WATER SIMULATION USING REALFLOW

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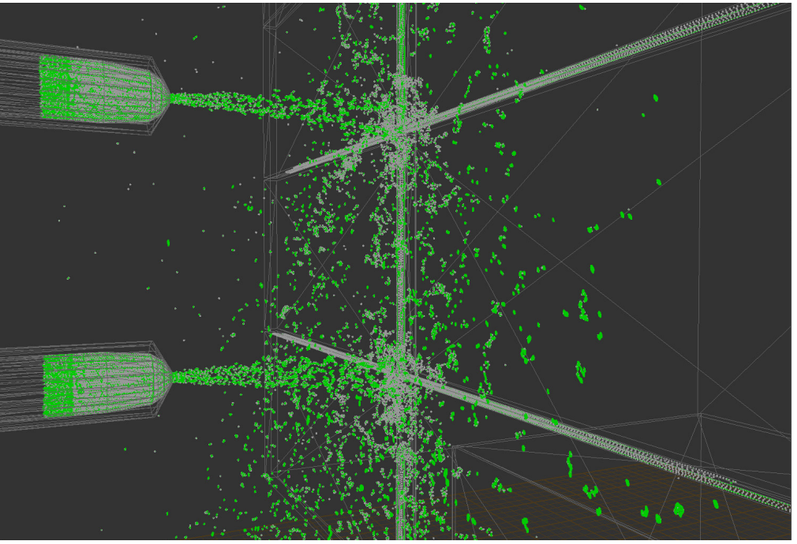
RealFlow uses a real-world, physics-based particle system to calculate realistic fluid and dynamics simulations. This 3D software is used primarily by the entertainment industry, however, with the correct settings, can be a powerful tool to test the Studio's wall systems using computer graphics (CG). Just like any 3D program, our systems can be imported into the RealFlow interface. From a wide array of emitters, our systems can be tested in any scenario by outputting a multitude of particles that are micro and macro-managed by the user. With this technology, the Studios can create more intricate and variable 3D tests to ensure that our curtainwall systems perform at the highest level.

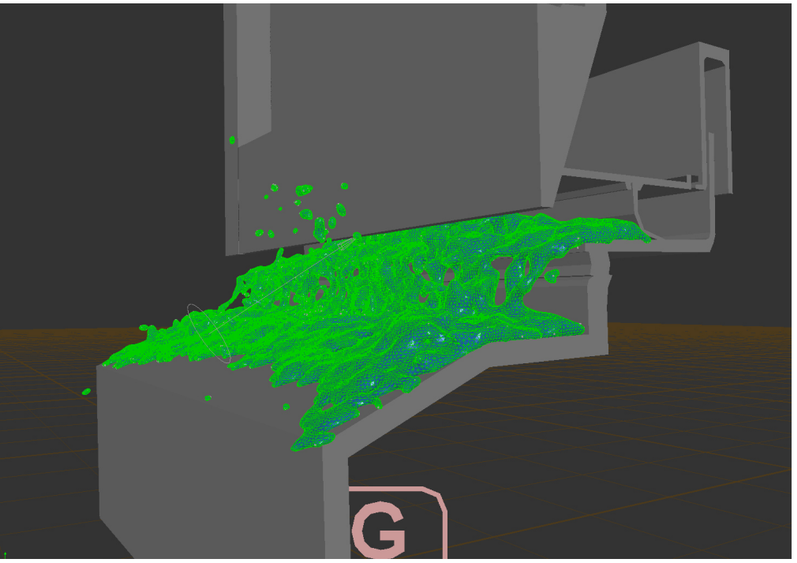
SOFTWARE OVERVIEW

RealFlow is a dynamic animation software. Unlike traditional 3D animation software, the user has little to no direct control over the final results of each simulation. Instead, controllers are placed into each scene to mimic gravity, viscosity, surface tension, etc. This powerful method of animation brings a great sense of realism to the Studios' 3D capabilities. Using this technology, a simulation with the same set of parameters can yield many different results. This is extremely beneficial for the Studios' water testing purposes because water, like all natural things, is essentially random.

The process begins with an emitter of any size and shape. The emitter acts like a hose or faucet and produces particles that interact with their given environment. A standard emitter will operate as if it is in a vacuum. It is then up to the user to recreate the physics i.e., gravity, wind, mass. RealFlow offers many control variables that can be modified to fit any scenario, and intricate adjustments are required to assure realism. It is becoming possible to create accurate physics that can be applied to increasingly elaborate and extreme scenarios — that which testing facilities cannot replicate.

The next step is to produce the mesh. Particles alone simulate only one part of fluid effects: motion. Meshing is another process that creates 3D geometry around each particle, in our case using liquid properties. There are varying levels of viscosity, density and surface tension that replicate the properties of water, oil, or even goo if need be. For water, we use a viscosity that allows the particles to stick together but break apart very easily. This lets the particles flow together then split up into drops as soon as it hits a surface. With minimal surface tension and a good amount of surface friction, we can create water that sticks to walls, then falls with gravity.





