5

PLACING, MOVING, AND ROTATING PARTS

Now we transition from looking at parts and part types back to building again. MLCad's commands for placing, moving, and rotating parts are easy to grasp with a little practice. Soon you will be able to handle parts connections with confidence in this WYSIWYG (What You See is What You Get) environment.

In Chapter 3, we discussed the steps you need to take when launching MLCad for the first time. This chapter assumes you have already configured MLCad and gone through the contents of Chapter 3. If you have not, please do so now.

If you haven't already done so, please start MLCad by clicking its desktop icon, or by accessing it from the Virtual LEGO Launcher.

Placing Parts

Placing parts in MLCad is very straightforward. We define parts "placing" as adding a part to the workspace area. Manipulating the part into its desired location is covered later under the topics "moving" and "rotating."

You should recall the basic drag-and-drop placement technique we taught you in Chapter 3. There you used the mouse to drag a part from the parts list window onto the workspace. There are a total of three ways to place parts in MLCad. They are:

Drag from the Parts List window: This is the first technique you learned. Find a part by name within the Parts List, and drag that entry onto the screen. An outline of the part will appear and you can place it.

Drag from the Parts Preview window: When you select a part in the Parts List window, it shows up as the first part below in the Parts Preview window. You can drag parts from that preview window onto the workspace as well. This is advantageous, especially if you are working with multiple parts in the same category: Pick the part you want off the screen, drag, drop, and go back for another. (Note that if your selected part is listed towards the end of a category, or if the category you are browsing has fewer parts than will fill the Parts Preview window, MLCad may not display the selected part first.)

Select Part Dialog: This dialog window gives a list of parts and allows you to pick from the list alphabetically (see Figure 5-1). It does not, however, give you a preview of the part you are selecting. This is recommended for users who are already familiar with the desired part name or number. Also, this window allows you to insert a "sub-model" by clicking the Browse button. Sub-models are complete LDraw models which when referenced in a separate model file act as one part — they can be moved and oriented as one single unit. We will introduce you to sub-models in Chapter 8, "Complex Models: Sub-modeling and SNOT."

The Select Part dialog can be accessed via the Add Part button on the toolbar ⊞ , **Edit > Add > Part**, or by right-clicking on the workspace and selecting **Add > Part**. It is also accessible using the Modify command (**Edit > Modify** or **CTRL+M**). Note that this command uses the dialog for the purpose of changing the current part, not adding a new part.
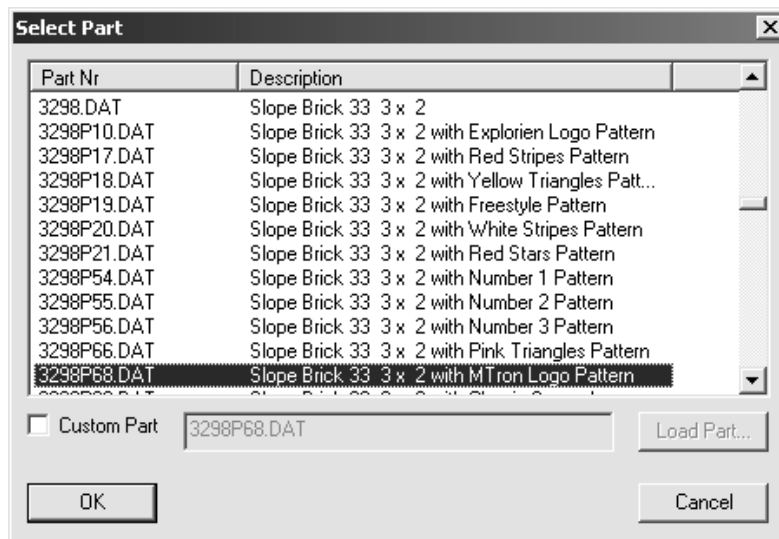
Part Nr	Description
3298.DAT	Slope Brick 33 3 x 2
3298P10.DAT	Slope Brick 33 3 x 2 with Explorien Logo Pattern
3298P17.DAT	Slope Brick 33 3 x 2 with Red Stripes Pattern
3298P18.DAT	Slope Brick 33 3 x 2 with Yellow Triangles Patt...
3298P19.DAT	Slope Brick 33 3 x 2 with Freestyle Pattern
3298P20.DAT	Slope Brick 33 3 x 2 with White Stripes Pattern
3298P21.DAT	Slope Brick 33 3 x 2 with Red Stars Pattern
3298P54.DAT	Slope Brick 33 3 x 2 with Number 1 Pattern
3298P55.DAT	Slope Brick 33 3 x 2 with Number 2 Pattern
3298P56.DAT	Slope Brick 33 3 x 2 with Number 3 Pattern
3298P66.DAT	Slope Brick 33 3 x 2 with Pink Triangles Pattern
3298P68.DAT	Slope Brick 33 3 x 2 with MTron Logo Pattern

Custom Part: 3298P68.DAT   Load Part...

