

Chapter 3

LDraw: A Virtual LEGO System

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- A Lego CAD System
- A Multitude of Resources
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Introduction

LDraw lies at the heart of the LEGO-based 3D illustration package described in this book. We chose LDraw precisely because it is the standard and most developed software in the LEGO CAD fan community. This software has quite a unique history and, consequently, some unique features. This chapter gives you a brief background and general overview of LDraw, the program that started it all.

This information is especially important for the first-time user. The rest of this book is a very practical guide dealing with how to use several applications to create 3D LEGO models using a computer. Building with virtual LEGO is very easy, but you will still have to concentrate on the finer points of the process to become a skillful modeler. In the following chapters we sometimes focus on *why* functions work the way they do, but we spend most of the time on *how* they work. To be focused from the start, you will be much better off knowing a few essential concepts about the LDraw software before you begin using the other programs.

First, you have to know that although LDraw is installed on your system, you will only really be using it *indirectly*. What does this mean? It means that you will not be directly using the original LDraw program but rather the *system* it has spawned. The software suite described in this book is the result of the work of many fans, both developers and users and testers. Many authors have contributed elements to these programs. In this book, we bring together some of these elements and show you how to use them to create 3D models using your computer. LDraw is the catalyst that binds them all together.

How can a program that we do not use directly have such an enormous influence on what we create? In certain ways, LDraw resembles the product that inspired it: LEGO. LEGO is fun to play with because a great deal of work has gone into its design. Even basic LEGO bricks are not as simple as they appear at first glance. For one thing, they contain several locking points that work flawlessly, almost seamlessly, every time you connect one brick to another. This and many other high-quality characteristics of LEGO bricks are the result of seriously intelligent design. If it is extremely easy to take this level of quality for granted, that is because the system is also designed to be *easy to use*.

The highly successful LEGO building system is the result of the ideas of Ole Kirk Christiansen, a Danish carpenter who lived in the first half of the twentieth century. Ole was bent on making the highest-quality toys possible; he simply would not settle for anything less. In the second half of the twentieth century, James Jessiman, an Australian programmer and avid LEGO fan, picked up on

Christiansen's original ideas and, with the creation of LDraw, set the rules for a high-quality LEGO-based building system using a computer. The important thing to understand is that James did not simply replicate the design of the LEGO parts using a computer. From the very beginning, he incorporated into the software the quality expectations found in the original LEGO toy. This means that the resulting product is both robust and easy to use. Read on to see how James Jessiman accomplished both objectives.

Created by Fans, Supported by Fans

Second only to its incredible quality is the fact that LDraw is an unofficial, fan-created software system. Tragically, James Jessiman, not only the creator of LDraw but also the key inspiration for all the LEGO CAD programs and materials that followed (including this book), died in 1997 at the young age of 26, barely two years after releasing his software to the world.

This was obviously a turning point in LDraw's history. The odds against its survival quickly piled up. Like most freeware, LDraw had no marketing budget and little initial support beyond a few of the creator's acquaintances. Not only that, at the time of Jessiman's passing, the software had become technically obsolete and was being overwhelmed by the newly emerging Windows operating system.

Yet the program and its specifications didn't disappear. There are probably a few factors that helped its survival, chief among them the emergence of the Internet and the ability to easily disseminate software all over the world online. However, the one key element was Jessiman's ingenious design guidelines for the LDraw file format and general program functions. They allowed the software's users to fight back against the odds and ultimately win, establishing the software in its justly deserved place at the top of the LEGO CAD pile—all, of course, still free of charge.

The Initial Release

James Jessiman released the first version of LDraw in 1995. At around the same time, Microsoft introduced Windows 95. Most developers, including James, were still creating applications for the DOS operating system (which was more reliable and familiar than Windows 3.1, the version of Windows that preceded the much more successful Windows 95). There cannot be a more fitting testament to Jessiman's immense and barely tapped talent than the fact that his DOS application has become the de facto LEGO CAD standard for the new millennium—long

after DOS, Windows 3.1, and Windows 95 have become obsolete. As the international LEGO community achieves maturity, its CAD efforts are articulated around Jessiman's original vision for LDraw. This is a truly impressive accomplishment.