RealFlow acts as an invaluable support to full-scale mockup tests. Where these tests take weeks to produce and days to test, RealFlow can simulate these tests in hours and produce multiple results not limited to the testing facility equipment. This also allows us to test for leaks and drainage solutions for our systems still in the design phase.

THE GLASS EXPERIMENT

A simple yet intricate project was created to perfect a base properties set up. With water pouring out of a semi-transparent object into a fully transparent object, we can clearly adjust the liquid interaction with these surfaces in order to prepare them for curtainwall interaction. This setup also enables us to assure that the material properties of the mesh lets the appropriate amount of light through in order to attain a realistic look.

The first adjustment was creating a sloshing emission of particles that flows out of the bottle. With this the water naturally forms a glugging vortex-like pour into the glass. The viscosity is set to break up the water into drops at high velocity, but since this experiment is designed with a gentle pour, the water stays together. The glass cup is given a slightly sticky property in order to let the geometry break up wherever the particles begin to thin. The water is also given a slight hue to test the accuracy of the light passing through a maximum of 10 surfaces before hitting the table. The table captures the bluish liquid as well as the refraction highlights reflected off of the glass. With these basic settings, we are ready to test on our systems.

CG WATER INTRUSION TEST

RealFlow's ultimate purpose is to test the Studios' designs purely in CG. A small portion of curtainwall taken from the recently awarded Hyundai Motor Americas Headquarters will be used for this simulation. For this test, emitters are set at a high velocity and funneled into a narrow opening. This method creates a spray identical to that of any testing facility. Each particle can then be tracked in order to show how they interact with the system. Any flaw in the system and the particles will pool in certain places drain poorly or penetrate past the seals. This standard test mimics that of any real world water intrusion test. Other variables can now be added to replicate more extreme scenarios: high winds, high water pressure and particle emission from any angle.

