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REALITY CAPTURE OF ICONIC AND HISTORIC FACILITIES -- THE STORY OF THE US AIR FORCE ACADEMY CHAPEL

SUERMANN, PATRICK C.
U.S. AIR FORCE ACADEMY AND HEADQUARTERS
AIR FORCE INSTALLATION & MISSION SUPPORT CENTER

Lt. Col. Patrick C. Suermann, PhD, PE, LEED AP
U.S. Air Force Academy and Headquarters, Air Force Installation & Mission Support Center

Reality Capture of Iconic and Historic Facilities -- the Story of the US Air Force Academy Chapel

Synopsis:

In the summer of 2014, civil engineers from Peterson Air Force Base and the U.S. Air Force Academy partnered with the Autodesk Corporation to conduct a "reality capture" of one of the most iconic facilities in the Air Force and perhaps, the country, the Air Force Academy cadet chapel.

Reality Capture of Iconic and Historic Facilities -- the story of the US Air Force Academy Chapel

Lt Col Patrick C. Suermann, PhD, PE, LEED AP
Associate Professor, HQ USAFA/DFCE and HQ AFIMSC/IZPS

While the Air Force Academy's iconic structure remains beautiful 50 years after its dedication, its foundation, envelope, and fenestration have not. This was the driver for a research and investigatory effort in the summer of 2014 in preparation for one of the most delicate and sensitive renovation projects ever undertaken in the U.S. Air Force.

Today's fiscally-constrained decisions require evermore data to inform decision makers, architects, and engineers. Luckily, there are new technologies helping to better document as-built conditions: reality capture through laser scanning and remotely piloted aircraft (RPAs) or "drones." Since 2011, Roger Clarke and his team at Peterson Air Force Base's 21st Civil Engineer Squadron (CES) had a challenge of supporting the largest, most geographically disparate wing in the Air Force. Their squadron is responsible for geographically separated units (GSUs) at places like Thule Air Base in Greenland to others at Maui. They solved the problem by using a Leica C10 ground-based High-Definition Survey (HDS) ScanStation. This equipment comprehensively captures vector and image data quickly. Using light detection and ranging (LiDAR), the scanner hits all the points it sees with a laser and times how long it takes for the points to come back. After a 360 degree sweep, it completes another revolution to capture the "picture" – populating all the laser-acquired data points with the colors and images it sees in the photo capture. The result is something out of the first person shooter video games our junior enlisted are likely playing in their dorms: hyper-accurate photo-realistic, virtual environments. It's taking engineering assistants from simply "surveying" where they collect a few data points to "reality capture" where they get everything that can be seen at once.

In the summer of 2014, the 21 CES and the CE Department at the Air Force Academy partnered with the Autodesk Corporation to conduct a reality capture at one of the most iconic facilities in the Air Force, the cadet chapel. In one week, government civilians, officers, enlisted, cadets, and contractors collected approximately 32 gigabytes of still photo data and another 100 gigabytes of videos of this more than 50-year old historic landmark. Two types of laser scanners were used: the Leica C10 mentioned earlier, and a FARO Focus3D X330 scanner. Additionally, a DJI Phantom II drone was piloted by Autodesk under the thorough supervision of a USAFA RPA pilot and small Unmanned Aerial Systems (UAS) Test Manager, Major "Pokey" Gorrell of USAFA's Astronautics Department. There are now videos and still shots from the GoPro camera on the drone that can be used to survey every bit of the outside of the chapel from the crumbling foundation to the laser scanning at the apex of the spires. From the laser scan, the end result was equally spectacular. For the first time ever, you can see all sections of the chapel in real time by sectioning the laser scan point cloud.

