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ICT application to design of drop spillway with GUI

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Abstract

The use of technology, ICT tools etc. area unit growing because the world goes ahead. Thus it's become very necessary to stay everything in-tuned with computers. With advancement in science & technology, the new operating development has been arisen. In our country, largely within the town area unites varied on-line systems are getting used for varied functions i.e. everything is computerized to save lots of area unit time & efforts. It additionally saves our work. Most of the organizations like Hospitals, Railways, Airways, Companies, Colleges, etc. have developed & rapt forward because of this mechanization. Still In most laptop establishments they're not victimization the digital tool for reposting of knowledge. Hence, all the work associated with it's done manually i.e. through work or documentation. In the Agriculture field it is important to research in it and make easy and very fast calculations and for agricultural formulae etc. Information communication technology is highly increasable field to research in. due to use of ICT in agriculture, the farms are being developed and digitalization is takes placed. The paper deals with how we can make digitalize and make agricultural formulas easily with the help of ICT tool.

Keywords: technology, ICT, agricultural, digitalization, computerized

1. Introduction

At the end of 1980s, the term 'computers' was replaced by 'IT' (information technology) representing a change of focus from computing technology to the capacity to store and also retrieve the more information (Pelgrum and Law, 2003) ^[1]. Which was followed by the introduction of the term 'ICT' (information and communication technology) around 1992, when e-mail started to become available to the general public (Pelgrum and Law, 2003) ^[2]. United Nations reported that (1999) ICTs cover Internet service provision, telecommunications equipment and services, information technology equipment and services, media and broadcasting, libraries, documentation network-based information services, and other related information and activities. The field of education also has been affected by ICTs, with teaching, learning, and research (Yusuf, 2005). The Agriculture and the education departments are two elements where the ICT can play the very important role in the development of the country (V. D. Jadhav, 2019) ^[5].

There are a number of methods and empirical formulae includes in design of drop spillway structure. Drop spillway is one of the most commonly used gully control structures. It is mainly used at the gully bed to create a control point. Straight drop spillway is a weir structure, in which flow passes through the weir opening, fall or drops on an approximately level apron or stilling basin and then passes into the downstream channel. Its use is limited to a maximum drop of 3 m. The main three purposes of drop spillways are to provide a transition between a broad or flat waterways and gully section, to raise the flow line to allow formation of sufficient soil depth for vegetative growth where bottom of the gully is at risk and to rise the flow line of the waterway so as to provide drainage in case of wet waterways.

The main three purposes of drop spillways are to provide a transition between a broad or flat waterways and ditch or gully section, to raise the flow line to allow formation of sufficient soil depth for vegetative growth where bottom of the gully is at risk and to rise the flow line of the waterway so as to provide drainage in case of wet waterways. The use of information communication technology is now growing in the various industries. So, it is necessary to increase the use of ICT in the agriculture field. Agriculture field will grow due to use of Information Technology. India is the country of the famers and represents India for the agriculture. It is necessary to research in agriculture field and develop the agricultural at the rural areas too.

2. Existing System

The Existing system is completely manual. The drop spillway calculation contains different formulas calculate the various values of drop spillways. These formulas are very complex to calculate with the use of calculators. It is purely paper based to store the records of the onetime calculated values of those formulas. The calculations are done with calculator by entering the each value of formula manually in the calculator.

2.1 Limitations in Present System

There are certain limitations in system, which areas follow:-

- There are various steps or formulae involved in drop spillway structure, so it is difficult to handle manually.
- Manually calculations are difficult to estimating various parameters in this design with different dimensions and also more time required.
- For recording purpose it should be note down in some paper, thus chances of losing the data is increases.
- It is difficult to search the old record of data.
- Manually calculations include more errors with less accuracy.
- To require the man power for calculation on the field and make it secure.

3. Proposed system

The proposed system is deals with the functionality of calculations of drop spillways. To remove the complexities, errors and difficulties the proposed system is developed. These difficulties can takes place at the time of managing the jobs at institution. Today the digitalization is directly comes with computerization, so the students, researchers are coming under the one roof to learn about digitalization and computerization. Calculate the drop spillways formulas manually on the paper are very complex method to find the accurate value of the specific component. Since these works does manually thus it takes more time and there are chances of errors such as wrong details, wrong value at wrong place etc.

So to reduce these faults “ICT Application to measure drop spillways” has been developed. The proposed system “ICT Application to measure drop spillways” deals with all the activities which are done by the agriculturist for measure the drop spillways. This paper is all about how can information communication technology reduce the manual work load and give the accurate results of the proper formulas. The data will store sequentially in the database and we can access it whenever we need it.

