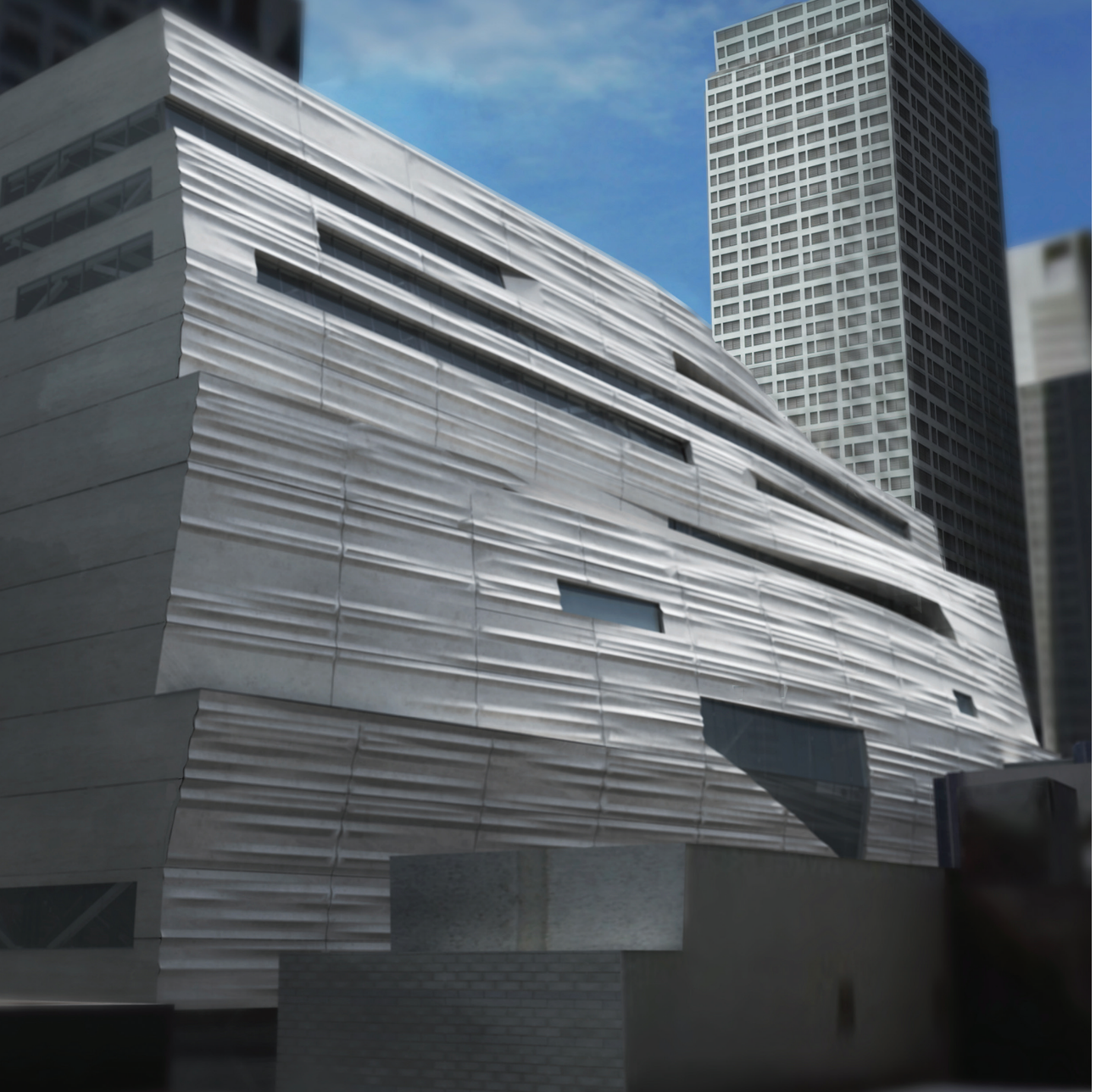


CG FACADE INSTALLATION STRATEGIES

KEVIN TAN + JEFF VAGLIO, P.E., LEED AP [BD+C]

