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# ANALYSIS AND DESIGN OF STRUCTURAL ELEMENT BY VISUAL BASIC PROGRAM

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## ABSTRACT

This project deals with the creation of a computer application that analyzes and designs structural elements i.e. Slab, beam and column. The project also aims at emphasizing the importance of computers in the solution of everyday engineering problems. The program developed analyses and design of structural elements. This program was created by using Visual Basic. The project also discusses various theoretical analysis techniques that can be implemented in developing a computer program. This report acts as a support document for the created software. It describes the program in detail and highlights the methodologies used in its development.
The increasing reliance of engineers on computer software in the performance of their tasks requires engineers, the future

Professionalengineers must be knowledgeable of sound engineering concepts, updated on the latest computer technology used in theindustry and aware of the limitations and capabilities of the computer in solving engineering problems."Computer Methods in Civil Engineering" to developed structural design program for design of structural element using Visual Basic. By creating my own software applications will demonstrate my creativity and integrate concepts, methods and skills in mathematics, basic engineering and specialized civil engineering subjects. This paper presents the learning objectives, requirements, methodology and outputs of my knowledge on "Computer Methods in Civil Engineering".

**KEYWORDS**: Slab, Beam, Column, V.B Programs

## INTRODUCTION

Structural engineering is a field of engineering dealing with the analysis and design of structures that support or resist loads. Structural engineering is usually considered a specialty within civil engineering, but it can also be studied in its own right. Structural engineers are most commonly involved in the design of buildings Structural engineers are responsible for engineering design and analysis. Entry-level structural engineers may design the individual structural elements of a structure, for example the beams, columns, and floors of a building. To perform an accurate analysis a structural engineer must determine such information as structural loads, geometry, support conditions, and materials properties. The results of such an analysis typically include support reactions, stresses and displacements. This information is then compared to criteria that indicate the conditions of failure. More experienced engineers would be responsible for the structural design and integrity of an entire system, such as a building. To apply the knowledge successfully a structural engineer generally requires detailed knowledge of relevant empirical and theoretical design codes, the techniques of structural analysis, as well as some knowledge of the corrosion resistance of the materials and structures, especially when those structures are exposed to the external environment.

This Project present a simple program created for structural elements design and analysis by using Visual basic.This program is created to provide a medium for user to design and analysed the Structural elements of multi storey building easily. This program is created based on IS code and provide the information about the design and analysis. Comparison is made between the program and manual calculation to validate the program. Generally the result from the program and manual calculation shows that both are comparable and do not have much difference .This indicates that the design and analysis result of the program is very accurate and reliable.

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## MATERIALS AND METHODS

**Structural elemens:**

Any structure is essentially made up of only a small number of different types of elements:

- Columns
- Beams
- Slab

***Columns***

Columns are elements that carry only axial force - compression - or both axial force and bending (which is technically called a beam-column but practically, just a column). The design of a column must check the axial capacity of the element, and the buckling capacity.The buckling capacity is the capacity of the element to withstand the propensity to buckle. Its capacity depends upon its geometry, material, and the effective length of the column, which depends upon the restraint conditions at the top and bottom of the column. The effective length is K*l where $l$ is the real length of the column.The capacity of a column to carry axial load depends on the degree of bending it is subjected to, and vice versa. This is represented on an interaction chart and is a complex non-linear relationship.

***Beam***

A beam may be defined as an element in which one dimension is much greater than the other two and the applied loads are usually normal to the main axis of the element. Beams and columns are called line elements and are often represented by simple lines in structural modelling.

- Cantilevered (supported at one end only with a fixed connection)
- Simply supported (supported vertically at each end; horizontally on only one to withstand friction, and able to rotate at the supports)
- Continuous (supported by three or more supports)
- A combination of the above (ex. supported at one end and in the middle)

Beams are elements which carry pure bending only. Bending causes one part of the section of a beam (divided along its length) to go into compression and the other part into tension. The compression part must be designed to resist buckling and crushing, while the tension part must be able to adequately resist the tension.

***Slab***

(a.) On the basis of shape: - Slabs may be rectangular, square, circular, and other conditions.
(b.) On the basis of Supporting conditions: - Based on the end conditions the slab are categorized as Slab simply supported along its edges. Continuous slab running over end and free and free at other end and flat slab directly supported by columns.
(c.) On the basis of Spanning direction:- when the main reinforcement is in one direction as it is a one-way slab while when the main steel is provided in two orthogonal it is a two- way slab.

