CS395 Internship

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Company: Rohde & Associates, Inc.

Company Overview:

Rohde & Associates, Inc. is an architectural firm with a staff of six employees. They have been in business since 1997 and have produced a wide array of projects throughout the state of Alaska. The focus is primarily on commercial grade design/build and bid projects but the company is fully qualified to produce residential construction documents. Their clients vary greatly from private owners, to state and government contracts. The latter makes up 90% of the work. Notable structures designed by Rohde & Associates, Inc. since 1997 are The newly remodeled East High School, The expanded wing of the Anchorage Senior Center, Ding How Mongolian BBQ, and the adjacent Samurai Sushi. Outside of Anchorage, The expansion to the Kodiak Senior Center, The new animal control shelter in Valdez, multiple restaurants in Fairbanks, and multiple tribal council buildings scattered in the northern bush villages. The company has grown since 1997 from a single employee to its current staff producing over $1,000,000.00 gross a year in contracts.

Project Overview:

Rohde & Associates, Inc., like the majority in the construction design industry today uses CAD (Computer Assisted Design) to produce construction documents. AutoCAD™ produced by Autodesk™ is their primary tool of production. Currently, all employees in the company have AutoCAD installed and running on their station. As is the case with a majority of things in life, redundancy is rampant within the designs of many projects and across multiple projects. For example, steel I beams are standard across the entire industry as specified by the AISC (American Institute of Steel Construction). A W12X14 is identical across designs, regardless of the type of structure. The only difference is the type of anchor bolts holding it in the concrete and the size of the base plate it sits on. A VBA routine or LISP routine would be an excellent choice for automating this otherwise redundant, and time consuming task of drawing a plan view of a W12X14 with 4 anchor bolts and a 12X16 base plate. Another example would be routine tasks within AutoCAD. Plotting, or printing as other applications refer to it. Plotting is very redundant and on the larger projects, can consume an entire day in itself. Another good routine would be one that takes the page setup from one drawing layout and repeats the plot procedure for every drawing sheet without the need of user intervention. The development of these routines was, in part, my assignment. Also my assignment, to convert the already existing routines the company has, written in an antiquated language LISP, into a modern language like VBA or C++. Finally, after completing the conversions of existing routines and developing a few new, needed routines, wrap them into one easy to install application that can be easily distributed as needed.

Planning Process:

The planning process what very cut and dry for this assignment, the company stated the process by which I should advance. First, convert the existing routines

into a language that is more user friendly and future development friendly. The only planning required here was internal planning on my part determining what routines to analyze first and start coding in VBA. The language to use was left for me to decide, but there are very few logical choices. Once an order of precedence was determined I proceeded to convert each one individually. Determining which to convert first was decided by which script appeared to require the least amount of lines of code. The logic to this was the learning curve I needed to overcome. I understood Visual Basic, but Visual Basic for AutoCAD, I was unfamiliar with. The application specific method calls and how objects were containerized was foreign to me. Starting easy and building up helped me learn as I progressed making the larger routines easier to design.

Detailed Analysis and Design

VBA is a very direct and easy to use, block code implemented design solution. The understanding by the company was that the code was going to be written so methods could be added to the routines later to improve their performance. This idea was carried though into the install application that was to be written in C++.

Description of Implementation

I started with two widely used and very popular routines that dramatically increase productivity within the company, "fixblock" and "stairs". Stairs is a very simple routine that draws a staircase. This routine is very nice because of the simple fact that it eliminates the math. Instead of the CAD operator having to manually figure out how many stair risers are needed to get from one floor to the next, that meet code, you run the routine, answer the questions as the routine progresses and when finished, you have a legal staircase drawn. Fixblock is a utility that fixes improper drawings. What that means is, as firms exchange drawings amongst each other for large projects, Rohde & Associates receives drawings with improper line weights and line types for particular objects, say a kitchen sink for the purposes of this example. The sink is on a layer that makes it print so dark, it prints out as a black blotch on our plotter. The only way to fix this without this routine is to manually go into the drawing that contains that sink, redraw the sink, re-block it together, save it, and reload it into the drawing. This is extremely time consuming, especially if you have forty sinks in this particular building. Fixblock, when used allows you to select the object, or block, within the drawing, then automatically enters the drawing containing the sink, changes the block to the proper line weights, re-blocks, saves and reloads the drawing. Both of these particular routines were converted from LISP to VBA. The design was to be object oriented and utilized existing encapsulation of VBA objects, together with custom AutoCAD method calls to objects. ObjectARX and C++ was implemented with a windows based .dll template that is once again object oriented.

