Architectural Design with SketchUp

Component-Based Modeling, Plugins, Rendering, and Scripting

Alexander C. Schreyer

Architectural Design with SketchUp

Architectural Design with SketchUp

Component-Based Modeling, Plugins, Rendering, and Scripting

Alexander C. Schreyer

John Wiley & Sons, Inc.

Cover design: David Riedy

Cover illustrations: (front and back) Courtesy of Alexander C. Schreyer

This book is printed on acid-free paper.

Published by John Wiley & Sons, Inc., Hoboken, New Jersey.

Published simultaneously in Canada.

Library of Congress Cataloging-in-Publication Data:

Schreyer, Alexander (Alexander C.)

Architectural Design with SketchUp: Component-based modeling, plugins, rendering, and scripting / Alexander Schreyer.
p. cm.
Includes index.
ISBN 978-1-118-12309-6 (pbk.), ISBN 978-1-118-37652-2 (ebk.); ISBN 978-1-118-37654-6 (ebk.); ISBN 978-1-118-38596-8 (ebk.); ISBN 978-1-118-38597-5 (ebk.); ISBN 978-1-118-38598-2 (ebk.); ISBN 978-1-118-56787-6 (ebk.); ISBN 978-1-118-56776-0 (ebk.)
1. Computer graphics. 2. SketchUp. 3. Three-dimensional display systems. 4. Engineering graphics. I. Title.
T385.S3347 2013
006.6'8—dc23
2012007297

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

For my father, Gerhard

Contents

Acknowledgments

Having taught SketchUp to varied audiences of eager students, I should start my acknowledgments with exactly those students whose many questions and creative ideas have inspired me not only to look deeper into the software, but also to put this text down on paper. *Keep pushing the boundaries of the third dimension in your work!*

An amazing product can often be judged by the community that develops around it. SketchUp has always been a small, yet transformative piece of software, whose simplicity and power have enthralled users for many years. This has created a large user community, which in forums, blogs, at user meetings, and other venues has—often passionately—taken to using it to design whatever came to their creative minds and educating others in how to use it to realize their ideas. I would like to hereby acknowledge that community for its devotion, support and inventiveness, and am with this book paying forward any support they ever gave me.

Among the makers of SketchUp I would like to foremost thank SketchUp product manager John Bacus and product evangelist Aidan Chopra for their feedback whenever I had a request—*and of course for the great time I had in Boulder.*

This book would not have been possible without the support and feedback from acquisitions editor Paul Drougas at John Wiley & Sons. This being my first book endeavor, I am still in awe of the amount of work that the editorial team puts into a publication like this. In particular, I would like to acknowledge production editor Nancy Cintron's tireless suggestions of edits and revisions as well as copyeditor Ginny Carroll's and editorial assistant Mike New's help in this process. Judging by the editing initials in the manuscript, it passed through many more hands whose anonymous work I hereby gratefully acknowledge.

Finally—and most importantly—I would like to thank the love of my life, my wonderful wife Peggi, and our two girls, Sophia and Mackenzie, for their love, tremendous encouragement, and support, as well as their patience with me while I was preparing the manuscript. I couldn't have done it without them! They are, together with my mother and my brother, the source of all my strength and joy.

Chapter 1
Introduction

In my years of teaching SketchUp, as well as other Computer-Aided Design (CAD) and Building Information Modeling (BIM) software, I have seen very proficient users of this software. Students and professionals take easily to SketchUp, and, before long, some of them produce very detailed building models and professional-grade renderings. But I have also found that too many people don't go beyond the basics and believe that some of the advanced modeling (or good-quality photorealistic rendering) needs to be done using other software. Very often, they painstakingly pick up that other software only to find that it is too complex, which likewise leaves them unable to do what they wanted.