3.1 Advantages of Proposed System:-

- Calculations are done very fast and it saves the time.
- It stores the old data, so data recovery is possible easily.
- No need to data note down on the paper because it stores digitally in computer.
- Modified the data as per requirement.
- System includes the various security features.
- System should be window based, user-friendly and efficient.
- Appropriate master tables must be present to record relevant data.
- Accuracy can be maintained

4. Material

This paper deals with the design of drop spillway. It includes different design formulae and those were used while

developing the software. It also encapsulates the configuration of the system and information about the used to develop software. The different components of drop structures are shown Fig. 1.1.

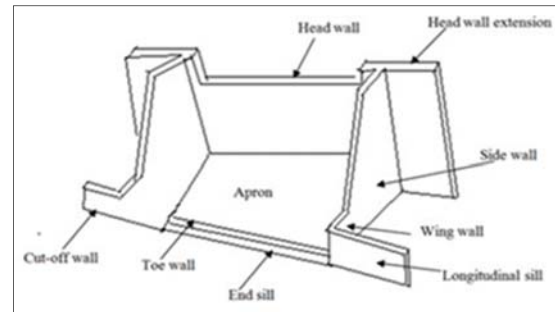


Fig 1.1: Components of Drop Spillway

5. System Requirements

5.1 Hardware Requirements

Content	Description
HDD	10 GB Min, 40 GB Recommended
RAM	512 GB Min, 1 GB Recommended

5.2 Software Requirements

Content	Description
OS	Windows XP or Higher Operating System
Database	MS-Access 2007
Technologies	ASP.NET with C#.NET
IDE	Ms-Visual Studio.Net 2017

6. About the Platform

6.1 Development Platform

The system is developed in the high level computer language that is, C# with the.net framework. To develop and edit the software we have used the Microsoft visual studio 2017 version.

6.2 Platforms to run on

To run or use this software your system must have to fulfill the above software as well as hardware specifications respectively.

7. The design of drop spillway structure contains following formulae

7.1 Inlet Design

This type of inlet is most suitable for wide and shallow gullies to handle small to medium flows. To calculate the inflow capacity of straight drop spillway, the following weir formula may be used:

$$Q = \frac{2}{3} C_d \sqrt{2g} L H^{\frac{3}{2}}$$

Where,

Q = Peak discharge rate (m³/s) which is to be handled by the structure;

L = Length of crest (m);

H = Head over the crest (m);

V = mean velocity of approach (m/s),

Cd = coefficient of discharge. The value of C commonly used

is 0.6.

g = acceleration due to gravity (9.81 m/s²).

7.2 Outlet Design

Outlet design is made with the considerations that the kinetic energy gained by the sheet of flowing water while falling from the crest of gully head to the downstream side of the structure must be dissipated and/or converted into potential energy. Froud Number, it may be calculated by the following formula:

$$F = \frac{v}{\sqrt{gd}}$$

Where,

F = Froud number (dimensionless);

v = velocity of flowing water entering into the apron to create the jump (m/s);

d = depth of flow at entrance (m).

7.3 Hydrologic Design

It involves the estimation of design runoff rate and flood volume which the structures have to handle safely. Runoff rate is calculated by the rational method.

$$Q_{peak} = \frac{CIA}{360}$$

Where,

Q_{peak} = peak runoff rate, m³/s

C = runoff coefficient

I = rainfall intensity (cm/h) for the duration equal to time of concentration of watershed and for a given recurrence interval

A = watershed area, ha.

7.4 Hydraulic Design

The design consists of determining the length of crest (L), and depth (h) of the weir to provide required capacity and to maintain an adequate freeboard under free flow condition.

7.5 Computation of Length and Depth of Weir

To calculate the inflow capacity of straight drop spillway, the following weir formula may be used,

$$Q = \frac{1.711Lh^{3/2}}{(1.1 + 0.01F)}$$

7.6 Head over the crest (h)

$$h = \left[\frac{Q(1.1 + 0.01F)}{C.L} \right]^{2/3}$$

Where,

Q = maximum discharge capacity of the weir (m³/s)

L = length of weir (m)

h = total depth of weir (m)

F = net drop from top of transverse sill to crest (m).

