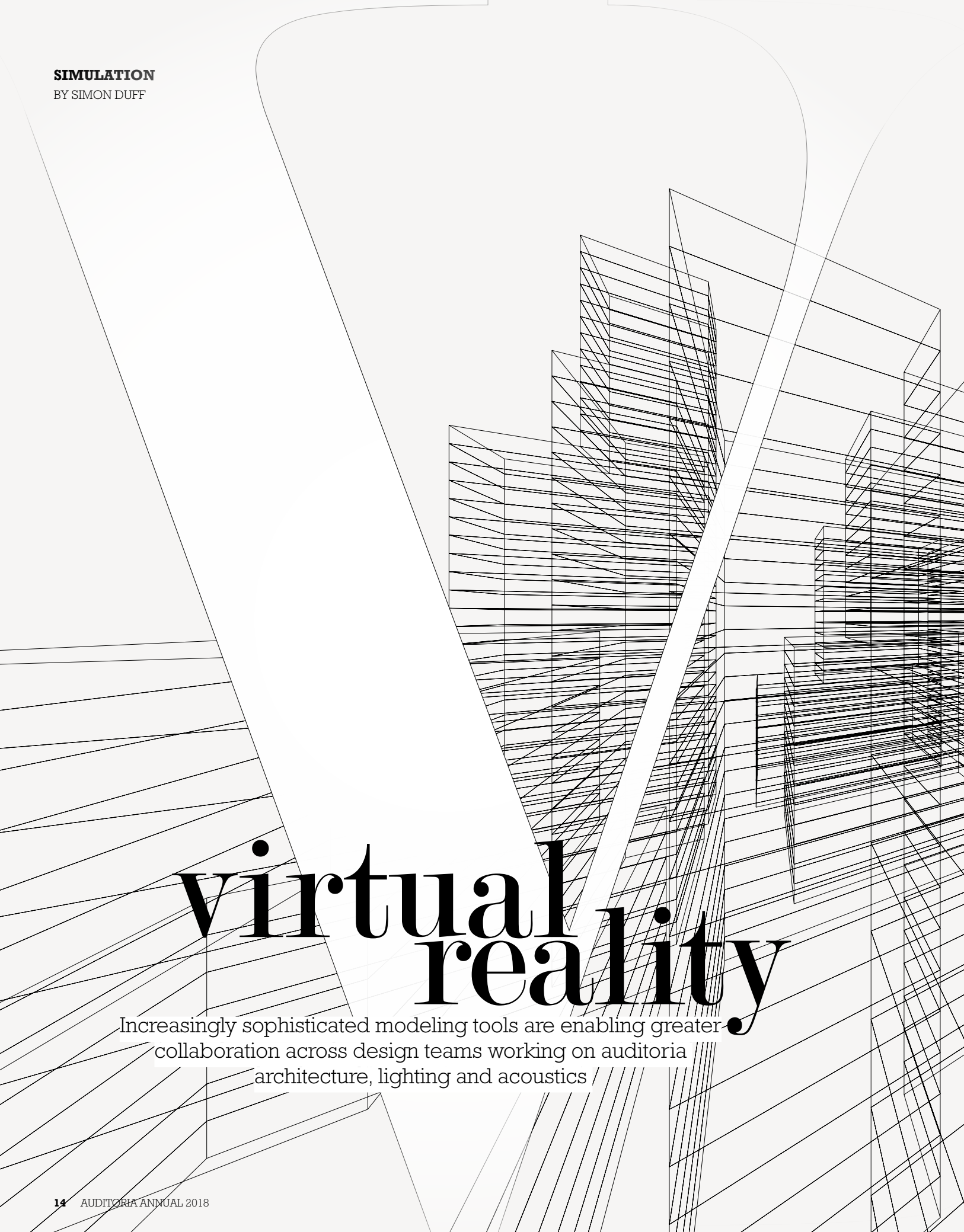