Product Discussion

Currently, the project is still in a state of development. All of our commonly used routines are converted to VBA for ease of use amongst the users. Developing these same routines in ObjectARX and C++ is currently in a sate of disarray. The packaging software is InstallShield but currently only installs one routine successfully. A major setback in the design was the idea to upgrade to AutoCAD 2006 in the middle of this assignment. There are quite a few method calls that are changed for ObjectARX 2006 vs. ObjectARX 2004 which was the previous version of AutoCAD that was installed.

Project Conclusion

To conclude, VBA development for AutoCAD will always be an on going task. This particular assignment given to me developed very smoothly within the VBA environment. Using C++ to develop these same routines is much more cumbersome. Implementing a company wide upgrade to AutoCAD 2006 did not help with my C++ development problems. I have now switched over completely to development of routines within C++.

Code Examples

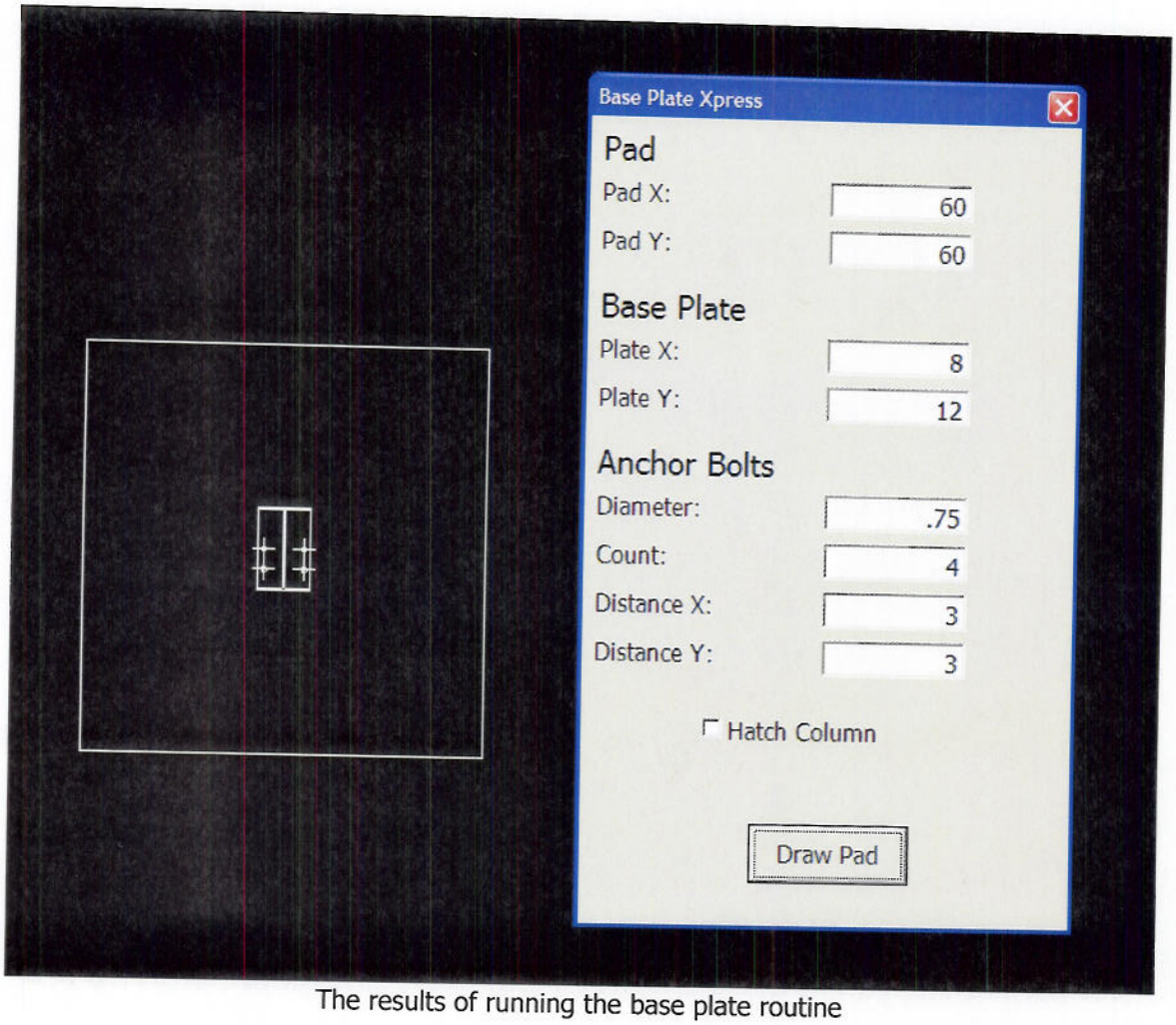
- This is the base plate routine written in VBA, My comments are mostly internal and helpful to myself as not many other people were going to understand this code anyways.

```
Private Sub CommandButton1_Click()

    Dim padx, pady, platex, platey As Double
    Dim padxhalf, padyhalf, platexhalf, plateyhalf As Double
    Dim abdia, abcount, abdistx, abdisty As Double

    padx = theform.TextBox1.Text
    pady = theform.TextBox2.Text
    platex = theform.TextBox3.Text
    platey = theform.TextBox4.Text
    abdia = theform.TextBox5.Text
    abcount = theform.TextBox6.Text
    abdistx = theform.TextBox7.Text
    abdisty = theform.TextBox8.Text

    padxhalf = padx / 2
    padyhalf = pady / 2
    platexhalf = platex / 2
    plateyhalf = platey / 2

    'the following draws the pad, nothing to magical here

    Dim pad As AcadLWPolyline
    Dim padpoints(0 To 9) As Double

    padpoints(0) = 0: padpoints(1) = 0
    padpoints(2) = padx: padpoints(3) = 0
    padpoints(4) = padx: padpoints(5) = pady
    padpoints(6) = 0: padpoints(7) = pady
    padpoints(8) = 0: padpoints(9) = 0

    Set pad = ThisDrawing.ModelSpace.AddLightWeightPolyline(padpoints)

    'the following draws the baseplate, it's pretty straight forward

    Dim plate As AcadLWPolyline
    Dim platepoints(0 To 9) As Double

    platepoints(0) = (padxhalf - platexhalf): platepoints(1) = (padyhalf - plateyhalf)
    platepoints(2) = (padxhalf + platexhalf): platepoints(3) = (padyhalf - plateyhalf)
    platepoints(4) = (padxhalf + platexhalf): platepoints(5) = (padyhalf + plateyhalf)
    platepoints(6) = (padxhalf - platexhalf): platepoints(7) = (padyhalf + plateyhalf)
    platepoints(8) = (padxhalf - platexhalf): platepoints(9) = (padyhalf - plateyhalf)

    Set plate = ThisDrawing.ModelSpace.AddLightWeightPolyline(platepoints)
```

```
    'the following mess draws the column
