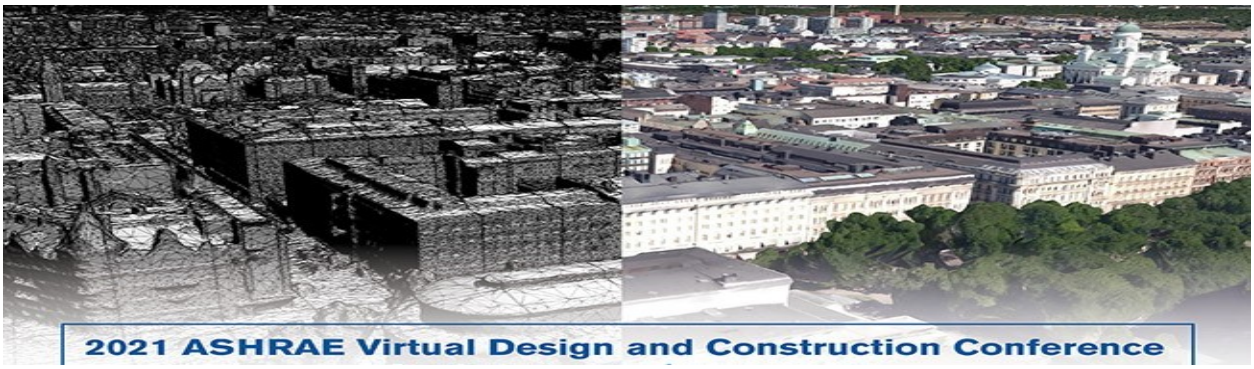

March 8-10, 2021
www.ashrae.org/VirtualDesign2021

Note: All times are Eastern Standard Time
Updated: Mar 5, 2021

Monday, March 8, 2021

Opening Session 11:00 a.m. – 11:15 a.m.

Keynote 1 11:15 a.m. – 12:15 p.m.
Session Chair: Mitchell Swann

Digital Twins for Digital Cities
Robert Mankowski, Senior Vice President, Digital Cities, Bentley
The US Census Bureau estimates that over 80% of the US population lives in an urban environment, and as we have unfortunately witnessed over the past year, urban areas have been the epicenter of the COVID-19 pandemic generating an estimated 90% of reported cases. Add to that the impacts of climate change and extreme weather, decarbonization goals, and increased regulations, all while US cities could

be facing a $360 billion revenue shortfall just over the next two years, and the situation looks quite grim. But it's not without hope. The pandemic has accelerated investments in digitalization, both in the public and private sector, and this investment will have benefits into a post-lockdown world. The interface between people and our environment is our infrastructure – the physical fabric of an urban environment – and how it is planned, designed, built and operated has a profound effect on our resilience, sustainability and quality of life. City-scale digital twins are a promising technology paradigm for helping evolve the physical fabric of urban areas and drive better outcomes. This presentation looks at what city digital twins are, how to get started in creating them, what technology megatrends have led to their feasibility and how we can evolve and apply them to some of our most important challenges and derive tangible benefits. We'll explore some real-world examples of their application in cities from around the world, and look to what the future might hold for a more automated creation and evolution of urban digital twins.

12:30 p.m. – 1:30 p.m.
Technical Session 1
Session Chair: Marcus Fich

Implementing Monitoring Based Cx During and to Assist with the COVID-19 Pandemic (Seminar)

Wade Conlan and Mathew Coalson, Hanson Professional Services

Pandemic safety measures have placed new constraints on physical access to HVAC systems. Remote monitoring and modern data analytics software offers paths to evaluate building system performance, including those that can impact the transmission of the SARS-CoV-2 virus that causes COVID-19, in buildings and their spaces. During this session, a brief overview of the current understanding of how COVID-19 is transmitted, and the impact HVAC systems play in that transmission is reviewed. In addition, methods for accessing building automation systems remotely are discussed. With remote analysis a new branch of analytic rules needs to be developed to help facilities managers keep their building occupants safe in addition to the energy efficiency analytics. Through consistent evaluation of the HVAC systems it is possible to evaluate outdoor air flow, balancing between the fresh air requirements for mitigating the spread of the virus and the associated increase in energy consumption. This presentation focuses on how consistent monitoring of the building's systems can optimize buildings for numerous use cases, including comfort, energy and safety.