OK   Cancel

Figure 5-1: The Select Part dialog box allows you to select parts by number or description, or load a separate LDraw file and represent it as a "sub-model" of your current file.

Moving Parts

When we say "moving" parts, we mean changing a part's position on the 3D coordinate plane, without changing its orientation (or rotation angle). Moving basic bricks, plates, and most other elements in a "studs-up" (or vertical) configuration is easy in any of the LDraw-based applications, including MLCad. The purpose of moving parts within the workspace is to align them with other parts, creating a digital representation of your LEGO model. Remember, in the LDraw system, parts don't snap together like your real LEGO pieces do. You have to view the part from multiple angles to ensure it is in the proper place — and to make sure you don't have one part placed inside of another! MLCad's four view panes make this easy, whereas in the days of LEdit, you could only use one view at a time.

Chapter 3 gave you a head start and taught you this technique when you built the pyramid. At that point, you were simply moving basic bricks next to each other. To review this, place a part on the screen and move it on all three axes. You can use your mouse, MLCad's toolbar, or the keyboard in the three 2D windows. Remember, when using the keyboard, the Left and Right arrows move a part along the X-axis, Home and End correspond to the Y-axis, and the Up and Down arrows move parts along the Z-axis.

This is basic parts movement. At the coarse Grid setting, parts move at a half-stud increment. A stud is the knob or bump on top of a LEGO part (and it corresponds with an antistud inside of the sockets and tubes underneath a LEGO part). Why do they move at half-stud increments? They use it because standard LEGO models use the half-stud all the time — parts like the "Plate 1×2 with 1 Stud" make it possible (see Figure 5-2). We will examine other grid settings next.
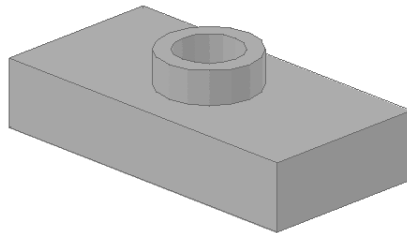

Figure 5-2: Part number 3794, Plate 1x2 with 1 Stud.

The 3D World: A Coordinate System

We've mentioned the 3D coordinate system a few times so far. Each part is assigned a set of coordinates inside of the file's coordinate system (which can be called the "world"). Every object in the world has a set of coordinates, so the software knows where it is placed. You may run into a few cases when you are using MLCad where you need to find out what a part's coordinates are, or perhaps you will need to manually set the part's coordinates. This is all accessible through the Enter Position and Orientation dialog as seen in Figure 5-3.

NOTE *Sometimes MLCad refers to this as the "Enter Position and Rotation" dialog. The two names mean the same thing in MLCad.*
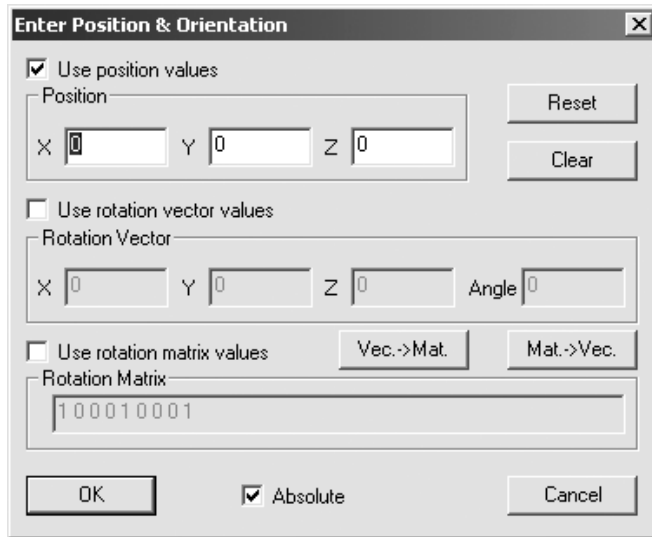
Figure 5-3: MLCad's Position and Rotation/Orientation dialog.

To access this dialog, click the ⌨ icon on the toolbar, or right-click the desired part and select **Enter Pos + Rot** from the context-sensitive menu. In order to access this menu by either method, there must be a part currently selected. In the dialog you will see fields for entering a brick's position, rotation vector, and rotation matrix. For most building applications, you will only need to use the position values and not the other two values. Manually entering rotation values is useful for authoring parts, which we'll cover in Chapter 21, "Creating Your Own LDraw Parts."