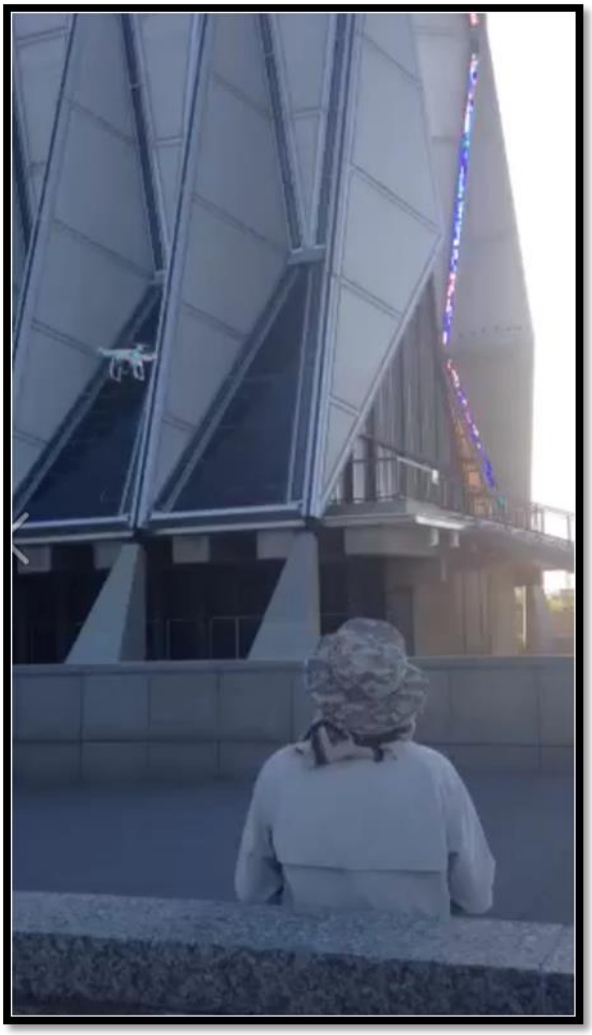

Figure 1. Mr. Pete Kelsey of Autodesk, Inc. flies a DJI Phantom II outside the cadet chapel in June, 2014

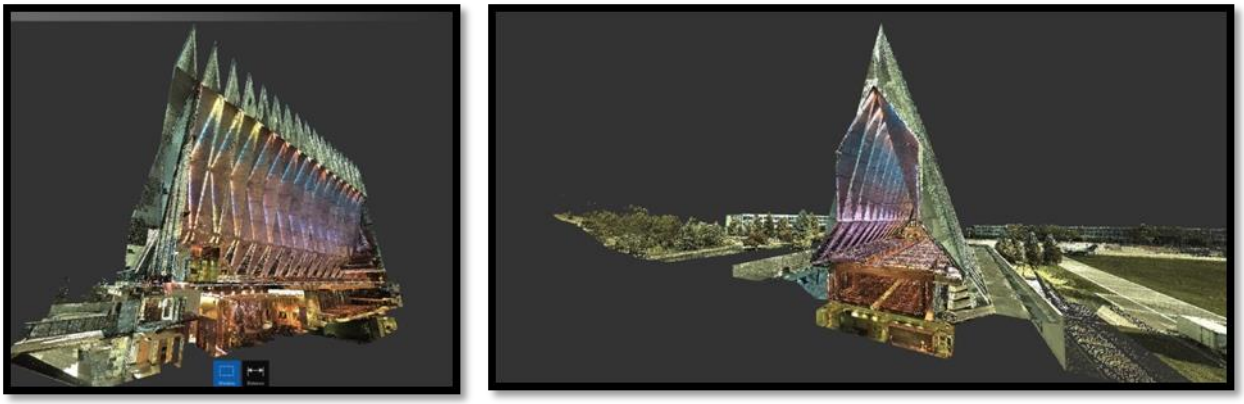

Figure 2a and 2b. Section views of the chapel point cloud (Courtesy of 21 CES and Autodesk, Inc.)