2:00 p.m. – 3:30 p.m.
Technical Session 2
Session Chair: Dru Crawley

Practical Implementation of Augmented, Extended Reality and Model Visualization in MEP

Three workflow examples of visualizing model information show how they facilitate transparent decision-making in projects through decision and construction.

1. AR on Engineering Drawings (Case Study)

Ben Pielhop, HGA

Augmented reality (AR) has been an exciting technology in recent years, but one struggle is how to use this technology effectively and efficiently. One practical use is seeing a complex MEP system in AR "pop" out directly over the construction document drawing. This presentation shows why this technology will

benefit the building owner, contractor and design engineers, and the process how to get there. We'll first look at the process in how to create an AR experience that makes the construction documents come alive. Like many extended reality experiences, it begins with a clean and accurate Revit model. Beyond sound geometry, the parameter information can also be important since that can be used in AR also. Some tips for a clean 3D model are presented.

2. VR for Engineering Design Decisions (Case Study)
Ben Pielhop, HGA
Any form of extended reality (XR) can be exciting, however the engineering community has been challenged with finding practical ways of using VR so that people of all ages can experience. This presentation touches on workflows that can help make design decisions in a better way. Whether it's a light-weight flythrough version of virtual reality or a completely immersive walkthrough, the process is explained along with some real-world case studies to elevate the engineering design.

3. Use of BIM Technology in Underground Metro Stations (Case Study)
Vikas Verma and L.R. Sharma, Ayesa India Pvt. Ltd.
This presentation presents the use of 3D BIM software for development of models for the under-construction Krishna Park Extension underground station at Delhi Metro. The Krishna Park Extension underground metro station is an extension of already operational Line-8 of Delhi Metro. The station is having total length of 220 m and contains two entrances. The station is 20.9 m in width and 17 m in burial depth. This presentation explains how the miniscule interface between different systems are being taken care of in the 3D model. The 3D view of the station enables the designer to see the requirement from any angle and the clashes in services if any can be identified very easily. This presentation also shows the details of all the electrical and mechanical components provided in different plant room of the station and the use of technology to estimate the quantities from the model itself. The installation of major equipment can be seen critically and the problem if any in installation can be identified at the designing stage itself.

4:00 p.m. – 5:30 p.m.
Technical Session 3
Session Chair: Mitchell Swann

Betting on Pre-Fabrication Construction: Casino in South Philadelphia (Seminar)
Cory Robbins, EDA Contractors, Jeff Dorneman, EDA Contractors and Nicholas Brown, BLTa

Off-site panelized construction is a growing and efficient method of production in commercial construction. Typically, panels are fabricated completely off-site and transported and installed on-site as a full wall system. However, due to potential irregularities in building materials, challenges with ensuring continuity of control functions between panels can arise, specifically related to air and water control. The Philly Live! Hotel and Casino opted for a hybrid approach combining pre-fabrication of the wall panels including the CFMF substrate, gypsum sheathing and air/water resistive membrane, allowing for appropriate sealing between panels on site prior to installation of the exterior insulation and cladding. The off-site fabrication process was aided using Revit to design the panels and BIM to piece together the full building façade in real time. Using technology and complex detailing, the clashes in the panels were identified early in the design and modified accordingly, enabling a more precise fabrication. The result is a quicker installation of the building façade providing flexibility with design and construction schedule. To ensure correct alignment between components, cloud scan modelling was used to survey sections of

the building including the fascia and ceilings that had many compound curves and elevation changes. In addition, certain portions of the building elevations were procured by overlaying the CAD models to ensure lineup of the panels at spandrel locations.

5:30 p.m. – 6:30 p.m.
Technical Session 4
Session Chair: Dru Crawley

VD&C: Stories from The Engine Room

Get fresh perspectives to all things VDC in this facilitated peer session. In The Engine Room, you'll be joining a series of breakout sessions where specific areas across the project lifecycle are discussed openly among peers. Be sure to give your input to our Engine Room design!