How does a program that a fan created come to have such an enormous influence on a community of users and developers? LDraw is a freeware program, like all applications described in this book. What this means is that the program is free to use. This factor might not seem to be all that important, but it was one of the key reasons for LDraw's growth and expansion. Since LDraw is a task-oriented piece of software offered for free, many people tested it just to see what it was all about. Once they actually used LDraw, they were hooked. Some well-known programs (especially videogames) started highly successful commercial lives this way. At this stage, the software passed its first critical test: Since it was good, many people clamored for more. Since programmers tend to know other programmers, word spread and some initial users came back asking how they could *modify* the program to fit their needs.

At this stage, Jessiman faced a very modern challenge: How exactly to manage his intellectual property. For an example of how other companies have answered this question, take a look at the LEGO company itself. LEGO puts out a product that lets users *create*. If a user invents a custom model and takes a picture of it, what part of that picture belongs to LEGO and what part belongs to the user? LEGO has taken (not surprisingly) a very intelligent approach to this dilemma: The company allows users to display any and all creations they have built with LEGO, as long as they make it perfectly clear that they are not *official* LEGO products. This suits all sides well, except maybe the pirates—tough luck for them!

Since James Jessiman did not have the backing of a global brand and was developing software, not plastic bricks, he used a different way to satisfy both creators and users. He retained the property of the LDraw software but allowed (and encouraged) full access to the file format. This way, he kept the intellectual property of his program but let people write their own programs and files using the same resources that he had used. This solution was quite generous, but also smart: It allowed James to retain the intellectual property of the program he had developed while at the same time sharing a common pool of users and testers to develop his software more fully.

LDraw Today

And develop they did. As we explain in Chapter 10, the international LEGO fan community was waiting for something like the Internet to happen—a way to share information and spread the word about the software. Although not all

LEGO fans use the LDraw software, its influx of users and developers keeps growing. With their input, the LDraw software system has grown stronger. As you will see in this book, LEGO-based 3D software is also part of a larger pool of 3D software developed for and by fans. Much of this software has reached a level of quality comparable to some of the best software available commercially. The relatively closed (and very experimental) world of computer-generated 3D graphics is being cracked open by programs such as these, which simplify and demystify the process, bringing it down to a level that is accessible to all. LDraw-based software is a key part of this scene (among other things, because it is one of the easiest ways to learn the discipline) and will increasingly continue to grow in influence as more people are exposed to it.

Additionally, the availability of the software and modern telecommunication tools has come close on the heels of a huge step forward in the development of computer hardware. Three-dimensional illustration relies *heavily* on hard-core computer equations; some software can literally require many millions of operations per second, putting even the fastest computer processor through its paces. In the past, the casual user required not only specialized software but also top-end (and thus expensive) hardware to create 3D images. Today, the situation is completely reversed. The software is easily available for free, and it will produce outstanding results in even medium-grade computers.

The LDraw resources are organized around two Web sites. The LDraw.org Web site is the beacon for all things related to LEGO-based construction software, including programs that do not follow the LDraw standard. The trustees of James Jessiman's memory have done a great job in providing all sorts of support to help LEGO fans use and further develop Jessiman's original work. Apart from the obvious benefit of having a central repository of information and resources on the LDraw.org site, users and developers find the CAD forums of the LEGO Users Group Network, or Lugnet, site a good place to meet people with a similar interest in all things LEGO, as well as peers willing to lend a hand or review additions to the LDraw system. You can find more information about these and other LEGO CAD resource sites in Chapter 10.

A LEGO CAD System

CAD stands for *computer-aided design*. The term refers to engineering tools such as the ones used in 3D industrial design to model objects using computers. CAD applications provide not only a visual representation of models (whether buildings, vehicles, or something else) but also technical information regarding materials,

element count, and so on. Reading this book, you will first learn how to use the programs to create models using computers. Once you have mastered these techniques, we will take a look at some of the advanced capabilities, such as the creation of instruction steps and animation sequences.

In order to get to that level of knowledge, you must first understand a few basic concepts behind all LDraw-based software. You can think of this software as a cross between a graphics program and a database. We will first explore how this software works in practical terms, by taking a look at the parts library, which is a fundamental part of the LDraw system. We will then briefly look at the importance of having an “open” file format.