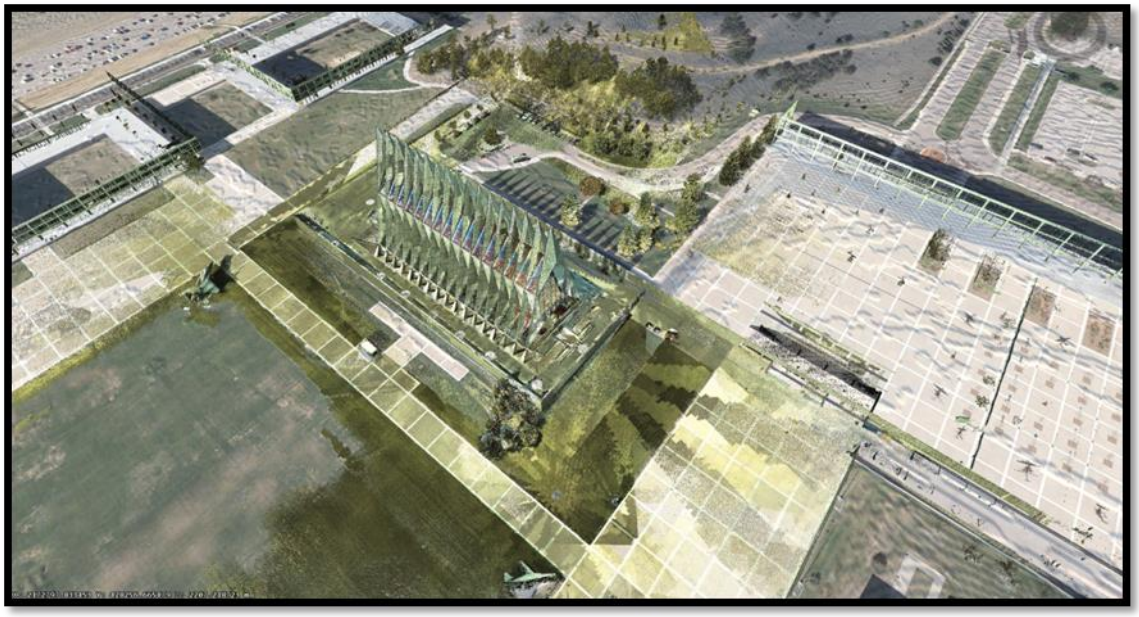

Figure 3. Chapel laser scan in Autodesk InfraWorks

More important are the downstream uses of the data. The principle of building information modeling (BIM) according to the National BIM Standard is to digitally represent the physical and functional characteristics of a facility from inception onward. As such, the BIM should serve as a shared resource for collaboration where information can be authored once and used again and again. In this case, modelers are using existing information and all the newly collected information for adding the model to macro level views in InfraWorks and smaller scale facility analysis for energy modeling and simulations. Now in Fiscal Year 2016, this data will inform a multi-million dollar renovation for a soon-to-be awarded renovation project which will require completely disassembling the structural envelope and reassembling it with improved flashing and waterproofing. These models, videos, and photos will be invaluable to the planning of that effort.

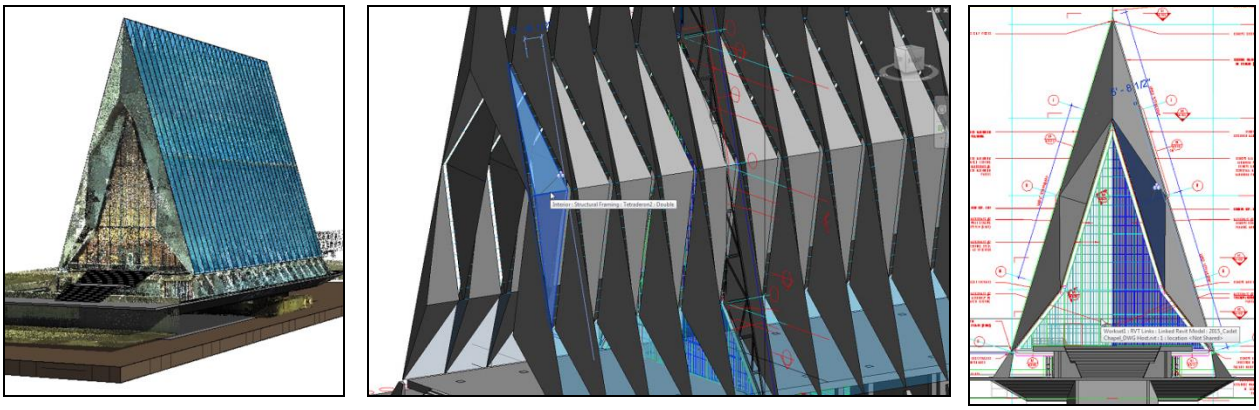

Figure 5a, 5b, and 5c. Chapel Laser scan to BIM in Revit using multiple sources for authoring geometry

Lt Col Pat Suermann helped launch GeoBase GIS mapping at Andersen AFB, Guam in 2000. He received his masters of construction management from Texas A&M University in 2003 and his PhD in Design,

Construction, and Planning from the University of Florida in 2009. Subsequently, he authored the Air Force's first BIM requirements in Fiscal Year 2010 at the Air Force Center for Engineering and the Environment. After time as a combat engineer in Afghanistan and a Commander in Greenland, he served as an Assistant and then Associate Professor in the Department of Civil and Environmental Engineering at the U.S. Air Force Academy from 2012 to 2015. Since 2015, he's served as the Chief of Emergency Services and Engineering at the newly formed Headquarters, Air Force Installation and Mission Support Center.

Note: similar information appeared in a highlight spot in Air Force Civil Engineer Center online news in April of 2015, but this article represents new information since then.