“Assessment and Analysis of Maximum Precipitation at Bharkawada Village, Palanpur for Storm Drainage Practices”

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Abstract: - Efficient Storm water network is the main tool to prevent the water gathering and scattering of a city. Selecting the Bharkawada as study area and its problem was identified to be of very less effective drainage system. In this study methods have been adopted to identify the possibilities of completing the research for designing the storm water drainage design. Our main aim is to design a very efficient and rapid drainage system which should drain the water very fastly with less concentration time and less spreading of water with less provision of slope. The present design is based on rainfall data. Past 30 years rainfall data has been taken for study. The system has been designed considering in total of 65% of the impervious area. Estimated rainfall intensity has been calculated as 33.02527 mm/hour with a recurrence interval of 2 years from the detailed analysis of rainfall data of 34 years. Rainfall Intensity is estimated after frequency analysis of the rainfall data. The calculated runoff is 25.056 m³/s, which can be used as a design discharge for network designing. Different methods can be used for runoff estimation. Here, Rational method seems to be best for use in estimation of storm water runoff. The outfalls of system are directed to proposed lakes. Ere at this stage rainfall calculations have been done and in future work complete rainfall and runoff analysis will be carried out for storm water network.

Key Words: Precipitation, Storm Network, Runoff, Drainage System.

I. INTRODUCTION

The design of the storm water drainage system is based on the estimation of quantity of runoff. Various methods are available for estimation of quantity of runoff.

1. Rational Method
2. Rainfall-Runoff Correlation Studies
3. Empirical Formula Method
4. Hydrograph Method
5. In our work Rational Method is used it is also suggested in CPHEEO Manual published by central government.

The design of storm sewers involves a decision as to the degree of protection to be provided against property damage, nuisance and inconvenience from surcharged sewers. It is not economically feasible to construct sewers of sufficient size to take the runoff from the extreme storms likely to occur at infrequent intervals i.e. storm sewers are not designed for the peak flow of rare occurrence. Thus, the quantity of storm water for which sewer capacity should be provided is a balance among the first cost and capitalized damage to private property, the hazard to health, and the curtailed convenience to the public. These factors, therefore, should be given consideration as well as technical hydraulic factors.

Storm work:

Need of project: The effective rainfall occurring in any region or area mainly causes devastating and ill effects of road blockage, trade and business stoppage, many other harms due to spreading of water. This may occurs due to

(a) Inadequate storm drainage networking,
(b) low lying accumulation of water,
(c) Improper topography of the region. The similar problem has been observed in the study area and solutions and proper management of storm during heavy precipitation and procurement of the region will done after proper designing of storm network.

Hydrological and geological parameters mostly influence the storm water in the area. The proper study of the precipitation, development of Intensity, Duration and Frequency curves and topography of the region is required due to which the problems of heavy runoff during rainfall occurs.

Catching and keeping stormwater as near the source as could be expected under the circumstances. Diminishing the volume of stormwater to minimize disintegration. Lessen crest stream rates to decrease flooding. Separating stormwater to evacuate toxins before the overflow enters groundwater, streams, or wetlands.

Utilizing and advancing strategies that give different natural advantages. Utilizing financially savvy systems as a part of request to diminish lifecycle costs and ecological expenses. Stormwater should be overseen as it can affect our urban/rural conduits. For new advancements, it's fundamental the right controls are set up to oversee stormwater, prevention of flooding and enhance water quality. This adjustment in the water adjust and timing of streams, incorporating sudden
surges in water volume and speed, sway on our conduits and
narrow. A portion of the impacts might be to:

change the structure, assortment and reasonableness of natural
surroundings for amphibian life, for example, fish and large
scale spineless creatures bother creatures and plants living in
the conduit, and influence creature rearing propensities
disintegrate stream banks, change regular flooding
administrations, expand turbidity and contamination,
influencing water quality expand volumes of litter and oils.

In general these progressions can diminish our capacity to
utilize conduits and fundamentally undermine creatures in
conduits, for example, platypus and winged creatures in
addition to marine life, for example, dolphins and fish.

Stormwater Management

At the point when new improvements are arranged,
framework and advancement controls are expected to oversee
stormwater and counteract flooding of properties.

Treating, utilizing and holding stormwater as a part of the
catchment can lessen the measure of stormwater achieving
conduits and decrease the recurrence and seriousness of
flooding.

Objective: This paper proposes to find rainfall intensity with
return period of 30 year for Bharkavada, palanpur city. Also
the maximum rainfall and storm drainage capacity at the town
is also assessed.