**Planning for analytical work**

This chapter will discuss on the design procedure for the reinforced concrete beam, slab and column which will be designed using Visual Basic based on I.S code. In this chapter the design process of beam, column and slab based on I.S code will be demonstrated.

**Proposed Work**

In order to ensure the program can run correctly, the problem need to analysed and calculated by hand to confirm the answer that produced from the program is correct. For this report, programs are analysed for slab, beam and column the program needs to define. The input, processing and output need to be identified and understand the requirements of the user. The programming is carried out in visual Basic software based on I.S code.

## VISUAL BASIC SOURCE CODING FOR ONE WAY SIAB-

**Design of one way Slab**

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Design of one way slab has been carried out by limit state method. Following are the steps involved in the design of one way slab.A samplewith input data & resulting output.

```
Dim pi As Double
Dim b As Double
Dim fck As Integer
Dim fy As Integer
Dim Ku_maxAs Double
Dim Pt_maxAs Double
Dim Ru_maxAs Double
Dim Ly, Lx As Double
Dim beta As Double
Dim ratio As Double
Dim slab_type As Integer
'Comment: If slab_type is 1, then slab is one-way
'Comment: If slab_type is 2, then slab is two-way

Dim Pt As Double
Dim Fs As Double
Dim alpha1 As Double
Dim d As Double
Dim L As Double
Dim dc_dash As Double
Dim bigD As Double
Dim Le As Double
Dim Ls As Double
Dim d_check As Double
Dim ax_pos, ax_neg As Double
Dim ay_pos, ay_neg As Double

Dim Dead_Load, Live_Load, Floor_FinishAs Double
Dim W As Double
Dim Mud, Mux_pos, Mux_neg, Muy_pos, Muy_negAs Double
Dim AST_prv, AST_minAs Double
Dim temp1, temp2, temp3, temp4 As Double
Dim dia_bar1, dia_bar2 As Double
Dim AsdAs Double
Dim SVD As Double
Dim Astor1, Astor2, Astor3 As Double
Dim Astx_posAs Double
Dim no_of_bar1, no_of_bar2, no_of_bar3 As Integer
Dim ret As Integer

Dim ADOConnectionAsADODB.Connection
Dim ADORecordSetAsADODB.Recordset
Dim ConnectionStringAs String
Dim panel_type, moment As String
Dim col1, col2 As String
Dim SQL As String

Private Sub Command1_Click()
fck = CDbl(Text8.Text)
fy = CDbl(Text9.Text)
   Fs = 0.58 * fy * 1

Ku_max = 700 / (1100 + 0.87 * fy)
Pt_max = ((0.36 * fck * Ku_max) / (0.87 * fy)) * 100
```

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```
Ru_max = 0.36 * fck * Ku_max * (1 - 0.42 * Ku_max)

   Lx = CDbl(Text1.Text) * 1000
   Ly = CDbl(Text2.Text) * 1000
beta = Round(Ly / Lx, 2)

dc_dash = 30
   alpha1 = 1.1

Ls = CDbl(Text3.Text) * 1000

   If (List1.ListIndex = 0) Then
ratio = 7
ElseIf (List1.ListIndex = 1) Then
ratio = 20
   Else
ratio = 26
   End If

   d = Lx / (ratio * alpha1)

bigD = d + dc_dash
   Form4.Label17.Caption = Val(bigD)

   Le = (Lx + d) / 1000

   Form4.Label7.Caption = d

   If (Le > Lx + Ls) Then
      Le = Lx + Ls
   End If

Dead_Load = ((bigD / 1000) * 25)
Floor_Finish = CDbl(Text4.Text)
Live_Load = CDbl(Text5.Text)

   W = (Dead_Load + Floor_Finish + Live_Load) * 1.5
   Form4.Label19.Caption = Val(W)

   If beta >= 2 Then
slab_type = 1
MsgBox "One Way Slab Design"
      Call One_Way
       Form4.Show

   Else
slab_type = 2
MsgBox "Two Way Slab Design"
      List2.Visible = True
      Label10.Visible = True
      Command2.Visible = True
   End If
  End Sub