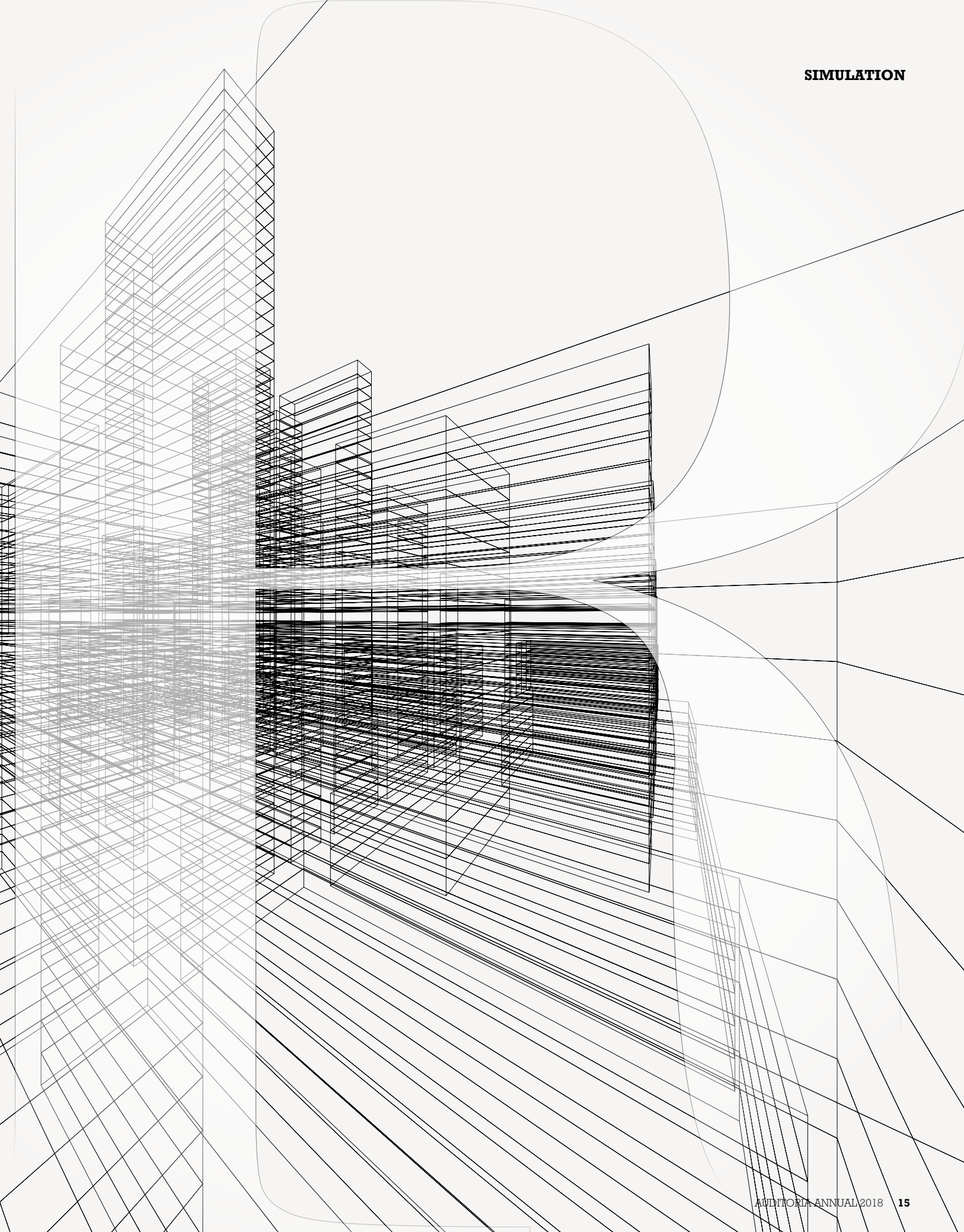
BY SIMON DUFF