    'if you change the math inside the array, and it's not working, it's probobly the parenthesis
    'for some odd reason, VBA is very picky about when and how you use parenthesis

    Dim column As AcadLWPolyline
    Dim columnpoints(0 To 33) As Double

    columnpoints(0) = (padxhalf - platexhalf + 0.25): columnpoints(1) = padyhalf - plateyhalf
    columnpoints(2) = (padxhalf + platexhalf - 0.25): columnpoints(3) = padyhalf - plateyhalf
    columnpoints(4) = (padxhalf + platexhalf) - 0.25: columnpoints(5) = (padyhalf - plateyhalf) +
0.25
    columnpoints(6) = (padxhalf + 0.375): columnpoints(7) = (padyhalf - plateyhalf) + 0.25
    columnpoints(8) = (padxhalf + 0.125): columnpoints(9) = (padyhalf - plateyhalf) + 0.5
    columnpoints(10) = (padxhalf + 0.125): columnpoints(11) = (padyhalf + plateyhalf) - 0.5
    columnpoints(12) = (padxhalf + 0.375): columnpoints(13) = (padyhalf + plateyhalf) - 0.25
    columnpoints(14) = (padxhalf + platexhalf) - 0.25: columnpoints(15) = (padyhalf +
plateyhalf) - 0.25
    columnpoints(16) = (padxhalf + platexhalf) - 0.25: columnpoints(17) = padyhalf + plateyhalf
    columnpoints(18) = (padxhalf - platexhalf) + 0.25: columnpoints(19) = padyhalf + plateyhalf
    columnpoints(20) = (padxhalf - platexhalf) + 0.25: columnpoints(21) = (padyhalf +
plateyhalf) - 0.25
    columnpoints(22) = padxhalf - 0.375: columnpoints(23) = (padyhalf + plateyhalf) - 0.25
    columnpoints(24) = padxhalf - 0.125: columnpoints(25) = (padyhalf + plateyhalf) - 0.5
    columnpoints(26) = padxhalf - 0.125: columnpoints(27) = (padyhalf - plateyhalf) + 0.5
    columnpoints(28) = padxhalf - 0.375: columnpoints(29) = (padyhalf - plateyhalf) + 0.25
    columnpoints(30) = (padxhalf - platexhalf) + 0.25: columnpoints(31) = (padyhalf - plateyhalf)
+ 0.25
    columnpoints(32) = (padxhalf - platexhalf) + 0.25: columnpoints(33) = padyhalf - plateyhalf

    Set column = ThisDrawing.ModelSpace.AddLightWeightPolyline(columnpoints)

    'this sets the fillets for the column, it's a method call inside the polyline object

    column.SetBulge 3, -0.375
    column.SetBulge 5, -0.375
    column.SetBulge 11, -0.375
    column.SetBulge 13, -0.375

    column.Update

    ' This section hatches the column, it uses the columnpoints array for the outer loop hatch
boundary

    If CheckBox1.Value = -1 Then

    Dim columnhatch As AcadHatch
    Dim patternName As String
    Dim PatternType As Long
    Dim bAssociativity As Boolean

    patternName = "ANSI31"
    PatternType = acHatchPatternTypePreDefined '0
    bAssociativity = True
```

```
    Set columnhatch = ThisDrawing.ModelSpace.AddHatch(PatternType, patternName,
bAssociativity)

    Dim outerLoop(0 To 0) As AcadEntity

    Set outerLoop(0) = ThisDrawing.ModelSpace.AddLightWeightPolyline(columnpoints)

    columnhatch.AppendOuterLoop (outerLoop)
    columnhatch.Evaluate

    End If

    'this section draws the anchor bolt holes, it's a simple loop, that draws 2 holes at a time