If you want to tell a brick's location within the 3D coordinate system, look at the X, Y, and Z Position values. In the case of Figure 5-3, the brick is located at 0, 0, 0. You can also use this dialog to manually enter the position you would like the brick to move to. Clicking **OK** will move the brick to that position.

Grid Settings and Movement

You've heard us mention "Grid settings" a couple of times already, and you're probably curious as to what that is. The Grid setting is the most important element within MLCad (and other LDraw editors as well) when it comes to properly positioning parts. When we say *grid,* we mean a set of evenly spaced invisible parallel lines running parallel to all three axes. The size of the grid is determined by the grid's setting. When you move a part, the part *snaps* to the grid, meaning the program only allows the part to move in these specified increments.

This is a very helpful feature because as we stated earlier, LDraw parts don't click with each other; you have to learn to position parts by observing them at multiple view angles. The grid helps you place parts next to each other accurately, instead of struggling each time to align freely moving parts perfectly. The half-stud increment of the coarse grid enables you to line up your part easily with neighboring parts.

The smaller grid settings, Medium and Fine, help you when you are dealing with parts that don't line up with each other in half-stud increments. These types of parts include clips and bars, parts with studs that face sideways, hinges, Technic parts, and many other specialty parts.

Changing the Grid Setting

The Grid setting can be changed by using the Grid icons 　　 on the toolbar.

Grid Coarse

The icon on the far left, selected in this image, is the Coarse Grid setting. This is the default selection and you should use this unless you need it to be finer. On the horizontal plane (X- and Z-axes) it moves in half-stud increments. In the vertical (Y-axis) it moves one third of a brick height, which is one plate. When you rotate the part on any axis, it rotates at a 90-degree angle.

Grid Medium

The middle button is Medium Grid. On the horizontal plane, it allows for movements of one-fourth of the width of a stud. When moving vertically, it is set at one-half of a plate height — requiring six steps to reach a brick height instead of three. The rotation increment is set at 45 degrees.

Grid Fine/Grid Off

The Grid icon furthest to the right represents Fine Grid. MLCad sometimes calls this "Grid Off" as well. This setting is used most often when you are creating assemblies on a model that uses hinges, or when you rotate a part to line up with a stud that is not facing up. With this setting, horizontal movements are made in one-twentieth of a stud width, vertical movements are one-eighth of a plate height (requiring 24 steps to reach a brick height), and by default, rotation in any direction is set in 5-degree increments.

Snap to Grid

If you have moved a piece using Fine Grid and want to return to using Coarse or Medium grid, MLCad's Snap to Grid feature can be of help. Sometimes it is easy to make the mistake of moving a piece while using too fine of a grid setting. Re-aligning a part you accidentally moved using fine grid with others aligned with coarse grid can be tedious. Snap to Grid takes the selected part (or parts) and aligns it with the closest grid increment. After snapping a part to the grid, you can proceed to align it with other parts easily. To use the Snap to Grid feature, click the 　 icon, select **Edit > Snap to Grid**, or use the keyboard shortcut **CTRL + SHIFT + G**.

Get Acclimated

If you haven't already, go ahead and play with these grid settings to get a feel for what each one does. Take a few minutes to move parts around, rotate them, and attempt to align them — even at odd angles!

LDraw Units

The LDraw parts library has its own system of measurement, called *LDraw Units* or *LDU* for short. LDraw Units are very important to MLCad's Grid settings — they are the basis for deciding how far in a given direction to move or rotate each part. Each part file is made up of components that rely on this measurement system to represent each part accurately. James Jessiman put a good deal of thought into defining the LDraw Unit in relation to the dimensions of an actual LEGO brick. Figure 5-4 on the next page shows you how many LDraw Units compose bricks, plates, and studs.
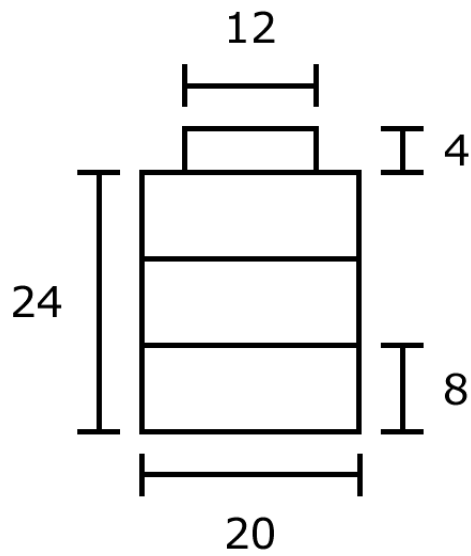
Figure 5-4: LDraw Units in relation to a LEGO brick.

