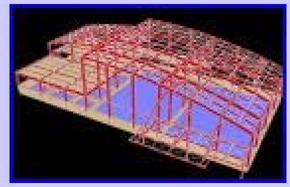
IES
10 Years (1994-2004)

VirtualWork

A newsletter for customers and friends



Volume 10.3, March 2004

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Timeline 1994: IES is Born

It was March of 1994 when the IES empire was officially launched. Dr. Dan and Ph.D. candidate Terry were discussing the future. The two had been working on a research project for the previous 18 months, which had culminated in a humble structural analysis tool called "*WinFinite*".

WinFinite for Windows

WinFinite represented a new state-of-the-art way of building and viewing finite element models. Finite element analysis had been around for a long time, but programs on the PC were still very difficult to use, holding tightly to their mainframe roots. Programs were also fairly costly to purchase. *WinFinite* was developed under a state grant at Montana State University and was also made possible by research funding from CH2M Hill. Envisioned primarily as a teaching tool and to provide basic structural analysis to engineers in the remoter areas of Montana, *WinFinite* was made very easy to use. *WinFinite* was the result of research in object-oriented design, human-computer interface ideas, and modern graphics. The whole project was based on a hunch that this "Windows thing" was going to be as successful in the engineering marketplace as it had been in the business world.

Will Windows Win?

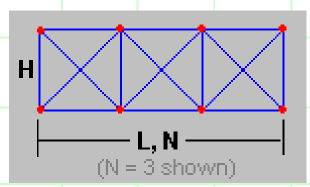
At that time, DOS was king and Windows was an upstart interface layer on top of DOS that made the computer palatable to business-people. Microsoft had created Word and Excel to compete with WordPerfect and Lotus 123. Yet, engineers still mostly preferred the command line without "fluffy" menus and icons that just got in the way of serious numerical processing. A few of the commercial providers of engineering software had "ported" their products to Windows, but most still retained their old command file, or command line structure and used "computer" rather than "engineering" terminology.

Research Success

WinFinite was different. This tool provided immediate graphical feedback for just about everything you created. It allowed you to sketch models directly (like a CAD program) and click to edit element properties. (Things we now take for granted.) It was an immediate success both with

Howe To Generate Standard?

Every now and then customers ask about **How To** create models that are not included in the **Generate Standard** command. We have built VisualAnalysis to allow you to create your own parametric structure types. Here is a "mini" tutorial on How to create this **Howe Truss:**



Step 1: Edit GenerateStandard.txt

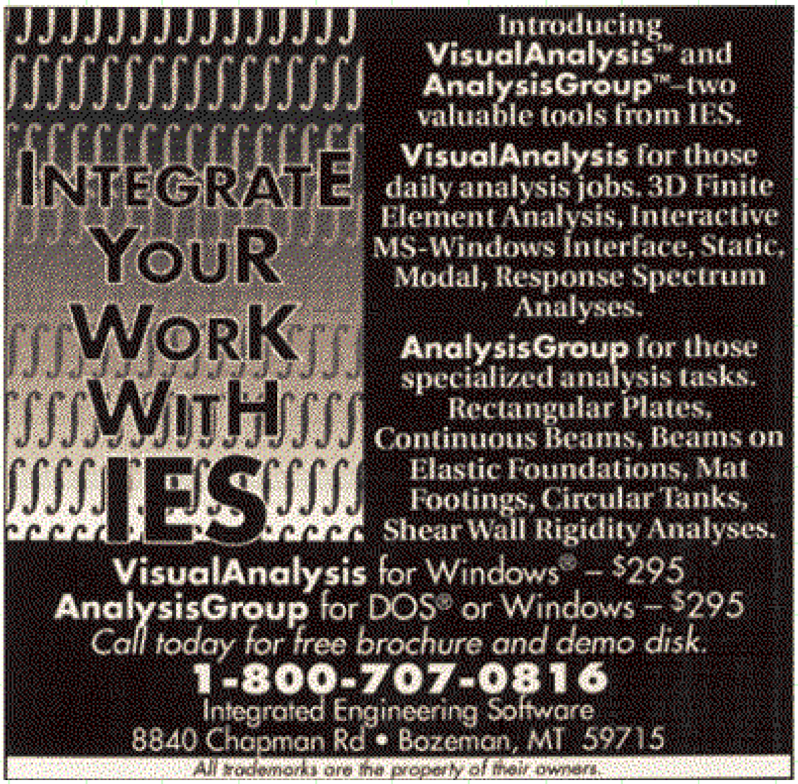
This text file is located in the IESCommonFiles folder typically located under "C:\Program Files\IES\". You may edit this file with NotePad or any text editor. There are instructions at the bottom of this file to help explain the commands and organization.