    'it negates the center value for the second hole and calls the method again

    Dim anchorbolthole As AcadCircle

    Dim count As Integer
    Dim aboffset As Double
    count = 1
    aboffset = abdisty

    Dim abcenterline1, abcenterline2 As AcadLine
    Dim startPoint(0 To 2) As Double
    Dim endPoint(0 To 2) As Double

    For count = 1 To (abcount / 2) Step 1

        Dim centerPoint(0 To 2) As Double
        Dim radius As Double

        radius = abdia / 2

        'the following draws the anchor bolt holes

        centerPoint(0) = padxhalf + abdistx: centerPoint(1) = (padyhalf - plateyhalf) + abdisty:
centerPoint(2) = 0#
        Set anchorbolthole = ThisDrawing.ModelSpace.AddCircle(centerPoint, radius)

        centerPoint(0) = padxhalf - abdistx: centerPoint(1) = (padyhalf - plateyhalf) + abdisty:
centerPoint(2) = 0#
        Set anchorbolthole = ThisDrawing.ModelSpace.AddCircle(centerPoint, radius)

        'the following draws the center lines

        startPoint(0) = padxhalf + abdistx - 1.5: startPoint(1) = (padyhalf - plateyhalf) + abdisty:
startPoint(2) = 0#
        endPoint(0) = padxhalf + abdistx + 1.5: endPoint(1) = (padyhalf - plateyhalf) + abdisty:
endPoint(2) = 0#
        Set abcenterline1 = ThisDrawing.ModelSpace.AddLine(startPoint, endPoint)
```

```
        startPoint(0) = padxhalf + abdistx: startPoint(1) = (padyhalf - plateyhalf) + abdisty - 1.5:
startPoint(2) = 0#
        endPoint(0) = padxhalf + abdistx: endPoint(1) = (padyhalf - plateyhalf) + abdisty + 1.5:
endPoint(2) = 0#
        Set abcenterline2 = ThisDrawing.ModelSpace.AddLine(startPoint, endPoint)

        startPoint(0) = padxhalf - abdistx - 1.5: startPoint(1) = (padyhalf - plateyhalf) + abdisty:
startPoint(2) = 0#
        endPoint(0) = padxhalf - abdistx + 1.5: endPoint(1) = (padyhalf - plateyhalf) + abdisty:
endPoint(2) = 0#
        Set abcenterline1 = ThisDrawing.ModelSpace.AddLine(startPoint, endPoint)

        startPoint(0) = padxhalf - abdistx: startPoint(1) = (padyhalf - plateyhalf) + abdisty - 1.5:
startPoint(2) = 0#
        endPoint(0) = padxhalf - abdistx: endPoint(1) = (padyhalf - plateyhalf) + abdisty + 1.5:
endPoint(2) = 0#
        Set abcenterline2 = ThisDrawing.ModelSpace.AddLine(startPoint, endPoint)

        abdisty = abdisty + aboffset

    Next count

    theform.Hide

End Sub

    'padx = theform.TextBox1.Text
   ' pady = ThisDrawing.Utility.GetReal("Enter Pad Dist. (Y Axis): ")
   ' platex = ThisDrawing.Utility.GetReal("Enter Plate Dist. (X Axis): ")
  '  platey = ThisDrawing.Utility.GetReal("Enter Plate Dist. (Y Axis): ")
   ' abdia = ThisDrawing.Utility.GetReal("Enter Anchor bolt Dia.: ")
   ' abcount = ThisDrawing.Utility.GetInteger("How Many Anchor Bolts?: ")
   ' abdistx = ThisDrawing.Utility.GetReal("Anchor Bolt Dist. From Center (X Axis)?: ")
  '  abdisty = ThisDrawing.Utility.GetReal("Anchor Bolt Dist. From Plate Edge (Y Axis)?: ")
Private Sub UserForm_Click()

End Sub
```



