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James Vandezande
Eddy Krygiel

Foreword by Brendan Dillon, BIM Manager
for Denver International Airport

A large, illuminated glass dome structure, likely the Denver International Airport terminal, is the central focus of the image. The dome is made of a grid of glass panels, and its interior lights are visible, creating a bright, glowing effect. The structure is set against a dark blue night sky. In the foreground, there are several palm trees and a paved area with some low-lying plants. The overall scene is a nighttime architectural photograph.

Mastering Autodesk® Revit® Architecture 2016

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PERSONAL TRANSPORTATION INTERMODAL CENTER

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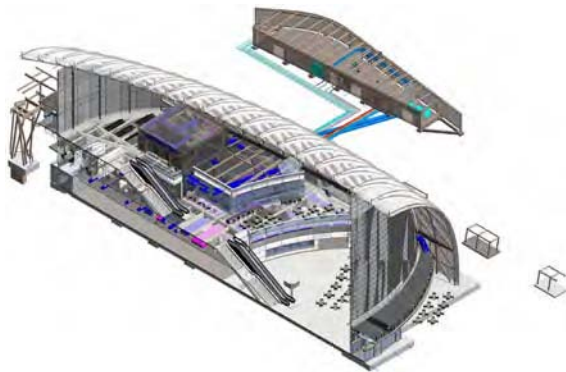
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The building photograph on the cover was provided by photographer John Linden and features the Anaheim Regional Transportation Intermodal Center (ARTIC) designed by HOK. ARTIC is a new world class transportation gateway to Orange County, California, the 5th most densely populated county in the United States. The project links freeways, major arterial roadways, bus, taxi and rail systems, as well as bike and pedestrian pathways in one central location.



ARTIC anchors the Anaheim Rapid Connection (ARC), a high-capacity, fixed-guideway transit system and will be the southern terminus of the California High Speed Rail which will link the State's southern and northern urban centers. The use of BIM on ARTIC helped engage the many engineers, builders, and public agencies involved in the project. For more information on this project, please visit the following web page: <http://www.hok.com/design/type/aviation-transportation/anaheim-regional-transit-center-artic/>

About the Author



James Vandezande is a registered architect and a principal at HOK in New York City, where he is a member of the firm-wide BIM leadership and is managing its buildingSMART initiatives. A graduate of the New York Institute of Technology, he worked in residential and small commercial architecture firms performing services ranging from estimating and computer modeling to construction administration. James transformed from an architect to a digital design manager in his 10-year span at SOM. In this capacity, he pioneered the implementation of BIM on such projects as One World Trade Center, aka Freedom Tower. James has been using Revit since version 3.1 and has lectured at many industry events, including Autodesk University, VisMasters Conference, CMAA BIM Conference, McGraw-Hill Construction, and the AIANYs Convention. He is a cofounder of the NYC Revit Users Group, and has been an adjunct lecturing professor at the NYU School for Continuing and Professional Studies as well as the Polytechnic Institute of NYU. James has served as the chair of the Design work group for the National BIM Standard-US and has been a long time contributor to the Level of Development (LOD) Specification.



Eddy Krygiel is a senior Business Consultant with the AEC team with Autodesk Consulting. Eddy focuses on BIM and technology workflows for architecture, engineering, and construction (AEC) clients. He received his bachelor's degree in architecture from the University of Kansas School of Architecture and Urban Design. He has almost 20 years of experience in architectural offices and on a range of projects from single-family residential to office, federal, civic, and aviation clients. Eddy has helped firms around the country at both the firm level and the project level.

His most recent project was the Denver International Airport, where he had the role of BIM Manager for the Program Management team. The BIM role involved supporting and steering stakeholder workflows from design through construction while not impacting the overall project fee or schedule. The final deliverable to the airport was a facility management-ready BIM model for both vertical and horizontal assets. Eddy has also led or been involved in other large-scale projects that have taken BIM beyond documentation.