Tuesday, March 9, 2021

11:00 a.m. – 12:00 p.m.
Keynote 2
Session Chair: Mitchell Swann

Spaceport Virtual Design and Construction

John Constantinide, Mechanical Engineer

Spaceports are increasing in number in response to opportunities for regional authorities and airports to provide access to Earth orbits, deep space and locations on other planets and lunar bodies. This keynote presentation sheds insight to spaceport design, construction and operational requirements that can drive virtual design, construction and maintenance solutions. Case studies of active spaceports illustrate opportunities for virtual applications bringing added value to spaceport owners and private launch users providing launch capabilities.

12:30 p.m. – 1:30 p.m.
Technical Session 5
Session Chair: Dru Crawley

How Building Operational Data Can Be a Powerful Tool!

This session presents two case studies showing how important building operational data is in helping diagnose under-performing buildings and taking buildings to the next level of performance to enable more effective building management.

1. Modeling and Simulation of a Structurally Integrated Building Energy Module (Case Study)

Youngjin Hwang, Alexandros Tsamis, Theodorian Borca-Tasciuc and Luigi Vanfretti, Rensselaer Polytechnic Institute

From a design perspective, we will show a structurally integrated heating and cooling module, which can be applied to various opaque building elements, including a slab, interior partition and envelope. This modular building structure consists of a unique double-sided hydronic heating and cooling layer embedded in a composite structural insulated panel. An integrated intelligent computer module

regulates the dynamic thermal behavior of the double-sided heating and cooling layer according to the change of environments and available renewable energy sources.
From a technical perspective, we will show a digital twin module developed for the proposed system by using Modelica to overcome current limitations in modeling thermally adaptive building components. To illustrate the value of this model, EnergyPlus is used for establishing a building's geometry and general building operations, while being coupled with a Modelica-based module that dynamically changes thermal resistance values. The functional mock-up interface standard for co-simulation is used in the coupling process.

2. Legacy Building Automation System Upgrades Powered by Haystack Tagging: University of Richmond (Case Study)
Jeremy Wolfe and Scott Muench, J2 Innovations
Project Haystack is an open-source initiative that has created a standard way to define and model data in smart buildings. Most existing building automation systems do not yet support semantic tagging, so how can building owners and managers upgrade, manage and control their buildings better by the adoption of the Haystack standard? One way is to use the nHaystack driver to existing software or to upgrade to new software that has Haystack tagging built-in. The University of Richmond is a great example of using the open standard Haystack connector within J2 Innovations' FIN Stack software to integrate legacy systems with Niagara JACEs using the nHaystack driver. The University's facilities management team have been working with FIN Stack and the nHaystack driver since 2014, so have been able to develop a consistent interface with alarm routing and data collection capabilities for all their many buildings. They are also using BACnet IP for new additions and renovations. The University will shortly roll-out new Edge2Cloud capabilities to allow for remote and secure connection to campus building systems and data. This presentation demonstrates the benefits of Project Haystack's semantic tagging open standard, also new technology such as Edge2Cloud connectivity that enables cyber-secure remote access to multiple sites and how existing building automation systems can be easily upgraded to enable more effective management.

2:00 p.m. – 3:30 p.m.
Technical Session 6

SMACNA-MCAA-NECA Prefabrication and Modularization (Panel)
Moderator: *Angie Simon, Western Allied Mechanical*
The alliance of the Sheet Metal and Air Conditioning Contractors National Association (SMACNA), the Mechanical Contractors Association of America (MCAA) and the National Electrical Contractors Association (NECA), representing the skilled MEP construction contractors, is proud to be a sponsor of ASHRAE's Virtual Design and Construction Conference. A panel of prominent, experienced contractors discusses the topic of offsite prefabrication and modularization, its benefits to the construction process and to project owners. This panel of mechanical, electrical, and HVAC contractors shares their real-life experiences and lessons learned in successfully delivering quality projects using offsite prefabrication and modularization methodologies and latest construction technologies. The panelists are:

Moderator: Angie Simon
SMACNA Representative: Dave Pikey
MCAA Representative: Stacy Zerr
NECA Representative: Steve Rose

4:00 p.m. – 5:30 p.m.
Technical Session 7
Session Chair: Dru Crawley

National-Scale Shared Development Platform to Enable Product-Process Innovation of Integrated Mechanical Pod Solutions: Design for Manufacturing and Assembly and Digital Twin Effort by NREL and Partners (Seminar)

Joseph Louis, Oregon State University, Shanti Pless, National Renewable Energy Laboratory, Ankur Podder, National Renewable Energy Laboratory, Stacey Rothgeb, National Renewable Energy Laboratory, Peter Schneider, Vermont Energy Investment Corporation

This session highlights early wins, updated progress and upcoming developments on 'national-scale shared development platform' for rapid prototyping, testing and validation of various integrated mechanical pod solutions and form factors. Such pod solutions consist of a set of all-electric heat pump mechanical equipment that have integrated functionalities through built-in controls, with heating, cooling, hot water, ventilation (including energy recovery), electrical management and battery storage within a single package. The session's presentations draw inspiration from the success of bathroom pods in the US modular construction industry, UK's efforts with unitizing mechanical systems as 'utility cupboards' and VEIC's early wins in design-build of all-electric mechanical pod solutions in Vermont. This session includes presentations from researchers and partners involved with NREL in DFMA, VDC and digital twin based process optimization modeling of integrated mechanical pod solutions.

5:30 p.m. – 6:30 p.m.
Technical Session 8
Session Chair: Robin Bryant

Technology Enabled Fast Track Project Execution

Two project case studies demonstrate how creative integration and technology can be used to meet the demand for fast track project execution.

1. University of Maryland Capital Region Medical Center: Central Utility Plant (Case Study)

Bill Bullock and Bryan Holcomb, Environmental Air Systems, LLC

This case study covers the University of Maryland's design of a complete central utility plant (CUP). The CUP serviced a new 600,000 sqft. hospital serving the entire Washington D.C. area. The CUP included combined heat and power to serve all of the main plumbing, electrical and mechanical infrastructure which had a total square footage of around 30,000. The CUP stood 2 stories tall with some of the electrical and cogeneration infrastructure on the second level and the cooling and heating infrastructure on the first level with cooling towers mounted on the roof on a structural steel dunnage platform. The design approach was to build the entire CUP off site, from the top of the foundations up, in approximately 100 modules that would be shipped to site and assembled completely. Off site construction was utilized for the entire scope of the CUP, which was manufactured in High Point NC, shipped to site in Largo, MD and then installed and commissioned.

A complete CUP design through a DFMA approach was provided. At the project onset, the hospital and its engineering partner determined the hospital electrical/cooling/heating loads and performance criteria which was provided to the design assist partner as a bridging document to use as the basis of the design. the basis of design was utilized to develop the CUP layout, system designs, permit set of drawings and construction/fabrication documents. The CUP was designed completely in 3D using the Revit platform to not only design and coordinate the project but also to fabricate. In the Revit model all systems were coordinated including architectural, structural, mechanical, plumbing, electrical, controls, fire protection and fire alarm. From this model fabrication level drawings, bills of materials, cut lists and assembly drawings were developed. This provided the production floor with the necessary information to manufacture and pre-assemble the CUP. The modules were shipped complete on tractor trailers to the site where they were rigged into place by crane. This case study presents a complete turnkey solution for the CUP including installation of the central utility plant.