Sometimes even advanced users of SketchUp master one aspect of the software (photorealistic rendering, for example) but are completely unaware of the power that SketchUp holds in other areas—Dynamic Components and Ruby scripting are good examples. As you will find out in this book, SketchUp is a very powerful design and 3D modeling tool. Some of its core features—for example, its extendibility with plugins—make it flexible enough to be useful for a variety of disciplines. The large number of high-quality plugins that are available for SketchUp these days bears powerful witness to this.

This book attempts to help the basic to intermediate user make the leap from simply creating "something" in SketchUp to using it as a powerful design tool. While it contains some more involved topics (such as photorealistic rendering, Dynamic Components, and Ruby scripting), it provides a clear learning path that takes you through easy-to-follow examples to a thorough understanding of the core topics. **Figure 1.1** shows an example of how one could use Ruby scripting to create geometry, then render the scene using a photorealistic rendering software and finally "dress-up" the image as a watercolor painting.

About This Book

Each chapter in this book presents a different SketchUp use in sufficient detail to get you started and working quickly. Interspersed with the text are many step-by-step examples, tips, and in-depth articles. At the end of each chapter, you will also find a collection of activities that you can undertake to try out new skills that you just learned.

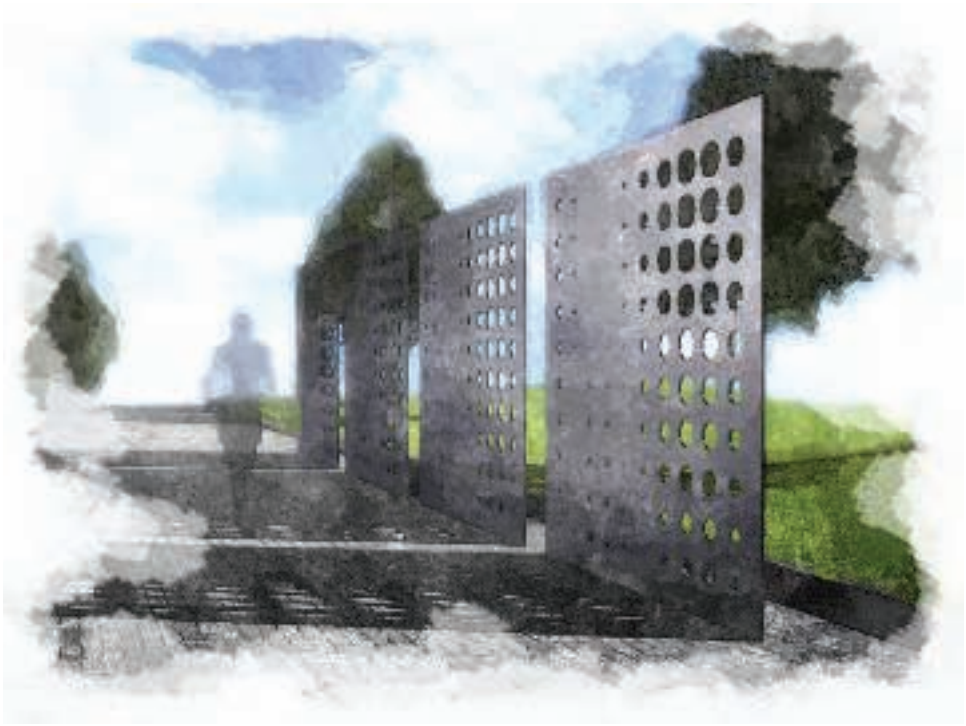

Figure 1.1: Watercolor of a rendering of script-generated panels

Chapter 2, which follows this introductory chapter, brings every reader up to speed. Its purpose as a "SketchUp Refresher" is to review some basic modeling techniques and teach good practices for modeling and software use. While many readers will already have some knowledge of SketchUp through introductory books or video tutorials, this chapter encompasses enough variety to be useful for everyone, independent of their skill level.

Chapter 3 uses SketchUp not only as a modeling tool but also as a tool to inform your designs. In this chapter, you will learn more ways to employ SketchUp as an aid in your design process. Examples of this are creating component-based models, using Dynamic Components, and geo-based modeling. One section also looks at how SketchUp can fit into a BIM-based architectural design process.