LDraw System Basics

Programs like LDraw and MLCad allow us to create 3D models using a computer—models that are made of existing elements based on LEGO parts. There are certainly several ways to accomplish this goal. James Jessiman took a three-pronged approach with his creation of LDraw. Instead of basing the system around a program, his approach actually gave equal or more relevance to two other elements of the system: the file format and the parts library. Thus, the LDraw system is composed of three essential elements:

- The file format
- The program(s)
- The parts library

Starting in Chapter 6, you will be introduced to the file format in detail and will learn how to tweak it to accomplish all sorts of special effects in your models. The hands-on use of the actual modeling programs (starting with MLCad) begins in Chapter 4. For now, what is important is that you become aware of the role of these other programs in the general LEGO CAD picture. To understand the overall LDraw scheme, the best place to start is the parts library. The role of the parts library is probably the element of the LDraw system that is easiest for beginning users to grasp. You can think of the parts library as a heap of virtual LEGO parts, much like the ones many of us had as children (and hopefully kept as adults!). In the parts library, you will find the basic material for your models. After all, you cannot build anything without parts.

The parts library has several advantages over a pile of real-life LEGO parts. It is actually a lot more like an organized catalog of part types linked to a warehouse with an infinite supply, available in any color we choose. We will look

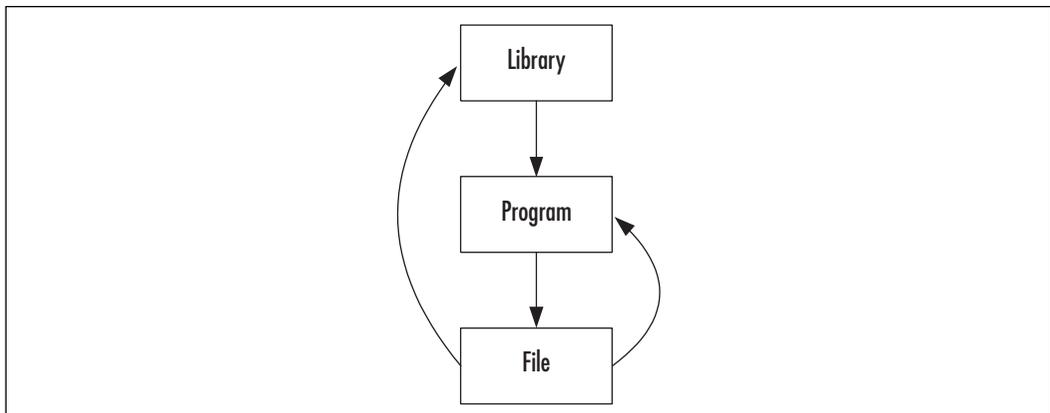
more closely at the parts library later in this book. For now, let's assume that we have the parts; what else do we need to build our computer models? We need a way to put the parts together and a way to store the models for later editing or perusing.

It would seem that the most obvious way to put these parts together would be to come up with a program that did just that. However, Jessiman took a slightly different approach in developing LDraw. Instead of creating the program side of LDraw first, he decided to define the file format first. As it turns out, this was a brilliant approach. Once he wrote the smart specifications for the file format, everything else came naturally—so much so that over seven years later we are still exploring the possibilities contained in those LDraw file format specifications. Additionally, it must be noted that when Jessiman died, he was still working on new ways to make the LDraw file format (and thus the system) even more efficient. Despite some advanced details of the system that are arguably “incomplete,” his LDraw system still performs in a flawless manner. When we call it an impressive achievement, we do not exaggerate.

A Virtuous Cycle

Let's see how all this works in practice to give you a clearer picture of what we are talking about. How can a file format sustain a parts library *and* a suite of programs? The answer is that the LDraw file format allows us to store both *parts* for the library and *models* made out of parts from the library in the same format. Figure 3.1 shows how the three elements—the files themselves, the parts library, and the program to assemble the parts—work together.

Figure 3.1 The LDraw Scheme



As we explained earlier, to create virtual LEGO models in a computer, you first need the library of virtual LEGO parts. You then need a program that allows you to put them together. Finally, you need a file format to store your finished models. By designing the LDraw file format so that it can *also* be used to define the LEGO parts in the library (allowing programs to use finished models as parts or submodels of larger models), James set up a *virtuous cycle*. Virtuous cycles are composed of elements organized in such a way that they reinforce each other automatically, strengthening the system as it is used.