Because the Howe Truss is so similar to the Warren Truss with verticals, you can copy that section of the file and then modify it.

Here is the definition of the Howe Truss that you can type into this file. The students at MSU and also with local engineers who came out for a seminar to learn about finite element analysis.

Academics or Business?
So Dr. Dan was asking Terry what he was going to do if and when he ever finished with school. Terry responded with something like "I want to marry my computer science education with my engineering background and write structural software." At that point we began discussing the possibility of creating our own software company using *WinFinite* as a springboard. We knew it was as good as many of the programs on the market. We made a small business plan and started talks with MSU regarding licensing the technology for private use.

Within a few months we were running this (ugly) ad in Modern Steel Construction and in ASCE Civil Engineer:



Next Month
Read about those first few months and the "virtual headquarters" in our next issue of *Virtual***Work**.

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ShapeBuilder 4 'I Want That!'

We all love to use new tools that work great and make our lives easier. ShapeBuilder 3.0 has been a great little utility knife for structural engineers and others in a wide variety of fields. Its ability to calculate areas and other properties of very complex geometries has made it indispensable for many IES customers.

Good News and Bad News

keywords are in bold, the rest is stuff we "made up" for our definition.

[Howe Truss (X-Y)**]**
{PT, PF, ST, SF, TRUSSES}
Howe.bmp
PARAMETERS
L H
N
PARAMETER DESCRIPTIONS
Truss &length, L:
Truss &height, H:
&Panels, N:
PARAMETER LIMITS
L none 0
H none 0
N none 0
PRIMITIVES
5
MEM N 0 0 L/N 0 0 0 0 0 L/N 0 0 BC **FIX**
MEM N 0 0 L/N 0 0 0 H 0 L/N H 0 TC **FIX**
MEM N 0 0 L/N 0 0 0 0 0 L/N H 0 D **PIN**
MEM N 0 0 L/N 0 0 0 H 0 L/N 0 0 D **PIN**
MEM N+1 0 0 L/N 0 0 0 0 0 0 H 0 V **PIN**

The first line consists of a name ("Howe Truss (X-Y)"), allowable structure types (**PT,PF,ST,SF**), and which 'group' to show this within the **Generate Standard** dialog box ("**Trusses**")

The next three sections define variables to use in creating the truss. The first two are distances and the second is an integer or "count".

The **Primitives** section is what actually generates the members of the truss. We require five commands to generate each of the following members: bottom chords (BC), top chords (TC), diagonals (D), and verticals (V).

The **MEM** command takes four X-Y-Z chunks of information. Look at the first **MEM** command to see these:

N 0 0 = Generate N copies in X, none in each of Y and Z directions.
L/N 0 0 = Space the members L/N apart in the X direction.
0 0 0 = Start the first member here.
L/N 0 0 = End the first member here.

Finally the MEM command defines a name prefix (BC) and a connection type. We want continuous chords, so we use **FIX**. For web members we want truss connections so we use **PIN**.

Step 2: Draw a Picture
In the VisualAnalysis 5.1 Package folder is a bitmap called *GenerateStandard.bmp*.

So many customers are using this product, that some days the technical support staff hears nothing but ShapeBuilder questions! This is both good and bad. Good because we know people are using the product, but it is also bad because that means that the software is probably not as "friendly" or "stable" as it should be. In a perfect world, the only comments we would receive would be for new features.

A Perfect World
We don't live in that perfect world and of course we did not implement the perfect product. ShapeBuilder 3.0 has some weak spots. The good news is that we are already working on version 4.0 to be released **later this year**. The new prototype in the lab has been given a blood transfusion through the new Microsoft .NET 2003 C++ compiler. This has cleared up some "quirky" behavior that we had traced back into the *Standard Template Library* implementation in the older environment.

