
Image courtesy of Foster+Partners

LEADING-EDGE TECHNOLOGY TRENDS FOR AECO DESIGN REVIEW

A report for the Architecture, Engineering, Construction and Operations Industry by NVIDIA

TECHNOLOGY PROVIDES NEW OPPORTUNITIES FOR AECO DESIGN REVIEW

In the architecture, engineering, construction, and operations (AECO) industry, design review is a critical phase in the workflow. It can also be one of the most time-consuming. To ensure a final building meets the client's expectations, AECO teams must constantly iterate on designs in response to almost continuous feedback. This review process is further complicated by the increasingly complex nature of AECO design projects, which is happening in more geographically distributed and hybrid work environments.

The AECO industry requires advanced solutions to streamline design review workflows and simplify complex projects. Ultimately, every AECO firm's long-term success depends on adopting and adapting to technology that accelerates design efficiency, facilitates collaboration, and saves money.

As with most industries, digital transformation has come to AECO, and it promises to have a major impact on the AECO design review process. This report highlights some of the key technology trends that will impact AECO design review in the coming years.

CHALLENGES IN AECO DESIGN REVIEW

Slow decision-making on the business side impacts the speed of design innovation.

Technical issues reduce workplace efficiency and contribute to project delays, missed deadlines, and fines.

Remote and geographically dispersed teams lack effective collaboration tools, which decreases productivity and profitability.

> “Sometimes the feedback and changes can seem endless. It’s definitely the most time consuming part of the AEC workflow.”

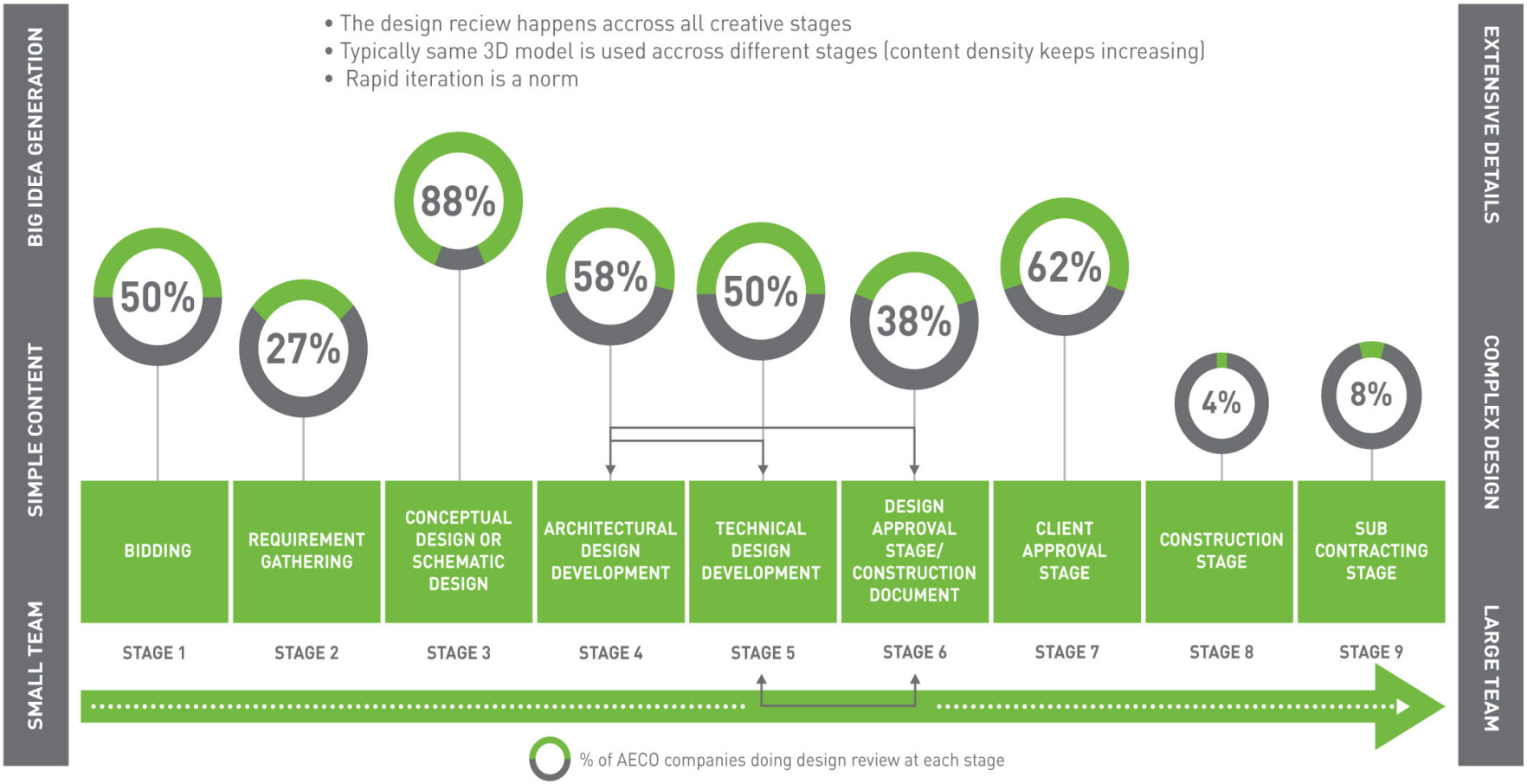
- Zhou, Senior Designer, Yu City Architectural Design Co, China

DESIGN IMPACTS MULTIPLE STAGES OF THE AECO WORKFLOW

The design review workflow takes place during numerous project stages. At each critical stage, engineers, architects, and designers collaborate to update a new version. New technology speeds up each of these workflows.