The above diagram shows a 1×1 brick broken down into LDraw Units. While not essential by any means in a WYSIWYG environment such as MLCad, it is a good idea to commit these measurements to memory. Knowing these will help you understand how a brick relates to another brick you are placing next to it. LDraw Units will be discussed more in depth in Chapter 21.

Customizing the Default Grid Increments

You can change the increments each Grid setting uses in MLCad's settings. Go to **Settings > General > Change**. When the window pops up, click the **Step, Grid, Snap** tab. This is where the Grid settings are stored. Note that what MLCad calls "Grid Off" is the same as the setting we called "Fine Grid."

The numbers in the fields for X, Y, and Z of each setting are LDraw units. Note how they correspond to Figure 5-5. If you are new to the LDraw format, MLCad, and the Grid tool, do not change these values. It is a good idea to make a mental note of the location of these settings. After you have experienced using MLCad, you may want to change the defaults here to make it easier to build your model. The most useful feature here is probably the rotation angle on the Grid Off section — you can change your default angle to 1 degree or less, allowing for much more freedom on hinged parts.

NOTE   *Undo? MLCad has a placeholder for an "undo" feature under Edit > Undo. However, this feature does not actually function. Be careful when moving and rotating parts, especially when using Fine Grid, since you cannot undo your most recent movement.*
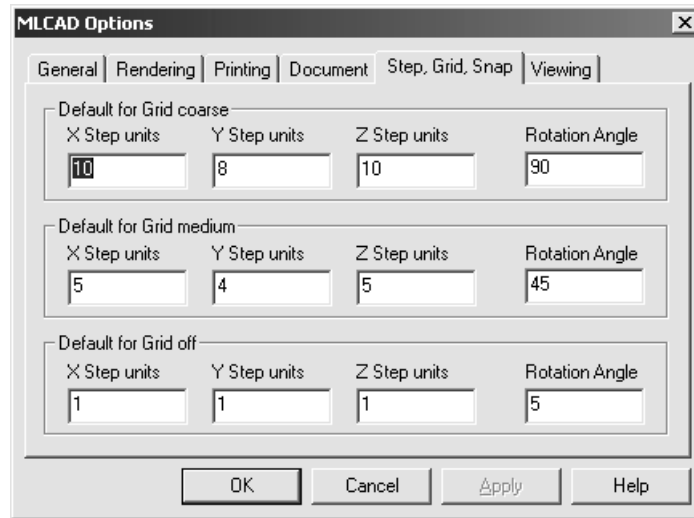
Figure 5-5: You can edit the Grid settings in MLCad's Options window.

Rotating Parts

This is perhaps the trickiest of all part positioning tasks. The model you are creating exists in a three-dimensional environment, just like your physical LEGO models. This time, however, you have to think carefully about exactly how your model's parts are placed. Rotating parts in the horizontal plane, or along the Y-axis, is a simple enough task. It gets more complicated when you start rotating along the other axes, and when you need to rotate one part along more than one axis.

The most convenient method of rotating parts is the icons on the toolbar, just right of the movement buttons (see Figure 5-6). A series of arrows following a circular path around a single bar illustrate clockwise and counter-clockwise rotations around an axis. A click of one of the buttons rotates the part one Grid increment. For Coarse Grid, that is 90 degrees.

Figure 5-6: Movement and Rotation commands on the Element Bar.

In order to see the effects of rotating a part easily, choose an asymmetrical part such as part number 2516, Space Chainsaw Body. First, start a new file, and then find the part in the Other Parts Space category and drag it onto the screen. Take some practice time now and rotate the part along each axis. Be sure to use only one axis at a time; this will help you avoid confusion. Notice how the part rotates at 90-degree increments.

For fun, try rotating the part on more than one axis at a time — click one axis, then another. See how many combinations you can come up with. Also, try to return the part back to its default orientation, shown in Figure 5-7 on the following page.
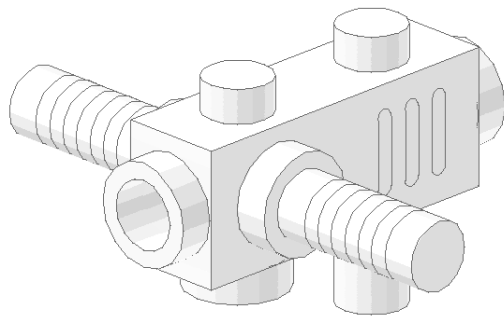
Figure 5-7: Part number 2516, Space Chainsaw Body, default orientation.

