FUJITSU

TECH INSIGHT

ARCHITECTURE, ENGINEERING AND CONSTRUCTION

Powerful new technologies, including reality modelling, real-time visualisation, simulation and VR, are transforming BIM-centric workflows for Architecture, Engineering and Construction (AEC)

Architecture, Engineering and Construction (AEC) technology has changed dramatically over the last few years. Along with an explosion of new technologies including reality modelling and Virtual Reality (VR), many tools have been dramatically simplified, making them accessible to a much wider range of users. Design visualisation is a perfect example, and there are now many architect-friendly real-time visualisation tools that can harness the power of NVIDIA® Quadro® GPUs to produce stunning visuals — results that could only previously be delivered by a skilled Computer Graphics (CG) artist.

BEYOND BIM

With Building Information Modelling (BIM) at the heart of the process, the 3D model has become an even more important asset that feeds many complementary workflows. These include real-time visualisation, ray trace rendering, VR, digital fabrication and many different forms of simulation, including pedestrian, light and energy.

Generative design and Artificial Intelligence (AI) are also helping drive the design process. Powerful FUJITSU CELSIUS workstations can be used to generate thousands of design options, which all meet pre-defined goals for things like floor space, daylight, cost and more. These can then be used as a starting point for detailed design. The intention is not to replace the designer, but to deliver better buildings and free up time for more strategic work.

DIGITISING THE REAL WORLD

While all of these advanced technologies help optimise and enhance the design process, as well as support better communication and decision making throughout extended AEC teams, the floodgates have also been opened to bring on-site reality into a digital environment.

The use of terrestrial laser scanners, portable Simultaneous Localisation and Mapping (SLAM) devices, drone-based photogrammetry, even quadruped surveying robots, is on the rise. On more advanced construction sites, there's now a constant stream of data flowing from the real to the virtual world. The data can also flow the other way, with Mixed Reality headsets enabling design models to be seen in the context of the physical site.

OPPORTUNITIES AND CHALLENGES

These exciting developments present a huge opportunity for AEC firms, but they're not without challenges. In addition to complex workflow optimisation and training, the workstation requirements for design visualisation, VR, reality modelling and simulation are very different to those for BIM. And in order for AEC firms to get the most out of these transformative new technologies, they will need to ensure that architects, engineers and construction professionals have access to the right workstation hardware.

▶ Over the page: spotlight on five key workflows
BIM, VR, visualisation, reality modelling and simulation

MODEL COURTESY OF ENSCAPE

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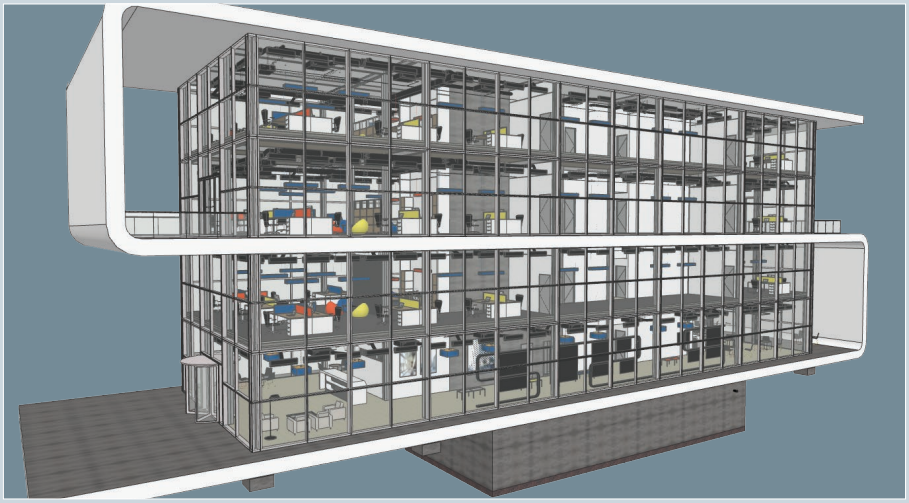
BUILDING INFORMATION MODELLING (BIM)



ARCHICAD IMAGE COURTESY OF GRAPHISOFT

Building Information Modelling (BIM) is at the heart of building design, and the resulting models can feed many other processes. Model complexity is increasing, both in terms of geometric data and the underlying object data that is so critical to the BIM process.

There is also a trend towards modular and prefabricated construction, where 3D models are used to drive manufacturing processes. It's still early days for this, however, and most general BIM tools will need to be completely redeveloped. More advanced firms are adapting powerful CAD technology that is used in the automotive and aerospace industry.

Meanwhile, for early stage design, generative design is increasingly being used to generate hundreds or thousands of design options, which all meet pre-defined goals.