As architecture grows increasingly complex in geometric form, so do the performance expectations and delivery strategies for building facades. As a facade subcontractor, Enclos is tasked not only with the design and engineering, but the constructability of enclosure systems. Jobsite experience acts as a primary driving force towards design solutions that are efficient and safe, and is a key reason why Enclos' field superintendents are brought to the table early in the design development process. In pursuit of on-site efficiency, Enclos operations teams are confronted with a number of challenges and considerations: operating on tight urban sites, coordinating just-in-time delivery, lifting strategies that include multiple-unit and mega-unit lifts, various types and scales of equipment, crew member position, safety and coordination with other trades. With many people involved in planning an enclosure's design and delivery, the Advanced Technology Studio utilizes project-specific animations to convey complex ideas and coordination issues to a diverse audience both internally and externally. The integration of animation as a communication tool has proven effective in accelerating a project team's common understanding of constructability logistics.

This paper evaluates visualization strategies utilized to convey design, delivery, installation, performance and safety narratives to project teams and crews alike. Additionally, this paper identifies forward-thinking visualization strategies and how they will further the role of animation in facade delivery processes.

DETAILED VISUAL COMMUNICATION

3D computer graphics have become a central part of envisioning increasingly difficult and complex construction processes. This is especially important when planning inventive installation techniques inside tight urban jobsites. A cooperative understanding of all aspects of custom installations is essential for all crew members. Planning a picking zone on the street, communicating the mobility of custom equipment, and measuring out anchor points are a few of many procedures better communicated through visual means.

The use of animation in the construction industry helps ensure quality and safety. Visual communication using CG is vital for the growth of new technical innovations.

This is only the beginning, as the integration of new experimental 3D software is around the corner. Dynamic animation, much like the method used for the Fulton Street Transit Center (see page 102)

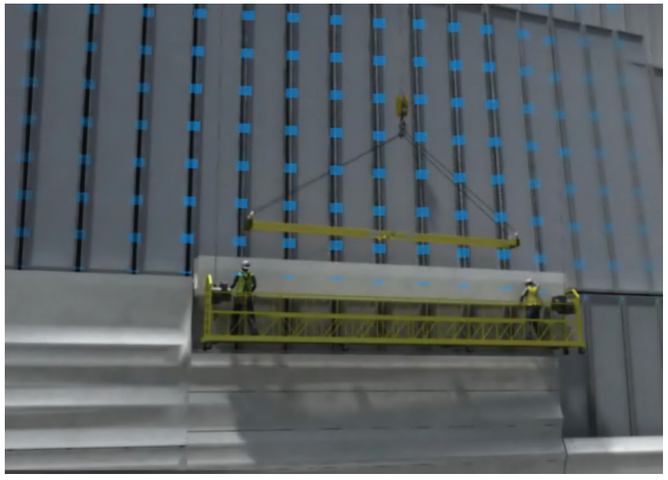


FIGURE 1
This project uses the street as the material staging and picking area for just-in-time delivery.

FIGURE 2
Gaskets are installed using a swingstage and gasket rollers on an opaque, insulated rain-screen system.

FIGURE 3
Surveying of anchor points overlaid on the system wall.

FIGURE 4
Depiction of crane range and sequence order for a 22-story tower.

