Design the Willis Tower

0. Sign up for Tinkercad and Create a new design

- On one of the library Macs, single left click one of the icons for Safari, Chrome, or Firefox web browsers in the bottom bar.
- On one of the library PCs, single left click one of the icons for Internet Explorer or Google Chrome in the bottom bar.

- All of the web browsers have a large bar across the top. It should say www.eapl.org. Type Tinkercad.com in that bar instead and then press the Enter key on your keyboard.
- Once it loads, click Sign up (or Sign in if you have an account) in the upper right corner.
- Fill out the information they ask for to create an account. Or type your username and password.

Username: __________________ Password: __________________

- On the page that loads, click the multicolor Tinkercad logo in the upper left corner.
- Click the Create new design button in the middle left of the page.
Design the Willis Tower

1. Right side menu
2. Design & Insert shapes
3. Moving shapes
4. Changing the view
5. Measuring shapes
6. Resizing shapes
7. Workplane tip
8. Copying
9. Floor 66
10. Floor 50
11. Grouping
12. Inspector
13. Workplane
14. Antennas
15. Multi select
16. Put the workplane back
17. Rename
18. Download to your computer
19. Upload for 3D printing
20. Keyboard shortcuts

1. Right side menu

- The Tinkercad right side menu has lots of the buttons you need for designing objects.

- Import lets you to bring in pre-made 3D files to add/modify your design.

- Export lets you create a 3D printable file of your design such as .STL.

- Share allows you to create a link to send your design to others.

- Workplane lets you change the surface where objects are initially placed.

- Ruler tool helps do advanced measurement and placement of pieces.

- Below those is a drop down menu that allows us to select from sections of shapes that either Tinkercad employees or other Community members created. These include geometric Basic Shapes, Text letters and numbers, @&! and other Symbols, Connectors for designing objects like robots, and a few Extras. Click the drop down arrow an extra time to hide the menu.

- Basic Shapes includes two premade holes (a box and a cylinder), although any shape can be turned into a hole in Tinkercad (more on this later).
2. Design & Inserting shapes

- We’re designing the Willis Tower (formerly Sears Tower) today!
- Let’s think of this building as 9 vertical 10x10mm (length x width) sections.

50 floors 66 floors 90 floors 108 floors

- We’ll use red boxes to make each of these sections. From Basic Shapes in the right side menu, click on a red box, drag your mouse in to the light blue workplane grid, and then click again to place your first red box.

3. Moving shapes

- It’s easiest to design an object when it is in the middle of the screen.
- Click and hold and drag the red box into the middle of the grid so it will be easier to see for later. Make sure NOT to click on any of the square or arrow handles before dragging. Use a location like this one on a shape to move it.
- Labels on the screen will let you know how far left/right and forward/backward you’ve moved the shape.

4. Changing the view

- This design requires us to rotate around a bunch to check our work.
- Drag the box in the upper corner side to rotate around the current center.
- Use the home button to return to the original starting view.
- Right click anywhere and drag to rotate around the center of your view. Do this often!
- Select a shape or shapes then click the 2nd circle fit view to selection to focus on them.
Changing the view (continued)

- Click + / – your mouse scroll wheel or 2 finger swipes on a trackpad to zoom in / out.
- To move left/right or forward/backwards without rotating, hold the Shift key and then right click and drag in any direction. This pan move changes the center around which you rotate.
- A slightly downward looking diagonal view is usually the best. Downward diagonal views allow you to see the top and at least two other sides of your object(s) and most if not all of the on-screen controls. You may want to rotate to make controls bigger and easier to click as well. Zooming in can also help.
- Right click and rotate to see the red box at a downward angle.

5. Measuring shapes

- Let’s see how big the red box is by default.
- Click on the red box to select it.
- Without clicking, place your mouse over any of the square resize handles and wait. In a few seconds, the measurements of your shape will appear. To see the height of the object, hover on the white resize square at the top. It should measure 20 x 20 x 20 millimeters.

