

The Times, They are a Changing....

The Changing Face of Software for Structural Engineers

Change has a considerable psychological impact on the human mind. To the fearful it is threatening because it means that things may get worse. To the hopeful it is encouraging because things may get better. To the confident it is inspiring because the challenge exists to make things better.

King Whitney Jr., 1967 Wall Street Journal

As this 10th anniversary issue was developed, we naturally took stock of where structural engineers have been and where we are going. Certainly the economy, global marketplaces, advances in materials, larger and larger projects and more have been decisive drivers of change for the structural engineering community. In addition, the impact of technology on the profession — how we design, construct, even run our businesses — has been definitive.

In 1964, Bob Dylan made “The Times...” phrase a mainstay in American vernacular. Things change... the underlying difficulty is how fast they change. With advances in technology, what took years to evolve back in the 60’s seems to take mere months today. The speed of change is disconcerting to many of us... in our businesses, in our profession, at home, everywhere.

Ten years is a short time frame in the scheme of things. Do you realize that ten years ago, when STRUCTURE was a fledgling newsletter, use of the internet, email, cell phones, and more were still very new and not very prevalent? Think back to a time when the fax machine was a new gadget. That technological advance in and of itself dramatically changed the way we do business. Clients could still call and request a design revision. However, their new expectation was “fax it to me”, which meant “I expect the information quickly – as fast as you can fax it.” A mere ten years later, that same request comes via email and expectations for a speedy reply increase exponentially. “Did you

get my email?” now means “I sent the email ten minutes ago, why haven’t you responded?” Cell phones, PDAs, smaller and smaller laptops, wireless, high-speed access... the times, they are a changing.

To write about all of the changes that technology has imposed on structural engineering and how we run our businesses would take much more space than is available here. Instead, we concentrated on software... where structural engineering software was ten years ago, where we are today and what is on the horizon as we look forward to STRUCTURE’s 20th anniversary. We talked to vendors and users alike for input and a little bit of “visioning”.

The firm’s challenge was to find a software package that would streamline the entire structural design process, from engineering to documentation. One obvious expectation is a drastic reduction in RFIs (requests for information). That will save time for the Contractor and the Engineer, which will make both of us more competitive.

*John Goetter, Graef, Anhalt, Schloemer and Associates, Inc.
Autodesk Revit Structure*

Where We’ve Been

Let’s start back in the 1970’s, when the explosion of structural engineering software had its beginnings. Individual vendors had individual platforms and directions. Some vendors ran their software on mainframes, and others took a chance on the emerging PC market. Jump to the 1980’s and see numerous smaller software companies decide to join the PC frenzy. The computing industry was quickly changing the access that structural engineers had to modeling programs, allowing for more complicated designs and new directions.

Santanu Das, VP Engineering, Research Engineers International, noted that the mid 1980’s brought automation and globalization into the mix. “STAAD decided to separate itself by taking a more graphical approach towards structural modeling, incorporating the first automatic load generation techniques (i.e. wind, seismic, floor, etc.) and broadened the scope of analysis and design by adding several international design codes from around the world. Multi-national companies could now use one product and multiple geographic design teams to work on projects from around the world. The ASCII based files produced by STAAD enabled engineers from around the world to parse the input and output and embed the relevant data into other design systems like PDS.”

In the early nineties, smaller companies decided to branch out of the mainstream and wrote specialized programs that addressed more specific structural venues like bridges, towers, offshore platforms, and other markets. Companies began to write software for the post-tensioned concrete, bridge and steel connection markets, respectively. Other companies addressed even smaller design processes like retaining walls, footings, foundations

and others. On top of this, hundreds of analysis and design software companies began cropping up in countries around the world including the UK, France, Germany, China, Australia, India, etc. The advantages of each basically revolved around the simple fact that they addressed their territories much better than similar software from the US. In response to this, US companies opened up offices around the world to bring local support and customization to markets not familiar with the US process of engineering. A simple steel portal frame in the UK is designed for different loading patterns, different design methodologies, different cross sections, etc.