All of the leading BIM tools are tested and certified to run on FUJITSU CELSIUS workstations. In terms of workstation specifications, BIM software will generally benefit from a high frequency CPU, and GHz should always be prioritised over the number of cores. Most BIM software is single threaded and not multi-threaded, although there are exceptions, including Graphisoft ArchiCAD.

Memory is very important and Autodesk Revit in particular can be very memory hungry when working with large models. Equipping your CELSIUS workstation with more memory can improve performance and mean models don't have to be broken down into smaller chunks, which improves workflows.

The GPU requirements of BIM software are relatively low so an NVIDIA® Quadro® GPU with up to 5GB of memory should deliver good 3D performance in most BIM software. Quadro® is designed specifically for professional applications.

VIRTUAL REALITY (VR)

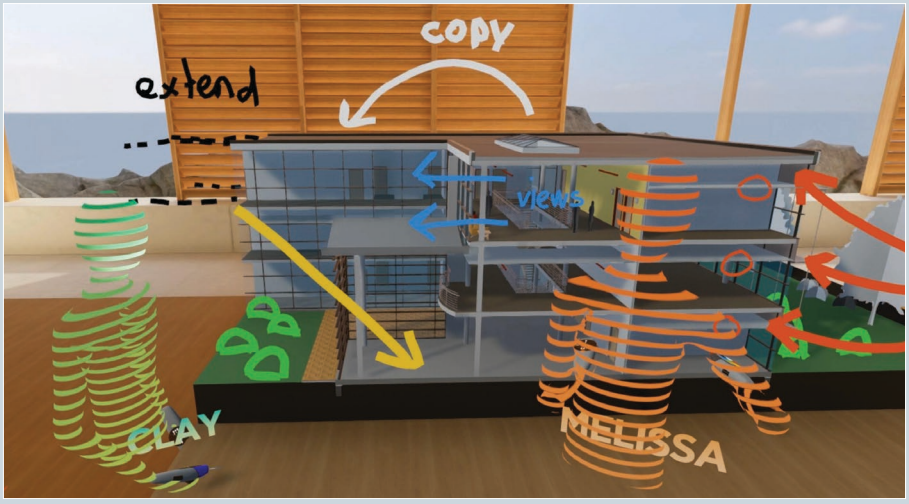


IMAGE COURTESY OF THE WILD

Virtual Reality (VR) is perfect for AEC as it enables teams to experience a building at human scale before it is built. Architects, engineers, contractors, clients and others can get an incredible understanding of space and proportion.

VR can be a solo experience, where an architect, for example, quickly puts on a VR headset to instantly get a sense of scale for what they are designing in their BIM authoring tool. There are several AEC-focused VR tools with 'live links' to Autodesk Revit and Graphisoft ArchiCAD and others. These include Enscape, Twinmotion and Lumion.

There has also been a huge rise in collaborative VR, where local or distributed teams can meet inside virtual buildings, using a combination of fully immersive VR headsets, desktop displays and tablets. This can be for conceptual design, using a tool like Arkio to model and sketch out new ideas, or for design review and issue resolution using IrisVR, InsiteVR, The Wild or VRcollab.

While some VR software focuses on geometry and BIM object data, others like Unreal Engine use advanced materials and lighting to increase realism. NVIDIA RTX-enabled applications take visual fidelity to new levels with real time ray tracing.

VR has quite substantial hardware requirements, especially when it comes to graphics. A FUJITSU CELSIUS workstation with an NVIDIA® Quadro® RTX GPU is recommended to deliver the high frame rates needed for a smooth VR experience.

Model complexity has a big influence on choosing the right GPU hardware. An entry-level Quadro® RTX GPU will be fine for creating simple massing models, but a high-end Quadro® RTX GPU with more memory may be needed for viewing colossal multi-disciplinary BIM models.

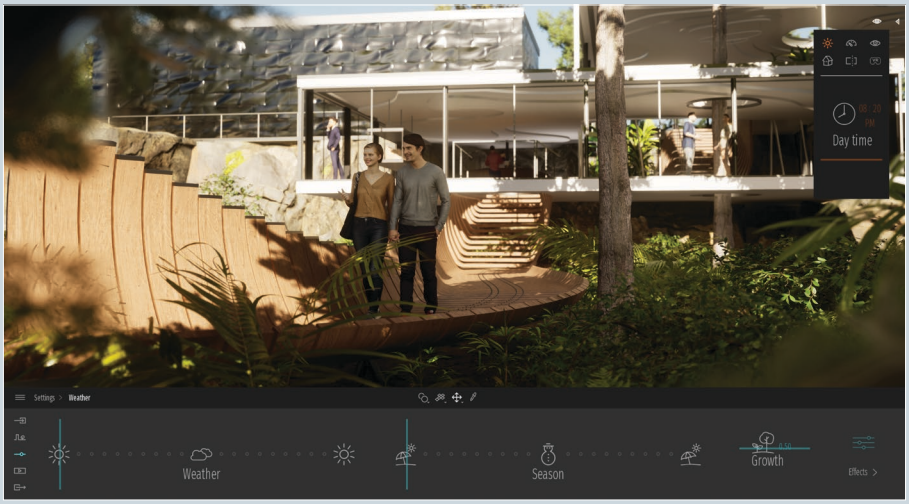
DESIGN VISUALISATION

There is now real momentum behind real-time visualisation with 'game engines' delivering high fidelity graphics at high frame rates, or enabling fast production of stills and animations.