The results of running the base plate routine

- The is the fixblock routine written in VBA, I pasted this particular example because you can see that a few of the routines got much simpler in VBA

```
Private Sub CommandButton1_Click()

theform.Hide

If (ComboBox1.ListIndex = 0) Then

   For Each Block In ThisDrawing.Blocks

        For Each Object In Block

          If (TextBox1.Text <> Null) Then Object.Layer = TextBox1.Text Else:

          If (TextBox2.Text <> Null) Then Object.color = TextBox2.Text Else: Object.color =
256

        Next Object

   Next Block
```

```
    ThisDrawing.Regen acActiveViewport

    theform.Hide

End If

If (ComboBox1.ListIndex = 1) Then

    Dim theSelection As AcadObject
    Dim selectedBlock As AcadBlock
    Dim thePoint As Variant

    ThisDrawing.Utility.GetEntity theSelection, thePoint

    If TypeOf theSelection Is AcadBlockReference Then Set selectedBlock =
ThisDrawing.Blocks.Item(theSelection.Name)

    For Each Object In selectedBlock

        If (TextBox1.Text <> Null) Then Object.Layer = TextBox1.Text Else: Object.Layer = 0

        If (TextBox2.Text <> Null) Then Object.color = TextBox2.Text Else: Object.color = 256

    Next Object

    ThisDrawing.Regen acActiveViewport

End If

    With ComboBox1
        .RemoveItem (0)
        .RemoveItem (0)
    End With


End Sub
```

The fixblock routine, revised and running in VBA

***for legality sake, I was unable to publish any of the ObjectARX and C++ raw code. Being that VBA is unprotected code, there was no legal issues with publishing it in this document.