Public Sub One_Way()
   Form1.Label1.Visible = False
```

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```
    Form1.Label2.Visible = False
    Form4.Label26.Caption = "Spacing"
    Form4.Label20.Caption = "Mud"

    Form4.Label1.Visible = False
    Form4.Label2.Visible = False
    Form4.Label3.Visible = False
    Form4.Label5.Visible = False

    Mud = (W * Le * Le) / 8
    Form4.Label21.Caption = Val(Mud)
d_check = Sqr((Mud * 1000) / Ru_max)

    Form4.Label12.Caption = d_check

    If d_check< d Then
       Form4.Label10.Caption = "SAFE FOR CHECK ON d"
    Else
       Form4.Label10.Caption = "UNSAFE FOR CHECK ON d"
    End If

AST_min = 0.12 / 100 * b * bigD
    Form4.Label25.Caption = Val(AST_min)

ASt = ((0.5 * fck) / fy) * (1 - Sqr(1 - ((4.6 * Mud * 10 ^ 6) / (fck * b * d * d)))) * b * d
    Form4.Label23.Caption = Val(ASt)

    If (AST_prv<AST_min) Then
AST_prv = AST_min
    End If

    dia_bar1 = Text6.Text

spacing = ((pi / 4) * (dia_bar1 ^ 2) * 1000) / AST_prv
    If (spacing > 300) Then
spacing = 300
    End If

    Form4.Label27.Caption = Val(spacing)

    dia_bar2 = Text7.Text

Asd = 0.15 / 100 * b * bigD
    Form4.Label29.Caption = Val(Asd)

    SVD = (1000 * (pi / 4) * (dia_bar2 ^ 2)) / Asd
    Form4.Label31.Caption = Val(SVD)

    'Check for deflection
Pt = (AST_prv * 100) / (b * d)

    If Pt<Pt_max Then
       Form4.Label10.Caption = "SAFE FOR CHECK ON Pt"
    Else
       Form4.Label10.Caption = "UNSAFE FOR CHECK ON Pt"
    End If
```