The typical AECO workflow below illustrates several important design review intervention points:

INCREASING DESIGN TEAM SIZE AND COMPLEXITY



Courtesy of Business Advantage

TODAY'S MOST ADVANCED AECO TECHNOLOGY TRENDS

Technology is increasingly improving AECO team collaboration, communication, and productivity. While some innovations, like GPU-accelerated rendering, are already on their way to industry-wide adoption, new breakthroughs—like artificial Intelligence, virtual reality, and 3D graphics virtualization—are only just beginning to revolutionize AECO design review.

In the future, these technologies will transform how AECO firms operate with their ability to reduce the number of review cycles, keep projects on track, and accelerate the path to design approvals.

GRAPHICS PROCESSING UNIT (GPU)

AECO firms rely on professional GPUs to optimize the user experience for CAD and BIM software tools. Unlike gaming GPUs, professional GPUs are tested and certified by leading software vendors and workstation OEMs to ensure they meet the highest performance standards. AECO firms can select from a broad range of desktop and mobile GPUs to match the diverse requirements of their users. Powerful GPUs in modern thin and light workstations deliver a consistently great user experience for the most graphically intensive AECO applications, ensuring the hybrid workforce can be productive from anywhere.

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GRAPHICS VIRTUALIZATION

AECO firms often have geographically dispersed teams that touch all parts of a project cycle, from design to construction. The new normal of hybrid work is adding further complexity to team collaboration and remote access to project resources. With GPU-accelerated 3D virtualization, engineers, architects, and designers can access the applications and resources they need from anywhere, on any device, while mission-critical designs remain securely in the data center. Users experience the same responsive performance for graphics-intensive software in a virtualized environment as they would from a physical workstation, with the added benefit of improved collaboration and version control. Teams can work remotely on large, complex Building Information Modeling (BIM) datasets while experiencing desktop-level graphics performance. With virtual desktop infrastructure (VDI), AECO company IT departments also gain the ability to on- and off-board project team members rapidly.

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> “NVIDIA RTX Virtual Workstation (NVIDIA RTX vWS) software enables 3D rendering on virtual desktops running in our data center. A lot of standard applications need [NVIDIA virtual GPU technology] for performance, even Windows 10 itself. When you get into using Revit or other high-end design tools, you absolutely need NVIDIA RTX vWS. Without it, performance will not be like a local desktop. With NVIDIA RTX vWS you can give someone less or more hardware resources based on what they need.”

- Leslie Balazs, Technical Analyst, Clark Builders, Canada

GPU-ACCELERATED RENDERING

GPU-accelerated, physically based, real-time ray traced rendering delivers incredibly realistic and accurate visualization of 3D models. Ray tracing is a method of graphics rendering that simulates the physical behavior of light. By combining NVIDIA RTX™ GPUs with GPU-accelerated rendering software, AECO firms can transform the visualization experience, add unmatched beauty and realism to renders, and even make visualizations interactive. Better visualizations can speed design decisions, boost innovation, and keep building and infrastructure projects on track.

NVIDIA RTX GPUs powered by the latest NVIDIA Ampere GPU architecture enable AECO professionals to instantly create cinematic quality ray traced renders—even when working with the most complex BIM models. Moreover, much of today's visualization technology is more accessible than in the past, no longer requiring advanced training to use. With NVIDIA GPUs, designers and architects can take advantage of accessible visualization technology to view their design changes in real time and deliver photorealistic models that help stakeholders make faster decisions with greater confidence.

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Image courtesy of HNTB

> "NVIDIA has helped designers and the renderers to quickly iterate so that the vision of the designer is conveyed through the 3D rendering. Designer and the client now have accurate discussions and the 3D models are updated. NVIDIA products have sped that up. We see far fewer crashes and are able again to orbit on or navigate around those gigantic files. It happens significantly more smoothly than five years ago."

- Visualization and VR specialist, USA

VIRTUAL REALITY

Virtual reality (VR) is revolutionizing AECO workflows with technology that makes it possible to work at scale. VR walkthroughs enable real-world and model-scale immersion of designs that provide a true sense of scale which cannot be matched by drawings and 3D models on a computer display. Design reviews are transformed when using NVIDIA RTX VR Ready desktop and mobile professional GPUs, especially helping non-experts such as owner/developers to more intuitively understand the 3D model with advanced immersive VR experiences.

With this technology, designers and architects can review their concepts in full fidelity and collaborate with clients and colleagues while immersed in VR from anywhere in the world. Conveying ideas and sharing feedback on designs and features early in a project ensures teams can reach design goals faster, identify potential flaws, and reduce costly rework once construction has begun.

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> "NVIDIA allowed for better productivity... we now use [VR] to sit down with clients and go through the building, so it provides a quicker and a faster method to signing off on design."