C = coefficient of discharge=1.77

7.7 Design of Straight drop spillway stilling basin

1. Minimum length of stilling basin (LB)

$$L_B = x_a + x_b + x_c$$

Where,

L_B = minimum length of stilling basin

x_a = distance between head wall and the point where surface of upper nappe strikes the floor of stilling basin

x_b = distance between the point where surface of upper nappe strikes the basin floor and u/s face of the floor blocks = 0.8 dc

x_c = distance between the u/s face of the floor blocks and the end of stilling basin= 1.75 dc

$$L_B = x_a + 2.55 * d_c$$

2. Floor blocks

- Height of floor blocks: = $0.8 * d_c$
 - Width and spacing of floor blocks: = $0.4 * d_c$
 - The plan of floor blocks should be square.
 - The floor blocks should be occupy the space between 50 to 60 % of the width of stilling basin.
1. Height of end sill= $0.4 * d_e$
 2. Height of sidewalls above tail water level: = $0.85 * d_e$
 3. Minimum height of tail water above the floor of stilling basin should be = $2.15 * d_e$

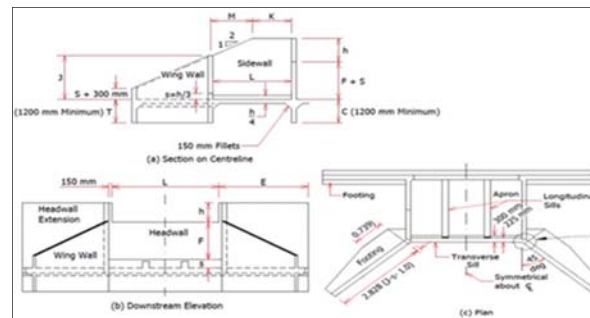


Fig 2.1: Different views of Drop Spillway

8. Computation of Hydraulic Components

8.1 Minimum length of headwall extension (E)

$$E = 3h + 0.6 \text{ or } E = 1.5 F$$

Where,

E = Minimum length of headwall extension

h = total depth of weir (m)

F = net drop from top of transverse sill to crest (m).

The greater value is counted as minimum length of head wall extension.

8.2 Minimum length of apron (LB)

$$L_B = F \left[2.28 \frac{h}{F} 0.54 \right]$$

Where,

L_B = Minimum length of apron

h = total depth of weir (m)

F = net drop from top of transverse sill to crest (m).

The greater value is counted as minimum length of apron.

8.3 Height of side wall and wing wall at the junction (J)

$$J = 2h$$

Or

$$J = \left[F + h + S - \frac{(L_B + 0.13)}{2} \right]$$

Where,

J=Height of side wall and wing wall at the junction

h = total depth of weir (m)

F = net drop from top of transverse sill to crest (m).

S = height of transverse sill

LB=Minimum length of stilling basin

The higher value is taken as the height of wing wall and side wall at the junction.

8.4 Height of transverse sill (HL)

$$H_L = \frac{h}{3}$$

Where,

HL=Height of transverse sill

h = total depth of weir (m)

8.5 Height of longitudinal sill

$$H_L = \frac{h}{4}$$

8.6 M and K parameters

$$M = 2(F + 1.33h - J)$$

$$K = (LB + 0.1) - M$$

Where,

J=Height of side wall and wing wall at the junction

h = total depth of weir (m)

F = net drop from top of transverse sill to crest (m).

LB=Minimum length of stilling basin

8.7 Height of headwall (HB)

$$HB = F + S$$

Where,

HB=Height headwall

F = net fall of head

S = height of transverse sill

$$S = \frac{d_c}{2}$$

The critical depth, (dc),

$$d_c = \sqrt[3]{\frac{Q^2}{L^3 g}}$$

8.8 Height of side wall (HS)

$$HS = 2.5 d_c + S$$

Where,

HS=Height side wall

dc = Critical depth

S = height of transverse sill

8.9 Depth of cut off wall (t1) (without flow)

$$C_w \cdot H = \frac{B}{3} + 2t_1 + 2t_2$$

$$t_1 = \left[\left(C_w \cdot H \right) - \left(\frac{B}{3} \right) - 2t_2 \right] / 2$$

Where,

Lb = length of basin

t1 = Height of cut off wall

t2 = Height of toe wall

Cw= Weighted creep ratio for the existing soil condition

H = Fall of water

8.10 Depth of toe wall (t2)

$$C_w \cdot H = \frac{B}{3} + 2t_1 + 2t_2$$

$$t_2 = \left[\left(C_w \cdot H \right) - \left(\frac{B}{3} \right) - 2t_1 \right] / 2$$

Where,

B = Horizontal distance from cut off wall to toe wall

t1 = Height of cut of wall

t2 = Height of toe wall

Cw= Weighted creep ratio for the existing soil condition

H = Fall of water

9. Source code

Inlet Design

using System;

using System.Collections.Generic;

using System.ComponentModel;

using System.Data;

using System.Drawing;

using System.Linq;

using System.Text;

using System.Windows.Forms;

using System.Data.OleDb;

namespace WindowsFormsApp1

{

public partial class Form4 : Form

{

OleDbConnection connection = new OleDbConnection();

public Form4()