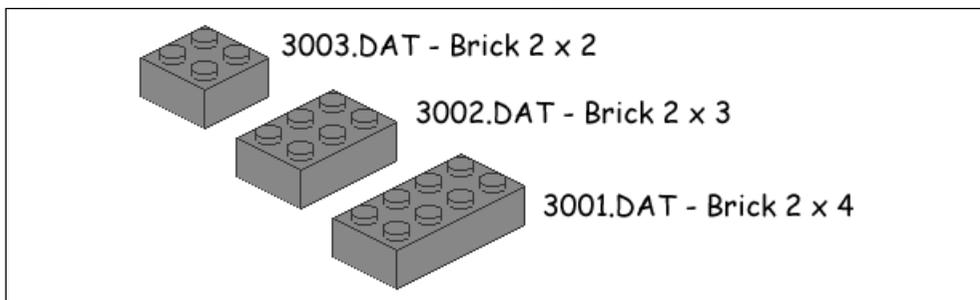
Let's see the real-life consequences of this approach. By setting up LDraw as shown in Figure 3.1, Jessiman recruited the potential help of every user of his LDraw system. The LDraw executable was actually the program that read the files. Users of the initial release of LDraw had to type the model files into a text editor. When LDraw read those files, it produced an image of the model on the computer screen. This by itself was pretty revolutionary because it let LEGO fans share their creations among each other in a way that had not been possible since LEGO was first created. Even this limited software release was enough to plant the seed for the cycle to take place. Along with the initial LDraw executable, Jessiman included a parts library with three parts in it and the specifications for the file format.



NOTE

The original LDraw parts library contained only the three parts pictured in Figure 3.2. These parts have been rendered in LDraw (we added the name lettering with an outside program). Not surprisingly, these initial parts were virtual replicas of the first brick types that gave birth to the LEGO system as we know it today.

Figure 3.2 The Initial LDraw Parts Library



Where is the seed for the cycle in that package? The seed was in the file format: If the users liked the program (and there was no reason for them not to), they would inevitably start contributing parts to the library, since they would need the parts for their own creations. The more parts in the library, the more attractive the cycle became to new users and the more potential developers there were to add parts to the existing library. From the original release of three parts, the library now holds well over 2,000 *official* parts today, with many more constantly being developed in a peer-reviewed process.

A Multitude of Resources

Close to 10 years later, the LDraw system is not only healthy and growing, it has become much more sophisticated as well. The LDraw file format is what brings it all together, but it is no longer the only “seed” of the cycle. Several other programs have been developed to manipulate LDraw files. These include modelers like MLCad as well as format translators such as L3P. Format translators widen the possibilities available to us as modelers, because they allow us to interact with non-LDraw (and non-LEGO-based) applications.

Strictly within the LDraw realm, things have changed quite a bit as well. The LDraw system is still used, but the actual model building is generally done via MLCad (which we look at in the next three chapters) or other similar programs that use the LDraw library and file format. However, it is not only programs and new parts that have come out of the LDraw fan community. It is possible that in the near future, “parallel” libraries will coexist with the LDraw parts library. These new libraries will not store parts; instead, they will hold such diverse things as different effects that better simulate the conditions of real-life LEGO modeling or elements that allow users to better organize their models and create instruction steps for them. Development on some of these components has already begun, with many more unexplored possibilities still to be realized.

Consider this book your first “LDraw kit.” When somebody (usually a child) gets his or her first LEGO kit, they are being exposed to a wide and gloriously intricate building system, even though they might not be aware of it right away. Similarly, in your first trips into the world of LDraw, you might not be completely aware of the complexity of the system you are using, either. However, once you get your feet wet and gain a basic understanding of these programs, you will quickly see that there is a wealth of opportunity for those looking to take the next step.

Other LEGO-Based Software

As we explain more fully in Chapter 10, deciding where to draw the line in terms of content was a major concern in writing this book. We finally decided to give readers a clear introductory path into the LDraw system and some of the major programs that have sprung up in its wake. This being the case, we decided to mention but not cover in detail everything not directly related to the LDraw system. As the experienced users of the software know well, once you are aware of the basics, there are simply too many options to try and explore them all in detail. For that reason, we encourage the reader to explore the other resources mentioned in Chapter 10 of this book.

In Chapter 10, the reader is exposed to information related to a fantastic fan community with a wealth of resources not easily matched in other hobbies. Many talented people have contributed all sorts of key elements to the LEGO and LDraw systems, from new part definitions to new programming languages for LEGO robots. Apart from being based in some way on products put out by the LEGO company, these elements all share another characteristic with LDraw: They are created by fans, for fans, and are offered free of charge.