Can You Zoom any Better?
We have also given the new prototype a good shot in the arm with "Zoom Technology". The new version will allow you to use a Zoom Window to drill down to a specific feature on the cross section.

Bugs and Features
About a dozen **minor bugs have been squashed** and we have a long list of features on our list of requested improvements. Of course, we will not be able to implement ALL of the requested features with the next version, so we want to implement the right ones. **We need your help!**

I Want That!
If you use ShapeBuilder, then we ask that you help bring this new version to life as quickly as possible. Visit the ShapeBuilder 4 'I Want' Form *[link expired]* to rank the new feature ideas and to add a few ideas of your own. This will help us get the next version out with a minimum of time and without disappointing you!

Click Here to: Help IES with ShapeBuilder 4 *[link expired]*

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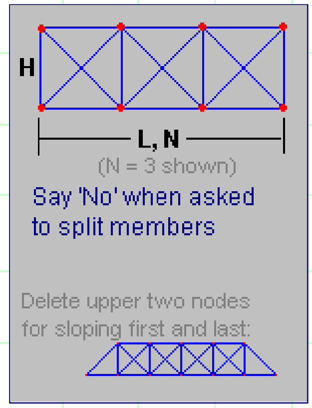
Ask Dr. Dan: Plate Results

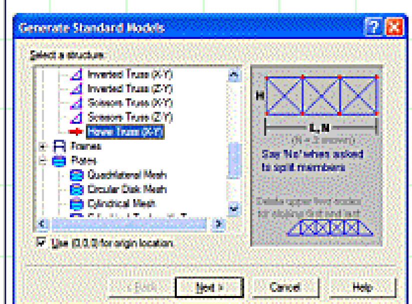
Caution: Theory Zone Ahead!

A Customer Writes:
I have a plate analysis with a linear plate pressure. When I look at the results, the shear values do not vary linearly across the plates. There must be a bug...

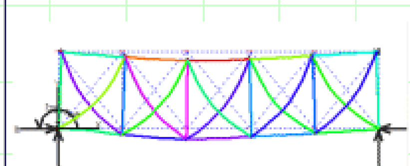
You can open this up in MS Paint, and draw a picture of your Howe Truss. Then save it as Howe.bmp, in the same folder. When the text file is read, it will read this name and display your picture.



Don't Believe It? Try It!
If you don't believe this works and is this easy, you can try our solution. Download the Howe.zip file into your C:\ folder and unzip it. Once the updated *GenerateStandard.txt* file is in place you should be able to generate the Howe Truss model. (Be sure to say "No" when VA asks to split crossing members!)



Feel free create more parametric model definitions to help you speed up your work. You could generate a full 3D Howe Truss including all the lateral bracing, floor beams and stringers all in one step if you have just a little 'programmer' in you.



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Dr. Dan Replies:
I agree with your comments about how the shear force in the plate should vary across it in much the same manner as a beam would carrying a distributed load. For beams in VisualAnalysis we actually use statics and cut the beam at different locations to get the shears we report so therefore we get numbers that make sense.

Numerical Approximations
Here is where we digress for plate elements. Because of the 2-way action in plates we cannot draw the simple free body diagrams we can for beams and calculate internal forces using statics. Instead we must rely on the displacements of the nodes (which are accurate) and the numerical approximations employed by the particular finite element used.

Derivative Accuracy
Without going into the reasons, the numerical solution is most accurate at the centroid and goes down in accuracy as you go away from the centroid. Furthermore the accuracy decreases as you take derivatives to arrive at the quantity, i.e. displacements are most accurate, followed by moments and last of all shears, which involve the 4th derivative of displacements. For plate elements, the applied pressure load is not considered at all in the calculations of the shear forces, only the derivates of displacements, therefore a statics argument while valid is not really used.

The Need for Mesh Refinement
You could argue that *"If statics are not valid what am I getting?"* and the answer is: *"An approximate solution!"* The only way to improve on the approximate solution is to use more elements (refine your mesh) which can reduce the discrepancies you are seeing.

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