virtual reality

Increasingly sophisticated modeling tools are enabling greater collaboration across design teams working on auditoria architecture, lighting and acoustics



This page: **The modernization of the Martin Luther King Jr Memorial Library benefited from collaboration made possible by a shared platform. Images: Martinez+Johnson Architecture/Mecanoo**

The introduction of Autodesk's AutoCAD in 1982 transformed modern architecture. The program still dominates design, not just for architects, but also across a range of industries, from moviemaking to product and show design. The cutting edge in 2017, for modeling, lies both in the development of building information modeling (BIM) and the rise in virtual reality – technologies that are fast becoming essential for evaluating how buildings will function, and as risk factor analysis tools.

An ideal platform

Washington DC-based architects Martinez + Johnson specializes in performing arts buildings, and uses Autodesk's Revit as its primary design tool, with the software supporting workflow from concept through to construction. One of the firm's current projects is the modernization of the Martin Luther King Jr Memorial Library (MLKML) in Washington DC. The 400,000ft² steel and glass structure, designed by famed modernist Ludwig Mies van der Rohe, is a rare example of modern architecture in the US capital and was designated a historic landmark in 2007.

Martinez + Johnson and Netherlands-based architects Mecanoo, which also uses Revit, are design partners on the US$208m project, due for completion in 2020. Joint ventures such as the library are common for Martinez + Johnson, and require a collaborative design platform. "Collaboration using Revit was like a dream come true," says Kal Houhou, director of technology at Martinez + Johnson. "As soon as we began using it, we knew it was going to revolutionize our collaborative design process. Our distributed design team, as well as staff working remotely, need 24-hour access to Revit design models."

In mid-2014, Martinez + Johnson began investigating cloud collaboration strategies for the MLKML project – in particular, ways to provide shared access to Revit models without a heavy IT cost and burden. Around this time, Autodesk announced a new cloud-based collaboration service – Autodesk A360 Collaboration for Revit. Martinez + Johnson became one of its first users.

The rise of VR

As immersive technology becomes increasingly popular at the design stage, a number of new

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Paul Whitaker, senior lighting designer, senior theater consultant, Schuler Shook


DSAI

companies are creating virtual reality software tools for the architect. One such company is IrisVR, based in New York, which has created software intended to empower end users to experience depth and scale. Two IrisVR software solutions are available – a desktop app, Prospect, and a mobile app, Scope. On both platforms, users simply import their 3D files into the software and get quick results, using a head-mounted display such as the Oculus Rift or HTC Vive. IrisVR currently supports Revit, OBJ, Rhino and SketchUp file formats.

Arup is another company making big strides in the use of VR, and has developed its own virtual reality headsets, used to help clients see, hear and move around virtual architectural and infrastructure environments. The in-house headset integrates high-resolution 360° viewing and noise-cancelling headphones, and uses a Leap Motion sensor. This scans users' hands, making it possible for them to interact with objects in virtual environments. Arup's visualization team uses these headsets alongside green screen image technology, 3D CAD models, panoramic visual recordings and audio techniques to create immersive design models.

Lighting the way

Architectural lighting has also been transformed by increasingly sophisticated modeling at the design phase. Schuler Shook is a theater consultancy and architectural lighting designer based in Chicago and Minneapolis, and makes use of a range of programs. For drafting and layouts, either AutoCAD or Revit are used, depending on the architect's choice and the electrical engineer's preference. Schuler Shook

AVOIDING COMPROMISE

Diamond Schmitt Architects (DSAI) is currently working on the design of The Buddy Holly Hall of Performing Arts and Sciences in Lubbock, Texas. There are two major design challenges. First, the extreme climate in West Texas, which ranges from snow and ice to dust storms, floods and tornadoes. Second, acoustic requirements for the 2,300-seat room, which must accommodate unamplified classical and band music, as well as amplified pop and Broadway musicals.

Multipurpose halls are typically a 'jack of all trades, master of none' in the theater world, adequate for a range of presentations but typically lackluster in any one form. The DSAI team, led by principal and project architect Matthew Lella, decided this wasn't good enough to showcase the depth and diversity of the arts scene in Lubbock. He comments, "We wanted no compromises in any of the modes. On the one hand, the symphony hall deserves a top tier natural acoustic, and on the other, the venue should also feel natural as an amplified 'house of blues' room with a flat floor."

DSAI's team adopted this 'no compromise' ethos to its work tools, and a collaborative, shared Revit model in AutoCAD A360 enables a geographically separated design team to benefit from a BIM setup that integrates all disciplines.


DSAI

Clockwise from above: **The Smart Financial Centre in Houston, Texas; Arup has made significant advances in simulating acoustic setups; SoundLab facilities make it possible to preview sound setups before construction has begun; The future of acoustic modeling could enable teams to listen to acoustic behaviors even as spaces are being designed; L-Acoustics' Soundvision software makes it possible to trial different speaker placements within 3D space**

uses Lighting Analysts' AGI program to help determine the spacing and layout of general lighting, as Paul Whitaker, senior lighting designer and senior theater consultant explains.

"AGI gives foot-candle readings, so it can be very helpful, especially in a theater where you are dealing with a variety of ceiling and floor elevations in the same room. Being able to model the lighting and foot-candle levels for, say, the balcony and the main floor allows us to balance the levels by choosing appropriate lumen packages for different ceiling heights."

"AGI also has a visual modeling component," Whitaker continues. "It is very helpful to see how the lighting will look in the room. Is there scalloping on the walls? Are we not washing the walls well enough? AGI provides a simple way to see this. We occasionally use this for final renderings. For more advanced modeling and finished rendering, we are using Thea Render. It takes a Sketchup model, or other 3D model, and enables us to integrate with lighting. It seems to provide the most accurate renditions of lighting and is easy to manipulate."