- Stephen Yates, Information Technology Director, TP Bennett, UK

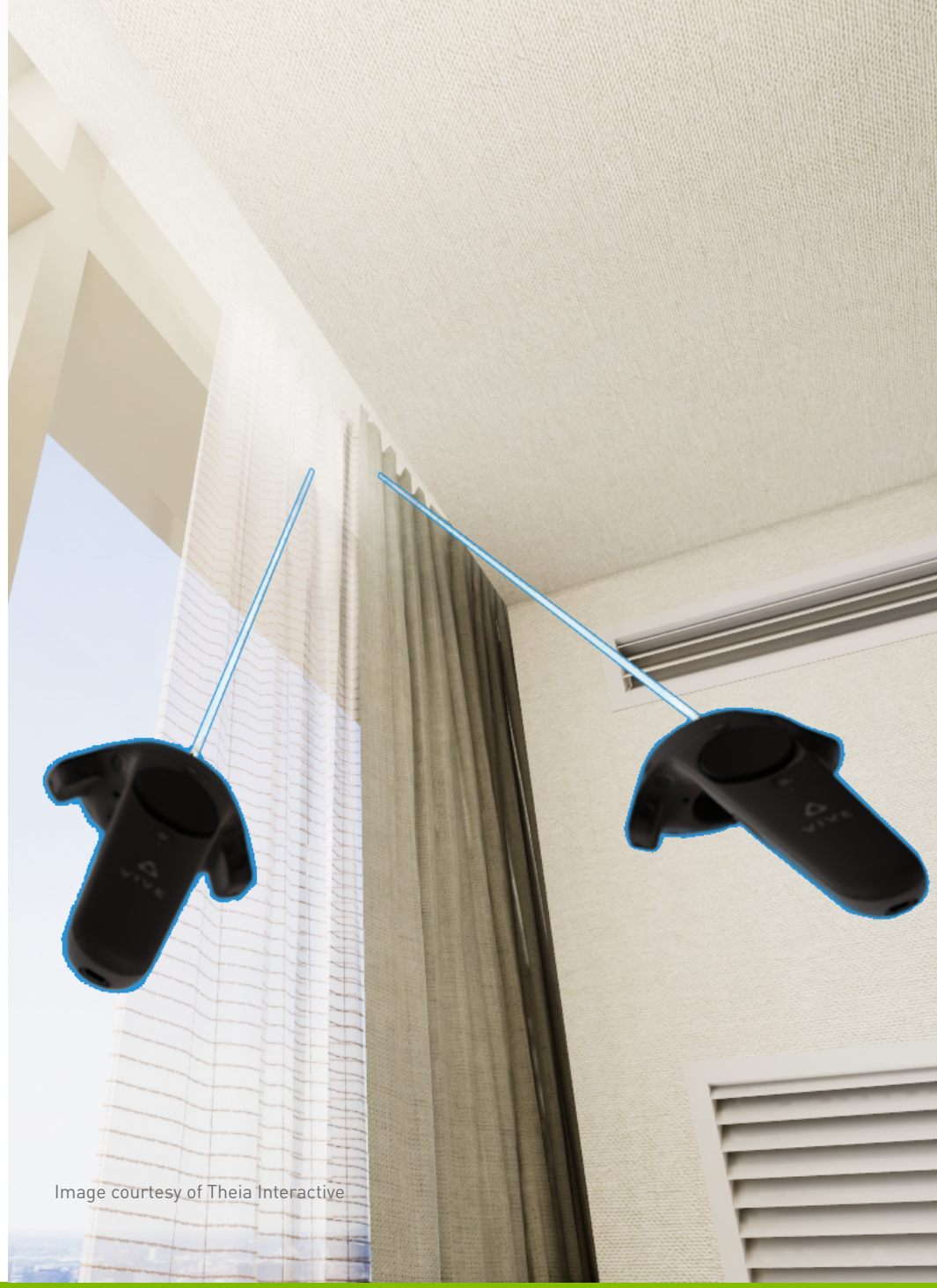

Image courtesy of Theia Interactive

EXTENDED REALITY

The term extended reality (XR) encompasses augmented reality (AR), mixed reality (MR), and virtual reality. The latest breakthrough in XR technology delivers high-quality virtual and augmented reality experiences over networks to standalone headsets and devices. Design teams and clients can stream these experiences from virtually anywhere—they don't need to be tethered to a physical workstation. NVIDIA CloudXR provides this powerful edge computing technology for AECO workflows. Built on NVIDIA RTX technology, CloudXR is an advanced streaming platform that delivers VR and XR across 5G and Wi-Fi networks while also providing bidirectional audio, so AECO teams and clients can discuss design options while immersed in these environments.

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> "From design reviews to digital twins, XR experiences are elevating AEC workflows. NVIDIA is driving the future of XR content with CloudXR, allowing us to easily stream and share high-end pre-visualizations through VR/AR across 5G and Wi-Fi networks."

