

## **BIM and the Structural Engineer: Why you need to pay attention**

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Building Information Modeling (BIM) is a rapidly approaching “wave” to our profession, and there are credible reasons why structural engineers must pay attention. This belief was reinforced in May during the 2007 Structures Congress in Long Beach, after attending the first meeting as a member of SEI’s newly formed Committee on Building Information Modeling. This committee will have a number of important functions, some of which include representing structural engineers’ interest in this important topic as well as providing timely information on BIM that structural engineers need to know. However, all of this activity raises a more fundamental question for the practicing structural engineer striving to complete quality, profitable work under demanding schedules: *“Why is BIM happening now and is this wave large enough to warrant our attention?”*

BIM is a parametric, object-based multi-dimensional model that is a dramatic departure from 2D or 3D CAD. These models have intelligent building objects that are capable of facilitating Electronic Data Interchange (EDI) of vast amounts of information with other models and analysis applications. BIM with EDI represents a paradigm shift unlike anything ever seen by our profession. Such a bold claim is based on the well-documented BIM pilot projects that demonstrate the integration of stakeholders from all aspects of building design, construction and ownership. While parametric modeling is new to building design and construction, it has significant history in other professions. For many years, the aerospace, automotive, processing, and manufacturing industries have employed parametric modeling. My interest in this topic began a decade ago, when my graduate work entailed parametric computer modeling of a mid-rise building for lateral analysis that fed separate applications for analysis via EDI. After many long nights working with the models, I came to some basic conclusions about parametric modeling. First, our profession would not fully embrace BIM until three essential criteria were in place, similar to other industries that transitioned to parametric modeling: (1) computer power, (2) affordable internet bandwidth, and (3) a common framework that would support EDI. Secondly, I realized that the industries that had already transitioned to parametric modeling never went back to CAD or board drafting. Many will say that our profession is very different because buildings are unique objects that are not mass-produced like airplanes and automobiles. Please consider the following.

Our profession is poised for BIM because the identified criteria are available - and finally considered economically “within reach” by the building and construction design community. Consider the first criterion, computer power. The CRAY-1 mainframe of 1976 cost \$8.8 million with 8 megabytes of memory. In today’s dollars that would be \$32 million. Today, a PC-based computer with 2 gigabytes of memory deemed BIM-capable and much more powerful than the CRAY-1 is readily purchased for less than \$2,000. In terms of internet bandwidth, the second criterion, transferring a typical BIM file takes around 10 Mb minimum. In the early 90’s, only 7 and 14 kbs dial-up modems were considered affordable for most firms, with speeds that realistically could not transfer BIM models. Now, even one-person design firms can afford bandwidth speeds 50 to 100 times faster than those first modems, easily facilitating the necessary transfer for BIM. The third and arguably most important criterion is the development of common platforms that allow the models to ‘talk’ to each other. Software vendors and industry standards organizations are enabling our profession to transition to parametric

modeling in an economically attainable way. This wave of change can be measured in months, not years. BIM software is updated on a semi-annual basis, and multi-million dollar acquisitions of BIM related software companies by Autodesk, Bentley, and Graphisoft are occurring at an almost quarterly frequency. These companies are making such substantial investments because they know that this transition will not take decades, like the transition from board drafting to CAD. In contrast to CAD, BIM involves electronic management and organization of databases that allow divergent groups of designers and contractors to extract useful information to aid in collaboration and more efficiently perform their respective roles in the process. Think of CAD production as a library filled with paper books while BIM is a fully searchable 'internet' version of the same information. Stakeholders and users of the information we create want the speed of the BIM "internet" method of organizing building design and construction information.

To get a sense of how rapidly BIM will advance on the building design profession, consider the results obtained by combining information, computer power, bandwidth, and a common platform as demonstrated in 1993 by Marc Andreessen. What began as a modest graduate project, creating a common computer platform for text and graphics over the internet, became a web browser Andreessen called "Mosaic". His version 1.0 was released on April 22, 1993, and very soon thereafter, the name was changed to Netscape and, of course, the rest is history. Consider that the internet actually began life in 1969 as ARPAnet (Advanced Research Projects Agency Network). In less than five years of a common graphic-rich platform that allowed EDI of massive amounts of information between different companies, many businesses and professions were radically transformed. The exponential speed of market acceptance after 1993 of this new paradigm did not follow the previous two decades of the Internet's linear development.

I am not saying that common BIM platforms will have as profound an effect on the overall economy as the common platform of the web browser. However, the BIM transition will happen at a surprising speed to many structural engineers, similar to the internet's amazing growth in the five to ten year time frame after 1993. Globally, this is seen in the building industry in the last two years in several areas. The governments of Norway and Singapore require the use of 3D parametric BIM models for plan submission and review. Germany will soon require BIM in public projects. Closer to home, the US Coast Guard and the General Services Administration have adopted BIM requirements at various stages of their projects. A 2004 National Institute of Standards and Testing (NIST) study documents almost \$6.7 billion lost annually during building construction as a result of poor data interchange (lack of BIM with EDI). This report also points to a large economic potential fueling the rapid paradigm change toward BIM in the building design profession. Last year the AGC issued "A Contractors Guide to BIM", and this year the first part of the National BIM Standard draft was published. The American Institute of Steel Construction has been working since 1998 on developing an open standard computer language that facilitates EDI. This effort has resulted in many well-documented successes with structural steel BIM models passing through into construction. Furthermore, private sector clients such as General Motors have mandated that BIM be used on all of their future facility construction. Without question, the financial impact of these examples for stakeholders throughout the building life cycle will drive this exponentially growing BIM wave in our profession.

While in Long Beach, I had some time to visit the beaches in the area. The ocean reminded me of some important aspects of waves. They seem to start small in the distance and it is hard to predict when they will crest. They can have surprising power that can sweep you under at times and it is hard to stand on the shifting sand created by the undertow after the wave hits. With proper planning and training, however, one has the ability to ride the wave instead of being pulled under. I look forward to participating in the work of the SEI Committee on Building Information Modeling as it gives structural engineers the information they need to embrace the

challenges and avoid the undertow while riding the growing BIM wave.

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