Eddy is the author of more than 15 books on BIM and sustainability including the Mastering Revit series and Green BIM. He also teaches BIM, construction documents, and architectural communication at the University of Kansas School of Architecture.

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Foreword

There are two great secrets, or as I think of them, two great sins, in the architecture profession. The first is that the actual practice of architecture is something that has to be learned on the job, after we've committed several years, and subsequently quite a lot of money, to an educational program that has only a small amount of carryover to the actual architectural practice. The second sin is a near mirror: that the actual operation of a building is also something that has to be learned on the job and after the fact, after several years and quite a lot of money is invested in the design and construction process. This is again with a disappointing amount of carryover from the design process.

At best, the status quo provides us with adequate starting points, but is adequate really good enough? Shouldn't we aim for better? I'm no educator, and addressing the issues of architectural education is not my purview. However, as to the second sin, the matter of delivering a building that is ready not just to be occupied but also to be maintained, this is the realm I scout and probe every day. Fortunately, BIM processes, facilitated by software like the Autodesk® Revit® Architecture program, are chipping away at the embedded processes surrounding the delivered facility.

My first exposure to BIM came in graduate school at the University of Cincinnati. I was taking a skyscraper design studio and our instructor, a forward-thinking, technologically minded architect, brought in a trainer to give us a crash course in Revit the first week. This wasn't a requirement, he noted, but he wanted us to at least try out this exciting, up-and-coming software. The breakneck pace of the project resulted in most of my classmates resorting quickly to more familiar tools. I held out longer and was probably the last to change at about the midpoint of the studio. As exciting as I found the design tools at the time, the learning curve was just too steep for a single day of training, although I probably would have finished the studio in Revit if I'd had a reference as useful as this book as a guide.

My first opportunity to explore the full depth of what BIM and Revit were capable of came in 2010. I had been working for some time for a firm that was committed to BIM implementation, but most of the time our work was lonely BIM, or BIM Lite, or BIM 1.0, depending on the catchphrase du jour. This was largely owing to the requirements of our clients and the lack of similar commitment among our design partners. As cliché as it sounds, any BIM effort must begin and end with the client—if a facility owner isn't going to make use of the data developed during design and construction, then that BIM effort will be fundamentally flawed and incomplete. Although we constantly pushed our clients to do more and some great strides were made, we never got quite as far as we hoped to go.

That changed when we joined the design team for Denver International Airport's new Hotel and Transit Center and I was subsequently selected as the project BIM manager. Little did I know what a career-defining moment that decision by my boss would turn out to be.

Whereas with other projects we would have to introduce our clients to what BIM was and what benefits it could bring, on the HTC project Denver International Airport (Airport code: DEN) was taking the lead and demanding BIM—not BIM Lite, which the industry seemed to have plateaued at for so many projects, but real BIM. I daresay none of us really knew what we were getting into.

To say this was an exciting and ambitious project would be to only scratch the surface. Though an incredible opportunity, it was also at times terrifying, frustrating, and

overwhelming. Few firms in the area were truly Revit literate, and none had ever worked on a project that took BIM as far as the airport wanted to go with it. The learning curve was steep for all parties involved and, naturally, the schedule was short.

The entire project was to be executed in BIM. The architectural and systems designs were done in Revit and the civil designs were developed in AutoCAD® Civil 3D® software. The general contractor and their trade subcontractors modeled all of their content as well. Spatial coordination was done in Autodesk Navisworks® software for design and construction, with the trades' means and methods reconciled back into the design models. The contractors, designers, and commissioning agents tracked RFIs, punch lists, and commissioning data in Autodesk BIM Field, and the whole shebang contained the necessary data to connect to and populate the airport's asset management program.