Center of Rotation

Each part has a default "center of rotation" that is defined by either the part's author or the LDraw.org parts administrator. When you rotate a part, it rotates around that specific point. Sometimes you may want to change the center of rotation to more easily position a part such as a hinge, or two Technic bricks joined with a pin. The default center of rotation on the part you are using may or may not be in the place you want it to be in. If it isn't in the place you like, you can take a few steps to move the point.

Understanding Center of Rotation

When you're changing the center of rotation in MLCad, realize you aren't actually changing a specific part's center of rotation. Instead you are creating a custom preset point in the 3D world of your LDraw file, which MLCad stores for reference, and can be used by any part you want to rotate. By default, MLCad uses the currently selected part's origin as the center of rotation. You can override this and tell MLCad to use your custom point for all parts in the file. You can define as many of these custom rotation points as you like. It is also possible to toggle between custom points, or return to using the selected part's origin as MLCad's center of rotation. This is all accessible via the Rotation Point Definition dialog window, which we will show you how to use in the following section.

Self-Centered

Do you really need to adjust the center of rotation to align parts? No. It becomes useful when you are making a model that needs to have its various components rotate or move with ease. If you are building a 3D model that you will never need to pose, it's not likely you'd need to use this technique. If you're building a model you want to animate, or you want to generate pictures of in many poses or positions, this will be quite useful to you. It really all depends on what you need your model to do.

Setting a Custom Rotation Point

For our example we will use two 1×6 Technic bricks joined by a pin, as seen in Figure 5-8. The default center of rotation for this part is on the top of the brick, in the middle, between the third and fourth studs. If you want to join the two via a pin in an axle hole, and rotate one on that axis, it will be very difficult to line up the parts as desired with the default rotation point. We need to set a custom rotation point inside the pinhole that we want to rotate around.
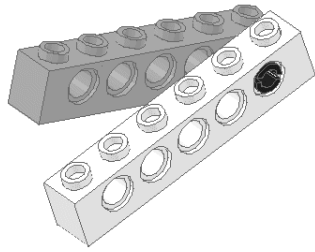
Figure 5-8: Our desired result: a 1x6 Technic Brick rotated around a single pin.

1. First, open a new file. Locate the 1×6 Technic Brick (**Technic Brick 1×6 with Holes**) and drag it into the workspace. Remember that you can center the part on the world's origin by dragging directly into the 3D workspace pane.

2. Find the **Technic Pin** on the parts list and properly align it with the last hole on your brick (Figure 5-9).
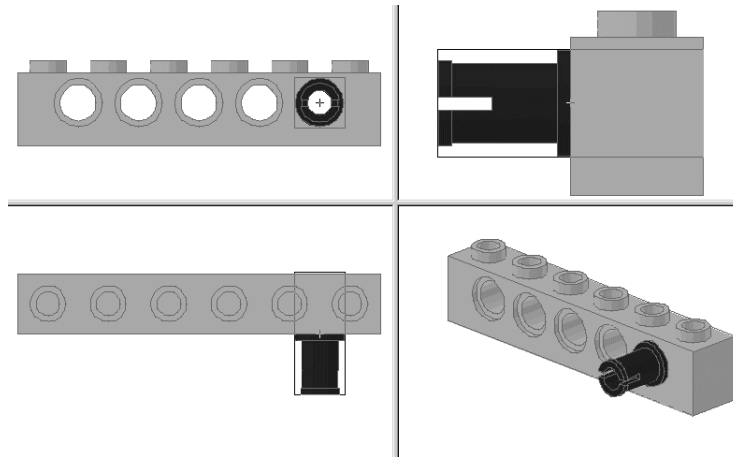

Figure 5-9: Pin alignment in a 1x6 Technic Brick.

3. Insert a second 1×6 Technic Brick and align it next to the first, as shown in Figure 5-10.
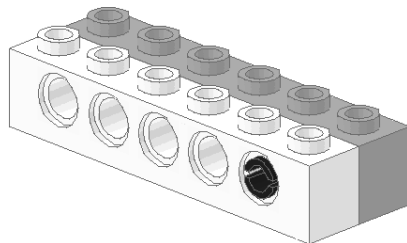
Figure 5-10: Two Technic Bricks with pin properly aligned.

4. Select the pin. We need to find the point we will use as the custom rotation point. To find this point, right-click the **Technic Pin** with your mouse, and choose **Enter Pos. + Rot**. . . . Note the pin's X, Y, and Z coordinates — in this case, if you centered your first beam by dragging it into the 3D window, it's 40, 10, and -10. This is our rotation point for the second brick. Write these numbers down and close the dialog by clicking **OK**. If your numbers differ from ours, write yours down and use them.