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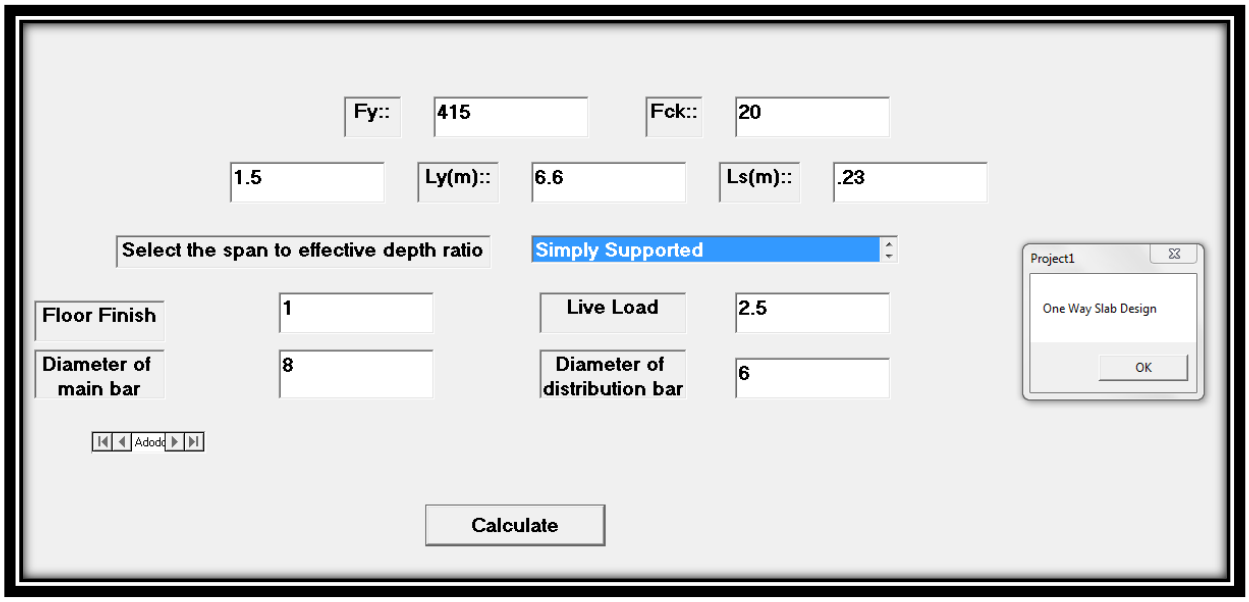
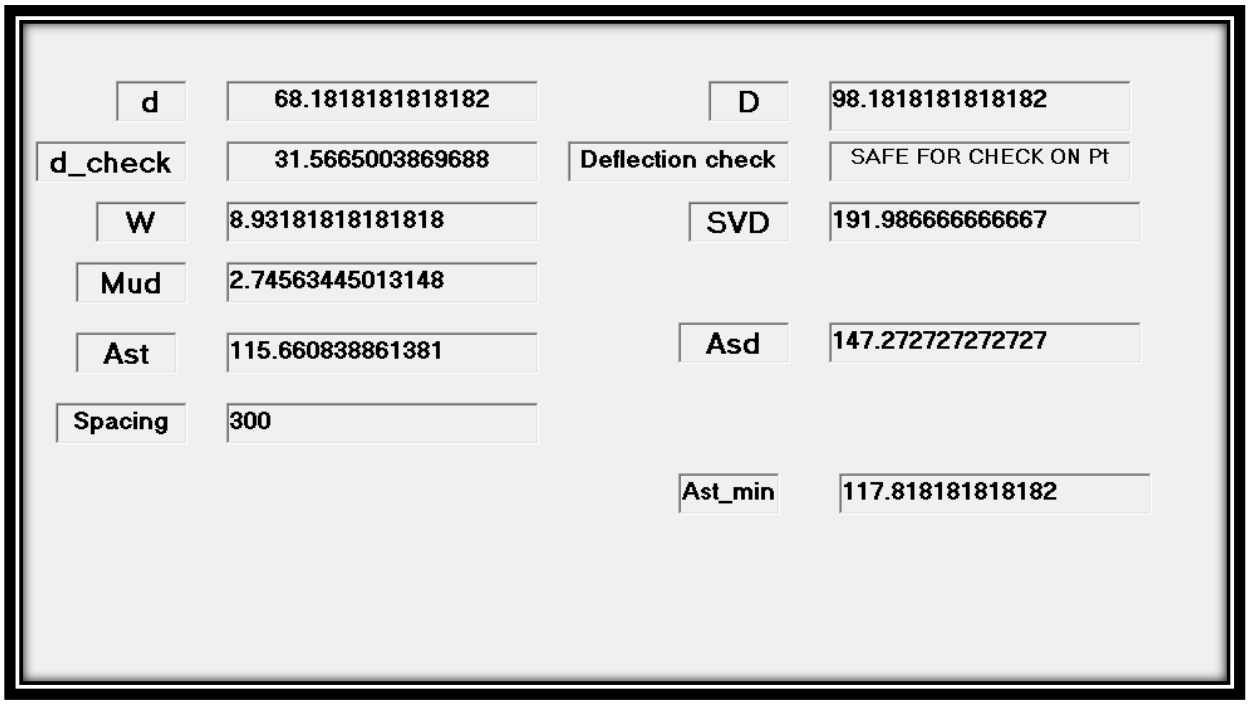
End Su

**Output from V.B program for One way Slab**




## RESULT AND ANALYSIS

The main objective of this project is to develop the computer program that used to design the structural elements of multi-storey building. This Chapter discussed about the result of software programming. The inputs and outputs in this software are explained in this chapter.

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***Table 1. Comparison of Analysis & Design parameter for One Way Slab by using manually & V.B***

| Sr.No. | Description | Manually | Visual Basic |
|---|---|---|---|
| 1. | *Ly& Lx* | 6.6 m & 1.5 m | 6.6m & 1.5m |
| 2. | Design Load $W_u$ | 9 KN/m | 8.931 KN/m |
| 3. | Moment | 2.88 KNm | 2.745 KNm |
| 4. | *Ast(req)* | 120mm² | 115.660 mm² |
| 5. | Spacing *Sv* | 300 mm | 300 mm |
| 6. | *Svd* | 188.46 mm | 191.986 mm |

From Above table, it is observed that there is slight difference between manual and visual basic calculation

## CONCLUSION

From the above study following conclusions are drawn.

During the last few decades, computer software has become more and easier in the analysis of engineering and scientific problems. Much of the reason for this change from manual methods has been the advancement of computer techniques developed by the research community and, in particular, universities.The overall ease with which a user applies this program to everyday structural elements analysis and design tasks by entering parameters and instantaneously receiving the results in an understandable manner enables a great time saving, accuracy and hence, an optimized design.A user-friendly program for the computer analysis of structural elements of multi-story buildings. It is used to remember my knowledge incivil engineering and to innovate new application to solve thedesign in easy way and it helpful to me for future work in todeveloping the application in widely.

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