2. Integrated Design and Construction of a COVID-19 Cleanroom (Case Study)
Andrew Phelps, Barnes & Dodge, Inc., Brian Wirfel, Thermo Fisher, Darren Orender, Jackson|Main Architecture, Adam Neth, Scott Keller, Insite Group, Don Payne, Purdum Construction
Thermo Fisher's Project Patriot is a $40 million, 120,000 sq ft facility designed to increase the company's production capability of viral transport media (VTM). In late May 2020, the company received a federal government contract to increase the production capacity of VTM, and on July 4, 2020, the first VTM tubes rolled off the production line. VTM is a critical component in COVID-19 testing. This project contained air cooled chillers, condensing boilers for heating hot water, process steam boilers, air handling units and modular HEPA diffuser systems in ISO Class 5 (Class 100) cleanroom areas. Work was completed on a 7-day week schedule, with several crafts working multiple shifts per day. This case study presents the challenges, processes, outcomes and lessons learned of this fast-paced project. Equipment procurement (chillers, boilers, air handling units, etc.), integrated design, mechanical system components and ductwork prefabrication are covered. All these facets enabled the design and construction team to complete this project in record time.

Wednesday, March 10, 2021

11:00 a.m. – 12:00 p.m.
Keynote 3
Session Chair: Marcus Fich

How Digitalization and Data Are Driving Better Outcomes
Steven Butler, Autodesk
In this presentation, we look at emerging digital trends and technologies in the AECO industry. Exploring how the digitalization of certain processes is both leverage and capturing data to help inform smarter decision making, increase construction productivity, improve build quality and ultimately deliver better outcomes.

12:15 p.m. – 1:45 p.m.
Technical Session 9
Session Chair: Dennis Knight

Engineers and Trades Living Collaboratively in the VDC World: Presidential Perspectives (Panel)

Brian Helm, Helm, Larry Beltramo, Rosendin, Angie Simon, Western Allied Mechanical, Charles Gulledge, III, Environmental Air Systems, LLC, Dennis Knight, Whole Building Systems LLC

What's at the heart of 7D BIM collaboration between Engineering and Construction process? Find out in this 'can't miss' session with the presidential members of trade associations and the current ASHRAE president as they address the future of virtual design and the role it plays with contractors and how it interfaces with engineers.

Moderator: Dennis Knight

Panelists:

Brian Helm, MCAA
Larry Beltramo, NECA
Angie Simon, SMACNA
Chuck Gulledge, ASHRAE

2:00 p.m. – 3:30 p.m.
Technical Session 10
Session Chair: Krishnan Gowri

Going Digital and Digital Twins

BIM has paved the way to create digital twins for physical assets to be represented in virtual building models which can be maintained and managed in real time. This session brings together three leading experts in the industry transforming the built environment with digital twins. Case studies of recent building projects will be presented discussing how engineering drawings and BIM models created during the design stage can become as-built digital twins and used for optimizing building performance. An innovative workflow of integrating digital twins with asset documents, asset work orders, asset preventative maintenance and asset controls data for improving operational performance is demonstrated with actual use cases. Attendees are introduced to the new technologies including photogrammetry and LiDAR for evaluating resiliency and disaster mitigation using digital twins in a city scale.

1. Digital Twins: Digitalizing a Better Built Environment and Facilities Management (Seminar)

Chip Branscum, Pinnacle Infotech Inc.

The concept of digital twin is more than just a progression of BIM; advanced digital twin involves two-way interactions that theoretically permits for the physical assets to be managed remotely by its virtual twin. It enables facilities management to digitally test-drive workplace elements before their employment in real life.

Digital twin establishes a link between the physical and digital world, which will collect and track project progression over time and utilize the data to optimize performance. This case study illustrates how it epitomizes engineering drawings dimensions and represents all the sub components right from the design stage to the as-built digital twin.

The concept discussing how digital twin can enhance a collaborative workflow and how it is helping to digitalize a better-built environment is presented. The session focuses on how to leverage the digital

twin concept to influence a multitude of datasets for exceptionally digitalizing a built environment and performing facility management.

2. Going Digital: Modeling Infrastructure Resilience for Sustainable Urban Development (Case Study)
Drury Crawley, Bentley
It is now possible to quickly model a city using 3D technologies such as photogrammetry, LiDAR and BIM. By federating data from these sources, it is possible to evaluate the resilience of a city under different planning and disaster scenarios. This presentation includes example models of several cities around the world. The photogrammetry model of downtown Philadelphia created for the Pope's visit is merged with the Philadelphia building benchmark data which includes energy, water and other data. For Helsinki, the 26 km2 (10 mi2) reality model is shown along with disaster planning and automated asset identification using deep learning algorithms. In Lisbon and Paris, 3D modeling demonstrates issues of flooding due in insufficient infrastructure. And finally using thermography and photogrammetry to create 3D models of buildings thermal signatures.