- Jason Cooper, Chief Digital Officer, Horizon Productions

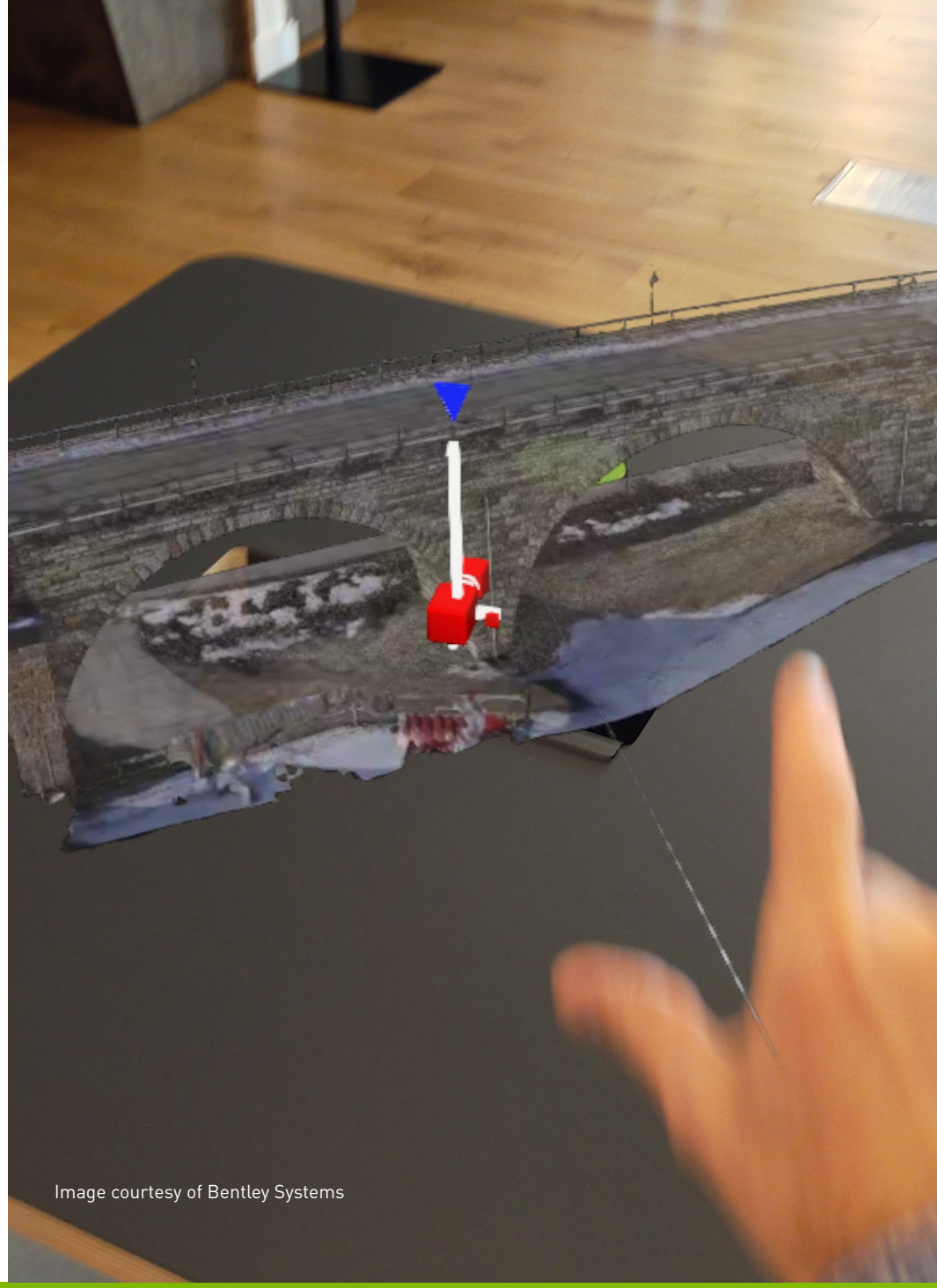

Image courtesy of Bentley Systems

EXPAND THE VALUE OF IMMERSIVE ENVIRONMENTS

Immersive XR environments improve 3D design and visualization workflows throughout the entire building design process and even beyond, to training and marketing. Globally dispersed project teams can use NVIDIA CloudXR to stream extended virtual environments to low-cost, low-powered mobile devices anywhere in the world, while maintaining the experience typically reserved for high-performance computers. Anyone can move around realistic 3D digital building models without being constrained by cables. And built-in audio functionality gives team members and clients the ability to walk through virtual environments and make design decisions in the moment.

WATCH WEBINAR »

Image courtesy of Horizon Productions

> “NVIDIA lets us dive deeper into the 3D realm. Before we had that kind of power we had to look at projects in 2D. Most architects and engineers can look at a project in 2D and visualize in 3D without having to see it on a screen, but walking through a 3D model has really made the platform, the delivery process and design review accessible to everyone. The more power we can put behind a 3D delivery system for faster navigation or VR, the faster the [design review] will be.”

- Associate Designer, USA

REMOTE COLLABORATION

Real-time simulation and collaboration tools are enabling architectural design teams to work together in a shared virtual world. NVIDIA Omniverse™ Enterprise offers project teams an open platform to unite their assets, libraries, and software applications, so they can rapidly iterate on design concepts in real time and instantly share high-fidelity renders of building models. Omniverse™ Enterprise helps geographically dispersed AECO teams collaborate while working with multiple software products—like Autodesk Revit, McNeel Rhino, Trimble SketchUp, and Epic Games Unreal Engine—on a single, common model.

Instead of meeting in-person or exchanging and individually iterating on massive files, designers, architects, and engineers can work simultaneously in a virtual world from anywhere, on almost any device. Powered by NVIDIA RTX GPUs, Omniverse™ Enterprise helps accelerate the design process, boosts project team productivity, and makes design reviews more effective with compelling, photorealistic visualization of 3D models.