{

InitializeComponent();

connection.ConnectionString=@"Provider=Microsoft.ACE.OLEDB.12.0;DataSource=E:\WindowsFormsApp1\Sanjani.accdb;Persist Security Info=False;";

App1\Sanjani.accdb;Persist Security Info=False;";

}

private void button1_Click(object sender, EventArgs e)

{

double cd, g, L, Hn, Q;

cd = double.Parse(creepratio.Text);

L = float.Parse(fallht.Text);

Hn = double.Parse(cutofftoewall.Text);

double H = Math.Pow(Hn, 1.5);

Q = 0.66 * cd * 4.438 * L * H;

htofoewall.Text = " " + Q + " ";

}

private void button2_Click(object sender, EventArgs e)

{

try

{

connection.Open();

OleDbCommand cmd = new OleDbCommand();

cmd.Connection = connection;

cmd.CommandText = "insert into Inletdesign values(" +

creepratio.Text + "," + fallht.Text + "," + cutofftoewall.Text

+ "," + htofoewall.Text + "," + dateTimePicker1.Value +


```

    ");
    cmd.ExecuteNonQuery();
    MessageBox.Show("Data is inserted successfully.");
    connection.Close();
    }
    catch (Exception ex)
    {
    MessageBox.Show("Error " + ex);
    }
    }
    }
    }

```

10. Computation of Peak Runoff Rate

```

using System;
using System.Collections.Generic;
using System.ComponentModel;
using System.Data;
using System.Drawing;
using System.Linq;
using System.Text;
using System.Windows.Forms;
using System.Data.OleDb;
namespace WindowsFormsApp1
{
public partial class Form12 : Form
{
OleDbConnection connection = new OleDbConnection();
public Form12()
{
InitializeComponent();
connection.ConnectionString=@"Provider=Microsoft.ACE.O
LEDB.12.0;DataSource=E:\WindowsFormsApp1\Sanjani.acc
db;
Persist Security Info=False;";

```

```

}
private void button1_Click(object sender, EventArgs e)
{
float C, I, A, Qpeak;
C = float.Parse(coefficient.Text);
I = float.Parse(intensity.Text);
A = float.Parse(area.Text);
Qpeak = (C * I * A) / 360;
peakrunoff.Text = " " + Qpeak + " ";
}
private void button2_Click(object sender, EventArgs e)
{
try
{
connection.Open();
OleDbCommand cmd = new OleDbCommand();
cmd.Connection = connection;
cmd.CommandText = "insert into PeakRunoffRate values(" +
coefficient.Text + "," + intensity.Text + "," + area.Text +
"," + peakrunoff.Text + "," + dateTimePicker1.Value + ")";
cmd.ExecuteNonQuery()

MessageBox.Show("Data is inserted successfully.");
connection.Close();
}
catch (Exception ex)
{
MessageBox.Show("Error " + ex);
}
}
}
}

```

11. Results and Screen Layouts



Screen 1: Peak Discharge Rate

Coefficient	Length of crest (L)	Head over the crest (H)	Peak discharge rate (Q)	SavedDate
1	5	2	25	19-Feb-19 11:14:26 PM
1	4	3	49	19-Feb-19 11:30:32 PM
1	2	4	28	20-Feb-19 3:48:21 PM
1	3	2	15	02-Mar-19 1:39:58 PM
1	3	2	15	02-Mar-19 1:39:58 PM

Screen 2: Peak Discharge Rate stored in Database

12. Conclusion

This study deals with the design of drop spillway using ICT application. Drop spillway is one of the most commonly used gully control structures. It is mainly used at the gully bed to create a control point. Several such drop structures are constructed across the gully width throughout the length at fixed intervals. So, the development the software for the design different components of drop spillway structure includes the calculations of the various formulas. It also encapsulates the configuration of the system and information about the used to develop software. The system is developed in the high level computer language i.e. c# language in the .net framework. The use of information communication technology is now growing in the various industries. So, it is necessary to increase the use of ICT in the agriculture field. Agriculture field will grow due to use of Information Technology. India is the country of the famers and represents India for the agriculture. It is necessary to research in agriculture field and develop the agricultural at the rural areas too. This is designed to estimate the design parameters of drop spillway. The software was developed for different formulae using ASP. NET with C# was used as programming language. It will be very useful software for the agricultural work. It can used at the scientists, students as well as farmers level to calculate the related formulas in the agricultural fundamentals.

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