Over the same time frame, software programs began to become much more affordable. Bruce Bates, President, RISA Technologies, explained the change. "In earlier years, the engineer was required to reserve space on a mainframe to run his or her analysis. These costs could equate to thousands of dollars per run. Back then, the engineer spent a lot of time making sure that the input was perfect, in order to save the cost of multiple runs. In addition, little was done to create multiple scenarios or 'what if' situations, again to save run costs." With the cost of computing power coming down, the engineers' time was optimized. And, the ability to run multiple versions opened up possibilities for lots of new and more creative designs.

With new found efficiency, productivity and creativity, the structural engineering community began to see more entrepreneurs open their own shops. And design possibilities seemed to be endless.

However, according to Santanu Das, "To complicate matters, larger CAD companies defined the basic platforms for the A/E/C industry, forcing companies to migrate data from an architect to an engineer to a designer to a detailer and possibly back the other way. With multiple formats like DXF, DWG, DGN, STAAD, etc. and various out of phase versions, it was impossible to get a consistent streamlined workflow."



In China, we are able to use software based on local and national building codes. This allows for better communication and facilitates review by local institutes and jurisdictions.

*Peter Lee, S.E.
SOM*



Fast Forward to Today's Market

As engineers continued to manually transfer information and data from one system to the next, the common frustration was "Why don't things talk to each other?" To overcome the problem, industry consortiums formed to produce a standard neutral file system that all vendors could read and write. The first version never really caught on, but CIS/2 is slowly being embraced. However, competing file formats began muddying the waters again. Some companies came up with their own architecture, enabling engineers to extract any data they wished and link it to third party applications.

Today, the buzz words are modeling and integration. As Bruce Bates commented, "Over the past ten years, the move to modeling is extremely important. Today, an engineer can look at all kinds of views, slices, pieces and more." Peter Lee, S.E., Associate Partner with Skidmore, Owings & Merrill LLP (SOM) in the San Francisco office, comments that advances in structural engineering software and modeling have provided his company with the opportunity to further design excellence at all levels. The continued increases in capacity and capabilities of structural engineering software have allowed for great strides in the automation of analyzing and designing structures. "However, we still look at our structural analysis modeling and results very carefully. We ask 'Does this make sense?' 'Are we capturing the real structural behavior in our model?' 'Can we build what we model?' We are able to verify what we are looking at. It gives insight into the behavior of the structures and quality of design."



The bidirectional link between RISAFloor and Autodesk Revit Structure will improve efficiency and increase the ability for structural engineers and drafters to do concurrent building modeling and analysis.

*Olimpio DeMarco
Autodesk Structural Solutions*



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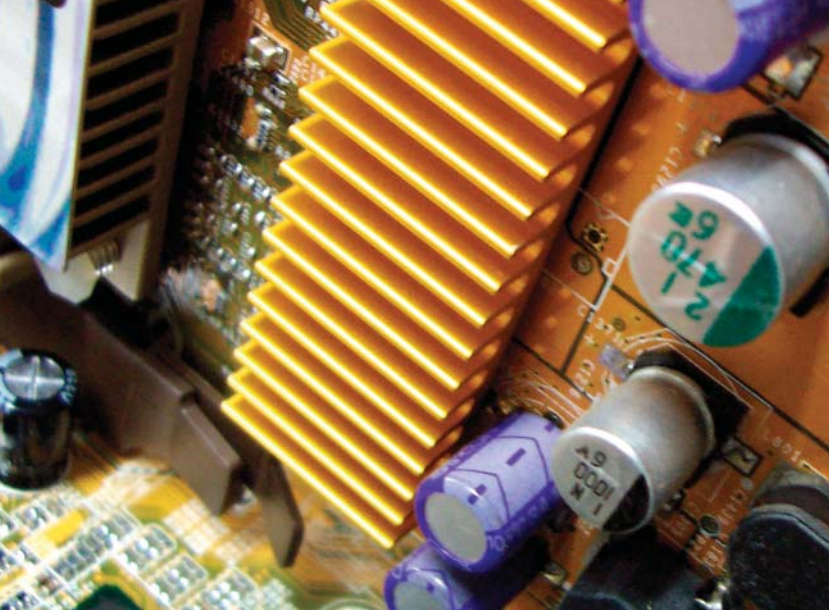
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The good news is that software vendors employ structural engineers and/or collaborate with SE firms when developing the tools that the industry needs. For many years, SOM has collaborated in the development and application of structural and earthquake engineering software with Computers & Structures, Inc. (CSI). Although there is always room for improvement, “these tools have been very important in our work,” says Lee.