6. Resizing shapes

- The Willis Tower has four sections that top out at different heights, so we have to resize often. The easiest way to design this is from the top down so we can see everything easily.
- We’re going to make each of the 9 sections 10 x 10 mm long and wide.
- But the top part is two sections (20x10 mm total).
- So we need to make this first red box 10 mm wide, 20 mm long, and 108 mm tall.
- Click on the red box to select it.
- Once you’ve selected it, rotation, lifting, and resize handles should appear.
- Dragging the white resize handles on the bottom resizes both length and width.
- Dragging the black handles on the bottom resizes either length or width. (Use these if you have trouble.)
- To increase or decrease the height without raising/lowering, use top white resize square.
7. Workplane tip

- Look at the workplane grid. See the darker blue lines?
- They make 10 x 10 mm squares.
- Our 9 sections of the tower are all 10 x 10 mm (except for the top which is 20 x 10 mm). So these guide lines can really help us to make sure all of the sections are perfectly next to each other.
- Let’s put our top section perfectly in line with two of these 10 x 10 mm sections as shown in the picture to the right.
- You may need to zoom in to be precise enough. Also, rotating underneath the workplane is a great way to check you’ve got it correct.

8. Copying

- Let’s do the next tallest sections now. There are 3 sections that are all 90 stories.
- We can make one and copy + paste the other two.
- From the right side menu, let’s insert another red box.
- Resize it to 10 x 10 mm long and wide, and 90 mm tall.
- Drag it to one of the three locations we need a 90 mm tall section.
- Now, once you’ve got that one perfect, single left click it to select it, and on your keyboard either do Command+C on a Mac or Ctrl+C on a PC to copy it.
- Hit Command+V on a Mac or Ctrl+V on a PC to paste it.
- It won’t paste to where we need it to go. Move this new copy to another of the 3 locations we need a 90 mm tall section. Take your time: be precise.
- Hit Command+V or Ctrl+V again to paste the final 90 mm section. Again, move it to the final location we need a 90 mm tall section.
- You will almost definitely need to rotate your view since these 3 sections are on different sides of the building.
9. Floor 66
- From the right side menu insert another red box.
- Change its size to 10 x 10 x 66 mm (length x width x height).
- Drag it to one of the two locations we need 66 story high sections.
- Either do Command+C on a Mac or Ctrl+C on a PC to copy it and Command+V on a Mac or Ctrl+V on a PC to paste another copy. We only have to make one copy this time.
- Drag this second copy to the other location. Remember to rotate and/or zoom in to make this easier.
- If you make any mistakes, click the Undo button to go back.
- Click and hit the Delete key to remove extra shape copies.

10. Floor 50
- One more time: from the right side menu, insert one last red box.
- Change its size to 10 x 10 x 50 mm (length x width x height).
- Drag it to one of the two locations we need 50 story high sections.
- Either do Command+C on a Mac or Ctrl+C on a PC to copy it and Command+V on a Mac or Ctrl+V on a PC to paste another copy.
- Drag this second copy to the other location in the opposite corner. Remember to rotate and/or zoom in to make this easier.

11. Grouping
- Now that we’ve got the whole building done, we don’t want to screw it up accidentally.
- Drag your mouse over the whole design to select all the pieces, and then click the Group button to combine the pieces into one solid.
12. Inspector

- You’ve probably been wondering the whole time: “Why aren’t we making it black?”
- Red is a lot easier to see as we’re designing the tower, but now that we’re most of the way done, let’s change it to black.
- Click anywhere on our now grouped shape to select it. A Shape menu should appear in the upper right corner next to the right side menu.
- Click on the red Solid button to pull up the menu to change the color. Pick one of the black colors.
- Click on any blank space to deselect the tower.

13. Workplane

- We’re not done yet! We still need to put the antennas on top. They should start on top of the 108th floor.
- We can make this easy using the workplane tool.
- The workplane tool allows us to change the base where shapes are placed when you first insert them into your design. We can change the workplane from the default base to be even with one of the sides of our object.

- From the right side menu, open up the Helpers section, and click on the Workplane tool.

- Move your mouse onto the top of the building and single click once it looks like Picture 1 to the right.

- Once you’ve clicked, you’ll get a new orange grid workplane.

- Zoom out and use your view controls or right click and drag around to get a sense of what this did.

- Notice a faint outline of the default workplane can be seen at the base of the tower.