3. A Digital Twin Case Study from an Owner's and a Digital Twin Operator's Perspective (Case Study)
Raj Setty, Setty and Associates
The presentation discusses how to convert a BIM model into a navigable asset level digital twin. From here asset documents, asset work orders, asset preventative maintenance, asset controls data and asset videos shall be hosted in the same location. Aggregation of this data and assimilation into a coherent data structure is the next step. Once the data is formatted and labeled, algorithms can be applied for operational and energy efficiency for the unique asset. Most importantly, as changes are made in the field with preventative maintenance or corrective actions, the asset will be fine tuned for operational performance.

4:00 p.m. – 5:30 p.m.
Technical Session 11
Session Chair: Robin Bryant

A Picture Is Worth a Thousand Words (and a moving picture is worth even more!)

VD&C tools can greatly assist project teams in speeding up design interactions; evaluate and refine design solutions, 'build' mock-ups and 'test drive' a buildout before the expensive world of real steel pipe, copper wire and concrete are put into play. This program illustrates a range of ways in which those tools can be brought to bear in coordination between disciplines and capturing the impacts of changes; model, analyze, evaluate and refine project design solutions; create models and mock-ups and allow for virtual hands-on experiences for designers, builders and users at a stage where the knowledge gained can have a multiplier effect on the built value. Attend this program to add some tools to your toolbox or words to your vocabulary.

1. Using Technology in a Remote Work World: Tools to Communicate and Coordinate During the Pandemic (Case Study)
Noble Lilliestierna and Adam Posorske, BSA LifeStructures
In a world where an office can be anywhere, new technologies are giving engineers unprecedented flexibility in how they communicate and produce designs. This case study shows how an engineering team has reimagined the visualization techniques used to communicate their design in a recent chiller plant design project, and used reality capture technology to account for existing conditions in a

challenging equipment replacement project for an operating hospital with only one site visit allowed during the design period of the project.

2. Indoor Environment Construction Using Coupling of CFD and Human Thermal Physiology Numerical Models (Case Study)

Eusébio Z.E. Conceição, University of Algarve, Inês Conceição, Manuela Lúcio, João Gomes, and Hazim Awbi,
The study is performed in a virtual chamber, similar to an existing experimental chamber, with dimensions of 4.50×2.55×2.50 m3. The chamber, occupied with 12 virtual manikins, is equipped with six tables, twelve chairs, one exhaust system and one inlet system, based in impinging jet ventilation. This simulation considers the descendent inlet airflow near the walls corner. The airflow is distributed in the ground floor. The ascendant airflow transport all bioeffluents and heat release by the occupants to the exhaust system located above the head level. This kind of airflow topology promotes good air quality levels because it removes the bioeffluent contaminants released in the respiration process, promotes acceptable thermal comfort levels because it removes the heat emanated from the body and promotes low draught risk levels because the higher air velocity levels are located near the wall, in the non-occupied space, and low air velocity in the occupied area.

3. Automating Pressure Cascade Calculations with Dynamo (Case Study)
Nathaniel MacDonald, TestFit
Mechanical engineers often find themselves doing repetitive calculations throughout the course of a project. These calculations are necessary for accurate HVAC design however, they can be time consuming and if the architectural layout changes, often need to be redone entirely. The purpose of this case study is to show how Dynamo can be utilized as a mechanical design tool to automate the calculation a Dynamo graph that receives rooms and doors from a linked architectural model, interpret their dimensions and calculate transfer airflow through doors and overall infiltration/exfiltration airflows. Using these calculations this workflow automatically creates views and sheets that place cascade flow arrows and airflow values above each door in a floor plan for final documentation. In the end, attendees will better understand how Dynamo can be used as a tool to automate repetitive HVAC design tasks and calculations in Revit.

5:30 p.m. – 5:45 p.m.
Session Chair: Dennis Knight

Closing Session