Noah Cole, Public Relations Consultant, Building Solutions Division, Autodesk, Inc. summed it up as, “Progressive firms recognize that technology should be an integral part of doing business, in order to make the job of engineering easier. That change is good. Up until now, we had ‘point’ solutions and analysis software that each served a particular function. And, many software components each specialized in a particular solution. The move is, and should be, to a common 3D model.”

The engineering software industry has been consolidating and moving toward full integration of software capabilities. The joining of REI’s engineering operations, including the STAAD brand of software, with Bentley as a leading software provider to the AEC market, form(s) a powerful complement (to) seamless workflow processing capabilities for engineers around the world.

*Amrit Das
netGuru Chairman and Chief Executive*

The solution for many software firms is partnering. Many of the industry’s vendors are collaborating with, even out right purchasing, other vendors to make their products more seamless. Not only in terms of program language, but across disciplines, like piping, HVAC, fabrication, and more. Also between analysis, design, modeling and CAD. The goal is to reduce the number of entry points to increase efficiency across the board.

However, who “owns” what, how to preserve each industry’s portion of the design, licensure issues and more remains a strong debate and continues to define how fast this new change can occur. Michael Gustafson, Product Engineer with Tekla, Inc. sees causes and solutions in delivery systems. “The whole Design/Bid/Build environment created a mentality of barriers across trades. With the push to Design/Build and larger projects, better coordination is a necessity. Visionaries who find ways to overcome the concerns are being highly successful. Efficiencies and productivity are improving immensely, and the quality of drawings is becoming much better for those who stay up-to-date with the model.”

Five years ago, about 5% of the various building disciplines were using and sharing 3D models; today, that number is nearly 40%. More and more, the problem of “how do we talk to each other” is being overcome. And the results are more profitable projects.

General Motor’s Worldwide Facilities Group is applying 3D Virtual Factory Initiative (VFI) solutions for the design, coordination, and construction of the new Lansing Delta Township Assembly Complex in Michigan. Ghafari Associates, lead architect/engineer for the project, was able to help decrease re-work and increase the quality of the 3D model by implementing workflows and procedures to incorporate structural 3D analysis data directly into the 3D models.

*Christine Byrne, Bentley Systems, Inc.
TriForma*

What Does the Crystal Ball Say About the Next Ten Years?

In talking to software vendors, the crystal ball answer is essentially the same... we will still be using the same software programs, but the overall experience will be more centralized throughout the whole chain of industries involved in designing/constructing a structure.

The next step is not necessarily changing the software dramatically, but rather moving the “workflow” to a higher level. The whole process of Building Information Modeling (BIM) will continue to improve communications across team members and provide a more cohesive project atmosphere. According to Peter Lee, “The challenges and opportunities in future software development lie with the integration of different platforms, using CAD + structural modeling + data management systems in the A/E/C delivery process... using 3d modeling across disciplines, with building information *management* as an integral part of project design-to-construction.”

Except, BIM is really nothing new. Even with paper and pen, we all used to design and change and redesign, and then pass the information along to another link in the chain. With technology, the whole process is just more efficient. The improvements will be made in how well we all play together in the BIM “sandbox”. There are two basic approaches: one big “black box”, or a node that is fed by individual software programs found in any industry. Both have their merits, and both are feasible.