Fast-forward to today, and I find myself sitting on the other side of the table and up to my chin in information as the BIM manager at Denver International Airport. When our new hotel and transit center comes online in November 2015, we would, under a non-BIM process, have to manually enter the thousands of assets we track into our asset management program. This would have to take place after the contractor manually tracked a slightly smaller slice of that same information for all those assets for their own needs, and the design team manually tracked a yet again smaller slice of the information for those same assets for their needs. Duplication of effort atop duplication of effort.

That is not what we will be doing here at DEN, because of the ambitious BIM and asset management program for our 53 square miles of campus and 20 million square feet of facilities. What will happen instead is that a month before the facility opens, we will have all of the asset information easily ported from a Revit model that was created by the design team, coordinated with the built conditions via Navisworks and the Autodesk® BIM 360™ Glue® software, and informed with construction and commissioning data through BIM Field with minimal duplication of effort. Data supplementation and addition, not duplication.

It would be difficult to overstate what a significant step the adoption of BIM processes are for DEN. BIM processes and technologies are still developing for many on the facilities ownership side and the integration of BIM with an asset management program as outlined in the UK's PAS 1192-2 and 1192-3 is even further out on the cutting edge. This is particularly true in the United States, which trails the UK in asset management leadership and lacks the broad BIM requirements being rolled out there. That DEN has taken this leap to a more holistic implementation throughout the length of a facility's entire life cycle speaks to the vision and drive for industry leadership at DEN from the top down.

Our BIM models will feed information into almost every aspect of the airport's operations in one way or another—from GIS, planning, and maintenance to tenant management and finance. We'll have the data to better track and analyze our construction and maintenance processes. We have maintenance staff going into the field with tablets loaded with asset data and facilities models. Driving it all, we have all that data, all that precious information, that makes BIM so valuable and Revit such a powerful authoring tool.

In your hand, you hold the information you need to learn how to apply the latest version of that tool. Between them, Eddy and James have written more than 20 books on Revit and BIM. They've led countless BIM projects that span broadly from lonely BIM to true BIM at every size and scale. There is no better single reference for Revit than this one. Here within these pages you will find guidance not just on how to create sensual renderings and crisp construction documents, and how to clean up the peskiest warnings, but also the understanding of the value

of that precious information on which a facility runs for the length of its life. I know that I am excited to add this latest edition to my library, and I hope you are as well.

—Brendan Dillon

Brendan Dillon, LEED AP, is the BIM manager for Denver International Airport. Brendan is leading DEN in an industry-leading implementation of BIM and integration of BIM technologies with GIS and asset management systems. Prior to joining DEN staff, Brendan had managed over \$1 billion in BIM projects in the design industry, including four years working on DEN projects, along with an alphabet's soup worth of other governmental agencies.

In his spare time Brendan brews a variety of award-winning meads and is a firm believer that Han shot first.

Introduction

Architecture is the process of turning a thought into space. Although it's so simple to convey that in the written word, the actual act of doing so is much more than it is possible to write. It's glory, it's torment, it's frustration, it's freedom, it's the realization that one miscalculation means a complete redesign, like blowing on a house of cards, and it's the 3 a.m. epiphany when you realize that the new design was what you were meant to get to in the first place. With all of that, it's also the burning desire to work relentlessly to make something better one step at a time.

Autodesk® Revit® Architecture software is one of the many tools we employ to help us through this organic process. It's one tool in the toolbox, but it can be much more than that. It can be the workflow that helps to empower a team. That team is the designers, the contractors, and ultimately the owners who are all looking to speak the same language.

We hope that in the process of using this book, you'll experience a bit of the struggle to realize a bit of the satisfaction of finding the solution. We hope what you learn in this book helps inspire you to your own bit of greatness, because what's most important is that architecture isn't about buildings. It's about what we are able to accomplish with what little time we have. This is the elegant essence of Revit. Before we go much further, there are a few semantics to discuss.

First off, all the tutorial files necessary to complete the book's exercises plus sample families are hosted online at www.sybex.com/go/masteringrevitarch2016.