Unreal Engine is becoming increasingly popular with design viz specialists, but there are also many easy-to-use real-time viz tools designed for architects, including Enscape, Twinmotion and Lumion. With these tools, architects can get instant feedback on designs, or quickly create assets for better communication with clients and project teams.

Real-time visualisation will benefit from a FUJITSU CELSIUS workstation with a high-end NVIDIA® Quadro® RTX GPU, which is much more powerful than a GPU typically used for BIM.

In terms of visual fidelity, ray tracing is the next step up, delivering photorealistic output. Increasingly, the complex calculations are done on the GPU using one or more NVIDIA® Quadro® RTX graphics cards. RTX-enabled applications can use the RTX GPU's dedicated RT cores for ray tracing and Tensor cores for AI denoising to deliver results instantly, which can transform workflows.



TWINMOTION IMAGE COURTESY OF EPIC GAMES

NVIDIA® RTX is supported in several AEC viz tools including Enscape, V-Ray and Unreal Engine. RTX is also at the heart of NVIDIA® Omniverse, a new platform technology which brings together architects and other stakeholders in a visually rich, real-time collaborative environment.

CPU rendering is still important, particularly when working with huge datasets, very high-res materials and exceedingly complex HDRi environments, when large amounts of system memory become very important. CPU ray tracing is highly multi-threaded so it will benefit from a CPU with lots of cores.

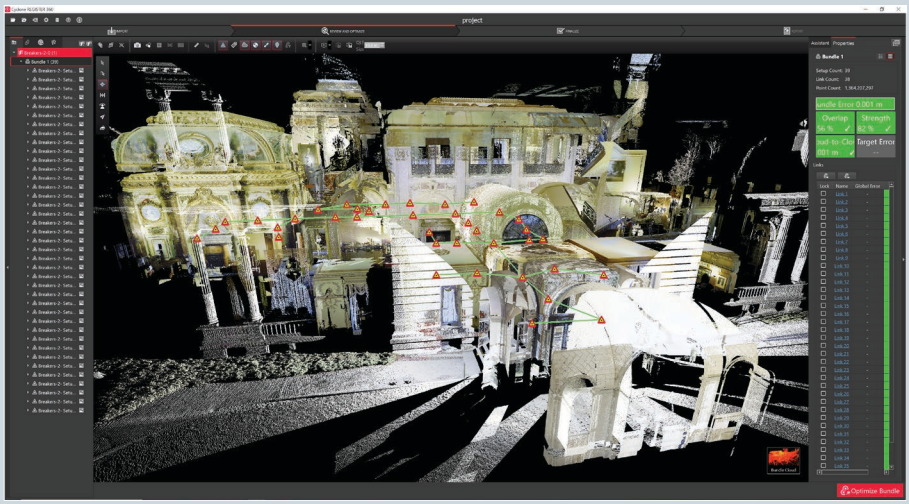
REALITY MODELLING

The use of reality modelling in AEC is on the rise. There are many use cases: to provide context for new builds, to use as a starting point for retrofit projects, or to compare 'as-built' with 'as-designed' for construction verification.

Point clouds are used widely. Data is generated by laser scanners, which capture millions of 3D points. Capturing an entire building requires multiple scans from different locations, often resulting in tens or hundreds of individual point clouds. These then need to be processed and registered into a single dataset using a powerful FUJITSU CELSIUS workstation.

Processing is generally done on the CPU and is multi-threaded, so will benefit from a CPU with lots of cores. Some software is more multi-threaded than others.

Datasets are generally huge, so point cloud processing will benefit from large amounts of high-bandwidth memory and high-performance storage. Ideally, the data should be held entirely in system memory, but this is not often possible, so fast storage becomes even more important. PCIe NVMe SSDs are recommended.



LEICA CYCLONE REGISTER 360: MODEL COURTESY OF LEICA GEOSYSTEMS

Reality meshes are an alternative to point clouds. They can be generated from photogrammetry, using photos or videos captured by drones or a camera attached to a crane or a construction worker's hard hat.

Hundreds or thousands of images are processed to create dimensionally accurate reality meshes, which can then be used in CAD or design viz software.

