AUTODESK UNIVERSITY

CS21297

Visualizing Mars: Enabling STEM Learning Using Revit, Autodesk LIVE, and Stingray

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Learning Objectives

- Demonstrate how virtual reality (VR) can enhance STEM education programs
- Understand the applicability of real-time information within a VR environment
- Describe how virtual reality visualization can be used during the design process by using Revit, Autodesk LIVE, and Stingray
- Harness the power of live design optioning visualization within immersive environments

Figure 1 Rendering: Mars City Base

Class Description

In this course, speakers will discuss the power of immersive visualization to promote innovative STEM education initiatives. Using the Mars City Facility Ops challenge as a case study, speakers will show how information within BIM can be integrated into virtual reality. They will also share the insights they gained while creating an immersive environment for a visionary organization using Revit, Autodesk LIVE, and Stingray.

Mars City was founded by the National Institute of Building Sciences (NIBS) to recruit a new generation of professionals capable of working with high performance buildings. The program allows high school students to use building information models (BIM) and facility maintenance tools to manage a virtual base on Mars. Philadelphia-based architecture firm KieranTimberlake enhanced the Mars City curriculum by using an immersive environment that engages students as they play out various scenarios in virtual reality. Members of the KieranTimberlake Mars City team will highlight challenges and opportunities captured in the case study, as well as broader application of the workflow in architectural visualization, facilities management, and education

About the Speakers

Efrie Friedlander, AIA, and Fátima Olivieri, AIA, are co-leaders of KieranTimberlake's BIM Practices group. They are responsible for integrating novel practices with traditional BIM modeling, and their work has been published in peer-reviewed journals and websites. Both Efrie and Fátima have taught design studio courses at the University of Virginia and the University of Michigan and have lectured at the AIA National Convention, Greenbuild, and other national and international conferences. Alongside Rolando Lopez, they lead the project team for the award-winning Mars City project, a collaboration between KieranTimberlake and the National Institute of Building Sciences.

Efrie's research explores topics related to materials, digital technologies, and the environment at KieranTimberlake. She also works on Tally, a Revit-based Life Cycle Assessment (LCA) tool for designers that measures environmental impacts. Efrie has received a Master of Urban Ecology from Yale University and a Master of Architecture from the University of Michigan.

Fátima has been involved with projects of various scales and typologies during her time at KieranTimberlake, most recently on a mixed-use project in New York City. Fátima has a Master of Architecture from the University of Virginia, where she also received the Design Excellence Award.

While at KieranTimberlake, Rolando has worked on educational projects for both Rice University and Washington University in Saint Louis, the university from which he received his Master of Architecture. While at Washington University, he developed a framework for drone delivery centers in urban environments.

The Mars Facility Ops Challenge

Mars City serves as a virtual environment that allows high school students to explore the learning opportunities offered by STEM disciplines. The Mars Facility Ops Challenge, developed by the National Institute of Building Sciences (NIBS) in partnership with the Total Learning Research Institute (TLRI) and the National Aeronautics and Space Administration (NASA), allows students to act as facility managers responsible for maintaining a virtual base on Mars, empowering them to learn about building systems and the importance of teamwork. As members of the Mars City Operations Teams, participating students assign virtual work orders and prioritize tasks ranging from routine maintenance to life-threatening emergencies. These tasks cover both preventive maintenance, such as regularly cleaning the city's photovoltaic panels, and more dire situations, like an atmospheric leak in a habitation module. Designed to teach students valuable problem-solving, time management, and teamwork skills, these simulations can be integrated into the participating high schools' math and science curricula with the goal of exciting students about potential career paths in the building sciences.