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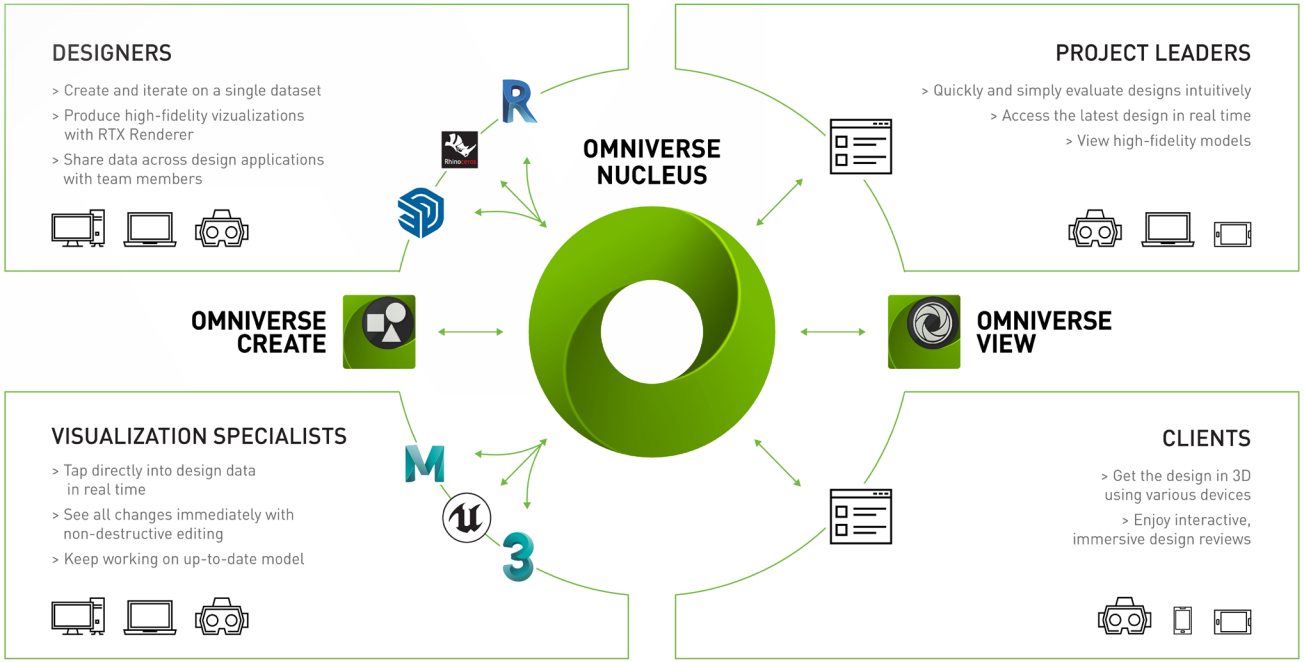

Built on open source NVIDIA MDL NVIDIA PHYSX

REAL-TIME SIMULATION

Recent breakthroughs with new, easy-to-use GPU-powered simulation software tools have given AECO teams the ability to perform rapid engineering simulation while visualizing in real time the effects of design modifications on the building model. Teams can quickly evaluate thermal, gas, and fluid studies to prepare better optimized models for design reviews. Introducing real time simulation early not only helps save time and money, but can result in a more optimally designed built environment. More refined designs can then be submitted for validation with advanced simulation tools.

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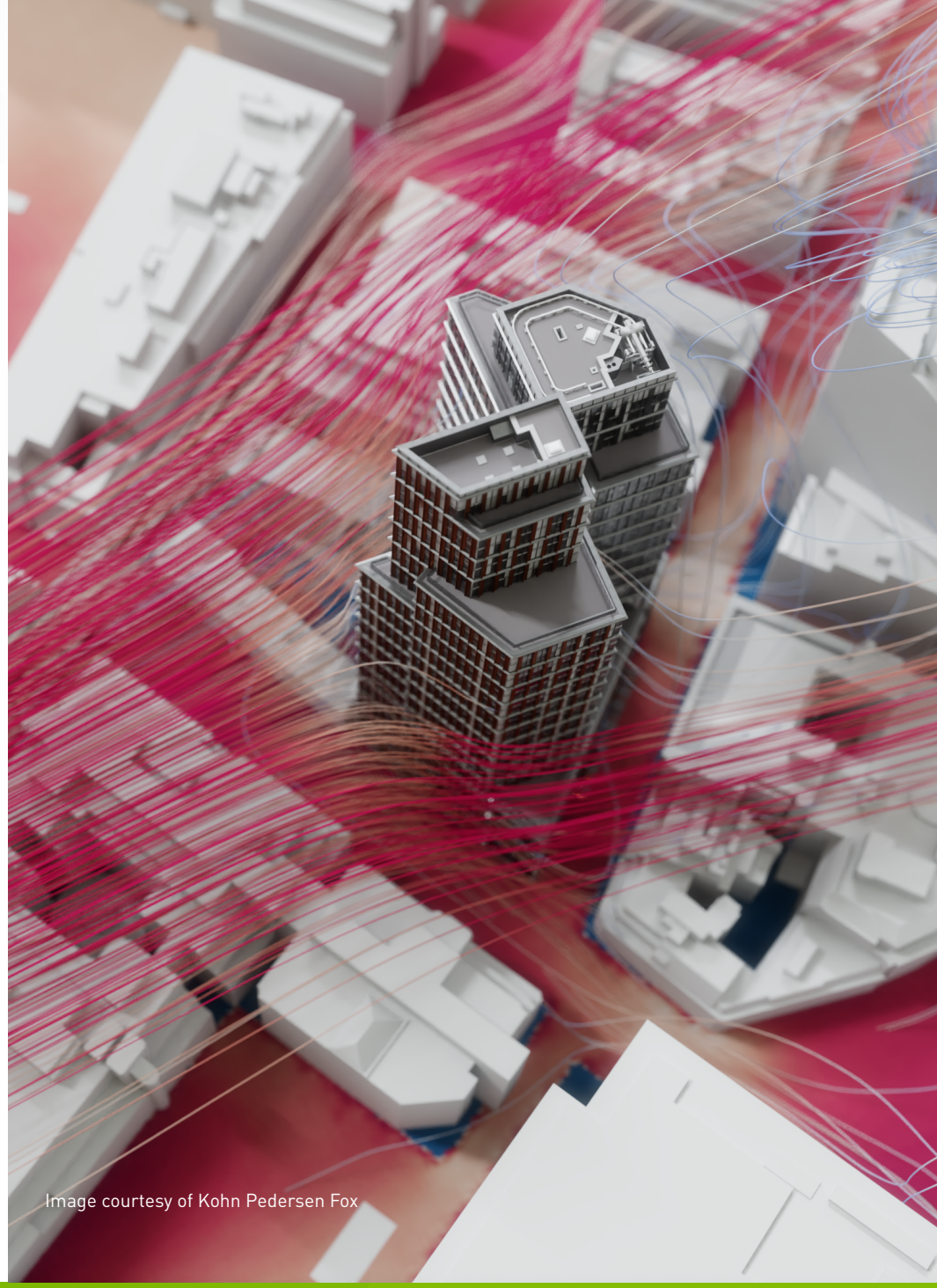