5. Click the toolbar icon ![icon], or from the menu, choose **Settings > Rotation Point**. The Rotation Point Definition dialog appears (see Figure 5-11). Here is where you can select what rotation point MLCad uses for the model. Choose **Custom Point** among the buttons on the left. Enter the coordinates of the pin that you noted from the last step. Change the point's name to **Pin**, and click **OK**.
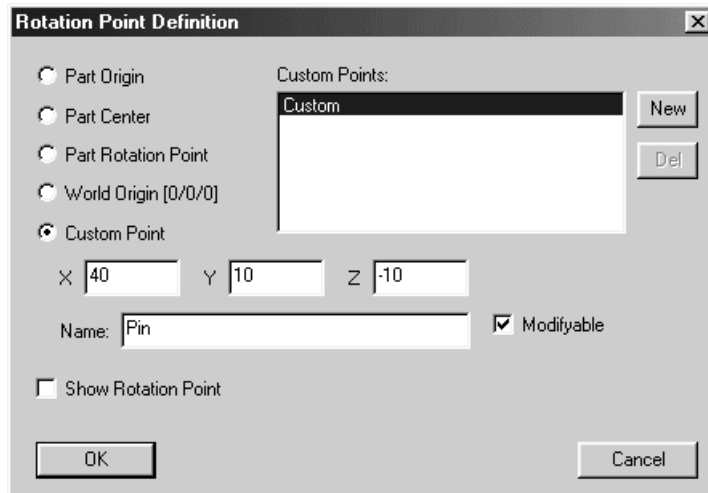

Figure 5-11: Rotation Point dialog.

6. Now you may rotate your brick around the pin. Choose the fine grid setting, and rotate the brick along the Z-axis. ![icon]

By setting a custom rotation point as you just did, you told MLCad to use that specific point in 3D space for every single part you may select. In most cases, you don't want to do that; you only want to use a custom point for a specific connection. To go back to rotating parts as normal, return to the Rotation Point Definition dialog and select **Part Origin** as the rotation point. You will not lose the custom rotation point you just set; it will be saved and listed in the Custom Points list. To use that point again, select **Custom Point** and select the point **Pin** from the list.

Defining and Using Multiple Custom Points

You can define as many custom rotation points as you like. To do this, click the New button on the right hand side of the Custom Points list. The "Name" field will read "New Custom"; change this to your desired name. When you click OK and return to the Rotation Point Definition dialog, you should see your new custom point listed in the Custom Point list.

Other Rotation Points

There are also a few other rotation points you can use as MLCad's rotation point for parts. Besides Part Origin and Custom Point, you can define the rotation point as the center of a part, or at the origin of the world (0, 0, 0). There is also an option for "Part Rotation Point"; however, this does not differ from the Part Origin.

Showing the Rotation Point in the Workspace

You can select the checkbox **Show Rotation Point** if you want to see the rotation point in the workspace. When this box is selected, MLCad will display the rotation point in the form of a dark gray box in each of the 2-dimensional view panes.

Aligning Different Types of Parts

Now that you know how to place, move, and rotate parts, it's time to put your knowledge to good use. While it may be easy for you to line up bricks and plates in simple studs-up configurations, most LEGO models contain parts that require some degree of rotation — whether it is something as simple as placing wheels on a Minifig scale car or as complex as the landing gear assembly on a gigantic Technic fighter jet.

No Tissues Needed

Non studs-up construction is such an important part of LEGO-building that a group of die-hard fanatics coined the acronym "SNOT," which stands for Studs Not On Top. This affectionate but mucus-free phrase encompasses any brick or part with studs that are facing any direction but up. There are some builders who focus on building entire chunks of their models this way, to take advantage of the parts' geometries and come up with new and interesting shapes, or shapes that more accurately reflect the subject being modeled.

Truth is, there are many types of parts that require rotation. The LEGO Company has introduced countless specialty parts to the market over the last twenty years, which give builders a large sphere of creative possibilities. Learning how to align the LDraw versions of these parts can be rather tricky. Let's learn about some of the basic types of parts, and how to use the grid to align them.

Tires, Wheels and Axles

Wheels and axles are common parts, but lining them up with each other is pretty tricky. You need to use the Fine Grid setting to get the tire, wheel, and axle to line up with each other. Here are a few simple steps to accomplish this task.

1. Find the following parts and place them in the workspace.

   - Plate 2×2 with Wheels Holder Wide

   - Wheel Wide

   - Tyre Wide (Note: James Jessiman introduced tyres spelled with a "y." To a North American reader, this is the incorrect spelling. In Europe and in British-influenced English speaking countries, "tire" is spelled with a "y.")