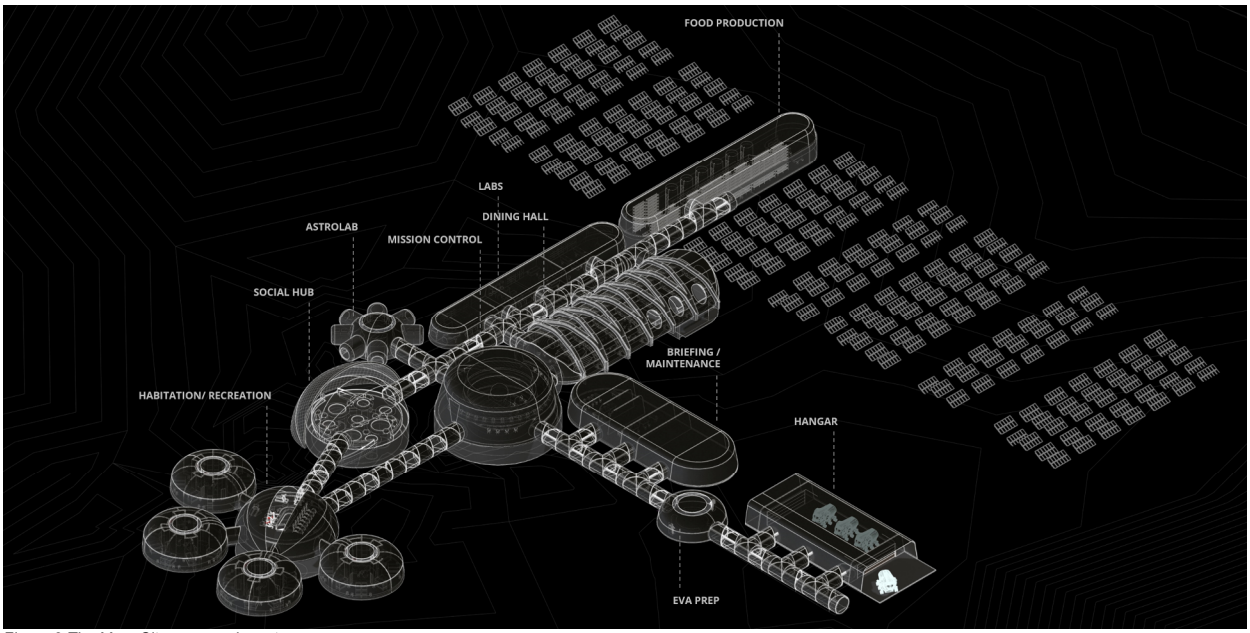

Figure 2 The Mars City program layout

Figure 3 Renderings of the Social Hub and Mission Control sectors within Mars City

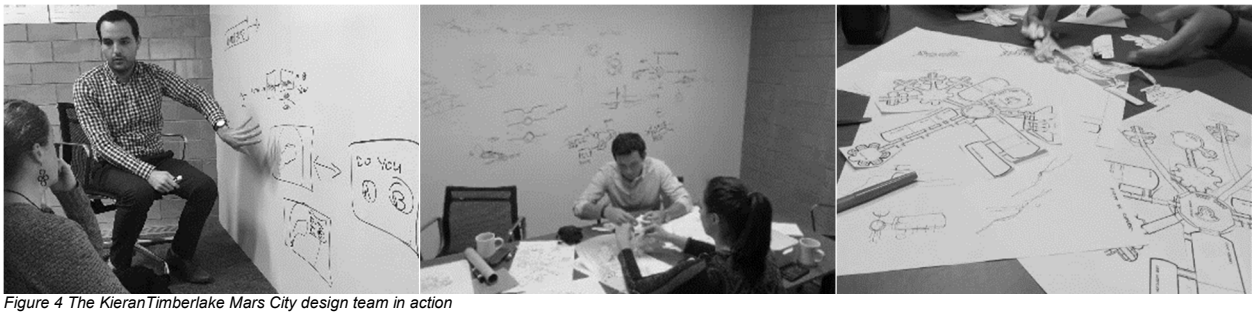

Figure 4 The KieranTimberlake Mars City design team in action

The Role of Virtual Reality

As part of KieranTimberlake's community involvement initiative, a team of architects and researchers have been evolving the design of this educational tool in order to create a more engaging and realistic virtual environment in which the Mars City work scenarios can take place. Alongside members from Gilbane Construction Group and Alderson Engineering, the team generated a BIM model in Revit using existing Mars City drawings provided by TLRI. This model then became the framework for the current virtual reality model.

In addition to increasing exposure to building sciences in the classroom, the Mars Facility Ops Challenge can pioneer the role of facility manager in the real world. Because it uses a BIM-based design to inform facilities management, the program Mars City demonstrates a new approach to virtual facilities management that the building industry will be able to adopt as a best practice. Projects like Mars City that use BIM-based designs can start working before a shovel even hits the ground by compiling a database of more than 85% of the information needed to maintain a building. In the real world, utilizing such data prior to construction allows for more comprehensive facility planning, customizable operations and maintenance staff training, preventive maintenance scheduling, and preemptive disaster planning.