Chapter 4 leads you into the wide field of SketchUp plugins and their uses. After an introductory section on finding and installing plugins, many individual plugins are discussed. Those small software add-ons to SketchUp provide tools for general modeling, such as drawing splines and lofting curves; tools for architectural design, such as stair making and wood framing; and tools for digital fabrication that will help you prepare your model for 2D and 3D digital printing and assembly. (See **Figure 1.2** for an example of a fabricated SketchUp model). Furthermore, there are plugins for data integration that can import or export data such as LIDAR laser-scan points, plugins for animation and presentation that add object animation or serve as helpers for creating animations and walk-throughs using SketchUp, and,

finally, plugins for analysis, which provide analytical tools—mainly from the fields of building energy analysis and green building.

Chapter 5 introduces photorealistic rendering and covers all aspects of rendering in detail (see **Figure 1.3**). This chapter was written to be as independent of your actual choice of rendering software as possible, thus providing a useful resource no matter which software you download or buy. As part of this chapter, you will learn about modeling for rendering, lighting, sky environment, materials, and objects, as well as how to edit and modify renderings using image-editing software.

Figure 1.2: Infrared photography house model made in SketchUp and physically built using plugins

The final chapter in this book (Chapter 6) introduces you to the exciting field of computational geometry in SketchUp. This chapter presents Ruby Script examples that create undulating brick walls, solar-responsive facades, attractor-based colorful building designs, and other fun ways to create geometry in SketchUp without excessive use of the mouse (see **Figure 1.4**). Most of the script examples accomplish their tasks in just a few lines of code, and all are a good introduction to both the Ruby scripting language and the general field of computational geometry.

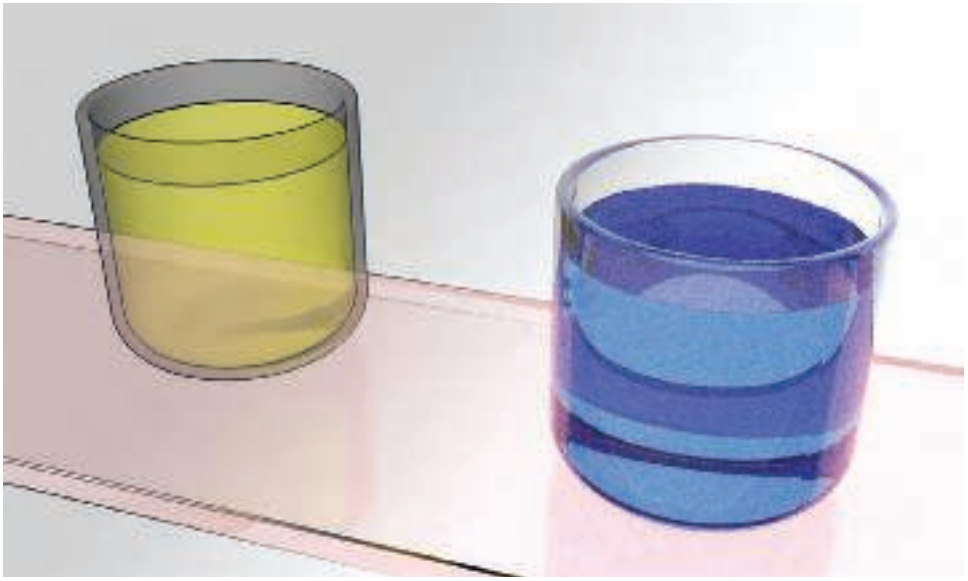

Figure 1.3: Glasses and liquid, rendered in SketchUp

Figure 1.4: A grassy hill made in SketchUp

As you will see in the chapters that follow, this book is intended to serve as a textbook as well as a desk reference. It was written to convey the presented material in a thorough yet easy-to-follow manner. It also covers common tasks using a "cookbook" approach, which allows you to simply copy the procedure to get a satisfactory result or modify it according to your individual needs.