2. Rotate the parts into their proper orientation, so the wheel and tire are ready to be lined up with the axle peg.
3. Move the wheel into place over the axle. Note that in some views, the two do not appear to line up when using the Coarse Grid setting. Set your grid to **Fine**, and use the keyboard to move the tire into place. (See Figure 5-12 on the following page.)

NOTE *On the Fine Grid setting, it is easiest to use the keyboard or toolbars versus the mouse for all movements, as the increments are small enough that you are liable to slip a fraction of a stud away from your intended target. Make it a practice of using the keyboard while on Fine Grid.*

4. Switch your Grid settings back to **Coarse**.
5. Move the tire approximately around the wheel.
6. Switch your Grid settings to **Fine** again, and move the tire into place using the keyboard. (Remember, use the HOME key to move the tire in the vertical.)
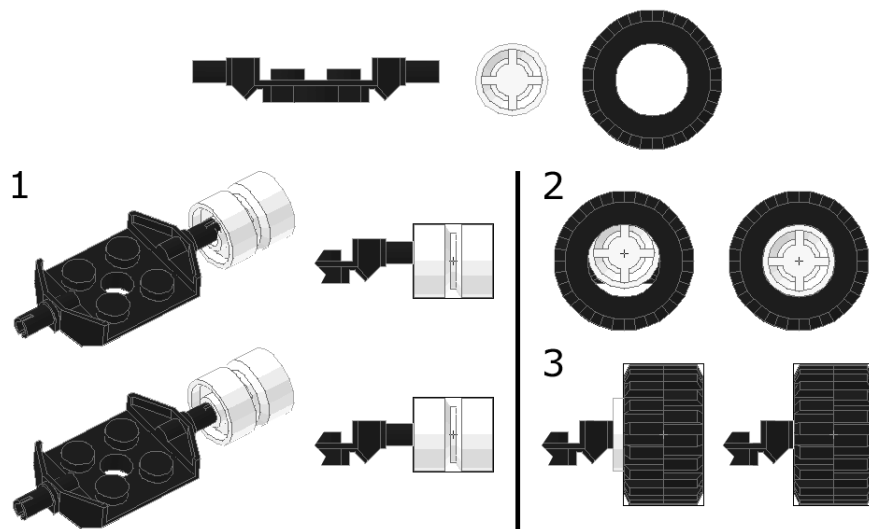
Figure 5-12: Aligning wheels and tires using Fine Grid and multiple views.

Congratulations! You have successfully assembled wheel parts.

SNOT Bricks

Another common case you will experience is the need to connect one brick to a horizontal-facing stud on another brick. As we said before, this type of technique falls under the term SNOT. There are many bricks that feature studs at 90-degree (or other) angles. Here is one example of that technique.

NOTE *Make sure your Grid is set to Coarse before dragging new parts onto the workspace. It is much easier to work off of an even grid increment than off of small LDraw units.*

1. Find the following parts and place them in the workspace.

   • Brick 1×1

   • Brick 1×1 with Headlight

2. Determine which axis you need to rotate the brick on to meet up with the horizontal stud on the "headlight" brick. Rotate the brick so the antistud, or socket, aligns with the sideways-facing stud. Hint: Make sure you reset your 3D view by a **Right Click > View > 3D** in that pane. Next, compare the parts and their orientations to the axes on the tool-bar icons.

3. Move the bricks as close together as you can on the Coarse Grid.

4. Switch to **Fine Grid** and finish aligning the pieces.

Clips and Bars

Another major part category has to do with clips and bars. These two categories encompass a wide range of parts. For the purpose of this section, we will group together parts with similar elements. Clips can be anything from minifig hands to wall mount brackets. Bars are standard LEGO-sized cylinders; they are present in minifig hand tools, Star Wars light sabers, fences and railings, and more.
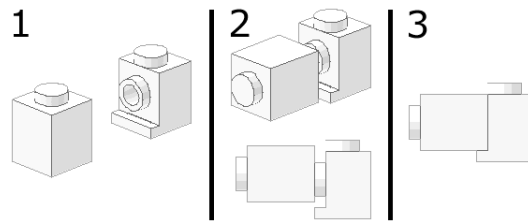
Figure 5-13: Aligning SNOT bricks using Fine Grid and multiple views.

The first image in Figure 5-14 shows a Plate 1×1 with Clip Vertical – Type 3 holding a Bar 4L Light Sabre Blade. Go ahead and bring these parts into the workspace and align them. You should notice that if your Grid is set to Coarse, they line up right away. This is because the parts' origins allow for easy alignment in this orientation.