Virtual reality models are also increasingly useful tools for design iteration. Since it allows designers to effortlessly explore the relationship between space, movement, virtual reality offers the unprecedented ability to visually explore and virtually inhabit a building, decreasing the gap between digital design models and physical experiences. In using virtual reality to model potential designs, architects, contractors, and the overall building industry can further understand how design decisions will play out in the real world, giving clients and stakeholders a more holistic understanding of the design. Using a similar workflow between Revit, Autodesk LIVE, and Stingray that KieranTimberlake's Mars City team used, teams can move quickly from their working Revit model into a virtual reality environment, allowing them to easily incorporate VR models into their daily design workflow.

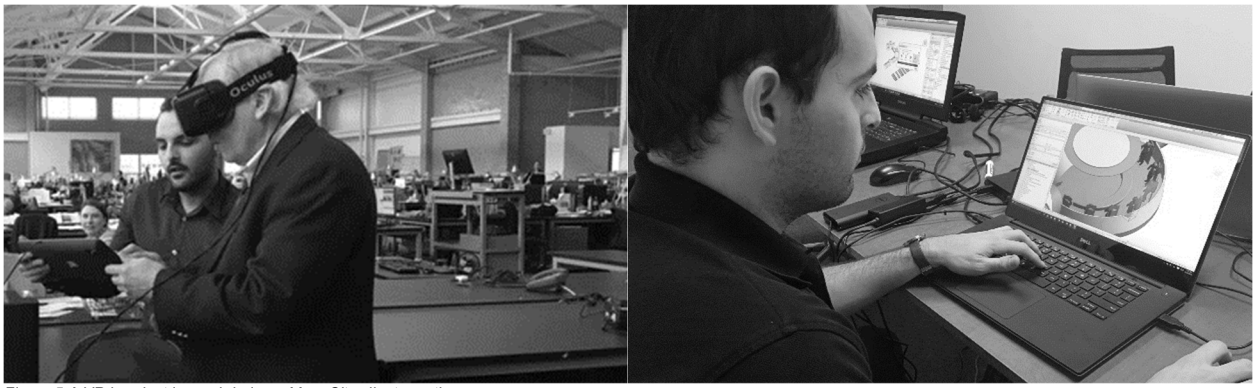

Figure 5 A VR headset is used during a Mars City client meeting

The Path to VR: Workflow between Revit, Autodesk LIVE, and Stingray

Tools such as Autodesk LIVE help facilitate the use of immersive environments and virtual reality within the design workflow. Because the majority of the architectural design and documentation process increasingly occurs within Revit, Autodesk LIVE provides the vital link to facilitate a streamlined virtual reality workflow directly from the working documentation and design software. For more advanced users, the interoperability between Autodesk LIVE and Stingray allows for increased customization, giving designers the ability to create specific narratives and storylines within the design process in order to craft a comprehensive educational experience.

The diagram below outlines the workflow the KieranTimberlake team established between the BIM model and the Oculus headset virtual reality interactive environment:

1. BIM model geometry and materials are uploaded and processed
2. Collision mapping, lighting, and Revit texture mapping are added in the cloud, and the LIVE model is downloaded to a local machine
3. Data from the Construction Operations Building Information Exchange (COBie) is collected within the Dashboard/WebTMA interface
4. Scenarios are inputted into the virtual environment as interactive storylines
5. Entourage is added, scenario-specific objects are animated, and materials are customized
6. Geometry, scenes, scenarios, and interactivity are aggregated and pushed into the virtual reality headset for deployment