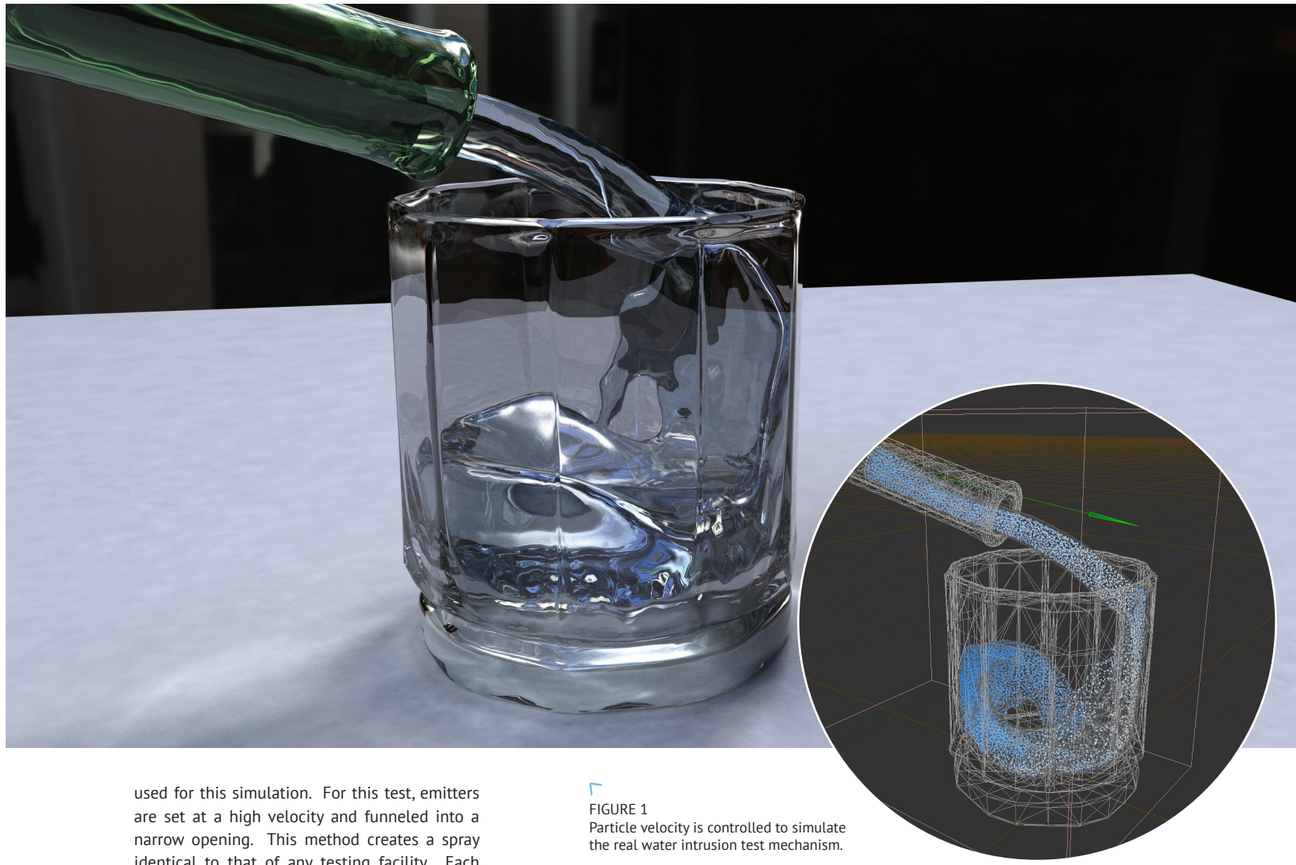
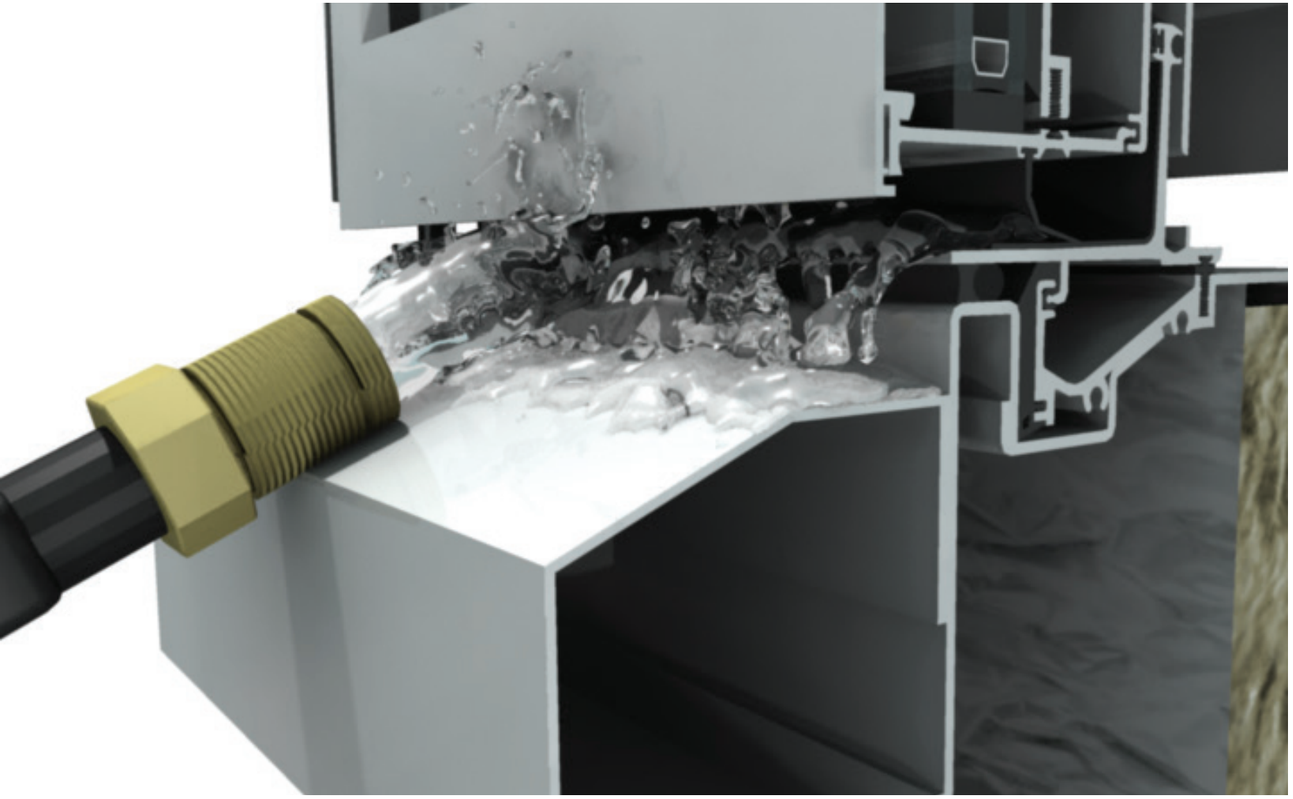


FIGURE 1
Particle velocity is controlled to simulate the real water intrusion test mechanism.

FIGURE 2
Each particle is coated with a geometric mesh that performs and acts as any desired liquid.

FIGURE 3
Emitted particles respond to their environment like fluid.



The test shows particles entering the system and effectively draining to the sides without penetration. Ultimately CG analysis will not take the place of a real mock up test, however, there is no doubt that this will be a valuable asset to the Studios' future design process. As jobs become more complex and specialized, so can our tests be modified to ensure that given optimal field conditions, the system will have a 100% success rate.

RealFlow's physics engine is realistic, but controlling the logic to fulfill the Studios' needs will require time and effort. However, with dedication the Studios can intimately study the nature of fluids and its effects on the properties of glass, steel, aluminum, etc., making it possible for Enclos to treat design problems before they arise. RealFlow is a 3D powerhouse, and its development and integration into our workflow can revolutionize the industry.

FIGURE 4
Simulating an intimately close fluid intrusion test of our system.

FIGURE 5
Full system CG water intrusion test for Hyundai Motor America Headquarters.