II. LITERATURE REVIEW

The effective rainfall occurring in any region or area mainly
causes devastating and ill effects of road blockage, trade and
business stoppage, many other harms due to spreading of
water. This may occurs due to (a) inadequate storm drainage
networking, (b) low lying accumulation of water, (c) improper
topography of the region. The similar problem has been
observed in the study area and solutions and proper
management of storm during heavy precipitation and
procurement of the region will done after proper designing of
storm network.

Neeraj D.Sharma, Dr. J.N.Patel, 2010: studied storm drainage
network analysis of Surat city. The development of urban
regions in developing country needs the multifaceted study of
qualitative and quantitative stresses on available natural
resources there within.

Priyanka D. Harpalani studied Rainfall data available from
1969 to 1983 are with duration of 5,10,15,30,45,60,75,90
minute. Ria Roy, Md Kutubuddin Dhali,2016 studied Seasonal Water logging Problem In A Mega City: Water
logging is become a severe problem in Kolkata metropolitan
region with the increase of the high-rise buildings, which
made the land congested and disrupted also.

A Review of Sustainable Urban Drainage Systems
Considering the Climate Change and Urbanization Impacts
2014: Climate change and urbanization are converging to
challenge city drainage infrastructure due to their adverse
impacts on precipitation extremes and the environment of
urban areas. Sustainable drainage systems have gained
growing public interest in recent years, as a result of its
positive effects on water quality and quantity issues and
additional recreational amenities perceived in the urban
landscape. Michael Okpara studied Drainage System:
The Drainage system cleaner is a machine which helps to
protect the environment from different kinds of environmental
hazards through the promotion waste management by the
removal of garbage from the drainage system.

Harshil H. Gajjar, Dr. M.B.Dholakia studied Storm Water
Network Design of Jodhpur Tekra Area of City of Ahmedabad: This paper has presented novel design of storm
water drainage system for Jodhpur Tekra Area of city of Ahmedabad.

III. STUDY AREA-BHARAKAWADA-GUJARAT AND
DATA COLLECTION
### Table 1: Details of Study Area

<table>
<thead>
<tr>
<th>Sr.no</th>
<th>Items</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>No. of people (Population)</td>
<td>2288</td>
</tr>
<tr>
<td>2</td>
<td>Area of Agriculture</td>
<td>215</td>
</tr>
<tr>
<td>3</td>
<td>Area of Roads</td>
<td>7</td>
</tr>
<tr>
<td>4</td>
<td>Area of Houses</td>
<td>584</td>
</tr>
<tr>
<td>5</td>
<td>Area of field playground(field)</td>
<td>1</td>
</tr>
<tr>
<td>6</td>
<td>Population of Farming or Farming based family</td>
<td>215</td>
</tr>
<tr>
<td>7</td>
<td>Migrants</td>
<td>10%</td>
</tr>
</tbody>
</table>

**Data Collection - Rainfall Graph:**

### Table 2: Rain Fall Data Collection

<table>
<thead>
<tr>
<th>Sr no</th>
<th>Year</th>
<th>Maximum Hourly Rainfall in mm</th>
<th>Annual Rainfall in mm</th>
<th>1 Hr. Max. Rainfall Pt = P24 (t/24)1/3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1981</td>
<td>88.0</td>
<td>456.0</td>
<td>30.50</td>
</tr>
<tr>
<td>2</td>
<td>1982</td>
<td>88.0</td>
<td>408.0</td>
<td>30.50</td>
</tr>
<tr>
<td>3</td>
<td>1983</td>
<td>237</td>
<td>885</td>
<td>82.14</td>
</tr>
<tr>
<td>4</td>
<td>1984</td>
<td>236</td>
<td>702</td>
<td>81.79</td>
</tr>
<tr>
<td>5</td>
<td>2015</td>
<td>319</td>
<td>980</td>
<td>110.56</td>
</tr>
<tr>
<td>Min.</td>
<td></td>
<td>60.0</td>
<td></td>
<td>50.29</td>
</tr>
<tr>
<td>Max.</td>
<td></td>
<td>446.0</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **C=runoff coefficient**
- **i=rainfall intensity**
- **A=watershed area**

- The assumptions associated with the rational method are:
  1. The computed peak rate of runoff at the outlet point is a function of the average rainfall rate during the time of concentration, i.e., the peak discharge does not result from a more intense storm of a shorter duration, during which only a portion of the watershed is contributing to runoff at the outlet.
  2. The time of concentration employed is the time for runoff to become established and flow from the most remote part of the drainage area to the inflow point of the sewer being designed.
  3. Rainfall intensity is constant throughout the storm duration.