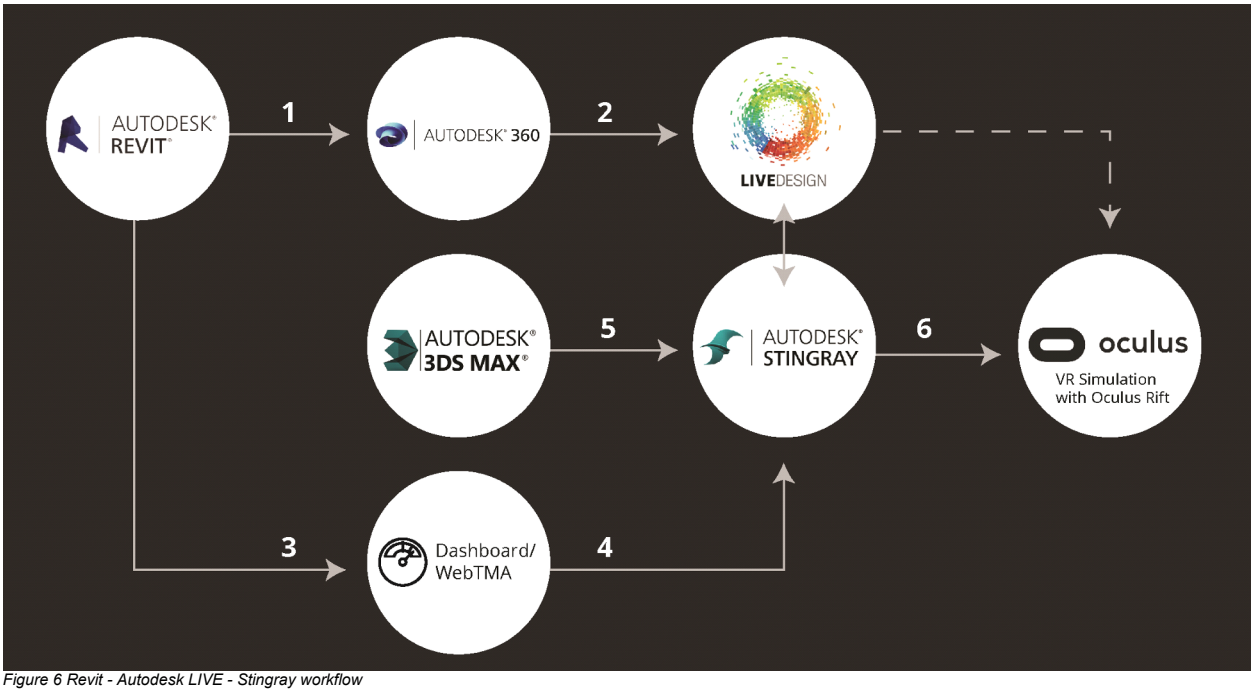

Figure 6 Revit - Autodesk LIVE - Stingray workflow

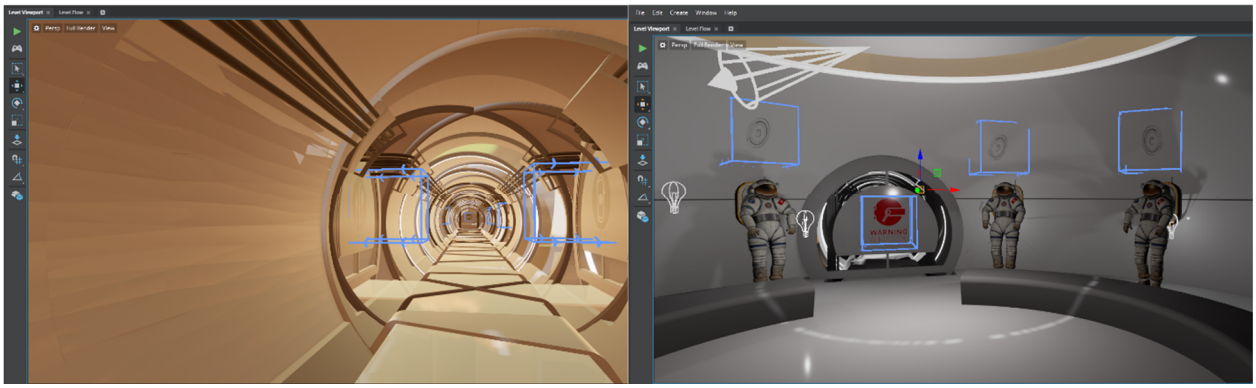

Figure 7 An Autodesk LIVE model environment

Resources

STEM Education

- National Institute of Building Sciences (NIBS)
  http://www.nibs.org/?page=stem
- Total Learning Research Institute (TLRI)
  http://www.tlri.org/

Autodesk LIVE

- General Overview
  http://www.autodesk.com/products/live/overview

Stingray

- General Overview
  http://help.autodesk.com/view/Stingray/ENU/?guid=__stingray_help_getting_started_what_is_stingray_html