Image courtesy of Kohn Pedersen Fox

AI AND DEEP LEARNING-ENABLED APPLICATIONS

Artificial intelligence and deep learning-enabled generative design software offers AECO teams a powerful new aid to reduce time spent on mundane repetitive tasks and dramatically shorten rendering times. AI-accelerated denoisers, like NVIDIA OptiX™, are trained on tens of thousands of images rendered from thousands of 3D scenes. Running AI-powered rendering denoising on NVIDIA RTX GPUs or RTX Virtual Workstation (RTX vWS) software significantly speeds up noiseless visualization of photoreal renders, resulting in faster iteration and decision making during the design process.

NVIDIA DLSS (Deep Learning Super Sampling) is groundbreaking AI-enabled rendering technology that taps into the power of a deep learning neural network to increase graphics performance. Powered by Tensor Cores—dedicated processors for AI on NVIDIA RTX professional GPUs—NVIDIA DLSS renders images internally at a lower resolution while delivering crisp, clean high-resolution images and high-quality videos for visually powerful VR walkthroughs.

> "The whole process, especially the rendering process, got shortened. Before NVIDIA, we needed two to three days to render big images. Now we can render four to eight images within one day. The impact is big considering labor cost, electricity bills, and so on."

- Zhan, CEO, Sichuan Chaoyu Group Architect Design Co, China

Image courtesy of Enscape

NVIDIA SOLUTIONS

TRANSFORM AECO TEAM COLLABORATION

With NVIDIA Omniverse, designers, architects, and engineers can design, visualize, iterate, and review while collaborating in real time from anywhere in the world using multiple design software tools. AECO teams running Omniverse on any RTX-powered workstation or from the data center can produce ray traced accurate and photorealistic 3D visuals with minimal effort—no data preparation or model data decimation required. By streamlining communication, collaboration, and design visualization, Omniverse speeds up AECO design reviews for faster time to approvals.

LEARN MORE »

SUPPORT A REMOTE WORKFORCE

By virtualizing GPUs in the data center, AECO firms can deliver superior graphics performance to architects and engineers on virtual desktops so that they can maintain their productivity no matter where they're working—at the office, on the road, on site, or at home. With NVIDIA virtual GPUs (vGPUs) designers and engineers have fully capable 3D virtual workstations anywhere. Users get the same responsive experience in a virtualized environment as they would expect from a physical workstation.

MAKE PRODUCTIVITY GAINS

New technology is having a two-pronged impact on improving productivity and efficiency. First, NVIDIA RTX-powered desktops and mobile workstations ensure graphics-intensive applications deliver maximum performance, which helps designers iterate designs faster and shortens project timelines. Second, technology like multi-vGPU support provides AECO firms with the ability to assign up to four NVIDIA GPUs to a single virtual machine (VM). As a result, designers can achieve exponentially faster rendering times and arrive at their best designs faster, which reduces the risk of project delays and lost billable hours.

BETTER MANAGE BIM MODELS

As more companies embrace BIM—and the massive 3D models that come with it—there's an increasing need for much higher graphics capability to smooth the design and model-development experience. Using advanced technology for BIM model management simplifies design reviews and introduces time savings and efficiency into the project life-cycle. It reduces re-work, minimizes conflicts, accelerates changes, and effectively controls error rates. It also makes it easy to update and retrieve relevant information specific to a model.

> "NVIDIA RTX GPUs makes it significantly easier to manage the use of multiple applications simultaneously to present good design materials."

- Cori Moran, Visualization and Virtual Reality Specialist, SLR Consulting, UK

ADVANTAGES FOR AECO FIRMS

By adopting leading-edge technology, AECO firms gain a competitive advantage that not only yields intrinsic benefits, like client satisfaction and higher staff morale, but also extrinsic factors, like faster project delivery and repeat business.