Some software visionaries we spoke to believe that the solution is to have more consolidation, resulting in one or two vendors who bring many of the industries under one roof. Although terminology and even modeling approaches may differ, the underlying analysis is the same. So rather than have hundreds of vendors address each specialization, why not have one or two? The cost of training, maintenance, procurement (contracts with a hundred vendors versus 2 or 3), etc. theoretically would go down. Mechanical engineers can interact with structural engineers in real time.

Our firm is developing and embracing BIM modeling as a means to better coordinate and interact with our clients and downstream suppliers. This allows us to interact better with other disciplines during the design phase and provide a higher order of information to detailers that will process our documents and models into shop drawings.

*J.R. Barker, Structural Consultants, Inc.
Tekla Structures*

On the other hand, some of the software visionaries believe that the impetus should be on a common node to input data into the model, allowing all the specialties to continue rely on their usual vendors. The theory is that individual vendors can continue to concentrate on a specialty, and will be better equipped and more nimble in responding to change that occurs within a specialty. The trick is in getting the data transfer to be seamless, regardless of the origin or the model. And still, mechanical engineers can interact with structural engineers in real time.

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Either option is feasible. As usual in a free commerce, the marketplace will decide the outcome. It is even possible that both options will exist simultaneously.

The future will also rely heavily on collaboration. Some companies are realizing the need for the building of digital libraries to allow for "immediate" access to past project design work to aid current and future projects. And for business owners, employers and employees, it is also about managing the whole job. We need to share not only drawings, reports, schematics, and a plethora of engineering data, but budgets, expenses and resources.

We can now assign staff to tasks easily and balance their workload. Also, we can promise completion dates for projects, there is no more guessing. Instead we make informed decisions using real-time data.

*Tony Ashai, Ashai Design Corp.
BillQuick Resource Allocator*

Will Breiholz, General Manager, BQE Software Inc., deals with the business side of engineering software, and is familiar with the workplace trends that are driving change in that market. "In today's business environment, everyone seems to be displaced. Employees often work in multiple offices and at multiple jobsites. And, businesses utilize consultants for specialized portions of projects. All of these professionals, from all sorts of locations, need access to project information. From timelines, to budgets, expenses and who is available to work on what." Rapid access, the ability to input new data and immediately see impacts on the project is critical. The old way of waiting for reports from accounting or HR, or going through a myriad of supervisors and crew chiefs to determine where the project schedule and budget are really at, or whether Jane Doe is available to work on the revisions this Friday, will not be expedient enough for the projects of the future. Collaboration software and technology will allow for "instant" access by numerous users to data, programs and more.

...a 'firm-wide' view of all projects and resources. Having real-time data at my fingertips tells me when I can take on new work or re-allocate resources to projects that have fallen behind schedule to ensure that the deadlines are not missed.

*Lionel Garcia, Sole Practitioner, Structural Engineer
BillQuick Resource Allocator*

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How Do We Get There?

Impediments to change will continue to be "engineering inertia". Engineers can tend to have a hard time seeing the advantage or efficiency in something new. Many live by the rule "wait for a year or two to see if the new technology really works." The trouble is that the speed of change has begun to exceed our one or two year timeframes and we can rapidly be left behind. It's about risk and reward. When counterparts decide to take the risk and begin to reap the rewards in competitive advantages and more, we will be forced to change the old inertia.

Technology will change the way we work, the way we conduct business, the incredible structures that we will design, and much more. "Visioning" what the next ten years will specifically bring is difficult, at best. We can, however, speculate. And we can accept that we should be prepared for the changes that will inevitably come. The underlying theme has been defined – integration and collaboration. Our job now is to watch for the most efficient solutions that will allow us to succeed.

For the future, the best scenario was summed up well by Olimpio DeMarco from Autodesk, "Whatever the future, the bottom line is to make engineers more efficient, so that they can spend more *quality* time doing what they were trained for... engineering." ■

The impacts of technology and software on structural engineering...watch for updates throughout 2006 in STRUCTURE magazine. If you have a story on how technology changed the way you engineer your projects or your business, contact publisher@structuremag.org