In addition to reading this book, keep an eye on its companion website, which features blog posts, links, videos, and discussions related to this book. Web links will be frequently updated there and new ones added as new software is released.

This book's companion sites can be found here:

www.sketchupfordesign.com—Authors companion site.

www.wiley.com/go/schreyer—Companion site for students and instructors.

3D for All

Because SketchUp is not domain-specific, it has found a following with professionals and enthusiasts from many disciplines. This is why you will find SketchUp mentioned in discussions not only by architects, landscape architects, urban planners, engineers, construction professionals, woodworkers, and timber framers but also by model builders, artists, sculptors, model-plane builders, model-plane builders, mapmakers, historians, 3D game developers, and movie set designers (just to mention a few).

The techniques in this book are applicable to a variety of disciplines. Although many examples come from architecture or construction, some are from other disciplines (e.g., landscape design and interior design). Whatever your background is, feel free to take the examples that are presented here and adapt them to your discipline. (See **Figure 1.5** for a non-traditional use of SketchUp.) The techniques you learn will be equally useful.

Taking this one step further, I can even say that I can't think of anyone who should not be using SketchUp. Living in a three-dimensional world and dealing with three-dimensional objects, everyone has the need at some point to model and visualize in three-dimensional space.

Consider this: You're in a situation where you want to build a deck in your backyard and need to explain to the builder how it should look. Another example is a physicist who needs to explain a lab setup in a presentation. In both cases we resort to 3D representations of our thoughts (the classic floor plan, for example), which leaves too much to unknown and unexplored.

Admittedly, many people are not trained in hand-sketching in 3D, which often leads to poor visualizations of things that can actually be quite interesting when presented right. *That* is where SketchUp shines. Its 3D modeling capabilities and its ease of use make it a simple yet very powerful tool for anyone to give shape to their thoughts.

Figure 1.5: Rendered 3D QR-code model

How Does SketchUp Fit into the Designer's Toolbox?

As a student or professional, you likely already have assembled a sizable software "tool chest" by now. Depending on your discipline, this might include office software, CAD software, image-editing software, print layout software, analysis software (for energy or structural analysis, for example), coordination tools, and many others.

The free version of SketchUp fits into this collection very well. Depending on your needs and knowledge of the software, you can use it as an early design tool—after all, as its name indicates, it was developed for 3D "sketching." You can also use it for the complete design process from initial stages to a finished product (whatever that may be). SketchUp Pro broadens this even further by providing layout and documentation abilities and other professional-oriented tools.

SketchUp works well with other software. 3D models from SketchUp can often be directly opened in other software, making data exchange easy. Even if that isn't available, SketchUp's built-in file exchange options allow you to export a 3D model in a variety of formats.

If SketchUp is already part of your tool set, then it is the best use of your time to expand on the skill set that you have developed and deepen your knowledge of this software. This book provides you many avenues to do so.

Windows or Mac, Free or Pro?

SketchUp comes in two flavors: free and Pro. It is also multiplatform software, which means it is available for both Windows and Mac computers.

In the free version, a user can do almost everything that is available in the Pro version. The main differences are that the free version does not include the more professionally oriented DWG/DXF file exchange options (plus some others), it also does not include the ability to create Dynamic Components (and report them), and it does not include Pro's excellent Solid Tools.

Looking at the Pro version, you will find that it comes with two additional pieces of software: LayOut, which is a tool for drawing preparation and presentations based on SketchUp models, and Style Builder, a program that lets you make your own hand-drawn styles based on pencil-sketched lines.

While the free version can be downloaded by anyone from SketchUp's website, the Pro version is moderately priced (under $500 in the U.S.) and can be purchased from the website as well. Both versions are currently available in twelve languages (Traditional Chinese, Simplified Chinese, Dutch, English, French, German, Italian, Japanese, Korean, Brazilian Portuguese, Spanish, and Russian), which gives this software global reach. At this point, qualified students (in the U.S.) can get a time-limited license to use SketchUp Pro for $45.