BENEFITS OF ADVANCED AECO TECHNOLOGY

Resource optimization

- Quicker renderings
- Faster project delivery
- Greater workforce mobility

Higher quality output

- Improved quality of visualizations
- Higher efficiency in the design for improved productivity
- More accurate comprehension of designs by clients

Positive business impact

- Higher client satisfaction due to shorter rendering time
- Improved client retention through improved quality of visualizations
- Better project visualizations to share with prospects
- Repeat client business

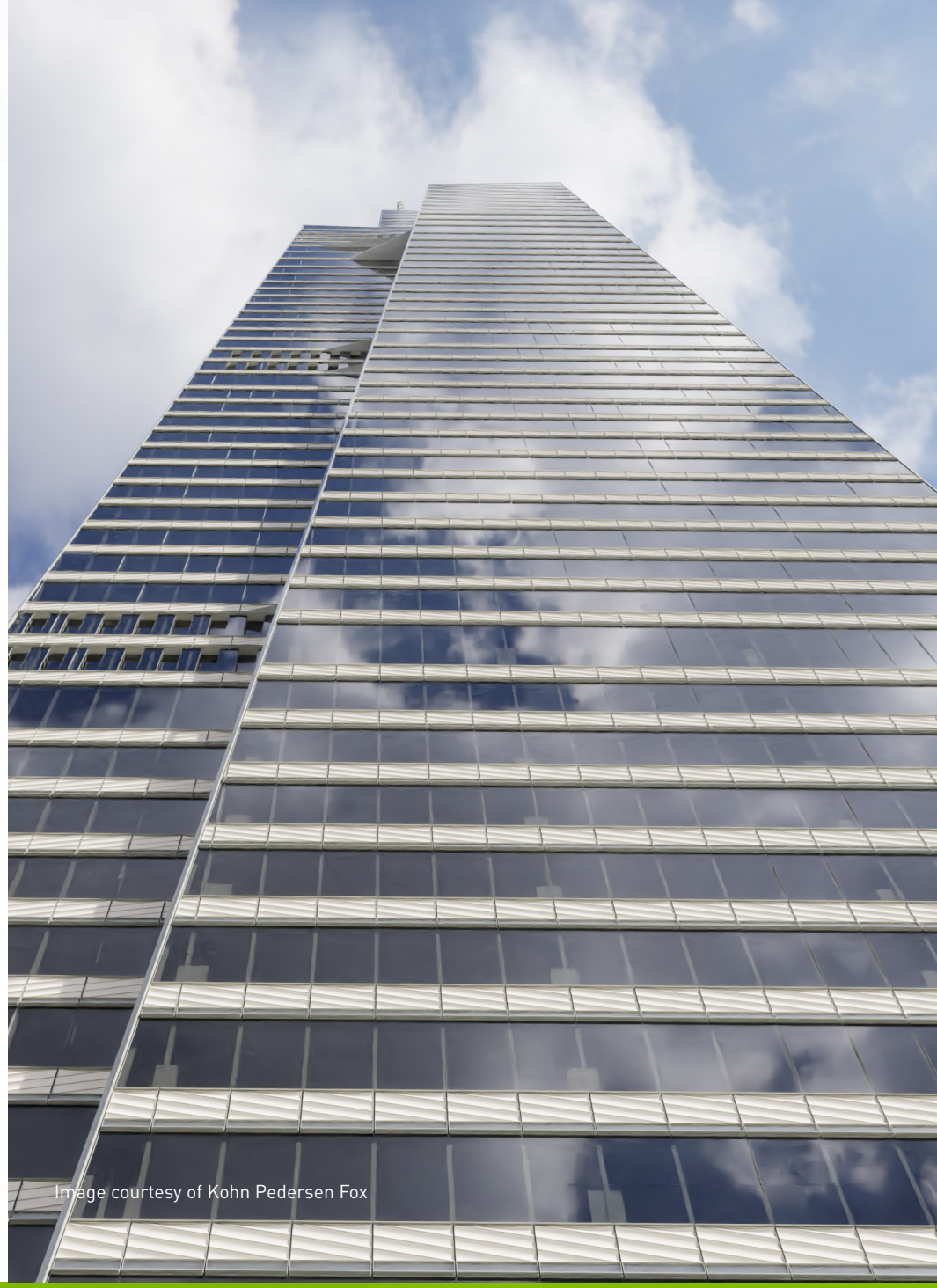

Image courtesy of Kohn Pedersen Fox

LAKE|FLATO, TEXAS

CHALLENGE

Award-winning architecture firm Lake|Flato is a leader in sustainable design that is rapidly expanding. With 135 employees, many of whom are power users of Autodesk AutoCAD and Revit and Enscape, the firm was looking to hire an additional 200 employees. To meet its burgeoning technology needs, it needed to make IT upgrades that provided high levels of performance while minimizing energy consumption.

SOLUTION

Lake|Flato deployed VDI powered by NVIDIA A40 professional GPUs combined with NVIDIA RTX Virtual Workstation (vWS) software. To improve its remote work environment, the company also installed NVIDIA Quadro RTX 5000 graphics in its Dell Precision desktops.

IMPACT

Lake|Flato was able to significantly cut costs without reducing performance. With its PCs consuming 300 watts each, adding 200 employees would've required the firm to make electrical upgrades costing about half a million dollars. With VDI, the firm was able to stay under 135 watts per user while providing an equivalent experience to RTX-powered desktops. Running apps like Enscape in the A40-powered virtual machines reduced power consumption per person by 70 percent—while achieving the same performance as physical RTX-powered desktops.

READ BLOG »

"The NVIDIA RTX vWS-enabled VDI solution powered by NVIDIA A40 has nearly the same overall performance compared to our dedicated workstation-grade desktops, and only uses a fraction of the power."