Now grab a Plate 1×1 with Clip Horizontal. The only difference between this part and the previous is the clip is rotated 90º. With your Grid still set to Coarse, you will find these two don't line up when you rotate the bar. It needs to be moved into position using the Fine Grid (note images 2 and 3 of Figure 5-14).
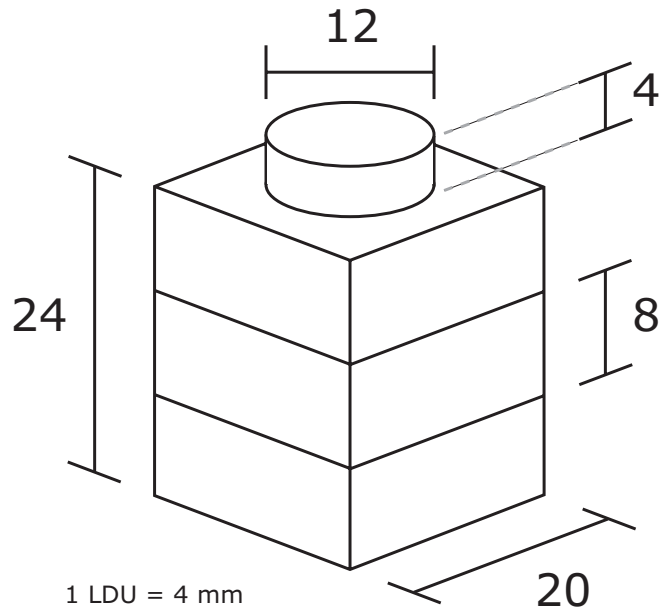
Figure 5-14: Aligning clips and bars using Fine Grid and multiple views.

Hinges

Hinges are relatively straightforward parts to align once you have mastered the use of Fine Grid. However, these parts are often used at arbitrary orientations, and this adds to the complexity of the alignment process. You should practice with a couple types of hinges to get the feel for aligning them after fine rotations.

Figure 5-15 demonstrates hinge alignment first using a Hinge Plate 1×2 with 2 Fingers, and its counterpart the Hinge Plate 1×2 with 3 Fingers. The second example uses the Hinge 1×2 Base and Hinge 1×2 Top. Practice these on your own.
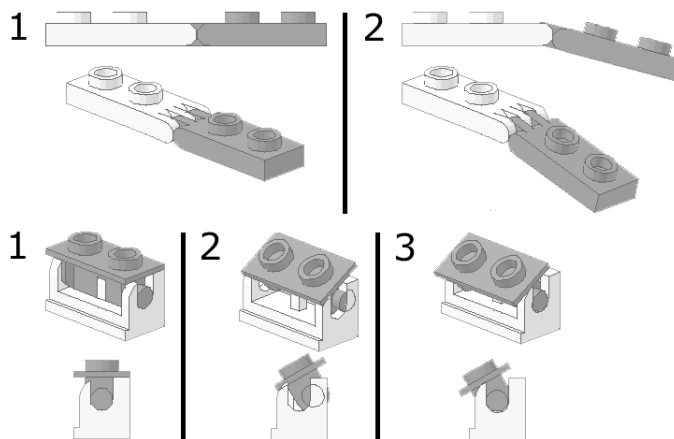

Figure 5-15: Aligning clips and bars using Fine Grid and multiple views.

Technic

The various Technic parts require heavy use of the Fine Grid. Gears go on axles, pegs and axles inside holes, and more. While you probably have the hang of Fine Grid positioning, why not go ahead and grab a few Technic parts to try out. In Figure 15-16, you see a Technic Brick 1×4 with Holes, a Technic Pin, Technic Axle 4, and Technic Gear 16 Tooth.
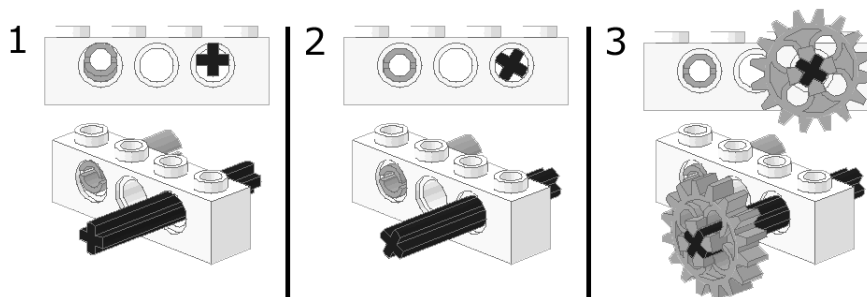

Figure 5-16: Aligning Technic parts using Fine Grid and multiple views.

Summary

In this chapter, we covered moving parts, rotating parts, and aligning parts within LDraw, and gave you examples of each task. You learned how to use the grid settings and how to set custom rotation points for your parts. The skills you learned in this chapter will equip you for building models later in this book and on your own in the future.