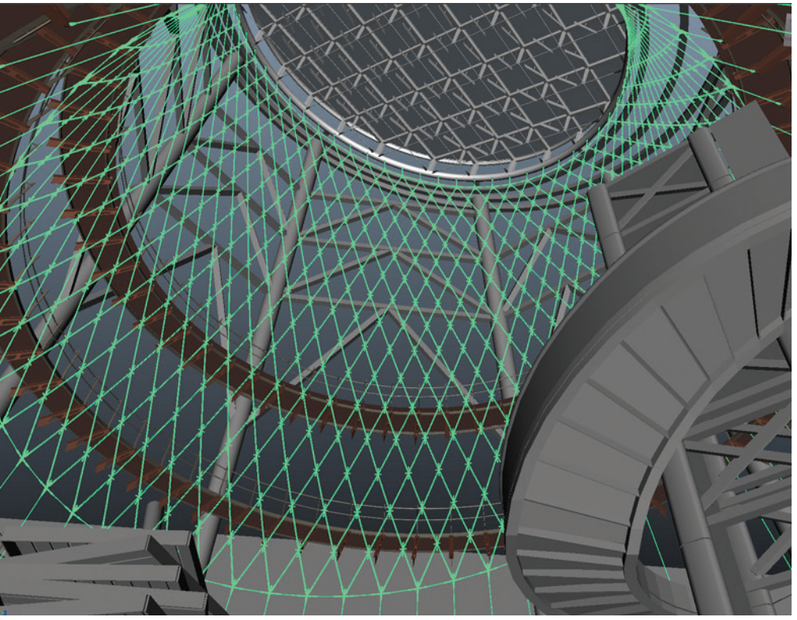
in New York City, uses CG physics, but is also capable of simulating particles. This opens up a new 3D world in visualizing our technology that would otherwise be rendered impossible on a 2D sheet of paper. Using particles to mimic liquid, gas or solids not only becomes a great tool for demonstrating thermal capabilities, water intrusion testing and facade skin airflow, but will eventually become the standard for visual communication.

EQUIPMENT COORDINATION

Many times project timelines are heavily based on the equipment schedules available, and in most cases, it is impractical (if not impossible) to operate different equipment in the same job site simultaneously. Careful instruction must be communicated to ensure that all tasks for each type of equipment are successfully completed on time and in order. Visual instruction also directly benefits the work flow of each construction site layout. Knowing exactly where every component of construction enters, exits and operates solidifies the means and methods of each job.

OPTIONEERING

Routine projects often have several different ways of accomplishing a task. Visualizing the pros and cons of each operation is an invaluable asset for construction planning. Certain methods might show optimized speed, risk and efficiency, ultimately leading to the final decision. Jobs with typical units have many options available for a successful installation. Using animation, one can see side-by-side comparisons of the advantages and disadvantages of choosing one option over another, i.e., single span pick vs double span pick.



ANIMATION DYNAMICS

Complex jobs are a nightmare to visualize with sketches and drawings alone. Animation software has become so powerful that real physics can be applied to objects. The way certain real world materials interact with each other can be simulated in CG. Conversely, using the same material settings, object interaction for future construction can be predicted. This tool is crucial to the growth of more complex systems. The Fulton Street Transit Center demonstrates a custom system installed within a tight interior space. For this job, a 3D modeled cable net was applied with physics and material properties to simulate the accuracy of the proposed method. Visualizing the installation process step-by-step refined the methods used to successfully erect the cable net.

EFFICIENCY

In the end, some jobs simply need to be completed within a tight schedule. Visually demonstrating when and how this gets accomplished in a timeline is essential for completion. The number of transported and installed units per day, crane location crew location, and picking areas can all be communicated clearly using CG animation. The Hyundai Motor Americas Headquarters in Fountain Valley, California needed to be completed in an extremely short amount of time. Animation was used to depict where units were being built and the fastest routes to the job site. For this project, crane coordination was key to a fast completion, as two crews operated simultaneously on opposite ends.

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FIGURE 5
Cables are embedded with gravity and steel properties.

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FIGURE 6
Order of installation with crane position.

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FIGURE 7
Simultaneous material staging and picking area.

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FIGURE 8
Option 1 – Shows a double span unit pick using a tower crane.

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FIGURE 9
Option 2 – Shows a single span unit lifted from the floors.