A recent Schuler Shook project – a collaboration with Martinez + Johnson – is the Smart Financial Centre in Houston, Texas, which opened in January 2017. "We used many of the programs above to determine the layout of the architectural lighting," says Whitaker. "We provided some early renderings and visualizations of our own to communicate the lighting to both the architects and the owners. This was done with Revit, Thea and Photoshop. For the finished renderings, created by Martinez + Johnson, we worked with them to make sure they had the right types of fixtures in their model, and that the renderings accurately illustrated what we thought the lighting would look like."

"We started off with eight loudspeakers and one subwoofer. We now use 18 loudspeakers plus four subwoofers, currently all Genelec studio monitors"

Raj Patel, principal and global leader of acoustics, Arup

Hearing things

In the past 60 years, acoustic design has grown in prominence – on many new concert hall projects, the acoustician is appointed ahead of the architect. Raj Patel, principal and global leader of acoustics at Arup and based in New York, has helped the practice's acoustics division gain a reputation as one of the largest and best-respected consultancies in the industry, employing over 100 acousticians in 13 offices around the world. Recent projects include Stormen Kulturkvartalet in Bodø, Norway; National Sawdust in Brooklyn, New York; Northrop Auditorium at the University of Minnesota in Minneapolis; and the San Francisco Museum of Modern Art and the Diane B Wilsey Center for Opera in San Francisco, California.

A major part of Arup Acoustics' current practice is the pioneering use of auralization (the sound equivalent of visualization) as a design and demonstration tool. Arup's SoundLabs in New York, London, Glasgow, Melbourne, Hong Kong and Singapore are enabling clients and designers to 'listen' to rooms and other aural environments before they are constructed. The purpose-built labs are all acoustically isolated floated rooms, with acoustic treatment, a large projector and

screen, and client facilities. They feature an Ambisonics surround-sound system – a series of loudspeakers arranged on a sphere – to replay calibrated simulations. Over time, Patel and his team have increased the number and quality of loudspeakers used, enabling higher spatial resolution of the reproduced sound field.

"We started off with eight loudspeakers and one subwoofer," Patel explains. "We now use 18 loudspeakers plus four subwoofers, currently all Genelec studio monitors. VR, using Oculus Rift, and AR technologies are also available in each SoundLab, offering a greater level of immersion into multidisciplinary environments. In terms of software, we use Odeon for acoustic modeling and EASE for loudspeaker prediction. CATT is used for room acoustics prediction and auralization and Arup has also developed a number of in-house modeling tools. We have also undertaken a series of recordings, both of speech and music, in the anechoic chamber at Eero Saarinen's Bell Labs building in Holmdel, New Jersey, for use in the SoundLabs."

The New York SoundLab includes a wave field synthesis (WFS) system. A rapidly developing technology that enables immersive and accurate sound field reproduction, it will soon be replicated in all the SoundLabs. Separate to the Ambisonics system, WFS uses 32 JBL loudspeakers in a continuous horizontal line on all four sides of the room plus four subwoofers.

Once an acoustic has been designed, choosing the right loudspeaker system can be the first step even before construction begins. This too can be modeled, and many leading loudspeaker developers have their own software packages to model how their products will perform. One of the leaders in the field is L-Acoustics, whose Soundvision application is dedicated to the acoustic and mechanical simulation of the company's systems. Soundvision enables the prediction of direct SPL and audio coverage quality of any space in 3D. The customizable user interface features drag-and-drop speaker placement, which makes it simple to try out different design solutions. The software gives free field mapping of a wide bandwidth, including low frequencies. This means designers can sample a range of system uses, from speech through to dynamic music. Each design is accompanied by a detailed mechanical report, complete with rigging and safety information.

In the future, Patel believes acoustic modeling tools will become faster and more compatible with 3D design software. "Already in a version we have created you can hear the results of changes instantaneously. So very soon anyone working in 3D or BIM environments, will be able to listen to spaces in real time as they are designing. While that will be a great plus, it will also require great diligence from all parties. Accurate information on acoustic performance of materials will have to be in the models at the earliest stages."

Simulation and modeling present opportunities for ever more ambitious architecture, lighting and acoustic design, enabling multiple parties to interface via compatible platforms. On large projects, agencies that are able to bring all the models together, to ensure accurate flow, will be the ones that will find themselves increasingly sought after. These players will be able to coordinate extensive projects in which design changes can be implemented across the board as quickly as possible. ■

Author
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