The idea behind the rational method is that if a rainfall of intensity ‘i’ begins instantaneously and continues indefinitely, the rate of runoff will increase until the time of concentration ‘t_c’, when the entire watershed is contributing to flow at the outlet. The product of rainfall intensity ‘i’ and watershed area ‘A’ is the inflow rate of the system, iA, and the ratio of this rate to the rate of peak discharge Q (which occurs at time t_c) is termed the runoff coefficient C. The following figure.

#### IV. METHODOLOGY & DATA ANALYSIS

**Methodology:**

*Generating peak runoff curves by Rational and other methods:*

Like that Rational method, soil conservation service runoff method, modified rational method. **Rational method:** Rational method was first used in 1889 developed by Emil Kuichling. The rational method is the oldest method still probably the most widely used method for design of storm drains.

**Formula by rational method:**

\[ Q = 0.0028 \cdot C \cdot i \cdot A \]

where, \( Q \) = rate of peak discharge

**Figure 2: Hydrograph for Rational Method**

### Table 2: Calculation of Maximum Hourly Rainfall with Graph
V. RESULT & CONCLUSIONS

The effective rainfall occurring in any region or area mainly causes devastating and ill effects of road blockage, trade and business stoppage, many other harms due to spreading of water. This may occur due to (a) inadequate storm drainage networking, (b) low lying accumulation of water, (c) improper topography of the region. The similar problem has been observed in the study area and solutions and proper management of storm during heavy precipitation and procurement of the region will be done after proper designing of storm network.

Analysis of rainfall and runoff calculation has been done to estimate the network efficiency of drainage network using rational method. Determination of maximum rainfall Intensity is required to design efficient storm drainage network. In the absence of short duration rainfall and with daily data, Empirical formula can be easily used to compute the short duration rainfall from daily rainfall data to aid in the design of storm water drainage network. Estimated rainfall intensity has been calculated as 33.02527 mm/hour with a recurrence interval of 2 years from the detailed analysis of rainfall data of 34 years. Rainfall Intensity is estimated after frequency analysis of the rainfall data. The calculated runoff is 25.056 m³/s, which can be used as a design discharge for network designing.
Table 4: Sample Calculations for Designing the Sample (Needhidasan.S et.al, IJET)

<table>
<thead>
<tr>
<th>Drain</th>
<th>L</th>
<th>A</th>
<th>C</th>
<th>C*A</th>
<th>Q</th>
<th>TRAPEZOIDAL SECTION</th>
<th>RECTANGULAR SECTION</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(m)</td>
<td>(ha)</td>
<td></td>
<td></td>
<td></td>
<td>(m) * 10^-3</td>
<td>(m)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>d</td>
<td>S</td>
</tr>
<tr>
<td>L</td>
<td>60</td>
<td>8950</td>
<td>0.9</td>
<td>8055</td>
<td>0.1014</td>
<td>1 in 0.3</td>
<td>0.3</td>
</tr>
<tr>
<td>E</td>
<td>1-2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1 in 0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>F</td>
<td>90</td>
<td>1600</td>
<td>0.7</td>
<td>640</td>
<td>0.24</td>
<td>1 in 0.3</td>
<td>0.5</td>
</tr>
<tr>
<td>T</td>
<td>2-3</td>
<td>14000</td>
<td>0.9</td>
<td>10480</td>
<td></td>
<td></td>
<td>3-4</td>
</tr>
<tr>
<td></td>
<td>180</td>
<td>18000</td>
<td>0.9</td>
<td>16200</td>
<td>0.47</td>
<td>1 in 0.2</td>
<td>0.5</td>
</tr>
<tr>
<td>R</td>
<td>90</td>
<td>7350</td>
<td>0.9</td>
<td>6615</td>
<td>0.09</td>
<td>1 in 0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>I</td>
<td>2-3</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td>6-7</td>
</tr>
<tr>
<td>G</td>
<td>180</td>
<td>7200</td>
<td>0.9</td>
<td>6480</td>
<td>0.23</td>
<td>1 in 0.3</td>
<td>0.4</td>
</tr>
<tr>
<td>H</td>
<td>3-4</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>4-5</td>
</tr>
<tr>
<td>T</td>
<td>180</td>
<td>7200</td>
<td>0.9</td>
<td>6480</td>
<td>0.32</td>
<td>1 in 0.3</td>
<td>-0.4</td>
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</table>

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REFERENCES