Depending on your needs, you have to decide which version is right for you. For almost all of this book's content, it is *not* necessary to have the Pro version; photorealistic rendering, many plugins, and scripting work perfectly well in the free version. This book, therefore, offers a cost-efficient entry into relevant and current topics (such as 3D modeling, rendering, and computational geometry). Because SketchUp comes in a free version, it provides an opportunity to use advanced software approaches without having to resort to costly software.

Nevertheless, some Pro tools are covered in this book (e.g., creating a Dynamic Component and using Solid Tools). Whenever a chapter in this book mentions a Pro tool, it is visually presented as a "Pro Only" section.

Pro Only sections look like this. **PRO ONLY**

While all of this book's illustrations have been created using the Windows version of SketchUp, the tasks and tutorials are similarly usable with the Mac version. Menus and dialogs generally look the same and are in the same location on both platforms. There are minor

user interface preferences, but those are easy to figure out. Consult SketchUp's Help system if you run into trouble.

About SketchUp's Transition from Google to Trimble

On April 26th, 2012, Google (who had bought the SketchUp software in 2006 from @Last, its original maker) announced that they sold SketchUp to Trimble, a company known for AEC (architecture, engineering, and construction) technology and software. The announcement came with assurances from both companies that SketchUp will remain available in a free version as well as a Pro version and that software development will increase in the future. Given the transition to Trimble, some changes have to be expected, but for a foreseeable time, the largest extent of those changes will be differing URLs and documentation changes.

Fortunately for the user community, this transition infuses energy into SketchUp development and it is very likely that new features will be created soon while its core functionality (as described in this book) will be retained.

Keep an eye on the companion website (**www.sketchupfordesign.com**) during this period of transition. I will post updated URLs and announcements of new features as they become public. In the meantime, this book will use currently known URLs and the "Google" name where relevant to current installations.

It's a good idea to stay up to date with SketchUp. In addition to the book's companion website, bookmark the following sites to help you with that:

www.sketchup.com—The official home of SketchUp. You can download the latest free version or buy the Pro version here.

http://sketchupdate.blogspot.com—The official SketchUp blog—a great source for updates, tutorials, and tips.

https://support.google.com/sketchup—SketchUp's help system. If you get stuck, go here first!

www.alexschreyer.net—My personal blog where I frequently post about SketchUp and other AEC software.

@alexschreyer and **@sketchupplugins**—My Twitter handles under which I post news and links about SketchUp and AEC software.

How This Book Works

One way to use this book is linearly as a learning tool by moving from chapter to chapter. This method builds your skill set gradually and allows you to logically approach each subject.

You may also want to use it as a desk reference, or you might be interested just in individual chapters. In these cases, make use of the index and the appendices.

Some conventions in this book:

- Whenever I mention a "window" (e.g., the Materials window), this means the dialog window that can be accessed from SketchUp's Window menu.

- Other dialogs that open when the user clicks on something are commonly called "dialog" in the text.
- Menu locations are typically presented in this format: **File** → **Open . . .**

- Any toolbars mentioned in the text can be opened from the **View** → **Toolbars** menu in SketchUp. Plugins often install their own toolbars. Those will, of course, not be available until a plugin has been installed.
- Following are some Mac-specific differences:
  - SketchUp's preferences cannot be found under the Window menu item, but instead are under the SketchUp menu.
  - Toolbars are called "Tool Palettes."
  - Instead of right-clicking to bring up the context-menu, you can left-click the mouse while holding the Control key.

Let's Go!

It's time to explore the world in the third dimension. Enjoy your modeling endeavors!

Chapter 2
A SketchUp Refresher

This chapter reviews some of SketchUp's basic techniques. You'll also learn about customizing the software environment and adjusting settings to help you with your daily tasks.