- (We’ll show you how to put the workplane back later.)
14. Antennas
- Adjust your view so you can easily see the top of the tower, zoom in pretty close.
- From the right side menu, insert a cylinder as our first antenna.
- Place it toward the back of the 108 story tall section.
- Change its size to 2 x 2 x 30 mm (length x width x height).
- You may need to zoom in to get the small length and width sizes correct.
- Use your keyboard shortcuts to create a copy and drag it toward the front of the 108 story tall section.
- Decrease the height of this second antenna cylinder to 28 mm.

15. Multi select
- We want to change the antennas to be white instead of the default orange cylinder color. We can change both at the same time.
- Click one of the cylinders, and then hold your shift key and click on the other cylinder. This selects both of them at the same time.
- Now, click on the orange Color button in the Shapes(2) menu, and pick a white color.

16. Put workplane the back
- We’re completed designing our version of the Willis Tower and want to see it without the distracting orange workplane.
- To put the workplane back to its default, select the Workplane tool from the right side menu and simply click in any blank space around the foot of the tower. The orange grid will disappear.
17. Rename

- By default, Tinkercad gives our designs wacky names like “Shiny Blojo”. We can change them!

- In the upper left side, left click on the funny automatic name.

- Type a new name, like Willis Tower (or maybe Sears Tower), then hit Enter on your keyboard.

18. Download to your computer

- Once you’ve completed your design, you can download it as a 3D file onto your computer.

- Above the right side menu, click Export.

- In the menu that appears, make sure Everything in the design is selected.

- Then click .STL. Use the next window that appears to pick where to save your model. (If another window doesn’t appear, it may have saved the design to the default location, likely the Desktop, or Downloads folders.)

- Make sure to save it somewhere you’ll remember. We recommend the Desktop.
19. Upload for 3D printing

- Go to http://www.eapl.org/create/forge/3d-print-job-submission in a web browser.
- Scroll down to see the form. Fill out your name, library card #, email address, phone number. We ask for this contact info so we can get back to you with any questions.
- Click the circle button for the single color you would like your object printed in.
- (Our 3D printer filament can be painted over if you want to make the antennas white.)
- Click Choose File and then find the 3D file you want to submit and click Open.

```
File upload *
Choose File  No file chosen  Upload
```

- Click Upload to the right once the file name of your 3D model appears. *Uploading may take a while, please be patient.* As soon as it says your file name next to Choose file, you’re ready to submit your design – you don’t have to click the extra Upload button

```
File upload *
Choose File  yoda.stl  Upload
```

- Type in any Comments you have for us.
- Click the button pictured to the right once.

- *Our Willis Tower model will print fine since our 3D printer can print objects with volumes of less than or equal to 145 x 145 x 150.7mm or 5.7 x 5.7 x 5.9 inches (length x width x height).*
Tinkercad keyboard shortcuts

<table>
<thead>
<tr>
<th>Moving object(s)</th>
<th>General shortcuts</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 / ← / → / ↓</td>
<td>ctrl + C</td>
</tr>
<tr>
<td>ctrl + 1 / 1</td>
<td>Copy object(s)</td>
</tr>
<tr>
<td>ctrl + 1 / 1</td>
<td>Paste object(s)</td>
</tr>
<tr>
<td>shift + 1 / ← / → / ↓ / 1</td>
<td>undo action(s)</td>
</tr>
<tr>
<td>ctrl + 1 / shift + 1 / 1</td>
<td>Re-do action(s)</td>
</tr>
<tr>
<td>×10 Nudge along X/Y</td>
<td>ctrl + g</td>
</tr>
<tr>
<td>ctrl + shift + 1 / 1</td>
<td>Group object(s)</td>
</tr>
<tr>
<td>×10 Nudge along Z</td>
<td>ctrl + shift + 1 / 1</td>
</tr>
<tr>
<td>keyboard + mouse shortcuts (press and hold kbd btn, then move mouse)</td>
<td></td>
</tr>
<tr>
<td>All + left mouse button</td>
<td>ctrl + p</td>
</tr>
<tr>
<td>shift + left mouse button</td>
<td>Duplicate in-place</td>
</tr>
<tr>
<td>shift + hold while rotating</td>
<td>Lock object(s)</td>
</tr>
<tr>
<td>All + hold side handle</td>
<td>ctrl + a</td>
</tr>
<tr>
<td>All + hold corner handle</td>
<td>Select all object(s)</td>
</tr>
<tr>
<td>shift + hold corner handle</td>
<td>delete object(s)</td>
</tr>
<tr>
<td>shift + hold corner handle</td>
<td>Workplane toggle</td>
</tr>
<tr>
<td>shift + right mouse button</td>
<td>Ruler toggle</td>
</tr>
<tr>
<td>shift + hold top handle</td>
<td>S</td>
</tr>
<tr>
<td>shift + hold top handle</td>
<td>Fit view to selected object(s)</td>
</tr>
<tr>
<td>shift + right mouse button</td>
<td>Drops object(s) to work plane</td>
</tr>
</tbody>
</table>

