is overcrowded with 300 students. Waste management monitoring[6] has been outsourced to A to Z Infrastructure pvt ltd. IET has its own open sewage line which finally ends into drainage of *school of pharmacy* on western Ring Road.

In IET, asbestos cement pipes are used as drain pipes. It has only one septic tank with the capacity of around 20,000 litres whereas the water consumption in boys hostel only is 35,000 litres a day.

According to reports of Ministry of Urban Development[7], New Delhi, the per capita waste generation[8,9] varies between 0.2 to 0.6 kg per day, and cities like Indore has calculated amount of waste generation of about 0.3 kgs/day/person.

**At Present:**

| | |
|---|---|
| Total strength of hostels | = 160+140+215= 515 |
| Workers and other staff of hostel | =15 |
| Total | = 530 |
| Waste generation | = (530×3=159kgs/day) |
| Waste generation from mess | = 15 kgs /day |
| So Total Waste generation | = 174kgs/day |
| Round about | = 200kgs/day |

Therefore the facilities within this campus are far behind the requirements of this campus. Hence the proposed plans[10] can be calculated as

**Future Proposal and Proposed Design (As Per I S 1172-1993 And 4111-1986): Using Mannig's formula for appropriate combined sewer line design[10].**
Total run off IET = $157.051\times10^3$ lit/day = $0.00181 m^3$/sec
Total sewer discharge from all sources is calculated and found to be =
Population × per capita consumption/24×60×60 =530×225/24×60×60 =1.380lit/sec=$0.0013 m^3$/sec

**$V=1/N \times m^{2/3}\times\sqrt{i}$**
N = Coefficient of Roughness = .011
m=hydraulic mean depth $(\pi d^2/4)/(\pi d/2)$
i = Slope of Pipe =1 in 550m

**$V=0.0268d^{2/3}$**
**Q=A×V**
Q = Discharge = $m^3$/sec $(0.00181+0.0013) m^3$/sec, $0.00311=(\pi d^2/4)\times0.0268d^{2/3}$
# Diameter of pipe comes out to be =$d \geq 0.205$m

## Conclusion

We propose the strategy to save money and energy around the IET campus. This report will help authorities to understand the importance of "Money and Energy saved today, will bring the better tomorrow"

**Solar energy:** We can save $2.44\times10^5$ kWh power every year i e an amount of Rs 1570800 and by this saving we can attain the break point in 3yrs. After 3 years from installation this amount will be saved continuously up to its life cycle.

**Water resources:** From table-2 data total water demand of IET-DAVV campus is $=55\times10^3$ litres per day

As run-off of IET-DAVV campus comes out to be 32.94 cm/year

$=157.051\times10^3$ litres/day

This amount of runoff water[11,12] is distributed and collected primarily in two low lying areas i.e. one behind the M block and second in front of A block. Since this amount is almost thrice to the demand, a pond behind M block is constructed for the same purpose while a similar pond can be created in front of A block. Thus, this pond can put a check on the surface runoff for which the suitable site should be in front of the A block with sloppy low level area having good natural catchment area.

Economic viability is a critical parameter to be ascertained before taking a decision to implement any artificial recharge scheme. The appraisal of economic viability has to be carried out after taking into account all possible expenses including those for investigation, source water (conveyance, treatment), construction of recharge structures, operation and maintenance etc. All benefits should be appropriately accounted for and assessed in order to decide the acceptability of the scheme as per its priority in the overall scheme of development.

**Waste management:** A new storm sewer line which collects excess Run off water from the campus (other than water which is being used for rain water harvesting or pond) is to be laid from back of the hostel area via play ground and school of pharmacy. i. The pipes should be of concrete (ferrocement) and diameter should not be less than 200mm. For joining two pipes a collar joint (with cement mortar 1:1) should be made with an epoxy paint at finishing. ii. Chambers of minimum $1m^3$ should be made at every 15m interval for carrying out maintenance work which should be covered with Galvanized Iron cover. iii. Over burdened garbage bin must be replaced by a new capacity of mobile Bin with capacity of 100kg each .and around 2 more are required in campus. iv. Construction of new septic tank of capacity 30,000lit for new and old boys hostels are required for better waste management. v. Initiating regular pre–monsoon repair works in hostel building with detecting and treating the water leakage points is mandatory.

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