– Dan Stine, Director of Design Technology, Lake|Flato

THEIA INTERACTIVE, CALIFORNIA

CHALLENGE

Theia Interactive specializes in creating custom configurators designed for viewing a broad range of design options in interior spaces. It also produces award-winning visualizations for AECO clients. To make imagery look as realistic as possible, the firm was creating static or built lighting. However, using a configurator in a built environment presents multiple challenges. With the lighting baked in, it's difficult to test out multiple lighting scenarios.

SOLUTION

By integrating NVIDIA Deep Learning Super Sampling (DLSS) and RTX Global Illumination (RTXGI), and running on NVIDIA Quadro RTX 5000 professional GPUs, Theia Interactive created a high-fidelity custom configurator that lets teams view models in any lighting environment in real time.

IMPACT

With RTXGI real time, ray-traced lighting, Theia Interactive has accelerated design reviews. Today, the design team uses RTXGI and DLSS while meeting with designers and lighting architects, and tweaks all of a project's light values in real time to get the right look and feel for a virtual reality experience. Iterations are now faster. The team can respond to client requests during reviews and make lighting changes on the spot.

READ STORY »

> "With NVIDIA DLSS and RTXGI, we can now easily evaluate scenes and use the dynamic aspects of lighting. We're able to work faster and therefore, accept more projects."

– Matt Shouse, Chief Operating Officer, Theia Interactive

STUDIO 4D, URUGUAY

CHALLENGE

Architectural visualization firm Studio 4D needed to digitally create an interactive cloud-based 4D walkthrough of a U.S.-based real estate mega development for its client JBG SMITH. The goal was to visually tell the story of this mega project with photorealistic 3D models. Developers also needed to be able to stream, modify, and present models to other stakeholders.

SOLUTION

Studio 4D selected NVIDIA RTX A6000 professional GPUs for ray tracing and rendering of 3D visualizations. To achieve an experience that can be viewed on any device from any location, Studio 4D hosted this project in the cloud on Amazon Interactive Video Service using AWS EC2 G4dn instances with NVIDIA T4 GPUs.

IMPACT

NVIDIA RTX helped Studio 4D achieve real time ray tracing throughout their design process. Plus, the accelerated workflows with DLSS was a game-changer. Studio 4D's GPU-accelerated renders and visualizations provide JBG SMITH with holistic control of their design. JBG SMITH also saves time in meetings with vendors, consultants, pre-sales and marketing teams, and investment teams because the complete design is available years before the actual construction.

READ STORY »

"NVIDIA RTX and DLSS truly stood out in the market. There was no other GPU and software combination that allowed us to achieve real time ray tracing. It's a truly remarkable achievement by NVIDIA."

– Aaron Stopak, Principal, Studio 4D

WOODS BAGOT, AUSTRALIA

CHALLENGE

Woods Bagot is a global architecture firm with more than a dozen studios around the world. The firm was looking for a solution that would enable its geographically dispersed design teams to collaborate more efficiently. Ideally team members would be able to use different software and applications while working on ray-traced rendered images.

SOLUTION

Woods Bagot added NVIDIA Omniverse into their design workflows and pipelines using Omniverse Connectors to integrate multiple applications, including Autodesk Revit and 3ds Max, McNeel Rhino, and Unreal Engine 4. The firm selected NVIDIA RTX A5000 and NVIDIA Quadro RTX 8000 for multi-GPU support to view real time ray-traced visualizations with Omniverse View.

IMPACT

NVIDIA Omniverse accelerated Woods Bagot's design process by removing barriers between design software and design iteration. Omniverse supports multiple existing workflows while also enabling teams to maintain a unified design model in Omniverse Create. Designers can use their preferred applications and publish their assets to a universal asset exchange and collaboration engine— Omniverse Nucleus—where they can access content and visualize all the parts of a design to gain a deeper understanding.

READ STORY »

> "Omniverse is the only platform currently out there that solves the challenges of multi-user, real time collaboration and visualization."

-Shane Burger, Principal, Woods Bagot

OUTDOORLIVING3D, TEXAS

CHALLENGE

OutdoorLiving3D designs high-quality renders of architectural visualizations and animations. Every year, its team renders over 500,000 frames of animation for sales and design presentations, with each project taking up to 12 hours to render. During the pandemic, the company needed a solution to speed up rendering and facilitate collaboration while everyone worked from home.

SOLUTION

OutdoorLiving3D registered to use NVIDIA Omniverse and worked with NVIDIA's support team to fully optimize the technology to meet OutdoorLiving3D's needs. The firm ran Omniverse on a server installed with a NVIDIA GeForce RTX 3090 graphics card.

IMPACT

NVIDIA Omniverse enables OutdoorLiving3D's designers and artists to collaborate in real time while using tools like Autodesk Revit, Trimble SketchUp, and Epic Games Unreal Engine. Omniverse has reduced the firm's rendering times for animations to 20 minutes. Omniverse components like RTX Renderer and Nucleus ensure designers can immediately identify any problems and fix them in real time, which has lowered production time by 1,000 hours per year.

READ STORY »

> "Our workflows can now go from conceptual design all the way to renderings and real time presentations. We can show clients the projects and interact with the scene: where we can drag and drop objects, move things around, or even hide things.... [NVIDIA] Omniverse will make rendering animations as trivial as sending and email."

– Chris Scott, Owner and CEO, OutdoorLiving3D

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