Legend

![Keyboard shortcuts legend](image)
Design the Willis Tower

Recommended Additional Resources:

*Other technology classes*
Go to [http://www.eapl.org/events](http://www.eapl.org/events) to view and signup for other computer classes.

*Class handouts*
Go to [http://eapl.org/events/computer-programs/class-handouts](http://eapl.org/events/computer-programs/class-handouts) to download copies of class handouts and exercise files.

*Librarians, Computer Aides, and Makerspace Assistants*
We are glad to help you out at the second floor reference desk or in the Makerspace as best we can while helping others.

*Help appointments*
Ela Library cardholders can schedule one-on-one appointments with librarians for further help. We can help with our Digital Media Labs or with general technology questions in our areas of expertise. Appointments last up to one hour. Paper appointment request forms are available at the 2nd floor reference desk. You can also request appointments online:

- Go here [http://www.eapl.org/DMLhelp](http://www.eapl.org/DMLhelp) to sign up for a Digital Media Lab appointment.

*Tech Tutoring*
The last Wednesday of some months, a tech savvy librarian is available for six 30 minute tech tutoring appointments. Bring a list of questions and we’ll help with as many as possible. Limit one tutoring appointment per month per patron. First registered first served, no library card required. Go to [http://www.eapl.org/events](http://www.eapl.org/events) to register for a session.

*Databases*
The Library offers card holders access to many premium databases. These include two which can help you learn more about technology.

- **Gale Courses** offers a wide range of highly interactive, instructor led courses that you can take entirely online. As an Ela Area Public Library card holder in good standing, you are entitled to these courses at no cost. Courses run for six weeks and new session begin every month.
- **Lynda.com** offers technology training with over 20,000 training videos on over 300 topics with exercise files included. The Library pays for you card holders in good standing to access this resource, however you will be required to create a free account. *Please remember to log out when you are finished.*

Access both of these databases from the library Research page: [http://www.eapl.org/resources](http://www.eapl.org/resources)

*Books*
A few books in the library collection related to this book are:

- **3D modeling and printing with Tinkercad: create and print your own 3D models** by James F. Kelly
  Call Number: 006.686 TINKERCAD
- **3D printing with AutoDesk 123D, Tinkercad, and Makerbot** by Lydia Sloan Cline
  Call Number: 621.988 CLI

*Free online tech training websites*
Forge Class Evaluation

Class Title: Design the Willis Tower taught by Brian and Chris Date: 3/14/2017

In terms of your skill with technology, how do you consider yourself?

- Absolute Beginner (no or little experience with computers, NOT yet comfortable using a mouse and keyboard)
- Beginner
- Intermediate
- Advanced

In terms of your skill doing 3D design or using Tinkercad, how do you consider yourself?

- Absolute Beginner (no experience)
- Beginner (some experience, but not comfortable using)
- Intermediate (some experience, comfortable with the basics)
- Intermediate/Advanced (experienced with basic and intermediate functions, but require training on advanced functions)

How much do you feel that you learned?

- I learned a lot
- I learned some
- I didn’t learn much
- I learned nothing

How did you perceive the pace of the class?

- Too Fast
- Just Right
- Too Slow

Were the handouts helpful?

- Yes   - No   - If no, why not?

What did you like most about the class?

What did you like least about the class?

What other topics would you like to see in a future Forge classes?

How do you normally find out about library computer classes?

- Footnotes (Library Newsletter)
- Library Website
- Other

If you are not an Ela Area Public Library card holder, where is your home library?

Any additional comments: