Developing software module for BP and BMEP parameters in IC Engine using VB.Net

Manish Kumar Pandey[1], Rohit Chaudhary[2], Sanjeev[3]

[1]M.Tech (Machine Design) student, CBS Group of Institutions (Affiliated to MDU), Jhajjar, India
[2]Northern India Engineering College, New Delhi, India
[3]CBS Group of Institutions (Affiliated To MDU), Jhajjar, India

Abstract— *This document reviews the history of free-piston internal combustion engines, from the air compressors and gas generators used in the mid-20th century through to recent free-piston hydraulic engines and linear electric generators. Unique features of the free-piston engine are presented and their effects on engine operation are discussed, along with potential advantages and disadvantages compared to conventional engines. The paper focuses mainly on developed engines where operational data has been reported. Finally, the potential of the free-piston engine is evaluated and the most promising designs identified.*

For different requirements different types of piston are made, but all that work has to do manually which is usually time consuming, complex in calculation, more chance of error occurs. For getting rid of this problem a software or execution of a program in a computer language such as in C, VB.Net

Keywords— VB.Net, Break Power, Break Mean Effective Pressure, C#

I. INTRODUCTION

Reference:http://www.cast-alloys.com/products/aluminium_piston.htm, 2012

Design of piston refers to dimensions of a piston that may be either diameter of piston, length of piston, or no. of piston rings etc. On basis of these data mechanical parameters are described of a piston such as gas pressure on head of piston, force exerted by piston on the wall of cylinder.

Further to design the piston there may be two methods one is to calculate all the stresses and forces according to given parameter of piston such as diameter, piston skirt etc, while another way of designing is to calculate piston parameter such as diameter of piston on the basis of provided mechanical parameters such as stresses and bearable pressure and forces.

In traditional way to design a piston is manual calculation, in which formulas are used to calculate dimensions as well as stresses acting on a piston. That traditional old method of designing a piston is time consuming and usually shows little bit error or inaccuracy and a lot of calculation is required, so to get rid of that problem an software could be prepare in any computer coding language such as c, c++, java, visual basic.net etc. A proper coding/programming could be done with mathematical formulas of piston designing, so that if we run that program. And provide some parameters of piston either dimensions or stresses it computationally provide us mechanical forces or piston parameters respectively.

II. MATERIAL USED

The alloy from which a piston is made not only determines its strength and wears characteristics, but also its thermal expansion characteristics. Hotter engines require more stable alloys to maintain close tolerances without scuffing.

Many pistons used to be made from “hypoeutectic” aluminum alloys like SAE 332 which contains 8-1/2 to 10-1/2 percent silicone. Today we see more “eutectic” alloy pistons which have 11 to 12 percent silicone, and “hypereutectic” alloys that have 12-1/2 to over 16 percent silicone.

Silicone improves high heat strength and reduces the coefficient of expansion so tighter tolerances can be held as temperatures change. Hypereutectic pistons have a coefficient of thermal expansion that is about 15 percent less than that for standard F-132 alloy pistons.

III. OBJECTIVE

The objective of this paper is to developing software module for BP and BMEP parameters in IC Engine using VB.Net

IV. SOFTWARE DEVELOPMENT

Basically the designing of piston is done on the basis of some formulas of piston designing according to book of machine design. In designed software implementation of those formulas has been done. To make that software simply those formulas are used through the coding of this software. There are various formulas which are used for designing the software.

3.1 ASSUMPTIONS:

Throughout the designing process there are several constants which are used and various factors are considered throughout the coding, which are used in the conventional formulas. Which are as-

- Pressure on cylinder walls, pw=0.025N/mm2 to 0.042N/mm2.
- Bending (tensile) stress, _t=85 N/mm2 to 110N/mm2 for cast iron rings.
- Co-efficient of friction, μ=0.1
- Pai, π=3.14
- Pressure on piston barrel, pb=0.45N/mm2
- factor of safety is to be considered as, FOS=1

These above mentioned are some assumptions which are considered during the designing of software. Basically the values of these parameters vary according to material used for manufacturing of pistons. Such as bending (tensile) stress is considered for cast iron rings , for another materials it would be different or says it would be vary between another ranges. Besides these kind of parameters some parameters are as which contain a particular range for all kind of materials such as pressure on walls of cylinder, pressure on piston barrel etc. Beside some variable parameters there are also some parameters which are kept constant for all materials such as value of pi, co-efficient of friction which has definite values universally.

3.2 ALGORITHM:

There are various steps in algorithm of development of software, which are as-

- First of all for designing process a design software named as visual basics studio 2010 is used, it is a work frame in which c sharpe (c#) is a programming language.
- First step is to opening a new project work in that frame work that is done by clicking on icon of visual studio then on option of file in that click on new project.
- After that c# installed template and window form application is chosen from the open window, which further shows a form on screen.

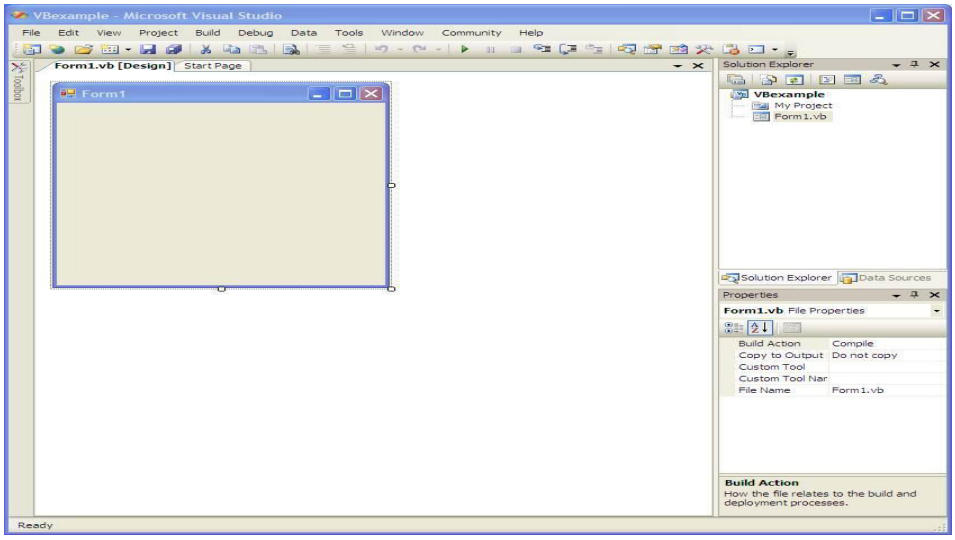

Fig.1: Window for formal VB design

- Then select a label from tool box and named it diameter from its properties which are showed right hand side of form.
- After that a text box is selected from tool box which is on left side of form and aligned it with label that is named diameter.
- Then same procedure is done for two times, this time name were kept maximum gas pressure and bending stress and same kind text boxes are aligned with both of them, which are input boxes.
- After that a button is chosen from that tool box which is fixed below those labels and text boxes and named as calculate from its properties as done before.
- Then again label is selected from tool box five times and named as thickness of piston head, width of top land, thickness of piston ring, piston barrel and finally length of piston skirt.
- Similarly text boxes are aligned in front of those labels respectively, which are output boxes.
- Then a picture box is selected from tool box which is fixed at right hand side of calculate named button, on right button clicking of mouse a image is chosen from some another location in system and stretch image is done from picture

box tasks to adjust the picture in picture box.

- After that another button is chosen from tool box and fixed below the image that was fixed before and this button is named as assumptions after changing its name from its properties section.
- Further functioning or said coding of those both buttons are done after double clicking on them respectively, and that coding will be described under section of coding.

3.3 PROGRAMMING/CODING :

The following are the codes for the design parameters.

3.3.1 Break power

```
private void button1_Click_1(object sender, EventArgs
e)
        {
            Double BP, N, T,BHP;
            T = Convert.ToDouble(textBox1.Text);
            N = Convert.ToDouble(textBox2.Text);
            BP = (2 * 22 * N * T) / (7 * 60); BHP =
            BP / 745;
            textBox3.Text =
            Convert.ToString(Math.Round(BP,2));
            textBox4.Text =
            Convert.ToString(Math.Round(BHP,2));
        }
        private void button2_Click(object sender,
EventArgs e)
{
        textBox1.Text = ""; textBox2.Text = "";
        textBox3.Text = ""; textBox4.Text = "";
}
private void linkLabel1_LinkClicked(object
sender, LinkLabelLinkClickedEventArgs e)
{
        BMEP w = new BMEP(); // w.MdiParent
      = this;
        w.Show();
}
private void button3_Click(object sender,
EventArgs e)
{
        BMEP obj = new BMEP();
        obj.textBox1.Text = this.textBox3.Text;
        obj.ShowDialog();
}
private void check_Number(object sender,
KeyPressEventArgs e)
{
        if(!((e.KeyChar>='0' && e.KeyChar<='9')
        || e.KeyChar=='.' || (int)e.KeyChar==8))
        {
            e.KeyChar='\0';                    }
```

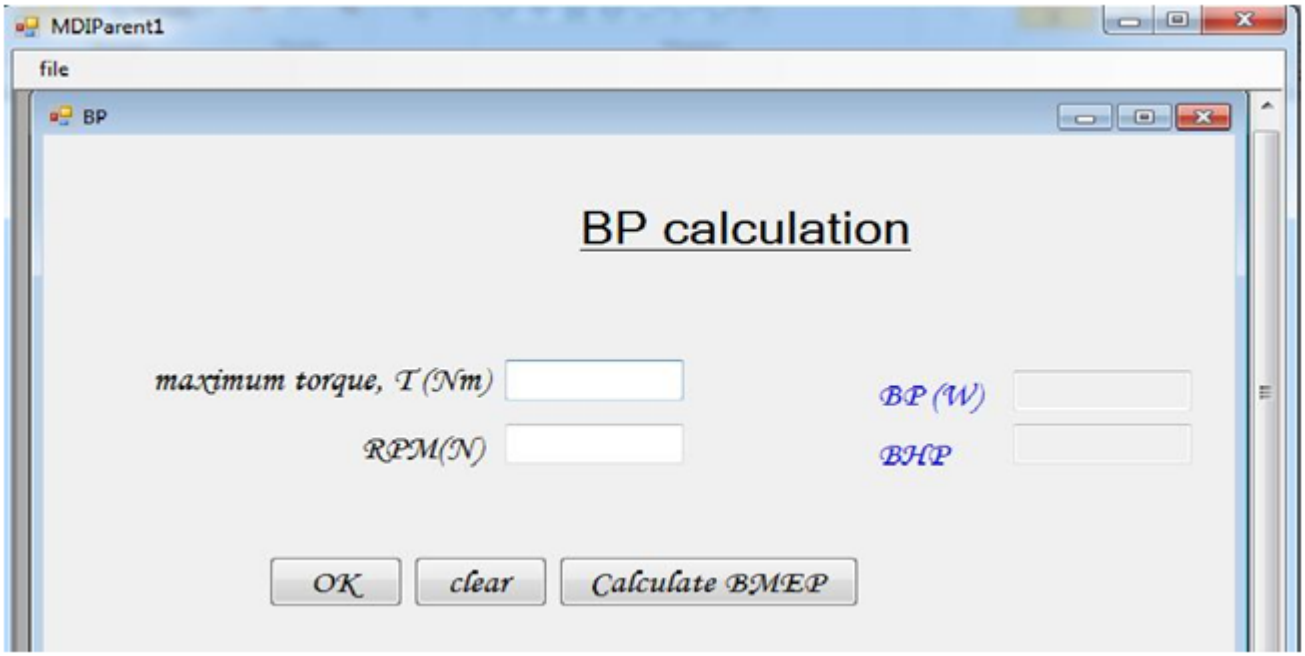

Fig.2: Window for BP calculation

3.3.2 Break mean effective pressure

```
private void button1_Click(object sender, EventArgs e)
        {
            Double L, D, N, BP,
            BMEP,A,BEMPinbar;
            L = Convert.ToDouble(textBox2.Text);
            D = Convert.ToDouble(textBox3.Text);
            N = Convert.ToDouble(textBox4.Text);
            BP = Convert.ToDouble(textBox1.Text);
            A = (22 * D * D) / (7 * 4);
            BMEP = (BP * 60 * 1000) / (L * A * N);
            BEMPinbar = 10 * BMEP;
            textBox5.Text =
            Convert.ToString(BMEP); textBox6.Text
            = Convert.ToString(BEMPinbar);
        }
        private void button2_Click(object sender,
        EventArgs e)
            {
                textBox1.Text = ""; textBox2.Text = "";
                textBox3.Text = ""; textBox4.Text = "";
            private void label2_Click(object sender,
EventArgs e)

            {

            }
            private void checkNumber(object sender,
            KeyPressEventArgs e)
            {
                if (!((e.KeyChar >= '0' && e.KeyChar <=
'9') || e.KeyChar == '.' || (int)e.KeyChar == 8))
                {
                    e.KeyChar = '\0';
                }
            }
```