We apologize to the developers of some of these other LEGO-based programs for not reviewing their often excellent, unique, and incredibly engaging software in the detail it deserves. Our main objective with this book is to introduce as many people as possible to the wonderful world of virtual LEGO-based modeling. It is our sincere belief that the LEGO community as a whole gets better as more people become involved. We think James Jessiman would agree.

Summary

This chapter provides some background on LDraw and its place in the LDraw system as a whole. This information is important for the first-time user because it is essential to understand that LDraw is the basic system that sustains the rest of the software described in this book. Although we do not directly use the LDraw program as we work through this book, we do use and rely on its file format and other key components.

The most important aspect of LDraw (aside from its quality) is the fact that it was created by a LEGO fan and thoroughly tested and further developed by other fans. James Jessiman, creator of the original LDraw software, passed away at a young age. In LDraw, he has left behind a technical legacy of impressive elegance and absolute rigor.

The system that Jessiman designed relies on three elements: a parts library, a program to create models, and a file format to store them. Jessiman started by designing a file format that, when completed, would allow the other two elements to happen naturally in the software development cycle. Since the file format accommodates parts from the library as well as models made of those parts, from the beginning there was the possibility to add new parts to the library, which made the program more attractive.

Thus, the more LDraw users, the better the LDraw system became. Today, the LDraw system has grown in both the number of parts in the library as well as the number of auxiliary programs, extensions to the file format, and a host of other goodies waiting for users to discover them.

Solutions Fast Track

Created by Fans, Supported by Fans

- ☑ LDraw is a *system* designed to create virtual LEGO models with computers.
- ☑ LDraw's great success lies in a three-pronged approach that ultimately has created a wide and sophisticated building system that resembles the real LEGO system in many ways.
- ☑ The key resemblance between the LDraw system and the LEGO system is the obsession with top-quality results and nothing else. This approach has ultimately proved successful in both cases.

A LEGO CAD System

- ☑ The LDraw system relies on a parts library that holds the basic building blocks, program(s) to put them together, and a file format that stores the completed models.
- ☑ By designing a file format that could store both models and parts for the library, James Jessiman set the successful specifications for a *whole* virtual LEGO CAD building system.
- ☑ By design, this system gets better as more people use it. It has already evolved quite a bit, and the future looks very bright.

A Multitude of Resources

- ☑ LDraw is not only a highly successful software system; it is also a great exponent of the pool of resources available to LEGO fans.
- ☑ These programs are generally created by fans, free of charge; those fans often accept (and even ask for) collaboration and user input.

Frequently Asked Questions

The following Frequently Asked Questions, answered by the authors of this book, are designed to both measure your understanding of the concepts presented in this chapter and to assist you with real-life implementation of these concepts. To have your questions about this chapter answered by the author, browse to www.syngress.com/solutions and click on the “Ask the Author” form.

Q: Is LDraw a program?

A: LDraw defines both a program and a file format to create and view LEGO models in virtual computer space. The file format and the general program structure have outlived the executable itself as new applications based on it have been developed. LDraw is most often thought of as a complete system of LEGO CAD.

Q: What is freeware?

A: Freeware are programs whose authors have allowed their free use and distribution. They do not carry any moral obligation to pay for their use. Not all freeware programs are open source. In fact, the LDraw program code is not public. But its file format is, which is a key element in its success.

Q: Who created LDraw?

A: Its author, James Jessiman, died in 1997, but the LDraw legacy has been embraced by the international LEGO community. The Web site dedicated to all things LDraw, LDraw.org, has become one of the pillars of this community.

Q: How can I get support for LDraw?

A: The international LEGO community, largely structured around the sites www.lugnet.com and www.LDraw.org, is full of incredibly talented and generous individuals who not only have created free tutorials and additional programs but will also answer any and all LEGO-related questions, no matter how complicated. In fact, the complicated questions posed on these sites are generally the ones that draw the most attention!

- Q:** Am I expected to fully understand the concept of “virtuous cycles” before using the programs in the next chapter?
- A:** No. The concepts covered in this chapter are general working principles. It is useful to be aware (even vaguely) of them. They will be of help when you’re learning the finer details of creating virtual LEGO models. Overall, the important message contained in this chapter is that the top quality we often take for granted in the LEGO and LDraw building systems is in fact deeply rooted in a very intelligent and accomplished design. Take advantage of it!