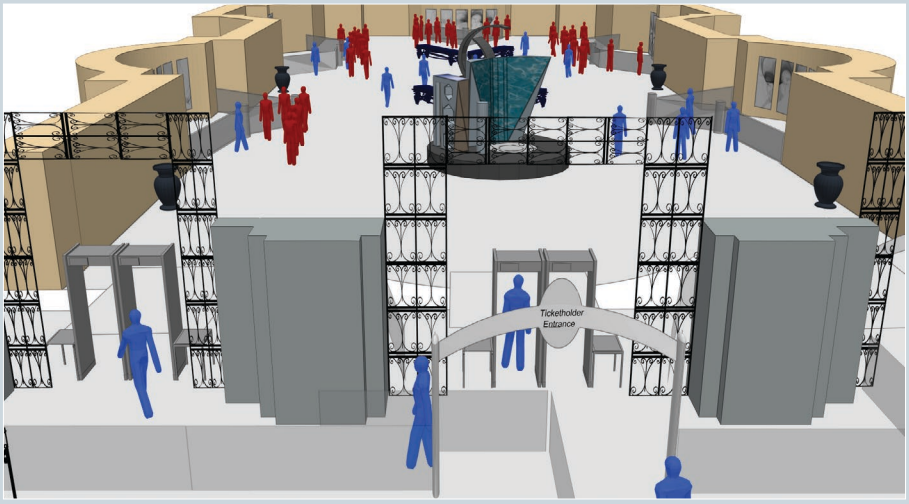
Depending on the application, this is done on the CPU or GPU or both. The software is generally multi-threaded and will benefit from a CPU with lots of cores. Larger datasets comprising thousands of photos will also benefit from lots of memory, and fast storage is important to read data in and out of memory quickly.

SIMULATION

There are many different simulation technologies used in AEC, from more traditional structural applications, which analyse forces on steel and concrete members, to advanced tools for wind engineering, geotechnical engineering, HVAC engineering, fire and smoke propagation, and pedestrian wind comfort.

Recent trends due to the Covid-19 pandemic include the increased use of pedestrian simulation to help develop social distancing strategies and the use of Computational Fluid Dynamics (CFD) to study airborne virus transmission in buildings. Most simulation software is multi-threaded, but the extent to which it can utilise multiple CPU cores in a FUJITSU CELSIUS workstation can vary dramatically.

Some software will benefit from just a few CPU cores, while others will effectively scale up to tens of cores. High bandwidth Error Correcting Code (ECC) memory can significantly boost performance and help prevent crashes.



MASSMOTION PEDESTRIAN SIMULATION IMAGE COURTESY OF OASYS

Datasets can be huge and there are performance benefits to holding them entirely in memory. Sometimes this can't be avoided, as the datasets are simply too large. In these 'out of core' cases, fast storage becomes even more important as applications continually need to move data between disk and memory.

An increasing number of simulation tools use the highly parallel architecture of NVIDIA® CUDA GPUs to solve the complex equations. Ansys Discovery uses the GPU in a completely different way to other 'solvers' and delivers near instant results, which can have a huge impact on the design process.

FUJITSU CELSIUS - ADVANCED WORKSTATIONS FOR ALL AEC WORKFLOWS

With professional grade NVIDIA® Quadro® GPUs and Intel® Xeon® CPUs, FUJITSU CELSIUS workstations are designed and engineered in Europe, and have gained a reputation for being reliable and whisper quiet, thanks to advanced thermal management

FUJITSU CELSIUS J SERIES

No need to choose between performance and size in a Small Form Factor (SFF). CELSIUS J series workstations offer high-end performance in a compact design and are ideally suited to BIM and entry-level reality modelling and simulation workflows.

FUJITSU CELSIUS W SERIES

A great combination of performance, price, expandability and energy efficiency in a microtower design. The CELSIUS W series is a good all-rounder, well suited to BIM, visualisation, VR, simulation and reality modelling.

FUJITSU CELSIUS M SERIES

Optimised for the most demanding workflows including high-end real-time viz, VR, rendering, simulation and reality modelling, the CELSIUS M series combines high-spec CPUs, GPUs and memory with near silent noise emissions.

FUJITSU CELSIUS R SERIES

This reliable, high-end dual processor desktop workstation is optimised for extremely demanding and memory intensive multi-threaded workflows, including design visualisation, rendering, reality modelling and simulation.

FUJITSU CELSIUS H SERIES

For work at the office, at home or on site, CELSIUS H series mobile workstations combine stylish design with maximum security thanks to optional palm vein technology. Available in a 15.6-inch form factor, models can be configured for a variety of workflows including BIM, visualisation, VR, simulation and reality modelling.

FUJITSU CELSIUS C SERIES

The CELSIUS C series of rack workstations offers full workstation performance in a 1U chassis designed for the datacentre. The machine can be configured for Remote Access (1:1), GPU pass-through or graphics virtualisation (1:n), to support a variety of workflows from BIM to design viz.