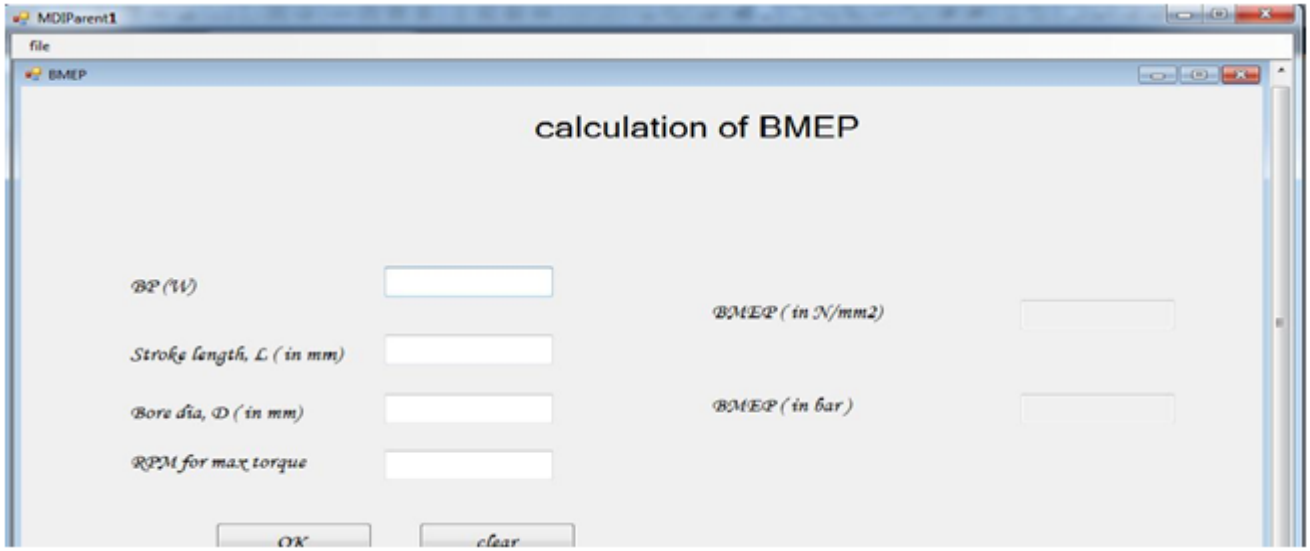

Fig.3: Window for BMEP calculation

V. CONCLUSION

As we know that in the manual method of designing of piston. We have to find out the value of different dimensions of piston like piston diameter, thickness of piston head, length of piston skirt etc. The process of finding these values manually is time consuming, that is why an idea click into our mind suddenly that if we find out these values automatically by developing a software than we not only save the time in these values but also save the money to whom, who done this process manually. So we developed a software through which we found out these values quickly and we finally successful in doing so. There were two ways through which we can make the software. The first one is we provide the values of piston diameter, maximum gas pressure and find out the value
of stresses developed in piston, acting on it, length of piston skirt, thickness of piston head value of side thrust etc. In the second method reverse of it. We choose the first way for developing a software and the language that is used for development of software is C# which is a frame work of visual basics studio as it said before because this language is user friendly and anyone can easily understand it. The conclusion thus arrived is that project is a systematic consideration discussed and purposed in a particular subject from the meaning of project is a systematic. We can say that the project includes complete requirement of mechanism, tools,

application and needs.

It considers that circuit diagram and in various operation performances in sequence and data about the instrument and in the last we can say about the project profit loss.

REFERENCES

[1] R. Mikalsen, A.P. Roskily, a review of piston history and application, sir joseph swaninstitute of energy research, new castle university, new castle upon tyne, united kingdom, 2011.

[2] Reinaldo Santiago Bermudez, Josue Cortes Irizarry, Carmen Sanchez, Machine component design "Piston Rod", University of Puerto Rico Mayaguez Campus Mechanical Engeneering Department, 2012.

[3] http://www.cast-alloys.com/products/aluminium_piston.htm, 2012

[4] Design of Machine Elements, V.B. Bhandari.

[5] B. Shah, & K. Patel, 'ASP.NET with C#', 3rd edition (2012), Computer World Publication

[6] Adam Freeman, 'Pro ASP.NET' 5th edition (2015) Apress;