Key Topics:

- Where to get help with SketchUp
- Program interface and workspace customization
- Program and model preferences
- Working with templates
- Navigating SketchUp's 3D workspace
- Aids for accurate modeling
- Groups and components
- Applying materials and using other common tools
- Best practices for working with SketchUp

Let's Get Started!

Before we look at any of the more advanced SketchUp techniques such as plugins, rendering, or even scripting, it would be helpful for any new or refresher user to brush up on some of the basic modeling techniques. This chapter therefore presents in a condensed fashion an overview of the interface and the modeling and editing tools, as well as best practices and usability hints.

If you are new to SketchUp or would like to learn more about many of the basic tools, then my recommendation is to get a copy of Aidan Chopra's excellent SketchUp primer *Google SketchUp 8 for Dummies* (Wiley Publishing). It is a thorough reference not only for modeling with SketchUp but also for creating building models for the free 3D earth viewer Google Earth.

Two further sources for help are available to SketchUp users. One is the official help documentation. You can access it through the Help menu item, which simply opens a browser window at the following URL. If you end up using it frequently, it might be a good idea to bookmark it in your browser.

> **http://sketchup.google.com/support**—SketchUp's online help system.

Alternatively, you can turn on the Instructor feature by selecting Instructor from the Window menu. This opens (and keeps open) a window that displays a help page for the tool that is currently in use. For example, if you start using the Circle tool (by clicking on the Circle toolbar button, selecting Circle on the Draw menu, or simply hitting the C key on the keyboard), the Instructor shows the appropriate help, complete with a small animation. (see Figure 2.1)

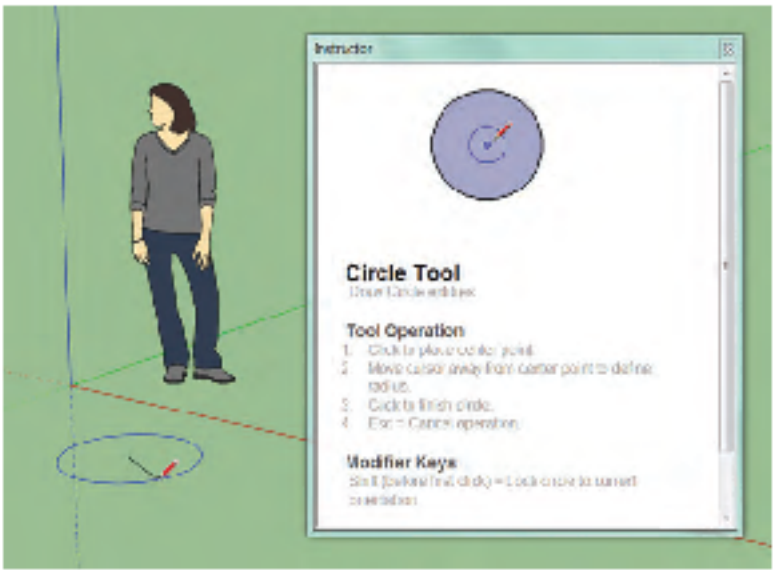

Figure 2.1: Select Instructor now

I also encourage you to visit this book's companion website (www.sketchuparchitecture.com) for an updated list of links to online resources. In addition, there are currently many discussion forums, wikis, and online video sites available that offer help for both beginners and advanced users. The most popular ones are:

http://productforums.google.com/forum/#!forum/sketchup—SketchUp's official help forum.

https://forums.sketchucation.com—The SketchUcation forums, a user-based worldwide community.

www.aidanchopra.com—Aidan's companion site to his book, which contains many YouTube instructional videos.

Interface and Program Setup

Once installed, SketchUp has a clean and rather empty appearance. The main portion of the screen is taken up by a large 3D-space work area in which only the ground plane (shown in solid green), sky (blue gradient), the three main axes, and a modeled person (included as a size reference) are visible.