PREPARED FOR ANY DISASTER

Building Information Modeling provides 3D information helpful in planning before, during and after a disaster event

Imagine this scenario:

Firefighters have been called in as first responders to a blaze in a commuter tunnel. There is no power and no ambient light. Working in the pitch dark, they must always be aware of their surroundings relative to the incident and the exits — while also knowing where people are likely to be sheltering, and where equipment containing flammable fuels is stored.

"A tunnel fire is every firefighter's nightmare," says David Loughery, regional account manager for Allplan. Loughery knows — as an engineer, he's been on scene at such incidents.

Until fairly recently, an event like this was a recipe for potential disaster. Engineering drawings that contain the layout of the tunnel might be available, but they would have to be acquired and then analyzed. Reading large rolls of paper

plans in a burning tunnel, which may also be experiencing water damage, isn't a practical option, nor is having someone try to explain them second-hand via radio. Getting electronic versions of them would be ideal, but that's assuming they're available in the first place. How much of the design was altered after the plans were drawn? This is a very common occurrence, but with the citizens' and the firefighters' lives at stake, there's no room for guesswork.

BIM is a comprehensive and practical tool that can provide vital and accurate information during and after a disaster event.

Now, instead, imagine that the responders have durable, battery-powered tablets containing the entire plans for the tunnel in three dimensions. The model indicates the location of every key element, equipment room, exit, supporting structure, and walkway. Emergency personnel can travel with precision through the tunnel by simultaneously traversing the 3D model as a reference.

Even better, if the software integrates with global positioning systems, the firefighters can orient themselves in the tunnel with pinpoint accuracy in the dark, using that information to formulate an evacuation plan and mitigate the hazards.

This isn't science fiction. It's real, and it's called BIM.

WHAT IS BIM?

BIM (an acronym for building information modeling) is highly sophisticated software that draws and renders the plans for structures like bridges, buildings and tunnels in 3D. BIM models replace traditional, printed plans and CAD drawings, and contain critical data that conventional drawing methods can't capture. However, BIM is much more than just an upgraded blueprint.

BIM models are integrated three-dimensional plans that show:

> Structural reinforcement
> Fixtures
> Tendons
> Visualizations, sections and views

BIM also:

> Performs structural analysis
> Calculates stresses and tolerances
> Catalogs hazardous materials used in construction
> Identifies at-risk components during a disaster
> Compiles a database of key construction information
> Allows internet-based sharing of plans

With these features, BIM represents a highly comprehensive and practical tool. This is not limited to design and construction; BIM can incorporate crucial information in disaster planning during the construction phase, as well as dealing with disasters during and after they occur.

BEFORE AND DURING CONSTRUCTION

BIM can address the following questions during the design and construction phases, providing and archiving critical information that will be needed in the event of a disaster.

How will the structure react to extreme wind or tremors? During the design phase of construction, BIM can perform simulations of stressors from natural disasters like earthquakes and hurricanes.

What materials are in the structure? Because the software tracks all the materials to be used in the design, it can provide a "deconstructability analysis" which will be useful if debris needs to be removed after an incident, thereby facilitating the waste management effort.

How safe is the structure? Knowing how compliant the structure is with occupational health and safety standards is key, not only when it comes to permitting and construction, but after a disaster occurs. If there are hazardous substances or special dangers present, responders must know about them.

DURING AND AFTER A DISASTER

If the BIM models have been updated with the revisions made during the design and construction processes, they

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will provide vital and accurate information during and after a disaster event by:

> **Assisting evacuation efforts.** BIM can not only provide information about where people are likely to go in an incident, but it can also assist first responders in organizing and controlling the evacuation process to minimize the time it takes to get to the exits and avoid further hazards.

> **Mitigating damage during the event.** Emergency responders can use BIM data to determine on the fly where and how fire will spread, and where the points of potential structural failure are. If there are hazardous materials, responders can take appropriate action to avoid them and prevent them from being compromised.

> **Assessing severity of damage.** Consider surface structural damage, like concrete loss or hairline cracking on a bridge as a result of a collision. In fact, this may or may not be associated with structural compromise. In the past, engineers may have erred on the side of caution by recommending costly repairs, without having full knowledge of whether the visible damage is truly indicative of structural defect. That's because until the advent of BIM, there was no way to be certain.
Or consider a parking garage after an earthquake—BIM can reveal whether the post-disaster sag in the floors is within normal tolerance or if it requires remediation.

> **Pinpointing repairs.** A full BIM model, one that includes rebar position, identifies supporting columns and walls, calculates acceptable stress tolerances, and shows the location of non-structural features like power lines, HVAC ducts and plumbing. Engineers are in a far better position to know how safe the structure is after the incident and how to safely stage any needed repairs.

> **Managing debris.** If the structure collapses partially or completely, waste management will be easier, less expensive and safer if the volumes and types of materials that require disposal are known and identified.

THE FUTURE

"We're going to see a wider acceptance of BIM in the future," says Loughery. "It will become realized as a powerful and dynamic tool rather than as a buzzword."

The data extracted through the software can also serve as a reference database for future projects. Structural deficiencies recorded over time, and analyzed in context with the accompanying specifications, can be used to develop better construction designs and enable prevention of these exact problems in the future.

As BIM becomes more fully integrated with GPS, it will evolve into an even more powerful tool for disaster management. First responders will have access to precise coordinates of key components, like the rebar inside a bridge, which traditional plan drawings don't usually address.

"Infrastructure works on a shoestring," Loughery says. "BIM is already being embraced by departments of transportation who recognize that it makes them much more cost-efficient than they would have been just 10 years ago."

It's only a matter of time before other sectors learn that BIM is an indispensable solution that also reduces material waste during construction and improves the design process to withstand the effects of predicted global climate change.

It's not only about economy and structural integrity, however. "Those of us involved with BIM see it as an important tool for building our vision for a safer future," Loughery says.

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Allplan is a leading vendor of OpenBIM solutions for structural and civil engineers, building contractors, project managers, and BIM managers. Our software enables the integration of 3D into preexisting 2D workflows, and allows different disciplines and trades to collaborate in a streamlined, efficient workflow. A key subsidiary of the Nemetschek Group, Allplan solutions are used by over 240,000 engineers, contractors, and AEC professionals in 41 countries.

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