Don't have a copy of Revit 2016? Download the trial version of Revit Architecture at <http://usa.autodesk.com/revit-architecture>, where you'll also find complete system requirements for running Revit. Are you a student or educator? Someone with a .edu email address? You can get a copy of Revit for free starting with the 2016 version at <http://students.autodesk.com>.

For the clearest direction when following the exercises in this book, please make sure to install all the Revit support files that come with the default installation. We reference them heavily, and you'll need them to best leverage the software.

Also, it should be noted there are a few flavors of Revit. Starting with the 2013 edition, Autodesk released the Revit Architecture, Autodesk® Revit® Structure, and Autodesk® Revit® MEP packages separately. They also released a One Box solution that has all those products in a single version of Revit. Depending on what you have installed—Revit as One Box or Revit Architecture—there will be some slight variations in the user interface. We have focused this book on the use of Revit Architecture. If you're using the One Box solution, the variations will be slight and hopefully manageable.

Finally, most of our offices purchase the Revit software on subscription. With subscription comes a host of benefits and add-ons to Revit. This includes tools like access to cloud rendering, storage, and analysis, which we demonstrate in Chapter 9, "Conceptual Design and Design Analysis." You can go here to create an account: <http://subscription.autodesk.com>.

Who Should Read This Book

This book is written for architects and designers who have had some exposure to Revit and are eager to learn more. It's for architects of any generation—you don't need to be a computer wizard to understand or appreciate the content within. We've designed the book to follow real

project workflows and processes to help make the tools easier to use. The chapters are full of handy tips to make Revit easier to leverage in your day-to-day world.

This book is also for the entire range of architects, from those who are fresh out of school to seasoned project managers. We have endeavored to include content for all walks of the profession so that regardless of your role on a project, you can learn how BIM changes both workflow and culture within a project team. With that, a basic understanding of Revit will make it easier to work through the book. Revit is a very robust tool requiring more than one project iteration to master.

For BIM managers, the book offers insights into the best practices for creating good project or office templates; these managers should also take a sneak peek into the powerful world of building content and Revit families. We've added many time-saving and inspiring concepts to the book, supported by examples from our own projects and the rest of the real world, to help motivate and inspire you on your journey through building information modeling.

What You Will Learn

This book will help you take the basics of Revit and BIM that you already know and expand on them using real-world examples. We will show you how to take a preliminary model and add layers of intelligence to help analyze and augment your designs. We'll show you how to create robust and accurate documentation, and then we'll help you through the construction process.

We go beyond introductory topics. To that end, we won't be starting a project from scratch or teaching you how to build a simple BIM model. If you are interested in learning at that level, we strongly recommend you pick up *Autodesk® Revit® Architecture 2016 Essentials* (Wiley, 2015) before plunging headlong into this book. Instead, our book begins with a brief overview of the BIM approach. As you are already aware, BIM is more than just a change in software; it's a change in architectural workflow and culture. To leverage the full advantages of both BIM and Revit in your office structure, you will need to make some changes to your practice. We've designed the book around an ideal, integrated workflow to help you make this transition.

Starting with the project team, standards, and culture, we'll discuss how BIM changes your project approach and how to best build your team around a newer workflow. From there, we'll delve into conceptual design and sustainability studies, continuing through best practices for design iteration and refinement. You'll learn how to use powerful modeling techniques, how to design documentation best practices, how to make compelling presentation graphics, and how to take advantage of parametric design with the Family Editor. We'll explore workflow topics like tracking changes and work sharing as well as some strategies that move beyond traditional concepts of BIM. The book concludes with an appendix on troubleshooting and best practices so you can avoid common pitfalls. Throughout the book we've shared our practical experience with you, particularly in the form of real-world-scenario sidebars.

Whether you're studying Revit on your own or in a class or training program, you can use the "Master It" questions in the section called "The Bottom Line" at the end of each chapter to test your mastery of the skills you've learned.